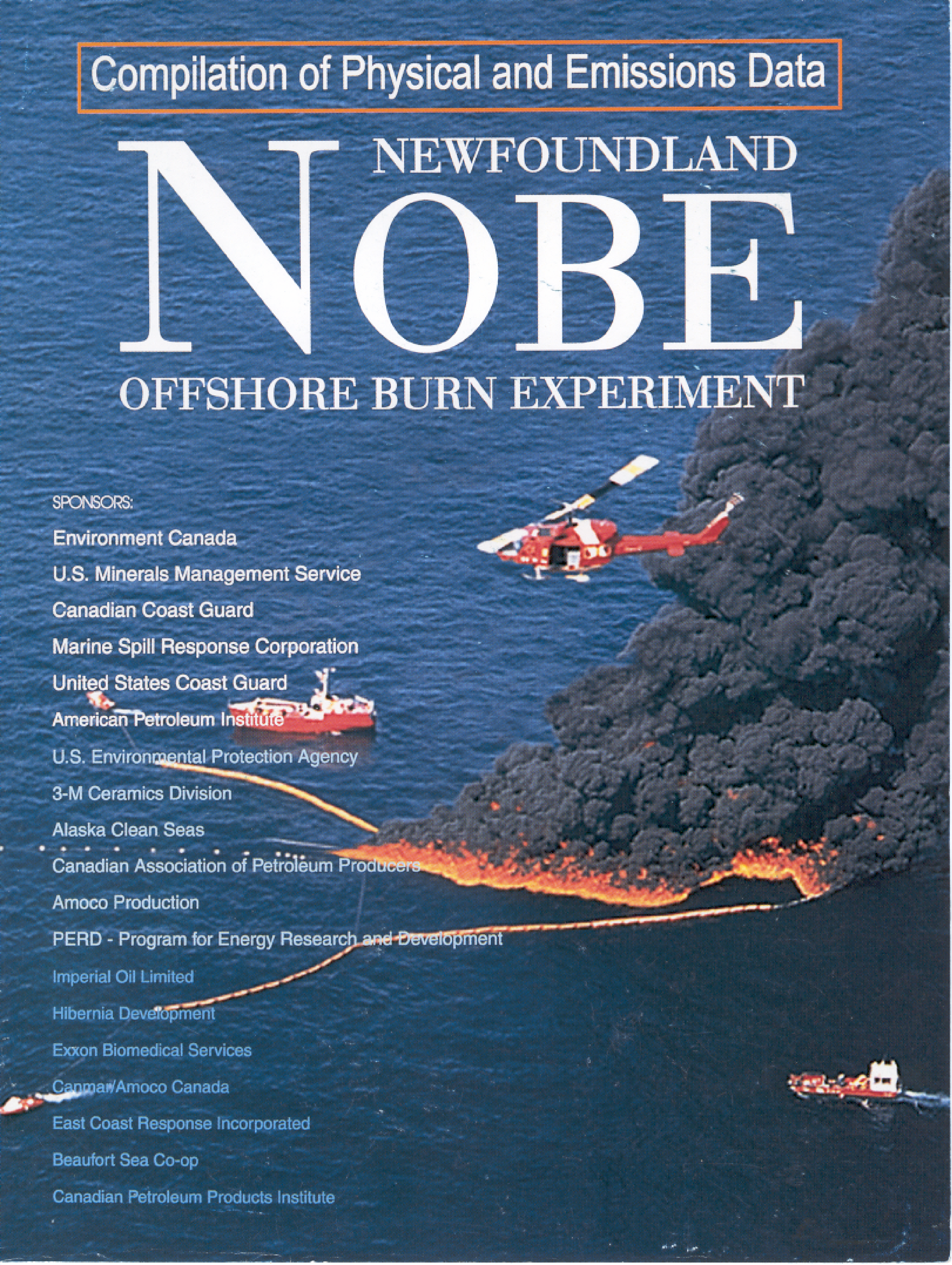
Compilation of Physical and Emissions Data

NEWFOUNDLAND NOBE

OFFSHORE BURN EXPERIMENT



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Reader's Comments

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Review Notice

This report has been reviewed by the Emergencies Science Division of Environment Canada and approved for publication. Approval does not necessarily signify that the contents reflect the views and policies of Environment Canada. Mention of trade names or commercial products does not constitute recommendations or endorsement for use.

Foreword

This report is a compilation of most of the data collected during the 1993 "Newfoundland Offshore Burn Experiment" or NOBE. Most of the material is presented in the form of raw data. Where noted, some data have been corrected for background and calibration values. Data treatments are described in the text at the beginning of each section. Log books and other verbal descriptions have not been edited. Material in the appendices has been printed as received from the parties conducting the work.

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Section 1

Polycyclic Aromatic Hydrocarbons (PAHs)
NOBE 93

Polycyclic Aromatic Hydrocarbons (PAHs)
NOBE 93

The samples collected for PAH analysis on August 12, 1993 include air and plume samples taken at sea level and at various altitudes, water samples, and oil and residue samples. Background samples were collected earlier on August 7, 1993.

PS-1 Particulate and Vapour Collection System

The General Metal Works PUF (polyurethane foam) Sampler is a complete system, designed to simultaneously collect suspended airborne particulates and trap airborne vapours at flow rates up to 280 L/min.

Instrumentation

- The pump from the PS-1 drew air through a 7.6-cm diameter glass fibre filter followed by a polyurethane foam (PUF) filter 7.6 cm thick with a density of 0.022 g/cm^3.
- The flow rate varied between 128 and 279 L/min during the two burns. This yielded volumes between 9200 and 13,600 L for the various instruments.
- The PS-1 sampling head was rinsed with hexane before loading the collection media.
- The collecting media were manipulated with powderless gloves.
- The glass fibre filters were wrapped in aluminum foil and put in petri dishes, the PUFs were wrapped in separate aluminum foil and placed in a glass jar, and both samples were kept refrigerated on ice.
- All glass fibre filters were weighed at constant atmospheric conditions before and after the experiment, under the same conditions.
- After the glass fibre filters were reweighed, the PUF filter and fibre filter were combined to undergo extraction and GC/MSD analysis for PAH.
- An extended PAH analysis was also done on these extracts.

Location

Two PS-1 were located at each of the following stations.

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

Cyclone

A Cyclone sampler, equipped with a Gilian 513A pump was used to trap particulate smaller than 5 micron. The particulates were collected on a 37-mm PVC filter inside a cassette connected to the pump with Tygon tubing connections.

Instrumentation

- The Gilian 513A pump flow rate varied between 1.7 and 2 L/min and the volumes sampled between 57 and 122 L.
- After sampling, the filters were wrapped in aluminum foil, put in Qorpak bottles, and kept refrigerated on ice.
- All parts of the Cyclone were cleaned with hexane after each experiment.
- All filters were weighed at constant atmospheric conditions before and after the experiment, under the same conditions and analysed for PAH concentration using the GC/MSD method.

Location

Two Cyclones were located at each of the following positions

- Remote Station 1 (RS-1) - 50 to 100 m downwind from fireboom apex. Tygon tubing was used to connect the instrument to the mast to allow sampling at approximately 1.2 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from fireboom apex. Tygon tubing was used to connect the instrument to the mast to allow sampling at approximately 1.2 m above sea level.
- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

Cascade Impactor (Andersen 1 ACFM Non-Viable Ambient Particle Sizing Samplers)

The Cascade Impactor is an eight-stage, multi-orifice impactor, measuring the size distribution and total concentration levels of solid particulate matter. Its eight aluminum stages contain multiple precision-drilled orifices. When air is drawn through the sampler, multiple jets of air in each stage direct any airborne particles toward the surface of the collection plate for the stage. The size of the jets is uniform at each stage, but is smaller at each succeeding stage. Whether a particle is impacted on any given stage depends on its aerodynamic dimension. Glass fibre filters are used as collection media. This sampler collects particulates between 0.4 and 10 micron in diameter.

Instrumentation

- The impactor was loaded with two top fibre filters with a hole in middle, followed by six solid fibre filters.
- The sampling rate was 28.3 L/min.
- The unit was washed with hexane before each experiment.
- After a run, the fibre filters were wrapped in aluminum foil, placed in an envelope, and refrigerated in coolers with ice packs.
- All filters were weighed at constant atmospheric conditions before and after the experiment, under the same conditions.
- The variation in weight was so small that all eight filters for each stack were combined to undergo extraction and GC/MSD analysis for PAH.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from fireboom apex. The instrument was mounted on the mast at approximately 1.4 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from fireboom apex. The instrument was mounted on the mast at approximately 1.4 m above sea level.
- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

Remote Control Helicopter

For the Newfoundland burn, ESD constructed a fleet of four US Miniature X-Cell 60-series. These remote control helicopters were custom fitted with a pair of lightweight fiberglass/foam floats for overwater operations. Measuring about 1.2 m long and with a total weight of approximately 8.2 kg , the latest X-Cell helicopter is the first of its kind to be adapted for ocean deployment.

Although the radio has a range of up to 0.8 km, because of the visual limitation, the normal operation distance is approximately 150 m. Flight duration is generally 20 minutes or less. In normal operation, the helicopter requires a team of two, the pilot and a 'spotter' who directs the flight pattern and warns the pilot of any obstruction or danger in the vicinity of the flight envelope.

Specifications for Remote Control Helicopter

Platform:	US Miniature Aircraft X-Cell 60-Series with Hiller Stabilized flybar system, modified for overwater operation.
Radio:	JR X-347 7-Channel digital proportional R/C system
Gyro:	Quest-rated gyro; automatically trims down unwanted activity in helicopter while permitting radio commands to be obeyed without resistance
Fuel:	12% Nitro
Engine:	OS Max SF 10 cc; 3 hp
Roto span:	147 cm (58 in) diameter
Height:	61 cm (24 in) with floats
Length:	132 cm (52 in)
Weight:	8.1 kg (18 lbs) at liftoff with all sampling equipment

Plume Samples

These samples were drawn through a 150-mg XAD sorbent tube, preceded by a 37-mm (1 micron) Teflon pre-filter in a cassette. The XAD tube collected the gaseous portion of the sample, while the pre-filter collected the particulate fraction of the same sample. To draw this plume sample through the collection tube, the miniature helicopters were equipped with a Gilian lo-flow personal pump (model LFS-113) working at a flow rate of 1 L/min and powered by an explosion-proof 6V 2 AH battery. The PAH analysis was done on the combined extracts from the filter and the XAD tube using the GC/MSD method.

- Burn 1 - R/C Heli 1 - Plume sample (field # T1B1F5) was collected by Team 1 on board the CCG 207. It is the result of a single sampling run done during the burn period with a filter and an XAD tube as sampling media at approximately 30 m from the fireboom apex. The sampling time was 6 minutes for a volume of 6 L. The PAH analysis was done on the combined extracts from the filter and the XAD tube using the GC/MSD method.
- Burn 1 - R/C Heli 2 - Plume sample (field # T2B1F4) was collected by Team 2 on board the CCG 211. It is the result of one plume sampling run done during the burn period with a filter and an XAD tube for sampling media. This sample was taken at approximately 170 m from the fireboom apex. The sampling time was 10 minutes for a volume of 10 L. The PAH analysis was done on the combined extracts from the filter and the XAD tube using the GC/MSD method.
- Burn 2 - R/C Heli 1 - Plume sample (field # T1B2F3) was collected by Team 1 on board the CCG 207. It is the result of one plume sampling run done during the burn period with a filter and an XAD tube for sampling media. This sample was taken at approximately 30 m from the fireboom apex traversing the plume. The sampling time was 6 minutes for a volume of 6 L. The PAH analysis was done on the combined extracts from the filter and the XAD tube using the GC/MSD method.
- Burn 2 - R/C Heli 2 - Plume sample (field # T2B2F4) was collected by Team 2 on board the CCG 211. It is the result of one plume sampling run done during the burn period with a filter and an XAD tube for sampling media. This sample was taken at approximately 170 m from the fireboom apex. The sampling time was 7 minutes for a volume of 7 L. The PAH analysis was done on the combined extracts from the filter and the XAD tube using the GC/MSD method.

Clear Air Samples

The clear air samples were collected outside the path of the smoke plume using Summa canisters. The interior of these stainless steel canisters are specially treated by the SUMMA™ passivation process, which leaves a surface of pure chrome-nickel oxide, reducing the adsorption of gases. A 1 L Summa, evacuated to minus 30 inHg, was preceded by a 37-mm (1 micron) Teflon pre-filter in a cassette and equipped with an adjustable restricting needle valve which was set to allow an approximate flow rate of 100 cc/min. The pre-filters were analysed for PAH concentration using the GC/MSD method.

- Burn 1 - Filter R/C Heli 1 - Composite air sample (field # T1B1F1-4), was collected by Team 1 operating on board the CCG 207. This refers to a composite sample of four runs done with Summa canisters using the same pre-filter. It includes a background and evaporation run, and two sampling runs, one done at approximately 15 m in front of the plume and the other at approximately 30 m from the fireboom apex and under the plume. The combined sampling time was 23 minutes for a total volume of 3.4 L. The PAH analysis was done on the filters using the GC/MSD method.
- Burn 2 - R/C Heli 1 - Composite air sample (field # T1B2F1-2) was collected by Team 1 on board the CCG 207. It is the result of two air sampling runs done with Summa canisters using the same filter, one done at approximately 15 m in front of the plume and the other at approximately 30 m from the fireboom apex and under the plume. The combined sampling time was 12 minutes for a total volume of 1.1 L. The PAH analysis was done on the filter using the GC/MSD method.

Blade Wipes

- The blades of the remote control helicopters were cleaned with hexane using a 20.3 x 25.4 cm glass fibre filter. The filters was weighed and numbered in a controlled environment and then cut in four pieces. The four pieces were kept together as a unit throughout the experiment.
- The blades of the helicopter were wiped at the end of each time period with all four pieces of this glass fibre filter soaked in hexane.
- The filter pieces were then wrapped in foil and placed in a plastic bag and refrigerated until analysed.
- The filter, as a unit, was reweighed before analysis of PAH under the same conditions as the pre-weight was done.
- The filter, as a unit, was extracted and analysed for PAH concentration using the GC/MSD method.

PUF Samples from the University of Washington Aircraft (Convair)

The University of Washington aircraft used a series of high-density polyethylene grab-sample bags, with a capacity of 2.5 m^3, to collect a variety of clean air and smoke samples. These bags can be filled in about 10 seconds. A polyurethane foam plug (PUF) was used as the collection media for PAH analysis of particulate material. More then one bag was usually used to collect the samples needed on the PUF media.

Data

- NFP1: August 7, 1993 background sample, volume = 1.522 m^3, 3.2 km downwind from the ships.
- NFP3: Background before Burn 1, volume = 4.972 m^3 from a composite sample of five grab bags taken 3.2 km downwind at 121.9 m altitude.
- NFP4: During Burn 1, sample volume = 2.655 m^3 from a composite sample of three grab bags taken 1.6 km downwind.
- NFP5: During Burn 2 (field # NFP5), sample volume = 2.580 m^3 from a composite sample of three grab bags taken 3.2 km downwind and at 304.8 m altitude.

- NFP6: During Burn 2 , sample volume = 2.220 m^3 from a composite sample of three grab bags at 9.7 km downwind and at 335.3, 426.7, and 518.2 m altitude.
- NFP7: Background after Burn 2, volume = 2.932 m^3 from a composite sample of four grab bags taken away from the smoke.

Smoke Sample from NIST's Blimp

NIST operated a smoke-sampling package suspended from a tethered helium-filled miniblimp. An aluminum box, with overall dimensions of 300 x 310 x 130 mm, held up to four battery-operated sampling pumps. For NOBE 93, two pumps were used for Burn 1 and three for Burn 2. The miniblimp, 5.5 m long x 2.1 m in diameter, was kept above the plume with its package positioned in the plume 30 m below. A tether line from the blimp was connected to the top of the package. Another tether line was connected from the bottom of the package to the tending vessel, allowing the package to orient itself into the wind.

Instrumentation

- For Burn 1, two pumps equipped with a 37-mm smoke particulate filter were run simultaneously at 4 L/min. The sample pumps were started with the miniblimp at sea level 300 seconds after the burn had started. The total running time was 3338 seconds.
- For Burn 2, two pumps were also used as for Burn 1. The starting time was 180 seconds after the burn had started and the total running time of 3877 seconds.
- The filters were weighed before and after sampling to determine the total mass of smoke particulate and analysed for PAH concentration using the GC/MSD method.
- An extended PAH analysis was also done on these extracts.

Location

- The CCG 210 tending to the miniblimp was positioned 200 to 600 m downwind from the apex of the fireboom.
- As observed on the aerial photos, the CCG 210 always navigated between the edge and the centre of the plume for Burn 1. Only a few photos are available for Burn 2 and they position the CCG 210 under the plume.
- The miniblimp followed a pattern similar to the CCG 210 with distances from the apex of the fireboom varying from 200 to 600 m for Burn 1 and Burn 2 in the path of the plume.
- For both burns, the miniblimp was deployed at 152.4 m high from the deck level with the sampling package hanging 30 m below.

Water Samples

A Sigma Streamline 800SL Portable Sampler was used to collect water samples for both toxicity and organic compounds analysis. These samplers are designed to automatically collect and preserve samples from a liquid source.

Instrumentation

- From the samplers, Teflon tubing was attached to a pole which was lowered into the water collecting the samples at approximately 1 m.
- The flow rate of the samplers was set at 2 L/min.
- One of the samplers was set up with 24 bottles (350 mL) collecting water samples for analysis of organic compounds. This sampler was set up to work on sets of six bottles at a time. A first set was set up to collect the samples during off-loading, two other sets were programmed to collect their samples 15 minutes and 30 minutes after the beginning of the burn, and the last set was to collect its water sample after the burn had ended.
- The second sampler was set up with 4 bottles (3.8 L each) and collected water samples to be analysed for toxicity. This sampler was modified to accommodate this sample volume and programmed to work with one bottle at a time. The collection time table was the same as described above for the 350 mL sample bottles.
- The samplers were cleaned with hexane between burns.
- All samples collected were placed in refrigerated coolers and shipped to testing facilities within 24 hours of collection.

Location

Two samplers were located at each of the following positions.

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.

Sample Description

The description of the sampling times and codes can be found in Table 1.1.

Oil and Residue Sampling

An Alberta Sweet Mix Crude Oil was used for this burn experiment. The description of time and position for samples of oil and residue can be found in Table 1.2.

NOBE 93 Table 1.1

Water Samples Collection Time Table

Pre-ignition 1 (10:15 am)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 4		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B4-PI1	679	BR1-B2-PI1	880
BR1-B4-PI2	679	BR1-B2-PI2	1048
Burn 1 (10:41)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB1-1	684		
BR1-B2-DB1-2	687		
Burn 1 (11:03)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB2-1	876		
BR1-B2-DB2-2	850		
Post-burn 1 (12:09)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-PB1	900		
BR1-B2-PB2	820		

Pre-ignition 2 (13:59)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PI1	682		
BR2-B1-PI2	782		
Burn 2 (14:46)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB1-1	686		
BR2-B1-DB1-2	683		
Burn 2 (15:00)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB2-1	686		
BR2-B1-DB2-2	659		
Post-burn 2 (15:20)			
Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PB1	655		
BR2-B1-PB2	680		

*LEGEND: BR: Burn; B: Boat; PI: Preignition; PB: Post burn;
DB1 & DB2: During the first and second half of burn
CS: Control seawater; BG: Background;
EB: Early burn; LB: Late burn
M96: 96 hr Menidia test endpoint sample

NOBE 93 Table 1.2

NOBE Oil and Residue Samples
Alberta Sweet Mix Crude Oil

I.D. #	Type	Qty	Description
1	Fresh Crude	1 L	Sample taken from 3rd truck in Hughenden, Alb., 7/22/93. Only sample of fresh crude which was not damaged during transport.
2	Fresh Crude	3.5 L	Sample taken from 2nd truck in Hughenden, Alb., 7/22/93; 2 container collected split into 2A & 2B. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
3	Fresh Crude	2.5 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
4	Weathered	3 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Only sample of weathered crude collected in Alberta, container remained intact during transport.
5	Weathered Crude	60 L	Sample collected from trucks while loading oil into CCG Sir Wilfred Grenfell, St. John's, NFLD., 8/2/93. On 9/2/93 sample from truck 3 was mixed with sample from truck 1 and 2 respectively to simulate the oil on the ship. 5A = trucks 3 + 1, 5B = trucks 3 + 2
6	Oily Water	10 L	Separated from weathered oil (sample 5), 9/2/93.
7	Weathered Crude	3 L	Collected before Burn 1, from apex of fire boom, 8/12/93.
8	Oily Water	10 L	Separated from weathered oil (sample 7), 9/2/93.
9	Surface Sheen	5	1 sorbent pad was used to collect 5 surface samples. Samples collected during Burn 1, between fireboom and row boom, 8/12/93.
10	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, behind row boom, 8/12/93.
11	Residue	1 L	Sample collected during Burn 1, from water surface between fire boom and row boom, 8/12/93.
12	Residue	7 L	Sample collected after Burn 1, from apex of fire boom, 8/12/93.
13	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, between fire boom and row boom, 8/12/93.
14	Residue	4 L	Collected during Burn 2, from water surface between fire boom and row boom, 8/12/93.
15	Residue	7 L	Collected after Burn 2, from apex of row boom, 8/12/93.
16	Residue	0.3 L	Collected from sides of remote control sample boats, 8/14/93.
17	Residue	15 L	Collected from surface of row boom, Sept 93. Sample contaminated with cleaning agents.

NOBE 93 Table 1.3

Burn 1 PAH Analysis of Sea Level Air Samples

PS-1 Glass Fibre Filters + PUF (polyurethane foam)

	Burn period								
Sample I.D.	Remote Station # 1 * Remote control boat # 2 50-100 m from fire			Remote Station # 2 ** Remote control boat # 1 100-150 m from fire			Downwind Station CCG 206 900 m from fire		
Internal sample reference	P17F17	P18F18		P6F6	P8F8		P3F3	P5F5	
Sample Size (m^3)	12.42	12.74	AVE	11.590	12.240	AVE	7.424	9.106	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Naphthalene	1.41	1.11	1.26	2.07	2.26	2.16	2.12	1.31	1.71
1-Methylnaphthalene	1.64	2.00	1.82	2.10	2.09	2.10	0.55	0.39	0.47
2-Methylnaphthalene	2.27	2.75	2.51	1.33	1.19	1.26	0.28	0.20	0.24
Biphenyl	0.17	0.14	0.15	0.30	0.30	0.30	0.03	0.03	0.03
2,6-Dimethylnaphthalene	0.94	1.62	1.28	1.00	0.87	0.93	0.16	0.12	0.14
Other Dimethylnaphthalenes	2.25	0.77	1.51	2.95	2.52	2.74	0.48	0.34	0.41
Acenaphthalene	0.14	0.71	0.43	0.29	0.24	0.26	0.03	0.02	0.02
Acenaphthene	0.01	0.08	0.05	0.05	0.05	0.05	0.01	0.01	0.01
2,3,5-Trimethylnaphthalene	0.21	0.36	0.28	0.26	0.15	0.20	0.03	0.03	0.03
Other Trimethylnaphthalenes	0.73	1.84	1.28	1.14	0.63	0.89	0.14	0.15	0.14
Fluorene	0.14	0.21	0.18	0.12	0.14	0.13	0.02	0.02	0.02
Phenanthrene	<0.008	0.06	0.06	0.12	0.19	0.15	0.03	0.02	0.03
Anthracene	0.02	0.04	0.03	0.12	0.02	0.07	0.03	0.02	0.03
1-Methylphenanthrene	0.02	0.02	0.02	0.01	0.01	0.01	<0.013	<0.011	LMDL
Other Methylphenanthrenes	0.01	0.04	0.02	0.02	0.03	0.02	<0.013	0.01	0.01
Fluoranthene	0.04	0.05	0.05	0.02	0.04	0.03	<0.013	<0.011	LMDL
Pyrene	0.04	0.05	0.05	0.02	0.03	0.02	<0.013	<0.011	LMDL
Benz(a)anthracene	0.01	0.01	0.01	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Chrysene	<0.008	0.06	0.06	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Benzo(b)fluoranthene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Benzo(k)fluoranthene	<0.008	0.02	0.02	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Benzo(e)pyrene	0.01	0.01	0.01	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Benzo(a)pyrene	0.01	0.01	0.01	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Perylene	<0.008	0.05	0.05	<0.009	<0.008	LMDL	0.02	<0.011	0.02
Indeno(1,2,3-c,d)Pyrene	<0.008	0.02	0.02	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Dibenz(a,h)anthracene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Benzo(g,h,i)Perylene	0.01	0.01	0.01	<0.009	<0.008	LMDL	<0.013	<0.011	LMDL
Total	**10.07**	**12.04**	**11.16**	**11.92**	**10.77**	**11.35**	**3.93**	**2.67**	**3.31**
Surrogates (% recovery)									
d8-Naphthalene	not added	N/D		92	121		117	106	
d10-Acenaphthene	not added	105		109	93		85	76	
d10-Phenanthrene	not added	82		90	80		87	80	
d12-Chrysene	not added	78		99	99		94	97	
d12-Perylene	not added	61		77	84		74	80	
d14-Terphenyl (I.S. area x1000)	not added	N/D		233	254		250	262	

* Remote Control boat # 2 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position
** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling; results applied to RS-2 position
N/D indicates not detectable
< symbol indicates below method detection limit
LMDL: Lower than Method Detectable Limit
PS-1 on remote control boats were positioned at approximately 0.7 m above sea level.
For Downwind Station results: recoveries of d8 naphthalene are high due to interfering ions

NOBE 93 Table 1.4

Burn 2 PAH Analysis of Sea Level Air Samples
PS-1 Glass Fibre Filters + PUF (polyurethane foam)

	Burn period								
Sample I.D.	Remote Station # 1 Remote control boat # 1 50-100 m from fire			Remote Station # 2 Remote control boat # 2 100-150 m from fire			Downwind Station CCG 206 500-600 m from fire		
Internal sample reference	P12F12	P9F9		P15F15	P16F16		P1F1	P4F4	
Sample Size (m^3)	12.1	12.74	AVE	13.671	13.328	AVE	9.216	11.95	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Naphthalene	1.91	1.74	1.83	2.55	2.77	2.66	2.42	1.04	1.73
1-Methylnaphthalene	1.39	1.88	1.64	3.07	2.88	2.97	0.88	0.67	0.77
2-Methylnaphthalene	1.97	1.86	1.92	1.61	1.56	1.59	0.46	0.32	0.39
Biphenyl	0.15	0.18	0.16	0.17	0.20	0.18	0.15	0.04	0.09
2,6-Dimethylnaphthalene	0.94	1.41	1.18	0.93	0.88	0.90	0.21	0.16	0.19
Other Dimethylnaphthalenes	2.38	1.47	1.93	1.88	1.74	1.81	0.59	0.46	0.52
Acenaphthalene	0.71	1.24	0.97	0.14	0.14	0.14	0.05	0.04	0.04
Acenaphthene	0.01	0.07	0.04	0.03	0.03	0.03	0.01	0.01	0.01
2,3,5-Trimethylnaphthalene	0.24	0.32	0.28	0.14	0.12	0.13	0.04	0.05	0.05
Other Trimethylnaphthalenes	0.61	1.00	0.81	0.60	0.32	0.46	0.19	0.22	0.20
Fluorene	0.20	0.28	0.24	0.08	0.07	0.08	0.02	0.02	0.02
Phenanthrene	0.00	0.06	0.03	0.08	0.10	0.09	0.06	0.07	0.06
Anthracene	0.08	0.11	0.10	0.01	0.11	0.06	<0.011	<0.008	LMDL
1-Methylphenanthrene	0.02	0.03	0.03	0.01	0.01	0.01	<0.011	0.01	0.01
Other Methylphenanthrenes	0.03	0.06	0.05	0.02	0.02	0.02	<0.011	0.02	0.02
Fluoranthene	0.23	0.31	0.27	0.03	0.04	0.03	<0.011	0.01	0.01
Pyrene	0.23	0.31	0.27	0.03	0.03	0.03	<0.011	0.01	0.01
Benz(a)anthracene	0.05	0.06	0.06	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Chrysene	0.00	0.06	0.03	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Benzo(b)fluoranthene	0.15	0.20	0.17	0.01	0.01	0.01	<0.011	<0.008	LMDL
Benzo(k)fluoranthene	0.01	0.01	0.01	0.01	<0.008	0.01	<0.011	<0.008	LMDL
Benzo(e)pyrene	0.04	0.06	0.05	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Benzo(a)pyrene	0.07	0.08	0.07	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Perylene	0.01	0.05	0.03	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Indeno(1,2,3-c,d)Pyrene	0.10	0.15	0.13	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Dibenz(a,h)anthracene	0.01	0.01	0.01	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Benzo(g,h,i)Perylene	0.06	0.10	0.08	<0.007	<0.008	LMDL	<0.011	<0.008	LMDL
Total	**11.59**	**13.12**	**12.35**	**11.39**	**11.05**	**11.22**	**5.07**	**3.15**	**4.11**
Surrogates (% recovery)									
d8-Naphthalene	N/D	N/D		100	111		124	105	
d10-Acenaphthene	4	93		103	98		91	83	
d10-Phenanthrene	0	80		100	92		99	87	
d12-Chrysene	0	72		97	94		94	103	
d12-Perylene	3	61		84	85		70	89	
d14-Terphenyl (I.S. area x1000)	N/D	N/D		248	235		246	255	

LMDL: Lower than Method Detectable Limit
for Downwind Station results : recoveries of d8 naphthalene are high due to interfering ions
N/D indicates not detectable
< indicates below method detection limit
PS-1 on remote control boats were positioned at approximately 0.7 m above sea level

NOBE 93 Table 1.5

Background and Blanks PAH Analysis of Sea Level Air Samples

PS-1 Glass Fibre Filters + PUF (polyurethane foam)

Sample I.D.	Background, August 07 1993				Trip Blanks, August 12 1993			
	Remote control boat # 1			CCG 206	Remote control boat # 1			CCG 206
Internal sample reference	P19F19	P20F20	AVE	P14F14	P13F13	P10F10	AVE	P2F2
Sample Size (m^3)	8.184	8.184		2.550	0	0		0
Compound	µg/m³	µg/m³	µg/m³	µg/m³	mass (µg)	mass (µg)	mass (µg)	mass (µg)
Naphthalene	0.50	0.94	0.72	6.33	2.28	1.27	1.77	0.84
1-Methylnaphthalene	0.58	1.02	0.80	0.41	0.30	0.37	0.34	0.48
2-Methylnaphthalene	0.30	0.50	0.40	0.19	0.55	0.17	0.36	0.22
Biphenyl	0.12	0.15	0.14	<0.1	0.12	<0.1	0.12	0.13
2,6-Dimethylnaphthalene	0.49	0.64	0.57	0.13	0.19	<0.1	0.19	0.17
Other Dimethylnaphthalenes	1.30	1.68	1.49	0.48	0.52	<0.1	0.52	0.62
Acenaphthalene	0.02	0.03	0.03	<0.1	<0.08	<0.1	LMDL	<0.1
Acenaphthene	0.03	0.03	0.03	<0.1	<0.08	<0.1	LMDL	<0.1
2,3,5-Trimethylnaphthalene	0.22	0.24	0.23	<0.1	<0.08	<0.1	LMDL	<0.1
Other Trimethylnaphthalenes	1.00	1.04	1.02	<0.1	<0.08	<0.1	LMDL	<0.1
Fluorene	0.12	0.10	0.11	<0.1	0.14	<0.1	0.14	<0.1
Phenanthrene	0.32	0.33	0.32	0.34	0.51	0.23	0.37	0.53
Anthracene	0.02	0.35	0.19	<0.1	<0.08	0.26	0.26	0.56
1-Methylphenanthrene	0.05	0.05	0.05	<0.1	<0.08	<0.1	LMDL	<0.1
Other Methylphenanthrenes	0.10	0.11	0.11	<0.1	<0.08	<0.1	LMDL	<0.1
Fluoranthene	0.02	0.01	0.01	<0.1	0.12	<0.1	0.12	0.12
Pyrene	0.05	0.06	0.06	<0.1	<0.08	<0.1	LMDL	<0.1
Benz(a)anthracene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Chrysene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Benzo(b)fluoranthene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Benzo(k)fluoranthene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Benzo(e)pyrene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Benzo(a)pyrene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Perylene	<0.012	<0.012	LMDL	0.10	<0.08	<0.1	LMDL	<0.1
Indeno(1,2,3-c,d)Pyrene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Dibenz(a,h)anthracene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Benzo(g,h,i)Perylene	<0.012	<0.012	LMDL	<0.1	<0.08	<0.1	LMDL	<0.1
Total	**5.25**	**7.28**	**6.27**	**7.98**	**4.72**	**2.31**	**3.51**	**3.67**
Surrogates (% recovery)								
d8-Naphthalene	78	89		59	not added	56		98
d10-Acenaphthene	88	88		51	not added	51		76
d10-Phenanthrene	95	94		69	not added	63		87
d12-Chrysene	100	99		79	not added	70		90
d12-Perylene	82	82		66	not added	55		69
d14-Terphenyl (I.S. area x1000)	247	258		203	240	202		235

LMDL: Lower than Method Detectable Limit
For Downwind Station results: recoveries of d8 naphthalene are high due to interfering ions
< indicates below method detection limit
PS-1 on remote control boats were positioned at approximately 0.7 m above sea level

NOBE 93 Table 1.6 BURN 1 PAH Analysis of Sea Level Air Samples

Cyclone (particulate <5 micron)

	Burn									Background, August 07 1993			
Sample I.D.	Remote Station # 1 * Remote control boat # 2 50-100 m from fire			Remote Station # 2 ** Remote control boat # 1 100-150 m from fire			Downwind Station CCG 206 900 m from fire			Remote control boat # 1			CCG 206
Internal sample reference	C19	C11	AVE	C17	C18	AVE	C1	C2	AVE	C14	C15	AVE	C16
Sample Size (m^3)	0.088	0.0855		0.09	0.09		0.0986	0.0986		0.062	0.062		0.0578
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Naphthalene	<1.1	<1.1	LMDL	<1.1	1.43	1.43	<1.0	<1.0	LMDL	3.68	2.88	3.28	2.03
1-Methylnaphthalene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
2-Methylnaphthalene	1.42	<1.1	1.42	<1.1	2.35	2.35	<1.0	<1.0	LMDL	4.21	3.72	3.96	<1.7
Biphenyl	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	3.37	<1.0	3.37	<1.6	<1.6	LMDL	<1.7
2,6-Dimethylnaphthalene	1.42	<1.1	1.42	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	6.85	4.15	5.50	<1.7
Acenaphthalene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Acenaphthene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
2,3,5-Trimethylnaphthalene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Fluorene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Phenanthrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Anthracene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
1-Methylphenanthrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Fluoranthene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Pyrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benz(a)anthracene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Chrysene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benzo(b)fluoranthene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benzo(k)fluoranthene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benzo(e)pyrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benzo(a)pyrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Perylene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Indeno(1,2,3-c,d)Pyrene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Dibenz(a,h)anthracene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Benzo(g,h,i)Perylene	<1.1	<1.1	LMDL	<1.1	<1.1	LMDL	<1.0	<1.0	LMDL	<1.6	<1.6	LMDL	<1.7
Total	**2.83**	**LMDL**	**2.83**	**LMDL**	**3.78**	**3.78**	**3.37**	**LMDL**	**3.37**	**14.73**	**10.74**	**12.74**	**2.03**
Surrogates (% recovery)													
d8-Naphthalene	21	61		3	53		51	24		60	59		42
d10-Acenaphthene	54	66		35	69		63	47		69	66		68
d10-Phenanthrene	76	82		85	95		68	75		82	96		91
d12-Chrysene	100	96		122	118		58	60		98	104		110
d12-Perylene	36	69		99	124		45	44		82	61		49
d14-Terphenyl (I.S. area x1000)	N/D	185		N/D	N/D		183	173		197	N/D		N/D

* Remote Control boat # 2 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position.
** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling; results applied to RS-2 position.
< symbol indicates below method detection limit.
N/D indicates not detectable.
LMDL : Lower than Method Detectable Limit.
Cyclones on remote control boats were positioned at approximately 1.2 m above sea level.

NOBE 93 Table 1.7

BURN 2 PAH Analysis of Sea Level Air Samples

Cyclone (particulate <5 micron)

	Burn									Trip Blank		
Sample I.D.	Remote Station # 1 Remote control boat # 1 50-100 m from fire			Remote Station # 2 Remote control boat # 2 100-150 m from fire			Downwind Station CCG 206 500-600 m from fire					
Internal sample reference	C7	C8	AVE	C5	C6	AVE	C3	C4	AVE	C12	C13	AVE
Sample Size (m^3)	0.0980	0.098		0.096	0.0931		0.1224	0.1224		0	0	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	Mass (ug)	Mass (ug)	Mass (ug)
Naphthalene	<1.0	<1.0	LMDL	<1.0	1.29	1.29	<0.8	<0.8	LMDL	0.10	0.21	0.15
1-Methylnaphthalene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
2-Methylnaphthalene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Biphenyl	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	4.21	<0.8	4.21	<0.1	<0.1	LMDL
2,6-Dimethylnaphthalene	2.12	<1.0	2.12	<1.0	8.49	8.49	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Acenaphthalene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Acenaphthene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
2,3,5-Trimethylnaphthalene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Fluorene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Phenanthrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Anthracene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
1-Methylphenanthrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Fluoranthene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Pyrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benz(a)anthracene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Chrysene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benzo(b)fluoranthene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benzo(k)fluoranthene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benzo(e)pyrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benzo(a)pyrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Perylene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Indeno(1,2,3-c,d)Pyrene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Dibenz(a,h)anthracene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Benzo(g,h,i)Perylene	<1.0	<1.0	LMDL	<1.0	<1.1	LMDL	<0.8	<0.8	LMDL	<0.1	<0.1	LMDL
Total	**2.12**	**LMDL**	**2.12**	**LMDL**	**9.77**	**9.77**	**4.21**	**LMDL**	**4.21**	**0.10**	**0.21**	**0.15**
Surrogates (% recovery)												
d8-Naphthalene	15	7		0	26		71	80		46	57	
d10-Acenaphthene	57	47		4	49		61	67		54	64	
d10-Phenanthrene	73	70		48	65		66	71		75	80	
d12-Chrysene	99	104		103	96		60	61		98	95	
d12-Perylene	56	49		84	21		42	45		64	44	
d14-Terphenyl (I.S. area x1000)	N/D	N/D		N/D	N/D		145	194		188	197	

< symbol indicates below method detection limit.
N/D indicates not detectable.
LMDL: Lower than Method Detectable Limit.
Cyclones on remote control boats were positioned at approximately 1.2 m above sea level.

NOBE 93 Table 1.8

PAH Analysis of Sea Level Air Samples

Cascade Impactor (particulate 0.4 to 10 micron)

	Burn 1			Burn 2		Background, August 07 1993		Trip Blank
Sample I.D.	Remote Station # 1* Remote control boat # 2 50-100 m from fire	Remote Station # 2** Remote control boat # 1 100-150 m from fire	Downwind Station CCG 206 900 m from fire	Remote Station # 2 Remote control boat # 2 100-150 m from fire	Downwind Station CCG 206 500-600 m from fire	Remote control boat # 1	CCG 206	
Internal sample reference	CIM-S2	CIM-S9	CIM-S7	CIM-S3	CIM-S6	CIM-S4	CIM-S5	CIM-S10
Sample Size (m^3)	1.303	1.303	1.643	1.388	2.039	0.878	0.2832	0
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	Mass (µg)
Naphthalene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
1-Methylnaphthalene	<0.08	<0.08	<0.06	<0.07	0.01	<0.11	<0.35	N/D
2-Methylnaphthalene	<0.08	<0.08	<0.06	<0.07	0.00	<0.11	<0.35	N/D
Biphenyl	0.32	0.36	0.19	0.21	0.15	0.55	<0.35	0.55
2,6-Dimethylnaphthalene	<0.08	<0.08	<0.06	<0.07	0.00	<0.11	<0.35	N/D
Acenaphthalene	<0.08	<0.08	<0.06	<0.07	0.00	<0.11	<0.35	N/D
Acenaphthene	<0.08	<0.08	<0.06	<0.07	0.01	<0.11	<0.35	N/D
2,3,5-Trimethylnaphthalene	<0.08	<0.08	<0.06	<0.07	0.01	<0.11	<0.35	N/D
Fluorene	0.14	<0.08	<0.06	0.15	0.11	0.20	0.59	N/D
Phenanthrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Anthracene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
1-Methylphenanthrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Fluoranthene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Pyrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benz(a)anthracene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Chrysene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benzo(b)fluoranthene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benzo(k)fluoranthene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benzo(e)pyrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benzo(a)pyrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Perylene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Indeno(1,2,3-c,d)Pyrene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Dibenz(a,h)anthracene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Benzo(g,h,i)Perylene	<0.08	<0.08	<0.06	<0.07	<0.05	<0.11	<0.35	N/D
Total	**0.46**	**0.36**	**0.19**	**0.35**	**0.29**	**0.75**	**0.59**	**0.55**
Surrogates (% recovery)								
d8-Naphthalene	89	92	80	121	94	93	50	94
d10-Acenaphthene	88	91	88	110	93	67	62	91
d10-Phenanthrene	90	93	102	104	92	74	77	94
d12-Chrysene	95	91	116	84	94	92	84	89
d12-Perylene	83	74	106	63	80	74	70	71
d14-Terphenyl (I.S. area x1000)	265	282	Not added	244	265	209	215	260

* Remote Control boat # 2 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position

** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling ; results applied to RS-2 position

< symbol indicates below method detection limit

N/D indicates not detectable

LMDL: Lower than Method Detectable Limit

Cascade impactors on remote control boats were positioned at approximately 1.4 m above sea level

NOBE 93 Table 1.9

PAH Analysis of Airborne Samples

Remote Control Helicopter

	Burn 1			Burn 2			Blanks	
Sample I.D.	Team 1 CCG 207	Team 1 CCG 207	Team 2 CCG 211	Team 1 CCG 207	Team 1 CCG 207	Team 2 CCG 211	Team 1 CCG 207	Trip Blank
	*composite sample clear air	30 m downwind from fire plume sample	167 m downwind from fire plume sample	**composite sampl clear air	30 m downwind from fire plume sample	167 m downwind from fire plume sample		
PAH analysis	filter only	filter + XAD tube	filter + XAD tube	filter only	filter + XAD tube	filter + XAD tube	filter only	XAD tube
Internal sample reference	T1B1F1-4	T1B1F5	T2B1F4	T1B2F1-2	T1B2F3	T2B2F4	T1B2F5	n/a
Sample Size (m^3)	0.003	0.006	0.0100	0.0120	0.006	0.007	0	0
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	Mass (µg)	Mass (µg)
Naphthalene	<4.35	77.62	26.45	<8.3	78.25	41.39	<20	0.33
1-Methylnaphthalene	<4.35	<16.7	<10	<8.3	16.70	<14.3	<20	<0.1
2-Methylnaphthalene	<4.35	26.66	10.59	<8.3	33.24	17.61	<20	0.11
Biphenyl	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
2,6-Dimethylnaphthalene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Acenaphthalene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Acenaphthene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
2,3,5-Trimethylnaphthalen	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Fluorene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Phenanthrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Anthracene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
1-Methylphenanthrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Fluoranthene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Pyrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benz(a)anthracene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Chrysene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benzo(b)fluoranthene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benzo(k)fluoranthene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benzo(e)pyrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benzo(a)pyrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Perylene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Indeno(1,2,3-c,d)Pyrene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Dibenz(a,h)anthracene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Benzo(g,h,i)Perylene	<4.35	<16.7	<10	<8.3	<16.7	<14.3	<20	<0.1
Total	**LMDL**	**104.28**	**37.04**	**LMDL**	**128.18**	**59.00**	**LMDL**	**0.43**
Surrogates (% recovery)								
d8-Naphthalene	108	95	88	88	89	87	93	88
d10-Acenaphthene	108	97	89	89	93	90	95	88
d10-Phenanthrene	103	94	87	86	89	88	91	86
d12-Chrysene	76	85	86	70	86	86	81	80
d12-Perylene	58	76	76	61	79	75	63	68
d14-Terphenyl (I.S. area x10	253	277	303	261	277	304	294	311

LMDL: Lower than Method Detectable limit.

* Four Summa runs with the same pre-filter: background, evaporation, 15 m in front of plume, and 30 m downwind from the fire and under the plume.

** Two Summa runs with the same pre-filter: 15 m in front of plume, and 30 m downwind from the fire and under the plume

NOBE 93 Table 1.10

PAH Analysis of Blade Wipes
Remote Control Helicopter

	Pre-evaporation 1		Burn 1		Burn 2		Blanks	
Sample I.D.	Team 1 CCG 207 1 flight	Team 2 CCG 211 1 flight	Team 1 CCG 207 composite of 4 flights	Team 2 CCG 211 composite of 3 flights	Team 1 CCG 207 composite of 5 flights	Team 2 CCG 211 composite of 3 flights	Team 1 CCG 207 unused filter	Team 2 CCG 211 unused filter
Total flight time (min)	6	4	23	22.5	24	25		
Internal sample reference	pack # 9	pack # 10	pack # 5	pack # 6	pack # 1	pack # 7		
Sample Size (g)	0.0045	0.0078	0.037	0.0576	0.0169	0.1222	0	0
Compound	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	Mass (µg)	mass (µg)
Naphthalene	<22	<0.3	12.58	8.60	11.44	5.48	<43	<250
1-Methylnaphthalene	<22	<0.3	<3	<2	<6	<1	<43	<250
2-Methylnaphthalene	<22	<0.3	<3	<2	<6	1.10	<43	<250
Biphenyl	<22	<0.3	<3	<2	<6	<1	<43	<250
2,6-Dimethylnaphthalene	<22	<0.3	<3	<2	<6	<1	<43	<250
Acenaphthalene	<22	<0.3	8.94	5.67	19.92	5.24	<43	<250
Acenaphthene	<22	<0.3	<3	<2	<6	<1	<43	<250
2,3,5-Trimethylnaphthalene	<22	<0.3	<3	<2	<6	<1	<43	<250
Fluorene	<22	<0.3	<3	<2	<6	1.05	<43	<250
Phenanthrene	<22	<0.3	19.82	14.15	52.47	10.68	<43	<250
Anthracene	<22	<0.3	18.33	13.66	50.72	2.36	<43	<250
1-Methylphenanthrene	<22	<0.3	<3	<2	<6	<1	<43	<250
Fluoranthene	<22	<0.3	13.13	12.72	34.58	11.18	<43	<250
Pyrene	<22	<0.3	12.32	12.81	33.63	10.54	<43	<250
Benz(a)anthracene	<22	<0.3	<3	<2	<6	1.18	<43	<250
Chrysene	<22	<0.3	<3	2.03	<6	<1	<43	<250
Benzo(b)fluoranthene	<22	<0.3	<3	5.45	11.16	5.48	<43	<250
Benzo(k)fluoranthene	<22	<0.3	<3	3.32	6.80	3.34	<43	<250
Benzo(e)pyrene	<22	<0.3	<3	<2	<6	1.67	<43	<250
Benzo(a)pyrene	<22	<0.3	<3	2.26	<6	2.16	<43	<250
Perylene	<22	<0.3	<3	<2	<6	<1	<43	<250
Indeno(1,2,3-c,d)Pyrene	<22	<0.3	<3	<2	<6	<1	<43	<250
Dibenz(a,h)anthracene	<22	<0.3	<3	<2	<6	<1	<43	<250
Benzo(g,h,i)Perylene	<22	<0.3	<3	<2	<6	4.23	<43	<250
Total	**LMDL**	**LMDL**	**85.12**	**80.68**	**220.72**	**65.70**	**LMDL**	**LMDL**
Surrogates (% recovery)								
d8-Naphthalene	64	68	64	56	30	49	25	39
d10-Acenaphthene	62	67	62	75	62	79	44	52
d10-Phenanthrene	64	75	64	76	77	88	61	67
d12-Chrysene	83	81	83	78	79	90	78	69
d12-Perylene	49	59	49	74	77	95	54	45
d14-Terphenyl (I.S. area x1000)	241	232	Not added	218	Not added	212	208	197

WIPES: 20 x 25 cm glass fibre filter cut in 4 pieces (kept as a unit) and used for one wipe

LMDL : Lower than Method Detectable Limit

NOBE 93 Table 1.11

PAH Analysis of Airborne Samples

PUF / Grab Bag System Onboard the Washington University Convair Aircraft

Sample I.D.	Background		Burn 1	Burn 2	Post-burn 2	Post-residue 2	Blank	Trip Blank
	Aug 07 Ship exhaust 3.2 km Downwind	8:21 to 8:45 Before burn 1 3.2 km Downwind altitude 121.9 m	10:56 to 11:08 Above clouds 1.6 km Downwind	14:13 to 14:24 Above clouds 3.2 km Downwind altitude 304.8 m	15:28 to 15:38 Cross section 9.7 km Downwind	16:23 to 16:38	Aug 07 Loaded blank	
Internal sample reference	NFP1	NFP3	NFP4	NFP5	NFP6	NFP7	NFP2	
Sample Size (m^3)	1.522	4.972	2.655	2.58	2.2	2.932	0	0
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	Mass (ug)	Mass (ug)
Naphthalene	0.46	0.14	0.41	0.22	0.34	0.11	0.43	0.79
1-Methylnaphthalene	0.66	0.16	0.36	0.27	0.49	0.19	0.40	0.75
2-Methylnaphthalene	0.34	0.08	0.18	0.15	0.24	0.10	0.17	0.37
Biphenyl	0.22	<0.05	0.06	0.08	0.15	0.05	0.06	<0.1
2,6-Dimethylnaphthalene	0.25	0.05	0.12	0.13	0.19	0.09	0.10	0.17
Acenaphthalene	<0.05	<0.05	0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Acenaphthene	0.13	<0.05	0.06	0.06	<0.05	0.06	<0.05	<0.1
2,3,5-Trimethylnaphthalene	0.08	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.1
Fluorene	0.11	<0.05	<0.05	<0.05	0.10	<0.05	<0.05	<0.1
Phenanthrene	0.60	<0.05	0.12	0.11	0.52	0.07	0.08	0.49
Anthracene	0.05	<0.05	<0.05	<0.05	0.05	<0.05	<0.05	<0.1
1-Methylphenanthrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Fluoranthene	0.13	<0.05	<0.05	<0.05	0.13	<0.05	<0.05	0.15
Pyrene	0.05	<0.05	<0.05	<0.05	0.06	<0.05	<0.05	<0.1
Benz(a)anthracene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Chrysene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Benzo(b)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Benzo(k)fluoranthene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Benzo(e)pyrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Benzo(a)pyrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Perylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Indeno(1,2,3-c,d)Pyrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Dibenz(a,h)anthracene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Benzo(g,h,i)Perylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.1
Total	**3.08**	**0.42**	**1.36**	**1.02**	**2.43**	**0.78**	**1.24**	**3.10**
Surrogates (% recovery)								
d8-Naphthalene	61	46	64	61	63	46	45	46
d10-Acenaphthene	93	58	95	100	122	87	59	60
d10-Phenanthrene	80	70	83	85	93	79	65	75
d12-Chrysene	76	68	91	96	94	88	63	79
d12-Perylene	64	58	81	88	79	77	52	68
d14-Terphenyl(I.S. area x1000)	237	199	215	187	186	195	237	169

< indicates lower than detectable limit

NOBE 93 Table 1.12

PAH Analysis of Smoke Samples from Miniblimp (CCG 210)
37-mm Smoke Particulate Sampling Filters

	Burn 1			Burn 2		
Sample I.D.	package at approximately 120 m above sea level 200-600 m from fire in smoke plume Filter 2			package at approximately 120 m above sea level 200-600 m from fire in smoke plume Filter 3		
Internal sample reference	FH1	FH2	AVE	FH3	FH4	AVE
Sample Size (m^3)	0.1938	0.1939		0.2243	0.224	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Naphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
1-Methylnaphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
2-Methylnaphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Biphenyl	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
2,6-Dimethylnaphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Other Dimethylnaphthalenes	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Acenaphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Acenaphthene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
2,3,5-Trimethylnaphthalene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Other Trimethylnaphthalenes	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Fluorene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Phenanthrene	<0.5	0.58	0.58	0.80	0.70	0.75
Anthracene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
1-Methylphenanthrene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Other Methylphenanthrenes	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Fluoranthene	<0.5	<0.5	LMDL	0.58	0.45	0.51
Pyrene	0.50	<0.5	0.50	0.62	0.57	0.59
Benz(a)anthracene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Chrysene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Benzo(b)fluoranthene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Benzo(k)fluoranthene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Benzo(e)pyrene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Benzo(a)pyrene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Perylene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Indeno(1,2,3-c,d)Pyrene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Dibenz(a,h)anthracene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Benzo(g,h,i)Perylene	<0.5	<0.5	LMDL	<0.45	<0.45	LMDL
Total	**0.50**	**0.58**	**0.54**	**1.99**	**1.72**	**1.86**
Surrogates (% recovery)						
d8-Naphthalene	83	86		90	81	
d10-Acenaphthene	87	88		92	82	
d10-Phenanthrene	88	84		87	80	
d12-Chrysene	81	72		75	71	
d12-Perylene	59	55		56	54	
d14-Terphenyl(I.S. area x1000)	173	181		167	189	

< indicates below method detection limit
LMDL: Lower than Method Detectable Limit

NOBE 93 Table 1.13 Burn 1 PAH Analysis of Water Samples

	Remote Station # 1 50 to 100 m from apex of fireboom									Remote Station # 2 100 to 150m from apex of fireboom					
Sample I.D.	Remote control boat # 4 Pre-ignition (10:15)			Remote control boat # 2 Burn (11:03)			Remote control boat # 2 Post-burn (12:09)			Remote control boat # 2 Pre-ignition (10:15)			Remote control boat # 2 Burn (10:41)		
Sample internal reference	BR1-B4-PI1	BR1-B4-PI2	AVE	BR1-B2-DB2-1	BR1-B2-DB2-2	AVE	BR1-B2-PB1	BR1-B2-PB2	AVE	BR1-B2-PI1	BR1-B2-PI2	AVE	BR1-B2-DB1-1	BR1-B2-DB1-2	AVE
Sample size (g)															
Compound	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
naphthalene	0.15	0.00	0.08	0.10	0.10	0.10	0.11	0.12	0.12	0.00	0.10	0.05	0.00	0.00	0.00
2-mehtyl-naphthalene	0.15	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-methyl-naphthalene	0.15	0.00	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
biphenyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,6-dimethyl-napthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
acenaphthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3,5-trimethyl-napthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fluorene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
phenanthrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-methyl-phenanthrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fluoranthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benz(a)anthracene / chrysene *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benz(b)fluoranthene / b(k)fluor.*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benzo(e)pyrene / benzo(a)pyrene*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indeno(1,2,3-cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dibenz (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benzo (ghi) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.45**	**0.00**	**0.23**	**0.10**	**0.10**	**0.10**	**0.11**	**0.12**	**0.12**	**0.00**	**0.10**	**0.05**	**0.00**	**0.00**	**0.00**
Surrogates (% recovery)															
d10-acenaphthalene	40	40		60	40		50	30		40	40		40	50	
d10-phenanthrene	50	60		70	50		70	40		50	60		50	60	
d12-benz(a)anthracene	60	70		80	50		80	50		60	80		70	70	
d12-perylene	50	60		70	50		80	40		60	70		70	70	

* Compounds are reported in pairs due to a lack of resolution in the signal.

Remote Control boat # 2 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position

Water samples were collected at approximately 1 m below sea level

NOBE 93 Table 1.14

Burn 2 PAH Analysis of Water Samples

Sample I.D.	Remote Station # 1 50-100 m from apex of fireboom Remote control boat # 1											
	Pre-ignition (13:59)			Burn (14:46)			Burn (15:00)			Post-burn (15:20)		
Sample internal reference / Sample size (g)	BR2-B1-PI1	BR2-B1-PI2	AVE	BR2-B1-DB1-1	BR2-B1-DB1-2	AVE	BR2-B1-DB2-1	BR2-B1-DB2-2	AVE	BR2-B1-PB1	BR2-B1-PB2	AVE
Compound	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L	µg/L
naphthalene	0.00	0.00	0.00	0.15	0.15	0.15	0.15	0.00	0.08	0.00	0.15	0.08
2-mehtyl-naphthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-methyl-naphthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
biphenyl	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,6-dimethyl-napthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
acenaphthylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
acenaphthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2,3,5-trimethyl-napthalene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fluorene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dibenzothiophene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
phenanthrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1-methyl-phenanthrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
fluoranthene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benz(a)anthracene / chrysene *	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benz(b)fluoranthene / b(k)fluor.*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benzo(e)pyrene / benzo(a)pyrene*	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
indeno(1,2,3-cd) pyrene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
dibenz (a,h) anthracene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
benzo (ghi) perylene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	**0.00**	**0.00**	**0.00**	**0.15**	**0.15**	**0.15**	**0.15**	**0.00**	**0.08**	**0.00**	**0.15**	**0.08**
Surrogates (% recovery)												
d10-acenaphthalene	40	80		40	50		50	30		40	40	
d10-phenanthrene	50	100		50	70		70	40		50	50	
d12-benz(a)anthracene	70	140		60	80		80	40		60	60	
d12-perylene	60	110		60	80		70	40		50	50	

* Compounds are reported in pairs due to a lack of resolution in the signal.

Water samples were collected at approximately 1 m below sea level

NOBE 93 Table 1.15

PAH Analysis of Oil and Residue Samples
Alberta Sweet Mix Crude Oil

Source	Reference #	PAH (µg/g)
Hughenden, truck # 3, fresh crude oil	1 - Reference oil	12085
Hughenden, truck # 2, fresh crude oil	2A - Fresh	11563
Hughenden, truck # 2 fresh crude oil	2B - Fresh	11752
Hughenden, truck # 1 fresh crude oil	3 - Fresh	11933
Hughenden, truck # 1, weathered Oil	4 - Weathered	11383
St-John's, truck # 3 + 1, weathered Oil	5A - Weathered	11603
St-John's, truck # 3 + 2, weathered Oil	5B - Weathered	11525
Weathered oil from apex of fireboom before Burn # 1	7 - Weathered	8467
Residue between fireboom and rowboom during Burn # 1	11 - Residue	4304
Residue from apex of fireboom after Burn # 1	12 - Residue	2985
Residue between fireboom and rowboom during Burn # 2	14 - Residue	2917
Residue from apex of rowboom after Burn # 2	15 - Residue	3468
Residue from side of Remote Control boats, collected Aug 14, 93	16 - Residue	2991

NOBE 93 Table 1.16

Burn 1 Extended PAH Results
PS-1 Filters from Remote Stations 1 and 2

	Burn period					
Sample I.D.	Remote Station # 1 * 50-100 m from fire Remote control boat # 2			Remote Station # 2 ** 100-150 m from fire Remote control boat # 1		
Internal sample reference	P17F17	P18F18	AVE	P6F6	P8F8	AVE
Sample Size (m^3)	12.420	12.742		11.590	12.240	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
C4-Naphthalenes	0.192	0.348	0.270	0.445	0.294	0.370
Benzothiophene	0.029	N/D	0.029	N/D	N/D	N/D
Dibenzofuran	0.041	0.063	0.052	0.036	0.052	0.044
Methylfluorenes	0.056	0.072	0.064	0.058	0.052	0.055
Dibenzothiophene	0.011	0.012	0.011	<0.009	0.015	0.015
Carbazole	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
4H-Cyclopenta[def]phenanthrene	0.012	0.015	0.014	<0.009	0.011	0.011
Acephenanthrylene	<0.008	0.008	0.008	<0.009	<0.008	LMDL
4H-Cyclopenta[cd]pyrene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
Methylchrysenes	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
Picene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
Anthanthrene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
Coronene	<0.008	<0.008	LMDL	<0.009	<0.008	LMDL
Total	**0.342**	**0.517**	**0.429**	**0.539**	**0.424**	**0.481**

	Background, August 07 1993			Trip Blank		
Sample I.D.	Remote control boat # 1			Remote control boat # 1		
Internal sample reference	P19F19	P20F20	AVE	P10F10	P13F13	AVE
Sample Size (m^3)	8.184	8.184				
Compound	µg/m³	µg/m³	µg/m³	Mass (µg)	Mass (µg)	Mass (µg)
C4-Naphthalenes	0.556	0.517	0.537	<0.1	<0.1	LMDL
Benzothiophene	N/D	N/D	N/D	N/D	<0.1	LMDL
Dibenzofuran	0.043	0.036	0.039	<0.1	<0.1	LMDL
Methylfluorenes	0.164	0.172	0.168	<0.1	0.290	0.290
Dibenzothiophene	0.081	0.066	0.074	<0.1	<0.1	LMDL
Carbazole	<0.011	<0.011	LMDL	<0.1	0.098	0.098
4H-Cyclopenta[def]phenanthrene	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
Acephenanthrylene	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
4H-Cyclopenta[cd]pyrene	<0.011	<0.011	LMDL	<0.1	0.118	0.118
Methylchrysenes	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
Picene	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
Anthanthrene	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
Coronene	<0.011	<0.011	LMDL	<0.1	<0.1	LMDL
Total	**0.844**	**0.791**	**0.818**	**LMDL**	**0.506**	**0.253**

* Remote control boat # 2 at Remote Station # 2 from 10:30 to 10:47, moved to Remote Station # 1 at 10:47 to end of sampling; results applied to Remote Station # 1 position
** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling; results applied to RS-2 position
< symbol indicates below method detection limit
N/D indicates not detectable
LMDL: Lower than Method Detectable Limit
PS-1 sampling at 0.7 m above sea level on the remote control boats

NOBE 93 Table 1.17

Burn 1 Extended PAH Results

PS-1 Filters from Downwind Station and Miniblimp Smoke Samples

	Burn period					
Sample I.D.	Downwind Station (CCG 206) 900 m from fire			Miniblimp (CCG 210) 200-600 m from fire and 120 m above sea level		
				Filter 1	Filter 2	
Internal sample reference	P3F3	P5F5	AVE	FH1	FH2	AVE
Sample Size (m^3)	7.424	9.106		0.194	0.194	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
C4-Naphthalenes	0.058	0.059	0.059	<0.5	<0.52	LMDL
Benzothiophene	N/D	N/D	N/D	<0.5	<0.52	LMDL
Dibenzofuran	0.016	0.013	0.014	<0.5	<0.52	LMDL
Methylfluorenes	<0.013	0.013	0.013	<0.5	<0.52	LMDL
Dibenzothiophene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Carbazole	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
4H-Cyclopenta[def]phenanthrene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Acephenanthrylene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
4H-Cyclopenta[cd]pyrene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Methylchrysenes	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Picene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Anthanthrene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Coronene	<0.013	<0.011	LMDL	<0.5	<0.52	LMDL
Total	**0.074**	**0.085**	**0.079**	**LMDL**	**LMDL**	**LMDL**

	Background, August 07 1993	Trip Blank
Sample I.D.	CCG 206	CCG 206
Internal sample reference	P14F14	P2F2
Sample Size (m^3)		
Compound	µg/m³	µg/m³
C4-Naphthalenes	<0.039	<0.1
Benzothiophene	N/D	N/D
Dibenzofuran	0.039	0.113
Methylfluorenes	<0.039	<0.1
Dibenzothiophene	<0.039	<0.1
Carbazole	<0.039	<0.1
4H-Cyclopenta[def]phenanthrene	<0.039	<0.1
Acephenanthrylene	<0.039	<0.1
4H-Cyclopenta[cd]pyrene	<0.039	<0.1
Methylchrysenes	<0.039	<0.1
Picene	<0.039	<0.1
Anthanthrene	<0.039	<0.1
Coronene	<0.039	<0.1
Total	**0.039**	**0.113**

< symbol indicates below method detection limit
N/D indicates not detectable
LMDL: Lower than Method Detectable Limit

NOBE 93 Table 1.18

Burn 2 Extended PAH Results

PS-1 Filters from Remote and Downwind Stations and Miniblimp

	Burn period					
Sample I.D.	Remote Station # 1 50-100 m from fire Remote control boat # 1			Remote Station # 2 100-150 m from fire Remote control boat # 2		
Internal sample reference	P9F9	P12F12	AVE	P15F15	P16F16	AVE
Sample Size (m^3)	12.740	12.103		13.671	13.328	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
C4-Naphthalenes	0.405	0.170	0.288	0.180	0.090	0.135
Benzothiophene	N/A	0.032	0.032	N/A	N/A	LMDL
Dibenzofuran	0.116	0.067	0.092	0.023	0.023	0.023
Methylfluorenes	0.102	0.119	0.111	0.024	0.027	0.026
Dibenzothiophene	0.024	0.018	0.021	<0.007	<0.008	LMDL
Carbazole	<0.008	<0.008	LMDL	<0.007	<0.008	LMDL
4H-Cyclopenta[def]phenanthrene	0.058	0.053	0.056	<0.007	<0.008	LMDL
Acephenanthrylene	0.058	0.049	0.054	<0.007	<0.008	LMDL
4H-Cyclopenta[cd]pyrene	0.015	0.016	0.016	<0.007	<0.008	LMDL
Methylchrysenes	<0.008	<0.008	LMDL	<0.007	<0.008	LMDL
Picene	<0.008	0.014	0.014	<0.007	<0.008	LMDL
Anthanthrene	0.010	0.009	0.010	<0.007	<0.008	LMDL
Coronene	0.035	0.031	0.033	<0.007	<0.008	LMDL
Total	**0.822**	**0.578**	**0.700**	**0.227**	**0.140**	**0.183**

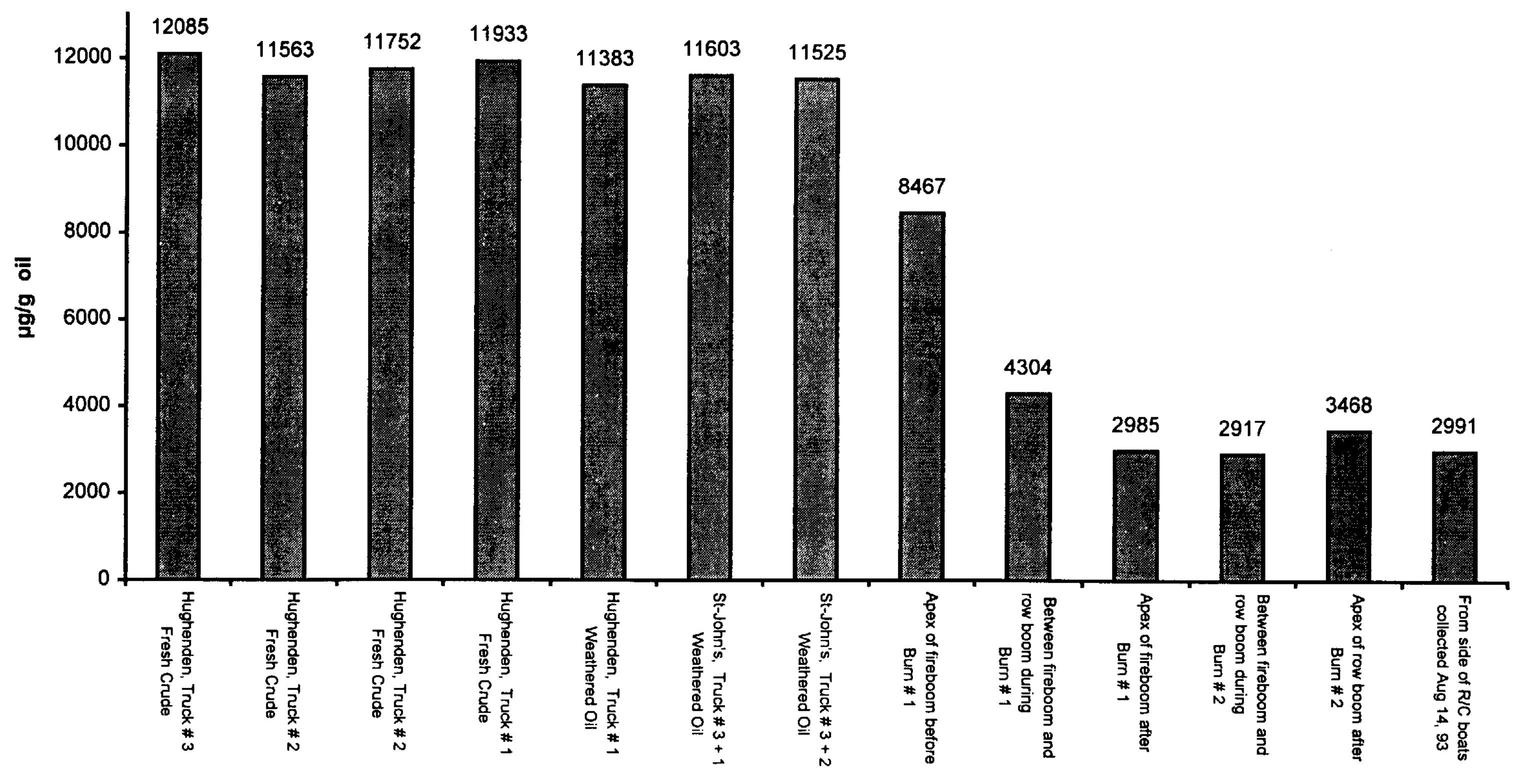
	Burn period					
Sample I.D.	Downwind Station (CCG 206) 500 to 600 m from fire CCG 206			Miniblimp (CCG 210) 200-400 m from fire		
				Filter 3	Filter 4	
Internal sample reference	P1F1	P4F4	AVE	FH3	FH4	AVE
Sample Size (m^3)	9.216	11.950		0.2243	0.2240	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
C4-Naphthalenes	0.099	0.114	0.107	<0.45	<0.44	LMDL
Benzothiophene	N/A	N/A	LMDL	<0.45	<0.44	LMDL
Dibenzofuran	0.018	0.019	0.018	<0.45	<0.44	LMDL
Methylfluorenes	0.089	0.026	0.058	<0.45	<0.44	LMDL
Dibenzothiophene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Carbazole	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
4H-Cyclopenta[def]phenanthrene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Acephenanthrylene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
4H-Cyclopenta[cd]pyrene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Methylchrysenes	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Picene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Anthanthrene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Coronene	<0.011	<0.008	LMDL	<0.45	<0.44	LMDL
Total	**0.206**	**0.159**	**0.182**	**LMDL**	**LMDL**	**LMDL**

LMDL: Lower than Method Detectable Limit
N/A not available
< symbol indicates below method detection limit
PS-1 sampling at 0.7 m above sea level on the remote control boats

NOBE 93 Figure 1.1

PAH in Oil and Residue Samples

Alberta Sweet Mix Crude Oil



Polycyclic Aromatic Hydrocarbons (PAHs)
NOBE 93

Laboratory Methodology

Methodology for Polycyclic Aromatic Hydrocarbons (PAH) Analysis NOBE 93

Scope

The PAH sample is first spiked with a surrogate PAH mixture. The water sample is extracted by liquid/liquid partitioning using dichloromethane (DCM). The air/soot sample is soxhlet-extracted in benzene/DCM. An aliquot of oil or residue is weighed and dissolved in a known volume of cyclohexane. The raw extract is concentrated down and then put through a silica column cleanup. The PAH is eluted using benzene/hexane and concentrated to 1 mL before GC/MSD analysis. The minimum amount of PAH detectable is 0.1 µg per sample.

Sample Workup

Air/soot (Filter/XAD)

1. Spike sample with 1 µg each of four surrogate PAHs.
2. Soxhlet-extract entire sample overnight in 10% benzene/dichloromethane (DCM).
3. Filter raw extract through anhydrous sodium sulphate and concentrate by rotary evaporation.
4. Clean up extract by Silica adsorption chromatography. Elute column with hexane, followed by hexane/benzene which contains the PAHs. This fraction is collected.
5. Transfer to a calibrated test tube and blow down to less than 0.9 mL under nitrogen.
6. Add 0.1 mL 10 µg/mL (1 µg) d14-terphenyl as an internal standard and make up to 1 mL for GC/MSD analysis.

Water

1. Transfer contents of the sample bottle to a separate funnel.
2. Spike with 1 µg each of four surrogate PAHs.
3. Perform liquid-liquid extraction using 50, 50, and 25 mL DCM.
4. Combine DCM extracts and filter through sodium sulphate. Concentrate by rotary evaporation.
5. Transfer to a calibrated test tube and blow down to less than 0.9 mL under nitrogen.
6. Add 0.1 mL 10 µg/mL (1 µg) d14-terphenyl as an internal standard and make up to 1 mL for GC/MSD analysis.

Crude oil and residue

1. Weigh 0.5 g oil in a large vial and dissolve in 10 mL cyclohexane.
2. Transfer 0.5 mL (= 25 mg oil) to a flask and spike with 1 µg each of four surrogate PAHs.
3. Fill a glass cleanup column 20 cm long and 1 cm i.d. with 3 g activated silica. Top with about 0.5 g anhydrous sodium sulphate and wash immediately with 5 mL hexane.
4. Transfer sample quantitatively to column. Elute with 10 mL hexane. This fraction containing aliphatics and light aromatics is discarded.
5. Elute with 10 mL 1:1 hexane/benzene. Collect this aromatics (PAH) fraction.
6. Add internal standard and make up to 1 mL for GC/MSD analysis.

Sample Analysis
Instrumentation: Hewlett Packard (HP) 5890GC/5971A Mass Selective Detector (MSD), HPCHEM data station (DOS series)

Parameters	
GC:	DB-5 column 30 m long and 0.25 mm i.d. (0.25 μm film thickness)
Oven:	90°C hold 1 min, ramp 15°C/min to 180°C, ramp 5°C/min to 280°C hold 10 min
Injector:	ALS Splitless injection, purge off 0.75 min, 290°C
Interface:	direct to ion source, 300°C
MSD:	electron impact ionization
Operation:	Selected ion monitoring mode (SIM), 2 to 3 ions/PAH compound dwell time 50 milliseconds
Data station:	DOS ChemPC (386-PC) with HP G1034B software

Quantification
Quantification is based on internal standard method in which the response and retention time of the internal standard d12-terphenyl is used to correct for changes in instrumental response and retention time. Confirmation of the analyte is based on the following criteria.

1. GC retention time is within 5% of the authentic standard.
2. The analyte has the right quantification and qualifying ions.
3. The ratio of quantifying and qualifying ions is within 25% of the authentic standard.
4. Both ions have to be within a correlation window of 0.03 min.

A 5-point calibration curve is constructed and used to generate a peak table from which the amount of PAH in the sample is determined. The GC/MSD is calibrated daily by a mixture of 26 PAHs (SRM 1491) with a nominal concentration of 0.7 ppm. Analysis is not corrected for surrogate recovery. Generally, surrogate recovery should be within 40 to 125%.

Detection Limit for Various Samples
Under the described conditions, a typical instrumental reproducibility is +/-10%. The instrumental detection is 0.1 ng/μL (0.1 ppm). For a sample volume of 1 mL, the minimum detectable quantity is therefore 0.1 μg PAH.

Air:	0.01 $\mu g/m^3$ (assuming sample volume of 10 m^3)
Water:	0.4 ppb (assuming sample volume of 250 mL)
Crude/Residue:	4 ppm (sample size of 25 mg)

Quality Assurance
1. The daily calibration mixture is run daily before and after each batch of samples and is checked against the old standard whenever a new standard is made.
2. Method recovery is performed by using a mixture of native and surrogate standards spiked on filter/XAD media to ascertain validity of sample workup procedure.
3. For every batch of ten samples analysed, one sample is randomly selected and re-analysed to check consistency of the instrumental measurement.
4. For lack of suitable soot reference material, the NBS urban particulate matter (SRM 1649) and NRC reference sediment (HS-3 to -6) are also analysed to assess overall method accuracy.

Section 2

Volatile Organic Compounds (VOCs)
NOBE 93

Volatile Organic Compounds (VOCs)
NOBE 93

The samples collected for VOC analysis on August 12, 1993 include air samples taken at sea level and at various altitudes, and water samples. Background samples were collected earlier on August 7, 1993.

SUMMA^{TM} Stainless Steel Canisters

SUMMA^{TM} canisters were used to collect air samples during NOBE 93 for VOC analysis. The interior of these stainless steel canisters is specially treated to produce an interior passive surface of pure chrome-nickel oxide. Samples can be collected using a pressurized technique or a sub-atmospheric pressure technique. For NOBE 93, the sub-atmospheric technique was used.

Instrumentation

- The canisters were initially evacuated in the laboratory to a sub-atmospheric pressure of approximately -101.6 kPa.
- The flow controllers on the SUMMAs were adjusted to 500 cc/min for the evaporation period and to 100 cc/min for the burn.
- The VOC concentration was determined by gas chromatography and mass selective detector (GC-MSD).

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.5 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.5 m above sea level
- Downwind Station, CCG 206 - during Burn 1: 900 m downwind from the fireboom apex, and during Burn 2: 500-600 m from the fire.
- Sir Wilfred Grenfell - 200 m from the fire.
- Ann Harvey - 100 m from the fire.
- Casaco - 350 m from the fire.
- CCG 203 - tow vessel for the fireboom, 75 m from the fire.
- CCG 204 - tow vessel for the fireboom, 75 m from the fire.
- CCG 212 - tow vessel for the backup boom, 400 m from the fire.
- CCG 214 - tow vessel for the backup boom, 400 m from the fire.
- Remote Helicopter - Team 1.
- Remote Helicopter - Team 2.
- University of Washington aircraft (Convair).

Water Samples

A Sigma Streamline 800SL Portable Sampler was used to collect water samples for both toxicity and organic compounds analysis. These samplers are designed to automatically collect and preserve samples from a liquid source.

Instrumentation

- From the samplers, Teflon tubing was attached to a pole which was lowered into the water collecting the samples at approximately 1 m.
- The flow rate of the samplers was set at 2 L/min.
- One of the samplers was set up with 24 bottles (350 mL) collecting water samples for analysis of organic compounds. This sampler was set up to work on sets of six bottles at a time. A first set was set up to collect the samples during off-loading, two other sets were programmed to collect their samples 15 minutes and 30 minutes after the beginning of the burn, and the last set was to collect its water sample after the burn had ended.
- The second sampler was set up with 4 bottles (3.8 L each) and collected water samples to be analysed for toxicity. This sampler was modified to accommodate this sample volume and programmed to work with one bottle at a time. The collection time table was the same as described above for the 350 mL sample bottles.
- The samplers were cleaned with hexane between burns.
- All samples collected were placed in refrigerated coolers and shipped to testing facilities within 24 hours of collection.

Location

Two samplers were located at each of the following positions.

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.

Sample Description

The description of the sampling times and codes can be found in Table 2.1.

NOBE 93 Table 2.1

Water Samples Collection Time Table

Pre-ignition 1 (10:15 am)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 4		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B4-PI1	679	BR1-B2-PI1	880
BR1-B4-PI2	679	BR1-B2-PI2	1048

Burn 1 (10:41)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB1-1	684		
BR1-B2-DB1-2	687		

Burn 1 (11:03)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB2-1	876		
BR1-B2-DB2-2	850		

Post-burn 1 (12:09)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-PB1	900		
BR1-B2-PB2	820		

Pre-ignition 2 (13:59)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PI1	682		
BR2-B1-PI2	782		

Burn 2 (14:46)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB1-1	686		
BR2-B1-DB1-2	683		

Burn 2 (15:00)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB2-1	686		
BR2-B1-DB2-2	659		

Post-burn 2 (15:20)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PB1	655		
BR2-B1-PB2	680		

*LEGEND: BR: Burn; B: Boat; PI: Preignition; PB: Post burn;
DB1 & DB2: During the first and second half of burn
CS: Control seawater; BG: Background;
EB: Early burn; LB: Late burn
M96: 96 hr Menidia test endpoint sample

NOBE 93 Table 2.2

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote control boat # 1					Remote Station # 1 * 50 to 100 m from fire						Remote Station # 2** 100 to 150 m from fire					
						Remote control boat # 4			Remote control boat # 2			Remote control boat # 2			Remote control boat # 1		
	Background, August 07 1993					Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1		
Internal sample reference	ESD-6	REAC221	REAC220	REAC222	AVE	REAC196	REAC202	AVE	ESD-17	ESD-16	AVE	REAC160	REAC177	AVE	ESD-8	ESD-7	AVE
Sample size (mL)	492	511	511	511		502	506		490	490		492	520		520	504	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1026**	**961**	**874**	**1056**	**979**	**321**	**271**	**296**	**374**	**197**	**285**	**938**	**670**	**804**	**1036**	**1449**	**1242**
Propene	26.9	11.7	18.4	12.2	14.1	3.2	7.2	5.2	0.4	1.6	1.0	54.3	15.9	35.1	1.6	2.9	2.3
Propane	15.9	12.4	0.3	19.3	10.7	4.0	3.9	3.9	2.0	2.8	2.4	26.8	10.8	18.8	7.3	38.4	22.8
Freon22 (Chlorodifluoromethane)	1.2	1.6	1.0	1.1	1.3	0.0	0.7	0.4	1.1	1.2	1.2	2.8	2.0	2.4	0.6	0.0	0.3
Propyne	0.0	0.4	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	0.5	1.5	2.0	3.1	2.2	1.4	1.5	1.5	0.8	0.7	0.7	0.7	2.4	1.6	0.7	0.9	0.8
Isobutane (2-Methylpropane)	111.6	68.1	84.4	107.4	86.7	12.9	11.8	12.4	8.7	7.3	8.0	21.1	13.7	17.4	32.8	51.1	41.9
Freon114 (1,2-Dichlorotetrafluoroetha	0.8	0.4	0.9	0.8	0.7	0.6	0.7	0.6	0.4	0.4	0.4	2.4	2.5	2.4	0.6	0.6	0.6
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	41.7	34.7	43.4	52.2	43.4	10.2	9.4	9.8	3.2	1.1	2.1	8.7	22.5	15.6	4.6	2.4	3.5
1,3-Butadiene	2.0	3.2	2.4	2.3	2.6	0.4	0.0	0.2	0.6	0.4	0.5	0.8	1.4	1.1	0.8	0.9	0.9
Butane	113.1	72.7	87.2	110.9	90.3	11.5	10.8	11.1	10.1	6.0	8.1	10.0	7.6	8.8	76.8	135.9	106.3
t-2-Butene	23.5	14.3	17.2	23.6	18.4	2.4	2.2	2.3	0.9	1.0	1.0	0.7	1.5	1.1	2.0	0.4	1.2
2,2-Dimethylpropane	0.3	0.3	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.5	0.4
Bromomethane	0.0	0.1	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	22.1	15.1	18.5	24.7	19.4	2.2	2.2	2.2	0.8	0.8	0.8	0.6	1.4	1.0	1.8	0.3	1.0
Chloroethane	0.0	0.8	1.7	1.6	1.4	1.2	1.2	1.2	0.0	0.0	0.0	0.0	3.0	1.5	0.0	0.0	0.0
2-Methylbutane	143.1	102.6	106.6	143.8	117.7	16.1	14.6	15.4	17.2	9.9	13.5	15.1	11.0	13.1	100.0	149.9	125.0
Freon11 (Trichlorofluoromethane)	7.3								3.8	3.7	3.8				2.6		2.6
1-Pentene	6.3	6.0	6.9	8.2	7.0	1.9	1.4	1.7	0.5	0.4	0.4	0.6	5.6	3.1	0.6	0.3	0.5
Pentane	65.6	46.6	48.6	64.5	53.2	9.3	8.5	8.9	13.9	5.8	9.8	14.2	11.4	12.8	96.0	164.1	130.0
Isoprene (2-Methyl-1,3-Butadiene)	1.1	1.5	1.4	1.6	1.5	0.0	0.0	0.0	0.3	0.0	0.1	0.4	0.0	0.2	0.3	0.3	0.3
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	9.3	6.0	6.5	9.4	7.3	1.1	1.4	1.3	0.9	0.7	0.8	0.3	0.6	0.5	1.0	0.4	0.7
1,1-Dichloroethene	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	11.0	8.2	9.5	12.8	10.2	0.9	0.9	0.9	0.5	0.4	0.5	0.4	0.0	0.2	0.8	0.2	0.5
Freon113 (1,1,2-Trichlorotrifluoroeth	4.8	3.2	7.2	8.7	6.4	2.9	3.5	3.2	2.3	2.3	2.3	14.5	12.9	13.7	3.1	3.3	3.2
2,2-Dimethylbutane	4.0	4.3	2.5	2.9	3.2	0.6	0.6	0.6	0.8	0.4	0.6	0.7	0.0	0.3	2.4	3.3	2.9
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.2	0.1	0.0	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	6.1	4.9	4.6	6.2	5.2	1.1	0.9	1.0	1.8	0.7	1.3	2.0	1.8	1.9	11.9	18.2	15.1
2,3-Dimethylbutane	7.5	6.5	5.0	6.6	6.0	1.2	1.0	1.1	1.6	0.7	1.2	1.7	1.3	1.5	7.5	12.0	9.7
t-4-Methyl-2-Pentene	0.6	0.5	0.5	0.6	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	35.6	46.2	51.9	55.5	51.2	19.4	6.1	12.7	12.0	4.7	8.4	12.6	16.4	14.5	55.8	86.1	71.0
c-4-Methyl-2-Pentene	2.2	2.0	2.1	2.7	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1
3-Methylpentane	21.2	20.8	15.3	19.9	18.7	4.5	3.7	4.1	7.2	2.7	4.9	14.0	7.2	10.6	39.6	54.4	47.0
1-Hexene/2-Methyl-1-Pentene	2.1	4.5	5.3	5.5	5.1	1.7	1.3	1.5	0.5	0.3	0.4	0.0	5.0	2.5	0.5	0.4	0.5
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	26.7	76.4	23.3	25.2	41.6	10.5	8.5	9.5	19.0	8.0	13.5	175.9	27.3	101.6	161.0	121.2	141.1
Chloroform	0.5	0.4	0.2	0.2	0.3	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.2	0.0	0.1
t-2-Hexene	1.7	1.5	1.4	1.9	1.6	0.3	0.3	0.3	0.2	0.2	0.2	0.0	0.4	0.2	0.3	0.1	0.2
t-3-Methyl-2-Pentene	1.9	1.6	1.6	2.0	1.7	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1
c-2-Hexene	1.2	1.0	1.0	1.3	1.1	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1
c-3-Methyl-2-Pentene	2.3	2.2	2.1	2.7	2.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3	0.0	0.1	0.3	0.1	0.2
2,2-Dimethylpentane	0.7	0.8	0.5	0.6	0.6	0.2	0.0	0.1	0.4	0.1	0.2	0.5	0.5	0.5	1.7	2.6	2.1
1,2-Dichloroethane	0.2	0.3	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2
Methylcyclopentane	14.2	22.9	11.0	13.5	15.8	5.6	5.0	5.3	10.3	3.4	6.8	31.4	12.2	21.8	55.1	73.4	64.2

NOBE 93 Table 2.2 cont.

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote control boat # 1					Remote Station # 1* 50 to 100 m from fire: Remote control boat # 4			Remote control boat # 2			Remote Station # 2** 100 to 150 m from fire: Remote control boat # 2			Remote control boat # 1		
	Background, August 07 1993					Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1		
Internal sample reference	ESD-5	REAC221	REAC220	REAC222	AVE	REAC196	REAC202	AVE	ESD-17	ESD-16	AVE	REAC160	REAC177	AVE	ESD-9	ESD-7	AVE
Sample size (mL)	492	511	511	511		502	506		490	490		492	520		520	504	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1026**	**961**	**874**	**1056**	**979**	**321**	**271**	**296**	**374**	**197**	**285**	**938**	**670**	**804**	**1036**	**1449**	**1242**
2,4-Dimethylpentane	2.3	2.3	1.5	1.8	1.9	0.6	0.6	0.6	0.9	0.3	0.6	1.2	1.1	1.2	4.0	6.1	5.1
1,1,1-Trichloroethane	1.1	1.2	1.3	1.0	1.2	3.0	1.2	2.1	0.8	0.8	0.8	2.6		2.6	0.7	0.7	0.7
2,2,3-Trimethylbutane	0.2	0.8	0.9	1.1	0.9	0.5	1.0	0.7	0.1	0.0	0.1	0.0	0.0	0.0	0.4	0.6	0.5
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	10.4	11.4	8.6	10.4	10.1	1.8	1.5	1.7	1.9	1.1	1.5	2.3	2.1	2.2	3.9	4.0	3.9
Carbontetrachloride	0.7	0.8	0.8	0.8	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.8	0.6	0.7	0.7	0.7	0.7
Cyclohexane	4.5	4.6	3.8	4.6	4.3	4.2	3.7	4.0	7.8	2.3	5.1	18.9	11.9	15.4	34.7	53.8	44.3
2-Methylhexane	3.7	4.6	3.2	3.7	3.8	1.8	1.4	1.6	2.9	0.9	1.9	3.4	3.6	3.5	9.9	16.2	13.1
2,3-Dimethylpentane	3.3	3.5	2.2	2.6	2.7	1.8	1.1	1.5	1.8	0.6	1.2	2.7	0.0	1.4	8.1	11.1	9.6
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	8.7	8.5	5.4	6.7	6.8	4.2	3.7	3.9	5.7	1.9	3.8	9.6	8.6	9.1	20.1	33.5	26.8
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-Trimethylpentane	1.6	2.4	1.6	1.6	1.8	1.0	1.0	1.0	0.5	0.3	0.4	1.0	1.6	1.3	0.0	0.0	0.0
t-3-Heptene	0.1	0.3	0.2	0.3	0.3	0.1	0.4	0.3	0.0	0.0	0.0	0.0	1.3	0.6	0.0	0.0	0.0
Heptane	7.1	7.7	6.1	6.2	6.7	9.2	8.6	8.9	14.2	4.4	9.3	26.2	26.7	26.5	48.9	75.7	62.3
t-2-Heptene	0.6	1.4	1.0	1.1	1.1	0.5	0.5	0.5	0.0	0.0	0.0	0.0	4.7	2.4	0.0	0.0	0.0
c-2-Heptene	0.9	2.4	2.0	2.5	2.3	0.7	0.5	0.6	0.0	0.0	0.0	0.0	5.5	2.7	0.0	0.0	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.3	0.3	0.2	0.3	0.3	0.0	0.2	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	4.2	4.0	3.4	3.6	3.7	12.4	11.3	11.9	21.2	6.4	13.8	38.0	35.1	36.6	63.6	105.4	84.5
2,5-Dimethylhexane	0.9	1.2	0.9	0.7	1.0	0.6	0.7	0.6	0.7	0.3	0.5	1.1	1.4	1.2	2.1	2.9	2.5
2,4-Dimethylhexane	1.3	1.4	1.0	1.0	1.1	0.7	0.7	0.7	0.9	0.3	0.6	1.7	1.6	1.6	2.3	3.8	3.1
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.3	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.7	0.8	0.4	0.4	0.6	0.3	0.3	0.3	0.3	0.1	0.2	0.5	0.4	0.4	0.7	0.9	0.8
Toluene	26.4	26.8	23.3	24.6	24.9	7.2	6.4	6.8	5.7	3.3	4.5	10.0	8.8	9.4	8.7	8.7	8.7
2-Methylheptane	3.5	4.3	3.7	3.3	3.8	3.9	4.1	4.0	5.4	1.8	3.6	10.3	11.6	11.0	14.1	19.1	16.6
4-Methylheptane	1.5	1.5	1.2	1.2	1.3	0.0	1.1	0.5	1.7	0.6	1.1	3.3	0.0	1.7	0.0	5.6	2.8
1-Methylcyclohexene	40.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	4.3	5.3	3.6	3.8	4.2	3.2	2.8	3.0	4.7	1.7	3.2	7.8	8.6	8.2	10.7	15.3	13.0
c-1,3-Dimethylcyclohexane	1.4	1.4	1.3	1.4	1.4	3.4	2.8	3.1	4.7	1.5	3.1	11.7	0.0	5.9	9.3	16.4	12.9
t-1,4-Dimethylcyclohexane	0.7	0.7	0.7	0.7	0.7	1.8	1.5	1.6	2.5	0.8	1.7	4.8	0.0	2.4	3.5	9.0	6.3
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.2	0.3	0.1	0.2	0.2	0.1	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.1	0.2	0.3	0.2
1-Octene	0.5	3.3	7.6	4.1	5.0	3.9	1.3	2.6	0.0	0.0	0.0	0.0	8.0	4.0	0.0	0.0	0.0
Octane	4.0	4.2	4.4	3.8	4.1	8.8	8.2	8.5	11.7	4.1	7.9	25.2	27.6	26.4	22.6	32.9	27.8
Tetrachloroethene	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.9	0.8	0.8	0.8	0.8	1.0	0.9	0.9	1.3	0.5	0.9	2.9	2.4	2.6	2.3	4.0	3.2
c-2-Octene	0.6	1.2	1.4	1.4	1.4	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	15.4	15.2	14.3	16.4	15.3	2.3	2.1	2.2	2.3	1.3	1.8	4.2	3.7	4.0	2.7	2.8	2.8
m/p-Xylene	53.8	52.1	52.3	58.7	54.4	9.0	8.5	8.8	7.9	4.7	6.3	17.4	15.8	16.6	9.2	9.5	9.3

NOBE 93

Table 2.2 cont.

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote control boat # 1					Remote Station # 1* 50 to 100 m from fire						Remote Station # 2** 100 to 150 m from fire					
						Remote control boat # 4			Remote control boat # 2			Remote control boat # 2			Remote control boat # 1		
	Background, August 07 1993					Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1		
Internal sample reference	ESD-5	REAC221	REAC220	REAC222	AVE	REAC196	REAC202	AVE	ESD-17	ESD-16	AVE	REAC180	REAC177	AVE	ESD-9	ESD-7	AVE
Sample size (mL)	492	511	511	511		502	506		490	490		492	520		520	504	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1026**	**961**	**874**	**1056**	**979**	**321**	**271**	**296**	**374**	**197**	**285**	**938**	**670**	**804**	**1036**	**1449**	**1242**
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	0.8	3.5	0.5	0.5	1.5	0.3	0.0	0.2	0.5	0.4	0.5	0.9	0.0	0.4	0.2	0.1	0.2
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.4	0.0	0.0	0.0
o-Xylene	17.2	17.2	16.2	18.0	17.1	2.9	2.6	2.8	2.9	1.8	2.3	6.2	4.9	5.6	2.9	3.0	2.9
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	4.4	5.9	5.7	4.3	5.3	11.8	11.4	11.6	13.8	6.0	9.9	31.5	33.4	32.5	14.6	19.8	17.2
iso-Propylbenzene	0.6	0.9	0.6	0.6	0.7	0.4	0.4	0.4	0.5	0.3	0.4	1.4	1.0	1.2	0.4	0.6	0.5
3,6-Dimethyloctane	0.4	0.5	0.3	0.3	0.4	0.0	0.6	0.3	1.6	0.8	1.2	3.6	2.7	3.1	1.2	1.6	1.4
n-Propylbenzene	1.8	3.0	2.3	2.4	2.5	1.2	1.2	1.2	1.5	0.9	1.2	4.3	2.8	3.6	1.0	1.0	1.0
3-Ethyltoluene	6.2	8.6	6.2	6.1	6.9	3.1	2.8	3.0	4.4	2.7	3.5	14.5	6.1	10.3	2.9	2.9	2.9
4-Ethyltoluene	2.9	4.7	3.1	3.0	3.6	1.5	1.4	1.5	2.2	1.3	1.7	7.4	3.0	5.2	1.3	1.3	1.3
1,3,5-Trimethylbenzene	3.2	5.5	3.7	3.7	4.3	2.4	2.3	2.3	3.2	1.9	2.6	11.1	5.0	8.0	1.8	1.7	1.8
2-Ethyltoluene	2.3	3.8	2.2	2.3	2.8	1.3	1.1	1.2	2.2	1.4	1.8	6.2	2.6	4.4	1.2	1.2	1.2
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	11.1	19.0	15.6	12.0	15.6	9.4	7.1	8.2	11.5	7.7	9.6	38.0	14.1	26.1	5.6	5.2	5.4
Decane	6.9	15.1	9.2	7.4	10.6	15.0	14.4	14.7	20.9	11.2	16.1	45.0	38.2	41.6	11.9	14.2	13.1
1,3-Dichlorobenzene	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.4	1.3	0.7	0.7	0.9	0.5	0.4	0.5	0.6	0.3	0.4	1.4	0.8	1.1	0.0	0.2	0.1
iso-Butylbenzene	0.2	0.3	0.2	0.2	0.3	0.2	0.2	0.2	0.4	0.2	0.3	0.8	0.5	0.7	0.2	0.2	0.2
sec-Butylbenzene	0.3	0.6	0.3	0.3	0.4	0.3	0.3	0.3	0.6	0.3	0.5	1.3	0.8	1.0	0.3	0.3	0.3
1,2,3-Trimethylbenzene	2.8	6.2	3.0	3.1	4.1	2.4	2.1	2.2	4.5	2.9	3.7	10.5	4.9	7.7	1.9	1.7	1.8
p-Cymene	0.5	2.1	0.7	0.6	1.1	0.8	0.7	0.7	1.3	0.7	1.0	2.3	0.0	1.1	0.3	0.5	0.4
1,2-Dichlorobenzene	0.1	0.2	0.1	0.1	0.1	0.0	0.0	0.0	0.3	0.1	0.2	0.3	0.0	0.2	0.0	0.0	0.0
Indane	0.9	1.6	0.9	0.9	1.1	0.5	0.4	0.4	1.0	0.6	0.8	1.7	0.8	1.3	0.4	0.4	0.4
1,3-Diethylbenzene	0.6	1.6	0.9	0.8	1.1	0.5	0.5	0.5	1.3	0.6	0.9	1.9	1.1	1.5	0.3	0.3	0.3
1,4-Diethylbenzene	1.6	5.7	3.2	3.2	4.0	0.0	1.9	1.0	5.2	3.0	4.1	6.0	0.0	3.0	0.0	0.0	0.0
n-Butylbenzene	0.5	1.8	0.9	0.9	1.2	0.7	0.6	0.7	1.6	0.8	1.2	1.8	1.6	1.7	0.5	0.4	0.5
1,2-Diethylbenzene	0.2	0.5	0.2	0.3	0.3	0.2	0.0	0.1	0.8	0.2	0.5	0.6	0.5	0.5	0.1	0.1	0.1
Undecane	8.2	29.9	15.7	15.1	20.2	19.9	14.6	17.2	30.2	17.7	23.9	55.4	56.8	56.1	14.5	13.9	14.2
Naphthalene	0.0	6.5	4.8	8.3	6.6	2.3	1.2	1.8	3.6	4.4	4.0	5.8	5.5	5.6	1.7	1.0	1.4
Dodecane	8.2	24.6	18.0	21.4	21.3	21.2	11.6	16.4	24.1	18.6	21.3	56.3	56.9	56.6	15.1	13.0	14.0
Hexylbenzene	0.0	5.0	7.0	12.4	8.2	0.0	1.4	0.7	1.7	1.4	1.6	0.0	34.2	17.1	0.5	0.0	0.3

* Remote Control boat # 3 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position.
** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling; results applied to RS-1 position.
Shaded areas = SUMMAs with final pressure lower than 33.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.3

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the Sir Wilfred Grenfell and Ann Harvey

Sample I.D.	Downwind Station CCG 206 August 07 1993			Lot Blank	Downwind Station CCG 206 900 m from fire						Sir Wilfred Grenfell 200 m from fire		Ann Harvey 100 m from fire	
	Background			BLANK	Pre-Ignition 1			Burn 1			Pre-Ignition 1	Burn 1	Pre-Ignition 1	Burn 1
Internal sample reference / Sample size (mL)	REAC181 494	REAC180 485	AVE	GVRD431 504	REAC123 485	REAC182 485	AVE	REAC77 494	REAC73 494	AVE	REAC173 507	REAC172 507	REAC141 490	REAC166 490
Compound	µg/m³	µg/m³	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	43	256	149	2	43	182	112	696	720	708	237	68	100	72
Propene	2.2	2.3	2.2	0.0	1.1	14.5	7.8	2.0	2.6	2.3	58.5	21.2	7.5	1.6
Propane	1.5	0.7	1.1	0.0	1.3	1.5	1.4	31.7	30.5	31.1	0.0	0.0	0.0	0.0
Freon22 (Chlorodifluoromethane)	0.6	1.3	0.9	0.0	0.0	14.0	7.0	0.7	0.0	0.4	1.3	0.6	2.7	1.3
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	1.7	1.6	1.6	0.1	1.2	2.6	1.9	1.0	1.1	1.0	3.1	0.9	2.8	1.0
Isobutane (2-Methylpropane)	0.2	0.2	0.2	0.3	1.1	2.2	1.7	30.4	31.0	30.7	0.8	0.0	1.2	0.5
Freon114 (1,2-Dichlorotetrafluroeth	0.7	0.4	0.6	0.3	1.2	2.1	1.6	0.7	0.8	0.7	2.4	0.7	2.6	0.7
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	4.2	4.1	4.1	0.1	2.4	17.2	9.8	1.8	2.4	2.1	25.7	8.0	7.3	5.3
1,3-Butadiene	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.0	0.6	0.0	0.0
Butane	0.5	0.4	0.5	0.1	2.3	5.0	3.6	90.6	92.2	91.4	2.2	0.5	2.3	1.0
t-2-Butene	0.3	0.4	0.3	0.0	0.0	1.3	0.7	0.4	0.4	0.4	0.0	0.0	0.0	0.4
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	0.3	0.4	0.4	0.0	0.0	1.1	0.6	0.4	0.4	0.4	1.3	0.3	0.0	0.4
Chloroethane	1.0	0.9	0.9	0.0	0.0	2.3	1.1	0.0	0.0	0.0	3.2	1.4	0.0	1.0
2-Methylbutane	0.2	0.4	0.3	0.0	2.7	6.3	4.5	94.8	98.0	96.4	1.1	0.2	2.9	1.1
Freon11 (Trichlorofluoromethane)	1.9	6.3	4.1	0.0							2.5	2.0		
1-Pentene	0.7	0.8	0.7	0.0	0.3	3.9	2.1	0.3	0.3	0.3	6.4	1.6	2.5	1.2
Pentane	0.2	0.3	0.2	0.0	2.1	3.5	2.8	91.9	95.0	93.5	1.7	0.3	2.0	0.9
Isoprene (2-Methyl-1,3-Butadiene)	0.0	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.0	0.1	0.1	0.0	0.0	1.0	0.5	0.6	0.6	0.6	0.0	0.0	0.0	0.0
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	0.0
c-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0
Freon113 (1,1,2-Trichlorotrifluoroet	4.5	2.1	3.3	1.1	5.9	10.7	8.3	3.4	4.0	3.7	13.3	4.8	14.9	4.4
2,2-Dimethylbutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	2.4	2.4	0.0	0.0	0.0	0.0
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	1.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.4	9.5	9.5	0.0	0.0	0.0	0.0
2,3-Dimethylbutane	0.0	0.0	0.0	0.0	0.2	0.4	0.3	6.1	6.2	6.2	0.0	0.0	0.0	0.0
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	6.9	7.6	7.3	0.0	1.1	26.8	13.9	44.5	45.7	45.1	5.9	3.2	1.0	1.3
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	0.0	9.7	4.8	0.0	0.8	1.3	1.1	26.6	26.9	26.7	0.4	0.0	1.2	0.5
1-Hexene/2-Methyl-1-Pentene	0.5	0.7	0.6	0.0	0.0	3.9	2.0	0.0	0.0	0.0	5.1	1.7	2.5	0.9
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	1.7	183.8	92.8	0.1	2.8	5.4	4.1	55.5	55.0	55.3	1.6	0.4	5.5	5.9
Chloroform	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.3 cont.

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the Sir Wilfred Grenfell and Ann Harvey

Sample I.D.	Downwind Station CCG 206 August 07 1993			Lot Blank	Downwind Station CCG 206 900 m from fire						Sir Wilfred Grenfell 200 m from fire		Ann Harvey 100 m from fire	
	Background			BLANK	Pre-ignition 1			Burn 1			Pre-ignition 1	Burn 1	Pre-ignition 1	Burn 1
Internal sample reference / Sample size (mL)	REAC181 494	REAC180 485	AVE	GVRD431 504	REAC123 485	REAC182 485	AVE	REAC77 494	REAC73 494	AVE	REAC173 507	REAC172 507	REAC141 490	REAC186 490
Compound	µg/m³	µg/m³	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**43**	**256**	**149**	**2**	**43**	**182**	**112**	**696**	**720**	**708**	**237**	**68**	**100**	**72**
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.0
2,2-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	0.0	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclopentane	0.2	20.5	10.4	0.0	0.8	1.2	1.0	31.4	32.0	31.7	0.0	0.0	1.0	0.8
2,4-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.6	2.5	0.0	0.0	0.0	0.0
1,1,1-Trichloroethane	0.7	0.8	0.7	0.0	0.8	0.8	0.8	0.7	0.7	0.7	3.5	0.9	3.3	3.2
2,2,3-Trimethylbutane	0.2	0.0	0.1	0.0	0.0	2.2	1.1	0.3	0.3	0.3	1.3	0.9	0.0	0.0
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	0.2	0.2	0.2	0.0	0.7	0.8	0.7	3.1	3.3	3.2	0.7	0.2	1.1	0.4
Carbontetrachloride	0.7	0.8	0.7	0.0	0.7	0.7	0.7	0.7	0.7	0.7	0.6	0.7	0.9	0.7
Cyclohexane	0.0	0.2	0.1	0.0	0.6	0.8	0.7	20.0	20.3	20.2	0.0	0.0	0.0	1.7
2-Methylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	6.3	6.2	0.0	0.0	0.0	0.0
2,3-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.8	3.8	0.0	0.0	0.0	0.0
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	11.4	11.6	11.5	0.0	0.0	0.0	0.0
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.7	0.3	0.0	0.0	3.6	1.8	0.0	0.0	0.0	5.7	1.3	1.8	1.1
2,2,4-Trimethylpentane	0.0	0.3	0.2	0.0	0.2	0.9	0.5	0.8	0.9	0.8	1.8	0.7	0.0	0.0
t-3-Heptene	0.3	0.3	0.3	0.0	0.0	1.1	0.5	0.0	0.0	0.0	2.2	0.6	0.0	0.5
Heptane	0.2	0.2	0.2	0.0	1.0	1.4	1.2	23.9	24.7	24.3	1.9	0.4	1.2	0.5
t-2-Heptene	0.6	0.8	0.7	0.0	0.0	2.8	1.4	0.0	0.0	0.0	5.9	1.0	0.0	1.2
c-2-Heptene	0.5	0.7	0.6	0.0	0.0	2.5	1.3	0.0	0.0	0.0	7.1	1.0	0.0	1.3
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	0.0	0.0	0.0	0.0
Methylcyclohexane	0.0	0.0	0.0	0.0	1.0	1.0	1.0	30.6	31.8	31.2	0.0	0.0	0.0	0.3
2,5-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	0.9	0.0	0.0	0.0	0.0
2,4-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.2	1.2	0.0	0.0	0.0	0.0
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.4	0.4	0.0	0.0	0.0	0.0
Toluene	0.3	0.4	0.4	0.0	2.1	1.6	1.9	9.6	10.0	9.8	1.9	0.5	2.9	1.4
2-Methylheptane	0.0	0.0	0.0	0.0	0.3	0.4	0.3	4.9	5.1	5.0	0.0	0.0	0.0	0.2
4-Methylheptane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	1.5	1.5	0.0	0.0	0.0	0.0
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.0	0.0	0.0	0.0	0.3	7.0	3.6	4.4	4.5	4.4	0.0	0.0	0.0	0.0
c-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.2	0.0	0.1	3.7	3.8	3.8	0.0	0.0	0.0	0.0
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.7	2.0	1.9	0.0	0.0	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1-Octene	0.3	0.7	0.5	0.0	0.0	3.3	1.7	0.0	0.0	0.0	7.4	1.6	1.0	1.3
Octane	0.1	0.1	0.1	0.0	0.7	0.9	0.8	7.6	7.7	7.6	1.0	0.2	0.9	0.4

NOBE 93 Table 2.3 cont

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the Sir Wilfred Grenfell and Ann Harvey

Sample I.D.	Downwind Station CCG 206 August 07 1993			Lot Blank	Downwind Station CCG 206 900 m from fire						Sir Wilfred Grenfell 200 m from fire		Ann Harvey 100 m from fire	
	Background			BLANK	Pre-ignition 1			Burn 1			Pre-ignition 1	Burn 1	Pre-ignition 1	Burn 1
Internal sample reference	REAC181	REAC180	AVE	GVRD431	REAC123	REAC182	AVE	REAC77	REAC73	AVE	REAC173	REAC172	REAC141	REAC166
Sample size (mL)	494	485		504	485	485		494	494		507	507	490	490
Compound	µg/m³	µg/m³	µg/m³		µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**43**	**256**	**149**	**2**	**43**	**182**	**112**	**696**	**720**	**708**	**237**	**68**	**100**	**72**
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0	0.9	0.0	0.0	0.0	0.0
c-2-Octene	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.1	0.1	0.1	0.0	0.4	0.3	0.4	2.4	2.6	2.5	0.7	0.2	0.7	0.3
m/p-Xylene	0.2	0.3	0.3	0.0	1.4	1.2	1.3	7.5	7.9	7.7	2.8	0.6	2.4	1.1
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	3.4	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.2	0.0	0.0	0.0	0.0
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.1	0.1	0.1	0.0	0.5	0.4	0.4	2.5	2.6	2.5	0.9	0.2	0.9	0.4
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	1.7	0.8	1.2
Nonane	0.1	0.1	0.1	0.0	0.5	1.0	0.8	3.2	3.3	3.2	3.4	0.4	0.9	0.5
iso-Propylbenzene	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	0.2	0.2	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	2.5	0.0	1.3	0.0	0.0	0.0	0.0	0.3	0.3	0.3	0.0	0.0	0.0	0.0
n-Propylbenzene	0.1	0.2	0.1	0.0	0.1	0.8	0.4	0.5	0.5	0.5	0.8	0.4	0.7	0.4
3-Ethyltoluene	0.0	0.1	0.1	0.0	0.2	0.3	0.3	1.4	1.6	1.5	0.9	0.2	1.5	0.7
4-Ethyltoluene	0.0	0.1	0.0	0.0	0.1	0.3	0.2	0.6	0.7	0.6	0.5	0.3	1.0	0.4
1,3,5-Trimethylbenzene	0.0	0.1	0.1	0.0	0.2	0.4	0.3	0.5	0.7	0.6	0.7	0.2	1.1	0.5
2-Ethyltoluene	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.6	0.7	0.6	0.4	0.2	0.9	0.4
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.6	0.2	0.4	0.0	0.6	0.8	0.7	1.7	2.3	2.0	19.7	0.6	3.8	6.5
Decane	0.1	0.2	0.2	0.0	0.6	0.8	0.7	1.2	1.5	1.3	3.3	0.4	1.3	1.0
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.1	0.4	0.0
1,2,3-Trimethylbenzene	0.0	0.1	0.0	0.0	0.2	0.3	0.3	0.4	0.6	0.5	0.8	0.3	1.3	0.6
p-Cymene	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.8	0.0
Indane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.2	0.5	0.1
1,3-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.2	0.6	0.0
1,4-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.7	0.3	0.0	0.3	0.1	0.0	0.6	1.6	0.6
n-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.3	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.0
Undecane	0.1	0.2	0.2	0.0	0.8	1.3	1.0	1.0	1.3	1.2	4.9	0.4	1.6	1.7
Naphthalene	0.2	0.5	0.4	0.0	0.0	4.9	2.4	0.0	0.7	0.3	2.8	0.0	0.0	1.9
Dodecane	0.2	0.4	0.3	0.0	1.1	4.4	2.8	0.8	1.8	1.3	11.8	0.7	1.6	4.0
Hexylbenzene	0.3	1.6	0.9	0.0	0.0	2.2	1.1	0.5	3.8	2.1	0.0	0.0	0.0	4.6

* Remote Control boat # 3 at Remote Station # 2 (RS-2) from 10:30 to 10:47, then moved to Remote Station # 1 (RS-1) from 10:47 to end of sampling; results applied to Remote Station # 1 position.

** Remote Control boat # 1 at Remote Station # 2 (RS-2) from 11:23 to end of sampling; results applied to RS-1 position.

Shaded areas = SUMMAs with final pressure lower than 38.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.4

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters Onboard the Casaco, the CCG 203 and the CCG 204

Sample I.D.	Casaco 350 m from fire						CCG 203 75 m from fire				CCG 204 75 m from fire	
	Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1	Pre-ignition 1	Burn 1
Internal sample reference / Sample size (mL)	REAC185 507	REAC211 502	AVE	ESD-18 495	REAC214 490	AVE	REAC183 490	REAC183 490	AVE	REAC75 490	REAC186 495	REAC183 502
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**186**	**258**	**222**	**57**	**76**	**67**	**3274**	**3383**	**3328**	**485**	**137**	**65**
Propene	9.5	17.6	13.5	0.8	3.8	2.3	53.6	77.5	65.6	7.5	0.0	2.7
Propane	0.0	1.2	0.6	0.0	0.0	0.0	8.0	0.3	4.1	0.0	0.0	1.0
Freon22 (Chlorodifluoromethane)	3.2	1.3	2.2	0.5	0.4	0.5	0.6	0.4	0.5	0.3	0.7	0.6
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	2.0	1.6	1.8	0.0	0.0	0.0
Chloromethane	3.1	2.1	2.6	1.4	1.1	1.3	1.4	1.0	1.2	1.0	1.7	1.4
Isobutane (2-Methylpropane)	0.5	1.8	1.1	2.7	0.5	1.6	59.0	60.3	59.7	10.6	1.2	0.4
Freon114 (1,2-Dichlorotetrafluroethan	1.9	2.5	2.2	1.0	0.5	0.8	1.4	1.4	1.4	0.8	1.8	0.5
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	22.2	28.1	25.1	3.7	6.0	4.8	53.4	56.0	54.7	7.4	16.0	5.6
1,3-Butadiene	1.0	0.0	0.5	0.0	0.0	0.0	17.6	16.3	16.9	2.2	0.9	0.4
Butane	3.1	2.2	2.6	2.3	1.3	1.8	115.4	121.2	118.3	19.4	2.5	1.1
t-2-Butene	1.2	1.3	1.2	0.3	0.5	0.4	15.5	15.4	15.5	2.7	0.9	0.9
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.4	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	1.3	1.3	1.3	0.3	0.4	0.3	13.7	14.2	14.0	2.6	0.8	1.1
Chloroethane	3.6	0.0	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	0.5
2-Methylbutane	1.6	1.0	1.3	3.0	2.2	2.6	354.5	375.2	364.9	52.0	4.1	1.0
Freon11 (Trichlorofluoromethane)	2.8	4.9	3.8	2.3	2.6	2.4	5.8	5.9	5.8	11.3		5.2
1-Pentene	4.3	5.9	5.1	0.3	1.6	0.9	10.8	10.9	10.9	1.6	3.4	0.7
Pentane	1.2	1.2	1.2	1.6	1.4	1.5	175.4	182.2	178.8	27.7	2.2	0.8
Isoprene (2-Methyl-1,3-Butadiene)	0.0	0.0	0.0	0.0	0.0	0.0	11.4	11.8	11.6	1.7	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.3	0.0	0.2	0.2	0.4	0.3	21.2	22.1	21.7	3.3	0.4	0.1
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	19.0	19.0	19.0	2.8	0.0	0.0
Freon113 (1,1,2-Trichlorotrifluoroethan	9.9	11.4	10.6	4.4	4.5	4.5	7.1	7.7	7.4	4.7	9.1	3.4
2,2-Dimethylbutane	0.0	0.0	0.0	0.0	0.0	0.0	34.2	35.8	35.0	3.6	0.0	0.0
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.0	0.0	0.0	0.2	0.0	0.1	25.1	26.4	25.7	4.0	0.0	0.0
2,3-Dimethylbutane	0.0	0.0	0.0	0.3	0.3	0.3	45.5	46.8	46.2	5.4	0.4	0.1
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	1.7	1.6	1.6	0.2	0.0	0.0
2-Methylpentane	33.8	81.1	57.5	2.5	3.4	3.0	177.2	182.6	179.9	24.6	26.4	14.5
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	8.1	8.6	8.3	1.3	0.0	0.0
3-Methylpentane	0.0	0.0	0.0	1.3	0.7	1.0	130.3	132.4	131.4	15.6	0.0	0.3
1-Hexene/2-Methyl-1-Pentene	3.6	5.8	4.7	0.0	1.5	0.8	14.0	14.2	14.1	2.1	2.8	0.5
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	3.4	1.5	2.4	1.3	3.1	2.2	417.0	435.7	426.4	23.8	2.5	4.8
Chloroform	0.0	0.0	0.0	0.5	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Hexene	0.0	0.0	0.0	0.0	0.2	0.1	9.6	10.4	10.0	1.5	0.0	0.1
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	10.3	10.1	10.2	1.4	0.0	0.0
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.5	6.5	1.1	0.0	0.0

NOBE 93 Table 2.4 cont.

Burn 1 VOC Analysis of Sea Level Air Samples

SUMMA Canisters Onboard the Casaco, the CCG 203 and the CCG 204

Sample I.D.	Casaco						CCG 203				CCG 204	
	350 m from fire						75 m from fire				75 m from fire	
	Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1	Pre-ignition 1	Burn 1
Internal sample reference Sample size (mL)	REAC185 507	REAC211 502	AVE	ESD-18 495	REAC214 490	AVE	REAC163 490	REAC163 490	AVE	REAC75 490	REAC186 495	REAC183 502
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	186	258	222	57	76	67	3274	3383	3328	485	137	65
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	13.2	13.5	13.4	2.0	0.0	0.0
2,2-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	5.7	6.0	5.9	0.6	0.0	0.0
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.6	0.7	0.0	0.0	0.0
Methylcyclopentane	0.6	0.5	0.6	0.8	1.0	0.9	120.3	124.5	122.4	12.1	0.8	0.2
2,4-Dimethylpentane	0.0	0.0	0.0	0.2	0.0	0.1	20.2	20.9	20.6	2.4	0.0	0.0
1,1,1-Trichloroethane	1.1	2.4	1.7	1.4	1.2	1.3	1.0	1.0	1.0	1.0	1.3	0.8
2,2,3-Trimethylbutane	0.9	2.0	1.5	0.0	0.0	0.0	1.5	1.5	1.5	0.2	0.9	0.3
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	0.8	0.9	0.8	1.0	0.9	0.9	62.1	64.8	63.4	15.0	1.2	0.3
Carbontetrachloride	0.8	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Cyclohexane	1.0	0.7	0.9	0.8	1.2	1.0	33.8	35.1	34.4	4.4	0.6	0.1
2-Methylhexane	0.0	0.0	0.0	0.3	0.3	0.3	37.1	39.9	38.5	4.6	0.0	0.0
2,3-Dimethylpentane	0.6	0.0	0.3	0.4	0.3	0.4	31.8	32.5	32.2	3.8	0.0	0.0
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	1.4	0.0	0.7	1.1	1.2	1.1	72.6	74.5	73.6	8.7	1.3	0.5
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	4.5	0.0	2.2	0.0	2.0	1.0	0.0	0.0	0.0	0.0	3.5	1.9
2,2,4-Trimethylpentane	1.8	2.2	2.0	0.3	0.0	0.1	22.7	23.2	22.9	2.4	1.0	0.0
t-3-Heptene	0.9	0.5	0.7	0.0	0.6	0.3	1.2	1.3	1.2	0.2	0.9	0.2
Heptane	1.8	3.3	2.5	1.2	1.7	1.4	57.9	59.8	58.8	6.8	1.5	0.4
t-2-Heptene	4.1	1.8	3.0	0.0	1.2	0.6	4.1	4.4	4.2	0.6	3.2	0.7
c-2-Heptene	5.5	3.2	4.4	0.0	1.0	0.5	0.0	0.0	0.0	0.9	3.6	0.8
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.6	2.5	0.3	0.0	0.0
Methylcyclohexane	1.5	1.2	1.3	1.6	1.5	1.6	34.1	34.8	34.5	4.6	0.8	0.1
2,5-Dimethylhexane	0.0	12.5	6.3	0.0	0.0	0.0	9.6	10.2	9.9	1.1	0.4	0.0
2,4-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	12.2	12.3	12.3	1.4	0.0	0.0
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.3	0.0	0.2	0.0	0.0	0.0	10.8	11.3	11.0	1.1	0.0	0.0
Toluene	3.6	1.9	2.7	2.7	2.8	2.8	191.9	196.3	194.1	43.4	2.7	0.7
2-Methylheptane	0.9	0.0	0.5	0.5	0.9	0.7	28.0	28.4	28.2	3.1	0.9	0.0
4-Methylheptane	0.0	0.0	0.0	0.0	0.0	0.0	12.2	12.6	12.4	1.4	0.0	0.0
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.0	0.0	0.0	0.5	0.5	0.5	43.4	44.1	43.8	4.6	0.4	0.1
c-1,3-Dimethylcyclohexane	0.5	0.0	0.3	0.4	0.4	0.4	6.4	7.2	6.8	0.8	0.4	0.0
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.4	2.5	0.4	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.6	3.6	0.3	0.0	0.0
1-Octene	6.3	7.5	6.9	0.0	2.0	1.0	0.0	0.0	0.0	0.0	3.9	0.4
Octane	1.1	1.2	1.1	0.8	1.0	0.9	21.0	21.6	21.3	2.3	0.8	0.2

NOBE 93 Table 2.4 cont.

Burn 1 VOC Analysis of Sea Level Air Samples
SUMMA Canisters Onboard the Casaco, the CCG 203 and the CCG 204

Sample I.D.	Casaco, 350 m from fire						CCG 203, 75 m from fire				CCG 204, 75 m from fire	
	Pre-ignition 1			Burn 1			Pre-ignition 1			Burn 1	Pre-ignition 1	Burn 1
Internal sample reference / Sample size (mL)	REAC185 507	REAC211 502	AVE	ESD-18 495	REAC214 490	AVE	REAC163 490	REAC163 490	AVE	REAC75 490	REAC186 495	REAC183 502
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**186**	**258**	**222**	**57**	**76**	**67**	**3274**	**3383**	**3328**	**485**	**137**	**65**
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	4.2	4.2	4.2	0.6	0.0	0.0
c-2-Octene	0.0	0.0	0.0	0.0	0.0	0.0	4.3	3.8	4.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.6	0.8	0.7	0.8	0.7	0.7	52.8	52.9	52.8	10.9	0.7	0.2
m/p-Xylene	2.0	2.8	2.4	2.2	2.1	2.1	163.2	164.7	164.0	34.2	2.2	0.7
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	6.0	5.7	5.8	0.3	0.0	0.1	0.6	0.0	0.3	0.2	0.0	0.0
Styrene	0.0	0.0	0.0	0.0	0.0	0.0	3.7	3.6	3.6	0.5	0.0	0.1
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.8	1.0	0.9	0.8	0.8	0.8	55.2	54.8	55.0	11.9	0.7	0.2
1-Nonene	0.0	12.9	6.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	0.0
Nonane	1.7	3.2	2.5	1.0	1.2	1.1	9.4	9.5	9.5	1.3	1.0	0.2
iso-Propylbenzene	0.3	0.0	0.1	0.1	0.1	0.1	3.4	3.4	3.4	0.7	0.2	0.0
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	0.3	0.0	0.0
n-Propylbenzene	0.9	0.7	0.8	0.3	0.5	0.4	13.7	13.8	13.8	2.5	0.6	0.2
3-Ethyltoluene	0.8	0.9	0.8	0.6	0.7	0.6	46.7	47.1	46.9	8.9	0.7	0.2
4-Ethyltoluene	0.4	0.5	0.4	0.3	0.3	0.3	22.9	23.0	22.9	3.9	0.4	0.1
1,3,5-Trimethylbenzene	0.6	0.6	0.6	0.2	0.4	0.3	24.4	24.4	24.4	4.0	0.5	0.2
2-Ethyltoluene	0.4	0.5	0.4	0.3	0.3	0.3	16.7	16.7	16.7	3.2	0.3	0.1
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	9.2	4.6	6.9	1.0	1.9	1.4	75.4	73.8	74.6	13.6	6.5	2.3
Decane	2.4	3.3	2.8	0.9	1.2	1.0	6.2	6.7	6.4	1.0	1.3	0.3
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	1.3	1.9	1.6	0.4	0.5	0.4	0.0	0.0	0.0	0.0	0.0	0.1
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1	0.2	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.1	0.1	0.1	1.1	1.1	1.1	0.2	0.0	0.0
1,2,3-Trimethylbenzene	0.7	0.8	0.7	0.3	0.4	0.4	15.6	15.0	15.3	2.8	0.5	0.2
p-Cymene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.0	0.0	0.0	0.1	0.1	0.1	7.7	7.8	7.8	1.4	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	4.4	4.1	4.2	0.7	0.0	0.0
1,4-Diethylbenzene	0.7	0.0	0.4	0.2	0.0	0.1	22.8	21.5	22.2	0.0	0.0	0.0
n-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	3.0	2.9	3.0	0.4	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.9	0.9	0.2	0.0	0.0
Undecane	3.0	2.4	2.7	0.6	0.9	0.8	4.4	4.8	4.6	1.1	2.0	0.6
Naphthalene	1.1	0.0	0.6	0.0	0.0	0.0	12.1	11.8	11.9	3.8	0.0	1.2
Dodecane	1.8	1.2	1.5	0.8	1.4	1.1	4.8	3.6	4.2	1.2	4.3	1.5
Hexylbenzene	0.0	0.0	0.0	0.0	3.8	1.9	0.0	0.0	0.0	0.0	0.0	0.0

Shaded areas = SUMMAs with final pressure lower than 38.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.5

Burn 1 VOC Analysis of Sea Level and Airborne Samples

SUMMA Canisters Onboard the CCG 212, the CCG 214 and from the Remote Control Helicopters

Sample I.D.	CCG 212 400 m from fire						CCG 214 400 m from fire		Remote Control Helicopter Team 1				Remote Control Helicopter Team 2		
	Pre-ignition 1			Burn 1			Pre-ignition 1	Burn 1	Background	Pre-ignition 1	Burn 1 under plume	Burn 1 front of plume	Background	Burn 1 20 m high	Burn 1 40 m high
Internal sample reference	REAC174	REAC174	AVE	REAC171	REAC171	AVE	REAC188	REAC187	T1,BLK	T1BKPRE	F4T1B1R2	T1B1R1F3	13872	T2B1R2	T2B1R3
Sample size (mL)	502	495		502	495		511	511	249	246	248	256	270	246	270
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**264**	**408**	**336**	**97**	**114**	**105**	**134**	**399**	**325**	**253**	**2082**	**281**	**270**	**402**	**257**
Propene	51.8	167.7	109.7	23.1	30.8	26.9	0.0	175.4	125.5	16.6	0.9		22.8	38.6	19.8
Propane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	2.4	60.9	0.0	3.8	9.7	0.6
Freon22 (Chlorodifluoromethane)	6.6	7.3	6.9	0.6	1.4	1.0	0.8	2.1	0.7	0.6	0.3	0.0	0.3	0.5	0.6
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.7	0.2	0.0	0.0	0.2	0.3	0.0
Chloromethane	4.1	3.9	4.0	1.2	1.1	1.1	1.5	2.6	0.8	1.4	0.7	1.7	0.8	0.8	0.6
Isobutane (2-Methylpropane)	6.2	6.6	6.4	0.4	0.6	0.5	0.4	1.4	3.9	7.6	83.6	4.0	1.8	8.4	1.1
Freon114 (1,2-Dichlorotetrafluroeth	0.9	2.1	1.5	0.6	0.7	0.6	0.4	2.8	1.0	0.5	0.4	0.5	0.4	0.5	0.5
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	17.3	5.3	11.3	7.1	7.4	7.3	5.4	30.4	10.3	8.3	3.5	10.6	5.8	3.3	3.1
1,3-Butadiene	1.2	0.0	0.6	0.6	0.6	0.6	0.4	1.9	8.9	1.3	1.5	1.1	0.6	0.3	0.2
Butane	10.9	11.3	11.1	0.9	1.0	0.9	0.9	2.2	6.9	15.3	251.6	9.7	4.3	26.2	3.2
t-2-Butene	3.0	3.3	3.1	0.4	0.5	0.5	0.5	1.1	1.2	0.0	0.2	1.9	0.5	0.3	0.2
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.1	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	2.8	2.9	2.9	0.5	0.5	0.5	0.7	1.4	1.3	2.0	0.3	2.8	0.7	0.4	0.4
Chloroethane	2.3	2.3	2.3	1.4	1.4	1.4	1.0	3.1	0.0	0.8	0.0	0.0	0.6	0.7	0.6
2-Methylbutane	11.2	13.1	12.2	1.1	1.2	1.2	1.3	1.9	16.6	27.6	254.2	9.3	8.9	28.5	3.5
Freon11 (Trichlorofluoromethane)				1.9	2.0	2.0	2.0	3.6	1.1	1.4	3.7	1.1	1.0	0.9	0.8
1-Pentene	3.9	4.0	4.0	1.3	1.3	1.3	1.0	6.4	1.5	1.0	0.7	0.5	0.7	0.5	0.4
Pentane	8.5	9.7	9.1	1.0	1.3	1.1	1.2	2.1	8.6	15.9	260.3	11.8	6.1	27.4	3.6
Isoprene (2-Methyl-1,3-Butadiene)	0.8	0.0	0.4	0.0	0.0	0.0	0.2	0.8	0.8	0.8	0.5	0.4	0.4	0.2	0.2
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	1.4	3.1	2.3	0.1	0.0	0.1	0.1	0.4	0.8	1.4	0.2	0.2	0.5	0.5	0.1
1,1-Dichloroethene	0.6	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	1.7	1.6	1.6	0.0	0.0	0.0	0.1	0.5	1.3	1.3	0.2	0.0	0.4	0.3	0.1
Freon113 (1,1,2-Trichlorotrifluoroet	6.5	10.4	8.4	3.8	5.1	4.4	3.6	21.7	6.6	2.7	2.7	3.4	3.3	3.4	3.7
2,2-Dimethylbutane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	1.6	2.4	5.1	0.2	0.8	1.3	0.1
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.2	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0
Cyclopentane	0.9	1.1	1.0	0.0	0.0	0.0	0.2	0.0	1.2	1.7	27.9	1.1	0.9	2.7	0.4
2,3-Dimethylbutane	0.7	0.8	0.8	0.1	0.0	0.1	0.2	0.2	2.0	3.1	18.2	0.6	1.1	2.3	0.3
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	5.0	5.9	5.5	2.1	3.7	2.9	2.4	12.4	9.6	16.5	125.9	7.8	5.2	17.5	2.4
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.0	0.0	0.1	0.1	0.0
3-Methylpentane	3.2	3.8	3.5	0.5	0.6	0.6	0.8	0.8	5.7	9.4	81.5	5.0	3.9	9.1	4.6
1-Hexene/2-Methyl-1-Pentene	3.0	2.9	3.0	1.3	1.2	1.2	1.0	6.0	3.5	1.3	1.0	0.0	1.1	0.6	0.6
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	25.4	30.5	27.9	1.8	2.0	1.9	2.0	2.5	6.1	11.7	182.2	91.6	11.7	22.8	90.6
Chloroform	0.8	1.0	0.9	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
t-2-Hexene	0.6	1.0	0.8	0.0	0.0	0.0	0.1	0.3	0.4	0.6	0.0	0.1	0.3	0.3	0.1
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.7	0.0	0.4	0.3	0.2	0.1
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2	0.3	0.5	0.0	0.0	0.2	0.2	0.1
c-3-Methyl-2-Pentene	0.5	1.0	0.8	0.0	0.0	0.0	0.0	0.2	0.7	0.8	0.0	0.4	0.3	0.3	0.1
2,2-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.5	3.9	0.0	0.2	0.4	0.1
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.1

NOBE 93 Table 2.5 cont.

Burn 1 VOC Analysis of Sea Level and Airborne Samples
SUMMA Canisters Onboard the CCG 212, the CCG 214 and from the Remote Control Helicopters

Sample I.D.	CCG 212 400 m from fire						CCG 214 400 m from fire		Remote Control Helicopter Team 1				Remote Control Helicopter Team 2		
	Pre-Ignition 1			Burn 1			Pre-Ignition 1	Burn 1	Background	Pre-Ignition 1	Burn 1 under plume	Burn 1 front of plume	Background	Burn 1 20 m high	Burn 1 40 m high
Internal sample reference	REAC174	REAC174	AVE	REAC171	REAC171	AVE	REAC188	REAC187	T1,BLK	T1BKPRE	F4T1B1R2	T1B1R1F3	13872	T2B1R2	T2B1R3
Sample size (mL)	502	495		502	495		511	511	249	248	248	256	270	248	270
Compound	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
TOTAL VOC	**264**	**408**	**336**	**97**	**114**	**105**	**134**	**399**	**325**	**253**	**2082**	**281**	**270**	**402**	**257**
Methylcyclopentane	4.3	5.3	4.8	0.8	0.9	0.8	1.2	0.8	3.8	6.7	109.3	11.2	4.7	10.3	10.8
2,4-Dimethylpentane	0.4	0.0	0.2	0.0	0.0	0.0	0.1	0.0	0.9	1.5	8.7	0.3	0.6	1.1	0.2
1,1,1-Trichloroethane	1.9	2.0	1.9	0.8	0.8	0.8	0.8	0.9	0.5	0.6	0.6	1.7	0.6	0.6	0.3
2,2,3-Trimethylbutane	0.6	0.7	0.6	0.3	0.4	0.3	0.3	1.9	0.2	0.4	1.0	0.3	0.4	0.4	0.4
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	3.9	4.5	4.2	0.4	0.5	0.4	0.4	0.7	9.3	2.2	6.3	1.0	3.3	2.7	1.0
Carbontetrachloride	0.8	0.9	0.9	0.7	0.8	0.8	0.8	0.7	0.4	0.5	0.4	0.2	0.4	0.3	0.2
Cyclohexane	1.3	2.0	1.6	0.9	1.0	0.9	1.0	0.7	1.6	3.1	76.1	2.4	2.5	8.6	2.6
2-Methylhexane	0.6	0.0	0.3	0.3	0.3	0.3	0.5	0.2	1.9	2.5	0.0	0.9	1.5	2.2	0.5
2,3-Dimethylpentane	0.5	0.0	0.3	0.2	0.0	0.1	0.3	0.0	1.4	2.5	14.2	0.5	1.1	1.8	0.4
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	1.1	1.4	1.3	0.6	0.6	0.6	1.1	0.6	3.5	5.9	44.6	1.9	3.2	5.0	1.2
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	3.3	0.0	1.7	2.7	0.0	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-Trimethylpentane	6.4	7.2	6.8	0.4	0.0	0.2	0.4	0.0	1.1	1.7	2.3	0.3	0.7	0.9	0.3
t-3-Heptene	0.7	2.0	1.3	0.3	0.8	0.5	0.1	0.7	0.0	0.1	0.1	0.1	0.1	0.1	0.0
Heptane	2.0	2.1	2.0	1.8	2.0	1.9	2.7	2.8	2.8	6.4	97.1	5.0	5.0	8.6	2.3
t-2-Heptene	3.1	4.2	3.7	1.3	1.6	1.4	0.5	3.0	0.2	0.3	0.2	0.3	0.3	0.3	0.2
c-2-Heptene	4.0	2.5	3.3	1.9	0.9	1.4	1.1	4.9	0.0		0.0	0.0	0.5	0.0	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.2	3.4	0.0	0.0	0.3	0.0
Methylcyclohexane	0.7	0.8	0.8	2.2	2.4	2.3	3.6	1.8	1.6	5.1	139.4	3.9	4.9	10.2	2.2
2,5-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.5	0.7	3.6	0.2	0.4	0.5	0.1
2,4-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.6	1.1	5.2	0.0	0.6	0.8	0.2
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.5	0.8	1.0	0.0	0.3	0.5	0.1
Toluene	15.8	19.1	17.4	1.1	1.7	1.4	2.7	2.0	11.6	7.6	12.1	10.9	25.8	58.5	35.3
2-Methylheptane	0.5	0.6	0.6	0.9	1.4	1.1	1.3	0.8	1.2	2.2	22.0	1.0	1.9	2.2	0.7
4-Methylheptane	0.2	0.0	0.1	0.2	0.0	0.1	0.4	0.0	0.0	1.1	0.0	0.0	0.7	0.9	0.3
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.1	0.0	10.8
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.6	0.6	0.6	0.6	0.7	0.6	1.1	0.5	1.8	3.0	17.4	0.9	2.3	2.7	0.8
c-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.6	0.7	0.7	1.0	0.7	0.2	0.9	20.3	0.7	1.0	1.7	0.4
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.3	0.3	0.3	0.5	0.3	0.0	0.4	11.5	0.3	0.4	0.7	0.2
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.2	0.2	0.2	0.0	0.1	0.3	0.1
1-Octene	3.5	1.5	2.5	1.9	0.9	1.4	4.0	12.8	1.3	0.8	0.0	0.0	1.0	0.2	0.6
Octane	1.0	1.0	1.0	1.6	1.8	1.7	2.8	1.8	1.0	2.1	34.4	2.3	3.1	3.7	1.2
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.3	0.2	0.5	4.9	0.2	0.4	0.6	0.2
c-2-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.5	2.3	0.0	0.4	0.0	0.0	0.0	0.3	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	2.3	2.7	2.5	0.5	0.6	0.5	1.5	0.6	2.9	2.1	2.6	2.5	5.4	4.7	2.7
m/p-Xylene	7.5	9.0	8.2	1.9	2.3	2.1	5.6	2.2	9.5	6.4	8.7	9.6	17.6	14.9	8.7

NOBE 93 Table 2.5 cont.

Burn 1 VOC Analysis of Sea Level and Airborne Samples
SUMMA Canisters Onboard the CCG 212, the CCG 214 and from the Remote Control Helicopters

Sample I.D.	CCG 212, 400 m from fire						CCG 214, 400 m from fire		Remote Control Helicopter Team 1				Remote Control Helicopter Team 2		
	Pre-Ignition 1			Burn 1			Pre-Ignition 1	Burn 1	Background	Pre-Ignition 1	Burn 1 under plume	Burn 1 front of plume	Background	Burn 1 20 m high	Burn 1 40 m high
Internal sample reference	REAC174	REAC174	AVE	REAC171	REAC171	AVE	REAC188	REAC187	T1,BLK	T1BKPRE	F4T1B1R2	T1B1R1F3	13872	T2B1R2	T2B1R3
Sample size (mL)	502	495		502	495		511	511	249	246	248	256	270	246	270
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**264**	**408**	**336**	**97**	**114**	**105**	**134**	**399**	**325**	**253**	**2082**	**281**	**270**	**402**	**257**
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	0.0	1.0	0.5	0.0	0.3	0.2	0.1	0.0	0.5	0.2	0.6	1.5	0.5	0.3	0.3
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	2.4	2.7	2.5	0.7	0.8	0.8	2.0	0.8	3.1	2.1	2.5	3.2	6.2	5.3	3.1
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	1.2	1.3	1.2	2.0	2.1	2.0	3.6	3.0	0.5	1.2	14.4	2.8	2.7	3.3	1.2
iso-Propylbenzene	0.0	0.0	0.0	0.1	0.1	0.1	0.3	0.2	0.2	0.2	0.5	0.5	14.5	0.4	0.3
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	1.4	0.6	0.2	0.5	0.1
n-Propylbenzene	0.6	0.8	0.7	0.5	0.6	0.6	0.9	1.2	0.7	0.7	0.9	1.2	2.1	1.5	1.0
3-Ethyltoluene	1.1	1.6	1.4	1.0	1.2	1.1	2.4	1.2	2.1	2.0	2.2	3.4	6.4	4.3	2.8
4-Ethyltoluene	0.5	0.8	0.7	0.5	0.6	0.5	1.1	0.6	1.0	1.0	1.0	1.7	3.2	2.0	1.3
1,3,5-Trimethylbenzene	0.7	0.9	0.8	0.7	0.8	0.8	1.5	1.0	1.0	1.1	1.5	2.2	3.4	2.4	1.6
2-Ethyltoluene	0.5	0.6	0.6	0.4	0.5	0.5	1.0	0.7	0.7	0.7	0.9	1.5	2.2	1.6	1.0
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	2.2	15.6	8.9	3.5	7.9	5.7	4.8	5.4	3.2	3.4	4.4	8.9	11.6	7.7	5.1
Decane	1.4	1.9	1.6	2.3	2.8	2.5	5.4	4.7	0.6	0.8	8.3	8.3	3.7	4.3	2.5
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.2	0.1	0.1
1,4-Dichlorobenzene	1.0	1.5	1.3	0.0	0.3	0.2	0.1	0.0	0.0	0.1	0.2	1.4	0.8	0.8	0.8
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1
sec-Butylbenzene	0.0	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.3	0.4	0.2	0.2	0.1
1,2,3-Trimethylbenzene	0.6	0.9	0.7	0.6	0.8	0.7	1.4	1.2	0.7	0.8	1.5	3.1	2.8	1.9	1.3
p-Cymene	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.8	0.0	2.6	0.4	0.8	0.4
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.2	0.0	0.0	0.1	0.1	0.1
Indane	0.0	0.0	0.0	0.2	0.3	0.2	0.5	0.3	0.3	0.4	0.3	0.7	1.2	0.7	0.5
1,3-Diethylbenzene	0.0	0.0	0.0	0.2	0.2	0.2	0.4	0.3	0.2	0.3	0.3	0.6	0.7	0.4	0.3
1,4-Diethylbenzene	0.0	0.8	0.4	0.6	0.0	0.3	1.7	1.1	1.0	0.7	1.6	0.0	2.5	1.1	0.9
n-Butylbenzene	0.0	0.0	0.0	0.2	0.3	0.2	0.6	0.5	0.2	0.3	0.4	0.7	0.7	0.4	0.3
1,2-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0	0.2	0.2	0.1	0.1
Undecane	1.6	1.9	1.7	3.0	3.2	3.1	11.0	9.8	0.6	1.0	7.2	8.0	4.0	3.3	2.1
Naphthalene	0.0	1.2	0.6	0.0	0.6	0.3	2.5	0.0	2.0	1.5	1.4	1.2	1.8	0.0	0.7
Dodecane	1.4	1.8	1.6	3.4	2.2	2.8	17.2	10.7	1.6	2.0	5.6	1.7	1.6	2.8	0.9
Hexylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	8.5	0.0	6.3	2.5	3.9	0.0	0.0	0.0	0.0

Shaded areas = SUMMAs with final pressure lower than 38.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.6

Burn 1 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

	Background									Burn 1								
Sample I.D.	August 07 1993 3 km downwind ship exhaust			8:21 to 8:45 AM 1.5 km downwind of backup boom 122 m above sea level, ship exhaust						10:39 AM 1.5 km downwind 230 m above sea level	10:56 AM 1.5 km downwind			11:08 AM 1.5 km downwind	11:27 AM 5 km downwind			11:43 AM 32 km downwind
Internal sample reference	EPS233	EPS233	AVE	EPS53	EPS53	AVE	EPS132	EPS132	AVE	EPS27	EPS151	EPS151	AVE	EPS-6	EPS-22	EPS22	AVE	GVRD430
Sample size (mL)	495	248		494	504		497	248		504	497	246		511	497	272		504
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**100**	**83**	**91**	**83**	**78**	**81**	**69**	**62**	**65**	**408**	**99**	**88**	**94**	**156**	**162**	**143**	**152**	**43**
Propene	25.8	1.2	13.5	0.0	0.0	0.0	17.1	6.6	11.8	1.1	18.6	2.8	10.7	9.3	33.1	4.0	18.6	0.0
Propane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.2	0.0	0.1	0.1	5.7	2.4	0.0	1.2	0.0
Freon22 (Chlorodifluoromethane)	0.3	0.3	0.3	0.3	0.2	0.3	0.5	0.2	0.4	0.2	0.7	0.4	0.5	0.0	0.6	0.3	0.4	0.3
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	1.0	0.3	0.6	0.9	0.7	0.8	0.8	0.4	0.6	0.5	0.9	0.9	0.9	0.9	0.5	0.4	0.4	0.9
Isobutane (2-Methylpropane)	0.3	0.0	0.2	0.2	0.0	0.1	0.2	0.0	0.1	9.8	0.4	0.3	0.4	5.1	2.3	2.6	2.4	0.4
Freon114 (1,2-Dichlorotetrafluroeth	0.2	0.5	0.4	0.2	0.2	0.2	0.0	0.4	0.2	0.2	0.2	0.3	0.3	0.2	0.2	0.5	0.3	0.2
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	0.4	0.4	0.4	0.4	0.4	0.4	0.7	0.4	0.5	1.0	0.8	0.7	0.7	1.6	1.1	1.1	1.1	0.3
1,3-Butadiene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.3	0.3	0.5	0.3	0.0	0.2	0.0
Butane	0.7	0.7	0.7	1.5	1.3	1.4	0.6	0.7	0.7	47.3	1.2	1.4	1.3	16.4	7.8	9.0	8.4	1.2
t-2-Butene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.1	0.5	0.6	0.5	0.0
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.4	0.5	0.4	0.0
Chloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylbutane	1.7	1.5	1.6	3.9	3.4	3.7	1.5	1.6	1.6	54.7	2.4	2.6	2.5	16.0	9.1	10.6	9.9	1.9
Freon11 (Trichlorofluoromethane)	2.3	2.1	2.2	2.3	2.1	2.2	2.1	2.2	2.1	1.9	2.0	2.0	2.0	2.1	2.2	2.4	2.3	2.0
1-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.2	0.2	0.2	0.0
Pentane	0.2	0.2	0.2	0.2	0.2	0.2	0.1	0.0	0.1	53.7	1.1	1.2	1.1	15.7	7.8	9.1	8.5	1.1
Isoprene (2-Methyl-1,3-Butadiene)	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.4	0.5	0.4	0.0
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.0
Freon113 (1,1,2-Trichlorotrifluoroet	1.6	3.1	2.3	1.5	1.5	1.5	1.5	2.5	2.0	1.5	1.5	2.2	1.8	1.8	1.5	3.3	2.4	1.6
2,2-Dimethylbutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	0.0	0.1	0.0	0.3	0.1	0.0	0.1	0.0
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.2	0.2	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	5.6	0.2	0.2	0.2	1.4	0.7	0.8	0.8	0.1
2,3-Dimethylbutane	0.5	0.4	0.4	1.2	1.1	1.2	0.5	0.5	0.5	3.9	0.6	0.6	0.6	1.2	1.2	1.3	1.3	0.3
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	0.3	0.3	0.3	0.6	0.5	0.6	0.3	0.3	0.3	24.2	1.0	1.1	1.1	6.6	3.7	4.1	3.9	0.7
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	0.3	0.2	0.2	0.4	0.3	0.4	0.2	0.2	0.2	14.8	0.7	0.8	0.7	3.8	2.2	2.4	2.3	0.5
1-Hexene/2-Methyl-1-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.4	0.5	0.0	0.2	0.0
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	0.2	0.2	0.2	1.0	0.4	0.7	0.1	0.2	0.2	28.4	1.4	1.4	1.4	8.3	5.2	5.7	5.5	0.7
Chloroform	0.5	0.4	0.5	0.3	0.3	0.3	0.2	0.3	0.2	0.3	0.2	0.3	0.3	0.2	0.3	0.3	0.3	0.1
t-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.0
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.2	0.0	0.1	0.0
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.1	0.0
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.2	0.3	0.2	0.3	0.0
2,2-Dimethylpentane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.6 cont.

Burn 1 VOC Analysis of Airborne Samples

SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

	Background									Burn 1								
Sample I.D.	August 07 1993 3 km downwind ship exhaust			8:21 to 8:45 AM 1.5 km downwind of backup boom 122 m above sea level, ship exhaust						10:39 AM 1.5 km downwind 230 m above sea level	10:56 AM 1.5 km downwind			11:08 AM 1.5 km downwind	11:27 AM 5 km downwind			11:43 AM 32 km downwind
Internal sample reference	EPS233	EPS233	AVE	EPS53	EPS53	AVE	EPS132	EPS132	AVE	EPS27	EPS151	EPS151	AVE	EPS-6	EPS-22	EPS22	AVE	GVRD430
Sample size (mL)	495	248		494	504		497	248		504	497	246		511	497	272		504
Compound	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
TOTAL VOC	**100**	**83**	**91**	**83**	**78**	**81**	**69**	**62**	**65**	**408**	**99**	**88**	**94**	**156**	**162**	**143**	**152**	**43**
Methylcyclopentane	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	17.3	0.9	1.0	0.9	4.7	2.3	2.5	2.4	0.4
2,4-Dimethylpentane	0.5	0.4	0.4	1.3	1.2	1.2	0.6	0.6	0.6	1.8	0.6	0.6	0.6	0.7	1.1	1.2	1.1	0.3
1,1,1-Trichloroethane	0.8	0.7	0.8	0.7	0.7	0.7	0.7	0.8	0.8	0.7	0.9	0.8	0.8	0.7	1.1	1.4	1.2	0.7
2,2,3-Trimethylbutane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	5.4	2.7	2.6	2.6	5.6	3.2	3.3	3.3	0.5
Carbontetrachloride	0.8	0.7	0.8	0.8	0.7	0.7	0.8	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Cyclohexane	0.0	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	11.3	0.8	0.8	0.8	2.9	1.2	1.2	1.2	0.2
2-Methylhexane	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	3.1	0.3	0.3	0.3	0.8	0.6	0.6	0.6	0.1
2,3-Dimethylpentane	0.3	0.3	0.3	0.7	0.7	0.7	0.3	0.4	0.4	2.4	0.5	0.5	0.5	0.7	0.8	0.8	0.8	0.2
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	5.9	0.6	0.6	0.6	1.6	1.0	0.9	1.0	0.2
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-Trimethylpentane	6.0	4.8	5.4	15.1	14.7	14.9	7.8	8.6	8.2	4.3	7.0	7.2	7.1	5.5	11.8	13.1	12.5	3.4
t-3-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heptane	0.0	0.1	0.0	0.1	0.0	0.1	0.0	0.0	0.0	11.6	1.5	1.5	1.5	3.1	1.6	1.7	1.6	0.3
t-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	15.2	2.4	2.4	2.4	4.4	1.8	2.0	1.9	0.4
2,5-Dimethylhexane	0.6	0.5	0.6	2.0	1.9	2.0	1.0	1.1	1.1	1.1	1.0	1.0	1.0	0.8	1.6	1.6	1.6	0.5
2,4-Dimethylhexane	0.9	0.7	0.8	2.4	2.4	2.4	1.4	1.4	1.4	1.4	1.3	1.3	1.3	1.1	2.1	2.2	2.2	0.6
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	1.8	1.5	1.6	5.2	5.1	5.2	2.8	3.1	2.9	1.8	2.6	2.6	2.6	1.9	3.9	4.2	4.1	1.2
Toluene	5.2	4.7	4.9	11.4	11.0	11.2	7.1	8.1	7.6	9.8	8.4	7.2	7.8	4.6	11.6	14.9	13.3	3.0
2-Methylheptane	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	2.2	0.5	0.6	0.5	0.6	0.4	0.4	0.4	0.1
4-Methylheptane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	1.9	0.5	0.5	0.5	0.5	0.3	0.3	0.3	0.1
c-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	0.5	0.5	0.5	0.5	0.2	0.3	0.2	0.0
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.2	0.3	0.2	0.2	0.1	0.0	0.1	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.7	0.5	0.6	2.0	1.9	2.0	1.3	1.4	1.3	0.7	1.1	1.1	1.1	0.8	1.6	1.7	1.6	0.5
1-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Octane	0.0	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	3.0	1.0	1.0	1.0	0.8	0.4	0.5	0.5	0.1
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
c-2-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.4	0.4	0.4	0.3	0.2	0.3	0.5	0.4	0.4	1.0	0.7	0.3	0.5	0.4	0.7	0.8	0.8	0.1
m/p-Xylene	0.4	1.0	0.7	0.3	0.3	0.3	0.3	0.4	0.4	2.7	0.8	0.8	0.8	0.5	1.6	1.8	1.7	0.3

NOBE 93 Table 2.6 cont.

Burn 1 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

Sample I.D.	Background: August 07 1993, 3 km downwind ship exhaust			Background: 8:21 to 8:45 AM, 1.5 km downwind of backup boom, 122 m above sea level, ship exhaust					
Internal sample reference	EPS233	EPS233	AVE	EPS53	EPS53	AVE	EPS132	EPS132	AVE
Sample size (mL)	495	248		494	504		497	248	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**100**	**83**	**91**	**83**	**78**	**81**	**69**	**62**	**65**
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	41.8	44.9	43.3	21.0	20.9	21.0	16.2	17.6	16.9
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	0.0	0.1	0.0	0.2	0.1	0.1	0.0	0.0	0.0
iso-Propylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Propylbenzene	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
3-Ethyltoluene	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
4-Ethyltoluene	0.1	0.2	0.1	0.1	0.0	0.0	0.1	0.0	0.0
1,3,5-Trimethylbenzene	0.1	0.2	0.1	0.1	0.0	0.1	0.1	0.1	0.1
2-Ethyltoluene	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.2	1.2	0.7	0.3	0.1	0.2	0.2	0.2	0.2
Decane	0.3	0.3	0.3	0.2	0.1	0.2	0.1	0.0	0.1
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-Trimethylbenzene	0.1	0.3	0.2	0.1	0.1	0.1	0.1	0.0	0.0
p-Cymene	0.0	0.5	0.2	0.1	0.0	0.1	0.0	0.0	0.0
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Diethylbenzene	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0
n-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Undecane	0.5	0.8	0.7	0.3	0.3	0.3	0.1	0.0	0.0
Naphthalene	0.3	1.1	0.7	0.7	0.6	0.6	0.1	0.0	0.1
Dodecane	0.9	1.4	1.1	0.7	0.8	0.7	0.3	0.0	0.1
Hexylbenzene	0.0	2.6	1.3	0.0	0.0	0.0	0.0	0.0	0.0

Sample I.D.	Burn 1: 10:39 AM, 1.5 km downwind, 230 m above sea level	Burn 1: 10:56 AM, 1.5 km downwind			Burn 1: 11:08 AM, 1.5 km downwind	Burn 1: 11:27 AM, 5 km downwind			Burn 1: 11:43 AM, 32 km downwind
Internal sample reference	EPS27	EPS151	EPS151	AVE	EPS-6	EPS-22	EPS22	AVE	GVRD430
Sample size (mL)	504	497	246		511	497	272		504
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**408**	**99**	**88**	**94**	**156**	**162**	**143**	**152**	**43**
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Styrene	22.7	21.1	25.2	23.1	9.9	19.8	21.2	20.5	11.0
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.8	0.3	0.3	0.3	0.2	0.5	0.5	0.5	0.1
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	1.0	0.7	0.7	0.7	0.3	0.3	0.2	0.2	0.1
iso-Propylbenzene	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Propylbenzene	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
3-Ethyltoluene	0.4	0.2	0.2	0.2	0.1	0.2	0.2	0.2	0.1
4-Ethyltoluene	0.2	0.1	0.2	0.1	0.0	0.1	0.1	0.1	0.0
1,3,5-Trimethylbenzene	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	0.1
2-Ethyltoluene	0.2	0.1	0.1	0.1	0.0	0.1	0.1	0.1	0.0
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.7	0.5	0.6	0.5	0.4	0.4	0.4	0.4	0.3
Decane	0.6	0.7	0.5	0.6	0.3	0.3	0.4	0.4	0.3
1,3-Dichlorobenzene	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-Trimethylbenzene	0.2	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1
p-Cymene	0.0	0.2	0.4	0.3	0.0	0.3	0.0	0.1	0.3
1,2-Dichlorobenzene	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Indane	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0
1,4-Diethylbenzene	0.2	0.1	0.2	0.2	0.0	0.1	0.0	0.1	0.2
n-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0
Undecane	0.6	0.9	0.7	0.8	0.5	0.5	0.5	0.5	1.1
Naphthalene	1.2	0.6	0.0	0.3	0.9	0.5	0.0	0.2	1.0
Dodecane	1.5	0.9	1.2	1.0	0.8	0.7	0.7	0.7	1.7
Hexylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.7

Burn 2 VOC Analysis of Sea Level Air Samples
SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote Station # 1 Remote control boat # 1 50-100 m from fire									Remote Station # 2 Remote control boat # 2 100-150 m from fire				
	Pre-ignition 2				Burn 2					Burn 2				
Internal sample reference	REAC178	REAC178	REAC178	AVE	REAC167	REAC167	REAC197	REAC197	AVE	ESD-4	REAC212	REAC212	REAC212	AVE
Sample size (mL)	504	20	504		509	20	507	123		95	504	494	125	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1476**	**2808**	**1533**	**1939**	**5387**	**24715**	**12112**	**22190**	**16101**	**1709**	**6755**	**7867**	**10699**	**6758**
Propene	4.8	0.0	4.7	3.2	11.8	0.0	8.6	167.9	47.1	3.3	4.7	4.0	5.5	4.4
Propane	38.2	67.1	35.1	46.8	143.1	428.9	231.6	319.6	280.8	0.0	69.5	144.8	116.2	82.6
Freon22 (Chlorodifluoromethane)	0.9		1.0	1.0	0.4		0.4	0.7	0.5	5.1	1.3	1.6	1.3	2.3
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	1.4	0.0	1.5	1.0	0.6	0.0	2.5	3.6	1.7	4.2	1.1	1.5	1.7	2.1
Isobutane (2-Methylpropane)	49.1	52.7	45.9	49.3	413.2	547.7	526.1	647.8	533.7	140.7	174.3	214.4	235.4	191.2
Freon114 (1,2-Dichlorotetrafluroethane)	0.4	0.0	0.4	0.2	0.7	0.0	0.6	1.4	0.7	2.0	0.3	0.5	1.3	1.0
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	7.7	6.5	7.7	7.3	8.9	0.0	13.2	7.2	7.3	51.7	8.3	10.1	11.7	20.5
1,3-Butadiene	1.3	0.0	1.3	0.9	2.9	0.0	3.1	2.6	2.1	2.2	0.8	0.8	1.0	1.2
Butane	122.6	151.4	121.3	131.8		2070.6		2326.0	2198.3	170.5	573.7	704.9	824.3	568.3
t-2-Butene	1.9	0.0	1.9	1.3	0.0	0.0	0.0	1.1	0.3	34.1	3.6	4.2	4.5	11.6
2,2-Dimethylpropane	0.5	0.0	0.5	0.3	7.0	8.7	9.6	10.6	8.9	0.0	2.5	3.4	3.6	2.4
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.1	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	1.8	0.0	1.8	1.2	1.0	0.0	1.7	1.8	1.1	28.9	2.7	3.4	3.9	9.7
Chloroethane	1.0	0.0	1.0	0.7	0.7	0.0	1.5	1.6	0.9	0.0	0.9	1.2	1.7	0.9
2-Methylbutane	140.3	184.7	148.3	157.8		2892.6	2078.3	2884.5	2618.5	227.2	798.4	932.1	1209.5	791.8
Freon11 (Trichlorofluoromethane)			3.6	3.6	5.3	0.0		9.9	5.1		3.6	14.1	4.1	7.3
1-Pentene	1.2	0.0	1.3	0.8	1.5	0.0	1.9	1.9	1.3	8.3	1.8	2.2	2.7	3.7
Pentane	150.1	200.0	156.3	168.8		3303.8			3303.8	120.8		668.3	1285.3	691.5
Isoprene (2-Methyl-1,3-Butadiene)	0.5	0.0	0.5	0.3	0.6	0.0	0.9	1.0	0.6	1.8	0.5	0.5	0.0	0.7
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	1.2	0.0	1.3	0.9	1.1	0.0	1.8	1.6	1.1	17.2	2.9	3.4	2.7	6.5
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.2	0.0	0.3	0.3	0.0	0.1
c-2-Pentene	0.7	0.0	0.7	0.5	0.5	0.0	1.0	1.1	0.7	13.9	1.6	1.8	2.4	4.9
Freon113 (1,1,2-Trichlorotrifluoroethan	2.2	13.1	2.2	5.8	4.0	24.2	3.2	10.6	10.5	11.6	2.4	3.0	9.3	6.6
2,2-Dimethylbutane	3.4	0.0	3.4	2.3	44.4	63.7	64.2	67.4	59.9	4.2	20.6	24.9	28.5	19.6
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.1
1,1-Dichloroethane	0.0	0.0	0.0	0.0	2.0	0.0	2.7	0.0	1.2	0.0	1.1	1.1	0.0	0.5
Cyclopentane	17.1	22.0	18.1	19.0	237.9	386.1	273.6	363.6	315.3	12.1	126.8	130.7	160.8	107.6
2,3-Dimethylbutane	11.8	14.2	11.9	12.6	151.6	233.8	176.3	245.3	201.8	11.0	81.3	85.9	104.8	70.8
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.2
2-Methylpentane	85.5	107.5	89.5	94.2		1740.2	887.1	1633.0	1420.1	75.0	514.4	487.1	727.0	450.9
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.2	0.0	0.0	0.0	0.8
3-Methylpentane	74.6	97.0	79.2	83.6	651.2	1103.9	829.6	1044.3	907.3	39.0	335.1	366.0	475.7	304.0
1-Hexene/2-Methyl-1-Pentene	1.0	0.0	1.1	0.7	1.4	0.0	1.9	1.8	1.3	4.3	1.6	1.8	2.4	2.5
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane		1016.0		1016.0		2521.2		2596.6	2558.9	60.2	679.1	666.4	1018.2	606.0
Chloroform	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.2
t-2-Hexene	0.3	0.0	0.4	0.2	0.6	0.0	0.6	0.8	0.5	2.9	0.7	0.9	0.8	1.3
t-3-Methyl-2-Pentene	0.2	0.0	0.2	0.1	0.3	0.0	0.4	0.4	0.3	3.0	0.5	0.6	0.7	1.2
c-2-Hexene	0.2	0.0	0.3	0.2	0.4	0.0	0.0	0.5	0.2	2.1	0.6	0.7	0.6	1.0

NOBE 93 Table 2.7 cont.

Burn 2 VOC Analysis of Sea Level Air Samples
SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote Station # 1, Remote control boat # 1, 50-100 m from fire									Remote Station # 2, Remote control boat # 2, 100-150 m from fire				
	Pre-ignition 2				Burn 2					Burn 2				
Internal sample reference	REAC178	REAC178	REAC178	AVE	REAC167	REAC167	REAC197	REAC197	AVE	ESD-4	REAC212	REAC212	REAC212	AVE
Sample size (mL)	504	20	504		509	20	507	123		95	504	494	125	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	1476	2808	1533	1939	5387	24715	12112	22190	16101	1709	6755	7867	10699	6758
c-3-Methyl-2-Pentene	0.2	0.0	0.2	0.2	0.3	0.0	0.5	0.6	0.3	3.9	0.7	0.8	0.9	1.6
2,2-Dimethylpentane	2.5	3.3	2.7	2.8	36.6	50.5	51.1	55.4	48.4	1.3	17.5	20.0	23.0	15.4
1,2-Dichloroethane	1.0	0.0	1.0	0.6	6.2	0.0	7.2	9.0	5.6	0.0	2.9	3.3	3.4	2.4
Methylcyclopentane	147.1	205.8	154.8	169.2		1472.2	1070.2	1423.8	1322.1	36.6	455.9	445.1	652.0	397.4
2,4-Dimethylpentane	6.0	7.9	6.4	6.8	79.0	113.1	107.9	122.0	105.5	3.8	41.5	43.4	52.7	35.4
1,1,1-Trichloroethane	0.8	0.0	0.9	0.6	0.8	0.0	1.1	1.2	0.8	4.6	1.1	1.2	1.2	2.0
2,2,3-Trimethylbutane	0.8	0.0	0.9	0.6	8.7	11.3	12.1	12.4	11.1	0.5	4.3	4.8	5.5	3.8
1-Methylcyclopentene	0.0	0.0	0.0	0.0	150.0	0.0	76.5	0.0	56.6	0.0	0.0	0.0	0.0	0.0
Benzene	4.8	6.7	5.1	5.5	30.9	44.3	38.6	44.4	39.6	15.9	14.5	16.0	19.4	16.5
Carbontetrachloride	0.7	0.0	0.7	0.5	0.7	0.0	0.7	0.8	0.6		0.7	0.8	0.8	0.7
Cyclohexane	51.9	68.0	54.9	58.3	614.5	1043.4	747.2	1008.7	853.5	20.8	342.3	339.1	457.6	290.0
2-Methylhexane	15.9	19.5	17.0	17.5	187.8	287.5	0.0	268.8	186.0	8.6	104.9	110.6	141.6	91.4
2,3-Dimethylpentane	10.2	12.7	11.1	11.3	133.8	183.6	174.3	201.3	173.3	9.1	65.0	67.1	127.2	67.1
Cyclohexene	0.0	0.0	0.0	0.0	4.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	32.1	45.4	34.3	37.3	378.5	583.1	480.1	635.8	519.4	18.4	195.5	208.7	278.1	175.2
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	69.8	0.0	0.0	0.0	17.5	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-Trimethylpentane	0.0	10.7	0.0	3.6	0.0	0.0	24.9	0.0	6.2	2.1	10.2	11.2	14.4	9.5
t-3-Heptene	0.4	0.0	0.4	0.3	0.0	0.0	0.0	0.2	0.0	0.4	0.0	0.4	0.2	0.2
Heptane	75.5	97.2	80.1	84.3		1359.6	986.5	1346.3	1230.8	31.8	421.6	445.1	573.2	367.9
t-2-Heptene	0.9	0.0	0.9	0.6	1.1	0.0	0.6	1.0	0.7	0.6	0.7	0.9	0.8	0.8
c-2-Heptene	0.6	0.0	0.6	0.4	0.7	0.0	0.4	0.6	0.4	0.0	0.7	0.7	1.3	0.7
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	2.7	0.0	2.8	1.8	30.9	0.0	19.7	0.0	12.7	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	106.8	141.4	113.9	120.7		1938.0	1368.5	1992.4	1766.3	42.2	596.2	610.7	854.8	526.0
2,5-Dimethylhexane	3.0	3.5	3.2	3.3	36.0	47.1	36.1	48.7	42.0	1.8	18.8	18.8	22.5	15.5
2,4-Dimethylhexane	4.2	5.8	4.3	4.8	49.4	68.5	67.0	78.6	65.9	2.5	25.1	26.4	33.0	21.7
t-1,3-Dichloropropene	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	1.0	0.0	1.0	0.7	10.1	13.2	12.9	14.1	12.6	1.0	4.9	5.4	6.1	4.3
Toluene	9.9	14.3	10.4	11.5	73.8	106.7	94.7	107.5	95.7	35.8	42.9	44.8	58.2	45.4
2-Methylheptane	20.3	25.9	20.9	22.4	212.1	294.1	206.2	286.4	249.7	11.4	109.6	110.1	141.4	93.1
4-Methylheptane	6.4	0.0	6.5	4.3	68.5	0.0	90.7	110.1	67.3	0.0	37.3	36.2	0.0	18.4
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	16.2	18.3	17.0	17.2	177.3	246.3	199.6	247.8	217.7	10.8	94.8	91.6	115.1	78.1
c-1,3-Dimethylcyclohexane	17.6	21.2	18.8	19.2	175.4	263.4	0.0	326.1	191.2	9.4	93.5	99.8	140.1	85.7
t-1,4-Dimethylcyclohexane	10.3	10.6	10.6	10.5	105.6	109.7	0.0	145.5	90.2	4.9	56.4	47.7	76.1	46.3
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.3	0.0	0.3	0.2	2.5	0.0	2.8	2.9	2.1	0.3	1.1	1.3	1.4	1.0
1-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Octane	36.0	38.5	37.0	37.1	347.4	500.0	358.9	481.0	421.8	23.1	183.9	183.0	230.5	155.1

NOBE 93 Table 2.7 cont.

Burn 2 VOC Analysis of Sea Level Air Samples
SUMMA Canisters at Remote Stations 1 and 2

Sample I.D.	Remote Station # 1 Remote control boat # 1 50-100 m from fire									Remote Station # 2 Remote control boat # 2 100-150 m from fire				
	Pre-Ignition 2				Burn 2					Burn 2				
Internal sample reference / Sample size (mL)	REAC178 504	REAC178 20	REAC178 504	AVE	REAC167 509	REAC167 20	REAC197 507	REAC197 123	AVE	ESD-4 95	REAC212 504	REAC212 494	REAC212 125	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1476**	**2808**	**1533**	**1939**	**5387**	**24715**	**12112**	**22190**	**16101**	**1709**	**6755**	**7867**	**10699**	**6758**
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	4.6	5.8	4.8	5.0	50.0	66.5	64.4	85.7	66.7	2.8	25.4	26.1	33.8	22.0
c-2-Octene	0.1	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	3.7	2.8	3.8	3.4	24.9	26.9	30.5	34.6	29.2	10.9	14.8	15.1	18.2	14.8
m/p-Xylene	12.3	10.9	12.7	12.0	83.4	95.3	101.9	116.3	99.2	37.7	48.7	50.4	61.7	49.6
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.1	0.0	0.0	0.0	0.0	0.0
Styrene	0.9	0.0	0.9	0.6	0.7	0.0	0.9	0.7	0.6	2.3	0.8	0.8	1.2	1.3
1,1,2,2-Tetrachloroethane	0.6	0.0	0.6	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2
o-Xylene	4.1	3.7	4.2	4.0	24.6	27.9	29.7	34.8	29.2	12.8	14.7	15.0	18.2	15.2
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	23.9	17.3	24.5	21.9	167.5	200.8	195.7	223.7	196.9	24.3	92.0	88.2	109.0	78.4
iso-Propylbenzene	0.8	0.0	0.8	0.5	5.2	5.7	6.0	7.1	6.0	1.4	2.6	2.9	3.2	2.5
3,6-Dimethyloctane	1.8	0.0	1.8	1.2	15.1	17.0	0.0	18.7	12.7	2.7	6.9	6.9	0.0	4.1
n-Propylbenzene	1.7	11.8	1.7	5.1	7.8	5.0	9.1	10.6	8.1	3.9	4.6	4.9	5.4	4.7
3-Ethyltoluene	4.4	3.0	4.5	3.9	19.6	11.3	21.5	27.7	20.0	12.3	11.5	12.2	13.9	12.5
4-Ethyltoluene	2.1	1.8	2.1	2.0	8.7	4.0	9.8	11.5	8.5	6.1	5.0	5.5	6.2	5.7
1,3,5-Trimethylbenzene	3.1	3.6	3.2	3.3	13.5	12.7	15.2	18.4	15.0	8.1	7.3	8.1	9.2	8.2
2-Ethyltoluene	1.9	2.7	2.0	2.2	7.6	6.9	8.6	10.4	8.4	5.5	4.5	4.9	5.3	5.0
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	9.6	7.7	9.6	9.0	31.3	26.2	32.8	43.5	33.4	31.3	19.7	20.0	26.5	24.4
Decane	20.6	12.7	20.9	18.1	80.1	60.5	87.3	98.2	81.5	37.4	41.7	41.3	47.3	41.9
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
1,4-Dichlorobenzene	0.3	0.0	0.2	0.2	0.3	0.0	0.3	0.4	0.2	1.5	0.5	0.5	0.6	0.8
iso-Butylbenzene	0.3	0.0	0.3	0.2	1.2	0.0	1.2	1.5	1.0	0.7	0.6	0.7	0.7	0.7
sec-Butylbenzene	0.5	0.0	0.5	0.3	2.2	0.0	2.4	2.9	1.9	1.1	1.1	1.2	1.3	1.2
1,2,3-Trimethylbenzene	3.4	3.2	3.4	3.3	10.4	9.5	11.9	13.6	11.4	10.8	6.2	6.7	7.2	7.7
p-Cymene	1.1	0.0	1.1	0.7	3.1	0.0	3.6	6.1	3.2	2.6	1.6	1.8	2.4	2.1
1,2-Dichlorobenzene	0.1	0.0	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.1
Indane	0.7	0.0	0.7	0.5	2.1	0.0	2.4	2.9	1.9	2.6	1.4	1.6	1.7	1.8
1,3-Diethylbenzene	0.6	0.0	0.6	0.4	1.5	0.0	1.8	1.8	1.3	2.1	1.0	1.1	1.2	1.4
1,4-Diethylbenzene	3.6	0.0	3.6	2.4	8.7	0.0	9.9	7.6	6.6	0.0	5.5	6.0	0.0	2.9
n-Butylbenzene	1.0	0.0	1.0	0.7	2.6	0.0	2.9	2.7	2.0	3.1	1.6	1.7	1.7	2.0
1,2-Diethylbenzene	0.2	0.0	0.2	0.1	0.6	0.0	0.6	0.8	0.5	0.8	0.3	0.4	0.4	0.5
Undecane	24.3	16.2	24.9	21.8	61.6	44.0	55.3	54.6	53.9	57.5	32.2	28.8	27.5	36.5
Naphthalene	5.3	0.0	6.0	3.8	12.0	0.0	7.3	0.0	4.8	8.4	5.9	5.9	0.0	5.1
Dodecane	28.4	15.5	30.1	24.7	49.9	34.1	38.8	23.2	36.5	54.1	34.0	24.2	14.7	31.7
Hexylbenzene	1.3	0.0	1.2	0.9	4.3	0.0	0.0	0.0	1.1	0.0	1.7	2.0	0.0	0.9

NOBE 93 Table 2.8

Burn 2 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the CCG 203, CCG 204, CCG 212

Sample I.D.	Downwind Station CCG 206 500-600 m from fire							CCG 203 75 m from fire		CCG 204 75 m from fire		CCG 212 400 m from fire					
	Pre-ignition 2			Burn 2				Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2			Burn 2		
Internal sample reference	REAC 215	REAC72	AVE	REAC219	REAC 200	REAC 200	AVE	REAC162	ESD-3	REAC 184	ESD-13	REAC193	REAC193	AVE	REAC194	REAC194	AVE
Sample size (mL)	488	504		504	488	488		490	520	488	490	495	502		502	495	
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	72	44	58	521	340	336	399	3343	746	87	18	245	174	210	64	93	79
Propene	3.4	5.6	4.5	6.9	6.0	5.8	6.2	45.0	7.0	4.9	0.4	129.5	71.0	100.3	24.0	49.7	36.8
Propane	0.0	0.0	0.0	1.9	1.3	0.0	1.1	8.5	0.0	1.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0
Freon22 (Chlorodifluoromethane)	0.0	0.0	0.0	0.6	0.3	0.3	0.4	0.2	0.4	0.4	0.0	3.2	1.9	2.5	0.7	1.2	0.9
Propyne	0.0	0.0	0.0	0.3	0.2	0.0	0.2	3.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	2.5	1.1	1.8	2.0	1.3	1.2	1.5	1.0	0.7	1.4	0.9	2.2	2.1	2.1	1.7	1.7	1.7
Isobutane (2-Methylpropane)	0.7	0.7	0.7	5.6	5.6	5.4	5.5	59.5	15.8	1.9	0.9	1.2	0.7	1.0	0.3	0.4	0.3
Freon114 (1,2-Dichlorotetrafluroeth	1.9	1.3	1.6	0.9	0.6	0.7	0.7	0.4	0.7	0.9	0.5	2.0	0.8	1.4	0.6	0.6	0.6
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	8.7	6.0	7.4	8.3	5.9	5.9	6.7	37.7	14.5	6.9	0.5	18.3	18.4	18.4	7.2	6.9	7.0
1,3-Butadiene	0.0	0.0	0.0	1.3	1.2	1.2	1.2	12.9	4.7	0.6	0.0	2.3	1.4	1.9	0.4	0.7	0.6
Butane	1.2	1.4	1.3	11.5	11.7	11.6	11.6	118.6	30.6	3.1	0.9	2.0	1.4	1.7	0.6	0.8	0.7
t-2-Butene	0.7	0.4	0.6	1.3	1.6	1.6	1.5	12.2	4.0	0.8	0.0	1.3	1.1	1.2	0.5	0.6	0.5
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	0.0	0.3	0.2	1.2	1.1	1.1	1.2	13.0	3.6	0.6	0.0	1.1	1.1	1.1	0.6	0.6	0.6
Chloroethane	1.3	0.0	0.6	1.3	0.5	0.4	0.8	0.0	0.0	0.9	0.0	2.3	2.4	2.3	1.4	1.4	1.4
2-Methylbutane	1.8	1.9	1.9	30.7	33.6	33.4	32.6	366.0	90.2	3.5	1.2	2.3	1.7	2.0	0.6	0.7	0.6
Freon11 (Trichlorofluoromethane)	5.4		5.4		2.6	2.6	2.6	4.5	2.1	8.6	2.4	2.2	2.0	2.1	1.9	2.0	1.9
1-Pentene	1.0	1.2	1.1	1.1	1.3	1.2	1.2	9.5	2.4	1.4	0.0	4.5	4.4	4.5	1.2	1.2	1.2
Pentane	1.1	1.2	1.2	16.5	17.4	17.7	17.2	170.6	40.2	1.8	0.6	1.8	1.2	1.5	0.5	0.5	0.5
Isoprene (2-Methyl-1,3-Butadiene)	0.0	0.0	0.0	0.7	0.7	0.7	0.7	7.8	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.0	0.4	0.2	2.1	2.1	2.2	2.1	19.5	4.7	0.4	0.0	0.9	0.4	0.7	0.1	0.0	0.0
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.0	0.0	0.0	1.1	1.2	1.2	1.2	17.7	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Freon113 (1,1,2-Trichlorotrifluoroet	11.1	5.6	8.4	5.7	3.9	4.5	4.7	2.3	4.1	4.4	2.8	12.2	9.8	11.0	3.5	4.4	4.0
2,2-Dimethylbutane	0.0	0.0	0.0	3.0	3.2	3.2	3.2	41.3	9.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentene		0.0	0.0	0.0			0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.7	0.0	0.3	0.0	0.3	0.0	0.1	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.0	0.0	0.0	2.2	2.5	2.6	2.4	29.5	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-Dimethylbutane	0.0	0.2	0.1	3.5	3.9	3.9	3.8	48.9	10.2	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.3	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	9.0	0.7	4.8	22.1	22.7	23.6	22.8	168.6	45.3	7.5	0.4	7.1	5.7	6.4	1.6	2.0	1.8
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.7	0.7	0.7	0.7	7.7	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	0.4	1.0	0.7	10.7	10.9	10.6	10.7	114.7	27.7	0.8	0.3	0.8	2.2	1.5	0.1	0.0	0.0
1-Hexene/2-Methyl-1-Pentene	0.9	1.0	1.0	1.2	1.3	1.3	1.2	11.9	2.6	1.0	0.0	3.6	4.0	3.8	1.3	1.2	1.2
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	2.5	1.4	2.0	10.8	12.9	12.0	11.9	109.7	31.5	2.5	0.7	3.6	2.6	3.1	0.5	0.8	0.6
Chloroform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Hexene	0.0	0.0	0.0	0.8	0.9	0.9	0.9	9.1	2.0	0.0	0.0	0.0	0.3	0.2	0.0	0.0	0.0
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.7	0.7	0.7	0.7	8.8	1.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Hexene	0.0	0.0	0.0	0.7	0.7	0.7	0.7	6.4	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.9	1.0	1.0	0.9	11.8	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.8 cont.

Burn 2 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the CCG 203, CCG 204, CCG 212

Sample I.D.	Downwind Station CCG 206 500-600 m from fire							CCG 203 75 m from fire		CCG 204 75 m from fire		CCG 212 400 m from fire					
	Pre-ignition 2			Burn 2				Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2			Burn 2		
Internal sample reference / Sample size (mL)	REAC 215 488	REAC72 504	AVE	REAC219 504	REAC 200 488	REAC 200 488	AVE	REAC182 490	ESD-3 520	REAC 184 488	ESD-13 490	REAC193 495	REAC193 502	AVE	REAC194 502	REAC194 495	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	72	44	58	521	340	336	399	3343	746	87	18	245	174	210	64	93	79
2,2-Dimethylpentane	0.0	0.0	0.0	0.5	0.5	0.6	0.5	6.5	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclopentane	0.5	0.4	0.5	6.7	7.9	7.8	7.5	81.6	17.6	0.7	0.2	0.7	0.5	0.6	0.0	0.0	0.0
2,4-Dimethylpentane	0.0	0.0	0.0	1.5	1.7	1.6	1.6	22.1	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,1-Trichloroethane	0.7	0.7	0.7	0.7	0.8	0.8	0.8	0.9	0.9	0.7	0.7	1.1	1.0	1.0	0.7	0.8	0.8
2,2,3-Trimethylbutane	0.4	0.0	0.2	0.4	0.4	0.3	0.4	1.7	0.4	0.3	0.0	2.2	1.8	2.0	0.4	0.4	0.4
1-Methylcyclopentene		0.0	0.0	178.3			178.3	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	0.8	0.7	0.8	7.1	8.8	8.9	8.3	101.3	22.4	1.6	0.3	1.0	0.8	0.9	0.3	0.4	0.3
Carbontetrachloride	0.7	0.7	0.7	0.7	0.6	0.6	0.6	0.7	0.7	0.6	0.7	0.8	0.7	0.7	0.7	0.8	0.8
Cyclohexane	0.0	0.3	0.1	3.0	3.5	3.4	3.3	36.8	7.9	0.5	0.0	1.1	1.0	1.1	0.0	0.3	0.2
2-Methylhexane	0.0	0.0	0.0	2.8	7.4	7.5	5.9	39.8	6.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-Dimethylpentane	0.0	0.0	0.0	2.4	2.6	2.7	2.6	34.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclohexene		0.0	0.0	0.0			0.0	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	0.0	0.9	0.4	5.8	6.3	6.4	6.1	72.3	13.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.9	0.0	0.4	0.0	3.3	3.1	2.1	0.0	0.0	1.0	0.0	3.1	4.6	3.9	1.5	0.0	0.7
2,2,4-Trimethylpentane	0.5	0.3	0.4	1.9	1.7	1.7	1.8	28.9	7.1	0.4	0.1	1.2	0.9	1.1	0.4	0.5	0.4
t-3-Heptene	0.2	0.0	0.1	0.3	0.5	0.5	0.4	1.1	0.3	0.7	0.0	2.5	0.8	1.6	0.2	0.6	0.4
Heptane	0.8	0.7	0.7	5.7	6.0	6.0	5.9	56.4	12.0	0.7	0.1	0.6	1.0	0.8	0.1	0.4	0.3
t-2-Heptene	0.0	0.0	0.0	0.5	0.8	0.9	0.7	4.2	0.8	1.5	0.0	5.0	3.7	4.4	0.9	1.1	1.0
c-2-Heptene	0.0	0.0	0.0	0.4	0.7	0.7	0.6	5.2	0.9	1.0	0.0	2.6	6.3	4.4	1.8	0.8	1.3
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.2	0.2	0.2	0.2	2.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	0.0	0.0	0.0	3.3	3.6	3.6	3.5	34.2	6.1	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,5-Dimethylhexane	0.0	0.0	0.0	0.7	0.8	0.8	0.8	11.0	2.3	0.0	0.0	1.1	0.0	0.6	0.0	0.0	0.0
2,4-Dimethylhexane	0.0	0.0	0.0	0.9	1.0	1.0	1.0	13.6	2.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.6	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.0	0.0	0.0	0.7	0.7	0.7	0.7	15.0	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Toluene	1.8	1.7	1.7	21.9	26.6	26.6	25.0	298.8	67.8	2.9	0.8	3.1	2.3	2.7	0.5	0.7	0.6
2-Methylheptane	0.0	0.0	0.0	2.4	2.6	2.7	2.6	28.0	6.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-Methylheptane	0.0	0.0	0.0	0.0	1.2	1.1	0.8	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Methylcyclohexene		0.0	0.0	39.4			39.4	0.0	0.0		0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.0	0.0	0.0	3.4	3.8	3.8	3.7	42.9	8.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.6	0.6	0.6	0.6	5.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.3	0.3	0.3	0.3	3.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.0	0.0	0.0	0.2	0.2	0.2	0.2	4.9	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Octene	1.0	0.6	0.8	0.3	0.5	0.5	0.4	0.0	0.0	0.7	0.0	1.7	4.5	3.1	2.3	0.7	1.5
Octane	0.4	0.4	0.4	2.4	2.4	2.5	2.4	21.7	4.4	0.4	0.1	0.6	0.5	0.6	0.2	0.2	0.2
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.4	0.4	0.4	0.4	4.1	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.8 cont

Burn 2 VOC Analysis of Sea Level Air Samples

SUMMA Canisters at Downwind Station and Onboard the CCG 203, CCG 204, CCG 212

Sample I.D.	Downwind Station CCG 206 500-600 m from fire							CCG 203 75 m from fire		CCG 204 75 m from fire		CCG 212 400 m from fire					
	Pre-ignition 2			Burn 2				Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2			Burn 2		
Internal sample reference / Sample size (mL)	REAC 215 488	REAC72 504	AVE	REAC219 504	REAC 200 488	REAC 200 488	AVE	REAC182 490	ESD-3 520	REAC 184 488	ESD-13 490	REAC193 495	REAC193 502	AVE	REAC194 502	REAC194 495	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	72	44	58	521	340	336	399	3343	746	87	18	246	174	210	64	93	79
c-2-Octene	0.0	0.0	0.0	0.2	0.0	0.0	0.1	3.2	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.4	0.4	0.4	6.0	7.1	7.2	6.7	77.8	17.2	0.6	0.2	0.6	0.5	0.6	0.1	0.2	0.1
m/p-Xylene	1.4	1.4	1.4	18.5	22.0	22.0	20.8	239.7	53.4	1.9	0.5	2.2	1.8	2.0	0.3	0.6	0.5
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	1.5	1.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	0.0	0.0	0.0	0.3	0.3	0.3	0.3	4.7	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.5	0.5	0.5	6.5	8.2	8.3	7.6	80.4	18.2	0.6	0.2	0.7	0.6	0.7	0.1	0.2	0.2
1-Nonene	0.0	0.0	0.0	0.0	0.4	0.3	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	0.5	0.2	0.4	1.8	1.5	1.5	1.6	10.9	1.9	0.4	0.0	0.8	0.6	0.7	0.2	0.3	0.3
iso-Propylbenzene	0.0	0.0	0.0	0.4	0.5	0.6	0.5	5.4	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.2	0.2	0.1	2.2	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Propylbenzene	0.3	0.0	0.2	1.8	1.9	1.9	1.8	20.7	4.4	0.2	0.0	0.5	0.4	0.4	0.3	0.3	0.3
3-Ethyltoluene	0.4	0.2	0.3	5.2	5.7	5.8	5.6	67.4	14.5	0.4	0.1	0.5	0.3	0.4	0.1	0.1	0.1
4-Ethyltoluene	0.2	0.1	0.2	2.4	2.8	2.8	2.7	33.8	6.7	0.2	0.0	0.1	0.2	0.2	0.1	0.1	0.1
1,3,5-Trimethylbenzene	0.3	0.2	0.2	2.7	3.0	2.9	2.8	35.3	6.9	0.3	0.1	0.4	0.3	0.3	0.1	0.1	0.1
2-Ethyltoluene	0.2	0.1	0.2	1.8	2.0	2.0	2.0	24.5	5.1	0.2	0.1	0.2	0.2	0.2	0.0	0.1	0.1
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.9	0.5	0.7	8.3	9.5	9.6	9.1	105.0	21.9	0.7	0.2	4.0	0.7	2.3	3.1	4.5	3.8
Decane	0.6	0.2	0.4	1.3	1.1	1.1	1.2	8.3	1.2	0.3	0.0	0.9	0.6	0.7	0.2	0.4	0.3
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.0	0.1	0.2	0.1	0.1	1.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.1	0.1	0.2	0.1	1.7	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-Trimethylbenzene	0.3	0.2	0.2	1.8	1.9	1.9	1.8	23.1	4.6	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
p-Cymene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.0	0.0	0.0	0.8	0.9	0.9	0.9	12.5	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.0	0.4	0.4	0.4	0.4	6.8	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Diethylbenzene	0.0	0.0	0.0	0.0	2.3	2.3	1.5	33.8	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Butylbenzene	0.0	0.0	0.0	0.4	0.4	0.4	0.4	5.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.1	0.1	0.1	0.1	1.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Undecane	0.7	0.0	0.4	1.3	1.0	1.0	1.1	12.0	1.3	0.5	0.0	0.9	0.6	0.8	0.3	0.4	0.3
Naphthalene	1.0	0.0	0.5	1.8	1.5	1.5	1.6	34.7	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1
Dodecane	0.9	0.3	0.6	1.5	1.1	1.0	1.2	13.2	2.0	1.0	0.1	0.4	0.3	0.4	0.3	0.4	0.3
Hexylbenzene	0.0	0.0	0.0	0.8	2.3	0.0	1.0	1.5	0.8	8.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Shaded areas = SUMMAs with final pressure lower than 38.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.9

Burn 2 VOC Analysis of Sea Level and Airborne Air Samples

SUMMA Canisters Onboard the CCG 214, Ann Harvey, Sir Wilfred Grenfell, Casaco, and Remote Control Helicopters

Sample I.D.	CCG 214 400 m from fire		Ann Harvey 100 m from fire		Sir Wilfred Grenfell 200 m from fire				Casaco 350 m from fire						Remote Control Helicopter Team 1	Remote Control Helicopter Team 2 18 m high
	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2			Pre-ignition 2			Burn 2			Burn 2 Front plume	Burn 2 under plume
Internal sample reference	REAC190	REAC189	REAC66	ESD-1	REAC191	REAC192		AVE	REAC144	REAC168	AVE	REAC213	REAC165	AVE	T1B2R1	T2B1R1
Sample size (mL)	511	495	495	504	502	502	502		502	507		502	507		246	246
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	**1402**	**1188**	**74**	**23**	**206**	**72**	**71**	**72**	**92**	**159**	**125**	**65**	**55**	**60**	**43**	**881**
Propene	25.7	6.1	0.0	0.0	68.8	16.4	11.8	14.1	1.8	10.7	6.3	4.5	3.6	4.1	20.4	54.0
Propane	55.2	9.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.1
Freon22 (Chlorodifluoromethane)	0.9	0.0	2.2	0.7	2.0	0.6	1.2	0.9	0.9	1.7	1.3	0.6	1.2	0.9	0.3	0.5
Propyne	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	3.6	1.3	0.9	0.9	3.4	1.4	1.3	1.3	1.5	4.9	3.2	1.6	1.2	1.4	0.6	0.6
Isobutane (2-Methylpropane)	46.9	27.6	1.5	1.0	0.6	0.4	0.2	0.3	1.8	0.9	1.4	0.3	0.0	0.2	0.5	0.6
Freon114 (1,2-Dichlorotetrafluroeth	1.7	0.4	1.9	0.7	2.1	1.3	0.7	1.0	1.3	2.1	1.7	0.7	0.7	0.7	0.3	0.4
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	25.1	11.2	4.8	0.8	18.4	8.2	8.7	8.4	5.0	16.1	10.5	6.3	7.3	6.8	1.1	3.2
1,3-Butadiene	2.4	2.1	0.0	0.0	1.7	0.4	0.5	0.4	0.0	0.9	0.5	0.4	0.0	0.2	0.2	0.1
Butane	152.3	85.5	2.6	0.5	1.3	0.4	0.4	0.4	4.0	1.9	2.9	0.6	0.8	0.7	1.2	1.1
t-2-Butene	1.4	2.0	0.5	0.0	0.8	0.4	0.3	0.4	0.8	1.1	1.0	0.4	0.4	0.4	0.0	0.1
2,2-Dimethylpropane	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	1.5	2.5	0.0	0.0	1.1	0.5	0.5	0.5	0.7	1.5	1.1	0.4	0.5	0.5	0.2	0.3
Chloroethane	3.3	0.8	0.0	0.0	2.7	0.9	0.9	0.9	0.0	2.2	1.1	1.0	1.4	1.2	0.2	0.8
2-Methylbutane	160.7	126.1	7.2	0.7	0.5	0.3	0.2	0.3	4.2	1.1	2.7	0.4	0.4	0.4	1.4	1.7
Freon11 (Trichlorofluoromethane)	3.4	1.9		3.0	2.0	1.9	1.9	1.9							1.1	6.3
1-Pentene	3.5	2.2	0.6	0.1	4.3	2.1	2.2	2.1	1.2	4.4	2.8	2.4	1.4	1.9	0.1	0.4
Pentane	168.0	97.4	3.3	0.5	0.7	0.3	0.4	0.4	3.4	1.1	2.2	0.4	0.5	0.5	1.0	1.2
Isoprene (2-Methyl-1,3-Butadiene)	1.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.4	1.5	0.0	0.0	0.0	0.1	0.0	0.1	0.7	0.0	0.3	0.1	0.1	0.1	0.1	0.2
1,1-Dichloroethene	0.0	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.6	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.3	0.0	0.0	0.0	0.1	0.2
Freon113 (1,1,2-Trichlorotrifluoroet	14.5	1.3	9.3	4.4	11.3	8.8	4.0	6.4	6.6	11.2	8.9	3.7	3.6	3.7	2.1	2.8
2,2-Dimethylbutane	3.2	4.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	17.3	10.1	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.1	0.2
2,3-Dimethylbutane	10.3	8.9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	0.0	0.1	0.3
t-4-Methyl-2-Pentene	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	122.7	62.2	1.0	0.3	2.7	2.4	2.8	2.6	1.3	30.2	15.7	12.3	1.1	6.7	0.5	2.5
c-4-Methyl-2-Pentene	0.0	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	51.5	35.4	1.2	0.6	0.0	0.0	0.0	0.0	1.4	0.0	0.7	0.0	0.0	0.0	0.1	39.4
1-Hexene/2-Methyl-1-Pentene	3.5	2.1	0.0	0.0	4.1	2.1	2.2	2.1	1.4	3.2	2.3	1.9	1.4	1.7	0.2	0.6
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	107.6	70.7	5.8	1.6	1.1	0.6	0.5	0.6	18.7	2.4	10.6	1.2	1.0	1.1	2.8	602.0
Chloroform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Hexene	0.3	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
t-3-Methyl-2-Pentene	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
c-2-Hexene	0.3	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
c-3-Methyl-2-Pentene	0.2	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.0	0.0	0.0	0.0	0.1

NOBE 93 Table 2.9 cont.

Burn 2 VOC Analysis of Sea Level and Airborne Air Samples

SUMMA Canisters Onboard the CCG 214, Ann Harvey, Sir Wilfred Grenfell, Casaco, and Remote Control Helicopters

Sample I.D.	CCG 214 400 m from fire		Ann Harvey 100 m from fire		Sir Wilfred Grenfell 200 m from fire				Casaco 350 m from fire						Remote Control Helicopter Team 1	Remote Control Helicopter Team 2 18 m high
	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2			Pre-ignition 2			Burn 2			Burn 2 Front plume	Burn 2 under plume
Internal sample reference	REAC190	REAC189	REAC66	ESD-1	REAC191	REAC192		AVE	REAC144	REAC168	AVE	REAC213	REAC165	AVE	T1B2R1	T2B1R1
Sample size (mL)	511	495	495	504	502	502	502		502	507		502	507		246	246
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	1402	1188	74	23	206	72	71	72	92	159	125	65	55	60	43	881
2,2-Dimethylpentane	2.0	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
Methylcyclopentane	61.3	44.8	1.2	0.4	0.0	0.0	0.0	0.0	0.9	0.4	0.7	0.2	0.2	0.2	0.6	98.0
2,4-Dimethylpentane	4.4	4.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
1,1,1-Trichloroethane	1.0	0.6	4.0	1.0	1.5	0.9	0.9	0.9	1.2	1.3	1.3	1.0	0.9	1.0	0.4	1.0
2,2,3-Trimethylbutane	1.5	0.8	0.0	0.0	0.7	0.7	0.7	0.7	0.0	0.9	0.4	0.7	0.4	0.5	0.1	0.0
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	2.5	10.7	0.9	0.3	0.6	0.2	0.2	0.2	1.6	0.8	1.2	0.3	0.4	0.3	0.3	1.6
Carbontetrachloride	0.8	0.5	0.7	0.7	0.7	0.7	0.7	0.7	0.5	0.8	0.6	0.7	0.8	0.7	0.4	0.2
Cyclohexane	39.5	32.0	0.8	0.3	0.0	0.0	0.0	0.0	0.8	0.9	0.8	0.3	0.4	0.4	0.2	0.8
2-Methylhexane	11.3	11.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
2,3-Dimethylpentane	6.7	8.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.4
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	20.5	24.8	1.3	0.0	0.0	0.0	0.0	0.0	1.1	1.4	1.3	0.0	0.0	0.0	0.2	0.9
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	0.0	0.0	6.3	2.4	2.8	2.6	1.4	3.5	2.4	2.8	0.0	1.4	0.0	0.0
2,2,4-Trimethylpentane	0.0	3.0	0.3	0.1	0.9	0.4	0.5	0.5	0.4	1.1	0.7	0.0	0.5	0.3	0.1	0.0
t-3-Heptene	0.7	0.2	0.0	0.0	0.5	0.3	0.2	0.3	0.0	0.9	0.5	0.2	0.2	0.2	0.0	0.1
Heptane	47.1	50.4	1.1	0.3	0.4	0.4	0.4	0.4	1.0	1.5	1.2	0.8	0.7	0.8	0.3	1.2
t-2-Heptene	2.9	0.7	0.0	0.0	2.9	1.5	1.2	1.4	0.0	3.8	1.9	0.7	0.9	0.8	0.1	0.3
c-2-Heptene	4.6	1.8	0.0	0.0	7.1	3.1	2.8	2.9	0.0	6.8	3.4	1.1	1.5	1.3	0.0	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	61.1	68.1	0.6	0.0	0.0	0.0	0.0	0.0	0.9	1.1	1.0	0.6	0.7	0.6	0.2	0.5
2,5-Dimethylhexane	2.1	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.1
2,4-Dimethylhexane	2.3	3.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0
2,3,4-Trimethylpentane	0.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
Toluene	6.5	38.1	3.9	0.6	1.1	0.4	0.4	0.4	5.2	2.3	3.7	0.7	1.2	1.0	0.8	18.3
2-Methylheptane	10.4	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.4	0.4	0.5	0.2	0.3	0.1	0.5
4-Methylheptane	2.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	6.9	16.3	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.2	0.1	0.2	0.1	0.1	0.8
c-1,3-Dimethylcyclohexane	7.4	12.9	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.1	0.2	0.3	0.2	0.1	0.2
t-1,4-Dimethylcyclohexane	3.9	6.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,5-Trimethylhexane	0.1	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1-Octene	4.3	0.0	0.0	0.0	13.2	4.0	5.8	4.9	1.1	5.7	3.4	4.4	2.6	3.5	0.0	0.3
Octane	14.8	29.6	0.6	0.2	0.4	0.2	0.2	0.2	0.7	0.9	0.8	0.4	0.5	0.5	0.1	0.7
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
c-1,4/t-1,3-Dimethylcyclohexane	1.7	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1

NOBE 93 Table 2.9 cont.

Burn 2 VOC Analysis of Sea Level and Airborne Air Samples

SUMMA Canisters Onboard the CCG 214, Ann Harvey, Sir Wilfred Grenfell, Casaco, and Remote Control Helicopters

Sample I.D.	CCG 214 400 m from fire		Ann Harvey 100 m from fire		Sir Wilfred Grenfell 200 m from fire				Casaco 350 m from fire						Remote Control Helicopter Team 1	Remote Control Helicopter Team 2 18 m high
	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2	Pre-ignition 2	Burn 2			Pre-ignition 2			Burn 2			Burn 2 Front plume	Burn 2 under plume
Internal sample reference	REAC190	REAC189	REAC66	ESD-1	REAC191	REAC192		AVE	REAC144	REAC168	AVE	REAC213	REAC165	AVE	T1B2R1	T2B1R1
Sample size (mL)	511	495	495	504	502	502	502		502	507		502	507		246	246
Compound	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³	μg/m³
TOTAL VOC	1402	1188	74	23	206	72	71	72	92	159	125	65	55	60	43	881
c-2-Octene	2.1	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	1.6	11.8	0.7	0.3	0.4	0.1	0.1	0.1	1.0	0.5	0.8	0.2	0.3	0.2	0.2	2.7
m/p-Xylene	5.3	38.6	1.9	0.8	1.3	0.4	0.3	0.3	2.9	1.7	2.3	0.7	0.9	0.8	0.7	8.7
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.1	2.5	0.0	0.0	0.0	0.0	0.0
Styrene	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.2	0.0	0.0	0.0	0.0	0.4
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	1.7	13.2	0.8	0.3	0.4	0.1	0.1	0.1	0.9	0.6	0.8	0.3	0.3	0.3	0.2	2.8
1-Nonene	0.0	0.0	0.0	0.0	25.2	5.3	11.3	8.3	0.0	0.0	0.0	3.8	3.7	3.8	0.0	0.0
Nonane	6.8	23.8	0.6	0.2	0.5	0.2	0.2	0.2	1.2	1.4	1.3	0.7	0.8	0.7	0.1	0.9
iso-Propylbenzene	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.2	0.1	0.1	0.1	0.0	0.2
3,6-Dimethyloctane	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
n-Propylbenzene	1.1	3.9	0.2	0.1	0.6	0.2	0.2	0.2	0.4	0.6	0.5	0.4	0.4	0.4	0.1	0.8
3-Ethyltoluene	1.6	11.8	0.4	0.2	0.2	0.1	0.1	0.1	0.6	0.8	0.7	0.3	0.4	0.3	0.1	1.9
4-Ethyltoluene	0.7	5.8	0.3	0.1	0.1	0.1	0.1	0.1	0.3	0.4	0.4	0.1	0.2	0.2	0.1	0.9
1,3,5-Trimethylbenzene	1.1	6.7	0.3	0.1	0.2	0.1	0.1	0.1	0.4	0.5	0.4	0.2	0.3	0.2	0.1	1.2
2-Ethyltoluene	0.7	4.5	0.3	0.2	0.1	0.1	0.1	0.1	0.3	0.4	0.3	0.1	0.2	0.2	0.1	0.7
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	17.2	20.1	1.0	0.4	8.4	0.3	0.3	0.3	1.8	2.0	1.9	1.0	1.0	1.0	0.3	3.6
Decane	5.0	16.1	0.6	0.2	0.8	0.2	0.2	0.2	1.7	1.7	1.7	0.7	0.8	0.8	0.1	1.7
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	0.9	0.2	0.4	0.3	0.0	0.6
iso-Butylbenzene	0.0	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
sec-Butylbenzene	0.2	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
1,2,3-Trimethylbenzene	1.1	5.2	0.3	0.2	0.0	0.0	0.0	0.0	0.5	0.6	0.5	0.2	0.4	0.3	0.1	1.0
p-Cymene	0.6	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.3	0.3	0.7
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.3	1.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3
1,3-Diethylbenzene	0.3	1.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1,4-Diethylbenzene	1.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.7	0.3	0.0	0.4	0.2	0.0	0.5
n-Butylbenzene	0.4	1.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2
1,2-Diethylbenzene	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Undecane	8.7	14.7	0.4	0.0	0.9	0.3	0.2	0.2	1.5	2.9	2.2	0.6	1.2	0.9	0.2	1.3
Naphthalene	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	1.2	0.0	0.9	0.5	0.0	0.0
Dodecane	11.1	12.1	0.4	0.4	0.7	0.4	0.2	0.3	1.0	2.8	1.9	0.5	1.1	0.8	0.4	0.4
Hexylbenzene	10.1	3.1	6.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	0.6	0.0	0.0

Shaded areas = SUMMAs with final pressure lower than 38.9 kPa; air sample too small for reliable data

NOBE 93 Table 2.10

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

	Pre-ignition 2	Burn 2										
Sample I.D.	no ship exhaust	3.2 km downwind 305 m altitude					14.5 km downwind			24 km downwind 61 m altitude		
Internal sample reference	14:00 pm EPS223	14:13 pm EPS226	14:24 pm EPS220			14:32 pm AB-02	14:58 pm EPS100			15:18 pm EPS24		
Sample size (mL)	498	489	545	495	AVE	489	497	492	AVE	497	495	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	22	64	220	158	189	56	48	38	43	28	31	30
Propene	0.0	0.3	28.6	3.5	16.1	0.5	18.3	6.5	12.4	8.8	10.1	9.5
Propane	0.0	0.1	0.0	1.4	0.7	0.2	0.3	0.1	0.2	0.0	0.0	0.0
Freon22 (Chlorodifluoromethane)	0.8	1.0	1.5	1.3	1.4	0.0	0.8	0.6	0.7	0.4	0.6	0.5
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	1.0	0.9	0.9	0.7	0.8	1.0	0.4	0.2	0.3	0.9	0.3	0.6
Isobutane (2-Methylpropane)	0.0	0.3	3.4	3.3	3.4	0.5	0.3	0.2	0.2	0.0	0.0	0.0
Freon114 (1,2-Dichlorotetrafluroethane)	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	0.4	1.0	1.1	1.1	1.1	0.5	0.7	0.7	0.7	0.7	0.5	0.6
1,3-Butadiene	0.0	0.2	0.4	0.4	0.4	0.2	0.0	0.1	0.0	0.0	0.0	0.0
Butane	0.2	1.7	14.2	13.0	13.6	1.8	0.8	0.9	0.9	0.2	0.2	0.2
t-2-Butene	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylpropane	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylbutane	0.3	3.2	21.3	16.2	18.7	2.7	1.1	1.3	1.2	0.3	0.3	0.3
Freon11 (Trichlorofluoromethane)	2.0	2.1	2.3	2.0	2.1	2.0	1.8	2.0	1.9	2.0	1.9	1.9
1-Pentene	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Pentane	0.1	2.2	22.3	16.2	19.2	2.3	0.9	1.1	1.0	0.0	0.0	0.0
Isoprene (2-Methyl-1,3-Butadiene)	0.0	0.1	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Freon113 (1,1,2-Trichlorotrifluoroethan	1.5	1.4	1.5	1.2	1.4	1.3	1.5	1.4	1.4	1.5	1.6	1.6
2,2-Dimethylbutane	0.0	0.0	0.4	0.3	0.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.0	0.3	2.4	1.7	2.0	0.3	0.1	0.1	0.1	0.0	0.0	0.0
2,3-Dimethylbutane	0.1	0.7	2.1	1.5	1.8	0.5	0.2	0.2	0.2	0.1	0.1	0.1
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	0.1	1.9	10.0	9.0	9.5	1.6	0.6	0.6	0.6	0.1	0.1	0.1
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	0.0	1.3	7.2	5.2	6.2	1.1	0.4	0.5	0.4	0.0	0.0	0.0
1-Hexene/2-Methyl-1-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	0.1	2.9	15.3	11.1	13.2	2.2	0.9	0.8	0.8	0.2	0.2	0.2
Chloroform	0.1	0.2	0.2	0.1	0.2	0.1	0.0	0.1	0.1	0.0	0.1	0.1
t-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.10 cont.

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

	Pre-ignition 2	Burn 2										
Sample I.D.	no ship exhaust	3.2 km downwind 305 m altitude					14.5 km downwind			24 km downwind 61 m altitude		
Internal sample reference	14:00 pm EPS223	14:13 pm EPS226	14:24 pm EPS220			14:32 pm AB-02	14:58 pm EPS100			15:18 pm EPS24		
Sample size (mL)	498	489	545	495	AVE	489	497	492	AVE	497	495	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	22	64	**220**	**158**	189	56	48	**38**	**43**	**28**	**31**	30
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylpentane	0.0	0.1	0.3	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclopentane	0.0	1.9	9.2	6.6	7.9	1.4	0.4	0.5	0.4	0.0	0.0	0.0
2,4-Dimethylpentane	0.1	0.7	1.4	1.0	1.2	0.5	0.2	0.2	0.2	0.1	0.1	0.1
1,1,1-Trichloroethane	0.7	0.9	0.8	0.7	0.8	0.8	0.7	0.8	0.7	0.7	0.7	0.7
2,2,3-Trimethylbutane	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	0.1	1.4	2.7	2.0	2.4	3.2	0.5	0.5	0.5	0.1	0.1	0.1
Carbontetrachloride	0.8	0.8	0.9	0.7	0.8	0.8	0.7	0.8	0.8	0.8	0.8	0.8
Cyclohexane	0.2	1.4	5.8	4.1	4.9	1.0	0.3	0.3	0.3	0.0	0.0	0.0
2-Methylhexane	0.0	0.4	1.6	1.2	1.4	0.3	0.1	0.1	0.1	0.0	0.0	0.0
2,3-Dimethylpentane	0.1	0.7	1.4	1.1	1.2	0.4	0.2	0.2	0.2	0.1	0.1	0.1
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	0.0	0.9	3.1	2.5	2.8	0.6	0.2	0.2	0.2	0.0	0.0	0.0
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2,4-Trimethylpentane	1.4	8.5	9.9	7.6	8.7	5.3	2.7	2.8	2.8	2.0	1.9	2.0
t-3-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Heptane	0.0	2.1	6.8	5.3	6.1	1.4	0.4	0.4	0.4	0.0	0.0	0.0
t-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	0.0	3.3	9.8	7.2	8.5	2.2	0.6	0.6	0.6	0.0	0.0	0.0
2,5-Dimethylhexane	0.2	1.2	1.4	1.1	1.2	0.7	0.4	0.4	0.4	0.3	0.3	0.3
2,4-Dimethylhexane	0.3	1.5	2.0	1.5	1.8	1.0	0.5	0.6	0.6	0.4	0.4	0.4
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	0.6	3.0	3.2	2.5	2.9	1.7	1.1	1.1	1.1	0.8	0.8	0.8
Toluene	1.6	5.0	5.7	4.4	5.0	3.1	2.3	2.4	2.4	1.6	2.0	1.8
2-Methylheptane	0.0	0.5	1.3	1.0	1.2	0.3	0.1	0.1	0.1	0.0	0.0	0.0
4-Methylheptane	0.0	0.2	0.4	0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.0	0.4	1.0	0.8	0.9	0.3	0.1	0.1	0.1	0.0	0.0	0.0
c-1,3-Dimethylcyclohexane	0.0	0.4	1.1	0.8	1.0	0.3	0.1	0.1	0.1	0.0	0.0	0.0
t-1,4-Dimethylcyclohexane	0.0	0.2	0.6	0.5	0.6	0.1	0.0	0.0	0.0	0.0	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.10 cont.

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

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Sample size (mL)	498	489	545	495	AVE	489	497	492	AVE	497	495	AVE
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	22	64	220	158	189	56	48	38	43	28	31	30
2,2,5-Trimethylhexane	0.2	1.3	1.5	1.2	1.3	0.8	0.5	0.5	0.5	0.3	0.3	0.3
1-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Octane	0.0	0.7	1.8	1.5	1.6	0.5	0.2	0.2	0.2	0.0	0.0	0.0
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.1	0.3	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Octene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.0	0.2	0.3	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.2	0.2
m/p-Xylene	0.1	0.3	0.6	0.5	0.5	0.3	0.2	0.2	0.2	0.1	0.4	0.3
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	6.5	4.0	5.4	5.9	5.6	4.7	4.3	4.9	4.6	3.2	4.2	3.7
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.1	0.1	0.2	0.2	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1
1-Nonene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Nonane	0.0	0.0	0.5	0.5	0.5	0.3	0.1	0.1	0.1	0.0	0.0	0.0
iso-Propylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Propylbenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.3
3-Ethyltoluene	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.2	0.1
4-Ethyltoluene	0.0	0.0	0.6	0.1	0.3	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1,3,5-Trimethylbenzene	0.0	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.1	0.1
2-Ethyltoluene	0.0	0.0	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.1
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.1	0.0	0.3	0.4	0.3	0.2	0.2	0.1	0.2	0.1	0.8	0.5
Decane	0.2	0.0	0.3	0.3	0.3	0.2	0.2	0.2	0.2	0.1	0.2	0.1
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-Trimethylbenzene	0.1	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1
p-Cymene	0.2	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.1	0.0	0.0	0.0
1,2-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Diethylbenzene	0.0	0.0	0.1	0.1	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0
n-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Undecane	0.4	0.0	0.5	0.5	0.5	0.4	0.4	0.3	0.4	0.3	0.4	0.3
Naphthalene	0.0	0.0	0.4	1.2	0.8	1.2	0.3	0.0	0.1	0.2	0.0	0.1
Dodecane	0.9		0.8	1.0	0.9	1.0	0.6	0.7	0.7	0.6	0.6	0.6
Hexylbenzene	0.0	0.0	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.11

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

Post-burn 2													
Sample I.D.	9.7 km downwind			19 km downwind	Background sample				Blanks				Unused
	335 m	427 m	518 m	457 m									
		cross sections		old smoke	out of smoke								
	15:28 pm	15:32 pm	15:38 pm	16:10 pm	16:23 pm			16:34 pm					
Internal sample reference	GVRD433	EPS163	ESD-20	REAC223	EPS164	EPS164	AVE	REAC224	REAC216	REAC218	REAC111	AVE	ESD-15
Sample size (mL)	489	498	498	489	489	513		489	489	489	489		20
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	57.6	53.6	76.6	108.2	44.3	41.4	42.9	25.9	24.2	13.4	7.7	15.1	75.3
Propene	0.3	0.2	0.3	0.6	0.0	0.0	0.0	0.7	0.7	0.8	0.0	0.5	0.0
Propane	0.1	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.0
Freon22 (Chlorodifluoromethane)	0.0	0.8	0.7		10.2	9.8	10.0	1.6	0.0	0.2	0.0	0.1	4.6
Propyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chloromethane	0.8	1.0	1.0	1.1	1.0	0.9	0.9	0.7	0.4	0.2	0.1	0.2	0.6
Isobutane (2-Methylpropane)	0.7	0.7	0.8	0.3	0.2	0.2	0.2	0.0	0.2	0.1	0.1	0.1	0.0
Freon114 (1,2-Dichlorotetrafluroethane)	0.2	0.2	0.4	0.2	0.2	0.2	0.2	0.2	0.6	0.3	0.4	0.4	7.9
Vinylchloride (Chloroethene)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butene/2-Methylpropene	0.6	0.5	0.9	1.7	0.3	0.3	0.3	1.8	1.3	1.5	0.3	1.0	8.2
1,3-Butadiene	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Butane	2.6	2.9	3.7	3.1	0.8	0.7	0.8	0.4	0.1	0.2	0.2	0.2	3.8
t-2-Butene	0.0	0.0	0.1	0.3	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.1	0.0
2,2-Dimethylpropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Butyne	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Butene	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.3	0.1	0.1	0.0	0.1	0.0
Chloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0
2-Methylbutane	4.3	4.4	6.1	6.3	1.7	1.7	1.7	0.7	0.1	0.1	0.1	0.1	2.0
Freon11 (Trichlorofluoromethane)	2.3	2.2	2.6	2.8	2.2	2.2	2.2	1.9	0.2	0.0	2.3	0.8	0.0
1-Pentene	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.3	0.5	0.0	0.3	0.0
Pentane	2.5	2.9	3.4	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.1	2.5
Isoprene (2-Methyl-1,3-Butadiene)	0.2	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
Ethylbromide	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Freon113 (1,1,2-Trichlorotrifluoroethan	1.6	1.4	2.8	1.4	1.4	1.4	1.4	1.6	3.6	1.6	1.9	2.3	34.6
2,2-Dimethylbutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0
1,1-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cyclopentane	0.2	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-Dimethylbutane	0.9	0.8	1.2	2.2	0.5	0.5	0.5	0.2	0.0	0.0	0.0	0.0	0.0
t-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylpentane	1.4	1.6	2.0	1.5	0.2	0.2	0.2	0.5	0.2	0.2	0.1	0.1	0.5
c-4-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylpentane	0.9	1.0	1.3	0.5	0.2	0.2	0.2	0.0	0.3	0.0	0.0	0.1	0.0
1-Hexene/2-Methyl-1-Pentene	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1	0.2	0.4	0.0	0.2	0.0
c-1,2-Dichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Hexane	1.7	2.0	2.2	0.6	0.2	0.2	0.2	0.1	8.8	0.2	0.3	3.1	4.2
Chloroform	0.2	0.1	0.1	0.5	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.0
t-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.11 cont.

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

Post-burn 2													
Sample I.D.	9.7 km downwind 335 m	9.7 km downwind 427 m cross sections	9.7 km downwind 518 m	19 km downwind 457 m old smoke	Background sample out of smoke				Blanks				Unused
	15:28 pm	15:32 pm	15:38 pm	16:10 pm	16:23 pm	16:23 pm		16:34 pm					
Internal sample reference	GVRD433	EPS163	ESD-20	REAC223	EPS164	EPS164	AVE	REAC224	REAC216	REAC218	REAC111	AVE	ESD-15
Sample size (mL)	489	498	498	489	489	513		489	489	489	489		20
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	57.6	53.6	76.6	108.2	44.3	41.4	42.9	25.9	24.2	13.4	7.7	15.1	75.3
t-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Hexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-3-Methyl-2-Pentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylpentane	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclopentane	0.9	1.1	1.2	0.2	0.0	0.0	0.0	0.0	1.0	0.1	0.1	0.4	0.0
2,4-Dimethylpentane	0.8	0.7	1.2	2.4	0.6	0.6	0.6	0.2	0.0	0.0	0.0	0.0	0.0
1,1,1-Trichloroethane	0.7	0.7	0.7	0.8	0.9	0.7	0.8	0.7	0.1	0.0	0.0	0.0	0.0
2,2,3-Trimethylbutane	0.0	0.0	0.1	0.2	0.0	0.0	0.0	0.2	0.1	0.1	0.0	0.0	0.0
1-Methylcyclopentene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Benzene	1.1	0.9	1.1	0.5	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	1.1
Carbontetrachloride	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.7	0.0	0.0	0.0	0.0	0.0
Cyclohexane	0.5	0.7	0.9	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Methylhexane	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3-Dimethylpentane	0.5	0.5	0.6	1.3	0.3	0.3	0.3	0.1	0.0	0.0	0.0	0.0	0.0
Cyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylhexane	0.3	0.4	0.5	0.4	0.0	0.0	0.0	0.0	0.2	0.0	0.0	0.1	0.0
Dibromomethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Dichloropropane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromodichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Trichloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Heptene	0.0	0.0	1.2	0.0	0.0	0.0	0.0	0.0	0.3	0.6	0.0	0.3	0.0
2,2,4-Trimethylpentane	9.3	8.8	14.6	28.5	7.9	7.6	7.7	3.3	0.0	0.1	0.0	0.0	1.1
t-3-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Heptane	0.7	0.7	0.9	0.3	0.0	0.0	0.0	0.0	0.2	0.1	0.2	0.2	0.0
t-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.3	0.0	0.1	0.0
c-2-Heptene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	0.0	0.2	0.0
c-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,2-Dimethylhexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Methylcyclohexane	0.8	1.0	1.1	0.2	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0
2,5-Dimethylhexane	1.1	1.0	1.7	3.6	0.9	0.9	0.9	0.4	0.0	0.0	0.0	0.0	0.0
2,4-Dimethylhexane	1.3	1.3	2.1	4.6	1.2	1.1	1.2	0.5	0.0	0.0	0.0	0.0	0.0
t-1,3-Dichloropropene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,1,2-Trichloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Bromotrichloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2,3,4-Trimethylpentane	2.5	2.5	4.3	9.1	2.4	2.3	2.4	0.9	0.0	0.0	0.0	0.0	0.0
Toluene	4.1	3.5	5.6	11.0	3.8	3.5	3.6	1.9	0.2	0.2	0.1	0.2	2.4
2-Methylheptane	0.2	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
4-Methylheptane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Methylcyclohexene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Dibromochloromethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3-Methylheptane	0.1	0.1	0.2	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
c-1,3-Dimethylcyclohexane	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
t-1,4-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
EDB (1,2-Dibromoethane)	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

NOBE 93 Table 2.11 cont.

Burn 2 VOC Analysis of Airborne Samples
SUMMA Canisters Onboard the University of Washington Aircraft (Convair)

	Post-burn 2												
Sample I.D.	335 m	9.7 km downwind 427 m cross sections	518 m	19 km downwind 457 m old smoke	Background sample out of smoke	16:23 pm			Blanks				Unused
Internal sample reference	15:28 pm GVRD433	15:32 pm EPS163	15:38 pm ESD-20	16:10 pm REAC223	EPS164	EPS164	AVE	16:34 pm REAC224	REAC216	REAC218	REAC111	AVE	ESD-15
Sample size (mL)	489	498	498	489	489	513		489	489	489	489		20
Compound	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
TOTAL VOC	57.6	53.6	76.6	108.2	44.3	41.4	42.9	25.9	24.2	13.4	7.7	15.1	75.3
2,2,5-Trimethylhexane	1.0	1.0	2.1	4.4	1.1	1.1	1.1	0.4	0.0	0.0	0.0	0.0	0.0
1-Octene	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.5	1.0	0.0	0.5	0.0
Octane	0.2	0.2	0.2	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.0
Tetrachloroethene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-1,4/t-1,3-Dimethylcyclohexane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
c-2-Octene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Chlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Ethylbenzene	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0
m/p-Xylene	0.2	0.2	0.2	0.3	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1	2.0
Bromoform	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobutane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Styrene	3.7	2.2	2.3	6.0	2.5	1.8	2.1	1.2	0.0	0.0	0.0	0.0	0.0
1,1,2,2-Tetrachloroethane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
o-Xylene	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0
1-Nonene	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0	1.3	1.5	0.0	1.0	0.0
Nonane	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.1	0.2	0.1	0.1	0.1	0.0
iso-Propylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3,6-Dimethyloctane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Propylbenzene	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.0	0.0
3-Ethyltoluene	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
4-Ethyltoluene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3,5-Trimethylbenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2-Ethyltoluene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1-Decene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,4-Trimethylbenzene	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1	1.2	0.4	0.1	0.6	0.0
Decane	0.2	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.0
1,3-Dichlorobenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Dichlorobenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
iso-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
sec-Butylbenzene	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2,3-Trimethylbenzene	0.1	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
p-Cymene	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0
1,2-Dichlorobenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Indane	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,3-Diethylbenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,4-Diethylbenzene	0.1	0.0	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
n-Butylbenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1,2-Diethylbenzene	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Undecane	0.5	0.3	0.3	0.8	0.3	0.2	0.3	0.3	0.3	0.1	0.1	0.2	0.0
Naphthalene	1.1	0.0	0.5	1.6	0.5	0.5	0.5	0.7	0.0	0.0	0.0	0.0	0.0
Dodecane	1.8	0.7	0.9	2.0	0.8	0.6	0.7	1.1	0.3	0.2	0.1	0.2	0.0
Hexylbenzene	0.4	0.0	0.0	0.7	0.0	0.0	0.0	0.4	0.0	0.3	0.0	0.1	0.0

NOBE 93 Table 2.12 Burn 1 Headspace Analysis of NOBE Water Samples for Volatile Organics

	Sample I.D.	Remote Station # 1, 50 to 100 m from apex of fireboom				Remote Station # 2, 100 to 150 m from apex of fireboom		Blanks	
		Remote control boat # 4	Remote control boat # 1			Remote control boat # 2	Remote control boat # 1		
		Pre-ignition 1	Burn 1			Pre-ignition 1	Burn 1	Blank 1	Blank 2
		(10:15)	(11:03)	(11:43)	(11:43) duplicate	(10:15)	(10:41)		
Peak #	Compounds	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
2	1,1,1-Trichloroethane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
3	Carbon tetrachloride	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4	Benzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
5	Cyclohexene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6	n-Heptane, C-7	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
7	Trichloroethene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
8	Methylcyclohexane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
9	1,2-Dichloropropane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
10	Methylisobutylketone	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
12	Toluene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
13	n-Octane, C-8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
14	Tetrachloroethene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
15	Chlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
16	Ethylbenzene/Nonene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
17	p-Xylene/n-Nonane, C-9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	0-Xylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
19	Bromoform	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Cumene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Decene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	n-Decane, C-10/Mesitylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Alpha-methylstyrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Alpha-terpinene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Limonene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	1,3-Dichlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	1,4-Dichlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
28	Undecene/Butylchloride	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
29	n-Undecane, C-11/1,2-Dichlor	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
30	4-ter-Butyltoluene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	n-Nonanal	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
32	n-Dodecane, C-12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Naphthalene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
34	n-Tridecane, C-13	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
35	n-Tetradecane, C-14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
36	n-Pentadecane, C-15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
37	n-Hexadecane, C-16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Internal Standard Response, *10exp6 cts								
	d12-Cyclohexane	5	4.7	4.9	4.4	4.9	3.5	6.6	6.4
	d8-Toluene	10.4	8.7	5.5	4.5	10.2	6.5	9.5	7.5
	d4-1,4-Dichlorobenzene	7.8	6.5	5.6	4.3	10.3	5.5	6.7	7.5
	Chloro-Octane	4	5.7	4.7	4.1	5.9	4.1	4.6	4.4

	Mean	Std Dev	CV, %
d12-Cyclohexane	4.64	1.06	22.89
d8-Toluene	7.68	2.24	29.20
d4-1,4-Dichlorobenzene	6.25	1.78	28.42
Chloro-Octane	4.50	0.81	17.96

NOBE 93 Table 2.13 Burn 2 Headspace Analysis of NOBE Water Samples for Volatile Organics

Peak #	Compounds (Sample I.D.)	Remote Station # 1, 50 to 100 m from apex of fireboom, Remote control boat # 1: Pre-ignition 2 (13:59)	Burn 2 (14:46)	Burn 2 (15:00)	Post-burn 2 (15:20)	Post-burn 2 (15:20) duplicate	Remote Station # 2, 100 to 150 m from apex of fireboom, Remote control boat # 2: Burn 2 (15:00)	Blanks: Blank 1	Blank 2
		ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm
2	1,1,1-Trichloroethane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
3	Carbon tetrachloride	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4	Benzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
5	Cyclohexene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
6	n-Heptane, C-7	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
7	Trichloroethene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
8	Methylcyclohexane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
9	1,2-Dichloropropane	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
10	Methylisobutylketone	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
12	Toluene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
13	n-Octane, C-8	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
14	Tetrachloroethene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
15	Chlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
16	Ethylbenzene/Nonene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
17	p-Xylene/n-Nonane, C-9	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
18	0-Xylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
19	Bromoform	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
20	Cumene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
21	Decene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
22	n-Decane, C-10/Mesitylene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
23	Alpha-methylstyrene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
24	Alpha-terpinene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
25	Limonene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
26	1,3-Dichlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
27	1,4-Dichlorobenzene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
28	Undecene/Butylchloride	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
29	n-Undecane, C-11/1,2-Dichlor	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
30	4-ter-Butyltoluene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
31	n-Nonanal	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
32	n-Dodecane, C-12	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
33	Naphthalene	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
34	n-Tridecane, C-13	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
35	n-Tetradecane, C-14	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
36	n-Pentadecane, C-15	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
37	n-Hexadecane, C-16	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Internal Standard Response, *10exp6 cts								
	d12-Cyclohexane	4.1	3.5	4.7	4.5	5.6	4.3	6.6	6.4
	d8-Toluene	8.8	6.7	10.4	4.2	10.2	7.2	9.5	7.5
	d4-1,4-Dichlorobenzene	8.8	4.8	6.7	4.4	5.7	5	6.7	7.5
	Chloro-Octane	4.7	3.4	3.9	5.9	3.7	4.8	4.6	4.4

	Mean	Std Dev	CV, %
d12-Cyclohexane	4.64	1.06	22.89
d8-Toluene	7.68	2.24	29.20
d4-1,4-Dichlorobenzene	6.25	1.78	28.42
Chloro-Octane	4.50	0.81	17.96

Volatile Organic Compounds (VOCs)
NOBE 93

Laboratory Methodology

Methodology for Identification and Quantification of VOCs NOBE 93

Whole air samples are collected in previously cleaned and evacuated Summa™ polished stainless steel canisters. The canisters used were obtained from SIS™ or BRC-Rasmussen™. Volatile organic compounds (VOCs) are identified and quantified by capillary column gas chromatography and mass selective detector (GC-MSD). The canister-based whole air method is applicable to the entire volatility range of VOCs of interest with the exception of polar organic compounds. The method used by the Air Toxics Section of the Pollution Measurement Division at Environment Canada is based on the United States Environmental Protection Agency (EPA) TO-14 Method.

An aliquot of the air sample is withdrawn from the canister, the water is removed and the VOCs are concentrated prior to injection onto the head of a GC capillary column. The major components of this system include two electronic flow controllers (FC260 with RO-32 control box, Tylan Corp., Torrance, Ca), a Nafion PermaPure™ dryer, a six port Valco™ gas valve, a cryogenic pre-concentration trap and a sub-atmospheric temperature programmable gas chromatograph equipped with a quadruple mass selective detector (GC-MSD).

Sample Preparation

Canisters that are returned from the field at atmospheric or sub-atmospheric pressures following sampling must be pressurized prior to analysis. The canister is filled to approximately 69 kPa with clean humidified air and a dilution factor is calculated from a previously obtained calibration curve. All lines are evacuated and purged with clean humidified air prior to filling. A flow rate of approximately 200 mL/min. is maintained by an electronic mass flow controller and verified with a Gilian™ soap-film bubble flowmeter. A certified clean canister is also filled and serves as a blank. A dilution factor adjustment for carbon dioxide (CO_2) is calculated from this blank sample.

Sample Aliquots

The volume of sample aliquots is adjusted so that target compounds fall within the analytical system calibration range of each of the target compounds. This varies from 1 mL to 500 mL depending on the initial concentration of the sample. A sample loop is used for 1 mL and 10 mL aliquots and a gas-tight syringe is used for 20 mL to 200 mL aliquots. Larger aliquots (250 mL to 1000 mL) are withdrawn from the cylinder for 10, 15, 20 or 30 minutes at a constant flow of 25 mL/min. The flow rate is maintained by electronic mass flow controllers and verified with a Gilian™ soap-film bubble flowmeter.

Water Removal

A Nafion PermaPure™ dryer is used to prevent blockage of the trap and/or capillary column by ice formation at reduced temperature. To prevent excessive moisture build-up and memory effects, the dryer is heated to 100°C and purged with clean dry air for 20 minutes following each sample injection.

VOC Pre-concentration

The cryogenic trap pre-concentrator used is a 30 cm, 0.32 O.D. nickel tube packed with 60/80 mesh untreated glass beads. The trap is immersed in liquid oxygen (-183°C) which is condensed from air by liquid nitrogen. This trap condenses NMOC while allowing air and methane to pass through. Following trapping mode, the six-port valve is switched to the inject position directing the helium carrier gas through the trap for a few seconds in the direction opposite to the previous air sample flow. The collected VOCs are then revolatilized by heating the trap to 100°C and simultaneously removing the cryogen. The VOCs pass through a heated transfer line to the GC where they are again concentrated at the head of the capillary column which is held at -60°C.

Data Acquisition

The gas chromatograph used for species identification and quantification is a Hewlett-Packard™ model 5890 series II gas chromatograph and model 5971 MSD. VOCs are separated on a 50 m, 0.32 mm I.D. fused silica capillary column with a 1.0 μm thick film of HP-1 bonded liquid phase. The initial temperature of -60°C is held for 3 minutes then raised to 250°C at 8°C/min. The rate is then increased to 20°C/min. and the temperature is held at 280°C for 8 min. after which it is lowered to 150°C. Operated in selected ion monitoring (SIM) mode the GC-MSD acquires data for target compounds only and ignores all others. This detection technique is highly specific and sensitive. Peak identification is based on GC retention time and MSD confirmation. Quantification is based on a 3-point calibration internal standard method. The internal standards used are bromochloromethane, 1,4-difluorobenzene, chlorobenzene-d_5 and 1-bromo-4-fluorobenzene. Repeatability is <3% RSD and inter-day reproducibility is <10% RSD. A second aliquot is analyzed in SCAN mode and tentative identification of major non-target compounds is made using the National Bureau of Standards NBS49 mass spectral library.

CALIBRATION STANDARDS

Instrument calibration standards are made using stock gas standards prepared in our laboratory from three multi-component liquid mixtures and gas mixture cylinders purchased from Scott™ Environmental Technology Inc. The three liquid mixtures are a 26-component alkene and alkane mixture, a 25-component aromatic mixture and a 31-component halogenated hydrocarbon mixture. Gravimetric techniques are used in the preparation of these standards which are stored separately in 0.5 mL amber ampoule. The stock gas standard mixtures are made in a 3-L flask equipped with two Teflon™ stopcocks. Ten μL of each of the three mixtures is weighed by difference and injected into the 3-L flask filled with clean humidified air. The flask is heated to 50°C for 1 hour to allow the components to vaporize and then left overnight to allow for equilibration.

Aliquots are withdrawn from the standard mixtures and Scott™ gas mixtures with a gas-tight syringe (Pressure-Lok™, Precision Sampling Corp.) and injected into an evacuated 16 L Summa polished canister together with clean humidified air. The dilution gas is generated by the AADCO™ clean air generator and humidified by bubbling through HPLC water. The resulting mixture is pressurized to approximately 414 kPa to produce a daily instrumentation calibration standard (canmix) of approximately 10 ppbv for each of the target compounds.

Methodology for Headspace Volatile Organics Analysis
NOBE 93

Scope

Volatile organics having boiling points generally less than 120°C can be analysed by a static headspace method. VOCs most amenable to headspace analysis are those having low Henry's Law constant which readily partition into the headspace above the liquid. Such compounds include benzene, toluene, ethylbenzene and xylenes (BTEX). Instrument detection limit is 0.05 ppm BTEX and 0.1 ppm for other organics.

Sample Workup

A 10-mL aliquot is placed in a 20-mL capped vial, d8-toluene is added as an internal standard. Headspace equilibrium is achieved by incubating the vial in the headspace sampler at 85°C for a nominal 45 minutes. The headspace inside the vial is pressurized and allowed to vent through a 3-mL gas sampling loop. The valve is turned so that the contents of the loop are swept into the GC column via a transfer line at 90°C.

Samples are loaded onto a constant heating time magazine by which each sample is equilibrated for a time equivalent to one GC run time (nominally 45 minutes).

Instrumentation

HP 19395A Headspace sampler coupled to HP 5890GC/5971 MSD. Data Station:HPCHEM (DOS series).

Instrumentation Parameters

Hewlett-Packard (HP) 19395A Headspace Analyser

Equilibration time:	45 min. (nominal)
Bath temperature:	85°C
Sample loop:	3-mL
Valve/loop temperature:	90°C
Valve timing:	pressurize 10 sec. vent/fill loop 5 sec. inject 10 sec.
Carrier gas (at sample transfer line):	Helium 38 mL/min
Aux pressure:	1.5 bar
HP 5890 (Series 2) GC	

Conditions	
Inlet temperature:	225°C
Inlet mode:	split operation, split ratio 1:5
Split vent flow:	40 mL/min
Oven temperature:	35°C hold 5 min., rate 5°C/min to final temperature 200°C hold 5 min.
Column:	30 m SPB-1, 0.53 mm id, 1.5-μm film
Column flow:	7 mL/min nominal
Linear velocity:	40 cm/sec at 100°C

HP 5971 MSD	
Interface:	Open-split, restrictor flow 0.7 mL/min nominal
Operating mode:	Selective Ion Monitoring
Interface temperature:	280°C
Detector temperature:	160°C nominal
Tune:	Autotune
Electron multiplier:	2000 V nominal
Data Station:	HP ChemStation (DOS-series)

Standards

A 20-components volatile organic mixture is created by weighing known amounts of solid/liquid neat compounds and dissolved in an alkane mixture (D3710 Quantitative Calibration Mixture, Catalog No: 4-8879). Addition of 1 μl of this mixture to 10-mL of water gives a final concentration of 7 ppm (nominal) covering C-5 to C-15.

Section 3

Carbon Dioxide (CO_2) NOBE 93

Carbon Dioxide (CO_2)
NOBE 93

The samples collected for CO_2 analysis on August 12, 1993 include air and plume samples taken at sea level and at various altitudes. Background samples were collected earlier on August 7, 1993.

SUMMA™ Stainless Steel Canisters

SUMMA™ canisters were used to collect air samples during NOBE 93 for Carbon dioxide analysis. The interior of these stainless steel canisters is specially treated to produce an interior passive surface of pure chrome-nickel oxide. Samples can be collected using a pressurized technique or a sub-atmospheric pressure technique. For NOBE 93, the sub-atmospheric technique was used.

Instrumentation

- The canisters were initially evacuated in the laboratory to a sub-atmospheric pressure of approximately -101.6 kPa.
- The flow controllers on the SUMMAs were adjusted to 500 cc/min for the evaporation period and to 100 cc/min for the burn.
- The CO_2 concentration was determined by gas chromatography (GC).

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.5 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.5 m above sea level
- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500-600 m from the fire.
- Sir Wilfred Grenfell - 200 m from the fire.
- Ann Harvey - 100 m from the fire.
- Casaco - 350 m from the fire.
- CCG 203 - tow vessel for the fireboom, 75 m from the fire.
- CCG 204 - tow vessel for the fireboom, 75 m from the fire.
- CCG 212 - tow vessel for the backup boom, 400 m from the fire.
- CCG 214 - tow vessel for the backup boom, 400 m from the fire.
- Remote Helicopter - Team 1.
- Remote Helicopter - Team 2.
- University of Washington aircraft (Convair).

Tedlar Collection Bags from NIST's Blimp

NIST operated a smoke-sampling package suspended from a tethered helium-filled miniblimp. An aluminum box, with overall dimensions of 300 x 310 x 130 mm, held up to four battery-operated sampling pumps. For NOBE 93, two pumps were used for Burn 1 and three for Burn 2. The miniblimp, 5.5 m long x 2.1 m in diameter, was kept above the plume with its package positioned in the plume 30 m below. A tether line from the blimp was connected to the top of the package. Another tether line was connected from the bottom of the package to the tending vessel, allowing the package to orient itself into the wind.

Instrumentation

The suspended package included pumps which drew air through 37-mm filters and directed the discharge into collection bags. The samples collected in these Tedlar bags (2 litres capacity) were analysed for CO_2 concentration with a portable gas chromatograph.

- For Burn 1, two pumps equipped with a 37-mm smoke particulate filter were run simultaneously at 4 L/min. The sample pumps were started with the miniblimp at sea level 300 seconds after the burn had started. The total running time was 3338 seconds.
- For Burn 2, two pumps were also used as for Burn 1, with a 37-mm filter. The starting time was 180 seconds after the burn had started and the total running time of 3877 seconds.

Location

- The CCG 210 tending to the miniblimp was positioned 200 to 600 m away from the apex of the fireboom.
- As observed on the aerial photos, the CCG 210 always navigated between the edge and the centre of the plume for Burn 1. Only a few photos are available for Burn 2 and they position the CCG 210 under the plume.
- The miniblimp followed a pattern similar to the CCG 210 with distances from the apex of the fireboom varying from 200 to 600 m from the apex of the fireboom for both burns.
- For both burns, the miniblimp was deployed at 152.4 m high from the deck level with the sampling package hanging 30 m below.

Metrosonics aq-501

Metrosonics aq-501 is an Air Quality Monitor, which measures, displays and records data on up to five channels. Each channel permits monitoring of one of the following: carbon dioxide, temperature, relative humidity, toxic gas, and a linear input. The carbon dioxide, temperature and relative humidity inputs are built into the monitoring unit. The toxic gas input allows you to optionally use Metrosonics toxic gas sensors to measure any of the following gases: carbon monoxide, hydrogen sulphide, sulphur dioxide, chlorine, nitrogen dioxide, nitric oxide, oxygen, hydrogen cyanide and ammonia.

Instrumentation

Carbon dioxide:

Range:	0 to 5000 ppm
Accuracy:	± 3% of full scale @ 25°C (77°F)
Resolution:	1 ppm
Detector:	NDIR (non-dispersive infrared)

- The data was logged every minute.

Location

Two Metrosonics were installed on the CCG 206 which was positioned to collect air samples at the Downwind position.

- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500-600 m from the fire.

NOBE 93 Table 3.1

Carbon Dioxide Analysis of Airborne Samples

Total ppm Recorded by SUMMAs

Time Periods	Remote Control Helicopter	Team 1 Sample I.D.	Team 1 ppm	Team 2 Sample I.D.	Team 2 ppm
Background 1	before burn period	13871	396	13872	346
Pre-Ignition 1	evaporation period	13875	368		
Burn 1	in front of plume	13876	310		
Burn 1	under plume	13377	347		
Burn 1	under plume, 20 m high			13877	380
Burn 1	under plume				
Burn 1	under plume, 40 m high			13870	308
Burn 2	in front of plume	13869	373	13376	359

Time Periods	Convair	Sample I.D.	ppm
Background, Aug 7 93	ship exhaust , 3.2 km downwind, 11:56 am	EPS 233	387
Background 1	background, 8:27:00 AM	EPS 53	364
Background 1	background, 8:40:00 AM	EPS 132	366
Burn 1	plume sample, 1.6 km downwind, 230 m high, 10:39 am	EPS 27	376
Burn 1	above cloud layer, 1.6 km downwind, 11:08 am	EPS 6	406
Burn 1	plume sample, 4.8 km downwind, 11:27 am	EPS 22	380
Burn 1	plume sample, 32.2 km downwind, 11:43 am	GVRD 430	374
Pre-ignition 2	no ship exhaust, 14:00 pm	EPS 223	378
Burn 2	plume sample, 3.2 km downwind, 300 m high, 14:13 pm	EPS 226	379
Burn 2	plume sample, 3.2 km downwind, 305 m high, 14:24 pm	EPS 220	376
Burn 2	plume sample, 305 km high, 14:32 pm	AB 02	386
Burn 2	plume sample, 14 km downwind, 14:58 pm	EPS 100	374
Post-burn 2	cross section, 10 km downwind, 443 m high, 15:32 pm	EPS 163	384
Post-burn 2	cross section, 10 mi downwind, 535 m high, 15:38 pm	ESD 20	376
Post-burn 2	background, out of smoke, 16:23 pm	EPS 164	362
Post-residue 2	background, out of smoke, 16:34 pm	REAC 224	366

NOBE 93 Table 3.2

Burn 1 Carbon Dioxide Analysis of Sea Level Air Samples using SUMMAs

Total ppm Recorded

Positions / Time Periods	RS-1	RS-2	Downwind Station	Sir Wilfred Grenfell	Ann Harvey	CCG 203	CCG 204	CCG 212	CCG 214	Casaco
Background...Aug 07, 93	274 REAC 220	360 REAC 222	374 REAC 180 260 REAC 181							
Pre-Ignition			365 REAC 123						375 REAC 188	
Burn	433 ESD 16 600 ESD 17	735 ESD 7 803 ESD 9	400 REAC 73 348 REAC 77	355 REAC 172	350 REAC 166	385 REAC 75	355 REAC 183	399 REAC 171		329 ESD 18 328 REAC 214

For Burn 1 only ...
R/C boat 2 at position RS-2 for first 17 minutes; mover to RS-1 at this point until end of burn; results applied to RS-1
R/C boat 1 at RS-2 position starting at 11:23 till end of burn; results applied to RS-2 position

Burn 2 Carbon Dioxide Analysis of Sea Level Air Samples using SUMMAs

Total ppm Recorded

Positions / Time Periods	RS-1	RS-2	Downwind Station	Sir Wilfred Grenfell	Ann Harvey	CCG 203	CCG 204	CCG 212	CCG 214	Casaco
Pre-Ignition	412 REAC 179 297 REAC 178		385 REAC 72	325 REAC 191		410 REAC 162	407 REAC 184			423 REAC 144
Burn	940 REAC 167 953 REAC 197	896 ESD 4 825 REAC 212	368 REAC 200 415 REAC 219	387 REAC 192	412 ESD 1	402 ESD 3	392 ESD 13	216 REAC 194	382 REAC 189	310 REAC 165 355 REAC 213

NOBE 93 Table 3.3

Carbon Dioxide Analysis from Miniblimp (CCG 210)

Tedlar Bags

Time Periods	Instrument 1 ppm	Instrument 2 ppm	Average ppm	Above Background ppm
900 m downwind from fire				
Background 1	390		390	
Burn 1	409	422	416	26
Post burn 1	369		369	0
500 to 600 m downwind from fire				
Pre-ignition 2	385		385	0
Burn 2	439	433	436	46
Post burn 2	380		380	0

Miniblimp airborne at 120 m above sea level

NOBE 93 Table 3.4

Carbon Dioxide Levels at the Downwind Station (CCG 206)

Metrosonics aq-501

Burn 1 approximately 900 m from apex of fireboom		Instrument 1 ppm	Instrument 2 ppm	Average ppm	Above Background ppm
Background 1	Minimum	417	413	419	
	Average	428	426	427	
	Maximum	522	444	471	
Pre-ignition 1	Minimum	385	411	399	0
	Average	405	425	415	0
	Maximum	493	437	455	0
Burn 1	Minimum	378	408	401	0
	Average	400	433	417	0
	Maximum	442	498	464	0

Burn 2 500 to 600 m from apex of fireboom					
Background 2	Minimum	414	420	419	
	Average	419	434	428	
	Maximum	438	449	449	
Pre-ignition 2	Minimum	416	407	413	0
	Average	422	419	421	0
	Maximum	490	430	456	0
Burn 2	Minimum	419	408	415	0
	Average	439	432	435	0
	Maximum	465	457	453	0
Post-burn 2	Minimum	424	418	424	0
	Average	441	424	431	0
	Maximum	449	440	443	0

NOBE 93 Table 3.5 **Carbon Dioxide at Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
Background 1	8:24	-126		444	444
	8:25	-125	432	431	432
	8:26	-124	431	429	430
	8:27	-123	427	420	424
	8:28	-122	428	422	425
	8:29	-121	430	418	424
	8:30	-120	431	428	430
	8:31	-119	431	431	431
	8:32	-118	430	423	427
	8:33	-117	429	415	422
	8:34	-116	429	429	429
	8:35	-115	427	425	426
	8:36	-114	429	413	421
	8:37	-113	428	416	422
	8:38	-112	428	418	423
	8:39	-111	432	429	431
	8:40	-110	432	432	432
	8:41	-109	428	435	432
	8:42	-108	428	434	431
	8:43	-107	426	431	429
	8:44	-106	430	421	426
	8:45	-105	429	428	429
	8:46	-104	428	429	429
	8:47	-103	428	424	426
	8:48	-102	428	426	427
	8:49	-101	458	420	439
	8:50	-100	522	420	471
	8:51	-99	430	428	429
	8:52	-98	427	433	430
	8:53	-97	429	431	430
	8:54	-96	428	429	429
	8:55	-95	424	430	427
	8:56	-94	424	431	428
	8:57	-93	428	418	423
	8:58	-92	427	425	426
	8:59	-91	424	432	428
	9:00	-90	423	428	426
	9:01	-89	425	428	427
	9:02	-88	424	426	425
	9:03	-87	426	428	427
	9:04	-86	426	426	426
	9:05	-85	428	430	429
	9:06	-84	426	428	427
	9:07	-83	428	424	426
	9:08	-82	425	419	422
	9:09	-81	423	430	427
	9:10	-80	422	420	421
	9:11	-79	422	424	423

NOBE 93 Table 3.5 cont. **Carbon Dioxide at Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	9:12	-78	426	430	428
	9:13	-77	421	433	427
	9:14	-76	421	432	427
	9:15	-75	421	416	419
	9:16	-74	430	418	424
	9:17	-73	424	422	423
	9:18	-72	422	424	423
	9:19	-71	422	419	421
	9:20	-70	420	435	428
	9:21	-69	422	428	425
	9:22	-68	423	422	423
	9:23	-67	422	435	429
	9:24	-66	422	429	426
	9:25	-65	419	429	424
	9:26	-64	419	418	419
	9:27	-63	417	422	420
	9:28	-62	417	429	423
	9:29	-61	417	429	423
Pre-ignition 1	9:30	-60	415	415	415
	9:31	-59	417	426	422
	9:32	-58	427	430	429
	9:33	-57	422	433	428
	9:34	-56	401	434	418
	9:35	-55	416	430	423
	9:36	-54	420	432	426
	9:37	-53	418	416	417
	9:38	-52	416	428	422
	9:39	-51	419	428	424
	9:40	-50	419	424	422
	9:41	-49	417	426	422
	9:42	-48	417	433	425
	9:43	-47	415	432	424
	9:44	-46	415	434	425
	9:45	-45	413	419	416
	9:46	-44	412	419	416
	9:47	-43	414	430	422
	9:48	-42	409	432	421
	9:49	-41	410	432	421
	9:50	-40	407	432	420
	9:51	-39	407	427	417
	9:52	-38	408	422	415
	9:53	-37	402	423	413
	9:54	-36	493	417	455
	9:55	-35	408	418	413
	9:56	-34	412	421	417
	9:57	-33	409	420	415
	9:58	-32	410	420	415

NOBE 93 Table 3.5 cont. **Carbon Dioxide at Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	9:59	-31	409	424	417
	10:00	-30	412	426	419
	10:01	-29	410	416	413
	10:02	-28	406	420	413
	10:03	-27	431	432	432
	10:04	-26	405	432	419
	10:05	-25	399	424	412
	10:06	-24	396	419	408
	10:07	-23	392	411	402
	10:08	-22	394	417	406
	10:09	-21	385	428	407
	10:10	-20	410	428	419
	10:11	-19	390	415	403
	10:12	-18	391	421	406
	10:13	-17	392	418	405
	10:14	-16	390	422	406
	10:15	-15	390	427	409
	10:16	-14	391	420	406
	10:17	-13	393	431	412
	10:18	-12	395	429	412
	10:19	-11	392	437	415
	10:20	-10	400	435	418
	10:21	-9	390	437	414
	10:22	-8	386	428	407
	10:23	-7	388	423	406
	10:24	-6	387	430	409
	10:25	-5	385	426	406
	10:26	-4	387	432	410
	10:27	-3	385	419	402
	10:28	-2	387	431	409
	10:29	-1	385	413	399
Burn 1	10:30	0	385	428	407
	10:31	1	385	428	407
	10:32	2	388	432	410
	10:33	3	386	426	406
	10:34	4	387	427	407
	10:35	5	386	430	408
	10:36	6	390	422	406
	10:37	7	383	430	407
	10:38	8	393	430	412
	10:39	9	393	420	407
	10:40	10	394	423	409
	10:41	11	442	424	433
	10:42	12	394	444	419
	10:43	13	394	408	401
	10:44	14	395	433	414
	10:45	15	396	434	415

NOBE 93 Table 3.5 cont.

Carbon Dioxide at Downwind Station (CCG 206)

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	10:46	16	396	444	420
	10:47	17	388	459	424
	10:48	18	378	426	402
	10:49	19	397	437	417
	10:50	20	397	452	425
	10:51	21	399	419	409
	10:52	22	399	437	418
	10:53	23	399	446	423
	10:54	24	399	426	413
	10:55	25	400	422	411
	10:56	26	401	426	414
	10:57	27	403	417	410
	10:58	28	402	445	424
	10:59	29	402	428	415
	11:00	30	403	426	415
	11:01	31	401	435	418
	11:02	32	403	456	430
	11:03	33	403	454	429
	11:04	34	403	455	429
	11:05	35	404	449	427
	11:06	36	402	456	429
	11:07	37	404	413	409
	11:08	38	406	466	436
	11:09	39	404	447	426
	11:10	40	404	435	420
	11:11	41	402	437	420
	11:12	42	403	443	423
	11:13	43	404	441	423
	11:14	44	402	422	412
	11:15	45	403	416	410
	11:16	46	405	429	417
	11:17	47	403	444	424
	11:18	48	405	440	423
	11:19	49	404	428	416
	11:20	50	405	444	425
	11:21	51	405	434	420
	11:22	52	404	446	425
	11:23	53	404	453	429
	11:24	54	405	455	430
	11:25	55	404	451	428
	11:26	56	405	466	436
	11:27	57	430	498	464
	11:28	58	417	422	420
	11:29	59	418	450	434
	11:30	60	406	425	416
	11:31	61	402	424	413
	11:32	62	403	418	411
	11:33	63	405	420	413

NOBE 93 Table 3.5 cont. **Carbon Dioxide at Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	11:34	64	402	426	414
	11:35	65	402	426	414
	11:36	66	405	429	417
	11:37	67	400	425	413
	11:38	68	399	429	414
	11:39	69	399	418	409
	11:40	70	398	421	410
	11:41	71	399	411	405
	11:42	72	398	422	410
	11:43	73	399	422	411
	11:44	74	397	416	407
	11:45	75	399	425	412
	11:46	76	397	424	411
	11:47	77	396	427	412
	11:48	78	396	423	410
	11:49	79	395	423	409
	11:50	80		412	412
Background 2	13:31	-35		449	449
	13:32	-34		435	435
	13:33	-33		434	434
	13:34	-32		435	435
	13:35	-31		436	436
	13:36	-30	414	436	425
	13:37	-29	438	442	440
	13:38	-28	424	448	436
	13:39	-27	419	435	427
	13:40	-26	418	431	425
	13:41	-25	419	427	423
	13:42	-24	415	435	425
	13:43	-23	415	437	426
	13:44	-22	415	432	424
	13:45	-21	415	432	424
	13:46	-20	415	428	422
	13:47	-19	427	432	430
	13:48	-18	414	428	421
	13:49	-17	416	427	422
	13:50	-16	416	427	422
	13:51	-15	418	420	419
Pre-ignition 2	13:52	-14	418	426	422
	13:53	-13	416	420	418
	13:54	-12	416	417	417
	13:55	-11	417	416	417
	13:56	-10	418	430	424
	13:57	-9	490	422	456
	13:58	-8	416	422	419
	13:59	-7	416	421	419

NOBE 93 Table 3.5 cont. **Carbon Dioxide at Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	14:00	-6	417	417	417
	14:01	-5	417	417	417
	14:02	-4	419	420	420
	14:03	-3	418	407	413
	14:04	-2	417	417	417
	14:05	-1	419	415	417
Burn 2	14:06	0	420	433	427
	14:07	1	419	430	425
	14:08	2	420	434	427
	14:09	3	421	420	421
	14:10	4	422	435	429
	14:11	5	419	411	415
	14:12	6	420	425	423
	14:13	7	421	431	426
	14:14	8	422	426	424
	14:15	9	423	421	422
	14:16	10	424	418	421
	14:17	11	427	431	429
	14:18	12	427	438	433
	14:19	13	428	427	428
	14:20	14	430	420	425
	14:21	15	431	427	429
	14:22	16	431	412	422
	14:23	17	437	417	427
	14:24	18	439	422	431
	14:25	19	441	440	441
	14:26	20	440	454	447
	14:27	21	453	452	453
	14:28	22	436	444	440
	14:29	23	438	442	440
	14:30	24	437	447	442
	14:31	25	438	435	437
	14:32	26	440	452	446
	14:33	27	439	457	448
	14:34	28	444	454	449
	14:35	29	439	450	445
	14:36	30	441	451	446
	14:37	31	440	438	439
	14:38	32	450	443	447
	14:39	33	443	448	446
	14:40	34	441	441	441
	14:41	35	439	431	435
	14:42	36	445	441	443
	14:43	37	441	440	441
	14:44	38	443	428	436
	14:45	39	445	433	439
	14:46	40	443	439	441

NOBE 93 Table 3.5 cont.

Carbon Dioxide at Downwind Station (CCG 206)

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded	Time Elapsed	replication 1 ppm	replication 2 ppm	AVE ppm
	14:47	41	438	438	438
	14:48	42	454	440	447
	14:49	43	443	417	430
	14:50	44	444	442	443
	14:51	45	444	430	437
	14:52	46	444	424	434
	14:53	47	440	432	436
	14:54	48	442	426	434
	14:55	49	448	430	439
	14:56	50	441	419	430
	14:57	51	443	421	432
	14:58	52	442	421	432
	14:59	53	441	430	436
	15:00	54	443	427	435
	15:01	55	465	437	451
	15:02	56	442	424	433
	15:03	57	441	443	442
	15:04	58	441	425	433
	15:05	59	442	408	425
	15:06	60	445	432	439
	15:07	61	444	421	433
	15:08	62	447	421	434
	15:09	63	449	446	448
	15:10	64	446	421	434
	15:11	65	444	427	436
	15:12	66	447	418	433
	15:13	67	445	431	438
	15:14	68	444	426	435
	15:15	69	447	413	430
	15:16	70	447	416	432
	15:17	71	445	431	438
	15:18	72	446	436	441
	15:19	73	449	433	441
Post-burn 2	15:20	74	446	440	443
	15:21	75	424	425	425
	15:22	76	445	418	432
	15:23	77	443	419	431
	15:24	78	440	423	432
	15:25	79	440	420	430
	15:26	80	449	422	436
	15:27	81		424	424

Carbon Dioxide (CO_2)
NOBE 93

Laboratory Methodology

Methodology for Carbon Dioxide Analysis

Instrumentation

Hewlett Packard 5890 Gas Chromatograph with microvolume TCD
Hewlett Packard 3365 DOS ChemStation software
Valco 6-port gas sampling valve with 1.0 mL loop in heated enclosure
Column: 2.1 m x 0.32 cm Porapak R (80/100)
Valve injection directly on column
Valve enclosure at 93°C
Detector block 200°C
Oven temperature 25°C hold 2.5 min 25°C/min to 180°C hold 2.8 min
Carrier: Helium 40.0 mL/min measured at initial conditions
TCD Reference: Helium 60.0 mL/min

The oven temperature program is primarily used to remove heavier compounds and water from the column before the next injection. The CO_2 peak emerges during the initial isothermal segment.

The TCD was calibrated by injection of a known concentration of CO_2 in N_2 (4758 ppmv) obtained from Matheson Gas Products. To verify calibration linearity, the CO_2 standard was dynamically diluted with CO_2 free N_2 using a master/slave mass flow controller system and various dilutions were analysed in the same manner as the samples. A small metal bellows vacuum pump was used to draw the sample into the loop from a TEDLAR bag. The pressure inside the loop was allowed to equilibrate with ambient pressure before injection onto the column. Since the canisters supplied were under vacuum, a gauge was used to measure the pressure inside the loop when attached to the canister. A pressure correction curve was prepared to correct the analysis results for reduced pressure. Both the ambient calibration curve and the pressure correction curve are given. Any canister with a pressure below 68 kPa could not be analysed due to the pumping capacity of the pump being used. For canisters with very low pressures (<34 kPa), the analysis is probably more representative of the gas used to clean and flush the canister than of the sample taken.

Calibration Linearity Check	ACTUAL	MEASURED (2 repeats)
	475.8	475.2
	95.2	98.6

For TEDLAR bag samples, the vacuum pump was used to draw sample out of the bag through the sample loop. The pump was then isolated and the pressure inside the loop was allowed to equilibrate to ambient before injection. Thus, no pressure correction was applied.

Section 4

Carbon Monoxide (CO)
NOBE 93

Carbon Monoxide (CO)
NOBE 93

Exotox 75

Instrumentation

- The Exotox 75 was used to analyse CO, SO_2, NO_2.
- Its flow rate is 300 mL/minute.
- Tubing was connected from the instrument to the mast to allow sampling at approximately 1.25 m above sea level.
- The data was logged every 30 seconds.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level

Cannonball

The Cannonball can monitor the atmosphere for up to four gases, using a variety of sensors. Working as a sample draw device, it will detect combustible gas, oxygen, and a choice of two other toxic gases. For NOBE 93 it was used to analyse carbon monoxide and sulphur dioxide. This equipment serves as both an area monitor and to check the atmosphere in a remote area. The Cannonball's waterproof case and a hydrophobic filter in the sample probe make it suitable for use in most rugged environments.

Instrumentation

- The instrument pumped air at a flow rate of 1 L/min.
- Tubing was connected from the instrument to the mast to allow sampling at 1.25 m above sea level.
- Data was logged every 30 seconds.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level

Metrosonics aq-501

Metrosonics aq-501 is an Air Quality Monitor, which measures, displays and records data on up to five channels. Each channel permits monitoring of one of the following: carbon dioxide, temperature, relative humidity, toxic gas, and a linear input. The carbon dioxide, temperature and relative humidity inputs are built into the monitoring unit. The toxic gas input allows you to optionally use Metrosonics toxic gas sensors to measure any of the following gases: carbon monoxide, hydrogen sulphide, sulphur dioxide, chlorine, nitrogen dioxide, nitric oxide, oxygen, hydrogen cyanide and ammonia.

Instrumentation

Carbon dioxide

Range:	0 to 5000 ppm
Accuracy:	± 3% of full scale @ 25°C
Resolution:	1 ppm
Detector:	NDIR (non-dispersive infrared)

- The data was logged every minute.

Location

Two Metrosonics were installed on the CCG 206 positioned to collect air samples at the Downwind position.

- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500-600 m from the fire.

NOBE 93 Table 4.1

Summary of Carbon Monoxide Levels

		Exotox 75	Cannonball	Exotox 75	Cannonball	Metrosonics aq-501
		Remote Station # 1, 50 to 100 m from the fire		Remote Station # 2, 100 to 150 m from the fire		Downwind Station, 900 m from the fire
		Remote control boat # 2		Remote control boat # 1		CCG 206
		ppm	ppm	ppm	ppm	ppm
Background 1	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.0	0.0	0.0	0.1	0.8
	Maximum	0.0	0.0	0.0	0.5	2.0
Pre-ignition 1	Minimum	0.0	0.0	0.0	0.0	1.0
	Average	0.0	0.0	0.0	0.2	1.6
	Maximum	0.0	0.1	0.0	0.9	3.0
Burn 1	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.0	0.5	0.0	0.1	0.5
	Maximum	0.0	2.7	0.0	1.9	2.5
Post-burn 1	Minimum	0.0	0.1	0.0	0.0	
	Average	0.0	0.5	0.0	0.1	
	Maximum	0.0	2.4	2.0	4.0	

		Remote control boat # 1		Remote control boat # 2		CCG 206, 500 to 600 m from fire
		ppm	ppm	ppm	ppm	ppm
Background 2	Minimum	0.0	0.0	0.0	0.1	0.0
	Average	0.3	0.7	0.0	0.9	1.3
	Maximum	6.0	5.3	1.0	3.2	2.0
Pre-ignition 2	Minimum	0.0	0.0	0.0	0.3	0.5
	Average	0.0	0.1	0.0	0.6	1.2
	Maximum	0.0	1.5	0.0	1.8	1.5
Burn 2	Minimum	0.0	0.0	0.0	0.1	0.5
	Average	0.0	0.1	0.0	0.7	1.9
	Maximum	0.0	3.1	0.0	2.6	4.0
Post-burn 2	Minimum	0.0	0.0	0.0	0.1	1.0
	Average	0.0	0.0	0.0	0.5	1.1
	Maximum	0.0	0.1	0.0	3.4	1.5

NOBE 93 Table 4.2

Carbon Monoxide - Downwind Station (CCG 206)
Metrosonics aq-501

Burn 1 - 900 m from fire Time Periods		Instrument # 1 ppm	Instrument # 2 ppm	Average ppm
Background 1	Minimum	0.0	0.0	0.0
	Average	0.3	1.4	0.8
	Maximum	1.0	4.0	2.0
Pre-ignition 1	Minimum	1.0	1.0	1.0
	Average	1.3	1.8	1.6
	Maximum	2.0	4.0	3.0
Burn 1	Minimum	0.0	0.0	0.0
	Average	0.3	0.7	0.5
	Maximum	2.0	3.0	2.5

Burn 2 - 500 to 600 m from fire Time Periods		Instrument # 1 ppm	Instrument # 2 ppm	Average ppm
Background 2	Minimum	1.0	0.0	0.0
	Average	1.9	1.0	1.3
	Maximum	3.0	2.0	2.0
Pre-ignition 2	Minimum	1.0	0.0	0.5
	Average	1.7	0.6	1.2
	Maximum	2.0	1.0	1.5
Burn 2	Minimum	1.0	0.0	0.5
	Average	1.3	2.3	1.9
	Maximum	3.0	5.0	4.0
Post-burn 2	Minimum	1.0	1.0	1.0
	Average	1.3	1.0	1.1
	Maximum	2.0	1.0	1.5

NOBE 93 Table 4.3

Carbon Monoxide Results from the Exotox 75 Remote Control Stations 1 and 2

Time Periods		Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
Background 1	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0
Pre-ignition 1	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0
Burn 1	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0
Post-burn 1	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	2.0

		Remote control boat # 1 ppm	Remote control boat # 2 ppm
Background 2	Minimum	0.0	0.0
	Average	0.3	0.0
	Maximum	6.0	1.0
Pre-ignition 2	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0
Burn 2	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0
Post-burn 2	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.0

NOBE 93 Table 4.4

Carbon Monoxide Results from the Cannonball Remote Control Stations 1 and 2

Time Periods		Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
Background 1	Minimum	0.0	0.0
	Average	0.0	0.1
	Maximum	0.0	0.5
Pre-ignition 1	Minimum	0.0	0.0
	Average	0.0	0.2
	Maximum	0.1	0.9
Burn 1	Minimum	0.0	0.0
	Average	0.5	0.1
	Maximum	2.7	1.9
Post-burn 1	Minimum	0.1	0.0
	Average	0.5	0.1
	Maximum	2.4	4.0

		Remote control boat # 1 ppm	Remote control boat # 2 ppm
Background 2	Minimum	0.0	0.1
	Average	0.7	0.9
	Maximum	5.3	3.2
Pre-ignition 2	Minimum	0.0	0.3
	Average	0.1	0.6
	Maximum	1.5	1.8
Burn 2	Minimum	0.0	0.1
	Average	0.1	0.7
	Maximum	3.1	2.6
Post-burn 2	Minimum	0.0	0.1
	Average	0.0	0.5
	Maximum	0.1	3.4

NOBE 93 Table 4.5 **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
Background 1	8:24	-126		0.0	0.0
	8:25	-125	0.0	0.0	0.0
	8:26	-124	0.0	1.0	0.5
	8:27	-123	0.0	2.0	1.0
	8:28	-122	0.0	2.0	1.0
	8:29	-121	0.0	1.0	0.5
	8:30	-120	0.0	1.0	0.5
	8:31	-119	0.0	1.0	0.5
	8:32	-118	0.0	0.0	0.0
	8:33	-117	0.0	0.0	0.0
	8:34	-116	0.0	0.0	0.0
	8:35	-115	0.0	0.0	0.0
	8:36	-114	0.0	0.0	0.0
	8:37	-113	0.0	0.0	0.0
	8:38	-112	0.0	0.0	0.0
	8:39	-111	0.0	0.0	0.0
	8:40	-110	0.0	0.0	0.0
	8:41	-109	0.0	0.0	0.0
	8:42	-108	0.0	0.0	0.0
	8:43	-107	0.0	0.0	0.0
	8:44	-106	0.0	0.0	0.0
	8:45	-105	0.0	0.0	0.0
	8:46	-104	0.0	0.0	0.0
	8:47	-103	0.0	2.0	1.0
	8:48	-102	0.0	2.0	1.0
	8:49	-101		2.0	1.0
	8:50	-100		4.0	2.0
	8:51	-99	1.0	2.0	1.5
	8:52	-98	1.0	2.0	1.5
	8:53	-97	1.0	2.0	1.5
	8:54	-96	1.0	2.0	1.5
	8:55	-95	0.0	2.0	1.0
	8:56	-94	0.0	1.0	0.5
	8:57	-93	0.0	2.0	1.0
	8:58	-92	0.0	2.0	1.0
	8:59	-91	0.0	2.0	1.0
	9:00	-90	0.0	2.0	1.0
	9:01	-89	0.0	2.0	1.0
	9:02	-88	0.0	2.0	1.0
	9:03	-87	0.0	2.0	1.0
	9:04	-86	0.0	2.0	1.0
	9:05	-85	0.0	2.0	1.0
	9:06	-84	0.0	2.0	1.0
	9:07	-83	0.0	2.0	1.0
	9:08	-82	0.0	2.0	1.0
	9:09	-81	0.0	2.0	1.0
	9:10	-80	0.0	2.0	1.0
	9:11	-79	0.0	2.0	1.0

NOBE 93 Table 4.5 cont. **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	9:12	-78	0.0	2.0	1.0
	9:13	-77	0.0	2.0	1.0
	9:14	-76	0.0	2.0	1.0
	9:15	-75	0.0	2.0	1.0
	9:16	-74	0.0	2.0	1.0
	9:17	-73	1.0	2.0	1.5
	9:18	-72	1.0	2.0	1.5
	9:19	-71	1.0	2.0	1.5
	9:20	-70	1.0	2.0	1.5
	9:21	-69	1.0	2.0	1.5
	9:22	-68	1.0	3.0	2.0
	9:23	-67	1.0	3.0	2.0
	9:24	-66	1.0	2.0	1.5
	9:25	-65	1.0	2.0	1.5
	9:26	-64	1.0	2.0	1.5
	9:27	-63	1.0	1.0	1.0
	9:28	-62	1.0	1.0	1.0
	9:29	-61	1.0	1.0	1.0
Pre-ignition 1	9:30	-60	1.0	1.0	1.0
	9:31	-59	1.0	1.0	1.0
	9:32	-58	1.0	1.0	1.0
	9:33	-57	2.0	1.0	1.5
	9:34	-56	1.0	1.0	1.0
	9:35	-55	1.0	1.0	1.0
	9:36	-54	1.0	1.0	1.0
	9:37	-53	1.0	1.0	1.0
	9:38	-52	1.0	1.0	1.0
	9:39	-51	1.0	1.0	1.0
	9:40	-50	1.0	1.0	1.0
	9:41	-49	1.0	1.0	1.0
	9:42	-48	1.0	1.0	1.0
	9:43	-47	1.0	1.0	1.0
	9:44	-46	1.0	1.0	1.0
	9:45	-45	1.0	1.0	1.0
	9:46	-44	1.0	1.0	1.0
	9:47	-43	1.0	1.0	1.0
	9:48	-42	1.0	1.0	1.0
	9:49	-41	1.0	1.0	1.0
	9:50	-40	1.0	2.0	1.5
	9:51	-39	1.0	2.0	1.5
	9:52	-38	1.0	2.0	1.5
	9:53	-37	1.0	2.0	1.5
	9:54	-36			
	9:55	-35	1.0	3.0	2.0
	9:56	-34	1.0	2.0	1.5
	9:57	-33	1.0	2.0	1.5
	9:58	-32	1.0	2.0	1.5

NOBE 93 Table 4.5 cont. **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	9:59	-31	1.0	2.0	1.5
	10:00	-30	1.0	2.0	1.5
	10:01	-29	1.0	2.0	1.5
	10:02	-28	1.0	2.0	1.5
	10:03	-27		2.0	2.0
	10:04	-26	1.0	3.0	2.0
	10:05	-25	1.0	2.0	1.5
	10:06	-24	1.0	2.0	1.5
	10:07	-23	2.0	2.0	2.0
	10:08	-22	1.0	2.0	1.5
	10:09	-21		2.0	2.0
	10:10	-20		2.0	2.0
	10:11	-19	2.0	2.0	2.0
	10:12	-18	1.0	2.0	1.5
	10:13	-17	1.0	2.0	1.5
	10:14	-16	2.0	3.0	2.5
	10:15	-15	1.0	2.0	1.5
	10:16	-14	2.0	2.0	2.0
	10:17	-13	2.0	2.0	2.0
	10:18	-12	2.0	2.0	2.0
	10:19	-11	1.0	2.0	1.5
	10:20	-10		2.0	2.0
	10:21	-9		2.0	2.0
	10:22	-8	1.0	2.0	1.5
	10:23	-7	2.0	3.0	2.5
	10:24	-6	2.0	4.0	3.0
	10:25	-5	2.0	3.0	2.5
	10:26	-4	2.0	3.0	2.5
	10:27	-3	2.0	3.0	2.5
	10:28	-2	2.0	3.0	2.5
	10:29	-1	2.0	1.0	1.5
Burn 1	10:30	0	2.0	1.0	1.5
	10:31	1	2.0	3.0	2.5
	10:32	2	2.0	3.0	2.5
	10:33	3	2.0	3.0	2.5
	10:34	4	1.0	3.0	2.0
	10:35	5	1.0	2.0	1.5
	10:36	6	1.0	2.0	1.5
	10:37	7	2.0	2.0	2.0
	10:38	8	1.0	1.0	1.0
	10:39	9	1.0	2.0	1.5
	10:40	10	1.0	2.0	1.5
	10:41	11		2.0	1.0
	10:42	12	1.0	1.0	1.0
	10:43	13	1.0	2.0	1.5
	10:44	14	1.0	2.0	1.5
	10:45	15	1.0	2.0	1.5

NOBE 93 Table 4.5 cont. **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	10:46	16	1.0	2.0	1.5
	10:47	17	1.0	2.0	1.5
	10:48	18	1.0	2.0	1.5
	10:49	19	1.0	2.0	1.5
	10:50	20	1.0	2.0	1.5
	10:51	21	0.0	2.0	1.0
	10:52	22	0.0	1.0	0.5
	10:53	23	0.0	1.0	0.5
	10:54	24	0.0	1.0	0.5
	10:55	25	0.0	1.0	0.5
	10:56	26	0.0	1.0	0.5
	10:57	27	0.0	1.0	0.5
	10:58	28	0.0	1.0	0.5
	10:59	29	0.0	1.0	0.5
	11:00	30	0.0	1.0	0.5
	11:01	31	0.0	1.0	0.5
	11:02	32	0.0	0.0	0.0
	11:03	33	0.0	0.0	0.0
	11:04	34	0.0	1.0	0.5
	11:05	35	0.0	1.0	0.5
	11:06	36	0.0	0.0	0.0
	11:07	37	0.0	0.0	0.0
	11:08	38	0.0	0.0	0.0
	11:09	39	0.0	0.0	0.0
	11:10	40	0.0	0.0	0.0
	11:11	41	0.0	0.0	0.0
	11:12	42	0.0	0.0	0.0
	11:13	43	0.0	0.0	0.0
	11:14	44	0.0	0.0	0.0
	11:15	45	0.0	0.0	0.0
	11:16	46	0.0	0.0	0.0
	11:17	47	0.0	0.0	0.0
	11:18	48	0.0	0.0	0.0
	11:19	49	0.0	0.0	0.0
	11:20	50	0.0	0.0	0.0
	11:21	51	0.0	0.0	0.0
	11:22	52	0.0	0.0	0.0
	11:23	53	0.0	0.0	0.0
	11:24	54	0.0	0.0	0.0
	11:25	55	0.0	0.0	0.0
	11:26	56	0.0	0.0	0.0
	11:27	57		1.0	0.5
	11:28	58	0.0	0.0	0.0
	11:29	59	0.0	0.0	0.0
	11:30	60	0.0	0.0	0.0
	11:31	61	0.0	0.0	0.0
	11:32	62	0.0	0.0	0.0
	11:33	63	0.0	0.0	0.0

NOBE 93 Table 4.5 cont. **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	11:34	64	0.0	0.0	0.0
	11:35	65	0.0	0.0	0.0
	11:36	66	0.0	0.0	0.0
	11:37	67	0.0	0.0	0.0
	11:38	68	0.0	0.0	0.0
	11:39	69	0.0	0.0	0.0
	11:40	70	0.0	0.0	0.0
	11:41	71	0.0	1.0	0.5
	11:42	72	0.0	1.0	0.5
	11:43	73	0.0	0.0	0.0
	11:44	74	0.0	0.0	0.0
	11:45	75	0.0	0.0	0.0
	11:46	76	0.0	0.0	0.0
	11:47	77	0.0	0.0	0.0
	11:48	78	0.0	0.0	0.0
	11:49	79	0.0	0.0	0.0
	11:50	80		0.0	0.0
Background 2	13:31	-35		1.0	1.0
	13:32	-34		1.0	1.0
	13:33	-33		1.0	1.0
	13:34	-32		1.0	1.0
	13:35	-31		0.0	0.0
	13:36	-30	3.0	0.0	1.5
	13:37	-29	2.0	1.0	1.5
	13:38	-28	2.0	1.0	1.5
	13:39	-27	2.0	1.0	1.5
	13:40	-26	2.0	2.0	2.0
	13:41	-25	2.0	2.0	2.0
	13:42	-24	2.0	1.0	1.5
	13:43	-23	2.0	1.0	1.5
	13:44	-22	2.0	1.0	1.5
	13:45	-21	2.0	1.0	1.5
	13:46	-20	2.0	1.0	1.5
	13:47	-19	2.0	1.0	1.5
	13:48	-18	1.0	1.0	1.0
	13:49	-17	1.0	1.0	1.0
	13:50	-16	2.0	1.0	1.5
	13:51	-15	2.0	1.0	1.5
Pre-ignition 2	13:52	-14	2.0	1.0	1.5
	13:53	-13	2.0	1.0	1.5
	13:54	-12	2.0	1.0	1.5
	13:55	-11	2.0	1.0	1.5
	13:56	-10	2.0	1.0	1.5
	13:57	-9	2.0	1.0	1.5
	13:58	-8	2.0	0.0	1.0
	13:59	-7	2.0	0.0	1.0

NOBE 93 Table 4.5 cont. **Carbon Monoxide - Downwind Station (CCG 206)**

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	14:00	-6	1.0	0.0	0.5
	14:01	-5	1.0	0.0	0.5
	14:02	-4	2.0	0.0	1.0
	14:03	-3	2.0	1.0	1.5
	14:04	-2	1.0	1.0	1.0
	14:05	-1	1.0	1.0	1.0
Burn 2	14:06	0	2.0	1.0	1.5
	14:07	1	2.0	2.0	2.0
	14:08	2	2.0	2.0	2.0
	14:09	3	1.0	3.0	2.0
	14:10	4	2.0	3.0	2.5
	14:11	5	2.0	3.0	2.5
	14:12	6	2.0	3.0	2.5
	14:13	7	2.0	3.0	2.5
	14:14	8	1.0	2.0	1.5
	14:15	9	1.0	2.0	1.5
	14:16	10	1.0	3.0	2.0
	14:17	11	1.0	3.0	2.0
	14:18	12	1.0	3.0	2.0
	14:19	13	1.0	3.0	2.0
	14:20	14	1.0	3.0	2.0
	14:21	15	1.0	3.0	2.0
	14:22	16	1.0	3.0	2.0
	14:23	17	1.0	3.0	2.0
	14:24	18	1.0	3.0	2.0
	14:25	19	1.0	3.0	2.0
	14:26	20	1.0	3.0	2.0
	14:27	21	1.0	3.0	2.0
	14:28	22	1.0	3.0	2.0
	14:29	23	1.0	2.0	1.5
	14:30	24	1.0	3.0	2.0
	14:31	25	1.0	3.0	2.0
	14:32	26	1.0	3.0	2.0
	14:33	27	1.0	2.0	1.5
	14:34	28	1.0	2.0	1.5
	14:35	29		3.0	3.0
	14:36	30	2.0	3.0	2.5
	14:37	31	1.0	4.0	2.5
	14:38	32	2.0	3.0	2.5
	14:39	33	3.0	4.0	3.5
	14:40	34	2.0	5.0	3.5
	14:41	35	1.0	4.0	2.5
	14:42	36	2.0	4.0	3.0
	14:43	37	1.0	4.0	2.5
	14:44	38	2.0	4.0	3.0
	14:45	39	2.0	4.0	3.0
	14:46	40	1.0	4.0	2.5

NOBE 93 Table 4.5 cont. Carbon Monoxide - Downwind Station (CCG 206)

Metrosonics aq-501

CCG 206 - approximately 900 m downwind from apex of fireboom for Burn 1
500 to 600 m from apex of fireboom for Burn 2

Time Periods	Time Recorded (hh:mm)	Time Elapsed (min)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	14:47	41		4.0	4.0
	14:48	42		4.0	4.0
	14:49	43	1.0	4.0	2.5
	14:50	44	2.0	4.0	3.0
	14:51	45	1.0	3.0	2.0
	14:52	46	1.0	3.0	2.0
	14:53	47	1.0	1.0	1.0
	14:54	48	2.0	2.0	2.0
	14:55	49			
	14:56	50	1.0	3.0	2.0
	14:57	51	2.0	2.0	2.0
	14:58	52	2.0	2.0	2.0
	14:59	53	2.0	3.0	2.5
	15:00	54	2.0	3.0	2.5
	15:01	55		2.0	2.0
	15:02	56	1.0	2.0	1.5
	15:03	57	2.0	1.0	1.5
	15:04	58	1.0	1.0	1.0
	15:05	59	1.0	1.0	1.0
	15:06	60	1.0	1.0	1.0
	15:07	61	1.0	0.0	0.5
	15:08	62	1.0	0.0	0.5
	15:09	63	1.0	0.0	0.5
	15:10	64	1.0	0.0	0.5
	15:11	65	1.0	0.0	0.5
	15:12	66	1.0	0.0	0.5
	15:13	67	1.0	0.0	0.5
	15:14	68	1.0	0.0	0.5
	15:15	69	1.0	0.0	0.5
	15:16	70	1.0	0.0	0.5
	15:17	71	1.0	0.0	0.5
	15:18	72	1.0	0.0	0.5
	15:19	73	1.0	0.0	0.5
Post-burn 2	15:20	74	1.0	1.0	1.0
	15:21	75		1.0	1.0
	15:22	76	1.0	1.0	1.0
	15:23	77	1.0	1.0	1.0
	15:24	78	1.0	1.0	1.0
	15:25	79	2.0	1.0	1.5
	15:26	80	2.0	1.0	1.5
	15:27	81		1.0	1.0

NOBE 93 Table 4.6

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
Background 1	08:21:00	-129.0		0
	08:21:30	-128.5		0
	08:22:00	-128.0		0
	08:22:30	-127.5		0
	08:23:00	-127.0		0
	08:23:30	-126.5		0
	08:24:00	-126.0		0
	08:24:30	-125.5		0
	08:25:00	-125.0		0
	08:25:30	-124.5		0
	08:26:00	-124.0		0
	08:26:30	-123.5		0
	08:27:00	-123.0		0
	08:27:30	-122.5		0
	08:38:00	-112.0	0	0
	08:38:30	-111.5	0	0
	08:39:00	-111.0	0	0
	08:39:30	-110.5	0	0
	08:40:00	-110.0	0	0
	08:40:30	-109.5	0	0
	08:41:00	-109.0	0	0
	08:41:30	-108.5	0	0
	08:42:00	-108.0	0	0
	08:42:30	-107.5	0	0
	08:43:00	-107.0	0	0
	08:43:30	-106.5	0	0
	08:44:00	-106.0	0	0
	08:44:30	-105.5	0	0
	08:45:00	-105.0	0	0
	08:45:30	-104.5	0	0
	08:46:00	-104.0	0	0
	08:46:30	-103.5	0	0
	08:47:00	-103.0	0	0
	08:47:30	-102.5	0	0
	08:48:00	-102.0	0	0
	08:48:30	-101.5	0	0
	08:49:00	-101.0	0	0
	08:49:30	-100.5	0	0
	08:50:00	-100.0	0	0
	08:50:30	-99.5	0	0
	08:51:00	-99.0	0	0
	08:51:30	-98.5	0	0
	08:52:00	-98.0	0	0
	08:52:30	-97.5	0	0
	08:53:00	-97.0	0	0
	08:53:30	-96.5	0	0
	08:54:00	-96.0	0	0
	08:54:30	-95.5	0	0
	08:55:00	-95.0	0	0
	08:55:30	-94.5	0	0
	08:56:00	-94.0	0	0
	08:56:30	-93.5	0	0
	08:57:00	-93.0	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	08:57:30	-92.5	0	0
	08:58:00	-92.0	0	0
	08:58:30	-91.5	0	0
	08:59:00	-91.0	0	0
	08:59:30	-90.5	0	0
	09:00:00	-90.0	0	0
	09:00:30	-89.5	0	0
	09:01:00	-89.0	0	0
	09:01:30	-88.5	0	0
	09:02:00	-88.0	0	0
	09:02:30	-87.5	0	0
	09:03:00	-87.0	0	0
	09:03:30	-86.5	0	0
	09:04:00	-86.0	0	0
	09:04:30	-85.5	0	0
	09:05:00	-85.0	0	0
	09:05:30	-84.5	0	0
	09:06:00	-84.0	0	0
	09:06:30	-83.5	0	0
	09:07:00	-83.0	0	0
	09:07:30	-82.5	0	0
	09:08:00	-82.0	0	0
	09:08:30	-81.5	0	0
	09:09:00	-81.0	0	0
	09:09:30	-80.5	0	0
	09:10:00	-80.0	0	0
	09:10:30	-79.5	0	0
	09:11:00	-79.0	0	0
	09:11:30	-78.5	0	0
	09:12:00	-78.0	0	0
	09:12:30	-77.5	0	0
	09:13:00	-77.0	0	0
	09:13:30	-76.5	0	0
	09:14:00	-76.0	0	0
	09:14:30	-75.5	0	0
	09:15:00	-75.0	0	0
	09:15:30	-74.5	0	0
	09:16:00	-74.0	0	0
	09:16:30	-73.5	0	0
	09:17:00	-73.0	0	0
	09:17:30	-72.5	0	0
	09:18:00	-72.0	0	0
	09:18:30	-71.5	0	0
	09:19:00	-71.0	0	0
	09:19:30	-70.5	0	0
	09:20:00	-70.0	0	0
	09:20:30	-69.5	0	0
	09:21:00	-69.0	0	0
	09:21:30	-68.5	0	0
	09:22:00	-68.0	0	0
	09:22:30	-67.5	0	0
	09:23:00	-67.0	0	0
	09:23:30	-66.5	0	0
	09:24:00	-66.0	0	0
	09:24:30	-65.5	0	0
	09:25:00	-65.0	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	09:25:30	-64.5		0
	09:26:00	-64.0		0
	09:26:30	-63.5		0
	09:27:00	-63.0		0
	09:27:30	-62.5		0
	09:28:00	-62.0		0
	09:28:30	-61.5		0
	09:29:00	-61.0		0
	09:29:30	-60.5		0
Pre-ignition 1	09:30:00	-60.0	0	0
	09:30:30	-59.5	0	0
	09:31:00	-59.0	0	0
	09:31:30	-58.5	0	0
	09:32:00	-58.0	0	0
	09:32:30	-57.5	0	0
	09:33:00	-57.0	0	0
	09:33:30	-56.5	0	0
	09:34:00	-56.0	0	0
	09:34:30	-55.5	0	0
	09:35:00	-55.0	0	0
	09:35:30	-54.5	0	0
	09:36:00	-54.0	0	0
	09:36:30	-53.5	0	0
	09:37:00	-53.0	0	0
	09:37:30	-52.5	0	0
	09:38:00	-52.0	0	0
	09:38:30	-51.5	0	0
	09:39:00	-51.0	0	0
	09:39:30	-50.5	0	0
	09:40:00	-50.0	0	0
	09:40:30	-49.5	0	0
	09:41:00	-49.0	0	0
	09:41:30	-48.5	0	0
	09:42:00	-48.0	0	0
	09:42:30	-47.5	0	0
	09:43:00	-47.0	0	0
	09:43:30	-46.5	0	0
	09:44:00	-46.0	0	0
	09:44:30	-45.5	0	0
	09:45:00	-45.0	0	0
	09:45:30	-44.5	0	0
	09:46:00	-44.0	0	0
	09:46:30	-43.5	0	0
	09:47:00	-43.0	0	0
	09:47:30	-42.5	0	0
	09:48:00	-42.0	0	0
	09:48:30	-41.5	0	0
	09:49:00	-41.0	0	0
	09:49:30	-40.5	0	0
	09:50:00	-40.0	0	0
	09:50:30	-39.5	0	0
	09:51:00	-39.0	0	0
	09:51:30	-38.5	0	0
	09:52:00	-38.0	0	0
	09:52:30	-37.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	09:53:00	-37.0	0	0
	09:53:30	-36.5	0	0
	09:54:00	-36.0	0	0
	09:54:30	-35.5	0	0
	09:55:00	-35.0	0	0
	09:55:30	-34.5	0	0
	09:56:00	-34.0	0	0
	09:56:30	-33.5	0	0
	09:57:00	-33.0	0	0
	09:57:30	-32.5	0	0
	09:58:00	-32.0	0	0
	09:58:30	-31.5	0	0
	09:59:00	-31.0	0	0
	09:59:30	-30.5	0	0
	10:00:00	-30.0	0	0
	10:00:30	-29.5	0	0
	10:01:00	-29.0	0	0
	10:01:30	-28.5	0	0
	10:02:00	-28.0	0	0
	10:02:30	-27.5	0	0
	10:03:00	-27.0	0	0
	10:03:30	-26.5	0	0
	10:04:00	-26.0	0	0
	10:04:30	-25.5	0	0
	10:05:00	-25.0	0	0
	10:05:30	-24.5	0	0
	10:06:00	-24.0	0	0
	10:06:30	-23.5	0	0
	10:07:00	-23.0	0	0
	10:07:30	-22.5	0	0
	10:08:00	-22.0	0	0
	10:08:30	-21.5	0	0
	10:09:00	-21.0	0	0
	10:09:30	-20.5	0	0
	10:10:00	-20.0	0	0
	10:10:30	-19.5	0	0
	10:11:00	-19.0	0	0
	10:11:30	-18.5	0	0
	10:12:00	-18.0	0	0
	10:12:30	-17.5	0	0
	10:13:00	-17.0	0	0
	10:13:30	-16.5	0	0
	10:14:00	-16.0	0	0
	10:14:30	-15.5	0	0
	10:15:00	-15.0	0	0
	10:15:30	-14.5	0	0
	10:16:00	-14.0	0	0
	10:16:30	-13.5	0	0
	10:17:00	-13.0	0	0
	10:17:30	-12.5		0
	10:18:00	-12.0	0	0
	10:18:30	-11.5	0	0
	10:19:00	-11.0	0	0
	10:19:30	-10.5	0	0
	10:20:00	-10.0	0	0
	10:20:30	-9.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	10:21:00	-9.0	0	0
	10:21:30	-8.5	0	0
	10:22:00	-8.0	0	0
	10:22:30	-7.5	0	0
	10:23:00	-7.0	0	0
	10:23:30	-6.5	0	0
	10:24:00	-6.0	0	0
	10:24:30	-5.5	0	0
	10:25:00	-5.0	0	
	10:25:30	-4.5	0	0
	10:26:00	-4.0	0	0
	10:26:30	-3.5	0	0
	10:27:00	-3.0	0	0
	10:27:30	-2.5	0	0
	10:28:00	-2.0	0	0
	10:28:30	-1.5	0	0
	10:29:00	-1.0	0	0
	10:29:30	-0.5	0	0
Burn 1	10:30:00	0.0	0	0
	10:30:30	0.5	0	
	10:31:00	1.0	0	0
	10:31:30	1.5	0	0
	10:32:00	2.0	0	0
	10:32:30	2.5	0	0
	10:33:00	3.0	0	0
	10:33:30	3.5	0	0
	10:34:00	4.0	0	0
	10:34:30	4.5	0	0
	10:35:00	5.0	0	0
	10:35:30	5.5	0	0
	10:36:00	6.0	0	0
	10:36:30	6.5	0	0
	10:37:00	7.0		0
	10:37:30	7.5		0
	10:38:00	8.0		0
	10:38:30	8.5		0
	10:39:00	9.0		0
	10:39:30	9.5		0
	10:40:00	10.0		0
	10:40:30	10.5		0
	10:41:00	11.0		0
	10:41:30	11.5		0
	10:42:00	12.0		0
	10:42:30	12.5		0
	10:43:00	13.0		0
	10:43:30	13.5		0
	10:44:00	14.0		0
	10:44:30	14.5		0
	10:45:00	15.0		0
	10:45:30	15.5		0
	10:46:00	16.0		0
	10:46:30	16.5		0
	10:47:00	17.0	0	
	10:47:30	17.5	0	

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
R/C boat changed	10:48:00	18.0	0	
	10:48:30	18.5	0	
	10:49:00	19.0	0	
	10:49:30	19.5	0	
	10:50:00	20.0	0	
	10:50:30	20.5	0	
	10:51:00	21.0	0	
	10:51:30	21.5	0	
	10:52:00	22.0	0	
	10:52:30	22.5	0	
	10:53:00	23.0	0	
	10:53:30	23.5	0	
	10:54:00	24.0	0	
	10:54:30	24.5	0	
	10:55:00	25.0	0	
	10:55:30	25.5	0	
	10:56:00	26.0	0	
	10:56:30	26.5	0	
	10:57:00	27.0	0	
	10:57:30	27.5	0	
	10:58:00	28.0	0	
	10:58:30	28.5	0	
	10:59:00	29.0	0	
	10:59:30	29.5	0	
	11:00:00	30.0	0	
	11:00:30	30.5	0	
	11:01:00	31.0	0	
	11:01:30	31.5	0	
	11:02:00	32.0	0	
	11:02:30	32.5	0	
	11:03:00	33.0	0	
	11:03:30	33.5	0	
	11:04:00	34.0	0	
	11:04:30	34.5	0	
	11:05:00	35.0	0	
	11:05:30	35.5	0	
	11:06:00	36.0	0	
	11:06:30	36.5	0	
	11:07:00	37.0	0	
	11:07:30	37.5	0	
	11:08:00	38.0	0	
	11:08:30	38.5	0	
	11:09:00	39.0	0	
	11:09:30	39.5	0	
	11:10:00	40.0	0	
	11:10:30	40.5	0	
	11:11:00	41.0	0	
	11:11:30	41.5	0	
	11:12:00	42.0	0	
	11:12:30	42.5	0	
	11:13:00	43.0	0	
	11:13:30	43.5	0	
	11:14:00	44.0	0	
	11:14:30	44.5	0	
	11:15:00	45.0	0	
	11:15:30	45.5	0	

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	11:16:00	46.0	0	
	11:16:30	46.5	0	
	11:17:00	47.0	0	
	11:17:30	47.5	0	
	11:18:00	48.0	0	
	11:18:30	48.5	0	
	11:19:00	49.0	0	
	11:19:30	49.5	0	
	11:20:00	50.0	0	
	11:20:30	50.5	0	
	11:21:00	51.0	0	
	11:21:30	51.5	0	
	11:22:00	52.0	0	
	11:22:30	52.5	0	
	11:23:00	53.0	0	0
	11:23:30	53.5	0	0
	11:24:00	54.0	0	0
	11:24:30	54.5	0	0
	11:25:00	55.0	0	0
	11:25:30	55.5	0	0
	11:26:00	56.0	0	0
	11:26:30	56.5	0	0
	11:27:00	57.0	0	0
	11:27:30	57.5	0	0
	11:28:00	58.0	0	0
	11:28:30	58.5	0	0
	11:29:00	59.0	0	0
	11:29:30	59.5	0	0
	11:30:00	60.0	0	0
	11:30:30	60.5	0	0
	11:31:00	61.0	0	0
	11:31:30	61.5	0	0
	11:32:00	62.0	0	0
	11:32:30	62.5	0	0
	11:33:00	63.0	0	0
	11:33:30	63.5	0	0
	11:34:00	64.0	0	0
	11:34:30	64.5	0	0
	11:35:00	65.0	0	0
	11:35:30	65.5	0	0
	11:36:00	66.0	0	0
	11:36:30	66.5	0	0
	11:37:00	67.0	0	0
	11:37:30	67.5	0	0
	11:38:00	68.0	0	0
	11:38:30	68.5	0	0
	11:39:00	69.0	0	0
	11:39:30	69.5	0	0
	11:40:00	70.0	0	0
	11:40:30	70.5	0	0
	11:41:00	71.0	0	0
	11:41:30	71.5	0	0
	11:42:00	72.0	0	0
	11:42:30	72.5	0	0
	11:43:00	73.0	0	0
	11:43:30	73.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	11:44:00	74.0	0	0
	11:44:30	74.5	0	0
	11:45:00	75.0	0	0
	11:45:30	75.5	0	0
	11:46:00	76.0	0	0
	11:46:30	76.5	0	0
	11:47:00	77.0	0	0
	11:47:30	77.5	0	0
	11:48:00	78.0	0	0
	11:48:30	78.5	0	0
	11:49:00	79.0	0	0
	11:49:30	79.5	0	0
	11:50:00	80.0	0	0
	11:50:30	80.5	0	0
	11:51:00	81.0	0	0
	11:51:30	81.5	0	0
	11:52:00	82.0	0	0
	11:52:30	82.5	0	0
	11:53:00	83.0	0	0
	11:53:30	83.5	0	0
	11:54:00	84.0	0	0
	11:54:30	84.5	0	0
	11:55:00	85.0	0	0
	11:55:30	85.5	0	0
	11:56:00	86.0	0	0
	11:56:30	86.5	0	0
	11:57:00	87.0	0	0
	11:57:30	87.5	0	0
	11:58:00	88.0	0	0
	11:58:30	88.5	0	0
	11:59:00	89.0	0	0
	11:59:30	89.5	0	0
	12:00:00	90.0	0	0
	12:00:30	90.5	0	0
	12:01:00	91.0	0	0
	12:01:30	91.5	0	0
	12:02:00	92.0	0	0
	12:02:30	92.5	0	0
	12:03:00	93.0	0	0
	12:03:30	93.5	0	0
	12:04:00	94.0	0	0
Post-burn 1	12:04:30	94.5	0	0
	12:05:00	95.0	0	0
	12:05:30	95.5	0	0
	12:06:00	96.0	0	0
	12:06:30	96.5	0	0
	12:07:00	97.0	0	0
	12:07:30	97.5	0	0
	12:08:00	98.0	0	0
	12:08:30	98.5	0	0
	12:09:00	99.0	0	0
	12:09:30	99.5	0	0
	12:10:00	100.0	0	0
	12:10:30	100.5	0	0
	12:11:00	101.0	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	12:11:30	101.5	0	0
	12:12:00	102.0	0	0
	12:12:30	102.5	0	0
	12:13:00	103.0	0	0
	12:13:30	103.5	0	0
	12:14:00	104.0	0	0
	12:14:30	104.5	0	0
	12:15:00	105.0	0	0
	12:15:30	105.5	0	0
	12:16:00	106.0	0	0
	12:16:30	106.5	0	0
	12:17:00	107.0	0	0
	12:17:30	107.5	0	0
	12:18:00	108.0	0	0
	12:18:30	108.5	0	0
	12:19:00	109.0	0	0
	12:19:30	109.5	0	0
	12:20:00	110.0	0	0
	12:20:30	110.5	0	0
	12:21:00	111.0	0	0
	12:21:30	111.5	0	0
	12:22:00	112.0	0	0
	12:22:30	112.5	0	0
	12:23:00	113.0	0	0
	12:23:30	113.5	0	1
	12:24:00	114.0	0	2
	12:24:30	114.5	0	0
	12:25:00	115.0	0	0
	12:25:30	115.5	0	0
	12:26:00	116.0	0	0
	12:26:30	116.5	0	0
	12:27:00	117.0	0	0
	12:27:30	117.5	0	0
	12:28:00	118.0	0	0
	12:28:30	118.5	0	0
	12:29:00	119.0	0	0
	12:29:30	119.5	0	0
	12:30:00	120.0	0	0
	12:30:30	120.5	0	0
	12:31:00	121.0	0	0
	12:31:30	121.5	0	0
	12:32:00	122.0	0	0
	12:32:30	122.5	0	0
	12:33:00	123.0	0	0
	12:33:30	123.5	0	0
	12:34:00	124.0	0	0
	12:34:30	124.5	0	0
	12:35:00	125.0	0	0
	12:35:30	125.5	0	0
	12:36:00	126.0	0	0
	12:36:30	126.5	0	0
	12:37:00	127.0	0	0
	12:37:30	127.5	0	0
	12:38:00	128.0	0	0
	12:38:30	128.5	0	0
	12:39:00	129.0	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire	Remote Station # 2 100-150 m from the fire
			Remote control boat # 2 ppm	Remote control boat # 1 ppm
	12:39:30	129.5	0	0
	12:40:00	130.0	0	0
	12:40:30	130.5	0	0
	12:41:00	131.0	0	0
	12:41:30	131.5	0	0
	12:42:00	132.0	0	0
	12:42:30	132.5	0	0
	12:43:00	133.0	0	0
	12:43:30	133.5	0	0
	12:44:00	134.0	0	0
	12:44:30	134.5	0	
	12:45:00	135.0	0	1
	12:45:30	135.5	0	0
	12:46:00	136.0	0	0
	12:46:30	136.5	0	0
	12:47:00	137.0	0	0
	12:47:30	137.5	0	0
	12:48:00	138.0	0	0
	12:48:30	138.5	0	0
	12:49:00	139.0	0	0
	12:49:30	139.5	0	0
	12:50:00	140.0	0	0
	12:50:30	140.5	0	0
	12:51:00	141.0	0	0
	12:51:30	141.5	0	0
	12:52:00	142.0	0	0
	12:52:30	142.5	0	0
	12:53:00	143.0	0	0
	12:53:30	143.5	0	0
	12:54:00	144.0	0	0
	12:54:30	144.5	0	0
	12:55:00	145.0	0	0
	12:55:30	145.5	0	0
	12:56:00	146.0	0	0
	12:56:30	146.5	0	0
	12:57:00	147.0	0	0
	12:57:30	147.5	0	0
	12:58:00	148.0	0	0
	12:58:30	148.5	0	0
	12:59:00	149.0	0	0
	12:59:30	149.5	0	0
			Remote Station # 1 50-100 m from the fire	Remote Station # 2 100-150 m from the fire
	Time Recorded	Time Elapsed	Remote control boat # 1 ppm	Remote control boat # 2 ppm
Background 2	13:00:00	-66.0	0	0
	13:00:30	-65.5	0	0
	13:01:00	-65.0	0	0
	13:01:30	-64.5	0	0
	13:02:00	-64.0	0	0
	13:02:30	-63.5	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	13:03:00	-63.0	0	0
	13:03:30	-62.5	0	0
	13:04:00	-62.0	0	0
	13:04:30	-61.5	0	1
	13:05:00	-61.0	0	0
	13:05:30	-60.5	0	0
	13:06:00	-60.0	0	0
	13:06:30	-59.5	0	0
	13:07:00	-59.0	1	0
	13:07:30	-58.5	2	0
	13:08:00	-58.0	0	0
	13:08:30	-57.5	0	0
	13:09:00	-57.0	0	0
	13:09:30	-56.5	0	0
	13:10:00	-56.0	0	0
	13:10:30	-55.5	0	0
	13:11:00	-55.0	0	0
	13:11:30	-54.5	3	0
	13:12:00	-54.0	0	0
	13:12:30	-53.5	6	0
	13:13:00	-53.0	0	0
	13:13:30	-52.5	0	0
	13:14:00	-52.0	0	0
	13:14:30	-51.5	2	0
	13:15:00	-51.0	4	0
	13:15:30	-50.5	0	0
	13:16:00	-50.0		0
	13:16:30	-49.5		0
	13:17:00	-49.0	2	0
	13:17:30	-48.5	0	0
	13:18:00	-48.0	0	0
	13:18:30	-47.5		0
	13:19:00	-47.0		0
	13:19:30	-46.5	0	0
	13:20:00	-46.0	0	0
	13:20:30	-45.5	0	0
	13:21:00	-45.0	0	0
	13:21:30	-44.5	1	0
	13:22:00	-44.0	0	0
	13:22:30	-43.5	0	0
	13:23:00	-43.0	0	0
	13:23:30	-42.5	1	0
	13:24:00	-42.0	2	0
	13:24:30	-41.5	1	0
	13:25:00	-41.0		0
	13:25:30	-40.5		0
	13:26:00	-40.0	0	0
	13:26:30	-39.5		0
	13:27:00	-39.0		0
	13:27:30	-38.5		0
	13:28:00	-38.0		0
	13:28:30	-37.5		0
	13:29:00	-37.0	0	0
	13:29:30	-36.5	0	0
	13:30:00	-36.0	0	0
	13:30:30	-35.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	13:31:00	-35.0	0	0
	13:31:30	-34.5	0	0
	13:32:00	-34.0	0	0
	13:32:30	-33.5	0	0
	13:33:00	-33.0	0	0
	13:33:30	-32.5	0	0
	13:34:00	-32.0	0	0
	13:34:30	-31.5	0	0
	13:35:00	-31.0	0	0
	13:35:30	-30.5	0	0
	13:36:00	-30.0	0	0
	13:36:30	-29.5	0	0
	13:37:00	-29.0	0	0
	13:37:30	-28.5	0	0
	13:38:00	-28.0	0	0
	13:38:30	-27.5	0	0
	13:39:00	-27.0	0	0
	13:39:30	-26.5	0	0
	13:40:00	-26.0	0	0
	13:40:30	-25.5	0	0
	13:41:00	-25.0	0	0
	13:41:30	-24.5	0	0
	13:42:00	-24.0	0	0
	13:42:30	-23.5	0	0
	13:43:00	-23.0	0	0
	13:43:30	-22.5	0	0
	13:44:00	-22.0	0	0
	13:44:30	-21.5	0	0
	13:45:00	-21.0	0	0
	13:45:30	-20.5	0	0
	13:46:00	-20.0	0	0
	13:46:30	-19.5	0	0
	13:47:00	-19.0	0	0
	13:47:30	-18.5	0	0
	13:48:00	-18.0	0	0
	13:48:30	-17.5	0	0
	13:49:00	-17.0	0	0
	13:49:30	-16.5	0	0
	13:50:00	-16.0	0	0
	13:50:30	-15.5	0	0
	13:51:00	-15.0	0	0
	13:51:30	-14.5	0	0
Pre-ignition 2	13:52:00	-14.0	0	0
	13:52:30	-13.5	0	0
	13:53:00	-13.0	0	0
	13:53:30	-12.5	0	0
	13:54:00	-12.0	0	0
	13:54:30	-11.5	0	0
	13:55:00	-11.0	0	0
	13:55:30	-10.5	0	0
	13:56:00	-10.0	0	0
	13:56:30	-9.5	0	0
	13:57:00	-9.0	0	0
	13:57:30	-8.5	0	0
	13:58:00	-8.0	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	13:58:30	-7.5	0	0
	13:59:00	-7.0	0	0
	13:59:30	-6.5	0	0
	14:00:00	-6.0	0	0
	14:00:30	-5.5	0	0
	14:01:00	-5.0	0	0
	14:01:30	-4.5	0	0
	14:02:00	-4.0	0	0
	14:02:30	-3.5	0	0
	14:03:00	-3.0	0	0
	14:03:30	-2.5	0	0
	14:04:00	-2.0	0	0
	14:04:30	-1.5	0	0
	14:05:00	-1.0	0	0
	14:05:30	-0.5	0	0
Burn 2	14:06:00	0.0	0	0
	14:06:30	0.5	0	0
	14:07:00	1.0	0	0
	14:07:30	1.5	0	0
	14:08:00	2.0	0	0
	14:08:30	2.5	0	0
	14:09:00	3.0	0	0
	14:09:30	3.5	0	0
	14:10:00	4.0	0	0
	14:10:30	4.5	0	0
	14:11:00	5.0	0	0
	14:11:30	5.5	0	0
	14:12:00	6.0	0	0
	14:12:30	6.5	0	0
	14:13:00	7.0	0	0
	14:13:30	7.5	0	0
	14:14:00	8.0	0	0
	14:14:30	8.5	0	0
	14:15:00	9.0	0	0
	14:15:30	9.5	0	0
	14:16:00	10.0	0	0
	14:16:30	10.5	0	0
	14:17:00	11.0	0	0
	14:17:30	11.5	0	0
	14:18:00	12.0	0	0
	14:18:30	12.5	0	0
	14:19:00	13.0	0	0
	14:19:30	13.5	0	0
	14:20:00	14.0	0	0
	14:20:30	14.5	0	0
	14:21:00	15.0	0	0
	14:21:30	15.5	0	0
	14:22:00	16.0	0	0
	14:22:30	16.5	0	0
	14:23:00	17.0	0	0
	14:23:30	17.5	0	0
	14:24:00	18.0	0	0
	14:24:30	18.5	0	0
	14:25:00	19.0	0	0
	14:25:30	19.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	14:26:00	20.0	0	0
	14:26:30	20.5	0	0
	14:27:00	21.0	0	0
	14:27:30	21.5	0	0
	14:28:00	22.0	0	0
	14:28:30	22.5	0	0
	14:29:00	23.0	0	0
	14:29:30	23.5	0	0
	14:30:00	24.0	0	0
	14:30:30	24.5	0	0
	14:31:00	25.0	0	0
	14:31:30	25.5	0	0
	14:32:00	26.0	0	0
	14:32:30	26.5	0	0
	14:33:00	27.0	0	0
	14:33:30	27.5	0	0
	14:34:00	28.0	0	0
	14:34:30	28.5	0	0
	14:35:00	29.0	0	0
	14:35:30	29.5	0	0
	14:36:00	30.0	0	0
	14:36:30	30.5	0	0
	14:37:00	31.0	0	0
	14:37:30	31.5	0	0
	14:38:00	32.0	0	0
	14:38:30	32.5	0	0
	14:39:00	33.0	0	0
	14:39:30	33.5	0	0
	14:40:00	34.0	0	0
	14:40:30	34.5	0	0
	14:41:00	35.0	0	0
	14:41:30	35.5	0	0
	14:42:00	36.0	0	0
	14:42:30	36.5	0	0
	14:43:00	37.0	0	0
	14:43:30	37.5	0	0
	14:44:00	38.0	0	0
	14:44:30	38.5	0	0
	14:45:00	39.0	0	0
	14:45:30	39.5	0	0
	14:46:00	40.0	0	0
	14:46:30	40.5	0	0
	14:47:00	41.0	0	0
	14:47:30	41.5	0	0
	14:48:00	42.0	0	0
	14:48:30	42.5	0	0
	14:49:00	43.0	0	0
	14:49:30	43.5	0	0
	14:50:00	44.0	0	0
	14:50:30	44.5	0	0
	14:51:00	45.0	0	0
	14:51:30	45.5	0	0
	14:52:00	46.0	0	0
	14:52:30	46.5	0	0
	14:53:00	47.0	0	0
	14:53:30	47.5	0	0

NOBE 93 Table 4.6 cont. **Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	14:54:00	48.0	0	0
	14:54:30	48.5	0	0
	14:55:00	49.0	0	0
	14:55:30	49.5	0	0
	14:56:00	50.0	0	0
	14:56:30	50.5	0	0
	14:57:00	51.0	0	0
	14:57:30	51.5	0	0
	14:58:00	52.0	0	0
	14:58:30	52.5	0	0
	14:59:00	53.0	0	0
	14:59:30	53.5	0	0
	15:00:00	54.0	0	0
	15:00:30	54.5	0	0
	15:01:00	55.0	0	0
	15:01:30	55.5	0	0
	15:02:00	56.0	0	0
	15:02:30	56.5	0	0
	15:03:00	57.0	0	0
	15:03:30	57.5	0	0
	15:04:00	58.0	0	0
	15:04:30	58.5	0	0
	15:05:00	59.0	0	0
	15:05:30	59.5	0	0
	15:06:00	60.0	0	0
	15:06:30	60.5	0	0
	15:07:00	61.0	0	0
	15:07:30	61.5	0	0
	15:08:00	62.0	0	0
	15:08:30	62.5	0	0
	15:09:00	63.0	0	0
	15:09:30	63.5	0	0
	15:10:00	64.0	0	0
	15:10:30	64.5	0	0
	15:11:00	65.0	0	0
	15:11:30	65.5	0	0
	15:12:00	66.0	0	0
	15:12:30	66.5	0	0
	15:13:00	67.0	0	0
	15:13:30	67.5	0	0
	15:14:00	68.0	0	0
	15:14:30	68.5	0	0
	15:15:00	69.0	0	0
	15:15:30	69.5	0	0
	15:16:00	70.0	0	0
	15:16:30	70.5	0	0
	15:17:00	71.0	0	0
	15:17:30	71.5	0	0
	15:18:00	72.0	0	0
	15:18:30	72.5	0	0
Post-burn 2	15:19:00	73.0	0	0
	15:19:30	73.5	0	0
	15:20:00	74.0	0	0
	15:20:30	74.5	0	0
	15:21:00	75.0	0	0

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	15:21:30	75.5	0	0
	15:22:00	76.0	0	0
	15:22:30	76.5	0	0
	15:23:00	77.0	0	0
	15:23:30	77.5	0	0
	15:24:00	78.0	0	0
	15:24:30	78.5	0	0
	15:25:00	79.0	0	0
	15:25:30	79.5	0	0
	15:26:00	80.0	0	0
	15:26:30	80.5	0	0
	15:27:00	81.0	0	0
	15:27:30	81.5	0	0
	15:28:00	82.0	0	0
	15:28:30	82.5	0	0
	15:29:00	83.0	0	0
	15:29:30	83.5	0	0
	15:30:00	84.0	0	0
	15:30:30	84.5	0	0
	15:31:00	85.0	0	0
	15:31:30	85.5	0	0
	15:32:00	86.0	0	0
	15:32:30	86.5	0	0
	15:33:00	87.0	0	0
	15:33:30	87.5	0	0
	15:34:00	88.0	0	0
	15:34:30	88.5	0	0
	15:35:00	89.0	0	0
	15:35:30	89.5	0	0
	15:36:00	90.0	0	0
	15:36:30	90.5	0	0
	15:37:00	91.0	0	0
	15:37:30	91.5	0	0
	15:38:00	92.0	0	0
	15:38:30	92.5	0	0
	15:39:00	93.0	0	0
	15:39:30	93.5	0	0
	15:40:00	94.0	0	0
	15:40:30	94.5	0	0
	15:41:00	95.0	0	0
	15:41:30	95.5	0	0
	15:42:00	96.0	0	0
	15:42:30	96.5	0	0
	15:43:00	97.0	0	0
	15:43:30	97.5	0	0
	15:44:00	98.0	0	
	15:44:30	98.5	0	0
	15:45:00	99.0	0	0
	15:45:30	99.5	0	0
	15:46:00	100.0	0	0
	15:46:30		0	
	15:47:00		0	
	15:47:30		0	
	15:48:00		0	
	15:48:30		0	
	15:49:00		0	

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	15:49:30		0	
	15:50:00		0	
	15:50:30		0	
	15:51:00		0	
	15:51:30		0	
	15:52:00		0	
	15:52:30		0	
	15:53:00		0	
	15:53:30		0	
	15:54:00		0	
	15:54:30		0	
	15:55:00		0	
	15:55:30		0	
	15:56:00		0	
	15:56:30		0	
	15:57:00		0	
	15:57:30		0	
	15:58:00		0	
	15:58:30		0	
	15:59:00		0	
	15:59:30		0	
	16:00:00		0	
	16:00:30		0	
	16:01:00		0	
	16:01:30		0	
	16:02:00		0	
	16:02:30		0	
	16:03:00		0	
	16:03:30		0	
	16:04:00		0	
	16:04:30		0	
	16:05:00		0	
	16:05:30		0	
	16:06:00		0	
	16:06:30		0	
	16:07:00		0	
	16:07:30		0	
	16:08:00		0	
	16:08:30		0	
	16:09:00		0	
	16:09:30		0	
	16:10:00		0	
	16:10:30		0	
	16:11:00		0	
	16:11:30		0	
	16:12:00		0	
	16:12:30		0	
	16:13:00		0	
	16:13:30		0	
	16:14:00		0	
	16:14:30		0	
	16:15:00		0	
	16:15:30		0	
	16:16:00		0	
	16:16:30		0	

NOBE 93 Table 4.6 cont.

Carbon Monoxide Results from the Exotox 75 Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	16:17:00		0	
	16:17:30		0	
	16:18:00		0	
	16:18:30		0	
	16:19:00			
	16:19:30			
	16:20:00			
	16:20:30		2	
	16:21:00			
	16:21:30			
	16:22:00			
	16:22:30			
	16:23:00			
	16:23:30			
	16:24:00			
	16:24:30			
	16:25:00			
	16:25:30			
	16:26:00		2	
	16:26:30		0	
	16:27:00		0	
	16:27:30		0	
	16:28:00		0	
	16:28:30		0	
	16:29:00		0	

NOBE 93 Table 4.7 **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
Background 1	8:22:00	-128.0		
	8:22:30	-127.5		
	8:23:00	-127.0		
	8:23:30	-126.5		
	8:24:00	-126.0		
	8:24:30	-125.5		0.1
	8:25:00	-125.0		0.1
	8:25:30	-124.5		0.3
	8:26:00	-124.0		0.3
	8:26:30	-123.5		0.2
	8:27:00	-123.0		0.2
	8:27:30	-122.5		0.1
	8:28:00	-122.0		0.2
	8:28:30	-121.5		0.1
	8:29:00	-121.0		0.2
	8:29:30	-120.5		0.1
	8:30:00	-120.0		0.1
	8:30:30	-119.5		0.4
	8:31:00	-119.0		0.1
	8:31:30	-118.5		0.0
	8:32:00	-118.0		0.1
	8:32:30	-117.5		0.4
	8:33:00	-117.0		0.3
	8:33:30	-116.5		0.5
	8:34:00	-116.0		0.4
	8:34:30	-115.5		0.2
	8:35:00	-115.0		0.1
	8:35:30	-114.5		0.0
	8:36:00	-114.0		0.0
	8:36:30	-113.5		0.0
	8:37:00	-113.0		0.0
	8:37:30	-112.5		0.0
	8:38:00	-112.0		0.1
	8:38:30	-111.5	0.0	0.1
	8:39:00	-111.0	0.0	0.0
	8:39:30	-110.5	0.0	0.0
	8:40:00	-110.0	0.0	0.0
	8:40:30	-109.5	0.0	0.0
	8:41:00	-109.0	0.0	0.0
	8:41:30	-108.5	0.0	0.0
	8:42:00	-108.0	0.0	0.0
	8:42:30	-107.5	0.0	0.1
	8:43:00	-107.0	0.0	0.2
	8:43:30	-106.5	0.0	0.2
	8:44:00	-106.0	0.0	0.2
	8:44:30	-105.5	0.0	0.0
	8:45:00	-105.0	0.0	0.2
	8:45:30	-104.5	0.0	0.2
	8:46:00	-104.0	0.0	0.0
	8:46:30	-103.5	0.0	0.1
	8:47:00	-103.0	0.0	0.0
	8:47:30	-102.5	0.0	0.0
	8:48:00	-102.0	0.0	0.1
	8:48:30	-101.5	0.0	0.0
	8:49:00	-101.0	0.0	0.1
	8:49:30	-100.5	0.0	0.1
	8:50:00	-100.0	0.0	0.0
	8:50:30	-99.5	0.0	0.2
	8:51:00	-99.0	0.0	0.1

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	8:51:30	-98.5	0.0	0.1
	8:52:00	-98.0	0.0	0.2
	8:52:30	-97.5	0.0	0.3
	8:53:00	-97.0	0.0	0.2
	8:53:30	-96.5	0.0	0.3
	8:54:00	-96.0	0.0	0.0
	8:54:30	-95.5	0.0	0.0
	8:55:00	-95.0	0.0	0.1
	8:55:30	-94.5	0.0	0.1
	8:56:00	-94.0	0.0	0.0
	8:56:30	-93.5	0.0	0.0
	8:57:00	-93.0	0.0	0.1
	8:57:30	-92.5	0.0	0.1
	8:58:00	-92.0	0.0	0.0
	8:58:30	-91.5	0.0	0.1
	8:59:00	-91.0	0.0	0.0
	8:59:30	-90.5	0.0	0.0
	9:00:00	-90.0	0.0	0.0
	9:00:30	-89.5	0.0	0.2
	9:01:00	-89.0	0.0	0.0
	9:01:30	-88.5	0.0	0.1
	9:02:00	-88.0	0.0	0.0
	9:02:30	-87.5	0.0	0.0
	9:03:00	-87.0	0.0	0.0
	9:03:30	-86.5	0.0	0.0
	9:04:00	-86.0	0.0	0.0
	9:04:30	-85.5	0.0	0.1
	9:05:00	-85.0	0.0	0.2
	9:05:30	-84.5	0.0	0.2
	9:06:00	-84.0	0.0	0.2
	9:06:30	-83.5	0.0	0.0
	9:07:00	-83.0	0.0	0.1
	9:07:30	-82.5	0.0	0.2
	9:08:00	-82.0	0.0	0.3
	9:08:30	-81.5	0.0	0.3
	9:09:00	-81.0	0.0	0.3
	9:09:30	-80.5	0.0	0.2
	9:10:00	-80.0	0.0	0.2
	9:10:30	-79.5	0.0	0.1
	9:11:00	-79.0	0.0	0.0
	9:11:30	-78.5	0.0	0.0
	9:12:00	-78.0	0.0	0.0
	9:12:30	-77.5	0.0	0.0
	9:13:00	-77.0	0.0	0.0
	9:13:30	-76.5	0.0	0.0
	9:14:00	-76.0	0.0	0.1
	9:14:30	-75.5	0.0	0.1
	9:15:00	-75.0	0.0	0.0
	9:15:30	-74.5	0.0	0.2
	9:16:00	-74.0	0.0	0.1
	9:16:30	-73.5	0.0	0.1
	9:17:00	-73.0	0.0	0.1
	9:17:30	-72.5	0.0	0.0
	9:18:00	-72.0	0.0	0.1
	9:18:30	-71.5	0.0	0.0
	9:19:00	-71.0	0.0	0.0
	9:19:30	-70.5	0.0	0.1
	9:20:00	-70.0	0.0	0.0
	9:20:30	-69.5	0.0	0.0
	9:21:00	-69.0	0.0	0.1
	9:21:30	-68.5	0.0	0.0

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	9:22:00	-68.0	0.0	0.0
	9:22:30	-67.5	0.0	0.0
	9:23:00	-67.0	0.0	0.4
	9:23:30	-66.5	0.0	0.2
	9:24:00	-66.0	0.0	0.0
	9:24:30	-65.5	0.0	0.1
	9:25:00	-65.0	0.0	0.1
	9:25:30	-64.5	0.0	0.0
	9:26:00	-64.0	0.0	0.0
	9:26:30	-63.5	0.0	0.1
	9:27:00	-63.0	0.0	0.0
	9:27:30	-62.5	0.0	0.0
	9:28:00	-62.0	0.0	0.0
	9:28:30	-61.5	0.0	0.2
	9:29:00	-61.0	0.0	0.0
	9:29:30	-60.5	0.0	0.1
Pre-ignition 1	9:30:00	-60.0	0.0	0.1
	9:30:30	-59.5	0.0	0.1
	9:31:00	-59.0	0.0	0.2
	9:31:30	-58.5	0.0	0.2
	9:32:00	-58.0	0.0	0.3
	9:32:30	-57.5	0.0	0.2
	9:33:00	-57.0	0.0	0.5
	9:33:30	-56.5	0.0	0.1
	9:34:00	-56.0	0.0	0.1
	9:34:30	-55.5	0.0	0.1
	9:35:00	-55.0	0.0	0.1
	9:35:30	-54.5	0.0	0.2
	9:36:00	-54.0	0.0	0.2
	9:36:30	-53.5	0.0	0.1
	9:37:00	-53.0	0.0	0.2
	9:37:30	-52.5	0.0	0.2
	9:38:00	-52.0	0.0	0.1
	9:38:30	-51.5	0.0	0.1
	9:39:00	-51.0	0.0	0.1
	9:39:30	-50.5	0.0	0.1
	9:40:00	-50.0	0.0	0.1
	9:40:30	-49.5	0.0	0.1
	9:41:00	-49.0	0.0	0.1
	9:41:30	-48.5	0.0	0.1
	9:42:00	-48.0	0.0	0.1
	9:42:30	-47.5	0.0	0.2
	9:43:00	-47.0	0.0	0.0
	9:43:30	-46.5	0.0	0.0
	9:44:00	-46.0	0.0	0.0
	9:44:30	-45.5	0.0	0.2
	9:45:00	-45.0	0.0	0.3
	9:45:30	-44.5	0.0	0.1
	9:46:00	-44.0	0.0	0.1
	9:46:30	-43.5	0.0	0.2
	9:47:00	-43.0	0.0	0.2
	9:47:30	-42.5	0.0	0.0
	9:48:00	-42.0	0.0	0.2
	9:48:30	-41.5	0.0	0.2
	9:49:00	-41.0	0.0	0.0
	9:49:30	-40.5	0.0	0.0
	9:50:00	-40.0	0.0	0.0
	9:50:30	-39.5	0.0	0.1
	9:51:00	-39.0	0.0	0.1
	9:51:30	-38.5	0.0	0.1

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	9:52:00	-38.0	0.0	0.1
	9:52:30	-37.5	0.0	0.1
	9:53:00	-37.0	0.0	0.2
	9:53:30	-36.5	0.0	0.3
	9:54:00	-36.0	0.0	0.2
	9:54:30	-35.5	0.0	0.3
	9:55:00	-35.0	0.0	0.2
	9:55:30	-34.5	0.0	0.2
	9:56:00	-34.0	0.0	0.2
	9:56:30	-33.5	0.0	0.3
	9:57:00	-33.0	0.0	0.3
	9:57:30	-32.5	0.0	0.2
	9:58:00	-32.0	0.0	0.4
	9:58:30	-31.5	0.0	0.4
	9:59:00	-31.0	0.0	0.2
	9:59:30	-30.5	0.0	0.0
	10:00:00	-30.0	0.0	0.1
	10:00:30	-29.5	0.0	0.2
	10:01:00	-29.0	0.0	0.1
	10:01:30	-28.5	0.0	0.3
	10:02:00	-28.0	0.0	0.3
	10:02:30	-27.5	0.0	0.7
	10:03:00	-27.0	0.0	0.9
	10:03:30	-26.5	0.0	0.8
	10:04:00	-26.0	0.1	0.6
	10:04:30	-25.5	0.0	0.5
	10:05:00	-25.0	0.0	0.5
	10:05:30	-24.5	0.0	0.2
	10:06:00	-24.0	0.0	0.2
	10:06:30	-23.5	0.0	0.1
	10:07:00	-23.0	0.0	0.2
	10:07:30	-22.5	0.0	0.5
	10:08:00	-22.0	0.0	0.4
	10:08:30	-21.5	0.1	0.4
	10:09:00	-21.0	0.0	0.2
	10:09:30	-20.5	0.0	0.2
	10:10:00	-20.0	0.0	0.0
	10:10:30	-19.5	0.0	0.1
	10:11:00	-19.0	0.0	0.1
	10:11:30	-18.5	0.0	0.2
	10:12:00	-18.0	0.0	0.2
	10:12:30	-17.5	0.0	0.1
	10:13:00	-17.0	0.0	0.1
	10:13:30	-16.5	0.0	0.2
	10:14:00	-16.0	0.0	0.2
	10:14:30	-15.5	0.0	0.2
	10:15:00	-15.0	0.0	0.1
	10:15:30	-14.5	0.0	0.3
	10:16:00	-14.0	0.0	0.3
	10:16:30	-13.5	0.0	0.2
	10:17:00	-13.0	0.0	0.3
	10:17:30	-12.5	0.0	0.2
	10:18:00	-12.0	0.1	0.2
	10:18:30	-11.5	0.0	0.0
	10:19:00	-11.0	0.0	0.2
	10:19:30	-10.5	0.0	0.2
	10:20:00	-10.0	0.0	0.2
	10:20:30	-9.5	0.0	0.1
	10:21:00	-9.0	0.0	0.2
	10:21:30	-8.5	0.0	0.0
	10:22:00	-8.0	0.0	0.1

NOBE 93 Table 4.7 cont

Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2

			Remote Station # 1 50-100 m from the fire	Remote Station # 2 100-150 m from the fire
Time Periods	Time Recorded	Time Elapsed	Remote control boat # 2 ppm	Remote control boat # 1 ppm
	10:22:30	-7.5	0.0	0.1
	10:23:00	-7.0	0.0	0.2
	10:23:30	-6.5	0.0	0.0
	10:24:00	-6.0	0.0	0.3
	10:24:30	-5.5	0.0	0.8
	10:25:00	-5.0	0.0	0.8
	10:25:30	-4.5	0.0	0.1
	10:26:00	-4.0	0.0	
	10:26:30	-3.5	0.0	
	10:27:00	-3.0	0.0	0.2
	10:27:30	-2.5	0.0	0.4
	10:28:00	-2.0	0.0	0.2
	10:28:30	-1.5	0.0	0.4
	10:29:00	-1.0	0.0	0.2
	10:29:30	-0.5	0.0	0.2
Burn 1	10:30:00	0.0	0.0	0.2
	10:30:30	0.5	0.0	0.1
	10:31:00	1.0	0.0	0.8
	10:31:30	1.5	0.0	
	10:32:00	2.0	0.0	1.9
	10:32:30	2.5	0.0	0.4
	10:33:00	3.0	0.0	0.2
	10:33:30	3.5	0.0	0.2
	10:34:00	4.0	0.0	0.1
	10:34:30	4.5	0.0	0.1
	10:35:00	5.0	0.0	0.1
	10:35:30	5.5	0.0	0.1
	10:36:00	6.0		0.3
	10:36:30	6.5		0.1
	10:37:00	7.0		0.1
	10:37:30	7.5		0.0
	10:38:00	8.0		0.0
	10:38:30	8.5		0.0
	10:39:00	9.0		0.0
	10:39:30	9.5		0.0
	10:40:00	10.0		0.2
	10:40:30	10.5		0.4
	10:41:00	11.0		0.2
	10:41:30	11.5		0.2
	10:42:00	12.0		0.4
	10:42:30	12.5		0.2
	10:43:00	13.0		0.2
	10:43:30	13.5		0.2
	10:44:00	14.0		0.1
	10:44:30	14.5		0.6
	10:45:00	15.0		0.5
	10:45:30	15.5		0.4
	10:46:00	16.0		0.5
	10:46:30	16.5		0.1
	10:47:00	17.0	0.1	
	10:47:30	17.5	0.0	
R/C boat changed	10:48:00	18.0	0.2	
	10:48:30	18.5	0.1	
	10:49:00	19.0	0.2	
	10:49:30	19.5	0.2	
	10:50:00	20.0	0.3	
	10:50:30	20.5	0.1	
	10:51:00	21.0	0.6	
	10:51:30	21.5	0.6	
	10:52:00	22.0	0.6	

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	10:52:30	22.5	0.5	
	10:53:00	23.0	0.6	
	10:53:30	23.5	0.6	
	10:54:00	24.0	0.5	
	10:54:30	24.5	0.5	
	10:55:00	25.0	0.3	
	10:55:30	25.5	0.1	
	10:56:00	26.0	0.4	
	10:56:30	26.5	0.3	
	10:57:00	27.0	0.5	
	10:57:30	27.5	0.4	
	10:58:00	28.0	0.7	
	10:58:30	28.5	0.7	
	10:59:00	29.0	0.9	
	10:59:30	29.5	0.7	
	11:00:00	30.0	0.7	
	11:00:30	30.5	0.3	
	11:01:00	31.0	0.6	
	11:01:30	31.5	0.8	
	11:02:00	32.0	0.3	
	11:02:30	32.5	0.2	
	11:03:00	33.0	0.1	
	11:03:30	33.5	0.2	
	11:04:00	34.0	0.4	
	11:04:30	34.5	0.5	
	11:05:00	35.0	1.5	
	11:05:30	35.5	2.7	
	11:06:00	36.0	1.8	
	11:06:30	36.5	1.3	
	11:07:00	37.0	0.9	
	11:07:30	37.5	0.6	
	11:08:00	38.0	0.4	
	11:08:30	38.5	0.5	
	11:09:00	39.0	0.6	
	11:09:30	39.5	0.4	
	11:10:00	40.0	0.3	
	11:10:30	40.5	0.2	
	11:11:00	41.0	0.3	
	11:11:30	41.5	0.4	
	11:12:00	42.0	0.5	
	11:12:30	42.5	0.6	
	11:13:00	43.0	0.6	
	11:13:30	43.5	0.6	
	11:14:00	44.0	0.4	
	11:14:30	44.5	0.9	
	11:15:00	45.0	0.7	
	11:15:30	45.5	0.5	
	11:16:00	46.0	0.2	
	11:16:30	46.5	0.3	
	11:17:00	47.0	1.0	
	11:17:30	47.5	1.2	
	11:18:00	48.0	1.5	
	11:18:30	48.5	0.3	
	11:19:00	49.0	0.5	
	11:19:30	49.5	0.3	
	11:20:00	50.0	0.6	
	11:20:30	50.5	0.4	
	11:21:00	51.0	0.3	
	11:21:30	51.5	0.2	
	11:22:00	52.0	0.2	
	11:22:30	52.5	0.6	

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	11:23:00	53.0	0.6	0.0
	11:23:30	53.5	0.5	0.0
	11:24:00	54.0	0.3	0.0
	11:24:30	54.5	0.6	0.0
	11:25:00	55.0	0.3	0.0
	11:25:30	55.5	0.9	0.0
	11:26:00	56.0	1.1	0.0
	11:26:30	56.5	1.3	0.0
	11:27:00	57.0	0.7	0.0
	11:27:30	57.5	0.4	0.0
	11:28:00	58.0	0.5	0.0
	11:28:30	58.5	0.5	0.0
	11:29:00	59.0	0.4	0.0
	11:29:30	59.5	0.3	0.0
	11:30:00	60.0	0.6	0.0
	11:30:30	60.5	0.5	0.0
	11:31:00	61.0	0.4	0.0
	11:31:30	61.5	0.4	0.0
	11:32:00	62.0	0.3	0.0
	11:32:30	62.5	0.3	0.0
	11:33:00	63.0	0.7	0.0
	11:33:30	63.5	0.4	0.0
	11:34:00	64.0	0.5	0.0
	11:34:30	64.5	0.4	0.0
	11:35:00	65.0	0.5	0.0
	11:35:30	65.5	0.7	0.0
	11:36:00	66.0	0.8	0.0
	11:36:30	66.5	0.8	0.0
	11:37:00	67.0	0.8	0.0
	11:37:30	67.5	0.9	0.0
	11:38:00	68.0	0.8	0.0
	11:38:30	68.5	0.7	0.0
	11:39:00	69.0	0.4	0.0
	11:39:30	69.5	0.3	0.0
	11:40:00	70.0	0.4	0.0
	11:40:30	70.5	0.3	0.0
	11:41:00	71.0	0.8	0.0
	11:41:30	71.5	0.4	0.0
	11:42:00	72.0	0.5	0.0
	11:42:30	72.5	0.5	0.0
	11:43:00	73.0	0.6	0.0
	11:43:30	73.5	0.4	0.0
	11:44:00	74.0	0.4	0.0
	11:44:30	74.5	0.2	0.0
	11:45:00	75.0	0.4	0.0
	11:45:30	75.5	0.4	0.0
	11:46:00	76.0	0.4	0.0
	11:46:30	76.5	0.2	0.0
	11:47:00	77.0	0.2	0.0
	11:47:30	77.5	0.3	0.0
	11:48:00	78.0	0.4	0.0
	11:48:30	78.5	0.9	0.0
	11:49:00	79.0	0.6	0.0
	11:49:30	79.5	0.8	0.0
	11:50:00	80.0	0.4	0.0
	11:50:30	80.5	0.4	0.0
	11:51:00	81.0	0.9	0.0
	11:51:30	81.5	0.9	0.0
	11:52:00	82.0	0.4	0.0
	11:52:30	82.5	0.3	0.0
	11:53:00	83.0	0.5	0.0

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

			Remote Station # 1 50-100 m from the fire	Remote Station # 2 100-150 m from the fire
Time Periods	Time Recorded	Time Elapsed	Remote control boat # 2 ppm	Remote control boat # 1 ppm
	11:53:30	83.5	0.3	0.0
	11:54:00	84.0	0.4	0.0
	11:54:30	84.5	0.3	0.0
	11:55:00	85.0	0.3	0.0
	11:55:30	85.5	0.3	0.0
	11:56:00	86.0	0.2	0.0
	11:56:30	86.5	0.3	0.0
	11:57:00	87.0	0.3	0.0
	11:57:30	87.5	0.2	0.0
	11:58:00	88.0	0.3	0.0
	11:58:30	88.5	0.3	0.0
	11:59:00	89.0	0.3	0.0
	11:59:30	89.5	0.3	0.0
	12:00:00	90.0	0.2	0.0
	12:00:30	90.5	0.3	0.0
	12:01:00	91.0	0.5	0.0
	12:01:30	91.5	1.0	0.0
	12:02:00	92.0	1.0	0.0
	12:02:30	92.5	0.5	0.0
	12:03:00	93.0	0.3	0.0
	12:03:30	93.5	0.3	0.0
	12:04:00	94.0	0.3	0.0
Post-burn 1	12:04:30	94.5	0.3	0.0
	12:05:00	95.0	0.3	0.0
	12:05:30	95.5	0.5	0.0
	12:06:00	96.0	0.3	0.0
	12:06:30	96.5	1.6	0.0
	12:07:00	97.0	1.5	0.0
	12:07:30	97.5	0.6	0.0
	12:08:00	98.0	1.6	0.0
	12:08:30	98.5	1.7	0.0
	12:09:00	99.0	1.4	0.0
	12:09:30	99.5	0.6	0.0
	12:10:00	100.0	0.7	0.0
	12:10:30	100.5	0.3	0.0
	12:11:00	101.0	0.3	0.0
	12:11:30	101.5	0.3	0.0
	12:12:00	102.0	0.3	0.0
	12:12:30	102.5	0.3	0.0
	12:13:00	103.0	0.3	0.0
	12:13:30	103.5	0.3	0.0
	12:14:00	104.0	0.2	0.0
	12:14:30	104.5	0.3	0.0
	12:15:00	105.0	0.3	0.0
	12:15:30	105.5	0.3	0.0
	12:16:00	106.0	0.2	0.0
	12:16:30	106.5	0.4	0.0
	12:17:00	107.0	0.2	0.0
	12:17:30	107.5	0.4	0.0
	12:18:00	108.0	0.3	0.0
	12:18:30	108.5	0.3	0.0
	12:19:00	109.0	0.3	0.0
	12:19:30	109.5	0.3	0.0
	12:20:00	110.0	0.3	0.0
	12:20:30	110.5	0.3	0.0
	12:21:00	111.0	1.0	0.0
	12:21:30	111.5	0.6	0.0
	12:22:00	112.0	0.3	0.0
	12:22:30	112.5	0.3	0.0
	12:23:00	113.0	0.3	0.0

NOBE 93 Table 4.7 cont.

Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	12:23:30	113.5	0.2	0.0
	12:24:00	114.0	0.2	0.0
	12:24:30	114.5	0.3	
	12:25:00	115.0	0.2	
	12:25:30	115.5	0.2	0.0
	12:26:00	116.0	0.2	0.0
	12:26:30	116.5	0.3	0.0
	12:27:00	117.0	0.2	0.0
	12:27:30	117.5	0.2	0.0
	12:28:00	118.0	0.6	0.0
	12:28:30	118.5	0.4	0.0
	12:29:00	119.0	0.4	0.0
	12:29:30	119.5	0.2	0.0
	12:30:00	120.0	0.5	0.0
	12:30:30	120.5	1.2	0.0
	12:31:00	121.0	0.5	0.0
	12:31:30	121.5	0.7	0.0
	12:32:00	122.0	0.4	0.0
	12:32:30	122.5	0.4	0.0
	12:33:00	123.0	0.5	0.0
	12:33:30	123.5	0.5	0.0
	12:34:00	124.0	0.2	0.0
	12:34:30	124.5	0.4	0.0
	12:35:00	125.0	0.2	0.0
	12:35:30	125.5	0.2	0.0
	12:36:00	126.0	0.2	0.0
	12:36:30	126.5	0.2	0.0
	12:37:00	127.0	0.2	0.0
	12:37:30	127.5	0.1	0.0
	12:38:00	128.0	0.3	0.0
	12:38:30	128.5	0.3	0.0
	12:39:00	129.0	0.5	0.0
	12:39:30	129.5	0.5	0.0
	12:40:00	130.0	0.4	0.0
	12:40:30	130.5	0.2	0.0
	12:41:00	131.0	0.3	0.0
	12:41:30	131.5	0.2	0.0
	12:42:00	132.0	0.3	0.0
	12:42:30	132.5	0.3	0.0
	12:43:00	133.0	0.2	0.0
	12:43:30	133.5	0.3	0.0
	12:44:00	134.0	0.2	0.0
	12:44:30	134.5	0.3	0.0
	12:45:00	135.0	0.2	0.0
	12:45:30	135.5		
	12:46:00	136.0	0.7	2.0
	12:46:30	136.5	1.1	0.0
	12:47:00	137.0	1.1	0.0
	12:47:30	137.5	0.6	0.0
	12:48:00	138.0	0.4	0.0
	12:48:30	138.5	0.3	0.0
	12:49:00	139.0	0.4	0.4
	12:49:30	139.5	0.7	0.0
	12:50:00	140.0	0.4	0.0
	12:50:30	140.5	0.4	0.0
	12:51:00	141.0	0.3	0.0
	12:51:30	141.5	0.2	0.0
	12:52:00	142.0	0.3	0.0
	12:52:30	142.5	0.2	0.0
	12:53:00	143.0	0.2	0.0
	12:53:30	143.5	0.3	0.0

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	12:54:00	144.0	0.3	0.0
	12:54:30	144.5	0.3	0.0
	12:55:00	145.0	0.3	0.0
	12:55:30	145.5	0.3	0.0
	12:56:00	146.0	0.3	0.0
	12:56:30	146.5	0.2	0.0
	12:57:00	147.0	0.2	0.0
	12:57:30	147.5	0.3	0.0
	12:58:00	148.0	0.2	0.0
	12:58:30	148.5	2.4	0.0
	12:59:00	149.0	2.3	0.0
	12:59:30	149.5	0.6	0.0

	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 1 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 2 ppm
Background 2	13:00:00	-66.0	0.0	0.3
	13:00:30	-65.5	0.0	0.2
	13:01:00	-65.0	0.0	0.3
	13:01:30	-64.5	0.0	0.3
	13:02:00	-64.0	0.0	0.4
	13:02:30	-63.5	0.0	0.3
	13:03:00	-63.0	0.0	0.3
	13:03:30	-62.5	0.0	0.3
	13:04:00	-62.0	0.0	0.2
	13:04:30	-61.5	0.0	0.3
	13:05:00	-61.0	0.0	0.2
	13:05:30	-60.5	0.0	1.2
	13:06:00	-60.0	0.0	0.6
	13:06:30	-59.5	1.2	0.2
	13:07:00	-59.0	0.9	0.3
	13:07:30	-58.5	0.0	0.6
	13:08:00	-58.0	3.8	0.6
	13:08:30	-57.5	5.0	0.2
	13:09:00	-57.0	0.0	0.3
	13:09:30	-56.5	0.3	0.8
	13:10:00	-56.0	0.3	1.2
	13:10:30	-55.5	0.0	1.6
	13:11:00	-55.0	0.0	2.2
	13:11:30	-54.5	0.2	2.4
	13:12:00	-54.0		2.6
	13:12:30	-53.5		1.3
	13:13:00	-53.0		0.8
	13:13:30	-52.5		0.3
	13:14:00	-52.0	1.1	0.4
	13:14:30	-51.5	0.9	0.4
	13:15:00	-51.0	0.0	0.4
	13:15:30	-50.5		0.3
	13:16:00	-50.0		0.2
	13:16:30	-49.5	0.0	0.2
	13:17:00	-49.0		0.3
	13:17:30	-48.5		0.2
	13:18:00	-48.0		0.3
	13:18:30	-47.5	0.0	0.1
	13:19:00	-47.0	0.7	0.2
	13:19:30	-46.5		0.3
	13:20:00	-46.0		0.3

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	13:20:30	-45.5	0.0	0.2
	13:21:00	-45.0	1.7	0.3
	13:21:30	-44.5	0.7	0.2
	13:22:00	-44.0	4.3	0.4
	13:22:30	-43.5	3.4	0.2
	13:23:00	-43.0	0.0	1.0
	13:23:30	-42.5	0.0	1.3
	13:24:00	-42.0	2.7	0.3
	13:24:30	-41.5	3.1	0.3
	13:25:00	-41.0	4.0	0.4
	13:25:30	-40.5	5.3	0.3
	13:26:00	-40.0		0.3
	13:26:30	-39.5		0.6
	13:27:00	-39.0	0.5	0.6
	13:27:30	-38.5		1.1
	13:28:00	-38.0		1.4
	13:28:30	-37.5		2.1
	13:29:00	-37.0		0.8
	13:29:30	-36.5		0.3
	13:30:00	-36.0	1.1	0.3
	13:30:30	-35.5	1.3	0.3
	13:31:00	-35.0	3.8	0.2
	13:31:30	-34.5	5.1	0.2
	13:32:00	-34.0	0.6	0.3
	13:32:30	-33.5	0.0	0.3
	13:33:00	-33.0	0.0	0.5
	13:33:30	-32.5	0.5	1.2
	13:34:00	-32.0		1.3
	13:34:30	-31.5		1.2
	13:35:00	-31.0		0.3
	13:35:30	-30.5	0.2	0.3
	13:36:00	-30.0	0.0	0.4
	13:36:30	-29.5	0.0	0.5
	13:37:00	-29.0		
	13:37:30	-28.5		
	13:38:00	-28.0		0.6
	13:38:30	-27.5		0.5
	13:39:00	-27.0		1.5
	13:39:30	-26.5		1.5
	13:40:00	-26.0		1.7
	13:40:30	-25.5		2.5
	13:41:00	-25.0		1.8
	13:41:30	-24.5	1.3	2.9
	13:42:00	-24.0	0.3	3.2
	13:42:30	-23.5	0.0	1.9
	13:43:00	-23.0	0.0	1.5
	13:43:30	-22.5		1.8
	13:44:00	-22.0		1.7
	13:44:30	-21.5	0.6	0.9
	13:45:00	-21.0	0.2	0.9
	13:45:30	-20.5	0.0	0.9
	13:46:00	-20.0	0.0	1.0
	13:46:30	-19.5	0.0	1.5
	13:47:00	-19.0	0.0	1.9
	13:47:30	-18.5	0.0	1.5
	13:48:00	-18.0	0.0	2.3
	13:48:30	-17.5	0.0	2.0
	13:49:00	-17.0	0.0	1.5
	13:49:30	-16.5	0.2	1.9
	13:50:00	-16.0	0.2	2.1
	13:50:30	-15.5	1.9	1.1

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	13:51:00	-15.0	0.0	0.7
	13:51:30	-14.5		1.2
Pre-ignition 2	13:52:00	-14.0		1.1
	13:52:30	-13.5		1.7
	13:53:00	-13.0		1.8
	13:53:30	-12.5	1.5	1.1
	13:54:00	-12.0	0.1	0.7
	13:54:30	-11.5	0.0	0.5
	13:55:00	-11.0	0.2	0.6
	13:55:30	-10.5	0.0	0.4
	13:56:00	-10.0	0.0	0.5
	13:56:30	-9.5	0.0	0.5
	13:57:00	-9.0	0.0	0.5
	13:57:30	-8.5	0.0	0.4
	13:58:00	-8.0	0.0	0.4
	13:58:30	-7.5	0.0	0.6
	13:59:00	-7.0	0.0	0.4
	13:59:30	-6.5	0.0	0.4
	14:00:00	-6.0	0.0	0.5
	14:00:30	-5.5	0.0	0.4
	14:01:00	-5.0	0.0	0.4
	14:01:30	-4.5	0.0	0.4
	14:02:00	-4.0	0.0	0.3
	14:02:30	-3.5	0.0	0.3
	14:03:00	-3.0	0.0	0.4
	14:03:30	-2.5	0.0	0.6
	14:04:00	-2.0	0.0	0.3
	14:04:30	-1.5	0.0	0.4
	14:05:00	-1.0	0.0	0.4
	14:05:30	-0.5	0.0	0.6
Burn 2	14:06:00	0.0	0.0	0.7
	14:06:30	0.5	0.0	0.5
	14:07:00	1.0	0.0	0.4
	14:07:30	1.5	0.0	0.5
	14:08:00	2.0	0.0	0.5
	14:08:30	2.5	0.0	0.4
	14:09:00	3.0	0.0	0.4
	14:09:30	3.5	0.0	0.3
	14:10:00	4.0	0.0	0.6
	14:10:30	4.5	0.0	0.7
	14:11:00	5.0	0.0	0.6
	14:11:30	5.5	0.0	0.5
	14:12:00	6.0	0.0	0.5
	14:12:30	6.5	0.0	0.4
	14:13:00	7.0	0.0	2.1
	14:13:30	7.5	0.0	2.6
	14:14:00	8.0	0.0	0.8
	14:14:30	8.5	0.0	0.3
	14:15:00	9.0	0.0	0.6
	14:15:30	9.5	0.0	0.7
	14:16:00	10.0	0.0	0.4
	14:16:30	10.5	0.0	0.4
	14:17:00	11.0	1.0	0.5
	14:17:30	11.5	1.0	0.6
	14:18:00	12.0	0.7	0.7
	14:18:30	12.5	2.7	0.5
	14:19:00	13.0	1.5	0.4
	14:19:30	13.5	0.0	0.4
	14:20:00	14.0	0.0	0.6

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	14:20:30	14.5	0.0	0.9
	14:21:00	15.0	0.0	0.5
	14:21:30	15.5	0.0	0.6
	14:22:00	16.0	0.0	0.5
	14:22:30	16.5	0.0	0.5
	14:23:00	17.0	0.0	0.7
	14:23:30	17.5	0.0	0.5
	14:24:00	18.0	0.0	0.8
	14:24:30	18.5	0.0	1.1
	14:25:00	19.0	1.0	1.0
	14:25:30	19.5	3.1	0.3
	14:26:00	20.0	1.5	0.6
	14:26:30	20.5	0.0	1.2
	14:27:00	21.0	0.0	1.7
	14:27:30	21.5	0.0	1.3
	14:28:00	22.0	0.0	0.6
	14:28:30	22.5	0.0	1.7
	14:29:00	23.0	0.0	1.7
	14:29:30	23.5	0.0	0.9
	14:30:00	24.0	0.0	0.4
	14:30:30	24.5	0.0	1.7
	14:31:00	25.0	0.0	1.9
	14:31:30	25.5	0.0	1.3
	14:32:00	26.0	0.0	1.2
	14:32:30	26.5	0.0	1.4
	14:33:00	27.0	0.0	1.6
	14:33:30	27.5	0.3	1.8
	14:34:00	28.0	0.0	1.7
	14:34:30	28.5	0.0	0.8
	14:35:00	29.0	0.0	0.3
	14:35:30	29.5	0.0	0.4
	14:36:00	30.0	0.0	0.3
	14:36:30	30.5	0.0	0.5
	14:37:00	31.0	0.0	0.7
	14:37:30	31.5	0.0	0.8
	14:38:00	32.0	0.0	1.1
	14:38:30	32.5	0.0	1.2
	14:39:00	33.0	0.0	1.1
	14:39:30	33.5	0.0	1.1
	14:40:00	34.0	0.0	1.2
	14:40:30	34.5	0.0	1.0
	14:41:00	35.0	0.0	1.0
	14:41:30	35.5	0.0	1.2
	14:42:00	36.0	0.0	1.2
	14:42:30	36.5	0.0	1.4
	14:43:00	37.0	0.0	0.8
	14:43:30	37.5	0.0	0.5
	14:44:00	38.0	0.0	0.7
	14:44:30	38.5	0.0	0.4
	14:45:00	39.0	0.0	0.5
	14:45:30	39.5	0.0	1.1
	14:46:00	40.0	0.4	1.5
	14:46:30	40.5	0.3	1.1
	14:47:00	41.0	0.0	1.5
	14:47:30	41.5	0.0	0.8
	14:48:00	42.0	0.0	0.4
	14:48:30	42.5	0.0	0.4
	14:49:00	43.0	0.0	0.6
	14:49:30	43.5	0.0	0.4
	14:50:00	44.0	0.0	0.4
	14:50:30	44.5	0.0	0.2

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	14:51:00	45.0	0.0	0.2
	14:51:30	45.5	0.0	0.3
	14:52:00	46.0	0.0	0.3
	14:52:30	46.5	0.0	0.3
	14:53:00	47.0	0.0	0.3
	14:53:30	47.5	0.0	0.3
	14:54:00	48.0	0.0	0.2
	14:54:30	48.5	0.0	0.3
	14:55:00	49.0	0.0	0.2
	14:55:30	49.5	0.0	0.3
	14:56:00	50.0	0.0	0.5
	14:56:30	50.5	0.0	0.3
	14:57:00	51.0	0.0	0.3
	14:57:30	51.5	0.0	0.4
	14:58:00	52.0	0.0	0.3
	14:58:30	52.5	0.0	0.1
	14:59:00	53.0	0.0	0.4
	14:59:30	53.5	0.0	0.2
	15:00:00	54.0	0.1	0.3
	15:00:30	54.5	0.1	0.1
	15:01:00	55.0	1.0	0.2
	15:01:30	55.5	0.0	0.2
	15:02:00	56.0	0.0	0.1
	15:02:30	56.5	0.0	0.2
	15:03:00	57.0	0.0	0.1
	15:03:30	57.5	0.0	0.2
	15:04:00	58.0	0.0	0.3
	15:04:30	58.5	0.0	0.3
	15:05:00	59.0	0.0	1.2
	15:05:30	59.5	0.0	0.6
	15:06:00	60.0	0.0	0.2
	15:06:30	60.5	0.0	0.2
	15:07:00	61.0	0.0	0.3
	15:07:30	61.5	0.0	0.7
	15:08:00	62.0	0.0	0.9
	15:08:30	62.5	0.0	0.7
	15:09:00	63.0	0.0	0.5
	15:09:30	63.5	0.0	0.2
	15:10:00	64.0	0.0	0.2
	15:10:30	64.5	0.0	0.3
	15:11:00	65.0	0.0	0.3
	15:11:30	65.5	0.0	0.4
	15:12:00	66.0	0.0	0.3
	15:12:30	66.5	0.0	0.3
	15:13:00	67.0	0.0	1.1
	15:13:30	67.5	0.0	1.4
	15:14:00	68.0	0.0	0.8
	15:14:30	68.5	0.0	0.4
	15:15:00	69.0	0.0	0.2
	15:15:30	69.5	0.0	0.3
	15:16:00	70.0	0.0	0.3
	15:16:30	70.5	0.0	0.3
	15:17:00	71.0	0.7	0.4
	15:17:30	71.5	0.2	0.3
	15:18:00	72.0	0.0	0.4
	15:18:30	72.5		2.1
	15:19:00	73.0		0.8
	15:19:30	73.5	0.2	0.2
Post-burn 2	15:20:00	74.0	0.0	0.3
	15:20:30	74.5	0.0	0.3

NOBE 93 Table 4.7 cont. **Carbon Monoxide Results from the Cannonball Remote Stations 1 and 2**

Time Periods	Time Recorded	Time Elapsed	Remote Station # 1 50-100 m from the fire Remote control boat # 2 ppm	Remote Station # 2 100-150 m from the fire Remote control boat # 1 ppm
	15:21:00	75.0	0.0	0.4
	15:21:30	75.5	0.0	0.3
	15:22:00	76.0	0.0	0.2
	15:22:30	76.5	0.0	0.8
	15:23:00	77.0	0.0	1.8
	15:23:30	77.5	0.0	1.1
	15:24:00	78.0	0.1	0.8
	15:24:30	78.5	0.0	0.8
	15:25:00	79.0	0.0	0.3
	15:25:30	79.5	0.0	0.1
	15:26:00	80.0	0.0	0.2
	15:26:30	80.5	0.0	0.2
	15:27:00	81.0	0.0	0.3
	15:27:30	81.5	0.0	0.3
	15:28:00	82.0	0.0	0.3
	15:28:30	82.5	0.0	0.2
	15:29:00	83.0	0.0	0.2
	15:29:30	83.5	0.0	0.1
	15:30:00	84.0	0.0	0.4
	15:30:30	84.5	0.0	0.2
	15:31:00	85.0	0.0	0.1
	15:31:30	85.5	0.0	0.2
	15:32:00	86.0	0.0	0.4
	15:32:30	86.5	0.0	0.2
	15:33:00	87.0	0.0	0.3
	15:33:30	87.5	0.0	0.1
	15:34:00	88.0	0.0	0.4
	15:34:30	88.5	0.0	0.3
	15:35:00	89.0	0.0	0.3
	15:35:30	89.5	0.0	0.3
	15:36:00	90.0	0.0	0.6
	15:36:30	90.5	0.0	0.6
	15:37:00	91.0	0.0	0.4
	15:37:30	91.5	0.0	0.7
	15:38:00	92.0	0.0	0.9
	15:38:30	92.5	0.0	1.3
	15:39:00	93.0	0.0	3.4
	15:39:30	93.5	0.0	0.9
	15:40:00	94.0		0.3
	15:40:30	94.5		0.6
	15:41:00	95.0		0.2
	15:41:30	95.5		0.2
	15:42:00	96.0		0.1
	15:42:30	96.5		0.3
	15:43:00	97.0		0.2
	15:43:30	97.5		0.3
	15:44:00	98.0		0.4
	15:44:30	98.5		0.3
	15:45:00	99.0		
	15:45:30	99.5		
	15:46:00	100.0		1.1
	15:46:30	100.5		0.3
	15:47:00	101.0		0.3
	15:47:30	101.5		0.3

Section 5

Nitrogen Dioxide (NO_2)
NOBE 93

Nitrogen Dioxide (NO_2)
NOBE 93

Exotox 75

Instrumentation

- The Exotox 75 was used to analyse CO, SO_2, NO_2.
- Its flow rate is 300 mL/minute.
- Tubing was connected from the instrument to the mast to allow sampling at approximately 1.25 m above sea level.
- The data was logged every 30 seconds.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.

Cannonball

The Cannonball can monitor the atmosphere for up to four gases, using a variety of sensors. Working as a sample draw device, it will detect combustible gas, oxygen, and a choice of two other toxic gases. For NOBE 93 it was used to analyse carbon monoxide and sulphur dioxide. This equipment serves as both an area monitor and to check the atmosphere in a remote area. The Cannonball's waterproof case and a hydrophobic filter in the sample probe makes it suitable for use in most rugged environments.

Instrumentation

- The instrument pumped air at a flow rate of 1 L/min.
- Tubing was connected from the instrument to the mast to allow sampling at 1.25 m above sea level.
- Data was logged every 30 seconds.

Location

- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500 to 600 m from the fire.

NOBE 93 Table 5.1

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods		Instrument 1 ppm	Instrument 2 ppm	Average ppm
Background Aug 07 93	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Background 1	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Pre-ignition 1	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Burn 1	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Post-burn 1	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Background 2	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Pre-ignition 2	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Burn 2	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0
Post-burn 2	Minimum	0.0	0.0	0.0
	Average	0.0	0.0	0.0
	Maximum	0.0	0.0	0.0

NOBE 93 Table 5.2

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods		Remote Station 1 50 to 100 m from fire ppm	Remote Station 2 100 to 150 m from fire ppm
Background 1	Minimum	0.0	0.0
	Average	0.0	0.4
	Maximum	0.0	0.4
Pre-ignition 1	Minimum	0.0	0.3
	Average	0.0	0.4
	Maximum	0.0	0.5
Burn 1	Minimum	0.0	0.0
	Average	0.3	0.1
	Maximum	0.5	0.5
Post-burn 1	Minimum	0.4	0.0
	Average	0.4	0.0
	Maximum	0.5	0.0
Background 2	Minimum	0.0	0.4
	Average	0.0	0.5
	Maximum	0.0	0.5
Pre-ignition 2	Minimum		0.4
	Average		0.4
	Maximum		0.5
Burn 2	Minimum		0.4
	Average		0.4
	Maximum		0.5
Post-burn 2	Minimum		0.4
	Average		0.4
	Maximum		0.5

NOBE 93 Table 5.3

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
11:09:15	0		0
11:09:30	0		0
11:09:45	0		0
11:10:00	0	0	0
11:10:15	0	0	0
11:10:30	0	0	0
11:10:45	0	0	0
11:11:00	0	0	0
11:11:15	0	0	0
11:11:30	0	0	0
11:11:45	0	0	0
11:12:00	0	0	0
11:12:15	0	0	0
11:12:30	0	0	0
11:12:45	0	0	0
11:13:00	0	0	0
11:13:15	0	0	0
11:13:30	0	0	0
11:13:45	0	0	0
11:14:00	0	0	0
11:14:15	0	0	0
11:14:30	0	0	0
11:14:45	0	0	0
11:15:00	0	0	0
11:15:15	0	0	0
11:15:30	0	0	0
11:15:45	0	0	0
11:16:00	0	0	0
11:16:15	0	0	0
11:16:30	0	0	0
11:16:45	0	0	0
11:17:00	0	0	0
11:17:15	0	0	0
11:17:30	0	0	0
11:17:45	0	0	0
11:18:00	0	0	0
11:18:15	0	0	0
11:18:30	0	0	0
11:18:45	0	0	0
11:19:00	0	0	0
11:19:15	0	0	0
11:19:30	0	0	0
11:19:45	0	0	0
11:20:00	0	0	0
11:20:15	0	0	0
11:20:30	0	0	0
11:20:45	0	0	0
11:21:00	0	0	0
11:21:15	0	0	0
11:21:30	0	0	0
11:21:45	0	0	0
11:22:00	0	0	0
11:22:15	0	0	0
11:22:30	0	0	0
11:22:45	0	0	0
11:23:00	0	0	0
11:23:15	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
11:23:30	0	0	0
11:23:45	0	0	0
11:24:00	0	0	0
11:24:15	0	0	0
11:24:30	0	0	0
11:24:45	0	0	0
11:25:00	0	0	0
11:25:15	0	0	0
11:25:30	0	0	0
11:25:45	0	0	0
11:26:00	0	0	0
11:26:15	0	0	0
11:26:30	0	0	0
11:26:45	0	0	0
11:27:00	0	0	0
11:27:15	0	0	0
11:27:30	0	0	0
11:27:45	0	0	0
11:28:00	0	0	0
11:28:15	0	0	0
11:28:30	0	0	0
11:28:45	0	0	0
11:29:00	0	0	0
11:29:15	0	0	0
11:29:30	0	0	0
11:29:45	0	0	0
11:30:00	0	0	0
11:30:15	0	0	0
11:30:30	0	0	0
11:30:45	0	0	0
11:31:00	0	0	0
11:31:15	0	0	0
11:31:30	0	0	0
11:31:45	0	0	0
11:32:00	0	0	0
11:32:15	0	0	0
11:32:30	0	0	0
11:32:45	0	0	0
11:33:00	0	0	0
11:33:15	0	0	0
11:33:30	0	0	0
11:33:45	0	0	0
11:34:00	0	0	0
11:34:15	0	0	0
11:34:30	0	0	0
11:34:45	0	0	0
11:35:00	0	0	0
11:35:15	0	0	0
11:35:30	0	0	0
11:35:45	0	0	0
11:36:00	0	0	0
11:36:15	0	0	0
11:36:30	0	0	0
11:36:45	0	0	0
11:37:00	0	0	0
11:37:15	0	0	0
11:37:30	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
11:37:45	0	0	0
11:38:00	0	0	0
11:38:15	0	0	0
11:38:30	0	0	0
11:38:45	0	0	0
11:39:00	0	0	0
11:39:15	0	0	0
11:39:30	0	0	0
11:39:45	0	0	0
11:40:00	0	0	0
11:40:15	0	0	0
11:40:30	0	0	0
11:40:45	0	0	0
11:41:00	0	0	0
11:41:15	0	0	0
11:41:30	0	0	0
11:41:45	0	0	0
11:42:00	0	0	0
11:42:15	0	0	0
11:42:30	0	0	0
11:42:45	0	0	0
11:43:00	0	0	0
11:43:15	0	0	0
11:43:30	0	0	0
11:43:45	0	0	0
11:44:00	0	0	0
11:44:15	0	0	0
11:44:30	0	0	0
11:44:45	0	0	0
11:45:00	0	0	0
11:45:15	0	0	0
11:45:30	0	0	0
11:45:45	0	0	0
11:46:00	0	0	0
11:46:15	0	0	0
11:46:30	0	0	0
11:46:45	0	0	0
11:47:00	0	0	0
11:47:15	0	0	0
11:47:30	0	0	0
11:47:45	0	0	0
11:48:00	0	0	0
11:48:15	0	0	0
11:48:30	0	0	0
11:48:45	0	0	0
11:49:00	0	0	0
11:49:15	0	0	0
11:49:30	0	0	0
11:49:45	0	0	0
11:50:00	0	0	0
11:50:15	0	0	0
11:50:30	0	0	0
11:50:45	0	0	0
11:51:00	0	0	0
11:51:15	0	0	0
11:51:30	0	0	0
11:51:45	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
11:52:00	0	0	0
11:52:15	0	0	0
11:52:30	0	0	0
11:52:45	0	0	0
11:53:00	0	0	0
11:53:15	0	0	0
11:53:30	0	0	0
11:53:45	0	0	0
11:54:00	0	0	0
11:54:15	0	0	0
11:54:30	0	0	0
11:54:45	0	0	0
11:55:00	0	0	0
11:55:15	0	0	0
11:55:30	0	0	0
11:55:45	0	0	0
11:56:00	0	0	0
11:56:15	0	0	0
11:56:30	0	0	0
11:56:45	0	0	0
11:57:00	0	0	0
11:57:15	0	0	0
11:57:30	0	0	0
11:57:45	0	0	0
11:58:00	0	0	0
11:58:15	0	0	0
11:58:30	0	0	0
11:58:45	0	0	0
11:59:00	0	0	0
11:59:15	0	0	0
11:59:30	0	0	0
11:59:45	0	0	0
12:00:00	0	0	0
12:00:15	0	0	0
12:00:30	0	0	0
12:00:45	0	0	0
12:01:00	0	0	0
12:01:15	0	0	0
12:01:30	0	0	0
12:01:45	0	0	0
12:02:00	0	0	0
12:02:15	0	0	0
12:02:30	0	0	0
12:02:45	0	0	0
12:03:00	0	0	0
12:03:15	0	0	0
12:03:30	0	0	0
12:03:45	0	0	0
12:04:00	0	0	0
12:04:15	0	0	0
12:04:30	0	0	0
12:04:45	0	0	0
12:05:00	0	0	0
12:05:15	0	0	0
12:05:30	0	0	0
12:05:45	0	0	0
12:06:00	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
12:06:15	0	0	0
12:06:30	0	0	0
12:06:45	0	0	0
12:07:00	0	0	0
12:07:15	0	0	0
12:07:30	0	0	0
12:07:45	0	0	0
12:08:00	0	0	0
12:08:15	0	0	0
12:08:30	0	0	0
12:08:45	0	0	0
12:09:00	0	0	0
12:09:15	0	0	0
12:09:30	0	0	0
12:09:45	0	0	0
12:10:00	0	0	0
12:10:15	0	0	0
12:10:30	0	0	0
12:10:45	0	0	0
12:11:00	0	0	0
12:11:15	0	0	0
12:11:30	0	0	0
12:11:45	0	0	0
12:12:00	0	0	0
12:12:15	0	0	0
12:12:30	0	0	0
12:12:45	0	0	0
12:13:00	0	0	0
12:13:15	0	0	0
12:13:30	0	0	0
12:13:45	0	0	0
12:14:00	0	0	0
12:14:15	0	0	0
12:14:30	0	0	0
12:14:45	0	0	0
12:15:00	0	0	0
12:15:15	0	0	0
12:15:30	0	0	0
12:15:45	0	0	0
12:16:00	0	0	0
12:16:15	0	0	0
12:16:30	0	0	0
12:16:45	0	0	0
12:17:00	0	0	0
12:17:15	0	0	0
12:17:30	0	0	0
12:17:45	0	0	0
12:18:00	0	0	0
12:18:15	0	0	0
12:18:30	0	0	0
12:18:45	0	0	0
12:19:00	0	0	0
12:19:15	0	0	0
12:19:30	0	0	0
12:19:45	0	0	0
12:20:00	0	0	0
12:20:15	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
12:20:30	0	0	0
12:20:45	0	0	0
12:21:00	0	0	0
12:21:15	0	0	0
12:21:30	0	0	0
12:21:45	0	0	0
12:22:00	0	0	0
12:22:15	0	0	0
12:22:30	0	0	0
12:22:45	0	0	0
12:23:00	0	0	0
12:23:15	0	0	0
12:23:30	0	0	0
12:23:45	0	0	0
12:24:00	0	0	0
12:24:15	0	0	0
12:24:30	0	0	0
12:24:45	0	0	0
12:25:00	0	0	0
12:25:15	0	0	0
12:25:30	0	0	0
12:25:45	0	0	0
12:26:00	0	0	0
12:26:15	0	0	0
12:26:30	0	0	0
12:26:45	0	0	0
12:27:00	0	0	0
12:27:15	0	0	0
12:27:30	0	0	0
12:27:45	0	0	0
12:28:00	0	0	0
12:28:15	0	0	0
12:28:30	0	0	0
12:28:45	0	0	0
12:29:00	0	0	0
12:29:15	0	0	0
12:29:30	0	0	0
12:29:45	0	0	0
12:30:00	0	0	0
12:30:15	0	0	0
12:30:30	0	0	0
12:30:45	0	0	0
12:31:00	0	0	0
12:31:15	0	0	0
12:31:30	0	0	0
12:31:45	0	0	0
12:32:00	0	0	0
12:32:15	0	0	0
12:32:30	0	0	0
12:32:45	0	0	0
12:33:00	0	0	0
12:33:15	0	0	0
12:33:30	0	0	0
12:33:45	0	0	0
12:34:00	0	0	0
12:34:15	0	0	0
12:34:30	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
12:34:45	0	0	0
12:35:00	0	0	0
12:35:15	0	0	0
12:35:30	0	0	0
12:35:45	0	0	0
12:36:00	0	0	0
12:36:15	0	0	0
12:36:30	0	0	0
12:36:45	0	0	0
12:37:00	0	0	0
12:37:15	0	0	0
12:37:30	0	0	0
12:37:45	0	0	0
12:38:00	0	0	0
12:38:15	0	0	0
12:38:30	0	0	0
12:38:45	0	0	0
12:39:00	0	0	0
12:39:15	0	0	0
12:39:30	0	0	0
12:39:45	0	0	0
12:40:00	0	0	0
12:40:15	0	0	0
12:40:30	0	0	0
12:40:45	0	0	0
12:41:00	0	0	0
12:41:15	0	0	0
12:41:30	0	0	0
12:41:45	0	0	0
12:42:00	0	0	0
12:42:15	0	0	0
12:42:30	0	0	0
12:42:45	0	0	0
12:43:00	0	0	0
12:43:15	0	0	0
12:43:30	0	0	0
12:43:45	0	0	0
12:44:00	0	0	0
12:44:15	0	0	0
12:44:30	0	0	0
12:44:45	0	0	0
12:45:00	0	0	0
12:45:15	0	0	0
12:45:30	0	0	0
12:45:45	0	0	0
12:46:00	0	0	0
12:46:15	0	0	0
12:46:30	0	0	0
12:46:45	0	0	0
12:47:00	0	0	0
12:47:15	0	0	0
12:47:30	0	0	0
12:47:45	0	0	0
12:48:00	0	0	0
12:48:15	0	0	0
12:48:30	0	0	0
12:48:45	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
12:49:00	0	0	0
12:49:15	0	0	0
12:49:30	0	0	0
12:49:45	0	0	0
12:50:00	0	0	0
12:50:15	0	0	0
12:50:30	0	0	0
12:50:45	0	0	0
12:51:00	0	0	0
12:51:15	0	0	0
12:51:30	0	0	0
12:51:45	0	0	0
12:52:00	0	0	0
12:52:15	0	0	0
12:52:30	0	0	0
12:52:45	0	0	0
12:53:00	0	0	0
12:53:15	0	0	0
12:53:30	0	0	0
12:53:45	0	0	0
12:54:00	0	0	0
12:54:15	0	0	0
12:54:30	0	0	0
12:54:45	0	0	0
12:55:00	0	0	0
12:55:15	0	0	0
12:55:30	0	0	0
12:55:45	0	0	0
12:56:00	0	0	0
12:56:15	0	0	0
12:56:30	0	0	0
12:56:45	0	0	0
12:57:00	0	0	0
12:57:15	0	0	0
12:57:30	0	0	0
12:57:45	0	0	0
12:58:00	0	0	0
12:58:15	0	0	0
12:58:30	0	0	0
12:58:45	0	0	0
12:59:00	0	0	0
12:59:15	0	0	0
12:59:30	0	0	0
12:59:45	0	0	0
13:00:00	0	0	0
13:00:15	0	0	0
13:00:30	0	0	0
13:00:45	0	0	0
13:01:00	0	0	0
13:01:15	0	0	0
13:01:30	0	0	0
13:01:45	0	0	0
13:02:00	0	0	0
13:02:15	0	0	0
13:02:30	0	0	0
13:02:45	0	0	0
13:03:00	0	0	0

NOBE 93 Table 5.3 cont.

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball, Background: August 07, 1993

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time (hh:mm:ss)	Instrument 1 ppm	Instrument 2 ppm	Average ppm
13:03:15	0	0	0
13:03:30	0	0	0
13:03:45	0	0	0
13:04:00	0	0	0
13:04:15	0	0	0
13:04:30	0	0	0
13:04:45	0	0	0
13:05:00	0	0	0
13:05:15	0	0	0
13:05:30	0	0	0
13:05:45	0	0	0
13:06:00	0	0	0
13:06:15	0	0	0
13:06:30	0	0	0
13:06:45	0	0	0
13:07:00	0	0	0
13:07:15	0	0	0
13:07:30	0	0	0
13:07:45	0	0	0
13:08:00	0	0	0
13:08:15	0	0	0
13:08:30	0	0	0
13:08:45	0	0	0
13:09:00	0	0	0
13:09:15	0	0	0
13:09:30	0	0	0
13:09:45	0	0	0
13:10:00	0	0	0
13:10:15	0	0	0
13:10:30	0	0	0
13:10:45	0	0	0
13:11:00	0	0	0
13:11:15	0	0	0
13:11:30	0	0	0
13:11:45	0	0	0
13:12:00		0	0
13:12:15		0	0
13:12:30		0	0
13:12:45		0	0

NOBE 93 Table 5.4

Nitrogen Dioxide - Downwind Station (CCG 206)
Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
Background 1	7:33	-177	0.0	0.0	0.0
	7:34	-176	0.0	0.0	0.0
	7:35	-175	0.0	0.0	0.0
	7:36	-174	0.0	0.0	0.0
	7:37	-173	0.0	0.0	0.0
	7:38	-172	0.0	0.0	0.0
	7:39	-171	0.0	0.0	0.0
	7:40	-170	0.0	0.0	0.0
	7:41	-169	0.0	0.0	0.0
	7:42	-168	0.0	0.0	0.0
	7:43	-167	0.0	0.0	0.0
	7:44	-166	0.0	0.0	0.0
	7:45	-165	0.0	0.0	0.0
	7:46	-164	0.0	0.0	0.0
	7:47	-163	0.0	0.0	0.0
	7:48	-162	0.0	0.0	0.0
	7:49	-161	0.0	0.0	0.0
	7:50	-160	0.0	0.0	0.0
	7:51	-159	0.0	0.0	0.0
	7:52	-158	0.0	0.0	0.0
	7:53	-157	0.0	0.0	0.0
	7:54	-156	0.0	0.0	0.0
	7:55	-155	0.0	0.0	0.0
	7:56	-154	0.0	0.0	0.0
	7:57	-153	0.0	0.0	0.0
	7:58	-152	0.0	0.0	0.0
	7:59	-151	0.0	0.0	0.0
	8:00	-150	0.0	0.0	0.0
	8:01	-149	0.0	0.0	0.0
	8:02	-148	0.0	0.0	0.0
	8:03	-147	0.0	0.0	0.0
	8:04	-146	0.0	0.0	0.0
	8:05	-145	0.0	0.0	0.0
	8:06	-144	0.0	0.0	0.0
	8:07	-143	0.0	0.0	0.0
	8:08	-142	0.0	0.0	0.0
	8:09	-141	0.0	0.0	0.0
	8:10	-140	0.0	0.0	0.0
	8:11	-139	0.0	0.0	0.0
	8:12	-138	0.0	0.0	0.0
	8:13	-137	0.0	0.0	0.0
	8:14	-136	0.0	0.0	0.0
	8:15	-135	0.0	0.0	0.0
	8:16	-134	0.0	0.0	0.0
	8:17	-133	0.0	0.0	0.0
	8:18	-132	0.0	0.0	0.0
	8:19	-131	0.0	0.0	0.0
	8:20	-130	0.0	0.0	0.0
	8:21	-129	0.0	0.0	0.0
	8:22	-128	0.0	0.0	0.0
	8:23	-127	0.0	0.0	0.0
	8:24	-126	0.0	0.0	0.0
	8:25	-125	0.0	0.0	0.0
	8:26	-124	0.0	0.0	0.0
	8:27	-123	0.0	0.0	0.0
	8:28	-122	0.0	0.0	0.0
	8:29	-121	0.0	0.0	0.0
	8:30	-120	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. **Nitrogen Dioxide - Downwind Station (CCG 206)**
Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	8:31	-119	0.0	0.0	0.0
	8:32	-118	0.0	0.0	0.0
	8:33	-117	0.0	0.0	0.0
	8:34	-116	0.0	0.0	0.0
	8:35	-115	0.0	0.0	0.0
	8:36	-114	0.0	0.0	0.0
	8:37	-113	0.0	0.0	0.0
	8:38	-112	0.0	0.0	0.0
	8:39	-111	0.0	0.0	0.0
	8:40	-110	0.0	0.0	0.0
	8:41	-109	0.0	0.0	0.0
	8:42	-108	0.0	0.0	0.0
	8:43	-107	0.0	0.0	0.0
	8:44	-106	0.0	0.0	0.0
	8:45	-105	0.0	0.0	0.0
	8:46	-104	0.0	0.0	0.0
	8:47	-103	0.0	0.0	0.0
	8:48	-102	0.0	0.0	0.0
	8:49	-101	0.0	0.0	0.0
	8:50	-100	0.0	0.0	0.0
	8:51	-99	0.0	0.0	0.0
	8:52	-98	0.0	0.0	0.0
	8:53	-97	0.0	0.0	0.0
	8:54	-96	0.0	0.0	0.0
	8:55	-95	0.0	0.0	0.0
	8:56	-94	0.0	0.0	0.0
	8:57	-93	0.0	0.0	0.0
	8:58	-92	0.0	0.0	0.0
	8:59	-91	0.0	0.0	0.0
	9:00	-90	0.0	0.0	0.0
	9:01	-89	0.0	0.0	0.0
	9:02	-88	0.0	0.0	0.0
	9:03	-87	0.0	0.0	0.0
	9:04	-86	0.0	0.0	0.0
	9:05	-85	0.0	0.0	0.0
	9:06	-84	0.0	0.0	0.0
	9:07	-83	0.0	0.0	0.0
	9:08	-82	0.0	0.0	0.0
	9:09	-81	0.0	0.0	0.0
	9:10	-80	0.0	0.0	0.0
	9:11	-79	0.0	0.0	0.0
	9:12	-78	0.0	0.0	0.0
	9:13	-77	0.0	0.0	0.0
	9:14	-76	0.0	0.0	0.0
	9:15	-75	0.0	0.0	0.0
	9:16	-74	0.0	0.0	0.0
	9:17	-73	0.0	0.0	0.0
	9:18	-72	0.0	0.0	0.0
	9:19	-71	0.0	0.0	0.0
	9:20	-70	0.0	0.0	0.0
	9:21	-69	0.0	0.0	0.0
	9:22	-68	0.0	0.0	0.0
	9:23	-67	0.0	0.0	0.0
	9:24	-66	0.0	0.0	0.0
	9:25	-65	0.0	0.0	0.0
	9:26	-64	0.0	0.0	0.0
	9:27	-63	0.0	0.0	0.0
	9:28	-62	0.0	0.0	0.0
	9:29	-61	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. **Nitrogen Dioxide - Downwind Station (CCG 206)**
Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
Pre-ignition 1	9:30	-60	0.0	0.0	0.0
	9:31	-59	0.0	0.0	0.0
	9:32	-58	0.0	0.0	0.0
	9:33	-57	0.0	0.0	0.0
	9:34	-56	0.0	0.0	0.0
	9:35	-55	0.0	0.0	0.0
	9:36	-54	0.0	0.0	0.0
	9:37	-53	0.0	0.0	0.0
	9:38	-52	0.0	0.0	0.0
	9:39	-51	0.0	0.0	0.0
	9:40	-50	0.0	0.0	0.0
	9:41	-49	0.0	0.0	0.0
	9:42	-48	0.0	0.0	0.0
	9:43	-47	0.0	0.0	0.0
	9:44	-46	0.0	0.0	0.0
	9:45	-45	0.0	0.0	0.0
	9:46	-44	0.0	0.0	0.0
	9:47	-43	0.0	0.0	0.0
	9:48	-42	0.0	0.0	0.0
	9:49	-41	0.0	0.0	0.0
	9:50	-40	0.0	0.0	0.0
	9:51	-39	0.0	0.0	0.0
	9:52	-38	0.0	0.0	0.0
	9:53	-37	0.0	0.0	0.0
	9:54	-36	0.0	0.0	0.0
	9:55	-35	0.0	0.0	0.0
	9:56	-34	0.0	0.0	0.0
	9:57	-33	0.0	0.0	0.0
	9:58	-32	0.0	0.0	0.0
	9:59	-31	0.0	0.0	0.0
	10:00	-30	0.0	0.0	0.0
	10:01	-29	0.0	0.0	0.0
	10:02	-28	0.0	0.0	0.0
	10:03	-27	0.0	0.0	0.0
	10:04	-26	0.0	0.0	0.0
	10:05	-25	0.0	0.0	0.0
	10:06	-24	0.0	0.0	0.0
	10:07	-23	0.0	0.0	0.0
	10:08	-22	0.0	0.0	0.0
	10:09	-21	0.0	0.0	0.0
	10:10	-20	0.0	0.0	0.0
	10:11	-19	0.0	0.0	0.0
	10:12	-18	0.0	0.0	0.0
	10:13	-17	0.0	0.0	0.0
	10:14	-16	0.0	0.0	0.0
	10:15	-15	0.0	0.0	0.0
	10:16	-14	0.0	0.0	0.0
	10:17	-13	0.0	0.0	0.0
	10:18	-12	0.0	0.0	0.0
	10:19	-11	0.0	0.0	0.0
	10:20	-10	0.0	0.0	0.0
	10:21	-9	0.0	0.0	0.0
	10:22	-8	0.0	0.0	0.0
	10:23	-7	0.0	0.0	0.0
	10:24	-6	0.0	0.0	0.0
	10:25	-5	0.0	0.0	0.0
	10:26	-4	0.0	0.0	0.0
	10:27	-3	0.0	0.0	0.0
	10:28	-2	0.0	0.0	0.0
	10:29	-1	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. **Nitrogen Dioxide - Downwind Station (CCG 206) Cannonball**

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
Burn 1	10:30	0	0.0	0.0	0.0
	10:31	1	0.0	0.0	0.0
	10:32	2	0.0	0.0	0.0
	10:33	3	0.0	0.0	0.0
	10:34	4	0.0	0.0	0.0
	10:35	5	0.0	0.0	0.0
	10:36	6	0.0	0.0	0.0
	10:37	7	0.0	0.0	0.0
	10:38	8	0.0	0.0	0.0
	10:39	9	0.0	0.0	0.0
	10:40	10	0.0	0.0	0.0
	10:41	11	0.0	0.0	0.0
	10:42	12	0.0	0.0	0.0
	10:43	13	0.0	0.0	0.0
	10:44	14	0.0	0.0	0.0
	10:45	15	0.0	0.0	0.0
	10:46	16	0.0	0.0	0.0
	10:47	17	0.0	0.0	0.0
	10:48	18	0.0	0.0	0.0
	10:49	19	0.0	0.0	0.0
	10:50	20	0.0	0.0	0.0
	10:51	21	0.0	0.0	0.0
	10:52	22	0.0	0.0	0.0
	10:53	23	0.0	0.0	0.0
	10:54	24	0.0	0.0	0.0
	10:55	25	0.0	0.0	0.0
	10:56	26	0.0	0.0	0.0
	10:57	27	0.0	0.0	0.0
	10:58	28	0.0	0.0	0.0
	10:59	29	0.0	0.0	0.0
	11:00	30	0.0	0.0	0.0
	11:01	31	0.0	0.0	0.0
	11:02	32	0.0	0.0	0.0
	11:03	33	0.0	0.0	0.0
	11:04	34	0.0	0.0	0.0
	11:05	35	0.0	0.0	0.0
	11:06	36	0.0	0.0	0.0
	11:07	37	0.0	0.0	0.0
	11:08	38	0.0	0.0	0.0
	11:09	39	0.0	0.0	0.0
	11:10	40	0.0	0.0	0.0
	11:11	41	0.0	0.0	0.0
	11:12	42	0.0	0.0	0.0
	11:13	43	0.0	0.0	0.0
	11:14	44	0.0	0.0	0.0
	11:15	45	0.0	0.0	0.0
	11:16	46	0.0	0.0	0.0
	11:17	47	0.0	0.0	0.0
	11:18	48	0.0	0.0	0.0
	11:19	49	0.0	0.0	0.0
	11:20	50	0.0	0.0	0.0
	11:21	51	0.0	0.0	0.0
	11:22	52	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. Nitrogen Dioxide - Downwind Station (CCG 206) Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	11:23	53	0.0	0.0	0.0
	11:24	54	0.0	0.0	0.0
	11:25	55	0.0	0.0	0.0
	11:26	56	0.0	0.0	0.0
	11:27	57	0.0	0.0	0.0
	11:28	58	0.0	0.0	0.0
	11:29	59	0.0	0.0	0.0
	11:30	60	0.0	0.0	0.0
	11:31	61	0.0	0.0	0.0
	11:32	62	0.0	0.0	0.0
	11:33	63	0.0	0.0	0.0
	11:34	64	0.0	0.0	0.0
	11:35	65	0.0	0.0	0.0
	11:36	66	0.0	0.0	0.0
	11:37	67	0.0	0.0	0.0
	11:38	68	0.0	0.0	0.0
	11:39	69	0.0	0.0	0.0
	11:40	70	0.0	0.0	0.0
	11:41	71	0.0	0.0	0.0
	11:42	72	0.0	0.0	0.0
	11:43	73	0.0	0.0	0.0
	11:44	74	0.0	0.0	0.0
	11:45	75	0.0	0.0	0.0
	11:46	76	0.0	0.0	0.0
	11:47	77	0.0	0.0	0.0
	11:48	78	0.0	0.0	0.0
	11:49	79	0.0	0.0	0.0
	11:50	80	0.0	0.0	0.0
	11:51	81	0.0	0.0	0.0
	11:52	82	0.0	0.0	0.0
	11:53	83	0.0	0.0	0.0
	11:54	84	0.0	0.0	0.0
	11:55	85	0.0	0.0	0.0
	11:56	86	0.0	0.0	0.0
	11:57	87	0.0	0.0	0.0
	11:58	88	0.0	0.0	0.0
	11:59	89	0.0	0.0	0.0
	12:00	90	0.0	0.0	0.0
	12:01	91	0.0	0.0	0.0
	12:02	92	0.0	0.0	0.0
	12:03	93	0.0	0.0	0.0
	12:04	94	0.0	0.0	0.0
Post-burn 1	12:05	95	0.0	0.0	0.0
	12:06	96	0.0	0.0	0.0
	12:07	97	0.0	0.0	0.0
	12:08	98	0.0	0.0	0.0
	12:09	99	0.0	0.0	0.0
	12:10	100	0.0	0.0	0.0
	12:11	101	0.0	0.0	0.0
	12:12	102	0.0	0.0	0.0
	12:13	103	0.0	0.0	0.0
	12:14	104	0.0	0.0	0.0
	12:15	105	0.0	0.0	0.0
	12:16	106	0.0	0.0	0.0
	12:17	107	0.0	0.0	0.0
	12:18	108	0.0	0.0	0.0
	12:19	109	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. Nitrogen Dioxide - Downwind Station (CCG 206) Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	12:20	110	0.0	0.0	0.0
	12:21	111	0.0	0.0	0.0
	12:22	112	0.0	0.0	0.0
	12:23	113	0.0	0.0	0.0
	12:24	114	0.0	0.0	0.0
	12:25	115	0.0	0.0	0.0
	12:26	116	0.0	0.0	0.0
	12:27	117	0.0	0.0	0.0
	12:28	118	0.0	0.0	0.0
	12:29	119	0.0	0.0	0.0
	12:30	120	0.0	0.0	0.0
	12:31	121	0.0	0.0	0.0
	12:32	122	0.0	0.0	0.0
	12:33	123	0.0	0.0	0.0
	12:34	124	0.0	0.0	0.0
	12:35	125	0.0	0.0	0.0
	12:36	126	0.0	0.0	0.0
	12:37	127	0.0	0.0	0.0
	12:38	128	0.0	0.0	0.0
	12:39	129	0.0	0.0	0.0
	12:40	130	0.0	0.0	0.0
	12:41	131	0.0	0.0	0.0
	12:42	132	0.0	0.0	0.0
	12:43	133	0.0	0.0	0.0
	12:44	134	0.0	0.0	0.0
	12:45	135	0.0	0.0	0.0
	12:46	136	0.0	0.0	0.0
	12:47	137	0.0	0.0	0.0
	12:48	138	0.0	0.0	0.0
	12:49	139	0.0	0.0	0.0
	12:50	140	0.0	0.0	0.0
	12:51	141	0.0	0.0	0.0
	12:52	142	0.0	0.0	0.0
	12:53	143	0.0	0.0	0.0
	12:54	144	0.0	0.0	0.0
	12:55	145	0.0	0.0	0.0
	12:56	146	0.0	0.0	0.0
	12:57	147	0.0	0.0	0.0
	12:58	148	0.0	0.0	0.0
	12:59	149	0.0	0.0	0.0
Background 2	13:00	-66	0.0	0.0	0.0
	13:01	-65	0.0	0.0	0.0
	13:02	-64	0.0	0.0	0.0
	13:03	-63	0.0	0.0	0.0
	13:04	-62	0.0	0.0	0.0
	13:05	-61	0.0	0.0	0.0
	13:06	-60	0.0	0.0	0.0
	13:07	-59	0.0	0.0	0.0
	13:08	-58	0.0	0.0	0.0
	13:09	-57	0.0	0.0	0.0
	13:10	-56	0.0	0.0	0.0
	13:11	-55	0.0	0.0	0.0
	13:12	-54	0.0	0.0	0.0
	13:13	-53	0.0	0.0	0.0
	13:14	-52	0.0	0.0	0.0
	13:15	-51	0.0	0.0	0.0
	13:16	-50	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. Nitrogen Dioxide - Downwind Station (CCG 206) Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	13:17	-49	0.0	0.0	0.0
	13:18	-48	0.0	0.0	0.0
	13:19	-47	0.0	0.0	0.0
	13:20	-46	0.0	0.0	0.0
	13:21	-45	0.0	0.0	0.0
	13:22	-44	0.0	0.0	0.0
	13:23	-43	0.0	0.0	0.0
	13:24	-42	0.0	0.0	0.0
	13:25	-41	0.0	0.0	0.0
	13:26	-40	0.0	0.0	0.0
	13:27	-39	0.0	0.0	0.0
	13:28	-38	0.0	0.0	0.0
	13:29	-37	0.0	0.0	0.0
	13:30	-36	0.0	0.0	0.0
	13:31	-35	0.0	0.0	0.0
	13:32	-34	0.0	0.0	0.0
	13:33	-33	0.0	0.0	0.0
	13:34	-32	0.0	0.0	0.0
	13:35	-31	0.0	0.0	0.0
	13:36	-30	0.0	0.0	0.0
	13:37	-29	0.0	0.0	0.0
	13:38	-28	0.0	0.0	0.0
	13:39	-27	0.0	0.0	0.0
	13:40	-26	0.0	0.0	0.0
	13:41	-25	0.0	0.0	0.0
	13:42	-24	0.0	0.0	0.0
	13:43	-23	0.0	0.0	0.0
	13:44	-22	0.0	0.0	0.0
	13:45	-21	0.0	0.0	0.0
	13:46	-20	0.0	0.0	0.0
	13:47	-19	0.0	0.0	0.0
	13:48	-18	0.0	0.0	0.0
	13:49	-17	0.0	0.0	0.0
	13:50	-16	0.0	0.0	0.0
	13:51	-15	0.0	0.0	0.0
Pre-ignition 2	13:52	-14	0.0	0.0	0.0
	13:53	-13	0.0	0.0	0.0
	13:54	-12	0.0	0.0	0.0
	13:55	-11	0.0	0.0	0.0
	13:56	-10	0.0	0.0	0.0
	13:57	-9	0.0	0.0	0.0
	13:58	-8	0.0	0.0	0.0
	13:59	-7	0.0	0.0	0.0
	14:00	-6	0.0	0.0	0.0
	14:01	-5	0.0	0.0	0.0
	14:02	-4	0.0	0.0	0.0
	14:03	-3	0.0	0.0	0.0
	14:04	-2	0.0	0.0	0.0
	14:05	-1	0.0	0.0	0.0
Burn 2	14:06	0	0.0	0.0	0.0
	14:07	1	0.0	0.0	0.0
	14:08	2	0.0	0.0	0.0
	14:09	3	0.0	0.0	0.0
	14:10	4	0.0	0.0	0.0
	14:11	5	0.0	0.0	0.0
	14:12	6	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. **Nitrogen Dioxide - Downwind Station (CCG 206) Cannonball**

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	14:13	7	0.0	0.0	0.0
	14:14	8	0.0	0.0	0.0
	14:15	9	0.0	0.0	0.0
	14:16	10	0.0	0.0	0.0
	14:17	11	0.0	0.0	0.0
	14:18	12	0.0	0.0	0.0
	14:19	13	0.0	0.0	0.0
	14:20	14	0.0	0.0	0.0
	14:21	15	0.0	0.0	0.0
	14:22	16	0.0	0.0	0.0
	14:23	17	0.0	0.0	0.0
	14:24	18	0.0	0.0	0.0
	14:25	19	0.0	0.0	0.0
	14:26	20	0.0	0.0	0.0
	14:27	21	0.0	0.0	0.0
	14:28	22	0.0	0.0	0.0
	14:29	23	0.0	0.0	0.0
	14:30	24	0.0	0.0	0.0
	14:31	25	0.0	0.0	0.0
	14:32	26	0.0	0.0	0.0
	14:33	27	0.0	0.0	0.0
	14:34	28	0.0	0.0	0.0
	14:35	29	0.0	0.0	0.0
	14:36	30	0.0	0.0	0.0
	14:37	31	0.0	0.0	0.0
	14:38	32	0.0	0.0	0.0
	14:39	33	0.0	0.0	0.0
	14:40	34	0.0	0.0	0.0
	14:41	35	0.0	0.0	0.0
	14:42	36	0.0	0.0	0.0
	14:43	37	0.0	0.0	0.0
	14:44	38	0.0	0.0	0.0
	14:45	39	0.0	0.0	0.0
	14:46	40	0.0	0.0	0.0
	14:47	41	0.0	0.0	0.0
	14:48	42	0.0	0.0	0.0
	14:49	43	0.0	0.0	0.0
	14:50	44	0.0	0.0	0.0
	14:51	45	0.0	0.0	0.0
	14:52	46	0.0	0.0	0.0
	14:53	47	0.0	0.0	0.0
	14:54	48	0.0	0.0	0.0
	14:55	49	0.0	0.0	0.0
	14:56	50	0.0	0.0	0.0
	14:57	51	0.0	0.0	0.0
	14:58	52	0.0	0.0	0.0
	14:59	53	0.0	0.0	0.0
	15:00	54	0.0	0.0	0.0
	15:01	55	0.0	0.0	0.0
	15:02	56	0.0	0.0	0.0
	15:03	57	0.0	0.0	0.0
	15:04	58	0.0	0.0	0.0
	15:05	59	0.0	0.0	0.0
	15:06	60	0.0	0.0	0.0
	15:07	61	0.0	0.0	0.0
	15:08	62	0.0	0.0	0.0
	15:09	63	0.0	0.0	0.0
	15:10	64	0.0	0.0	0.0

NOBE 93 Table 5.4 cont. **Nitrogen Dioxide - Downwind Station (CCG 206)**
Cannonball

CCG 206 - Burn 1: approximately 900 m from apex of fireboom
Burn 2: 500 to 600 m downwind from apex of fireboom

Time Periods	Clock (hh:mm)	Time Elapsed	Instrument 1 ppm	Instrument 2 ppm	Average ppm
	15:11	65	0.0	0.0	0.0
	15:12	66	0.0	0.0	0.0
	15:13	67	0.0	0.0	0.0
	15:14	68	0.0	0.0	0.0
	15:15	69	0.0	0.0	0.0
	15:16	70	0.0	0.0	0.0
	15:17	71	0.0	0.0	0.0
	15:18	72	0.0	0.0	0.0
	15:19	73	0.0	0.0	0.0
Post-burn 2	15:20	74	0.0	0.0	0.0
	15:21	75	0.0	0.0	0.0
	15:22	76	0.0	0.0	0.0
	15:23	77	0.0	0.0	0.0
	15:24	78	0.0	0.0	0.0
	15:25	79	0.0	0.0	0.0
	15:26	80		0.0	0.0

NOBE 93 Table 5.5

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
Background 1	08:21:00	-129.0		0.0
	08:21:30	-128.5		0.1
	08:22:00	-128.0		0.2
	08:22:30	-127.5		0.3
	08:23:00	-127.0		0.3
	08:23:30	-126.5		0.3
	08:24:00	-126.0		0.3
	08:24:30	-125.5		0.3
	08:25:00	-125.0		0.3
	08:25:30	-124.5		0.3
	08:26:00	-124.0		0.3
	08:26:30	-123.5		0.3
	08:27:00	-123.0		0.3
	08:27:30	-122.5		0.4
	08:38:00	-112.0	0.0	0.3
	08:38:30	-111.5	0.0	0.3
	08:39:00	-111.0	0.0	0.4
	08:39:30	-110.5	0.0	0.4
	08:40:00	-110.0	0.0	0.4
	08:40:30	-109.5	0.0	0.4
	08:41:00	-109.0	0.0	0.4
	08:41:30	-108.5	0.0	0.4
	08:42:00	-108.0	0.0	0.3
	08:42:30	-107.5	0.0	0.3
	08:43:00	-107.0	0.0	0.3
	08:43:30	-106.5	0.0	0.3
	08:44:00	-106.0	0.0	0.4
	08:44:30	-105.5	0.0	0.4
	08:45:00	-105.0	0.0	0.3
	08:45:30	-104.5	0.0	0.4
	08:46:00	-104.0	0.0	0.4
	08:46:30	-103.5	0.0	0.4
	08:47:00	-103.0	0.0	0.3
	08:47:30	-102.5	0.0	0.4
	08:48:00	-102.0	0.0	0.4
	08:48:30	-101.5	0.0	0.4
	08:49:00	-101.0	0.0	0.4
	08:49:30	-100.5	0.0	0.4
	08:50:00	-100.0	0.0	0.4
	08:50:30	-99.5	0.0	0.4
	08:51:00	-99.0	0.0	0.4
	08:51:30	-98.5	0.0	0.4
	08:52:00	-98.0	0.0	0.3
	08:52:30	-97.5	0.0	0.3
	08:53:00	-97.0	0.0	0.3
	08:53:30	-96.5	0.0	0.3
	08:54:00	-96.0	0.0	0.3
	08:54:30	-95.5	0.0	0.3
	08:55:00	-95.0	0.0	0.3
	08:55:30	-94.5	0.0	0.3
	08:56:00	-94.0	0.0	0.4
	08:56:30	-93.5	0.0	0.3
	08:57:00	-93.0	0.0	0.4
	08:57:30	-92.5	0.0	0.4
	08:58:00	-92.0	0.0	0.4
	08:58:30	-91.5	0.0	0.4
	08:59:00	-91.0	0.0	0.4
	08:59:30	-90.5	0.0	0.3
	09:00:00	-90.0	0.0	0.3
	09:00:30	-89.5	0.0	0.3
	09:01:00	-89.0	0.0	0.3
	09:01:30	-88.5	0.0	0.3
	09:02:00	-88.0	0.0	0.4
	09:02:30	-87.5	0.0	0.3
	09:03:00	-87.0	0.0	0.4
	09:03:30	-86.5	0.0	0.4

NOBE 93 Table 5.5 cont. **Nitrogen Dioxide - Remote Stations 1 and 2**
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	09:04:00	-86.0	0.0	0.4
	09:04:30	-85.5	0.0	0.4
	09:05:00	-85.0	0.0	0.4
	09:05:30	-84.5	0.0	0.4
	09:06:00	-84.0	0.0	0.4
	09:06:30	-83.5	0.0	0.4
	09:07:00	-83.0	0.0	0.4
	09:07:30	-82.5	0.0	0.4
	09:08:00	-82.0	0.0	0.4
	09:08:30	-81.5	0.0	0.4
	09:09:00	-81.0	0.0	0.3
	09:09:30	-80.5	0.0	0.4
	09:10:00	-80.0	0.0	0.4
	09:10:30	-79.5	0.0	0.4
	09:11:00	-79.0	0.0	0.4
	09:11:30	-78.5	0.0	0.4
	09:12:00	-78.0	0.0	0.4
	09:12:30	-77.5	0.0	0.4
	09:13:00	-77.0	0.0	0.3
	09:13:30	-76.5	0.0	0.3
	09:14:00	-76.0	0.0	0.3
	09:14:30	-75.5	0.0	0.3
	09:15:00	-75.0	0.0	0.4
	09:15:30	-74.5	0.0	0.4
	09:16:00	-74.0	0.0	0.4
	09:16:30	-73.5	0.0	0.3
	09:17:00	-73.0	0.0	0.3
	09:17:30	-72.5	0.0	0.3
	09:18:00	-72.0	0.0	0.3
	09:18:30	-71.5	0.0	0.3
	09:19:00	-71.0	0.0	0.4
	09:19:30	-70.5	0.0	0.4
	09:20:00	-70.0	0.0	0.4
	09:20:30	-69.5	0.0	0.4
	09:21:00	-69.0	0.0	0.4
	09:21:30	-68.5	0.0	0.4
	09:22:00	-68.0	0.0	0.4
	09:22:30	-67.5	0.0	0.4
	09:23:00	-67.0	0.0	0.4
	09:23:30	-66.5	0.0	0.4
	09:24:00	-66.0	0.0	0.4
	09:24:30	-65.5	0.0	0.4
	09:25:00	-65.0	0.0	0.4
	09:25:30	-64.5	0.0	0.4
	09:26:00	-64.0	0.0	0.4
	09:26:30	-63.5	0.0	0.4
	09:27:00	-63.0	0.0	0.4
	09:27:30	-62.5	0.0	0.4
	09:28:00	-62.0	0.0	0.4
	09:28:30	-61.5	0.0	0.4
	09:29:00	-61.0	0.0	0.4
	09:29:30	-60.5	0.0	0.3
Pre-ignition 1	09:30:00	-60.0	0.0	0.4
	09:30:30	-59.5	0.0	0.4
	09:31:00	-59.0	0.0	0.4
	09:31:30	-58.5	0.0	0.4
	09:32:00	-58.0	0.0	0.4
	09:32:30	-57.5	0.0	0.4
	09:33:00	-57.0	0.0	0.4
	09:33:30	-56.5	0.0	0.4
	09:34:00	-56.0	0.0	0.4
	09:34:30	-55.5	0.0	0.4
	09:35:00	-55.0	0.0	0.4
	09:35:30	-54.5	0.0	0.4
	09:36:00	-54.0	0.0	0.4
	09:36:30	-53.5	0.0	0.3
	09:37:00	-53.0	0.0	0.4

NOBE 93 Table 5.5 cont. **Nitrogen Dioxide - Remote Stations 1 and 2**

Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	09:37:30	-52.5	0.0	0.4
	09:38:00	-52.0	0.0	0.4
	09:38:30	-51.5	0.0	0.4
	09:39:00	-51.0	0.0	0.4
	09:39:30	-50.5	0.0	0.4
	09:40:00	-50.0	0.0	0.4
	09:40:30	-49.5	0.0	0.4
	09:41:00	-49.0	0.0	0.4
	09:41:30	-48.5	0.0	0.4
	09:42:00	-48.0	0.0	0.4
	09:42:30	-47.5	0.0	0.4
	09:43:00	-47.0	0.0	0.4
	09:43:30	-46.5	0.0	0.4
	09:44:00	-46.0	0.0	0.4
	09:44:30	-45.5	0.0	0.4
	09:45:00	-45.0	0.0	0.4
	09:45:30	-44.5	0.0	0.4
	09:46:00	-44.0	0.0	0.4
	09:46:30	-43.5	0.0	0.4
	09:47:00	-43.0	0.0	0.4
	09:47:30	-42.5	0.0	0.4
	09:48:00	-42.0	0.0	0.4
	09:48:30	-41.5	0.0	0.4
	09:49:00	-41.0	0.0	0.4
	09:49:30	-40.5	0.0	0.4
	09:50:00	-40.0	0.0	0.4
	09:50:30	-39.5	0.0	0.4
	09:51:00	-39.0	0.0	0.4
	09:51:30	-38.5	0.0	0.4
	09:52:00	-38.0	0.0	0.4
	09:52:30	-37.5	0.0	0.4
	09:53:00	-37.0	0.0	0.4
	09:53:30	-36.5	0.0	0.4
	09:54:00	-36.0	0.0	0.4
	09:54:30	-35.5	0.0	0.4
	09:55:00	-35.0	0.0	0.4
	09:55:30	-34.5	0.0	0.4
	09:56:00	-34.0	0.0	0.4
	09:56:30	-33.5	0.0	0.4
	09:57:00	-33.0	0.0	0.4
	09:57:30	-32.5	0.0	0.4
	09:58:00	-32.0	0.0	0.4
	09:58:30	-31.5	0.0	0.4
	09:59:00	-31.0	0.0	0.4
	09:59:30	-30.5	0.0	0.4
	10:00:00	-30.0	0.0	0.4
	10:00:30	-29.5	0.0	0.4
	10:01:00	-29.0	0.0	0.4
	10:01:30	-28.5	0.0	0.5
	10:02:00	-28.0	0.0	0.4
	10:02:30	-27.5	0.0	0.4
	10:03:00	-27.0	0.0	0.4
	10:03:30	-26.5	0.0	0.4
	10:04:00	-26.0	0.0	0.4
	10:04:30	-25.5	0.0	0.4
	10:05:00	-25.0	0.0	0.4
	10:05:30	-24.5	0.0	0.4
	10:06:00	-24.0	0.0	0.4
	10:06:30	-23.5	0.0	0.4
	10:07:00	-23.0	0.0	0.4
	10:07:30	-22.5	0.0	0.4
	10:08:00	-22.0	0.0	0.4
	10:08:30	-21.5	0.0	0.4
	10:09:00	-21.0	0.0	0.4
	10:09:30	-20.5	0.0	0.4
	10:10:00	-20.0	0.0	0.4
	10:10:30	-19.5	0.0	0.4
	10:11:00	-19.0	0.0	0.4
	10:11:30	-18.5	0.0	0.4
	10:12:00	-18.0	0.0	0.4

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	10:12:30	-17.5	0.0	0.4
	10:13:00	-17.0	0.0	0.4
	10:13:30	-16.5	0.0	0.4
	10:14:00	-16.0	0.0	0.4
	10:14:30	-15.5	0.0	0.4
	10:15:00	-15.0	0.0	0.4
	10:15:30	-14.5	0.0	0.4
	10:16:00	-14.0	0.0	0.4
	10:16:30	-13.5	0.0	0.4
	10:17:00	-13.0	0.0	0.4
	10:17:30	-12.5	0.0	0.4
	10:18:00	-12.0	0.0	0.4
	10:18:30	-11.5	0.0	0.4
	10:19:00	-11.0	0.0	0.4
	10:19:30	-10.5	0.0	0.4
	10:20:00	-10.0	0.0	0.4
	10:20:30	-9.5	0.0	0.4
	10:21:00	-9.0	0.0	0.4
	10:21:30	-8.5	0.0	0.4
	10:22:00	-8.0	0.0	0.4
	10:22:30	-7.5	0.0	0.4
	10:23:00	-7.0	0.0	0.4
	10:23:30	-6.5	0.0	0.4
	10:24:00	-6.0	0.0	0.4
	10:24:30	-5.5	0.0	0.4
	10:25:00	-5.0	0.0	0.4
	10:25:30	-4.5	0.0	0.4
	10:26:00	-4.0	0.0	0.4
	10:26:30	-3.5	0.0	0.4
	10:27:00	-3.0	0.0	0.4
	10:27:30	-2.5	0.0	0.4
	10:28:00	-2.0	0.0	0.4
	10:28:30	-1.5	0.0	0.4
	10:29:00	-1.0	0.0	0.4
	10:29:30	-0.5	0.0	0.4
Burn 1	10:30:00	0.0	0.0	0.4
	10:30:30	0.5	0.0	0.4
	10:31:00	1.0	0.0	0.4
	10:31:30	1.5	0.0	0.4
	10:32:00	2.0	0.0	0.4
	10:32:30	2.5	0.0	0.4
	10:33:00	3.0	0.0	0.5
	10:33:30	3.5	0.0	0.4
	10:34:00	4.0	0.0	0.5
	10:34:30	4.5	0.0	0.4
	10:35:00	5.0	0.0	0.4
	10:35:30	5.5	0.0	0.4
	10:36:00	6.0	0.0	0.4
	10:36:30	6.5	0.0	0.4
	10:37:00	7.0	0.0	0.4
	10:37:30	7.5	0.0	0.4
	10:38:00	8.0	0.0	0.4
	10:38:30	8.5	0.0	0.4
	10:39:00	9.0	0.0	0.4
	10:39:30	9.5	0.0	0.4
	10:40:00	10.0	0.0	0.4
	10:40:30	10.5	0.0	0.4
	10:41:00	11.0	0.0	0.4
	10:41:30	11.5	0.0	0.4
	10:42:00	12.0	0.0	0.4
	10:42:30	12.5	0.0	0.4
	10:43:00	13.0	0.0	0.4
	10:43:30	13.5	0.0	0.4
	10:44:00	14.0	0.0	0.4
	10:44:30	14.5	0.0	0.4
	10:45:00	15.0	0.0	0.4
	10:45:30	15.5	0.0	0.4
	10:46:00	16.0	0.0	0.4
	10:46:30	16.5	0.0	0.4

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	10:47:00	17.0	0.0	0.4
	10:47:30	17.5	0.0	0.4
Remote Control Boats Changed Position For Remote Station # 1	10:48:00	18.0	0.4	
	10:48:30	18.5	0.4	
	10:49:00	19.0	0.4	
	10:49:30	19.5	0.4	
	10:50:00	20.0	0.4	
	10:50:30	20.5	0.4	
	10:51:00	21.0	0.4	
	10:51:30	21.5	0.4	
	10:52:00	22.0	0.4	
	10:52:30	22.5	0.4	
	10:53:00	23.0	0.4	
	10:53:30	23.5	0.4	
	10:54:00	24.0	0.4	
	10:54:30	24.5	0.4	
	10:55:00	25.0	0.4	
	10:55:30	25.5	0.4	
	10:56:00	26.0	0.4	
	10:56:30	26.5	0.4	
	10:57:00	27.0	0.5	
	10:57:30	27.5	0.4	
	10:58:00	28.0	0.4	
	10:58:30	28.5	0.4	
	10:59:00	29.0	0.4	
	10:59:30	29.5	0.4	
	11:00:00	30.0	0.4	
	11:00:30	30.5	0.4	
	11:01:00	31.0	0.4	
	11:01:30	31.5	0.4	
	11:02:00	32.0	0.4	
	11:02:30	32.5	0.4	
	11:03:00	33.0	0.4	
	11:03:30	33.5	0.4	
	11:04:00	34.0	0.4	
	11:04:30	34.5	0.4	
	11:05:00	35.0	0.5	
	11:05:30	35.5	0.4	
	11:06:00	36.0	0.4	
	11:06:30	36.5	0.4	
	11:07:00	37.0	0.4	
	11:07:30	37.5	0.4	
	11:08:00	38.0	0.4	
	11:08:30	38.5	0.4	
	11:09:00	39.0	0.4	
	11:09:30	39.5	0.4	
	11:10:00	40.0	0.4	
	11:10:30	40.5	0.4	
	11:11:00	41.0	0.4	
	11:11:30	41.5	0.4	
	11:12:00	42.0	0.4	
	11:12:30	42.5	0.4	
	11:13:00	43.0	0.4	
	11:13:30	43.5	0.4	
	11:14:00	44.0	0.4	
	11:14:30	44.5	0.4	
	11:15:00	45.0	0.4	
	11:15:30	45.5	0.4	
	11:16:00	46.0	0.4	
	11:16:30	46.5	0.5	
	11:17:00	47.0	0.4	
	11:17:30	47.5	0.4	
	11:18:00	48.0	0.5	
	11:18:30	48.5	0.4	
	11:19:00	49.0	0.5	
	11:19:30	49.5	0.4	
	11:20:00	50.0	0.4	
	11:20:30	50.5	0.4	
	11:21:00	51.0	0.4	
	11:21:30	51.5	0.4	
	11:22:00	52.0	0.4	
	11:22:30	52.5	0.4	

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	11:23:00	53.0	0.4	0.0
	11:23:30	53.5	0.4	0.0
	11:24:00	54.0	0.4	0.0
	11:24:30	54.5	0.5	0.0
	11:25:00	55.0	0.4	0.0
	11:25:30	55.5	0.4	0.0
	11:26:00	56.0	0.4	0.0
	11:26:30	56.5	0.4	0.0
	11:27:00	57.0	0.5	0.0
	11:27:30	57.5	0.4	0.0
	11:28:00	58.0	0.4	0.0
	11:28:30	58.5	0.4	0.0
	11:29:00	59.0	0.4	0.0
	11:29:30	59.5	0.4	0.0
	11:30:00	60.0	0.4	0.0
	11:30:30	60.5	0.4	0.0
	11:31:00	61.0	0.4	0.0
	11:31:30	61.5	0.5	0.0
	11:32:00	62.0	0.4	0.0
	11:32:30	62.5	0.5	0.0
	11:33:00	63.0	0.4	0.0
	11:33:30	63.5	0.4	0.0
	11:34:00	64.0	0.4	0.0
	11:34:30	64.5	0.4	0.0
	11:35:00	65.0	0.4	0.0
	11:35:30	65.5	0.4	0.0
	11:36:00	66.0	0.5	0.0
	11:36:30	66.5	0.4	0.0
	11:37:00	67.0	0.4	0.0
	11:37:30	67.5	0.4	0.0
	11:38:00	68.0	0.5	0.0
	11:38:30	68.5	0.4	0.0
	11:39:00	69.0	0.4	0.0
	11:39:30	69.5	0.4	0.0
	11:40:00	70.0	0.4	0.0
	11:40:30	70.5	0.4	0.0
	11:41:00	71.0	0.4	0.0
	11:41:30	71.5	0.4	0.0
	11:42:00	72.0	0.4	0.0
	11:42:30	72.5	0.4	0.0
	11:43:00	73.0	0.5	0.0
	11:43:30	73.5	0.4	0.0
	11:44:00	74.0	0.4	0.0
	11:44:30	74.5	0.4	0.0
	11:45:00	75.0	0.4	0.0
	11:45:30	75.5	0.4	0.0
	11:46:00	76.0	0.4	0.0
	11:46:30	76.5	0.4	0.0
	11:47:00	77.0	0.4	0.0
	11:47:30	77.5	0.5	0.0
	11:48:00	78.0	0.4	0.0
	11:48:30	78.5	0.5	0.0
	11:49:00	79.0	0.5	0.0
	11:49:30	79.5	0.4	0.0
	11:50:00	80.0	0.4	0.0
	11:50:30	80.5	0.5	0.0
	11:51:00	81.0	0.4	0.0
	11:51:30	81.5	0.4	0.0
	11:52:00	82.0	0.4	0.0
	11:52:30	82.5	0.4	0.0
	11:53:00	83.0	0.4	0.0
	11:53:30	83.5	0.4	0.0
	11:54:00	84.0	0.4	0.0
	11:54:30	84.5	0.4	0.0
	11:55:00	85.0	0.4	0.0
	11:55:30	85.5	0.4	0.0
	11:56:00	86.0	0.5	0.0
	11:56:30	86.5	0.4	0.0
	11:57:00	87.0	0.5	0.0
	11:57:30	87.5	0.4	0.0
	11:58:00	88.0	0.4	0.0

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	11:58:30	88.5	0.5	0.0
	11:59:00	89.0	0.5	0.0
	11:59:30	89.5	0.5	0.0
	12:00:00	90.0	0.5	0.0
	12:00:30	90.5	0.5	0.0
	12:01:00	91.0	0.5	0.0
	12:01:30	91.5	0.5	0.0
	12:02:00	92.0	0.4	0.0
	12:02:30	92.5	0.4	0.0
	12:03:00	93.0	0.4	0.0
	12:03:30	93.5	0.4	0.0
	12:04:00	94.0	0.5	0.0
Post-burn 1	12:04:30	94.5	0.4	0.0
	12:05:00	95.0	0.5	0.0
	12:05:30	95.5	0.4	0.0
	12:06:00	96.0	0.5	0.0
	12:06:30	96.5	0.4	0.0
	12:07:00	97.0	0.4	0.0
	12:07:30	97.5	0.4	0.0
	12:08:00	98.0	0.4	0.0
	12:08:30	98.5	0.5	0.0
	12:09:00	99.0	0.4	0.0
	12:09:30	99.5	0.4	0.0
	12:10:00	100.0	0.5	0.0
	12:10:30	100.5	0.4	0.0
	12:11:00	101.0	0.4	0.0
	12:11:30	101.5	0.4	0.0
	12:12:00	102.0	0.4	0.0
	12:12:30	102.5	0.4	0.0
	12:13:00	103.0	0.4	0.0
	12:13:30	103.5	0.4	0.0
	12:14:00	104.0	0.5	0.0
	12:14:30	104.5	0.4	0.0
	12:15:00	105.0	0.4	0.0
	12:15:30	105.5	0.4	0.0
	12:16:00	106.0	0.4	0.0
	12:16:30	106.5	0.4	0.0
	12:17:00	107.0	0.4	0.0
	12:17:30	107.5	0.4	0.0
	12:18:00	108.0	0.4	0.0
	12:18:30	108.5	0.4	0.0
	12:19:00	109.0	0.5	0.0
	12:19:30	109.5	0.5	0.0
	12:20:00	110.0	0.4	0.0
	12:20:30	110.5	0.4	0.0
	12:21:00	111.0	0.5	0.0
	12:21:30	111.5	0.5	0.0
	12:22:00	112.0	0.4	0.0
	12:22:30	112.5	0.5	0.0
	12:23:00	113.0	0.5	0.0
	12:23:30	113.5	0.5	0.0
	12:24:00	114.0	0.4	0.0
	12:24:30	114.5	0.5	0.0
	12:25:00	115.0	0.5	0.0
	12:25:30	115.5	0.4	0.0
	12:26:00	116.0	0.4	0.0
	12:26:30	116.5	0.4	0.0
	12:27:00	117.0	0.4	0.0
	12:27:30	117.5	0.4	0.0
	12:28:00	118.0	0.4	0.0
	12:28:30	118.5	0.4	0.0
	12:29:00	119.0	0.4	0.0
	12:29:30	119.5	0.5	0.0
	12:30:00	120.0	0.4	0.0
	12:30:30	120.5	0.4	0.0
	12:31:00	121.0	0.4	0.0
	12:31:30	121.5	0.5	0.0
	12:32:00	122.0	0.5	0.0
	12:32:30	122.5	0.5	0.0

NOBE 93 Table 5.5 cont. **Nitrogen Dioxide - Remote Stations 1 and 2**

Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	12:33:00	123.0	0.5	0.0
	12:33:30	123.5	0.5	0.0
	12:34:00	124.0	0.5	0.0
	12:34:30	124.5	0.4	0.0
	12:35:00	125.0	0.4	0.0
	12:35:30	125.5	0.4	0.0
	12:36:00	126.0	0.4	0.0
	12:36:30	126.5	0.4	0.0
	12:37:00	127.0	0.5	0.0
	12:37:30	127.5	0.4	0.0
	12:38:00	128.0	0.5	0.0
	12:38:30	128.5	0.4	0.0
	12:39:00	129.0	0.4	0.0
	12:39:30	129.5	0.4	0.0
	12:40:00	130.0	0.4	0.0
	12:40:30	130.5	0.5	0.0
	12:41:00	131.0	0.5	0.0
	12:41:30	131.5	0.5	0.0
	12:42:00	132.0	0.4	0.0
	12:42:30	132.5	0.5	0.0
	12:43:00	133.0	0.4	0.0
	12:43:30	133.5	0.5	0.0
	12:44:00	134.0	0.4	0.0
	12:44:30	134.5	0.5	0.0
	12:45:00	135.0	0.5	0.0
	12:45:30	135.5	0.5	0.0
	12:46:00	136.0	0.5	0.0
	12:46:30	136.5	0.5	0.0
	12:47:00	137.0	0.5	0.0
	12:47:30	137.5	0.5	0.0
	12:48:00	138.0	0.5	0.0
	12:48:30	138.5	0.5	0.0
	12:49:00	139.0	0.4	0.0
	12:49:30	139.5	0.4	0.0
	12:50:00	140.0	0.4	0.0
	12:50:30	140.5	0.5	0.0
	12:51:00	141.0	0.4	0.0
	12:51:30	141.5	0.5	0.0
	12:52:00	142.0	0.5	0.0
	12:52:30	142.5	0.4	0.0
	12:53:00	143.0	0.4	0.0
	12:53:30	143.5	0.4	0.0
	12:54:00	144.0	0.4	0.0
	12:54:30	144.5	0.5	0.0
	12:55:00	145.0	0.5	0.0
	12:55:30	145.5	0.5	0.0
	12:56:00	146.0	0.5	0.0
	12:56:30	146.5	0.5	0.0
	12:57:00	147.0	0.5	0.0
	12:57:30	147.5	0.4	0.0
	12:58:00	148.0	0.4	0.0
	12:58:30	148.5	0.5	0.0
	12:59:00	149.0	0.5	0.0
	12:59:30	149.5	0.4	0.0
Background 2	13:00:00	-66.0	0.0	0.5
	13:00:30	-65.5	0.0	0.5
	13:01:00	-65.0	0.0	0.4
	13:01:30	-64.5	0.0	0.5
	13:02:00	-64.0	0.0	0.5
	13:02:30	-63.5	0.0	0.4
	13:03:00	-63.0	0.0	0.5
	13:03:30	-62.5	0.0	0.5
	13:04:00	-62.0	0.0	0.5
	13:04:30	-61.5	0.0	0.5
	13:05:00	-61.0	0.0	0.4
	13:05:30	-60.5	0.0	0.4
	13:06:00	-60.0	0.0	0.5
	13:06:30	-59.5	0.0	0.5
	13:07:00	-59.0	0.0	0.5
	13:07:30	-58.5	0.0	0.4
	13:08:00	-58.0	0.0	0.4

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	13:08:30	-57.5	0.0	0.5
	13:09:00	-57.0	0.0	0.4
	13:09:30	-56.5	0.0	0.4
	13:10:00	-56.0	0.0	0.5
	13:10:30	-55.5	0.0	0.5
	13:11:00	-55.0	0.0	0.5
	13:11:30	-54.5	0.0	0.5
	13:12:00	-54.0	0.0	0.4
	13:12:30	-53.5	0.0	0.4
	13:13:00	-53.0	0.0	0.4
	13:13:30	-52.5	0.0	0.4
	13:14:00	-52.0	0.0	0.5
	13:14:30	-51.5	0.0	0.4
	13:15:00	-51.0	0.0	0.4
	13:15:30	-50.5	0.0	0.5
	13:16:00	-50.0	0.0	0.5
	13:16:30	-49.5	0.0	0.4
	13:17:00	-49.0	0.0	0.5
	13:17:30	-48.5	0.0	0.5
	13:18:00	-48.0	0.0	0.5
	13:18:30	-47.5	0.0	0.4
	13:19:00	-47.0	0.0	0.5
	13:19:30	-46.5	0.0	0.5
	13:20:00	-46.0	0.0	0.4
	13:20:30	-45.5	0.0	0.4
	13:21:00	-45.0	0.0	0.4
	13:21:30	-44.5	0.0	0.5
	13:22:00	-44.0	0.0	0.5
	13:22:30	-43.5	0.0	0.4
	13:23:00	-43.0	0.0	0.5
	13:23:30	-42.5	0.0	0.5
	13:24:00	-42.0	0.0	0.4
	13:24:30	-41.5	0.0	0.4
	13:25:00	-41.0	0.0	0.4
	13:25:30	-40.5	0.0	0.5
	13:26:00	-40.0	0.0	0.5
	13:26:30	-39.5	0.0	0.5
	13:27:00	-39.0	0.0	0.5
	13:27:30	-38.5	0.0	0.5
	13:28:00	-38.0	0.0	0.5
	13:28:30	-37.5	0.0	0.5
	13:29:00	-37.0	0.0	0.5
	13:29:30	-36.5	0.0	0.5
	13:30:00	-36.0	0.0	0.5
	13:30:30	-35.5		0.4
	13:31:00	-35.0		0.5
	13:31:30	-34.5		0.5
	13:32:00	-34.0		0.4
	13:32:30	-33.5		0.5
	13:33:00	-33.0		0.5
	13:33:30	-32.5		0.4
	13:34:00	-32.0		0.4
	13:34:30	-31.5		0.4
	13:35:00	-31.0		0.5
	13:35:30	-30.5		0.4
	13:36:00	-30.0		0.4
	13:36:30	-29.5		0.4
	13:37:00	-29.0		0.5
	13:37:30	-28.5		0.4
	13:38:00	-28.0		0.5
	13:38:30	-27.5		0.5
	13:39:00	-27.0		0.5
	13:39:30	-26.5		0.4
	13:40:00	-26.0		0.5
	13:40:30	-25.5		0.5
	13:41:00	-25.0		0.4
	13:41:30	-24.5		0.5
	13:42:00	-24.0		0.5
	13:42:30	-23.5		0.4
	13:43:00	-23.0		0.5
	13:43:30	-22.5		0.5
	13:44:00	-22.0		0.5
	13:44:30	-21.5		0.5

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	13:46:30	-19.5		0.4
	13:47:00	-19.0		0.5
	13:47:30	-18.5		0.5
	13:48:00	-18.0		0.4
	13:48:30	-17.5		0.5
	13:49:00	-17.0		0.5
	13:49:30	-16.5		0.4
	13:50:00	-16.0		0.4
	13:50:30	-15.5		0.4
	13:51:00	-15.0		0.5
	13:51:30	-14.5		0.4
Pre-ignition 2	13:52:00	-14.0		0.4
	13:52:30	-13.5		0.4
	13:53:00	-13.0		0.4
	13:53:30	-12.5		0.5
	13:54:00	-12.0		0.4
	13:54:30	-11.5		0.4
	13:55:00	-11.0		0.4
	13:55:30	-10.5		0.4
	13:56:00	-10.0		0.5
	13:56:30	-9.5		0.5
	13:57:00	-9.0		0.4
	13:57:30	-8.5		0.4
	13:58:00	-8.0		0.4
	13:58:30	-7.5		0.5
	13:59:00	-7.0		0.4
	13:59:30	-6.5		0.4
	14:00:00	-6.0		0.4
	14:00:30	-5.5		0.4
	14:01:00	-5.0		0.5
	14:01:30	-4.5		0.4
	14:02:00	-4.0		0.5
	14:02:30	-3.5		0.5
	14:03:00	-3.0		0.4
	14:03:30	-2.5		0.4
	14:04:00	-2.0		0.5
	14:04:30	-1.5		0.4
	14:05:00	-1.0		0.4
	14:05:30	-0.5		0.5
Burn 2	14:06:00	0.0		0.5
	14:06:30	0.5		0.4
	14:07:00	1.0		0.5
	14:07:30	1.5		0.5
	14:08:00	2.0		0.4
	14:08:30	2.5		0.4
	14:09:00	3.0		0.4
	14:09:30	3.5		0.4
	14:10:00	4.0		0.5
	14:10:30	4.5		0.4
	14:11:00	5.0		0.4
	14:11:30	5.5		0.4
	14:12:00	6.0		0.4
	14:12:30	6.5		0.4
	14:13:00	7.0		0.4
	14:13:30	7.5		0.4
	14:14:00	8.0		0.4
	14:14:30	8.5		0.5
	14:15:00	9.0		0.4
	14:15:30	9.5		0.5
	14:16:00	10.0		0.4
	14:16:30	10.5		0.4
	14:17:00	11.0		0.4
	14:17:30	11.5		0.5
	14:18:00	12.0		0.4
	14:18:30	12.5		0.4
	14:19:00	13.0		0.5
	14:19:30	13.5		0.5
	14:20:00	14.0		0.5
	14:20:30	14.5		0.5

NOBE 93 Table 5.5 cont. **Nitrogen Dioxide - Remote Stations 1 and 2**

Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	14:21:00	15.0		0.5
	14:21:30	15.5		0.4
	14:22:00	16.0		0.4
	14:22:30	16.5		0.4
	14:23:00	17.0		0.4
	14:23:30	17.5		0.4
	14:24:00	18.0		0.5
	14:24:30	18.5		0.5
	14:25:00	19.0		0.4
	14:25:30	19.5		0.4
	14:26:00	20.0		0.5
	14:26:30	20.5		0.4
	14:27:00	21.0		0.4
	14:27:30	21.5		0.5
	14:28:00	22.0		0.5
	14:28:30	22.5		0.4
	14:29:00	23.0		0.4
	14:29:30	23.5		0.5
	14:30:00	24.0		0.4
	14:30:30	24.5		0.4
	14:31:00	25.0		0.4
	14:31:30	25.5		0.4
	14:32:00	26.0		0.5
	14:32:30	26.5		0.4
	14:33:00	27.0		0.4
	14:33:30	27.5		0.4
	14:34:00	28.0		0.4
	14:34:30	28.5		0.5
	14:35:00	29.0		0.5
	14:35:30	29.5		0.4
	14:36:00	30.0		0.4
	14:36:30	30.5		0.4
	14:37:00	31.0		0.4
	14:37:30	31.5		0.4
	14:38:00	32.0		0.4
	14:38:30	32.5		0.4
	14:39:00	33.0		0.4
	14:39:30	33.5		0.4
	14:40:00	34.0		0.5
	14:40:30	34.5		0.4
	14:41:00	35.0		0.4
	14:41:30	35.5		0.4
	14:42:00	36.0		0.4
	14:42:30	36.5		0.4
	14:43:00	37.0		0.4
	14:43:30	37.5		0.4
	14:44:00	38.0		0.4
	14:44:30	38.5		0.4
	14:45:00	39.0		0.4
	14:45:30	39.5		0.4
	14:46:00	40.0		0.4
	14:46:30	40.5		0.4
	14:47:00	41.0		0.4
	14:47:30	41.5		0.4
	14:48:00	42.0		0.4
	14:48:30	42.5		0.4
	14:49:00	43.0		0.5
	14:49:30	43.5		0.5
	14:50:00	44.0		0.5
	14:50:30	44.5		0.4
	14:51:00	45.0		0.5
	14:51:30	45.5		0.4
	14:52:00	46.0		0.4
	14:52:30	46.5		0.4
	14:53:00	47.0		0.4
	14:53:30	47.5		0.5

NOBE 93 Table 5.5 cont. **Nitrogen Dioxide - Remote Stations 1 and 2**

Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	14:54:00	48.0		0.4
	14:54:30	48.5		0.4
	14:55:00	49.0		0.4
	14:55:30	49.5		0.4
	14:56:00	50.0		0.4
	14:56:30	50.5		0.4
	14:57:00	51.0		0.4
	14:57:30	51.5		0.4
	14:58:00	52.0		0.4
	14:58:30	52.5		0.4
	14:59:00	53.0		0.4
	14:59:30	53.5		0.4
	15:00:00	54.0		0.4
	15:00:30	54.5		0.4
	15:01:00	55.0		0.4
	15:01:30	55.5		0.5
	15:02:00	56.0		0.4
	15:02:30	56.5		0.5
	15:03:00	57.0		0.4
	15:03:30	57.5		0.4
	15:04:00	58.0		0.4
	15:04:30	58.5		0.5
	15:05:00	59.0		0.4
	15:05:30	59.5		0.5
	15:06:00	60.0		0.4
	15:06:30	60.5		0.4
	15:07:00	61.0		0.4
	15:07:30	61.5		0.4
	15:08:00	62.0		0.4
	15:08:30	62.5		0.5
	15:09:00	63.0		0.4
	15:09:30	63.5		0.4
	15:10:00	64.0		0.4
	15:10:30	64.5		0.4
	15:11:00	65.0		0.5
	15:11:30	65.5		0.4
	15:12:00	66.0		0.4
	15:12:30	66.5		0.4
	15:13:00	67.0		0.4
	15:13:30	67.5		0.4
	15:14:00	68.0		0.4
	15:14:30	68.5		0.4
	15:15:00	69.0		0.4
	15:15:30	69.5		0.4
	15:16:00	70.0		0.4
	15:16:30	70.5		0.5
	15:17:00	71.0		0.5
	15:17:30	71.5		0.4
	15:18:00	72.0		0.4
	15:18:30	72.5		0.4
	15:19:00	73.0		0.5
Post-burn 2	15:19:30	73.5		0.4
	15:20:00	74.0		0.5
	15:20:30	74.5		0.4
	15:21:00	75.0		0.4
	15:21:30	75.5		0.4
	15:22:00	76.0		0.4
	15:22:30	76.5		0.4
	15:23:00	77.0		0.4
	15:23:30	77.5		0.4
	15:24:00	78.0		0.4
	15:24:30	78.5		0.4
	15:25:00	79.0		0.4
	15:25:30	79.5		0.4
	15:26:00	80.0		0.4

NOBE 93 Table 5.5 cont.

Nitrogen Dioxide - Remote Stations 1 and 2
Exotox

Time Periods	Clock (hh:mm:ss)	Time Elapsed (min)	Remote Station # 1 50 to 100 m from fire	Remote Station # 2 100 to 150 m from fire
	15:26:30	80.5		0.4
	15:27:00	81.0		0.4
	15:27:30	81.5		0.4
	15:28:00	82.0		0.4
	15:28:30	82.5		0.4
	15:29:00	83.0		0.5
	15:29:30	83.5		0.4
	15:30:00	84.0		0.4
	15:30:30	84.5		0.4
	15:31:00	85.0		0.5
	15:31:30	85.5		0.5
	15:32:00	86.0		0.4
	15:32:30	86.5		0.4
	15:33:00	87.0		0.4
	15:33:30	87.5		0.4
	15:34:00	88.0		0.4
	15:34:30	88.5		0.4
	15:35:00	89.0		0.4
	15:35:30	89.5		0.4
	15:36:00	90.0		0.4
	15:36:30	90.5		0.4
	15:37:00	91.0		0.4
	15:37:30	91.5		0.4
	15:38:00	92.0		0.4
	15:38:30	92.5		0.5
	15:39:00	93.0		0.4
	15:39:30	93.5		0.4
	15:40:00	94.0		0.4
	15:40:30	94.5		0.4
	15:41:00	95.0		0.4
	15:41:30	95.5		0.4
	15:42:00	96.0		0.4
	15:42:30	96.5		0.4
	15:43:00	97.0		0.4
	15:43:30	97.5		0.5
	15:44:00	98.0		0.4
	15:44:30	98.5		0.4
	15:45:00	99.0		0.4
	15:45:30	99.5		0.5
	15:46:00	100.0		0.4

Sulphur Dioxide (SO_2)
NOBE 93

Exotox 75

Instrumentation

- The Exotox 75 was used to analyse CO, SO_2, NO_2.
- Its flow rate is 300 mL/minute.
- Tubing was connected from the instrument to the mast to allow sampling at approximately 1.25 m above sea level.
- The data was logged every 30 seconds.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.

Cannonball

The Cannonball can monitor the atmosphere for up to four gases, using a variety of sensors. Working as a sample draw device, it will detect combustible gas, oxygen, and a choice of two other toxic gases. For NOBE 93, it was used to analyse carbon monoxide and sulphur dioxide. This equipment serves as both an area monitor and to check the atmosphere in a remote area. The Cannonball's waterproof case and a hydrophobic filter in the sample probe make it suitable for use in most rugged environments.

Instrumentation

- The instrument pumped air at a flow rate of 1 L/min.
- Tubing was connected from the instrument to the mast to allow sampling at 1.25 m above sea level.
- Data was logged every 30 seconds.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500 to 600 m from the fire.

Impinger

Instrumentation

- The concentration of sulphur dioxide in the air was also measured using the impinger method.
- It consisted of drawing a known volume of air through a Tygon tube attached to a filter (37-mm, 0.8 μm) contained in a cassette and through a midget bubbler (25 mL) containing 15 mL of 0.3N hydrogen peroxide.
- The end of the tubing was connected to the mast to allow sampling at 1.25 m above sea level.
- The flow rate of the Gilian 513A pump was set between 90 and 200 cc/min and air volumes between 3 and 14 L passed through the impinger.
- Samples were transferred in amber vials and refrigerated.
- Analysis will be performed using method NIOSH S308.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and approximately 1.25 m above sea level.
- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500 to 600 m from the fire.

NOBE 93 Table 6.1

Sulphur Dioxide Analysis
Impinger

Time Periods	Blanks	Burn period								
Sample I.D.		Remote Station # 1 Remote control boat # 2 50 to 100 m from fire			Remote Station # 2 Remote control boat # 1 100 to 150 m from fire			Downwind Station CCG 206 900 m from fire		
		Instrument 1 ppm	Instrument 2 ppm	AVE ppm	Instrument 1 ppm	Instrument 2 ppm	AVE ppm	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
Burn 1		12.6	7.9	10.3	13.3	7.9	10.6	9.9	2.7	6.3
		Remote control boat # 1			Remote control boat # 2			500 to 600 m from fire		
Burn 2		9.1	17.6	13.4	11.5	14.2	12.9	6.0	4.8	5.4
Background, August 07, 93		11.8	13.4	12.6						7.5
Lot Blank	0.0									
Trip Blank	0.0									

Burn 1 only ...
R/C boat 2 ... 10:30 to 10:47 in position RS-2, in position RS-1 from 10:47 to end of sampling; results applied to RS-1 position
R/C boat 1 ... from 11:23 to end of sampling in position RS-2; results applied to RS-2 position

NOBE 93 Table 6.2

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods / Sample I.D.		Remote Station # 1 Remote control boat # 2 50 to 100 m from fire ppm	Remote Station # 2 Remote control boat # 1 100 to 150 m from fire ppm	Downwind Station CCG 206 900 m from fire Instrument 1 ppm	Instrument 2 ppm	AVE ppm
				0.0	0.0	0.0
				0.0	0.0	0.0
Background 1	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.1	0.0	0.0	0.3	0.1
	Maximum	0.9	0.0	0.0	1.0	0.5
Pre-ignition 1	Minimum	0.0	0.0	0.0	1.0	0.5
	Average	0.3	0.0	0.0	1.1	0.6
	Maximum	1.6	0.0	0.0	2.0	1.0
Burn 1	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.0	0.0	0.0	0.9	0.4
	Maximum	0.1	0.0	0.0	2.0	1.0
Post-burn 1	Minimum	0.0	0.0	0.0	1.0	0.5
	Average	0.0	0.0	0.8	2.0	1.4
	Maximum	0.0	0.3	1.0	2.0	1.5
		Remote control boat # 1	Remote control boat # 2	500 to 600 m from fire		
Background 2	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.1	0.0	0.6	1.2	0.9
	Maximum	0.6	0.2	1.0	2.0	1.5
Pre-ignition 2	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.0	0.0	0.0	0.0	0.0
	Maximum	0.2	0.1	0.0	0.0	0.0
Burn 2	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.1	0.0	0.0	0.0	0.0
	Maximum	0.7	0.2	0.0	0.0	0.0
Post-burn 2	Minimum	0.0	0.0	0.0	0.0	0.0
	Average	0.0	0.0	0.0	0.0	0.0
	Maximum	0.1	0.0	0.0	0.0	0.0
Background , Aug 07 93	Minimum			0.0	0.0	0.0
	Average			0.0	0.0	0.0
	Maximum			0.0	0.0	0.0

Burn 1 only ...
R/C boat 2 ... 10:30 to 10:47 in position RS-2, in position RS-1 from 10:47 to end of sampling; results applied to RS-1 position
R/C boat 1 ... from 11:23 to end of sampling in position RS-2; results applied to RS-2 position

NOBE 93 Table 6.3

Sulphur Dioxide Analysis
Exotox

Time Periods		Remote Station # 1 Remote control Boat # 2 50 to 100 m from fire ppm	Remote Station # 2 Remote control boat # 1 100 to 150 m from fire ppm
Background 1	Minimum	2.5	0.0
	Average	2.6	0.0
	Maximum	2.7	0.8
Pre-ignition 1	Minimum	2.3	0.0
	Average	2.5	0.4
	Maximum	2.6	0.9
Burn 1	Minimum	0.0	0.0
	Average	0.5	0.0
	Maximum	2.5	0.4
Post-burn 1	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.3	0.0
		Remote control boat # 1	Remote control boat # 2
Background 2	Minimum	0.0	0.0
	Average	0.0	0.0
	Maximum	0.0	0.7
Pre-ignition 2	Minimum		0.1
	Average		0.4
	Maximum		0.7
Burn 2	Minimum		0.0
	Average		0.1
	Maximum		0.6
Post-burn 2	Minimum		0.0
	Average		0.0
	Maximum		0.0

Burn 1 only ...
R/C boat 2 ... 10:30 to 10:47 in position RS-2, in position RS-1 from 10:47 to end of sampling; results applied to RS-1 position
R/C boat 1 ... from 11:23 to end of sampling in position RS-2; results applied to RS-2 position

NOBE 93 Table 6.4

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
Background 1	8:22:00	-128.0		0.0
	8:22:30	-127.5		0.0
	8:23:00	-127.0		0.0
	8:23:30	-126.5		0.0
	8:24:00	-126.0		0.0
	8:24:30	-125.5		0.0
	8:25:00	-125.0		0.0
	8:25:30	-124.5		0.0
	8:26:00	-124.0		0.0
	8:26:30	-123.5		0.0
	8:27:00	-123.0		0.0
	8:27:30	-122.5		0.0
	8:28:00	-122.0		0.0
	8:28:30	-121.5		0.0
	8:29:00	-121.0		0.0
	8:29:30	-120.5		0.0
	8:30:00	-120.0		0.0
	8:30:30	-119.5		0.0
	8:31:00	-119.0		0.0
	8:31:30	-118.5		0.0
	8:32:00	-118.0		0.0
	8:32:30	-117.5		0.0
	8:33:00	-117.0		0.0
	8:33:30	-116.5		0.0
	8:34:00	-116.0		0.0
	8:34:30	-115.5		0.0
	8:35:00	-115.0		0.0
	8:35:30	-114.5		0.0
	8:36:00	-114.0		0.0
	8:36:30	-113.5		0.0
	8:37:00	-113.0		0.0
	8:37:30	-112.5		0.0
	8:38:00	-112.0		0.0
	8:38:30	-111.5	0.0	0.0
	8:39:00	-111.0	0.0	0.0
	8:39:30	-110.5	0.0	0.0
	8:40:00	-110.0	0.0	0.0
	8:40:30	-109.5	0.0	0.0
	8:41:00	-109.0	0.0	0.0
	8:41:30	-108.5	0.0	0.0
	8:42:00	-108.0	0.0	0.0
	8:42:30	-107.5	0.0	0.0
	8:43:00	-107.0	0.0	0.0
	8:43:30	-106.5	0.0	0.0
	8:44:00	-106.0	0.7	0.0
	8:44:30	-105.5	0.5	0.0
	8:45:00	-105.0	0.0	0.0
	8:45:30	-104.5	0.1	0.0
	8:46:00	-104.0	0.0	0.0
	8:46:30	-103.5	0.1	0.0
	8:47:00	-103.0	0.9	0.0
	8:47:30	-102.5	0.7	0.0
	8:48:00	-102.0	0.1	0.0
	8:48:30	-101.5	0.0	0.0
	8:49:00	-101.0	0.0	0.0
	8:49:30	-100.5	0.0	0.0
	8:50:00	-100.0	0.0	0.0
	8:50:30	-99.5	0.0	0.0
	8:51:00	-99.0	0.0	0.0
	8:51:30	-98.5	0.0	0.0
	8:52:00	-98.0	0.0	0.0
	8:52:30	-97.5	0.1	0.0
	8:53:00	-97.0	0.2	0.0
	8:53:30	-96.5	0.2	0.0
	8:54:00	-96.0	0.0	0.0
	8:54:30	-95.5	0.0	0.0
	8:55:00	-95.0	0.0	0.0
	8:55:30	-94.5	0.0	0.0

NOBE 93 Table 6.4 cont. Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	8:56:00	-94.0	0.0	0.0
	8:56:30	-93.5	0.0	0.0
	8:57:00	-93.0	0.0	0.0
	8:57:30	-92.5	0.0	0.0
	8:58:00	-92.0	0.0	0.0
	8:58:30	-91.5	0.0	0.0
	8:59:00	-91.0	0.0	0.0
	8:59:30	-90.5	0.0	0.0
	9:00:00	-90.0	0.0	0.0
	9:00:30	-89.5	0.0	0.0
	9:01:00	-89.0	0.0	0.0
	9:01:30	-88.5	0.0	0.0
	9:02:00	-88.0	0.0	0.0
	9:02:30	-87.5	0.0	0.0
	9:03:00	-87.0	0.0	0.0
	9:03:30	-86.5	0.0	0.0
	9:04:00	-86.0	0.0	0.0
	9:04:30	-85.5	0.0	0.0
	9:05:00	-85.0	0.0	0.0
	9:05:30	-84.5	0.0	0.0
	9:06:00	-84.0	0.0	0.0
	9:06:30	-83.5	0.0	0.0
	9:07:00	-83.0	0.0	0.0
	9:07:30	-82.5	0.0	0.0
	9:08:00	-82.0	0.1	0.0
	9:08:30	-81.5	0.0	0.0
	9:09:00	-81.0	0.0	0.0
	9:09:30	-80.5	0.0	0.0
	9:10:00	-80.0	0.0	0.0
	9:10:30	-79.5	0.0	0.0
	9:11:00	-79.0	0.0	0.0
	9:11:30	-78.5	0.0	0.0
	9:12:00	-78.0	0.0	0.0
	9:12:30	-77.5	0.1	0.0
	9:13:00	-77.0	0.0	0.0
	9:13:30	-76.5	0.0	0.0
	9:14:00	-76.0	0.0	0.0
	9:14:30	-75.5	0.0	0.0
	9:15:00	-75.0	0.1	0.0
	9:15:30	-74.5	0.0	0.0
	9:16:00	-74.0	0.0	0.0
	9:16:30	-73.5	0.0	0.0
	9:17:00	-73.0	0.0	0.0
	9:17:30	-72.5	0.0	0.0
	9:18:00	-72.0	0.0	0.0
	9:18:30	-71.5	0.1	0.0
	9:19:00	-71.0	0.0	0.0
	9:19:30	-70.5	0.2	0.0
	9:20:00	-70.0	0.2	0.0
	9:20:30	-69.5	0.1	0.0
	9:21:00	-69.0	0.0	0.0
	9:21:30	-68.5	0.0	0.0
	9:22:00	-68.0	0.4	0.0
	9:22:30	-67.5	0.5	0.0
	9:23:00	-67.0	0.3	0.0
	9:23:30	-66.5	0.1	0.0
	9:24:00	-66.0	0.1	0.0
	9:24:30	-65.5	0.1	0.0
	9:25:00	-65.0	0.2	0.0
	9:25:30	-64.5	0.1	0.0
	9:26:00	-64.0	0.1	0.0
	9:26:30	-63.5	0.0	0.0
	9:27:00	-63.0	0.2	0.0
	9:27:30	-62.5	0.3	0.0
	9:28:00	-62.0	0.1	0.0
	9:28:30	-61.5	0.0	0.0
	9:29:00	-61.0	0.1	0.0
	9:29:30	-60.5	0.0	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
Pre-ignition 1	9:30:00	-60.0	0.3	0.0
	9:30:30	-59.5	0.1	0.0
	9:31:00	-59.0	0.1	0.0
	9:31:30	-58.5	0.7	0.0
	9:32:00	-58.0	0.5	0.0
	9:32:30	-57.5	0.4	0.0
	9:33:00	-57.0	0.6	0.0
	9:33:30	-56.5	0.8	0.0
	9:34:00	-56.0	0.5	0.0
	9:34:30	-55.5	0.6	0.0
	9:35:00	-55.0	0.6	0.0
	9:35:30	-54.5	0.2	0.0
	9:36:00	-54.0	0.1	0.0
	9:36:30	-53.5	0.0	0.0
	9:37:00	-53.0	0.1	0.0
	9:37:30	-52.5	0.2	0.0
	9:38:00	-52.0	0.1	0.0
	9:38:30	-51.5	0.1	0.0
	9:39:00	-51.0	0.1	0.0
	9:39:30	-50.5	0.1	0.0
	9:40:00	-50.0	0.2	0.0
	9:40:30	-49.5	0.1	0.0
	9:41:00	-49.0	0.2	0.0
	9:41:30	-48.5	0.2	0.0
	9:42:00	-48.0	0.2	0.0
	9:42:30	-47.5	0.1	0.0
	9:43:00	-47.0	0.0	0.0
	9:43:30	-46.5	0.2	0.0
	9:44:00	-46.0	0.1	0.0
	9:44:30	-45.5	0.4	0.0
	9:45:00	-45.0	0.2	0.0
	9:45:30	-44.5	0.1	0.0
	9:46:00	-44.0	0.1	0.0
	9:46:30	-43.5	0.2	0.0
	9:47:00	-43.0	0.2	0.0
	9:47:30	-42.5	0.3	0.0
	9:48:00	-42.0	0.6	0.0
	9:48:30	-41.5	0.2	0.0
	9:49:00	-41.0	0.2	0.0
	9:49:30	-40.5	0.1	0.0
	9:50:00	-40.0	0.2	0.0
	9:50:30	-39.5	0.1	0.0
	9:51:00	-39.0	0.2	0.0
	9:51:30	-38.5	0.1	0.0
	9:52:00	-38.0	0.0	0.0
	9:52:30	-37.5	0.2	0.0
	9:53:00	-37.0	0.2	0.0
	9:53:30	-36.5	0.4	0.0
	9:54:00	-36.0	0.2	0.0
	9:54:30	-35.5	0.2	0.0
	9:55:00	-35.0	0.0	0.0
	9:55:30	-34.5	0.1	0.0
	9:56:00	-34.0	0.1	0.0
	9:56:30	-33.5	0.1	0.0
	9:57:00	-33.0	1.4	0.0
	9:57:30	-32.5	1.3	0.0
	9:58:00	-32.0	1.0	0.0
	9:58:30	-31.5	0.4	0.0
	9:59:00	-31.0	0.1	0.0
	9:59:30	-30.5	0.2	0.0
	10:00:00	-30.0	0.1	0.0
	10:00:30	-29.5	1.0	0.0
	10:01:00	-29.0	0.8	0.0
	10:01:30	-28.5	0.4	0.0
	10:02:00	-28.0	0.1	0.0
	10:02:30	-27.5	0.5	0.0
	10:03:00	-27.0	0.0	0.0
	10:03:30	-26.5	0.0	0.0
	10:04:00	-26.0		0.0
	10:04:30	-25.5		0.0
	10:05:00	-25.0		0.0

Section 6

Sulphur Dioxide (SO_2)
NOBE 93

NOBE 93 Table 6.4 cont. **Sulphur Dioxide Analysis at Sea Level**

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	10:05:30	-24.5	0.1	0.0
	10:06:00	-24.0	0.1	0.0
	10:06:30	-23.5	0.7	0.0
	10:07:00	-23.0	0.6	0.0
	10:07:30	-22.5	0.4	0.0
	10:08:00	-22.0	1.0	0.0
	10:08:30	-21.5	1.6	0.0
	10:09:00	-21.0	0.5	0.0
	10:09:30	-20.5	0.5	0.0
	10:10:00	-20.0	0.7	0.0
	10:10:30	-19.5	0.6	0.0
	10:11:00	-19.0	0.4	0.0
	10:11:30	-18.5	0.0	0.0
	10:12:00	-18.0	0.0	0.0
	10:12:30	-17.5	0.2	0.0
	10:13:00	-17.0	0.0	0.0
	10:13:30	-16.5	0.1	0.0
	10:14:00	-16.0	0.2	0.0
	10:14:30	-15.5	0.2	0.0
	10:15:00	-15.0	0.2	0.0
	10:15:30	-14.5	0.2	0.0
	10:16:00	-14.0	0.1	0.0
	10:16:30	-13.5	0.1	0.0
	10:17:00	-13.0	0.4	0.0
	10:17:30	-12.5		0.0
	10:18:00	-12.0		0.0
	10:18:30	-11.5	1.0	0.0
	10:19:00	-11.0	0.4	0.0
	10:19:30	-10.5	0.7	0.0
	10:20:00	-10.0	0.6	0.0
	10:20:30	-9.5	0.2	0.0
	10:21:00	-9.0	0.0	0.0
	10:21:30	-8.5	0.4	0.0
	10:22:00	-8.0	0.4	0.0
	10:22:30	-7.5	0.2	0.0
	10:23:00	-7.0	0.3	0.0
	10:23:30	-6.5	0.2	0.0
	10:24:00	-6.0	0.3	0.0
	10:24:30	-5.5	0.2	0.0
	10:25:00	-5.0	0.1	0.0
	10:25:30	-4.5	0.5	0.0
	10:26:00	-4.0	0.1	0.0
	10:26:30	-3.5	0.3	0.0
	10:27:00	-3.0	0.5	0.0
	10:27:30	-2.5	0.2	0.0
	10:28:00	-2.0	0.3	0.0
	10:28:30	-1.5	0.0	0.0
	10:29:00	-1.0	0.2	0.0
	10:29:30	-0.5	0.1	0.0
Burn 1	10:30:00	0.0	0.0	0.0
	10:30:30	0.5		0.0
	10:31:00	1.0		0.0
	10:31:30	1.5	0.1	0.0
	10:32:00	2.0	0.1	0.0
	10:32:30	2.5	0.0	0.0
	10:33:00	3.0	0.0	0.0
	10:33:30	3.5	0.0	0.0
	10:34:00	4.0	0.0	0.0
	10:34:30	4.5	0.0	0.0
	10:35:00	5.0	0.0	0.0
	10:35:30	5.5	0.0	0.0
	10:36:00	6.0	0.0	0.0
	10:36:30	6.5	0.0	0.0
	10:37:00	7.0		0.0
	10:37:30	7.5		0.0
	10:38:00	8.0		0.0
	10:38:30	8.5		0.0
	10:39:00	9.0		0.0
	10:39:30	9.5		0.0

NOBE 93 Table 6.4 cont. **Sulphur Dioxide Analysis at Sea Level**

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	10:40:00	10.0		0.0
	10:40:30	10.5		0.0
	10:41:00	11.0		0.0
	10:41:30	11.5		0.0
	10:42:00	12.0		0.0
	10:42:30	12.5		0.0
	10:43:00	13.0		0.0
	10:43:30	13.5		0.0
	10:44:00	14.0		0.0
	10:44:30	14.5		0.0
	10:45:00	15.0		0.0
	10:45:30	15.5		0.0
	10:46:00	16.0		0.0
	10:46:30	16.5		0.0
	10:47:00	17.0	0.0	
	10:47:30	17.5	0.0	
			Remote control boat # 2	Remote control boat # 1
R/C boat changed	10:48:00	18.0	0.0	
	10:48:30	18.5	0.0	
	10:49:00	19.0	0.0	
	10:49:30	19.5	0.0	
	10:50:00	20.0	0.0	
	10:50:30	20.5	0.0	
	10:51:00	21.0	0.0	
	10:51:30	21.5	0.0	
	10:52:00	22.0	0.0	
	10:52:30	22.5	0.0	
	10:53:00	23.0	0.0	
	10:53:30	23.5	0.0	
	10:54:00	24.0	0.0	
	10:54:30	24.5	0.0	
	10:55:00	25.0	0.0	
	10:55:30	25.5	0.0	
	10:56:00	26.0	0.0	
	10:56:30	26.5	0.0	
	10:57:00	27.0	0.0	
	10:57:30	27.5	0.0	
	10:58:00	28.0	0.0	
	10:58:30	28.5	0.0	
	10:59:00	29.0	0.0	
	10:59:30	29.5	0.0	
	11:00:00	30.0	0.0	
	11:00:30	30.5	0.0	
	11:01:00	31.0	0.0	
	11:01:30	31.5	0.0	
	11:02:00	32.0	0.0	
	11:02:30	32.5	0.0	
	11:03:00	33.0	0.0	
	11:03:30	33.5	0.0	
	11:04:00	34.0	0.0	
	11:04:30	34.5	0.0	
	11:05:00	35.0	0.0	
	11:05:30	35.5	0.0	
	11:06:00	36.0	0.0	
	11:06:30	36.5	0.0	
	11:07:00	37.0	0.0	
	11:07:30	37.5	0.0	
	11:08:00	38.0	0.0	
	11:08:30	38.5	0.0	
	11:09:00	39.0	0.0	
	11:09:30	39.5	0.0	
	11:10:00	40.0	0.0	
	11:10:30	40.5	0.0	
	11:11:00	41.0	0.0	
	11:11:30	41.5	0.0	
	11:12:00	42.0	0.0	
	11:12:30	42.5	0.0	
	11:13:00	43.0	0.0	

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level
Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	11:13:30	43.5	0.0	
	11:14:00	44.0	0.0	
	11:14:30	44.5	0.0	
	11:15:00	45.0	0.0	
	11:15:30	45.5	0.0	
	11:16:00	46.0	0.0	
	11:16:30	46.5	0.0	
	11:17:00	47.0	0.0	
	11:17:30	47.5	0.0	
	11:18:00	48.0	0.0	
	11:18:30	48.5	0.0	
	11:19:00	49.0	0.0	
	11:19:30	49.5	0.0	
	11:20:00	50.0	0.0	
	11:20:30	50.5	0.0	
	11:21:00	51.0	0.0	
	11:21:30	51.5	0.0	
	11:22:00	52.0	0.0	
	11:22:30	52.5	0.0	
	11:23:00	53.0	0.0	0.0
	11:23:30	53.5	0.0	0.0
	11:24:00	54.0	0.0	0.0
	11:24:30	54.5	0.0	0.0
	11:25:00	55.0	0.0	0.0
	11:25:30	55.5	0.0	0.0
	11:26:00	56.0	0.0	0.0
	11:26:30	56.5	0.0	0.0
	11:27:00	57.0	0.0	0.0
	11:27:30	57.5	0.0	0.0
	11:28:00	58.0	0.0	0.0
	11:28:30	58.5	0.0	0.0
	11:29:00	59.0	0.0	0.0
	11:29:30	59.5	0.0	0.0
	11:30:00	60.0	0.0	0.0
	11:30:30	60.5	0.0	0.0
	11:31:00	61.0	0.0	0.0
	11:31:30	61.5	0.0	0.0
	11:32:00	62.0	0.0	0.0
	11:32:30	62.5	0.0	0.0
	11:33:00	63.0	0.0	0.0
	11:33:30	63.5	0.0	0.0
	11:34:00	64.0	0.0	0.0
	11:34:30	64.5	0.0	0.0
	11:35:00	65.0	0.0	0.0
	11:35:30	65.5	0.0	0.0
	11:36:00	66.0	0.0	0.0
	11:36:30	66.5	0.0	0.0
	11:37:00	67.0	0.0	0.0
	11:37:30	67.5	0.0	0.0
	11:38:00	68.0	0.0	0.0
	11:38:30	68.5	0.0	0.0
	11:39:00	69.0	0.0	0.0
	11:39:30	69.5	0.0	0.0
	11:40:00	70.0	0.0	0.0
	11:40:30	70.5	0.0	0.0
	11:41:00	71.0	0.0	0.0
	11:41:30	71.5	0.0	0.0
	11:42:00	72.0	0.0	0.0
	11:42:30	72.5	0.0	0.0
	11:43:00	73.0	0.0	0.0
	11:43:30	73.5	0.0	0.0
	11:44:00	74.0	0.0	0.0
	11:44:30	74.5	0.0	0.0
	11:45:00	75.0	0.0	0.0
	11:45:30	75.5	0.0	0.0
	11:46:00	76.0	0.0	0.0
	11:46:30	76.5	0.0	0.0
	11:47:00	77.0	0.0	0.0
	11:47:30	77.5	0.0	0.0
	11:48:00	78.0	0.0	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	11:48:30	78.5	0.0	0.0
	11:49:00	79.0	0.0	0.0
	11:49:30	79.5	0.0	0.0
	11:50:00	80.0	0.0	0.0
	11:50:30	80.5	0.0	0.0
	11:51:00	81.0	0.0	0.0
	11:51:30	81.5	0.0	0.0
	11:52:00	82.0	0.0	0.0
	11:52:30	82.5	0.0	0.0
	11:53:00	83.0	0.0	0.0
	11:53:30	83.5	0.0	0.0
	11:54:00	84.0	0.0	0.0
	11:54:30	84.5	0.0	0.0
	11:55:00	85.0	0.0	0.0
	11:55:30	85.5	0.0	0.0
	11:56:00	86.0	0.0	0.0
	11:56:30	86.5	0.0	0.0
	11:57:00	87.0	0.0	0.0
	11:57:30	87.5	0.0	0.0
	11:58:00	88.0	0.0	0.0
	11:58:30	88.5	0.0	0.0
	11:59:00	89.0	0.0	0.0
	11:59:30	89.5	0.0	0.0
	12:00:00	90.0	0.0	0.0
	12:00:30	90.5	0.0	0.0
	12:01:00	91.0	0.0	0.0
	12:01:30	91.5	0.0	0.0
	12:02:00	92.0	0.0	0.0
	12:02:30	92.5	0.0	0.0
	12:03:00	93.0	0.0	0.0
	12:03:30	93.5	0.0	0.0
	12:04:00	94.0	0.0	0.0
Post-burn 1	12:04:30	94.5	0.0	0.0
	12:05:00	95.0	0.0	0.0
	12:05:30	95.5	0.0	0.0
	12:06:00	96.0	0.0	0.0
	12:06:30	96.5	0.0	0.0
	12:07:00	97.0	0.0	0.0
	12:07:30	97.5	0.0	0.0
	12:08:00	98.0	0.0	0.0
	12:08:30	98.5	0.0	0.0
	12:09:00	99.0	0.0	0.0
	12:09:30	99.5	0.0	0.0
	12:10:00	100.0	0.0	0.0
	12:10:30	100.5	0.0	0.0
	12:11:00	101.0	0.0	0.0
	12:11:30	101.5	0.0	0.0
	12:12:00	102.0	0.0	0.0
	12:12:30	102.5	0.0	0.0
	12:13:00	103.0	0.0	0.0
	12:13:30	103.5	0.0	0.0
	12:14:00	104.0	0.0	0.0
	12:14:30	104.5	0.0	0.0
	12:15:00	105.0	0.0	0.0
	12:15:30	105.5	0.0	0.0
	12:16:00	106.0	0.0	0.0
	12:16:30	106.5	0.0	0.0
	12:17:00	107.0	0.0	0.0
	12:17:30	107.5	0.0	0.0
	12:18:00	108.0	0.0	0.0
	12:18:30	108.5	0.0	0.0
	12:19:00	109.0	0.0	0.0
	12:19:30	109.5	0.0	0.0
	12:20:00	110.0	0.0	0.0
	12:20:30	110.5	0.0	0.0
	12:21:00	111.0	0.0	0.0
	12:21:30	111.5	0.0	0.0
	12:22:00	112.0	0.0	0.0
	12:22:30	112.5	0.0	0.1

NOBE 93 Table 6.4 cont. **Sulphur Dioxide Analysis at Sea Level**

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	12:23:00	113.0	0.0	0.0
	12:23:30	113.5	0.0	0.0
	12:24:00	114.0	0.0	0.0
	12:24:30	114.5	0.0	0.2
	12:25:00	115.0	0.0	0.2
	12:25:30	115.5	0.0	0.0
	12:26:00	116.0	0.0	0.0
	12:26:30	116.5	0.0	0.0
	12:27:00	117.0	0.0	0.0
	12:27:30	117.5	0.0	0.0
	12:28:00	118.0	0.0	0.0
	12:28:30	118.5	0.0	0.0
	12:29:00	119.0	0.0	0.0
	12:29:30	119.5	0.0	0.0
	12:30:00	120.0	0.0	0.0
	12:30:30	120.5	0.0	0.0
	12:31:00	121.0	0.0	0.0
	12:31:30	121.5	0.0	0.0
	12:32:00	122.0	0.0	0.0
	12:32:30	122.5	0.0	0.0
	12:33:00	123.0	0.0	0.0
	12:33:30	123.5	0.0	0.0
	12:34:00	124.0	0.0	0.0
	12:34:30	124.5	0.0	0.0
	12:35:00	125.0	0.0	0.0
	12:35:30	125.5	0.0	0.0
	12:36:00	126.0	0.0	0.0
	12:36:30	126.5	0.0	0.0
	12:37:00	127.0	0.0	0.0
	12:37:30	127.5	0.0	0.0
	12:38:00	128.0	0.0	0.0
	12:38:30	128.5	0.0	0.0
	12:39:00	129.0	0.0	0.0
	12:39:30	129.5	0.0	0.0
	12:40:00	130.0	0.0	0.0
	12:40:30	130.5	0.0	0.0
	12:41:00	131.0	0.0	0.0
	12:41:30	131.5	0.0	0.0
	12:42:00	132.0	0.0	0.0
	12:42:30	132.5	0.0	0.0
	12:43:00	133.0	0.0	0.0
	12:43:30	133.5	0.0	0.0
	12:44:00	134.0	0.0	0.0
	12:44:30	134.5	0.0	0.0
	12:45:00	135.0	0.0	0.0
	12:45:30	135.5	0.0	0.3
	12:46:00	136.0	0.0	0.0
	12:46:30	136.5	0.0	0.0
	12:47:00	137.0	0.0	0.0
	12:47:30	137.5	0.0	0.0
	12:48:00	138.0	0.0	0.0
	12:48:30	138.5	0.0	0.0
	12:49:00	139.0	0.0	0.0
	12:49:30	139.5	0.0	0.0
	12:50:00	140.0	0.0	0.0
	12:50:30	140.5	0.0	0.0
	12:51:00	141.0	0.0	0.0
	12:51:30	141.5	0.0	0.0
	12:52:00	142.0	0.0	0.0
	12:52:30	142.5	0.0	0.0
	12:53:00	143.0	0.0	0.0
	12:53:30	143.5	0.0	0.0
	12:54:00	144.0	0.0	0.0
	12:54:30	144.5	0.0	0.0
	12:55:00	145.0	0.0	0.0
	12:55:30	145.5	0.0	0.0
	12:56:00	146.0	0.0	0.0
	12:56:30	146.5	0.0	0.0
	12:57:00	147.0	0.0	0.0
	12:57:30	147.5	0.0	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level
Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	12:58:00	148.0	0.0	0.0
	12:58:30	148.5	0.0	0.0
	12:59:00	149.0	0.0	0.0
	12:59:30	149.5	0.0	0.0
			Remote control boat # 1	Remote control boat # 2
Background 2	13:00:00	-66.0	0.0	0.0
	13:00:30	-65.5	0.0	0.0
	13:01:00	-65.0	0.0	0.0
	13:01:30	-64.5	0.1	0.0
	13:02:00	-64.0	0.0	0.0
	13:02:30	-63.5	0.0	0.0
	13:03:00	-63.0	0.0	0.0
	13:03:30	-62.5	0.0	0.0
	13:04:00	-62.0	0.0	0.0
	13:04:30	-61.5	0.0	0.0
	13:05:00	-61.0	0.0	0.0
	13:05:30	-60.5	0.0	0.0
	13:06:00	-60.0	0.0	0.0
	13:06:30	-59.5	0.1	0.0
	13:07:00	-59.0	0.1	0.0
	13:07:30	-58.5	0.0	0.0
	13:08:00	-58.0	0.3	0.0
	13:08:30	-57.5	0.6	0.0
	13:09:00	-57.0	0.0	0.0
	13:09:30	-56.5	0.0	0.0
	13:10:00	-56.0	0.0	0.0
	13:10:30	-55.5	0.0	0.0
	13:11:00	-55.0	0.0	0.0
	13:11:30	-54.5	0.0	0.0
	13:12:00	-54.0	0.0	0.0
	13:12:30	-53.5	0.1	0.0
	13:13:00	-53.0	0.1	0.0
	13:13:30	-52.5	0.1	0.0
	13:14:00	-52.0	0.0	0.0
	13:14:30	-51.5	0.0	0.0
	13:15:00	-51.0	0.0	0.0
	13:15:30	-50.5	0.1	0.0
	13:16:00	-50.0	0.0	0.0
	13:16:30	-49.5	0.0	0.0
	13:17:00	-49.0	0.2	0.0
	13:17:30	-48.5	0.1	0.0
	13:18:00	-48.0	0.0	0.0
	13:18:30	-47.5	0.0	0.0
	13:19:00	-47.0	0.0	0.0
	13:19:30	-46.5	0.2	0.0
	13:20:00	-46.0	0.1	0.0
	13:20:30	-45.5	0.0	0.0
	13:21:00	-45.0	0.0	0.0
	13:21:30	-44.5	0.0	0.0
	13:22:00	-44.0	0.0	0.0
	13:22:30	-43.5	0.0	0.0
	13:23:00	-43.0	0.0	0.0
	13:23:30	-42.5	0.0	0.0
	13:24:00	-42.0	0.0	0.0
	13:24:30	-41.5	0.0	0.0
	13:25:00	-41.0	0.0	0.0
	13:25:30	-40.5	0.0	0.0
	13:26:00	-40.0	0.2	0.0
	13:26:30	-39.5	0.1	0.0
	13:27:00	-39.0	0.0	0.0
	13:27:30	-38.5	0.2	0.0
	13:28:00	-38.0	0.1	0.0
	13:28:30	-37.5	0.1	0.0
	13:29:00	-37.0	0.1	0.0
	13:29:30	-36.5	0.1	0.0
	13:30:00	-36.0	0.0	0.0
	13:30:30	-35.5	0.0	0.0
	13:31:00	-35.0	0.1	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level
Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	13:31:30	-34.5	0.1	0.0
	13:32:00	-34.0	0.0	0.0
	13:32:30	-33.5	0.0	0.0
	13:33:00	-33.0	0.0	0.1
	13:33:30	-32.5	0.1	0.0
	13:34:00	-32.0	0.1	0.0
	13:34:30	-31.5	0.1	0.0
	13:35:00	-31.0	0.1	0.0
	13:35:30	-30.5	0.0	0.0
	13:36:00	-30.0	0.0	0.0
	13:36:30	-29.5	0.0	0.0
	13:37:00	-29.0	0.1	0.0
	13:37:30	-28.5	0.1	0.0
	13:38:00	-28.0	0.1	0.0
	13:38:30	-27.5	0.1	0.0
	13:39:00	-27.0	0.1	0.1
	13:39:30	-26.5	0.2	0.0
	13:40:00	-26.0	0.1	0.0
	13:40:30	-25.5	0.1	0.1
	13:41:00	-25.0	0.2	0.1
	13:41:30	-24.5	0.1	0.1
	13:42:00	-24.0	0.1	0.1
	13:42:30	-23.5	0.0	0.1
	13:43:00	-23.0	0.0	0.1
	13:43:30	-22.5	0.1	0.1
	13:44:00	-22.0	0.1	0.1
	13:44:30	-21.5	0.0	0.1
	13:45:00	-21.0	0.1	0.0
	13:45:30	-20.5	0.0	0.2
	13:46:00	-20.0	0.0	0.1
	13:46:30	-19.5	0.0	0.1
	13:47:00	-19.0	0.0	0.1
	13:47:30	-18.5	0.0	0.1
	13:48:00	-18.0	0.0	0.1
	13:48:30	-17.5	0.0	0.1
	13:49:00	-17.0	0.1	0.1
	13:49:30	-16.5	0.0	0.1
	13:50:00	-16.0	0.0	0.1
	13:50:30	-15.5	0.0	0.1
	13:51:00	-15.0	0.0	0.0
	13:51:30	-14.5	0.1	0.1
Pre-ignition 2	13:52:00	-14.0	0.1	0.1
	13:52:30	-13.5	0.2	0.1
	13:53:00	-13.0	0.2	0.0
	13:53:30	-12.5	0.1	0.0
	13:54:00	-12.0	0.1	0.1
	13:54:30	-11.5	0.0	0.0
	13:55:00	-11.0	0.1	0.0
	13:55:30	-10.5	0.0	0.0
	13:56:00	-10.0	0.1	0.0
	13:56:30	-9.5	0.0	0.0
	13:57:00	-9.0	0.0	0.0
	13:57:30	-8.5	0.0	0.0
	13:58:00	-8.0	0.0	0.0
	13:58:30	-7.5	0.0	0.0
	13:59:00	-7.0	0.0	0.0
	13:59:30	-6.5	0.0	0.0
	14:00:00	-6.0	0.0	0.0
	14:00:30	-5.5	0.0	0.0
	14:01:00	-5.0	0.0	0.0
	14:01:30	-4.5	0.0	0.0
	14:02:00	-4.0	0.0	0.0
	14:02:30	-3.5	0.0	0.0
	14:03:00	-3.0	0.0	0.0
	14:03:30	-2.5	0.0	0.0
	14:04:00	-2.0	0.0	0.0
	14:04:30	-1.5	0.0	0.0
	14:05:00	-1.0	0.0	0.0
	14:05:30	-0.5	0.0	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
Burn 2	14:06:00	0.0	0.0	0.0
	14:06:30	0.5	0.0	0.0
	14:07:00	1.0	0.0	0.0
	14:07:30	1.5	0.1	0.0
	14:08:00	2.0	0.1	0.0
	14:08:30	2.5	0.0	0.0
	14:09:00	3.0	0.0	0.0
	14:09:30	3.5	0.0	0.0
	14:10:00	4.0	0.0	0.0
	14:10:30	4.5	0.0	0.0
	14:11:00	5.0	0.1	0.0
	14:11:30	5.5	0.0	0.0
	14:12:00	6.0	0.0	0.0
	14:12:30	6.5	0.0	0.0
	14:13:00	7.0	0.0	0.1
	14:13:30	7.5	0.0	0.0
	14:14:00	8.0	0.0	0.1
	14:14:30	8.5	0.0	0.1
	14:15:00	9.0	0.1	0.0
	14:15:30	9.5	0.0	0.0
	14:16:00	10.0	0.0	0.0
	14:16:30	10.5	0.1	0.0
	14:17:00	11.0	0.3	0.0
	14:17:30	11.5	0.2	0.1
	14:18:00	12.0	0.1	0.1
	14:18:30	12.5	0.3	0.0
	14:19:00	13.0	0.1	0.0
	14:19:30	13.5	0.1	0.0
	14:20:00	14.0	0.1	0.0
	14:20:30	14.5	0.1	0.1
	14:21:00	15.0	0.0	0.0
	14:21:30	15.5	0.1	0.0
	14:22:00	16.0	0.0	0.0
	14:22:30	16.5	0.1	0.0
	14:23:00	17.0	0.1	0.0
	14:23:30	17.5	0.1	0.0
	14:24:00	18.0	0.1	0.1
	14:24:30	18.5	0.1	0.0
	14:25:00	19.0	0.2	0.0
	14:25:30	19.5	0.5	0.0
	14:26:00	20.0	0.2	0.1
	14:26:30	20.5	0.0	0.0
	14:27:00	21.0	0.1	0.0
	14:27:30	21.5	0.1	0.0
	14:28:00	22.0	0.1	0.0
	14:28:30	22.5	0.0	0.0
	14:29:00	23.0	0.0	0.0
	14:29:30	23.5	0.0	0.0
	14:30:00	24.0	0.1	0.0
	14:30:30	24.5	0.0	0.0
	14:31:00	25.0	0.0	0.0
	14:31:30	25.5	0.1	0.0
	14:32:00	26.0	0.0	0.0
	14:32:30	26.5	0.0	0.0
	14:33:00	27.0	0.0	0.0
	14:33:30	27.5	0.1	0.1
	14:34:00	28.0	0.0	0.0
	14:34:30	28.5	0.0	0.0
	14:35:00	29.0	0.1	0.0
	14:35:30	29.5	0.1	0.0
	14:36:00	30.0	0.0	0.0
	14:36:30	30.5	0.0	0.0
	14:37:00	31.0	0.1	0.0
	14:37:30	31.5	0.0	0.0
	14:38:00	32.0	0.0	0.0
	14:38:30	32.5	0.1	0.1
	14:39:00	33.0	0.1	0.0
	14:39:30	33.5	0.0	0.0
	14:40:00	34.0	0.0	0.0
	14:40:30	34.5	0.1	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level

Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	14:41:00	35.0	0.0	0.0
	14:41:30	35.5	0.0	0.1
	14:42:00	36.0	0.1	0.0
	14:42:30	36.5	0.1	0.0
	14:43:00	37.0	0.0	0.0
	14:43:30	37.5	0.1	0.0
	14:44:00	38.0	0.0	0.0
	14:44:30	38.5	0.1	0.0
	14:45:00	39.0	0.0	0.0
	14:45:30	39.5	0.0	0.0
	14:46:00	40.0	0.0	0.0
	14:46:30	40.5	0.0	0.0
	14:47:00	41.0	0.1	0.0
	14:47:30	41.5	0.1	0.0
	14:48:00	42.0	0.0	0.0
	14:48:30	42.5	0.0	0.0
	14:49:00	43.0	0.0	0.0
	14:49:30	43.5	0.0	0.0
	14:50:00	44.0	0.1	0.0
	14:50:30	44.5	0.0	0.0
	14:51:00	45.0	0.0	0.0
	14:51:30	45.5	0.0	0.0
	14:52:00	46.0	0.1	0.0
	14:52:30	46.5	0.1	0.0
	14:53:00	47.0	0.0	0.0
	14:53:30	47.5	0.1	0.0
	14:54:00	48.0	0.0	0.0
	14:54:30	48.5	0.0	0.0
	14:55:00	49.0	0.0	0.0
	14:55:30	49.5	0.0	0.0
	14:56:00	50.0	0.0	0.0
	14:56:30	50.5	0.1	0.0
	14:57:00	51.0	0.0	0.0
	14:57:30	51.5	0.0	0.0
	14:58:00	52.0	0.0	0.0
	14:58:30	52.5	0.1	0.0
	14:59:00	53.0	0.0	0.0
	14:59:30	53.5	0.0	0.0
	15:00:00	54.0	0.2	0.0
	15:00:30	54.5	0.2	0.0
	15:01:00	55.0	0.3	0.0
	15:01:30	55.5	0.1	0.0
	15:02:00	56.0	0.0	0.0
	15:02:30	56.5	0.1	0.0
	15:03:00	57.0	0.1	0.0
	15:03:30	57.5	0.0	0.0
	15:04:00	58.0	0.0	0.0
	15:04:30	58.5	0.0	0.0
	15:05:00	59.0	0.0	0.0
	15:05:30	59.5	0.0	0.0
	15:06:00	60.0	0.0	0.0
	15:06:30	60.5	0.1	0.0
	15:07:00	61.0	0.0	0.0
	15:07:30	61.5	0.0	0.0
	15:08:00	62.0	0.0	0.0
	15:08:30	62.5	0.0	0.0
	15:09:00	63.0	0.0	0.0
	15:09:30	63.5	0.0	0.0
	15:10:00	64.0	0.0	0.0
	15:10:30	64.5	0.0	0.0
	15:11:00	65.0	0.0	0.0
	15:11:30	65.5	0.0	0.0
	15:12:00	66.0	0.0	0.0
	15:12:30	66.5	0.0	0.0
	15:13:00	67.0	0.0	0.0
	15:13:30	67.5	0.0	0.0
	15:14:00	68.0	0.0	0.0
	15:14:30	68.5	0.0	0.0
	15:15:00	69.0	0.0	0.0
	15:15:30	69.5	0.0	0.0

NOBE 93 Table 6.4 cont.

Sulphur Dioxide Analysis at Sea Level
Cannonball

Time Periods	Recorded hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
	15:16:00	70.0	0.0	0.0
	15:16:30	70.5	0.1	0.0
	15:17:00	71.0	0.2	0.0
	15:17:30	71.5	0.1	0.0
	15:18:00	72.0	0.0	0.0
	15:18:30	72.5	0.7	0.2
	15:19:00	73.0	0.5	0.0
Post-burn 2	15:19:30	73.5	0.0	0.0
	15:20:00	74.0	0.0	0.0
	15:20:30	74.5	0.1	0.0
	15:21:00	75.0	0.0	0.0
	15:21:30	75.5	0.0	0.0
	15:22:00	76.0	0.0	0.0
	15:22:30	76.5	0.0	0.0
	15:23:00	77.0	0.0	0.0
	15:23:30	77.5	0.1	0.0
	15:24:00	78.0	0.0	0.0
	15:24:30	78.5	0.0	0.0
	15:25:00	79.0	0.0	0.0
	15:25:30	79.5	0.0	0.0
	15:26:00	80.0	0.0	0.0
	15:26:30	80.5	0.0	0.0
	15:27:00	81.0	0.0	0.0
	15:27:30	81.5	0.0	0.0
	15:28:00	82.0	0.1	0.0
	15:28:30	82.5	0.0	0.0
	15:29:00	83.0	0.0	0.0
	15:29:30	83.5	0.0	0.0
	15:30:00	84.0	0.1	0.0
	15:30:30	84.5	0.0	0.0
	15:31:00	85.0	0.0	0.0
	15:31:30	85.5	0.0	0.0
	15:32:00	86.0	0.0	0.0
	15:32:30	86.5	0.0	0.0
	15:33:00	87.0	0.0	0.0
	15:33:30	87.5	0.0	0.0
	15:34:00	88.0	0.0	0.0
	15:34:30	88.5	0.0	0.0
	15:35:00	89.0	0.0	0.0
	15:35:30	89.5	0.0	0.0
	15:36:00	90.0	0.0	0.0
	15:36:30	90.5	0.0	0.0
	15:37:00	91.0	0.0	0.0
	15:37:30	91.5	0.0	0.0
	15:38:00	92.0	0.0	0.0
	15:38:30	92.5	0.1	0.0
	15:39:00	93.0	0.0	0.0
	15:39:30	93.5	0.0	0.0
	15:40:00	94.0		0.0
	15:40:30	94.5		0.0
	15:41:00	95.0		0.0
	15:41:30	95.5		0.0
	15:42:00	96.0		0.0
	15:42:30	96.5		0.0
	15:43:00	97.0		0.0
	15:43:30	97.5		0.0
	15:44:00	98.0		0.0
	15:44:30	98.5		0.0
	15:45:00	99.0		0.0
	15:45:30	99.5		0.0
	15:46:00	100.0		0.0
	15:46:30	100.5		0.0
	15:47:00	101.0		0.0
	15:47:30	101.5		0.0

Burn 1 only ...
R/C boat 2 ... 10:30 to 10:47 in position RS-2, in position RS-1 from 10:47 to end of sampling; results applied to RS-1 position
R/C boat 1 ... from 11:23 to end of sampling in position RS-2; results applied to RS-2 position

NOBE 93 Table 6.5 **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
11:09:15	0		0
11:09:30	0		0
11:09:45	0		0
11:10:00	0	0	0
11:10:15	0	0	0
11:10:30	0	0	0
11:10:45	0	0	0
11:11:00	0	0	0
11:11:15	0	0	0
11:11:30	0	0	0
11:11:45	0	0	0
11:12:00	0	0	0
11:12:15	0	0	0
11:12:30	0	0	0
11:12:45	0	0	0
11:13:00	0	0	0
11:13:15	0	0	0
11:13:30	0	0	0
11:13:45	0	0	0
11:14:00	0	0	0
11:14:15	0	0	0
11:14:30	0	0	0
11:14:45	0	0	0
11:15:00	0	0	0
11:15:15	0	0	0
11:15:30	0	0	0
11:15:45	0	0	0
11:16:00	0	0	0
11:16:15	0	0	0
11:16:30	0	0	0
11:16:45	0	0	0
11:17:00	0	0	0
11:17:15	0	0	0
11:17:30	0	0	0
11:17:45	0	0	0
11:18:00	0	0	0
11:18:15	0	0	0
11:18:30	0	0	0
11:18:45	0	0	0
11:19:00	0	0	0
11:19:15	0	0	0
11:19:30	0	0	0
11:19:45	0	0	0
11:20:00	0	0	0
11:20:15	0	0	0
11:20:30	0	0	0
11:20:45	0	0	0
11:21:00	0	0	0
11:21:15	0	0	0
11:21:30	0	0	0
11:21:45	0	0	0
11:22:00	0	0	0
11:22:15	0	0	0
11:22:30	0	0	0
11:22:45	0	0	0
11:23:00	0	0	0
11:23:15	0	0	0
11:23:30	0	0	0
11:23:45	0	0	0
11:24:00	0	0	0
11:24:15	0	0	0
11:24:30	0	0	0
11:24:45	0	0	0
11:25:00	0	0	0
11:25:15	0	0	0
11:25:30	0	0	0
11:25:45	0	0	0
11:26:00	0	0	0
11:26:15	0	0	0
11:26:30	0	0	0
11:26:45	0	0	0
11:27:00	0	0	0
11:27:15	0	0	0
11:27:30	0	0	0
11:27:45	0	0	0
11:28:00	0	0	0
11:28:15	0	0	0
11:28:30	0	0	0
11:28:45	0	0	0
11:29:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
11:29:15	0	0	0
11:29:30	0	0	0
11:29:45	0	0	0
11:30:00	0	0	0
11:30:15	0	0	0
11:30:30	0	0	0
11:30:45	0	0	0
11:31:00	0	0	0
11:31:15	0	0	0
11:31:30	0	0	0
11:31:45	0	0	0
11:32:00	0	0	0
11:32:15	0	0	0
11:32:30	0	0	0
11:32:45	0	0	0
11:33:00	0	0	0
11:33:15	0	0	0
11:33:30	0	0	0
11:33:45	0	0	0
11:34:00	0	0	0
11:34:15	0	0	0
11:34:30	0	0	0
11:34:45	0	0	0
11:35:00	0	0	0
11:35:15	0	0	0
11:35:30	0	0	0
11:35:45	0	0	0
11:36:00	0	0	0
11:36:15	0	0	0
11:36:30	0	0	0
11:36:45	0	0	0
11:37:00	0	0	0
11:37:15	0	0	0
11:37:30	0	0	0
11:37:45	0	0	0
11:38:00	0	0	0
11:38:15	0	0	0
11:38:30	0	0	0
11:38:45	0	0	0
11:39:00	0	0	0
11:39:15	0	0	0
11:39:30	0	0	0
11:39:45	0	0	0
11:40:00	0	0	0
11:40:15	0	0	0
11:40:30	0	0	0
11:40:45	0	0	0
11:41:00	0	0	0
11:41:15	0	0	0
11:41:30	0	0	0
11:41:45	0	0	0
11:42:00	0	0	0
11:42:15	0	0	0
11:42:30	0	0	0
11:42:45	0	0	0
11:43:00	0	0	0
11:43:15	0	0	0
11:43:30	0	0	0
11:43:45	0	0	0
11:44:00	0	0	0
11:44:15	0	0	0
11:44:30	0	0	0
11:44:45	0	0	0
11:45:00	0	0	0
11:45:15	0	0	0
11:45:30	0	0	0
11:45:45	0	0	0
11:46:00	0	0	0
11:46:15	0	0	0
11:46:30	0	0	0
11:46:45	0	0	0
11:47:00	0	0	0
11:47:15	0	0	0
11:47:30	0	0	0
11:47:45	0	0	0
11:48:00	0	0	0
11:48:15	0	0	0
11:48:30	0	0	0
11:48:45	0	0	0
11:49:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
11:49:15	0	0	0
11:49:30	0	0	0
11:49:45	0	0	0
11:50:00	0	0	0
11:50:15	0	0	0
11:50:30	0	0	0
11:50:45	0	0	0
11:51:00	0	0	0
11:51:15	0	0	0
11:51:30	0	0	0
11:51:45	0	0	0
11:52:00	0	0	0
11:52:15	0	0	0
11:52:30	0	0	0
11:52:45	0	0	0
11:53:00	0	0	0
11:53:15	0	0	0
11:53:30	0	0	0
11:53:45	0	0	0
11:54:00	0	0	0
11:54:15	0	0	0
11:54:30	0	0	0
11:54:45	0	0	0
11:55:00	0	0	0
11:55:15	0	0	0
11:55:30	0	0	0
11:55:45	0	0	0
11:56:00	0	0	0
11:56:15	0	0	0
11:56:30	0	0	0
11:56:45	0	0	0
11:57:00	0	0	0
11:57:15	0	0	0
11:57:30	0	0	0
11:57:45	0	0	0
11:58:00	0	0	0
11:58:15	0	0	0
11:58:30	0	0	0
11:58:45	0	0	0
11:59:00	0	0	0
11:59:15	0	0	0
11:59:30	0	0	0
11:59:45	0	0	0
12:00:00	0	0	0
12:00:15	0	0	0
12:00:30	0	0	0
12:00:45	0	0	0
12:01:00	0	0	0
12:01:15	0	0	0
12:01:30	0	0	0
12:01:45	0	0	0
12:02:00	0	0	0
12:02:15	0	0	0
12:02:30	0	0	0
12:02:45	0	0	0
12:03:00	0	0	0
12:03:15	0	0	0
12:03:30	0	0	0
12:03:45	0	0	0
12:04:00	0	0	0
12:04:15	0	0	0
12:04:30	0	0	0
12:04:45	0	0	0
12:05:00	0	0	0
12:05:15	0	0	0
12:05:30	0	0	0
12:05:45	0	0	0
12:06:00	0	0	0
12:06:15	0	0	0
12:06:30	0	0	0
12:06:45	0	0	0
12:07:00	0	0	0
12:07:15	0	0	0
12:07:30	0	0	0
12:07:45	0	0	0
12:08:00	0	0	0
12:08:15	0	0	0
12:08:30	0	0	0
12:08:45	0	0	0
12:09:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
12:09:15	0	0	0
12:09:30	0	0	0
12:09:45	0	0	0
12:10:00	0	0	0
12:10:15	0	0	0
12:10:30	0	0	0
12:10:45	0	0	0
12:11:00	0	0	0
12:11:15	0	0	0
12:11:30	0	0	0
12:11:45	0	0	0
12:12:00	0	0	0
12:12:15	0	0	0
12:12:30	0	0	0
12:12:45	0	0	0
12:13:00	0	0	0
12:13:15	0	0	0
12:13:30	0	0	0
12:13:45	0	0	0
12:14:00	0	0	0
12:14:15	0	0	0
12:14:30	0	0	0
12:14:45	0	0	0
12:15:00	0	0	0
12:15:15	0	0	0
12:15:30	0	0	0
12:15:45	0	0	0
12:16:00	0	0	0
12:16:15	0	0	0
12:16:30	0	0	0
12:16:45	0	0	0
12:17:00	0	0	0
12:17:15	0	0	0
12:17:30	0	0	0
12:17:45	0	0	0
12:18:00	0	0	0
12:18:15	0	0	0
12:18:30	0	0	0
12:18:45	0	0	0
12:19:00	0	0	0
12:19:15	0	0	0
12:19:30	0	0	0
12:19:45	0	0	0
12:20:00	0	0	0
12:20:15	0	0	0
12:20:30	0	0	0
12:20:45	0	0	0
12:21:00	0	0	0
12:21:15	0	0	0
12:21:30	0	0	0
12:21:45	0	0	0
12:22:00	0	0	0
12:22:15	0	0	0
12:22:30	0	0	0
12:22:45	0	0	0
12:23:00	0	0	0
12:23:15	0	0	0
12:23:30	0	0	0
12:23:45	0	0	0
12:24:00	0	0	0
12:24:15	0	0	0
12:24:30	0	0	0
12:24:45	0	0	0
12:25:00	0	0	0
12:25:15	0	0	0
12:25:30	0	0	0
12:25:45	0	0	0
12:26:00	0	0	0
12:26:15	0	0	0
12:26:30	0	0	0
12:26:45	0	0	0
12:27:00	0	0	0
12:27:15	0	0	0
12:27:30	0	0	0
12:27:45	0	0	0
12:28:00	0	0	0
12:28:15	0	0	0
12:28:30	0	0	0
12:28:45	0	0	0
12:29:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
12:29:15	0	0	0
12:29:30	0	0	0
12:29:45	0	0	0
12:30:00	0	0	0
12:30:15	0	0	0
12:30:30	0	0	0
12:30:45	0	0	0
12:31:00	0	0	0
12:31:15	0	0	0
12:31:30	0	0	0
12:31:45	0	0	0
12:32:00	0	0	0
12:32:15	0	0	0
12:32:30	0	0	0
12:32:45	0	0	0
12:33:00	0	0	0
12:33:15	0	0	0
12:33:30	0	0	0
12:33:45	0	0	0
12:34:00	0	0	0
12:34:15	0	0	0
12:34:30	0	0	0
12:34:45	0	0	0
12:35:00	0	0	0
12:35:15	0	0	0
12:35:30	0	0	0
12:35:45	0	0	0
12:36:00	0	0	0
12:36:15	0	0	0
12:36:30	0	0	0
12:36:45	0	0	0
12:37:00	0	0	0
12:37:15	0	0	0
12:37:30	0	0	0
12:37:45	0	0	0
12:38:00	0	0	0
12:38:15	0	0	0
12:38:30	0	0	0
12:38:45	0	0	0
12:39:00	0	0	0
12:39:15	0	0	0
12:39:30	0	0	0
12:39:45	0	0	0
12:40:00	0	0	0
12:40:15	0	0	0
12:40:30	0	0	0
12:40:45	0	0	0
12:41:00	0	0	0
12:41:15	0	0	0
12:41:30	0	0	0
12:41:45	0	0	0
12:42:00	0	0	0
12:42:15	0	0	0
12:42:30	0	0	0
12:42:45	0	0	0
12:43:00	0	0	0
12:43:15	0	0	0
12:43:30	0	0	0
12:43:45	0	0	0
12:44:00	0	0	0
12:44:15	0	0	0
12:44:30	0	0	0
12:44:45	0	0	0
12:45:00	0	0	0
12:45:15	0	0	0
12:45:30	0	0	0
12:45:45	0	0	0
12:46:00	0	0	0
12:46:15	0	0	0
12:46:30	0	0	0
12:46:45	0	0	0
12:47:00	0	0	0
12:47:15	0	0	0
12:47:30	0	0	0
12:47:45	0	0	0
12:48:00	0	0	0
12:48:15	0	0	0
12:48:30	0	0	0
12:48:45	0	0	0
12:49:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
12:49:15	0	0	0
12:49:30	0	0	0
12:49:45	0	0	0
12:50:00	0	0	0
12:50:15	0	0	0
12:50:30	0	0	0
12:50:45	0	0	0
12:51:00	0	0	0
12:51:15	0	0	0
12:51:30	0	0	0
12:51:45	0	0	0
12:52:00	0	0	0
12:52:15	0	0	0
12:52:30	0	0	0
12:52:45	0	0	0
12:53:00	0	0	0
12:53:15	0	0	0
12:53:30	0	0	0
12:53:45	0	0	0
12:54:00	0	0	0
12:54:15	0	0	0
12:54:30	0	0	0
12:54:45	0	0	0
12:55:00	0	0	0
12:55:15	0	0	0
12:55:30	0	0	0
12:55:45	0	0	0
12:56:00	0	0	0
12:56:15	0	0	0
12:56:30	0	0	0
12:56:45	0	0	0
12:57:00	0	0	0
12:57:15	0	0	0
12:57:30	0	0	0
12:57:45	0	0	0
12:58:00	0	0	0
12:58:15	0	0	0
12:58:30	0	0	0
12:58:45	0	0	0
12:59:00	0	0	0
12:59:15	0	0	0
12:59:30	0	0	0
12:59:45	0	0	0
13:00:00	0	0	0
13:00:15	0	0	0
13:00:30	0	0	0
13:00:45	0	0	0
13:01:00	0	0	0
13:01:15	0	0	0
13:01:30	0	0	0
13:01:45	0	0	0
13:02:00	0	0	0
13:02:15	0	0	0
13:02:30	0	0	0
13:02:45	0	0	0
13:03:00	0	0	0
13:03:15	0	0	0
13:03:30	0	0	0
13:03:45	0	0	0
13:04:00	0	0	0
13:04:15	0	0	0
13:04:30	0	0	0
13:04:45	0	0	0
13:05:00	0	0	0
13:05:15	0	0	0
13:05:30	0	0	0
13:05:45	0	0	0
13:06:00	0	0	0
13:06:15	0	0	0
13:06:30	0	0	0
13:06:45	0	0	0
13:07:00	0	0	0
13:07:15	0	0	0
13:07:30	0	0	0
13:07:45	0	0	0
13:08:00	0	0	0
13:08:15	0	0	0
13:08:30	0	0	0
13:08:45	0	0	0
13:09:00	0	0	0

NOBE 93 Table 6.5 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball, Background: August 07 1993

Time recorded hh:mm:ss	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
13:09:15	0	0	0
13:09:30	0	0	0
13:09:45	0	0	0
13:10:00	0	0	0
13:10:15	0	0	0
13:10:30	0	0	0
13:10:45	0	0	0
13:11:00	0	0	0
13:11:15	0	0	0
13:11:30	0	0	0
13:11:45	0	0	0
13:12:00		0	0
13:12:15		0	0
13:12:30		0	0
13:12:45		0	0

NOBE 93 Table 6.6

Sulphur Dioxide Analysis at Downwind Station (CCG 206)

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
Background 1	7:33	-177	0.0	0.0	0.0
	7:34	-176	0.0	0.0	0.0
	7:35	-175	0.0	0.0	0.0
	7:36	-174	0.0	0.0	0.0
	7:37	-173	0.0	0.0	0.0
	7:38	-172	0.0	0.0	0.0
	7:39	-171	0.0	0.0	0.0
	7:40	-170	0.0	0.0	0.0
	7:41	-169	0.0	0.0	0.0
	7:42	-168	0.0	0.0	0.0
	7:43	-167	0.0	0.0	0.0
	7:44	-166	0.0	0.0	0.0
	7:45	-165	0.0	0.0	0.0
	7:46	-164	0.0	0.0	0.0
	7:47	-163	0.0	0.0	0.0
	7:48	-162	0.0	0.0	0.0
	7:49	-161	0.0	0.0	0.0
	7:50	-160	0.0	0.0	0.0
	7:51	-159	0.0	0.0	0.0
	7:52	-158	0.0	0.0	0.0
	7:53	-157	0.0	0.0	0.0
	7:54	-156	0.0	0.0	0.0
	7:55	-155	0.0	0.0	0.0
	7:56	-154	0.0	0.0	0.0
	7:57	-153	0.0	0.0	0.0
	7:58	-152	0.0	0.0	0.0
	7:59	-151	0.0	0.0	0.0
	8:00	-150	0.0	0.0	0.0
	8:01	-149	0.0	0.0	0.0
	8:02	-148	0.0	0.0	0.0
	8:03	-147	0.0	0.0	0.0
	8:04	-146	0.0	0.0	0.0
	8:05	-145	0.0	0.0	0.0
	8:06	-144	0.0	0.0	0.0
	8:07	-143	0.0	0.0	0.0
	8:08	-142	0.0	0.0	0.0
	8:09	-141	0.0	0.0	0.0
	8:10	-140	0.0	0.0	0.0
	8:11	-139	0.0	0.0	0.0
	8:12	-138	0.0	0.0	0.0
	8:13	-137	0.0	0.0	0.0
	8:14	-136	0.0	0.0	0.0
	8:15	-135	0.0	0.0	0.0
	8:16	-134	0.0	0.0	0.0
	8:17	-133	0.0	0.0	0.0
	8:18	-132	0.0	0.0	0.0
	8:19	-131	0.0	0.0	0.0
	8:20	-130	0.0	0.0	0.0
	8:21	-129	0.0	0.0	0.0
	8:22	-128	0.0	0.0	0.0
	8:23	-127	0.0	0.0	0.0
	8:24	-126	0.0	0.0	0.0
	8:25	-125	0.0	0.0	0.0
	8:26	-124	0.0	0.0	0.0
	8:27	-123	0.0	0.0	0.0
	8:28	-122	0.0	0.0	0.0
	8:29	-121	0.0	0.0	0.0
	8:30	-120	0.0	0.0	0.0
	8:31	-119	0.0	0.0	0.0
	8:32	-118	0.0	0.0	0.0
	8:33	-117	0.0	0.0	0.0
	8:34	-116	0.0	0.0	0.0
	8:35	-115	0.0	0.0	0.0
	8:36	-114	0.0	0.0	0.0
	8:37	-113	0.0	0.0	0.0
	8:38	-112	0.0	0.0	0.0
	8:39	-111	0.0	0.0	0.0
	8:40	-110	0.0	0.0	0.0
	8:41	-109	0.0	0.0	0.0
	8:42	-108	0.0	0.0	0.0
	8:43	-107	0.0	0.0	0.0
	8:44	-106	0.0	0.0	0.0
	8:45	-105	0.0	0.0	0.0
	8:46	-104	0.0	0.0	0.0
	8:47	-103	0.0	0.0	0.0
	8:48	-102	0.0	0.0	0.0
	8:49	-101	0.0	0.0	0.0

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	8:50	-100	0.0	0.0	0.0
	8:51	-99	0.0	0.0	0.0
	8:52	-98	0.0	0.0	0.0
	8:53	-97	0.0	0.3	0.1
	8:54	-96	0.0	0.0	0.0
	8:55	-95	0.0	0.0	0.0
	8:56	-94	0.0	0.5	0.3
	8:57	-93	0.0	0.5	0.3
	8:58	-92	0.0	0.5	0.3
	8:59	-91	0.0	0.3	0.1
	9:00	-90	0.0	0.5	0.3
	9:01	-89	0.0	0.8	0.4
	9:02	-88	0.0	1.0	0.5
	9:03	-87	0.0	1.0	0.5
	9:04	-86	0.0	1.0	0.5
	9:05	-85	0.0	1.0	0.5
	9:06	-84	0.0	1.0	0.5
	9:07	-83	0.0	1.0	0.5
	9:08	-82	0.0	1.0	0.5
	9:09	-81	0.0	1.0	0.5
	9:10	-80	0.0	1.0	0.5
	9:11	-79	0.0	1.0	0.5
	9:12	-78	0.0	1.0	0.5
	9:13	-77	0.0	1.0	0.5
	9:14	-76	0.0	1.0	0.5
	9:15	-75	0.0	1.0	0.5
	9:16	-74	0.0	1.0	0.5
	9:17	-73	0.0	1.0	0.5
	9:18	-72	0.0	1.0	0.5
	9:19	-71	0.0	1.0	0.5
	9:20	-70	0.0	1.0	0.5
	9:21	-69	0.0	1.0	0.5
	9:22	-68	0.0	1.0	0.5
	9:23	-67	0.0	1.0	0.5
	9:24	-66	0.0	1.0	0.5
	9:25	-65	0.0	1.0	0.5
	9:26	-64	0.0	1.0	0.5
	9:27	-63	0.0	1.0	0.5
	9:28	-62	0.0	1.0	0.5
	9:29	-61	0.0	1.0	0.5
				900 m from apex of fireboom	
Pre-ignition 1	9:30	-60	0.0	1.0	0.5
	9:31	-59	0.0	1.0	0.5
	9:32	-58	0.0	1.0	0.5
	9:33	-57	0.0	1.0	0.5
	9:34	-56	0.0	1.0	0.5
	9:35	-55	0.0	1.0	0.5
	9:36	-54	0.0	1.0	0.5
	9:37	-53	0.0	1.0	0.5
	9:38	-52	0.0	1.0	0.5
	9:39	-51	0.0	1.0	0.5
	9:40	-50	0.0	1.0	0.5
	9:41	-49	0.0	1.0	0.5
	9:42	-48	0.0	1.0	0.5
	9:43	-47	0.0	1.0	0.5
	9:44	-46	0.0	1.0	0.5
	9:45	-45	0.0	1.0	0.5
	9:46	-44	0.0	1.0	0.5
	9:47	-43	0.0	1.0	0.5
	9:48	-42	0.0	1.0	0.5
	9:49	-41	0.0	1.0	0.5
	9:50	-40	0.0	1.0	0.5
	9:51	-39	0.0	1.0	0.5
	9:52	-38	0.0	1.0	0.5
	9:53	-37	0.0	1.0	0.5
	9:54	-36	0.0	1.0	0.5
	9:55	-35	0.0	1.0	0.5
	9:56	-34	0.0	1.0	0.5
	9:57	-33	0.0	1.0	0.5
	9:58	-32	0.0	1.0	0.5
	9:59	-31	0.0	1.0	0.5
	10:00	-30	0.0	1.0	0.5
	10:01	-29	0.0	1.0	0.5
	10:02	-28	0.0	1.0	0.5
	10:03	-27	0.0	1.0	0.5
	10:04	-26	0.0	1.0	0.5

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	10:05	-25	0.0	1.0	0.5
	10:06	-24	0.0	1.0	0.5
	10:07	-23	0.0	1.0	0.5
	10:08	-22	0.0	1.0	0.5
	10:09	-21	0.0	1.0	0.5
	10:10	-20	0.0	1.0	0.5
	10:11	-19	0.0	1.0	0.5
	10:12	-18	0.0	1.0	0.5
	10:13	-17	0.0	1.0	0.5
	10:14	-16	0.0	1.0	0.5
	10:15	-15	0.0	1.0	0.5
	10:16	-14	0.0	1.3	0.6
	10:17	-13	0.0	1.0	0.5
	10:18	-12	0.0	1.0	0.5
	10:19	-11	0.0	1.0	0.5
	10:20	-10	0.0	1.0	0.5
	10:21	-9	0.0	1.3	0.6
	10:22	-8	0.0	1.5	0.8
	10:23	-7	0.0	1.8	0.9
	10:24	-6	0.0	1.8	0.9
	10:25	-5	0.0	1.8	0.9
	10:26	-4	0.0	2.0	1.0
	10:27	-3	0.0	2.0	1.0
	10:28	-2	0.0	1.5	0.8
	10:29	-1	0.0	1.8	0.9
Burn 1	10:30	0	0.0	2.0	1.0
	10:31	1	0.0	2.0	1.0
	10:32	2	0.0	2.0	1.0
	10:33	3	0.0	2.0	1.0
	10:34	4	0.0	2.0	1.0
	10:35	5	0.0	2.0	1.0
	10:36	6	0.0	2.0	1.0
	10:37	7	0.0	2.0	1.0
	10:38	8	0.0	1.8	0.9
	10:39	9	0.0	1.5	0.8
	10:40	10	0.0	1.3	0.6
	10:41	11	0.0	1.3	0.6
	10:42	12	0.0	1.0	0.5
	10:43	13	0.0	1.0	0.5
	10:44	14	0.0	1.0	0.5
	10:45	15	0.0	1.0	0.5
	10:46	16	0.0	1.0	0.5
	10:47	17	0.0	1.0	0.5
	10:48	18	0.0	1.0	0.5
	10:49	19	0.0	1.0	0.5
	10:50	20	0.0	1.0	0.5
	10:51	21	0.0	1.0	0.5
	10:52	22	0.0	1.0	0.5
	10:53	23	0.0	1.0	0.5
	10:54	24	0.0	1.0	0.5
	10:55	25	0.0	1.0	0.5
	10:56	26	0.0	1.0	0.5
	10:57	27	0.0	1.0	0.5
	10:58	28	0.0	1.0	0.5
	10:59	29	0.0	1.0	0.5
	11:00	30	0.0	1.0	0.5
	11:01	31	0.0	1.0	0.5
	11:02	32	0.0	1.0	0.5
	11:03	33	0.0	1.0	0.5
	11:04	34	0.0	1.0	0.5
	11:05	35	0.0	1.0	0.5
	11:06	36	0.0	1.0	0.5
	11:07	37	0.0	1.0	0.5
	11:08	38	0.0	1.0	0.5
	11:09	39	0.0	1.0	0.5
	11:10	40	0.0	1.0	0.5
	11:11	41	0.0	1.0	0.5
	11:12	42	0.0	1.0	0.5
	11:13	43	0.0	0.8	0.4
	11:14	44	0.0	0.8	0.4
	11:15	45	0.0	0.8	0.4
	11:16	46	0.0	0.3	0.1
	11:17	47	0.0	0.5	0.3
	11:18	48	0.0	0.3	0.1
	11:19	49	0.0	0.0	0.0
	11:20	50	0.0	0.3	0.1
	11:21	51	0.0	0.0	0.0

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	11:22	52	0.0	0.0	0.0
	11:23	53	0.0	0.0	0.0
	11:24	54	0.0	0.0	0.0
	11:25	55	0.0	0.0	0.0
	11:26	56	0.0	0.0	0.0
	11:27	57	0.0	0.0	0.0
	11:28	58	0.0	0.0	0.0
	11:29	59	0.0	0.0	0.0
	11:30	60	0.0	0.0	0.0
	11:31	61	0.0	0.0	0.0
	11:32	62	0.0	0.0	0.0
	11:33	63	0.0	0.0	0.0
	11:34	64	0.0	0.0	0.0
	11:35	65	0.0	0.0	0.0
	11:36	66	0.0	0.0	0.0
	11:37	67	0.0	0.3	0.1
	11:38	68	0.0	0.8	0.4
	11:39	69	0.0	1.0	0.5
	11:40	70	0.0	1.0	0.5
	11:41	71	0.0	1.0	0.5
	11:42	72	0.0	1.0	0.5
	11:43	73	0.0	1.0	0.5
	11:44	74	0.0	1.0	0.5
	11:45	75	0.0	1.0	0.5
	11:46	76	0.0	1.0	0.5
	11:47	77	0.0	1.0	0.5
	11:48	78	0.0	1.0	0.5
	11:49	79	0.0	1.0	0.5
	11:50	80	0.0	1.0	0.5
	11:51	81	0.0	1.0	0.5
	11:52	82	0.0	1.0	0.5
	11:53	83	0.0	1.0	0.5
	11:54	84	0.0	1.0	0.5
	11:55	85	0.0	1.0	0.5
	11:56	86	0.0	1.0	0.5
	11:57	87	0.0	1.0	0.5
	11:58	88	0.0	1.0	0.5
	11:59	89	0.0	1.0	0.5
	12:00	90	0.0	1.0	0.5
	12:01	91	0.0	1.0	0.5
	12:02	92	0.0	1.0	0.5
	12:03	93	0.0	1.0	0.5
	12:04	94	0.0	1.0	0.5
Post-burn 1	12:05	95	0.0	1.0	0.5
	12:06	96	0.0	1.5	0.8
	12:07	97	0.0	1.5	0.8
	12:08	98	0.0	1.5	0.8
	12:09	99	0.0	2.0	1.0
	12:10	100	0.0	2.0	1.0
	12:11	101	0.0	2.0	1.0
	12:12	102	0.3	2.0	1.1
	12:13	103	0.5	2.0	1.3
	12:14	104	0.5	2.0	1.3
	12:15	105	0.0	2.0	1.0
	12:16	106	0.5	2.0	1.3
	12:17	107	1.0	2.0	1.5
	12:18	108	0.5	2.0	1.3
	12:19	109	0.5	2.0	1.3
	12:20	110	1.0	2.0	1.5
	12:21	111	1.0	2.0	1.5
	12:22	112	1.0	2.0	1.5
	12:23	113	1.0	2.0	1.5
	12:24	114	1.0	2.0	1.5
	12:25	115	1.0	2.0	1.5
	12:26	116	1.0	2.0	1.5
	12:27	117	1.0	2.0	1.5
	12:28	118	1.0	2.0	1.5
	12:29	119	1.0	2.0	1.5
	12:30	120	1.0	2.0	1.5
	12:31	121	1.0	2.0	1.5
	12:32	122	1.0	2.0	1.5
	12:33	123	1.0	2.0	1.5
	12:34	124	1.0	2.0	1.5
	12:35	125	1.0	2.0	1.5
	12:36	126	1.0	2.0	1.5
	12:37	127	1.0	2.0	1.5
	12:38	128	1.0	2.0	1.5

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	12:39	129	1.0	2.0	1.5
	12:40	130	1.0	2.0	1.5
	12:41	131	1.0	2.0	1.5
	12:42	132	1.0	2.0	1.5
	12:43	133	1.0	2.0	1.5
	12:44	134	1.0	2.0	1.5
	12:45	135	1.0	2.0	1.5
	12:46	136	1.0	2.0	1.5
	12:47	137	1.0	2.0	1.5
	12:48	138	1.0	2.0	1.5
	12:49	139	1.0	2.0	1.5
	12:50	140	1.0	2.0	1.5
	12:51	141	1.0	2.0	1.5
	12:52	142	1.0	2.0	1.5
	12:53	143	1.0	2.0	1.5
	12:54	144	1.0	2.0	1.5
	12:55	145	1.0	2.0	1.5
	12:56	146	1.0	2.0	1.5
	12:57	147	1.0	2.0	1.5
	12:58	148	1.0	2.0	1.5
	12:59	149	1.0	2.0	1.5
			500 to 600 m from apex of fireboom		
Background 2	13:00	-66	1.0	2.0	1.5
	13:01	-65	1.0	2.0	1.5
	13:02	-64	1.0	2.0	1.5
	13:03	-63	1.0	2.0	1.5
	13:04	-62	1.0	2.0	1.5
	13:05	-61	1.0	2.0	1.5
	13:06	-60	1.0	2.0	1.5
	13:07	-59	1.0	2.0	1.5
	13:08	-58	1.0	2.0	1.5
	13:09	-57	1.0	2.0	1.5
	13:10	-56	1.0	2.0	1.5
	13:11	-55	1.0	2.0	1.5
	13:12	-54	1.0	2.0	1.5
	13:13	-53	1.0	2.0	1.5
	13:14	-52	1.0	2.0	1.5
	13:15	-51	1.0	2.0	1.5
	13:16	-50	1.0	2.0	1.5
	13:17	-49	1.0	2.0	1.5
	13:18	-48	1.0	2.0	1.5
	13:19	-47	1.0	2.0	1.5
	13:20	-46	1.0	2.0	1.5
	13:21	-45	1.0	2.0	1.5
	13:22	-44	1.0	2.0	1.5
	13:23	-43	1.0	2.0	1.5
	13:24	-42	1.0	2.0	1.5
	13:25	-41	1.0	2.0	1.5
	13:26	-40	1.0	2.0	1.5
	13:27	-39	1.0	2.0	1.5
	13:28	-38	1.0	2.0	1.5
	13:29	-37	1.0	2.0	1.5
	13:30	-36	1.0	2.0	1.5
	13:31	-35	0.3	2.0	1.1
	13:32	-34	0.0	0.5	0.3
	13:33	-33	0.0	0.0	0.0
	13:34	-32	0.0	0.0	0.0
	13:35	-31	0.0	0.0	0.0
	13:36	-30	0.0	0.0	0.0
	13:37	-29	0.0	0.0	0.0
	13:38	-28	0.0	0.0	0.0
	13:39	-27	0.0	0.0	0.0
	13:40	-26	0.0	0.0	0.0
	13:41	-25	0.0	0.0	0.0
	13:42	-24	0.0	0.0	0.0
	13:43	-23	0.0	0.0	0.0
	13:44	-22	0.0	0.0	0.0
	13:45	-21	0.0	0.0	0.0
	13:46	-20	0.0	0.0	0.0
	13:47	-19	0.0	0.0	0.0
	13:48	-18	0.0	0.0	0.0
	13:49	-17	0.0	0.0	0.0
	13:50	-16	0.0	0.0	0.0
	13:51	-15	0.0	0.0	0.0
Pre-ignition 2	13:52	-14	0.0	0.0	0.0
	13:53	-13	0.0	0.0	0.0

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	13:54	-12	0.0	0.0	0.0
	13:55	-11	0.0	0.0	0.0
	13:56	-10	0.0	0.0	0.0
	13:57	-9	0.0	0.0	0.0
	13:58	-8	0.0	0.0	0.0
	13:59	-7	0.0	0.0	0.0
	14:00	-6	0.0	0.0	0.0
	14:01	-5	0.0	0.0	0.0
	14:02	-4	0.0	0.0	0.0
	14:03	-3	0.0	0.0	0.0
	14:04	-2	0.0	0.0	0.0
	14:05	-1	0.0	0.0	0.0
Burn 2	14:06	0	0.0	0.0	0.0
	14:07	1	0.0	0.0	0.0
	14:08	2	0.0	0.0	0.0
	14:09	3	0.0	0.0	0.0
	14:10	4	0.0	0.0	0.0
	14:11	5	0.0	0.0	0.0
	14:12	6	0.0	0.0	0.0
	14:13	7	0.0	0.0	0.0
	14:14	8	0.0	0.0	0.0
	14:15	9	0.0	0.0	0.0
	14:16	10	0.0	0.0	0.0
	14:17	11	0.0	0.0	0.0
	14:18	12	0.0	0.0	0.0
	14:19	13	0.0	0.0	0.0
	14:20	14	0.0	0.0	0.0
	14:21	15	0.0	0.0	0.0
	14:22	16	0.0	0.0	0.0
	14:23	17	0.0	0.0	0.0
	14:24	18	0.0	0.0	0.0
	14:25	19	0.0	0.0	0.0
	14:26	20	0.0	0.0	0.0
	14:27	21	0.0	0.0	0.0
	14:28	22	0.0	0.0	0.0
	14:29	23	0.0	0.0	0.0
	14:30	24	0.0	0.0	0.0
	14:31	25	0.0	0.0	0.0
	14:32	26	0.0	0.0	0.0
	14:33	27	0.0	0.0	0.0
	14:34	28	0.0	0.0	0.0
	14:35	29	0.0	0.0	0.0
	14:36	30	0.0	0.0	0.0
	14:37	31	0.0	0.0	0.0
	14:38	32	0.0	0.0	0.0
	14:39	33	0.0	0.0	0.0
	14:40	34	0.0	0.0	0.0
	14:41	35	0.0	0.0	0.0
	14:42	36	0.0	0.0	0.0
	14:43	37	0.0	0.0	0.0
	14:44	38	0.0	0.0	0.0
	14:45	39	0.0	0.0	0.0
	14:46	40	0.0	0.0	0.0
	14:47	41	0.0	0.0	0.0
	14:48	42	0.0	0.0	0.0
	14:49	43	0.0	0.0	0.0
	14:50	44	0.0	0.0	0.0
	14:51	45	0.0	0.0	0.0
	14:52	46	0.0	0.0	0.0
	14:53	47	0.0	0.0	0.0
	14:54	48	0.0	0.0	0.0
	14:55	49	0.0	0.0	0.0
	14:56	50	0.0	0.0	0.0
	14:57	51	0.0	0.0	0.0
	14:58	52	0.0	0.0	0.0
	14:59	53	0.0	0.0	0.0
	15:00	54	0.0	0.0	0.0
	15:01	55	0.0	0.0	0.0
	15:02	56	0.0	0.0	0.0
	15:03	57	0.0	0.0	0.0
	15:04	58	0.0	0.0	0.0
	15:05	59	0.0	0.0	0.0
	15:06	60	0.0	0.0	0.0
	15:07	61	0.0	0.0	0.0
	15:08	62	0.0	0.0	0.0
	15:09	63	0.0	0.0	0.0
	15:10	64	0.0	0.0	0.0

NOBE 93 Table 6.6 cont. **Sulphur Dioxide Analysis at Downwind Station (CCG 206)**

Cannonball

Time Periods	Clock hh:mm	Elapsed Time min	Instrument 1 ppm	Instrument 2 ppm	AVE ppm
	15:11	65	0.0	0.0	0.0
	15:12	66	0.0	0.0	0.0
	15:13	67	0.0	0.0	0.0
	15:14	68	0.0	0.0	0.0
	15:15	69	0.0	0.0	0.0
	15:16	70	0.0	0.0	0.0
	15:17	71	0.0	0.0	0.0
	15:18	72	0.0	0.0	0.0
	15:19	73	0.0	0.0	0.0
Post-burn 2	15:20	74	0.0	0.0	0.0
	15:21	75	0.0	0.0	0.0
	15:22	76	0.0	0.0	0.0
	15:23	77	0.0	0.0	0.0
	15:24	78	0.0	0.0	0.0
	15:25	79	0.0	0.0	0.0
	15:26			0.0	0.0

NOBE 93 Table 6.7

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
			Remote control boat # 4	Remote control boat # 2
Background 1	08:21:00	-129.0		0.0
	08:21:30	-128.5		0.0
	08:22:00	-128.0		0.0
	08:22:30	-127.5		0.0
	08:23:00	-127.0		0.0
	08:23:30	-126.5		0.0
	08:24:00	-126.0		0.1
	08:24:30	-125.5		0.0
	08:25:00	-125.0		0.0
	08:25:30	-124.5		0.0
	08:26:00	-124.0		0.0
	08:26:30	-123.5		0.0
	08:27:00	-123.0		0.0
	08:27:30	-122.5		0.0
	08:38:00	-112.0	2.6	0.0
	08:38:30	-111.5	2.6	0.0
	08:39:00	-111.0	2.6	0.0
	08:39:30	-110.5	2.6	0.0
	08:40:00	-110.0	2.6	0.0
	08:40:30	-109.5	2.6	0.0
	08:41:00	-109.0	2.7	0.0
	08:41:30	-108.5	2.6	0.0
	08:42:00	-108.0	2.6	0.0
	08:42:30	-107.5	2.6	0.0
	08:43:00	-107.0	2.6	0.0
	08:43:30	-106.5	2.6	0.0
	08:44:00	-106.0	2.6	0.0
	08:44:30	-105.5	2.6	0.0
	08:45:00	-105.0	2.6	0.0
	08:45:30	-104.5	2.6	0.0
	08:46:00	-104.0	2.6	0.0
	08:46:30	-103.5	2.6	0.0
	08:47:00	-103.0	2.6	0.0
	08:47:30	-102.5	2.6	0.0
	08:48:00	-102.0	2.6	0.0
	08:48:30	-101.5	2.6	0.0
	08:49:00	-101.0	2.6	0.0
	08:49:30	-100.5	2.6	0.0
	08:50:00	-100.0	2.6	0.0
	08:50:30	-99.5	2.6	0.0
	08:51:00	-99.0	2.6	0.0
	08:51:30	-98.5	2.6	0.0
	08:52:00	-98.0	2.6	0.0
	08:52:30	-97.5	2.7	0.0
	08:53:00	-97.0	2.6	0.0
	08:53:30	-96.5	2.6	0.0
	08:54:00	-96.0	2.6	0.0
	08:54:30	-95.5	2.6	0.0
	08:55:00	-95.0	2.6	0.0
	08:55:30	-94.5	2.6	0.1
	08:56:00	-94.0	2.6	0.1
	08:56:30	-93.5	2.6	0.0
	08:57:00	-93.0	2.6	0.0
	08:57:30	-92.5	2.5	0.0
	08:58:00	-92.0	2.6	0.0
	08:58:30	-91.5	2.6	0.0
	08:59:00	-91.0	2.6	0.0
	08:59:30	-90.5	2.6	0.0
	09:00:00	-90.0	2.6	0.0
	09:00:30	-89.5	2.6	0.0
	09:01:00	-89.0	2.6	0.0
	09:01:30	-88.5	2.6	0.0
	09:02:00	-88.0	2.5	0.0
	09:02:30	-87.5	2.6	0.0
	09:03:00	-87.0	2.6	0.0

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	09:03:30	-86.5	2.6	0.0
	09:04:00	-86.0	2.6	0.0
	09:04:30	-85.5	2.6	0.0
	09:05:00	-85.0	2.6	0.0
	09:05:30	-84.5	2.6	0.0
	09:06:00	-84.0	2.6	0.0
	09:06:30	-83.5	2.6	0.0
	09:07:00	-83.0	2.6	0.0
	09:07:30	-82.5	2.6	0.0
	09:08:00	-82.0	2.6	0.0
	09:08:30	-81.5	2.6	0.0
	09:09:00	-81.0	2.6	0.0
	09:09:30	-80.5	2.6	0.0
	09:10:00	-80.0	2.6	0.0
	09:10:30	-79.5	2.6	0.0
	09:11:00	-79.0	2.5	0.0
	09:11:30	-78.5	2.5	0.0
	09:12:00	-78.0	2.6	0.0
	09:12:30	-77.5	2.6	0.0
	09:13:00	-77.0	2.6	0.0
	09:13:30	-76.5	2.5	0.0
	09:14:00	-76.0	2.5	0.0
	09:14:30	-75.5	2.6	0.0
	09:15:00	-75.0	2.6	0.0
	09:15:30	-74.5	2.6	0.0
	09:16:00	-74.0	2.6	0.0
	09:16:30	-73.5	2.6	0.0
	09:17:00	-73.0	2.6	0.0
	09:17:30	-72.5	2.6	0.0
	09:18:00	-72.0	2.6	0.0
	09:18:30	-71.5	2.6	0.0
	09:19:00	-71.0	2.6	0.0
	09:19:30	-70.5	2.6	0.0
	09:20:00	-70.0	2.6	0.0
	09:20:30	-69.5	2.6	0.0
	09:21:00	-69.0	2.6	0.0
	09:21:30	-68.5	2.6	0.0
	09:22:00	-68.0	2.5	0.0
	09:22:30	-67.5	2.5	0.0
	09:23:00	-67.0	2.5	0.0
	09:23:30	-66.5	2.6	0.0
	09:24:00	-66.0	2.6	0.0
	09:24:30	-65.5	2.6	0.0
	09:25:00	-65.0	2.6	0.0
	09:25:30	-64.5	2.6	0.0
	09:26:00	-64.0	2.6	0.0
	09:26:30	-63.5	2.6	0.0
	09:27:00	-63.0	2.6	0.0
	09:27:30	-62.5	2.6	0.0
	09:28:00	-62.0	2.6	0.0
	09:28:30	-61.5	2.6	0.0
	09:29:00	-61.0	2.5	0.0
	09:29:30	-60.5	2.6	0.0
	09:20:00	-70.0		0.0
	09:20:30	-69.5		0.0
	09:21:00	-69.0		0.0
	09:21:30	-68.5		0.0
	09:22:00	-68.0		0.0
	09:22:30	-67.5		0.0
	09:23:00	-67.0		0.0
	09:23:30	-66.5		0.0
	09:24:00	-66.0		0.0
	09:24:30	-65.5		0.0
	09:25:00	-65.0		0.0
	09:25:30	-64.5		0.0
	09:26:00	-64.0		0.0
	09:26:30	-63.5		0.3

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	09:27:00	-63.0		0.7
	09:27:30	-62.5		0.8
	09:28:00	-62.0		0.6
	09:28:30	-61.5		0.5
	09:29:00	-61.0		0.4
	09:29:30	-60.5		0.5
Pre-ignition 1	09:30:00	-60.0	2.5	0.3
	09:30:30	-59.5	2.5	0.4
	09:31:00	-59.0	2.5	0.4
	09:31:30	-58.5	2.4	0.3
	09:32:00	-58.0	2.5	0.5
	09:32:30	-57.5	2.5	0.5
	09:33:00	-57.0	2.5	0.2
	09:33:30	-56.5	2.5	0.4
	09:34:00	-56.0	2.5	0.5
	09:34:30	-55.5	2.5	0.7
	09:35:00	-55.0	2.5	0.5
	09:35:30	-54.5	2.5	0.6
	09:36:00	-54.0	2.6	0.7
	09:36:30	-53.5	2.6	0.8
	09:37:00	-53.0	2.6	0.8
	09:37:30	-52.5	2.6	0.9
	09:38:00	-52.0	2.6	0.8
	09:38:30	-51.5	2.6	0.7
	09:39:00	-51.0	2.6	0.6
	09:39:30	-50.5	2.6	0.7
	09:40:00	-50.0	2.6	0.6
	09:40:30	-49.5	2.6	0.4
	09:41:00	-49.0	2.6	0.4
	09:41:30	-48.5	2.5	0.5
	09:42:00	-48.0	2.5	0.5
	09:42:30	-47.5	2.5	0.5
	09:43:00	-47.0	2.5	0.4
	09:43:30	-46.5	2.5	0.6
	09:44:00	-46.0	2.5	0.6
	09:44:30	-45.5	2.5	0.4
	09:45:00	-45.0	2.5	0.5
	09:45:30	-44.5	2.5	0.4
	09:46:00	-44.0	2.5	0.5
	09:46:30	-43.5	2.6	0.4
	09:47:00	-43.0	2.5	0.6
	09:47:30	-42.5	2.5	0.6
	09:48:00	-42.0	2.5	0.4
	09:48:30	-41.5	2.5	0.5
	09:49:00	-41.0	2.5	0.4
	09:49:30	-40.5	2.5	0.5
	09:50:00	-40.0	2.5	0.5
	09:50:30	-39.5	2.6	0.5
	09:51:00	-39.0	2.5	0.6
	09:51:30	-38.5	2.6	0.4
	09:52:00	-38.0	2.5	0.4
	09:52:30	-37.5	2.5	0.5
	09:53:00	-37.0	2.5	0.6
	09:53:30	-36.5	2.5	0.7
	09:54:00	-36.0	2.6	0.5
	09:54:30	-35.5	2.5	0.6
	09:55:00	-35.0	2.5	0.6
	09:55:30	-34.5	2.6	0.6
	09:56:00	-34.0	2.5	0.7
	09:56:30	-33.5	2.5	0.5
	09:57:00	-33.0	2.5	0.5
	09:57:30	-32.5	2.5	0.5
	09:58:00	-32.0	2.5	0.4
	09:58:30	-31.5	2.5	0.3
	09:59:00	-31.0	2.5	0.4
	09:59:30	-30.5	2.5	0.4

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	10:00:00	-30.0	2.5	0.4
	10:00:30	-29.5	2.5	0.5
	10:01:00	-29.0	2.4	0.3
	10:01:30	-28.5	2.5	0.1
	10:02:00	-28.0	2.5	0.1
	10:02:30	-27.5	2.5	0.1
	10:03:00	-27.0	2.5	0.2
	10:03:30	-26.5	2.5	0.2
	10:04:00	-26.0	2.4	0.2
	10:04:30	-25.5	2.3	0.4
	10:05:00	-25.0	2.4	0.3
	10:05:30	-24.5	2.4	0.2
	10:06:00	-24.0	2.4	0.1
	10:06:30	-23.5	2.5	0.2
	10:07:00	-23.0	2.4	0.1
	10:07:30	-22.5	2.5	0.1
	10:08:00	-22.0	2.4	0.2
	10:08:30	-21.5	2.4	0.2
	10:09:00	-21.0	2.4	0.2
	10:09:30	-20.5	2.4	0.3
	10:10:00	-20.0	2.4	0.2
	10:10:30	-19.5	2.4	0.2
	10:11:00	-19.0	2.5	0.1
	10:11:30	-18.5	2.5	0.2
	10:12:00	-18.0	2.5	0.1
	10:12:30	-17.5	2.5	0.1
	10:13:00	-17.0	2.5	0.4
	10:13:30	-16.5	2.5	0.1
	10:14:00	-16.0	2.5	0.2
	10:14:30	-15.5	2.5	0.2
	10:15:00	-15.0	2.5	0.4
	10:15:30	-14.5	2.6	0.2
	10:16:00	-14.0	2.6	0.0
	10:16:30	-13.5	2.5	0.1
	10:17:00	-13.0	2.5	0.1
	10:17:30	-12.5	2.4	0.1
	10:18:00	-12.0	2.3	0.3
	10:18:30	-11.5	2.4	0.3
	10:19:00	-11.0	2.4	0.4
	10:19:30	-10.5	2.5	0.3
	10:20:00	-10.0	2.5	0.3
	10:20:30	-9.5	2.5	0.2
	10:21:00	-9.0	2.5	0.3
	10:21:30	-8.5	2.5	0.3
	10:22:00	-8.0	2.5	0.2
	10:22:30	-7.5	2.5	0.1
	10:23:00	-7.0	2.5	0.0
	10:23:30	-6.5	2.5	0.0
	10:24:00	-6.0	2.5	0.1
	10:24:30	-5.5	2.5	0.2
	10:25:00	-5.0	2.5	0.0
	10:25:30	-4.5	2.5	0.0
	10:26:00	-4.0	2.5	0.2
	10:26:30	-3.5	2.5	0.3
	10:27:00	-3.0	2.5	0.4
	10:27:30	-2.5	2.5	0.5
	10:28:00	-2.0	2.5	0.6
	10:28:30	-1.5	2.5	0.2
	10:29:00	-1.0	2.5	0.0
	10:29:30	-0.5	2.5	0.0
Burn 1	10:30:00	0.0	2.4	0.0
	10:30:30	0.5	2.4	0.0
	10:31:00	1.0	2.4	0.0
	10:31:30	1.5	2.4	0.0
	10:32:00	2.0	2.4	0.0
	10:32:30	2.5	2.5	0.0

NOBE 93 Table 6.7 cont. Sulphur Dioxide Analysis at Remote Stations Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	10:33:00	3.0	2.5	0.0
	10:33:30	3.5	2.5	0.1
	10:34:00	4.0	2.5	0.0
	10:34:30	4.5	2.5	0.0
	10:35:00	5.0	2.5	0.0
	10:35:30	5.5	2.5	0.0
	10:36:00	6.0	2.5	0.0
	10:36:30	6.5	2.5	0.1
	10:37:00	7.0		0.1
	10:37:30	7.5		0.1
	10:38:00	8.0		0.2
	10:38:30	8.5		0.2
	10:39:00	9.0		0.1
	10:39:30	9.5		0.1
	10:40:00	10.0		0.1
	10:40:30	10.5		0.1
	10:41:00	11.0		0.4
	10:41:30	11.5		0.3
	10:42:00	12.0		0.2
	10:42:30	12.5		0.1
	10:43:00	13.0		0.1
	10:43:30	13.5		0.0
	10:44:00	14.0		0.1
	10:44:30	14.5		0.0
	10:45:00	15.0		0.0
	10:45:30	15.5		0.0
	10:46:00	16.0		0.0
	10:46:30	16.5		0.0
			Remote control boat # 2	Remote control boat # 1
R/C boat changed	10:47:00	17.0	0.1	
	10:47:30	17.5	0.1	
	10:48:00	18.0	0.1	
	10:48:30	18.5	0.1	
	10:49:00	19.0	0.1	
	10:49:30	19.5	0.1	
	10:50:00	20.0	0.1	
	10:50:30	20.5	0.2	
	10:51:00	21.0	0.1	
	10:51:30	21.5	0.1	
	10:52:00	22.0	0.3	
	10:52:30	22.5	0.5	
	10:53:00	23.0	0.2	
	10:53:30	23.5	0.0	
	10:54:00	24.0	0.0	
	10:54:30	24.5	0.0	
	10:55:00	25.0	0.0	
	10:55:30	25.5	0.0	
	10:56:00	26.0	0.1	
	10:56:30	26.5	0.0	
	10:57:00	27.0	0.1	
	10:57:30	27.5	0.0	
	10:58:00	28.0	0.0	
	10:58:30	28.5	0.0	
	10:59:00	29.0	0.0	
	10:59:30	29.5	0.2	
	11:00:00	30.0	0.4	
	11:00:30	30.5	0.1	
	11:01:00	31.0	0.0	
	11:01:30	31.5	0.0	
	11:02:00	32.0	0.0	
	11:02:30	32.5	0.0	
	11:03:00	33.0	0.0	
	11:03:30	33.5	0.0	
	11:04:00	34.0	0.0	
	11:04:30	34.5	0.1	

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	11:05:00	35.0	0.1	
	11:05:30	35.5	0.1	
	11:06:00	36.0	0.1	
	11:06:30	36.5	0.1	
	11:07:00	37.0	0.2	
	11:07:30	37.5	0.3	
	11:08:00	38.0	0.2	
	11:08:30	38.5	0.1	
	11:09:00	39.0	0.1	
	11:09:30	39.5	0.2	
	11:10:00	40.0	0.0	
	11:10:30	40.5	0.7	
	11:11:00	41.0	0.4	
	11:11:30	41.5	0.0	
	11:12:00	42.0	0.1	
	11:12:30	42.5	0.1	
	11:13:00	43.0	0.0	
	11:13:30	43.5	0.0	
	11:14:00	44.0	0.0	
	11:14:30	44.5	0.0	
	11:15:00	45.0	0.0	
	11:15:30	45.5	0.0	
	11:16:00	46.0	0.0	
	11:16:30	46.5	0.1	
	11:17:00	47.0	0.0	
	11:17:30	47.5	0.1	
	11:18:00	48.0	0.0	
	11:18:30	48.5	0.0	
	11:19:00	49.0	0.1	
	11:19:30	49.5	0.1	
	11:20:00	50.0	0.1	
	11:20:30	50.5	0.1	
	11:21:00	51.0	0.1	
	11:21:30	51.5	0.2	
	11:22:00	52.0	0.1	
	11:22:30	52.5	0.1	
	11:23:00	53.0	0.3	0.0
	11:23:30	53.5	0.3	0.0
	11:24:00	54.0	0.3	0.0
	11:24:30	54.5	0.4	0.0
	11:25:00	55.0	0.4	0.0
	11:25:30	55.5	0.3	0.0
	11:26:00	56.0	0.3	0.0
	11:26:30	56.5	0.3	0.0
	11:27:00	57.0	0.3	0.0
	11:27:30	57.5	0.2	0.0
	11:28:00	58.0	0.3	0.0
	11:28:30	58.5	0.6	0.0
	11:29:00	59.0	0.8	0.0
	11:29:30	59.5	0.0	0.0
	11:30:00	60.0	0.0	0.0
	11:30:30	60.5	0.0	0.0
	11:31:00	61.0	0.0	0.0
	11:31:30	61.5	0.0	0.0
	11:32:00	62.0	0.0	0.0
	11:32:30	62.5	0.0	0.0
	11:33:00	63.0	0.0	0.0
	11:33:30	63.5	0.0	0.0
	11:34:00	64.0	0.8	0.0
	11:34:30	64.5	0.8	0.0
	11:35:00	65.0	0.8	0.0
	11:35:30	65.5	0.6	0.0
	11:36:00	66.0	0.7	0.0
	11:36:30	66.5	0.7	0.0
	11:37:00	67.0	0.5	0.0
	11:37:30	67.5	0.5	0.0
	11:38:00	68.0	0.5	0.0

NOBE 93 Table 6.7 cont. **Sulphur Dioxide Analysis at Remote Stations**

Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	11:38:30	68.5	0.4	0.0
	11:39:00	69.0	0.6	0.0
	11:39:30	69.5	0.5	0.0
	11:40:00	70.0	0.8	0.0
	11:40:30	70.5	0.9	0.0
	11:41:00	71.0	0.9	0.0
	11:41:30	71.5	0.9	0.0
	11:42:00	72.0	0.5	0.0
	11:42:30	72.5	0.7	0.0
	11:43:00	73.0	0.7	0.0
	11:43:30	73.5	0.8	0.0
	11:44:00	74.0	0.7	0.0
	11:44:30	74.5	0.7	0.0
	11:45:00	75.0	0.6	0.0
	11:45:30	75.5	0.6	0.0
	11:46:00	76.0	0.6	0.0
	11:46:30	76.5	0.7	0.0
	11:47:00	77.0	0.6	0.0
	11:47:30	77.5	0.5	0.0
	11:48:00	78.0	0.7	0.0
	11:48:30	78.5	0.7	0.0
	11:49:00	79.0	0.7	0.0
	11:49:30	79.5	0.7	0.0
	11:50:00	80.0	0.7	0.0
	11:50:30	80.5	0.7	0.0
	11:51:00	81.0	0.7	0.0
	11:51:30	81.5	0.7	0.0
	11:52:00	82.0	0.8	0.0
	11:52:30	82.5	0.8	0.0
	11:53:00	83.0	0.7	0.0
	11:53:30	83.5	0.7	0.0
	11:54:00	84.0	0.4	0.0
	11:54:30	84.5	0.5	0.0
	11:55:00	85.0	0.4	0.0
	11:55:30	85.5	0.4	0.0
	11:56:00	86.0	0.4	0.0
	11:56:30	86.5	0.4	0.0
	11:57:00	87.0	0.2	0.0
	11:57:30	87.5	0.3	0.0
	11:58:00	88.0	0.2	0.0
	11:58:30	88.5	0.2	0.0
	11:59:00	89.0	0.2	0.0
	11:59:30	89.5	0.2	0.0
	12:00:00	90.0	0.3	0.0
	12:00:30	90.5	0.1	0.0
	12:01:00	91.0	0.1	0.0
	12:01:30	91.5	0.2	0.0
	12:02:00	92.0	0.3	0.0
	12:02:30	92.5	0.3	0.0
	12:03:00	93.0	0.3	0.0
	12:03:30	93.5	0.3	0.0
	12:04:00	94.0	0.3	0.0
Post-burn 1	12:04:30	94.5	0.3	0.0
	12:05:00	95.0	0.0	0.0
	12:05:30	95.5	0.0	0.0
	12:06:00	96.0	0.0	0.0
	12:06:30	96.5	0.0	0.0
	12:07:00	97.0	0.0	0.0
	12:07:30	97.5	0.0	0.0
	12:08:00	98.0	0.3	0.0
	12:08:30	98.5	0.2	0.0
	12:09:00	99.0	0.3	0.0
	12:09:30	99.5	0.0	0.0
	12:10:00	100.0	0.0	0.0
	12:10:30	100.5	0.0	0.0
	12:11:00	101.0	0.0	0.0

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	12:11:30	101.5	0.0	0.0
	12:12:00	102.0	0.0	0.0
	12:12:30	102.5	0.0	0.0
	12:13:00	103.0	0.0	0.0
	12:13:30	103.5	0.0	0.0
	12:14:00	104.0	0.0	0.0
	12:14:30	104.5	0.0	0.0
	12:15:00	105.0	0.0	0.0
	12:15:30	105.5	0.0	0.0
	12:16:00	106.0	0.0	0.0
	12:16:30	106.5	0.0	0.0
	12:17:00	107.0	0.0	0.0
	12:17:30	107.5	0.0	0.0
	12:18:00	108.0	0.0	0.0
	12:18:30	108.5	0.0	0.0
	12:19:00	109.0	0.0	0.0
	12:19:30	109.5	0.0	0.0
	12:20:00	110.0	0.0	0.0
	12:20:30	110.5	0.0	0.0
	12:21:00	111.0	0.0	0.0
	12:21:30	111.5	0.0	0.0
	12:22:00	112.0	0.0	0.0
	12:22:30	112.5	0.0	0.0
	12:23:00	113.0	0.0	0.0
	12:23:30	113.5	0.0	0.0
	12:24:00	114.0	0.0	0.0
	12:24:30	114.5	0.0	0.0
	12:25:00	115.0	0.0	0.0
	12:25:30	115.5	0.0	0.0
	12:26:00	116.0	0.0	0.0
	12:26:30	116.5	0.0	0.0
	12:27:00	117.0	0.0	0.0
	12:27:30	117.5	0.0	0.0
	12:28:00	118.0	0.0	0.0
	12:28:30	118.5	0.0	0.0
	12:29:00	119.0	0.0	0.0
	12:29:30	119.5	0.0	0.0
	12:30:00	120.0	0.0	0.0
	12:30:30	120.5	0.0	0.0
	12:31:00	121.0	0.0	0.0
	12:31:30	121.5	0.0	0.0
	12:32:00	122.0	0.0	0.0
	12:32:30	122.5	0.0	0.0
	12:33:00	123.0	0.0	0.0
	12:33:30	123.5	0.0	0.0
	12:34:00	124.0	0.0	0.0
	12:34:30	124.5	0.0	0.0
	12:35:00	125.0	0.0	0.0
	12:35:30	125.5	0.0	0.0
	12:36:00	126.0	0.0	0.0
	12:36:30	126.5	0.0	0.0
	12:37:00	127.0	0.0	0.0
	12:37:30	127.5	0.0	0.0
	12:38:00	128.0	0.0	0.0
	12:38:30	128.5	0.0	0.0
	12:39:00	129.0	0.0	0.0
	12:39:30	129.5	0.0	0.0
	12:40:00	130.0	0.0	0.0
	12:40:30	130.5	0.0	0.0
	12:41:00	131.0	0.0	0.0
	12:41:30	131.5	0.0	0.0
	12:42:00	132.0	0.0	0.0
	12:42:30	132.5	0.0	0.0
	12:43:00	133.0	0.0	0.0
	12:43:30	133.5	0.0	0.0
	12:44:00	134.0	0.0	0.0
	12:44:30	134.5	0.0	0.0

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	12:45:00	135.0	0.0	0.0
	12:45:30	135.5	0.0	0.0
	12:46:00	136.0	0.0	0.0
	12:46:30	136.5	0.0	0.0
	12:47:00	137.0	0.0	0.0
	12:47:30	137.5	0.0	0.0
	12:48:00	138.0	0.0	0.0
	12:48:30	138.5	0.0	0.0
	12:49:00	139.0	0.0	0.0
	12:49:30	139.5	0.0	0.0
	12:50:00	140.0	0.0	0.0
	12:50:30	140.5	0.0	0.0
	12:51:00	141.0	0.0	0.0
	12:51:30	141.5	0.0	0.0
	12:52:00	142.0	0.0	0.0
	12:52:30	142.5	0.0	0.0
	12:53:00	143.0	0.0	0.0
	12:53:30	143.5	0.0	0.0
	12:54:00	144.0	0.0	0.0
	12:54:30	144.5	0.0	0.0
	12:55:00	145.0	0.0	0.0
	12:55:30	145.5	0.0	0.0
	12:56:00	146.0	0.0	0.0
	12:56:30	146.5	0.0	0.0
	12:57:00	147.0	0.0	0.0
	12:57:30	147.5	0.0	0.0
	12:58:00	148.0	0.0	0.0
	12:58:30	148.5	0.0	0.0
	12:59:00	149.0	0.0	0.0
	12:59:30	149.5	0.0	0.0
			Remote control boat # 1	Remote control boat # 2
Background 2	13:00:00	-66.0	0.0	0.0
	13:00:30	-65.5	0.0	0.0
	13:01:00	-65.0	0.0	0.0
	13:01:30	-64.5	0.0	0.0
	13:02:00	-64.0	0.0	0.0
	13:02:30	-63.5	0.0	0.0
	13:03:00	-63.0	0.0	0.0
	13:03:30	-62.5	0.0	0.0
	13:04:00	-62.0	0.0	0.0
	13:04:30	-61.5	0.0	0.0
	13:05:00	-61.0	0.0	0.0
	13:05:30	-60.5	0.0	0.0
	13:06:00	-60.0	0.0	0.0
	13:06:30	-59.5	0.0	0.0
	13:07:00	-59.0	0.0	0.0
	13:07:30	-58.5	0.0	0.0
	13:08:00	-58.0	0.0	0.0
	13:08:30	-57.5	0.0	0.0
	13:09:00	-57.0	0.0	0.0
	13:09:30	-56.5	0.0	0.0
	13:10:00	-56.0	0.0	0.0
	13:10:30	-55.5	0.0	0.0
	13:11:00	-55.0	0.0	0.0
	13:11:30	-54.5	0.0	0.0
	13:12:00	-54.0	0.0	0.0
	13:12:30	-53.5	0.0	0.0
	13:13:00	-53.0	0.0	0.0
	13:13:30	-52.5	0.0	0.0
	13:14:00	-52.0	0.0	0.0
	13:14:30	-51.5	0.0	0.0
	13:15:00	-51.0	0.0	0.0
	13:15:30	-50.5	0.0	0.0
	13:16:00	-50.0	0.0	0.0
	13:16:30	-49.5	0.0	0.0

NOBE 93 Table 6.7 cont. **Sulphur Dioxide Analysis at Remote Stations**
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	13:17:00	-49.0	0.0	0.0
	13:17:30	-48.5	0.0	0.0
	13:18:00	-48.0	0.0	0.0
	13:18:30	-47.5	0.0	0.0
	13:19:00	-47.0	0.0	0.0
	13:19:30	-46.5	0.0	0.0
	13:20:00	-46.0	0.0	0.0
	13:20:30	-45.5	0.0	0.0
	13:21:00	-45.0	0.0	0.0
	13:21:30	-44.5	0.0	0.0
	13:22:00	-44.0	0.0	0.0
	13:22:30	-43.5	0.0	0.0
	13:23:00	-43.0	0.0	0.0
	13:23:30	-42.5	0.0	0.0
	13:24:00	-42.0	0.0	0.0
	13:24:30	-41.5	0.0	0.0
	13:25:00	-41.0	0.0	0.4
	13:25:30	-40.5	0.0	0.0
	13:26:00	-40.0	0.0	0.0
	13:26:30	-39.5	0.0	0.0
	13:27:00	-39.0	0.0	0.1
	13:27:30	-38.5	0.0	0.0
	13:28:00	-38.0	0.0	0.0
	13:28:30	-37.5	0.0	0.0
	13:29:00	-37.0	0.0	0.0
	13:29:30	-36.5	0.0	0.1
	13:30:00	-36.0	0.0	0.0
	13:30:30	-35.5		0.0
	13:31:00	-35.0		0.0
	13:31:30	-34.5		0.0
	13:32:00	-34.0		0.0
	13:32:30	-33.5		0.0
	13:33:00	-33.0		0.0
	13:33:30	-32.5		0.0
	13:34:00	-32.0		0.0
	13:34:30	-31.5		0.0
	13:35:00	-31.0		0.0
	13:35:30	-30.5		0.0
	13:36:00	-30.0		0.0
	13:36:30	-29.5		0.0
	13:37:00	-29.0		0.0
	13:37:30	-28.5		0.0
	13:38:00	-28.0		0.0
	13:38:30	-27.5		0.0
	13:39:00	-27.0		0.0
	13:39:30	-26.5		0.0
	13:40:00	-26.0		0.0
	13:40:30	-25.5		0.0
	13:41:00	-25.0		0.0
	13:41:30	-24.5		0.0
	13:42:00	-24.0		0.0
	13:42:30	-23.5		0.0
	13:43:00	-23.0		0.0
	13:43:30	-22.5		0.0
	13:44:00	-22.0		0.0
	13:44:30	-21.5		0.0
	13:45:00	-21.0		0.0
	13:45:30	-20.5		0.0
	13:46:00	-20.0		0.0
	13:46:30	-19.5		0.0
	13:47:00	-19.0		0.0
	13:47:30	-18.5		0.1
	13:48:00	-18.0		0.4
	13:48:30	-17.5		0.3
	13:49:00	-17.0		0.5
	13:49:30	-16.5		0.6
	13:50:00	-16.0		0.7

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	13:50:30	-15.5		0.5
	13:51:00	-15.0		0.2
	13:51:30	-14.5		0.0
Pre-ignition 2	13:52:00	-14.0		0.1
	13:52:30	-13.5		0.3
	13:53:00	-13.0		0.2
	13:53:30	-12.5		0.3
	13:54:00	-12.0		0.3
	13:54:30	-11.5		0.1
	13:55:00	-11.0		0.2
	13:55:30	-10.5		0.5
	13:56:00	-10.0		0.6
	13:56:30	-9.5		0.5
	13:57:00	-9.0		0.6
	13:57:30	-8.5		0.6
	13:58:00	-8.0		0.5
	13:58:30	-7.5		0.5
	13:59:00	-7.0		0.5
	13:59:30	-6.5		0.5
	14:00:00	-6.0		0.5
	14:00:30	-5.5		0.5
	14:01:00	-5.0		0.7
	14:01:30	-4.5		0.4
	14:02:00	-4.0		0.4
	14:02:30	-3.5		0.4
	14:03:00	-3.0		0.5
	14:03:30	-2.5		0.3
	14:04:00	-2.0		0.4
	14:04:30	-1.5		0.4
	14:05:00	-1.0		0.3
	14:05:30	-0.5		0.2
Burn 2	14:06:00	0.0		0.1
	14:06:30	0.5		0.3
	14:07:00	1.0		0.4
	14:07:30	1.5		0.3
	14:08:00	2.0		0.2
	14:08:30	2.5		0.3
	14:09:00	3.0		0.2
	14:09:30	3.5		0.3
	14:10:00	4.0		0.3
	14:10:30	4.5		0.6
	14:11:00	5.0		0.4
	14:11:30	5.5		0.2
	14:12:00	6.0		0.1
	14:12:30	6.5		0.1
	14:13:00	7.0		0.1
	14:13:30	7.5		0.2
	14:14:00	8.0		0.2
	14:14:30	8.5		0.3
	14:15:00	9.0		0.3
	14:15:30	9.5		0 2
	14:16:00	10.0		0.4
	14 16 30	10.5		0.3
	14 17 00	11 0		0.3
	14 17 30	11 5		0.2
	14 18 00	12 0		0 3
	14 18 30	12 5		0 1
	14 19 00	13 0		0 2
	14 19 30	13 5		0 2
	14 20 00	14 0		0 2
	14 20 30	14 5		0 3
	14 21 00	15 0		0 3
	14 21 30	15 5		0 2
	14 22 00	16 0		0 2
	14:22:30	16.5		0.4

NOBE 93 Table 6.7 cont.

Sulphur Dioxide Analysis at Remote Stations
Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	14:23:00	17.0		0.1
	14:23:30	17.5		0.1
	14:24:00	18.0		0.3
	14:24:30	18.5		0.2
	14:25:00	19.0		0.2
	14:25:30	19.5		0.3
	14:26:00	20.0		0.0
	14:26:30	20.5		0.0
	14:27:00	21.0		0.1
	14:27:30	21.5		0.0
	14:28:00	22.0		0.0
	14:28:30	22.5		0.1
	14:29:00	23.0		0.2
	14:29:30	23.5		0.1
	14:30:00	24.0		0.1
	14:30:30	24.5		0.1
	14:31:00	25.0		0.0
	14:31:30	25.5		0.0
	14:32:00	26.0		0.0
	14:32:30	26.5		0.0
	14:33:00	27.0		0.0
	14:33:30	27.5		0.1
	14:34:00	28.0		0.1
	14:34:30	28.5		0.1
	14:35:00	29.0		0.1
	14:35:30	29.5		0.1
	14:36:00	30.0		0.0
	14:36:30	30.5		0.0
	14:37:00	31.0		0.0
	14:37:30	31.5		0.0
	14:38:00	32.0		0.0
	14:38:30	32.5		0.0
	14:39:00	33.0		0.0
	14:39:30	33.5		0.0
	14:40:00	34.0		0.0
	14:40:30	34.5		0.0
	14:41:00	35.0		0.0
	14:41:30	35.5		0.0
	14:42:00	36.0		0.0
	14:42:30	36.5		0.1
	14:43:00	37.0		0.0
	14:43:30	37.5		0.0
	14:44:00	38.0		0.0
	14:44:30	38.5		0.0
	14:45:00	39.0		0.0
	14:45:30	39.5		0.0
	14:46:00	40.0		0.0
	14:46:30	40.5		0.0
	14:47:00	41.0		0.1
	14:47:30	41.5		0.1
	14:48:00	42.0		0.2
	14:48:30	42.5		0.1
	14:49:00	43.0		0.0
	14:49:30	43.5		0.1
	14:50:00	44.0		0.2
	14:50:30	44.5		0.1
	14:51:00	45.0		0.0
	14:51:30	45.5		0.0
	14:52:00	46.0		0.0
	14:52:30	46.5		0.0
	14:53:00	47.0		0.0
	14:53:30	47.5		0.0
	14:54:00	48.0		0.1
	14:54:30	48.5		0.1
	14:55:00	49.0		0.1
	14:55:30	49.5		0.0
	14:56:00	50.0		0.0

NOBE 93 Table 6.7 cont. **Sulphur Dioxide Analysis at Remote Stations**

Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	14:56:30	50.5		0.0
	14:57:00	51.0		0.0
	14:57:30	51.5		0.0
	14:58:00	52.0		0.0
	14:58:30	52.5		0.0
	14:59:00	53.0		0.2
	14:59:30	53.5		0.0
	15:00:00	54.0		0.0
	15:00:30	54.5		0.0
	15:01:00	55.0		0.1
	15:01:30	55.5		0.1
	15:02:00	56.0		0.1
	15:02:30	56.5		0.1
	15:03:00	57.0		0.3
	15:03:30	57.5		0.2
	15:04:00	58.0		0.0
	15:04:30	58.5		0.1
	15:05:00	59.0		0.2
	15:05:30	59.5		0.1
	15:06:00	60.0		0.1
	15:06:30	60.5		0.0
	15:07:00	61.0		0.1
	15:07:30	61.5		0.1
	15:08:00	62.0		0.0
	15:08:30	62.5		0.1
	15:09:00	63.0		0.0
	15:09:30	63.5		0.0
	15:10:00	64.0		0.0
	15:10:30	64.5		0.0
	15:11:00	65.0		0.0
	15:11:30	65.5		0.0
	15:12:00	66.0		0.0
	15:12:30	66.5		0.0
	15:13:00	67.0		0.0
	15:13:30	67.5		0.0
	15:14:00	68.0		0.0
	15:14:30	68.5		0.0
	15:15:00	69.0		0.0
	15:15:30	69.5		0.0
	15:16:00	70.0		0.0
	15:16:30	70.5		0.0
	15:17:00	71.0		0.0
	15:17:30	71.5		0.0
	15:18:00	72.0		0.0
	15:18:30	72.5		0.0
	15:19:00	73.0		0.0
Post-burn 2	15:19:30	73.5		0.0
	15:20:00	74.0		0.0
	15:20:30	74.5		0.0
	15:21:00	75.0		0.0
	15:21:30	75.5		0.0
	15:22:00	76.0		0.0
	15:22:30	76.5		0.0
	15 23:00	77.0		0.0
	15 23:30	77.5		0.0
	15 24 00	78 0		0 0
	15 24 30	78 5		0.0
	15 25 00	79 0		0 0
	15 25 30	79 5		0 0
	15 26 00	80 0		0 0
	15 26 30	80 5		0 0
	15 27 00	81 0		0 0
	15 27 30	81 5		0 0
	15 28 00	82 0		0 0
	15 28 30	82 5		0.0
	15.29:00	83.0		0.0

NOBE 93 Table 6.7 cont. **Sulphur Dioxide Analysis at Remote Stations**

Exotox

Time Periods	Clock hh:mm:ss	Time Elapsed min	Remote Station # 1 50 to 100 m from fire ppm	Remote Station # 2 100 to 150 m from fire ppm
	15:29:30	83.5		0.0
	15:30:00	84.0		0.0
	15:30:30	84.5		0.0
	15:31:00	85.0		0.0
	15:31:30	85.5		0.0
	15:32:00	86.0		0.0
	15:32:30	86.5		0.0
	15:33:00	87.0		0.0
	15:33:30	87.5		0.0
	15:34:00	88.0		0.0
	15:34:30	88.5		0.0
	15:35:00	89.0		0.0
	15:35:30	89.5		0.0
	15:36:00	90.0		0.0
	15:36:30	90.5		0.0
	15:37:00	91.0		0.0
	15:37:30	91.5		0.0
	15:38:00	92.0		0.0
	15:38:30	92.5		0.0
	15:39:00	93.0		0.0
	15:39:30	93.5		0.0
	15:40:00	94.0		0.0
	15:40:30	94.5		0.0
	15:41:00	95.0		0.0
	15:41:30	95.5		0.0
	15:42:00	96.0		0.0
	15:42:30	96.5		0.0
	15:43:00	97.0		0.0
	15:43:30	97.5		0.0
	15:44:00	98.0		0.0
	15:44:30	98.5		0.0
	15:45:00	99.0		0.0
	15:45:30	99.5		0.0
	15:46:00	100.0		0.0

Section 7

Total Particulates
NOBE 93

Total Particulates
NOBE 93

Real Time Aerosol Monitor (RAM)

The RAM-1 is a portable, self-contained aerosol monitor whose sensing principle is based on the detection of near-forward scattered electromagnetic radiation in the near-infrared. The instrument uses a pulsed Ga As semiconductor light-emitting diode which generates a narrow-band emission centred on 940 nm. The scattered radiation is detected by means of a silicon photo-voltaic-type diode with integral low noise preamplifier.

Instrumentation

- The monitoring was done when oil was off-loaded and at combustion time.
- The pumps were operated at a flow rate of 2 L/min.
- The instrument responds to a physical particle size of 0.1 to 10 micrometers.
- Tygon tubing was connected from the instrument to the mast to allow sampling at 1.25 m above sea level.
- The instrument was connected to a data logger (CR-10) which recorded the data every minute.
- The instrument calculated the average, minimum and maximum of each reading logged.

Location

- Downwind Station, CCG 206 - during Burn 1: approximately 900 m downwind from the fireboom apex, and during Burn 2: approximately 500 to 600 m from the fire.

NOBE 93 Table 7 1

Total Particulates Analysis at Downwind Station (CCG 206)

RAM

Time Periods		Minimum recorded by RAM Instrument 1 mg/m³	Minimum recorded by RAM Instrument 2 mg/m³	Minimum recorded by RAM AVE mg/m³	Average recorded by RAM Instrument 1 mg/m³	Average recorded by RAM Instrument 2 mg/m³	Average recorded by RAM AVE mg/m³	Maximum recorded by RAM Instrument 1 mg/m³	Maximum recorded by RAM Instrument 2 mg/m³	Maximum recorded by RAM AVE mg/m³
Background, August 07, 93	Minimum	0.00	0.04	0.02	0.02	0.04	0.03	0.00	0.06	0.03
	Average	0.10	0.09	0.10	0.12	0.10	0.11	0.15	0.14	0.15
	Maximum	0.16	0.13	0.15	0.19	0.15	0.17	0.23	0.21	0.22
		CCG 206 - 900 m from fire								
Background 1	Minimum	0.02		0.02	0.02		0.02	0.02		0.02
	Average	0.02		0.02	0.02		0.02	0.03		0.03
	Maximum	0.05		0.05	0.04		0.04	0.09		0.09
Pre-ignition 1	Minimum	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.04	0.02
	Average	0.02	0.03	0.03	0.05	0.04	0.05	0.03	0.05	0.04
	Maximum	0.04	0.05	0.04	0.69	0.42	0.69	0.47	0.06	0.26
Burn 1	Minimum	0.01	0.01	0.02	0.02	0.01	0.02	0.02	0.04	0.03
	Average	0.03	0.05	0.04	0.03	0.05	0.04	0.05	0.07	0.07
	Maximum	0.05	0.09	0.09	0.06	0.09	0.07	0.99	0.11	0.99
		CCG 206 - 500 to 600 m from fire								
Background 2	Minimum		0.02	0.02		0.02	0.02		0.03	0.03
	Average		0.02	0.02		0.03	0.03		0.04	0.04
	Maximum		0.04	0.04		0.09	0.09		0.07	0.07
Pre-ignition 2	Minimum		0.02	0.02		0.02	0.02		0.04	0.04
	Average		0.03	0.03		0.03	0.03		0.05	0.05
	Maximum		0.05	0.05		0.07	0.07		0.06	0.06
Burn 2	Minimum		0.02	0.02		0.02	0.02		0.03	0.03
	Average		0.04	0.04		0.05	0.05		0.07	0.07
	Maximum		0.09	0.09		0.09	0.09		0.13	0.13
Post-burn 2	Minimum		0.02	0.02		0.02	0.02		0.04	0.04
	Average		0.03	0.03		0.04	0.04		0.06	0.06
	Maximum		0.06	0.06		0.07	0.07		0.10	0.10

NOBE 93 Table 7.2

Total Particulates Analysis at Downwind Station (CCG 206)

RAM, Background: August 07, 1993

Instrument 1			
Clock hh mm:ss	Minimum mg/m^3	Average mg/m^3	Maximum mg/m^3
12 30 35	0.018	0.024	0.100
12 30 50	0.062	0.118	0.218
12 31 05	0.058	0.060	0.062
12 31 20	0.062	0.072	0.092
12 31 35	0.070	0.080	0.088
12 31 50	0.072	0.088	0.112
12 32 05	0.088	0.112	0.136
12 32 20	0.102	0.112	0.128
12 32 35	0.102	0.126	0.172
12 32 50	0.112	0.120	0.130
12 33 05	0.120	0.178	0.214
12 33 20	0.114	0.130	0.160
12 33 35	0.100	0.108	0.126
12 33 50	0.106	0.120	0.138
12 34 05	0.100	0.114	0.140
12 34 20	0.104	0.116	0.130
12 34 35	0.098	0.106	0.114
12 34 50	0.000	0.118	0.000
12 35 05	0.076	0.112	0.196
12 35 20	0.090	0.116	0.152
12 35 35	0.108	0.120	0.134
12 35 50	0.116	0.134	0.152
12 36 05	0.116	0.134	0.160
12 36 20	0.106	0.126	0.152
12 36 35	0.116	0.130	0.156
12 36 50	0.126	0.138	0.158
12 37 05	0.128	0.138	0.156
12 37 20	0.128	0.154	0.192
12 37 35	0.118	0.126	0.152
12 37 50	0.160	0.190	0.226
12 38 05	0.126	0.166	0.206
12 38 20	0.126	0.136	0.152
12 38 35	0.118	0.128	0.140
12 38 50	0.126	0.148	0.186
12 39 05	0.120	0.140	0.162
12 39 20	0.114	0.126	0.152
12 39 35	0.126	0.138	0.158

Instrument 2			
Clock hh:mm:ss	Minimum mg/m^3	Average mg/m^3	Maximum mg/m^3
12:30:51	0.040	0.040	0.060
12:31:06	0.060	0.060	0.060
12:31:21	0.060	0.060	0.080
12:31:36	0.080	0.080	0.100
12:31:51	0.080	0.100	0.130
12:32:06	0.100	0.100	0.150
12:32:21	0.100	0.100	0.150
12:32:36	0.100	0.100	0.130
12:32:51	0.080	0.130	0.190
12:33:06	0.130	0.150	0.210
12:33:21	0.080	0.080	0.190
12:33:36	0.080	0.080	0.100
12:33:51	0.080	0.080	0.130
12:34:06	0.100	0.100	0.130
12:34:21	0.100	0.100	0.130
12:34:36	0.100	0.100	0.150
12:34:51	0.080	0.100	0.190
12:35:06	0.060	0.080	0.150
12:35:21	0.060	0.060	0.080
12:35:36	0.060	0.080	0.100
12:35:51	0.080	0.080	0.150
12:36:06	0.080	0.100	0.190
12:36:21	0.080	0.080	0.130
12:36:36	0.100	0.100	0.150
12:36:51	0.080	0.100	0.130
12:37:06	0.080	0.100	0.130
12:37:21	0.100	0.100	0.130
12:37:36	0.080	0.100	0.150
12:37:51	0.100	0.130	0.170
12:38:06	0.130	0.150	0.210
12:38:21	0.100	0.100	0.150
12:38:36	0.100	0.100	0.130
12:38:51	0.100	0.130	0.150
12:39:06	0.100	0.100	0.150
12:39:21	0.100	0.100	0.170
12:39:36	0.100	0.100	0.130

NOBE 93 Table 7.3

Total Particulates Analysis at Downwind Station (CCG 206)

RAM

Time Periods	Clock	Elapsed Time	Minimum Instrument 1	Minimum Instrument 2	Minimum AVE	Average Instrument 1	Average Instrument 2	Average AVE	Maximum Instrument 1	Maximum Instrument 2	Maximum AVE
	hh:mm	min	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
Background 1	8:28	-122	0.024		0.024	0.040		0.040	0.090		0.090
	8:29	-121	0.023		0.023	0.023		0.023	0.025		0.025
	8:30	-120	0.022		0.022	0.022		0.022	0.025		0.025
	8:31	-119	0.022		0.022	0.023		0.023	0.025		0.025
	8:32	-118	0.026		0.026	0.026		0.026	0.028		0.028
	8:33	-117	0.022		0.022	0.023		0.023	0.026		0.026
	8:34	-116	0.022		0.022	0.022		0.022	0.024		0.024
	8:35	-115	0.022		0.022	0.023		0.023	0.025		0.025
	8:36	-114	0.022		0.022	0.022		0.022	0.024		0.024
	8:37	-113	0.021		0.021	0.021		0.021	0.024		0.024
	8:38	-112	0.025		0.025	0.025		0.025	0.027		0.027
	8:39	-111	0.023		0.023	0.025		0.025	0.028		0.028
	8:40	-110	0.022		0.022	0.023		0.023	0.027		0.027
	8:41	-109	0.022		0.022	0.022		0.022	0.025		0.025
	8:42	-108	0.022		0.022	0.022		0.022	0.024		0.024
	8:43	-107	0.022		0.022	0.022		0.022	0.024		0.024
	8:44	-106	0.022		0.022	0.022		0.022	0.024		0.024
	8:45	-105	0.022		0.022	0.022		0.022	0.025		0.025
	8:46	-104	0.022		0.022	0.023		0.023	0.026		0.026
	8:47	-103	0.022		0.022	0.023		0.023	0.026		0.026
	8:48	-102	0.022		0.022	0.022		0.022	0.024		0.024
	8:49	-101	0.022		0.022	0.022		0.022	0.025		0.025
	8:50	-100	0.051		0.051						
	8:51	-99	0.032		0.032						
	8:52	-98	0.028		0.028	0.030		0.030	0.037		0.037
	8:53	-97	0.025		0.025	0.027		0.027	0.031		0.031
	8:54	-96	0.029		0.029	0.031		0.031	0.035		0.035
	8:55	-95	0.026		0.026	0.027		0.027	0.031		0.031
	8:56	-94	0.022		0.022	0.023		0.023	0.025		0.025
	8:57	-93	0.022		0.022	0.022		0.022	0.024		0.024
	8:58	-92	0.024		0.024	0.025		0.025	0.028		0.028
	8:59	-91	0.024		0.024	0.025		0.025	0.027		0.027
	9:00	-90	0.022		0.022	0.022		0.022	0.025		0.025
	9:01	-89	0.026		0.026	0.028		0.028	0.031		0.031
	9:02	-88	0.023		0.023	0.024		0.024	0.028		0.028
	9:03	-87	0.022		0.022	0.023		0.023	0.025		0.025
	9:04	-86	0.022		0.022	0.023		0.023	0.025		0.025
	9:05	-85	0.023		0.023	0.023		0.023	0.027		0.027
	9:06	-84	0.024		0.024	0.025		0.025	0.029		0.029
	9:07	-83	0.025		0.025	0.027		0.027	0.030		0.030
	9:08	-82	0.026		0.026	0.027		0.027	0.031		0.031
	9:09	-81	0.024		0.024	0.025		0.025	0.029		0.029
	9:10	-80	0.022		0.022	0.023		0.023	0.025		0.025
	9:11	-79	0.022		0.022	0.022		0.022	0.025		0.025
	9:12	-78	0.022		0.022	0.022		0.022	0.024		0.024
	9:13	-77	0.025		0.025	0.026		0.026	0.029		0.029
	9:14	-76	0.026		0.026	0.027		0.027	0.029		0.029
	9:15	-75	0.025		0.025	0.027		0.027	0.029		0.029
	9:16	-74	0.026		0.026	0.026		0.026	0.029		0.029
	9:17	-73	0.025		0.025						
	9:18	-72	0.023		0.023	0.023		0.023	0.026		0.026
	9:19	-71	0.023		0.023	0.023		0.023	0.026		0.026
	9:20	-70	0.022		0.022	0.023		0.023	0.026		0.026
	9:21	-69	0.022		0.022	0.022		0.022	0.024		0.024
	9:22	-68	0.023		0.023	0.024		0.024	0.028		0.028
	9:23	-67	0.024		0.024	0.026		0.026	0.028		0.028
	9:24	-66	0.025		0.025	0.027		0.027	0.030		0.030
	9:25	-65	0.023		0.023	0.024		0.024	0.026		0.026
	9:26	-64	0.023		0.023	0.024		0.024	0.027		0.027
	9:27	-63	0.022		0.022	0.023		0.023	0.025		0.025
	9:28	-62	0.022		0.022	0.023		0.023	0.026		0.026
	9:29	-61	0.022		0.022	0.023		0.023	0.025		0.025
Pre-ignition 1	9:30	-60	0.022		0.02	0.023		0.02	0.026		0.03
	9:31	-59	0.023	0.040	0.03	0.024	0.040	0.03	0.026	0.055	0.04
	9:32	-58	0.024	0.045	0.03	0.045		0.05			N/A
	9:33	-57	0.036	0.035	0.04	0.086	0.040	0.06		0.060	0.06
	9:34	-56	0.028	0.035	0.03			N/A			N/A
	9:35	-55	0.025	0.035	0.03	0.026	0.035	0.03	0.030	0.050	0.04

NOBE 93 Table 7.3 cont.

Total Particulates Analysis at Downwind Station (CCG 206)

RAM

Time Periods	Clock	Elapsed Time	Minimum			Average			Maximum		
			Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE
	hh:mm	min	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
	9:36	-54	0.021	0.035	0.03	0.022	0.040	0.03	0.024	0.055	0.04
	9:37	-53	0.026	0.040	0.03	0.028	0.040	0.03	0.033	0.060	0.05
	9:38	-52	0.023	0.035	0.03	0.024	0.035	0.03	0.027	0.055	0.04
	9:39	-51	0.022	0.025	0.02	0.022	0.025	0.02	0.024	0.055	0.04
	9:40	-50	0.022	0.025	0.02	0.022	0.025	0.02	0.024	0.040	0.03
	9:41	-49	0.021	0.025	0.02	0.021	0.040	0.03	0.024	0.060	0.04
	9:42	-48	0.023	0.035	0.03	0.023	0.040	0.03	0.025	0.055	0.04
	9:43	-47	0.021	0.030	0.03	0.022	0.035	0.03	0.024	0.045	0.03
	9:44	-46	0.021	0.030	0.03	0.021	0.030	0.03	0.023	0.045	0.03
	9:45	-45	0.022	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
	9:46	-44	0.020	0.030	0.03	0.020	0.035	0.03	0.022	0.055	0.04
	9:47	-43	0.021	0.030	0.03	0.022	0.030	0.03	0.024	0.045	0.03
	9:48	-42	0.022	0.025	0.02	0.022	0.030	0.03	0.024	0.050	0.04
	9:49	-41	0.021	0.025	0.02	0.021	0.030	0.03	0.024	0.050	0.04
	9:50	-40	0.022	0.030	0.03	0.022	0.030	0.03	0.025	0.040	0.03
	9:51	-39	0.022	0.020	0.02	0.022	0.020	0.02	0.023	0.040	0.03
	9:52	-38	0.021	0.025	0.02	0.022	0.025	0.02	0.024	0.045	0.03
	9:53	-37	0.022	0.035	0.03	0.022	0.035	0.03	0.026	0.050	0.04
	9:54	-36	0.039	0.030	0.03						
	9:55	-35	0.029	0.030	0.03	0.039	0.035	0.04		0.055	0.06
	9:56	-34	0.027	0.030	0.03	0.028	0.030	0.03	0.031	0.045	0.04
	9:57	-33	0.024	0.025	0.02	0.025	0.030	0.03	0.028	0.045	0.04
	9:58	-32	0.023	0.020	0.02	0.023	0.020	0.02	0.025	0.040	0.03
	9:59	-31	0.022	0.030	0.03	0.022	0.030	0.03	0.025	0.045	0.03
	10:00	-30	0.025	0.030	0.03	0.026	0.030	0.03	0.028	0.045	0.04
	10:01	-29	0.023	0.020	0.02	0.024	0.020	0.02	0.026	0.040	0.03
	10:02	-28	0.022	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
	10:03	-27	0.022	0.020	0.02	0.023	0.420	0.22	0.024		0.02
	10:04	-26	0.029	0.035	0.03	0.694		0.69			N/A
	10:05	-25	0.027	0.030	0.03	0.028	0.030	0.03	0.030	0.040	0.03
	10:06	-24	0.023	0.025	0.02	0.025	0.030	0.03	0.028	0.050	0.04
	10:07	-23	0.022	0.020	0.02	0.023	0.025	0.02	0.026	0.045	0.04
	10:08	-22	0.025	0.025	0.02	0.027	0.035	0.03	0.030	0.050	0.04
	10:09	-21	0.028	0.035	0.03	0.028		0.03	0.032		0.03
	10:10	-20	0.031	0.030	0.03	0.664		0.66			N/A
	10:11	-19	0.028	0.030	0.03	0.092	0.030	0.06	0.468	0.045	0.26
	10:12	-18	0.023	0.020	0.02	0.023	0.020	0.02	0.027	0.040	0.03
	10:13	-17	0.023	0.020	0.02	0.024	0.020	0.02	0.026	0.040	0.03
	10:14	-16	0.022	0.025	0.02	0.022	0.025	0.02	0.025	0.040	0.03
	10:15	-15	0.022	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
	10:16	-14	0.021	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
	10:17	-13	0.023	0.025	0.02	0.025	0.025	0.02	0.028	0.040	0.03
	10:18	-12	0.022	0.025	0.02	0.022	0.030	0.03	0.025	0.045	0.03
	10:19	-11	0.025	0.025	0.02	0.026	0.030	0.03	0.030	0.050	0.04
	10:20	-10	0.022	0.020	0.02	0.022		0.02	0.025		0.03
	10:21	-9	0.024	0.020	0.02			N/A			N/A
	10:22	-8	0.025	0.020	0.02	0.032	0.020	0.03	0.058	0.040	0.05
	10:23	-7	0.025	0.020	0.02	0.026	0.020	0.02	0.030	0.040	0.04
	10:24	-6	0.024	0.020	0.02	0.026	0.020	0.02	0.030	0.040	0.03
	10:25	-5	0.023	0.020	0.02	0.024	0.020	0.02	0.026	0.040	0.03
	10:26	-4	0.021	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
	10:27	-3	0.022	0.020	0.02	0.022	0.020	0.02	0.025	0.040	0.03
	10:28	-2	0.020	0.020	0.02	0.020	0.020	0.02	0.023	0.040	0.03
	10:29	-1	0.022	0.020	0.02	0.022	0.020	0.02	0.024	0.040	0.03
Burn 1	10 30	0	0 022	0 010	0 02	0 022	0 010	0 02	0 025	0 035	0 03
	10 31	1	0 022	0 020	0 02	0 024	0 020	0 02	0 027	0 040	0 03
	10 32	2	0 022	0 025	0 02	0 026	0 030	0 03	0 030	0 050	0 04
	10 33	3	0 031	0 030	0 03	0 033	0 030	0 03	0 037	0 045	0 04
	10 34	4	0 024	0 020	0 02	0 026	0 020	0 02	0 029	0 040	0 03
	10 35	5	0 022	0 020	0 02	0 022	0 020	0 02	0 024	0 040	0 03
	10 36	6	0 021	0 020	0 02	0 021	0 020	0 02	0 023	0 045	0 03
	10 37	7	0 021	0 030	0 03	0 023		0 02	0 025		0 03
	10 38	8	0 022	0 025	0 02		0 025	0 03		0 045	0 05
	10 39	9	0 024	0 040	0 03			N/A			N/A
	10 40	10	0 032	0 075	0 05	0 041		0 04			N/A
	10 41	11		0 090	0 09			N/A			N/A
	10 42	12		0 035	0 04		0 040	0 04		0 060	0 06
	10 43	13	0 022	0 040	0 03	0 025	0 040	0 03	0 029	0 060	0 04
	10 44	14	0 023	0 050	0 04	0 024	0 050	0 04	0 028	0 080	0 05

NOBE 93 Table 7.3 cont. **Total Particulates Analysis at Downwind Station (CCG 206)**

RAM

Time Periods	Clock	Elapsed Time	Minimum			Average			Maximum		
			Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE
	hh:mm	min	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
	10:45	15	0.039	0.050	0.04	0.045	0.055	0.05	0.050	0.075	0.06
	10:46	16	0.030	0.050	0.04	0.033	0.050	0.04	0.036	0.075	0.06
	10:47	17	0.022	0.040	0.03	0.025	0.040	0.03	0.030	0.060	0.04
	10:48	18	0.033	0.035	0.03			N/A	0.991		0.99
	10:49	19	0.021	0.040	0.03	0.029	0.040	0.03	0.074	0.065	0.07
	10:50	20	0.043	0.065	0.05	0.051	0.070	0.06	0.062	0.100	0.08
	10:51	21	0.047	0.055	0.05	0.053	0.060	0.06	0.063	0.085	0.07
	10:52	22	0.026	0.040	0.03	0.029	0.040	0.03	0.035	0.065	0.05
	10:53	23	0.025	0.040	0.03	0.028	0.040	0.03	0.032	0.060	0.05
	10:54	24	0.025	0.045	0.03	0.028	0.055	0.04	0.031	0.080	0.06
	10:55	25	0.022	0.040	0.03	0.022	0.040	0.03	0.025	0.060	0.04
	10:56	26	0.023	0.040	0.03	0.025	0.040	0.03	0.028	0.060	0.04
	10:57	27	0.023	0.040	0.03	0.023	0.040	0.03	0.025	0.060	0.04
	10:58	28	0.024	0.040	0.03	0.024	0.040	0.03	0.026	0.060	0.04
	10:59	29	0.022	0.040	0.03	0.023	0.040	0.03	0.026	0.065	0.05
	11:00	30	0.025	0.045	0.03	0.028	0.045	0.04	0.038	0.060	0.05
	11:01	31	0.022	0.040	0.03	0.023	0.040	0.03	0.027	0.060	0.04
	11:02	32	0.023	0.050	0.04	0.025	0.050	0.04	0.028	0.075	0.05
	11:03	33	0.031	0.060	0.05	0.033	0.060	0.05	0.038	0.085	0.06
	11:04	34	0.036	0.060	0.05	0.040	0.060	0.05	0.047	0.085	0.07
	11:05	35	0.037	0.060	0.05	0.039	0.060	0.05	0.044	0.085	0.06
	11:06	36	0.032	0.060	0.05	0.033	0.060	0.05	0.036	0.080	0.06
	11:07	37	0.026	0.050	0.04	0.029	0.055	0.04	0.033	0.075	0.05
	11:08	38	0.025	0.040	0.03	0.027	0.055	0.04	0.031	0.075	0.05
	11:09	39	0.023	0.050	0.04	0.030	0.055	0.04	0.035	0.090	0.06
	11:10	40	0.029	0.050	0.04	0.034	0.050	0.04	0.041	0.080	0.06
	11:11	41	0.025	0.045	0.04	0.029	0.045	0.04	0.034	0.070	0.05
	11:12	42	0.033	0.060	0.05	0.037	0.060	0.05	0.044	0.085	0.06
	11:13	43	0.030	0.050	0.04	0.034	0.055	0.04	0.039	0.075	0.06
	11:14	44	0.027	0.055	0.04	0.030	0.055	0.04	0.034	0.075	0.05
	11:15	45	0.025	0.045	0.03	0.028	0.050	0.04	0.033	0.075	0.05
	11:16	46	0.030	0.060	0.04	0.036	0.060	0.05	0.046	0.085	0.07
	11:17	47	0.023	0.050	0.04	0.027	0.060	0.04	0.033	0.080	0.06
	11:18	48	0.031	0.060	0.05	0.036	0.065	0.05	0.041	0.085	0.06
	11:19	49	0.032	0.060	0.05	0.034	0.065	0.05	0.039	0.090	0.06
	11:20	50	0.033	0.065	0.05	0.055	0.085	0.07	0.082	0.113	0.10
	11:21	51	0.030	0.060	0.04	0.041	0.070	0.06	0.057	0.090	0.07
	11:22	52	0.020	0.040	0.03	0.025	0.040	0.03	0.030	0.065	0.05
	11:23	53	0.014	0.040	0.03	0.016	0.040	0.03	0.021	0.060	0.04
	11:24	54	0.016	0.040	0.03	0.017	0.050	0.03	0.022	0.080	0.05
	11:25	55	0.024	0.060	0.04	0.028	0.075	0.05	0.036	0.095	0.07
	11:26	56	0.035	0.060	0.05	0.043	0.060	0.05	0.051	0.080	0.07
Background 2	13:29	-37									
	13:30	-36		0.020	0.020		0.020	0.020		0.040	0.040
	13:31	-35		0.020	0.020		0.020	0.020		0.040	0.040
	13:32	-34		0.020	0.020		0.020	0.020		0.040	0.040
	13:33	-33		0.020	0.020		0.020	0.020		0.030	0.030
	13:34	-32		0.020	0.020		0.020	0.020		0.030	0.030
	13:35	-31		0.020	0.020		0.020	0.020		0.030	0.030
	13:36	-30		0.020	0.020		0.020	0.020		0.040	0.040
	13:37	-29		0.020	0.020		0.093	0.093			
	13:38	-28		0.020	0.020		0.020	0.020		0.040	0.040
	13:39	-27		0.020	0.020		0.020	0.020		0.040	0.040
	13:40	-26		0.020	0.020		0.020	0.020		0.040	0.040
	13:41	-25		0.020	0.020		0.020	0.020		0.035	0.035
	13:42	-24		0.020	0.020		0.020	0.020		0.040	0.040
	13:43	-23		0.020	0.020		0.020	0.020		0.040	0.040
	13:44	-22		0.020	0.020		0.020	0.020		0.040	0.040
	13:45	-21		0.020	0.020		0.020	0.020		0.040	0.040
	13:46	-20		0.020	0.020		0.020	0.020		0.040	0.040
	13:47	-19		0.020	0.020		0.020	0.020		0.040	0.040
	13:48	-18		0.020	0.020		0.053	0.053			
	13:49	-17		0.025	0.025		0.035	0.035		0.060	0.060
	13:50	-16		0.035	0.035		0.040	0.040		0.055	0.055
	13:51	-15		0.040	0.040		0.050	0.050		0.070	0.070
Pre-ignition 2	13:52	-14		0.045	0.045		0.045	0.045		0.060	0.060
	13:53	-13		0.030	0.030		0.035	0.035		0.055	0.055
	13:54	-12		0.035	0.035		0.035	0.035		0.055	0.055

NOBE 93 Table 7.3 cont. **Total Particulates Analysis at Downwind Station (CCG 206)**

RAM

Time Periods	Clock	Elapsed Time	Minimum Instrument 1	Minimum Instrument 2	Minimum AVE	Average Instrument 1	Average Instrument 2	Average AVE	Maximum Instrument 1	Maximum Instrument 2	Maximum AVE
	hh:mm	min	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
	13:55	-11		0.020	0.020		0.020	0.020		0.040	0.040
	13:56	-10		0.030	0.030		0.040	0.040		0.060	0.060
	13:57	-9		0.035	0.035		0.050	0.050			
	13:58	-8		0.020	0.020		0.068	0.068			
	13:59	-7		0.020	0.020		0.020	0.020		0.040	0.040
	14:00	-6		0.020	0.020		0.020	0.020		0.040	0.040
	14:01	-5		0.020	0.020		0.020	0.020		0.040	0.040
	14:02	-4		0.020	0.020		0.020	0.020		0.040	0.040
	14:03	-3		0.020	0.020		0.020	0.020		0.040	0.040
	14:04	-2		0.020	0.020		0.020	0.020		0.040	0.040
	14:05	-1		0.020	0.020		0.020	0.020		0.040	0.040
Burn 2	14:06	0		0.020	0.020		0.020	0.020		0.035	0.035
	14:07	1		0.015	0.015		0.015	0.015		0.025	0.025
	14:08	2		0.020	0.020		0.020	0.020		0.035	0.035
	14:09	3		0.020	0.020		0.020	0.020		0.035	0.035
	14:10	4		0.020	0.020		0.020	0.020		0.040	0.040
	14:11	5		0.025	0.025		0.030	0.030		0.050	0.050
	14:12	6		0.020	0.020		0.020	0.020		0.040	0.040
	14:13	7		0.025	0.025		0.025	0.025		0.040	0.040
	14:14	8		0.030	0.030		0.030	0.030		0.040	0.040
	14:15	9		0.020	0.020		0.020	0.020		0.045	0.045
	14:16	10		0.025	0.025		0.025	0.025		0.045	0.045
	14:17	11		0.020	0.020		0.020	0.020		0.040	0.040
	14:18	12		0.025	0.025		0.030	0.030		0.050	0.050
	14:19	13		0.035	0.035		0.040	0.040		0.060	0.060
	14:20	14		0.035	0.035		0.040	0.040		0.055	0.055
	14:21	15		0.030	0.030		0.045	0.045		0.060	0.060
	14:22	16		0.030	0.030		0.030	0.030		0.060	0.060
	14:23	17		0.035	0.035		0.045	0.045		0.065	0.065
	14:24	18		0.040	0.040		0.040	0.040		0.065	0.065
	14:25	19		0.065	0.065		0.065	0.065		0.090	0.090
	14:26	20		0.065	0.065		0.065	0.065		0.085	0.085
	14:27	21		0.050	0.050		0.050	0.050		0.070	0.070
	14:28	22		0.040	0.040		0.045	0.045		0.075	0.075
	14:29	23		0.035	0.035		0.040	0.040		0.060	0.060
	14:30	24		0.035	0.035		0.040	0.040		0.060	0.060
	14:31	25		0.035	0.035		0.040	0.040		0.060	0.060
	14:32	26		0.055	0.055		0.060	0.060		0.090	0.090
	14:33	27		0.040	0.040		0.040	0.040		0.060	0.060
	14:34	28		0.045	0.045		0.045	0.045		0.065	0.065
	14:35	29		0.055	0.055		0.075	0.075		0.123	0.123
	14:36	30		0.045	0.045						
	14:37	31		0.030	0.030		0.040	0.040		0.055	0.055
	14:38	32		0.050	0.050		0.050	0.050		0.070	0.070
	14:39	33		0.050	0.050		0.055	0.055		0.075	0.075
	14:40	34		0.040	0.040		0.040	0.040		0.065	0.065
	14:41	35		0.045	0.045		0.055	0.055		0.080	0.080
	14:42	36		0.060	0.060		0.065	0.065		0.085	0.085
	14:43	37		0.055	0.055		0.065	0.065		0.090	0.090
	14:44	38		0.090	0.090		0.090	0.090		0.115	0.115
	14:45	39		0.070	0.070		0.080	0.080		0.100	0.100
	14:46	40		0.060	0.060		0.060	0.060		0.080	0.080
	14:47	41		0.055	0.055		0.055	0.055		0.080	0.080
	14:48	42		0.050	0.050						
	14:49	43		0.060	0.060		0.070	0.070		0.090	0.090
	14:50	44		0.040	0.040		0.050	0.050		0.075	0.075
	14:51	45									
	14:52	46		0.075	0.075		0.080	0.080		0.100	0.100
	14:53	47		0.035	0.035		0.035	0.035		0.050	0.050
	14:54	48		0.030	0.030		0.040	0.040		0.060	0.060
	14:55	49		0.040	0.040		0.045	0.045		0.070	0.070
	14:56	50		0.040	0.040		0.088	0.088			
	14:57	51		0.020	0.020		0.025	0.025		0.045	0.045
	14:58	52		0.040	0.040		0.050	0.050		0.080	0.080
	14:59	53		0.040	0.040		0.040	0.040		0.065	0.065
	15:00	54		0.040	0.040		0.050	0.050		0.070	0.070
	15:01	55		0.045	0.045						
	15:02	56		0.050	0.050		0.055	0.055		0.075	0.075
	15:03	57		0.070	0.070		0.080	0.080		0.108	0.108

NOBE 93 Table 7.3 cont. **Total Particulates Analysis at Downwind Station (CCG 206)**

RAM

			Minimum			Average			Maximum		
	Clock	Elapsed Time	Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE	Instrument 1	Instrument 2	AVE
Time Periods	hh:mm	min	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³	mg/m³
	15:04	58		0.075	0.075		0.090	0.090		0.115	0.115
	15:05	59		0.070	0.070		0.085	0.085		0.125	0.125
	15:06	60		0.060	0.060		0.070	0.070		0.108	0.108
	15:07	61		0.040	0.040		0.040	0.040		0.060	0.060
	15:08	62		0.030	0.030		0.030	0.030		0.050	0.050
	15:09	63		0.030	0.030		0.030	0.030		0.040	0.040
	15:10	64		0.025	0.025		0.030	0.030		0.050	0.050
	15:11	65		0.035	0.035		0.035	0.035		0.050	0.050
	15:12	66		0.040	0.040		0.040	0.040		0.055	0.055
	15:13	67		0.035	0.035		0.035	0.035		0.050	0.050
	15:14	68		0.045	0.045		0.045	0.045		0.065	0.065
	15:15	69		0.035	0.035		0.035	0.035		0.055	0.055
	15:16	70		0.030	0.030		0.040	0.040		0.065	0.065
	15:17	71		0.030	0.030		0.040	0.040		0.070	0.070
	15:18	72		0.045	0.045						
	15:19	73									
Post-burn 2	15:20	74									
	15:21	75		0.055	0.055						
	15:22	76		0.040	0.040		0.050	0.050		0.070	0.070
	15:23	77		0.045	0.045		0.045	0.045		0.075	0.075
	15:24	78		0.040	0.040		0.040	0.040		0.065	0.065
	15:25	79		0.035	0.035		0.035	0.035		0.055	0.055
	15:26	80		0.055	0.055		0.070	0.070		0.095	0.095
	15:27	81		0.030	0.030		0.035	0.035		0.055	0.055
	15:28	82		0.025	0.025		0.025	0.025		0.040	0.040
	15:29	83		0.020	0.020		0.020	0.020		0.040	0.040
	15:30	84		0.020	0.020		0.020	0.020		0.040	0.040
	15:31	85		0.025	0.025		0.025	0.025		0.040	0.040
	15:32	86		0.020	0.020						

N/A not available

Section 8

Total Petroleum Hydrocarbons (TPHs)
NOBE 93

Total Petroleum Hydrocarbons (TPH)
NOBE 93

Water Samples

A Sigma Streamline 800SL Portable Sampler was used to collect water samples for both toxicity and organic compounds analysis. These samplers are designed to automatically collect and preserve samples from a liquid source.

Instrumentation

- From the samplers, Teflon tubing was attached to a pole which was lowered into the water collecting the samples at approximately 1 m.
- The flow rate of the samplers was set at 2 L/min.
- One of the samplers was set up with 24 bottles (350 mL) collecting water samples for analysis of organic compounds. This sampler was set up to work on sets of six bottles at a time. A first set was set up to collect the samples during off-loading, two other sets were programmed to collect their samples 15 minutes and 30 minutes after the beginning of the burn, and the last set was to collect its water sample after the burn had ended.
- The second sampler was set up with 4 bottles (3.8 L each) and collected water samples to be analysed for toxicity. This sampler was modified to accommodate this sample volume and programmed to work with one bottle at a time. The collection time table was the same as described above for the 350 mL sample bottles.
- The samplers were cleaned with hexane between burns.
- All samples collected were placed in refrigerated coolers and shipped to testing facilities within 24 hours of collection.

Location

Two samplers were located at each of the following positions.

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom with the intake at approximately 1 m below sea level.

Sample Description

The description of the sampling times and codes can be found in Table 8.1.

Oil and Residue Sampling

An Alberta Sweet Mix Crude Oil was used for this burn experiment. The description of time and position for samples of oil and residue can be found in Table 8.2.

NOBE 93 Table 8 1

Water Samples Collection Time Table

Pre-ignition 1 (10:15 am)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 4		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B4-PI1	679	BR1-B2-PI1	880
BR1-B4-PI2	679	BR1-B2-PI2	1048

Burn 1 (10:41)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB1-1	684		
BR1-B2-DB1-2	687		

Burn 1 (11:03)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-DB2-1	876		
BR1-B2-DB2-2	850		

Post-burn 1 (12:09)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 2		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 1	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR1-B2-PB1	900		
BR1-B2-PB2	820		

Pre-ignition 2 (13:59)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PI1	682		
BR2-B1-PI2	782		

Burn 2 (14:46)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB1-1	686		
BR2-B1-DB1-2	683		

Burn 2 (15:00)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-DB2-1	686		
BR2-B1-DB2-2	659		

Post-burn 2 (15:20)

Remote Station # 1 50 to 100 m from Fire Remote Control Boat # 1		Remote Station # 2 100 to 150 m from Fire Remote Control Boat # 2	
Sample I.D.	Weight (g)	Sample I.D.	Weight (g)
BR2-B1-PB1	655		
BR2-B1-PB2	680		

*LEGEND BR Burn, B Boat, PI: Preignition; PB: Post burn;
DB1 & DB2: During the first and second half of burn
CS Control seawater; BG: Background;
EB Early burn; LB: Late burn
M96 96 hr Menidia test endpoint sample

NOBE 93 Table 8.2

NOBE Oil and Residue Samples
Alberta Sweet Mix Crude Oil

I.D. #	Type	Qty	Description
1	Fresh Crude	1 L	Sample taken from 3rd truck in Hughenden, Alb., 7/22/93. Only sample of fresh crude which was not damaged during transport.
2	Fresh Crude	3.5 L	Sample taken from 2nd truck in Hughenden, Alb., 7/22/93; 2 container collected split into 2A & 2B. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
3	Fresh Crude	2.5 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
4	Weathered	3 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Only sample of weathered crude collected in Alberta, container remained intact during transport.
5	Weathered Crude	60 L	Sample collected from trucks while loading oil into CCG Sir Wilfred Grenfell, St. John's, NFLD., 8/2/93. On 9/2/93 sample from truck 3 was mixed with sample from truck 1 and 2 respectively to simulate the oil on the ship. 5A = trucks 3 + 1, 5B = trucks 3 + 2.
6	Oily Water	10 L	Separated from weathered oil (sample 5), 9/2/93.
7	Weathered Crude	3 L	Collected before Burn 1, from apex of fire boom, 8/12/93.
8	Oily Water	10 L	Separated from weathered oil (sample 7), 9/2/93.
9	Surface Sheen	5	1 sorbent pad was used to collect 5 surface samples. Samples collected during Burn 1, between fireboom and row boom, 8/12/93.
10	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, behind row boom, 8/12/93.
11	Residue	1 L	Sample collected during Burn 1, from water surface between fire boom and row boom, 8/12/93.
12	Residue	7 L	Sample collected after Burn 1, from apex of fire boom, 8/12/93.
13	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, between fire boom and row boom, 8/12/93.
14	Residue	4 L	Collected during Burn 2, from water surface between fire boom and row boom, 8/12/93.
15	Residue	7 L	Collected after Burn 2, from apex of row boom, 8/12/93.
16	Residue	0 3 L	Collected from sides of remote control sample boats, 8/14/93
17	Residue	15 L	Collected from surface of row boom, Sept 93 Sample contaminated with cleaning agents

NOBE 93 Table 8.3 TPH Analysis of Water Samples

	Remote Station # 1 Remote control boat # 4 50 to 100 m from fire **pre-ignition (10:15)**			Remote Station # 1 Remote control boat # 2 50 to 100 m from fire **burn (11:03)**			Remote Station # 1 Remote control boat # 2 50 to 100 m from fire **post-burn (12:09)**			Remote Station # 2 Remote control boat # 2 100 to 150 m from fire **pre-ignition (10:15)**			Remote Station # 2 Remote control boat # 1 100 to 150 m from fire **burn (10:41)**		
	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L
Burn 1	5.0	3.0	4.0	2.0	4.0	3.0	4.0	12.0	8.0	11.0	4.0	7.5	9.0	5.0	7.0

	Remote Station # 1 Remote control boat # 1 50 to 100 m from fire **pre-ignition (13:59)**			Remote Station # 1 Remote control boat # 1 50 to 100 m from fire **burn (14:46)**			Remote Station # 1 Remote control boat # 1 50 to 100 m from fire **burn (15:00)**			Remote Station # 1 Remote control boat # 1 50 to 100 m from fire **post-burn (15:20)**		
	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L	sample µg/L	sample µg/L	AVE µg/L
Burn 2	8.0	3.0	5.5	4.0	3.0	3.5	4.0	3.0	3.5	7.0	4.0	5.5

BURN 1	Remote Station # 1 Remote control boat # 2 50 to 100 m from fire Burn (11:03) µg/L	Remote Station # 2 Remote control boat # 2 100 to 150 m from fire pre-ignition (10:15) µg/L	Remote Station # 2 Remote control boat # 1 100 to 150 m from fire burn (10:41) µg/L	Control Seawater µg/L	Background µg/L	Blank 1	Blank 2	AVE
M96 Bootest (96h Menidia test endpoint)	4	18.0	22.0	6.0	7.0	10.0	19.0	14.5

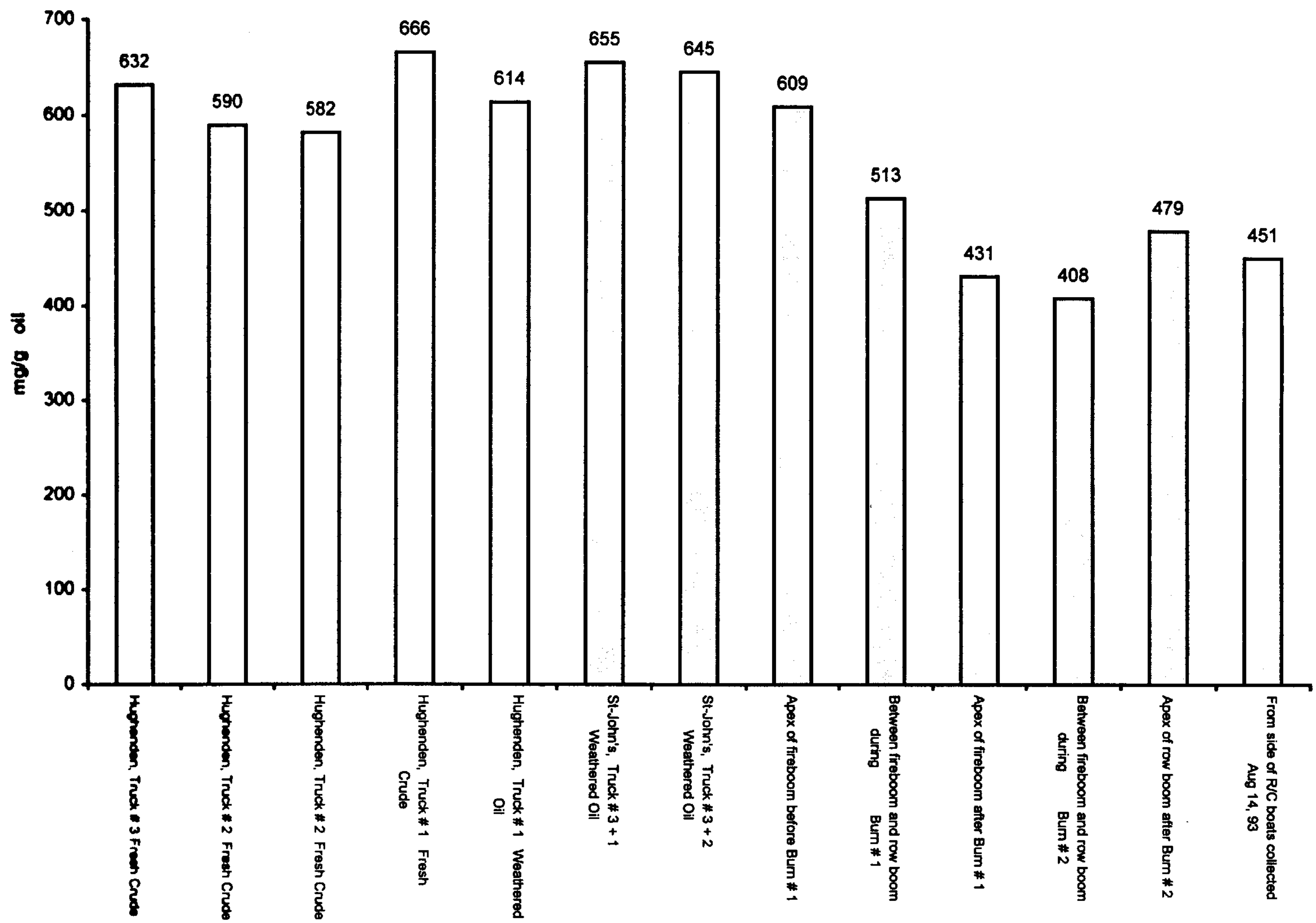
NOBE 93 Table 8.4

TPH Values and Weathered Percentages of Oil Samples

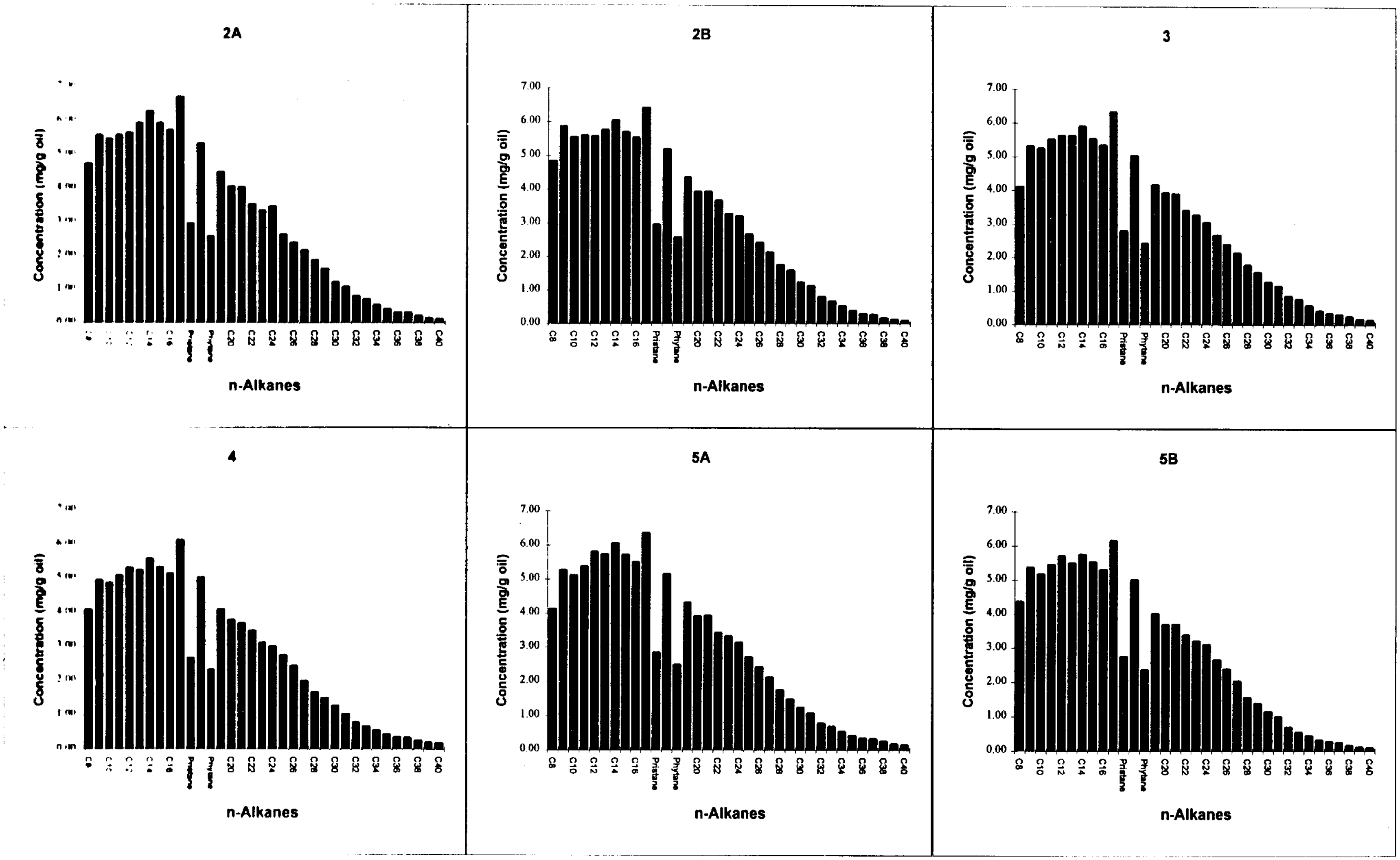
Sample	Total n-Alkanes (mg/g oil)	GCRTPH (mg/g oil)	TPH (mg/g oil)	GCRTPH/TPH	(C8+C10+C12+C14)/(C22+C24+C26+C28)	Weathered Percent (%)	C17/C18	Pris./Phy.
1 - Ref. oil	108	172	632	0.27	2.05		1.27	1.09
2A - Fresh	108	145	590	0.25	2.02	5.6	1.26	1.12
2B - Fresh	106	152	582	0.26	2.00	6.0	1.24	1.15
3 - Fresh	103	181	666	0.27	1.98	6.5	1.25	1.16
4 - Weathered	100	158	614	0.26	1.86	9.2	1.22	1.15
5A - Weathered	104	173	655	0.26	2.00	6.0	1.23	1.15
5B - Weathered	101	166	645	0.26	2.00	6.0	1.23	1.16
7 - Weathered	99	161	609	0.26	1.91	8.1	1.24	1.14
11 - Residue	50	74	513	0.14	0.11	48.6	0.99	0.97
12 - Residue	49	62	431	0.14	0.30	44.3	0.99	1.15
14 - Residue	39	51	408	0.13	0.10	48.9	0.88	0.97
15 - Residue	51	65	479	0.14	0.16	47.5	0.96	0.99
16 - Residue	48	57	451	0.13	0.07	49.5	0.90	1.00

Legend
- TPH: Total Petroleum Hydrocarbons
- GCR TPH: GC Resolvable TPH
- Pris./Phy.: Ratio of pristane/phytane

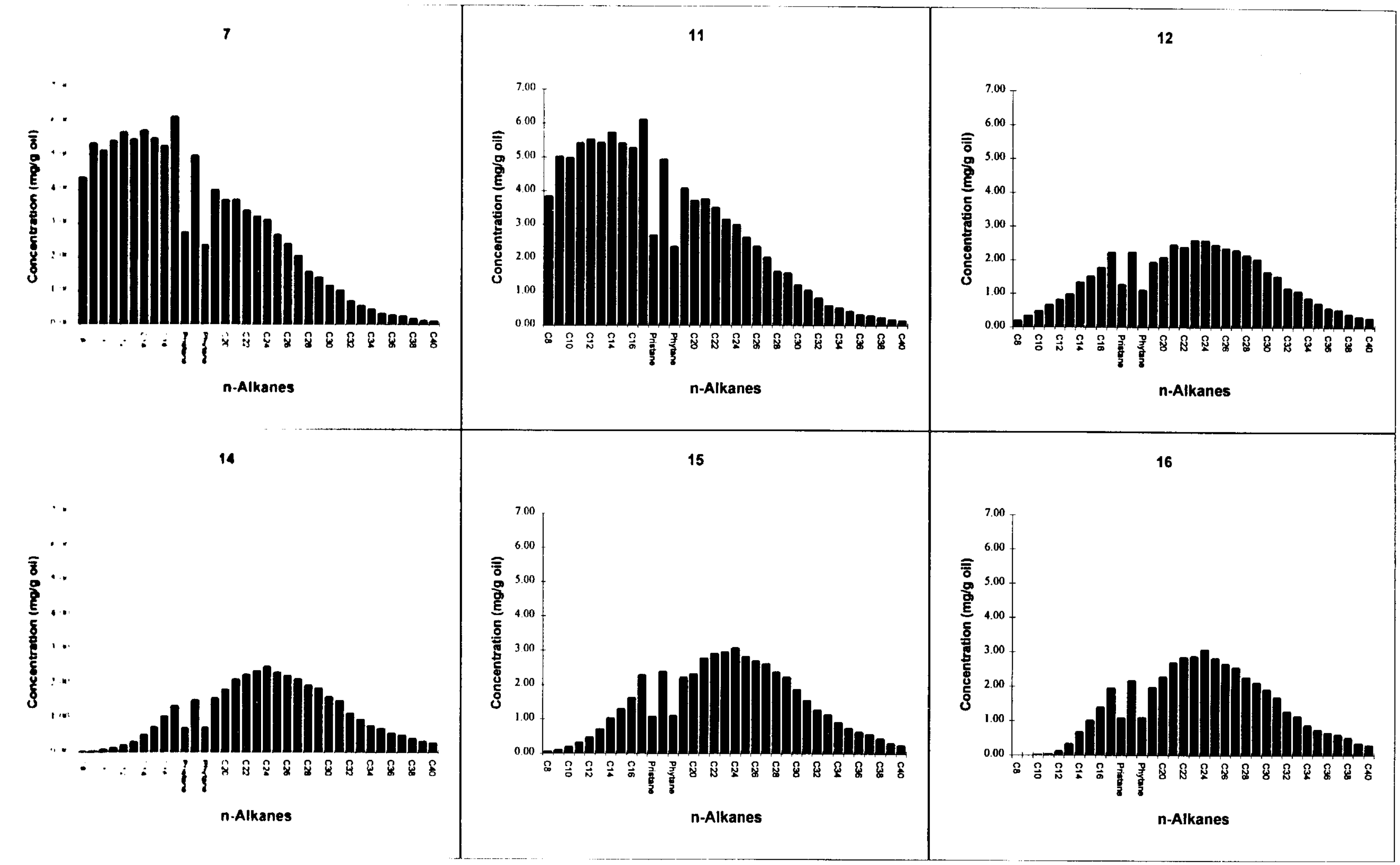
NOBE 93 Figure 8.1 **TPH of Oil and Residue Samples**



NOBE 93 Figure 8 2 **Distribution of n-Alkanes of Nobe Oil Samples 2A, 2B, 3, 4, 5A, 5B**



NOBE 93 Figure 8.3 Distribution of n-Alkanes of Nobe Oil Samples 7, 11, 12, 14, 15, 16



Total Petroleum Hydrocarbons (TPHs)
NOBE 93

Laboratory Methodology

Methodology for TPH Analysis for NOBE 93 Samples

Analytes: Total Petroleum Hydrocarbons

Scope
TPH in oil and residue is separated by silica column chromatography into the individual alkane and aromatic fractions and determined by GC/FID and GC/MSD. Method detection limit is 0.01-0.05 ppm for target PAH and 1 ppm for other hydrocarbons.

Sample Workup

1. Oil samples are dissolved in hexane at a concentration of 50 mg/mL, and spiked with the appropriate surrogate compounds.

2. Place 3.0 g of activated silica gel into a 30 mm long x 10.5 mm ID chromatographic column plugged with glass wool. Tap to settle the silica gel, and add 0.5 cm anhydrous sodium sulphate.

3. Pre-elute the column with 20 mL of hexane, discard the eluent. Just prior to exposure of the sodium sulphate layer to the air, quantitatively transfer 0.4 mL (approximate 20 mg oil) onto the column using an additional 3 mL of hexane to complete the transfer. Discard this 3 mL eluent. To avoid overloading the column, it is suggested that no more 40 mg of oil be placed on the column.

4. Just prior to exposure of the sodium sulphate to the air, elute the column with 12 mL of hexane. Collect the eluent in a centrifuge tube and label this fraction "F1". F1, the saturated fraction, is used for analysis of the distribution of n-alkanes and isoprenoids including pristane and phytane, and of C_{30} 17α(H), 21β(H)-hopane and other biomarker triterpane and sterane compounds.

5. Elute the column with 15 mL of 1:1 (V:V) benzene/hexane, collect the eluent in a centrifuge tube, and label this fraction "F2". F2, the aromatic fraction, is used for analysis of the target PAHs, alkylated PAH and dibenzothiophene compounds.

6. Combine half of F1 and F2, and label this composite fraction as "F3". This fraction is used for analysis of individual and total petroleum hydrocarbons (TPH).

7. Concentrate the fractions to the appropriate pre-injection volume (PIV), 0.5 to 1.0 mL, using nitrogen blowdown. The extracts are then spiked with the appropriate quantitation internal standard (IS) compounds (the IS 5-androstane, for determination of the individual n-alkanes and TPH; the IS d14-terphenyl, for determination of the target PAH and alkylated PAH homologues; the IS C_{30} 17β(H), 21α(H)-hopane, for determination of the biomarker compounds). To achieve lower quantitation limits, the PIV may be reduced to 0.25 mL, but the extract should not be blown dry to prevent loss of the volatile compounds, and importantly, to prevent the precipitation of the high molecular weight components.

Sample Analysis

Instrumentation

Target PAH and Biomarker analysis--Hewlett Packard (HP) 5890GC/5972A Mass Selective Detector (MSD), HP G1034C MS ChemStation (DOS series)
TPH analysis--Hewlett Packard (HP) 5890GC/FID and HP 3365ChemStation (DOS series)

Parameters

GC:	column: 30m*0.25mm DB-5 column (0.25 μm film thickness)
Oven:	50°C hold 2 min, rate 6°C/min to 300°C hold 16 min
Injector:	ALS Splitless injection, purge off 0.75 m, 290°C
Interface:	direct to ion source, 300°C
MSD:	electron impact ionization
Operation:	Selected ion monitoring mode (SIM), 2-3 ions/PAH compound dwell time 50 ms

Calibration

For GC/FID analysis, a mixture composed of C8-C30 alkanes, pristane/phytane and 5-a-Androstane (int std) was used. Average alkane response is corrected with that of int std and the total area under the non-resolved envelope is integrated using the manual baseline draw function.

Target PAH and biomarkers are analysed using SIM on the GC/MSD, where an int std of C30-17 beta(H) 21 beta (H) hopane is used. Selection criteria for the integration and reporting of each alkylated homologue and biomarker are based primarily on pattern recognition and the presence of selected confirmation ions.

Section 9

Dioxins / Dibenzofurans and Carbonyls NOBE 93

Dioxin / Furan Analysis
NOBE 93

Three combinations from the series of filter/PUF samples obtained using the PS-1 system were sent for Dioxin/Furan analysis. They were:

P-13 - Trip blank sample.
P-12 - Burn 2, Remote Station # 1, Remote control boat # 1, 50 to 100 m from the fire.
Volume = 12.103 m^3.
P-17 - Burn 1, Remote Station # 1, Remote control boat # 2, 50 to 100 m from the fire.
Volume = 12.420 m^3.

PS-1 Particulate and Vapour Collection System

The General Metal Works PUF (polyurethane foam) Sampler is a complete system, designed to simultaneously collect suspended airborne particulates and trap airborne vapours at flow rates up to 280 L/min.

Instrumentation

- The pump from the PS-1 drew air through a 7.6-cm diameter glass fibre filter followed by a polyurethane foam (PUF) filter 7.6 cm thick with a density of 0.022 g/cm^3.
- The flow rate varied between 128 and 279 L/min during the two burns. This yielded volumes between 9200 and 13,600 L for the various instruments.
- The PS-1 sampling head was rinsed with hexane before loading the collection media.
- The collecting media were manipulated with powderless gloves.
- The glass fibre filters were wrapped in aluminum foil and put in petri dishes, the PUFs were wrapped in separate aluminum foil and placed in a glass jar, and both samples were kept refrigerated on ice.
- All glass fibre filters were weighed at constant atmospheric conditions before and after the experiment, under the same conditions.
- After the glass fibre filters were reweighed, the PUF filter and fibre filter were combined to undergo extraction and GC/MSD analysis for PAH.
- An extended PAH analysis was also done on these extracts.

Location

Two PS-1 were located at each of the following stations
- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

NOBE 93 Tabel 9.1

Dioxins and Dibenzofurans Analysis
PS-1 combination of "filter/PUF"

Sample I.D.	Remote Station # 1, 50 to 100 m from fire		Trip Blank
	Burn 1 Remote control boat # 2	Burn 2 Remote control boat # 1	
Internal Reference I.D. #	P-17	P-12	P-13
Congener	pg/m³	pg/m³	pg
2378-TCDD	ND	ND	ND
12378-P5CDD*	ND	ND	ND
123478-H6CDD*	ND	ND	ND
123678-H6CDD*	ND	ND	ND
123789-H6CDD*	ND	ND	ND
1234678-H7CDD	ND	ND	ND
OCDD	1.9	15.5	65
2378-TCDF*	0.2	0.9	ND
12378-P5CDF*	ND	ND	ND
23478-P5CDF*	ND	ND	ND
123478-H6CDF*	ND	ND	ND
123678-H6CDF*	ND	ND	ND
234678-H6CDF*	ND	ND	ND
123789-H6CDF*	ND	ND	ND
1234678-H7CDF	ND	ND	ND
1234789-H7CDF	ND	ND	ND
OCDF	ND	ND	ND

Surrogate % Recovery			
13C12-TCDD	89	95	77
13C12-TCDF	107	114	89
13C12-P5CDD	93	89	72
13C12-P5CDF	109	118	85
13C12-H6CDD	95	106	95
13C12-H6CDF	104	127	98
13C12-H7CDD	106	95	105
13C12-H7CDF	99	104	93
13C12-OCDD	86	79	93

Note Results are corrected for surrogate recovery.
ND = not detected

Sample I.D.	Remote Station # 1, 50 to 100 m from fire		Trip Blank
	Burn 1 Remote control boat # 2	Burn 2 Remote control boat # 1	
	P-17	P-12	P-13
Homologue	pg/m³	pg/m³	pg
TCDD	<0.3	<0.4	<5
P5CDD	<0.3	<0.4	<5
H6CDD	<0.6	<0.8	<10
H7CDD	<0.5	<0.8	<10
OCDD	1.9	15.5	65
Total PCDD	1.9	15.5	65
TCDF	27.05	4.4	<4
P5CDF	5.15	<0.5	<4
H6CDF	<0.5	<0.5	<6
H7CDF	<0.6	<0.7	<6
OCDF	<0.8	<1.0	<10
Total PCDF	32.2	4.4	ND

Carbonyl
NOBE 93

Gilian 513 A Pump plus DNPH Cartridge

Instrumentation

- A Gilian 513A was used to pump air through a DNPH (2,4-dinitrophenylhydrazine)-silica cartridge.
- The DNPH cartridge contains 350 mg of silica coated with 1.0 mg of DNPH.
- Tygon tubing was connected from the instrument to the mast to allow sampling at 1.25 m above sea level.
- The flow rate was set between 185-250 cc/min and the pumped air volumes were between 1.1 and 18 L.
- The samples were wrapped in aluminum foil, placed in a small amber vial and refrigerated.

Location

- Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.7 m above sea level.
- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

NOBE 93 Table 9 2

Carbonyl Analysis of Sea Level Air Samples
Gilian 513 A Pump plus DNPH Cartridge

Sample I D	Background Aug 07 93 Remote control boat # 1	Burn 1 Remote Station # 1 Remote control boat # 4 pre-ignition 1	Burn 1 Remote Station # 1 Remote control boat # 2 Burn 1	Burn 1 Remote Station # 2 Remote control boat # 2 pre-ignition 1	Burn 1 Remote Station # 2 Remote control boat # 1 burn 1	Burn 2 Remote Station # 1 Remote control boat # 1 pre-ignition 2	Burn 2 Remote Station # 1 Remote control boat # 1 burn 2	Burn 2 Remote Station # 2 Remote control boat # 2 pre-ignition 2	Burn 2 Remote Station # 2 Remote control boat # 2 burn 2
Volumes (m^3)	0.00620	0.001116	0.008625	0.001125	0.0092	0.00132	0.0098	0.001221	0.009065
Compounds	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³	µg/m³
Data Corrected with Trip Blank Values									
Formaldehyde	1 61	456.25	42.44	261.75	28.37	101.44	9.19	265.47	32.78
Acetaldehyde	165 74	1289.89	178.58	1247.69	226.04	923.83	70.33	755.17	113.30
Acetone	65 69	1638.33	67.34	1010.85	97.36	1942.56	45.10	178.88	42.82
Acrolein	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propinaldehyde	55 49	323.67	48.14	321.85	54.09	211.03	19.86	167.27	23.19
Crotonaldehyde	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Butanone	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso/ Butylaldehyde	0 00	226.68	0.00	0.00	54.79	0.00	0.00	0.00	0.00
Benzaldehyde	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Pentanone	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isovaleraldehyde	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Valeraldehyde	18.57	286.58	16.77	376.93	26.32	113.92	13.60	107.02	12.07
o/m/p Tolualdehyde	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MIBK	11.58	209.64	7.05	187.42	14.37	53.98	7.27	436.41	3.39
Hexanal	9 09	110.17	8.75	114.36	8.38	86.19	4.61	63.57	8.80
2 5 Dimethyl	0 00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	327.77	4541.21	369.07	3520.85	509.72	3432.95	169.96	1973.78	236.34
Data Minus Background Values									
Formaldehyde		454.63	40.83	260.14	26.75	99.83	7.58	263.86	31.17
Acetaldehyde		1124.15	12.84	1081.95	60.30	758.09	0.00	589.43	0.00
Acetone		1572.64	1.65	945.16	31.67	1876.87	0.00	113.19	0.00
Acrolein		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Propinaldehyde		268.18	0.00	266.36	0.00	155.54	0.00	111.78	0.00
Crotonaldehyde		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Butanone		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
iso/ Butylaldehyde		226.68	0.00	0.00	54.79	0.00	0.00	0.00	0.00
Benzaldehyde		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
2 Pentanone		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isovaleraldehyde		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Valeraldehyde		268.01	0.00	358.37	7.76	95.36	0.00	88.45	0.00
o/m/p Tolualdehyde		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
MIBK		198.05	0.00	175.84	2.78	42.39	0.00	424.83	0.00
Hexanal		101.08	0.00	105.27	0.00	77.10	0.00	54.48	0.00
2 5 Dimethyl		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL		4213.42	55.32	3193.08	184.05	3105.17	7.58	1646.01	31.17

Dioxin / Furan
NOBE 93

Laboratory Methodology

Methodology for Dioxin/Furan Analysis for NOBE 93 Samples

Analytes: Polychlorinated Dibenzo-p-dioxins (DX) and Polychlorinated Dibenzofurans (DF)

Scope

This method is based on an ambient DX method in which air is drawn through a filter and polyurethane foam (PUF). The filter and PUF are extracted together by soxhlet and cleaned up using multi-column adsorption chromatography. The final extract is analysed on a high resolution GC/MS. Method detection limit based upon a 1000 m^3 sample volume is 0.05-0.02 pg/m^3.

Sample Workup

The filter and PUF are spiked with a mixture of surrogates and soxhlet extracted in toluene overnight. The raw extract is cleaned up by passing it through an acid/base-modified silica column to remove the easily oxidizable organics, followed by a silver nitrated coated silica column to remove sulphurous compounds. The extract is finally fractionated on an alumina column to separate chlorinated diphenyl ethers and PCB from the planar DX/DF. The DX/DF fraction is concentrated and an internal standard of C13-1234 TCDD is added. Final volume is made to 20-µL before GC/MS analysis.

Instrumentation

HP 5890 GC coupled to a VG-70S double focussing high resolution MS, system controlled by dedicated data system.

Parameters

Oven temperature:	70°C for 1 min, ramp 40°C/min to 200°C, ramp 3°C/min to 235°C and hold 10 min, ramp 8°C to 310°C and hold 15 min.
Column:	60 M DB-5, 0.25 mm id, 0.25-µm film thickness
Injector:	splitless manual injection, 300°C
Interface:	290°C
MS:	Electron Impact, operated in Selective Ion Monitoring mode
Tuning:	PKF to achieve 10000 resolution (10% valley)
Calibration:	Standard mixture of all 17 2,3,7,8-substituted DX/DF congeners
Instrument DL:	0.2-1 pg/µL operated at 10000 resolution
Method DL:	2 pg/m^3 for a 10 m^3 sample volume

Isomer Specific Analysis

The 60-M column can separate 2,3,7,8-TCDD from its neighbouring isomers of TCDD and isomer group from tetra to octa. To separate 2,3,7,8-TCDF, however, requires an additional GC run using a 30 M DB-225 column. A column test mixture is run daily to ensure adequate chromatographic separation is maintained.

Section 10

Metals
NOBE 93

Metals
NOBE 93

Oil and Residue Samples

- The crude oil and residue samples were manually collected at various times and locations as described in Table 10.1
- The samples were stored in metal containers (International Compliance Centre, Mississauga, Canada; Quality Containers, Weston, Canada). Metal cans were selected to minimize possible interferences to subsequent organic analysis.
- The 1 (US) gallon cans from the International Compliance Centre were designed to meet international air regulations for transport of dangerous goods.
- The 20-L pail was used for large volume samples. These were open-headed cans with removable lids and lined with a rust inhibitor. This style of container simplified the transfer/collection of large volumes of oil and residue.
- Upon returning to the Emergencies Science Division (ESD), Environmental Technology Centre (ETC), the samples were stored in a temperature-controlled room at 15°C.
- On September 9/93, the free water was removed from the oil and residue samples. Two representative 40-mL aliquots were taken from the samples in the metal containers, stored in precleaned, amber glass vials with Teflon-lined caps (Pierce, Rockford, USA) and used for the subsequent chemical analysis. The aliquots were stored at 15°C until analysed while the remainder of the oil was stored at another site. A detailed description of the oil and residue samples has been provided in Table 10.1.

Air Samples

- Sampling apparatus was positioned at three downwind locations; each sampling vessel had two separate sampling apparatus.
  - Remote Station 1 (RS-1) - 50 to 100 m downwind from the apex of the fireboom and 0.7 m above sea level.
  - Remote Station 2 (RS-2) - 100 to 150 m downwind from the apex of the fireboom and 0.7 m above sea level.
  - Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.
- Background samples were collected at sea on August 7/93 during the rehearsal. Two samples were collected with the remote control boat and one with CCG 206. Including two trip blank samples, a total of 19 air filter samples was collected.
- Air samples were collected via a Gilian Aircon 2 pump (Gilian Instrument Co., New Jersey, USA) and 37-mm diameter cassette containing a 0.8 μm mixed cellulose ester filter (Nuclepore, Pleasanton USA) as recommended in OSHA/NIOSH method 7300 (Occupational Safety and Health Administration, National Institute of Health and Human Services).
- The filter cassette was attached to one end of a length of Tygon tubing and fastened to the mast of the sample boat. The height of the intake was 1.25 m above sea level. The other end of the tubing was attached to the pump.

- A typical flow rate of 2 L/minute was used. Depending upon the length of time the pump was operating, a range from 62 to 144 L of air was drawn through the filter.
- Once collected, the filter was capped and stored in a sample cooler (Canadian Coleman Co., Toronto, Canada) at ambient temperatures.
- Upon returning to ETC, the samples were stored in a temperature controlled room at 15°C.
- To measure the loading on the filters, each filter was weighed before and after use in a temperature and humidity controlled room. The room was maintained at a temperature of 23 ± 3°C and a relative humidity of 45 ± 5 %. Steps taken to ensure accurate filter weights included placing the filters in the controlled chamber for a minimum of 24 hours prior to weighing to ensure they had reached an appropriate equilibrium and constant weight.
- Table 10.2 lists pertinent data on the air samples collected during the experiment for metal analysis.

Table 10.1 Oil and Residue Samples Analysed for Metal Content

Sample #	Description	Notes
1	Fresh Crude	- collected in Hughenden, Alb., 7/22/93. - sample taken from 3rd truck. - only sample of fresh crude which was not damaged during transport.
2a and 2b	Fresh Crude	- collected in Hughenden, Alb., 7/22/93. - sample taken from 2nd truck. - container was damaged during transport. Some sample was lost and expect some weathering of remaining crude.
3	Fresh Crude	- collected in Hughenden, Alb., 7/22/93. - sample taken from 1st truck. - container was damaged during transport. Some sample was lost and expect some weathering of remaining crude.
4	Weathered Crude	- collected in Hughenden, Alb., 7/22/93. - sample taken from 1st truck. - only sample of weathered crude collected in Alb. Container remained intact during transport.
5a and 5b	Weathered Crude	- collected in St. John's, NFLD., 8/2/93. - collected from trucks while loading oil into CCG Sir Wilfred Grenfell. - samples were mixed on 9/2/93 to simulate the oil on the ship. - Sample from truck 3 was mixed with sample from truck 1 and 2 respectively. - the water was removed from the samples.
7	Weathered Crude	- collected from apex of fire boom 8/12/93. - collected after burn 1.
11	Residue	- collected from water surface between fire boom and row boom, 8/12/93. - collected during burn 1.
12	Residue	- collected from apex of fire boom, 8/12/93. - collected after burn 1.
14	Residue	- collected from water surface between fire boom and row boom, 8/12/93. - collected during burn 2.
15	Residue	- collected from apex of row boom, 8/12/93. - collected after burn 2
16	Residue	- collected from sides of remote controlled sample boats - collected 8/14/93

Table 10.2 Air Filter Samples Analysed for Metal Content

Sample ID #	Filter Media ID#	Initial Weight (mg)	Final Weight (mg)	Difference (mg)	Unit ID	Burn #	Boat #	Pre-flow (L/min)	Post-flow (L/min)	Avg. Flow (L/Min)	Time (min)	Volume (L)
A1	AC*-24	32.04	32.3	0.26	AC**-1	2	1	2	2	2	49	98
A2	AC-23	32.07	32.37	0.3	AC-2	2	1	2	2	2	49	98
A3	AC-20	32.5	32.7	0.2	AC-7	1	4	2	2	2	45	90
A4	AC-34	32.29	32.46	0.17	AC-8	1	4	2	2	2	45	90
A5	AC-12	32.67	32.72	0.05	AC-3	2	2	2	2	2	49	98
A6	AC-14	32.58	32.69	0.11	AC-4	2	2	2	2	2	49	98
A7	AC-33	30.81	31.39	0..58	AC-3	1	2	2	2	2	45	90
A8	AC-29	31.23	31.49	0.26	AC-4	1	2	2	2	2	45	90
A9	AC-2	31.85	32	0.15		1A	206	2	2	2	58	116
A10	AC-6	32.28	32.26	-0.02		1B	206	2	2	2	58	116
A11	AC-4	35.98	36.23	0.25		2B	206	2	2	2	72	144
A12	AC-5	33.41	33.55	0.14		2A	206	2	2	2	72	144
A13	AC-21	34.1	34.22	0.12		Trip blank	0	0	0	0	0	0
A14	AC-36	30.51	30.78	0..27		Trip blank	0	0	0	0	0	0
A15	AC-27	32.26	32.46	0.2	AC-1	1	1	2	2	2	45	90
A16	AC-32	31.77	32.22	0.45	AC-2	1	1	2	2	2	45	90
A17	AC-30	31.81	31.94	0.13	AC-2	Background	1	2	2	2	31	62
A18	AC-31	30.45	30.7	0.25	AC-1	Background	1	2	2	2	31	62
A19	AC-10	32.53	32.67	0.14		Background	206	2	2	2	34	68

* A unique identification number was given to each filter media and ** Aircon pump.

Sample Preparation

For inductively coupled plasma atomic emission spectrometric (ICP-AE) analysis of metals, typically 0.2 g of crude oil and residue samples were digested with 10 mL of nitric acid (ARISTAR 69% - BDH, Montreal, Canada). The samples were digested in 100 mL, closed cup, Teflon vessels using a CEM model MDS 2000 microwave oven (630-watts- CEM Corp., Mathews, USA). Each run consisted of eight simultaneously digested samples, two of which were blanks. The digestion parameters were as follows: 10 minutes at 50% power, 190 minutes at 60 % power. The vessels remained in the microwave following the allotted digestion period until the pressure dropped below 40 psi, at which time they were manually vented, transferred to a 50-mL volumetric flask and diluted with deionized/distilled water to volume. Finally, the samples were filtered through Whatman #41 (Whatman, Hillsboro, USA) ashless paper into clean amber glass vials with Teflon-lined caps (Pierce, Rockford, USA). The air samples were collected on 37-mm cellulose ester membrane filters. The entire filter was digested and prepared in the same manner as the liquid samples.

Metal Analysis

The metal content was determined using an ARL 3410 ICP-AE (Fison Instruments, Valencia, USA) spectrometer controlled by a computer and Plasma Vision 10 software package. The 11 metals were molybdenum (Mo), zinc (Zn), lead (Pb), nickel (Ni), iron (Fe), chromium (Cr), magnesium (Mg), vanadium (V), copper (Cu), titanium (Ti), and barium (Ba).

To ensure accuracy and reproducibility of results the following steps were taken:

- Daily calibration over the range of 0 to 10 ppm was performed. Calibration standards were made from serial dilutions of commercial ICP standards (SCP Scientific, Montreal, Canada).
- These same serial dilution standards were measured as quality control solutions throughout the analysis.
- Standards of trace metals in residual fuel oils (National Institute of Standards and Technology, Gaitherburg, USA) were analysed in conjunction with and in the same manner as the samples.
- Two blanks, 10 mL of nitric acid, were included with each run of 8 vessels (6 samples, 2 blanks). The average of the blank values was used to correct the concentration of the sample.
- Each crude oil and residue sample was analysed in duplicate. The results are the average of the duplicate analysis and were calculated using the following formulas:

$$\text{Avg. Blank Conc. (ppm)} = \frac{\text{Instrument Value}_1\text{ (ppm)} + \text{Instrument Value}_2\text{ (ppm)}}{2}$$

$$\text{Sample}_1\text{ Conc. (ppm)} = (\text{Instrument Value}_1\text{ (ppm)} - \text{Avg. Blank Conc. (ppm)}) \times \frac{\text{Dilution Volume (50 mL)}}{\text{Sample Weight}_1\text{ (g)}}$$

$$\text{Sample}_2\text{ Conc. (ppm)} = (\text{Instrument Value}_2\text{ (ppm)} - \text{Avg. Blank Conc. (ppm)}) \times \frac{\text{Dilution Volume (50 mL)}}{\text{Sample Weight}_2\text{ (g)}}$$

where 1 mL $\approx$ 1 g

$$\text{Avg. Sample Conc. (ppm)} = \frac{\text{Sample}_1\text{ (ppm)} + \text{Sample}_2\text{ (ppm)}}{2}$$

Instrument parameters were as follows: (typical) incident watts 650; reflected watts 001; plate volts 3330; plate current 519 mA; grid current 083 mA; drive volts 2150; spectrometer profile; zero 76171; Argon 355.4617 nm; sample uptake rate 3.1 mL/minute.

The Instrument Detection Limits (IDL) and Background Equivalent Concentrations (BEC) provide an indication of the performance of the instrument. IDL is the smallest concentration which can be detected greater than background and BEC is an analyte's concentration which yields a net intensity equal to the intensity of the background. Prepared standard solutions are used in conjunction with the software package to determine their respective values. Upon completion, a summary table, as shown in Table 10.3, is printed out. The Instrument Detection Limits (IDL) and Background Equivalent Concentrations (BEC) have been provided in Table 10.3.

Table 10.3 Instrument Detection Limits and Background Equivalent Concentrations

Analyte	Channel	Lambda	Order	Blank Kpulse	Blank S.D.	Blank Int.	Std. Kpulse	Std. Conc.	Std. Int.	Integr. Time	BEC	IDL
Mo	94	201.976	1	0.109	0.003	11	6.027	10.00	3	1.0	0.1840	0.0096
Zn	179	213.820	1	0.146	0.004	11	41.131	10.00	3	1.0	0.0357	0.0022
Pb	110	220.344	1	0.146	0.004	11	3.711	10.00	3	1.0	0.4103	0.0202
Ni	103	231.586	1	0.163	0.005	11	10.993	10.00	3	1.0	0.1508	0.0091
Fe	58	259.953	1	0.413	0.007	11	43.792	10.00	3	1.0	0.0952	0.0034
Cr	44	267.705	1	0.291	0.005	11	27.325	10.00	3	1.0	0.1075	0.0034
Mg	88	279.551	1	2.834	0.027	11	266.835	10.00	3	1.0	0.1074	0.0021
V	170	309.336	1	0.366	0.006	11	63.312	10.00	3	1.0	0.0582	0.0019
Cu	47	324.778	1	0.281	0.005	11	81.457	10.00	3	1.0	0.0346	0.0012
Ti	158	337.287	1	0.483	0.010	11	95.369	10.00	3	1.0	0.0510	0.0021
Ba	18	455.468	1	0.500	0.007	11	69.820	1.00	3	1.0	0.0072	0.0002

The method detection limits (MDL) for the crude oil and residue samples were determined using a dilution factor of 50 mL and a typical sample weight of 0.2 g.

$$\text{MDL} = \text{IDL} \times 50 \text{ mL}/0.2 \text{ g}$$

The method detection limits (MDL) for the filter samples were determined using a dilution factor of 50 mL, and an average air volume through the samplers of 0.087 m^3.

$$\text{MDL} = \text{IDL} \times 50 \text{ mL}/0.087 \text{ m}^3$$

Discussion

Oil and Residue Analysis

- Analysis of Metal in Residual Fuel Oil Standards generated results typically within 90% of the accepted value. Quality control solutions remained within >96% of accepted value.
- Samples 1, 2, 3 and 4 were collected in Hughenden, Alberta while the oil was being artificially weathered. The shipping containers for both samples 2 and 3 were damaged during the return transport to ETC resulting in various amounts of leakage. Results from these samples have been included for information purposes only.
- The fresh oil had very low metal concentrations. Detectable quantities of metals were found only in the weathered oil and residue samples. It is theorized that as oil is burned removing the organic component, most of the metals would remain in the oil due to their higher boiling points. As such the metal concentration of the remaining oil should make up a higher percentage of the total concentration. The appearance of detectable quantities of metals in the residue but not in the fresh oil, and the larger concentration of magnesium in the residue tends to support that theory. Zinc, with a boiling point of 907°C, is the exception.
- Residue sample #16, like the other residue samples, had detectable quantities of iron (Fe), magnesium (Mg) and vanadium (V). However, the concentration was significantly higher than the other residues. This could be attributed to the fact that the residue was scraped off and collected from the sides of the aluminium sampling boats two days after the experiment. The increased exposure to salt water, the action of scraping the residue from the boat and the prolonged weathering period could account for the higher metal

concentrations. Sample #16 results have been included for information purposes only.

- The water separated from the crude oil samples on September 9, 1993 was collected and stored in a 20 L metal can. Months later the metal content of this water was measured. Results have been included for information purposes only. Detectable quantities of zinc (1.4 ppm), iron (147 ppm), magnesium (83 ppm), vanadium (0.6 ppm), copper (0.9 ppm) and barium (11 ppm) were found. Analysis was carried out in the same manner as the oil and residue samples. It should be noted that this was not sea water. The water was obtained when collecting weathered oil samples from the tank trucks as the oil was being placed on board the Coast Guard ships in St. John's, NFLD, August 2, 1993. More likely, this was ground water pumped up with the oil at the well head. Evidence of rust was visible on the 20 L metal pail. This would account for the high iron content of the water.

Air Samples Analysis

- No correction to the downwind sample results was made to account for the concentration of metals on trip blanks and/or background samples. Results are reported for all filter samples.
- The prominent metals appearing in the downwind sampling stations were zinc (Zn), iron (Fe), titanium (Ti) and barium (Ba). The low barium and titanium concentrations in the original oil make it difficult to conclude that the metals originated from the oil. Subsequent investigation has lead to the conclusion that the barium and titanium came from the skin of the boom burnt off during the experiment. During conversations with the manufacturers of the boom (Gennrich, 3M) and the manufacturers of the vinyl material used to cover the boom (Scott, Cooley Ind.) information was provided that the vinyl used typically contained 0.5% titanium dioxide in the paint pigment and 2% barium/cadmium as a heat stabilizer. Zinc and iron were present in the initial oil, however the elevated concentrations in the downwind samples appear out of line with the original oil concentrations. The boom was fabricated of ceramic "float", surrounded by a stainless steel mesh, which in turn was wrapped in a Nextel blanket followed by another stainless steel mesh surrounding the Nextel. Nextel is a specially designed, 3M, ceramic product comprised of aluminium borosilicate. The ceramic float was predominantly composed of oxides of aluminium (75%), silica (15%) and iron (2.5%). Finally, the boom connectors and handles were also made of metal. With this many sources of iron coupled with the fact that the residue samples contained measurable amounts of iron, it is reasonable to assume that the iron in the downwind samples was due in part to the burning boom and not solely the oil. Zinc has the lowest boiling point of the metals analysed at 907°C (CRC, 1994) and was the only metal with a boiling point less than the maximum recorded temperature of the fire at 1000°C (Fingas, 1994). As no measurable quantities of zinc were found in the residue, it appears that most of the zinc was vaporized.
- As expected, trip blank samples, filters taken to the site but not removed from the storage container, essentially had metal concentrations less than detection limits.
- Background samples were collected on August 7/93, at sea, when the burn was postponed due to the unfavourable weather. Metal concentrations were near or less than detection limits with the exception of magnesium on the background sample from downwind sampling station CG206. Magnesium at 279 $\mu g/m^3$ far exceeds the other samples which were all less than detection limit. Contamination by salt water would be a possible

explanation.

- Listed below are the concentrations of the detectable metals in the air samples in conjunction with the sampling location for each burn. Due to the changes in the positions of the remote controlled sample boats during burn one, correlating the metal-in-air concentration with distance downwind is difficult. For the second burn, in which the position of the sampling stations was consistent throughout, there is a general trend towards a decrease in concentration with distance from the burn oil. The exceptions were zinc and iron values at remote station #2.

Burn 1:

Remote Station #1	Remote Station #2	CG206
remote control boat #2	remote control boat #1	
avg conc. Zn = 10.3 µg/m³	avg conc. Zn = 2.8 µg/m³	avg conc. Zn = 11.4 µg/m³
avg. conc. Fe = <15.2 µg/m³	avg. conc. Fe = 3.0 µg/m³	avg. conc. Fe = 17.5 µg/m³
avg. conc. Ti = 20.3 µg/m³	avg. conc. Ti = <1.2 µg/m³	avg. conc. Ti = <25.15 µg/m³
avg. conc. Ba = 32.5 µg/m³	avg. conc. Ba = <0.1 µg/m³	avg. conc. Ba = <31.1µg/m³

Burn 2:

Remote Station #1	Remote Station #2	CG206
remote control boat #1	remote control boat #2	
avg conc. Zn = 19.4 µg/m³	avg conc. Zn = <4.5 µg/m³	avg conc. Zn = 15.8 µg/m³
avg. conc. Fe = 30.4 µg/m³	avg. conc. Fe = 39.3 µg/m³	avg. conc. Fe = 11.8 µg/m³
avg. conc. Ti = 25.3 µg/m³	avg. conc. Ti = 21.4 µg/m³	avg. conc. Ti = 20.5 µg/m³
avg. conc. Ba = 32.1 µg/m³	avg. conc. Ba = 23.7 µg/m³	avg. conc. Ba = 22.1 µg/m³

- For information purposes only, Table 10.4 provides a comparison between the highest detected metal in air concentration from NOBE, ambient air quality criteria for Ontario in 1998 (AAQC) and data obtained from the National Air Pollution Surveillance (NAPS) program for national mean concentrations of metals in air from 1983 to 1994 and maximum concentration measured during that time (Dann, 1994).

Table 10.4 A Comparison of Metal in Air Concentrations

	Mo µg/m³	Zn µg/m³	Pb µg/m³	Ni µg/m³	Fe µg/m³	Cr µg/m³	Mg µg/m³	V µg/m³	Cu µg/m³	Ti µg/m³	Ba µg/m³
NOBE	<5.5	30.1	<11.6	<5.2	35.7	13.7	5	1.1	0.8	49.1	60.3
AAQC 24 hour avg			3 to 5	2	4	10		2	50		10
NAPS (mean)	0.001	0.045	0.109	0.004	0.382	0.006		0.014	0.014		0.017
NAPS (max.)	0.026 Calgary	1.881 Halifax	1.550 Van	0.144 Halifax	6.085 Que	0.297 Wind		0.880 Halifax	0.418 Halifax		0.290 Winn

References

Dann, T., personal communication, Pollution Measurement Division, Environment Canada, Ottawa, Ontario, 1994.

Fingas, M., et al., "The Newfoundland Offshore Burn Experiment - NOBE, Experimental Design and Overview", *Proceedings of the Seventeenth Arctic and Marine Oil Spill Program Technical Seminar*, Vancouver, British Columbia, 1994, pp 1053- 1064.

CRC Handbook of Chemistry and Physics, Lide, D.R. (Ed.), CRC Press, Boca Raton, USA, 74 edition, 1994, pp. 12-134.

NOBE 93 Table 10 5

Metal Analysis of Oil and Residue Samples

Source	Internal Reference I.D.	Molybdenum ppm	Zinc ppm	Lead ppm	Nickel ppm	Iron ppm	Chromium ppm	Magnesium ppm	Vanadium ppm	Copper ppm	Titanium ppm	Barium ppm
Fresh Crude, Hughenden, Truck # 3	#1	<2.4	<0.6	<5.1	<2.3	<0.9	<0.9	<0.5	<0.5	<0.3	<0.5	<0.05
Fresh Crude, Hughenden, Truck # 2	#2a	<2.4	<0.6	<5.1	<2.3	<0.9	<0.9	<0.5	<0.5	<0.3	<0.5	<0.05
Fresh Crude, Hughenden, Truck # 2	#2b	<2.4	<0.6	<5.1	<2.3	<0.9	<0.9	<0.5	<0.5	<0.3	<0.5	<0.05
Fresh Crude, Hughenden, Truck # 1	#3	<2.4	6.3	<5.1	5	14.2	<0.9	331.3	<0.5	<0.3	<0.5	1.3
Weathered Oil, Hughenden, Truck # 1	#4	<2.4	3	<5.1	<2.3	9.4	<0.9	108.1	<0.5	<0.3	3.1	11.3
Weathered Oil, St-John's, Truck # 3 + 1	#5a	<2.4	8.7	<5.1	<2.3	16.2	<0.9	21.3	<0.5	1	<0.5	<0.05
Weathered Oil, St-John's, Truck # 3 + 2	#5b	<2.4	1.1	<5.1	<2.3	<0.9	<0.9	58.3	<0.5	<0.3	<0.5	5.7
Oil, from apex of fireboom before Burn # 1	#7	<2.4	7.1	<5.1	<2.3	<0.9	<0.9	57.4	<0.5	<0.3	<0.5	<0.05
Residue, between fireboom and rowboom during Burn	#11	<2.4	<0.6	<5.1	<2.3	<0.9	<0.9	142.3	0.6	<0.3	<0.5	0.4
Residue, from apex of fireboom after Burn # 1	#12	<2.4	<0.6	<5.1	<2.3	4.4	<0.9	493.2	3.9	1.2	<0.5	<0.05
Residue, between fireboom and rowboom during Burn	#14	<2.4	<0.6	<5.1	<2.3	20.5	<0.9	657.4	4.7	0.6	3.5	1.6
Residue, from apex of rowboom after Burn # 2	#15	<2.4	<0.6	<5.1	<2.3	3.1	<0.9	354.3	2.8	<0.3	<0.5	<0.05
Residue, from side of R/C boats collected Aug 14, 93	#16	<2.4	<0.6	<5.1	<2.3	162.5	<0.9	814	6.9	<0.3	<0.5	<0.05

NOBE 93 Table 10.6

Metal Analysis of Air Samples

Source		Internal Reference I.D.	Molybdenum µg/m³	Zinc µg/m³	Lead µg/m³	Nickel µg/m³	Iron µg/m³	Chromium µg/m³	Magnesium µg/m³	Vanadium µg/m³	Copper µg/m³	Titanium µg/m³	Barium µg/m³
Burn 1, Remote Station # 1													
50 to 100 m from fire	Instrument 1	A7	<5.5	16.7	<11.6	<5.2	<2.0	<2.0	<1.2	<1.1	<0.7	5	4.7
Remote control boat # 2	Instrument 2	A8	<5.5	3.9	<11.6	<5.2	28.3	<2.0	<1.2	<1.1	<0.7	35.6	60.3
Burn 1, Remote Station # 2													
100 to 150 m from fire	Instrument 1	A15	<5.5	<1.3	<11.6	<5.2	3.9	<2.0	<1.2	<1.1	<0.7	<1.2	<0.1
Remote control boat # 1	Instrument 2	A16	<5.5	4.2	<11.6	<5.2	<2.0	<2.0	5	<1.1	<0.7	<1.2	<0.1
Burn 2, Remote Station # 1													
50 to 100 m from fire	Instrument 1	A1	<5.5	8.7	<11.6	<5.2	25	<2.0	<1.2	<1.1	<0.7	15.1	17.3
Remote control boat # 1	Instrument 2	A2	<5.5	30.1	<11.6	<5.2	35.7	<2.0	<1.2	<1.1	<0.7	35.5	46.9
Burn 2, Remote Station # 2													
100 to 150 m from fire	Instrument 1	A5	<5.5	<1.3	<11.6	<5.2	18.4	4.1	<1.2	<1.1	<0.7	9.4	10.2
Remote control boat # 2	Instrument 2	A6	<5.5	7.7	<11.6	<5.2	60.2	13.7	<1.2	<1.1	<0.7	33.4	37.2
Burn 1, Downwind Station													
900 m from fire	Instrument 1	A9	<5.5	12.9	<11.6	<5.2	10.3	<2.0	<1.2	<1.1	<0.7	<1.2	<0.1
CCG 206	Instrument 2	A10	<5.5	9.9	<11.6	<5.2	24.6	<2.0	<1.2	<1.1	<0.7	49.1	61
Burn 2, Downwind Station													
500 to 600 m from fire	Instrument 1	A11	<5.5	22.9	<11.6	<5.2	13.9	<2.0	<1.2	<1.1	<0.7	19.8	23.4
CCG 206	Instrument 2	A12	<5.5	8.7	<11.6	<5.2	9.7	<2.0	<1.2	<1.1	<0.7	21.2	20.7
Trip Blank	Instrument 1	A13	<5.5	<1.3	<11.6	<5.2	<2.0	<2.0	<1.2	<1.1	<0.7	<1.2	0.3
	Instrument 2	A14	<5.5	<1.3	<11.6	<5.2	2.2	<2.0	<1.2	<1.1	<0.7	1.2	2.1
Background	Instrument 1	A17	<5.5	<1.3	<11.6	<5.2	<2.0	<2.0	<1.2	<1.1	<0.7	<1.2	<0.1
Remote control boat # 1	Instrument 2	A18	<5.5	<1.3	<11.6	<5.2	7.3	<2.0	<1.2	<1.1	0.8	4	<0.1
Background CCG 206		A19	<5.5	<1.3	<11.6	<5.2	<2.0	2.3	279	1.1	<0.7	<1.2	4.8

Section 11

Fresh Crude Oil, Weathered Crude, Residue NOBE 93

Analysis of "Fresh" Crude, Weathered Crude, and Residue Samples NOBE 93

The following are the analysis results of 19 oil samples including weathered NOBE oil standards, "fresh" crude, slightly weathered crude, and residue collected during burn and after burn from the Newfoundland Offshore Oil Burn Experiments (NOBE) which were conducted on August 12, 1993.

1. Table 11.1 presents detailed information about the nature of the NOBE oil samples ("fresh", weathered, or burn residue), the sampling date, and a description. Some samples were labeled as "fresh", but had actually been slightly weathered.

2. To avoid any composition change due to relatively high room temperature, all oil samples after arrival were tightly sealed and well stored in a cold room under 4°C.

3. The method used for the sample cleanup and analysis was "Analytical method for the determination of individual and total petroleum hydrocarbons, polycyclic aromatic hydrocarbons and biomarker triterpanes and steranes in crude oil, weathered oil and oil-spill related environmental samples" (internal report) developed in the ESD lab.

4. The conditions used for the high resolution capillary GC/FID analyses were as follows:

   Instrument: Hewlett Packard 5890 GC
   Column: 30 m x 0.32 mm ID DB-5 fused silica column (0.25 μm film thickness)
   Detector: FID
   Autosampler: HP 7673 Autoinjector
   Inlet: Splitless
   Gases: Carrier: Helium, 2.5 mL/min, nominal
   Make-up: Helium, 27.5 mL/min
   Detector air: 400 mL/min
   Detector hydrogen: 30 mL/min
   Injection volume: 1 μL
   Injector temperature: 290°C
   Detector temperature: 300°C
   Temperature program: 50°C for 2 min, then 6°C/min to 300°C, hold 16.7 min.
   The total run time is 60 minutes.
   Daily calibration: Alkane standard mixture

5. Target PAH compounds were analysed by GC/MS in the selected ion mode (SIM). The GC/MS conditions were as follows:

   Instrument: Hewlett Packard 5890 GC/5972 MS
   Column: 30 m x 0.25 mm ID HP-5 fused silica column (0.25 μm film thickness)
   Autosampler: HP 7673 Autoinjector
   Inlet: Splitless
   Gases: Carrier: Helium, 1.0 mL/min, nominal
   Injection volume: 1 μL
   Injector temperature: 290°C

Detector temperature: 300°C
Temperature program: 90°C for 1 min, then 25°C/min to 160°C, and then 8°C/min to 290°C, hold 15 min. The total run time is 35 minutes.
Daily calibration: SRM 1491 PAH standard mixture

6. Before performing sample analysis, all glassware was proved to be clean, and the solvent blank, method blank, surrogates and check standards were run to demonstrate the instrument performance with acceptable accuracy and precision.

7. Table 11.5 summarizes the values for total petroleum hydrocarbons (TPH) and weathered percentages of NOBE oil samples.
   The ratios of (C8+C10+C12+C14)/(C22+C24+C26+C28), C17/C18, and pristane/phytane are also listed in Table 11.5. The GC/FID chromatograms for TPH analysis are shown in Figures 11.15 to 11.26.

   The following procedures were used for chemical fractionation and analysis of oil residues: 20 mg of oil residue (in hexane) was loaded to a 3-g preconditioned silica gel column. Polar species and asphaltenes stayed on the column and were removed prior to further analysis. The nonpolar fraction passing the column was fractionated into saturated hydrocarbon fraction and aromatic hydrocarbon fraction, and was then analysed by capillary GC/FID and GC/MS to determine the concentrations of various hydrocarbon components.

   Key component groups are interpreted as follows:

   - TPH: total GC-detectable petroleum hydrocarbons is the sum of all resolved and unresolved distillable hydrocarbons detected by GC. The unresolved "envelope" or hump hydrocarbons appear as the area between the lower baseline and the curve defining the base of resolvable peaks.
   - Total n-alkanes: the sum of GC-resolvable n-alkanes from n-C8 to n-C40 plus pristane and phytane.
   - GCRTPH: GC-resolvable total petroleum hydrocarbons is the sum of the GC-resolvable saturated hydrocarbons (including the total n-alkanes, branched alkanes and cyclic saturates) and GC-resolvable aromatic hydrocarbons. The difference between TPH and GCRTPH is the GC-unresolvable total petroleum hydrocarbons.
   - (C8+C10+C12+C14)/(C22+C24+C26+C28): this n-alkane ratio is very useful for evaluating the extent and degree of oil weathering.
   - GCRTPH/TPH: this ratio is another useful parameter indicating the extent and degree of oil weathering.

   Figure 11.0 shows the plot of weathered percentages of NOBE oil standards against the values of (C8+C10+C12+C14)/(C22+C24+C26+C28) at various weathering percentages. The weathered percentages of the NOBE oil and residue samples were determined based on the plot of Figure 11.0.

8. It can be concluded from Table 11.5 and Figures 11.15 to 11.26 that:

   (a) compared to "fresh" and slightly weathered oil samples, very weathered residue samples (#11 to #16) collected during burn or after burn are characterized by much smaller values of total n-alkanes and GCRTPH and by much lower ratios of (C8+C10+C12+C14)/(C22+C24+C26+C28) and GCRTPH/TPH;

   (b) GCRTPH are mainly composed of n-alkanes;

   (c) as n-C17 and pristane are more degradable than n-C18 and phytane, the ratios of n-C17/n-C18 and pristane/phytane decrease as the weathering percentages increase;

   (d) the GC/FID chromatogram profiles of the NOBE oil and residue samples clearly demonstrated that both GC-resolvable low molecular weight (MW) n-alkanes, and GC-unresolved low MW hydrocarbons were lost due to combustion, resulting in great reduction of hump area before the GC retention time of 20 minutes;

   (e) the TPH values of residues #11 to #16 are significantly smaller than the "fresh" and slightly weathered oil samples, which indicates that the portion of polar and asphaltenes fraction in residue samples increases due to increased weathering.

9. Table 11.4 lists the concentration values of n-alkanes ranging from n-C8 to n-C40 for samples 2A through 16. Figures 11.27 and 11.28 graphically depict the distribution of n-alkanes. In order to compare all graphics on the same basis, the same scale range for the Y-axis was applied.

   The trends of change in n-alkane composition can be clearly seen in Figures 11.27 and 11.28:

   (a) the distribution profiles of n-alkanes are almost identical in samples 2 to 7, and n-C8 to n-C17 are more concentrated than other n-alkanes;

   (b) samples 11 to 16 were greatly degraded, with the distribution of n-alkanes appearing Gaussian and with the n-C24 having about the highest concentration.

   It is noted that the concentrations of n-alkanes from n-C8 to n-C24 including pristane and phytane in the residue samples are significantly lower than the concentrations of the corresponding n-alkanes in the "fresh" and slightly weathered oil samples. In sharp contrast, the concentrations of n-alkanes starting from n-C26 in the residues are significantly higher than the corresponding values of the "fresh" and slightly weathered oil samples.

   It is understandable that, as the weathering process proceeded, the low molecular weight n-alkanes continued to decrease, and at the same time, the high MW n-alkanes accumulated and were concentrated, relative to the unweathered oil.

10. The ratios of C17/pristane, C18/phytane and pristane/phytane are traditionally used as indicators of the extent and degree of weathering, and for slightly weathered oil, they are good indicators. They are not good indicators for badly weathered oil, however, as they are not highly degradation-resistant compounds and they degrade at different rates during the weathering process. In contrast, the ratio of (C8+C10+C12+C14)/(C22+C24+C26+C28) is a much better parameter to quantitatively evaluate the extent and degree of weathering.

11. Figures 11.32 and 11.43 show the n-alkane distribution chromatograms (at m/z 85) of NOBE oil samples obtained from GC/MS measurements. The ion 85 was chosen because it is a very characteristic ion fragment of saturated hydrocarbons. These chromatograms are not particularly useful for determining the source of the oil spill, but they can give information on the degree of weathering of the samples, which is indicated by the ion fragment 85 distribution profiles and the hump in the bottom chromatograms. These chromatograms can be used to qualitatively deduce whether a given sample is fresh crude or very weathered oil.

12. Table 11.3 summarizes the values of alkylated PAH homologues of NOBE oil samples determined from GC/MS. As a representative example, Figure 11.31 shows "fingerprinting" extracted ion chromatograms of alkylated PAH homologues in sample #2A. Table 11.3 reports the values of alkylated homologues of naphthalene, phenanthrene, dibenzothiophene, fluorene, and chrysene, instead of reporting the values of 16 conventional target PAHs. This is based on the following:

    (a) as alkylated PAHs are the most abundant components in oil and persist for relatively longer periods of time than the parent compounds, they are more useful for oil weathering and spill assessment;

    (b) alkylated homologues of naphthalene, phenanthrene, dibenzothiophene, fluorene, and chrysene are the most characteristic and abundant of all PAH homologues of oil, and different oils have different distribution profiles of alkylated PAH homologues. They are more valuable than the parent PAHs in fingerprinting the weathered and spill oil, distinguishing between sources of hydrocarbons, and providing information on the extent and degree of oil weathering and degradation;

    (c) values of alkylated PAH homologues more truly reflect the composition of PAHs in oil;

    (d) by reporting in this way, the composition change of the PAHs caused by weathering or biodegradation can be more easily detected and traced, and the data are more meaningful.

Figure 11.29 and 11.30 graphically depict the distribution of alkylated PAH homologues. For comparison purpose, the same scale range for the Y-axis was applied to Figures 11.29 and 11.30.

13. Among the five alkylated PAH homologues listed in Table 11.3, the alkyl homologues are the most easily degradable in naphthalene, followed by fluorene and then dibenzothiophene. Alkylated chrysenes are the most degradation-resistant homologues. The distribution mode and profile of the alkyl PAH homologues of NOBE oil samples are clearly seen in Figures 11.29 and 11.30.

14. For NOBE oil, the alkylated naphthalenes are the most abundant, constituting more than 70% of the total target PAH homologues. The concentrations of dibenzothiophene and its alkyl homologues are very low relative to the ASMB and other oils, which indicates the sulphur content in the NOBE oil is much lower than ASMB oil.

    As the result of combustion, the concentrations of alkylated naphthalenes in the residue samples #11 to #16 were greatly reduced: from ~9000 ppm to 1000-1900 ppm, approximately 5-9 times reduced. In contrast, the concentrations of alkylated chrysenes in the corresponding samples were increased, obviously due to the highly degradation-resistant nature of the alkylated chrysenes.

15. Table 11.3 shows the relative composition of alkylated naphthalenes and phenanthrenes, and the ratios of the total alkyl naphthalenes to total alkyl phenanthrenes and chrysenes. It can be seen from Table 11.3 that the ratios for residue samples are lower than the starting oil. These ratios can also be used to evaluate the degree of weathering.

16. It is interesting to note that the relative ratios of three isomers of methyl dibenzothiophenes (4-methyl-dibenzothiophene, 3-/2-methyl-dibenzothiophene and 1-methyl-dibenzothiophene) remain almost constant, whether samples are "fresh", slightly weathered, or badly weathered residue.

    So far, it has been demonstrated that the relative ratios of these three isomers are different for different oils from different sources. These three isomers can be used as another kind of marker for characterization and identification of sources of oil and weathered oil. The advantages of using methyl dibenzothiophenes as markers are that they are present in almost all petroleum; they are well separated and resolved; and they are subject to little interference from weathering effect.

NOBE 93 Table 11.1

NOBE Oil and Residue Samples
Alberta Sweet Mix Crude Oil

I.D. #	Type	Qty	Description
1	Fresh Crude	1 L	Sample taken from 3rd truck in Hughenden, Alb., 7/22/93. Only sample of fresh crude that was not damaged during transport.
2	Fresh Crude	3.5 L	Sample taken from 2nd truck in Hughenden, Alb., 7/22/93; 2 container collected split into 2A & 2B. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
3	Fresh Crude	2.5 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Container was damaged during transport, some sample was lost and expect some weathering of remaining crude.
4	Weathered	3 L	Sample taken from 1st truck in Hughenden, Alb., 7/22/93. Only sample of weathered crude collected in Alberta, container remained intact during transport.
5	Weathered Crude	60 L	Sample collected from trucks while loading oil into CCG Sir Wilfred Grenfell, St. John's, NFLD., 8/2/93. On 9/2/93 sample from truck 3 was mixed with sample from truck 1 and 2 respectively to simulate the oil on the ship. 5A = trucks 3 + 1, 5B = trucks 3 + 2.
6	Oily Water	10 L	Separated from weathered oil (sample 5), 9/2/93.
7	Weathered Crude	3 L	Collected before Burn 1, from apex of fire boom, 8/12/93.
8	Oily Water	10 L	Separated from weathered oil (sample 7), 9/2/93.
9	Surface Sheen	5	1 sorbent pad was used to collect 5 surface samples. Samples collected during Burn 1, between fireboom and row boom, 8/12/93.
10	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, behind row boom, 8/12/93.
11	Residue	1 L	Sample collected during Burn 1, from water surface between fire boom and row boom, 8/12/93.
12	Residue	7 L	Sample collected after Burn 1, from apex of fire boom, 8/12/93.
13	Surface Sheen	4	1 sorbent pad was used to collect 4 surface samples. Samples collected during Burn 2, between fire boom and row boom, 8/12/93.
14	Residue	4 L	Collected during Burn 2, from water surface between fire boom and row boom, 8/12/93.
15	Residue	7 L	Collected after Burn 2, from apex of row boom, 8/12/93
16	Residue	0 3 L	Collected from sides of remote control sample boats. 8/14/93
17	Residue	15 L	Collected from surface of row boom. Sept 93 Sample contaminated with cleaning agents

NOBE 93 Table 11 2

Summary of Oil Samples Analysis

	Hughenden, Truck # 3, Fresh Crude Oil	Hughenden, Truck # 2, Fresh Crude Oil	Hughenden, Truck # 2, Fresh Crude Oil	Hughenden, Truck # 1, Fresh Crude Oil	Hughenden, Truck # 1 Weathered Oil	St-John's, Truck # 3 + 1 Weathered Oil	St-John's, Truck # 3 + 2 Weathered Oil	Apex of fireboom before Burn # 1
	1 - Ref. oil	2A - Fresh	2B - Fresh	3 - Fresh	4 - Weath.	5A - Weath.	5B - Weath.	7 - Weath.
Weathering (%)	0	6	6	7	9	6	6	8
Asphaltene Content (weight %)	0.6				0.7		0.7	0.8
Density (g/ml)	0.8384				0.8431		0.8437	0.8496
Emulsion Formation (f_r)	0.0				0.0		0.0	0.0
Emulsion Stability (f_r)	0.0				0.0		0.0	0.0
Flash Point (°C)	-11				-15		-13	-9
Interfacial Tension (dynes/cm)								
Oil/Sea Water	17				15		13	15
Oil/Fresh Water	19				15		14	17
Air/Oil	23				21		21	21
Metals (µg/m³)	LMDL	LMDL	LMDL					
PAH (µg/g)	12085	11563	11752	11933	11383	11603	11525	8467
Pour Point (°C)	-21				-21		-21	-21
Sulphur Content (weight %)	0.2				0.2		0.2	
TPH (mg/g)	632	590	582	666	614	655	645	609
Viscosity (cP)								
@ 500/s Newtonian	8				10		11	13
@ 1/s 30100 @ 10/s non-Newtonian								
@1/s 24200 @ 10/s non-Newtonian								
Water Content (weight %)	0.1				0.2		0.5	0.3
Wax Content (weight %)	11				7		10	9

Fugitive Sheen (samples # 9, 10, 13) : non-detectable by methods employed

Thickness of the oil at the apex of the fire boom prior to ignition ... Burn 1 (only) : 7 cm (2.7 in) at approximately 10:25

- All tests done at 15°C
- Water content was determined by volumetric Karl Fisher titration using ASTM method D4377-92
- All other tests were done following the methodologies described in Whiticar, S. et. al., "A Catalogue of Crude Oil and Oil Product Properties" Environment Canada. EE-144. Ottawa, Ont., 1992

NOBE 93 Table 11 3

Summary of Residue Samples Analysis

	Between fireboom and rowboom during Burn # 1	Apex of fireboom after Burn # 1	Between fireboom and rowboom during Burn # 2	Apex of rowboom after Burn # 2	From side of R/C boats collected Aug 14, 93
	11 - Residue	12 - Residue	14 - Residue	15 - Residue	16 - Residue
Weathering (%)	49	44	49	48	50
Asphaltene Content (weight %)		1.8		2.3	
Density (g/ml)		0.9506		0.9365	
Emulsion Formation (f_i)		0.0		0.0	
Emulsion Stability (f_i)		0.0		0.0	
Flash Point (°C)		>90		>90	
Interfacial Tension (dynes/cm)					
Oil / Sea Water					
Oil / Fresh Water					
Air / Oil					
Metals (µg/m³)					
PAH (ug/g)	4304	2985	2917	3468	2991
Pour Point (°C)		31		34	
Sulphur Content (weight %)		0.4		0.4	
TPH (mg/g)	513	431	408	479	451
Viscosity (cP)					
@ 500/s Newtonian					
@ 1/s 30100 @ 10/s non-Newtonian				131000.0	
@1/s 24200 @ 10/s non-Newtonian		98600.0			
Water Content (weight %)		15.0		14.0	
Wax Content (weight %)		13		14	

Fugitive Sheen (samples # 9, 10, 13) : non-detectable by methods employed

Thickness of the oil at the apex of the fire boom prior to ignition ... Burn 1 (only) : 7 cm (2.7 in) at approximately 10:25

- All tests done at 15°C
- Water content was determined by volumetric Karl Fisher titration using ASTM method D4377-92
- All other tests were done following the methodologies described in Whiticar, S. et. al., "A Catalogue of Crude Oil and Oil Product Properties" Environment Canada, EE-144, Ottawa, Ont., 1992.

NOBE 93 Table 11.4

Alkylated PAH Homologue Distributions of Oil and Residue Samples

	1 Ref oil		2A - Fresh		2B - Fresh		3 - Fresh		4 - Weath.		5A - Weath.		5B - Weath.		7 - Weath.		11 - Residue		12 - Residue		14 - Residue		15 - Residue		16 - Residue	
weathering %	*0*		*6*		*6*		*7*		*9*		*6*		*6*		*8*		*49*		*44*		*49*		*48*		*50*	
	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%	µg/g	%
Naph.																										
C0-N	307	3.3	313	3.6	313	3.5	308	3.4	307	3.5	297	3.4	278	3.2	206	3.4	79	4.0	42	2.6	66	6.4	67	4.2	18	1.6
C1-N	1662	18.1	1496	17.0	1569	17.5	1592	17.5	1519	17.5	1540	17.4	1529	17.4	1049	17.2	222	11.4	217	13.5	128	12.5	190	11.9	82	7.4
C2-N	3073	33.4	2783	31.7	2855	31.8	2915	32.0	2755	31.7	2864	32.4	2842	32.4	2246	36.8	586	30.0	570	35.5	323	31.5	494	30.9	312	28.3
C3-N	3013	32.8	2902	33.0	2972	33.1	3013	33.1	2850	32.8	2915	32.9	2902	33.1	1749	28.6	678	34.7	499	31.1	271	26.4	523	32.7	411	37.3
C4-N	1144	12.4	1295	14.7	1275	14.2	1283	14.1	1255	14.4	1236	14.0	1212	13.8	859	14.1	387	19.8	279	17.4	237	23.1	326	20.4	278	25.2
SUM	**9199**		**8789**		**8984**		**9111**		**8686**		**8852**		**8763**		**6109**		**1952**		**1607**		**1025**		**1600**		**1101**	
Phen.																										
C0-P	175	10.2	155	9.1	153	9.1	156	9.1	146	8.9	152	9.0	153	9.1	109	7.4	142	9.2	69	7.8	214	17.3	150	12.3	193	15.8
C1-P	481	27.9	535	31.4	542	32.1	540	31.4	513	31.4	541	32.2	535	31.8	407	27.5	378	24.5	224	25.4	303	24.5	298	24.5	296	24.2
C2-P	497	28.9	489	28.7	479	28.3	475	27.6	463	28.3	452	26.9	463	27.5	450	30.4	452	29.4	270	30.6	319	25.7	360	29.6	337	27.6
C3-P	369	21.4	345	20.2	335	19.8	350	20.4	328	20.0	344	20.5	339	20.2	342	23.1	385	25.0	213	24.1	280	22.6	276	22.7	270	22.1
C4-P	200	11.6	182	10.7	181	10.7	197	11.5	186	11.4	191	11.4	191	11.4	173	11.7	183	11.9	106	12.0	123	9.9	132	10.9	125	10.2
SUM	**1722**		**1706**		**1690**		**1718**		**1636**		**1680**		**1681**		**1481**		**1540**		**882**		**1239**		**1216**		**1221**	
Diben.																										
C0-D	16	10.3	17	12.2	17	12.4	17	11.7	16	11.8	15	11.0	16	11.6	14	12.3	10	8.9	6	8.7	12	13.6	10	10.3	9	10.5
C1-D	37	23.7	35	25.2	36	26.3	36	24.8	34	25.0	36	26.5	34	24.6	28	24.6	26	23.2	15	21.7	22	25.0	22	22.7	21	24.4
C2-D	60	38.5	50	36.0	49	35.8	51	35.2	47	34.6	47	34.6	48	34.8	46	40.4	45	40.2	28	40.6	34	38.6	40	41.2	33	38.4
C3-D	43	27.6	37	26.6	35	25.5	41	28.3	39	28.7	38	27.9	40	29.0	26	22.8	31	27.7	20	29.0	20	22.7	25	25.8	23	26.7
SUM	**156**		**139**		**137**		**145**		**136**		**136**		**138**		**114**		**112**		**69**		**88**		**97**		**86**	
Fluo.																										
C0-F	123	15.1	108	14.4	119	15.6	110	14.3	116	15.5	123	16.3	116	15.3	82	14.2	66	16.0	33	13.5	78	23.4	58	19.3	58	19.2
C1-F	250	30.6	218	29.1	216	28.3	217	28.3	218	29.1	210	27.9	210	27.7	176	30.4	115	27.9	69	28.2	91	27.3	83	27.6	74	24.5
C2-F	269	33.0	237	31.6	255	33.5	260	33.9	240	32.0	252	33.4	253	33.3	176	30.4	109	26.5	76	31.0	87	26.1	91	30.2	92	30.5
C3-F	174	21.3	187	24.9	172	22.6	181	23.6	175	23.4	169	22.4	180	23.7	144	24.9	122	29.6	67	27.3	77	23.1	69	22.9	78	25.8
SUM	**816**		**750**		**762**		**768**		**749**		**754**		**759**		**578**		**412**		**245**		**333**		**301**		**302**	
Chry.																										
C0-C	33	17.2	30	16.8	31	17.3	34	17.8	30	17.0	32	17.7	32	17.4	35	18.9	56	19.4	33	18.1	8	3.4	57	22.4	78	27.8
C1-C	55	28.6	51	28.5	48	26.8	49	25.7	48	27.3	48	26.5	50	27.2	45	24.3	72	25.0	44	24.2	73	31.5	56	22.0	68	24.2
C2-C	70	36.5	66	36.9	64	35.8	72	37.7	62	35.2	66	36.5	66	35.9	55	29.7	91	31.6	58	31.9	82	35.3	76	29.9	76	27.0
C3-C	34	17.7	32	17.9	36	20.1	36	18.8	36	20.5	35	19.3	36	19.6	50	27.0	69	24.0	47	25.8	69	29.7	65	25.6	59	21.0
SUM	**192**		**179**		**179**		**191**		**176**		**181**		**184**		**185**		**288**		**182**		**232**		**254**		**281**	
TOTAL	**12085**		**11563**		**11752**		**11933**		**11383**		**11603**		**11525**		**8467**		**4304**		**2985**		**2917**		**3468**		**2991**	
Ratio Total Naph /Phen.				5.2		5.3		5.3		5.3		5.3		5.2		4.1		1.3		1.8		0.8		1.3		0.9
Ratio Total Naph/Chry.				74.8		81.4		75.5		82.8		74.9		72.0		75.5		74.5		29.6		48.7		13.1		27.6
Ratio Total Naph/Fluo.				11.3		11.7		11.8		11.9		11.6		11.7		11.5		10.6		4.7		6.6		3.1		5.3
Ratio Total Naph/Diben..				59.0		63.2		65.6		62.8		63.9		65.1		63.5		53.6		17.4		23.3		11.6		16.5
Ratio 4-M-D :2/3-M-D :1-M-D				1:0.54:0.26		1:0.52:0.23		1:2.51:0.25		1:2.51:0.25		1:0.51:0.24		1:0.51:0.24		1:0.52:0.25		1:0.51:0.25		1:0.51:0.26		1:0.52:0.27		1:0.52:0.26		1:0.51:0.27

NOBE 93 Table 11.5

n-Alkane Distributions of Oil and Residue Samples

	1 - Ref. oil	2A - Fresh	2B - Fresh	3 - Fresh	4 - Weath.	5A - Weath.	5B - Weath.	7 - Weath.	11 - Residue	12 - Residue	14 - Residue	15 - Residue	16 - Residue
eathering	0	6	6	7	9	6	6	8	49	44	49	48	50
	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g	mg/g
n-C8	5 19	4.75	4.85	4.11	4.09	4.13	4.36	3.83	0.03	0.19	0.02	0.05	-
n-C9	6 06	5.59	5.87	5.32	4.95	5.27	5.37	5.01	0.05	0.34	0.04	0.11	-
n-C10	5 73	5.49	5.55	5.25	4.88	5.11	5.17	4.97	0.11	0.48	0.09	0.19	0.02
n-C11	5 79	5.60	5.61	5.52	5.10	5.38	5.46	5.41	0.18	0.66	0.14	0.32	0.04
n-C12	5 88	5.67	5.58	5.63	5.32	5.81	5.70	5.52	0.29	0.82	0.21	0.47	0.12
n-C13	5 86	5.96	5.77	5.64	5.26	5.74	5.50	5.42	0.49	0.98	0.31	0.71	0.33
n-C14	5 96	6.29	6.04	5.90	5.59	6.06	5.75	5.72	0.79	1.34	0.52	1.03	0.67
n-C15	5 73	5.96	5.70	5.54	5.34	5.72	5.53	5.40	1.09	1.51	0.74	1.29	1.01
n-C16	5 62	5.75	5.54	5.35	5.15	5.51	5.31	5.27	1.45	1.77	1.05	1.62	1.39
n-C17	6 70	6.72	6.42	6.33	6.13	6.36	6.16	6.10	2.35	2.22	1.34	2.28	1.95
Pristane	2 71	2.98	2.96	2.80	2.68	2.86	2.76	2.68	1.04	1.27	0.71	1.08	1.08
n-C18	5 27	5.34	5.19	5.04	5.03	5.16	5.01	4.93	2.38	2.23	1.52	2.38	2.16
Phytane	2 48	2.60	2.58	2.43	2.34	2.50	2.38	2.34	1.07	1.10	0.73	1.10	1.09
n-C19	4 47	4.49	4.36	4.17	4.09	4.32	4.01	4.07	2.06	1.93	1.58	2.21	1.97
n-C20	4 03	4.07	3.93	3.94	3.79	3.92	3.71	3.71	2.33	2.08	1.83	2.31	2.27
n-C21	3 94	4.05	3.93	3.90	3.69	3.93	3.71	3.76	2.78	2.45	2.12	2.77	2.68
n-C22	3 65	3 54	3.67	3.41	3.47	3.43	3.39	3.50	2.87	2.39	2.26	2.90	2.84
n-C23	3 39	3 36	3.28	3.27	3.12	3.33	3.22	3.16	3.15	2.59	2.37	2.95	2.86
n-C24	3 19	3.47	3.21	3.06	3.01	3.15	3.12	2.99	3.14	2.58	2.49	3.06	3.06
n-C25	2.80	2.64	2.66	2.69	2.75	2.72	2.67	2.62	2.89	2.45	2.33	2.82	2.81
n-C26	2 46	2 40	2.42	2.40	2.44	2.44	2.40	2.35	2.79	2.35	2.23	2.69	2.65
n-C27	2 19	2.17	2.13	2.15	2.00	2.13	2.05	2.02	2.75	2.29	2.13	2.60	2.54
n-C28	1 79	1 88	1.76	1.78	1.67	1.76	1.57	1.60	2.24	2.14	1.95	2.37	2.26
n-C29	1 65	1 63	1.59	1.57	1.50	1.49	1.40	1.55	2.00	2.02	1.86	2.21	2.11
n-C30	1 22	1.22	1.24	1.28	1.28	1.25	1.16	1.21	1.71	1.64	1.61	1.86	1.91
n-C31	1 03	1 08	1.13	1.16	1.04	1.08	1.01	1.04	1.63	1.52	1.50	1.54	1.68
n-C32	0 86	0 81	0.80	0.86	0.79	0.78	0.70	0.81	1.32	1.16	1.13	1.26	1.27
n-C33	0 69	0.72	0.67	0.76	0.67	0.69	0.56	0.59	1.25	1.07	0.95	1.12	1.13
n-C34	0 60	0 54	0.53	0.58	0.56	0.54	0.45	0.52	0.91	0.87	0.77	0.90	0.86
n-C35	0 44	0 42	0.39	0.42	0.44	0.43	0.33	0.42	0.66	0.71	0.69	0.73	0.73
n-C36	0 35	0 32	0.30	0.34	0.36	0.35	0.28	0.32	0.59	0.57	0.56	0.62	0.65
n-C37	0 32	0 31	0.27	0.31	0.34	0.33	0.25	0.29	0.53	0.52	0.50	0.56	0.59
n-C38	0 24	0 21	0.17	0.25	0.25	0.26	0.17	0.24	0.37	0.39	0.40	0.43	0.50
n-C39	0 17	0 15	0.13	0.17	0.20	0.18	0.12	0.18	0.30	0.32	0.32	0.30	0.34
n-C40	0 17	0.12	0.10	0.15	0.18	0.15	0.10	0.15	0.26	0.28	0.27	0.24	0.29
TOTAL	109	108	106	103	100	104	101	100	50	49	39	51	48

NOBE 93 Table 11.6

TPH Values and Weathered Percentages of Oil and Residue Samples

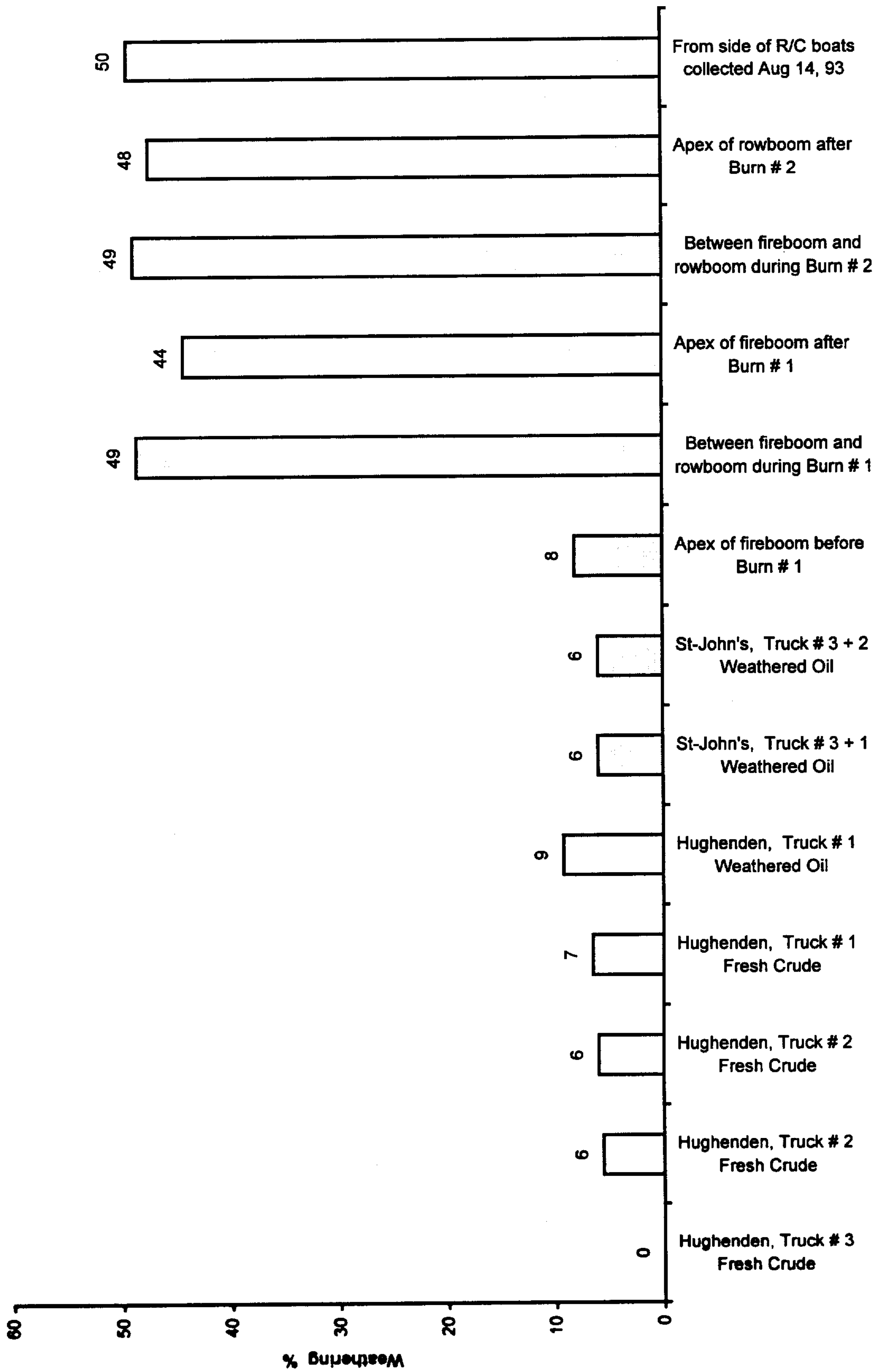
Sample	Total n-Alkanes (mg/g oil)	GCRTPH (mg/g oil)	TPH (mg/g oil)	GCRTPH/TPH	(C8+C10+C12+C14)/ (C22+C24+C26+C28)	Weathered Percent (%)	C17/C18	Pris./Phy.
1 - Ref. oil	108	172	632	0.27	2.05		1.27	1.09
2A - Fresh	108	145	590	0.25	2.02	5.6	1.26	1.12
2B - Fresh	106	152	582	0.26	2.00	6.0	1.24	1.15
3 - Fresh	103	181	666	0.27	1.98	6.5	1.25	1.16
4 - Weathered	100	158	614	0.26	1.86	9.2	1.22	1.15
5A - Weathered	104	173	655	0.26	2.00	6.0	1.23	1.15
5B - Weathered	101	166	645	0.26	2.00	6.0	1.23	1.16
7 - Weathered	99	161	609	0.26	1.91	8.1	1.24	1.14
11 - Residue	50	74	513	0.14	0.11	48.6	0.99	0.97
12 - Residue	49	62	431	0.14	0.30	44.3	0.99	1.15
14 - Residue	39	51	408	0.13	0.10	48.9	0.88	0.97
15 - Residue	51	65	479	0.14	0.16	47.5	0.96	0.99
16 - Residue	48	57	451	0.13	0.07	49.5	0.90	1.00

Legend

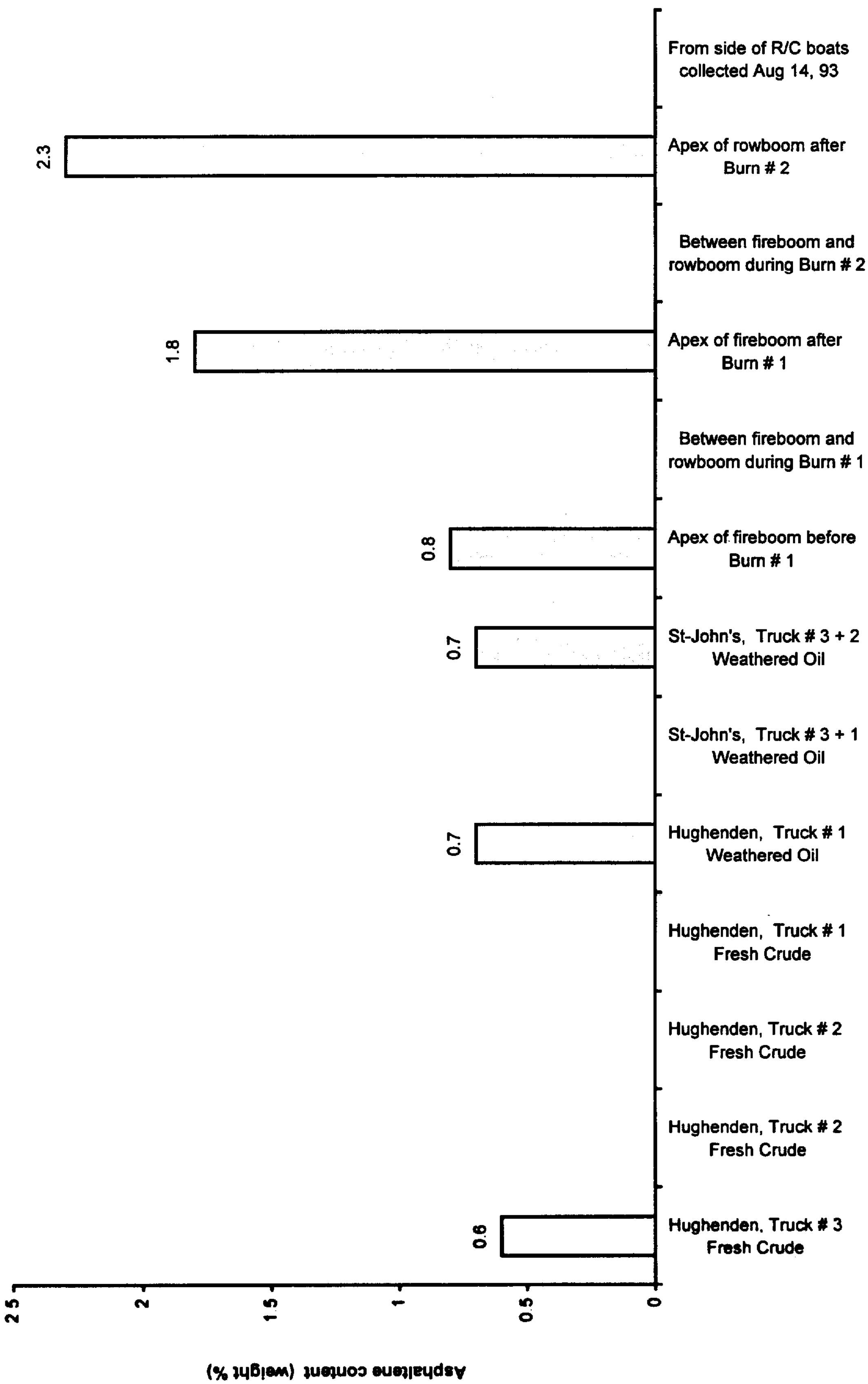
TPH: Total Petroleum Hydrocarbons
GCR TPH: GC Resolvable TPH
Pris./Phy.: Ratio of pristane/phytane

NOBE 93 Figure 11.0

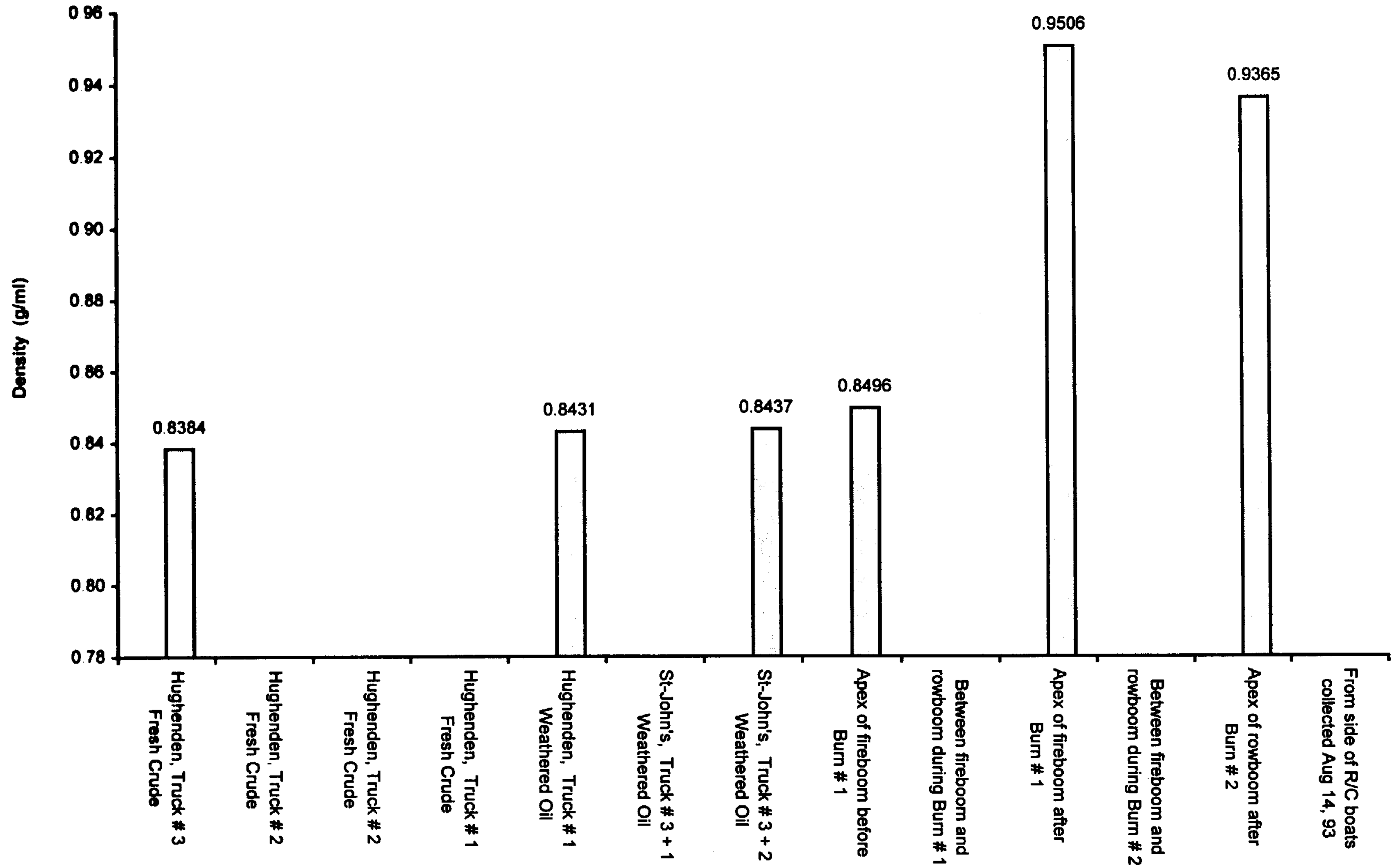
Weathering of Oil and Residue Samples



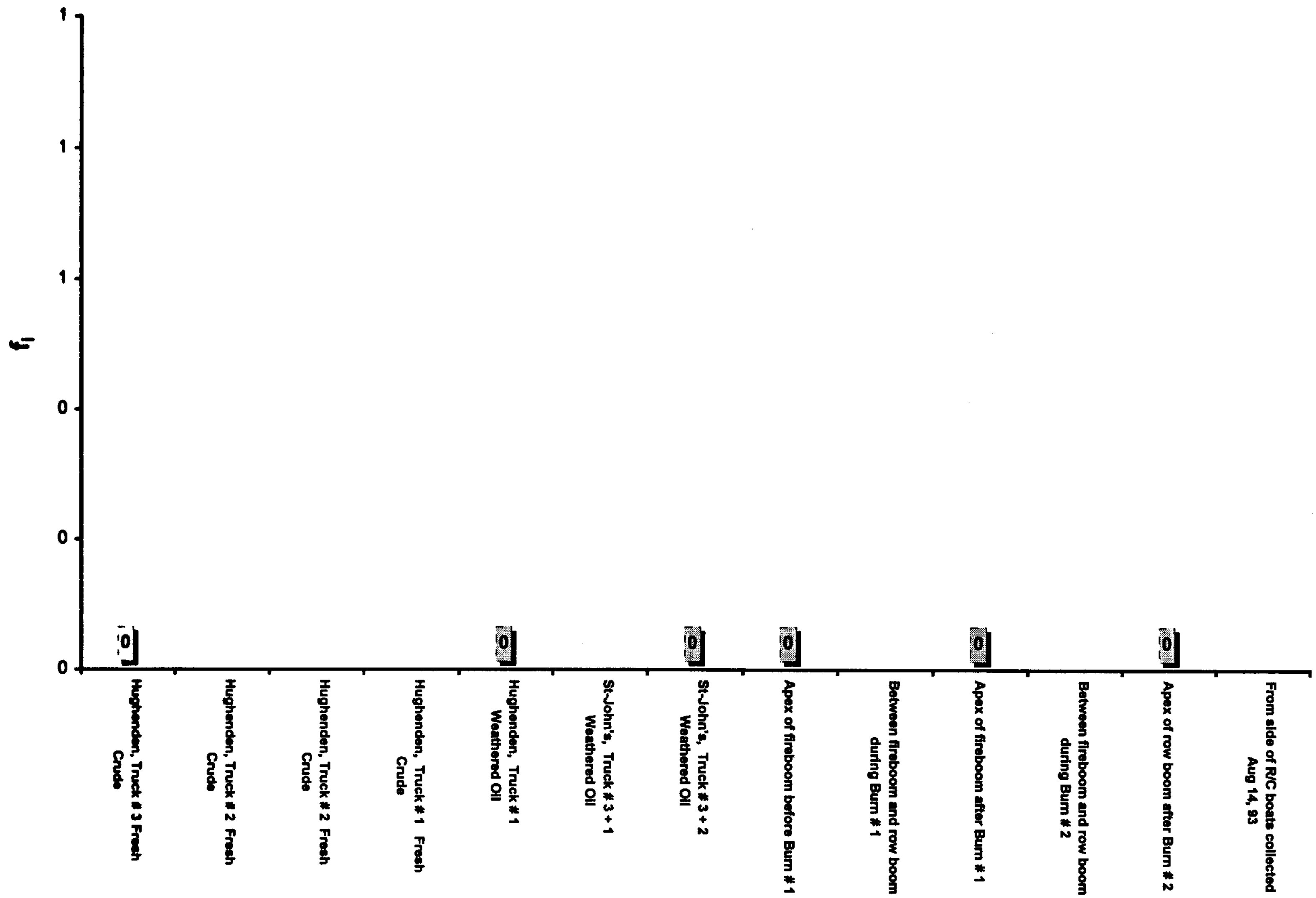
NOBE 93 Figure 11.1 Asphaltene Content of Oil and Residue Samples



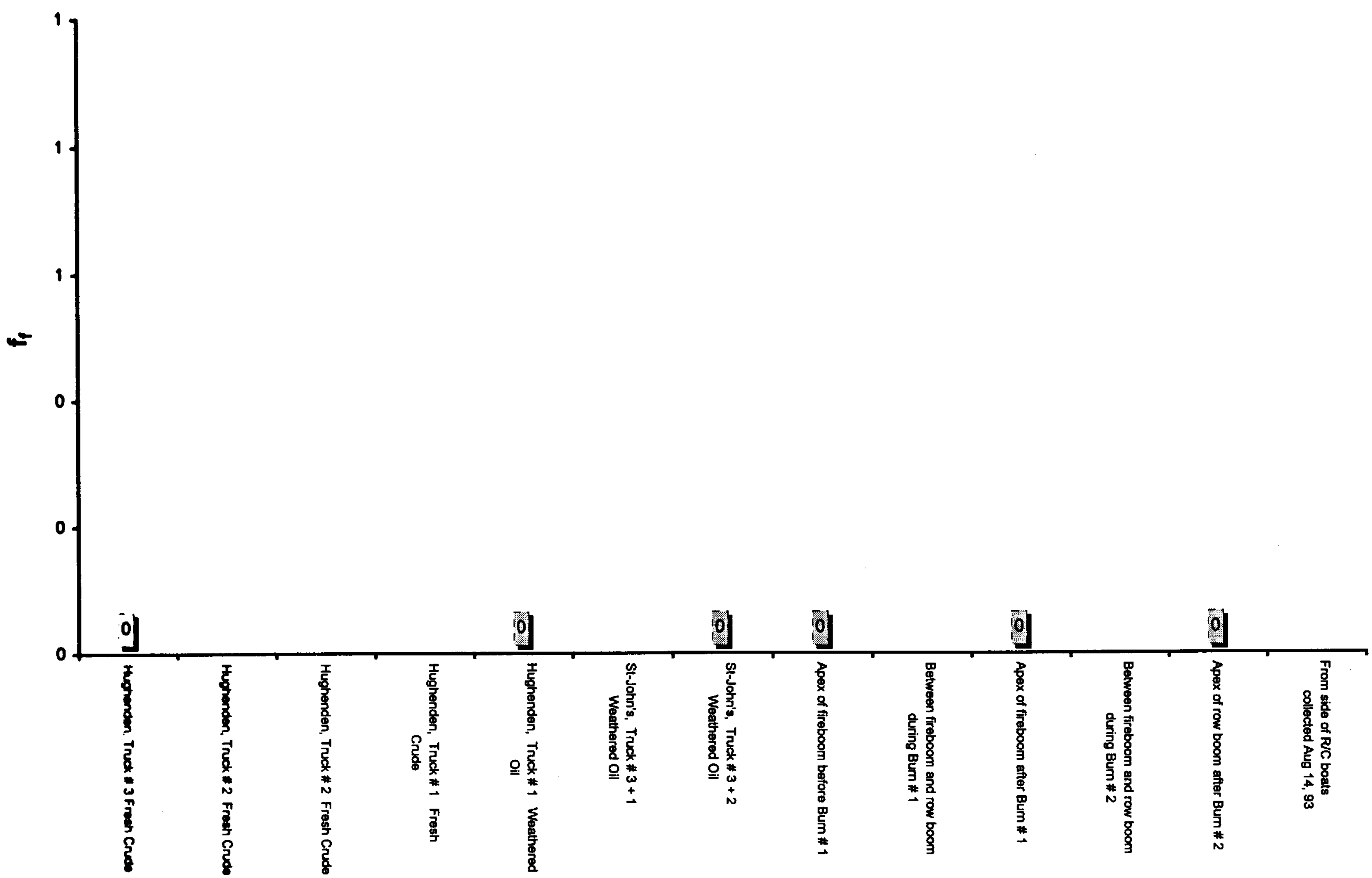
NOBE 93 Figure 11.2 **Density of Oil and Residue Samples at 15°C**



NOBE 93 Figure 11.3 **Emulsion Formation of Oil and Residue Samples at 15°C**

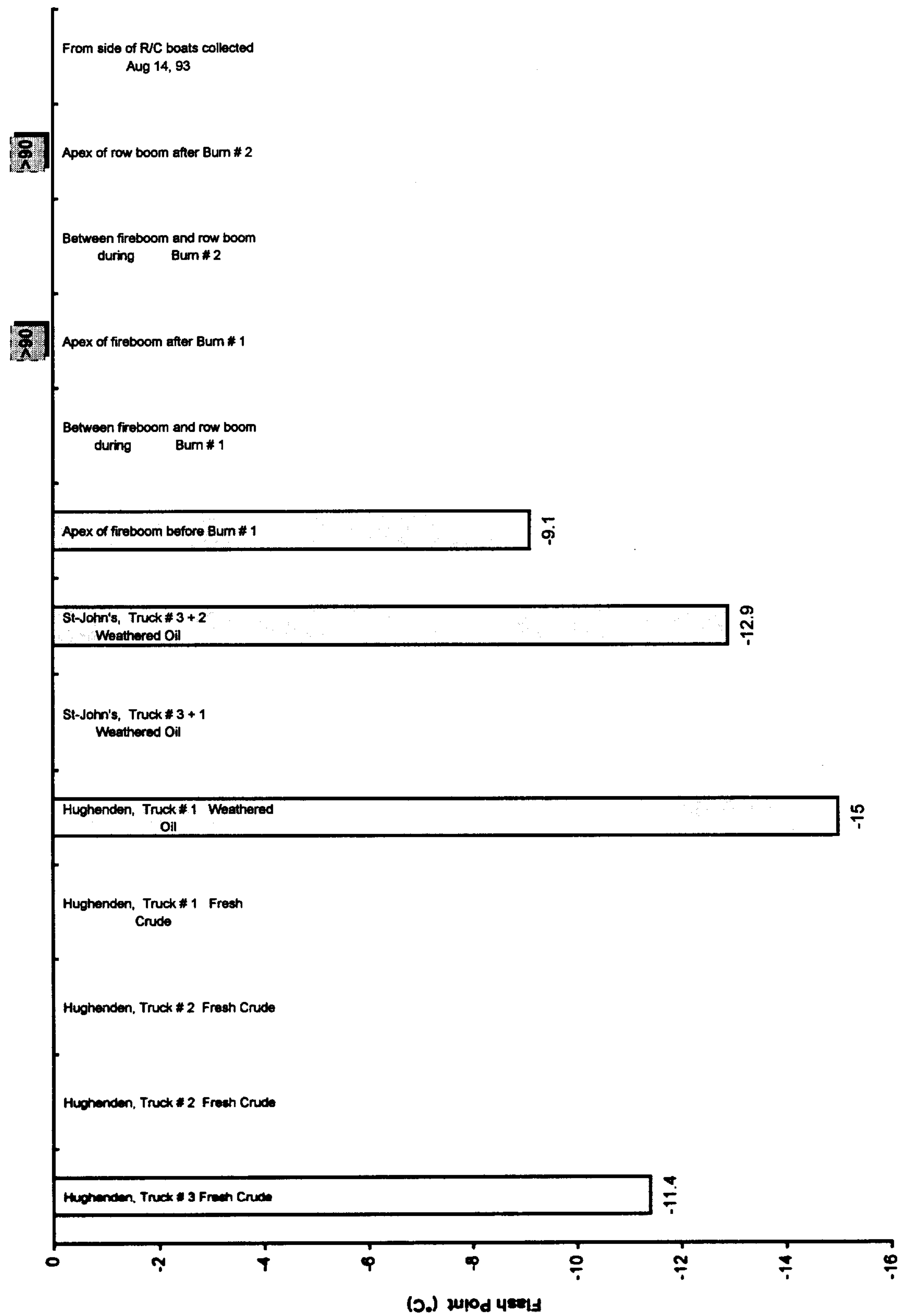


NOBE 93 Figure 11.4 **Emulsion Stability of Oil and Residue Samples at 15°C**

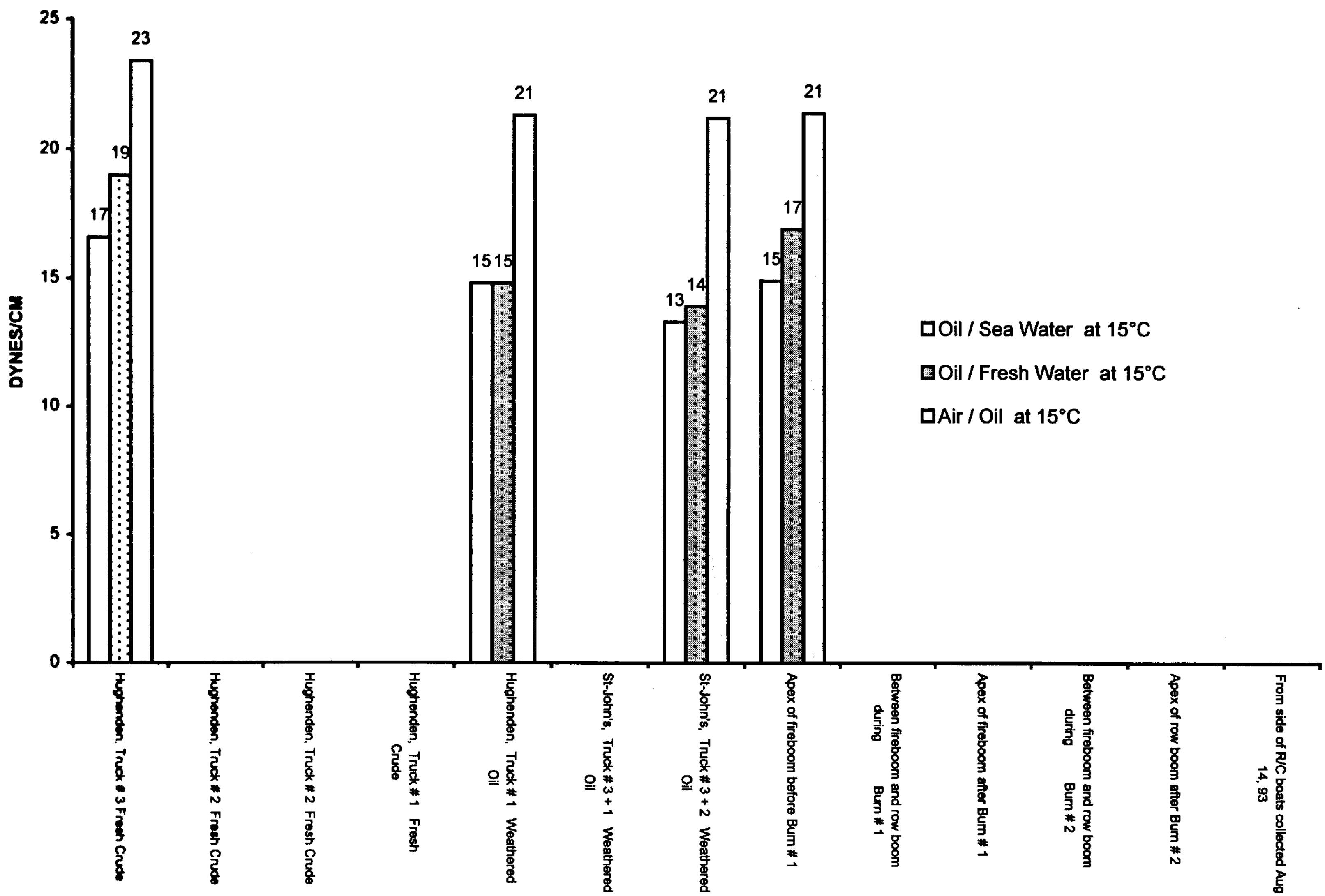


NOBE 93 Figure 11.5

Flash Point of Oil and Residue Samples



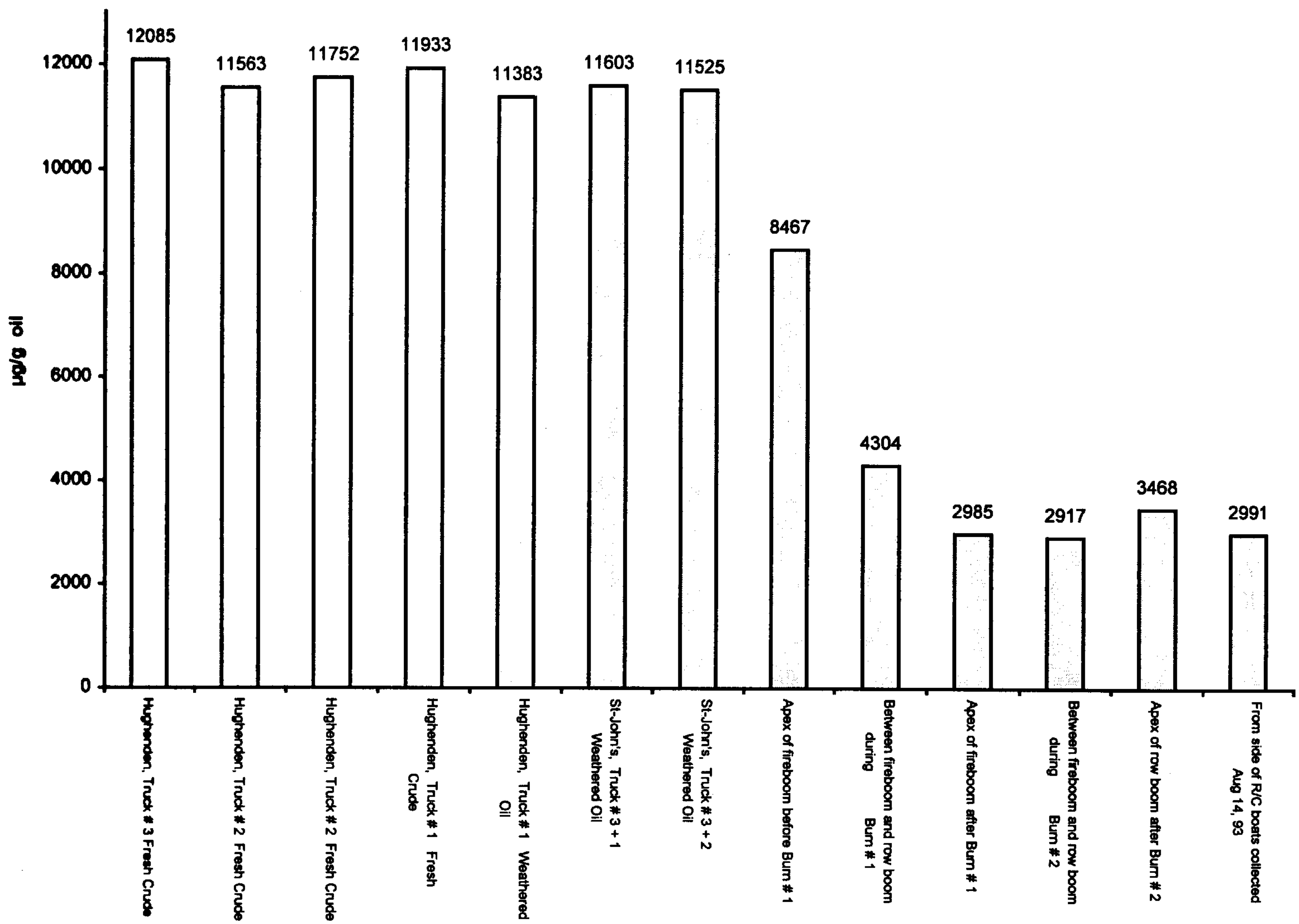
NOBE 93 Figure 11.6 **Interfacial Tension of Oil and Residue Samples**



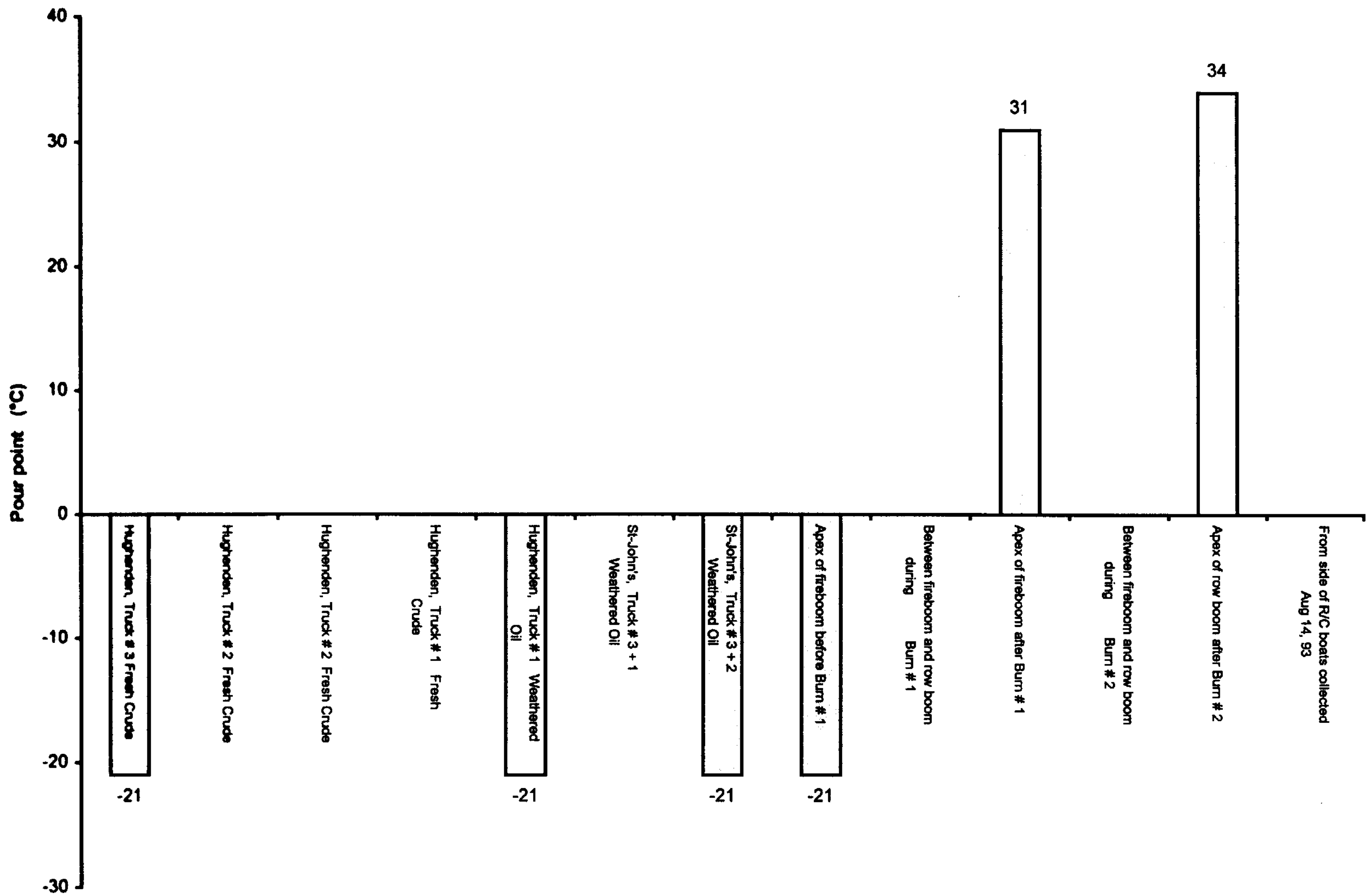
NOBE 93 Figure 11.7

PAH of Oil and Residue Samples

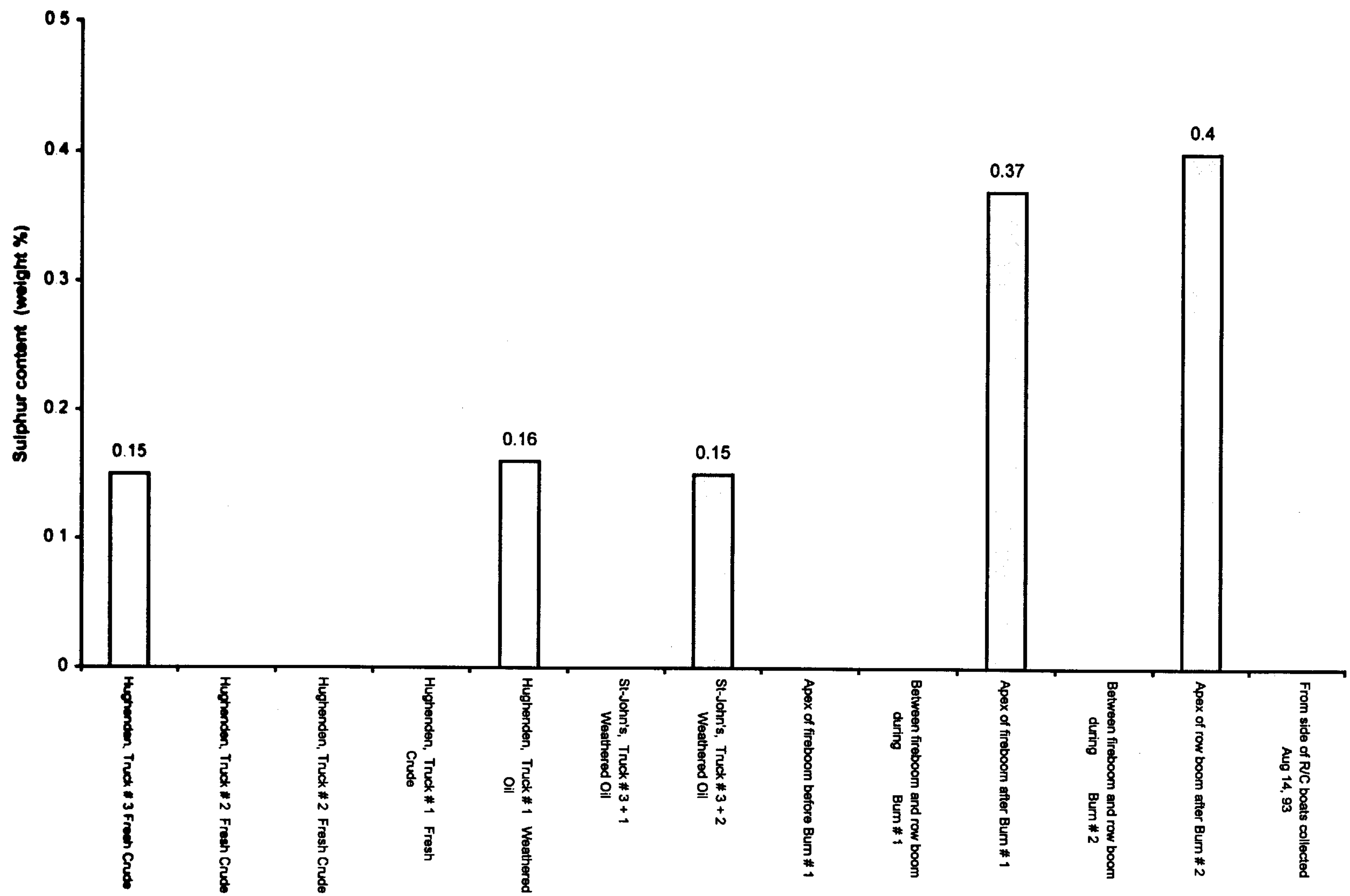
Alberta Sweet Mix Crude Oil



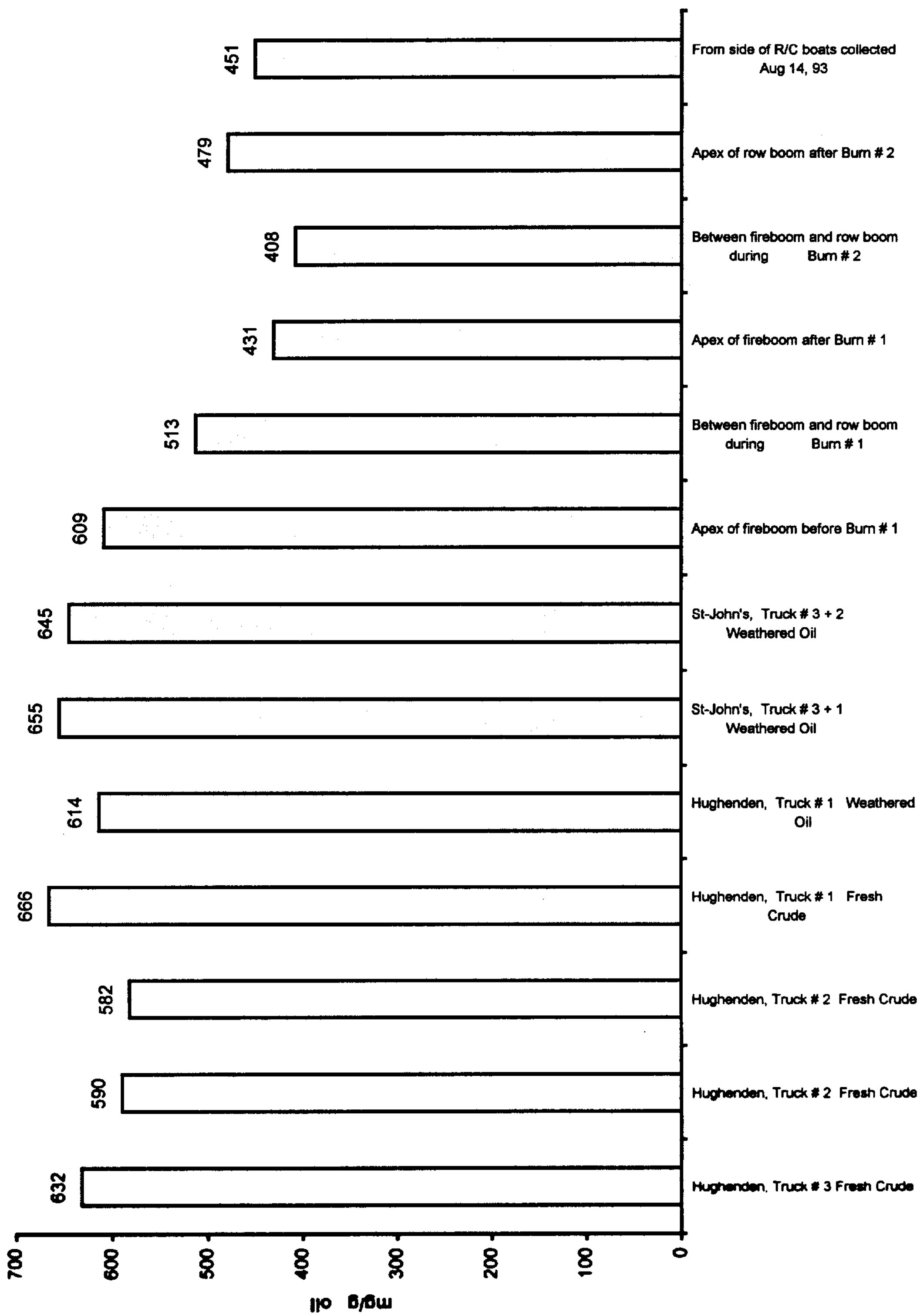
NOBE 93 Figure 11.8 **Pour Point of Oil and Residue Samples**



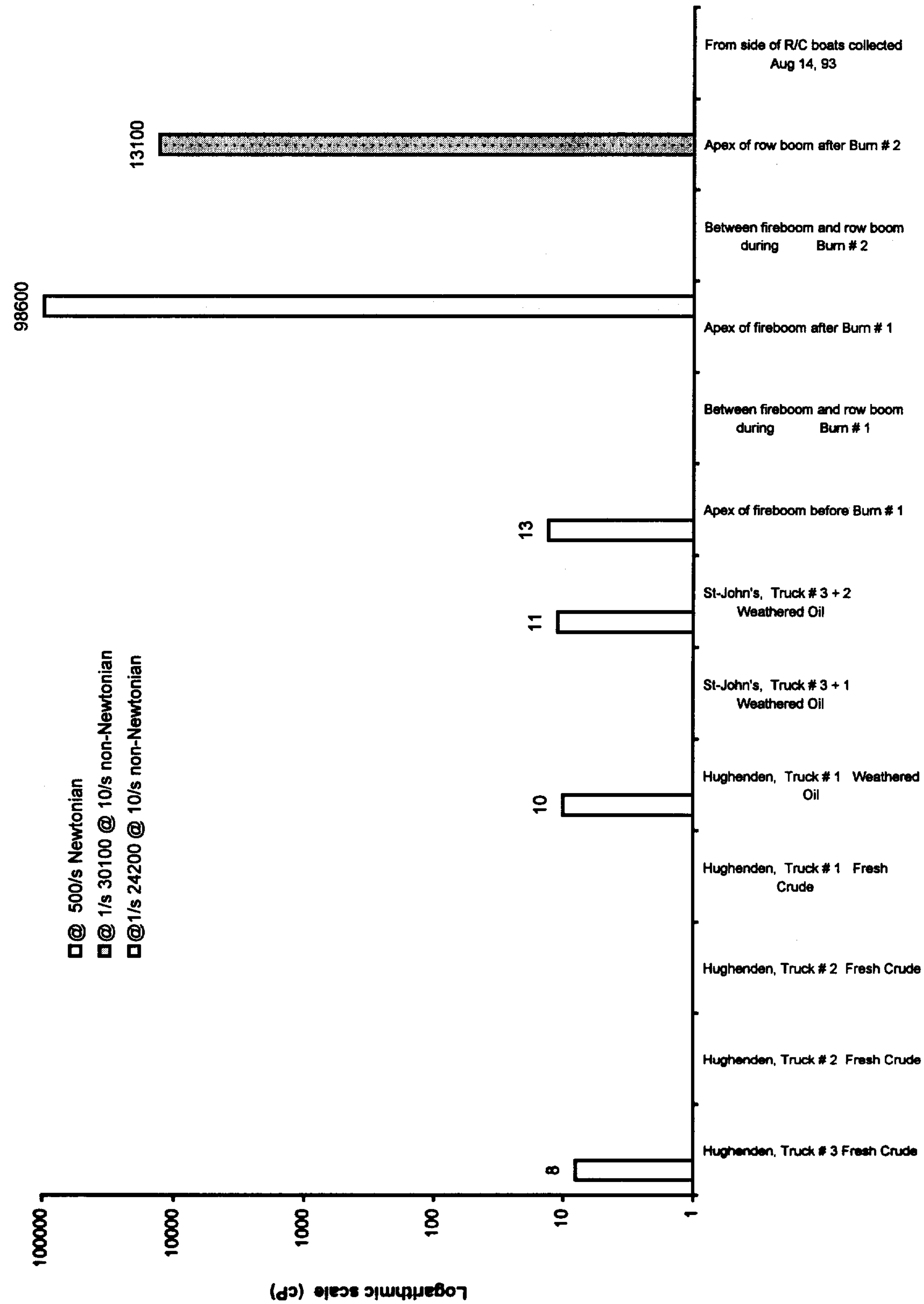
NOBE 93 Figure 11.9 **Sulphur Content of Oil and Residue Samples**



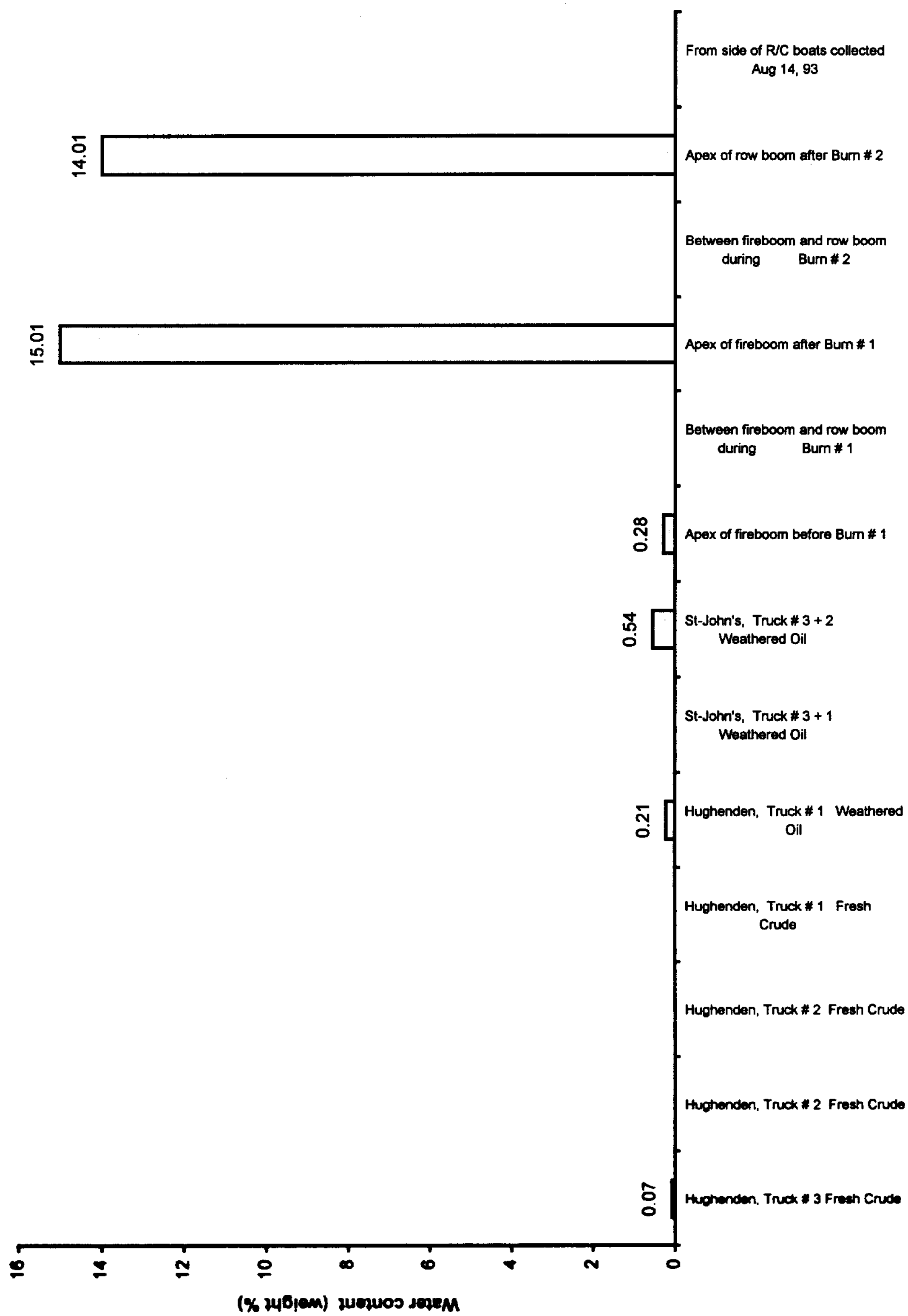
NOBE 93 Figure 11.10 **TPH of Oil and Residue Samples**



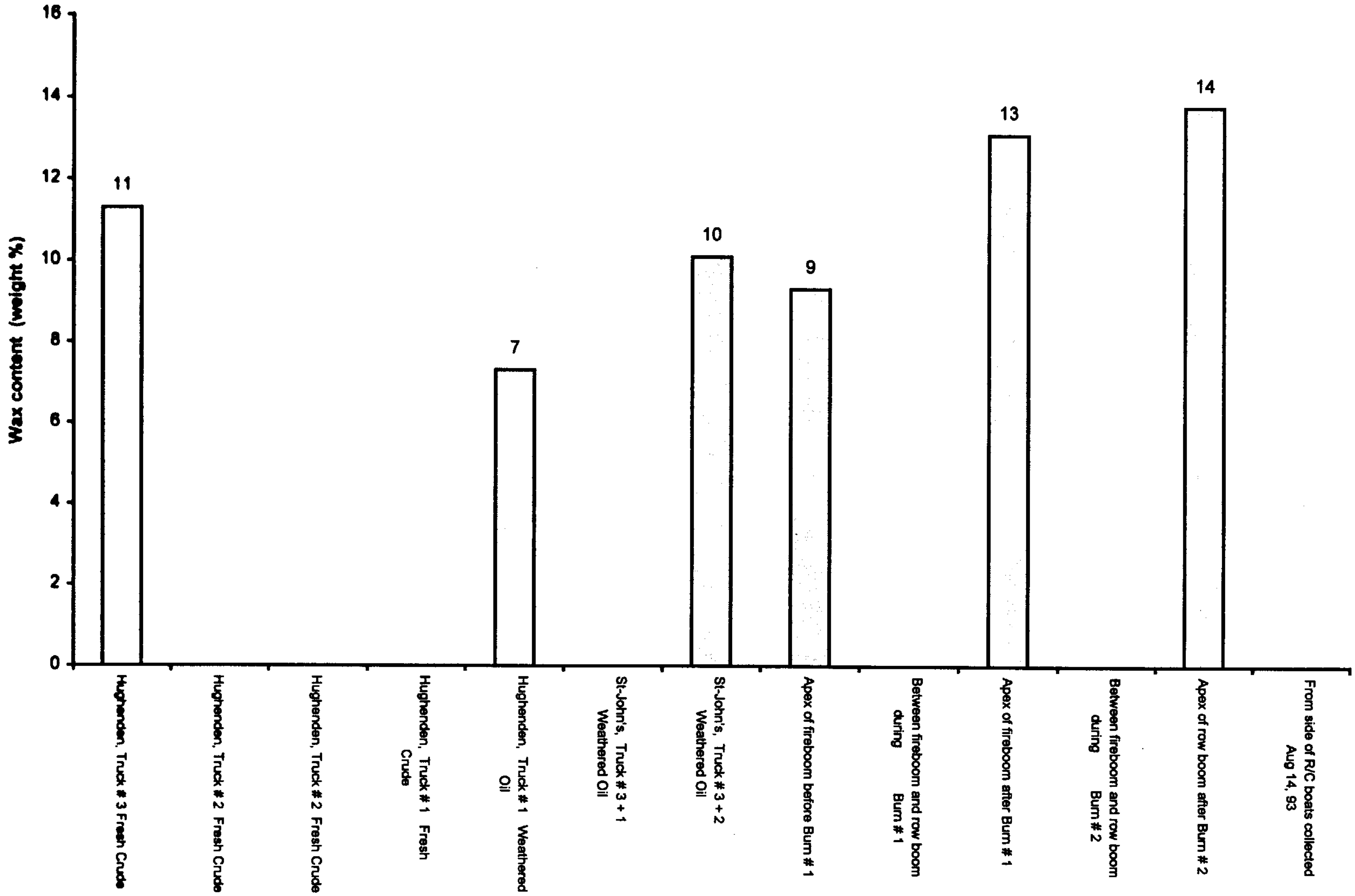
NOBE 93 Figure 11.11 **Viscosity of Oil and Residue Samples**



NOBE 93 Figure 11.12 **Water Content of Oil and Residue Samples**

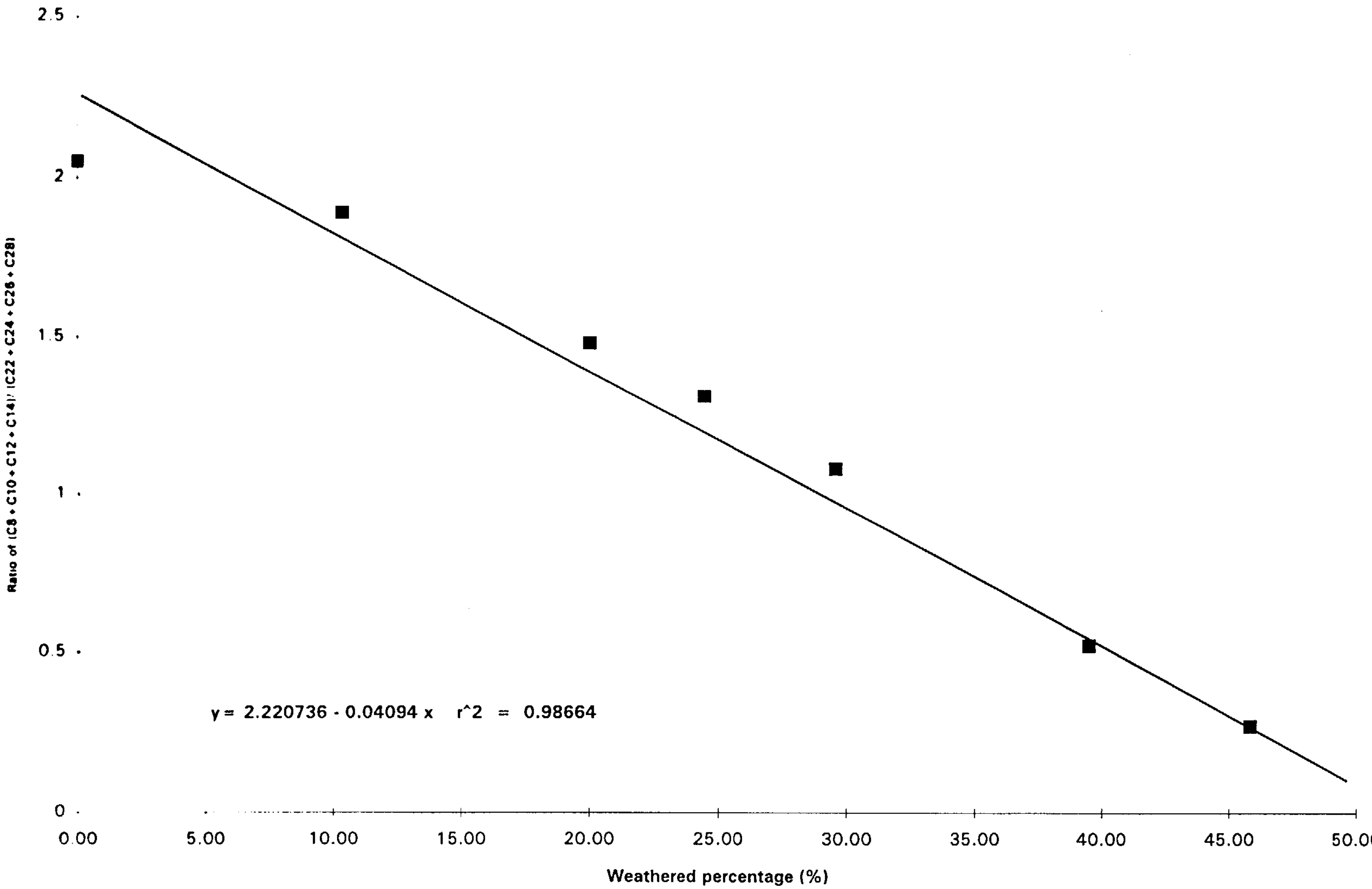


NOBE 93 Figure 11.13 **Wax Content of Oil and Residue Samples**



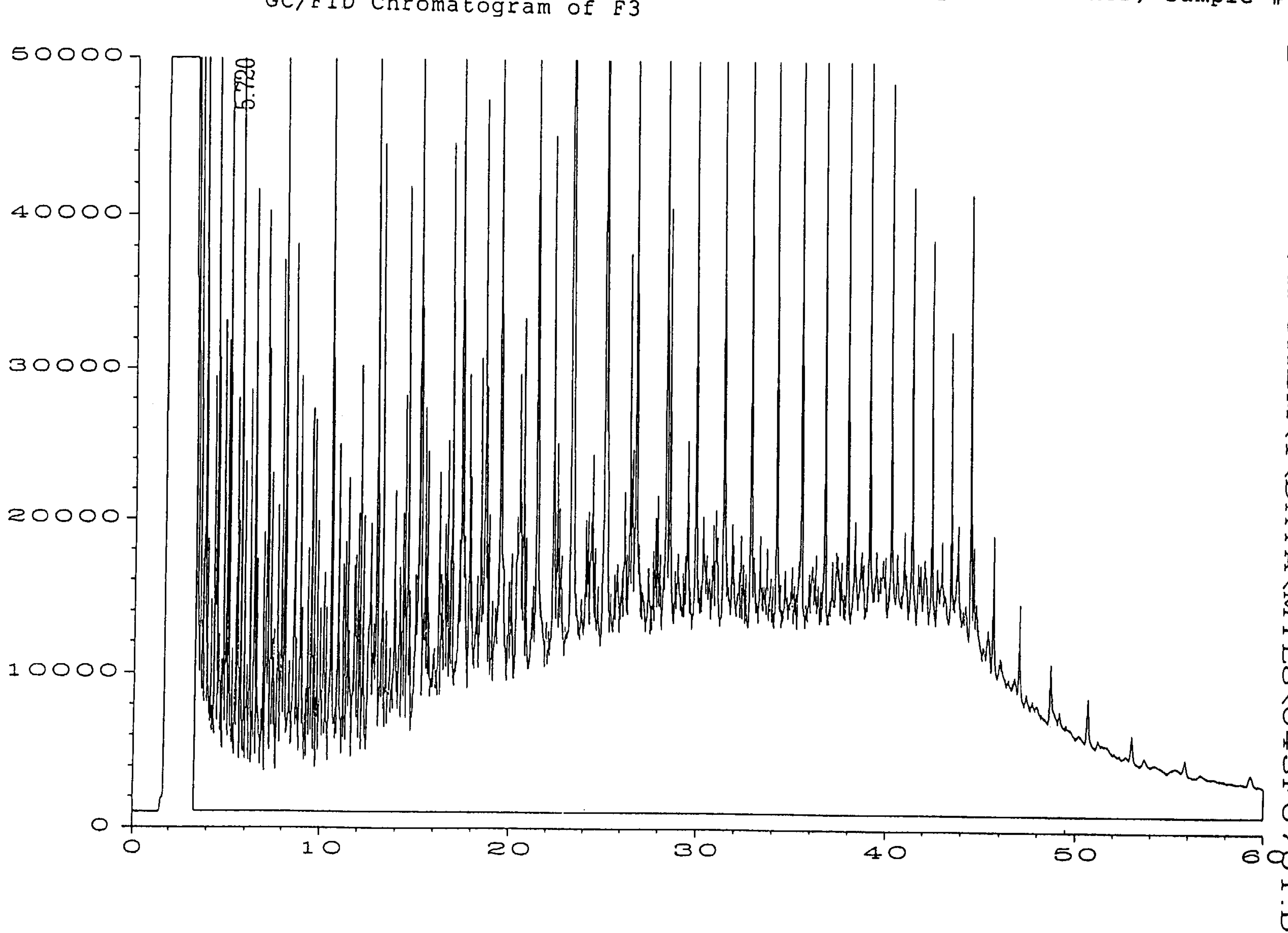
NOBE 93 Figure 11.14

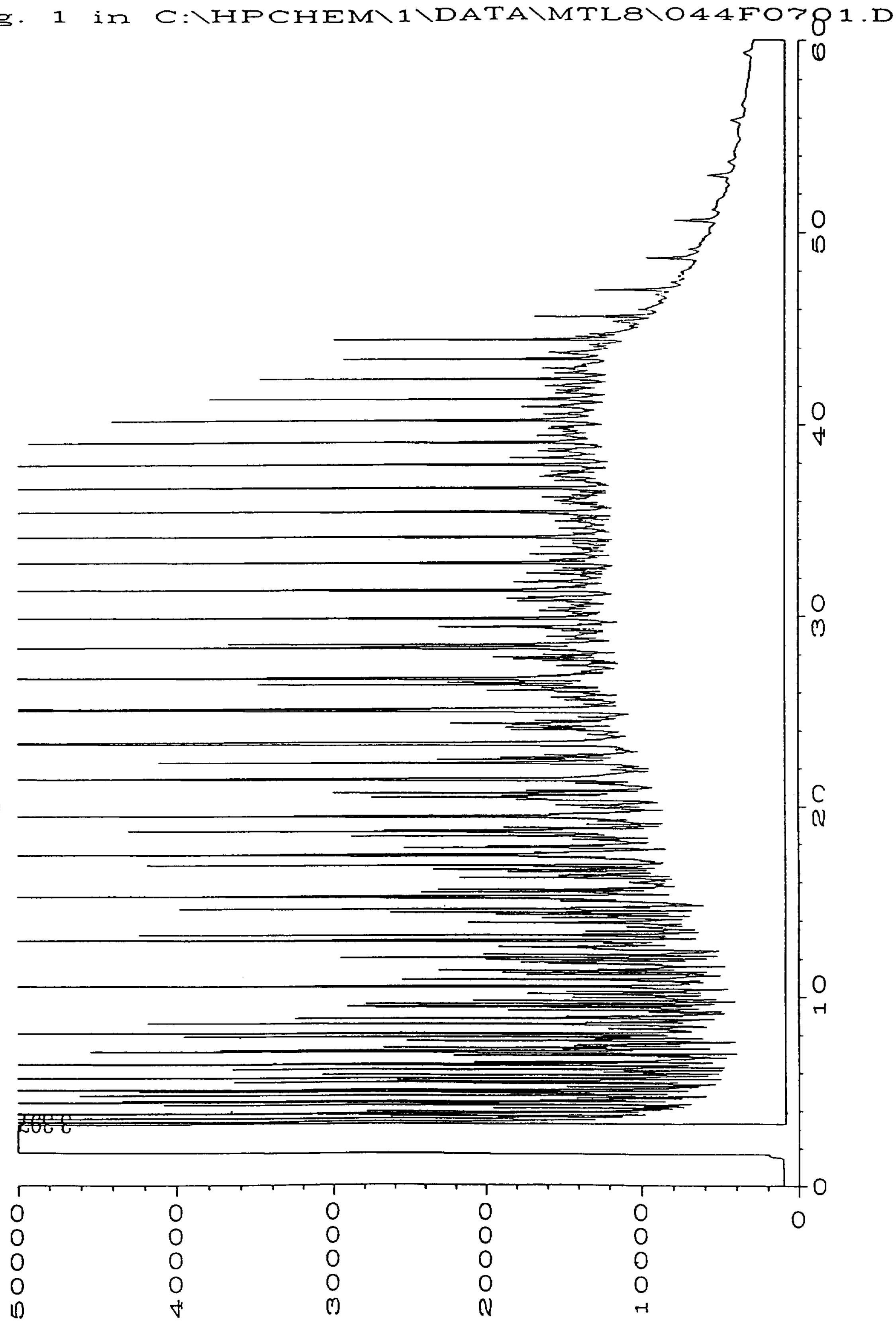
Standard Plot of (C8 + C10 + C12 + C14) / (C22 + C24 + C26 + C28)
to Weathered Percentage from Weathered Reference
NOBE Fresh Oil (# 1)



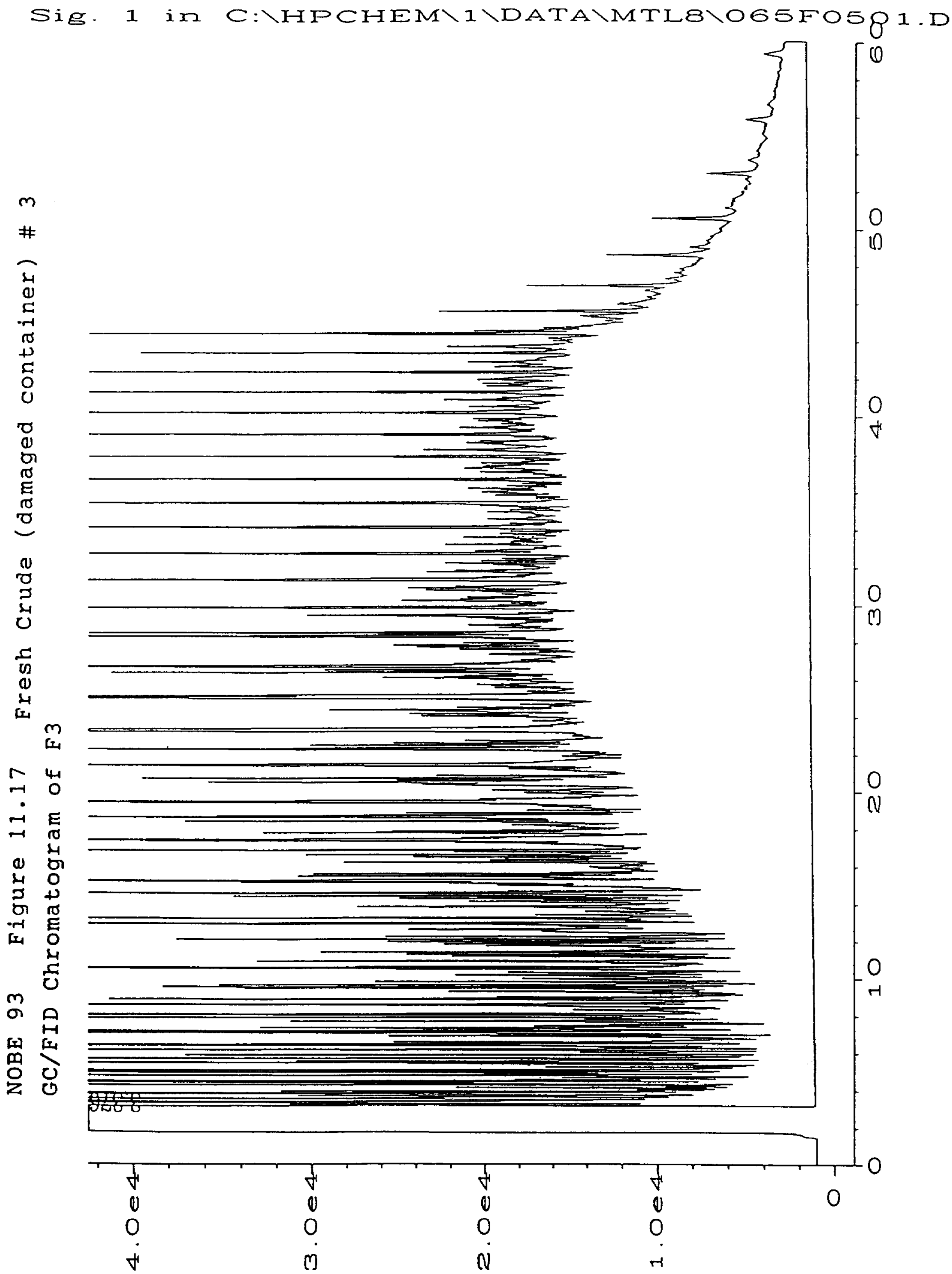
NOBE 93 Figure 11.15
GC/FID Chromatogram of F3

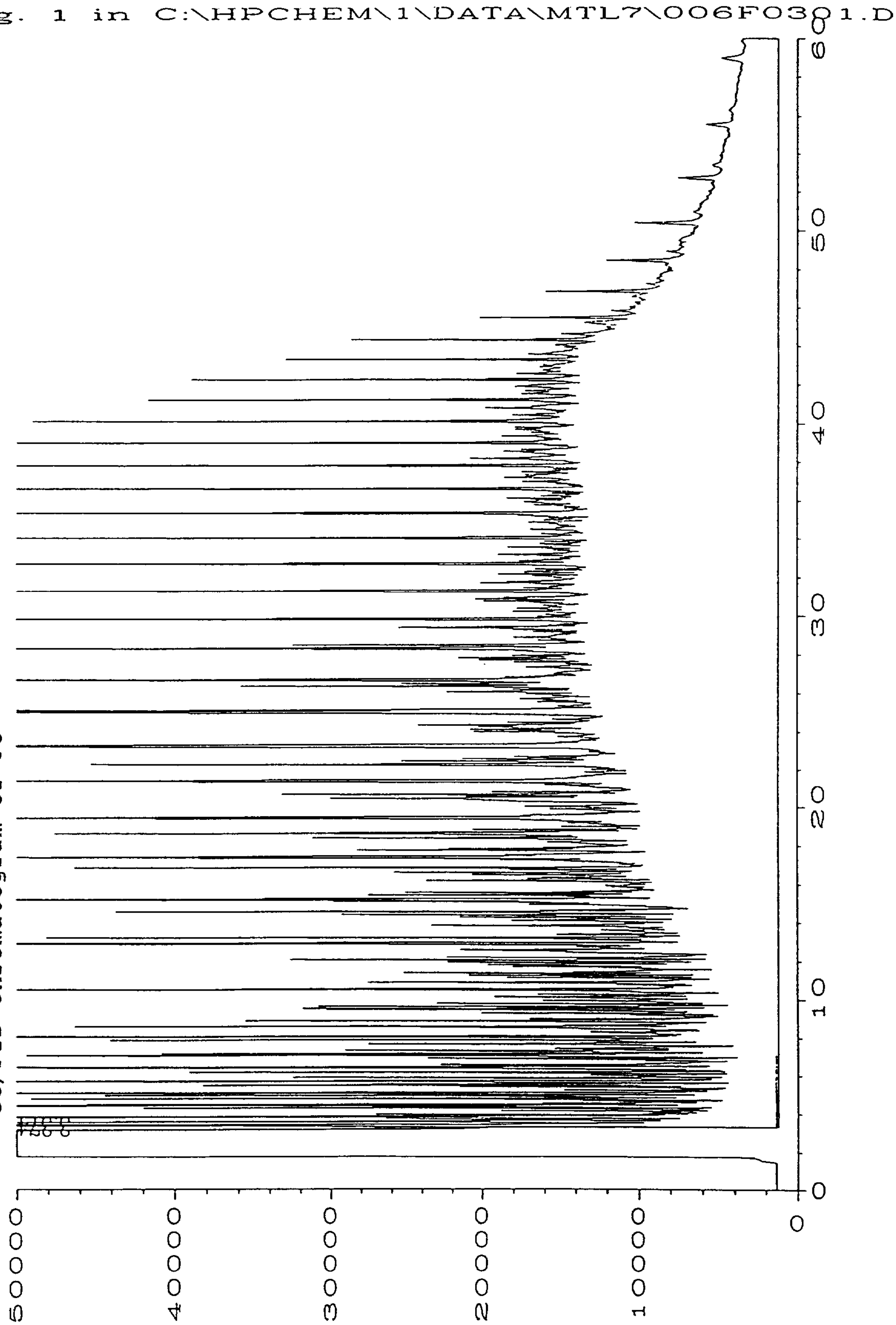
Fresh Crude (damaged container) sample # 2A



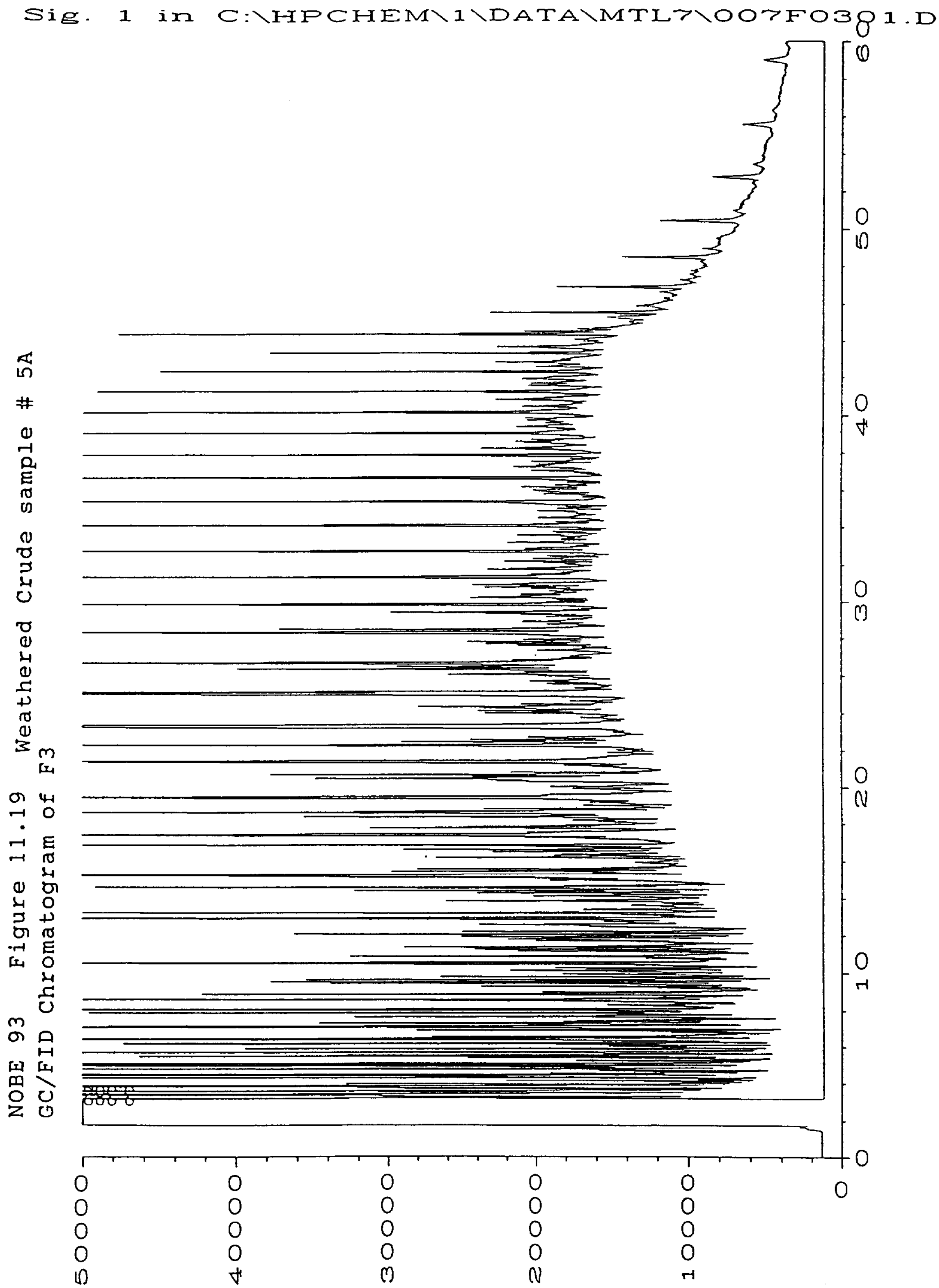


NOBE 93 Figure 11.16 Fresh Crude (damaged container) # 2B
GC/FID Chromatogram of F3

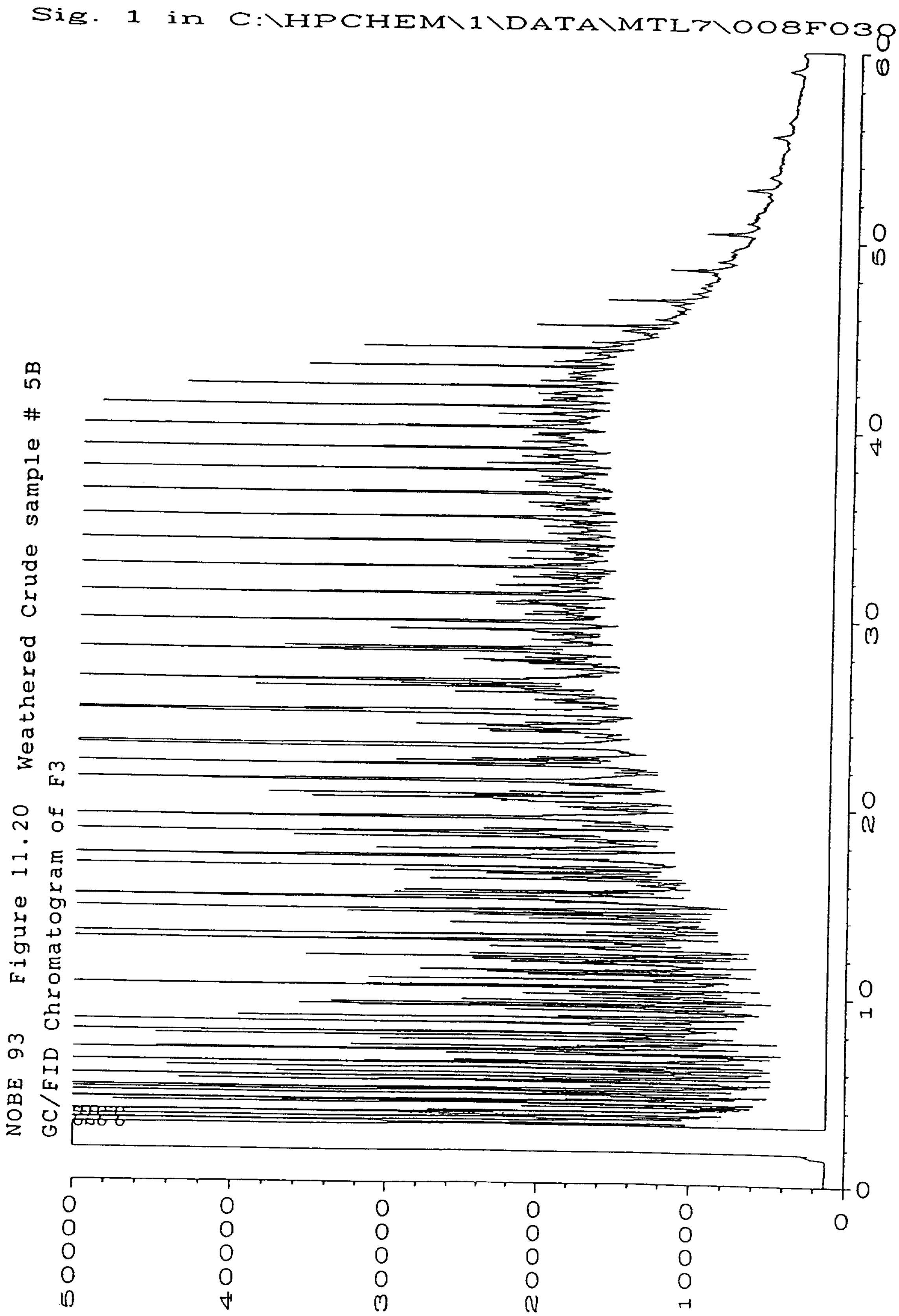

Sig. 1 in C:\HPCHEM\1\DATA\MTL8\065F0501.D
NOBE 93 Figure 11.17 Fresh Crude (damaged container) # 3
GC/FID Chromatogram of F3
4.0e4
3.0e4
2.0e4
1.0e4
0
0
10
20
30
40
50
60



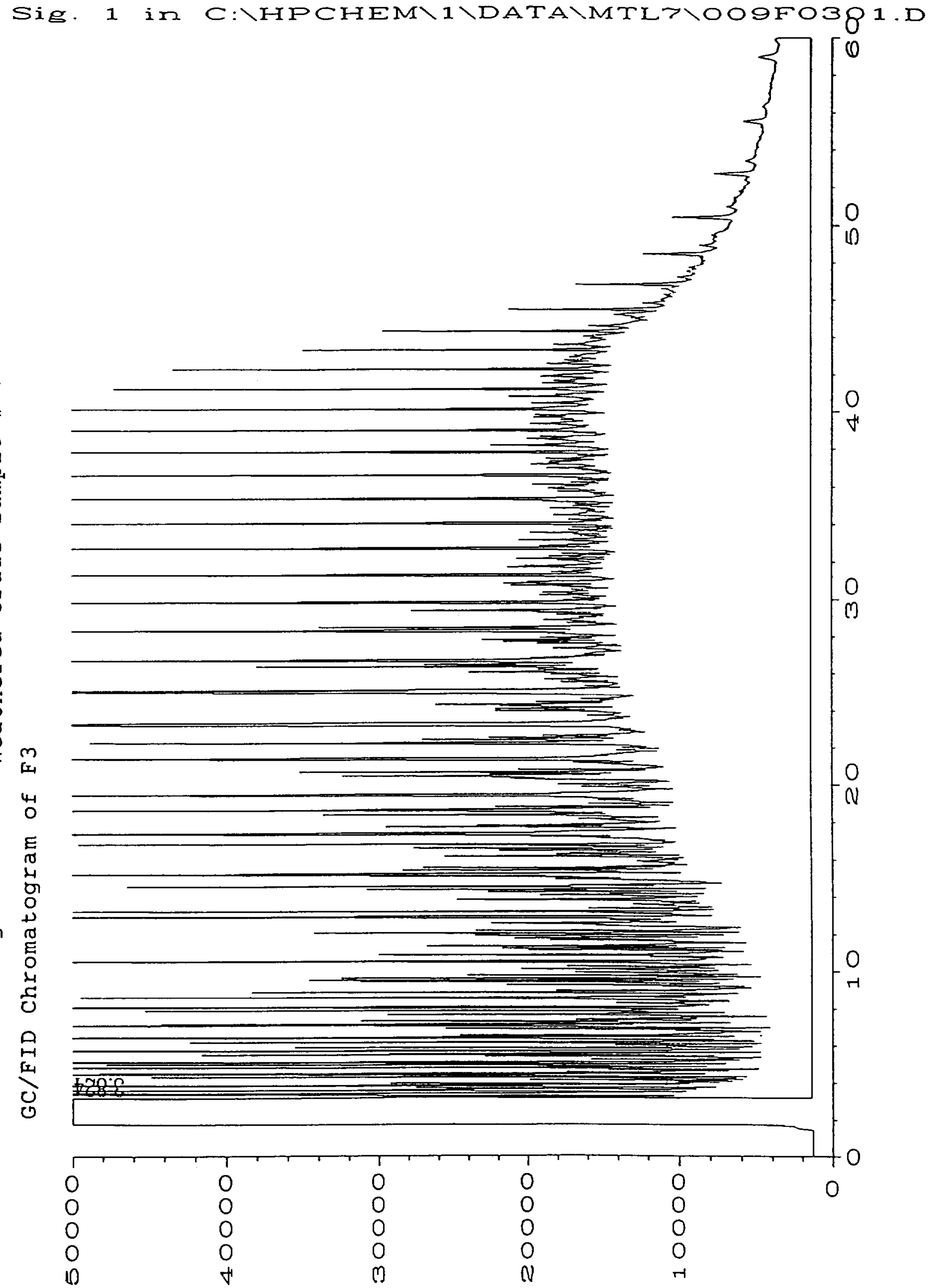
NOBE 93 Figure 11.18 Weathered Crude sample # 4
GC/FID Chromatogram of F3



NOBE 93 Figure 11.19 Weathered Crude sample # 5A
GC/FID Chromatogram of F3

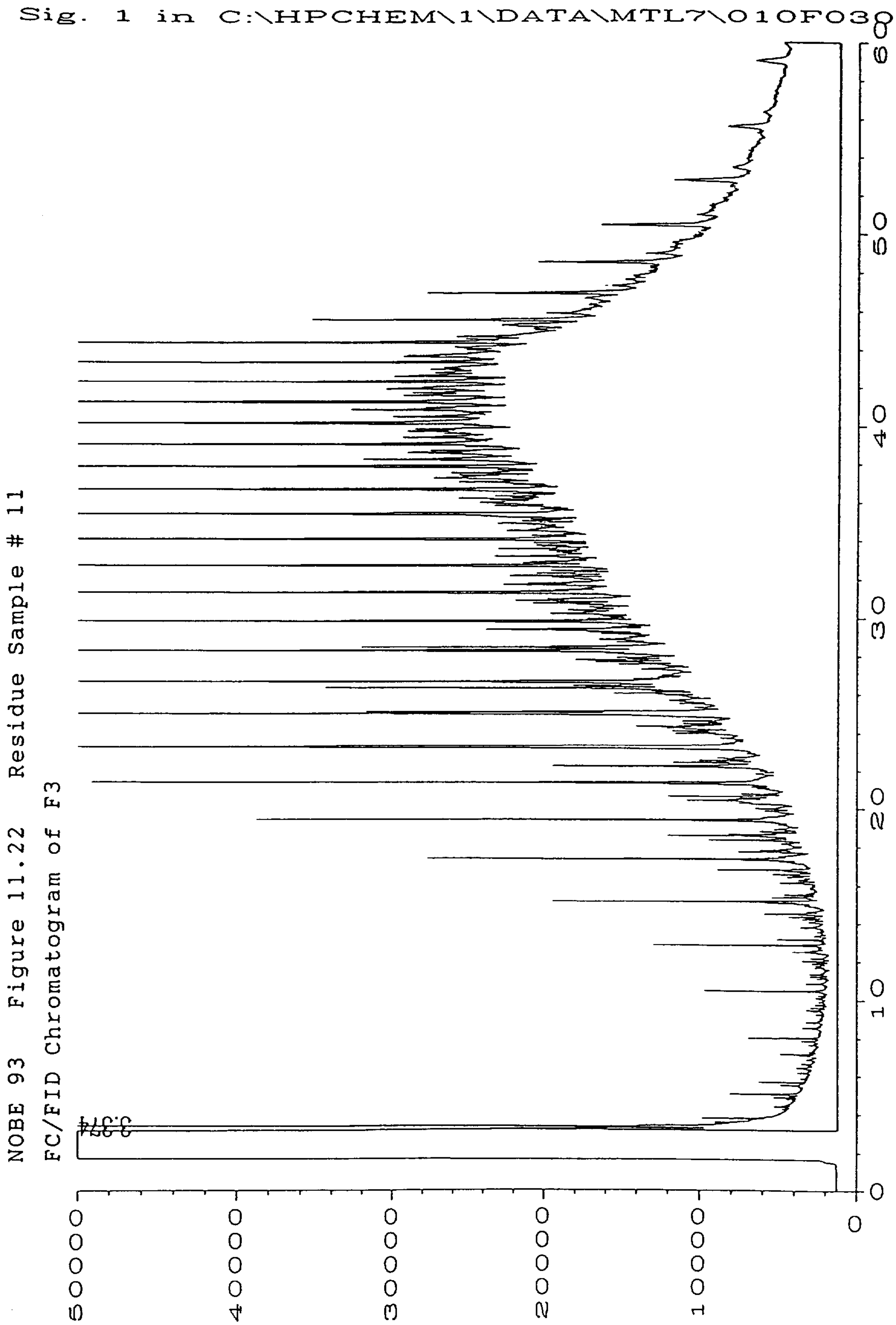


NOBE 93 Figure 11.20 Weathered Crude sample # 5B
GC/FID Chromatogram of F3



NOBE 93 Figure 11.21 Weathered Crude sample # 7

GC/FID Chromatogram of F3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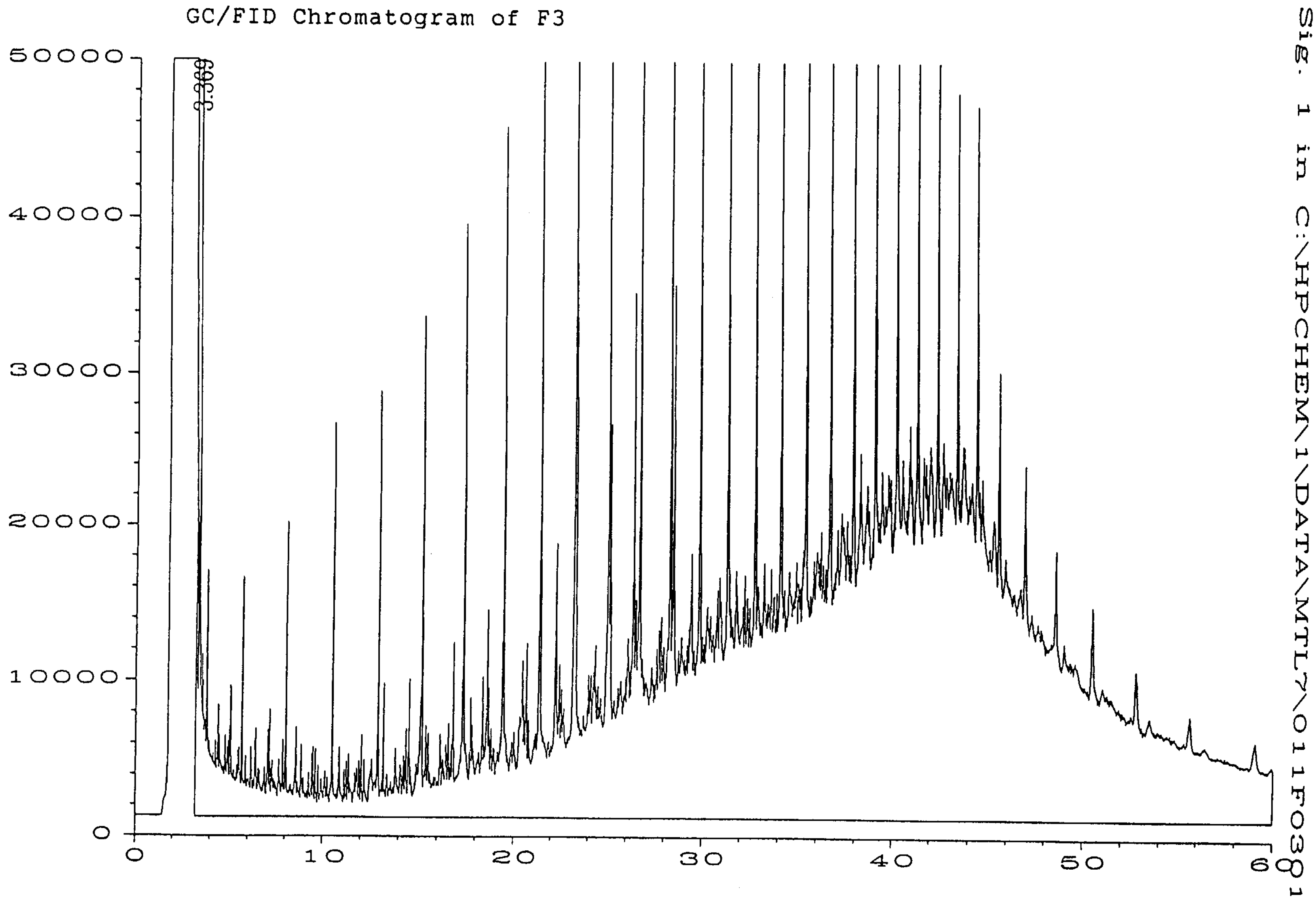
NOBE 93 Figure 11.22 Residue Sample # 11
FC/FID Chromatogram of F3
3.374
0
10
20
30
40
50
60
50000
40000
30000
20000
10000
0

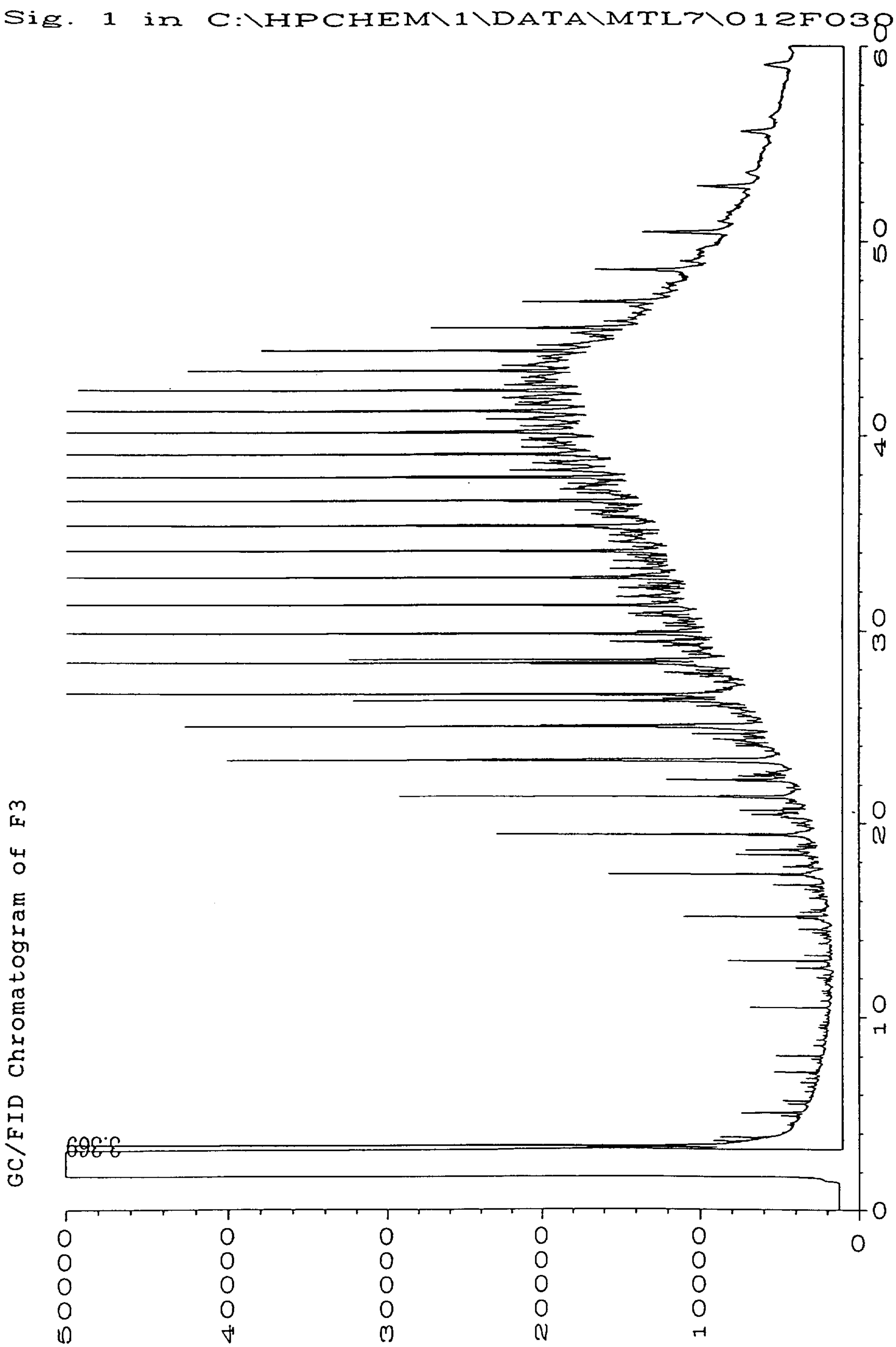
NOBE 93 Figure 11.23 Residue Sample # 12

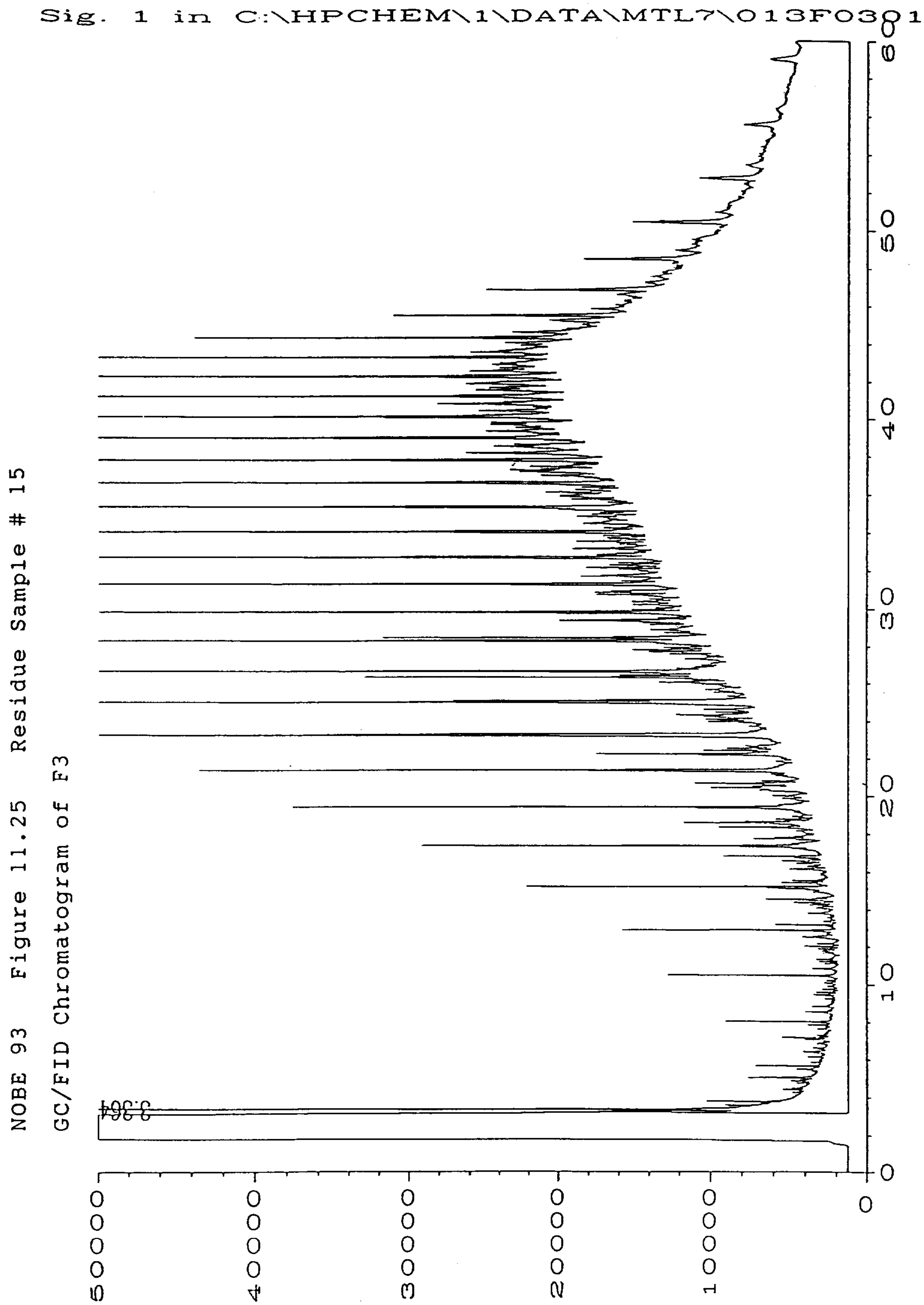
GC/FID Chromatogram of F3



NOBE 93 Figure 11.24 Residue Sample # 14

GC/FID Chromatogram of F3

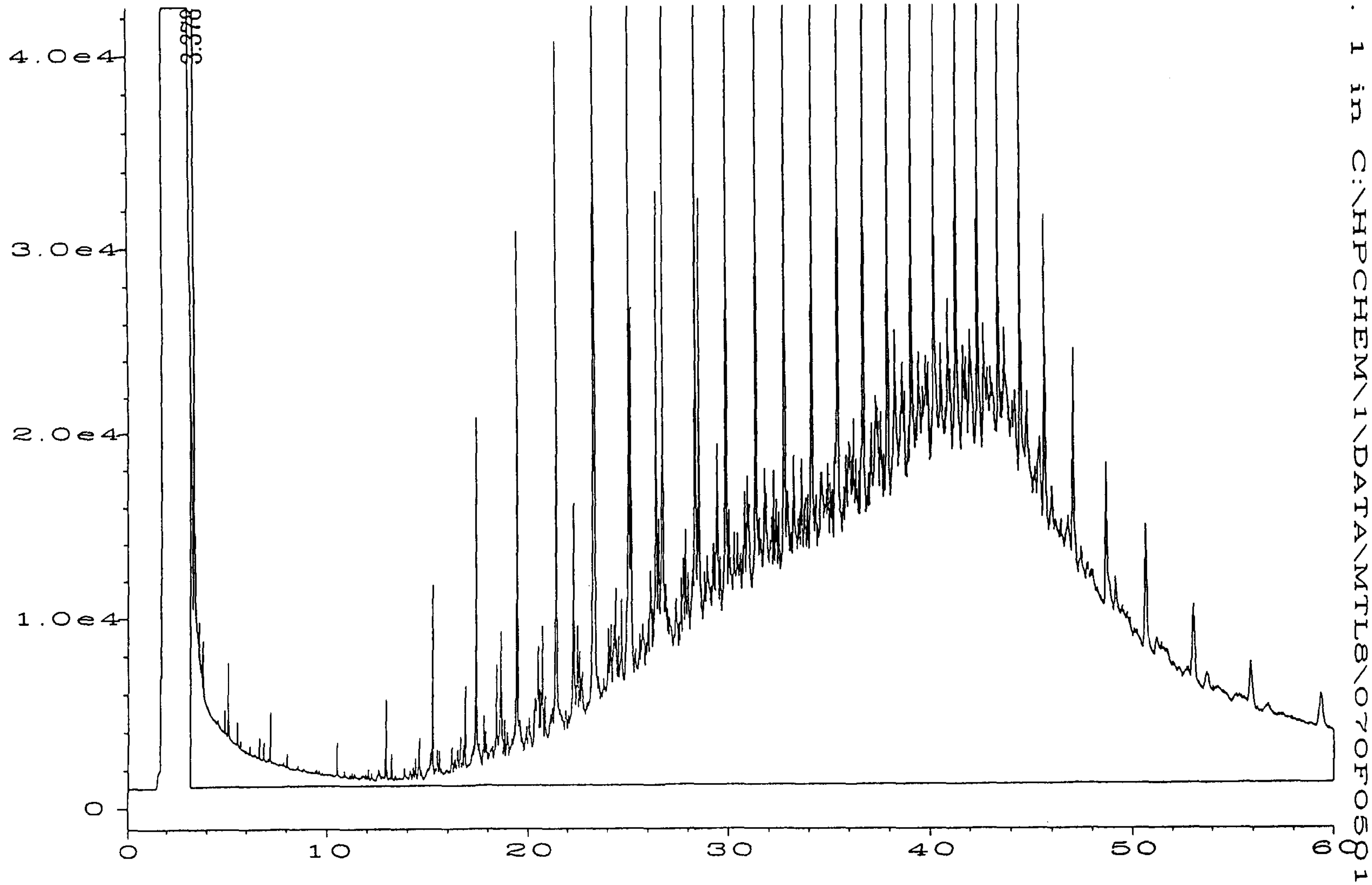




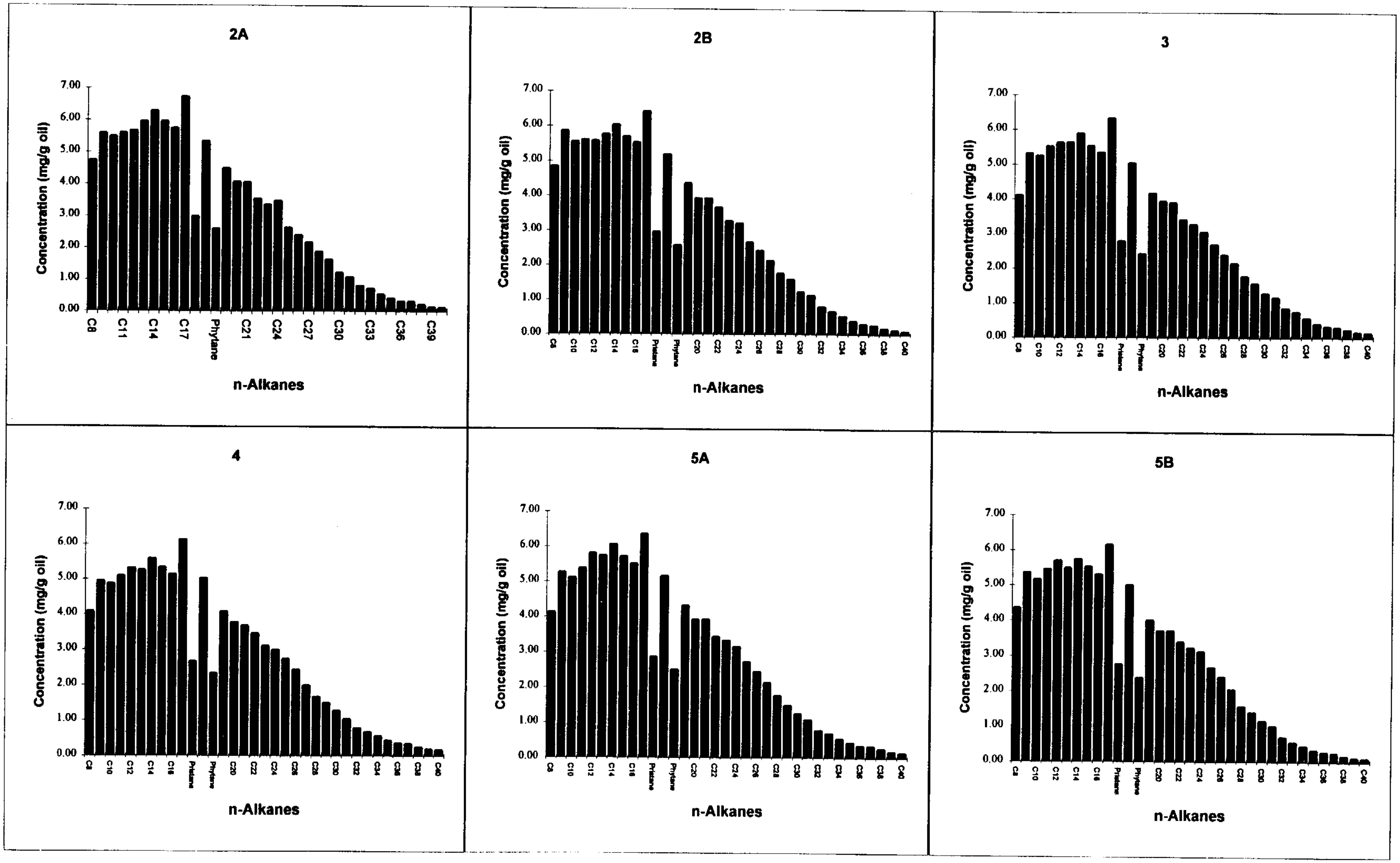
NOBE 93 Figure 11.25 Residue Sample # 15
GC/FID Chromatogram of F3

NOBE 93 Figure 11.26 Residue Sample # 16

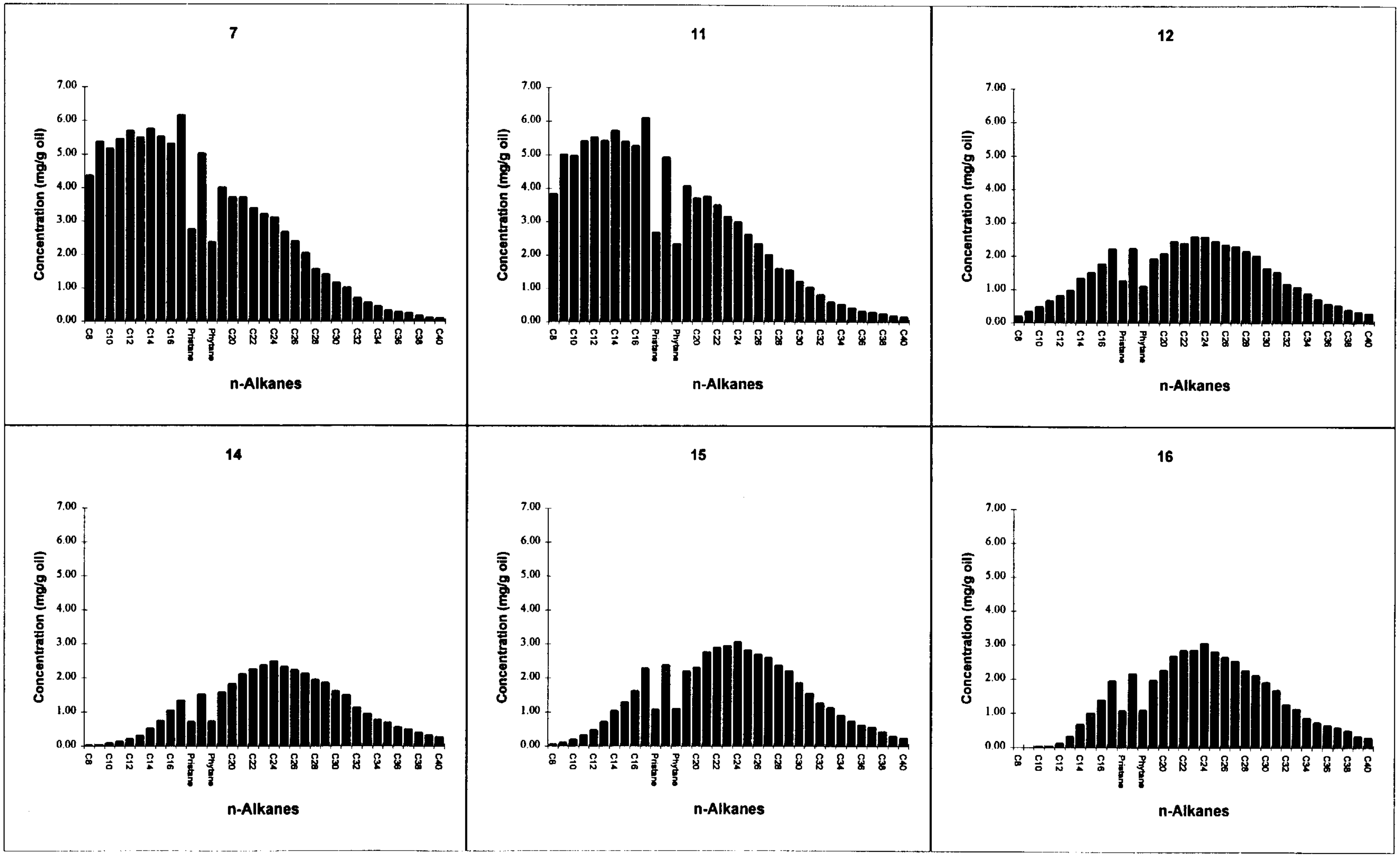
GC/FID Chromatogram of F3



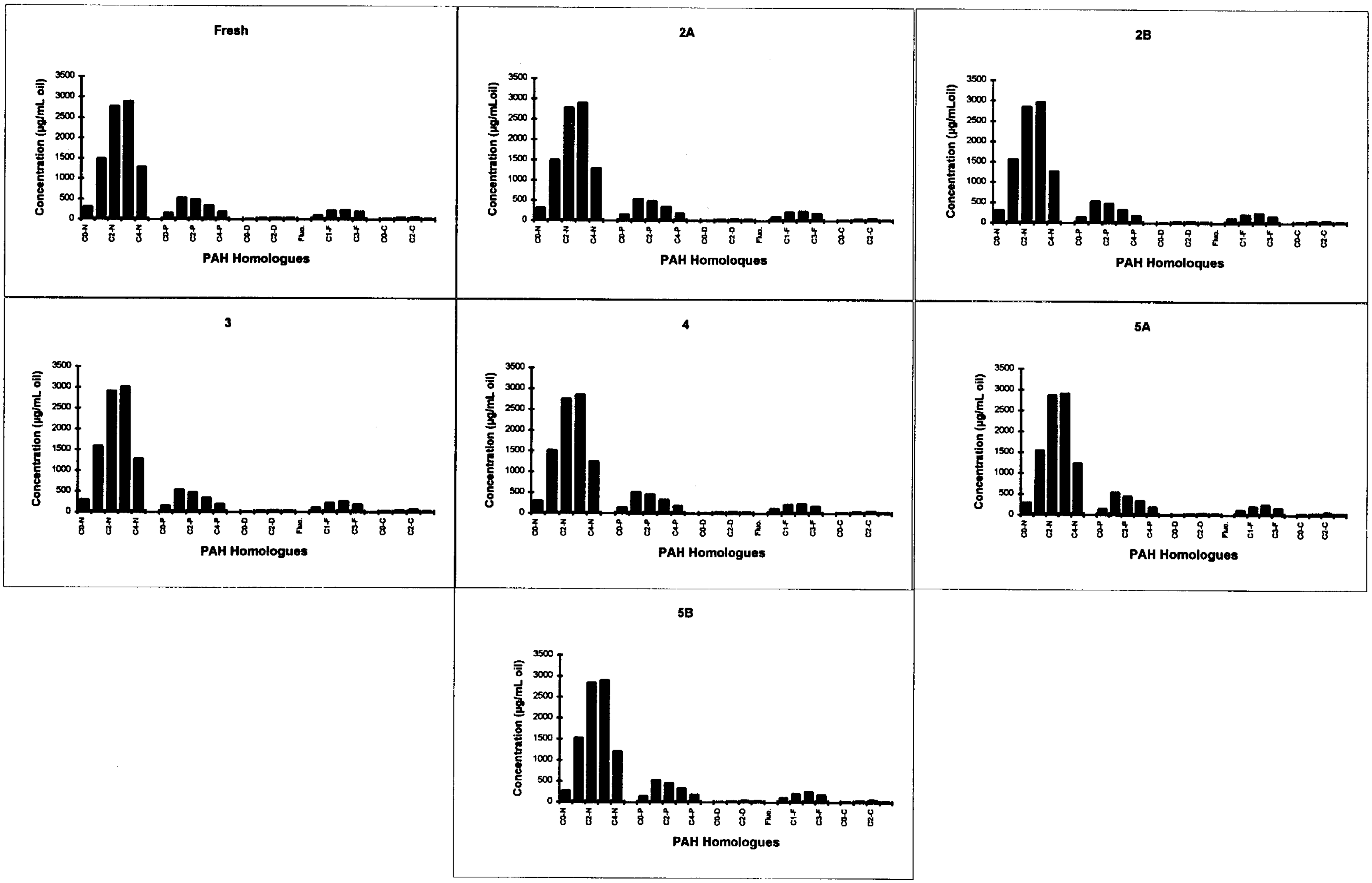
NOBE 93 Figure 11.27 **Distribution of n-Alkanes of Nobe Oil samples 2A, 2B, 3, 4, 5A, 5B**



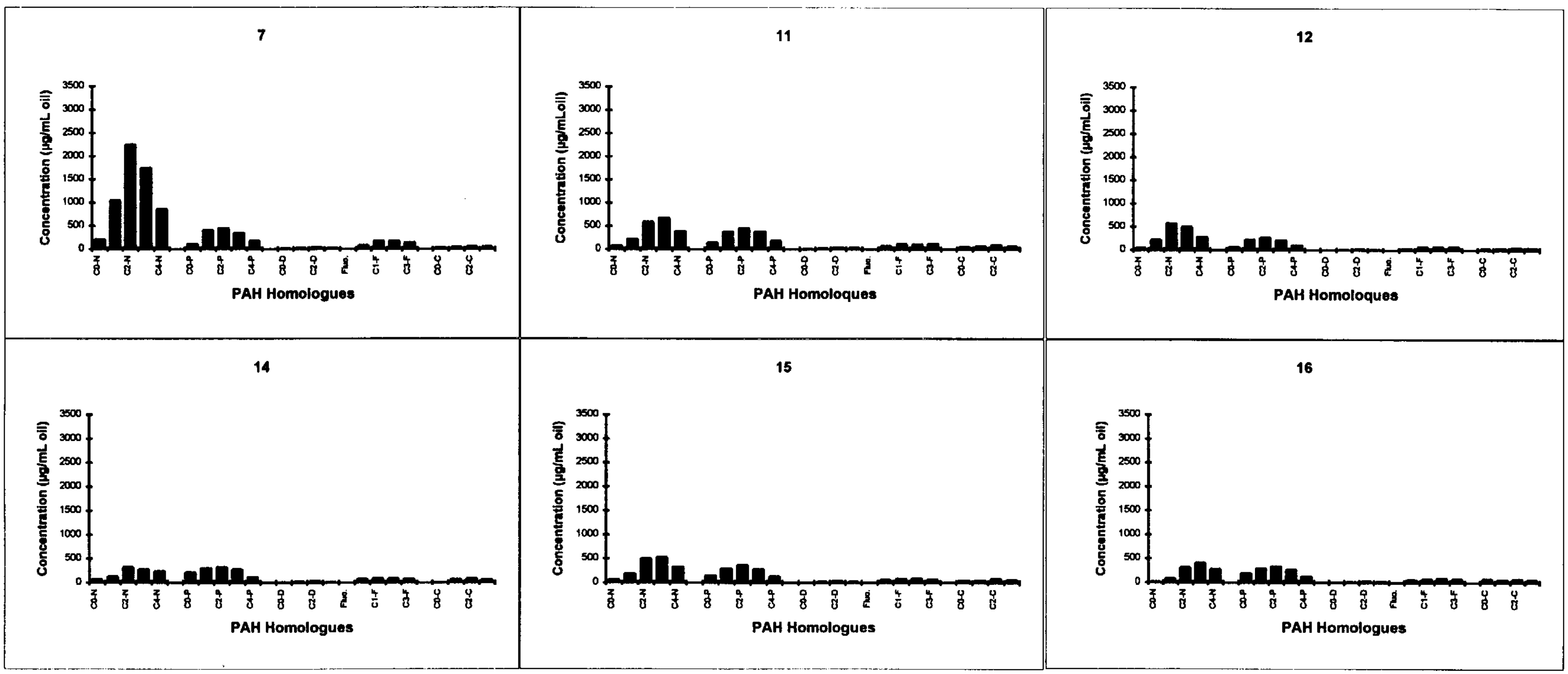
NOBE 93 Figure 11.28 **Distribution of n-Alkanes of Nobe Oil samples 7, 11, 12, 14, 15, 16**



NOBE 93 Figure 11.29 **Distribution of Alkyl PAH Homologues in NOBE Oil Samples Fresh, 2A, 2B, 3, 4, 5A, 5B**

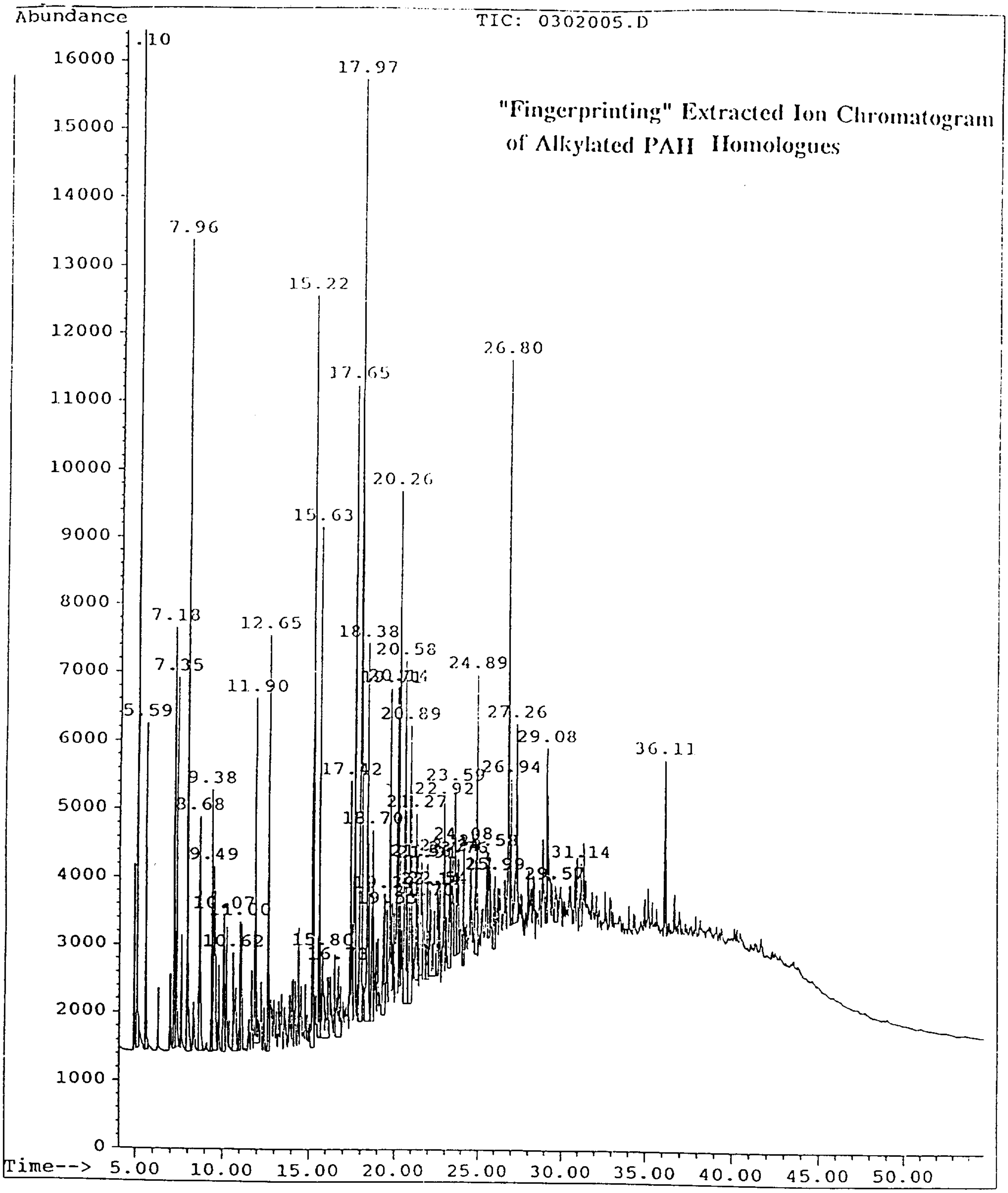


NOBE 93 Figure 11.30 **Distribution of Alkyl PAH Homologues in NOBE Oil Samples 7, 11, 12, 14, 15, 16**



NOBE 93 Figure 11.31

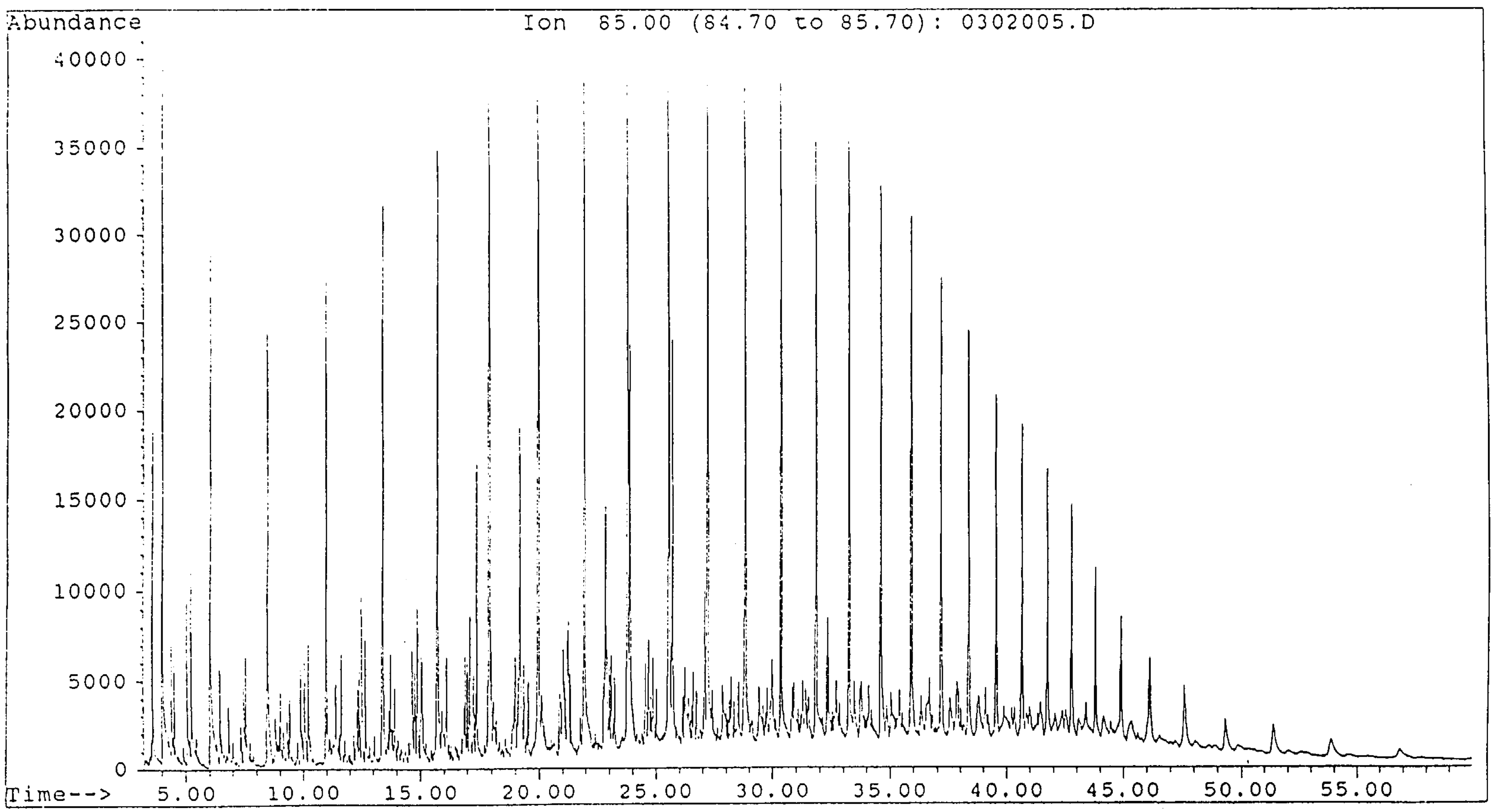
sample name: NOBE-2A-1 FR2



NOBE 93 **Figure 11.32**

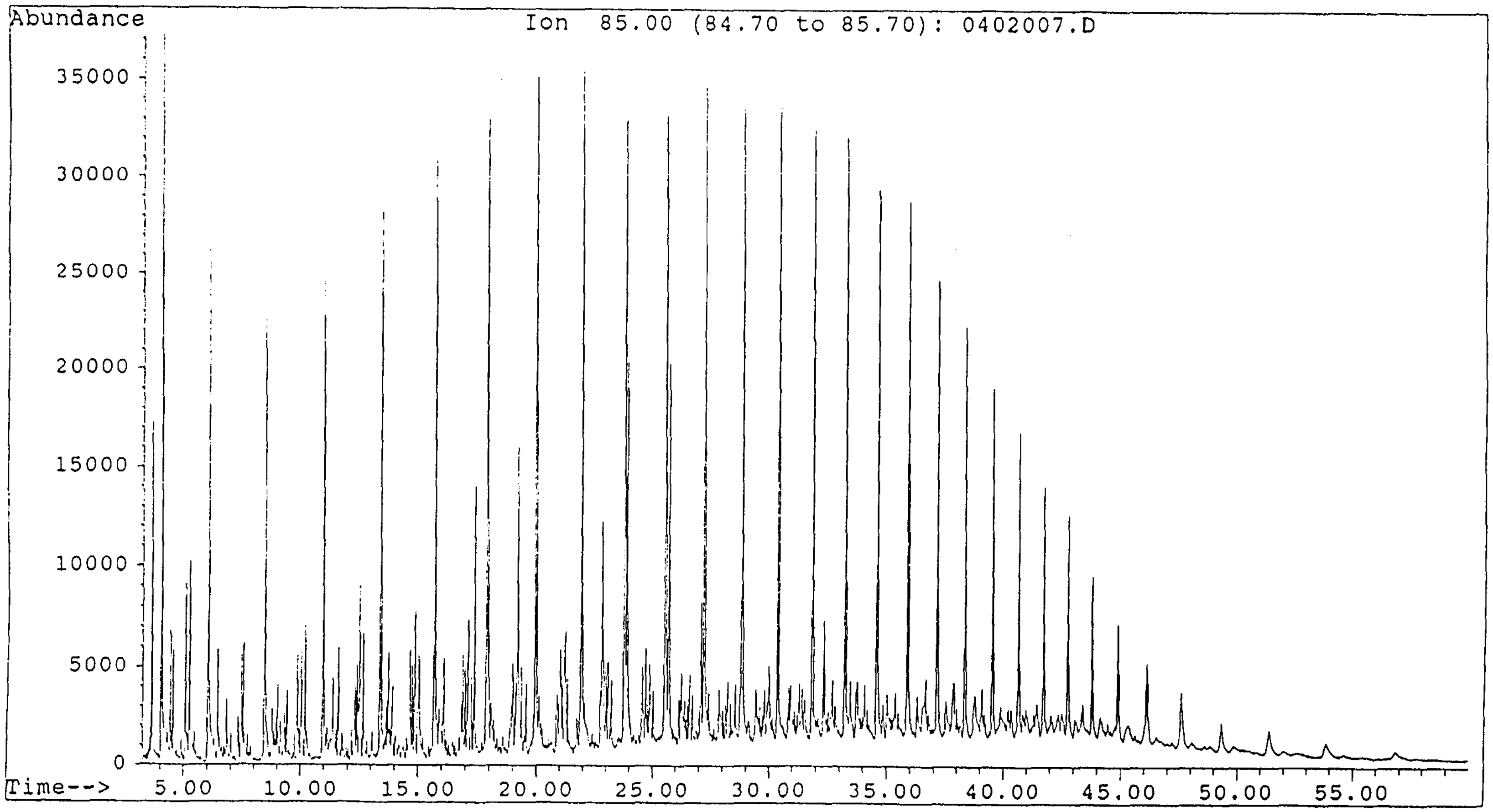
n-Alkane Distribution Chromatograms from GC/MS Measurement

```
File        : C:\HPCHEM\1\DATA\MIKE\SEP10\0302005.D
Operator    :
Acquired    : 10 Sep 93   2:45 pm using AcqMethod ALKANE
Instrument  :   5972 - In
Sample Name: NOBE-2A FR-1
Misc Info   :
Vial Number: 3
```



NOBE 93 Figure 11.33
n-Alkane Distribution Chromatograms from GC/MS Measurement

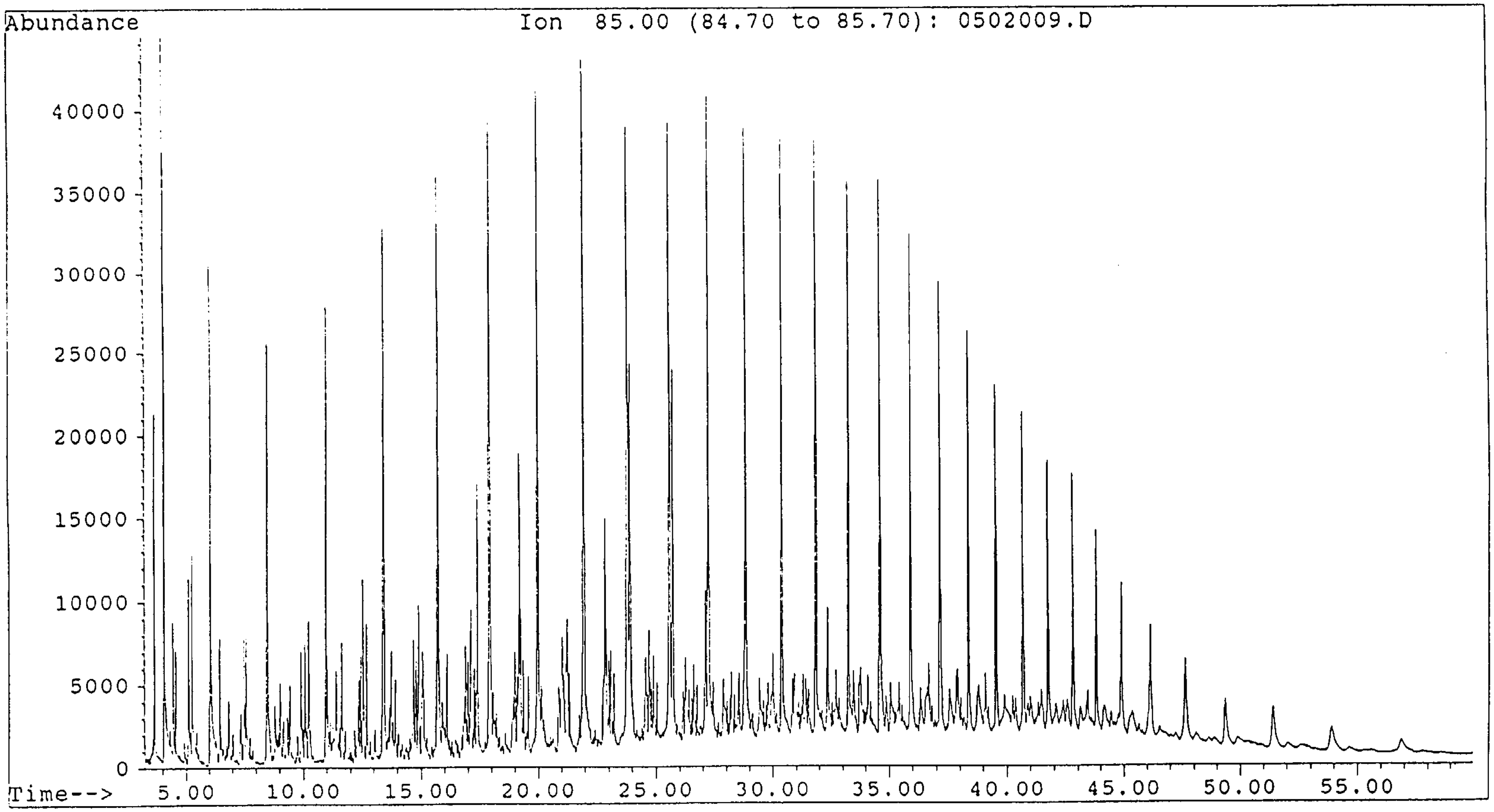
File : C:\HPCHEM\1\DATA\MIKE\SEP10\0402007.D
Operator :
Acquired : 10 Sep 93 4:59 pm using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-2B FR-1
Misc Info :
Vial Number: 4



NOBE 93 Figure 11.34

n-Alkane Distribution Chromatograms from GC/MS Measurement

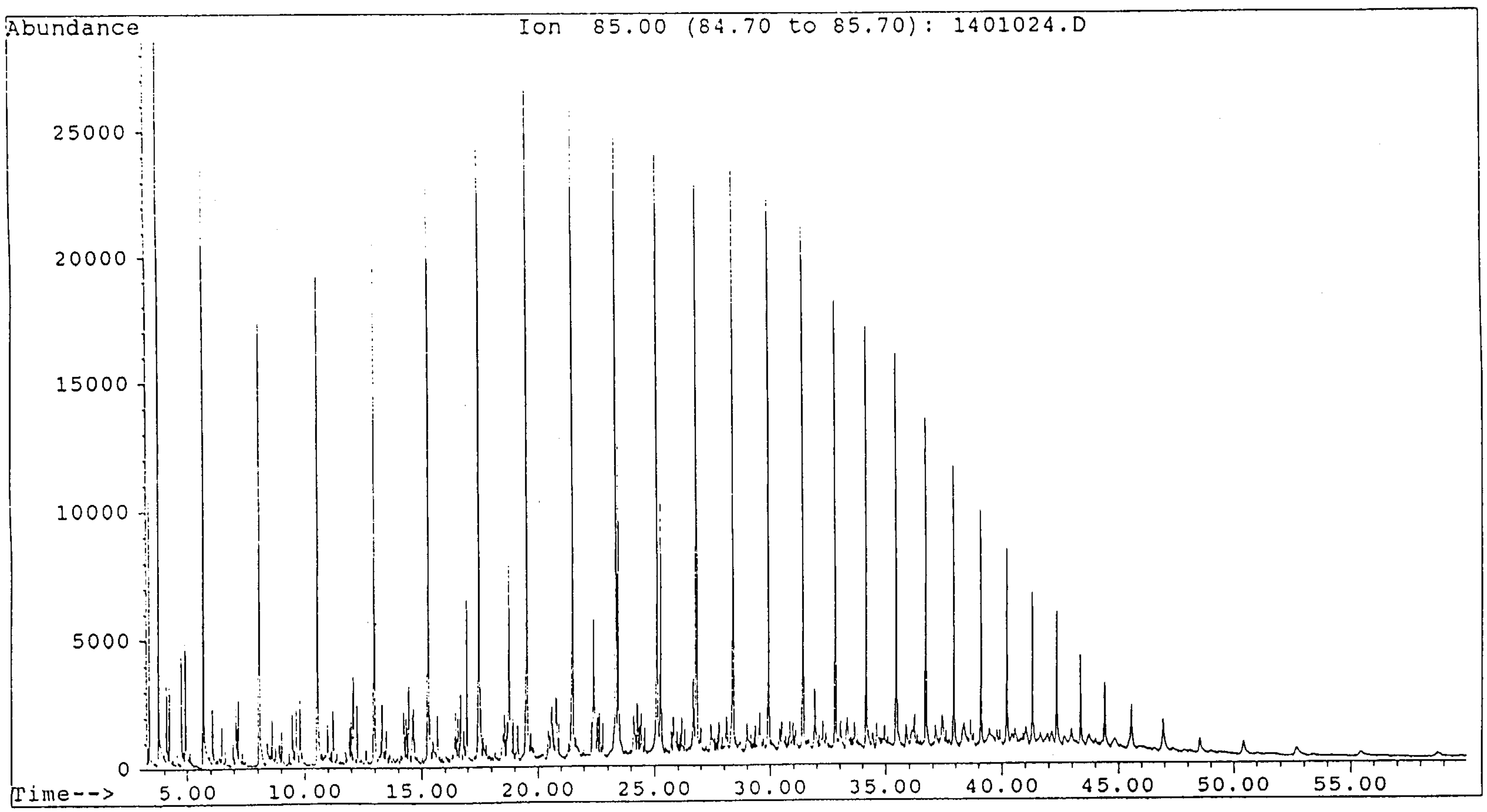
File : C:\HPCHEM\1\DATA\MIKE\SEP10\0502009.D
Operator :
Acquired : 10 Sep 93 7:13 pm using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-3 FR-1
Misc Info :
Vial Number: 5



NOBE 93 Figure 11.35

n-Alkane Distribution Chromatograms from GC/MS Measurement

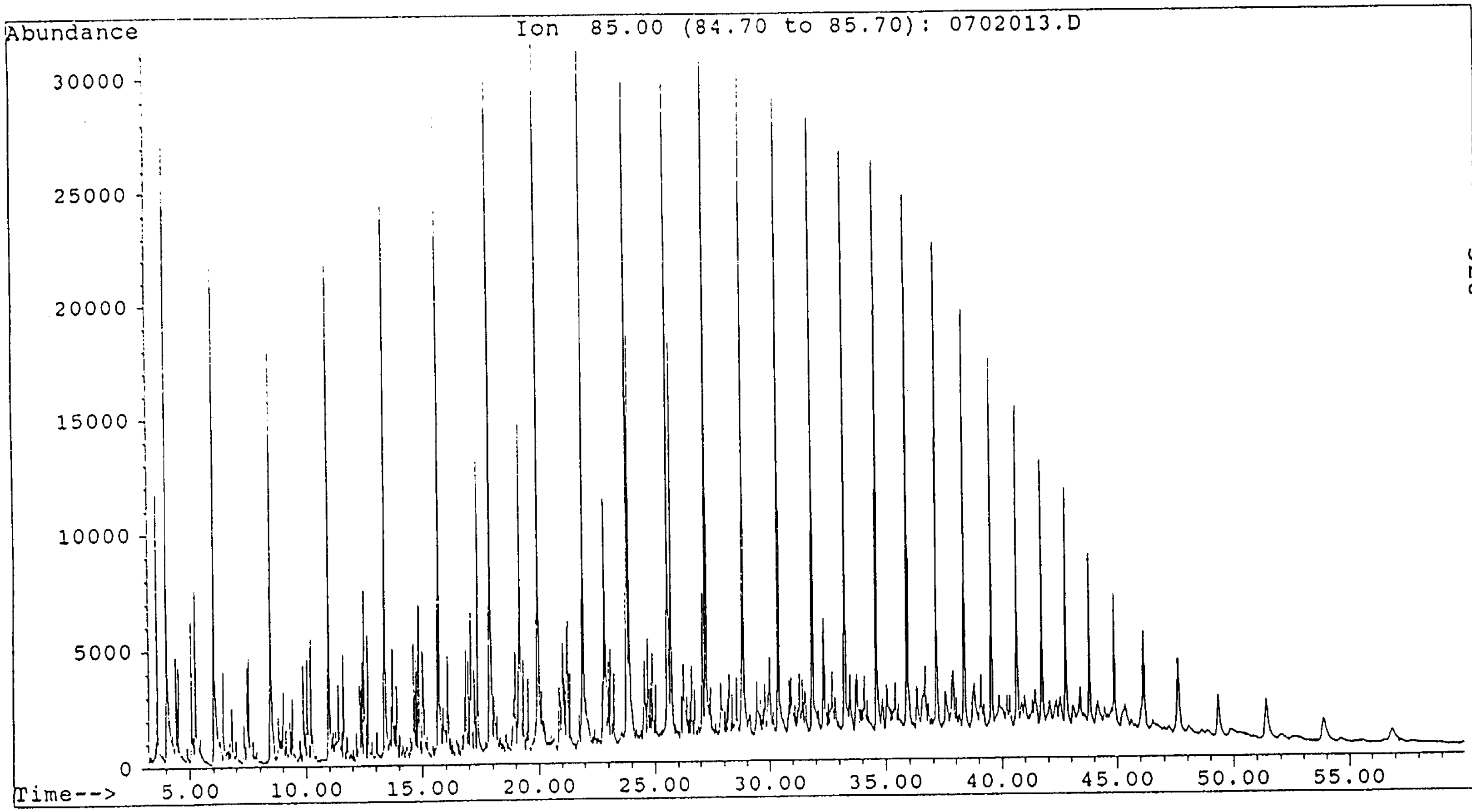
File : C:\HPCHEM\1\DATA\MIKE\NOV24\1401024.D
Operator :
Acquired : 26 Nov 93 11:09 am using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-4-1 2*DILUTION
Misc Info :
Vial Number: 14



NOBE 93 Figure 11.36

n-Alkane distribution Chromatograms from GC/MS Measurement

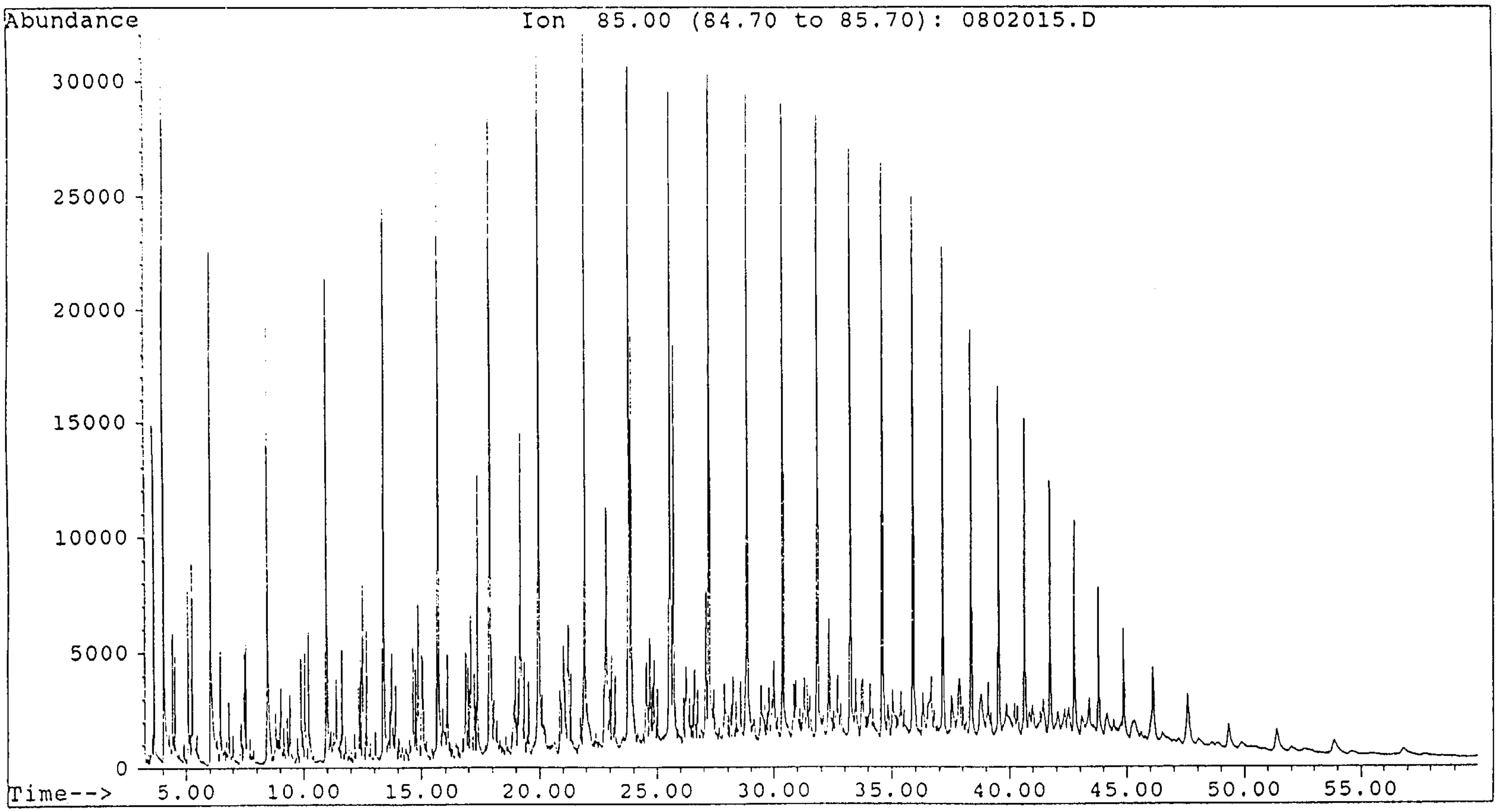
File : C:\HPCHEM\1\DATA\MIKE\SEP10\0702013.D
Operator :
Acquired : 10 Sep 93 11:40 pm using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-5A FR-1
Misc Info :
Vial Number: 7



NOBE 93 Figure 11.37

n-Alkane Distribution Chromatograms from GC/MS Measurement

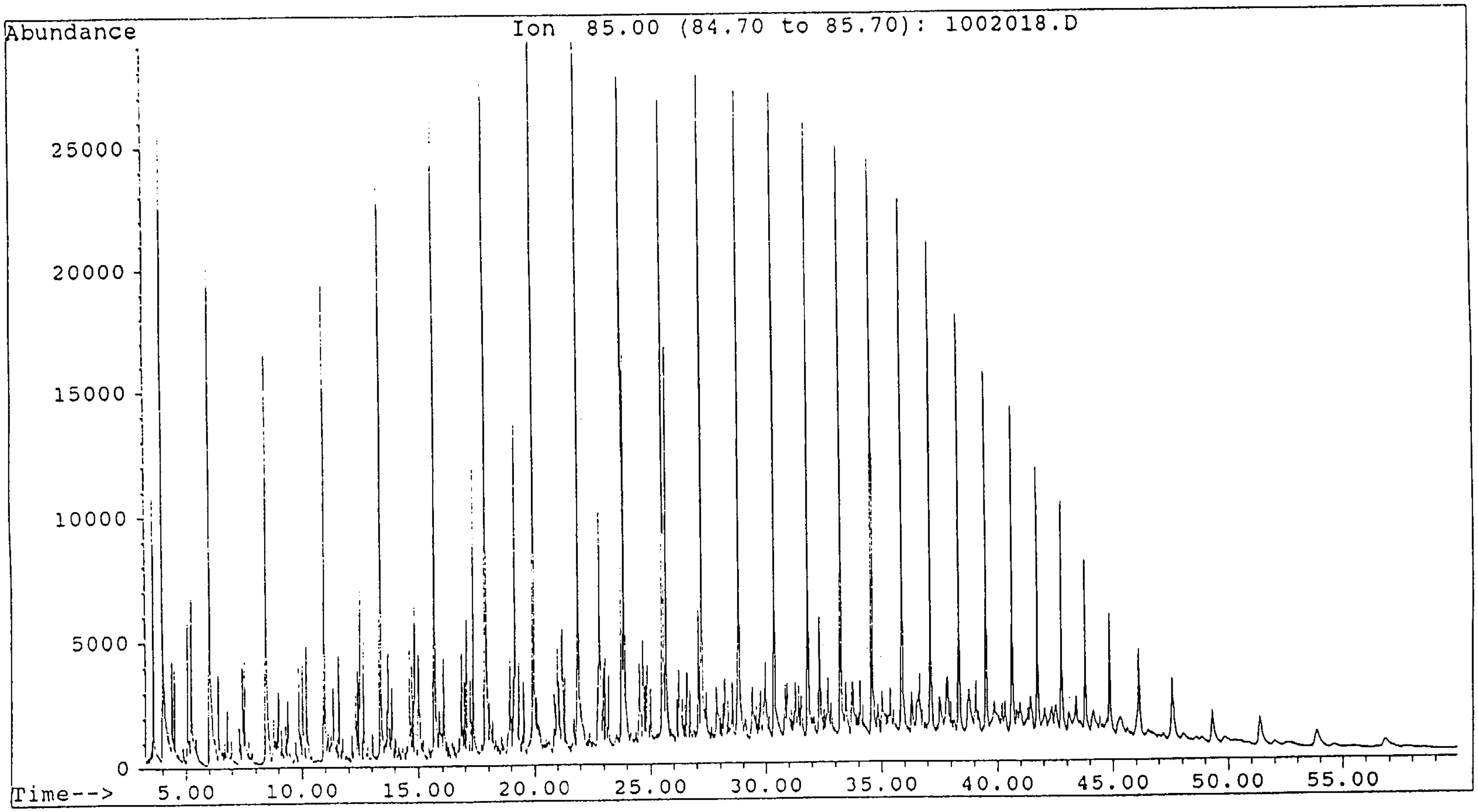
File : C:\HPCHEM\1\DATA\MIKE\SEP10\0802015.D
Operator :
Acquired : 11 Sep 93 1:54 am using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-5B FR-1
Misc Info :
Vial Number: 8



NOBE 93 Figure 11.38

n-Alkane Distribution Chromatograms from GC/MS Measurement

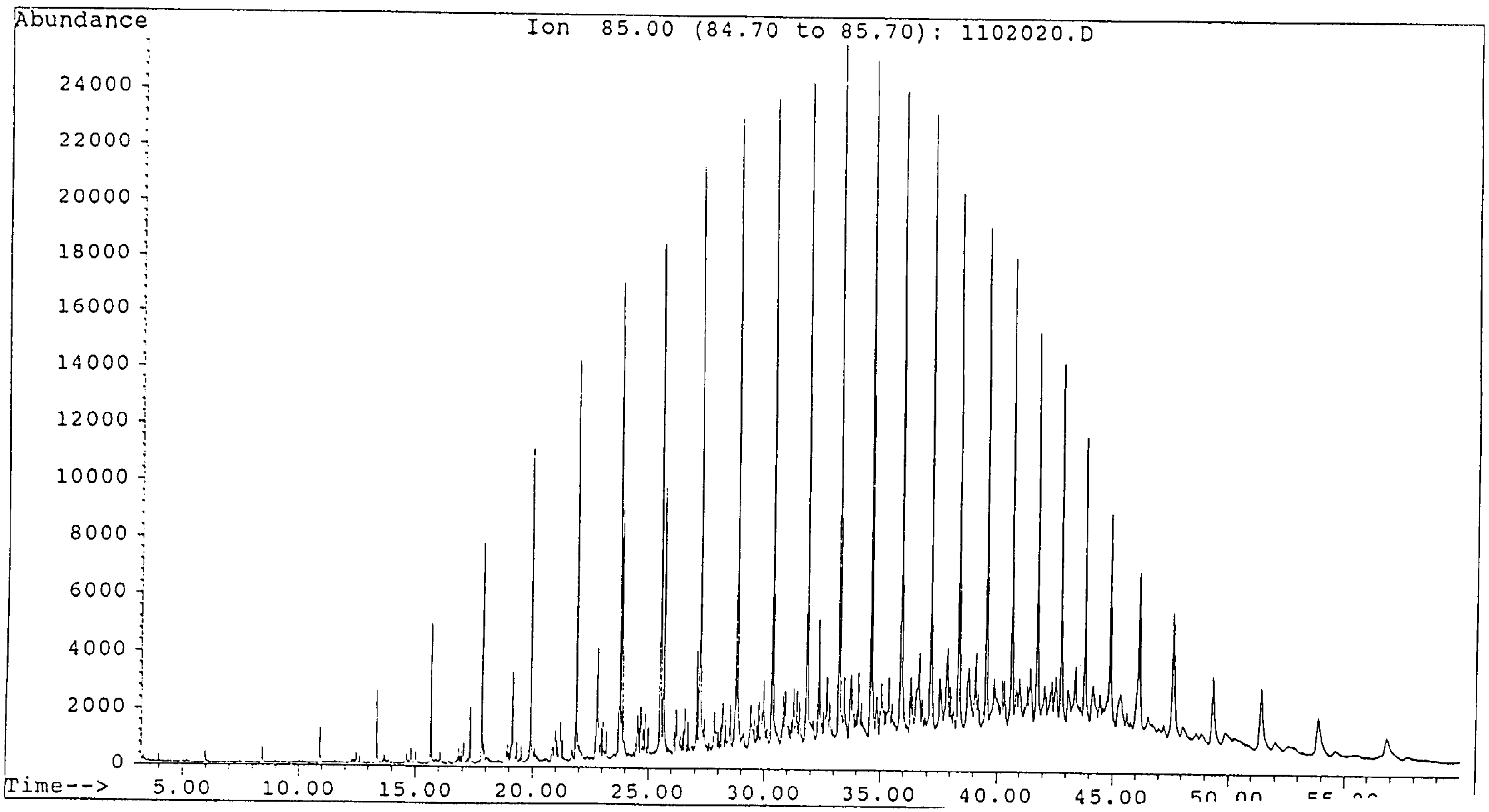
File : C:\HPCHEM\1\DATA\MIKE\SEP10\1002018.D
Operator :
Acquired : 11 Sep 93 5:14 am using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-7 FR-1
Misc Info :
Vial Number: 10



NOBE 93   Figure 11.39

n-Alkane Distribution Chromatograms from GC/MS Measurement

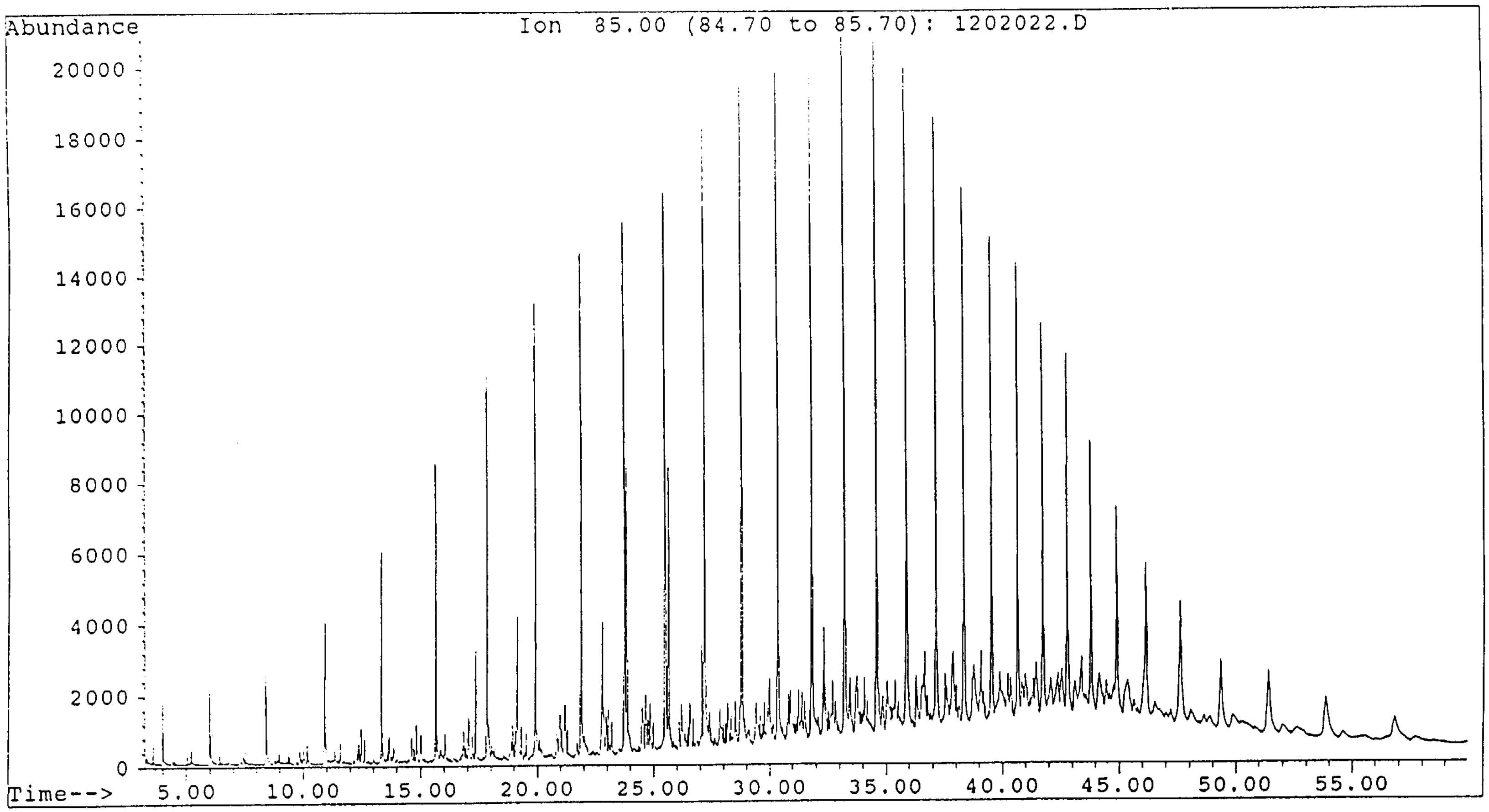
File   : C:\HPCHEM\1\DATA\MIKE\SEP10\1102020.D
Operator   :
Acquired   : 11 Sep 93   7:27 am using AcqMethod ALKANE
Instrument :   5972 - In
Sample Name: NOBE-11 FR-1
Misc Info   :
Vial Number: 11



NOBE 93 Figure 11.40

n-Alkane Distribution Chromatograms from GC/MS Measurement

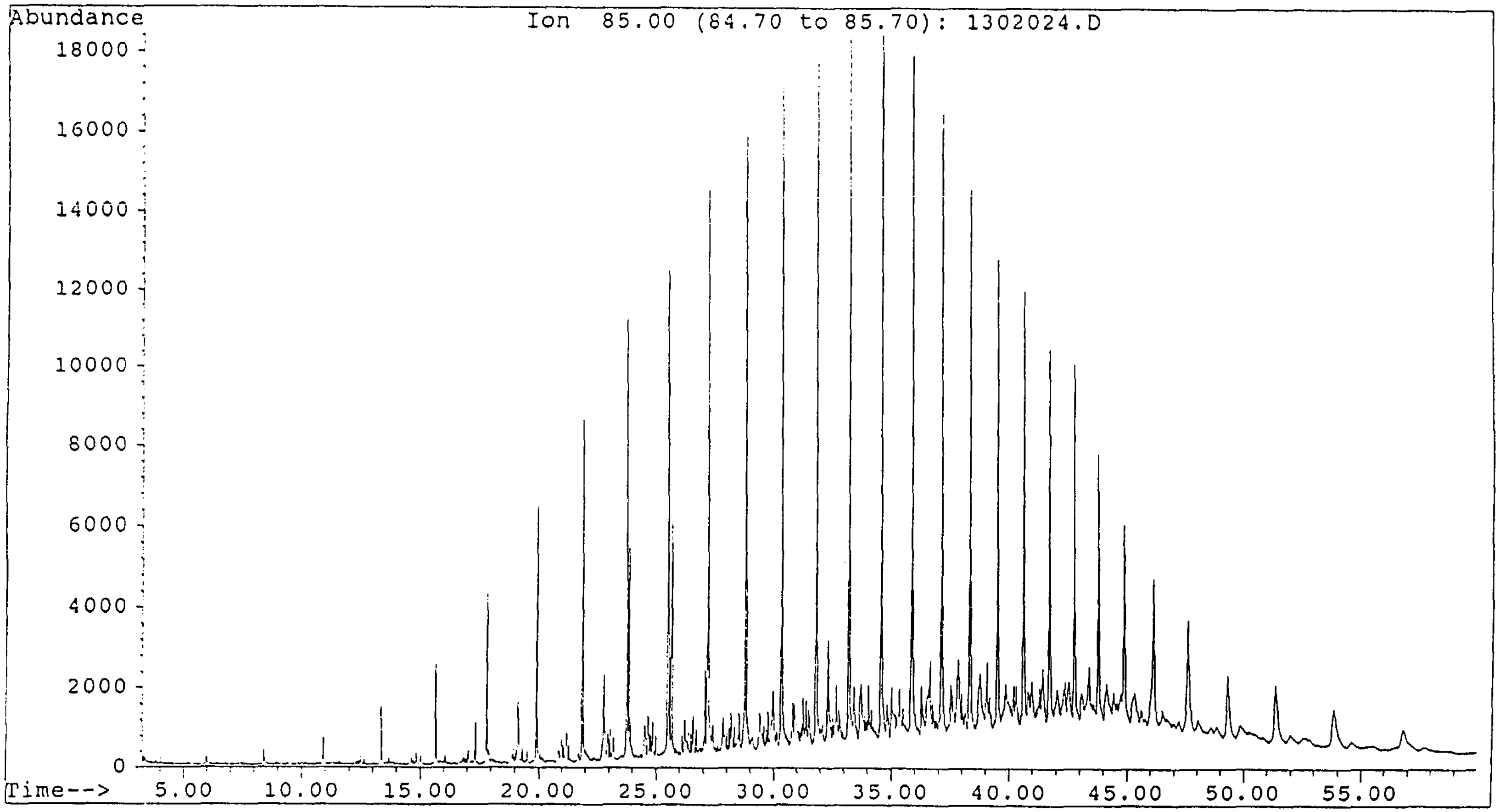
File : C:\HPCHEM\1\DATA\MIKE\SEP10\1202022.D
Operator :
Acquired : 11 Sep 93 9:41 am using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-12 FR-1
Misc Info :
Vial Number: 12



NOBE 93 Figure 11.41

n-Alkane Distribution Chromatograms from GC/MS Measurement

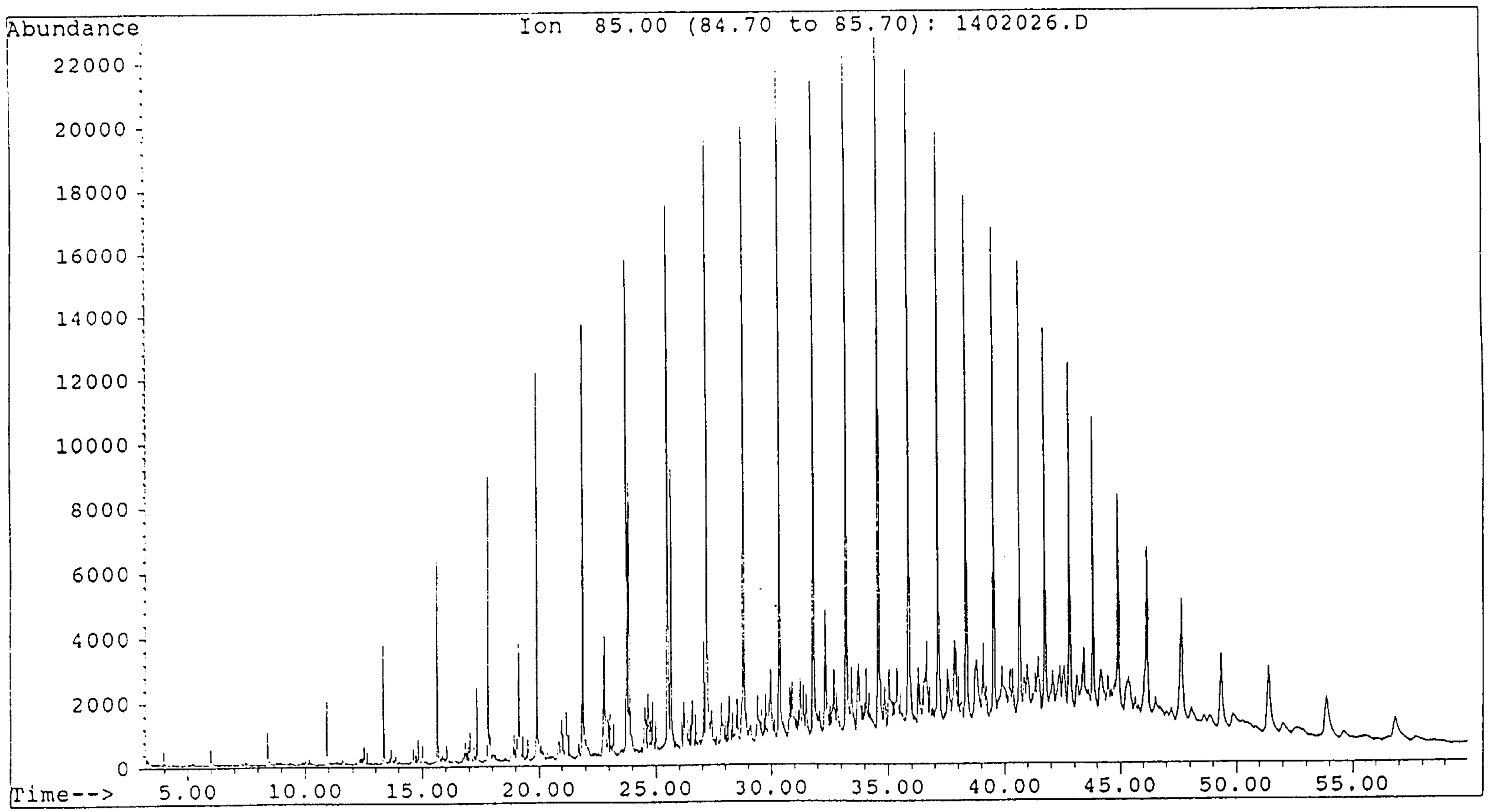
File : C:\HPCHEM\1\DATA\MIKE\SEP10\1302024.D
Operator :
Acquired : 11 Sep 93 11:54 am using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-14 FR-1
Misc Info :
Vial Number: 13



NOBE 93 Figure 11.42

n-Alkane Distribution Chromatograms from GC/MS Measurement

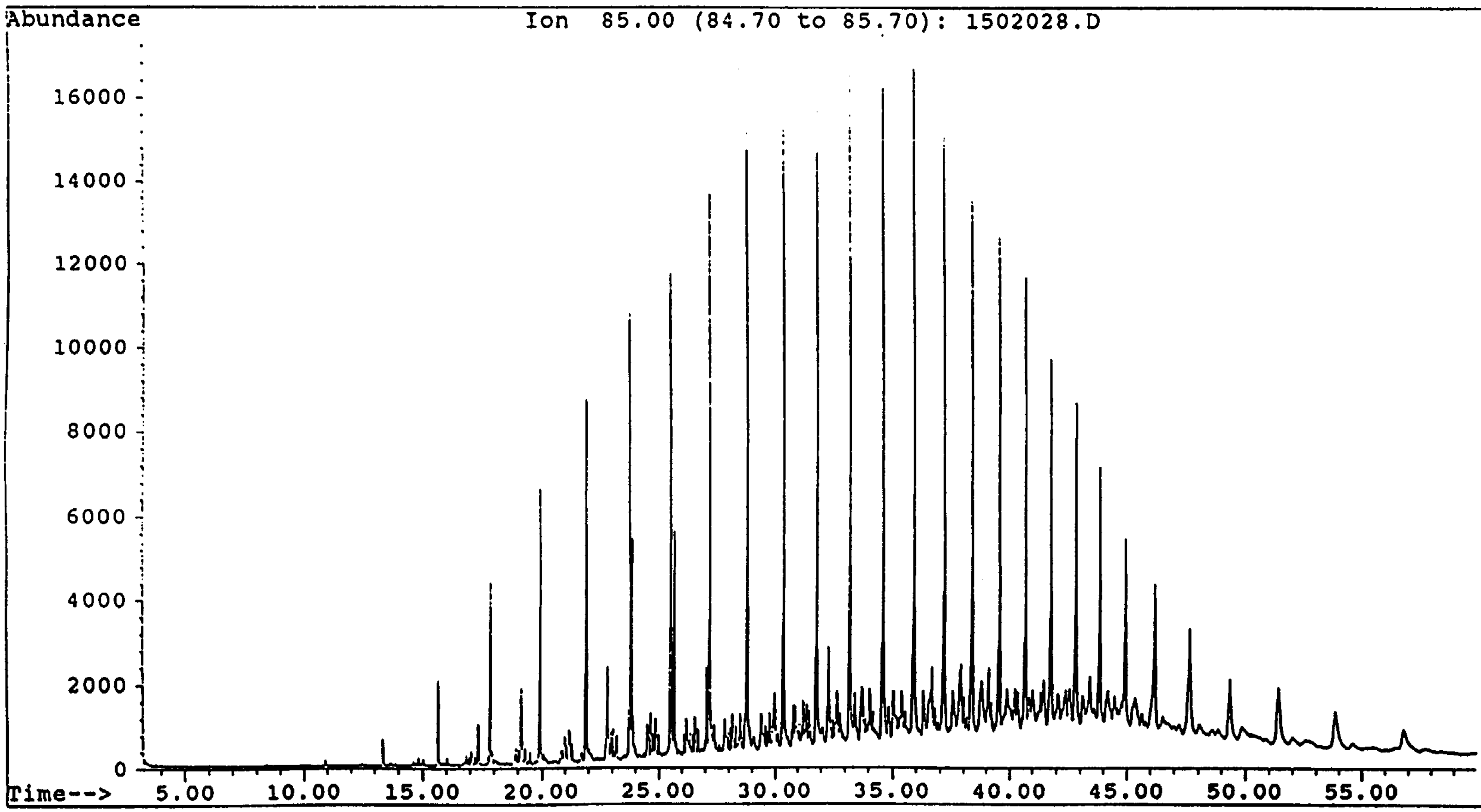
File : C:\HPCHEM\1\DATA\MIKE\SEP10\1402026.D
Operator :
Acquired : 11 Sep 93 2:08 pm using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-15 FR-1
Misc Info :
Vial Number: 14



NOBE 93 Figure 11.43

n-Alkane Distribution Chromatograms from GC/MS Measurement

File : C:\HPCHEM\1\DATA\MIKE\SEP10\1502028.D
Operator :
Acquired : 11 Sep 93 ::21 pm using AcqMethod ALKANE
Instrument : 5972 - In
Sample Name: NOBE-16 FR-1
Misc Info :
Vial Number: 15



Section 12

FIREBOOM
NOBE 93

Air and Water Temperature
Load Measurement

3M FIREBOOM
NOBE 93

As shown in Figure 12.0, the 3M fireboom consisted of fourteen 15.2-m sections, each section consisting of 7 segments, for a total length of 213.4 m. The boom was towed into a standard U-configuration, and a 45.7 m bridle was placed 30.5 m back from the leading ends of the boom. The bridle, when fully extended, allowed 152.4 m of the boom to be held in a U-configuration with a swath-to-boom length ("gap") ratio of 0.3. The towing bridles, connected to the leading ends of sections 1 and 14, could then be pulled sideways to widen the opening of the bridle as necessary. The flared-out boom sections (1,2,13,14) were pulled sideways in the direction of travel by two Boston Whalers, while the Sir Wilfred Grenfell took the major strain on the primary tow line.

Observations from personnel on site and a set of aerial photographs were used to estimate the area covered by the discharged oil and the surface covered by the burning oil. Air and water temperatures were also measured around some sections of the fireboom and the tow load was measured from onboard the Sir Wilfred Grenfell. The performance of the fireboom is discussed in Appendix D.

Air and Water Temperature Measured Around the Fireboom

Three segments of the fireboom were equipped with type K thermocouples to measure air and water temperature. These thermocouples were moulded assemblies with transition joints of moulded glass-filled nylon with Inconel 600 sheaths rated to 1148°C. These three segments (6G, 8C, 9A) are identified in Figure 12.0. Figure 12.2 shows a cross-section of a ceramic segment with the position of the thermocouples. The TC2 position is considered to be at water level, TC0 was positioned 28 cm above TC0, TC1 3.8 cm above TC0 and TC3 3.8 cm below TC2.

Load on Fireboom

The staff of the Sir Wilfred Grenfell measured the load exerted on the fireboom while it was being towed during the experiment.

Measurement of Oil Slick and Burn Area in 3M Fireboom

During the 1993 Newfoundland Offshore Burn Experiment, a series of aerial photographs of the flotilla and the fireboom were taken at an average scale of 1:10,000. A King Air Navajo type aircraft was equipped with a Zeiss RMKA 15/23 camera and 2445 Aerocolor film and approximately 100 aerial photos were taken of the fireboom and its entourage of vessels. These photos were used to determine the area of the oil slick contained by the fireboom and the burning zone during the two burns.

Technical Summary

Figure 12.1 shows the shape of the fireboom during the background period at 9:17 am as seen from an aerial photo. This image was representative of the shape of the fireboom during all of Burn 1 and was used as the standard diagram for the fireboom in motion. During Burn 2, the shape of the fireboom shifted significantly to a point that no standard shape could be used. This shift in the U-configuration was caused by damage to the fireboom during Burn 1. For Burn 2, when possible, individual corrections were made for each image, but the results were less accurate than for Burn 1. To help in the measurement of oil patterns and burning zones, the bottom of the U shape was divided into six theoretical zones and the area of each zone was calculated. From this diagram, a series of measurements were generated, such as the area inside the fireboom configuration, the area of oil slick and the burning zones as reported by field personnel and as seen on aerial photos.

In order to make these measurements, the aerial photos and field observations had to be converted to electronic files. This was done by scanning the images with a 600 dpi (dots per inch) colour scanner. The various areas were calculated using the Jandel's SigmaScan/Image program, which allows the user to outline an area, calculate it and save it.

Results

Field Observations

10:17 am, Pre-ignition to Burn 1 Oil slick visible back to delivery hose during pumping Reported by G. Warbanski on Helicopter CCG 305	446 m^2
10:20 am, Pre-ignition to Burn 1, pumping stopped at 10:19 am Oil slick accumulation in the apex of the fireboom Reported by G. Warbanski on Helicopter CCG 305	121 m^2
10:27 am, Pre-ignition to Burn 1 Oil slick visible back to delivery hose during pumping Reported by G. Warbanski on Helicopter CCG 305	549 m^2
10:28 am, Pre-ignition to Burn 1 Diesel accumulation in the apex of the fireboom Reported by G. Warbanski on helicopter CCG 305	236 m^2
11:19 am, during Burn 1, pumping stopped Burning zone in the apex of the fireboom Reported by G. Warbanski on helicopter CCG 305	351 m^2
11:59 am, 5 minutes before the end of Burn 1, pumping stopped Buring zone in the apex of the fireboom Reported by G. Warbanski on helicopter CCG 305	118 m^2
14:22 pm, during Burn 2, pumping diesel Burning zone in the apex of the fireboom Reported by G. Warbanski on helicopter CCG 305	118 m^2
Burning zone during Burn 2 at ignition point	223 m^2

Measurements as per Aerial Photographs

The second stage of area measurements was performed directly on aerial photographs. These photographs were also scanned into the computer and the resulting images were measured using the Sigma/Plot program. The following are the measurements of the burning zones within the fireboom.

10:38 to 10:39 am, Burn 1:	539 m^2
10:42 to 10:43 am, Burn 1:	91 m^2
10:42 to 10:43 am, Burn 1:	53 m^2
10:42 to 10:43 am, Burn 1:	47 m^2
10:48 to 10:49 am, Burn 1:	85 m^2
11:00 to 11:01 am, Burn 1:	77 m^2
11:00 to 11:01 am, Burn 1:	114 m^2
11:09 to 11:09 am, Burn 1:	67 m^2
11:23 to 11:24 am, Burn 1:	450 m^2
11:32 to 11:33 am, Burn 1:	342 m^2
11:39 to 11:40 am, Burn 1:	367 m^2
11:46 to 11:47 am, Burn 1:	162 m^2

The U-configuration of the fireboom started to change significantly between burns, due to damage to two sections of the boom. Three aerial photographs taken in the interval between the two burns revealed that the apparent changes made it impossible to rely on the standard shape for any calculations and measurements for Burn 2 would therefore be unreliable.

Discussion

The measurements of the burn areas were reproducible 0.5 to 5.0% of each other for images close to the standard shape with the lower values, closest to 37 m^2, having the largest difference.

The general conclusion is that the area of the burn can be measured from an aerial photograph if the photograph is taken directly above (at nadir) the boom. The increase in error can be related to the increase in the angle from nadir at which the photograph is taken. In such cases, the areas can still be measured with the Jandel SigmaScan/Image software, but the error involved with the measurement is much greater, approximately 10 to 20%.

NOBE 93 Table 12.1

3M Fireboom Air and Water Temperatures

Section 6G (°C)

Burn Periods		Ref Temp	TC-0 28 cm above TC-2 Min	Ave	Max	TC-1 3.8 cm above TC-2 Min	Ave	Max	TC-2 nominally at water line Min	Ave	Max	TC-3 3.8 cm below TC-2 Min	Ave	Max
Background 1	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	1
	Maximum	12	0	0	0	0	0	0	0	0	13	0	0	38
Pre-ignition 1	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	9	0	0	1	0	0	0	0	0	0	0	0	0
	Maximum	11	0	0	13	0	0	0	0	0	0	0	0	0
Burn 1	Minimum	9	0	0	0	-1	0	0	0	0	0	0	0	0
	Average	9	129	175	247	58	151	265	0	70	146	0	0	0
	Maximum	9	654	745	838	550	679	768	0	311	501	0	0	0
Post-burn 2	Minimum	9	12	3	12	0	0	0	0	0	0	0	0	0
	Average	9	12	4	13	0	0	0	0	0	0	0	0	0
	Maximum	9	12	10	25	0	0	0	0	0	0	0	0	0
Background 2	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	9	6	2	11	0	0	0	0	0	0	0	0	0
	Maximum	9	12	3	13	0	0	0	0	0	0	0	0	0
Pre-ignition 2	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	9	0	0	9	0	0	0	0	0	0	0	0	0
	Maximum	9	0	0	13	0	0	0	0	0	0	0	0	0
Burn 2	Minimum	9	0	-8	13	0	-2	0	0	0	0	0	0	0
	Average	9	298	400	491	58	105	175	0	49	82	0	0	0
	Maximum	9	918	955	968	303	406	617	0	219	301	0	0	0
Post-burn 2	Minimum	9	0	-3	0	0	0	0	0	0	0	0	0	0
	Average	10	10	7	16	0	0	1	0	0	1	0	0	0
	Maximum	14	61	53	62	0	1	13	0	1	13	0	0	0
Post Residue Collection period 2	Minimum	12	0	0	0	0	0	0	0	0	0	0	0	0
	Average	16	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	19	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.2

3M Fireboom Air and Water Temperatures
Section 8C (°C)

Burn Periods		Ref	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
		Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Background 1	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	12	0	0	0	0	0	0	0	0	0	0	0	0
Pre-ignition 1	Minimum	10	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	10	0	0	0	0	0	0	0	0	0	0	0	0
Burn 1	Minimum	10	0	0	0	0	0	0	0	0	0	0	0	0
	Average	11	723	814	877	275	376	508	48	179	248	51	80	108
	Maximum	13	955	980	1006	608	677	766	90	276	419	96	131	170
Post-burn 1	Minimum	10	12	2	12	0	0	0	0	0	0	0	0	0
	Average	10	14	4	16	0	0	0	0	0	0	0	0	0
	Maximum	11	24	14	25	0	0	0	0	0	0	0	0	0
Background 2	Minimum	10	0	-9	12	0	0	0	0	0	0	0	0	0
	Average	10	1	-5	13	0	0	0	0	0	0	0	0	0
	Maximum	10	12	2	13	0	0	0	0	0	0	0	0	0
Pre-ignition 2	Minimum	10	0	-9	13	0	0	0	0	0	0	0	0	0
	Average	10	0	-9	13	0	0	0	0	0	0	0	0	0
	Maximum	10	0	-7	13	0	0	0	0	0	0	0	0	0
Burn 2	Minimum	10	-5	-5	13	0	0	0	0	0	0	0	0	0
	Average	11	634	713	777	114	140	209	10	66	98	11	23	35
	Maximum	11	930	955	971	215	224	337	59	128	170	60	68	86
Post-burn 2	Minimum	11	0	-8	0	0	0	0	0	0	0	0	0	0
	Average	12	39	46	65	0	1	4	0	0	0	0	0	0
	Maximum	14	288	483	746	0	36	136	0	10	12	0	0	0
Post Residue Collection period 2	Minimum	12	0	0	0	0	0	0	0	0	0	0	0	0
	Average	15	0	0	0	0	0	0	0	0	0	0	0	1
	Maximum	17	0	0	0	0	0	0	0	0	0	0	7	13

NOBE 93 Table 12.3

3M Fireboom Air and Water Temperatures
Section 9A (°C)

Burn Periods		Ref Temp	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
			Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Background 1	Minimum	8	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	11	0	0	0	0	0	0	0	0	0	0	0	0
Pre-ignition 1	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	9	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	10	0	0	0	0	0	0	0	0	0	0	0	0
Burn 1	Minimum	9	-10	0	0	0	0	0	-8	0	0	-6	0	0
	Average	10	177	300	444	98	231	368	45	214	343	46	146	278
	Maxium	10	882	923	959	786	814	850	418	759	826	421	620	750
Post-burn 1	Minimum	9	0	-8	0	0	0	0	0	0	0	0	0	0
	Average	9	5	3	9	0	0	0	0	0	0	0	0	0
	Maximum	10	24	21	37	0	0	0	0	0	0	0	0	0
Background 2	Minimum	9	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	10	0	0	0	0	0	0	0	0	0	0	0	0
Pre-ignition 2	Minimum	10	0	0	0	0	0	0	0	0	0	0	0	0
	Average	10	0	0	0	0	0	0	0	0	0	0	0	0
	Maximum	10	0	0	0	0	0	0	0	0	0	0	0	0
Burn 2	Minimum	10	0	-8	0	-5	-3	0	0	0	0	0	0	0
	Average	10	180	267	347	68	134	223	15	73	133	16	34	62
	Maximum	10	845	896	945	597	664	754	175	354	500	178	226	289
Post-burn 2	Minimum	10	0	-8	0	0	0	0	0	0	0	0	0	0
	Average	11	9	7	16	0	0	0	0	0	0	0	0	0
	Maximum	13	49	40	74	0	0	0	0	0	0	0	0	0
Post Residue Collection Period 2	Minimum	13	0	0	0	0	0	0	0	0	0	0	0	0
	Average	13	0	0	0	0	0	1	0	0	0	0	0	0
	Maximum	14	0	0	0	0	5	12	0	0	0	0	0	0

NOBE 93 Table 12.4

3M Fireboom Air and Water Temperatures
Thermocouples at Section 6G (°C)

	Time	Time	Ref	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Background 1	7:40	-170	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:42	-168	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:44	-166	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:46	-164	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:48	-162	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:50	-160	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:52	-158	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:54	-156	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:56	-154	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:58	-152	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:00	-150	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:02	-148	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:04	-146	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:06	-144	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:08	-142	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:10	-140	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:12	-138	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:14	-136	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:16	-134	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:18	-132	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:20	-130	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:22	-128	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:24	-126	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:26	-124	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:28	-122	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:30	-120	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:32	-118	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:34	-116	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:36	-114	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:38	-112	10	0	0	0	0	0	0	0	0	0	0	0	38
	8:40	-110	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:42	-108	10	0	0	0	0	0	0	0	0	13	0	0	13
	8:44	-106	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:46	-104	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:48	-102	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:50	-100	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:52	-98	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:54	-96	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:56	-94	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:58	-92	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:00	-90	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:02	-88	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:04	-86	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:06	-84	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:08	-82	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:10	-80	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:12	-78	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:14	-76	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:16	-74	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:18	-72	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:20	-70	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:22	-68	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:24	-66	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:26	-64	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:28	-62	11	0	0	0	0	0	0	0	0	0	0	0	0
Pre-ignition 1	9:30	-60	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:32	-58	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:34	-56	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:36	-54	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:38	-52	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:40	-50	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:42	-48	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:44	-46	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:46	-44	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:48	-42	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:50	-40	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:52	-38	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:54	-36	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:56	-34	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:58	-32	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:00	-30	9	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.4 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 6G (°C)

	Time Recorded	Time Elapsed	Ref Temp	TC-0 28 cm above TC-2 Min	Ave	Max	TC-1 3.8 cm above TC-2 Min	Ave	Max	TC-2 nominally at water line Min	Ave	Max	TC-3 3.8 cm below TC-2 Min	Ave	Max
	10:02	-28	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:04	-26	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:06	-24	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:08	-22	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:10	-20	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:12	-18	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:14	-16	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:16	-14	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:18	-12	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:20	-10	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:22	-8	9	0	0	13	0	0	0	0	0	0	0	0	0
	10:24	-6	9	0	0	13	0	0	0	0	0	0	0	0	0
	10:26	-4	9	0	0	0	0	0	0	0	0	0	0	0	0
Burn 1	10:30	0	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:32	2	9	0	27	209	0	115	552	0	77	328	0	0	0
	10:34	4	9	203	470	771	550	679	717	0	270	419	0	0	0
	10:36	6	9	654	744	825	276	594	768	0	311	501	0	0	0
	10:38	8	9	583	745	837	337	532	697	0	289	394	0	0	0
	10:40	10	9	375	472	591	192	397	712	0	204	385	0	0	0
	10:42	12	9	512	684	838	278	476	651	0	255	371	0	0	0
	10:44	14	9	502	635	743	182	507	650	0	280	466	0	0	0
	10:46	16	9	221	328	512	0	27	197	0	3	50	0	0	0
	10:48	18	9	131	163	230	0	23	111	0	19	99	0	0	0
	10:50	20	9	131	174	205	15	195	385	0	96	244	0	0	0
	10:52	22	9	96	121	158	0	18	50	0	4	12	0	0	0
	10:54	24	9	72	77	98	0	2	13	0	0	0	0	0	0
	10:56	26	9	61	56	73	0	0	0	0	0	0	0	0	0
	10:58	28	9	48	44	61	0	0	0	0	0	0	0	0	0
	11:00	30	9	36	35	49	0	0	0	0	0	0	0	0	0
	11:02	32	9	36	29	49	0	8	12	0	0	0	0	0	0
	11:04	34	9	33	70	196	0	219	586	0	126	327	0	0	0
	11:06	36	9	190	244	312	133	421	652	0	197	373	0	0	0
	11:08	38	9	197	379	523	171	459	604	0	245	324	0	0	0
	11:10	40	9	525	674	778	230	502	650	0	240	348	0	0	0
	11:12	42	9	219	366	594	0	54	233	0	3	37	0	0	0
	11:14	44	9	44	92	232	0	0	0	0	0	0	0	0	0
	11:16	46	9	48	43	61	0	55	269	0	36	172	0	0	0
	11:18	48	9	49	49	61	31	131	267	0	25	111	0	0	0
	11:20	50	9	36	33	49	10	27	111	0	7	75	0	0	0
	11:22	52	9	36	41	61	78	238	360	0	100	183	0	0	0
	11:24	54	9	36	32	49	0	21	87	0	0	0	0	0	0
	11:26	56	9	24	28	37	12	19	25	0	0	0	0	0	0
	11:28	58	9	15	87	399	0	171	587	0	95	304	0	0	0
	11:30	60	9	268	452	580	98	412	581	0	172	338	0	0	0
	11:32	62	9	105	168	266	10	29	111	0	0	0	0	0	0
	11:34	64	9	60	72	110	12	24	37	0	1	13	0	0	0
	11:36	66	9	48	43	61	10	16	112	0	4	87	0	0	0
	11:38	68	9	48	55	74	5	120	291	0	52	208	0	0	0
	11:40	70	9	36	38	49	0	7	25	0	0	0	0	0	0
	11:42	72	9	37	28	37	24	34	37	0	2	12	0	0	0
	11:44	74	9	17	83	316	-1	161	528	0	90	268	0	0	0
	11:46	76	9	153	218	313	110	313	583	0	108	303	0	0	0
	11:48	78	9	83	114	158	14	217	432	0	73	268	0	0	0
	11:50	80	9	48	55	86	0	5	25	0	0	0	0	0	0
	11:52	82	9	36	31	49	0	0	0	0	0	0	0	0	0
	11:54	84	9	24	18	37	0	0	0	0	0	0	0	0	0
	11:56	86	9	24	16	25	0	0	0	0	0	0	0	0	0
	11:58	88	9	24	16	25	0	0	0	0	0	0	0	0	0
	12:00	90	9	24	16	25	0	0	0	0	0	0	0	0	0
	12:02	92	9	12	16	25	0	0	0	0	0	0	0	0	0
	12:04	94	9	12	16	25	0	0	0	0	0	0	0	0	0
Post-burn 1	12:06	96	9	12	10	25	0	0	0	0	0	0	0	0	0
	12:08	98	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:10	100	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:12	102	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:14	104	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:16	106	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:18	108	9	12	4	25	0	0	0	0	0	0	0	0	0
	12:20	110	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:22	112	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:24	114	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:26	116	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:28	118	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:30	120	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:32	122	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:34	124	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:36	126	9	12	3	12	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.4 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 6G (°C)

	Time	Time	Ref	TC-0			TC-1			TC-2			TC-3		
				28 cm above TC-2			3.8 cm above TC-2			nominally at water line			3.8 cm below TC-2		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	12:38	128	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:40	130	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:42	132	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:44	134	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:46	136	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:48	138	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:50	140	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:52	142	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:54	144	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:56	146	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:58	148	9	12	3	12	0	0	0	0	0	0	0	0	0
Background 2	13:00	-66	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:02	-64	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:04	-62	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:06	-60	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:08	-58	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:10	-56	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:12	-54	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:14	-52	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:16	-50	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:18	-48	9	0	3	12	0	0	0	0	0	0	0	0	0
	13:20	-46	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:22	-44	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:24	-42	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:26	-40	9	12	3	12	0	0	0	0	0	0	0	0	0
	13:28	-38	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:30	-36	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:32	-34	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:34	-32	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:36	-30	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:38	-28	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:40	-26	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:42	-24	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:44	-22	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:46	-20	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:48	-18	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:50	-16	9	0	0	13	0	0	0	0	0	0	0	0	0
Pre-ignition 2	13:52	-14	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:54	-12	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:56	-10	9	0	0	13	0	0	0	0	0	0	0	0	0
	13:58	-8	9	0	0	0	0	0	0	0	0	0	0	0	0
	14:00	-6	9	0	0	0	0	0	0	0	0	0	0	0	0
	14:02	-4	9	0	0	13	0	0	0	0	0	0	0	0	0
	14:04	-2	9	0	0	13	0	0	0	0	0	0	0	0	0
Burn 2	14:06	0	9	0	-8	13	0	0	0	0	0	0	0	0	0
	14:08	2	9	0	311	872	0	228	514	0	113	255	0	0	0
	14:10	4	9	809	859	883	271	362	464	0	199	277	0	0	0
	14:12	6	9	820	896	945	303	406	617	0	219	301	0	0	0
	14:14	8	9	857	916	932	271	326	441	0	183	254	0	0	0
	14:16	10	9	918	955	968	259	355	464	0	185	253	0	0	0
	14:18	12	9	844	926	944	199	289	430	0	145	194	0	0	0
	14:20	14	9	592	845	959	117	217	301	0	104	158	0	0	0
	14:22	16	9	414	679	963	18	140	279	0	45	86	0	0	0
	14:24	18	9	687	889	957	103	244	348	0	88	134	0	0	0
	14:26	20	9	289	434	687	0	12	112	0	2	13	0	0	0
	14:28	22	9	190	239	300	0	0	0	0	0	0	0	0	0
	14:30	24	9	144	166	206	0	0	0	0	0	0	0	0	0
	14:32	26	9	108	123	158	0	0	0	0	0	0	0	0	0
	14:34	28	9	85	95	110	0	0	0	0	0	0	0	0	0
	14:36	30	9	72	78	98	0	0	0	0	0	0	0	0	0
	14:38	32	9	60	63	86	0	0	0	0	0	0	0	0	0
	14:40	34	9	59	67	123	0	45	172	0	15	74	0	0	0
	14:42	36	9	92	114	315	0	51	233	0	16	124	0	0	0
	14:44	38	9	309	779	885	214	257	324	0	131	182	0	0	0
	14:46	40	9	700	854	908	154	203	277	0	96	171	0	0	0
	14:48	42	9	491	612	695	94	162	218	0	57	86	0	0	0
	14:50	44	9	222	324	488	0	6	99	0	2	25	0	0	0
	14:52	46	9	143	175	230	0	0	0	0	0	0	0	0	0
	14:54	48	9	144	162	194	0	59	123	0	9	12	0	0	0
	14:56	50	9	107	141	182	0	22	173	0	6	25	0	0	0
	14:58	52	9	163	306	418	6	137	243	0	35	99	0	0	0
	15:00	54	9	118	163	254	0	-2	13	0	0	0	0	0	0
	15:02	56	9	84	93	122	0	3	62	0	2	25	0	0	0
	15:04	58	9	77	660	926	68	201	265	0	96	159	0	0	0
	15:06	60	9	639	891	945	69	178	254	0	69	110	0	0	0
	15:08	62	9	255	394	641	0	0	62	0	0	0	0	0	0

NOBE 93 Table 12.4 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 6G (°C)

	Time	Time	Ref	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	15:10	64	9	179	211	265	0	0	0	0	0	0	0	0	0
	15:12	66	9	132	147	182	0	0	0	0	0	0	0	0	0
	15:14	68	9	96	108	134	0	0	0	0	0	0	0	0	0
	15:16	70	9	72	82	98	0	0	0	0	0	0	0	0	0
	15:18	72	9	60	66	86	0	0	0	0	0	0	0	0	0
Post-burn 2	15:20	74	9	61	53	61	0	0	0	0	0	0	0	0	0
	15:22	76	9	49	51	61	0	0	0	0	0	0	0	0	0
	15:24	78	9	36	38	62	0	0	0	0	0	0	0	0	0
	15:26	80	9	24	22	37	0	0	0	0	0	0	0	0	0
	15:28	82	9	24	16	37	0	0	0	0	0	0	0	0	0
	15:30	84	9	24	24	37	0	0	0	0	0	0	0	0	0
	15:32	86	9	24	17	37	0	0	0	0	0	0	0	0	0
	15:34	88	9	12	9	25	0	0	0	0	0	0	0	0	0
	15:36	90	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:38	92	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:40	94	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:42	96	9	12	3	25	0	0	0	0	0	0	0	0	0
	15:44	98	9	12	5	25	0	0	0	0	0	0	0	0	0
	15:46	100	9	12	3	25	0	0	0	0	0	0	0	0	0
	15:48	102	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:50	104	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:52	106	9	0	3	12	0	0	0	0	0	0	0	0	0
	15:54	108	9	0	2	12	0	0	0	0	0	0	0	0	0
	15:56	110	9	12	3	12	0	0	0	0	0	0	0	0	0
	15:58	112	9	0	-3	13	0	0	0	0	0	0	0	0	0
	16:00	114	9	0	0	0	0	0	0	0	0	0	0	0	0
	16:02	116	9	0	0	0	0	0	0	0	0	0	0	0	0
	16:04	118	10	0	0	0	0	0	0	0	0	0	0	0	0
	16:06	120	10	0	0	0	0	0	13	0	0	13	0	0	0
	16:08	122	10	0	0	0	0	0	0	0	1	13	0	0	0
	16:10	124	10	0	0	0	0	0	13	0	0	0	0	0	0
	16:12	126	11	0	0	0	0	1	13	0	0	0	0	0	0
	16:14	128	11	0	0	0	0	1	13	0	0	0	0	0	0
	16:16	130	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:18	132	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:20	134	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:22	136	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:24	138	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:26	140	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:28	142	14	0	0	0	0	0	0	0	0	0	0	0	0
Post Residue Collection period 2	16:30	144	15	0	0	0	0	0	0	0	0	0	0	0	0
	16:32	146	15	0	0	0	0	0	0	0	0	0	0	0	0
	16:34	148	16	0	0	0	0	0	0	0	0	0	0	0	0
	16:36	150	16	0	0	0	0	0	0	0	0	0	0	0	0
	16:38	152	17	0	0	0	0	0	0	0	0	0	0	0	0
	16:40	154	18	0	0	0	0	0	0	0	0	0	0	0	0
	16:42	156	18	0	0	0	0	0	0	0	0	0	0	0	0
	16:44	158	18	0	0	0	0	0	0	0	0	0	0	0	0
	16:46	160	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:48	162	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:50	164	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:52	166	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:54	168	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:56	170	19	0	0	0	0	0	0	0	0	0	0	0	0
	16:58	172	19	0	0	0	0	0	0	0	0	0	0	0	0
	17:00	174	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:02	176	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:04	178	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:06	180	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:08	182	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:10	184	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:12	186	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:14	188	18	0	0	0	0	0	0	0	0	0	0	0	0
	17:16	190	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:18	192	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:20	194	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:22	196	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:24	198	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:26	200	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:28	202	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:30	204	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:32	206	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:34	208	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:36	210	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:38	212	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:40	214	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:42	216	15	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.4 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 6G (°C)

Time	Time	Ref	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
17:44	218	15	0	0	0	0	0	0	0	0	0	0	0	0
17:46	220	15	0	0	0	0	0	0	0	0	0	0	0	0
17:48	222	14	0	0	0	0	0	0	0	0	0	0	0	0
17:50	224	14	0	0	0	0	0	0	0	0	0	0	0	0
17:52	226	14	0	0	0	0	0	0	0	0	0	0	0	0
17:54	228	14	0	0	0	0	0	0	0	0	0	0	0	0
17:56	230	14	0	0	0	0	0	0	0	0	0	0	0	0
17:58	232	14	0	0	0	0	0	0	0	0	0	0	0	0
18:00	234	13	0	0	0	0	0	0	0	0	0	0	0	0
18:02	236	13	0	0	0	0	0	0	0	0	0	0	0	0
18:04	238	13	0	0	0	0	0	0	0	0	0	0	0	0
18:06	240	13	0	0	0	0	0	0	0	0	0	0	0	0
18:08	242	13	0	0	0	0	0	0	0	0	0	0	0	0
18:10	244	13	0	0	0	0	0	0	0	0	0	0	0	0
18:12	246	13	0	0	0	0	0	0	0	0	0	0	0	0
18:14	248	13	0	0	0	0	0	0	0	0	0	0	0	0
18:16	250	13	0	0	0	0	0	0	0	0	0	0	0	0
18:18	252	13	0	0	0	0	0	0	0	0	0	0	0	0
18:20	254	13	0	0	0	0	0	0	0	0	0	0	0	0
18:22	256	13	0	0	0	0	0	0	0	0	0	0	0	0
18:24	258	13	0	0	0	0	0	0	0	0	0	0	0	0
18:26	260	13	0	0	0	0	0	0	0	0	0	0	0	0
18:28	262	13	0	0	0	0	0	0	0	0	0	0	0	0
18:30	264	13	0	0	0	0	0	0	0	0	0	0	0	0
18:32	266	12	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.5

3M Fireboom Air and Water Temperatures
Thermocouples at Section 8C (°C)

Burn Periods	Recorded	Elapsed	Ref Temp	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
				Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Background 1	7:50	-160	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:52	-158	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:54	-156	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:56	-154	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:58	-152	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:00	-150	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:02	-148	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:04	-146	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:06	-144	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:08	-142	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:10	-140	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:12	-138	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:14	-136	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:16	-134	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:18	-132	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:20	-130	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:22	-128	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:24	-126	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:26	-124	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:28	-122	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:30	-120	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:32	-118	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:34	-116	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:36	-114	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:38	-112	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:40	-110	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:42	-108	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:44	-106	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:46	-104	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:48	-102	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:50	-100	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:52	-98	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:54	-96	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:56	-94	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:58	-92	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:00	-90	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:02	-88	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:04	-86	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:06	-84	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:08	-82	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:10	-80	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:12	-78	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:14	-76	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:16	-74	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:18	-72	12	0	0	0	0	0	0	0	0	0	0	0	0
	9:20	-70	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:22	-68	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:24	-66	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:26	-64	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:28	-62	11	0	0	0	0	0	0	0	0	0	0	0	0
Pre-Ignition 1	9:30	-60	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:32	-58	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:34	-56	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:36	-54	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:38	-52	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:40	-50	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:42	-48	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:44	-46	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:46	-44	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:48	-42	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:50	-40	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:52	-38	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:54	-36	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:56	-34	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:58	-32	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:00	-30	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:02	-28	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:04	-26	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:06	-24	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:08	-22	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:10	-20	10	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.5 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 8C (°C)

Burn Periods	Recorded	Elapsed	Ref Temp	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
				Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	10:12	-18	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:14	-16	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:16	-14	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:18	-12	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:20	-10	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:22	-8	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:24	-6	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:26	-4	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:28	-2	10	0	0	0	0	0	0	0	0	0	0	0	0
Burn 1	10:30	0	10	0	0	0	0	0	0	0	0	0	0	0	0
	10:32	2	10	0	283	922	0	169	575	0	59	196	0	23	87
	10:34	4	10	881	910	932	549	677	766	64	274	419	71	125	170
	10:36	6	10	819	945	969	608	674	766	77	245	419	84	113	146
	10:38	8	10	892	960	994	324	561	756	55	209	313	59	90	134
	10:40	10	10	881	940	956	327	495	626	68	215	289	72	110	134
	10:42	12	11	892	968	1006	305	407	546	56	210	277	59	104	134
	10:44	14	11	893	956	968	289	491	722	68	231	288	71	113	146
	10:46	16	11	857	912	944	431	609	743	90	276	371	96	131	158
	10:48	18	11	893	959	981	288	503	746	80	219	301	84	108	122
	10:50	20	11	746	913	970	467	634	719	67	222	325	72	106	134
	10:52	22	12	750	796	823	245	331	547	56	188	265	59	87	134
	10:54	24	12	572	743	800	248	303	394	44	173	242	47	83	110
	10:56	26	12	526	593	744	259	347	452	56	187	265	59	90	122
	10:58	28	11	735	886	945	340	433	557	45	167	218	48	64	86
	11:00	30	11	918	954	968	255	410	640	43	188	277	47	80	122
	11:02	32	11	930	967	968	326	528	661	55	222	301	60	91	110
	11:04	34	11	955	980	993	419	590	744	67	248	336	71	111	146
	11:06	36	11	918	963	968	374	516	638	55	213	289	59	93	122
	11:08	38	11	819	932	969	291	381	617	68	206	277	72	97	122
	11:10	40	11	594	775	873	316	445	592	81	224	265	84	110	146
	11:12	42	11	591	840	971	245	393	522	56	202	253	59	88	122
	11:14	44	11	844	940	969	341	424	545	57	188	229	60	79	98
	11:16	46	11	831	922	969	341	418	533	57	190	229	60	79	110
	11:18	48	11	856	941	981	282	333	512	44	179	230	47	78	122
	11:20	50	11	856	953	981	306	369	499	42	206	325	47	96	134
	11:22	52	11	930	965	968	374	514	638	67	229	300	72	104	134
	11:24	54	11	819	885	958	373	516	674	56	201	253	60	89	110
	11:26	56	11	893	956	968	326	469	651	43	198	277	47	79	110
	11:28	58	12	783	878	945	234	330	500	44	184	254	47	88	122
	11:30	60	12	808	894	945	364	422	581	68	215	277	72	96	122
	11:32	62	12	771	879	945	352	442	580	67	232	336	72	103	134
	11:34	64	12	893	942	981	221	299	513	32	160	218	35	66	98
	11:36	66	12	893	947	956	249	300	382	45	188	217	47	87	110
	11:38	68	13	905	969	981	259	350	476	68	208	277	72	93	110
	11:40	70	13	735	848	933	236	314	429	31	187	253	35	77	110
	11:42	72	13	856	936	956	189	253	348	45	170	218	48	69	98
	11:44	74	13	832	884	958	225	284	383	56	184	241	59	89	134
	11:46	76	13	820	905	944	273	308	370	45	176	217	48	75	98
	11:48	78	12	713	795	848	238	271	335	33	149	182	35	64	86
	11:50	80	12	797	853	871	237	281	371	33	137	194	36	53	74
	11:52	82	12	797	835	872	238	256	312	33	140	194	36	53	74
	11:54	84	12	536	627	803	129	226	313	8	116	183	11	50	74
	11:56	86	11	537	649	754	249	296	370	32	154	218	35	67	98
	11:58	88	11	479	636	706	213	270	347	33	141	194	36	50	61
	12:00	90	11	358	656	802	28	202	373	0	91	183	0	37	74
	12:02	92	11	78	177	361	0	4	37	0	0	0	0	0	0
	12:04	94	11	23	42	86	0	0	0	0	0	0	0	0	0
Post-burn 1	12:06	96	11	12	11	25	0	0	0	0	0	0	0	0	0
	12:08	98	11	12	10	25	0	0	0	0	0	0	0	0	0
	12:10	100	11	24	14	25	0	0	0	0	0	0	0	0	0
	12:12	102	10	24	14	25	0	0	0	0	0	0	0	0	0
	12:14	104	10	24	14	25	0	0	0	0	0	0	0	0	0
	12:16	106	10	12	8	25	0	0	0	0	0	0	0	0	0
	12:18	108	10	12	4	25	0	0	0	0	0	0	0	0	0
	12:20	110	10	12	3	25	0	0	0	0	0	0	0	0	0
	12:22	112	10	12	2	13	0	0	0	0	0	0	0	0	0
	12:24	114	10	12	2	13	0	0	0	0	0	0	0	0	0
	12:26	116	10	12	2	13	0	0	0	0	0	0	0	0	0
	12:28	118	10	12	2	13	0	0	0	0	0	0	0	0	0
	12:30	120	10	12	2	12	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.5 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 8C (°C)

Burn Periods	Recorded	Elapsed	Ref Temp	TC-0 28 cm above TC-2 Min	Ave	Max	TC-1 3.8 cm above TC-2 Min	Ave	Max	TC-2 nominally at water line Min	Ave	Max	TC-3 3.8 cm below TC-2 Min	Ave	Max
	12:32	122	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:34	124	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:36	126	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:38	128	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:40	130	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:42	132	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:44	134	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:46	136	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:48	138	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:50	140	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:52	142	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:54	144	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:56	146	10	12	2	12	0	0	0	0	0	0	0	0	0
	12:58	148	10	12	2	12	0	0	0	0	0	0	0	0	0
Background 2	13:00	-66	10	12	2	12	0	0	0	0	0	0	0	0	0
	13:02	-64	10	12	2	12	0	0	0	0	0	0	0	0	0
	13:04	-62	10	0	2	13	0	0	0	0	0	0	0	0	0
	13:06	-60	10	0	0	13	0	0	0	0	0	0	0	0	0
	13:08	-58	10	0	-3	13	0	0	0	0	0	0	0	0	0
	13:10	-56	10	0	-5	13	0	0	0	0	0	0	0	0	0
	13:12	-54	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:14	-52	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:16	-50	10	0	-9	13	0	0	0	0	0	0	0	0	0
	13:18	-48	10	0	-7	13	0	0	0	0	0	0	0	0	0
	13:20	-46	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:22	-44	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:24	-42	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:26	-40	10	0	-6	13	0	0	0	0	0	0	0	0	0
	13:28	-38	10	0	-7	13	0	0	0	0	0	0	0	0	0
	13:30	-36	10	0	-8	13	0	0	0	0	0	0	0	0	0
	13:32	-34	10	0	-7	13	0	0	0	0	0	0	0	0	0
	13:36	-30	10	0	-8	13	0	0	0	0	0	0	0	0	0
	13:38	-28	10	0	-8	13	0	0	0	0	0	0	0	0	0
	13:42	-24	10	0	-9	13	0	0	0	0	0	0	0	0	0
	13:44	-22	10	0	-4	13	0	0	0	0	0	0	0	0	0
	13:46	-20	10	0	-2	13	0	0	0	0	0	0	0	0	0
	13:48	-18	10	0	-4	13	0	0	0	0	0	0	0	0	0
	13:50	-16	10	0	-3	13	0	0	0	0	0	0	0	0	0
Pre-Ignition 2	13:52	-14	10	0	-9	13	0	0	0	0	0	0	0	0	0
	13:54	-12	10	0	-7	13	0	0	0	0	0	0	0	0	0
	13:56	-10	10	0	-9	13	0	0	0	0	0	0	0	0	0
	13:58	-8	10	0	-8	13	0	0	0	0	0	0	0	0	0
	14:00	-6	10	0	-9	13	0	0	0	0	0	0	0	0	0
	14:02	-4	10	0	-9	13	0	0	0	0	0	0	0	0	0
Burn 2	14:08	2	10	0	-5	13	0	0	0	0	0	0	0	0	0
	14:10	4	10	11	20	62	0	20	124	0	8	62	0	2	13
	14:12	6	10	36	37	62	0	20	124	0			0		
	14:14	8	10	24	18	37	0	0	0	0	0	0	0	0	0
	14:16	10	10	24	14	25	0	0	0	0	0	0	0	0	0
	14:18	12	10	12	7	25	0	0	0	0	0	0	0	0	0
	14:20	14	10	-5	102	707	0	52	293	0	36	160	0	9	50
	14:22	16	11	712	881	908	154	196	265	34	104	134	36	46	61
	14:24	18	11	856	932	969	153	201	337	21	105	158	24	43	49
	14:26	20	11	832	891	945	179	201	277	33	118	170	36	51	74
	14:28	22	11	906	936	956	203	224	289	33	126	170	35	59	86
	14:30	24	11	894	929	944	215	221	265	59	128	158	60	68	86
	14:32	26	11	918	951	969	203	220	265	34	111	146	36	51	74
	14:34	28	11	687	847	971	165	214	325	9	86	122	11	29	49
	14:36	30	11	510	645	901	69	112	255	0	31	86	0	13	25
	14:38	32	11	893	938	969	155	188	253	9	99	146	11	39	49
	14:40	34	11	918	953	956	130	168	266	9	87	134	11	33	62
	14:42	36	11	930	955	968	119	135	206	10	66	86	12	17	25
	14:44	38	11	918	939	956	155	179	254	9	90	134	11	29	49
	14:46	40	11	784	876	920	191	195	253	9	102	134	11	31	49
	14:48	42	11	616	855	933	107	164	218	10	64	110	12	18	37
	14:50	44	11	652	873	933	155	183	229	0	78	98	0	12	12
	14:52	46	11	906	951	956	154	181	278	0	64	98	0	12	12
	14:54	48	11	510	714	912	69	143	218	0	37	62	0	5	12
	14:56	50	11	747	886	932	131	165	242	0	61	86	0		

NOBE 93 Table 12.5 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 8C (°C)

Burn Periods	Recorded	Elapsed	Ref Temp	TC-0 28 cm above TC-2			TC-1 3.8 cm above TC-2			TC-2 nominally at water line			TC-3 3.8 cm below TC-2		
				Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	14:58	52	11	906	940	956	143	160	230	0	65	98	0	10	12
	15:00	54	11	881	925	944	179	191	241	9	102	134	11	35	62
	15:02	56	11	869	922	944	155	186	241	35	94	122	36	47	74
	15:04	58	11	893	942	956	180	181	229	9	88	122	11	32	49
	15:06	60	11	894	925	931	180	185	229	10	66	86	12	13	25
	15:08	62	11	856	923	957	132	138	182	11	59	73	12	12	12
	15:10	64	11	881	924	931	119	145	194	0	69	98	0	11	12
	15:12	66	11	869	931	944	143	162	218	0	60	86	0	5	12
	15:14	68	11	809	865	883	131	159	206	0	59	86	0		
	15:16	70	11	380	736	886	7	118	207	0	23	49	0		
	15:18	72	11	289	498	698	9	49	123	0	7	12	0	0	0
Post-burn 2	15:20	74	11	288	483	746	0	36	136	0	10	12	0		
	15:22	76	11	178	227	301	0	0	0	0	0	0	0	0	0
	15:24	78	11	157	164	181	0	0	0	0	0	0	0	0	0
	15:26	80	11	95	132	170	0	0	0	0	0	0	0	0	0
	15:28	82	11	72	72	98	0	0	0	0	0	0	0	0	0
	15:30	84	11	48	51	74	0	0	0	0	0	0	0	0	0
	15:32	86	11	48	41	61	0	0	0	0	0	0	0	0	0
	15:34	88	11	48	51	74	0	0	0	0	0	0	0	0	0
	15:36	90	11	60	67	86	0	0	0	0	0	0	0	0	0
	15:38	92	11	61	61	73	0	0	0	0	0	0	0	0	0
	15:40	94	11	61	52	74	0	0	0	0	0	0	0	0	0
	15:42	96	11	48	46	61	0	0	0	0	0	0	0	0	0
	15:44	98	11	48	43	61	0	0	0	0	0	0	0	0	0
	15:46	100	11	36	37	49	0	0	0	0	0	0	0	0	0
	15:48	102	11	37	27	37	0	0	0	0	0	0	0	0	0
	15:50	104	11	37	27	37	0	0	0	0	0	0	0	0	0
	15:52	106	11	37	27	37	0	0	0	0	0	0	0	0	0
	15:54	108	11	12	20	37	0	0	0	0	0	0	0	0	0
	15:56	110	11	0	-8	13	0	0	0	0	0	0	0	0	0
	15:58	112	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:00	114	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:02	116	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:04	118	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:06	120	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:08	122	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:10	124	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:12	126	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:14	128	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:16	130	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:18	132	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:20	134	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:22	136	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:24	138	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:26	140	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:28	142	14	0	0	0	0	0	0	0	0	0	0	0	0
Post Residue Collection period 2	16:30	144	14	0	0	0	0	0	0	0	0	0	0		
	16:32	146	14	0	0	0	0	0	0	0	0	0	0		
	16:34	148	14	0	0	0	0	0	0	0	0	0	0		
	16:36	150	15	0	0	0	0	0	0	0			0	3	12
	16:38	152	15	0	0	0	0	0	0	0			0	6	12
	16:40	154	16	0	0	0	0	0	0	0			0	7	12
	16:42	156	16	0	0	0	0	0	0	0	0	0	0	1	13
	16:44	158	16	0	0	0	0	0	0	0	0	0	0	4	12
	16:46	160	16	0	0	0	0	0	0	0	0	0	0	2	13
	16:48	162	17	0	0	0	0	0	0	0	0	0	0		
	16:50	164	17	0	0	0	0	0	0	0	0	0	0	0	0
	16:52	166	17	0	0	0	0	0	0	0	0	0	0	0	0
	16:54	168	17	0	0	0	0	0	0	0	0	0	0	0	0
	16:56	170	17	0	0	0	0	0	0	0	0	0	0	0	0
	16:58	172	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:00	174	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:02	176	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:04	178	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:06	180	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:08	182	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:10	184	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:12	186	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:14	188	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:16	190	17	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.5 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 8C (°C)

Burn Periods	Recorded	Elapsed	Ref Temp	TC-0 28 cm above TC-2 Min	Ave	Max	TC-1 3.8 cm above TC-2 Min	Ave	Max	TC-2 nominally at water line Min	Ave	Max	TC-3 3.8 cm below TC-2 Min	Ave	Max
	17:18	192	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:20	194	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:22	196	17	0	0	0	0	0	0	0	0	0	0	0	0
	17:24	198	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:26	200	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:28	202	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:30	204	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:32	206	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:34	208	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:36	210	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:38	212	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:40	214	16	0	0	0	0	0	0	0	0	0	0	0	0
	17:42	216	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:44	218	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:46	220	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:48	222	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:50	224	15	0	0	0	0	0	0	0	0	0	0	0	0
	17:52	226	14	0	0	0	0	0	0	0	0	0	0	0	0
	17:54	228	14	0	0	0	0	0	0	0	0	0	0	0	0
	17:56	230	14	0	0	0	0	0	0	0	0	0	0	0	0
	17:58	232	14	0	0	0	0	0	0	0	0	0	0	0	0
	18:00	234	14	0	0	0	0	0	0	0	0	0	0	0	0
	18:02	236	14	0	0	0	0	0	0	0	0	0	0	0	0
	18:04	238	14	0	0	0	0	0	0	0	0	0	0	0	0
	18:06	240	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:08	242	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:10	244	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:12	246	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:14	248	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:16	250	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:18	252	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:20	254	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:22	256	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:24	258	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:26	260	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:28	262	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:30	264	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:32	266	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:34	268	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:36	270	13	0	0	0	0	0	0	0	0	0	0	0	0
	18:38	272	12	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.6

3M Fireboom Air and Water Temperatures
Thermocouples at Section 9A (°C)

				TC-0			TC-1			TC-2			TC-3		
			Ref	28 cm above water line			3.8 cm above water line			at water line			3.8 cm below water line		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Background 1	6:36	-234	8	0			0			0	0	0	0	0	0
	6:38	-232	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:40	-230	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:42	-228	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:44	-226	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:46	-224	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:48	-222	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:50	-220	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:52	-218	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:54	-216	8	0	0	0	0	0	0	0	0	0	0	0	0
	6:56	-214	9	0	0	0	0	0	0	0	0	0	0	0	0
	6:58	-212	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:00	-210	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:02	-208	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:04	-206	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:06	-204	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:08	-202	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:10	-200	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:12	-198	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:14	-196	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:16	-194	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:18	-192	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:20	-190	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:22	-188	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:24	-186	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:26	-184	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:28	-182	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:30	-180	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:32	-178	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:34	-176	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:36	-174	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:38	-172	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:40	-170	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:42	-168	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:44	-166	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:46	-164	9	0			0	0	0	0	0	0	0	0	0
	7:48	-162	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:50	-160	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:52	-158	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:54	-156	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:56	-154	9	0	0	0	0	0	0	0	0	0	0	0	0
	7:58	-152	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:00	-150	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:02	-148	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:04	-146	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:06	-144	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:08	-142	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:10	-140	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:12	-138	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:14	-136	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:16	-134	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:18	-132	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:20	-130	9	0	0	0	0	0	0	0	0	0	0	0	0
	8:22	-128	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:24	-126	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:26	-124	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:28	-122	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:30	-120	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:32	-118	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:34	-116	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:36	-114	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:38	-112	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:40	-110	10	0	0	0	0	0	0	0	0	0	0	0	0
	8:42	-108	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:44	-106	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:46	-104	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:48	-102	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:50	-100	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:52	-98	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:54	-96	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:56	-94	11	0	0	0	0	0	0	0	0	0	0	0	0
	8:58	-92	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:00	-90	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:02	-88	11	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.6 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 9A (°C)

				TC-0 28 cm above water line			TC-1 3.8 cm above water line			TC-2 at water line			TC-3 3.8 cm below water line		
	Recorded	Elapsed	Ref Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	9:04	-86	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:06	-84	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:08	-82	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:10	-80	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:12	-78	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:14	-76	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:16	-74	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:18	-72	11	0	0	0	0	0	0	0	0	0	0	0	0
	9:20	-70	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:22	-68	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:24	-66	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:26	-64	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:28	-62	10	0	0	0	0	0	0	0	0	0	0	0	0
Pre-ignition 1	9:30	-60	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:32	-58	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:34	-56	10	0	0	0	0	0	0	0	0	0	0	0	0
	9:36	-54	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:38	-52	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:40	-50	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:42	-48	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:44	-46	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:46	-44	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:48	-42	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:50	-40	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:52	-38	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:54	-36	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:56	-34	9	0	0	0	0	0	0	0	0	0	0	0	0
	9:58	-32	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:00	-30	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:02	-28	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:04	-26	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:06	-24	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:08	-22	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:10	-20	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:12	-18	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:14	-16	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:16	-14	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:18	-12	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:20	-10	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:22	-8	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:24	-6	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:26	-4	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:28	-2	9	0	0	0	0	0	0	0	0	0	0	0	0
Burn 1	10:30	0	9	0	0	0	0	0	0	0	0	0	0	0	0
	10:32	2	9	0	121	279	0	183	361	0	226	396	0	210	420
	10:34	4	9	22	44	123	21	62	172	0	72	220	0	21	148
	10:36	6	9	8	16	173	6	33	257	0	38	305	0	41	353
	10:38	8	9	176	758	898	263	715	801	371	693	777	375	514	602
	10:40	10	9	224	635	914	141	554	817	-7	445	795	-2	282	584
	10:42	12	9	56	119	243	9	44	160	0	18	62	0	2	12
	10:44	14	9	24	28	62	0	7	12	0	8	12	0	0	0
	10:46	16	9	-10	240	911	0	277	824	0	261	776	0	217	645
	10:48	18	9	663	854	946	618	764	836	310	724	813	313	519	709
	10:50	20	10	188	471	881	68	379	773	-6	319	726	-1	181	527
	10:52	22	10	82	126	207	0	24	87	0	13	50	0	2	12
	10:54	24	10	60	67	98	0	0	0	0	0	0	0	0	0
	10:56	26	10	36	39	61	0	0	0	0	0	0	0	0	0
	10:58	28	10	37	28	37	0	10	12	0	11	12	0	6	12
	11:00	30	10	35	38	86	6	71	256	0	92	328	0	108	387
	11:02	32	9	78	134	374	255	375	641	243	410	640	244	366	570
	11:04	34	9	356	619	889	630	756	837	311	735	801	314	557	661
	11:06	36	9	882	923	919	786	814	847	298	759	812	300	620	743
	11:08	38	9	296	678	925	202	597	828	-8	541	817	-6	324	750
	11:10	40	10	153	207	313	31	120	243	0	79	183	0	27	87
	11:12	42	10	83	112	158	10	49	111	0	38	86	0	16	62
	11:14	44	10	60	66	86	0	10	37	0	11	62	0	4	87
	11:16	46	10	52	585	940	30	619	803	80	611	779	82	528	709
	11:18	48	10	759	911	932	714	789	824	418	757	788	421	587	660
	11:20	50	10	264	444	747	107	354	701	8	292	691	9	185	634
	11:22	52	10	130	189	277	9	44	123	0	29	74	0	5	'25
	11:24	54	10	101	370	945	0	278	812	0	258	752	0	180	634
	11:26	56	10	473	833	959	322	723	850	42	695	826	44	438	723

NOBE 93 Table 12.6 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 9A (°C)

				TC-0			TC-1			TC-2			TC-3		
			Ref	28 cm above water line			3.8 cm above water line			at water line			3.8 cm below water line		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	11:28	58	10	198	300	477	17	121	327	0	79	304	0	10	62
	11:30	60	10	131	158	206	0	6	25	0		13	0	0	0
	11:32	62	10	114	406	907	0	310	774	0	295	727	0	220	633
	11:34	64	10	498	752	936	238	555	817	80	492	782	86	304	536
	11:36	66	10	277	418	724	11	195	574	0	160	540	0	51	376
	11:38	68	10	190	230	288	0	11	37	0	12	25	0	0	0
	11:40	70	10	153	443	844	0	397	784	0	386	748	0	258	561
	11:42	72	10	464	717	874	215	570	768	8	496	698	15	226	408
	11:44	74	10	271	352	476	0	39	184	0	8	62	0	1	13
	11:46	76	10	203	229	276	0			0	0	0	0	0	0
	11:48	78	10	156	172	205	0	0	0	0	0	0	0	0	0
	11:50	80	10	120	132	158	0	0	0	0	0	0	0	0	0
	11:52	82	10	109	113	121	0	0	0	0	0	0	0	0	0
	11:54	84	10	97	95	110	0	0	0	0	0	0	0	0	0
	11:56	86	10	72	76	98	0	0	0	0	0	0	0	0	0
	11:58	88	10	61	59	73	0	0	0	0	0	0	0	0	0
	12:00	90	10	48	42	61	0	0	0	0	0	0	0	0	0
	12:02	92	10	36	32	49	0	0	0	0	0	0	0	0	0
	12:04	94	10	24	28	37	0	0	0	0	0	0	0	0	0
Post-burn 1	12:06	96	10	24	21	37	0	0	0	0	0	0	0	0	0
	12:08	98	9	24	16	37	0	0	0	0	0	0	0	0	0
	12:10	100	9	24	15	25	0	0	0	0	0	0	0	0	0
	12:12	102	9	24	15	25	0	0	0	0	0	0	0	0	0
	12:14	104	9	12	14	25	0	0	0	0	0	0	0	0	0
	12:16	106	9	12	3	25	0	0	0	0	0	0	0	0	0
	12:18	108	9	12	3	12	0	0	0	0	0	0	0	0	0
	12:20	110	10	12	3	12	0	0	0	0	0	0	0	0	0
	12:22	112	10	0	1	13	0	0	0	0	0	0	0	0	0
	12:24	114	10	0	-8	13	0	0	0	0	0	0	0	0	0
	12:26	116	10	0	0	0	0	0	0	0	0	0	0	0	0
	12:28	118	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:30	120	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:32	122	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:34	124	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:36	126	9	0			0	0	0	0	0	0	0	0	0
	12:38	128	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:40	130	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:42	132	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:44	134	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:46	136	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:48	138	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:50	140	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:52	142	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:54	144	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:56	146	9	0	0	0	0	0	0	0	0	0	0	0	0
	12:58	148	9	0	0	0	0	0	0	0	0	0	0	0	0
Background 2	13:00	-66	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:02	-64	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:04	-62	9	0	0	0	0	0	0	0	0	0	0	0	0
	13:06	-60	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:08	-58	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:10	-56	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:12	-54	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:14	-52	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:16	-50	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:18	-48	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:20	-46	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:22	-44	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:24	-42	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:26	-40	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:28	-38	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:30	-36	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:32	-34	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:34	-32	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:36	-30	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:38	-28	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:40	-26	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:42	-24	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:44	-22	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:46	-20	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:48	-18	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:50	-16	10	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.6 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 9A (°C)

				TC-0			TC-1			TC-2			TC-3		
			Ref	28 cm above water line			3.8 cm above water line			at water line			3.8 cm below water line		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
Pre-ignition 2	13:52	-14	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:54	-12	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:56	-10	10	0	0	0	0	0	0	0	0	0	0	0	0
	13:58	-8	10	0	0	0	0	0	0	0	0	0	0	0	0
	14:00	-6	10	0	0	0	0	0	0	0	0	0	0	0	0
	14:02	-4	10	0	0	0	0	0	0	0	0	0	0	0	0
	14:04	-2	10	0	0	0	0	0	0	0	0	0	0	0	0
Burn 2	14:06	0	10	0	0	0	0	0	0	0	0	0	0	0	0
	14:08	2	10	0			0	0	0	0	0	0	0	0	0
	14:10	4	10	0	-8	13	0	0	0	0	0	0	0	0	0
	14:12	6	10	0	-7	13	0	0	0	0	0	0	0	0	0
	14:14	8	10	0	-8	13	0	0	0	0	0	0	0	0	0
	14:16	10	10	0	0	0	0	0	0	0	0	0	0	0	0
	14:18	12	10	0			0	0	0	0	0	0	0	0	0
	14:20	14	10	0	13	306	0	38	400	0	35	329	0	24	233
	14:22	16	10	308	725	899	409	570	672	175	327	441	178	226	289
	14:24	18	10	349	441	699	265	520	697	62	325	500	68	172	266
	14:26	20	10	699	896	945	597	664	754	124	354	500	131	170	206
	14:28	22	10	845	892	907	538	628	731	114	321	429	119	166	218
	14:30	24	10	522	763	898	266	571	672	2	268	407	8	122	195
	14:32	26	10	341	436	533	0	41	269	0	5	37	0	0	0
	14:34	28	10	225	289	347	0	0	0	0	0	0	0	0	0
	14:36	30	10	168	191	229	0	0	0	0	0	0	0	0	0
	14:38	32	10	132	141	170	0	0	0	0	0	0	0	0	0
	14:40	34	10	109	114	134	0	5	87	0	6	99	0	2	50
	14:42	36	10	105	583	792	70	547	709	52	283	430	59	91	122
	14:44	38	10	312	582	732	-5	285	703	0	137	350	0	35	86
	14:46	40	10	177	233	324	0	-3	13	0	0	0	0	0	0
	14:48	42	10	107	139	182	0	0	0	0	0	0	0	0	0
	14:50	44	10	60	71	110	0	0	0	0	0	0	0	0	0
	14:52	46	10	49	52	61	0	0	0	0	0	0	0	0	0
	14:54	48	10	48	40	61	0	0	0	0	0	0	0	0	0
	14:56	50	10	21	248	668	0	224	574	0	139	327	0	67	196
	14:58	52	10	479	619	707	231	379	629	16	224	360	21	109	183
	15:00	54	10	337	517	721	36	205	550	0	98	316	0	44	160
	15:02	56	10	355	395	439	92	200	313	0	89	195	0	24	74
	15:04	58	10	213	271	359	0	20	209	0	3	75	0	0	13
	15:06	60	10	156	184	217	0	5	12	0	0	0	0	0	0
	15:08	62	10	120	133	158	11	20	62	0	5	37	0	0	13
	15:10	64	10	109	108	134	0	33	123	0	10	62	0	0	0
	15:12	66	10	72	78	110	0	1	25	0	0	0	0	0	0
	15:14	68	10	73	67	86	0	9	25	0	4	12	0	0	0
	15:16	70	10	85	85	98	0	1	25	0		13	0	0	0
	15:18	72	10	72	75	98	0	0	0	0	0	0	0	0	0
Post-burn 2	15:20	74	10	36	39	74	0	0	0	0	0	0	0	0	0
	15:22	76	10	36	35	49	0	0	0	0	0	0	0	0	0
	15:24	78	10	49	40	49	0	0	0	0	0	0	0	0	0
	15:26	80	10	49	40	49	0	0	0	0	0	0	0	0	0
	15:28	82	10	36	36	49	0	0	0	0	0	0	0	0	0
	15:30	84	10	36	27	49	0	0	0	0	0	0	0	0	0
	15:32	86	10	12	16	37	0	0	0	0	0	0	0	0	0
	15:34	88	10	12	2	25	0	0	0	0	0	0	0	0	0
	15:36	90	10	12	2	12	0	0	0	0	0	0	0	0	0
	15:38	92	10	0	-2	13	0	0	0	0	0	0	0	0	0
	15:40	94	10	0	-8	13	0	0	0	0	0	0	0	0	0
	15:42	96	10	0	-7	13	0	0	0	0	0	0	0	0	0
	15:44	98	10	0	-1	13	0	0	0	0	0	0	0	0	0
	15:46	100	10	0	2	12	0	0	0	0	0	0	0	0	0
	15:48	102	10	0	0	13	0	0	0	0	0	0	0	0	0
	15:50	104	10	0	0	0	0	0	0	0	0	0	0	0	0
	15:52	106	10	0	0	0	0	0	0	0	0	0	0	0	0
	15:54	108	10	0	0	0	0	0	0	0	0	0	0	0	0
	15:56	110	11	0	13	25	0	0	0	0	0	0	0	0	0
	15:58	112	11	12	10	25	0	0	0	0	0	0	0	0	0
	16:00	114	11	12	1	13	0	0	0	0	0	0	0	0	0
	16:02	116	11	0	-6	13	0	0	0	0	0	0	0	0	0
	16:04	118	11	0	0	0	0	0	0	0	0	0	0	0	0
	16:06	120	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:08	122	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:10	124	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:12	126	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:14	128	12	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.6 cont.

3M Fireboom Air and Water Temperatures
Thermocouples at Section 9A (°C)

				TC-0			TC-1			TC-2			TC-3		
			Ref	28 cm above water line			3.8 cm above water line			at water line			3.8 cm below water line		
	Recorded	Elapsed	Temp	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max	Min	Ave	Max
	16:16	130	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:18	132	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:20	134	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:22	136	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:24	138	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:26	140	12	0	0	0	0	0	0	0	0	0	0	0	0
	16:28	142	13	0	0	0	0	0	0	0	0	0	0	0	0
Post Residue	16:30	144	13	0	0	0	0	0	0	0	0	0	0	0	0
Collection Period 2	16:32	146	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:34	148	13	0	0	0	0			0	0	0	0	0	0
	16:36	150	13	0	0	0	0			0	0	0	0	0	0
	16:38	152	13	0	0	0	0	5	12	0	0	0	0	0	0
	16:40	154	13	0	0	0	0	3	12	0	0	0	0	0	0
	16:42	156	13	0	0	0	0			0	0	0	0	0	0
	16:44	158	13	0	0	0	0	0	0	0	0	0	0	0	0
	16:46	160	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:48	162	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:50	164	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:52	166	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:54	168	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:56	170	14	0	0	0	0	0	0	0	0	0	0	0	0
	16:58	172	14	0	0	0	0	0	0	0	0	0	0	0	0
	17:00	174	14	0	0	0	0	0	0	0	0	0	0	0	0
	17:02	176	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:04	178	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:06	180	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:08	182	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:10	184	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:12	186	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:14	188	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:16	190	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:18	192	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:20	194	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:22	196	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:24	198	13	0	0	0	0	0	0	0	0	0	0	0	0
	17:26	200	13	0	0	0	0	0	0	0	0	0	0	0	0

NOBE 93 Table 12.7 **Load on Fireboom (kg)**

Elapsed Time minute	BURN # 1			BURN # 2		
	AVE	MAX	MIN	AVE	MAX	MIN
-65				20.3	38.9	6.2
-64				27.8	45.9	6.8
-63				19.5	29.9	7.4
-62				23.6	42.4	8.6
-61				34.5	53.8	26.0
-60	62.0	91.4	2.9	33.1	64.7	14.1
-59	76.3	94.1	51.0	23.2	36.7	9.2
-58	78.9	104.0	61.1	19.4	32.5	7.3
-57	73.6	107.2	43.3	23.2	43.7	13.7
-56	80.9	112.2	58.5	30.3	49.6	19.0
-55	69.2	98.1	45.7	34.2	66.1	18.1
-54	57.1	71.9	37.2	31.8	53.3	17.6
-53	47.9	58.9	33.7	32.7	56.0	13.3
-52	70.3	99.7	49.3	34.6	57.6	17.2
-51	79.8	95.9	58.8	37.3	67.4	17.9
-50	57.5	71.1	42.0	20.9	31.0	11.2
-49	63.5	83.5	42.5	10.7	25.8	4.1
-48	65.0	99.5	42.0	4.0	5.1	3.0
-47	79.7	97.8	58.0	6.8	14.9	3.4
-46	90.7	116.3	71.7	22.5	45.1	9.9
-45	94.9	121.3	70.9	40.2	63.0	22.3
-44	91.2	122.8	64.2	32.9	54.4	18.1
-43	96.3	113.4	60.2	40.0	56.4	12.2
-42	98.7	140.9	70.5	34.4	49.9	20.7
-41	93.0	120.7	61.9	16.2	27.4	7.3
-40	86.9	107.4	64.5	10.1	17.0	5.9
-39	68.2	113.5	36.0	13.5	24.1	5.8
-38	73.5	95.3	55.5	18.6	33.9	10.5
-37	86.0	113.6	52.8	26.5	41.3	14.7
-36	81.7	104.7	59.8	34.7	57.5	22.0
-35	68.6	103.3	30.1	32.1	60.4	11.8
-34	84.1	117.3	50.5	31.3	51.2	15.8
-33	85.8	110.9	49.0	26.7	43.6	13.5
-32	80.2	101.0	52.9	29.6	45.8	9.5
-31	84.8	112.5	44.3	35.6	51.3	17.8
-30	92.6	123.9	69.4	29.2	41.6	13.9
-29	68.0	100.1	45.2	27.5	46.4	16.3
-28	46.1	72.2	29.9	38.1	58.4	15.6
-27	64.4	93.5	42.8	39.2	66.0	21.6
-26	79.4	111.5	44.0	41.0	57.2	27.6
-25	57.4	70.7	23.8	43.8	58.6	24.4
-24	67.7	87.7	56.4	48.0	73.1	21.5
-23	65.5	89.2	43.8	43.5	78.9	24.7
-22	90.4	108.7	63.7	32.8	45.4	16.3
-21	78.6	99.1	60.1	27.1	47.3	12.1
-20	72.5	99.3	42.7	29.2	40.3	20.7
-19	53.6	82.0	37.6	33.5	50.9	21.8
-18	59.6	72.5	47.1	34.1	46.6	20.0
-17	86.2	102.0	61.8	22.2	41.5	10.1
-16	82.8	116.8	54.4	27.0	37.8	14.0
-15	100.6	128.2	74.6	20.3	34.9	8.7
-14	83.9	100.7	62.8	12.9	20.8	8.4
-13	85.1	119.3	65.9	24.5	40.0	15.7
-12	106.8	139.0	80.3	38.0	47.4	21.1
-11	80.0	120.7	55.7	30.4	40.6	20.5
-10	79.4	114.8	51.0	28.5	41.7	10.3
-9	74.2	99.3	44.7	30.7	42.6	14.2

NOBE 93 Table 12.7 cont. **Load on Fireboom (kg)**

Elapsed Time minute	BURN # 1 AVE	BURN # 1 MAX	BURN # 1 MIN	BURN # 2 AVE	BURN # 2 MAX	BURN # 2 MIN
-8	64.9	81.6	46.4	34.2	70.6	17.8
-7	87.3	122.5	59.2	36.5	56.0	21.1
-6	67.0	86.0	41.5	41.3	66.0	29.4
-5	73.0	99.0	54.5	36.5	73.6	22.1
-4	62.6	81.3	43.7	31.2	45.3	14.6
-3	86.4	103.8	64.9	30.2	41.6	17.8
-2	69.9	110.1	39.0	31.0	41.5	21.8
-1	60.1	76.9	35.8	25.7	53.6	11.5
0	53.8	80.6	32.9	23.7	37.8	7.2
1	59.5	81.3	34.7	19.0	32.9	13.7
2	64.7	84.1	40.9	31.2	51.5	12.4
3	65.3	90.3	45.0	33.7	52.4	18.2
4	62.4	86.5	40.7	35.4	51.8	19.6
5	54.1	74.4	31.0	27.2	37.7	18.3
6	60.4	79.1	39.2	33.9	59.1	12.8
7	54.1	74.8	35.4	42.2	64.2	16.4
8	61.1	86.8	32.7	37.9	51.5	27.4
9	52.6	64.8	27.6	38.5	55.9	19.4
10	58.1	93.6	32.4	42.6	69.0	23.4
11	52.0	80.0	32.2	45.6	59.8	19.0
12	58.5	76.9	38.3	32.7	57.2	20.4
13	57.6	75.7	36.7	21.9	41.4	8.8
14	77.6	124.6	47.5	8.3	16.1	5.2
15	53.9	69.1	40.6	14.8	23.3	3.9
16	68.2	101.1	43.0	18.5	29.0	6.3
17	42.5	56.3	31.4	20.5	32.3	9.9
18	42.4	66.2	25.7	15.5	31.9	8.4
19	51.2	85.4	31.7	14.0	23.1	9.0
20	56.6	78.4	45.4	5.6	8.0	3.5
21	65.7	80.1	52.7	4.9	8.3	3.2
22	69.2	96.0	46.4	4.3	6.7	2.8
23	54.9	76.1	37.6	5.1	9.8	2.4
24	56.7	75.1	45.0	4.0	6.1	2.9
25	63.8	75.3	42.1	2.9	3.5	2.4
26	64.9	88.4	45.9	3.7	5.8	2.6
27	67.7	76.3	58.4	6.0	9.0	3.7
28	62.3	87.5	43.0	5.1	10.5	2.7
29	60.4	79.1	40.6	3.6	4.9	2.6
30	74.3	91.1	48.1	3.3	4.0	2.6
31	84.0	127.2	54.4	2.9	3.6	2.6
32	88.4	108.5	65.1	2.7	2.9	2.5
33	86.4	113.6	53.3	2.9	3.5	2.6
34	78.3	99.1	50.3	3.5	4.8	3.0
35	57.7	82.0	40.5	3.4	5.5	2.7
36	59.0	82.4	39.3	2.8	3.3	2.4
37	64.1	84.9	48.2	2.7	3.1	2.3
38	64.8	87.7	48.3	2.6	2.9	2.4
39	57.2	70.0	37.4	3.5	5.8	2.5
40	45.8	80.0	20.2	5.0	7.1	3.7
41	91.4	119.5	68.8	14.7	26.1	8.9
42	96.7	109.5	80.1	29.5	52.2	16.2
43	70.1	97.4	43.5	31.4	50.8	16.9
44	70.5	92.8	37.4	32.3	42.7	16.8
45	73.0	89.0	58.3	32.4	46.1	18.9
46	70.2	91.6	55.2	37.2	49.9	19.3
47	64.1	89.4	34.9	30.0	53.1	20.1

NOBE 93 Table 12.7 cont. **Load on Fireboom (kg)**

Elapsed Time minute	BURN # 1 AVE	BURN # 1 MAX	BURN # 1 MIN		BURN # 2 AVE	BURN # 2 MAX	BURN # 2 MIN
48	70.0	98.3	45.6		23.1	30.6	13.3
49	42.1	62.1	25.7		18.4	28.9	10.1
50	51.4	86.9	17.3		12.6	19.2	7.6
51	69.3	110.2	44.6		22.3	33.1	15.3
52	68.1	118.3	35.0		20.2	27.7	10.9
53	85.1	123.2	61.5		25.0	39.1	13.7
54	72.6	101.4	51.3		30.8	43.1	22.6
55	65.4	86.4	44.3		22.3	40.8	10.2
56	49.8	74.6	36.2		26.7	57.3	11.7
57	42.5	55.4	33.3		52.9	82.6	23.9
58	40.0	94.5	22.3		13.8	28.9	4.3
59	65.0	103.3	30.3		2.9	3.4	2.7
60	81.4	108.5	62.1		2.7	3.0	2.4
61	68.9	94.4	49.6		2.7	3.0	2.4
62	64.9	85.6	39.5		3.0	4.7	2.3
63	76.2	102.2	56.8		2.4	2.6	2.3
64	72.4	88.5	47.4		2.4	2.6	2.2
65	67.9	92.4	38.2		2.4	2.6	2.3
66	67.6	105.0	48.4		2.4	2.6	2.3
67	76.9	93.8	62.5		2.3	2.4	2.2
68	68.9	95.4	44.9		2.3	2.5	2.2
69	43.9	62.1	31.6		2.3	2.6	2.1
70	59.3	87.9	43.4		2.3	2.6	2.2
71	48.7	68.8	24.8		2.3	2.4	2.3
72	49.9	80.3	30.0		2.4	2.6	2.2
73	61.4	84.9	26.6		**4.4**	**7.1**	**2.7**
74	55.3	83.7	36.2		4.3	6.0	2.4
75	78.6	113.6	47.4		2.7	3.2	2.4
76	56.1	90.8	35.1		2.4	2.6	2.3
77	61.5	89.2	33.5				
78	59.1	79.7	38.2	**Overall**	**10.9**	**82.6**	**2.1**
79	63.4	88.0	36.2				
80	67.5	105.3	50.2				
81	47.5	66.0	28.1				
82	53.4	71.3	30.0				
83	58.5	82.1	38.0				
84	55.3	66.5	43.4				
85	60.5	71.5	44.9				
86	57.4	74.6	37.4				
87	44.7	81.3	24.8				
88	39.6	61.4	28.8				
89	34.2	48.0	20.9				
90	31.7	50.8	17.9				
91	27.0	32.7	13.9				
92	20.4	30.7	9.3				
93	17.6	29.4	8.5				
94	**34.5**	**62.6**	**19.9**				
95	47.2	71.3	29.7				
96	20.8	27.9	13.7				
97	52.9	76.3	28.2				
98	71.8	92.4	38.7				
99	44.6	60.7	23.5				
100	34.4	47.9	23.2				
101	30.1	60.7	17.5				
102	44.9	66.4	29.4				
103	58.7	80.9	45.7				

NOBE 93 Table 12.7 cont. **Load on Fireboom (kg)**

Elapsed Time minute	BURN # 1 AVE	BURN # 1 MAX	BURN # 1 MIN	BURN # 2 AVE	BURN # 2 MAX	BURN # 2 MIN
104	44.1	82.0	23.2			
105	63.7	81.1	48.0			
106	36.3	56.2	21.2			
107	18.9	27.0	13.7			
108	51.8	105.0	23.9			
109	34.5	64.5	13.2			
110	31.3	61.0	15.2			
111	19.0	27.2	10.0			
112	17.2	29.0	8.3			
113	13.8	21.7	5.3			
114	10.8	19.4	6.1			
115	8.9	16.2	4.9			
116	12.2	26.6	5.3			
117	13.7	25.6	4.8			
118	15.6	25.4	8.7			
119	14.7	29.4	7.3			
120	13.5	26.5	6.3			
121	16.0	25.6	7.3			
122	13.7	26.8	5.2			
123	17.4	24.2	10.2			
124	19.4	39.3	8.7			
125	19.6	35.5	10.0			
126	15.9	32.5	7.4			
127	18.4	31.8	6.6			
128	14.3	25.9	5.8			
129	11.6	22.2	7.1			
130	12.2	26.7	5.3			
131	10.1	31.0	3.6			
132	12.1	18.8	6.2			
133	13.7	31.4	5.2			
134	16.4	30.3	6.6			
135	17.6	34.5	8.3			
136	16.2	25.8	7.0			
137	13.1	18.8	6.4			
138	14.4	22.0	6.1			
139	16.3	30.2	6.5			
140	20.8	30.8	9.9			
141	25.6	38.8	12.7			
142	13.4	35.6	7.0			
143	10.4	22.8	5.7			
144	11.7	22.0	5.8			
145	12.7	30.7	5.8			
146	10.7	22.2	4.8			
147	16.4	29.1	7.0			
148	19.2	35.6	6.8			
149	20.0	30.6	9.5			
150	23.7	33.9	12.6			
Overall	**19.0**	**105.0**	**3.6**			

Fireboom Layout
NOBE 93

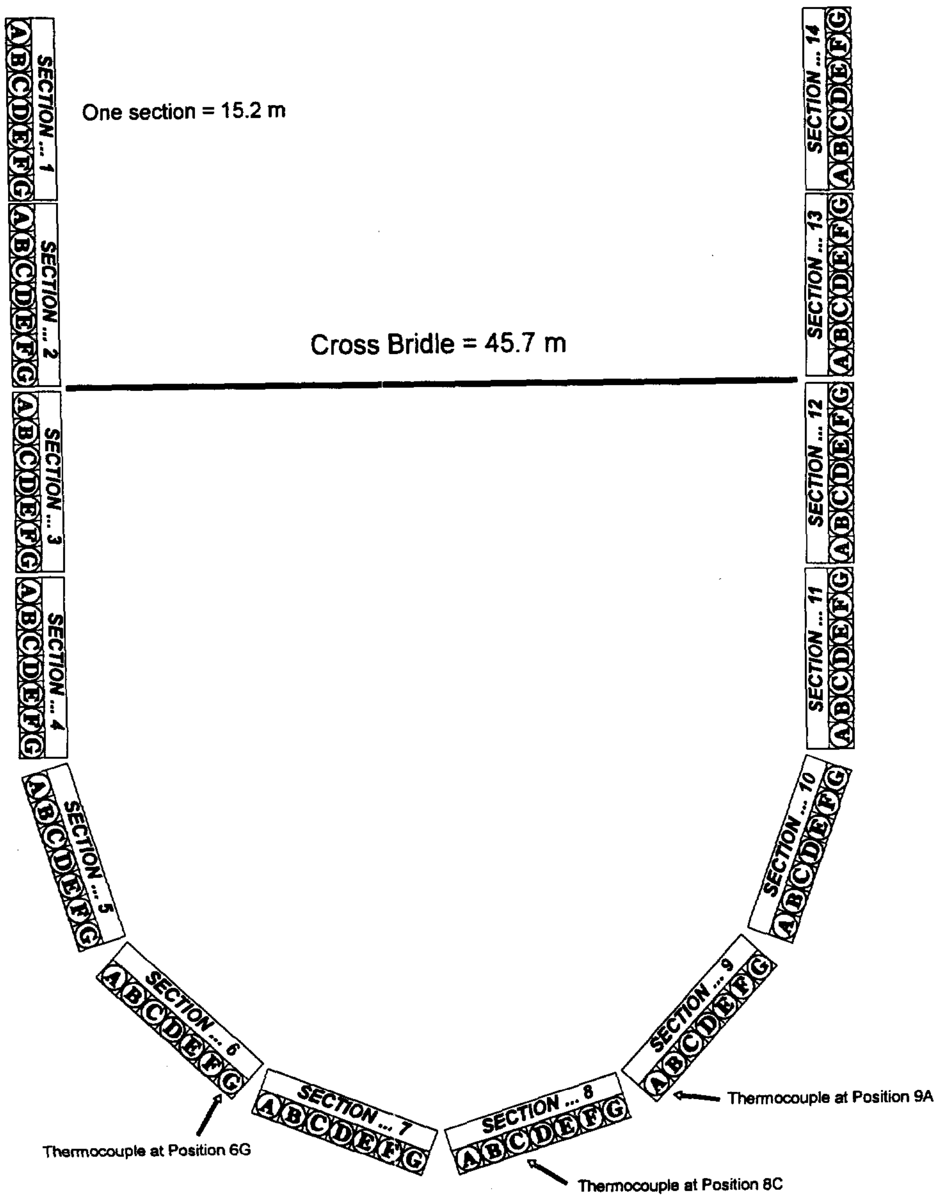


Figure 12.0

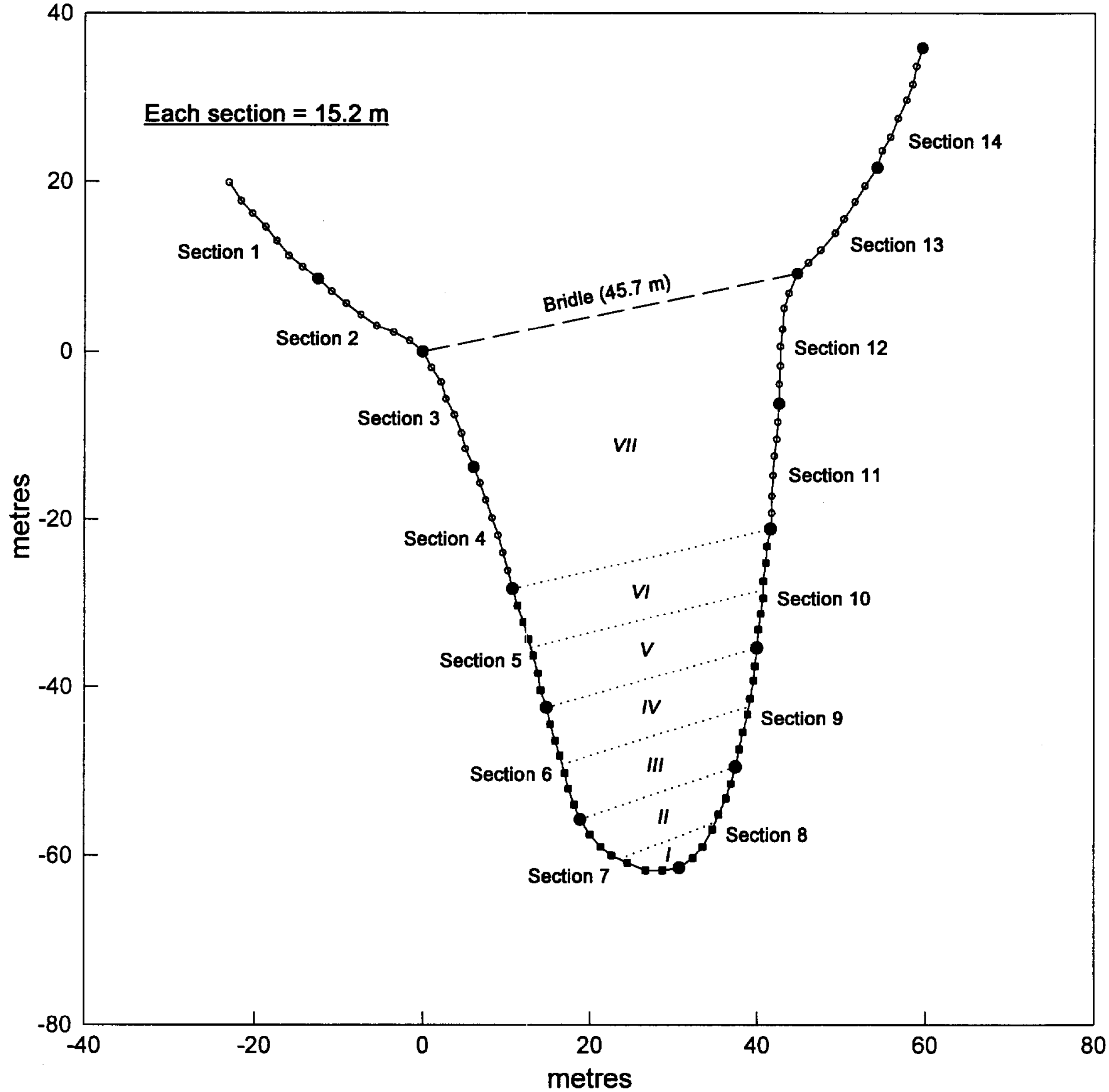
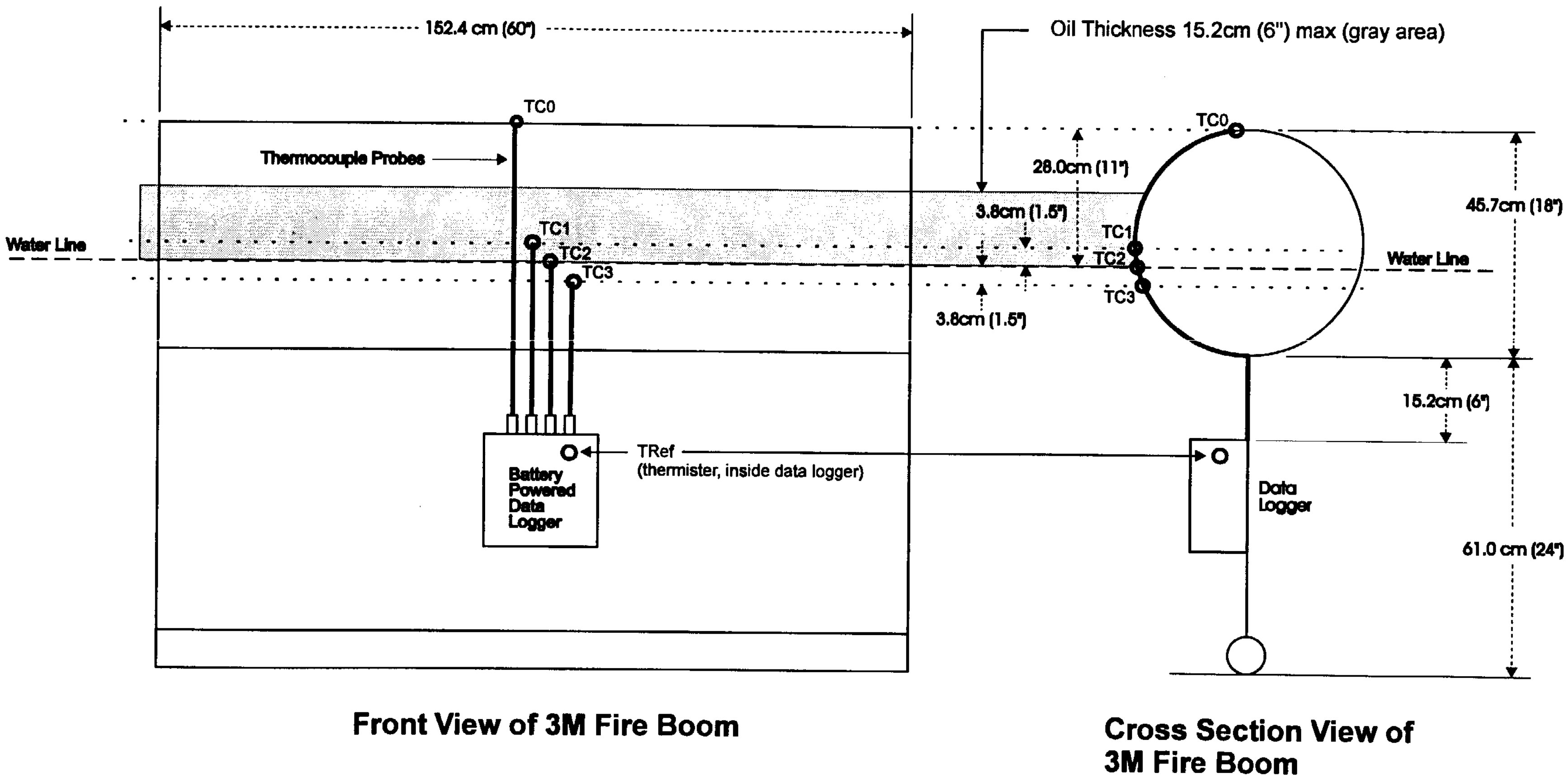


Figure 12.1 Standard shape of fireboom in motion during Burn 1 (based on aerial photo # 003 taken at 9:17 am)

Area VII: 1110 m²
Area VI: 215 m²
Area V: 195 m²
Area IV: 170 m²
Area III: 145 m²
Area II: 91 m²
Area I: 29 m²

NOBE 93 Figure 12.2 3M Fire Boom Detail Showing Thermocouple Layout



Front View of 3M Fire Boom

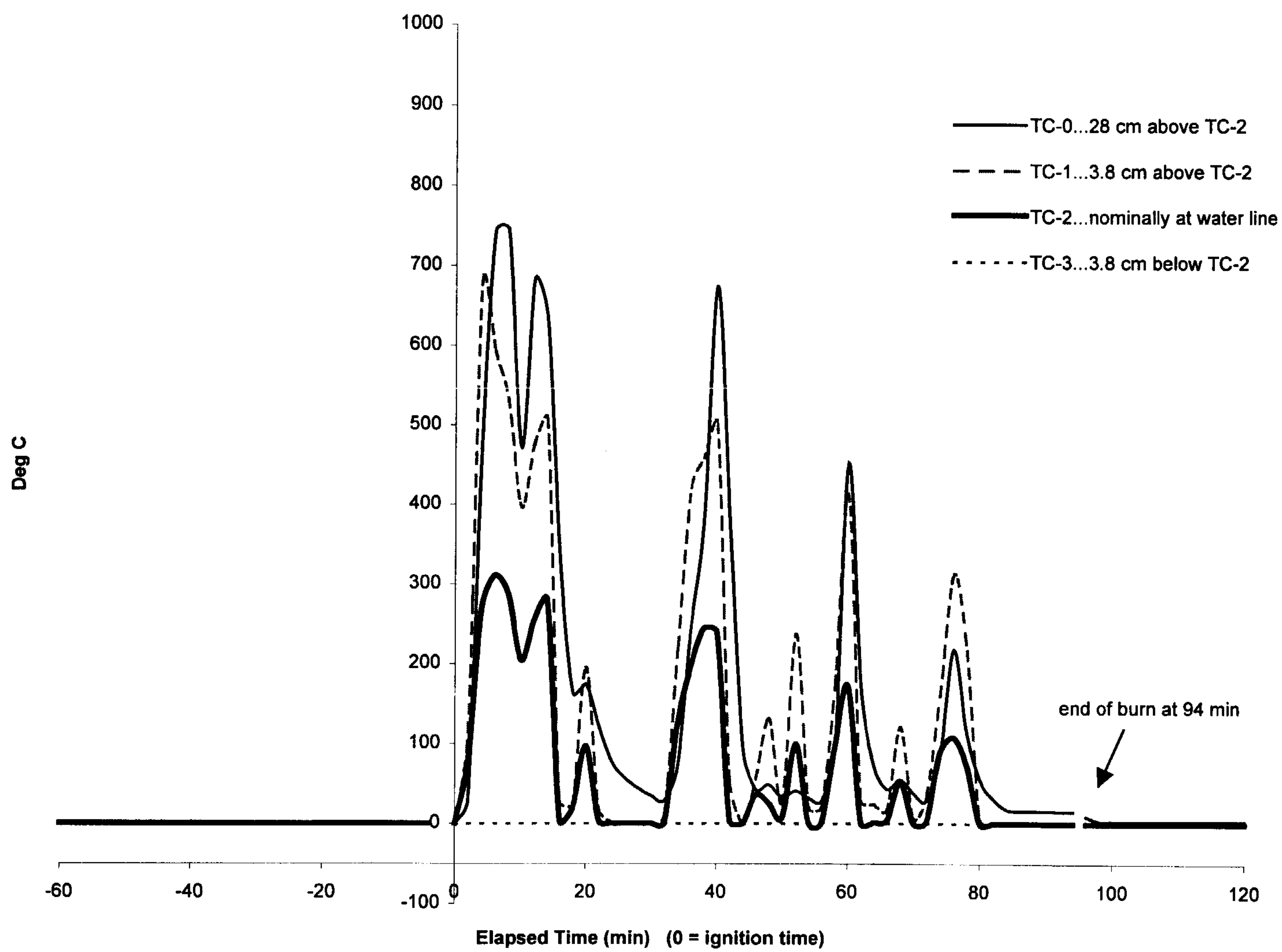
Cross Section View of 3M Fire Boom

Notes: Water line will vary, due to wave action.

Oil thickness will vary, due to wind and burning.

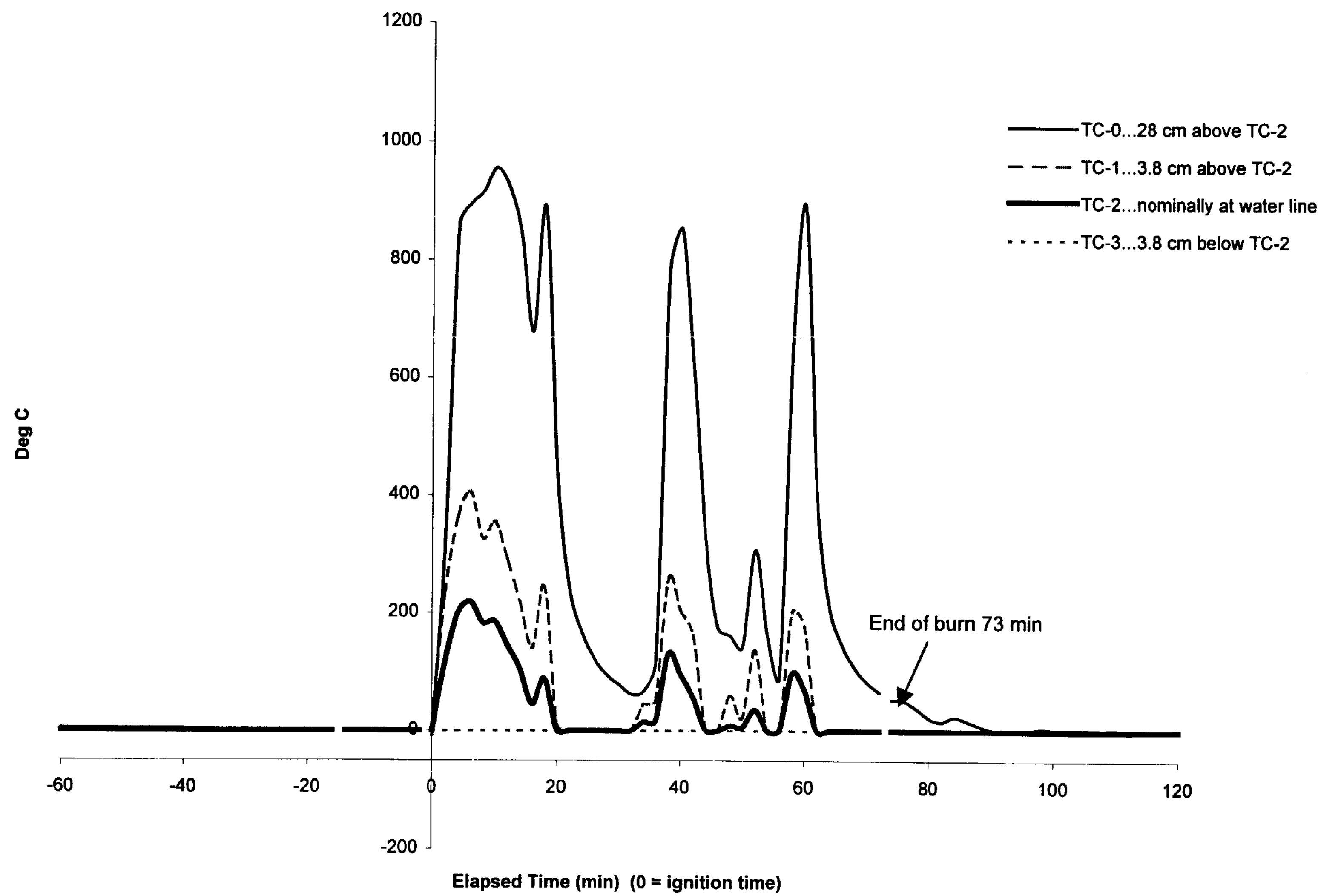
Thermocouples are mounted on burn side of 3M Fire Boom.

NOBE 93 Figure 12.3 **Burn 1 3M Fireboom Section 6G**
Air & Water Temperatures (thermocouple)

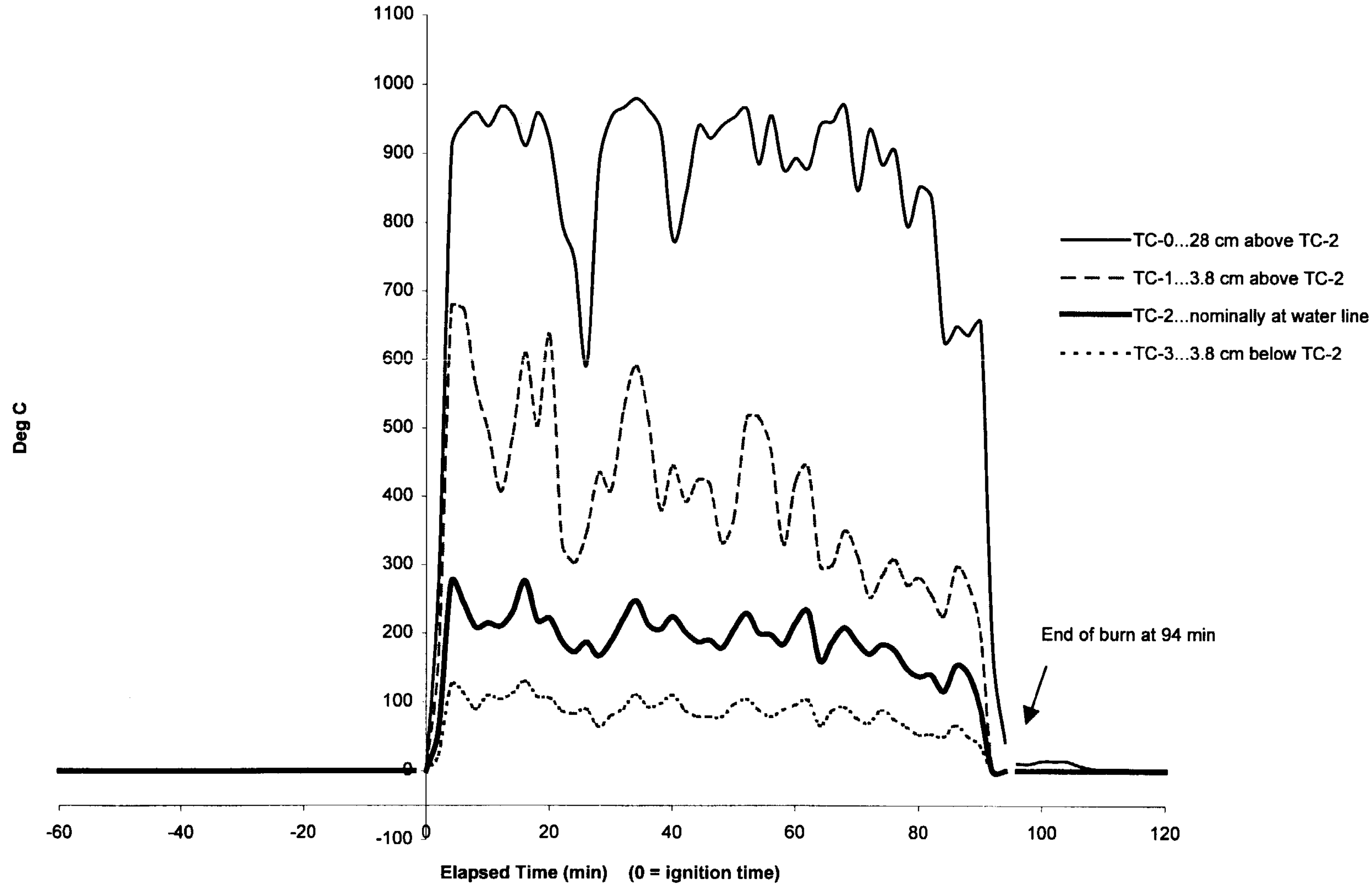


NOBE 93 Figure 12.4

Burn 2 3M Fireboom Section 6G
Air & Water Temperatures (thermocouple)

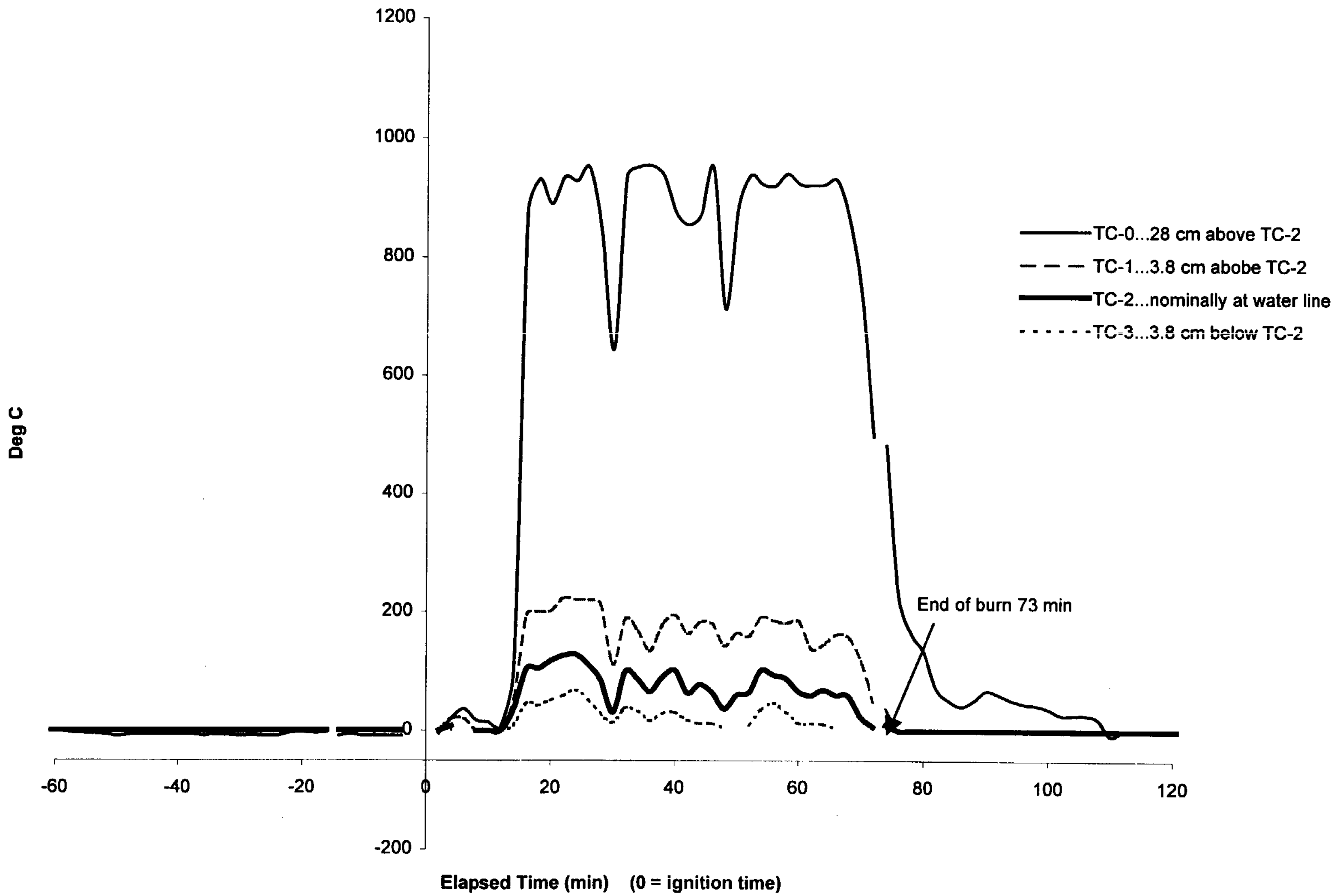


NOBE 93 Figure 12.5 **Burn 1 3M Fireboom Section 8C**
Air and Water Temperatures (thermocouple)



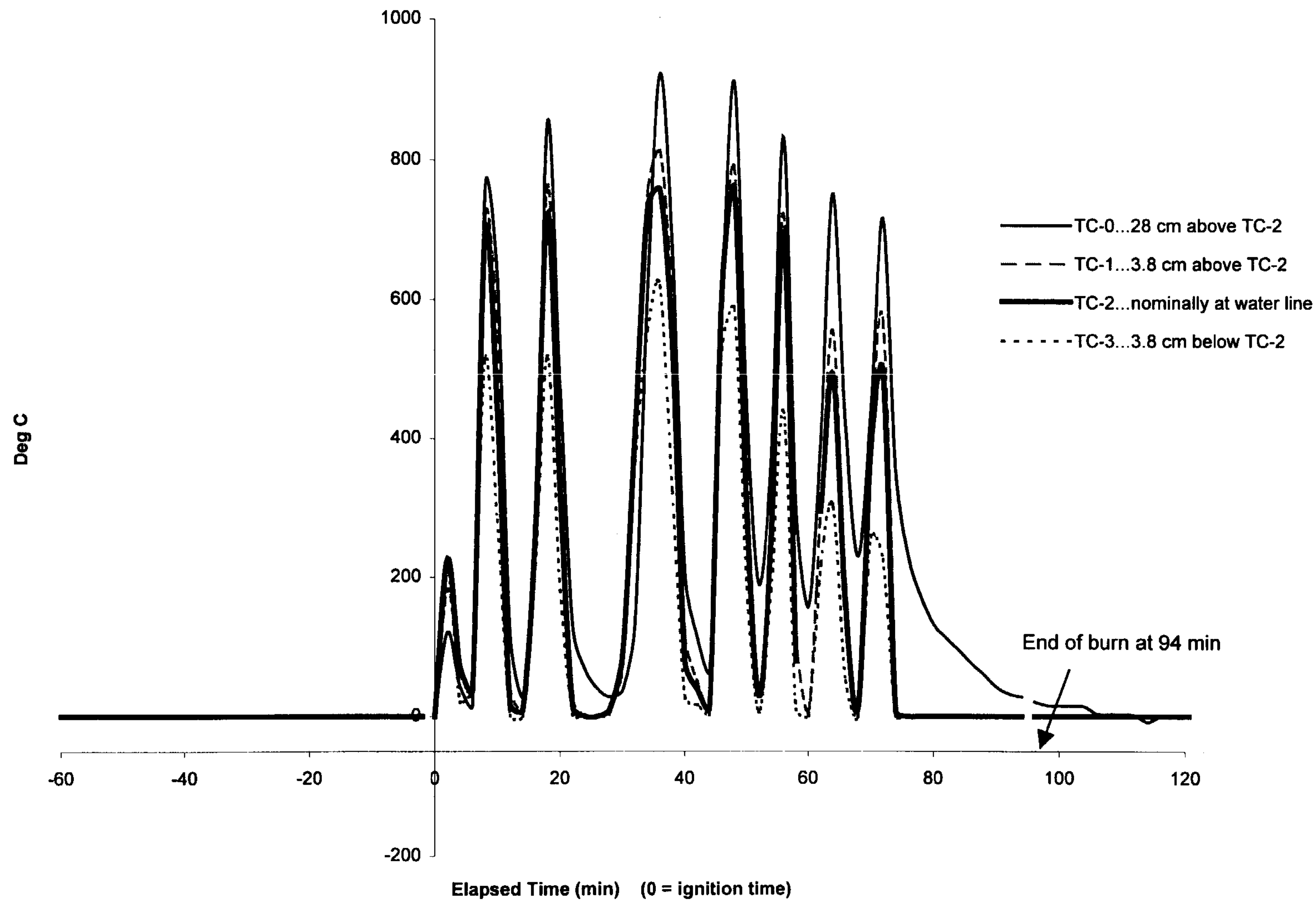
NOBE 93 Figure 12.6

Burn 2 3M Fireboom Section 8C
Air and Water Temperatures (thermocouple)



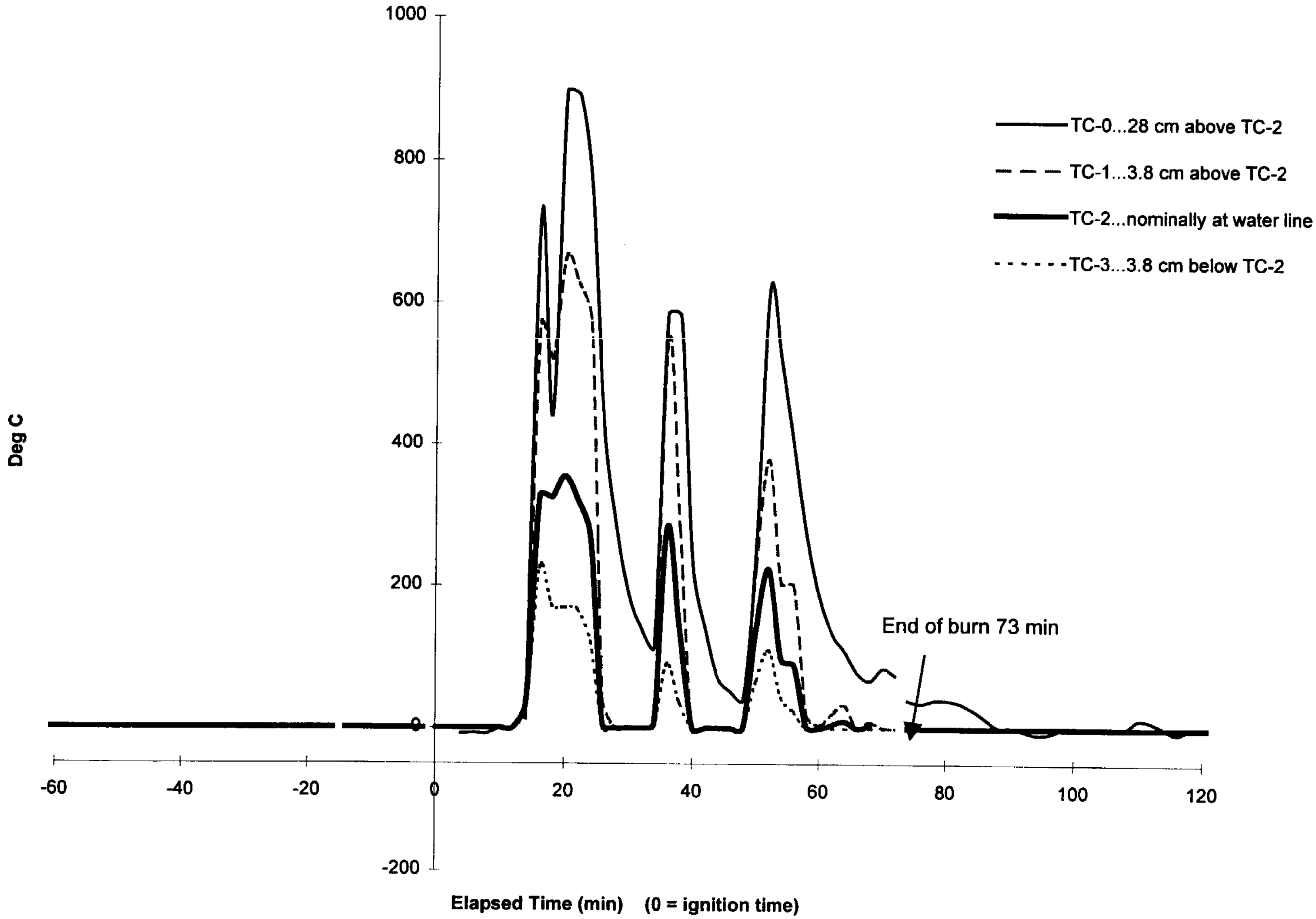
NOBE 93 Figure 12.7

Burn 1 3M Fireboom Section 9A
Air & Water Temperatures (thermocouple)

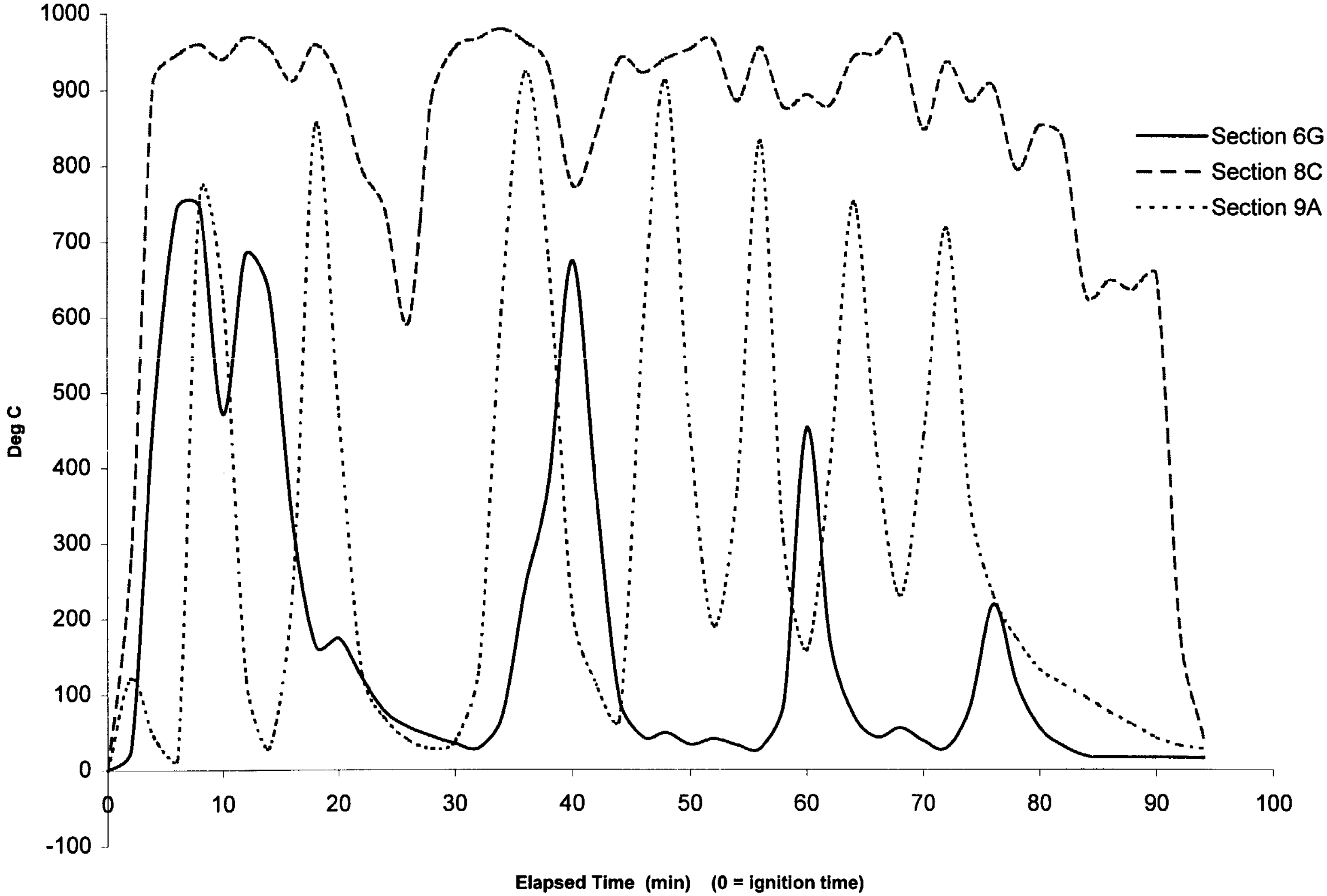


NOBE 93 Figure 12.8

Burn 2 3M Fireboom Section 9A
Air & Water Temperatures (thermocouple)

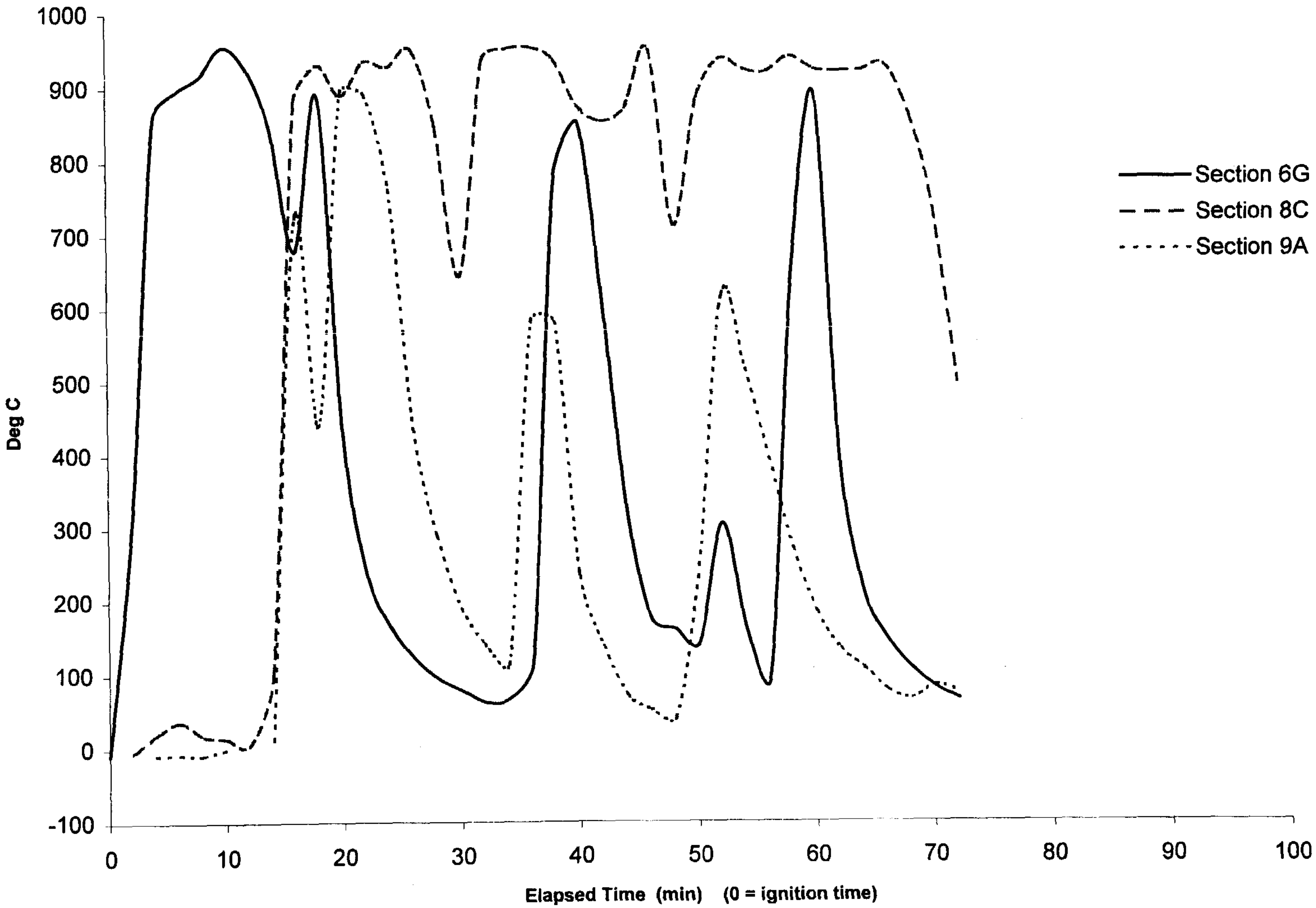


NOBE 93 Figure 12.9 **Burn 1 3M Fireboom Position TC-0**
Air Temperature
28 cm above TC-2 (TC-2 nominally at water line)



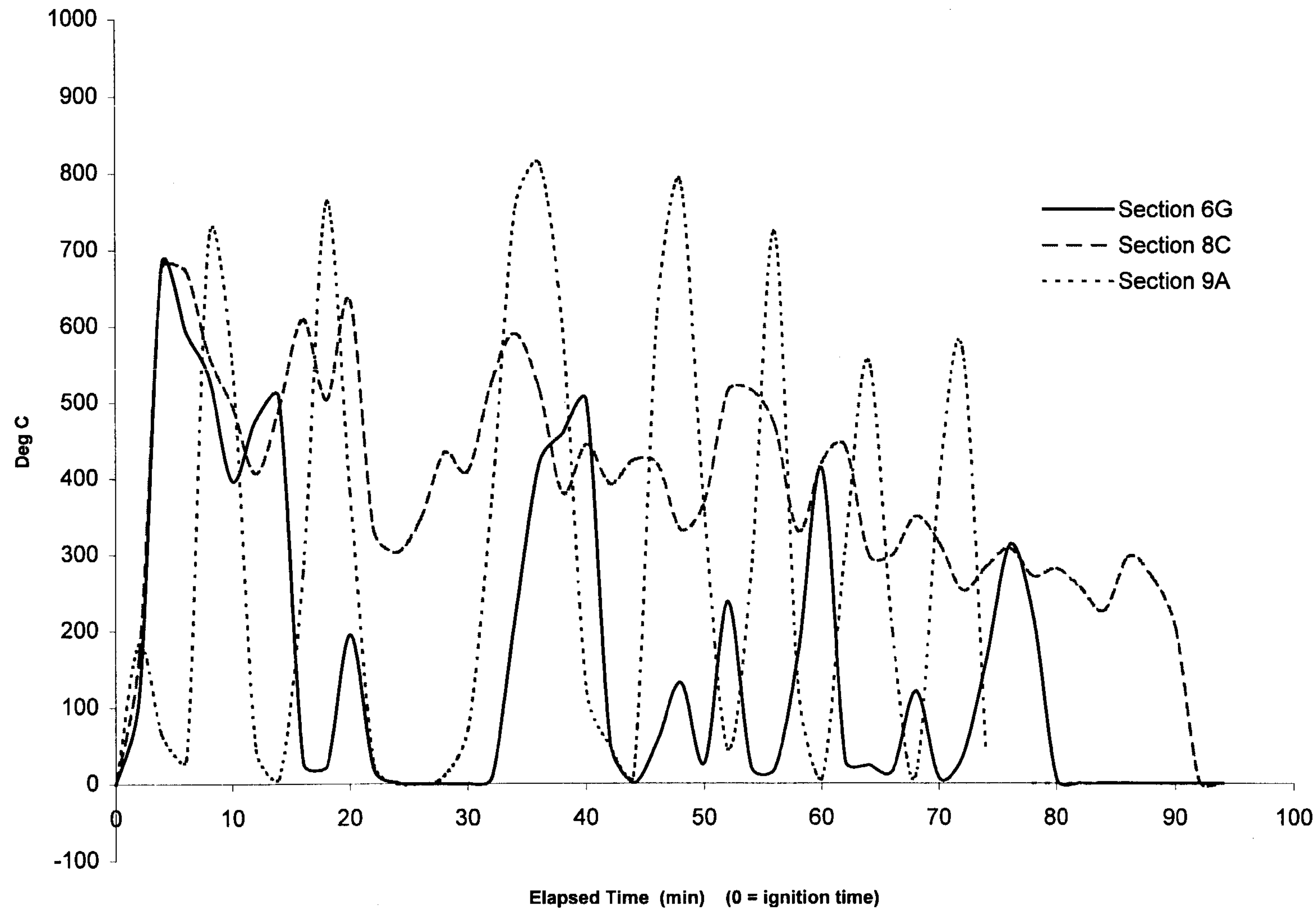
NOBE 93 Figure 12.10

Burn 2 3M Fireboom Position TC-0
Air Temperature
28 cm above TC-2 (TC-2 nominally at water line)



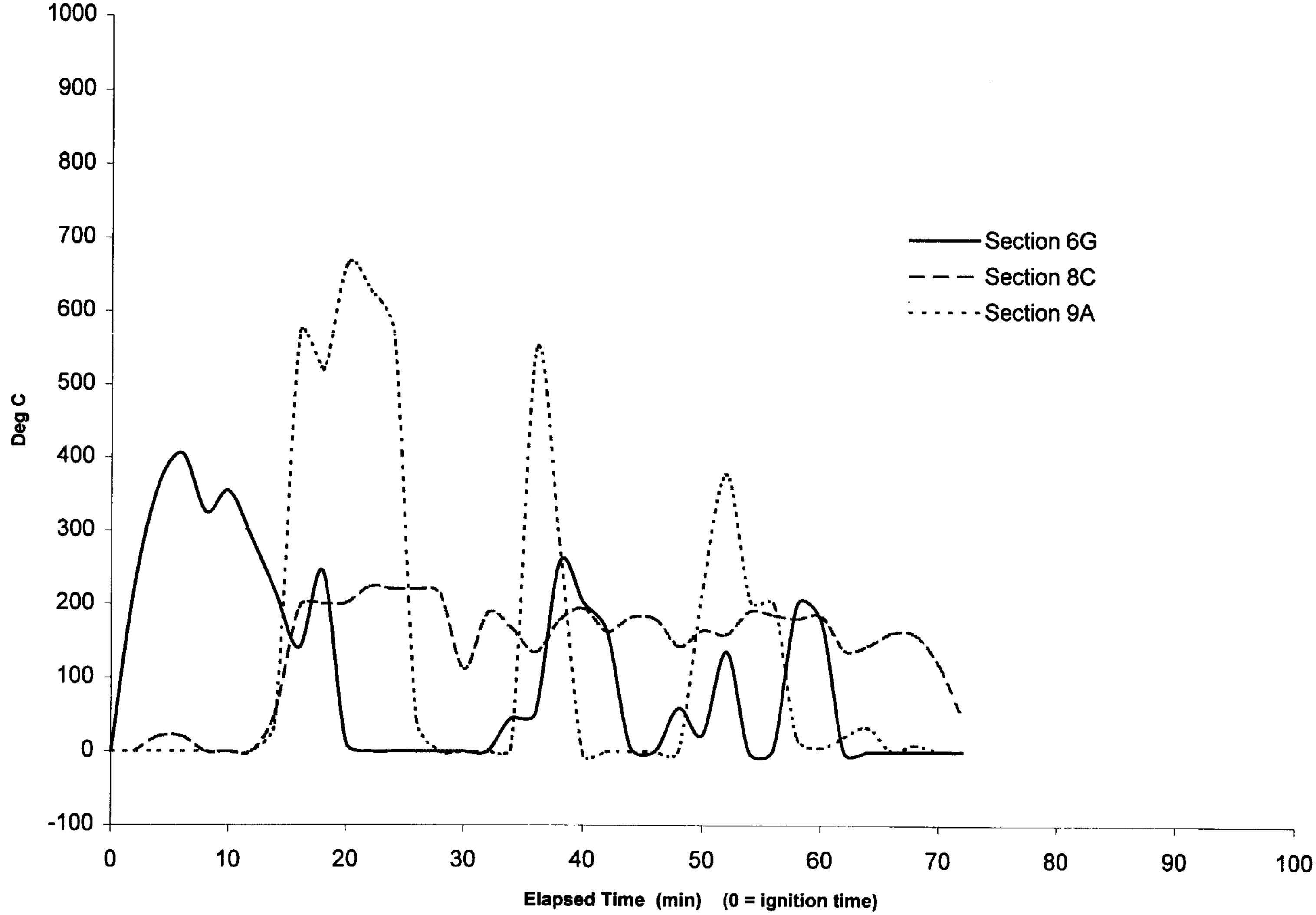
NOBE 93 Figure 12.11

Burn 1 3M Fireboom Position TC-1
Air Temperature
3.8 cm above TC-2 (TC-2 nominally at water line)



NOBE 93 Figure 12.12

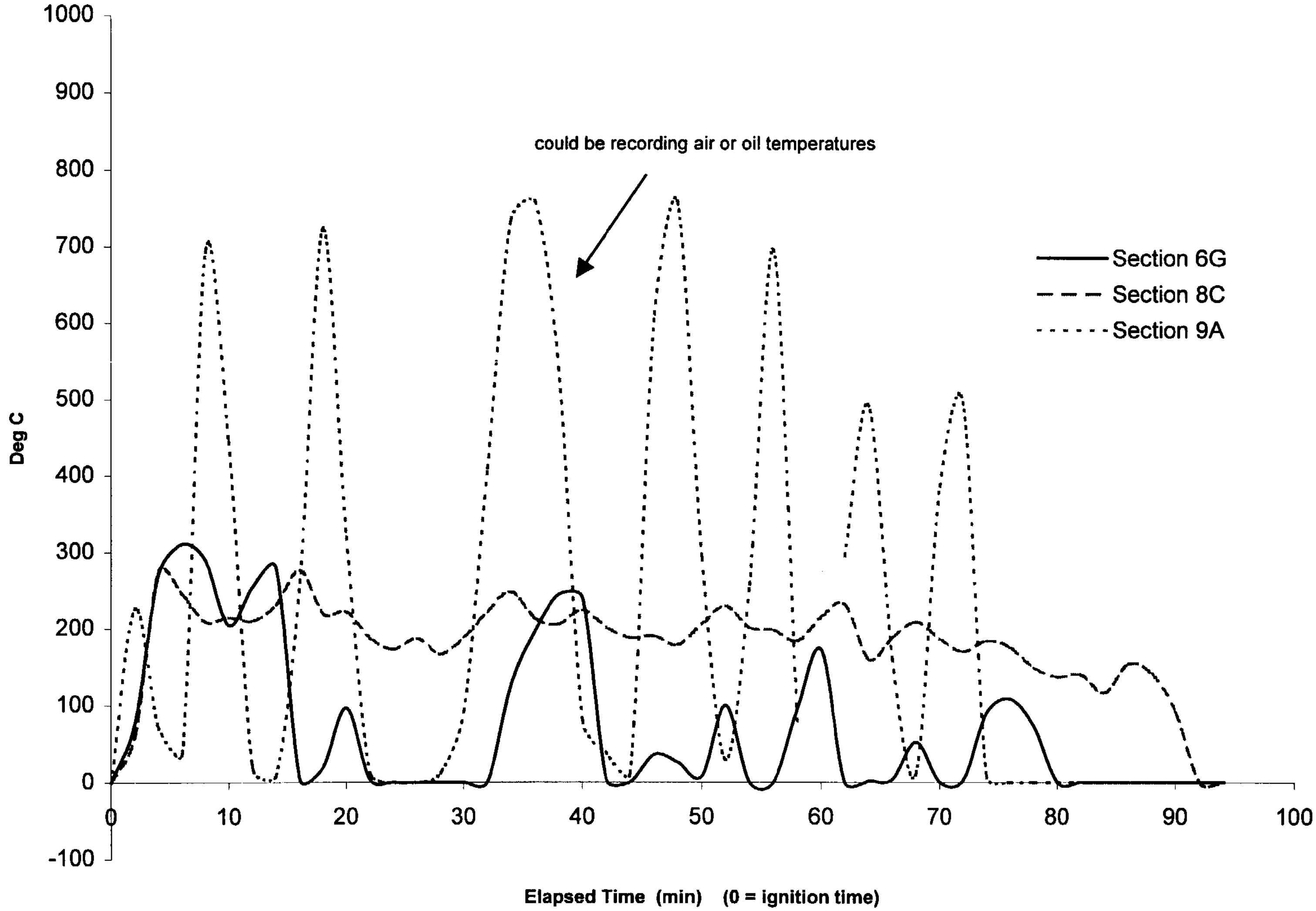
Burn 2 3M Fireboom Position TC-1
Air Temperature
3.8 cm above TC-2 (TC-2 nominally at water line)



NOBE 93 Figure 12.13 **Burn 1 3M Fireboom Position TC-2**

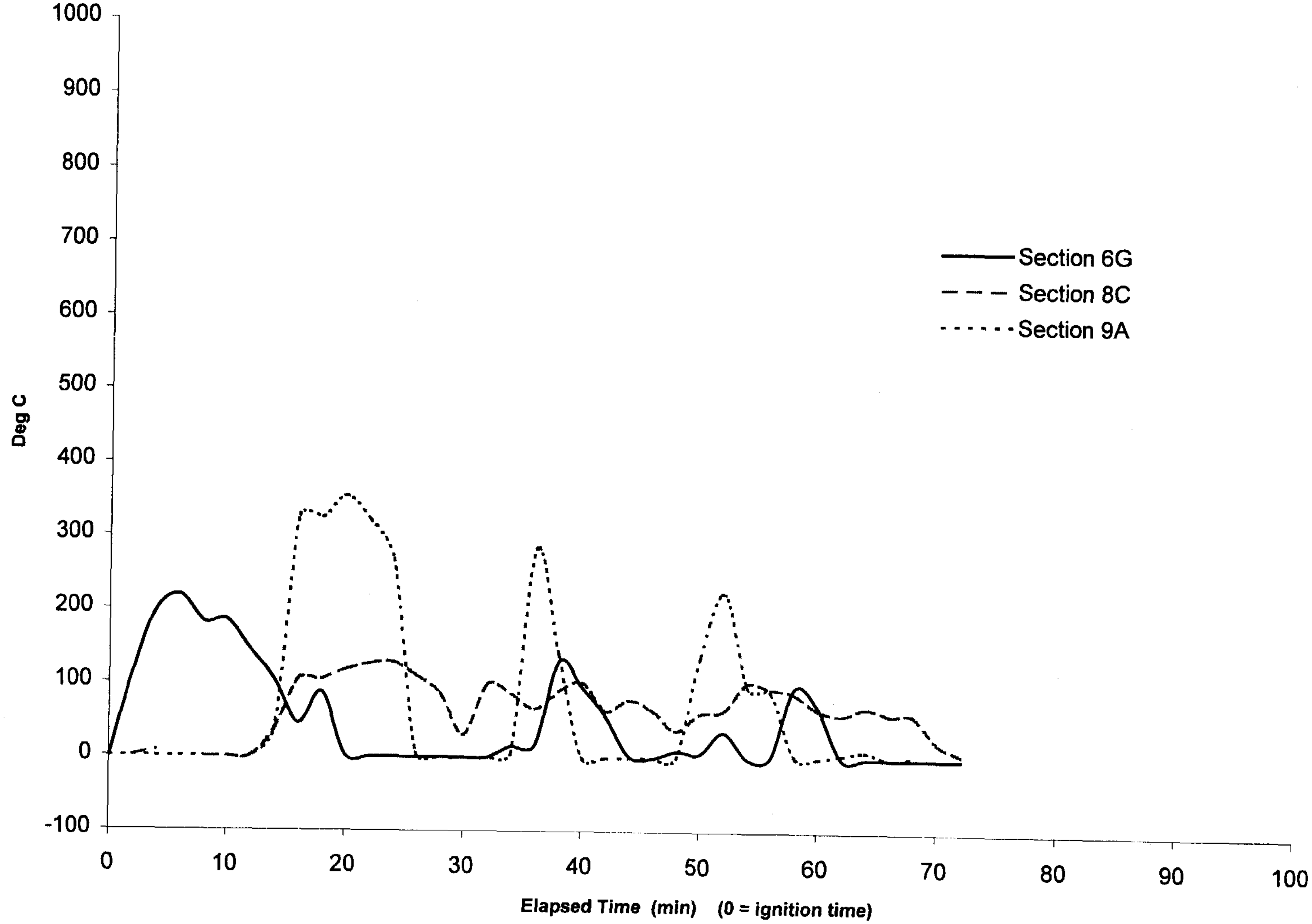
Air / Water Temperature

TC-2 nominally at water line

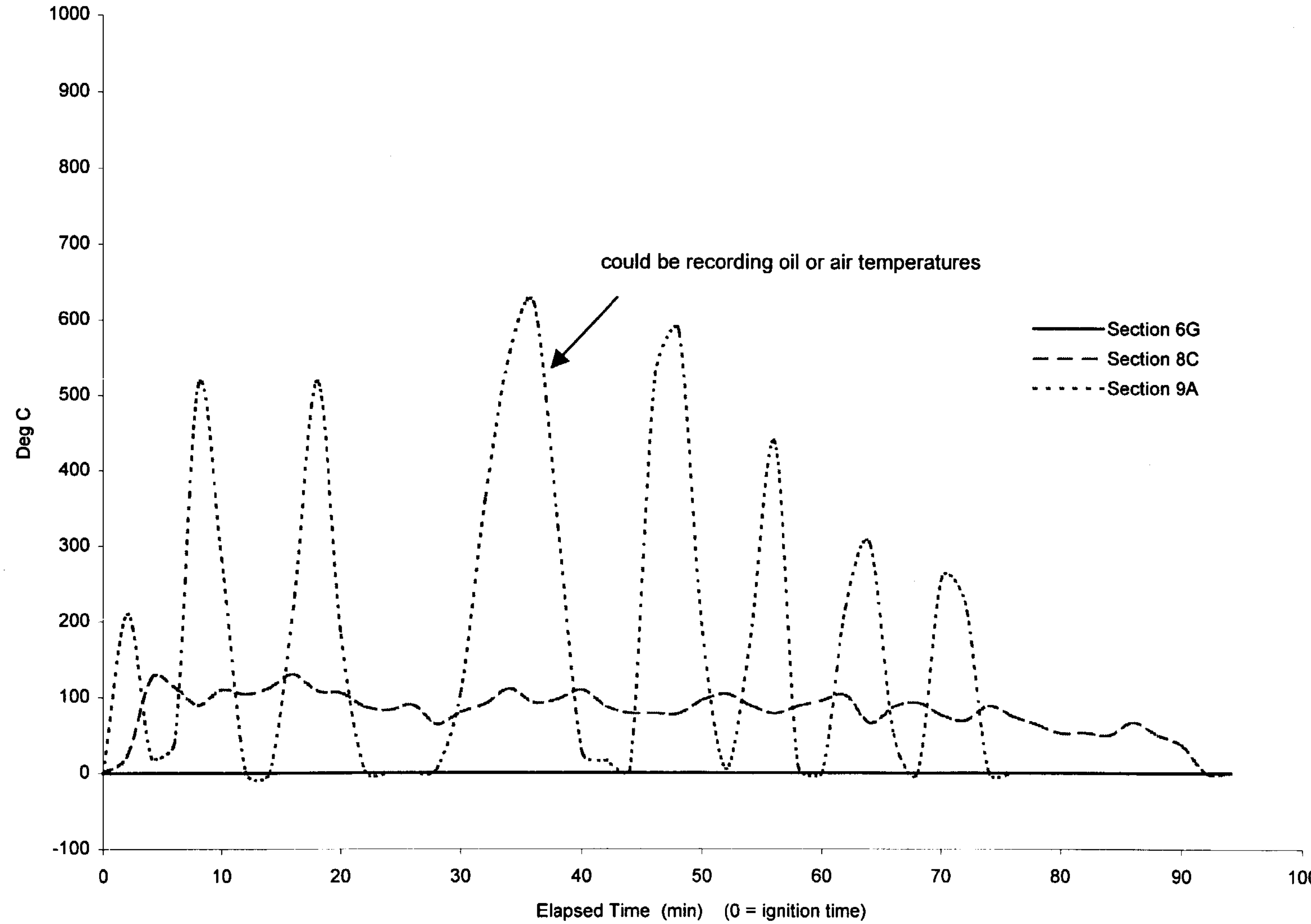


NOBE 93 Figure 12.14

Burn 2 3M Fireboom Position TC-2
Air / Water Temperature
TC-2 nominally at water line

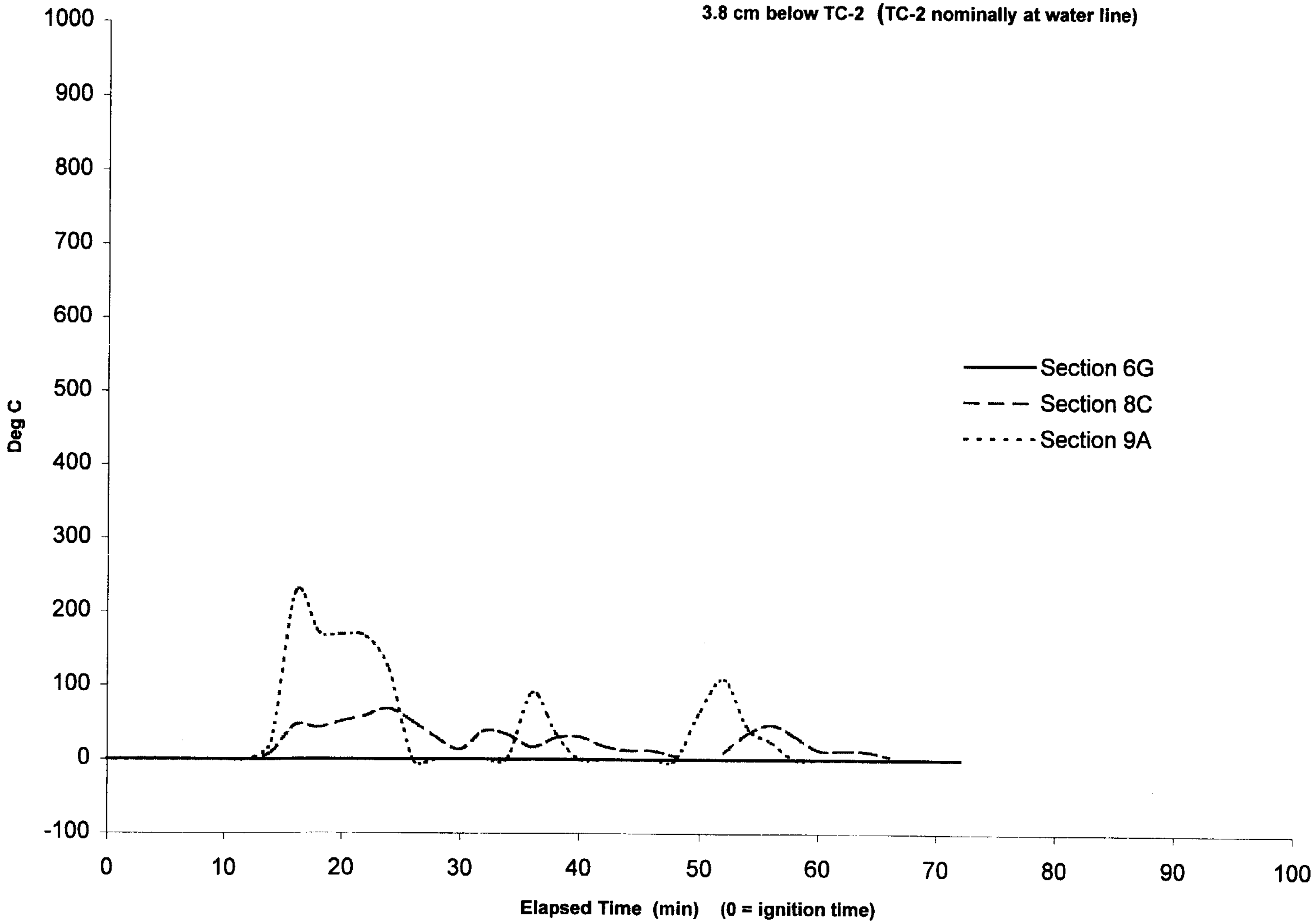


NOBE 93 Figure 12.15 **Burn 1 3M Fireboom Position TC-3**
Water Temperature
3.8 cm below TC-2 (TC-2 nominally at water line)

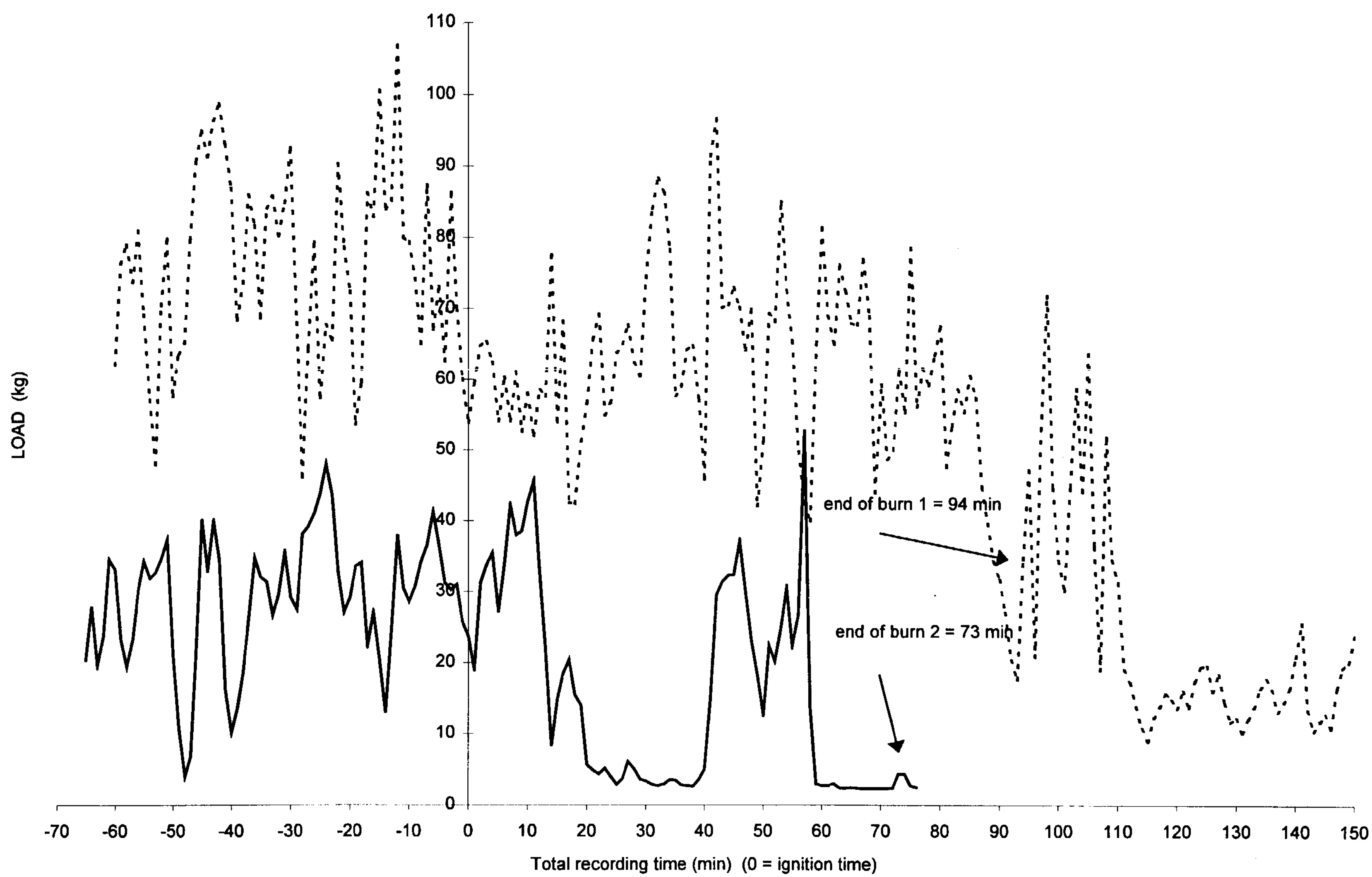


NOBE 93 Figure 12.16

Burn 2 3M Fireboom Position TC-3
Water Temperature
3.8 cm below TC-2 (TC-2 nominally at water line)



NOBE 93 Figure 12.17 **Average Load on Fireboom**



Section 13

Experimental Parameters
NOBE 93

NOBE 93 Table 13.1 Experimental Parameters

	Thickness of Oil at Apex of Fireboom prior to Ignition	Oil Volume (m^3)	Burn Area (m^3)	Load (kg)	Average Burn Rate (kg/min.m^2)	Surface Regression Rate (mm/min)	Current Meter (CCG 218) (knots)	Oil FLow (L/min)
BURN ... 1								
Background ... before oil discharge				28.1			0.6	
Pre-ignition ... oil being discharged	7 cm			31.6			0.5	332<918<1190
Burn period ... oil is burning		48260	314<803	8<127<60				159<578<845
Post-burn				2.5				
Post residue collection period			42					
BURN ... 2								
Background ... before oil discharge				28.1				
Pre-ignition ... oil being discharged	N/D			31.6				437<642<903
Burn period ... oil is burning		25900	223<427<652	2<83<16				159<578<845
Post-burn				2.5				
Post residue collection period								
Burn site location	47°40'N, 52°00'W							
Water depth	180 meters							
N/D : not done								

NOBE 93 Table 13.2

Time Periods Relative to the Burn and Sample Collection

	BURN ... 1		BURN ... 2		
	Actual time (hh:mm)	Standardized time (min)	Actual time (hh:mm)	Standardized time (min)	Burn period %
Background (0.0)	taken before Aug 12, 93		not applicable		
Background ... before oil discharge (1.1)	before 9:30 on Aug 12, 93		13:00 to 13:52		
Pre-ignition ... oil being discharged (1.2)	9:30 to 10:30	60	13:52 to 14:06	14	
Ignition time	10:30	0	14:06	0	
Early burn (1.3)	10:30 to 10:53	24	14:06 to 14:24	0 to 18	0 to 25
Midway Point	11:17	47	14:42	36.5	50
Middle burn (1.4)	10:54 to 11:40	24 to 70	14:24 to 15:00	18 to 55	25 to 75
Late burn (1.5)	11:41 to 12:04	70 to 94	15:00 to 15:19	55 to 73	75 to 100
End of burn	12:04		15:19		
Burn period ... oil is burning (1.6)	10:30 to 12:04	94	14:06 to 15:19	73	0 to 100
Post-burn (1.7)	12:04 to 13:00		15:19 to 16:30		
Post residue collection period (1.8)	not applicable		16:30 to as long as 2 days later		

NOBE 93 Table 13.3 **Oil Flow Data ... Burn # 1**

Elapsed Time Minutes	Flow Rate L/min	Average L/min	Total Volume L
-60	0.0		3
-59	56.4		60
-58	0.0		60
-57	0.0		60
-56	0.0		60
-55	0.0		60
-54	0.0		60
-53	0.0		60
-52	0.0		60
-51	0.0		60
-50	0.0		60
-49	2.5		62
-48	0.0		62
-47	0.0		62
-46	0.0		62
-45	0.0		62
-44	36.3		99
-43	13.4		112
-42	6.3		118
-41	22.2		141
-40	56.9		197
-39	26.1		224
-38	55.1		279
-37	45.1		324
-36	42.2		366
-35	332.1		698
-34	856.7	682.7	1555
-33	859.2		2414
-32	34.5		2449
-31	1.2		2450
-30	0.2		2450
-29	0.5		2450
-28	0.4		2451
-27	0.3		2451
-26	0.5		2452
-25	0.1		2452
-24	0.3		2452
-23	0.1		2452
-22	0.0		2452
-21	0.1		2452
-20	0.0		2452
-19	0.0		2452
-18	89.4		2542
-17	984.7		3526
-16	1165.8		4692
-15	1163.3		5855
-14	1156.4	1127.4	7010
-13	1149.4		8160
-12	1144.5		9300
-11	265.0		9570
-10	2.1		9570
-9	0.9		9570
-8	1.5		9570
-7	1.9		9580
-6	1.4		9580
-5	0.9		9580
-4	0.4		9580
-3	0.3		9580
-2	0.5		9580
-1	0.3		9580
0	**0.0**		**9580**
1	0.5		9580
2	780.8		10360
3	1163.3		11520
4	1166.8	1083.4	12690
5	1180.7		13870
6	1125.1		15000
7	43.5		15040
8	0.0		15040
9	0.2		15040
10	0.2		15040
11	935.6		15980
12	1163.8		17140
13	1159.4	1040.1	18300
14	1158.9		19460
15	782.8		20240
16	14.2		20260
17	11.1		20270
18	7.5		20270
19	4.6		20280
20	275.0		20550
21	503.5		21060
22	539.7		21600
23	540.7		22140
24	542.2		22680
25	542.7		23220
26	541.2	670.9	23760
27	539.2		24300
28	537.8		24840
29	536.8		25380
30	542.2		25920
31	1133.6		27050
32	1156.9		28210
33	1064.6		29270
34	17.6		29290
35	16.0		29310
36	16.3		29320
37	13.8		29340
38	10.7		29350
39	115.1		29460
40	897.4		30360
41	894.0		31260
42	1006.1	948.6	32260
43	1027.9		33290
44	917.8		34210
45	27.4		34230
46	21.5		34260
47	38.6		34290
48	0.8		34300
49	42.9		34340
50	1147.5		35490
51	1188.1	976.1	36670
52	1190.1		37860
53	378.5		38240
54	9.8		38250
55	0.5		38250
56	0.0		38250
57	898.4		39150
58	1179.2	1022.3	40330
59	1184.2		41510
60	1176.2		42690
61	673.7		43360
62	6.6		43370
63	2.0		43370
64	0.0		43370
65	776.9		44150
66	1177.7		45330
67	1170.8	976.6	46500
68	1171.3		47670
69	586.4		48250
70	5.7		48260

Minimum = 332
Average = 918
Maximum = 1190

Elapsed time 0 refers to ignition time
Elapsed time 70 refers to end of flow

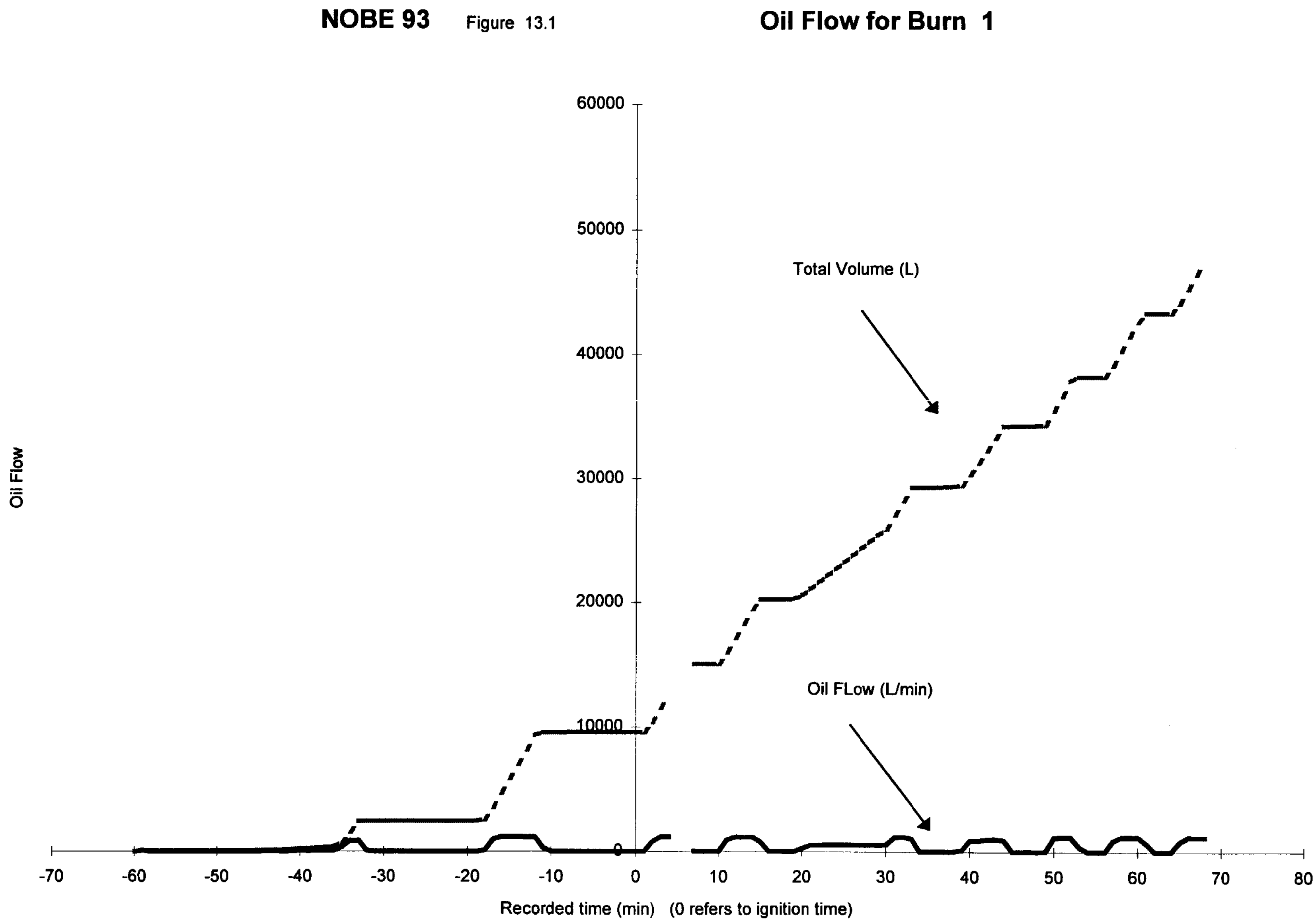
NOBE 93 Table 13.4 **Oil Flow Data ... Burn # 2**

Elapsed Time Minutes	Flow Rate L/min	Average L/min	Total Volume L
-15	0		0
-14	13		13
-13	72		84
-12	0		84
-11	0		84
-10	243		327
-9	903		1230
-8	855		2085
-7	854	871	2939
-6	868		3806
-5	873		4679
-4	360		5039
-3	20		5059
-2	0		5059
-1	0		5059
0	0		5059
1	0		5059
2	0		5059
3	0		5059
4	0		5059
5	159		5218
6	483		5700
7	479		6179
8	733		6912
9	829		7740
10	841		8580
11	840	724	9420
12	845		10270
13	841		11110
14	845		11950
15	504		12460
16	5		12460
17	0		12460
18	0		12460
19	0		12460
20	0		12460
21	0		12460
22	0		12460
23	0		12460
24	0		12460
25	375		12840
26	535		13370
27	556		13930
28	561		14490
29	562		15050
30	564	558	15610
31	563		16180
32	563		16740
33	562		17300
34	561		17860
35	229		18090
36	1		18090
37	0		18090
38	0		18090
39	0		18090
40	0		18090
41	0		18090
42	437		18530
43	552		19080
44	567		19650
45	569		20220
46	569		20790
47	571		21360
48	569		21930
49	571	556	22500
50	571		23070
51	570		23640
52	570		24210
53	570		24780
54	570		25350
55	522		25870
56	27		25900

Minimum = 437
Average = 642
Maximum = 903

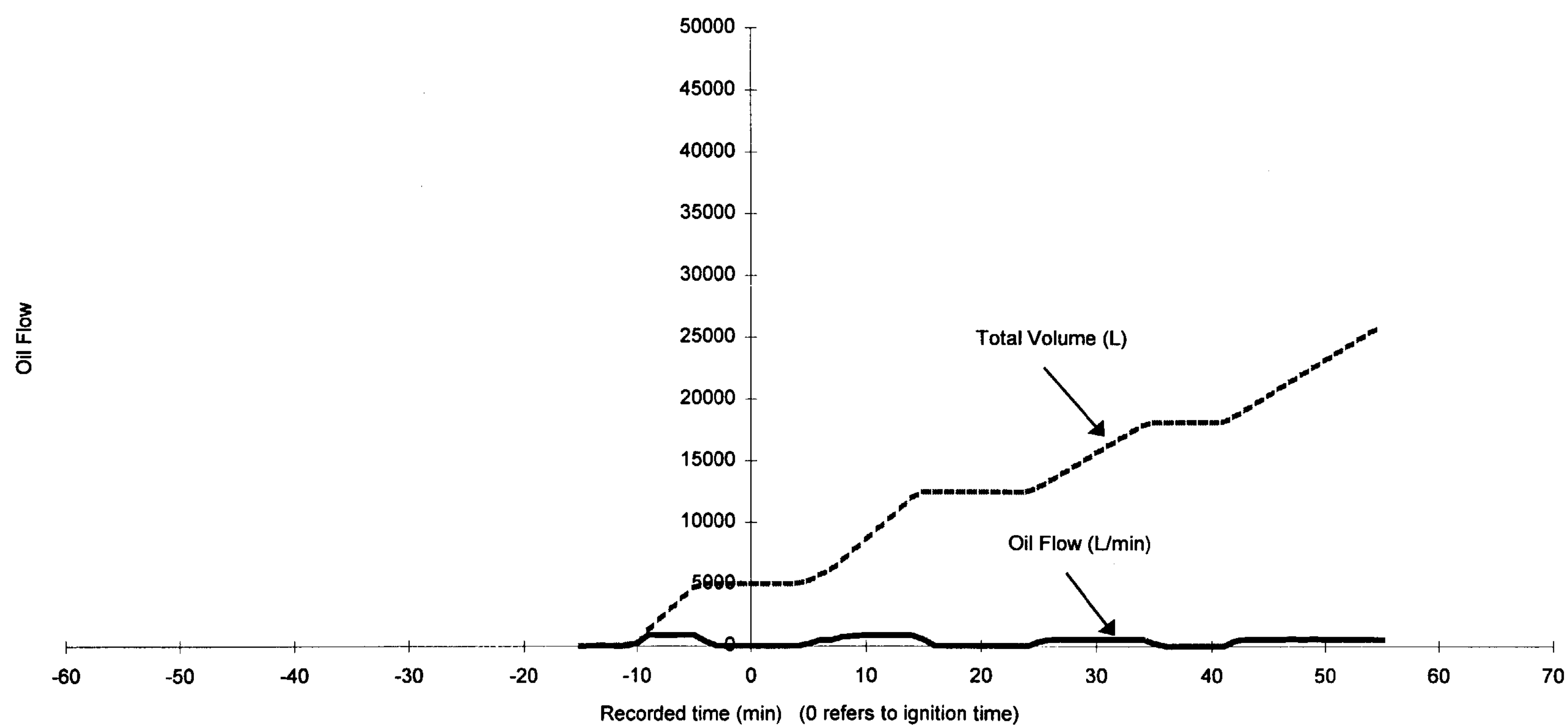
Elapsed time 0 refers to ignition time
Elapsed time 56 refers to end of flow

NOBE 93 Figure 13.1



NOBE 93 Figure 13.2

Oil Flow for Burn 2



Section 14

Current Measurement and Waverider Data at Fireboom NOBE 93

Measurement of Current with Movement of Flotilla NOBE 93

Marsh - McBirney, Inc. Model 511 Electromagnetic Water Current Meter

The Model 511 Electromagnetic Water Current Meter is a general purpose instrument designed for use in both the laboratory and field applications. The instrument consists of a transducer probe with a cable and a signal processor housed in a portable case.

The instrument senses water flow in a plane normal to the longitudinal axis of the electromagnetic sensor. Panel meters display water velocity components along the Y axis and X axis of the electromagnetic sensor. Analog voltages representative of water velocity are available at an output signal jack on the current meter.

A Model 511 Electromagnetic Water Current Meter was used during the NOBE burn to measure the speed of the 3M fire boom. The current meter was mounted on board a Boston Whaler (CCG 218). The analog output of the current meter was connected to a Campbell Scientific CR10 data logger. Both X axis and Y axis water velocities were recorded by the CR10 data logger.

Waverider Buoys and Meters
NOBE 93

Seaconsult Limited was contracted to deploy the on-site Waveriders and establish the remote communication links to enable near real-time monitoring of site conditions from shore in the pre-spill mode and true real-time recording of waves at the site during the dry-run and the actual burn. Two Datawell Waverider buoys were deployed, one equipped with a standard transmitting system (continuous transmissions on VHF) and the other with an ARGOS platform transmitter terminal.

A Remote Wave Height meter was also installed on the CCGS Ann Harvey for this project (meter is the property of the Environment Technology Centre in Ottawa).

Datawell Standard Waverider with VHF Data Telemetry

Deployed at 1631 NDT on August 02, 1993
GPS position = 47°40.036'N , 51°59.099'W, at a water depth of 179 meters

Analogue signals received on board are digitized at the rate of 2.56 Hz and provided to the system computer through standard RS232 output. This buoy was used as the primary source of wave data during the burns. It transmitted to a computerized wave data receiving station on Signal Hill as well as to a computerized data receiving station onboard the CCGS Ann Harvey, providing the user with on-screen data product while automatically archiving raw data.

Datawell Waverider with ARGOS Data Telemetry

Deployed at 1619 NDT on August 02, 1993
GPS position = 47°39.997'N , 52°00.006'W, at a water depth of 180 meters

This Waverider was capable of transmitting its data to two separate satellites when they passed over the site. Only a total of 5 hours of raw data collection were lost due to the absence of the satellites.

TSK Remote Wave Height Meter

This meter uses the measured Doppler shift of microwave radar emissions directed down at the water surface to calculate the vertical wave velocity which is then integrated to produce the actual wave height. Ship motions are removed by an accelerometer clamped to the hull. Full spectral information is available from this system; data were logged at a 2 Hz sample rate on a portable computer. This instrument was used as a backup to the moored Waveriders.

AES Weather Buoy

Weather data were provided by an AES weather buoy (6m Nomad) which measured and transmitted the following information on the hour: wind speed and direction (average over the previous ten minutes); air and sea temperature (instantaneous reading); wave height over a 37-minute record (responds principally to swell and longer period waves >5.5 sec); and pressure (averaged over a 10-minute period). This buoy was the primary source of surface weather information both prior to and during the test.

Deployed at NDT 1350 on August 02, 1993.
GPS position = 47°45.014'N , 52°04.888'W , at a water depth of 190 m (northwest corner of the experiment permit area)
Recovered by the CCGS Ann Harvey on August 18, 1993.

The standard for Wave data collection in Canada has been set by the Marine Environmental Data Service (MEDS) of the Department of Fisheries and Oceans (DFO) using the Datawell Waverider.

The Waverider is a surface buoy which measures non-directional seastate and transmits analogue raw-data to a receiving station on shore via a VHF telemetry link. The specifications set by Environment Canada for the Newfoundland Offshore Burn Experiment called for wave data collection to MEDS standards. Furthermore, it was specified that two wave buoys be deployed to ensure continuous operation in the event of equipment failure. As the burn site was expected to be beyond the range of a Waverider transmitting to a shore receiving facility, Environment Canada requested that the wave buoys used for NOBE be equipped with satellite transmitters. Every hour, the Waverider onboard processor ran spectral and statistical analysis (based on upcrossing) for a synoptic sample consisting of 20 minutes of raw wave data collected immediately before the hour (Greenwich Mean Time).

The satellite data telemetry option used by Seaconsult for NOBE was ARGOS, a satellite system developed for the collection and dissemination of environmental data by CNES (the French Space Agency), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA). In addition to handling sensor data, the ARGOS system is capable of determining the location of a transmitting platform.

One of the ARGOS buoys failed the day before being deployed, and was replaced by a Standard Waverider with VHF data telemetry.

NOTE: A full report on the performance of the Waveriders is provided in Appendix A and B.

NOBE 93 Table 14.1 Current Meter ... Forward Motion (knots)

(Meter mounted on CCG 218)

Elapsed Time (min)	BURN # 1 MIN	BURN # 1 AVE	BURN # 1 MAX	BURN # 2 Elapsed Time (min)	BURN # 2 Direct Reading
Minimum	0.21	0.36	0.58		
Average	0.43	0.57	0.71		
Maximum	0.56	0.69	0.91		
-90.0	0.48	0.56	0.65	-42	0.45
-89.0	0.46	0.54	0.65		
-88.0	0.25	0.45	0.65	-40	0.5
-87.0	0.21	0.36	0.58		
-86.0	0.42	0.56	0.69	28	0.5
-85.0	0.51	0.59	0.65		
-84.0	0.48	0.57	0.68		
-83.0	0.51	0.67	0.72		
-82.0	0.43	0.54	0.60		
-81.0	0.47	0.62	0.77		
-80.0	0.37	0.50	0.65		
-79.0	0.33	0.52	0.78		
-78.0	0.53	0.67	0.82		
-77.0	0.47	0.55	0.70		
-76.0	0.43	0.59	0.71		
-75.0	0.53	0.61	0.70		
-74.0	0.43	0.51	0.62		
-73.0	0.30	0.52	0.67		
-72.0	0.45	0.57	0.66		
-71.0	0.51	0.64	0.78		
-70.0	0.45	0.58	0.69		
-69.0	0.48	0.56	0.67		
-68.0	0.44	0.58	0.80		
-67.0	0.34	0.55	0.76		
-66.0	0.41	0.55	0.69		
-65.0	0.56	0.69	0.91		
-64.0	0.48	0.62	0.83		

Elapsed time calculated on the "0 = Ignition time" formula

Readings recorded every 5 seconds, averaged to the minute

NOBE 93 Table 14.2 **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement (knots)			
			Per minute averages				Per minute averages		
Time hh:mm:ss	Elapsed Time		MIN	AVE	MAX		MIN	AVE	MAX
Calibration Period up to 8:58									
8:36:10		-2.14				1.88			
8:36:15		0.11				0.68			
8:36:20		0.19				0.77			
8:36:25		0.28				0.69			
8:36:30		0.34				0.58			
8:36:35		0.25				0.59			
8:36:40		0.22				0.58			
8:36:45		0.22				0.41			
8:36:50		0.19				0.41			
8:36:55		0.25				0.30			
8:37:00	-112.9	0.17	-2.14	0.01	0.34	0.30	0.30	0.65	1.88
8:37:05		0.15				0.28			
8:37:10		0.16				0.27			
8:37:15		0.22				0.21			
8:37:20		0.24				0.14			
8:37:25		0.27				0.09			
8:37:30		0.24				0.09			
8:37:35		0.24				0.00			
8:37:40		0.23				0.05			
8:37:45		0.08				0.08			
8:37:50		0.09				0.03			
8:37:55		0.03				-0.07			
8:38:00	-112.0	0.03	0.03	0.16	0.27	0.04	-0.07	0.10	0.28
8:38:05		0.06				0.02			
8:38:10		0.14				0.24			
8:38:15		0.30				0.44			
8:38:20		0.18				0.60			
8:38:25		0.15				0.52			
8:38:30		0.16				0.54			
8:38:35		0.22				0.57			
8:38:40		0.26				0.57			
8:38:45		0.15				0.49			
8:38:50		0.21				0.42			
8:38:55		0.17				0.65			
8:39:00	-111.0	-0.06	-0.06	0.16	0.30	0.74	0.02	0.48	0.74
8:39:05		0.04				0.68			
8:39:10		0.00				0.60			
8:39:15		0.02				0.44			
8:39:20		0.06				0.38			
8:39:25		0.08				0.39			
8:39:30		0.08				0.33			
8:39:35		0.18				0.34			
8:39:40		0.23				0.26			
8:39:45		0.12				0.22			
8:39:50		0.23				0.26			
8:39:55		0.22				0.24			
8:40:00	-110.0	0.11	0.00	0.11	0.23	0.27	0.22	0.37	0.68
8:40:05		0.16				0.31			
8:40:10		0.05				0.29			
8:40:15		0.07				0.37			
8:40:20		0.06				0.32			
8:40:25		0.02				0.49			
8:40:30		-0.10				0.33			
8:40:35		-0.17				0.31			
8:40:40		0.02				0.28			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement (knots)			
Time hh:mm:ss	Elapsed Time		Per minute averages MIN	AVE	MAX		Per minute averages MIN	AVE	MAX
8:40:45		0.04				0.34			
8:40:50		0.12				0.34			
8:40:55		0.15				0.38			
8:41:00	-109.0	0.19	-0.17	0.05	0.19	0.49	0.28	0.35	0.49
8:41:05		0.10				0.46			
8:41:10		0.14				0.33			
8:41:15		0.08				0.25			
8:41:20		0.02				0.28			
8:41:25		0.06				0.37			
8:41:30		0.03				0.35			
8:41:35		0.01				0.41			
8:41:40		0.06				0.35			
8:41:45		0.10				0.39			
8:41:50		0.08				0.35			
8:41:55		0.22				0.37			
8:42:00	-108.0	0.20	0.01	0.09	0.22	0.31	0.25	0.35	0.46
8:42:05		0.14				0.31			
8:42:10		0.07				0.24			
8:42:15		0.00				0.16			
8:42:20		0.04				0.25			
8:42:25		0.20				0.25			
8:42:30		0.25				0.16			
8:42:35		0.24				0.12			
8:42:40		0.22				0.16			
8:42:45		0.11				0.09			
8:42:50		0.10				0.05			
8:42:55		0.14				0.03			
8:43:00	-107.0	0.05	0.00	0.13	0.25	-0.02	-0.02	0.15	0.31
8:43:05		0.10				-0.03			
8:43:10		0.17				0.09			
8:43:15		0.14				0.08			
8:43:20		0.20				0.18			
8:43:25		0.23				0.25			
8:43:30		0.22				0.19			
8:43:35		0.21				0.11			
8:43:40		0.21				0.07			
8:43:45		0.16				0.06			
8:43:50		0.19				-0.03			
8:43:55		0.20				-0.06			
8:44:00	-106.0	0.14	0.10	0.18	0.23	-0.08	-0.08	0.07	0.25
8:44:05		0.27				-0.17			
8:44:10		0.22				-0.18			
8:44:15		0.12				-0.10			
8:44:20		0.10				-0.08			
8:44:25		0.17				0.00			
8:44:30		0.16				0.08			
8:44:35		0.22				0.13			
8:44:40		0.19				0.16			
8:44:45		0.20				0.23			
8:44:50		0.22				0.16			
8:44:55		0.20				0.22			
8:45:00	-105.0	0.20	0.10	0.19	0.27	0.24	-0.18	0.06	0.24
8:45:05		0.09				0.13			
8:45:10		0.11				0.14			
8:45:15		0.09				0.28			
8:45:20		0.09				0.30			
8:45:25		0.02				0.17			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

Time hh:mm:ss	Elapsed Time	Y Current side movement	Y Per minute averages MIN	Y AVE	Y MAX	X Current forward movement (knots)	X Per minute averages MIN	X AVE	X MAX
8:45:30		0.11				0.19			
8:45:35		0.12				0.21			
8:45:40		0.10				0.26			
8:45:45		0.09				0.20			
8:45:50		0.20				0.19			
8:45:55		0.25				0.21			
8:46:00	-104.0	0.20	0.02	0.12	0.25	0.38	0.13	0.22	0.38
8:46:05		0.21				0.32			
8:46:10		0.26				0.17			
8:46:15		0.21				0.01			
8:46:20		0.15				0.03			
8:46:25		0.10				-0.03			
8:46:30		0.16				-0.11			
8:46:35		0.02				0.00			
8:46:40		0.08				0.04			
8:46:45		-0.05				0.11			
8:46:50		0.03				0.14			
8:46:55		0.01				0.30			
8:47:00	-103.0	0.01	-0.05	0.10	0.26	0.24	-0.11	0.10	0.32
8:47:05		0.02				0.20			
8:47:10		0.03				0.19			
8:47:15		0.10				0.20			
8:47:20		0.03				0.20			
8:47:25		0.08				0.19			
8:47:30		0.07				0.14			
8:47:35		0.02				0.25			
8:47:40		0.14				0.31			
8:47:45		0.00				0.29			
8:47:50		0.16				0.25			
8:47:55		0.23				0.26			
8:48:00	-102.0	0.28	0.00	0.10	0.28	0.27	0.14	0.23	0.31
8:48:05		0.27				0.27			
8:48:10		0.32				0.24			
8:48:15		0.31				0.19			
8:48:20		0.19				0.20			
8:48:25		0.22				0.15			
8:48:30		0.14				0.15			
8:48:35		0.08				0.19			
8:48:40		0.02				0.19			
8:48:45		0.03				0.22			
8:48:50		0.10				0.22			
8:48:55		0.00				0.24			
8:49:00	-101.0	0.06	0.00	0.15	0.32	0.36	0.15	0.22	0.36
8:49:05		0.18				0.32			
8:49:10		0.25				0.40			
8:49:15		0.34				0.36			
8:49:20		0.36				0.50			
8:49:25		0.39				0.55			
8:49:30		0.38				0.53			
8:49:35		0.39				0.45			
8:49:40		0.32				0.59			
8:49:45		0.20				0.55			
8:49:50		0.21				0.51			
8:49:55		0.20				0.53			
8:50:00	-100.0	0.22	0.18	0.29	0.39	0.55	0.32	0.49	0.59
8:50:05		0.34				0.56			
8:50:10		0.29				0.57			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement			
						(knots)			
Time	Elapsed		Per minute averages				Per minute averages		
hh:mm:ss	Time		MIN	AVE	MAX		MIN	AVE	MAX
8:50:15		0.19				0.51			
8:50:20		0.15				0.55			
8:50:25		0.08				0.43			
8:50:30		-0.01				0.42			
8:50:35		0.14				0.46			
8:50:40		0.19				0.45			
8:50:45		0.18				0.36			
8:50:50		0.16				0.37			
8:50:55		0.18				0.27			
8:51:00	-99.0	0.10	-0.01	0.17	0.34	0.33	0.27	0.44	0.57
8:51:05		0.18				0.39			
8:51:10		0.22				0.36			
8:51:15		0.16				0.26			
8:51:20		0.18				0.37			
8:51:25		0.13				0.33			
8:51:30		0.14				0.33			
8:51:35		0.21				0.37			
8:51:40		0.28				0.19			
8:51:45		0.26				0.37			
8:51:50		0.26				0.22			
8:51:55		0.29				0.00			
8:52:00	-98.0	0.31	0.13	0.22	0.31	-0.11	-0.11	0.26	0.39
8:52:05		0.30				0.05			
8:52:10		0.22				0.04			
8:52:15		0.12				0.14			
8:52:20		0.18				0.17			
8:52:25		0.15				0.27			
8:52:30		0.22				0.24			
8:52:35		0.20				0.27			
8:52:40		0.26				0.27			
8:52:45		0.19				0.19			
8:52:50		0.21				0.15			
8:52:55		0.24				0.14			
8:53:00	-97.0	0.22	0.12	0.21	0.30	0.17	0.04	0.17	0.27
8:53:05		0.29				0.22			
8:53:10		0.16				0.20			
8:53:40		0.37				-0.19			
8:53:45		0.48				-0.29			
8:53:50		0.51				-0.31			
8:53:55		0.47				-0.28			
8:54:00	-96.0	0.50	0.16	0.40	0.51	-0.27	-0.31	-0.13	0.22
8:54:05		0.44				-0.12			
8:54:10		0.51				0.07			
8:54:15		0.49				-0.06			
8:54:20		0.45				-0.07			
8:54:25		0.43				0.21			
8:54:30		0.46				-0.05			
8:54:35		0.44				-0.10			
8:54:40		0.45				-0.08			
8:54:45		0.30				-0.16			
8:54:50		0.18				-0.17			
8:54:55		0.17				-0.22			
8:55:00	-95.0	0.17	0.17	0.37	0.51	-0.08	-0.22	-0.07	0.21
8:55:05		0.02				-0.05			
8:55:10		-0.02				0.15			
8:55:15		-0.03				0.04			
8:55:20		0.02				0.07			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement (knots)			
Time hh:mm:ss	Elapsed Time		Per minute averages MIN	AVE	MAX		Per minute averages MIN	AVE	MAX
8:55:25		0.05				-0.05			
8:55:30		0.16				0.13			
8:55:35		0.18				0.12			
8:55:40		0.18				0.14			
8:55:45		0.25				0.28			
8:55:50		0.32				0.19			
8:55:55		0.43				0.26			
8:56:00	-94.0	0.51	-0.03	0.17	0.51	0.30	-0.05	0.13	0.30
8:56:05		0.53				0.09			
8:56:10		0.40				0.26			
8:56:15		0.43				0.23			
8:56:20		0.43				0.25			
8:56:25		0.49				0.34			
8:56:30		0.42				0.19			
8:56:35		0.38				0.32			
8:56:40		0.41				0.14			
8:56:45		0.38				0.25			
8:56:50		0.41				0.17			
8:56:55		0.38				0.17			
8:57:00	-93.0	0.54	0.38	0.43	0.54	0.17	0.09	0.21	0.34
8:57:05		0.53				0.22			
8:57:10		0.55				0.18			
8:57:15		0.60				0.21			
8:57:20		0.53				0.18			
8:57:25		0.56				0.12			
8:57:30		0.57				0.24			
8:57:35		0.45				0.13			
8:57:40		0.43				0.22			
8:57:45		0.52				0.22			
8:57:50		0.42				0.39			
8:57:55		0.38				0.28			
8:58:00	-92.0	0.36	0.36	0.49	0.60	0.25	0.12	0.22	0.39
8:58:05		0.45				0.36			
8:58:10		0.52				0.21			
8:58:15		0.68				0.36			
8:58:20		0.64				0.30			
8:58:25		0.49				0.37			
8:58:30		0.43				0.17			
8:58:35		0.45				0.31			
8:58:40		0.28				0.69			
8:58:45		-0.04				0.69			
8:58:50		-0.12				0.50			
8:58:55		-0.21				0.60			
8:59:00	-91.0	-0.31	-0.31	0.27	0.68	0.52	0.17	0.42	0.69
Background, 8:59 to 9:26 (27 minutes)									
Minimum		-0.26	-0.26	-0.08	0.08	**0.21**	0.21	0.36	0.58
Average		0.06	-0.05	0.06	0.17	**0.57**	0.43	0.57	0.71
Maximum		0.29	0.04	0.13	0.29	**0.91**	0.56	0.69	0.91
8:59:05		-0.15				0.51			
8:59:10		-0.14				0.58			
8:59:15		-0.10				0.53			
8:59:20		-0.02				0.57			
8:59:25		-0.02				0.48			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement (knots)			
			Per minute averages				Per minute averages		
Time hh:mm:ss	Elapsed Time		MIN	AVE	MAX		MIN	AVE	MAX
8:59:30		0.08				0.55			
8:59:35		0.09				0.48			
8:59:40		0.13				0.53			
8:59:45		0.07				0.57			
8:59:50		-0.06				0.65			
8:59:55		-0.01				0.58			
9:00:00	-90.0	-0.03	-0.15	-0.01	0.13	0.64	0.48	0.56	0.65
9:00:05		-0.02				0.65			
9:00:10		-0.10				0.48			
9:00:15		-0.06				0.63			
9:00:20		0.03				0.50			
9:00:25		0.16				0.47			
9:00:30		0.10				0.62			
9:00:35		0.11				0.49			
9:00:40		0.15				0.48			
9:00:45		0.25				0.46			
9:00:50		0.06				0.53			
9:00:55		0.06				0.59			
9:01:00	-89.0	0.02	-0.10	0.06	0.25	0.55	0.46	0.54	0.65
9:01:05		0.00				0.61			
9:01:10		0.00				0.60			
9:01:15		0.10				0.65			
9:01:20		0.06				0.64			
9:01:25		0.03				0.53			
9:01:30		0.04				0.44			
9:01:35		0.11				0.32			
9:01:40		0.11				0.33			
9:01:45		0.15				0.41			
9:01:50		0.08				0.33			
9:01:55		0.17				0.25			
9:02:00	-88.0	0.09	0.00	0.08	0.17	0.34	0.25	0.45	0.65
9:02:05		0.05				0.37			
9:02:10		0.11				0.27			
9:02:15		0.11				0.21			
9:02:20		0.13				0.27			
9:02:25		0.19				0.27			
9:02:30		0.15				0.32			
9:02:35		0.09				0.45			
9:02:40		-0.03				0.34			
9:02:45		-0.05				0.41			
9:02:50		-0.18				0.37			
9:02:55		-0.09				0.58			
9:03:00	-87.0	-0.08	-0.18	0.03	0.19	0.50	0.21	0.36	0.58
9:03:05		-0.03				0.55			
9:03:10		0.14				0.69			
9:03:15		0.06				0.55			
9:03:20		0.20				0.50			
9:03:25		0.17				0.56			
9:03:30		0.14				0.57			
9:03:35		0.10				0.51			
9:03:40		0.04				0.61			
9:03:45		0.03				0.60			
9:03:50		0.09				0.55			
9:03:55		0.14				0.57			
9:04:00	-86.0	0.09	-0.03	0.10	0.20	0.42	0.42	0.56	0.69
9:04:05		0.09				0.62			
9:04:10		0.10				0.59			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

Time hh:mm:ss	Elapsed Time	Y Current side movement	Y Per minute averages MIN	Y AVE	Y MAX	X Current forward movement (knots)	X Per minute averages MIN	X AVE	X MAX
9:04:15		0.05				0.57			
9:04:20		0.07				0.58			
9:04:25		0.08				0.51			
9:04:30		0.02				0.57			
9:04:35		0.05				0.57			
9:04:40		0.02				0.59			
9:04:45		-0.02				0.57			
9:04:50		0.05				0.65			
9:04:55		0.07				0.65			
9:05:00	-85.0	0.11	-0.02	0.06	0.11	0.60	0.51	0.59	0.65
9:05:05		0.05				0.68			
9:05:10		0.09				0.56			
9:05:15		0.02				0.48			
9:05:20		0.03				0.56			
9:05:25		0.03				0.55			
9:05:30		0.09				0.59			
9:05:35		0.13				0.61			
9:05:40		0.15				0.61			
9:05:45		0.17				0.58			
9:05:50		0.20				0.55			
9:05:55		0.09				0.56			
9:06:00	-84.0	0.16	0.02	0.10	0.20	0.52	0.48	0.57	0.68
9:06:05		0.07				0.69			
9:06:10		0.13				0.68			
9:06:15		0.00				0.72			
9:06:20		0.04				0.70			
9:06:25		0.03				0.72			
9:06:30		0.05				0.63			
9:06:35		0.09				0.71			
9:06:40		0.06				0.69			
9:06:45		0.09				0.67			
9:06:50		0.04				0.72			
9:06:55		0.06				0.57			
9:07:00	-83.0	-0.01	-0.01	0.05	0.13	0.51	0.51	0.67	0.72
9:07:05		0.04				0.56			
9:07:10		0.00				0.60			
9:07:15		0.07				0.59			
9:07:20		0.17				0.58			
9:07:25		0.10				0.55			
9:07:30		0.13				0.48			
9:07:35		0.22				0.43			
9:07:40		0.16				0.50			
9:07:45		0.08				0.52			
9:07:50		0.19				0.59			
9:07:55		0.14				0.56			
9:08:00	-82.0	0.04	0.00	0.11	0.22	0.54	0.43	0.54	0.60
9:08:05		-0.04				0.47			
9:08:10		-0.05				0.58			
9:08:15		-0.02				0.60			
9:08:20		-0.04				0.67			
9:08:25		-0.06				0.69			
9:08:30		-0.09				0.76			
9:08:35		0.08				0.62			
9:08:40		0.03				0.77			
9:08:45		0.00				0.59			
9:08:50		-0.01				0.50			
9:08:55		0.10				0.54			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

Time hh:mm:ss	Elapsed Time	Y Current side movement	Y Per minute averages MIN	Y AVE	Y MAX	X Current forward movement (knots)	X Per minute averages MIN	X AVE	X MAX
9:09:00	-81.0	0.09	-0.09	0.00	0.10	0.65	0.47	0.62	0.77
9:09:05		0.11				0.45			
9:09:10		0.15				0.43			
9:09:15		0.09				0.52			
9:09:20		0.06				0.47			
9:09:25		0.04				0.65			
9:09:30		0.16				0.58			
9:09:35		0.15				0.53			
9:09:40		0.22				0.51			
9:09:45		0.16				0.55			
9:09:50		0.07				0.37			
9:09:55		0.16				0.40			
9:10:00	-80.0	0.11	0.04	0.12	0.22	0.57	0.37	0.50	0.65
9:10:05		0.14				0.47			
9:10:10		0.00				0.40			
9:10:15		0.10				0.33			
9:10:20		0.16				0.47			
9:10:25		0.02				0.38			
9:10:30		0.06				0.48			
9:10:35		0.03				0.45			
9:10:40		-0.03				0.48			
9:10:45		-0.07				0.67			
9:10:50		-0.05				0.65			
9:10:55		-0.05				0.66			
9:11:00	-79.0	-0.11	-0.11	0.02	0.16	0.78	0.33	0.52	0.78
9:11:05		-0.13				0.70			
9:11:10		-0.08				0.68			
9:11:15		-0.03				0.69			
9:11:20		-0.02				0.82			
9:11:25		-0.06				0.62			
9:11:30		-0.08				0.53			
9:11:35		-0.06				0.62			
9:11:40		-0.18				0.74			
9:11:45		-0.26				0.64			
9:11:50		-0.11				0.72			
9:11:55		-0.04				0.64			
9:12:00	-78.0	0.08	-0.26	-0.08	0.08	0.67	0.53	0.67	0.82
9:12:05		0.12				0.63			
9:12:10		0.16				0.70			
9:12:15		0.03				0.61			
9:12:20		0.13				0.55			
9:12:25		0.00				0.56			
9:12:30		0.04				0.51			
9:12:35		0.09				0.57			
9:12:40		0.04				0.52			
9:12:45		-0.06				0.48			
9:12:50		0.07				0.53			
9:12:55		0.15				0.47			
9:13:00	-77.0	0.10	-0.06	0.07	0.16	0.52	0.47	0.55	0.70
9:13:05		0.04				0.51			
9:13:10		0.06				0.56			
9:13:15		0.03				0.63			
9:13:20		0.02				0.58			
9:13:25		0.03				0.43			
9:13:30		0.03				0.57			
9:13:35		0.03				0.56			
9:13:40		0.04				0.71			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement			
						(knots)			
Time	Elapsed		Per minute averages				Per minute averages		
hh:mm:ss	Time		MIN	AVE	MAX		MIN	AVE	MAX
9:13:45		0.02				0.70			
9:13:50		-0.06				0.68			
9:13:55		0.05				0.58			
9:14:00	-76.0	0.16	-0.06	0.04	0.16	0.64	0.43	0.59	0.71
9:14:05		0.03				0.66			
9:14:10		0.10				0.67			
9:14:15		0.00				0.70			
9:14:20		0.03				0.67			
9:14:25		0.02				0.61			
9:14:30		-0.04				0.59			
9:14:35		-0.05				0.65			
9:14:40		0.03				0.54			
9:14:45		0.09				0.55			
9:14:50		0.00				0.60			
9:14:55		0.02				0.53			
9:15:00	-75.0	0.05	-0.05	0.02	0.10	0.61	0.53	0.61	0.70
9:15:05		0.04				0.54			
9:15:10		0.10				0.52			
9:15:15		0.12				0.47			
9:15:20		0.29				0.51			
9:15:25		0.19				0.43			
9:15:30		0.13				0.50			
9:15:35		0.13				0.45			
9:15:40		0.06				0.44			
9:15:45		0.05				0.55			
9:15:50		0.04				0.55			
9:15:55		0.03				0.62			
9:16:00	-74.0	0.16	0.03	0.11	0.29	0.55	0.43	0.51	0.62
9:16:05		0.22				0.51			
9:16:10		0.17				0.55			
9:16:15		0.05				0.63			
9:16:20		0.14				0.49			
9:16:25		0.10				0.53			
9:16:30		0.10				0.58			
9:16:35		0.05				0.67			
9:16:40		0.06				0.56			
9:16:45		0.03				0.52			
9:16:50		-0.01				0.42			
9:16:55		0.02				0.30			
9:17:00	-73.0	0.12	-0.01	0.09	0.22	0.54	0.30	0.52	0.67
9:17:05		0.12				0.55			
9:17:10		0.15				0.55			
9:17:15		0.19				0.51			
9:17:20		0.21				0.55			
9:17:25		0.09				0.61			
9:17:30		0.06				0.57			
9:17:35		-0.03				0.45			
9:17:40		0.02				0.51			
9:17:45		0.07				0.57			
9:17:50		0.03				0.66			
9:17:55		0.14				0.65			
9:18:00	-72.0	0.10	-0.03	0.10	0.21	0.66	0.45	0.57	0.66
9:18:05		0.23				0.72			
9:18:10		0.05				0.65			
9:18:15		0.01				0.66			
9:18:20		0.06				0.68			
9:18:25		-0.02				0.64			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement (knots)			
			Per minute averages				Per minute averages		
Time hh:mm:ss	Elapsed Time		MIN	AVE	MAX		MIN	AVE	MAX
9:18:30		0.04				0.59			
9:18:35		0.05				0.51			
9:18:40		0.03				0.56			
9:18:45		0.05				0.62			
9:18:50		0.02				0.60			
9:18:55		0.11				0.64			
9:19:00	-71.0	0.02	-0.02	0.06	0.23	0.78	0.51	0.64	0.78
9:19:05		0.06				0.67			
9:19:10		0.03				0.69			
9:19:15		0.03				0.67			
9:19:20		0.06				0.60			
9:19:25		0.08				0.50			
9:19:30		0.01				0.57			
9:19:35		0.10				0.51			
9:19:40		0.06				0.53			
9:19:45		0.09				0.53			
9:19:50		0.05				0.62			
9:19:55		0.02				0.59			
9:20:00	-70.0	0.03	0.01	0.05	0.10	0.45	0.45	0.58	0.69
9:20:05		0.06				0.50			
9:20:10		0.00				0.67			
9:20:15		0.14				0.50			
9:20:20		0.09				0.52			
9:20:25		0.20				0.50			
9:20:30		0.05				0.48			
9:20:35		0.03				0.56			
9:20:40		0.02				0.53			
9:20:45		0.07				0.59			
9:20:50		0.08				0.60			
9:20:55		0.09				0.62			
9:21:00	-69.0	0.07	0.00	0.08	0.20	0.67	0.48	0.56	0.67
9:21:05		0.03				0.67			
9:21:10		0.16				0.80			
9:21:15		0.13				0.57			
9:21:20		0.17				0.58			
9:21:25		0.08				0.58			
9:21:30		0.04				0.60			
9:21:35		0.02				0.51			
9:21:40		-0.01				0.67			
9:21:45		0.08				0.55			
9:21:50		0.01				0.44			
9:21:55		0.04				0.48			
9:22:00	-68.0	0.02	-0.01	0.06	0.17	0.51	0.44	0.58	0.80
9:22:05		-0.02				0.61			
9:22:10		0.10				0.57			
9:22:15		0.05				0.48			
9:22:20		0.07				0.53			
9:22:25		0.07				0.34			
9:22:30		0.07				0.45			
9:22:35		0.15				0.55			
9:22:40		0.06				0.54			
9:22:45		0.02				0.59			
9:22:50		-0.10				0.76			
9:22:55		0.03				0.63			
9:23:00	-67.0	0.05	-0.10	0.04	0.15	0.59	0.34	0.55	0.76
9:23:05		0.03				0.69			
9:23:10		0.00				0.62			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement			
						(knots)			
Time	Elapsed		Per minute averages				Per minute averages		
hh:mm:ss	Time		MIN	AVE	MAX		MIN	AVE	MAX
9:23:15		0.03				0.65			
9:23:20		0.03				0.61			
9:23:25		0.12				0.59			
9:23:30		0.10				0.55			
9:23:35		0.07				0.49			
9:23:40		0.25				0.53			
9:23:45		0.21				0.46			
9:23:50		0.21				0.41			
9:23:55		0.24				0.54			
9:24:00	-66.0	0.24	0.00	0.13	0.25	0.51	0.41	0.55	0.69
9:24:05		0.16				0.56			
9:24:10		0.07				0.64			
9:24:15		0.13				0.64			
9:24:20		0.06				0.63			
9:24:25		0.15				0.81			
9:24:30		0.17				0.68			
9:24:35		0.21				0.62			
9:24:40		0.08				0.67			
9:24:45		0.09				0.68			
9:24:50		0.03				0.91			
9:24:55		0.01				0.78			
9:25:00	-65.0	-0.05	-0.05	0.09	0.21	0.67	0.56	0.69	0.91
9:25:05		0.10				0.83			
9:25:10		0.12				0.65			
9:25:15		0.09				0.73			
9:25:20		0.05				0.63			
9:25:25		0.08				0.48			
9:25:30		0.04				0.49			
9:25:35		0.13				0.58			
9:25:40		0.03				0.61			
9:25:45		0.05				0.59			
9:25:50		0.03				0.69			
9:25:55		0.11				0.49			
9:26:00	-64.0	0.00	0.00	0.07	0.13	0.72	0.48	0.62	0.83
CCG 218 leaving its position by the apex									
9:26:05		0.06				0.77			
9:26:10		0.02				0.84			
9:26:15		0.06				0.84			
9:26:20		0.03				0.90			
9:26:25		0.07				0.93			
9:26:30		0.10				0.74			
9:26:35		0.14				0.70			
9:26:40		0.14				0.75			
9:26:45		0.07				0.91			
9:26:50		0.06				0.79			
9:26:55		0.02				0.71			
9:27:00	-63.0	0.00	0.00	0.06	0.14	0.88	0.70	0.81	0.93
9:27:05		0.03				0.70			
9:27:10		0.05				0.64			
9:27:15		0.01				0.69			
9:27:20		0.08				0.82			
9:27:25		0.06				0.87			
9:27:30		0.06				0.84			
9:27:35		0.03				0.87			
9:27:40		0.06				0.82			

NOBE 93 Table 14.2 cont. **Current Meter Readings (mounted on CCG 218)**

		Y Current side movement				X Current forward movement			
						(knots)			
Time	Elapsed		Per minute averages				Per minute averages		
hh:mm:ss	Time		MIN	AVE	MAX		MIN	AVE	MAX
9:27:45		0.10				0.75			
9:27:50		0.05				0.81			
9:27:55		0.08				0.75			
9:28:00	-62.0	0.08	0.01	0.06	0.10	0.73	0.64	0.77	0.87
9:28:05		0.07				0.79			
9:28:10		0.06				0.73			
9:28:15		0.20				0.68			
9:28:20		0.30				0.73			
9:28:25		0.23				0.73			
9:28:30		0.06				0.72			
9:28:35		0.09				1.38			
9:28:40		0.59				1.82			
9:28:45		0.63				1.87			
9:28:50		0.19				2.09			
9:28:55		-0.21				0.86			
9:29:00	-61.0	-0.31	-0.31	0.16	0.63	0.28	0.28	1.05	2.09
9:29:05		-0.34				0.42			
9:29:10		-0.37				0.65			
9:29:15		-0.07				0.62			
9:29:20		-0.20				0.48			
9:29:25		-0.41				0.87			
9:29:30		-0.29				2.13			
9:29:35		0.17				2.66			
9:29:40		0.53				2.75			
9:29:45		0.63				2.66			
9:29:50		0.69				2.59			
9:29:55		0.66				2.31			
9:30:00	-60.0	0.59	-0.41	0.13	0.69	1.76	0.42	1.66	2.75
Pre-ignition ... 9:30 to 9:30:35 (35 secondes)									
9:30:05		0.40				1.24			
9:30:10		0.42				0.85			
9:30:15		0.41				0.56			
9:30:20		0.35				0.41			
9:30:25		0.40				0.12			
9:30:30		0.16				0.13			
9:30:35	-59.6	0.05	0.05	0.31	0.42	0.04	0.04	0.48	1.24

NOBE 93 Table 14.3 **Summary of Data Recorded by the Waveriders, August 12, 1993**

Time hh:mm (local)	Command Ship Position		Wind Speed (knots)		Wind Direction	hs (m)		
	Latitude	Longitude	Average	Gust	(°T)	W	T	VHF
7:30			6	8	170	0.74		
7:47								0.77
8:00							0.77	
8:07								0.74
8:27								0.85
8:30			8	10	160	0.7	0.81	
8:35								
8:38	47°43.8'	52°03.0'						
8:44								
8:47								0.78
9:00							0.8	
9:07								0.8
9:27								0.95
9:30			8	10	160	0.81	0.74	
9:47								0.82
10:00							0.88	
10:07								0.73
10:27								0.96
10:30			8	10	160	0.79	0.86	
10:35								
10:37								
10:46								0.89
11:00								
11:04								
11:06								0.88
11:08	47°41.6'	52°04.6'						
11:23								
11:26								0.9
11:30			8	8	150	0.84	0.85	
11:46								0.89
11:49								
12:00							0.91	
12:06								0.91
12:26								0.84
12:30			8	8	140	0.84	0.82	
12:46								0.96
13:00								
13:06								0.8
13:26								0.78
13:30			8	10	150	0.84	0.85	
13:46								0.83
13:58								
14:00	47 40.4	52 05.9				0.83		
14:06								0.85
14:23								
14:25	47 40.3	52 05.9						
14:26								0.97
14:30			8	10	160	0.84	0.89	
14:46								0.73
14:53								
14:55	47 40.3	52 05.9						
15:00			9	11				
15:06								0.84
15:19	47 40.4	52 06.0						
15:26								0.85
15:30			10	10	170	0.84	0.84	
15:45	47 40.9	52 06.1						
15:46								0.77
16:00							0.89	
16:06								0.82
16:15	47 41.2	52 05.9						
16:26								0.64
16:30			8	10	160	0.79		
16:45	47 41.5	52 05.5						
16:46								0.78
17:00								
17:06								0.83
17:26								0.9
17:30			12	12	170			
17:46								0.81
17:50								
18:06								0.89
18:26								0.94

W = Seaconsult Waverider
T = TSK Remote Wave Height Meter on the Ann Harvey
B = AES Weather buoy
O = onboard

hs = the significant wave height
h10 = the average height of the 1/10 largest waves in an hourly sample
hmax = height of the largest single wave in an hourly sample
Tavg = average wave period of an hourly sample
Tp = period corresponding to the peak in the wave energy spectrum

NOBE 93 Table 14.3 cont. **Summary of Data Recorded by the Waveriders, August 12, 1993**

Time hh:mm (local)	H10 (m) W	H10 (m) T	hmax (m) W	hmax (m) T	Tavg (sec) W	Tavg (sec) T	Tp (sec) W	Tp (sec) VHF	Tmax (sec) W
7:30	0.84		1.11		5.17		8.3		14.4
7:47								12.5	
8:00		0.93		1.28		4.8			
8:07								7.69	
8:27								6.25	
8:30	0.77	0.96	0.97	1.15	5.1	4.8	13.3		11.8
8:35									
8:38									
8:44									
8:47								9.09	
9:00		0.97		1.13		4.7			
9:07								7.69	
9:27								9.09	
9:30	0.94	0.88	1.71	1.15	5.1	4.5	8.3		13.2
9:47								9.09	
10:00		1.06		1.35		4.8			
10:07								9.09	
10:27								8.33	
10:30	0.91	1.05	1.11	1.45	5.4	4.9	8		11
10:35									
10:37									
10:46								8.33	
11:00									
11:04									
11:06								8.33	
11:08									
11:23									
11:26								7.69	
11:30	1.02	1	1.36	1.23	5.7	4.6	8		10.9
11:46								8.33	
11:49									
12:00		1.1		1.39		5			
12:06								7.69	
12:26								8.33	
12:30	0.99	1	1.49	1.27	5.3	4.9	8.3		11.5
12:46								7.69	
13:00									
13:06								9.09	
13:26								7.69	
13:30	0.99	1.02	1.23	1.17	5.2	5.1	8		11.1
13:46								14.29	
13:58									
14:00		0.99		1.25		5.1			
14:06								7.69	
14:23									
14:25									
14:26								8.33	
14:30	0.99	1.1	1.36	1.4	4.7	5.2	8		10.5
14:46								7.69	
14:53									
14:55									
15:00									
15:06								14.29	
15:19									
15:26								7.69	
15:30	0.97	0.98	1.46	1.27	5	5	7.4		13.2
15:45									
15:46								7.69	
16:00		1.05		1.21		5.2			
16:06								7.14	
16:15									
16:26								7.69	
16:30	0.94		1.23		4.9		8		11.2
16:45									
16:46								7.69	
17:00									
17:06								14.29	
17:26								7.69	
17:30									
17:46								8.33	
17:50									
18:06								7.14	
18:26								8.33	

W = Seaconsult Waverider
T = TSK Remote Wave Height Meter on the Ann Harvey
B = AES Weather buoy
O = onboard

hs = the significant wave height
h10 = the average height of the 1/10 largest waves in an hourly sample
hmax = height of the largest single wave in an hourly sample
Tavg = average wave period of an hourly sample
Tp = period corresponding to the peak in the wave energy spectrum

NOBE 93 Table 14.4

Wave Data Collected by the TSK Remote Wave Height Meter
(mounted on the CCGS Ann Harvey)

		Wave Height (meters)					Periods (seconds)			
Date	Time	Average	Maximum	$H_{1/10}$	Sig		Average	Maximum	$H_{1/10}$	Sig.
Aug 12 94	7.41	0.51	1.25	0.91	0.75		4.41	6.51	6.31	5.77
Aug 12 94	8:00	0.53	1.45	0.93	0.77		4.80	7.50	6.40	6.38
Aug 12 94	8:20	0.56	1.15	0.96	0.81		4.76	4.50	6.10	5.89
Aug 12 94	8:43	0.53	1.13	0.97	0.80		4.68	5.00	6.12	6.03
Aug 12 94	9:05	0.50	1.15	0.88	0.74		4.49	6.50	6.17	5.81
Aug 12 94	9:25	0.54	1.22	0.96	0.80		4.63	6.00	6.00	6.12
Aug 12 94	9:45	0.60	1.35	1.06	0.88		4.78	6.00	6.71	6.13
Aug 12 94	10:07	0.58	1.45	1.05	0.86		4.88	6.00	6.52	6.08
Aug 12 94	10:30	0.53	1.17	0.93	0.79		4.60	6.50	6.02	6.08
Aug 12 94	10:50	0.59	1.23	1.00	0.85		4.63	7.00	6.02	5.90
Aug 12 94	11:20	0.56	1.38	1.01	0.84		4.71	5.50	6.60	5.88
Aug 12 94	11:40	0.61	1.39	1.10	0.91		4.95	5.50	6.71	6.13
Aug 12 94	12:00	0.59	1.35	1.08	0.88		5.10	5.00	7.07	6.67
Aug 12 94	12:20	0.54	1.27	1.00	0.82		4.86	7.00	6.24	6.02
Aug 12 94	12:40	0.56	1.21	0.96	0.80		4.89	6.00	6.83	6.18
Aug 12 94	13:00	0.58	1.30	1.04	0.87		5.10	6.00	6.38	6.56
Aug 12 94	13:20	0.58	1.17	1.02	0.85		5.07	7.00	6.46	6.13
Aug 12 94	13:40	0.55	1.25	0.99	0.83		5.12	5.50	6.50	6.24
Aug 12 94	14:00	0.58	1.47	1.05	0.88		4.93	6.50	6.26	6.04
Aug 12 94	14:20	0.61	1.40	1.06	0.89		5.16	6.50	6.31	6.33
Aug 12 94	14:40	0.62	1.30	1.08	0.90		5.26	6.00	6.48	6.30
Aug 12 94	15:00	0.58	1.22	1.00	0.85		5.01	6.50	5.95	6.08
Aug 12 94	15:20	0.59	1.27	0.98	0.84		5.05	6.50	6.21	6.13
Aug 12 94	15:40	0.60	1.21	1.05	0.89		5.16	7.50	6.48	6.53

$H_{1/10}$ Average height of the 1/10 largest waves in an hourly sample.

NOBE 93 Table 14.5 **Wave Data Collected by the VHF Conventional Buoy and the ARGOS Buoy**

Records from each buoy can be easily discriminated as only significant wave height (H_s) and peak period (T_p) are computed for the conventional buoy

Date UTC	Time	H_s	H_a	H_3	H_{10}	H_{max}	MCS	T_p	T_z	T_a	T_3	T_{max}
12-Aug-94	0:00	0.70	0.43	0.65	0.79	1.17	1.46	13.31	4.76	4.27	5.98	12.04
12-Aug-94	1:00	0.74	0.45	0.70	0.86	1.20	1.29	14.25	4.66	4.36	5.98	12.61
12-Aug-94	2:00	0.77	0.47	0.70	0.89	1.05	1.26	14.25	4.86	4.56	6.08	12.50
12-Aug-94	3:00	0.77	0.45	0.72	0.89	1.20	1.71	6.08	4.96	4.56	6.29	11.58
12-Aug-94	4:00	0.74	0.45	0.67	0.86	1.23	1.32	13.31	4.86	4.56	6.18	12.38
12-Aug-94	5:00	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.69
	5:38	0.00						33.33				
12-Aug-94	6:00	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.31
	6:38	0.31						33.33				
	6:58	0.49						16.67				
12-Aug-94	7:00	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.81
	7:18	0.71						7.69				
	7:38	0.60						9.09				
	7:58	0.82						5.56				
12-Aug-94	8:00	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.08
	8:18	0.67						16.67				
	8:38	0.68						7.69				
12-Aug-94	9:00	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.45
	9:37	0.65						6.25				
	9:57	0.79						14.29				
12-Aug-94	10:00	0.74	0.45	0.67	0.84	1.11	1.46	8.28	5.17	5.17	7.01	14.37
	10:17	0.77						12.50				
	10:37	0.74						7.69				
	10:57	0.85						6.25				
12-Aug-94	11:00	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.81
	11:17	0.78						9.09				
	11:37	0.80						7.69				
	11:57	0.95						9.09				
12-Aug-94	12:00	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.19
	12:17	0.82						9.09				
	12:37	0.73						9.09				
	12:57	0.96						8.33				
12-Aug-94	13:00	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.02
	13:16	0.89						8.33				
	13:36	0.88						8.33				
	13:56	0.90						7.69				
12-Aug-94	14:00	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.91
	14:16	0.89						8.33				
	14:36	0.91						7.69				
	14:56	0.84						8.33				
12-Aug-94	15:00	0.84	0.51	0.79	0.99	1.49	1.71	8.28	5.67	5.27	7.12	11.47
	15:16	0.96						7.69				
	15:36	0.80						9.09				
	15:56	0.78						7.69				
12-Aug-94	16:00	0.84	0.49	0.79	0.99	1.23	1.67	7.96	5.67	5.17	7.12	11.13
	16:16	0.83						14.29				
	16:36	0.85						7.69				
	16:56	0.97						8.33				
12-Aug-94	17:00	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.46
	17:16	0.73						7.69				
	17:36	0.84						14.29				
	17:56	0.85						7.69				
12-Aug-94	18:00	0.84	0.49	0.77	0.97	1.46	1.46	7.43	5.37	4.96	7.12	13.19
	18:16	0.77						7.69				
	18:36	0.82						7.14				
	18:56	0.64						7.69				
12-Aug-94	19:00	0.79	0.51	0.77	0.94	1.23	1.42	7.96	5.06	4.86	6.80	11.24
	19:16	0.78						7.69				
	19:36	0.83						14.29				
	19:56	0.90						7.69				

NOBE 93 Table 14.5 cont. Wave Data Collected by the VHF Conventional Buoy and the ARGOS Buoy

Records from each buoy can be easily discriminated as only significant wave height (H_s) and peak period (T_p) are computed for the conventional buoy

Date UTC	Time	H_s	H_a	H_3	H_{10}	H_{max}	MCS	T_p	T_z	T_a	T_3	T_{max}
12-Aug-94	20:00	0.86	0.53	0.81	1.02	1.32	1.46	8.28	5.17	5.06	7.12	12.61
	20:16	0.81						8.33				
	20:36	0.89						7.14				
	20:56	0.94						8.33				
12-Aug-94	21:00	0.81	0.47	0.74	0.94	1.67	1.75	7.64	5.17	4.66	6.60	13.90
	21:16	1.01						8.33				
	21:36	0.94						8.33				
	21:56	0.94						8.33				
12-Aug-94	22:00	0.89	0.53	0.81	0.99	1.39	1.56	7.96	4.86	4.76	6.49	13.54
	22:16	0.89						7.69				
	22:36	0.89						7.69				
	22:56	0.83						7.14				
12-Aug-94	23:00	0.94	0.55	0.86	1.11	1.39	2.00	8.28	4.96	4.76	6.60	15.45
	23:16	1.10						7.69				
	23:36	0.91						12.50				

Frequency Domain (Spectral Analysis)

S (f) Wave energy spectrum consisting of energy determined for 24 bands covering a frequency range having equivalent wave periods of 2.5 s to 28.6 s

H_{mo} Significant Wave Height. Spectral approximation of H_s. Statistical computation of H_s is described below. H_{mo} is proportional to the area under the curve in the spectral plot.

T_p Peak Period. This is the period associated with the peak energy in the computed spectrum.

T_z Mean Wave Period. Also referred to as $T_{mo,2}$. Spectral approximation of the mean wave period, T_a (see below).

Time Domain (Upcrossing Analysis)

H_3 Significant Wave Height. Average height of the 1/3 largest waves in a sample (also referred to as H_s or $H_{1/3}$)

T_3 Significant Wave Period. Average period of the 1/3 largest waves in a sample.

H_{max} Maximum Wave Height. Height of the largest single wave in a sample.

T_{max} Maximum Wave Period. This does not necessarily correspond to the H_{max} wave.

MCS Maximum Combines Sea. The separation between the highest peak and the lowest trough in a sample. This is not necessarily a measure of the highest single wave.

H_{10} Average height of the 1/10 largest waves.

H_a Average Wave Height of a sample.

T_a Average Wave Period of a sample.

NOBE 93 Table 14.6 **Wave Data Collected Aug 12 by the ARGOS Waverider (via satellite)**

Time from	Time to	H_s	H_a	H_3	H_{10}	H_{max}	MCS	T_p	T_z	T_a	T_3	T_{max}
23:40	0:00	0.70	0.43	0.65	0.79	1.17	1.46	13.31	4.76	4.27	5.98	12.04
0:40	1:00	0.74	0.45	0.70	0.86	1.20	1.29	14.25	4.66	4.36	5.98	12.61
1:40	2:00	0.77	0.47	0.70	0.89	1.05	1.26	14.25	4.86	4.56	6.08	12.50
2:40	3:00	0.77	0.45	0.72	0.89	1.20	1.71	6.08	4.96	4.56	6.29	11.58
3:40	4:00	0.74	0.45	0.67	0.86	1.23	1.32	13.31	4.86	4.56	6.18	12.38
4:40	5:00	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.69
5:40	6:00	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.31
6:40	7:00	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.81
7:40	8:00	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.08
8:40	9:00	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.45
9:40	10:00	0.74	0.45	0.67	0.84	1.11	1.46	8.28	5.17	5.17	7.01	14.37
10:40	11:00	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.81
11:40	12:00	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.19
12:40	13:00	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.02
13:40	14:00	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.91
14:40	15:00	0.84	0.51	0.79	0.99	1.49	1.71	8.28	5.67	5.27	7.12	11.47
15:40	16:00	0.84	0.49	0.79	0.99	1.23	1.67	7.96	5.67	5.17	7.12	11.13
16:40	17:00	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.46
17:40	18:00	0.84	0.49	0.77	0.97	1.46	1.46	7.43	5.37	4.96	7.12	13.19
18:40	19:00	0.79	0.51	0.77	0.94	1.23	1.42	7.96	5.06	4.86	6.80	11.24
19:40	20:00	0.86	0.53	0.81	1.02	1.32	1.46	8.28	5.17	5.06	7.12	12.61
20:40	21:00	0.81	0.47	0.74	0.94	1.67	1.75	7.64	5.17	4.66	6.60	13.90
21:40	22:00	0.89	0.53	0.81	0.99	1.39	1.56	7.96	4.86	4.76	6.49	13.54
22:40	23:00	0.94	0.55	0.86	1.11	1.39	2.00	8.28	4.96	4.76	6.60	15.45

Frequency Domain (Spectral Analysis)

S(f) Wave energy spectrum consisting of energy determined for 24 bands covering a frequency range having equivalent wave periods of 2.5 s to 28.6 s.

H_{mo} Significant Wave Height. Spectral approximation of H_s. Statistical computation of H_s is described below. H_{mo} is proportional to the area under the curve in the spectral plot.

T_p Peak Period. This is the period associated with the peak energy in the computed spectrum.

T_z Mean Wave Period. Also referred to as $T_{mo,2}$. Spectral approximation of the mean wave period, T_a (see below).

Time Domain (Upcrossing Analysis)

H_3 Significant Wave Height. Average height of the 1/3 largest waves in a sample (also referred to as H_s or $H_{1/3}$).

T_3 Significant Wave Period. Average period of the 1/3 largest waves in a sample.

H_{max} Maximum Wave Height. Height of the largest single wave in a sample.

T_{max} Maximum Wave Period. This does not necessarily correspond to the H_{max} wave.

MCS Maximum Combined Sea. The separation between the highest peak and the lowest trough in a sample. This is not necessarily a measure of the highest single wave.

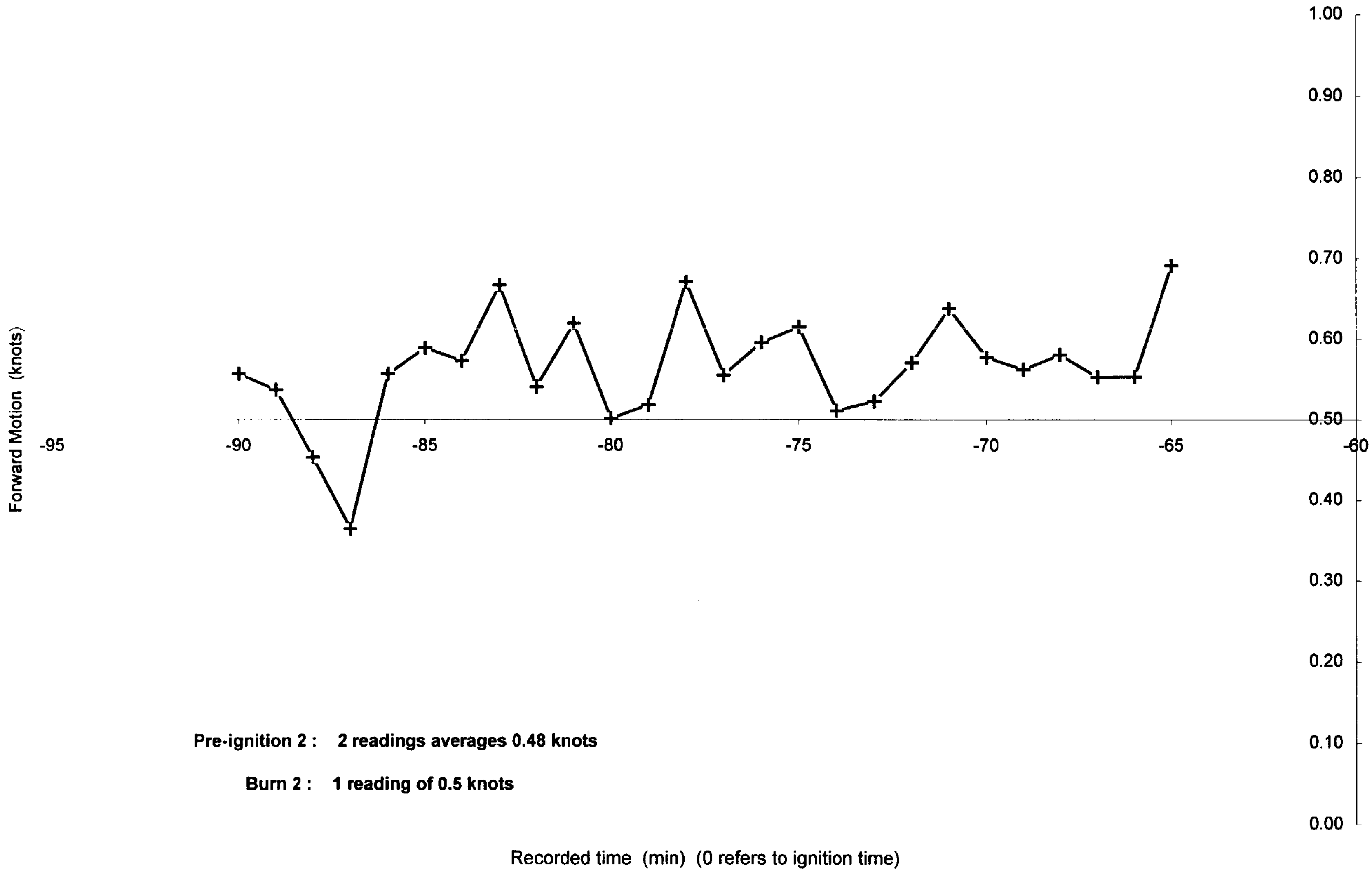
H_{10} Average height of the 1/10 largest waves.

H_a Average Wave Height of a sample.

T_a Average Wave Period of a sample.

NOBE 93 Figure 14.1

Forward Motion during Background 1
(current meter on CCG 218 at apex of fireboom)



Section 15

Weather Information
NOBE 93

Weather Information
NOBE 93

AES Weather Buoy

Weather data were provided by an AES weather buoy (6m Nomad) which measured and transmitted on the hour:

- wind speed and direction (average over the previous ten minutes);
- air and sea temperature (instantaneous reading);
- wave height over a 37-minute record (responds principally to swell and longer period waves <5.5 sec); and
- pressure (averaged over a 10-minute period).

This buoy was the primary source of surface weather information both prior to and during the test.

Deployed at NDT 1350 on August 02, 1993.
GPS position = 47°45.014'N, 52°04.888'W, at a water depth of 190 m (northwest corner of the experiment permit area).
Recovered by the CCGS Ann Harvey on August 18, 1993.

CCG 206, Downwind Station

Air temperature and relative humidity were recorded onboard the CCG 206 by the Metrosonics.

- Downwind Station, CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

Luminance

Luminance was recorded during both burns using a hand-held meter facing vertically up.

NOTE: Detailed information on weather data is provided in Appendix B.

NOBE 93 Table 15.1

Summary of the Weather Data

Local Time	CCG Ann Harvey Command Ship Latitude	CCG Ann Harvey Command Ship Longitude	Air (°C) Buoy (B)	Air (°C) Onboard (O)	Sea Temperature (°C)	Wind Speed Avg (knots)	Wind Speed Gust (knots)	Wind Direction (°T)	Downwind Air Temperature (°C)	Downwind Relative Humidity %	Pressure (hPa)	Luminance (lux)
7:30			10		11	6	8	170			276	
7:47												
8:00												
8:07												
8:27												
8:30			10		11	8	10	160	12.3	77	272	
8:35												570-635, bright sun with cloudy patches
8:38	47°43.8'	52°03.0'										
8:44												270-330, cloud
8:47												
9:00				11.5					11.6	79.2		
9:07												
9:27												
9:30			10		11	8	10	160	12.2	77.7	269	
9:47												
10:00									13.4	75.4		
10:07												
10:27												
10:30			10	11.5		8	10	160	13.3	75.3	268	
10:35												1061-1125, bright sun & cloudy patches
10:37												650-750, thin cloud obscuring sun
10:46												
11:00									11.1	87.7		
11:04												850-940, bright sun diffused by low cloud layer
11:06												1000-1070, clear sky
11:08	47°41.6'	52°04.6'										
11:23												1099-1105, clear sky
11:26												
11:30			11		11	8	8	150	11.7	87.4	261	
11:46												
11:49												11:53, clear sky
12:00												
12:06												
12:26												
12:30			11		11	8	8	140			256	
12:46												
13:00												
13:06												
13:26												
13:30			11		11	8	10	150	15.2	69.6	248	

NOBE 93 Table 15.1 cont.

Summary of the Weather Data

Local Time	CCG Ann Harvey Command Ship Latitude	CCG Ann Harvey Command Ship Longitude	Air (°C) Buoy (B)	Air (°C) Onboard (O)	Sea Temperature (°C)	Wind Speed Avg (knots)	Wind Speed Gust (knots)	Wind Direction (°T)	Downwind Air Temperature (°C)	Downwind Relative Humidity %	Pressure (hPa)	Luminance (lux)
13:58												1140-1160, bright sun with high thin cloud
14:00	47 40.4	52 05.9							13.8	75.4		
14:06												
14:23												1110, bright sun with high thin cloud
14:25	47 40.3	52 05.9										
14:26												
14:30			11		11	8	10	160	12.3	83.2	243	
14:46												
14:53												1105, bright sun (high cloud)
14:55	47 40.3	52 05.9										
15:00						9	11		13.2	78.5		
15:06												
15:19	47 40.4	52 06.0										1035, bright sun (high cloud)
15:26												
15:30			11		11	10	10	170	15.1		240	
15:45	47 40.9	52 06.1										
15:46												
16:00												
16:06												
16:15	47 41.2	52 05.9										
16:26												
16:30			12		11	8	10	160			237	
16:45	47 41.5	52 05.5										
16:46												
17:00												
17:06												
17:26												
17:30						12	12	170				
17:46												
17:50			13									
18:06												
18:26												

W = Seaconsult Waverider
T = TSK Remote Wave Height Meter on the Ann Harvey
B = AES Weather buoy
O = onboard
Downwind: CCG 206 - 900 m downwind from the fireboom apex for Burn 1, and 500 to 600 m downwind from the fireboom apex for Burn 2.

NOBE 93 Table 15.2

Air Temperature Recorded at Downwind Station

Metrosonics aq-501 (Summary)

		Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1		900 m downwind from the fireboom apex		
Background	Minimum	11.4	11.4	11.4
	Average	12.1	12.1	12.1
	Maximum	13.0	13.5	13.2
Pre-ignition	Minimum	12.2	12.1	12.2
	Average	13.0	13.1	13.0
	Maximum	13.8	14.1	14.0
Burn	Minimum	10.8	10.8	10.9
	Average	11.5	11.7	11.6
	Maximum	12.9	13.6	13.3
Burn 2		500 to 600 m from the fireboom apex		
Background	Minimum	13.6	14.2	14.0
	Average	13.9	14.8	14.4
	Maximum	14.7	15.2	15.2
Pre-ignition	Minimum	13.4	14.1	13.8
	Average	13.5	14.4	14.0
	Maximum	13.7	15.1	14.4
Burn	Minimum	11.8	12.2	12.0
	Average	12.5	13.0	12.7
	Maximum	13.4	14.8	14.1
Post-burn	Minimum	12.8	14.2	13.5
	Average	13.4	14.8	14.2
	Maximum	13.9	15.4	15.1

NOBE 93 Table 15.3 **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			900 m from fireboom apex		
Background 1	8:24	-126		11.5	11.5
	8:25	-125	11.7	11.8	11.8
	8:26	-124	11.9	12.3	12.1
	8:27	-123	12.1	12.7	12.4
	8:28	-122	12.1	12.9	12.5
	8:29	-121	12.1	12.9	12.5
	8:30	-120	11.9	12.7	12.3
	8:31	-119	11.9	12.7	12.3
	8:32	-118	12.0	12.8	12.4
	8:33	-117	12.2	12.7	12.5
	8:34	-116	12.0	12.2	12.1
	8:35	-115	11.7	11.7	11.7
	8:36	-114	11.4	11.4	11.4
	8:37	-113	11.4	11.6	11.5
	8:38	-112	11.6	11.8	11.7
	8:39	-111	11.8	11.9	11.9
	8:40	-110	11.9	12.1	12.0
	8:41	-109	11.8	12.2	12.0
	8:42	-108	11.8	12.0	11.9
	8:43	-107	11.8	11.7	11.8
	8:44	-106	12.0	11.6	11.8
	8:45	-105	12.1	11.8	12.0
	8:46	-104	12.1	12.1	12.1
	8:47	-103	12.1	12.1	12.1
	8:48	-102	12.0	11.8	11.9
	8:49	-101	11.8	11.6	11.7
	8:50	-100	11.7	11.5	11.6
	8:51	-99	11.7	11.7	11.7
	8:52	-98	11.7	11.6	11.7
	8:53	-97	11.7	11.4	11.6
	8:54	-96	11.8	11.5	11.7
	8:55	-95	12.0	11.8	11.9
	8:56	-94	12.0	12.0	12.0
	8:57	-93	11.9	11.8	11.9
	8:58	-92	11.8	11.5	11.7
	8:59	-91	11.7	11.4	11.6
	9:00	-90	11.7	11.4	11.6
	9:01	-89	11.8	11.7	11.8
	9:02	-88	11.9	11.9	11.9
	9:03	-87	12.1	12.1	12.1
	9:04	-86	11.9	12.2	12.1
	9:05	-85	11.8	12.3	12.1
	9:06	-84	11.9	12.2	12.1
	9:07	-83	12.1	12.1	12.1
	9:08	-82	12.3	12.1	12.2
	9:09	-81	12.4	12.1	12.3
	9:10	-80	12.4	12.2	12.3
	9:11	-79	12.4	12.3	12.4
	9:12	-78	12.3	12.1	12.2
	9:13	-77	12.3	12.2	12.3
	9:14	-76	12.4	12.4	12.4
	9:15	-75	12.7	12.6	12.7
	9:16	-74	12.9	13.0	13.0
	9:17	-73	13.0	13.4	13.2
	9:18	-72	12.9	13.5	13.2
	9:19	-71	12.9	13.3	13.1
	9:20	-70	12.8	12.9	12.9
	9:21	-69	12.6	12.7	12.7
	9:22	-68	12.7	12.4	12.6
	9:23	-67	12.6	12.2	12.4
	9:24	-66	12.4	12.1	12.3

NOBE 93 Table 15.3 cont. **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m from fireboom apex**		
	9:25	-65	12.5	12.1	12.3
	9:26	-64	12.6	12.0	12.3
	9:27	-63	12.4	12.0	12.2
	9:28	-62	12.4	12.1	12.3
	9:29	-61	12.3	12.1	12.2
Pre-ignition 1	9:30	-60	12.2	12.2	12.2
	9:31	-59	12.3	12.2	12.3
	9:32	-58	12.3	12.3	12.3
	9:33	-57	12.4	12.4	12.4
	9:34	-56	12.4	12.3	12.4
	9:35	-55	12.4	12.2	12.3
	9:36	-54	12.3	12.1	12.2
	9:37	-53	12.3	12.1	12.2
	9:38	-52	12.3	12.2	12.3
	9:39	-51	12.3	12.3	12.3
	9:40	-50	12.3	12.3	12.3
	9:41	-49	12.3	12.2	12.3
	9:42	-48	12.6	12.3	12.5
	9:43	-47	12.8	12.5	12.7
	9:44	-46	12.9	12.5	12.7
	9:45	-45	12.9	12.5	12.7
	9:46	-44	12.9	12.4	12.7
	9:47	-43	13.1	12.5	12.8
	9:48	-42	13.1	12.6	12.9
	9:49	-41	12.9	12.5	12.7
	9:50	-40	12.7	12.6	12.7
	9:51	-39	12.6	12.6	12.6
	9:52	-38	12.4	12.6	12.5
	9:53	-37	12.4	12.7	12.6
	9:54	-36	12.4	12.8	12.6
	9:55	-35	12.5	12.8	12.7
	9:56	-34	12.8	12.8	12.8
	9:57	-33	12.8	13.1	13.0
	9:58	-32	12.9	13.3	13.1
	9:59	-31	13.2	13.2	13.2
	10:00	-30	13.4	13.3	13.4
	10:01	-29	13.3	13.2	13.3
	10:02	-28	13.2	13.2	13.2
	10:03	-27	13.2	13.2	13.2
	10:04	-26	13.3	13.2	13.3
	10:05	-25	13.4	13.3	13.4
	10:06	-24	13.3	13.4	13.4
	10:07	-23	13.2	13.3	13.3
	10:08	-22	13.1	13.3	13.2
	10:09	-21	13.1	13.4	13.3
	10:10	-20	13.1	13.5	13.3
	10:11	-19	13.1	13.5	13.3
	10:12	-18	13.3	13.4	13.4
	10:13	-17	13.4	13.6	13.5
	10:14	-16	13.4	13.7	13.6
	10:15	-15	13.5	13.8	13.7
	10:16	-14	13.7	13.9	13.8
	10:17	-13	13.7	14.0	13.9
	10:18	-12	13.5	14.0	13.8
	10:19	-11	13.6	14.1	13.9
	10:20	-10	13.5	14.1	13.8
	10:21	-9	13.3	13.9	13.6
	10:22	-8	13.6	14.0	13.8
	10:23	-7	13.7	14.1	13.9
	10:24	-6	13.8	14.1	14.0

NOBE 93 Table 15.3 cont. **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m from fireboom apex**		
	10:25	-5	13.7	14.0	13.9
	10:26	-4	13.5	13.8	13.7
	10:27	-3	13.4	13.8	13.6
	10:28	-2	13.3	13.8	13.6
	10:29	-1	13.1	13.7	13.4
Burn 1	10:30	0	12.9	13.6	13.3
	10:31	1	12.9	13.4	13.2
	10:32	2	12.9	13.5	13.2
	10:33	3	12.9	13.4	13.2
	10:34	4	12.8	13.5	13.2
	10:35	5	12.5	13.3	12.9
	10:36	6	12.1	12.8	12.5
	10:37	7	12.0	12.5	12.3
	10:38	8	12.1	12.5	12.3
	10:39	9	11.9	12.4	12.2
	10:40	10	11.7	12.2	12.0
	10:41	11	11.5	11.9	11.7
	10:42	12	11.3	11.6	11.5
	10:43	13	11.2	11.4	11.3
	10:44	14	11.2	11.3	11.3
	10:45	15	11.2	11.3	11.3
	10:46	16	11.3	11.4	11.4
	10:47	17	11.2	11.4	11.3
	10:48	18	11.2	11.3	11.3
	10:49	19	11.1	11.2	11.2
	10:50	20	11.0	11.1	11.1
	10:51	21	10.9	11.0	11.0
	10:52	22	10.9	10.9	10.9
	10:53	23	11.0	11.0	11.0
	10:54	24	10.9	11.0	11.0
	10:55	25	11.0	10.9	11.0
	10:56	26	11.1	10.9	11.0
	10:57	27	11.1	10.9	11.0
	10:58	28	11.1	11.0	11.1
	10:59	29	11.1	11.0	11.1
	11:00	30	11.1	11.1	11.1
	11:01	31	11.1	11.1	11.1
	11:02	32	11.0	11.0	11.0
	11:03	33	11.1	11.0	11.1
	11:04	34	11.1	11.0	11.1
	11:05	35	11.0	10.9	11.0
	11:06	36	10.9	10.8	10.9
	11:07	37	10.9	10.8	10.9
	11:08	38	10.9	10.8	10.9
	11:09	39	11.0	10.9	11.0
	11:10	40	11.1	11.1	11.1
	11:11	41	11.1	11.2	11.2
	11:12	42	11.1	11.2	11.2
	11:13	43	11.0	11.2	11.1
	11:14	44	11.0	11.2	11.1
	11:15	45	11.0	11.2	11.1
	11:16	46	10.9	11.1	11.0
	11:17	47	10.8	10.9	10.9
	11:18	48	10.9	10.9	10.9
	11:19	49	10.9	11.0	11.0
	11:20	50	11.1	11.2	11.2
	11:21	51	11.1	11.3	11.2
	11:22	52	11.1	11.3	11.2
	11:23	53	11.1	11.3	11.2
	11:24	54	10.9	11.2	11.1

NOBE 93 Table 15.3 cont. **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m from fireboom apex**		
	11:25	55	10.9	11.1	11.0
	11:26	56	10.9	11.0	11.0
	11:27	57	11.1	11.1	11.1
	11:28	58	11.3	11.2	11.3
	11:29	59	11.6	11.5	11.6
	11:30	60	11.7	11.7	11.7
	11:31	61	11.9	11.8	11.9
	11:32	62	11.9	12.0	12.0
	11:33	63	11.8	12.1	12.0
	11:34	64	11.7	11.8	11.8
	11:35	65	11.8	11.8	11.8
	11:36	66	12.1	12.0	12.1
	11:37	67	12.3	12.3	12.3
	11:38	68	12.4	12.3	12.4
	11:39	69	12.5	12.3	12.4
	11:40	70	12.6	12.3	12.5
	11:41	71	12.4	12.4	12.4
	11:42	72	12.0	12.3	12.2
	11:43	73	11.8	12.1	12.0
	11:44	74	11.9	12.1	12.0
	11:45	75	11.9	12.2	12.1
	11:46	76	12.0	12.3	12.2
	11:47	77	12.2	12.6	12.4
	11:48	78	12.4	12.9	12.7
	11:49	79	12.6	13.2	12.9
	11:50	80		13.3	13.3
Burn 2			**500 to 600 m from fireboom apex**		
Background 2	13:31	-35		15.2	15.2
	13:32	-34		15.2	15.2
	13:33	-33		14.9	14.9
	13:34	-32		14.7	14.7
	13:35	-31		14.3	14.3
	13:36	-30	13.8	14.2	14.0
	13:37	-29	14.2	14.2	14.2
	13:38	-28	14.5	14.4	14.5
	13:39	-27	14.7	14.6	14.7
	13:40	-26	14.4	14.8	14.6
	13:41	-25	14.1	14.8	14.5
	13:42	-24	13.8	14.8	14.3
	13:43	-23	13.9	14.9	14.4
	13:44	-22	13.8	15.0	14.4
	13:45	-21	13.7	15.0	14.4
	13:46	-20	13.7	15.1	14.4
	13:47	-19	13.6	14.9	14.3
	13:48	-18	13.6	14.6	14.1
	13:49	-17	13.6	14.5	14.1
	13:50	-16	13.6	14.7	14.2
	13:51	-15	13.6	15.0	14.3
Pre-ignition 2	13:52	-14	13.6	15.1	14.4
	13:53	-13	13.6	14.8	14.2
	13:54	-12	13.7	14.6	14.2
	13:55	-11	13.6	14.7	14.2
	13:56	-10	13.6	14.7	14.2
	13:57	-9	13.6	14.3	14.0
	13:58	-8	13.4	14.2	13.8
	13:59	-7	13.4	14.1	13.8
	14:00	-6	13.4	14.1	13.8
	14:01	-5	13.4	14.2	13.8
	14:02	-4	13.5	14.3	13.9

NOBE 93 Table 15.3 cont. **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m from fireboom apex**		
	14:03	-3	13.5	14.3	13.9
	14:04	-2	13.5	14.3	13.9
	14:05	-1	13.5	14.5	14.0
Burn 2	14:06	0	13.4	14.8	14.1
	14:07	1	13.2	14.7	14.0
	14:08	2	13.2	14.3	13.8
	14:09	3	13.3	14.3	13.8
	14:10	4	13.2	14.2	13.7
	14:11	5	13.0	13.9	13.5
	14:12	6	12.8	13.6	13.2
	14:13	7	12.7	13.3	13.0
	14:14	8	12.6	13.1	12.9
	14:15	9	12.5	12.9	12.7
	14:16	10	12.4	12.8	12.6
	14:17	11	12.3	12.6	12.5
	14:18	12	12.2	12.4	12.3
	14:19	13	12.2	12.4	12.3
	14:20	14	12.1	12.4	12.3
	14:21	15	12.1	12.5	12.3
	14:22	16	12.1	12.6	12.4
	14:23	17	12.0	12.4	12.2
	14:24	18	11.9	12.2	12.1
	14:25	19	11.9	12.2	12.1
	14:26	20	11.9	12.2	12.1
	14:27	21	11.9	12.3	12.1
	14:28	22	11.8	12.2	12.0
	14:29	23	11.9	12.2	12.1
	14:30	24	12.1	12.4	12.3
	14:31	25	12.2	12.6	12.4
	14:32	26	12.2	12.6	12.4
	14:33	27	12.3	12.6	12.5
	14:34	28	12.4	12.6	12.5
	14:35	29	12.6	12.8	12.7
	14:36	30	12.7	12.9	12.8
	14:37	31	12.9	13.2	13.1
	14:38	32	12.9	13.4	13.2
	14:39	33	12.8	13.4	13.1
	14:40	34	12.8	13.3	13.1
	14:41	35	12.8	13.2	13.0
	14:42	36	12.7	13.0	12.9
	14:43	37	12.7	12.8	12.8
	14:44	38	12.6	12.8	12.7
	14:45	39	12.5	12.9	12.7
	14:46	40	12.5	12.8	12.7
	14:47	41	12.4	12.7	12.6
	14:48	42	12.4	12.6	12.5
	14:49	43	12.3	12.6	12.5
	14:50	44	12.3	12.6	12.5
	14:51	45	12.2	12.6	12.4
	14:52	46	12.3	12.6	12.5
	14:53	47	12.4	12.7	12.6
	14:54	48	12.6	12.9	12.8
	14:55	49	12.7	13.1	12.9
	14:56	50	12.9	13.4	13.2
	14:57	51	13.1	13.8	13.5
	14:58	52	13.2	13.8	13.5
	14:59	53	13.2	13.7	13.5
	15:00	54	13.0	13.4	13.2
	15:01	55	12.9	13.2	13.1
	15:02	56	12.8	13.0	12.9

NOBE 93 Table 15.3 cont. **Air Temperature Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

Time Periods	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m from fireboom apex**		
	15:03	57	12.7	12.8	12.8
	15:04	58	12.5	12.6	12.6
	15:05	59	12.4	12.3	12.4
	15:06	60	12.3	12.2	12.3
	15:07	61	12.2	12.2	12.2
	15:08	62	12.2	12.3	12.3
	15:09	63	12.2	12.4	12.3
	15:10	64	12.2	12.7	12.5
	15:11	65	12.2	12.8	12.5
	15:12	66	12.2	12.9	12.6
	15:13	67	12.4	13.0	12.7
	15:14	68	12.4	13.2	12.8
	15:15	69	12.5	13.3	12.9
	15:16	70	12.6	13.4	13.0
	15:17	71	12.8	13.7	13.3
	15:18	72	12.8	14.1	13.5
Post-burn 2	15:19	73	12.8	14.2	13.5
	15:20	74	12.9	14.3	13.6
	15:21	75	13.0	14.4	13.7
	15:22	76	13.3	14.7	14.0
	15:23	77	13.7	14.9	14.3
	15:24	78	13.9	15.2	14.6
	15:25	79	13.8	15.4	14.6
	15:26	80	13.7	15.3	14.5
	15:27	81		15.1	15.1

NOBE 93 Table 15.4

% Relative Humidity Recorded at Downwind Station (CCG 206)

Metrosonics aq-501 (Summary)

		Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1		900 m downwind from the fireboom apex		
Background	Minimum	76	71	73
	Average	79	75	77
	Maximum	81	79	80
Pre-ignition	Minimum	76	69	73
	Average	78	73	76
	Maximum	81	76	79
Burn	Minimum	80	71	75
	Average	89	82	85
	Maximum	93	87	90
Burn 2		500 to 600 m downwind from fireboom apex		
Background	Minimum	76	68	72
	Average	78	69	74
	Maximum	80	72	76
Pre-ignition	Minimum	78	67	73
	Average	79	69	74
	Maximum	80	71	75
Burn	Minimum	78	68	73
	Average	84	77	81
	Maximum	88	81	85
Post-burn	Minimum	79	69	74
	Average	81	71	76
	Maximum	83	72	78

NOBE 93 Table 15.5 **% Relative Humidity Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
Background 1	8:24	-126		78.7	78.7
	8:25	-125	79.8	78.1	79.0
	8:26	-124	78.1	77.1	77.6
	8:27	-123	77.0	74.8	75.9
	8:28	-122	77.3	73.9	75.6
	8:29	-121	77.2	73.1	75.2
	8:30	-120	77.0	72.6	74.8
	8:31	-119	77.8	72.5	75.2
	8:32	-118	77.9	73.1	75.5
	8:33	-117	77.5	72.4	75.0
	8:34	-116	78.1	73.0	75.6
	8:35	-115	79.8	75.1	77.5
	8:36	-114	80.5	76.9	78.7
	8:37	-113	81.3	77.5	79.4
	8:38	-112	81.2	77.4	79.3
	8:39	-111	78.6	76.0	77.3
	8:40	-110	77.6	74.9	76.3
	8:41	-109	77.7	74.3	76.0
	8:42	-108	78.3	74.1	76.2
	8:43	-107	78.7	74.6	76.7
	8:44	-106	79.0	76.0	77.5
	8:45	-105	77.9	75.7	76.8
	8:46	-104	78.6	75.5	77.1
	8:47	-103	78.7	75.3	77.0
	8:48	-102	78.0	74.5	76.3
	8:49	-101	79.2	75.2	77.2
	8:50	-100	79.4	76.5	78.0
	8:51	-99	79.0	76.4	77.7
	8:52	-98	78.5	75.9	77.2
	8:53	-97	78.7	76.2	77.5
	8:54	-96	78.9	76.9	77.9
	8:55	-95	78.7	76.8	77.8
	8:56	-94	78.8	76.3	77.6
	8:57	-93	79.5	76.0	77.8
	8:58	-92	79.5	76.8	78.2
	8:59	-91	79.6	76.7	78.2
	9:00	-90	80.9	77.4	79.2
	9:01	-89	80.7	78.0	79.4
	9:02	-88	79.9	76.8	78.4
	9:03	-87	79.6	76.3	78.0
	9:04	-86	79.7	76.0	77.9
	9:05	-85	79.9	75.6	77.8
	9:06	-84	79.7	74.6	77.2
	9:07	-83	79.9	74.9	77.4
	9:08	-82	79.3	75.1	77.2
	9:09	-81	78.5	75.2	76.9
	9:10	-80	78.6	75.4	77.0
	9:11	-79	78.2	74.6	76.4
	9:12	-78	78.7	74.5	76.6
	9:13	-77	79.6	75.4	77.5
	9:14	-76	78.5	75.0	76.8
	9:15	-75	77.5	74.8	76.2
	9:16	-74	76.7	74.6	75.7
	9:17	-73	75.6	72.8	74.2
	9:18	-72	75.9	71.9	73.9
	9:19	-71	76.3	71.3	73.8
	9:20	-70	77.3	72.1	74.7
	9:21	-69	78.2	73.0	75.6
	9:22	-68	77.8	73.4	75.6
	9:23	-67	78.0	74.0	76.0
	9:24	-66	78.7	75.0	76.9

NOBE 93 Table 15.5 cont. **% Relative Humidity Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
	9:25	-65	79.2	75.4	77.3
	9:26	-64	78.4	75.3	76.9
	9:27	-63	78.6	75.5	77.1
	9:28	-62	78.8	75.6	77.2
	9:29	-61	79.6	75.6	77.6
Pre-ignition 1	9:30	-60	79.8	75.6	77.7
	9:31	-59	80.6	75.7	78.2
	9:32	-58	80.6	76.2	78.4
	9:33	-57	79.3	75.8	77.6
	9:34	-56	79.1	74.5	76.8
	9:35	-55	79.3	75.4	77.4
	9:36	-54	80.0	75.5	77.8
	9:37	-53	80.5	76.2	78.4
	9:38	-52	80.3	76.2	78.3
	9:39	-51	79.3	75.2	77.3
	9:40	-50	79.4	74.8	77.1
	9:41	-49	80.1	75.2	77.7
	9:42	-48	79.8	75.1	77.5
	9:43	-47	79.4	74.8	77.1
	9:44	-46	78.8	74.7	76.8
	9:45	-45	78.8	74.4	76.6
	9:46	-44	79.1	74.7	76.9
	9:47	-43	77.9	74.9	76.4
	9:48	-42	77.8	74.0	75.9
	9:49	-41	78.8	74.9	76.9
	9:50	-40	78.8	74.8	76.8
	9:51	-39	79.7	74.7	77.2
	9:52	-38	80.0	74.3	77.2
	9:53	-37	80.9	74.4	77.7
	9:54	-36	80.8	74.5	77.7
	9:55	-35	80.0	74.1	77.1
	9:56	-34	78.8	74.4	76.6
	9:57	-33	77.9	73.7	75.8
	9:58	-32	77.9	72.6	75.3
	9:59	-31	78.6	72.5	75.6
	10:00	-30	77.9	72.9	75.4
	10:01	-29	77.5	72.6	75.1
	10:02	-28	77.9	72.7	75.3
	10:03	-27	77.8	72.4	75.1
	10:04	-26	77.8	71.8	74.8
	10:05	-25	77.0	71.8	74.4
	10:06	-24	77.3	71.5	74.4
	10:07	-23	77.4	71.5	74.5
	10:08	-22	78.2	71.8	75.0
	10:09	-21	78.1	71.8	75.0
	10:10	-20	78.1	71.6	74.9
	10:11	-19	78.2	71.4	74.8
	10:12	-18	77.8	71.6	74.7
	10:13	-17	77.1	71.2	74.2
	10:14	-16	77.2	70.8	74.0
	10:15	-15	76.8	70.2	73.5
	10:16	-14	76.5	69.7	73.1
	10:17	-13	76.0	69.5	72.8
	10:18	-12	76.5	69.1	72.8
	10:19	-11	77.0	69.5	73.3
	10:20	-10	76.4	69.2	72.8
	10:21	-9	77.8	69.7	73.8
	10:22	-8	77.6	70.4	74.0
	10:23	-7	76.6	69.8	73.2
	10:24	-6	76.7	69.8	73.3

NOBE 93 Table 15.5 cont. **% Relative Humidity Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
	10:25	-5	76.4	69.8	73.1
	10:26	-4	76.7	70.0	73.4
	10:27	-3	77.6	70.5	74.1
	10:28	-2	77.9	70.3	74.1
	10:29	-1	78.9	70.6	74.8
Burn 1	10:30	0	79.6	71.0	75.3
	10:31	1	79.9	71.8	75.9
	10:32	2	79.6	72.2	75.9
	10:33	3	80.1	72.9	76.5
	10:34	4	80.1	73.2	76.7
	10:35	5	80.9	73.4	77.2
	10:36	6	82.5	74.2	78.4
	10:37	7	84.2	75.8	80.0
	10:38	8	84.7	76.9	80.8
	10:39	9	84.5	77.0	80.8
	10:40	10	84.9	77.3	81.1
	10:41	11	85.8	78.2	82.0
	10:42	12	86.5	79.1	82.8
	10:43	13	87.6	80.2	83.9
	10:44	14	88.5	81.2	84.9
	10:45	15	89.1	82.2	85.7
	10:46	16	88.8	82.4	85.6
	10:47	17	88.1	81.9	85.0
	10:48	18	88.5	82.0	85.3
	10:49	19	88.8	82.3	85.6
	10:50	20	89.4	82.7	86.1
	10:51	21	90.0	83.3	86.7
	10:52	22	90.3	83.9	87.1
	10:53	23	90.4	84.4	87.4
	10:54	24	90.1	84.4	87.3
	10:55	25	90.1	84.3	87.2
	10:56	26	90.0	84.5	87.3
	10:57	27	90.2	84.6	87.4
	10:58	28	90.0	84.8	87.4
	10:59	29	90.2	84.8	87.5
	11:00	30	90.4	84.9	87.7
	11:01	31	90.3	84.6	87.5
	11:02	32	90.5	84.6	87.6
	11:03	33	90.9	85.0	88.0
	11:04	34	91.0	85.3	88.2
	11:05	35	90.6	85.0	87.8
	11:06	36	90.9	85.2	88.1
	11:07	37	91.4	85.7	88.6
	11:08	38	91.7	86.3	89.0
	11:09	39	91.5	86.5	89.0
	11:10	40	91.3	86.4	88.9
	11:11	41	90.9	85.9	88.4
	11:12	42	90.8	85.4	88.1
	11:13	43	91.0	85.1	88.1
	11:14	44	91.3	85.1	88.2
	11:15	45	91.7	85.4	88.6
	11:16	46	91.8	85.5	88.7
	11:17	47	91.8	85.7	88.8
	11:18	48	92.5	86.4	89.5
	11:19	49	92.6	86.9	89.8
	11:20	50	92.6	86.9	89.8
	11:21	51	92.0	86.5	89.3
	11:22	52	91.2	85.6	88.4
	11:23	53	90.9	84.9	87.9
	11:24	54	91.3	84.9	88.1

NOBE 93 Table 15.5 cont. **% Relative Humidity Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
	11:25	55	91.9	85.5	88.7
	11:26	56	92.7	86.2	89.5
	11:27	57	93.1	86.9	90.0
	11:28	58	93.3	87.1	90.2
	11:29	59	92.1	87.3	89.7
	11:30	60	88.9	85.8	87.4
	11:31	61	87.5	84.6	86.1
	11:32	62	87.1	83.4	85.3
	11:33	63	86.9	82.3	84.6
	11:34	64	87.7	82.0	84.9
	11:35	65	89.5	82.9	86.2
	11:36	66	88.6	83.6	86.1
	11:37	67	87.2	82.8	85.0
	11:38	68	86.5	82.1	84.3
	11:39	69	85.6	81.4	83.5
	11:40	70	85.1	81.4	83.3
	11:41	71	85.2	81.3	83.3
	11:42	72	85.7	80.5	83.1
	11:43	73	87.7	81.0	84.4
	11:44	74	88.6	82.0	85.3
	11:45	75	88.1	82.0	85.1
	11:46	76	87.8	81.2	84.5
	11:47	77	87.6	80.7	84.2
	11:48	78	86.7	79.4	83.1
	11:49	79	85.8	78.1	82.0
	11:50	80		77.2	77.2
Burn 2			**500 to 600 m downwind from fireboom apex**		
Background 2	13:31	-35		69.6	69.6
	13:32	-34		68.7	68.7
	13:33	-33		68.8	68.8
	13:34	-32		69.2	69.2
	13:35	-31		70.3	70.3
	13:36	-30	79.8	71.3	75.6
	13:37	-29	78.8	71.8	75.3
	13:38	-28	77.4	71.6	74.5
	13:39	-27	75.9	70.8	73.4
	13:40	-26	75.8	70.2	73.0
	13:41	-25	76.2	69.1	72.7
	13:42	-24	77.3	68.5	72.9
	13:43	-23	78.4	68.6	73.5
	13:44	-22	77.8	68.4	73.1
	13:45	-21	78.5	68.3	73.4
	13:46	-20	78.4	68.0	73.2
	13:47	-19	78.5	67.7	73.1
	13:48	-18	78.8	68.7	73.8
	13:49	-17	78.8	69.6	74.2
	13:50	-16	78.3	69.1	73.7
	13:51	-15	78.4	68.0	73.2
Pre-ignition 2	13:52	-14	78.3	67.2	72.8
	13:53	-13	78.8	67.9	73.4
	13:54	-12	78.0	68.9	73.5
	13:55	-11	77.8	68.2	73.0
	13:56	-10	78.0	68.0	73.0
	13:57	-9	78.8	69.1	74.0
	13:58	-8	79.2	70.5	74.9
	13:59	-7	79.5	70.5	75.0
	14:00	-6	79.7	71.1	75.4
	14:01	-5	79.6	70.9	75.3
	14:02	-4	78.6	70.3	74.5

NOBE 93 Table 15.5 cont. **% Relative Humidity Recorded at Downwind Station (CCG 206)**

Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
	14:03	-3	78.8	69.9	74.4
	14:04	-2	79.1	70.5	74.8
	14:05	-1	78.8	69.9	74.4
Burn 2	14:06	0	78.3	68.3	73.3
	14:07	1	80.0	67.7	73.9
	14:08	2	81.9	69.8	75.9
	14:09	3	81.3	71.0	76.2
	14:10	4	81.0	70.7	75.9
	14:11	5	82.4	71.6	77.0
	14:12	6	83.5	73.0	78.3
	14:13	7	84.2	74.0	79.1
	14:14	8	84.5	75.4	80.0
	14:15	9	84.3	75.6	80.0
	14:16	10	84.7	76.5	80.6
	14:17	11	85.5	77.3	81.4
	14:18	12	85.9	78.6	82.3
	14:19	13	86.0	79.1	82.6
	14:20	14	86.6	79.3	83.0
	14:21	15	86.8	79.0	82.9
	14:22	16	86.4	78.4	82.4
	14:23	17	86.8	78.1	82.5
	14:24	18	87.3	79.2	83.3
	14:25	19	87.7	80.0	83.9
	14:26	20	87.6	80.4	84.0
	14:27	21	87.4	79.8	83.6
	14:28	22	87.9	79.7	83.8
	14:29	23	88.2	80.2	84.2
	14:30	24	86.8	79.5	83.2
	14:31	25	85.6	78.6	82.1
	14:32	26	85.6	78.3	82.0
	14:33	27	85.4	78.5	82.0
	14:34	28	84.4	78.1	81.3
	14:35	29	83.9	77.6	80.8
	14:36	30	83.6	77.1	80.4
	14:37	31	82.4	76.3	79.4
	14:38	32	81.8	74.6	78.2
	14:39	33	82.4	74.4	78.4
	14:40	34	82.0	74.7	78.4
	14:41	35	82.0	75.0	78.5
	14:42	36	82.9	75.2	79.1
	14:43	37	83.2	76.1	79.7
	14:44	38	83.6	76.9	80.3
	14:45	39	84.0	76.7	80.4
	14:46	40	84.1	76.4	80.3
	14:47	41	83.9	76.4	80.2
	14:48	42	85.0	77.7	81.4
	14:49	43	85.5	78.4	82.0
	14:50	44	85.8	78.3	82.1
	14:51	45	85.8	78.0	81.9
	14:52	46	86.4	78.4	82.4
	14:53	47	85.5	78.3	81.9
	14:54	48	84.7	77.5	81.1
	14:55	49	84.0	77.1	80.6
	14:56	50	83.1	76.3	79.7
	14:57	51	81.7	74.6	78.2
	14:58	52	81.0	73.7	77.4
	14:59	53	81.1	74.0	77.6
	15:00	54	82.2	74.8	78.5
	15:01	55	82.9	76.2	79.6
	15:02	56	83.0	76.8	79.9

NOBE 93 Table 15.5 cont. **% Relative Humidity Recorded at Downwind Station (CCG 206)**

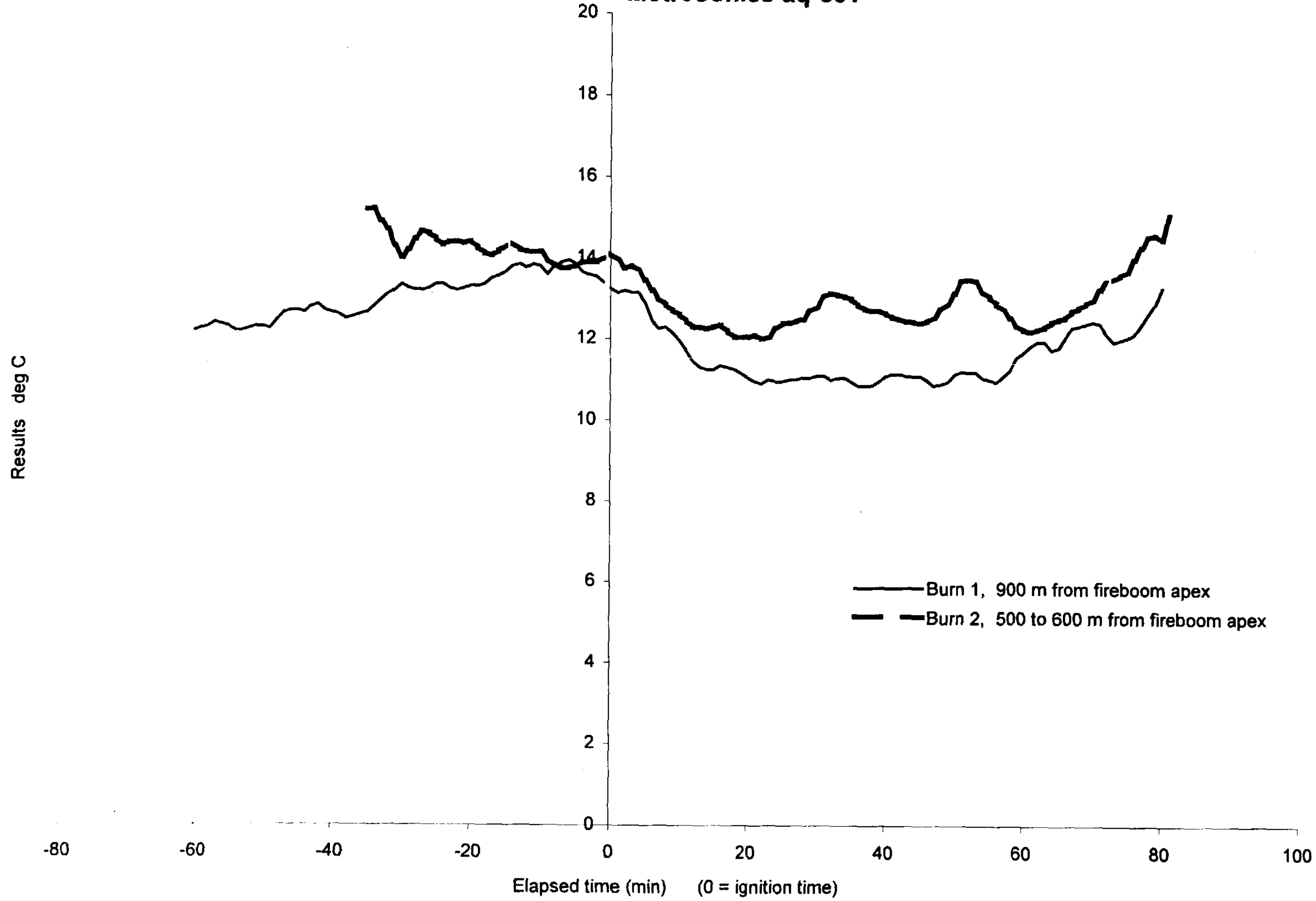
Metrosonics aq-501 (Raw Data)

	Time Recorded	Time Elapsed	Instrument 1 °C	Instrument 2 °C	Average °C
Burn 1			**900 m downwind from fireboom apex**		
	15:03	57	83.9	77.4	80.7
	15:04	58	85.2	78.7	82.0
	15:05	59	86.2	79.8	83.0
	15:06	60	86.3	80.8	83.6
	15:07	61	86.7	81.2	84.0
	15:08	62	86.6	81.1	83.9
	15:09	63	86.2	80.1	83.2
	15:10	64	86.2	79.1	82.7
	15:11	65	86.2	78.3	82.3
	15:12	66	86.2	77.9	82.1
	15:13	67	86.2	77.9	82.1
	15:14	68	85.8	77.6	81.7
	15:15	69	85.5	77.1	81.3
	15:16	70	83.7	76.3	80.0
	15:17	71	82.7	74.8	78.8
	15:18	72	82.1	73.0	77.6
Post-burn 2	15:19	73	82.2	72.1	77.2
	15:20	74	82.3	71.5	76.9
	15:21	75	82.9	71.5	77.2
	15:22	76	81.9	71.2	76.6
	15:23	77	80.8	70.4	75.6
	15:24	78	80.2	70.5	75.4
	15:25	79	78.9	69.9	74.4
	15:26	80	79.0	68.8	73.9
	15:27	81		69.2	69.2

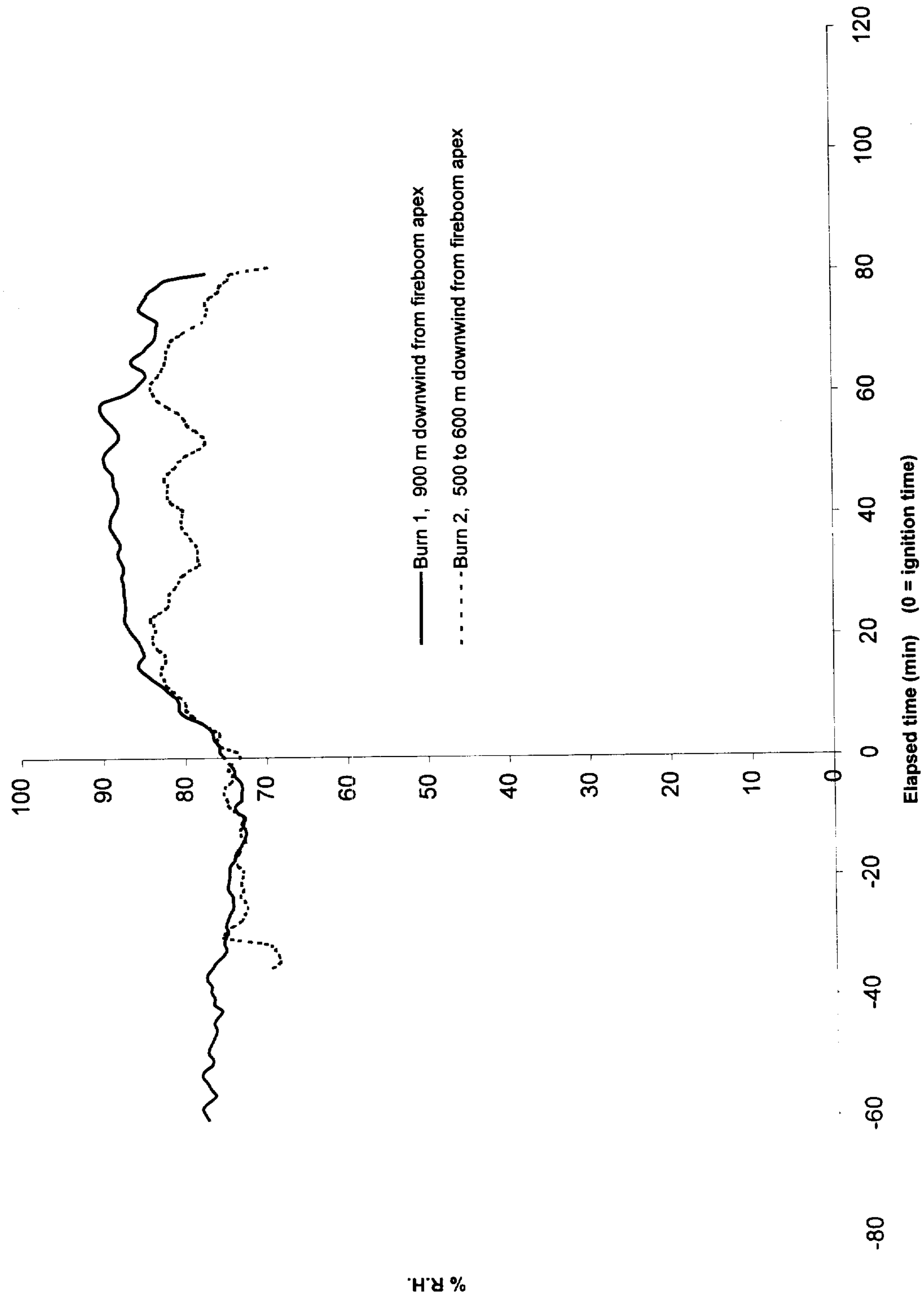
NOBE 93 Figure 15.1

Air Temperature at Downwind Station (CCG 206)

Metrosonics aq-501



NOBE 93 Figure 15.2
% Relative Humidity at Downwind Station (CCG 206)
Metrosonics aq-501



Appendix A

Wave Data Collection
NOBE 93

Wave Data Collection During the Newfoundland Offshore Burn Experiment August 1993

Prepared for:

Emergencies Science Division
Environment Canada

Prepared by:

Seaconsult Limited
St. John's, NF

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1. INTRODUCTION

This report presents a record of the services provided by Seaconsult Limited in support of the Newfoundland Offshore Burn Experiment (NOBE) conducted off St. John's, Newfoundland, during early August, 1993.

NOBE was a large scale study conducted in an operational setting to determine the procedural and environmental feasibility of burning oil on the surface of the open ocean. The program was sponsored by a variety of Canadian and US agencies responsible for oil spill countermeasures, prevention, and management. Principals in NOBE were Environment Canada, the Canadian Coast Guard (CCG), the US Coast Guard, and the US Mineral Management Service.

Seaconsult was contracted directly by Environment Canada to collect wave data at the site prior to and during the experimental burn. During the operational portion of the experiment Seaconsult was responsible for the provision of wave data in near-real-time to the project meteorologist. The data collected have also been assembled and presented here for future use in analysis of other NOBE data.

The comprehensive Seaconsult wave data collection program included:

- the lease of two Datawell Waverider buoys (one with ARGOS data telemetry and one with VHF data telemetry) with associated subsurface mooring systems;
- field personnel to deploy the Waverider systems;
- an ARGOS satellite data link which would provide the experiment's weather forecaster with wave data products on a near-real-time basis;
- on-call trouble-shooting services during the program;
- a final report including all data collected.

2. DATA COLLECTION OUTLINE

The oceanographic measurement program undertaken by Seaconsult was designed to fulfil the wave data collection needs of the NOBE project team as outlined in the Environment Canada Request For Proposals (RFP). At the time of contract award, the optional requirement for provision of site barometric pressure data was dropped.

The burn site was located at 47°40' N, 52°00' W, about 28 nm from the entrance to St. John's harbour (see Fig. 2.1). Water depth at the site is about 180 metres.

2.1 Environment Canada Equipment Specifications

The standard for wave data collection in Canada has been set by the Marine Environmental Data Service (MEDS) of the Department of Fisheries and Oceans (DFO) using the Datawell Waverider. The Waverider is a surface buoy which measures non-directional seastate and transmits analogue raw data to a receiving station on shore via a VHF telemetry link. For several years, Seaconsult has collected wave data in coastal and offshore waters on behalf of industrial and government clients. Seaconsult owns several Waverider buoys and operates a Waverider test facility in St. John's.

The specifications set by Environment Canada for the Newfoundland Offshore Burn Experiment called for wave data collection to MEDS standards. Furthermore, it was specified that two wave buoys be deployed to ensure continuous operation in the event of equipment failure. As the burn site was expected to be beyond the range of a Waverider transmitting to a shore receiving facility, Environment Canada requested that the wave buoys used for NOBE be equipped with satellite transmitters.

2.2 Data Processing and Telemetry

The satellite data telemetry option used by Seaconsult for NOBE was ARGOS, a satellite system developed for the collection and dissemination of environmental data by CNES (the French Space Agency), the National Aeronautics and Space Administration (NASA), and the National Oceanic and Atmospheric Administration (NOAA). In addition to handling sensor data, the ARGOS system is capable of determining the location of a transmitting platform.

In preparation for the burn experiment, two of Seaconsult's Waverider transmitters were retrofitted with ARGOS platform Transmitter Terminals (PTT). Onboard processors were also installed to digitize raw wave data, compute wave spectra, and control data transmission. The retrofit was undertaken in conjunction with Seimac Limited, an ocean instrumentation company in Dartmouth, NS, which specializes in ARGOS applications. Information on the Seimac Smart Cat PTT is presented here in Appendix 1.

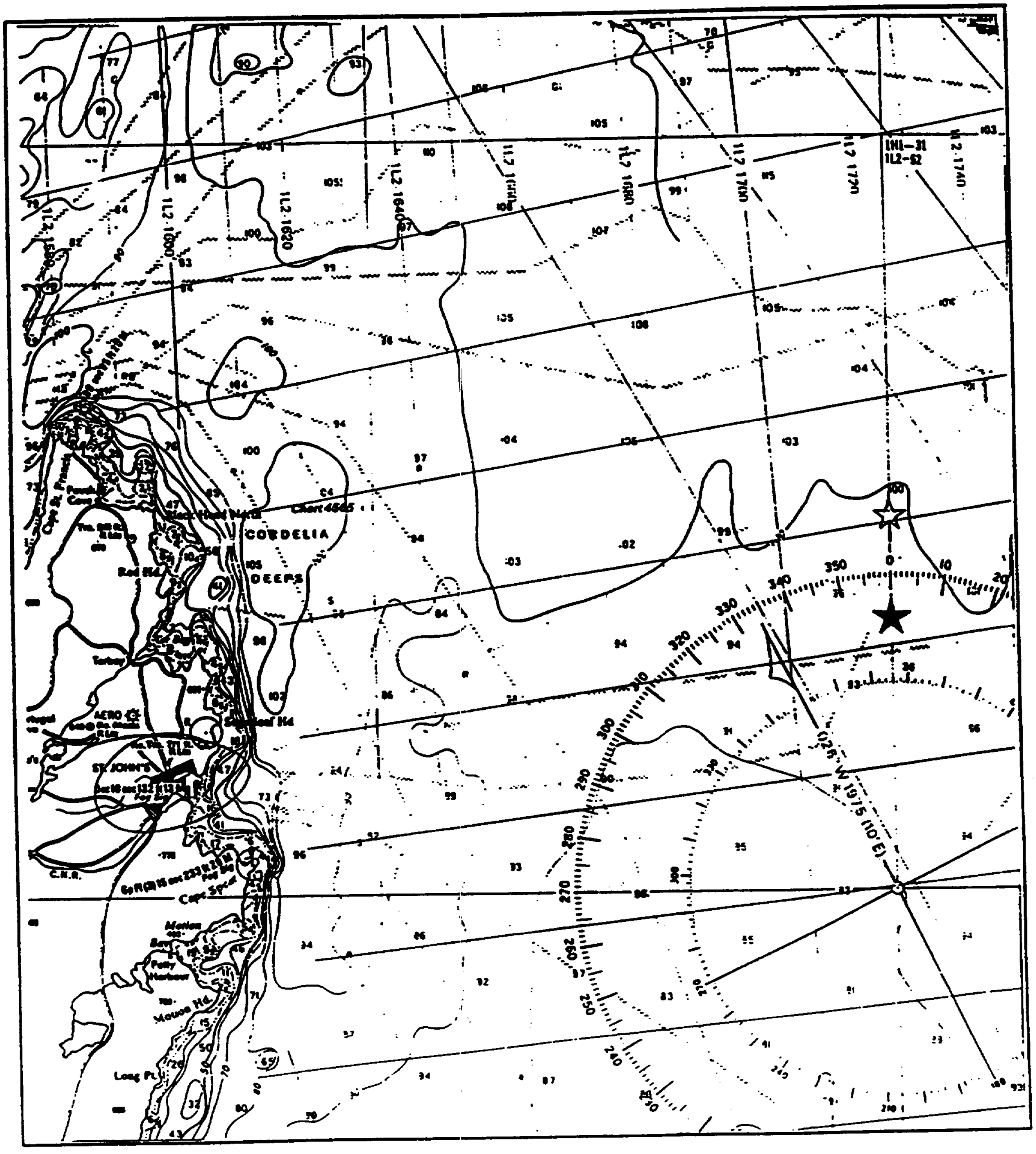


Fig. 2.1 Location of NOBE Waverider buoys.

The ARGOS data link depends upon one of two polar-orbiting NOAA TIROS satellites being in a position to receive buoy transmissions. In fact, the portion of the day when a satellite is capable of receiving data from any platform is very small. During NOBE, satellite coverage averaged 12 passes per day at irregular intervals. North American Collection and Location by Satellite (NACLS), the distributor of ARGOS data in North America, prepared a prediction for satellite coverage at the NOBE site for the period July 27 - August 15, 1993 (see Fig. 2.2). It can be clearly seen from this schedule that there were long periods of poor coverage during NOBE which could have resulted in long gaps in the data time series.

Every hour, the Waverider's onboard processor ran spectral and statistical analyses (based on upcrossing) for a synoptic sample consisting of 20 minutes of raw wave data collected immediately before the hour (GMT). The resulting computed parameters and spectral plot data were assembled into a 256-bit message in ARGOS format. Messages were stored sequentially in a temporary buffer for eight hours. As the latest message was added to the buffer, the oldest was discarded. The message queue was structured so that the most recent data was included twice and so would be received in near-real-time on any pass in which four or more transmissions are received. All historical data were received multiple times so that gaps can be filled in later. Every 110 seconds, the Seaconsult Waverider PTT transmitted two data messages. The processor provided the PTT with each of the messages assembled in the buffer on a rotational basis so that all available messages were transmitted during an interval of 440 seconds.

As the ARGOS Waverider system continued to transmit historical data, recovery of data was possible after the fact for times when a satellite was not in view of the buoy. Using the eight-record buffer and the two-channel data transmission schedule incorporated into the Seaconsult data collection system, only five hourly samples were not recovered due to lack of satellite coverage (see Fig. 4.1).

Predicted Satellite Pass Coverage at 47°40'N, 52°00'W
Min. pass duration = 6.75 min
Max. pass duration = 15.63 min
Mean pass duration = 12.73 min
Average passes per day = 12.3

Hr (UTC)		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
07/25	12						04	16	20	12	14	18	20		10		14	02	20		34		20	
07/26	14						20		20		34		20		14		14		20	04	30		20	16
07/27							18		20	06	28	02	16	14			14		20	20	14	20		18
07/28							18		20	22	12	20		16			12	12	08	32		26		20
07/29							16	14	06	32		20	06	12			10	18		29		29	20	
07/30	12					04	10	20		30	10	20	18		10	08		18		20	28	02	20	
07/31	14					12		22		18	30		20	10	04			18	08	14	32	04	16	16
08/01								20	10	10	32	12	08	14				18	20		28	20		18
08/02								20	22	14	16	20		18			10	06	20	12	18	18	08	12
08/03	10						16	04	20	14	16	20	16	02			14		20		26	10	20	
08/04	14						18		20	14	32		20		12		14		20	18	18		20	08
08/05	08						18		20	18	20		20	14			14	08	12	20	16	14	06	18
08/06							16	10	10	18	18	20		16			12	20		30	02	32		18
08/07							14	20		34		30		18		08	02	18		32	08	24	18	02
08/08	12					12		20		32	10	20	18		08			18	04	16	34		20	
08/09	16					10		20	04	14	32		20		12			18	20	02	32		18	18
08/10								20	20		34	04	16	14			06	10	20		32	20		20
08/11							12	08	22	06	28	20		16			16		20	12	18	20		18
08/12							18		20	16	16	20	08	10			14		20	14	06	18	20	
08/13	14						18		20	26	12	10	18		12		14	04	16	20	18		20	
08/14	16						16	06	14	18	18		20	10	02		12	20		20	14	18	14	18
08/15							16	20		18	16	24	06	16		04	06	20		22	16	30		20

Value in each cell indicates the number of anticipated transmissions (110 secor
frequency) possible during each pass for the Seaconsult Waverider 2-channel PT

Fig. 2.2 Satellite pass predicitons for the NOBE site, July 27-August 15, 1993.

2.3 Delivery of Data

Waverider data received by the ARGOS Satellite were relayed to a ground station at Wallops Island, Virginia, and delivered to the ARGOS Global Processing Centre (GPC) at Landover, Maryland. After processing, wave data products were deposited in a mailbox on the TymeNet network run by British Telecom. Once in the mailbox, archived data were downloaded in St. John's as required. To ensure that there was no confusion in timing of messages caused by the lag in data transfer between buoy, satellite, ground station, and GPC, the Seaconsult onboard processing software assigned an identification code to each message.

Seaconsult software installed on a computer at the AES weather office at St. John's airport allowed the project meteorologist to download wave data from the GPC. Following data transfer to the AES computer, automated routines updated the St. John's system by selecting hourly wave records not yet contained in the local archive. A series of data products allowed the meteorologist to review wave data in the form of energy spectra or as tables of computed parameters.

The transfer of data from the field to the NOBE project office in St. John's is presented in steps A-E below.

A. Waverider Buoy

- Wave height measured by an accelerometer was digitized and processed into spectral products by an onboard computer.
- Summary digital wave data products were produced every hour, labelled with a record identification code, and placed in an eight message buffer.
- Every 110 seconds, a message consisting of the top hourly record in the buffer was transmitted on PTT ID #1 (channel 1). A few seconds later, the next hourly record in the buffer was transmitted on PTT ID #2. 110 seconds later, the next two messages were transmitted in the same manner.
- The messages in the buffer were updated every hour with the addition of the processed data from the current hour and the deletion of the oldest.

B. NOAA TIROS satellite

- Two satellites in polar orbit with period of 102 minutes.
- Transmissions were received from the Waverider by one of the satellites when the buoy is within the satellite's zone of reception.
- Recent data were stored on the satellite and re-transmitted when the satellite is within sight of the ground receiving station at Wallops Island, Virginia.

C. Ground Station

- Waverider data were received at the NASA satellite receiving station at Wallops Island.

D. Global Processing Centre

- Data received at the ground station were transferred to the north american processing centre at NACLS in Landover, Maryland.
- Wave data products were processed, placed in a format that is recognizable by the end user, and put into an electronic mail box for distribution.

E. St. John's Weather Office

- Through an automated Seaconsult routine, data were recovered from the electronic mailbox and put through final quality control.
- Data were archived for future use.
- Data products were created for use of the project meteorologist.

3. FIELD PROGRAM

Following the preparation of two ARGOS-transmitting Waveriders and their associated mooring systems, the data collection phase of the program commenced. Deployment of the Waveriders had been scheduled for July 27 - ten days before the start of the scheduled experimental window of opportunity. This early provision of site wave data was to provide the forecaster with an opportunity to become familiar with available data sources and local conditions before operational decisions might be made in earnest. In fact, Waveriders were not deployed until August 2, the earliest date that CCG could provide a vessel for mooring work.

3.1 Deployment of Waverider Buoys

Only one of the two satellite-transmitting Waveriders prepared for NOBE was deployed at the site. The second ARGOS Waverider was not deployed as it failed final data transmission tests during the evening of August 1 and the morning of August 2. The buoy had been working the night before but became affected by internal RF interference caused by damage to shielding of the ARGOS transmitter wiring harness.

As an alternative, Seaconsult deployed a conventional Waverider buoy at the site. Although this buoy transmitted data via short-range radio telemetry link, it proved to be useful as a back up to the ARGOS buoy during the operational planning stages and as a means of obtaining real-time wave data during the experiment.

All Waverider and mooring equipment was transported by Seaconsult van to the CCG wharf on Southside Road in St. John's on the morning of August 2. Mooring system anchors in the form of scrap ship's anchor chain were provided by CCG at Southside Road. All Seaconsult equipment was loaded on CCGs SIR HUMPHREY GILBERT along with an AES offshore meteorological buoy which was also to be deployed at the burn site.

The ship departed St. John's at 1100 NDT on August 2. En route, mooring systems were assembled on deck and wave buoys prepared for deployment. Transmitted outputs from both the conventional and the ARGOS Waverider were confirmed at sea.

At 1350 (NDT) the AES weather buoy was deployed at the north west corner of the experiment permit area (GPS position = 47°45.014'N, 52°04.888'W, water depth = 190 m). Following deployment, anemometers were installed by AES technicians working from the ship's fast rescue craft and the ship remained on site to confirm proper operation.

Prior to Waverider deployments, a current drogue was deployed to obtain an estimate of surface currents at the burn site. The drogue consisted of a 2m wide by 3m deep sail suspended immediately below the surface from a floating spar. The drogue design minimizes the effect of wind in overall drift so that only surface water movement was measured. Following recovery of the drogue nearly two hours later, plotted current velocity was southerly at about 0.25 knots.

The ARGOS Waverider was deployed at 1619 NDT in 180 metres of water at GPS position: 47° 39.997'N, 52°00.006'W. The conventional Waverider was deployed at 1631 NDT, in 179 metres of water at GPS position: 47° 40.036'N, 51° 59.099'W. The mooring design used for each of these buoys is presented below in Fig. 3.1.

Immediately following mooring deployment, a notice to mariners was filed with the CCG Vessel Traffic Services Centre in St. John's. This notice was broadcast regularly until the moorings were recovered.

CCGS SIR HUMPHREY GILBERT arrived at St. John's at 1930 NDT.

3.2 Installation of The Cabot Tower Waverider Receiving Station

Data transmissions from the conventional Waverider at the NOBE site were monitored while the SIR HUMPHREY GILBERT returned to St. John's following mooring deployments on August 2. Contrary to expectations, good data were received until the ship was only five nautical miles from St. John's harbour. Encouraged by this experience, Seaconsult established a temporary receiving station in the parking lot at the top of Signal Hill on the morning of August 3 and found that conventional Waverider data reception was quite good. Arrangements were then made with the Parks Canada administrators of the Signal Hill National Historic Site to install a computerized wave data receiving station on Signal Hill for the duration of NOBE. On August 4, such a system was installed in the Cabot Tower at the summit of Signal Hill.

The Cabot Tower receiving station provided a back up to the satellite data received from the ARGOS Waverider at the NOBE site. Because of the range to the conventional Waverider at the site, there were occasional data drop-outs in data received at Cabot Tower during periods of higher seastate. The Cabot Tower station did have some operational use, however, as real-time wave data received at Signal Hill were provided to the project meteorologist immediately prior to the departure of the NOBE flotilla for the attempted experiment on August 7 and again before the actual experiment on August 12.

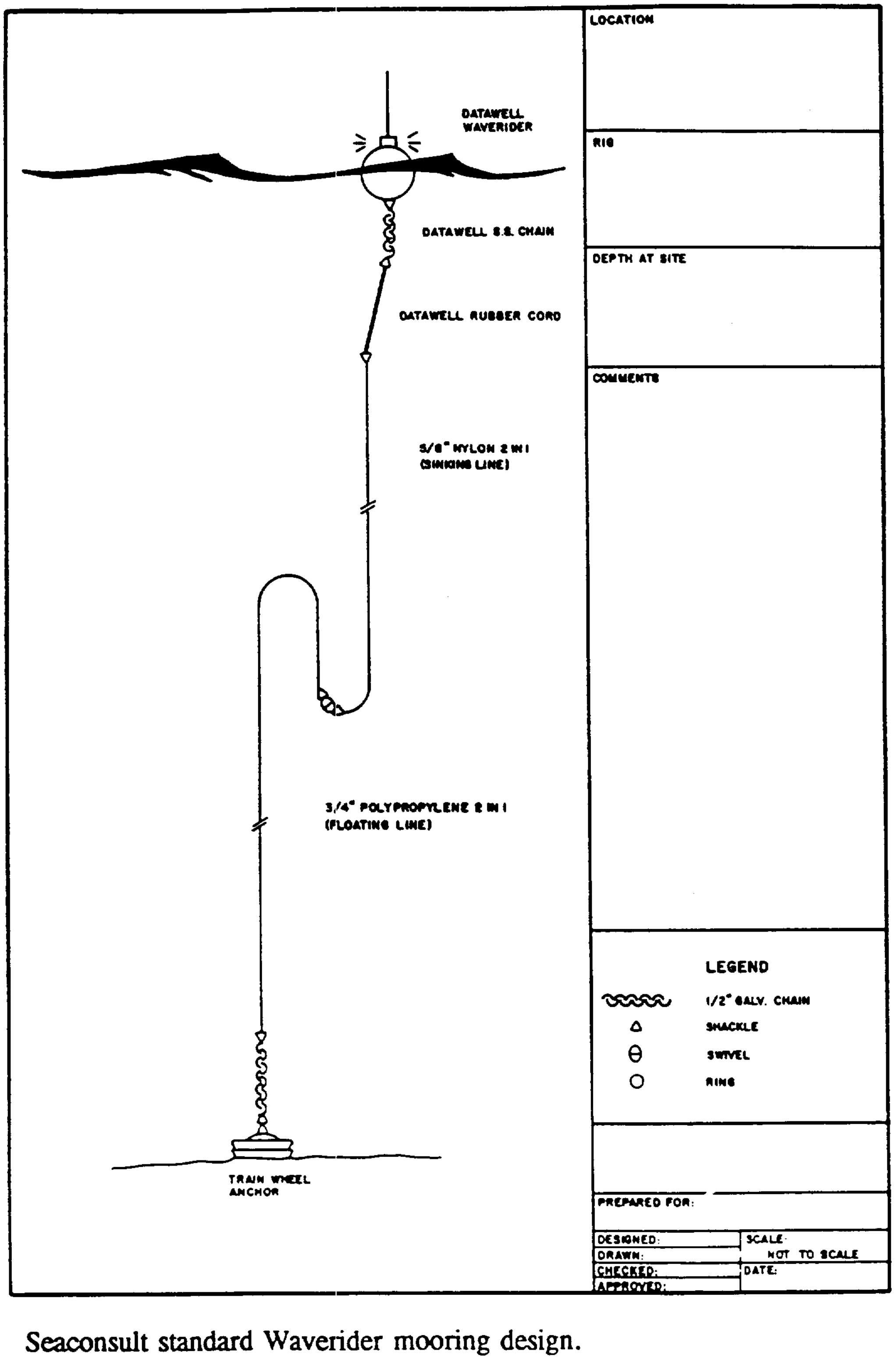


Fig. 3.1 Seaconsult standard Waverider mooring design.

3.3 Installation of CCGS ANN HARVEY Waverider Receiving Station

With a conventional Waverider deployed at the burn site, it was possible to provide project personnel with real-time wave data on board the project command vessel. To this end, Seaconsult installed a computerized wave data receiving station in the officers' lounge on CCGS ANN HARVEY on August 5.

The system on the ANN HARVEY was identical in function to that installed in the Cabot Tower. The Seaconsult automated software used for these applications was originally developed for use offshore by drill rig weather observers and has been used reliably in many programs over the past five years. The system provides the user with on-screen data products while automatically archiving raw data.

3.4 Installation of the Weather Office Data Terminal

Following initial provision of data by fax from Seaconsult's office, automated data terminal software was installed on August 4 on the NOBE forecaster's computer at the St. John's Weather Office. The software was updated on August 6 to provide additional products requested by the forecaster.

3.5 Recovery of Waverider Buoys

Because of commitments of the coast guard vessels used during NOBE, the Seaconsult Waverider moorings were not recovered immediately upon completion of the burn experiment. The AES weather buoy deployed on August 2 was recovered by CCGS ANN HARVEY on August 18. At that time, the ship had not been directed to recover the Seaconsult wave buoys. The Waveriders were eventually recovered on August 25 when the ship returned to St. John's from her next assignment. In the absence of a Seaconsult representative on board the recovery vessel, the buoys were recovered safely according to instructions provided to the ship by fax and telephone.

4. DATA PRESENTATION

4.1 Computed Wave Parameters

On board processing of the 20-minute raw wave data sample was undertaken in the frequency domain, providing seastate estimates based on spectral analysis of data, and in the time domain providing estimates based on zero-upcrossing analysis. The following products were included in each ARGOS message:

Frequency Domain (Spectral Analysis)

S(f)	Wave energy spectrum consisting of energy determined for 24 bands covering a frequency range having equivalent wave periods of 2.5 s to 28.6 s.
H_{mo}	Significant Wave Height. Spectral approximation of H_s. Statistical computation of H_s is described below. H_{mo} is proportional to the area under the curve in the spectral plot.
T_p	Peak Period. This is the period associated with the peak energy in the computed spectrum.
T_z	Mean Wave Period. Also referred to as $T_{mo,2}$. Spectral approximation of the mean wave period, T_a (see below).

Time Domain (Upcrossing Analysis)

H_3	Significant Wave Height. Average height of the 1/3 largest waves in a sample (also referred to as H_s or $H_{1/3}$).
T_3	Significant Wave Period. Average period of the 1/3 largest waves in a sample.
H_{max}	Maximum Wave Height. Height of the largest single wave in a sample.
T_{max}	Maximum Wave Period. This does not necessarily correspond to the H_{max} wave.
MCS	Maximum Combined Sea. The separation between the highest peak and the lowest trough in a sample. This is not necessarily a measure of the highest single wave.
H_{10}	Average height of the 1/10 largest waves.
H_a	Average Wave Height of a sample.
T_a	Average Wave Period of a sample.

4.2 Data Products Available at the Shore Terminal

On shore, transmitted buoy data were made available to the project meteorologist on a terminal at the St. John's Weather Office. The software first allowed the meteorologist to automatically download data and update the local archive. Once the wave data archive had been updated, a number of data products were available. In most cases, the user was able to window on a specific period of data. Data products available to the user included:

1. A tabular presentation of the effective satellite coverage in terms of hourly messages received to date. (see Fig. 4.1).

2. A tabular presentation of all of the computed parameters presented in 4.1 (see Fig. 4.2).

3. A graphical presentation of the spectral plot generated for any hourly wave sample (see NOBE data from August 11 in Fig. 4.3). In this presentation, energy is shown as a function of both frequency and period as an aid to the user. The user has the option of reviewing these plots sequentially on a screen-by screen basis.

4. A cumulative presentation of the spectral plots described in 3 above. By selecting a starting time and duration in hours, this product presents a "time series" of spectra (see NOBE data for August 10 - August 13 in Fig. 4.4). Also presented here in this product are plots of H_{mo} and T_p vs time for the period selected.

5. The last product allowed the user to determine the approximate heights of swell and wind wave components in a given seastate observation. This is done by using wind speed to determine an inflection point that divides the spectral diagram into a "swell portion" and a "wind portion". By integrating under each of these resultant curves, individual swell- and wind-based significant wave heights are computed. The product is presented in a tabular form.

Day	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
AUG02				*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG03	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG04	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG05	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG06	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG07	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG08	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG09	*		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG10		*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG11			*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	
AUG12	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*
AUG13		*	*	*	*	*	*	*	*	*	*	*	*	*	*		*	*	*	*	*	*	*	*
AUG14	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*

Fig. 4.1 Tabular presentation of satellite coverage at the NOBE site.

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
12AUG	00	0.70	0.43	0.65	0.79	1.17	1.46	13.31	4.76	4.27	5.98	12.04
12AUG	01	0.74	0.45	0.70	0.86	1.20	1.29	14.25	4.66	4.36	5.98	12.61
12AUG	02	0.77	0.47	0.70	0.89	1.05	1.26	14.25	4.86	4.56	6.08	12.50
12AUG	03	0.77	0.45	0.72	0.89	1.20	1.71	6.08	4.96	4.56	6.29	11.58
12AUG	04	0.74	0.45	0.67	0.86	1.23	1.32	13.31	4.86	4.56	6.18	12.38
12AUG	05	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.69
12AUG	06	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.31
12AUG	07	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.81
12AUG	08	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.08
12AUG	09	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.45
12AUG	10	0.74	0.45	0.67	0.84	1.11	1.46	8.28	5.17	5.17	7.01	14.37
12AUG	11	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.81
12AUG	12	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.19
12AUG	13	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.02
12AUG	14	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.91
12AUG	15	0.84	0.51	0.79	0.99	1.49	1.71	8.28	5.67	5.27	7.12	11.47
12AUG	16	0.84	0.49	0.79	0.99	1.23	1.67	7.96	5.67	5.17	7.12	11.13
12AUG	17	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.46
12AUG	18	0.84	0.49	0.77	0.97	1.46	1.46	7.43	5.37	4.96	7.12	13.19
12AUG	19	0.79	0.51	0.77	0.94	1.23	1.42	7.96	5.06	4.86	6.80	11.24
12AUG	20	0.86	0.53	0.81	1.02	1.32	1.46	8.28	5.17	5.06	7.12	12.61

Fig. 4.2 A tabular presentation of processed ARGOS wave data for August 12, 1993.

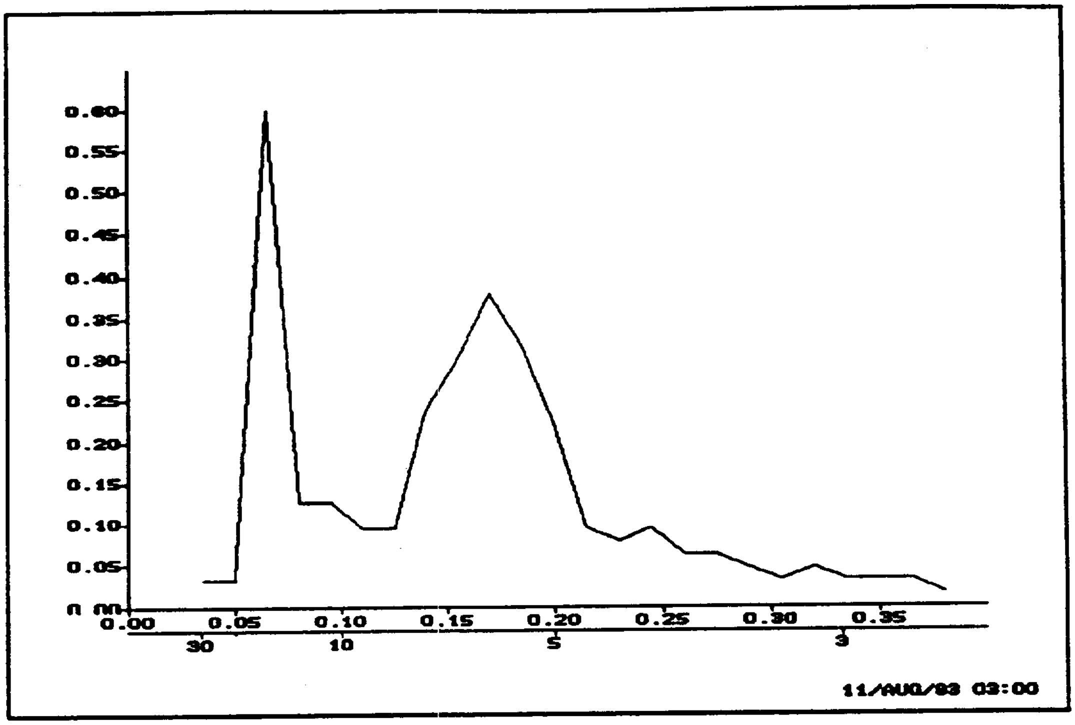


Fig. 4.3 Representative wave energy spectral plot.

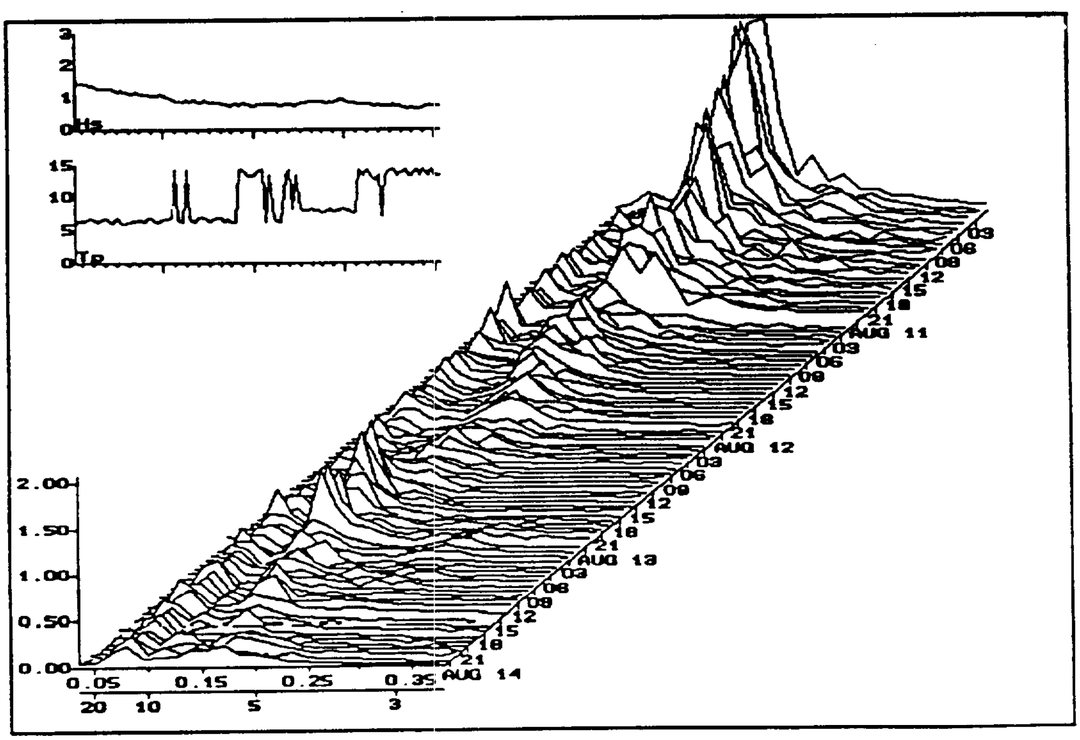


Fig. 4.4 "Time series" of wave spectral plots for the period August 10 - 13, 1993.

4.3 Complete Data Presentation

Appendix 2 presents computed parameters for all available satellite data collected during NOBE. Appendix 3 presents computed H_s and T_p for the data collected on CCGS ANN HARVEY during the attempted experiment on August 7 and the actual experiment on August 12. The shipboard data are interspersed with the ARGOS buoy data for comparison purposes. Given the separation of the two buoys and the range of the seastates at the time, the computed parameters from each buoy compare favourably. The format for data presented in each of these appendices follows that described for data product #2 of 4.2 above.

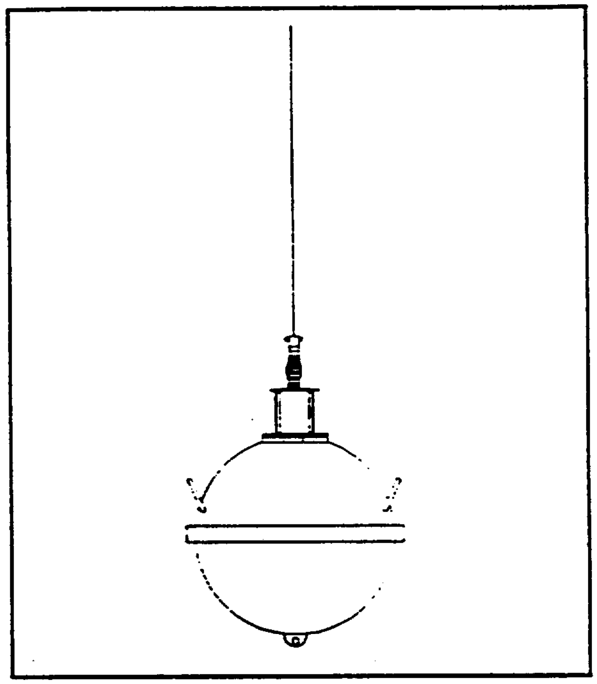
Appendix 4 presents all spectral data computed by the ARGOS Waverider. Format includes a record header with time and date, H_s, and T_p. Below that spectral energy values are presented for each of 24 frequency bands. A header at the top of the file provides key information to interpret each record. The spectral plots for each record can be re-constructed by simply plotting the listed energy values against the standard frequency band values.

The data presented in each of these appendices are provided in separate digital files in ASCII format on the accompanying diskette with explanatory documentation. ARGOS wave parameters are found in the file \ARGOSPAR.DAT; ARGOS spectral data are found in the file \ARGOSSPC.DAT; and ANN HARVEY shipboard wave data parameters (with comparative ARGOS data) are found in \SHIPPAR.DAT.

Appendix 1

Equipment Specifications

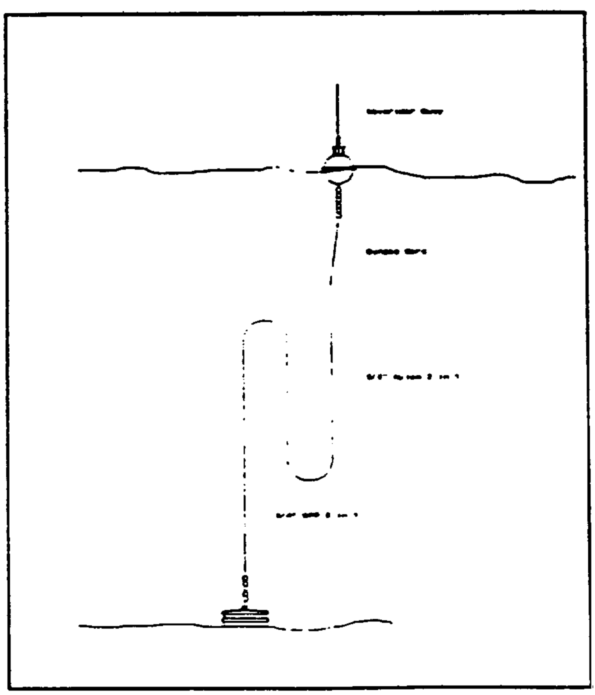
DATAWELL STANDARD WAVERIDER



General Description

The Waverider is a floating buoy which measures non-directional waves. Wave action is measured by a vertical accelerometer inside the Waverider as the buoy follows the movement of the sea surface. The buoy provides real time data from a remote location by means of a radio telemetry link to a land or vessel-based operating station. The Waverider is built by Datawell bv in The Netherlands and has long been the standard for wave data collection in Canada. A Datawell Waverider has been installed at almost every Canadian offshore drilling location over the past 15 years.

To avoid measurement of unwanted accelerations accompanying roll and pitch of the buoy (horizontal acceleration and decreasing effect of gravitation), the sensitive axis of the accelerometer is mounted on a stabilized platform. By this means, the sensitive axis of the accelerometer is kept within a few degrees of vertical. If the suspension of the accelerometer platform is entangled, the zero line of the wave record will become unstable. Such entanglement can occur if the Waverider is spun more than 6 times in a 2 minute period.



The DC analog signal produced by the accelerometer is converted into an fm square wave signal which in turn modulates the transmitter on/off. Transmission frequency is in the 27.5 - 28.0 MHz range with 0.2 Watt output. The phase-locked receiver will provide dependable reception over a range of up to 15 - 20 nautical miles if man-made noise is low and line of sight to the buoy is good. The analogue signal is digitized at the receiver at a rate of 2.56 Hz and provided to the operator's computer through RS232 output.

Seaconsult UNIWAVE software allows the operator to display incoming data and computed data products in near real time, will provide synoptic data records and reports, and will log all raw data in the best format for the immediate application.

The Waverider can be used in moored or free-floating applications. Waverider moorings are designed to include appropriate line scope and one or more 15-metre rubber shock cords to prevent the buoy from being submerged by forces caused by high currents or large waves. Seaconsult has successfully moored Waverider buoys in all seastate conditions in water depths between 20 and 1,650 metres.

SPECIFICATIONS

WAVERIDER

Diameter:	70 cm
Minimum Wave Ht.:	Ncise peak-peak (bandwidth 1 Hz) 0.02 m
Maximum Wave Ht.:	Twice max. amplitude = 2 x 20 m
Wave Freq. Range:	0.065-0.5 Hz (0.3 Db) 0.035-0.65 Hz (3 Db)

The wave amplitude with frequencies between 0.035 and 0.065 Hz can be corrected within 3% of their value from the frequency given.

Linearity:	Non linearity rectification $<2.10^{-3}$ m/sec.^{2} for 6 m/sec.^{2} amplitude.
Horizontal Sensitivity:	< 3% of vertical sensitivity.
Radiated Power:	80 mW ±20%
Battery Life:	>9 months

Maximum deviations from nominal if temperature of surrounding water is between -5 and +35°C:

Zero:	<0.5 m
Sensitivity:	<1.5%
Carrier freq.:	<500 Hz

Extreme Storage:	-5 to +40°C -55°C (weeks))

Maximum changes during one year at (20°C):

Sensitivity:	1.0%
Zero:	1.0 m
Platform angle:	1°
Carrier frequency:	300 Hz
Radiated power:	20%

DIGITAL WAVE DATA RECEIVER (DIWAR)

Construction:	Mounted in 48 cm cabinet, suitable for rack mounting.
Height:	3 units
Ambient temperature:	-10 to +40°C
Power requirement:	100-300 VAC, 40-2000 Hz (<10 VA) or 10-30 VDC (<0.5 W)
Antenna:	¼ wave "CB" whip
Range:	20-30 km
Receiver:	
Freq. range:	27.5-28.0 MHz
Sensitivity:	0.2 Uv into 50 Ω
Bandwidth:	Receiver, 2.4 kHz (6 dB) Phase-lock system, 3 Hz (3 dB)
Output:	DC output
Sensitivity:	0.2 V/m vertical displacement
Range:	±4.1 V (±20.48 m)
Overall linearity (incl. Waverider):	Within 0.4%
Accuracy within temperature range (incl. Waverider):	Within 3.5%
Load impedance:	>10 kΩ
Filter:	anti-aliasing, 5th order low-pass filter (0.6 Hz (3 dB))
Baud Rate RS232c	300,600,1200 or 2400 baud selected by jumper.

2 - The Argos System

2.1 - Introduction

The Argos system provides an operational satellite-based means to collect, locate, and disseminate environmental data from fixed and mobile platforms.

Argos is the result of a cooperative program between the Centre National d'Etudes Spatiales (CNES, the French Space Agency), the National Aeronautics and Space Administration (NASA, USA) and the National Oceanic and Atmospheric Administration (NOAA, USA).

The Argos onboard package is carried by NOAA satellites. Two spacecraft simultaneously in circular, polar orbit are operationally scheduled to provide the Argos system with complete global coverage.

The Argos system comprises three separate segments which affect the performance you can expect as a user.

The three segments, described below, are:
- the user platforms,
- the satellites, and
- the Argos processing centers.

2.2 - Platforms

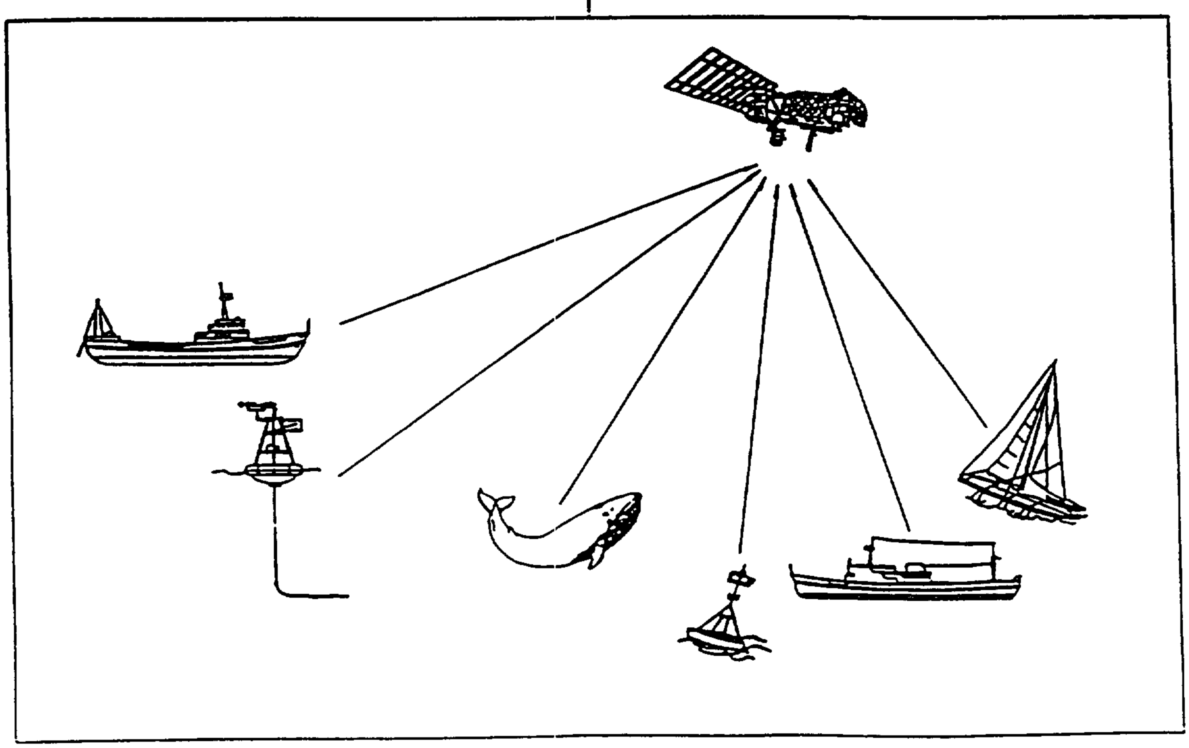
2.2.1 - Description

An Argos platform is a data acquisition station transmitting via the Argos system. Each platform has an ID number, uniquely assigned to its Platform Transmitter Terminal (PTT).

Features of the signals transmitted by Argos platforms include:

- transmit frequency (401.650 MHz ± 1.2 kHz), which must remain stable since the location computation is based on Doppler shift measurements,
- repetition period, assigned exclusively by Service Argos according to the application. Location-type platforms have repetition periods less than or equal to 120 seconds, and data collection platforms greater than 200 seconds,
- the message, comprising a synchronization preamble, an indicator stating the number of transmitted sensor data bits (32 - 256), the platform ID number, and the sensor data (32-256 bits).

The transmission duration is 360 to 920 milliseconds, as a function of the message length.



2.2.2 - Programs

Platforms implemented for the same purpose and belonging to the same user are grouped together in "programs". However, a program can comprise different types of platforms, for example location-type and data-collection-only. Sensor data for different platforms or sensors can be processed differently.

2.3 - Satellites

2.3.1 - Description

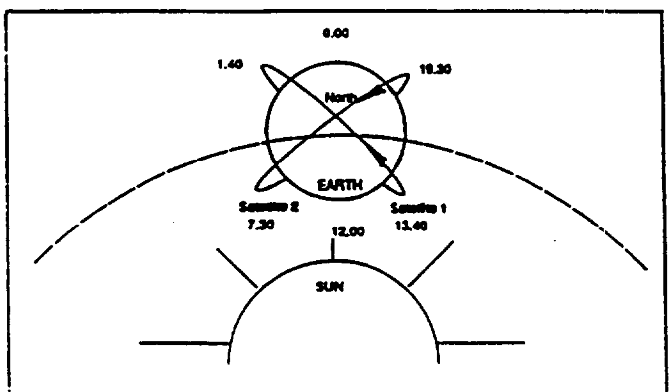
The space segment of the Argos system comprises two NOAA satellites of the TIROS family, simultaneously in terrestrial orbit at altitudes around 850 km. Each spacecraft carries the Argos Data Collection and Location System (DCLS). This onboard package receives and records the platform messages, then "dumps" them to ground stations.

2.3.2 - Satellite orbit, and how it affects users

a - Orbit

Circular, near-polar orbits
The satellites see both the North and South Poles on each orbital revolution.

Sun-synchronous orbits

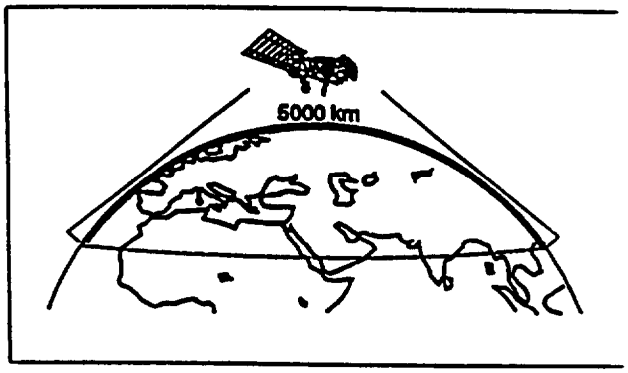


- The orbital planes rotate about the polar axis at the same rate as the Earth about the Sun, or one complete revolution a year.
- Each orbit transects the equatorial plane at fixed local solar times. Each satellite passes within visibility of any given platform at around the same local time every day.

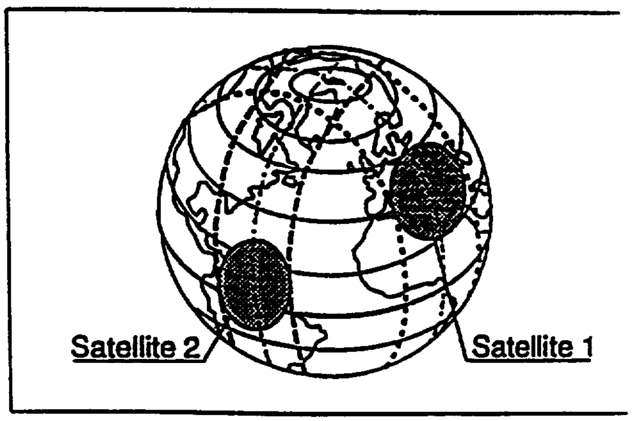
The orbital period, or time to complete a revolution about the Earth, is approximately 102 minutes. Each satellite therefore makes about 14 revolutions a day.

b - Visibility area

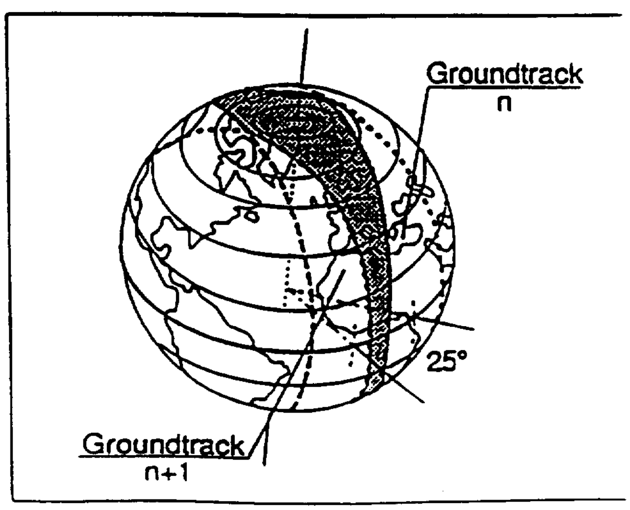
Each satellite simultaneously sees all platforms within a 50(km-diameter "footprint", or visibility circle.



As the satellite moves along its orbit, the visibility circle swe a 5000-km swath around the Earth, covering both poles.



As a result of the Earth's rotation, the swath shifts 25° west (2£ km at the Equator) about the polar axis on each revolution. Th is thus sidelap between successive swaths.



c - Pass frequency duration

PTT LATITUDE (°)	CUMULATIVE VISIBILITY over 24 hours	MINIMUM NUMBER OF PASSES per 24 hours	MEAN NUMBER OF PASSES per 24 hours	MAXIMUM NUMBER OF PASSES per 24 hours
0 degree	80 min.	6	7	8
± 15 degrees	88 min.	8	8	9
± 30 degrees	100 min.	8	9	12
± 45 degrees	128 min.	10	11	12
± 55 degrees	170 min.	16	16	18
± 65 degrees	246 min.	21	22	23
± 75 degrees	322 min.	28	28	28
± 90 degrees	384 min.	28	28	28

Because sidelap increases with latitude, the number of daily passes over a platform is a function of latitude. At the poles, the satellites see each platform on every pass, i.e. 28 times a day for two satellites.

The duration of platform visibility by the spacecraft (or of the pass duration over the platform) is the "window" during which the satellite can receive messages from the platform. It lasts 10 minutes on the average. The table above gives an idea of the satellite visibility that can be expected over a 24-hour period at different latitudes.

2.3.3 - Coverage

The messages received by the DCLS are processed on board and retransmitted to the ground in real-time. They are also recorded on board throughout the orbital revolution, and retransmitted in a delayed-time mode.

These two data sources can be characterized by "regional" coverage and "global" coverage, respectively, with different performance capabilities.

a - Global coverage

Messages received and recorded by the onboard DCLS are "dumped" to ground, generally once per revolution when the satellite is within visibility of one of the three ground stations (Fairbanks, Wallops Island, and Lannion).

They are then routed to the Argos processing centers where the results are processed and made available to users.

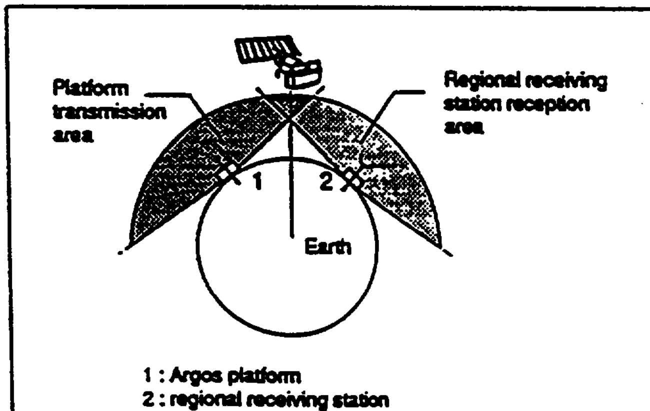
On average, over three-quarters of the processed results are available to users within three hours of message receipt by the DCLS.

The current data availability as a function of time is as follows:

< 2hrs	< 3hrs	< 4hrs	< 5hrs	< 6hrs
42%	78%	85%	92%	94%

b - Regional coverage

Service Argos is presently using the same stations as above (Fairbanks, Wallops Island, Lannion) for regional reception. The stations receive the telemetry transmitted in real-time by the onboard DCLS and retransmit it to the Argos processing centers.



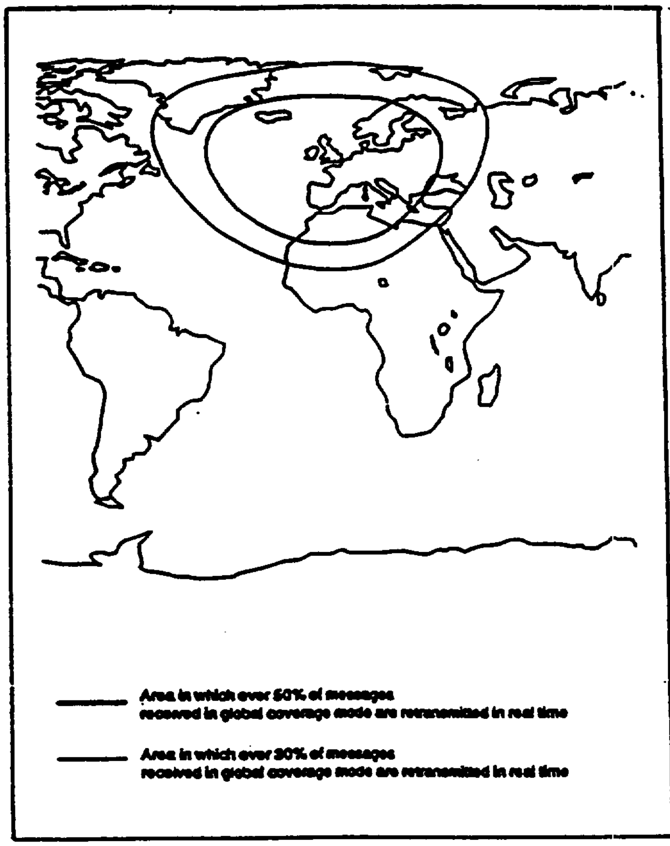
Regional coverage is achieved when the satellite simultaneously sees a Regional Receiving Station (RRS) and a particular platform.

The number of messages received in this mode is usually lower than with global coverage, and decreases with the distance from the platform to the station.

The regional coverage (station visibility) areas are shown below. The schematic shows two areas:

- in the first area, over 50% of the messages received by the onboard DCLS and retransmitted in delayed time (global coverage) are received in real-time,
- in the second, the larger of the two areas, the proportion is over 30%.

RRS visibility areas:



Messages received under regional coverage are forwarded to the Argos processing centers where the results are processed and made available to users.

This type of coverage provides users with their results within less than 20 minutes after collection by the DCLS.

2.4 - Argos Processing Centers

Messages transmitted by user platforms, received by the satellites and relayed to the ground stations arrive at the Argos Global Processing Centers (GPCs).

2.4.1 - Introduction

There are two Argos Global Processing Centers: the French GPC (FRGPC) in Toulouse and the United States GPC (USGPC) in Landover. The centers are identical and redundant. The USGPC serves United States and Canadian users, and the FRGPC the other users.

The centers' main tasks are:

- telemetry acquisition,
- processing and formatting of location and sensor data,
- managing results: making them available to users, dissen nation,
- system performance monitoring and calculation of the satellite orbits.
- provide back-up for the other center.

2.4.2 - Acquisition, processing, results

a - Telemetry acquisition

During the acquisition process, the work of the GPC include

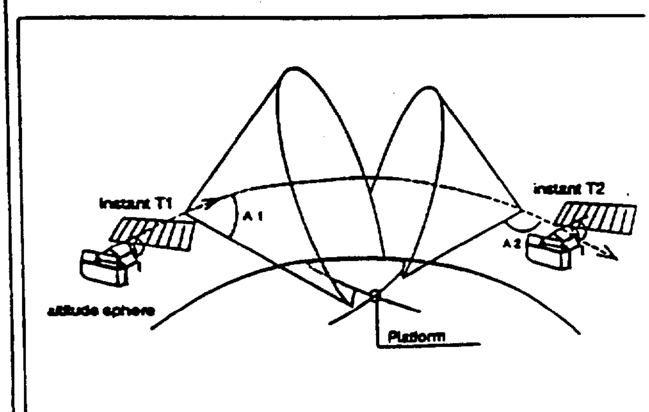
- telemetry decommutation and message regeneration; on the messages to be processed by the center concerned a retained for the following operations.
- quality control, including checking of message time-taggin signal level, PTT ID number, length of sensor data sectio and reception frequency for use in Doppler calculation.
- time-tagging in Coordinated Universal Time (UTC).
- message classification by platform and by ascending chron logical order.

b - Data processing

This is the conversion of the platform message into location sensor data.

• Location

Argos location is achieved by measuring the "Doppler shift" the platform signals. Doppler shift is the name given to t change in frequency of a sound or electromagnetic wave wh a source and a "listener" are in relative motion.



A common example of this phenomenon is the changing pit heard when a train approaches (higher pitch) or moves aw from (lower pitch) a listener.

When a satellite "approaches" a PTT, the frequency of the electromagnetic waves measured by the DCLS is higher than the transmit frequency (nominal frequency), and lower when the satellite moves away.

The principle of the Argos location calculation is as follows. Each time a message is received, the DCLS measures the receive frequency and time-tagging the message arrival.
The nominal platform transmit frequency is estimated using the set of reception frequencies.
For each message, a location "cone" is obtained from satellite orbital data, the calculated nominal frequency and the reception frequency.
The position is given by the intersection of the cones obtained with the platform altitude sphere.

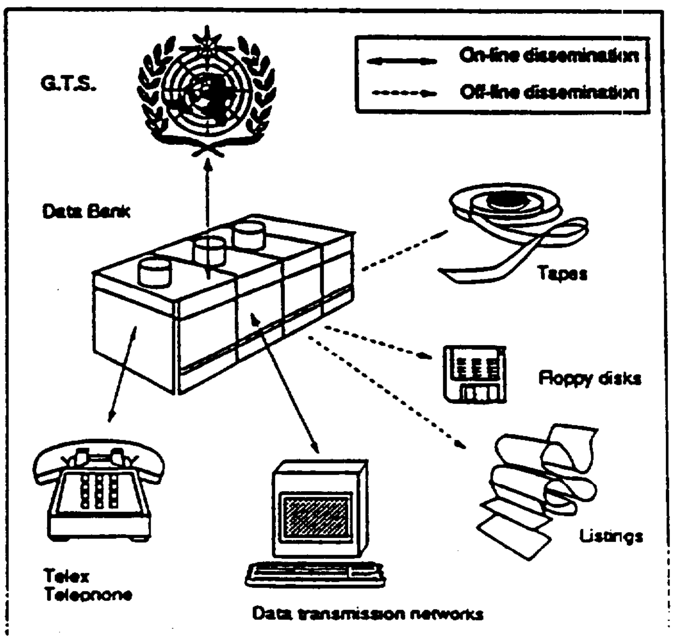
Only platforms for which the user explicitly requests location processing are located in this way.

• **Sensor data processing**
The data generated by the different sensors on each platform are processed independently of each other.

c - Managements of results

All processed results are stored on disks and input to the Argos databank. Results management essentially comprises updating results, eliminating identical messages in overlapping orbits, files and the databank.

d - Dissemination of results



2.4.3 - Regional Argos centers

To shorten communication times, reduce throughput times for delivery of results and make access to the system easier, CLS has designed Argos Regional Processing Centers (RPCs).
Such centers assure standard Argos services locally and provide real-time regional coverage.
The Australian RPC has been installed in Melbourne.
Since May 1989, the Melbourne RPC has assured the entire processing line and a local Users Guidance Office has been completed.

Appendix 2

Complete Summary of Data Parameters
computed for the NOBE ARGOS Waverider

All summary wave data parameter values received through ARGOS from the Seaconsult Waverider at the NOBE site are presented here in Tabular form. The list below describes each parameter. The data presented here have also been provided in digital format in the ASCII text file \ARGOS.DAT.

Frequency Domain (Spectral Analysis)

$S(f)$	Wave energy spectrum consisting of energy determined for 24 bands covering a frequency range having equivalent wave periods of 2.5 s to 28.6 s.
H_{mo}	Significant Wave Height. Spectral approximation of H_s. Statistical computation of H_s is described below. H_{mo} is proportional to the area under the curve in the spectral plot.
T_p	Peak Period. This is the period associated with the peak energy in the computed spectrum.
T_z	Mean Wave Period. Also referred to as $T_{mo,2}$. Spectral approximation of the mean wave period, T_a (see below).

Time Domain (Upcrossing Analysis)

H_3	Significant Wave Height. Average height of the 1/3 largest waves in a sample (also referred to as H_s or $H_{1/3}$).
T_3	Significant Wave Period. Average period of the 1/3 largest waves in a sample.
H_{max}	Maximum Wave Height. Height of the largest single wave in a sample.
T_{max}	Maximum Wave Period. This does not necessarily correspond to the H_{max} wave.
MCS	Maximum Combined Sea. The separation between the highest peak and the lowest trough in a sample. This is not necessarily a measure of the highest single wave.
H_{10}	Average height of the 1/10 largest waves.
H_a	Average Wave Height of a sample.
T_a	Average Wave Period of a sample.

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
02AUG	03	2.78	1.87	1.91	1.91	1.91	1.91	22.21	20.09	20.74	21.14	21.27
02AUG	04	0.04	0.02	0.04	0.05	0.07	0.09	28.52	4.36	3.38	4.56	21.27
02AUG	05	0.04	0.02	0.05	0.06	0.11	0.13	28.52	5.47	4.36	6.39	30.00
02AUG	06	0.04	0.02	0.04	0.05	0.09	0.13	28.52	5.27	4.36	6.39	29.26
02AUG	07	0.05	0.02	0.05	0.07	0.13	0.17	28.52	5.37	3.77	5.57	30.00
02AUG	08	0.04	0.02	0.05	0.07	0.11	0.15	28.52	5.37	3.97	5.47	30.00
02AUG	09	0.05	0.02	0.05	0.07	0.14	0.18	28.52	7.33	5.17	7.85	30.00
02AUG	10	2.78	1.91	1.95	1.95	2.00	2.04	11.81	11.81	11.81	12.04	13.19
02AUG	11	2.04	0.65	1.87	4.08	6.18	6.62	28.52	22.07	20.48	30.00	30.00
02AUG	12	0.04	0.02	0.04	0.06	0.10	0.11	28.52	6.91	4.36	7.22	30.00
02AUG	13	0.05	0.02	0.05	0.07	0.11	0.15	28.52	7.85	5.77	10.24	30.00
02AUG	14	0.79	0.49	0.74	0.91	1.08	1.26	7.12	6.29	6.29	6.91	13.08
02AUG	15	0.89	0.55	0.81	1.05	1.29	1.36	5.67	6.29	6.18	6.49	18.04
02AUG	16	0.81	0.51	0.79	1.02	1.46	1.49	8.71	7.33	7.12	7.85	12.15
02AUG	17	0.67	0.41	0.65	0.84	1.02	1.17	9.58	7.75	7.85	8.39	15.69
02AUG	18	0.70	0.39	0.65	0.84	1.20	1.23	11.13	8.49	7.75	9.36	16.79
02AUG	19	0.81	0.49	0.77	0.97	1.42	1.42	8.28	6.08	5.88	8.07	17.17
02AUG	20	0.84	0.49	0.79	0.94	1.26	1.87	7.12	6.08	5.77	7.64	12.84
02AUG	21	0.86	0.53	0.84	1.02	1.29	1.39	7.64	6.08	5.98	7.85	14.01
02AUG	22	0.84	0.51	0.79	0.99	1.29	1.53	7.43	5.57	5.27	6.91	12.04
02AUG	23	0.99	0.57	0.89	1.11	1.56	1.95	8.28	4.86	4.46	6.08	12.04
03AUG	00	0.91	0.55	0.84	1.08	1.42	1.53	7.43	5.06	4.66	6.91	11.81
03AUG	01	0.86	0.55	0.81	0.99	1.49	1.64	7.43	4.66	4.56	6.29	11.92
03AUG	02	0.91	0.55	0.81	1.05	1.49	2.13	8.71	4.46	4.07	5.17	10.13
03AUG	03	1.02	0.61	0.91	1.14	1.56	1.75	7.96	4.66	4.36	5.77	9.80
03AUG	04	0.94	0.57	0.86	1.05	1.42	1.53	7.96	4.86	4.56	5.98	11.81
03AUG	05	0.86	0.55	0.84	1.02	1.26	1.49	7.64	5.06	4.96	6.60	10.24
03AUG	06	0.81	0.51	0.74	0.94	1.20	1.39	7.64	4.66	4.46	5.98	10.80
03AUG	07	0.84	0.53	0.77	0.94	1.56	1.60	8.28	4.66	4.66	6.18	12.27
03AUG	08	0.89	0.53	0.81	1.02	1.39	1.67	7.96	4.46	4.36	5.77	10.02
03AUG	09	0.99	0.59	0.89	1.14	1.67	1.87	6.49	4.46	4.36	5.57	9.69
03AUG	10	0.97	0.63	0.91	1.11	1.29	1.67	7.43	4.46	4.46	5.98	9.91
03AUG	11	0.97	0.61	0.91	1.08	1.42	1.67	4.36	4.27	4.07	5.06	12.96
03AUG	12	0.97	0.59	0.89	1.14	1.91	2.08	7.96	4.36	4.07	5.27	11.13
03AUG	13	0.99	0.61	0.91	1.11	1.60	2.13	7.64	4.27	4.07	5.17	11.58
03AUG	14	0.99	0.61	0.91	1.11	1.83	2.13	4.46	4.27	4.07	5.27	11.02
03AUG	15	1.02	0.63	0.97	1.20	1.75	1.79	7.43	4.36	4.17	5.47	11.13
03AUG	16	0.99	0.61	0.91	1.14	1.60	1.83	4.46	4.36	4.07	4.96	8.49
03AUG	17	1.02	0.63	0.97	1.20	1.75	2.27	4.66	4.27	4.17	5.17	13.31
03AUG	18	1.08	0.70	1.05	1.29	1.60	2.18	4.56	4.36	4.46	5.17	10.24
03AUG	19	1.14	0.72	1.11	1.39	1.67	2.04	4.66	4.27	4.27	4.86	10.80
03AUG	20	1.08	0.65	1.02	1.23	1.95	2.57	4.66	4.56	4.36	5.47	10.68
03AUG	21	1.05	0.63	0.99	1.23	1.56	1.95	4.66	4.36	4.17	5.17	11.81
03AUG	22	1.08	0.67	1.02	1.23	1.75	2.04	4.66	4.36	4.36	5.37	10.68
03AUG	23	1.02	0.65	0.97	1.20	1.56	1.67	4.46	4.36	4.27	5.27	9.58

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
04AUG	00	1.05	0.67	0.99	1.23	1.56	1.91	4.66	4.46	4.36	5.27	10.35
04AUG	01	0.97	0.61	0.89	1.08	1.49	1.53	4.36	4.36	4.36	5.57	11.70
04AUG	02	0.99	0.59	0.91	1.20	2.57	2.73	4.96	4.46	4.17	5.57	11.58
04AUG	03	0.97	0.59	0.91	1.11	1.46	1.64	4.76	4.36	4.17	5.27	11.70
04AUG	04	0.97	0.59	0.89	1.14	1.64	2.18	4.66	4.17	3.97	5.06	11.36
04AUG	05	0.97	0.61	0.89	1.08	1.29	1.64	4.36	4.17	4.07	5.17	9.69
04AUG	06	0.99	0.63	0.94	1.14	1.46	1.83	4.17	4.27	4.07	4.86	9.47
04AUG	07	0.99	0.61	0.94	1.17	1.46	1.95	5.67	4.36	4.27	5.17	11.13
04AUG	08	0.91	0.59	0.84	1.05	1.26	1.53	5.27	4.36	4.17	5.06	13.43
04AUG	09	0.99	0.63	0.94	1.17	1.53	1.71	7.96	4.56	4.36	5.57	10.68
04AUG	10	0.94	0.57	0.89	1.11	1.95	2.00	5.27	4.66	4.27	5.57	11.02
04AUG	11	0.99	0.61	0.89	1.14	1.95	2.22	7.96	4.66	4.46	5.57	10.57
04AUG	12	0.91	0.57	0.86	1.05	1.39	1.49	5.67	4.56	4.36	5.47	10.80
04AUG	13	0.91	0.55	0.84	1.02	1.39	1.49	8.71	4.66	4.27	5.77	11.81
04AUG	14	0.91	0.55	0.84	1.08	1.79	2.00	7.96	4.56	4.36	5.47	11.13
04AUG	15	0.97	0.59	0.89	1.11	1.39	1.67	8.71	4.56	4.36	5.67	13.66
04AUG	16	0.99	0.63	0.94	1.17	1.53	1.91	8.28	4.36	4.17	5.37	11.36
04AUG	17	0.97	0.61	0.91	1.14	1.49	1.95	8.28	4.46	4.27	5.67	9.58
04AUG	18	1.05	0.67	0.97	1.17	1.36	1.95	7.96	4.27	4.17	5.17	10.80
04AUG	19	1.14	0.70	1.02	1.26	1.60	1.87	8.28	4.36	4.17	5.17	10.68
04AUG	20	1.20	0.72	1.11	1.42	2.08	2.67	7.43	4.46	4.17	5.27	12.27
04AUG	21	1.05	0.67	1.02	1.23	1.60	1.91	4.86	4.46	4.36	5.47	10.46
04AUG	22	1.02	0.65	0.97	1.20	1.64	1.71	4.96	4.56	4.36	5.57	11.36
04AUG	23	0.99	0.63	0.97	1.20	1.53	1.75	4.66	4.56	4.56	5.57	9.36
05AUG	00	0.99	0.63	0.94	1.20	1.49	1.67	4.76	4.66	4.56	5.67	10.91
05AUG	01	0.89	0.57	0.84	1.02	1.32	1.91	4.86	4.46	4.46	5.67	10.91
05AUG	02	0.94	0.59	0.89	1.11	1.60	1.71	8.28	4.36	4.27	5.37	9.14
05AUG	03	0.99	0.61	0.91	1.14	1.60	2.13	7.96	4.27	4.07	4.96	10.24
05AUG	04	1.02	0.65	0.97	1.20	1.53	1.95	4.36	4.27	4.27	4.86	9.58
05AUG	05	0.99	0.61	0.91	1.14	1.42	1.79	4.27	4.27	4.07	5.06	10.80
05AUG	06	1.02	0.65	0.97	1.20	1.67	1.83	4.36	4.27	4.17	5.06	10.02
05AUG	07	0.89	0.57	0.84	1.02	1.20	1.64	4.07	4.17	4.07	5.06	11.47
05AUG	08	0.89	0.55	0.84	1.05	1.42	1.64	7.12	4.17	4.07	5.37	13.08
05AUG	09	0.84	0.53	0.81	0.97	1.20	1.79	7.64	4.36	4.17	5.37	11.36
05AUG	10	0.84	0.53	0.79	0.97	1.26	1.79	3.97	4.27	4.17	5.27	10.91
05AUG	11	0.91	0.59	0.86	1.05	1.46	1.56	3.97	4.17	4.07	5.17	11.24
05AUG	12	0.91	0.59	0.86	1.05	1.36	1.53	3.97	4.07	3.97	4.86	10.02
05AUG	13	0.81	0.51	0.74	0.89	1.23	1.42	7.64	4.07	3.97	4.86	9.25
05AUG	14	0.81	0.51	0.74	0.86	1.08	1.32	7.64	4.27	3.87	4.96	9.47
05AUG	15	0.84	0.53	0.79	0.94	1.29	1.83	7.64	4.27	4.17	5.37	11.92
05AUG	16	0.79	0.49	0.74	0.94	1.36	1.53	3.87	3.97	3.77	4.76	10.35
05AUG	17	0.74	0.47	0.70	0.86	1.26	1.46	7.43	4.17	4.07	5.17	9.69
05AUG	18	0.79	0.47	0.70	0.86	1.42	2.00	7.43	4.27	4.07	5.06	10.46
05AUG	19	0.81	0.49	0.74	0.97	1.87	2.18	7.43	4.17	3.97	5.17	9.47
05AUG	20	0.74	0.47	0.70	0.84	1.14	1.46	7.64	4.17	3.97	4.96	9.58
05AUG	21	0.77	0.49	0.70	0.89	1.39	1.42	7.43	4.27	3.97	5.06	11.02
05AUG	22	0.74	0.47	0.67	0.86	1.14	1.46	3.87	4.27	4.07	5.17	14.85
05AUG	23	0.72	0.45	0.65	0.79	0.99	1.26	8.28	4.07	3.87	5.06	10.35

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
06AUG	00	0.77	0.47	0.67	0.84	1.05	1.64	7.43	4.07	3.87	4.86	11.36
06AUG	01	0.72	0.45	0.67	0.84	1.02	1.29	7.96	4.17	3.97	5.06	9.91
06AUG	02	0.70	0.43	0.63	0.79	1.17	1.64	7.96	4.36	4.17	5.47	10.02
06AUG	03	0.65	0.41	0.61	0.74	0.97	1.20	7.43	4.36	4.17	5.37	11.36
06AUG	04	0.67	0.41	0.61	0.77	1.14	1.17	8.71	4.66	4.46	6.18	13.19
06AUG	05	0.77	0.49	0.72	0.89	1.20	1.60	7.64	4.07	4.07	5.06	10.80
06AUG	06	0.70	0.43	0.63	0.79	1.23	1.32	7.43	4.07	3.87	4.86	10.35
06AUG	07	0.77	0.49	0.70	0.86	1.08	1.39	9.14	4.07	3.87	4.76	9.58
06AUG	08	0.86	0.55	0.77	0.94	1.26	1.60	4.17	3.97	3.77	4.36	9.36
06AUG	09	0.94	0.59	0.86	1.05	1.39	1.83	4.27	4.07	4.07	4.66	10.02
06AUG	10	0.99	0.61	0.91	1.17	1.56	1.64	4.56	4.07	3.97	4.56	9.03
06AUG	11	1.02	0.63	0.99	1.23	1.60	2.00	4.76	4.17	4.07	4.76	10.24
06AUG	12	1.17	0.74	1.08	1.36	2.73	2.78	4.56	4.36	4.17	4.96	11.47
06AUG	13	1.26	0.79	1.20	1.42	1.75	2.27	5.17	4.36	4.27	5.06	10.80
06AUG	14	1.49	0.97	1.46	1.75	2.27	2.95	4.86	4.17	4.17	4.76	7.96
06AUG	15	1.91	1.17	1.83	2.27	3.07	3.51	5.67	4.66	4.46	5.27	8.49
06AUG	16	2.00	1.23	1.95	2.41	3.07	3.79	5.88	4.76	4.56	5.57	10.80
06AUG	17	1.91	1.20	1.83	2.27	3.13	3.72	6.29	4.96	4.76	5.98	12.50
06AUG	18	1.83	1.14	1.71	2.18	3.07	3.07	6.49	5.06	4.96	5.98	10.91
06AUG	19	1.83	1.05	1.71	2.32	3.19	3.31	6.91	5.67	5.17	6.70	15.33
06AUG	20	1.95	1.20	1.87	2.32	2.78	3.01	7.43	5.98	5.77	6.80	9.25
06AUG	21	1.95	1.20	1.87	2.32	2.89	3.31	7.12	5.98	5.77	7.12	12.84
06AUG	22	1.67	1.02	1.60	1.95	2.62	2.73	7.64	5.77	5.67	6.91	10.02
06AUG	23	1.49	0.89	1.42	1.83	2.32	2.32	7.64	5.67	5.37	7.22	11.13
07AUG	00	1.71	1.05	1.67	2.08	2.62	2.67	7.43	5.57	5.57	6.91	10.46
07AUG	01	1.56	0.94	1.46	1.83	2.78	2.95	6.91	5.47	5.37	6.80	10.68
07AUG	02	1.42	0.86	1.36	1.64	2.18	2.73	7.64	5.47	5.27	6.80	10.13
07AUG	03	1.42	0.89	1.36	1.67	1.95	2.41	7.64	5.27	5.27	6.80	9.69
07AUG	04	1.36	0.81	1.32	1.64	1.95	2.57	7.43	5.17	4.76	6.29	9.25
07AUG	05	1.36	0.79	1.26	1.60	2.22	2.51	6.70	5.17	4.76	6.29	12.73
07AUG	06	1.20	0.70	1.14	1.42	1.87	2.13	6.49	4.96	4.46	5.77	9.80
07AUG	07	1.20	0.72	1.14	1.42	1.95	2.22	7.43	5.06	4.66	6.18	9.58
07AUG	08	1.11	0.70	1.08	1.32	2.00	2.32	7.12	5.06	5.06	6.39	11.02
07AUG	09	1.02	0.63	0.94	1.14	1.53	1.64	7.43	5.06	4.76	6.29	9.14
07AUG	10	0.99	0.61	0.94	1.17	1.46	1.64	7.12	5.27	5.06	6.49	11.24
07AUG	11	0.99	0.59	0.91	1.14	1.60	1.71	9.58	5.67	5.27	7.01	11.13
07AUG	12	1.05	0.63	0.99	1.20	1.42	1.64	9.58	5.77	5.77	7.43	11.24
07AUG	13	1.11	0.70	1.05	1.26	1.42	1.91	9.14	6.29	6.29	7.85	10.91
07AUG	14	1.08	0.63	0.99	1.23	1.49	1.79	9.14	6.18	5.98	8.07	12.27
07AUG	15	1.05	0.65	1.02	1.20	1.60	1.67	9.14	6.08	6.18	8.07	11.47
07AUG	16	0.94	0.55	0.89	1.14	1.75	1.79	8.28	5.88	5.57	7.22	12.38
07AUG	17	0.97	0.59	0.94	1.14	1.32	1.56	8.28	6.08	5.98	7.75	16.06
07AUG	18	1.02	0.61	0.97	1.23	1.71	1.71	8.71	6.18	5.88	7.43	10.80
07AUG	19	0.97	0.55	0.89	1.14	1.53	1.91	8.28	6.08	5.67	7.43	11.47
07AUG	20	0.91	0.55	0.86	1.02	1.26	1.36	8.28	6.08	5.77	7.33	12.50
07AUG	21	0.89	0.55	0.86	1.05	1.23	1.39	7.64	5.88	5.88	6.91	13.19
07AUG	22	0.81	0.51	0.77	0.99	1.71	1.95	7.64	5.98	5.88	6.70	10.68
07AUG	23	0.79	0.49	0.77	0.94	1.36	1.36	7.12	5.67	5.88	6.80	11.24

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
08AUG	00	0.79	0.51	0.77	0.94	1.20	1.29	7.43	5.77	5.88	6.80	11.81
08AUG	01	0.81	0.49	0.77	0.91	1.23	1.29	7.43	5.77	5.77	6.70	17.04
08AUG	02	0.84	0.53	0.79	0.94	1.17	1.60	7.64	5.67	5.77	6.80	12.15
08AUG	03	0.81	0.51	0.79	0.97	1.20	1.36	6.49	5.57	5.77	6.70	13.08
08AUG	04	0.77	0.47	0.72	0.91	1.36	1.75	5.88	5.47	5.47	6.49	12.84
08AUG	05	0.81	0.51	0.77	0.94	1.17	1.32	7.43	5.67	5.47	6.70	11.24
08AUG	06	0.81	0.51	0.77	0.97	1.17	1.46	5.67	5.57	5.67	6.80	12.38
08AUG	07	0.79	0.47	0.72	0.89	1.49	1.75	6.91	5.88	5.57	6.60	12.50
08AUG	08	0.70	0.43	0.63	0.77	0.97	1.17	7.43	5.77	5.77	6.70	11.58
08AUG	09	0.74	0.47	0.70	0.81	0.97	1.17	7.12	5.98	6.18	7.12	11.36
08AUG	10	0.74	0.45	0.70	0.84	1.05	1.20	7.12	6.08	6.08	7.01	13.19
08AUG	11	0.86	0.51	0.81	1.05	1.32	1.56	7.43	6.18	5.88	6.91	12.50
08AUG	12	0.86	0.55	0.86	1.08	1.39	1.75	7.12	6.18	5.47	7.01	12.84
08AUG	13	0.91	0.57	0.89	1.11	1.67	1.79	6.70	5.17	4.96	6.70	9.80
08AUG	14	1.02	0.61	0.97	1.26	1.91	2.32	6.49	5.27	4.86	6.60	9.69
08AUG	15	0.99	0.63	0.97	1.17	1.49	1.67	7.64	4.96	4.76	6.18	11.02
08AUG	16	0.99	0.59	0.94	1.17	1.91	2.00	7.12	4.86	4.56	5.98	11.24
08AUG	17	0.99	0.61	0.94	1.14	1.60	1.71	6.91	5.06	4.86	6.39	12.73
08AUG	18	0.86	0.55	0.84	1.02	1.29	1.60	6.49	5.06	4.86	6.29	11.47
08AUG	19	0.97	0.57	0.91	1.14	1.46	2.08	6.91	4.76	4.36	5.67	8.93
08AUG	20	0.94	0.59	0.89	1.11	1.42	1.79	7.12	4.66	4.46	5.77	11.24
08AUG	21	0.94	0.57	0.86	1.11	1.56	2.36	7.43	4.56	4.17	5.27	8.93
08AUG	22	1.08	0.67	1.02	1.23	1.56	1.67	7.43	4.27	4.17	5.67	13.08
08AUG	23	1.08	0.65	0.99	1.23	1.83	2.27	7.43	4.17	3.77	4.66	8.71
09AUG	00	1.17	0.72	1.08	1.36	1.87	2.08	7.43	4.27	4.07	4.96	11.13
09AUG	02	1.32	0.81	1.26	1.56	2.04	2.78	7.64	4.46	4.46	5.77	11.13
09AUG	03	1.26	0.81	1.20	1.42	1.75	2.13	7.64	4.36	4.36	5.27	9.25
09AUG	04	1.23	0.77	1.14	1.39	1.95	2.13	7.64	4.56	4.46	5.67	10.68
09AUG	05	1.36	0.84	1.26	1.56	2.18	2.41	7.43	4.76	4.56	5.98	9.25
09AUG	06	1.36	0.86	1.29	1.64	2.22	2.73	7.12	4.86	4.96	6.08	10.02
09AUG	07	1.42	0.89	1.36	1.67	2.13	2.41	7.64	4.66	4.66	5.57	9.36
09AUG	08	1.60	0.99	1.53	1.87	2.57	2.57	5.27	4.86	4.66	5.67	9.69
09AUG	09	1.64	0.97	1.53	1.91	2.57	2.62	5.27	4.76	4.66	5.47	10.46
09AUG	10	1.49	0.94	1.46	1.75	2.27	2.32	7.43	4.76	4.76	5.57	11.58
09AUG	11	1.60	0.99	1.49	1.79	2.46	3.07	5.27	4.66	4.56	5.37	9.91
09AUG	12	1.53	0.97	1.46	1.83	2.22	2.89	5.37	4.66	4.56	5.57	9.58
09AUG	13	1.53	0.94	1.42	1.75	2.36	2.73	5.57	4.56	4.36	5.27	8.93
09AUG	14	1.64	0.99	1.56	1.91	2.36	2.62	5.37	4.66	4.46	5.67	10.24
09AUG	15	1.64	1.05	1.56	1.87	2.57	2.95	5.67	4.76	4.76	5.67	9.36
09AUG	16	1.60	0.99	1.53	1.87	2.78	3.07	5.57	4.66	4.56	5.77	14.85
09AUG	17	1.67	1.02	1.56	1.91	2.46	2.95	5.67	4.86	4.56	5.77	12.27
09AUG	18	1.60	0.99	1.53	1.95	2.89	3.19	5.67	4.76	4.56	5.57	9.80
09AUG	19	1.64	0.99	1.53	1.87	2.27	2.84	5.88	4.76	4.66	5.77	11.70
09AUG	20	1.64	1.02	1.56	1.83	2.18	2.73	6.08	4.86	4.76	5.88	8.60
09AUG	21	1.64	0.99	1.53	1.95	2.51	2.73	5.67	4.86	4.76	5.67	12.04
09AUG	22	1.53	0.97	1.49	1.83	2.18	2.41	5.88	5.06	4.96	5.88	9.03
09AUG	23	1.64	0.99	1.53	1.87	2.41	2.73	6.08	4.96	4.66	5.77	10.68

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
10AUG	01	1.53	0.91	1.42	1.79	2.46	2.51	5.67	4.86	4.66	5.67	10.35
10AUG	02	1.42	0.84	1.36	1.75	2.36	2.62	6.29	4.96	4.56	5.77	12.15
10AUG	03	1.46	0.91	1.39	1.79	2.27	2.46	6.29	4.86	4.86	5.77	9.03
10AUG	04	1.39	0.84	1.32	1.67	2.46	2.67	6.29	4.76	4.56	5.67	9.14
10AUG	05	1.36	0.86	1.29	1.67	2.41	2.57	6.70	4.86	4.96	6.08	9.36
10AUG	06	1.36	0.84	1.29	1.64	2.18	2.57	6.49	4.96	4.66	5.77	12.50
10AUG	07	1.26	0.79	1.20	1.49	2.04	2.18	6.08	4.76	4.66	5.77	11.81
10AUG	08	1.26	0.79	1.23	1.56	2.00	2.22	6.49	5.06	4.96	6.08	9.36
10AUG	09	1.26	0.79	1.20	1.46	1.87	2.13	6.70	5.06	4.86	5.98	9.58
10AUG	10	1.29	0.79	1.20	1.46	1.83	2.57	6.29	4.76	4.46	5.67	10.57
10AUG	11	1.26	0.79	1.20	1.46	2.18	2.32	5.88	4.86	4.76	5.88	9.58
10AUG	12	1.17	0.72	1.11	1.36	1.83	2.08	6.70	4.66	4.36	5.67	13.78
10AUG	13	1.23	0.77	1.17	1.39	1.83	1.95	6.08	4.66	4.66	5.88	11.24
10AUG	14	1.20	0.74	1.14	1.32	2.18	2.62	5.88	4.76	4.66	5.88	10.13
10AUG	15	1.14	0.72	1.05	1.29	1.87	2.00	6.08	4.76	4.66	5.88	11.70
10AUG	16	1.11	0.67	1.05	1.26	1.56	1.91	6.29	4.86	4.56	5.67	12.38
10AUG	17	1.17	0.72	1.11	1.39	1.91	2.27	6.29	5.06	5.06	6.18	12.96
10AUG	18	1.11	0.67	1.02	1.29	2.18	2.18	6.49	5.06	4.76	6.08	11.81
10AUG	19	1.08	0.67	1.02	1.23	1.60	1.95	6.08	5.06	5.06	6.29	10.68
10AUG	20	1.11	0.67	1.02	1.29	1.60	1.79	6.70	5.17	4.96	6.29	10.35
10AUG	21	1.05	0.65	0.99	1.17	1.46	1.64	6.70	4.96	4.86	5.77	9.69
10AUG	22	1.05	0.65	0.99	1.20	1.46	2.04	6.08	5.17	5.17	6.18	11.24
10AUG	23	1.08	0.67	1.02	1.20	1.49	1.95	6.29	5.06	5.17	6.18	12.73
11AUG	02	0.94	0.57	0.86	1.08	1.29	1.60	6.70	5.06	4.86	6.29	11.92
11AUG	03	0.89	0.53	0.81	0.99	1.17	1.56	14.25	5.27	4.76	6.49	12.61
11AUG	04	0.84	0.53	0.79	0.97	1.23	1.39	6.29	4.96	4.86	6.08	13.54
11AUG	05	0.84	0.53	0.77	0.94	1.17	1.32	6.08	4.96	4.86	6.18	11.47
11AUG	06	0.91	0.55	0.84	1.05	1.39	1.56	14.25	5.27	5.17	6.60	14.37
11AUG	07	0.86	0.53	0.81	0.99	1.49	1.56	6.49	5.17	4.86	6.18	11.70
11AUG	08	0.89	0.55	0.84	1.02	1.39	1.67	6.08	5.47	5.37	6.49	10.91
11AUG	09	0.84	0.53	0.79	0.94	1.26	1.39	6.91	5.37	5.27	6.39	10.68
11AUG	10	0.81	0.49	0.77	0.94	1.11	1.46	7.12	5.47	5.37	6.60	13.31
11AUG	11	0.89	0.55	0.84	0.99	1.23	1.39	6.70	5.57	5.37	6.49	11.92
11AUG	12	0.81	0.49	0.74	0.91	1.32	1.49	6.08	5.47	5.06	6.18	10.13
11AUG	13	0.84	0.53	0.79	0.99	1.17	1.42	6.49	5.37	5.37	6.08	13.43
11AUG	14	0.81	0.51	0.77	0.97	1.39	1.46	6.91	5.67	5.57	6.80	13.66
11AUG	15	0.79	0.47	0.72	0.86	1.05	1.42	6.70	5.47	5.27	6.49	13.78
11AUG	16	0.77	0.47	0.70	0.86	1.11	1.26	6.08	5.27	5.17	6.49	13.19
11AUG	17	0.74	0.45	0.70	0.86	1.08	1.20	6.49	5.37	5.47	6.49	12.15
11AUG	18	0.72	0.43	0.67	0.84	1.02	1.36	6.08	5.27	5.17	6.49	12.15
11AUG	19	0.81	0.51	0.79	0.94	1.20	1.49	6.08	5.57	5.57	7.01	13.54
11AUG	20	0.72	0.43	0.67	0.84	1.08	1.42	14.25	5.67	4.96	6.49	15.09
11AUG	21	0.81	0.49	0.74	0.94	1.75	1.83	14.25	5.57	4.96	6.60	12.38
11AUG	22	0.74	0.47	0.72	0.94	1.26	1.49	13.31	5.27	4.66	6.49	14.01

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
12AUG	00	0.70	0.43	0.65	0.79	1.17	1.46	13.31	4.76	4.27	5.98	12.04
12AUG	01	0.74	0.45	0.70	0.86	1.20	1.29	14.25	4.66	4.36	5.98	12.61
12AUG	02	0.77	0.47	0.70	0.89	1.05	1.26	14.25	4.86	4.56	6.08	12.50
12AUG	03	0.77	0.45	0.72	0.89	1.20	1.71	6.08	4.96	4.56	6.29	11.58
12AUG	04	0.74	0.45	0.67	0.86	1.23	1.32	13.31	4.86	4.56	6.18	12.38
12AUG	05	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.69
12AUG	06	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.31
12AUG	07	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.81
12AUG	08	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.08
12AUG	09	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.45
12AUG	10	0.74	0.45	0.67	0.84	1.11	1.46	8.28	5.17	5.17	7.01	14.37
12AUG	11	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.81
12AUG	12	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.19
12AUG	13	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.02
12AUG	14	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.91
12AUG	15	0.84	0.51	0.79	0.99	1.49	1.71	8.28	5.67	5.27	7.12	11.47
12AUG	16	0.84	0.49	0.79	0.99	1.23	1.67	7.96	5.67	5.17	7.12	11.13
12AUG	17	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.46
12AUG	18	0.84	0.49	0.77	0.97	1.46	1.46	7.43	5.37	4.96	7.12	13.19
12AUG	19	0.79	0.51	0.77	0.94	1.23	1.42	7.96	5.06	4.86	6.80	11.24
12AUG	20	0.86	0.53	0.81	1.02	1.32	1.46	8.28	5.17	5.06	7.12	12.61
12AUG	21	0.81	0.47	0.74	0.94	1.67	1.75	7.64	5.17	4.66	6.60	13.90
12AUG	22	0.89	0.53	0.81	0.99	1.39	1.56	7.96	4.86	4.76	6.49	13.54
12AUG	23	0.94	0.55	0.86	1.11	1.39	2.00	8.28	4.96	4.76	6.60	15.45

Appendix 3

H_s and T_p computed for conventional Waverider data received on board CCGS ANN HARVEY

H_s and T_p computed for the data collected from the conventional Waverider installed on the CCGS ANN HARVEY are included in this appendix. Also included here are listings of computed parameters for ARGOS data records which correlate to the conventional buoy data. Records from each buoy can be easily discriminated as only significant wave height and peak period are computed for the conventional buoy.

The list below describes each parameter. The data presented here have also been provided in digital format in the ASCII text file \SHIP.DAT.

Frequency Domain (Spectral Analysis)

S(f)	Wave energy spectrum consisting of energy determined for 24 bands covering a frequency range having equivalent wave periods of 2.5 s to 28.6 s.
H_{mo}	Significant Wave Height. Spectral approximation of H_s. Statistical computation of H_s is described below. H_{mo} is proportional to the area under the curve in the spectral plot.
T_p	Peak Period. This is the period associated with the peak energy in the computed spectrum.
T_z	Mean Wave Period. Also referred to as $T_{mo,2}$. Spectral approximation of the mean wave period, T_a (see below).

Time Domain (Upcrossing Analysis)

H_3	Significant Wave Height. Average height of the 1/3 largest waves in a sample (also referred to as H_s or $H_{1/3}$).
T_3	Significant Wave Period. Average period of the 1/3 largest waves in a sample.
H_{max}	Maximum Wave Height. Height of the largest single wave in a sample.
T_{max}	Maximum Wave Period. This does not necessarily correspond to the H_{max} wave.
MCS	Maximum Combined Sea. The separation between the highest peak and the lowest trough in a sample. This is not necessarily a measure of the highest single wave.
H_{10}	Average height of the 1/10 largest waves.
H_a	Average Wave Height of a sample.
T_a	Average Wave Period of a sample.

Date UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
02AUG 15	0.89	0.55	0.81	1.05	1.29	1.36	5.67	6.29	6.18	6.49	18.04
1538	0.87						7.69				
1558	0.92						8.33				
02AUG 16	0.81	0.51	0.79	1.02	1.46	1.49	8.71	7.33	7.12	7.85	12.15
1618	0.85						7.69				
1638	0.66						8.33				
1658	0.84						6.25				
02AUG 17	0.67	0.41	0.65	0.84	1.02	1.17	9.58	7.75	7.85	8.39	15.69
1718	0.92						9.09				
1738	0.68						8.33				
1758	0.82						9.09				
02AUG 18	0.70	0.39	0.65	0.84	1.20	1.23	11.13	8.49	7.75	9.36	16.79
1818	0.91						5.26				
1838	0.82						8.33				
1858	0.86						8.33				
02AUG 19	0.81	0.49	0.77	0.97	1.42	1.42	8.28	6.08	5.88	8.07	17.17
1918	0.82						14.29				
1938	0.76						14.29				
1958	0.87						7.14				
02AUG 20	0.84	0.49	0.79	0.94	1.26	1.87	7.12	6.08	5.77	7.64	12.84
2018	0.63						6.67				
2038	0.82						9.09				
2058	0.72						5.56				
02AUG 21	0.86	0.53	0.84	1.02	1.29	1.39	7.64	6.08	5.98	7.85	14.01
2118	0.96						6.67				
02AUG 22	0.84	0.51	0.79	0.99	1.29	1.53	7.43	5.57	5.27	6.91	12.04

Date UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
07AUG 05	1.36	0.79	1.26	1.60	2.22	2.51	6.70	5.17	4.76	6.29	12.73
558	0.00						33.33				
07AUG 06	1.20	0.70	1.14	1.42	1.87	2.13	6.49	4.96	4.46	5.77	9.80
618	2.97						25.00				
638	1.39						7.69				
658	1.22						6.67				
07AUG 07	1.20	0.72	1.14	1.42	1.95	2.22	7.43	5.06	4.66	6.18	9.58
718	1.29						6.67				
738	1.20						6.67				
07AUG 08	1.11	0.70	1.08	1.32	2.00	2.32	7.12	5.06	5.06	6.39	11.02
838	1.22						6.25				
07AUG 09	1.02	0.63	0.94	1.14	1.53	1.64	7.43	5.06	4.76	6.29	9.14
07AUG 10	0.99	0.61	0.94	1.17	1.46	1.64	7.12	5.27	5.06	6.49	11.24
07AUG 11	0.99	0.59	0.91	1.14	1.60	1.71	9.58	5.67	5.27	7.01	11.13
1137	0.97						8.33				
07AUG 12	1.05	0.63	0.99	1.20	1.42	1.64	9.58	5.77	5.77	7.43	11.24
07AUG 13	1.11	0.70	1.05	1.26	1.42	1.91	9.14	6.29	6.29	7.85	10.91
1318	0.88						7.69				
1338	1.09						9.09				
1358	1.09						9.09				
07AUG 14	1.08	0.63	0.99	1.23	1.49	1.79	9.14	6.18	5.98	8.07	12.27
1418	1.25						8.33				
1438	1.03						8.33				
1458	0.91						7.69				
07AUG 15	1.05	0.65	1.02	1.20	1.60	1.67	9.14	6.08	6.18	8.07	11.47
1518	1.02						9.09				
1538	1.23						9.09				
1558	1.09						9.09				
07AUG 16	0.94	0.55	0.89	1.14	1.75	1.79	8.28	5.88	5.57	7.22	12.38
1618	0.95						7.14				
1638	1.07						8.33				
1658	1.05						9.09				
07AUG 17	0.97	0.59	0.94	1.14	1.32	1.56	8.28	6.08	5.98	7.75	16.06
1718	1.09						9.09				
1738	0.90						7.69				
1758	0.94						8.33				
07AUG 18	1.02	0.61	0.97	1.23	1.71	1.71	8.71	6.18	5.88	7.43	10.80
1818	0.93						8.33				
1838	0.94						9.09				
1858	1.01						9.09				
07AUG 19	0.97	0.55	0.89	1.14	1.53	1.91	8.28	6.08	5.67	7.43	11.47
1918	1.20						8.33				
1938	0.96						7.69				
1958	0.97						8.33				

Date UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
07AUG 20	0.91	0.55	0.86	1.02	1.26	1.36	8.28	6.08	5.77	7.33	12.50
2018	0.95						7.14				
2038	0.81						7.69				
2057	0.94						7.69				
07AUG 21	0.89	0.55	0.86	1.05	1.23	1.39	7.64	5.88	5.88	6.91	13.19
2117	0.78						8.33				
2137	1.00						7.69				
2157	0.85						7.69				
07AUG 22	0.81	0.51	0.77	0.99	1.71	1.95	7.64	5.98	5.88	6.70	10.68
2217	0.90						6.25				
07AUG 23	0.79	0.49	0.77	0.94	1.36	1.36	7.12	5.67	5.88	6.80	11.24

Date UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
12AUG 05	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.69
538	0.00						33.33				
12AUG 06	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.31
638	0.31						33.33				
658	0.49						16.67				
12AUG 07	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.81
718	0.71						7.69				
738	0.60						9.09				
758	0.82						5.56				
12AUG 08	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.08
818	0.67						16.67				
838	0.68						7.69				
12AUG 09	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.45
937	0.65						6.25				
957	0.79						14.29				
12AUG 10	0.74	0.45	0.67	0.84	1.11	1.46	8.28	5.17	5.17	7.01	14.37
1017	0.77						12.50				
1037	0.74						7.69				
1057	0.85						6.25				
12AUG 11	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.81
1117	0.78						9.09				
1137	0.80						7.69				
1157	0.95						9.09				
12AUG 12	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.19
1217	0.82						9.09				
1237	0.73						9.09				
1257	0.96						8.33				
12AUG 13	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.02
1316	0.89						8.33				
1336	0.88						8.33				
1356	0.90						7.69				
12AUG 14	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.91
1416	0.89						8.33				
1436	0.91						7.69				
1456	0.84						8.33				
12AUG 15	0.84	0.51	0.79	0.99	1.49	1.71	8.28	5.67	5.27	7.12	11.47
1516	0.96						7.69				
1536	0.80						9.09				
1556	0.78						7.69				
12AUG 16	0.84	0.49	0.79	0.99	1.23	1.67	7.96	5.67	5.17	7.12	11.13
1616	0.83						14.29				
1636	0.85						7.69				
1656	0.97						8.33				

Date UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tmax
12AUG 17	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.46
1716	0.73						7.69				
1736	0.84						14.29				
1756	0.85						7.69				
12AUG 18	0.84	0.49	0.77	0.97	1.46	1.46	7.43	5.37	4.96	7.12	13.19
1816	0.77						7.69				
1836	0.82						7.14				
1856	0.64						7.69				
12AUG 19	0.79	0.51	0.77	0.94	1.23	1.42	7.96	5.06	4.86	6.80	11.24
1916	0.78						7.69				
1936	0.83						14.29				
1956	0.90						7.69				
12AUG 20	0.86	0.53	0.81	1.02	1.32	1.46	8.28	5.17	5.06	7.12	12.61
2016	0.81						8.33				
2036	0.89						7.14				
2056	0.94						8.33				
12AUG 21	0.81	0.47	0.74	0.94	1.67	1.75	7.64	5.17	4.66	6.60	13.90
2116	1.01						8.33				
2136	0.94						8.33				
2156	0.94						8.33				
12AUG 22	0.89	0.53	0.81	0.99	1.39	1.56	7.96	4.86	4.76	6.49	13.54
2216	0.89						7.69				
2236	0.89						7.69				
2256	0.83						7.14				
12AUG 23	0.94	0.55	0.86	1.11	1.39	2.00	8.28	4.96	4.76	6.60	15.45
2316	1.10						7.69				
2336	0.91						12.50				

Appendix 4

ARGOS Wave Spectrum Data

```
YY/MM/DD HH:MM    Hs       Tp
Frequency Estimate (Hz)
  0.035    0.050    0.065    0.080    0.095    0.110    0.125    0.140
  0.155    0.170    0.185    0.200    0.215    0.230    0.245    0.260
  0.275    0.290    0.305    0.320    0.335    0.350    0.365    0.380
```

```
93/08/02 03:00    2.780   22.205
  0.000   34.696    0.000    0.000    1.101    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 04:00    0.036   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 05:00    0.036   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 06:00    0.036   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 07:00    0.048   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 08:00    0.036   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 09:00    0.048   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 10:00    2.780   11.811
  0.000    0.000    0.000   33.860    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 11:00    2.041   28.520
 16.922    4.027    0.805    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 12:00    0.036   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 13:00    0.048   28.520
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
  0.000    0.000    0.000    0.000    0.000    0.000    0.000    0.000
93/08/02 14:00    0.789    7.117
  0.016    0.047    0.111    0.174    0.095    0.142    0.142    0.489
```

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.268	0.442	0.300	0.253	0.111	0.063	0.016	0.016
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93/08/02	15:00	0.889	5.672				
0.016	0.079	0.126	0.174	0.095	0.174	0.205	0.268
0.553	0.600	0.474	0.205	0.079	0.047	0.032	0.016
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93/08/02	16:00	0.814	8.709				
0.016	0.032	0.126	0.111	0.142	0.758	0.363	0.379
0.426	0.189	0.142	0.095	0.047	0.016	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93/08/02	17:00	0.673	9.578				
0.000	0.016	0.142	0.158	0.221	0.237	0.268	0.268
0.237	0.095	0.063	0.016	0.016	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93/08/02	18:00	0.696	11.132				
0.047	0.221	0.158	0.221	0.332	0.332	0.158	0.189
0.205	0.079	0.063	0.047	0.016	0.000	0.000	0.000
0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
93/08/02	19:00	0.814	8.280				
0.032	0.032	0.189	0.126	0.221	0.284	0.521	0.395
0.221	0.126	0.111	0.111	0.111	0.047	0.032	0.032
0.032	0.016	0.032	0.016	0.016	0.016	0.016	0.016
93/08/02	20:00	0.838	7.117				
0.063	0.047	0.142	0.095	0.174	0.411	0.395	0.521
0.300	0.174	0.142	0.063	0.095	0.047	0.047	0.032
0.016	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/02	21:00	0.863	7.642				
0.016	0.016	0.142	0.126	0.189	0.395	0.521	0.521
0.395	0.142	0.158	0.079	0.063	0.047	0.032	0.032
0.032	0.016	0.016	0.016	0.016	0.016	0.016	0.016
93/08/02	22:00	0.838	7.431				
0.016	0.016	0.126	0.095	0.111	0.253	0.474	0.458
0.426	0.111	0.142	0.095	0.111	0.079	0.047	0.047
0.063	0.063	0.047	0.047	0.016	0.016	0.016	0.016
93/08/02	23:00	0.995	8.280				
0.047	0.047	0.268	0.237	0.158	0.442	0.553	0.347
0.411	0.142	0.111	0.126	0.111	0.079	0.047	0.079
0.063	0.142	0.111	0.142	0.079	0.095	0.063	0.032
93/08/03	00:00	0.915	7.431				
0.016	0.016	0.174	0.189	0.174	0.347	0.347	0.647
0.363	0.142	0.095	0.095	0.063	0.047	0.063	0.047
0.079	0.063	0.047	0.047	0.047	0.032	0.016	0.016
93/08/03	01:00	0.863	7.431				
0.016	0.016	0.158	0.189	0.111	0.205	0.300	0.379
0.284	0.174	0.095	0.063	0.095	0.111	0.142	0.111
0.079	0.079	0.047	0.063	0.063	0.047	0.047	0.047

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

93/08/03	02:00	0.915	8.709				
0.047	0.032	0.111	0.237	0.158	0.300	0.268	0.284
0.205	0.142	0.111	0.079	0.126	0.126	0.142	0.189
0.142	0.079	0.079	0.095	0.063	0.063	0.047	0.047
93/08/03	03:00	1.022	7.960				
0.047	0.047	0.111	0.189	0.221	0.253	0.505	0.268
0.347	0.174	0.142	0.142	0.205	0.316	0.332	0.126
0.205	0.126	0.063	0.063	0.079	0.032	0.047	0.047
93/08/03	04:00	0.941	7.960				
0.016	0.016	0.174	0.174	0.142	0.268	0.411	0.379
0.253	0.253	0.158	0.079	0.158	0.142	0.316	0.158
0.142	0.063	0.047	0.047	0.047	0.047	0.032	0.032
93/08/03	05:00	0.863	7.642				
0.016	0.016	0.126	0.095	0.095	0.205	0.489	0.347
0.379	0.237	0.142	0.111	0.063	0.095	0.126	0.095
0.126	0.063	0.063	0.047	0.032	0.032	0.032	0.016
93/08/03	06:00	0.814	7.642				
0.016	0.016	0.079	0.111	0.111	0.126	0.363	0.284
0.284	0.174	0.158	0.111	0.063	0.079	0.142	0.111
0.079	0.063	0.047	0.032	0.032	0.032	0.032	0.032
93/08/03	07:00	0.838	8.280				
0.016	0.016	0.111	0.158	0.063	0.158	0.316	0.268
0.300	0.205	0.205	0.095	0.079	0.063	0.095	0.079
0.095	0.079	0.047	0.047	0.032	0.063	0.032	0.032
93/08/03	08:00	0.889	7.960				
0.016	0.016	0.095	0.111	0.063	0.221	0.426	0.379
0.363	0.221	0.174	0.126	0.063	0.047	0.063	0.063
0.079	0.063	0.095	0.126	0.079	0.063	0.047	0.047
93/08/03	09:00	0.995	6.492				
0.032	0.032	0.205	0.205	0.142	0.268	0.332	0.221
0.505	0.268	0.111	0.095	0.111	0.111	0.079	0.126
0.237	0.237	0.174	0.079	0.063	0.079	0.063	0.047
93/08/03	10:00	0.968	7.431				
0.063	0.047	0.111	0.095	0.095	0.205	0.505	0.568
0.221	0.158	0.095	0.079	0.079	0.126	0.253	0.174
0.189	0.189	0.111	0.095	0.079	0.063	0.079	0.047
93/08/03	11:00	0.968	4.365				
0.047	0.032	0.095	0.111	0.111	0.253	0.316	0.253
0.158	0.237	0.142	0.095	0.158	0.363	0.268	0.332
0.142	0.126	0.126	0.142	0.079	0.063	0.047	0.032
93/08/03	12:00	0.968	7.960				
0.111	0.095	0.237	0.158	0.111	0.142	0.379	0.284
0.189	0.142	0.079	0.126	0.095	0.268	0.268	0.189
0.253	0.126	0.111	0.095	0.063	0.032	0.047	0.063
93/08/03	13:00	0.995	7.642				
0.063	0.047	0.111	0.158	0.126	0.189	0.347	0.316

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
0.284	0.158	0.158	0.126	0.174	0.347	0.237	0.268
0.174	0.111	0.126	0.095	0.079	0.095	0.079	0.063
93/08/03	14:00	0.995	4.464				
0.079	0.063	0.221	0.174	0.126	0.332	0.174	0.174
0.221	0.095	0.063	0.142	0.221	0.426	0.205	0.189
0.174	0.142	0.142	0.079	0.095	0.095	0.063	0.063
93/08/03	15:00	1.022	7.431				
0.079	0.063	0.111	0.174	0.142	0.221	0.284	0.458
0.268	0.126	0.095	0.126	0.268	0.395	0.268	0.316
0.111	0.142	0.142	0.047	0.079	0.063	0.047	0.047
93/08/03	16:00	0.995	4.464				
0.047	0.032	0.095	0.158	0.063	0.253	0.253	0.284
0.253	0.174	0.189	0.268	0.284	0.316	0.332	0.205
0.126	0.111	0.095	0.079	0.079	0.047	0.063	0.047
93/08/03	17:00	1.022	4.664				
0.047	0.032	0.174	0.237	0.111	0.189	0.253	0.347
0.300	0.158	0.142	0.253	0.442	0.253	0.221	0.174
0.174	0.174	0.111	0.111	0.095	0.079	0.047	0.063
93/08/03	18:00	1.079	4.564				
0.063	0.063	0.126	0.237	0.111	0.268	0.174	0.268
0.268	0.237	0.142	0.205	0.600	0.426	0.568	0.189
0.221	0.158	0.079	0.079	0.063	0.079	0.063	0.047
93/08/03	19:00	1.137	4.664				
0.047	0.032	0.063	0.158	0.126	0.332	0.205	0.189
0.205	0.174	0.237	0.568	0.790	0.647	0.347	0.268
0.142	0.126	0.079	0.079	0.079	0.126	0.079	0.047
93/08/03	20:00	1.079	4.664				
0.111	0.063	0.158	0.221	0.142	0.221	0.316	0.237
0.347	0.174	0.363	0.442	0.521	0.395	0.205	0.158
0.221	0.126	0.063	0.095	0.095	0.063	0.063	0.032
93/08/03	21:00	1.050	4.664				
0.079	0.079	0.142	0.205	0.095	0.268	0.221	0.174
0.174	0.205	0.363	0.395	0.584	0.300	0.189	0.332
0.126	0.142	0.111	0.079	0.063	0.047	0.032	0.047
93/08/03	22:00	1.079	4.664				
0.095	0.079	0.142	0.205	0.111	0.205	0.174	0.284
0.347	0.205	0.221	0.284	0.663	0.316	0.300	0.189
0.126	0.189	0.158	0.079	0.079	0.079	0.063	0.047
93/08/03	23:00	1.022	4.464				
0.032	0.032	0.095	0.158	0.079	0.142	0.237	0.284
0.237	0.221	0.332	0.347	0.347	0.505	0.221	0.158
0.126	0.126	0.111	0.079	0.047	0.095	0.063	0.063
93/08/04	00:00	1.050	4.664				
0.016	0.016	0.111	0.142	0.158	0.126	0.237	0.237
0.284	0.205	0.379	0.442	0.632	0.442	0.347	0.142
0.158	0.079	0.079	0.079	0.063	0.063	0.063	0.032

YY/MM/DD HH:MM		Hs	Tp				
Frequency Estimate (Hz)							
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/04	01:00	0.968	4.365				
0.047	0.047	0.205	0.158	0.111	0.174	0.300	0.237
0.205	0.142	0.158	0.284	0.253	0.316	0.189	0.142
0.174	0.158	0.079	0.063	0.079	0.047	0.047	0.063
93/08/04	02:00	0.995	4.964				
0.095	0.063	0.142	0.221	0.142	0.158	0.237	0.189
0.300	0.253	0.189	0.395	0.221	0.300	0.284	0.158
0.126	0.095	0.095	0.079	0.063	0.063	0.047	0.032
93/08/04	03:00	0.968	4.763				
0.032	0.032	0.126	0.174	0.079	0.205	0.221	0.174
0.158	0.174	0.300	0.221	0.316	0.316	0.253	0.158
0.142	0.095	0.111	0.095	0.063	0.047	0.032	0.032
93/08/04	04:00	0.968	4.664				
0.063	0.063	0.142	0.142	0.111	0.189	0.205	0.158
0.142	0.268	0.221	0.189	0.395	0.253	0.158	0.142
0.158	0.205	0.079	0.142	0.079	0.142	0.063	0.047
93/08/04	05:00	0.968	4.365				
0.032	0.016	0.126	0.158	0.079	0.205	0.174	0.205
0.142	0.205	0.284	0.237	0.237	0.316	0.189	0.126
0.111	0.095	0.095	0.174	0.095	0.095	0.063	0.047
93/08/04	06:00	0.995	4.167				
0.032	0.032	0.047	0.158	0.079	0.189	0.411	0.174
0.174	0.158	0.205	0.268	0.316	0.300	0.395	0.205
0.189	0.142	0.158	0.079	0.095	0.063	0.047	0.032
93/08/04	07:00	0.995	5.672				
0.047	0.063	0.095	0.111	0.079	0.189	0.284	0.174
0.095	0.284	0.316	0.300	0.284	0.268	0.253	0.268
0.174	0.174	0.079	0.063	0.063	0.047	0.047	0.047
93/08/04	08:00	0.915	5.266				
0.032	0.047	0.063	0.126	0.079	0.205	0.205	0.174
0.111	0.174	0.316	0.300	0.347	0.158	0.142	0.189
0.174	0.126	0.079	0.047	0.095	0.047	0.047	0.032
93/08/04	09:00	0.995	7.960				
0.032	0.016	0.063	0.126	0.095	0.284	0.537	0.142
0.174	0.237	0.332	0.363	0.347	0.221	0.237	0.189
0.111	0.111	0.111	0.047	0.047	0.047	0.032	0.032
93/08/04	10:00	0.941	5.266				
0.095	0.079	0.221	0.205	0.111	0.300	0.300	0.158
0.111	0.158	0.268	0.253	0.253	0.253	0.111	0.095
0.126	0.158	0.095	0.063	0.032	0.032	0.047	0.032
93/08/04	11:00	0.995	7.960				
0.047	0.047	0.111	0.174	0.142	0.332	0.458	0.189
0.237	0.095	0.284	0.316	0.395	0.158	0.174	0.174
0.079	0.095	0.063	0.079	0.063	0.047	0.047	0.032
93/08/04	12:00	0.915	5.672				
0.063	0.032	0.063	0.095	0.095	0.221	0.268	0.237

```
YY/MM/DD HH:MM   Hs      Tp
Frequency Estimate (Hz)
  0.035   0.050   0.065   0.080   0.095   0.110   0.125   0.140
  0.155   0.170   0.185   0.200   0.215   0.230   0.245   0.260
  0.275   0.290   0.305   0.320   0.335   0.350   0.365   0.380
-----------------------------------------------------------------

  0.189   0.284   0.221   0.300   0.300   0.174   0.174   0.111
  0.174   0.111   0.079   0.063   0.047   0.047   0.032   0.032
93/08/04 13:00   0.915   8.709
  0.047   0.032   0.063   0.095   0.111   0.411   0.237   0.347
  0.253   0.142   0.174   0.268   0.189   0.158   0.174   0.111
  0.095   0.079   0.095   0.063   0.047   0.032   0.032   0.032
93/08/04 14:00   0.915   7.960
  0.095   0.079   0.095   0.142   0.079   0.300   0.300   0.284
  0.174   0.174   0.142   0.189   0.189   0.174   0.126   0.126
  0.142   0.079   0.111   0.095   0.047   0.063   0.032   0.032
93/08/04 15:00   0.968   8.709
  0.063   0.063   0.095   0.189   0.111   0.332   0.379   0.174
  0.142   0.174   0.174   0.300   0.284   0.237   0.111   0.142
  0.126   0.142   0.079   0.079   0.063   0.032   0.032   0.047
93/08/04 16:00   0.995   8.280
  0.095   0.063   0.095   0.158   0.111   0.284   0.363   0.268
  0.237   0.142   0.174   0.189   0.300   0.316   0.253   0.205
  0.111   0.126   0.126   0.079   0.079   0.095   0.079   0.032
93/08/04 17:00   0.968   8.280
  0.047   0.032   0.079   0.189   0.095   0.347   0.411   0.347
  0.237   0.142   0.205   0.126   0.205   0.221   0.174   0.158
  0.158   0.079   0.095   0.095   0.063   0.095   0.047   0.063
93/08/04 18:00   1.050   7.960
  0.047   0.032   0.126   0.174   0.111   0.284   0.521   0.316
  0.284   0.142   0.111   0.237   0.126   0.158   0.442   0.253
  0.300   0.221   0.142   0.079   0.095   0.095   0.047   0.047
93/08/04 19:00   1.137   8.280
  0.032   0.032   0.111   0.221   0.111   0.316   0.584   0.474
  0.221   0.158   0.158   0.158   0.237   0.395   0.553   0.300
  0.221   0.158   0.142   0.142   0.079   0.063   0.063   0.063
93/08/04 20:00   1.197   7.431
  0.158   0.126   0.142   0.379   0.111   0.284   0.379   0.505
  0.237   0.221   0.174   0.316   0.458   0.332   0.600   0.347
  0.221   0.142   0.189   0.111   0.111   0.079   0.063   0.047
93/08/04 21:00   1.050   4.864
  0.032   0.032   0.095   0.126   0.126   0.237   0.411   0.474
  0.158   0.174   0.253   0.553   0.411   0.174   0.253   0.142
  0.189   0.158   0.095   0.079   0.079   0.063   0.047   0.047
93/08/04 22:00   1.022   4.964
  0.032   0.016   0.063   0.174   0.063   0.268   0.553   0.268
  0.189   0.142   0.253   0.695   0.379   0.300   0.142   0.142
  0.142   0.095   0.095   0.063   0.063   0.063   0.047   0.047
93/08/04 23:00   0.995   4.664
  0.047   0.047   0.095   0.111   0.095   0.237   0.300   0.316
  0.237   0.268   0.332   0.474   0.505   0.158   0.221   0.158
  0.079   0.063   0.063   0.079   0.032   0.047   0.047   0.032
```

YY/MM/DD	HH:MM	Hs	Tp				
Frequency	Estimate	(Hz)					
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/05	00:00	0.995	4.763				
0.032	0.016	0.126	0.095	0.126	0.316	0.426	0.253
0.205	0.174	0.253	0.379	0.458	0.316	0.111	0.189
0.142	0.095	0.063	0.063	0.047	0.047	0.032	0.032
93/08/05	01:00	0.889	4.864				
0.063	0.063	0.079	0.158	0.063	0.158	0.253	0.268
0.142	0.126	0.268	0.284	0.221	0.205	0.111	0.142
0.079	0.079	0.079	0.032	0.079	0.047	0.047	0.032
93/08/05	02:00	0.941	8.280				
0.032	0.032	0.111	0.126	0.095	0.253	0.379	0.237
0.158	0.126	0.111	0.189	0.347	0.284	0.284	0.158
0.142	0.111	0.079	0.095	0.063	0.047	0.047	0.047
93/08/05	03:00	0.995	7.960				
0.063	0.079	0.111	0.126	0.063	0.174	0.474	0.158
0.237	0.126	0.174	0.158	0.363	0.347	0.237	0.174
0.158	0.111	0.174	0.142	0.095	0.079	0.063	0.047
93/08/05	04:00	1.022	4.365				
0.079	0.063	0.142	0.126	0.111	0.158	0.411	0.189
0.189	0.142	0.174	0.221	0.379	0.568	0.332	0.142
0.174	0.158	0.158	0.095	0.095	0.079	0.047	0.079
93/08/05	05:00	0.995	4.266				
0.047	0.032	0.111	0.174	0.111	0.111	0.284	0.379
0.142	0.095	0.126	0.237	0.237	0.426	0.237	0.268
0.174	0.205	0.111	0.095	0.111	0.095	0.047	0.047
93/08/05	06:00	1.022	4.365				
0.047	0.047	0.079	0.142	0.111	0.158	0.253	0.411
0.158	0.158	0.126	0.221	0.268	0.742	0.363	0.205
0.111	0.142	0.079	0.111	0.063	0.047	0.063	0.032
93/08/05	07:00	0.889	4.068				
0.016	0.016	0.095	0.095	0.079	0.142	0.253	0.237
0.142	0.126	0.095	0.158	0.221	0.268	0.363	0.111
0.111	0.158	0.111	0.079	0.063	0.047	0.063	0.032
93/08/05	08:00	0.889	7.117				
0.047	0.047	0.111	0.095	0.063	0.158	0.205	0.363
0.111	0.174	0.142	0.126	0.158	0.237	0.221	0.126
0.111	0.079	0.111	0.063	0.047	0.063	0.047	0.047
93/08/05	09:00	0.838	7.642				
0.032	0.016	0.095	0.126	0.063	0.174	0.268	0.253
0.142	0.142	0.158	0.111	0.158	0.189	0.189	0.174
0.095	0.095	0.063	0.079	0.047	0.032	0.032	0.047
93/08/05	10:00	0.838	3.970				
0.047	0.032	0.095	0.111	0.079	0.111	0.221	0.189
0.174	0.205	0.111	0.079	0.095	0.221	0.205	0.237
0.142	0.111	0.095	0.063	0.047	0.063	0.032	0.047
93/08/05	11:00	0.915	3.970				
0.047	0.032	0.126	0.079	0.063	0.158	0.189	0.300

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.189	0.142	0.079	0.142	0.142	0.268	0.395	0.300
0.174	0.079	0.079	0.079	0.047	0.079	0.047	0.032
93/08/05	12:00	0.915	3.970				
0.032	0.032	0.063	0.079	0.047	0.189	0.221	0.347
0.095	0.095	0.063	0.126	0.126	0.237	0.363	0.316
0.158	0.126	0.095	0.095	0.095	0.032	0.032	0.047
93/08/05	13:00	0.814	7.642				
0.032	0.032	0.095	0.095	0.063	0.111	0.300	0.205
0.142	0.095	0.063	0.095	0.095	0.063	0.189	0.237
0.158	0.095	0.079	0.063	0.063	0.047	0.063	0.063
93/08/05	14:00	0.814	7.642				
0.032	0.032	0.189	0.111	0.063	0.158	0.268	0.174
0.111	0.079	0.095	0.063	0.111	0.205	0.221	0.111
0.111	0.063	0.142	0.063	0.032	0.047	0.032	0.032
93/08/05	15:00	0.838	7.642				
0.047	0.016	0.158	0.142	0.126	0.142	0.268	0.189
0.205	0.126	0.079	0.111	0.079	0.095	0.142	0.189
0.126	0.111	0.095	0.063	0.047	0.063	0.063	0.032
93/08/05	16:00	0.789	3.871				
0.016	0.016	0.158	0.095	0.095	0.142	0.158	0.142
0.079	0.079	0.079	0.095	0.063	0.063	0.174	0.300
0.158	0.142	0.063	0.079	0.047	0.079	0.063	0.032
93/08/05	17:00	0.742	7.431				
0.032	0.016	0.063	0.095	0.079	0.174	0.189	0.268
0.111	0.111	0.063	0.079	0.063	0.047	0.047	0.111
0.095	0.142	0.111	0.079	0.047	0.047	0.047	0.047
93/08/05	18:00	0.789	7.431				
0.095	0.079	0.205	0.095	0.095	0.126	0.205	0.332
0.063	0.063	0.095	0.063	0.063	0.047	0.095	0.111
0.111	0.158	0.079	0.063	0.047	0.063	0.047	0.032
93/08/05	19:00	0.814	7.431				
0.047	0.032	0.079	0.142	0.111	0.158	0.189	0.332
0.095	0.126	0.142	0.047	0.079	0.047	0.158	0.174
0.126	0.174	0.126	0.079	0.063	0.047	0.047	0.047
93/08/05	20:00	0.742	7.642				
0.016	0.016	0.126	0.126	0.063	0.079	0.205	0.205
0.142	0.079	0.063	0.079	0.047	0.063	0.111	0.079
0.174	0.111	0.095	0.047	0.047	0.047	0.047	0.032
93/08/05	21:00	0.765	7.431				
0.016	0.016	0.079	0.063	0.111	0.158	0.237	0.363
0.079	0.032	0.063	0.032	0.063	0.095	0.079	0.126
0.158	0.158	0.079	0.063	0.063	0.063	0.047	0.016
93/08/05	22:00	0.742	3.871				
0.032	0.047	0.158	0.142	0.079	0.126	0.158	0.158
0.142	0.063	0.063	0.047	0.047	0.047	0.079	0.205
0.174	0.126	0.063	0.063	0.047	0.047	0.032	0.032

YY/MM/DD	HH:MM	Hs	Tp				
Frequency Estimate (Hz)							
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/05	23:00	0.719	8.280				
0.016	0.016	0.095	0.095	0.079	0.126	0.158	0.126
0.126	0.126	0.063	0.047	0.032	0.095	0.111	0.142
0.142	0.079	0.047	0.047	0.047	0.047	0.047	0.032
93/08/06	00:00	0.765	7.431				
0.047	0.047	0.142	0.142	0.079	0.111	0.158	0.237
0.079	0.063	0.095	0.063	0.047	0.032	0.063	0.111
0.158	0.158	0.111	0.079	0.047	0.063	0.063	0.032
93/08/06	01:00	0.719	7.960				
0.016	0.016	0.174	0.095	0.111	0.174	0.205	0.158
0.158	0.079	0.063	0.047	0.032	0.047	0.047	0.111
0.158	0.095	0.095	0.079	0.047	0.047	0.032	0.047
93/08/06	02:00	0.696	7.960				
0.032	0.016	0.126	0.126	0.079	0.095	0.221	0.189
0.063	0.079	0.079	0.079	0.047	0.016	0.047	0.095
0.158	0.111	0.079	0.063	0.032	0.047	0.016	0.016
93/08/06	03:00	0.651	7.431				
0.000	0.000	0.111	0.111	0.047	0.142	0.174	0.158
0.142	0.063	0.032	0.032	0.047	0.032	0.032	0.047
0.079	0.142	0.095	0.079	0.047	0.032	0.032	0.016
93/08/06	04:00	0.673	8.709				
0.016	0.016	0.237	0.095	0.079	0.189	0.205	0.158
0.095	0.063	0.047	0.032	0.032	0.032	0.016	0.032
0.079	0.079	0.079	0.063	0.047	0.032	0.032	0.032
93/08/06	05:00	0.765	7.642				
0.032	0.016	0.126	0.142	0.063	0.126	0.189	0.158
0.126	0.063	0.063	0.063	0.079	0.063	0.063	0.174
0.142	0.174	0.126	0.079	0.063	0.063	0.032	0.032
93/08/06	06:00	0.696	7.431				
0.016	0.016	0.111	0.095	0.063	0.126	0.126	0.142
0.095	0.079	0.047	0.047	0.032	0.047	0.095	0.126
0.111	0.111	0.079	0.079	0.047	0.047	0.032	0.032
93/08/06	07:00	0.765	9.142				
0.016	0.016	0.205	0.095	0.063	0.284	0.142	0.095
0.063	0.063	0.047	0.063	0.079	0.111	0.142	0.174
0.174	0.111	0.111	0.095	0.063	0.032	0.032	0.032
93/08/06	08:00	0.863	4.167				
0.047	0.032	0.095	0.111	0.047	0.142	0.158	0.079
0.047	0.032	0.063	0.095	0.111	0.237	0.332	0.332
0.237	0.142	0.079	0.095	0.079	0.063	0.047	0.047
93/08/06	09:00	0.941	4.266				
0.047	0.032	0.158	0.111	0.063	0.079	0.142	0.174
0.063	0.095	0.063	0.142	0.284	0.632	0.489	0.189
0.142	0.111	0.095	0.079	0.063	0.063	0.079	0.047
93/08/06	10:00	0.995	4.564				
0.047	0.032	0.158	0.111	0.063	0.142	0.174	0.174

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.063	0.079	0.047	0.174	0.616	0.521	0.474	0.174
0.095	0.126	0.158	0.126	0.095	0.063	0.047	0.063
93/08/06	11:00	1.022	4.763				
0.047	0.032	0.174	0.126	0.079	0.205	0.174	0.126
0.095	0.095	0.253	0.489	0.505	0.426	0.284	0.284
0.189	0.221	0.111	0.095	0.079	0.063	0.063	0.032
93/08/06	12:00	1.166	4.564				
0.111	0.079	0.284	0.158	0.095	0.158	0.142	0.079
0.126	0.111	0.284	0.900	0.916	0.616	0.316	0.284
0.111	0.189	0.126	0.079	0.095	0.079	0.063	0.063
93/08/06	13:00	1.259	5.165				
0.070	0.070	0.175	0.175	0.175	0.157	0.140	0.087
0.210	0.297	0.893	1.103	0.735	0.490	0.315	0.262
0.157	0.140	0.122	0.122	0.122	0.087	0.087	0.070
93/08/06	14:00	1.491	4.864				
0.085	0.057	0.171	0.142	0.085	0.114	0.171	0.114
0.171	0.484	0.855	1.796	1.739	0.826	0.370	0.313
0.399	0.285	0.199	0.114	0.171	0.114	0.085	0.114
93/08/06	15:00	1.913	5.672				
0.142	0.142	0.236	0.142	0.142	0.331	0.236	0.284
1.088	2.981	2.697	2.271	1.135	0.851	0.709	0.520
0.331	0.236	0.142	0.142	0.189	0.142	0.095	0.142
93/08/06	16:00	1.997	5.876				
0.237	0.119	0.178	0.237	0.237	0.237	0.296	0.415
3.203	3.737	2.313	0.771	0.771	0.771	0.830	0.534
0.296	0.296	0.237	0.178	0.119	0.237	0.119	0.119
93/08/06	17:00	1.913	6.286				
0.122	0.122	0.245	0.122	0.122	0.184	0.489	1.162
3.856	1.958	2.080	0.673	0.795	0.428	0.428	0.367
0.367	0.306	0.245	0.245	0.122	0.061	0.061	0.122
93/08/06	18:00	1.831	6.492				
0.057	0.000	0.172	0.115	0.057	0.345	0.862	1.437
3.621	1.896	1.092	0.804	0.632	0.517	0.517	0.345
0.230	0.230	0.172	0.172	0.115	0.115	0.057	0.057
93/08/06	19:00	1.831	6.908				
0.287	0.172	0.402	0.287	0.115	0.402	2.241	3.621
2.011	1.092	0.689	0.517	0.575	0.287	0.230	0.230
0.230	0.172	0.172	0.057	0.057	0.057	0.057	0.057
93/08/06	20:00	1.955	7.431				
0.078	0.078	0.234	0.156	0.078	0.390	3.196	4.911
2.104	1.715	0.701	0.468	0.390	0.312	0.234	0.234
0.156	0.078	0.078	0.078	0.078	0.078	0.078	0.078
93/08/06	21:00	1.955	7.117				
0.083	0.083	0.248	0.165	0.165	1.240	3.471	5.208
1.487	0.744	0.826	0.413	0.331	0.413	0.248	0.165
0.165	0.165	0.083	0.083	0.083	0.083	0.000	0.000

YY/MM/DD	HH:MM	Hs	Tp				
Frequency Estimate (Hz)							
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/06	22:00	1.674	7.642				
0.077	0.038	0.192	0.154	0.077	0.846	2.425	2.425
1.039	0.846	0.385	0.616	0.500	0.154	0.192	0.192
0.115	0.115	0.115	0.077	0.077	0.038	0.038	0.038
93/08/06	23:00	1.491	7.642				
0.037	0.074	0.148	0.223	0.148	0.928	2.340	1.671
1.225	0.557	0.408	0.297	0.297	0.148	0.186	0.186
0.111	0.074	0.074	0.074	0.074	0.037	0.037	0.037
93/08/07	00:00	1.712	7.431				
0.052	0.052	0.157	0.104	0.104	0.679	2.663	3.290
1.148	0.731	0.679	0.313	0.209	0.313	0.261	0.313
0.209	0.209	0.209	0.104	0.052	0.052	0.052	0.052
93/08/07	01:00	1.563	6.908				
0.154	0.077	0.192	0.115	0.154	0.885	1.462	2.425
1.270	0.539	0.423	0.500	0.308	0.231	0.192	0.269
0.192	0.154	0.077	0.077	0.038	0.038	0.038	0.077
93/08/07	02:00	1.422	7.642				
0.062	0.062	0.123	0.185	0.092	0.493	1.942	1.325
1.079	0.524	0.431	0.339	0.216	0.185	0.216	0.216
0.154	0.123	0.092	0.062	0.062	0.031	0.062	0.062
93/08/07	03:00	1.422	7.642				
0.059	0.030	0.089	0.119	0.089	0.356	1.868	1.720
0.771	0.741	0.385	0.267	0.326	0.296	0.326	0.207
0.148	0.119	0.119	0.089	0.059	0.030	0.059	0.030
93/08/07	04:00	1.355	7.431				
0.044	0.044	0.221	0.133	0.089	0.244	0.842	1.396
1.196	0.487	0.509	0.421	0.288	0.310	0.177	0.221
0.111	0.089	0.133	0.089	0.044	0.044	0.066	0.066
93/08/07	05:00	1.355	6.700				
0.105	0.105	0.227	0.210	0.105	0.245	0.858	1.103
0.980	0.630	0.367	0.385	0.332	0.315	0.192	0.122
0.175	0.122	0.087	0.087	0.070	0.070	0.035	0.052
93/08/07	06:00	1.197	6.492				
0.055	0.037	0.147	0.147	0.074	0.165	0.515	0.772
1.159	0.404	0.607	0.386	0.257	0.165	0.110	0.147
0.184	0.092	0.055	0.074	0.055	0.055	0.055	0.037
93/08/07	07:00	1.197	7.431				
0.055	0.037	0.092	0.184	0.074	0.129	0.570	1.159
0.809	0.460	0.423	0.239	0.386	0.313	0.110	0.165
0.092	0.092	0.055	0.055	0.055	0.074	0.037	0.037
93/08/07	08:00	1.107	7.117				
0.047	0.032	0.079	0.158	0.126	0.126	0.616	0.948
0.568	0.411	0.300	0.268	0.284	0.221	0.221	0.111
0.142	0.079	0.079	0.063	0.032	0.032	0.016	0.016
93/08/07	09:00	1.022	7.431				
0.032	0.032	0.111	0.126	0.079	0.237	0.442	0.600

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.458	0.411	0.237	0.300	0.221	0.158	0.095	0.111
0.111	0.095	0.063	0.063	0.032	0.032	0.032	0.016
93/08/07	10:00	0.995	7.117				
0.016	0.016	0.063	0.095	0.142	0.237	0.395	0.884
0.379	0.363	0.268	0.253	0.126	0.142	0.142	0.095
0.079	0.047	0.032	0.032	0.047	0.032	0.016	0.016
93/08/07	11:00	0.995	9.578				
0.032	0.032	0.095	0.142	0.205	0.647	0.347	0.647
0.395	0.347	0.174	0.221	0.158	0.111	0.079	0.095
0.063	0.063	0.032	0.016	0.032	0.016	0.016	0.016
93/08/07	12:00	1.050	9.578				
0.016	0.016	0.095	0.205	0.205	0.900	0.584	0.395
0.426	0.300	0.284	0.189	0.158	0.126	0.063	0.063
0.063	0.063	0.047	0.032	0.032	0.016	0.016	0.016
93/08/07	13:00	1.107	9.142				
0.057	0.028	0.114	0.114	0.199	1.796	0.712	0.313
0.370	0.370	0.256	0.114	0.142	0.057	0.114	0.057
0.057	0.028	0.028	0.028	0.028	0.028	0.028	0.000
93/08/07	14:00	1.079	9.142				
0.048	0.048	0.097	0.193	0.169	1.523	0.677	0.483
0.266	0.217	0.217	0.145	0.072	0.097	0.048	0.048
0.048	0.048	0.024	0.024	0.024	0.024	0.024	0.024
93/08/07	15:00	1.050	9.142				
0.021	0.021	0.085	0.148	0.191	1.334	0.572	0.614
0.466	0.169	0.191	0.191	0.085	0.085	0.064	0.085
0.042	0.042	0.021	0.021	0.021	0.021	0.021	0.021
93/08/07	16:00	0.941	8.280				
0.016	0.032	0.063	0.111	0.142	0.726	0.805	0.347
0.268	0.174	0.221	0.142	0.095	0.079	0.079	0.079
0.047	0.032	0.047	0.032	0.016	0.016	0.016	0.016
93/08/07	17:00	0.968	8.280				
0.047	0.047	0.047	0.221	0.095	0.616	0.853	0.521
0.284	0.237	0.174	0.126	0.142	0.063	0.079	0.063
0.032	0.032	0.016	0.016	0.032	0.016	0.016	0.016
93/08/07	18:00	1.022	8.709				
0.017	0.017	0.070	0.175	0.087	1.103	0.700	0.613
0.280	0.315	0.122	0.105	0.105	0.070	0.087	0.052
0.052	0.035	0.035	0.017	0.017	0.017	0.017	0.017
93/08/07	19:00	0.968	8.280				
0.016	0.016	0.095	0.363	0.063	0.537	0.821	0.363
0.332	0.253	0.158	0.189	0.111	0.079	0.079	0.063
0.047	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/07	20:00	0.915	8.280				
0.017	0.000	0.105	0.175	0.052	0.402	1.103	0.385
0.280	0.280	0.157	0.105	0.105	0.070	0.070	0.052
0.017	0.052	0.035	0.035	0.017	0.017	0.017	0.017

YY/MM/DD	HH:MM	Hs	Tp				
Frequency	Estimate (Hz)						
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/07	21:00	0.889	7.642				
0.016	0.016	0.079	0.158	0.047	0.189	0.742	0.553
0.221	0.332	0.237	0.111	0.095	0.095	0.079	0.047
0.063	0.032	0.032	0.016	0.016	0.016	0.000	0.016
93/08/07	22:00	0.814	7.642				
0.063	0.063	0.079	0.111	0.079	0.126	0.584	0.489
0.316	0.237	0.174	0.111	0.079	0.047	0.063	0.047
0.032	0.016	0.016	0.016	0.016	0.016	0.016	0.000
93/08/07	23:00	0.789	7.117				
0.032	0.016	0.047	0.095	0.095	0.142	0.316	0.632
0.347	0.237	0.142	0.126	0.063	0.079	0.079	0.079
0.032	0.016	0.032	0.016	0.016	0.016	0.000	0.000
93/08/08	00:00	0.789	7.431				
0.016	0.016	0.047	0.142	0.063	0.142	0.316	0.521
0.332	0.237	0.158	0.205	0.095	0.063	0.063	0.032
0.032	0.032	0.016	0.016	0.016	0.000	0.000	0.000
93/08/08	01:00	0.814	7.431				
0.016	0.032	0.063	0.174	0.063	0.126	0.395	0.489
0.347	0.268	0.221	0.095	0.063	0.079	0.063	0.047
0.032	0.016	0.032	0.016	0.016	0.016	0.016	0.000
93/08/08	02:00	0.838	7.642				
0.032	0.016	0.063	0.189	0.047	0.158	0.474	0.379
0.411	0.300	0.205	0.205	0.111	0.079	0.063	0.047
0.047	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/08	03:00	0.814	6.492				
0.016	0.016	0.047	0.126	0.079	0.174	0.300	0.426
0.537	0.300	0.205	0.158	0.111	0.079	0.079	0.032
0.032	0.016	0.016	0.032	0.016	0.016	0.016	0.000
93/08/08	04:00	0.765	5.876				
0.016	0.016	0.047	0.079	0.079	0.142	0.174	0.300
0.205	0.584	0.332	0.126	0.063	0.079	0.079	0.032
0.032	0.032	0.032	0.016	0.016	0.016	0.016	0.016
93/08/08	05:00	0.814	7.431				
0.016	0.016	0.063	0.158	0.079	0.158	0.268	0.347
0.332	0.363	0.363	0.174	0.142	0.079	0.047	0.032
0.047	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/08	06:00	0.814	5.672				
0.016	0.016	0.063	0.126	0.079	0.268	0.237	0.237
0.363	0.411	0.284	0.158	0.126	0.063	0.047	0.047
0.032	0.016	0.016	0.016	0.016	0.016	0.016	0.000
93/08/08	07:00	0.789	6.908				
0.047	0.047	0.095	0.174	0.079	0.111	0.268	0.395
0.363	0.237	0.158	0.189	0.095	0.063	0.047	0.047
0.032	0.016	0.016	0.016	0.016	0.000	0.016	0.016
93/08/08	08:00	0.696	7.431				
0.016	0.016	0.063	0.095	0.047	0.174	0.221	0.284

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.205	0.284	0.142	0.142	0.047	0.032	0.047	0.032
0.016	0.032	0.016	0.016	0.016	0.000	0.016	0.000
93/08/08	09:00	0.742	7.117				
0.000	0.016	0.047	0.174	0.079	0.126	0.237	0.505
0.332	0.205	0.158	0.095	0.063	0.047	0.047	0.032
0.016	0.016	0.016	0.016	0.000	0.000	0.000	0.000
93/08/08	10:00	0.742	7.117				
0.016	0.032	0.047	0.142	0.095	0.189	0.205	0.489
0.332	0.205	0.111	0.158	0.079	0.063	0.032	0.032
0.016	0.016	0.016	0.000	0.000	0.000	0.000	0.000
93/08/08	11:00	0.863	7.431				
0.016	0.016	0.063	0.189	0.095	0.268	0.284	0.663
0.584	0.253	0.158	0.095	0.174	0.047	0.032	0.016
0.016	0.016	0.016	0.016	0.016	0.000	0.000	0.000
93/08/08	12:00	0.863	7.117				
0.032	0.047	0.079	0.189	0.111	0.505	0.300	0.695
0.395	0.395	0.126	0.111	0.095	0.063	0.047	0.032
0.016	0.016	0.016	0.016	0.016	0.000	0.000	0.000
93/08/08	13:00	0.915	6.700				
0.016	0.032	0.032	0.158	0.079	0.316	0.363	0.553
0.632	0.332	0.189	0.126	0.079	0.079	0.047	0.032
0.032	0.016	0.016	0.016	0.016	0.016	0.032	0.032
93/08/08	14:00	1.022	6.492				
0.095	0.063	0.095	0.221	0.111	0.395	0.568	0.379
0.837	0.426	0.237	0.174	0.142	0.095	0.063	0.047
0.047	0.032	0.047	0.047	0.047	0.047	0.047	0.032
93/08/08	15:00	0.995	7.642				
0.032	0.016	0.047	0.158	0.047	0.205	0.568	0.537
0.600	0.474	0.253	0.205	0.126	0.095	0.111	0.111
0.095	0.111	0.047	0.063	0.047	0.032	0.032	0.032
93/08/08	16:00	0.995	7.117				
0.016	0.032	0.063	0.158	0.079	0.158	0.442	0.600
0.442	0.505	0.237	0.111	0.158	0.095	0.063	0.063
0.095	0.189	0.111	0.063	0.047	0.032	0.032	0.032
93/08/08	17:00	0.995	6.908				
0.016	0.016	0.047	0.174	0.063	0.284	0.568	0.553
0.568	0.347	0.268	0.189	0.095	0.095	0.126	0.063
0.095	0.095	0.079	0.079	0.047	0.032	0.063	0.032
93/08/08	18:00	0.863	6.492				
0.032	0.047	0.063	0.189	0.047	0.126	0.411	0.347
0.474	0.189	0.253	0.126	0.174	0.111	0.111	0.079
0.063	0.063	0.079	0.047	0.016	0.016	0.032	0.016
93/08/08	19:00	0.968	6.908				
0.016	0.032	0.032	0.126	0.032	0.174	0.395	0.711
0.395	0.347	0.237	0.158	0.126	0.095	0.142	0.189
0.095	0.079	0.063	0.047	0.032	0.047	0.047	0.032

YY/MM/DD	HH:MM	Hs	Tp				
Frequency	Estimate (Hz)						
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/08	20:00	0.941	7.117				
0.032	0.047	0.032	0.142	0.079	0.126	0.474	0.521
0.316	0.347	0.174	0.174	0.095	0.126	0.189	0.142
0.142	0.095	0.063	0.063	0.047	0.095	0.047	0.047
93/08/08	21:00	0.941	7.431				
0.047	0.079	0.095	0.268	0.079	0.158	0.253	0.411
0.347	0.174	0.158	0.221	0.174	0.111	0.126	0.142
0.126	0.063	0.111	0.142	0.079	0.111	0.047	0.032
93/08/08	22:00	1.079	7.431				
0.063	0.063	0.063	0.221	0.079	0.268	0.505	0.521
0.363	0.316	0.158	0.126	0.142	0.111	0.174	0.205
0.142	0.253	0.205	0.158	0.142	0.095	0.079	0.063
93/08/08	23:00	1.079	7.431				
0.047	0.047	0.047	0.189	0.047	0.237	0.284	0.458
0.426	0.300	0.174	0.174	0.142	0.174	0.174	0.253
0.284	0.489	0.126	0.126	0.079	0.063	0.063	0.063
93/08/09	00:00	1.166	7.431				
0.047	0.063	0.111	0.158	0.063	0.426	0.505	0.521
0.505	0.300	0.189	0.095	0.111	0.111	0.395	0.379
0.332	0.284	0.158	0.126	0.095	0.095	0.079	0.063
93/08/09	02:00	1.323	7.642				
0.047	0.063	0.063	0.253	0.095	0.411	0.932	0.900
0.363	0.332	0.142	0.253	0.332	0.537	0.632	0.442
0.284	0.189	0.174	0.095	0.079	0.095	0.079	0.063
93/08/09	03:00	1.259	7.642				
0.032	0.032	0.063	0.221	0.063	0.253	0.837	0.774
0.284	0.205	0.142	0.142	0.395	0.790	0.805	0.363
0.221	0.205	0.126	0.111	0.095	0.079	0.063	0.079
93/08/09	04:00	1.227	7.642				
0.032	0.032	0.047	0.174	0.063	0.300	0.726	0.726
0.537	0.363	0.142	0.332	0.442	0.489	0.332	0.284
0.205	0.174	0.126	0.063	0.111	0.047	0.063	0.047
93/08/09	05:00	1.355	7.431				
0.040	0.061	0.081	0.222	0.101	0.303	1.274	1.153
0.809	0.202	0.182	0.364	0.688	0.586	0.404	0.243
0.182	0.121	0.121	0.121	0.101	0.101	0.061	0.061
93/08/09	06:00	1.355	7.117				
0.122	0.122	0.157	0.227	0.140	0.297	0.910	1.103
0.578	0.507	0.210	0.455	0.613	0.683	0.350	0.245
0.157	0.122	0.087	0.052	0.087	0.052	0.052	0.070
93/08/09	07:00	1.422	7.642				
0.058	0.039	0.077	0.193	0.058	0.212	1.216	1.196
0.579	0.231	0.270	0.888	1.216	0.540	0.270	0.289
0.289	0.135	0.212	0.077	0.116	0.096	0.077	0.077
93/08/09	08:00	1.599	5.266				
0.085	0.106	0.106	0.212	0.106	0.275	1.207	1.228

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.550	0.402	1.334	1.313	1.228	0.614	0.296	0.212
0.212	0.212	0.169	0.106	0.148	0.106	0.064	0.042
93/08/09	09:00	1.636	5.266				
0.062	0.062	0.092	0.185	0.092	0.216	0.616	1.171
0.524	0.585	1.942	1.849	0.770	0.678	0.277	0.216
0.216	0.154	0.154	0.092	0.092	0.092	0.092	0.031
93/08/09	10:00	1.491	7.431				
0.077	0.135	0.116	0.174	0.077	0.193	0.868	1.216
0.579	0.559	1.100	1.003	0.695	0.386	0.289	0.328
0.154	0.174	0.154	0.116	0.135	0.077	0.077	0.077
93/08/09	11:00	1.599	5.266				
0.193	0.217	0.169	0.387	0.145	0.145	0.604	0.773
0.411	0.942	1.523	1.402	0.894	0.725	0.411	0.411
0.193	0.145	0.193	0.193	0.121	0.097	0.097	0.072
93/08/09	12:00	1.527	5.367				
0.138	0.138	0.173	0.242	0.173	0.345	0.587	0.483
0.345	0.966	2.175	1.070	0.518	0.483	0.311	0.345
0.207	0.173	0.173	0.173	0.138	0.069	0.069	0.104
93/08/09	13:00	1.527	5.570				
0.093	0.116	0.185	0.185	0.208	0.579	0.602	0.417
0.440	1.042	1.458	1.111	0.463	0.579	0.440	0.278
0.301	0.255	0.278	0.162	0.162	0.139	0.116	0.093
93/08/09	14:00	1.636	5.367				
0.089	0.089	0.089	0.296	0.207	0.771	1.126	0.711
0.533	0.741	1.868	0.919	0.593	0.445	0.504	0.533
0.356	0.237	0.178	0.207	0.148	0.119	0.119	0.119
93/08/09	15:00	1.636	5.672				
0.109	0.137	0.164	0.219	0.547	0.794	1.068	0.356
0.411	1.725	0.985	1.040	0.630	0.630	0.602	0.383
0.301	0.164	0.164	0.137	0.109	0.109	0.109	0.082
93/08/09	16:00	1.599	5.570				
0.145	0.145	0.145	0.290	0.701	0.652	0.435	0.483
0.701	0.797	1.523	1.015	0.773	0.435	0.314	0.459
0.217	0.217	0.193	0.145	0.121	0.169	0.121	0.048
93/08/09	17:00	1.674	5.672				
0.115	0.115	0.192	0.269	0.577	0.577	0.385	0.231
0.731	2.425	1.693	0.962	0.616	0.346	0.346	0.423
0.192	0.231	0.192	0.115	0.115	0.077	0.077	0.077
93/08/09	18:00	1.599	5.672				
0.055	0.055	0.109	0.219	0.547	0.794	0.383	0.274
0.739	1.725	1.478	0.712	0.520	0.547	0.383	0.411
0.301	0.219	0.192	0.137	0.137	0.109	0.082	0.082
93/08/09	19:00	1.636	5.876				
0.100	0.100	0.133	0.166	0.366	0.931	0.332	0.266
0.798	2.095	1.330	0.865	0.731	0.598	0.565	0.299
0.399	0.199	0.199	0.133	0.100	0.100	0.100	0.066

YY/MM/DD HH:MM		Hs	Tp				
Frequency Estimate (Hz)							
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/09	20:00	1.636	6.080				
0.031	0.062	0.154	0.123	0.246	0.801	0.370	0.308
1.109	1.942	1.603	0.955	0.493	0.339	0.401	0.339
0.308	0.154	0.216	0.154	0.154	0.092	0.092	0.062
93/08/09	21:00	1.636	5.672				
0.069	0.104	0.138	0.207	0.345	0.690	0.345	0.173
0.897	2.175	1.519	0.932	0.587	0.621	0.276	0.311
0.207	0.104	0.138	0.138	0.104	0.104	0.138	0.104
93/08/09	22:00	1.527	5.876				
0.085	0.085	0.085	0.128	0.214	0.598	0.513	0.299
1.154	2.693	1.111	0.555	0.342	0.299	0.256	0.171
0.171	0.214	0.128	0.085	0.085	0.085	0.043	0.043
93/08/09	23:00	1.636	6.080				
0.080	0.080	0.199	0.159	0.159	0.438	0.359	0.438
1.714	2.512	1.355	1.036	0.478	0.319	0.359	0.279
0.279	0.159	0.120	0.120	0.080	0.080	0.120	0.040
93/08/10	01:00	1.527	5.672				
0.033	0.066	0.199	0.133	0.100	0.366	0.332	0.366
2.029	2.095	0.998	0.399	0.598	0.332	0.399	0.233
0.233	0.166	0.166	0.133	0.100	0.100	0.066	0.066
93/08/10	02:00	1.422	6.286				
0.100	0.133	0.266	0.199	0.133	0.166	0.199	0.332
2.095	1.696	0.698	0.432	0.266	0.332	0.299	0.199
0.233	0.166	0.133	0.100	0.066	0.066	0.066	0.033
93/08/10	03:00	1.456	6.286				
0.033	0.066	0.133	0.100	0.166	0.266	0.166	0.432
2.095	1.530	0.765	0.499	0.399	0.299	0.366	0.233
0.233	0.133	0.100	0.100	0.066	0.100	0.066	0.066
93/08/10	04:00	1.388	6.286				
0.032	0.032	0.128	0.160	0.160	0.192	0.192	0.256
1.569	2.018	0.704	0.352	0.256	0.256	0.320	0.352
0.224	0.128	0.128	0.096	0.096	0.096	0.064	0.064
93/08/10	05:00	1.355	6.700				
0.053	0.053	0.131	0.158	0.079	0.184	0.342	0.709
1.656	0.762	0.893	0.552	0.342	0.236	0.289	0.236
0.131	0.158	0.105	0.079	0.105	0.079	0.053	0.053
93/08/10	06:00	1.355	6.492				
0.050	0.050	0.176	0.101	0.126	0.176	0.328	0.681
1.589	1.160	0.630	0.781	0.328	0.328	0.151	0.176
0.176	0.151	0.126	0.101	0.050	0.076	0.076	0.050
93/08/10	07:00	1.259	6.080				
0.033	0.033	0.349	0.133	0.133	0.116	0.283	0.582
0.965	1.048	0.582	0.416	0.266	0.316	0.216	0.183
0.183	0.183	0.116	0.100	0.100	0.100	0.050	0.067
93/08/10	08:00	1.259	6.492				
0.046	0.069	0.231	0.139	0.093	0.162	0.486	0.717

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

1.458	0.602	0.532	0.463	0.347	0.231	0.185	0.093
0.093	0.139	0.046	0.139	0.069	0.046	0.023	0.069
93/08/10	09:00	1.259	6.700				
0.040	0.061	0.222	0.202	0.121	0.121	0.324	0.829
1.274	1.011	0.485	0.485	0.263	0.263	0.182	0.142
0.121	0.101	0.081	0.081	0.101	0.061	0.061	0.040
93/08/10	10:00	1.290	6.286				
0.022	0.066	0.177	0.133	0.066	0.111	0.354	0.443
1.396	1.152	0.487	0.465	0.310	0.288	0.133	0.177
0.155	0.133	0.111	0.111	0.066	0.066	0.066	0.044
93/08/10	11:00	1.259	5.876				
0.069	0.069	0.301	0.162	0.093	0.162	0.185	0.671
0.879	1.458	0.463	0.231	0.324	0.231	0.208	0.162
0.116	0.093	0.093	0.093	0.069	0.093	0.069	0.093
93/08/10	12:00	1.166	6.700				
0.032	0.032	0.300	0.095	0.095	0.158	0.284	0.616
0.884	0.568	0.347	0.284	0.284	0.253	0.221	0.189
0.126	0.095	0.079	0.095	0.126	0.079	0.047	0.047
93/08/10	13:00	1.227	6.080				
0.063	0.047	0.253	0.111	0.079	0.142	0.284	0.474
0.695	0.979	0.442	0.584	0.253	0.268	0.142	0.316
0.111	0.126	0.111	0.079	0.095	0.063	0.047	0.016
93/08/10	14:00	1.197	5.876				
0.063	0.079	0.205	0.126	0.158	0.095	0.268	0.568
0.584	0.884	0.616	0.442	0.189	0.284	0.174	0.205
0.158	0.126	0.174	0.063	0.063	0.032	0.063	0.047
93/08/10	15:00	1.137	6.080				
0.047	0.063	0.332	0.174	0.189	0.095	0.268	0.316
0.647	0.853	0.363	0.332	0.284	0.205	0.205	0.221
0.095	0.079	0.063	0.079	0.095	0.047	0.063	0.047
93/08/10	16:00	1.107	6.286				
0.032	0.047	0.332	0.095	0.126	0.095	0.189	0.395
0.679	0.679	0.458	0.458	0.284	0.221	0.174	0.205
0.126	0.126	0.095	0.063	0.047	0.032	0.047	0.032
93/08/10	17:00	1.166	6.286				
0.079	0.063	0.395	0.142	0.142	0.079	0.379	0.521
0.884	0.821	0.395	0.237	0.237	0.300	0.126	0.126
0.095	0.079	0.111	0.063	0.047	0.047	0.047	0.032
93/08/10	18:00	1.107	6.492				
0.050	0.050	0.316	0.067	0.116	0.133	0.316	0.516
1.048	0.432	0.383	0.366	0.316	0.183	0.150	0.100
0.150	0.067	0.050	0.067	0.050	0.033	0.067	0.017
93/08/10	19:00	1.079	6.080				
0.047	0.032	0.205	0.063	0.126	0.095	0.268	0.647
0.632	0.758	0.363	0.379	0.284	0.142	0.221	0.079
0.079	0.047	0.047	0.032	0.047	0.032	0.032	0.016

YY/MM/DD	HH:MM	Hs	Tp				
Frequency	Estimate	(Hz)					
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/10	20:00	1.107	6.700				
0.047	0.032	0.363	0.142	0.079	0.142	0.205	0.758
0.821	0.679	0.379	0.253	0.158	0.158	0.142	0.095
0.095	0.063	0.063	0.063	0.063	0.032	0.032	0.032
93/08/10	21:00	1.050	6.700				
0.032	0.047	0.221	0.047	0.079	0.095	0.253	0.584
0.600	0.600	0.426	0.363	0.284	0.126	0.142	0.142
0.126	0.063	0.032	0.047	0.063	0.063	0.032	0.032
93/08/10	22:00	1.050	6.080				
0.047	0.047	0.253	0.095	0.126	0.079	0.174	0.505
0.742	0.695	0.316	0.253	0.205	0.189	0.126	0.111
0.063	0.047	0.063	0.047	0.032	0.032	0.032	0.016
93/08/10	23:00	1.079	6.286				
0.063	0.032	0.300	0.111	0.111	0.126	0.126	0.442
0.758	0.474	0.695	0.411	0.126	0.205	0.221	0.126
0.095	0.063	0.079	0.047	0.032	0.032	0.032	0.032
93/08/11	02:00	0.941	6.700				
0.032	0.032	0.363	0.079	0.126	0.095	0.158	0.379
0.553	0.363	0.174	0.174	0.174	0.174	0.126	0.095
0.047	0.079	0.047	0.079	0.016	0.047	0.016	0.016
93/08/11	03:00	0.889	14.251				
0.032	0.032	0.600	0.126	0.126	0.095	0.095	0.237
0.300	0.379	0.316	0.221	0.095	0.079	0.095	0.063
0.063	0.047	0.032	0.047	0.032	0.032	0.032	0.016
93/08/11	04:00	0.838	6.286				
0.016	0.016	0.237	0.063	0.111	0.079	0.126	0.221
0.347	0.284	0.284	0.300	0.142	0.158	0.126	0.079
0.063	0.047	0.063	0.032	0.032	0.016	0.032	0.016
93/08/11	05:00	0.838	6.080				
0.016	0.016	0.300	0.079	0.126	0.063	0.142	0.347
0.347	0.347	0.174	0.111	0.079	0.158	0.079	0.095
0.063	0.047	0.032	0.032	0.047	0.032	0.032	0.016
93/08/11	06:00	0.915	14.251				
0.016	0.016	0.458	0.079	0.111	0.126	0.174	0.284
0.600	0.332	0.221	0.237	0.158	0.111	0.126	0.079
0.079	0.047	0.047	0.032	0.016	0.032	0.032	0.032
93/08/11	07:00	0.863	6.492				
0.016	0.032	0.221	0.142	0.126	0.079	0.095	0.316
0.616	0.316	0.237	0.189	0.158	0.111	0.111	0.079
0.047	0.047	0.047	0.047	0.032	0.016	0.016	0.016
93/08/11	08:00	0.889	6.080				
0.016	0.032	0.316	0.126	0.111	0.063	0.221	0.300
0.442	0.442	0.253	0.189	0.126	0.142	0.095	0.079
0.063	0.047	0.032	0.032	0.016	0.016	0.016	0.016
93/08/11	09:00	0.838	6.908				
0.016	0.032	0.142	0.095	0.079	0.047	0.095	0.505

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.537	0.268	0.300	0.174	0.142	0.095	0.095	0.047
0.047	0.032	0.016	0.032	0.032	0.016	0.016	0.016
93/08/11	10:00	0.814	7.117				
0.016	0.047	0.205	0.126	0.095	0.079	0.126	0.489
0.379	0.253	0.189	0.158	0.095	0.095	0.079	0.047
0.063	0.032	0.047	0.016	0.016	0.016	0.016	0.016
93/08/11	11:00	0.889	6.700				
0.047	0.047	0.253	0.126	0.079	0.095	0.079	0.395
0.521	0.284	0.395	0.174	0.111	0.126	0.063	0.032
0.047	0.032	0.032	0.032	0.016	0.016	0.016	0.016
93/08/11	12:00	0.814	6.080				
0.016	0.032	0.316	0.111	0.095	0.079	0.079	0.268
0.363	0.379	0.284	0.142	0.142	0.111	0.063	0.063
0.032	0.032	0.032	0.032	0.016	0.016	0.016	0.016
93/08/11	13:00	0.838	6.492				
0.016	0.032	0.205	0.079	0.047	0.079	0.095	0.411
0.521	0.379	0.332	0.284	0.142	0.111	0.063	0.047
0.047	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/11	14:00	0.814	6.908				
0.016	0.032	0.332	0.174	0.095	0.032	0.079	0.411
0.442	0.316	0.221	0.142	0.111	0.079	0.047	0.032
0.047	0.032	0.032	0.016	0.016	0.016	0.016	0.016
93/08/11	15:00	0.789	6.700				
0.032	0.032	0.284	0.095	0.047	0.063	0.079	0.300
0.442	0.174	0.253	0.174	0.111	0.079	0.079	0.047
0.047	0.047	0.032	0.016	0.016	0.016	0.016	0.016
93/08/11	16:00	0.765	6.080				
0.032	0.032	0.253	0.126	0.047	0.063	0.111	0.205
0.253	0.379	0.189	0.158	0.126	0.095	0.079	0.063
0.032	0.047	0.032	0.032	0.016	0.016	0.016	0.016
93/08/11	17:00	0.742	6.492				
0.016	0.016	0.205	0.126	0.047	0.063	0.111	0.158
0.300	0.300	0.268	0.142	0.079	0.095	0.047	0.047
0.047	0.016	0.032	0.016	0.016	0.016	0.016	0.016
93/08/11	18:00	0.719	6.080				
0.016	0.016	0.189	0.111	0.063	0.095	0.063	0.142
0.316	0.332	0.205	0.126	0.095	0.063	0.047	0.047
0.032	0.032	0.032	0.016	0.016	0.016	0.016	0.016
93/08/11	19:00	0.814	6.080				
0.032	0.032	0.268	0.189	0.079	0.079	0.079	0.205
0.300	0.426	0.253	0.142	0.126	0.095	0.063	0.032
0.047	0.047	0.032	0.032	0.016	0.016	0.016	0.016
93/08/11	20:00	0.719	14.251				
0.016	0.032	0.253	0.221	0.095	0.063	0.079	0.126
0.268	0.221	0.158	0.158	0.142	0.063	0.047	0.047
0.016	0.016	0.016	0.016	0.016	0.016	0.016	0.016

YY/MM/DD	HH:MM	Hs	Tp				
Frequency Estimate (Hz)							
0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380
93/08/11	21:00	0.814	14.251				
0.079	0.095	0.332	0.205	0.142	0.126	0.095	0.189
0.237	0.332	0.126	0.158	0.095	0.111	0.079	0.032
0.032	0.032	0.016	0.016	0.016	0.016	0.016	0.016
93/08/11	22:00	0.742	13.310				
0.016	0.016	0.205	0.205	0.095	0.111	0.079	0.158
0.253	0.316	0.268	0.142	0.079	0.063	0.063	0.047
0.032	0.016	0.016	0.016	0.016	0.000	0.000	0.016
93/08/12	00:00	0.696	13.310				
0.016	0.016	0.189	0.205	0.079	0.079	0.111	0.095
0.189	0.142	0.142	0.174	0.063	0.111	0.063	0.047
0.032	0.016	0.016	0.016	0.016	0.032	0.016	0.016
93/08/12	01:00	0.742	14.251				
0.016	0.016	0.174	0.142	0.063	0.126	0.126	0.126
0.237	0.205	0.237	0.142	0.063	0.063	0.047	0.047
0.047	0.032	0.016	0.032	0.032	0.032	0.032	0.016
93/08/12	02:00	0.765	14.251				
0.016	0.016	0.316	0.095	0.111	0.095	0.111	0.205
0.253	0.158	0.174	0.142	0.079	0.079	0.063	0.047
0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032
93/08/12	03:00	0.765	6.080				
0.032	0.047	0.221	0.126	0.079	0.111	0.126	0.205
0.253	0.253	0.189	0.095	0.079	0.047	0.047	0.047
0.032	0.047	0.047	0.032	0.032	0.032	0.016	0.016
93/08/12	04:00	0.742	13.310				
0.016	0.016	0.142	0.221	0.079	0.095	0.079	0.221
0.237	0.126	0.221	0.126	0.079	0.095	0.063	0.047
0.063	0.032	0.032	0.032	0.032	0.032	0.032	0.016
93/08/12	05:00	0.742	6.492				
0.016	0.016	0.174	0.142	0.095	0.095	0.158	0.221
0.363	0.205	0.111	0.111	0.095	0.063	0.047	0.047
0.047	0.063	0.047	0.016	0.032	0.032	0.016	0.016
93/08/12	06:00	0.765	6.286				
0.016	0.016	0.126	0.189	0.079	0.126	0.142	0.126
0.300	0.205	0.158	0.111	0.095	0.063	0.079	0.032
0.047	0.047	0.047	0.032	0.047	0.047	0.032	0.032
93/08/12	07:00	0.719	6.080				
0.000	0.016	0.189	0.174	0.079	0.111	0.095	0.268
0.221	0.189	0.158	0.063	0.063	0.063	0.047	0.032
0.032	0.032	0.063	0.032	0.016	0.032	0.032	0.016
93/08/12	08:00	0.765	13.310				
0.016	0.016	0.268	0.300	0.111	0.158	0.111	0.174
0.189	0.158	0.095	0.111	0.063	0.063	0.047	0.047
0.047	0.032	0.047	0.047	0.047	0.032	0.032	0.016
93/08/12	09:00	0.742	14.251				
0.016	0.016	0.253	0.205	0.063	0.284	0.158	0.174

YY/MM/DD HH:MM Hs Tp
Frequency Estimate (Hz)

0.035	0.050	0.065	0.080	0.095	0.110	0.125	0.140
0.155	0.170	0.185	0.200	0.215	0.230	0.245	0.260
0.275	0.290	0.305	0.320	0.335	0.350	0.365	0.380

0.253	0.174	0.111	0.095	0.047	0.063	0.047	0.032
0.032	0.032	0.047	0.047	0.032	0.016	0.016	0.016
93/08/12	10:00	0.742	8.280				
0.016	0.016	0.174	0.158	0.126	0.221	0.268	0.221
0.237	0.142	0.095	0.095	0.047	0.063	0.032	0.047
0.032	0.032	0.047	0.032	0.032	0.032	0.016	0.032
93/08/12	11:00	0.696	13.310				
0.016	0.016	0.221	0.205	0.095	0.189	0.126	0.142
0.142	0.111	0.111	0.095	0.032	0.047	0.032	0.032
0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.016
93/08/12	12:00	0.814	8.280				
0.047	0.047	0.268	0.253	0.126	0.332	0.411	0.253
0.205	0.237	0.126	0.063	0.047	0.032	0.032	0.032
0.047	0.047	0.032	0.032	0.032	0.032	0.016	0.032
93/08/12	13:00	0.789	7.960				
0.016	0.016	0.126	0.268	0.095	0.379	0.553	0.205
0.189	0.142	0.111	0.063	0.079	0.063	0.047	0.032
0.032	0.032	0.032	0.032	0.016	0.016	0.032	0.016
93/08/12	14:00	0.838	7.960				
0.016	0.016	0.205	0.189	0.079	0.268	0.900	0.300
0.237	0.189	0.111	0.047	0.047	0.047	0.032	0.032
0.032	0.032	0.032	0.032	0.032	0.032	0.016	0.032
93/08/12	15:00	0.838	8.280				
0.016	0.032	0.237	0.158	0.063	0.332	0.726	0.411
0.142	0.174	0.126	0.063	0.047	0.032	0.047	0.047
0.047	0.047	0.047	0.047	0.032	0.016	0.016	0.016
93/08/12	16:00	0.838	7.960				
0.032	0.032	0.142	0.189	0.063	0.316	0.869	0.316
0.174	0.126	0.142	0.079	0.063	0.047	0.047	0.047
0.047	0.032	0.032	0.032	0.016	0.016	0.016	0.016
93/08/12	17:00	0.838	7.960				
0.016	0.016	0.158	0.221	0.079	0.268	0.632	0.379
0.237	0.126	0.111	0.095	0.063	0.032	0.047	0.047
0.063	0.032	0.032	0.047	0.032	0.016	0.032	0.032
93/08/12	18:00	0.838	7.431				
0.016	0.016	0.284	0.284	0.063	0.142	0.505	0.521
0.158	0.158	0.111	0.095	0.047	0.063	0.016	0.032
0.032	0.047	0.032	0.032	0.032	0.032	0.032	0.016
93/08/12	19:00	0.789	7.960				
0.016	0.016	0.111	0.205	0.063	0.189	0.411	0.411
0.205	0.142	0.079	0.047	0.063	0.063	0.063	0.063
0.063	0.063	0.032	0.079	0.032	0.032	0.016	0.016
93/08/12	20:00	0.863	8.280				
0.016	0.016	0.458	0.189	0.063	0.284	0.663	0.158
0.189	0.158	0.142	0.063	0.047	0.063	0.095	0.063
0.047	0.047	0.063	0.047	0.032	0.032	0.032	0.016

```
YY/MM/DD HH:MM    Hs      Tp
Frequency Estimate (Hz)
   0.035    0.050    0.065    0.080    0.095    0.110    0.125    0.140
   0.155    0.170    0.185    0.200    0.215    0.230    0.245    0.260
   0.275    0.290    0.305    0.320    0.335    0.350    0.365    0.380
------------------------------------------------------------------------

93/08/12 21:00    0.814    7.642
   0.079    0.063    0.237    0.221    0.095    0.237    0.363    0.221
   0.158    0.174    0.079    0.063    0.047    0.047    0.047    0.047
   0.095    0.111    0.063    0.063    0.032    0.032    0.032    0.016
93/08/12 22:00    0.889    7.960
   0.016    0.016    0.111    0.174    0.079    0.158    0.821    0.411
   0.237    0.174    0.079    0.047    0.079    0.047    0.047    0.063
   0.111    0.095    0.079    0.079    0.032    0.047    0.063    0.032
93/08/12 23:00    0.941    8.280
   0.095    0.063    0.205    0.221    0.095    0.205    0.805    0.426
   0.221    0.189    0.111    0.079    0.032    0.095    0.111    0.079
   0.126    0.079    0.095    0.047    0.079    0.063    0.047    0.032
```

Appendix B

Ocean and Meteorological Data Report
NOBE 93

NOBE (August 1993)
Ocean and Meteorological
Data Report

Prepared for:

Emergencies Science Division
Environment Canada

Prepared by:

DF Dickins Associates Ltd.
Vancouver, B.C.

ACKNOWLEDGEMENTS

The author would like to acknowledge the support of the Canadian Coast Guard, St. John's in deploying and recovering the weather and waverider buoys. In addition the crew appreciated the cooperation of the crew of the Ann Harvie in allowing the officers lounge to be taken over by a variety of computers and receivers.

PROJECT TEAM

Norm Henry (from AES Gander) acted as the dedicated meteorologist for the duration of the project. He integrated all available weather and wave data into a daily forecast, and provided a briefing which formed the basis of the "go/no go" decisions. In addition he monitored conditions on site during the field programs.

Jim Dempsey of Seaconsult in St. John's was contracted to deploy the on-site waveriders and establish the remote communications links to enable near real-time monitoring of site conditions from shore in the pre-spill mode and true real-time recording waves at the site during the dry-run and the actual burn.

David Dickins coordinated the activities of AES and Seaconsult during the planning stages leading up to the burn and participated in the field trial to collect and summarize the marine climate data from different sources.

Roy Overstreet of NOOA Hazmat in Seattle assisted in the installation of the on-board wave-meter and participated in the field trial by monitoring sea state trends.

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MEASURING SYSTEMS	2
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APPENDICES

A Pre-spill AES forecasts

B Site Records - August 7 Dry Run
- VHF Waverider output (Seaconsult)
- AES Buoy Hourly Reports

B Site Records - August 12 Burns
- VHF Waverider output (Seaconsult)
- TSK Onboard Wave Height Meter output
- ARGOS Waverider output (Seaconsult)
- AES Buoy Hourly Reports

INTRODUCTION AND OBJECTIVES

This report summarizes the data on marine climate (near surface) and sea state collected by a variety of sensors (onboard and moored) during the Newfoundland Offshore Burn Experiment (NOBE).

The NOBE ocean/meteorological program was developed to satisfy the following objectives:

- provide a reliable forecast of conditions expected at the site as input to a daily go/no go decision during the allowed window of opportunity
- provide moored buoys at the site in advance of the experiment (to allow near-real time monitoring of weather and waves via satellite)
- provide on-board professional forecasting services to monitor changes in conditions during the test
- ensure that the experiment is conducted within the terms of the permit (winds not to exceed 14 knots, wind-waves of less than 1 m, visibility >4 km, and ceiling in excess of 300 m).

The optimum experimental window was established as August 5 to 15 (calculated as the period with the highest probability of encountering acceptable sea states, winds and visibility based on historical data provided by AES).

MEASURING SYSTEMS

Weather and wave data were provided by four independent systems:

- AES weather buoy (6 m Nomad) measuring and transmitting on the hour - wind speed and direction (average over the previous ten minutes), air and sea temperature (instantaneous reading), wave height (over a 37 minute record - responds principally to swell and longer period waves >5.5 sec), and pressure (averaged over a 10 minute period). This buoy was the primary source for surface weather information both prior to and during the test.

- one Datawell Standard Waverider transmitting continuously on VHF. Reception distances exceeded 15 nm during the program. Analogue signals received onboard are digitized at the rate of 2.56 Hz and provided to the system computer through standard RS232 output. This buoy was used as the primary wave data source during the burns.

- one Datawell Waverider fitted with an ARGOS Platform Transmitter Terminal. As configured for this project the buoy transmitted hourly summary data including wave spectra and barometric pressure. Near real-time receipt of data was provided by the contractors software installed the St. John's airport office for the use of the AES forecaster assigned to the project. This buoy was used as the primary wave data source (reporting both swell and wind-wave conditions) during the period leading up to the decision to proceed.

- one TSK Remote Wave Height meter installed on the CCGS Ann Harvie for the project (meter is the property of RRETC of C&P Ottawa). This meter uses the measured Doppler shift of microwave radar emissions directed down at the water surface to calculate the vertical wave velocity which is then integrated to produce the actual wave height. Ship motions are removed by an accelerometer clamped to the hull. Full spectral information is available from this system; data was logged at a 2 Hz sample rate on a portable computer. This instrument was used as a back-up to the moored Waveriders.

- additional measurements included surface drifter positions, luminance, independent wind readings at the surface in the immediate vicinity of the burns, and a record of command ship positions.

RESULTS

The AES Nomad weather buoy was deployed at 47°45.014'N, 52°04.888'W (the NW corner of the proposed test area) in 190 m water on August 2, 1993. On the same day, both Datawell Waveriders were deployed in close proximity at ~47°40'N, 51°59'W (the SW corner of the proposed test area) in 180 m of water.

The following sections summarize the results of the three primary data collection activities associated with the NOBE met/ocean program: forecasting, August 7 dry run, and the two burns of August 12. The focus is on the most important aspect of conditions associated with the burns themselves. Supporting information including daily forecasts leading up the experiment, and print-outs from the weather buoy and waverider are included in the Appendices.

Forecasting

A complete weather briefing was provided every day by the AES forecaster assigned to the project. The briefing sheets (included in Appendix A) contained a detailed forecast for the following day as well as a three day outlook. It is beyond the scope of this report to evaluate the quantitative reliability of the forecast; the overall impression of all the project participants was extremely favourable with regard to the performance of AES throughout the project. It appeared that a remarkable number of the forecasts predicted the actual conditions with a high degree of accuracy.

It can be seen from the forecast sheets that the initial period from August 3 to August 6 was characterized by predicted strong winds and variable flying conditions (patchy fog). A decision was made to proceed on August 7 on the basis that although predicted conditions were very close to the limits allowed for wind and waves, the long range forecast was for significantly worse conditions with waves up to 2 m and poor visibility in showers and fog (refer to Aug 6 forecast sheet in Appendix A). As it turned out, the seas were better than predicted on August 7 but the visibility prediction was "dead on" and an encounter with a fog bank ultimately terminating the exercise.

From August 9 to the 11th either the visibility was below limits, or the wind tended from the east (not permitted under the terms of the permit). A wind shift predicted for early morning on August 12 led to the next (and final) decision to proceed. As shown in the results below, the actual conditions were quite close to predicted (wind speed 2 to 4 knots higher, wind direction within 10°T, significant wave height about 0.2 m higher with a longer period swell and visibility somewhat better than expected).

The detail and quality of the AES forecasts (supported by real-time on site measurements) contributed greatly to the success of the overall project.

Site Conditions - August 7 Dry Run

The continuously transmitting Waverider buoy was logged during the transits to and from the site, and while on-site from 0700 to 19000, August 7. Printouts obtained onboard are contained in Appendix B as a record of the fireboom wave exposure during the dry run.

> *Note that the term significant refers to the average of the 1/3 highest waves over a particular period. Other terms related to the data tables are noted in the frontpiece to Appendix A. Times reported as UTC can be converted to local by subtracting 2.5 hours. All times are local unless otherwise noted.*

The sea state gradually moderated throughout the day, dropping from ~1.1 m significant (1.8 m maximum) and a 6 to 7 sec peak period in the early morning to 0.9 m significant (1.4 m maximum) and an 8 to 9 sec peak period in the late afternoon. This can be seen in the gradual shift of the peak of the wave energy spectrum (App A). The AES weather buoy record shows a corresponding decrease in the winds through the day from SSW 10 to 14 knots at 0400 to calm (in fog) by 1730. The ship mounted TSK meter and the moored waverider compared favourably with the reported significant heights being within 0.1 m.

Surface drifter measurements between 1041 and 1141 showed a net surface water motion of 1.4 km (0.75 kt) in a southerly direction.

Site Conditions - August 12 Burn

Tides

Tides reported for St. John's on August 12, 1993 were as follows:

0210	2.5 m
0845	1.6 m
1500	3.3 m
2220	1.8 m

Surface Drift

During the Waverider buoy deployment on August 2, Seaconsult plotted a surface current velocity of 0.25 knots to the south (from surface drogues). A surface drift of 0.75 knots (again to the south) was recorded during the dry run on August 7 (see above).

Surface drifter readings on August 12 between 1545 and 1645 (following the second burn) showed a net movement of 1.4 km (0.75 kt) to the NE. During the course of the hour, the surface current appeared to shift from a southerly set, to the north (see also ship postions below). The tide betgan to ebb at St. John's at 1500.

Periodic readings of the position of the Ann Harvie were logged from GPS receivers during the course of the experiment (Table 1).

Table 1
Command Ship Positions

Time	Lat	Long.
0838	47 43.8	52 03.0
1108	47 41.6	52 04.6
1400	47 40.4	52 05.9
1425	47 40.3	52 05.9
1455	47 40.3	52 05.9
1519	47 40.4	52 06.0
1545	47 40.9	52 06.1
1615	47 41.2	52 05.9
1645	47 41.5	52 05.5

Weather and Sea State Conditions

Table 2 summarizes the weather and sea state conditions derived from a number of sources denoted in the table as:

W = Seaconsult Waverider
T = TSK Remote Wave Height Meter on the *Ann Harvie*
B = AES Weather buoy
O = onboard

Data was chosen to cover the following general phases of the experiment (times are not exact - refer to other sources for actual events):

Pre-burn (preparation)	0800 to 1030 (1030 to 1300 UTC)
Burn 1	1030 to 1200 (1300 to 1430 UTC)
Between burns	1200 to 1400 (1430 to 1630 UTC)
Burn 2	1400 to 1530 (1630 to 1900 UTC)

Table 2 includes the following wave parameters derived from the data listing transmitted through the ARGOS system (see printout in Appendix C):

h_s	the significant wave height
h_{10}	the average height of the 1/10 largest waves in an hourly sample
h_{max}	height of the largest single wave in an hourly sample
T_{avg}	average wave period of an hourly sample
T_p	period corresponding to the peak in the wave energy spectrum (see plots in App A).
T_{max}	Maximum wave period recorded over one hour (not necessarily corresponding to h_{max})

Note: the peak period T_p is derived from spectral analysis in the frequency domain while the maximum wave period is derived from upcrossing analysis in the time domain. In some instances T_p exceeds T_{max}

Additional information is contained in the hard copy printout obtained from the continuously transmitting (VHF) Waverider received onboard: including wave spectral plots, and a record of discrete wave profiles over a twenty minute period from 16 to 36 minutes past the hour (Appendix C).

The spectral plots illustrate the changing nature of the sea conditions through the course of the experiment. During the initial stages of the equipment deployment and set-up (from 0800 to 0900 or 1030 to 1130 UTC) there was still a substantial number of long period swells in the area (up to a 14 sec period). The wave energy at this time was about evenly divided between these swells and a shorter period wave of about 7 sec. By 1000 local time (1230 UTC) the swell had all but died out with only a few waves up to about an 11 sec period reported. Most of the wave energy by this time was concentrated in the 7 to 9 second range.

Table 2
Oceanographic and Meteorological Parameters: August 12, 1993

Times Chosen to Bracket Start and End of Each Burn:
Pre-Burn: 0800 to 1030, Burn 1: 1030 to 1200, Between Burns: 1200 to 1400, Burn 2: 1400 to 1530.

Time (local)	Air (°C)		Sea (°C)	Wind Speed (knots)		Wind Direction	h_s (m)		h_{10} (m)		h_{max} (m)		T_{avg} (sec)		T_p (sec)	T_{max} (sec)	Pressure (hPa)
	B	O		Avg	Gust	(°T)	W	T	W	T	W	T	W	T	W	W	
0730	10		11	6	8	170°	0.74		0.84		1.11		5.17		8.3	14.4	276
0800								0.77		0.93	1.28			4.8			
0830	10		11	8	10	160°	0.70	0.81	0.77	0.96	0.97	1.15	5.10	4.8	13.3	11.8	272
0900		11.5						0.80		0.97		1.13		4.7			
0930	10		11	8	10	160°	0.81	0.74	0.94	0.88	1.71	1.15	5.10	4.5	8.3	13.2	26.9
1000								0.88		1.06		1.35		4.8			
1030	10	11.5		8	10	160°	0.79	0.86	0.91	1.05	1.11	1.45	5.40	4.9	8.0	11.0	268
1100																	
1130	11		11	8	8	150°	0.84	0.85	1.02	1.00	1.36	1.23	5.70	4.6	8.0	109	261
1200								0.91		1.10		1.39		5.0			
1230	11		11	8	8	140°	0.84	0.82	0.99	1.00	1.49	1.27	5.30	4.9	8.3	11.5	256
1300																	
1330	11		11	8	10	150°	0.84	0.85	0.99	1.02	1.23	1.17	5.20	5.1	8.0	11.1	248
1400							0.83			0.99		1.25		5.1			
1430	11		11	8	10	160°	0.84	0.89	0.99	1.10	1.36	1.40	4.70	5.2	8.0	10.5	243
1500				9	11												
1530	11		11	10	10	170°	0.84	0.84	0.97	0.98	1.46	1.27	5.00	5.0	7.4	13.2	240
1600								0.89		1.05		1.21		5.2			
1630	12		11	8	10	160°	0.79		0.94		1.23		4.90		8.0	11.2	237
1700																	
1730				12	12	170°											
1750	13																

The two burns both experienced similar sea conditions: 0.79 to 0.84 m significant wave, 1.23 to 1.46 m maximum wave, and a 5 to 5.7 sec average period (the average period slowly decreased through the day as the swell continued to dissipate).

Hourly data from the ARGOS transmitting waverider was processed by the contractor to produce independent values for the significant wave height of both the sea (wind generated) and swell waves. Table 3 shows the trend to a slight worsening in the short period (4 to 5 sec) wind generated waves between the first and second burn: the significant height for the sea waves increased from 0.25 m during Burn 1 to ~0.31 m during Burn 2 (a copy of the waverider output is included in Appendix C).

Table 3
Comparison of Significant Wave Heights and Periods for Sea and Swell Waves: 0730 to 1930 August 12, 1993

Time	Sea Height (m) -	Period	Swell (m) -	Period
0730	0.15	2.99	0.70	8.00
0830	0.26	4.08	0.60	15.40
0930	0.27	3.64	0.76	8.00
1030	0.25	4.08	0.73	8.00
1130	0.25	4.08	0.79	8.00
1230	0.28	4.08	0.78	8.00
1330	0.26	4.08	0.78	8.00
1430	0.29	3.64	0.76	8.00
1530	0.33	5.00	0.71	7.14
1630	0.32	3.12	0.68	8.00
1730	0.46	5.88	0.66	8.00
1830	0.47	5.88	0.58	8.00
1930	0.6	7.14	0.40	12.50

Wind conditions were similar between the two burns. The average speed was 8 knots in Burn 1 increasing to between 9 and 10 knots during Burn 2. A check with a hand held anemometer on the Command vessel showed wind speeds at about 10 m above the surface within 1 knot of the buoy reports. Surface wind directions were steady with a gradual shift to the south between the two burns, varying from 150 to 160°T during the first burn and from 160 to 170°T during the second burn.

There have been reports that conditions were significantly windier during the second burn. This observation is not borne out by the available data. One plausible explanation is that the first burn was partly in the wind shadow of the Ann Harvie (winds slightly off the port quarter) which could have created a local anomaly in the vicinity of the boom and burn area. The Ann Harvie is a large enough vessel to significantly affect the local surface wind field.

Spot readings obtained by NIST near the surface in the immediate vicinity of the burn area between 0812 and 0835 (during setup) showed a speed of 10.7 knots, or about 2 knots higher than the weather buoy. A similar difference was noted between 1527 and 1553 when surface readings in a similar location with respect to the burn reported a speed of 12.6 knots.

Air and sea surface temperatures remained constant at 11°C during the course of the experiments. Temperatures onboard at the bridge level reached 13.5 °C by 1400 (removed from the cooling effect of the ocean surface).

Luminance was recorded during both burns using a hand-held meter facing vertically up. The following values were measured.

Table 4
Luminance Values & Visual Sky Conditions

Time	Value (lux)	Sky Condition
0835	570 - 635	bright sun with cloudy patches
0844	270 - 330	cloud
1035	1061 - 1125	bright sun & cloudy patches
1037	650 - 750	thin cloud obscuring sun
1104	850 - 940	bright sun diffused by low cloud layer
1106	1000 - 1070	clear sky
1123	1099 - 1105	clear sky
1149	1153	clear sky
1358	1140 - 1160	bright sun with high thin cloud
1423	1110	" " " " " " "
1453	1105	bright sun (high cloud)
1519	1035	" " " "

APPENDIX A

Pre-spill AES forecasts

AES NOBE FORECASTS

August 4 to August 12, 1993

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT TUESDAY AUGUST 03 1993 VALID UNTIL 1700 NDT WEDNESDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	WEDNESDAY AUGUST 05 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10m:						
DIRECTION (T)	225	220	220	220	215	210
SPEED (KT)	18	18	18	18	16	18
MAX SPEED (KT)	22	22	22	22	20	22
SEA:						
SIG HEIGHT (FT)	4	4	4	4	4	2
MAX HEIGHT (FT)	6	6	6	6	6	3
PERIOD (S)	5	5	5	5	5	3
SWELL:						
DIRECTION (T)	200	200	200	200	200	225
HEIGHT (FT)	3	2	2	1	1	4
PERIOD (S)	4	5	5	6	6	5
COMBINED SEA:						
SIG HEIGHT (FT)	5	4	4	4	4	4
MAX HEIGHT (FT)	8	7	7	7	7	6

SKY COVER SCT..

CEILING (HND FT) NIL......OCNL OBSCURED 1...NIL..................

VISIBILITY (NM) 6+.......OCNL 1/2 FOG......6+....................

WEATHER NIL......FOG PATCHES.......NIL..................

TEMP (C) 12.......10................11.........12..........
SEA SURFACE TEMPERATURE 10 DEG C.

OUTLOOK:
THU AUG 05: WIND SW 15-20KT. VIS FAIR-POOR IN SHOWERS/FOG PATCHES. COMBINED SIG WAVE 5 FT.
FRI AUG 06: WIND S 20-25KT. VIS FAIR-POOR IN SHOWERS/FOG PATCHES. COMBINED SIG WAVE 7 FT.
SAT AUG 07: WIND SW 15-20KT. VIS FAIR TO POOR IN FOG PATCHES. COMBINED SIG WAVE 6 FT.

SYNOPSIS:
A RIDGE OF HIGH PRESSURE ANCHORED SOUTHEAST OF THE GRAND BANKS WILL MAINTAIN A MODERATE TO STRONG SOUTHWESTERLY FLOW OVER THE AREA THROUGH SATURDAY. FOG PATCHES WILL PERSIST DUE TO THE WARM MOIST AIR FLOWING OVER COOL WATER. A WEAK SYSTEM IS EXPECTED TO MOVE THROUGH LATE THURSDAY AND INTO FRIDAY GIVING OCCASIONAL SHOWERS.

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT WEDNESDAY AUGUST 04 1993 VALID UNTIL 1700 NDT THURSDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	THURSDAY AUGUST 05 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10m:						
DIRECTION (T)	210	200	190	180	180	190
SPEED (KT)	12	14	16	20	24	24
MAX SPEED (KT)	14	16	18	24	30	30
SEA:						
SIG HEIGHT (FT)	3	3	2	3	5	6
MAX HEIGHT (FT)	4	4	3	5	8	10
PERIOD (S)	4	4	3	4	5	5
SWELL:						
DIRECTION (T)	200	200	210	210	210	210
HEIGHT (FT)	2	2	3	3	3	2
PERIOD (S)	9	9	4	4	4	5
COMBINED SEA:						
SIG HEIGHT (FT)	4	4	4	4	6	6
MAX HEIGHT (FT)	6	6	5	6	9	10

SKY COVER BROKEN VARIABLE OVERCAST........................

CEILING (HND FT) 10 VARIABLE OBSCURED 2..........................

VISIBILITY (Mi) 6+ VARIABLE 1/2..................................

WEATHER FOG PATCHES...........SHOWERS/FOG PSBL THNDRSHOWER

TEMP (C) 12...
SEA SURFACE TEMPERATURE 10 DEG C.

OUTLOOK:
FRI AUG 06: WINDS S 15-20KT. VIS FAIR-POOR SHOWERS/FOG. SIG WAVE 6 FT.
SAT AUG 07: WINDS SW 15 KT BCMG LIGHT. VIS FAIR-POOR FOG. SIG WAVE 4 FT.
SUN AUG 08: WINDS SE10-20KT. VIS POOR FOG. SIG WAVE 4 FT.

SYNOPSIS:
A BROAD RIDGE OF HIGH PRESSURE REMAINS ANCHORED SOUTHEAST OF THE GRAND BANKS WITH A TROUGH OF LOW PRESSURE OVER WESTERN LABRADOR. THIS PATTERN IS PRODUCING A MODERATE TO STRONG SOUTHWESTERLY FLOW OF WARM HUMID AIR OVER EASTERN NEWFOUNDLAND, AND IS EXPECTED TO PERSIST INTO SATURDAY.
ON THURSDAY A SMALLER SCALE DISTURBANCE EMBEDDED IN THIS FLOW WILL MOVE THROUGH IN THE AFTERNOON BRINGING SHOWERS AND STRONGER WINDS. THROUGHOUT THE PERIOD EXTENSIVE FOG IS EXPECTED OFFSHORE AS WARM MOIST AIR MOVES OVER COOL WATER.

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT THURSDAY AUGUST 05 1993 VALID UNTIL 1700 NDT FRIDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	FRIDAY AUGUST 06 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	195	190	190	190	200	210
SPEED (KT)	14	15	18	18	15	13
MAX SPEED (KT)	16	17	22	22	18	15
SEA:						
SIG HEIGHT (M)	0.8	1.0	1.2	1.4	1.4	1.4
MAX HEIGHT (M)	1.2	1.5	1.8	2.2	2.4	2.0
PERIOD (S)	4	4	4	4	5	5
SWELL:						
DIRECTION (T)	210	210	210	210	210	210
HEIGHT (M)	0.6	0.5	0.4	0.3	0.3	0.2
PERIOD (S)	8	9	9	9	9	9
COMBINED SEA:						
SIG HEIGHT (M)	1.0	1.1	1.3	1.4	1.4	1.4
MAX HEIGHT (M)	1.5	1.6	2.0	2.5	2.5	2.2

SKY COVER BROKEN VARIABLE OVERCAST.........................

CEILING (HND FT) 10 VARIABLE OBSCURED 2..........................

VISIBILITY (Mi) 4 VARIABLE 1/2...................................

WEATHER SHOWERS/FOG PATCHES CHANCE OF A THUNDERSHOWER....

TEMP (C) 12....................................13..........
SEA SURFACE TEMPERATURE 10.5 DEG C

OUTLOOK:
SAT AUG 07: WIND SW 15KT. VIS FAIR-POOR FOG PATCHES. MAX WAVE 2.5M.
SUN AUG 08: WIND LIGHT/VARIABLE INCREASING TO EASTERLY 15.
VIS FAIR-POOR FOG PATCHES. MAX WAVE 2.0M.
MON AUG 09: WIND SE 10-20KT. VIS POOR SHOWERS/FOG PATCHES.
MAX WAVE 2.5M.

SYNOPSIS:
A MODERATE TO STRONG SOUTHWESTERLY FLOW WILL CONTINUE OVER THE AREA ON FRIDAY. A WEAK DISTURBANCE WHICH WAS FORECAST TO MOVE THROUGH THIS AFTERNOON HAS DEVELOPED MORE SLOWLY THAN EXPECTED. THIS SYSTEM IS NOW FORECAST TO GIVE SHOWERS AND SLIGHTLY STRONGER WINDS TONIGHT AND FRIDAY.

WINDS WILL DIMINISH TO LIGHT TO MODERATE ON SATURDAY AS A RIDGE OF HIGH PRESSURE MOVES OVER EASTERN NEWFOUNDLAND. MEANWHILE A LOW PRESSURE SYSTEM DEVELOPING OFF CAPE HATTERAS IS FORECAST TO MOVE INTO

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT FRIDAY AUGUST 06 1993 VALID UNTIL 1700 NDT SATURDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	SATURDAY AUGUST 07 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	220	220	230	230	220	220
SPEED (KT)	14	12	12	12	12	10
MAX SPEED (KT)	16	15	15	15	15	12
SEA:						
SIG HEIGHT (M)	0.6	0.7	0.8	0.8	0.8	0.8
MAX HEIGHT (M)	1.2	1.2	1.2	1.2	1.2	1.2
PERIOD (S)	3	3	4	4	4	4
SWELL:						
DIRECTION (T)	180	180	180	180	180	180
HEIGHT (M)	1.6	1.3	1.0	0.8	0.7	0.6
PERIOD (S)	6	6	7	7	7	8
COMBINED SEA:						
SIG HEIGHT (M)	1.7	1.5	1.3	1.2	1.0	0.9
MAX HEIGHT (M)	2.5	2.3	1.9	1.8	1.5	1.2

SKY COVER SCATTERED VARIABLE OVERCAST.......................

CEILING (HND FT) NIL VARIABLE OBSCURED 2............................

VISIBILITY (Mi) 4 VARIABLE 1/2...................................

WEATHER FOG BANK VICINITY.................................

TEMP (C) 12...
SEA SURFACE TEMPERATURE 10 DEG C

OUTLOOK:
SUN AUG 08: WIND SE 10KT BCMG E 10-15KT. VIS POOR SHOWERS/FOG. MAX WAVE 2M.
MON AUG 09: WIND NE 10 KT. VIS POOR SHOWERS/FOG. MAX WAVE 1.5M.
TUE AUG 10: WIND NE 10-15KT. VIS POOR IN FOG. MAX WAVE 1M.

SYNOPSIS:

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1800 NDT SUNDAY AUGUST 08 1993 VALID UNTIL 1700 NDT MONDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	MONDAY AUGUST 09 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	030	020	010	360	360	360
SPEED (KT)	10	08	06	06	06	06
MAX SPEED (KT)	12	10	08	08	08	08
SEA:						
SIG HEIGHT (M)	0.6	0.6	0.5	0.5	0.5	0.5
MAX HEIGHT (M)	1.0	0.9	0.8	0.8	0.8	0.8
PERIOD (S)	3	3	3	3	3	3
SWELL:						
DIRECTION (T)	190	190	190	190	190	190
HEIGHT (M)	1.0	0.9	0.8	0.7	0.7	0.6
PERIOD (S)	7	7	7	8	8	8
COMBINED SEA:						
SIG HEIGHT (M)	1.2	1.1	0.9	0.9	0.9	0.8
MAX HEIGHT (M)	1.8	1.6	1.4	1.4	1.4	1.2

SKY COVER OVERCAST......................................

CEILING (HND FT) ZERO......................OBSCURED 2-4..........

VISIBILITY (Mi) ZERO......................OCCASIONAL 1/2-2......

WEATHER FOG/DRIZZLE...................................

TEMP (C) 10..
SEA SURFACE TEMPERATURE 10 DEG C.

OUTLOOK:
TUE AUG 10: WIND EASTERLY 4-8KT. VISIBILITY FAIR-POOR FOG PATCHES. MAX WAVE 1M.
WED AUG 11: WIND LIGHT/VARIABLE. VISIBILITY GOOD. MAX WAVE 1M.
THU AUG 12: WIND WESTERLY 4-8KT. VISIBILITY GOOD. MAX WAVE 1M.

SYNOPSIS:
A RIDGE OF HIGH PRESSURE IS FORECAST TO MOVE OVER EASTERN NEWFOUNDLAND LATE MONDAY AND REMAIN NEARLY STATIONARY. THE RIDGE WILL BRING A DRIER AIRMASS WHICH SHOULD DISSIPATE THE FOG WHICH HAS AFFECTED THE AREA FOR THE PAST WEEK. AT THIS TIME IT LOOKS LIKE THE HIGH PRESSURE CENTRE WILL LIE JUST TO THE NORTH OF US ON TUESDAY WHICH WILL PRODUCE A LIGHT EAST TO NORTHEAST FLOW. THE HIGH IS EXPECTED TO DRIFT SLOWLY SOUTHWARD WHICH WILL BRING WINDS AROUND TO WESTERLY BY THURSDAY.

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT MONDAY AUGUST 09 1993 VALID UNTIL 1700 NDT TUESDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	TUESDAY AUGUST 10 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	010	010	010	020	030	030
SPEED (KT)	08	08	08	06	05	05
MAX SPEED (KT)	12	12	12	10	08	08
SEA:						
SIG HEIGHT (M)	0.3	0.5	0.6	0.6	0.6	0.6
MAX HEIGHT (M)	0.5	0.7	0.9	0.9	0.9	0.9
PERIOD (S)	2	2	2	2	2	2
SWELL:						
DIRECTION (T)	010	010	010	010	010	010
HEIGHT (M)	1.5	1.4	1.3	1.1	1.0	0.9
PERIOD (S)	5	5	6	6	7	7
COMBINED SEA:						
SIG HEIGHT (M)	1.6	1.5	1.5	1.2	1.2	1.1
MAX HEIGHT (M)	2.4	2.2	2.2	1.8	1.8	1.5

SKY COVER OVERCAST...

CEILING (HND FT) ZERO VARIABLE 2-4..................................

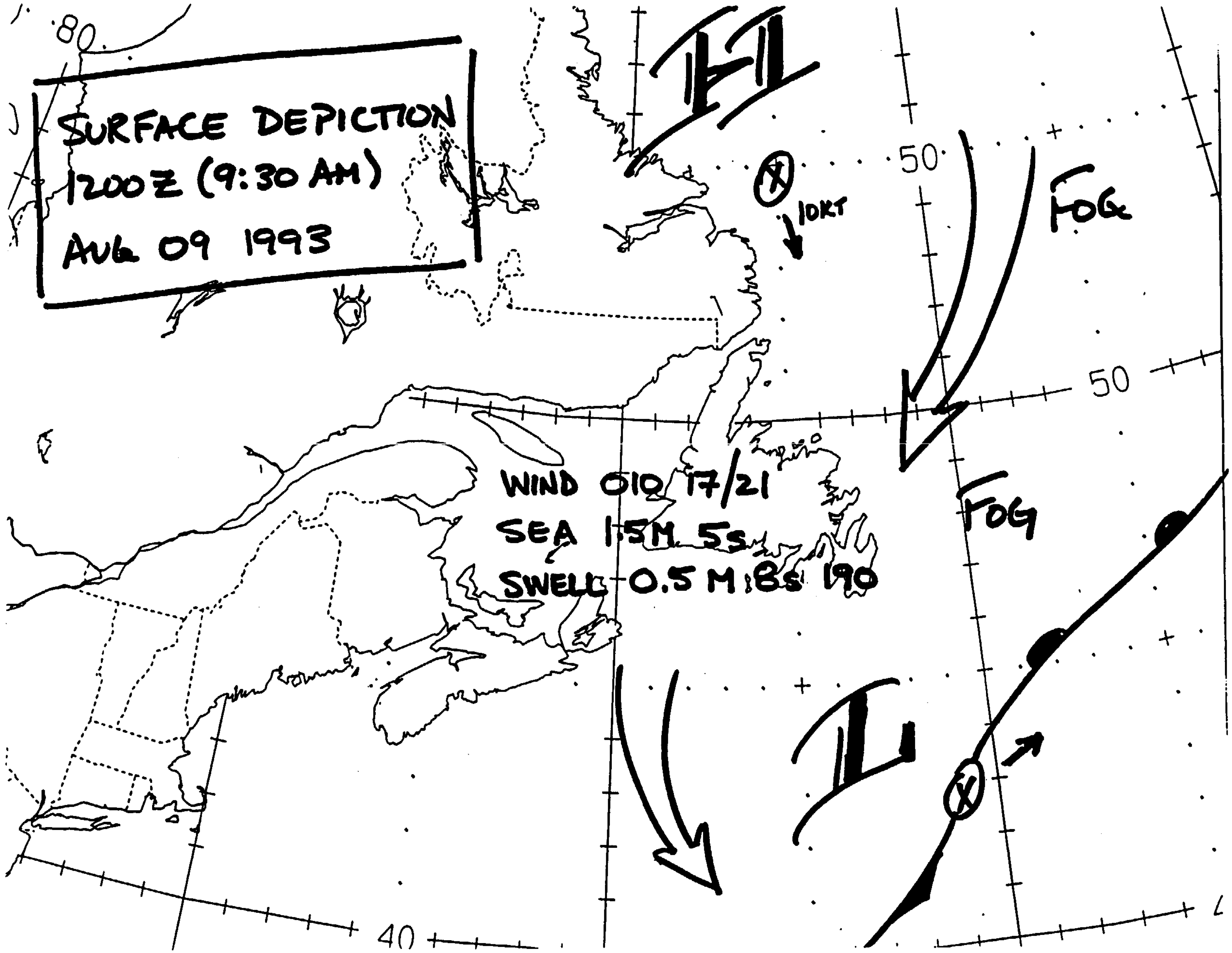
VISIBILITY (Mi) ZERO VARIABLE 1/2-2................................

WEATHER FOG...

TEMP (C) 10..
SEA SURFACE TEMP 11 DEG C.

OUTLOOK:
WED AUG 11: WINDS LIGHT/VARIABLE. VISIBILITY POOR-FAIR FOG PATCHES LIFTING. MAX WAVE 1M.
THU AUG 12: WINDS SW 5KT. VISIBILITY GOOD. MAX WAVE 1M.
FRI AUG 13: WINDS S-SW 5KT. VISIBILITY GOOD. MAX WAVE 1M.

SYNOPSIS:
A RIDGE OF HIGH PRESSURE WILL MOVE OVER THE AREA THIS EVENING AND REMAIN NEARLY STATIONARY FOR THE NEXT FEW DAYS. THE RIDGE WILL BRING A DRIER AIRMASS WHICH SHOULD DISSIPATE THE FOG WHICH HAS AFFECTED THE AREA FOR THE PAST WEEK. THE HIGH CENTRE WILL LIE JUST NORTH OF THE AREA ON TUESDAY GIVING A LIGHT NOTHEAST FLOW. THE HIGH IS EXPECTED TO DRIFT SLOWLY TOWARD THE SOUTH BRINGING WINDS AROUND TO THE SOUTHWEST BY THURSDAY.


SURFACE DEPICTION
1200Z (9:30 AM)
AUG 09 1993
80
50
50
40
H
L
10KT
FOG
FOG
WIND 010 17/21
SEA 1.5M 5s
SWELL 0.5M 8s 190

FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT TUESDAY AUGUST 10 1993 VALID UNTIL 1700 NDT WEDNESDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	WEDNESDAY AUGUST 11 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	040	050	050	050	060	070
SPEED (KT)	10	08	08	08	08	08
MAX SPEED (KT)	12	10	10	10	10	10
SEA:						
SIG HEIGHT (M)	0.5	0.5	0.5	0.5	0.5	0.5
MAX HEIGHT (M)	0.8	0.8	0.8	0.8	0.8	0.8
PERIOD (S)	3	3	3	3	3	3
SWELL:						
DIRECTION (T)	020	020	020	020	020	020
HEIGHT (M)	0.8	0.7	0.7	0.6	0.6	0.5
PERIOD (S)	8	8	8	9	9	9
COMBINED SEA:						
SIG HEIGHT (M)	1.0	0.9	0.9	0.8	0.8	0.7
MAX HEIGHT (M)	1.3	1.2	1.2	1.0	1.0	1.0

SKY COVER OVERCAST OCCASIONAL BROKEN......................

CEILING (HND FT) 3-5...............6-9...........................

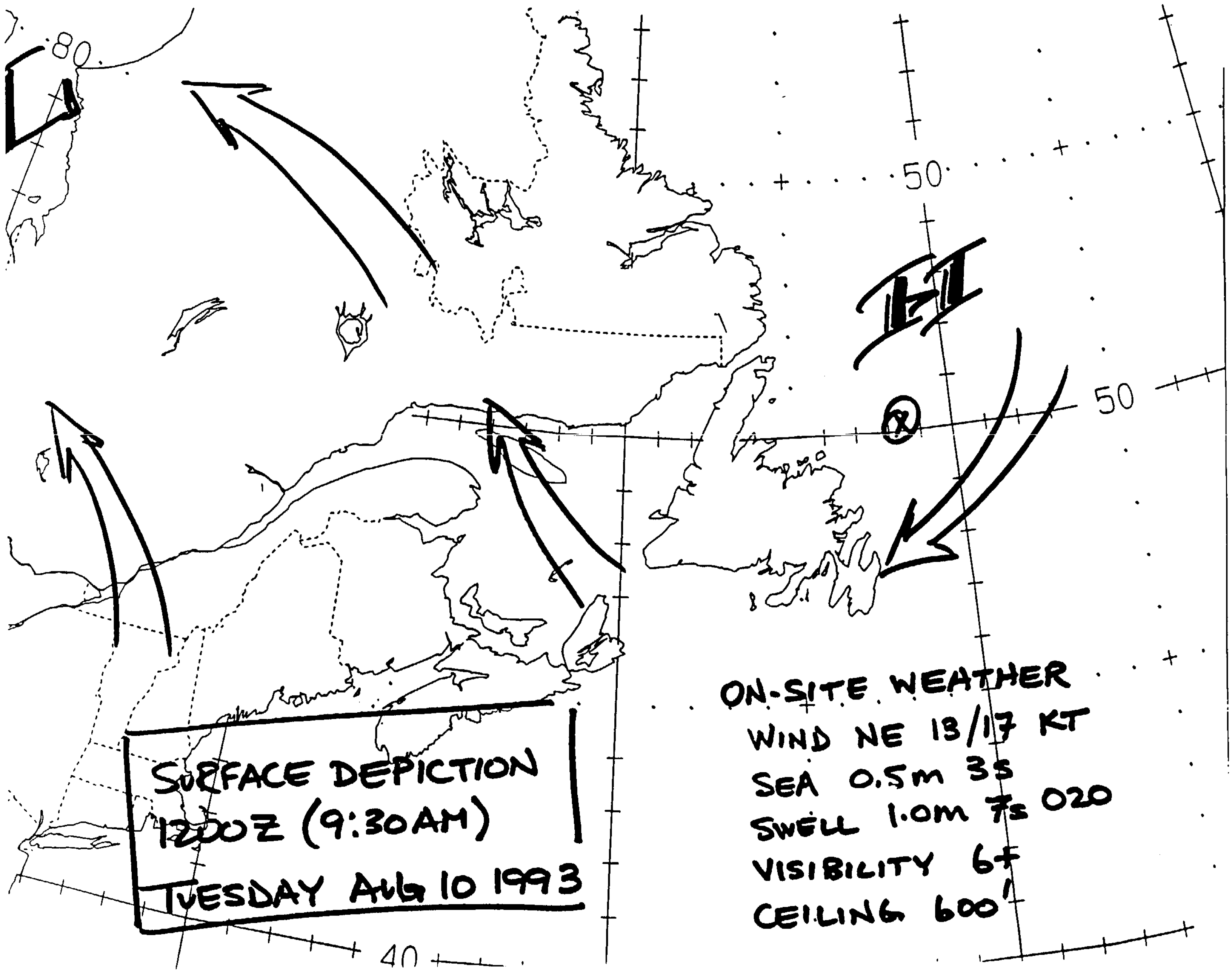
VISIBILITY (Mi) 1-3...............6+.............................

WEATHER FOG PATCHES.......NIL............................

TEMP (C) 12...
SEA SURFACE TEMPERATURE 11 DEG C.

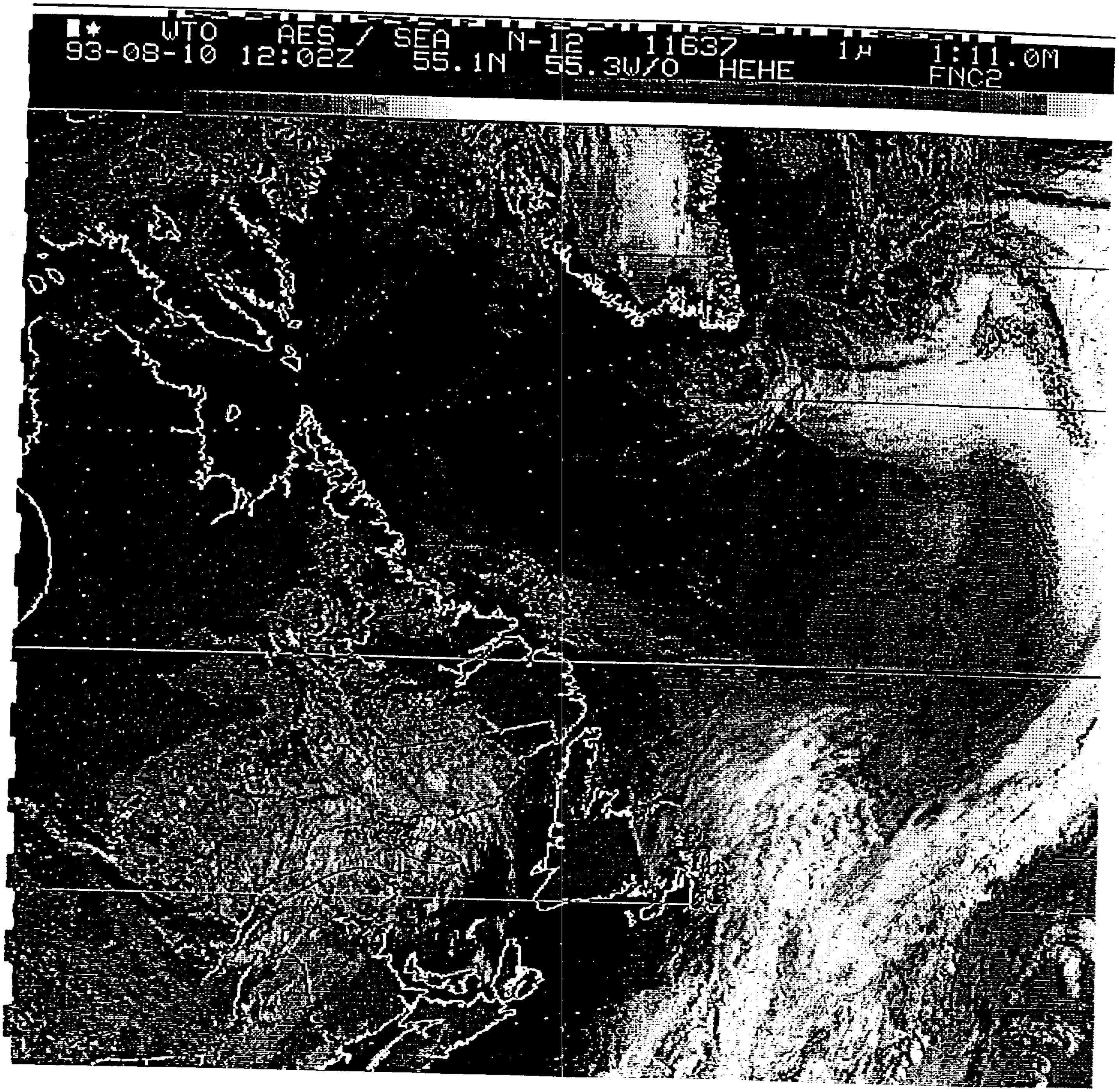
OUTLOOK:
THU AUG 12: WIND S-SE 5-10KT. VISIBILITY GOOD. MAX WAVE 1M.
FRI AUG 13: WIND S-SE 5-10KT. VISIBILITY FAIR. MAX WAVE 1M.
SAT AUG 14: WIND S-SE 5-10KT. VISIBILITY FAIR-POOR FOG PATCHES FORMING. MAX WAVE 2M.

SYNOPSIS:
A HIGH PRESSURE CENTRE ABOUT 120 MILES NORTH OF THE AREA WILL CONTINUE TO DRIFT SLOWLY TOWARD THE SOUTH OVER THE NEXT COUPLE DAYS. A LIGHT NORTHEAST FLOW OVER THE AREA IS FORECAST TO CONTINUE ON WEDNESDAY. ON THURSDAY AND FRIDAY THE WINDS ARE EXPECTED TO SHIFT AROUND TO LIGHT SOUTHEASTERLY. THIS HIGH PRESSURE SYSTEM HAS BROUGHT SOMEWHAT DRIER AIR TO THE AREA WHICH IS SLOWLY CLEARING OUT THE FOG AND LOW CLOUD.



80
50
50
40
H
L
SURFACE DEPICTION
1200Z (9:30AM)
TUESDAY AUG 10 1993
ON-SITE WEATHER
WIND NE 13/17 KT
SEA 0.5m 3s
SWELL 1.0m 7s 020
VISIBILITY 6+
CEILING 600'

FOTO D8073P WTO N-12 11637 NIR 1:11.0 93/08/10 12:02Z 55.1N 55.3W HEHE
Printed Tue Aug 10 17:29:50 UTC 1993



FORECAST FOR NOBE SITE AT 47.7N 52.0W ISSUED BY ENVIRONMENT CANADA AT 1600 NDT WEDNESDAY AUGUST 11 1993 VALID UNTIL 1700 NDT THURSDAY WITH AN OUTLOOK FOR THE NEXT THREE DAYS.

VALID DATE	THURSDAY AUGUST 12 1993					
VALID TIME NDT	0000	0530	0830	1100	1400	1700
WIND AT 10M:						
DIRECTION (T)	120	140	150	160	160	150
SPEED (KT)	02	02	03	05	05	05
MAX SPEED (KT)	05	05	06	08	08	08
SEA:						
SIG HEIGHT (M)	0.3	0.3	0.3	0.3	0.3	0.3
MAX HEIGHT (M)	0.5	0.5	0.5	0.5	0.5	0.5
PERIOD (S)	2	2	2	2	2	2
SWELL:						
DIRECTION (T)	030	030	030	030	030	030
HEIGHT (M)	0.7	0.6	0.6	0.5	0.5	0.4
PERIOD (S)	7	8	8	8	9	9
COMBINED SEA:						
SIG HEIGHT (M)	0.8	0.7	0.7	0.6	0.6	0.6
MAX HEIGHT (M)	1.0	0.9	0.9	0.8	0.8	0.8

SKY COVER OVERCAST....................BROKEN.......SCATTERED

CEILING (HND FT) 2........2........4........6.............NIL......

VISIBILITY (Mi) 1........1........2........4........6+...........

WEATHER FOG...................................NIL..........

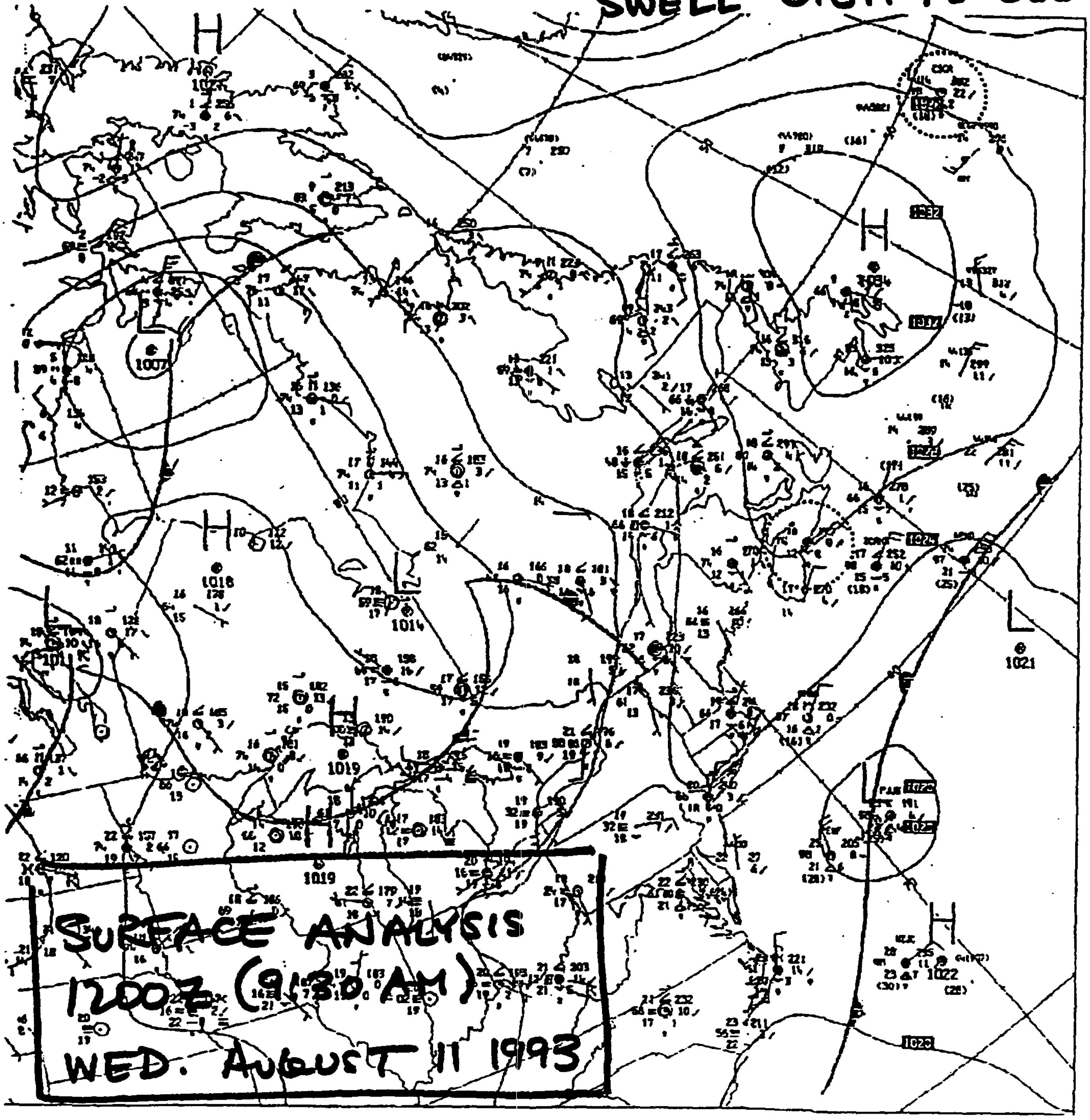
TEMP (C) 8..........................10..........12.......

SEA SURFACE TEMPERATURE 11 DEG C.

OUTLOOK:
FRI AUG 13: WIND E-SE 5KT. VISIBILITY GOOD. MAX WAVE 1M.
SAT AUG 14: WIND E-NE 5KT. VISIBILITY GOOD-FAIR. MAX WAVE 1M.
SUN AUG 15: WIND VARIABLE 5KT. VISIBILITY FAIR. MAX WAVE 1M.

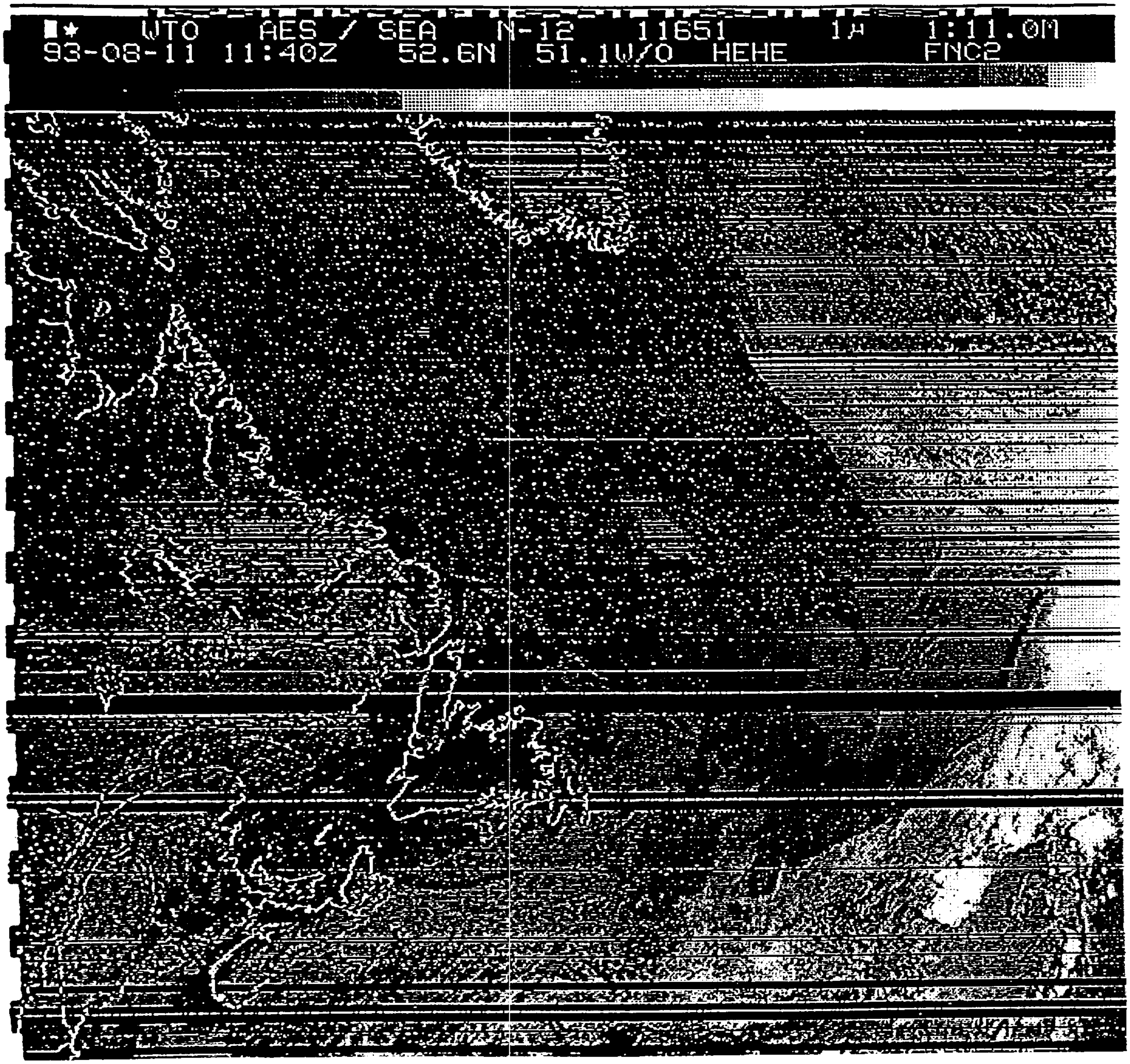
SYNOPSIS:
A HIGH PRESSURE CENTRE LOCATED JUST NORTH OF THE AREA AT FORECAST TIME WILL DRIFT SLOWLY TOWARD THE SOUTHEAST TODAY. LIGHT EASTERLY WINDS OVER THE AREA ARE EXPECTED TO SHIFT TO SOUTHEAST BY THURSDAY MORNING. THE EXTENSIVE LOW CLOUD DECK WHICH HAS COVERED THE AREA FOR THE PAST WEEK CONTINUES TO BREAK UP RAPIDLY AS THE HIGH BRINGS COOL DRY AIR FROM THE NORTH. WHILE SOME CLOUD WILL LIKELY REMAIN IN THE MORNING THE SUN IS EXPECTED TO MAKE AN APPEARANCE THURSDAY AFTERNOON. THE LONG RANGE OUTLOOK IS NOT FAVOURABLE AT THIS TIME WITH LIGHT EASTERLIES FORECAST FOR FRIDAY AND SATURDAY.

9:30 AM ON-SITE
WIND 060 01/03
SEA NIL
SWELL 0.8M 7s 030



MAPS W093IC CMC32A0 SUB STD A SFC EARLY 12Z

FOTO D8073P WTO N-12 11651 NIR 1:11.0 93/08/11 11:41Z 52.6N 51.1W HEHE
Printed Wed Aug 11 13:06:58 UTC 1993



APPENDIX B

Site Records - August 7 Dry Run

- VHF Waverider output (Seaconsult)
- AES Buoy Hourly Reports

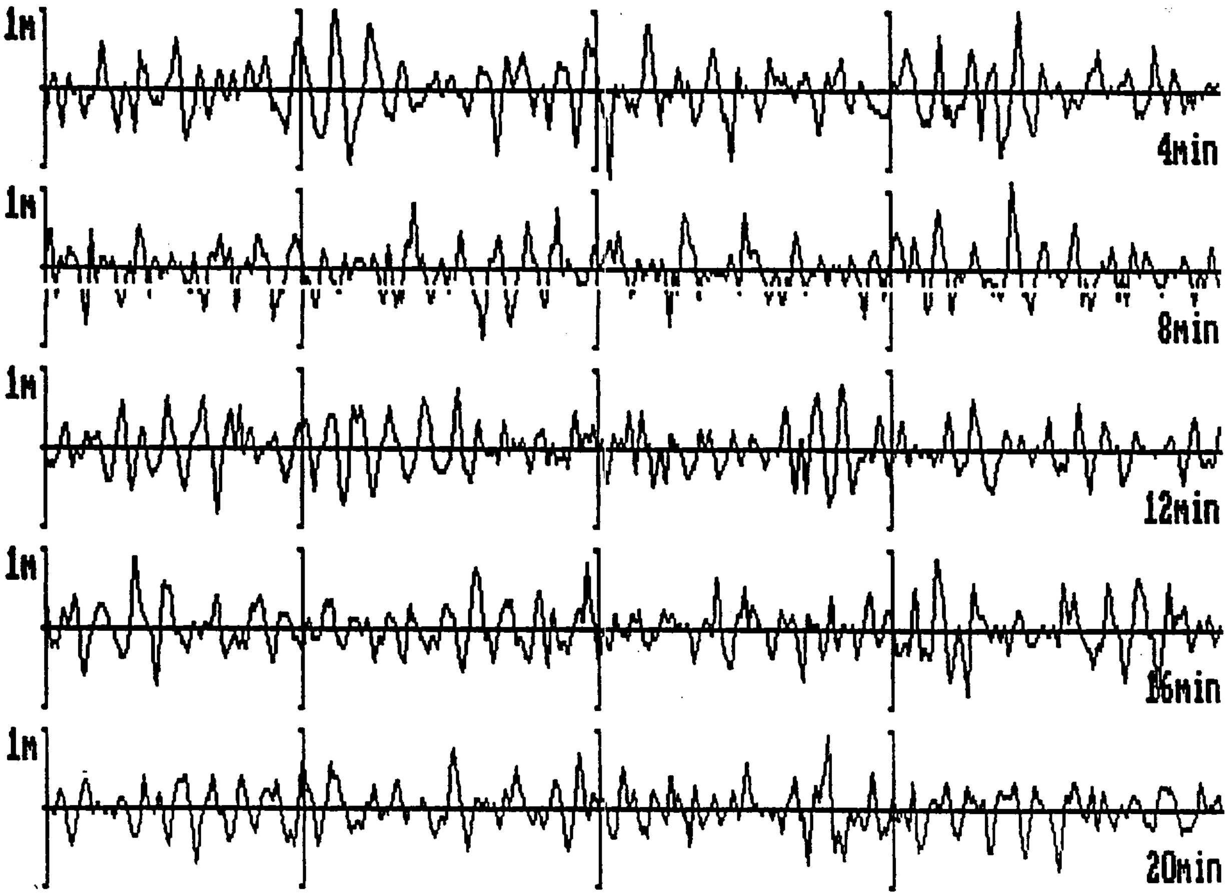
LOCALLY TRANSMITTING WAVERIDER

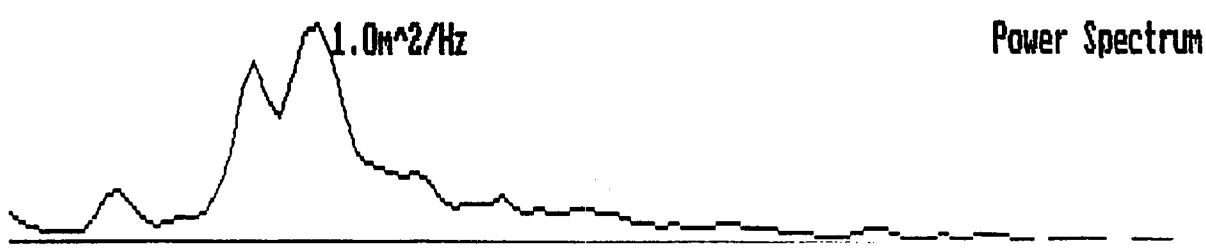
0638 - 2137 UTC (local + 2.5 h)

Seaconsult

Wave Data Station 47°40.036', 51°59.099'W
Report for the 20 minute period commencing 06:38 07/08/1993 UTC

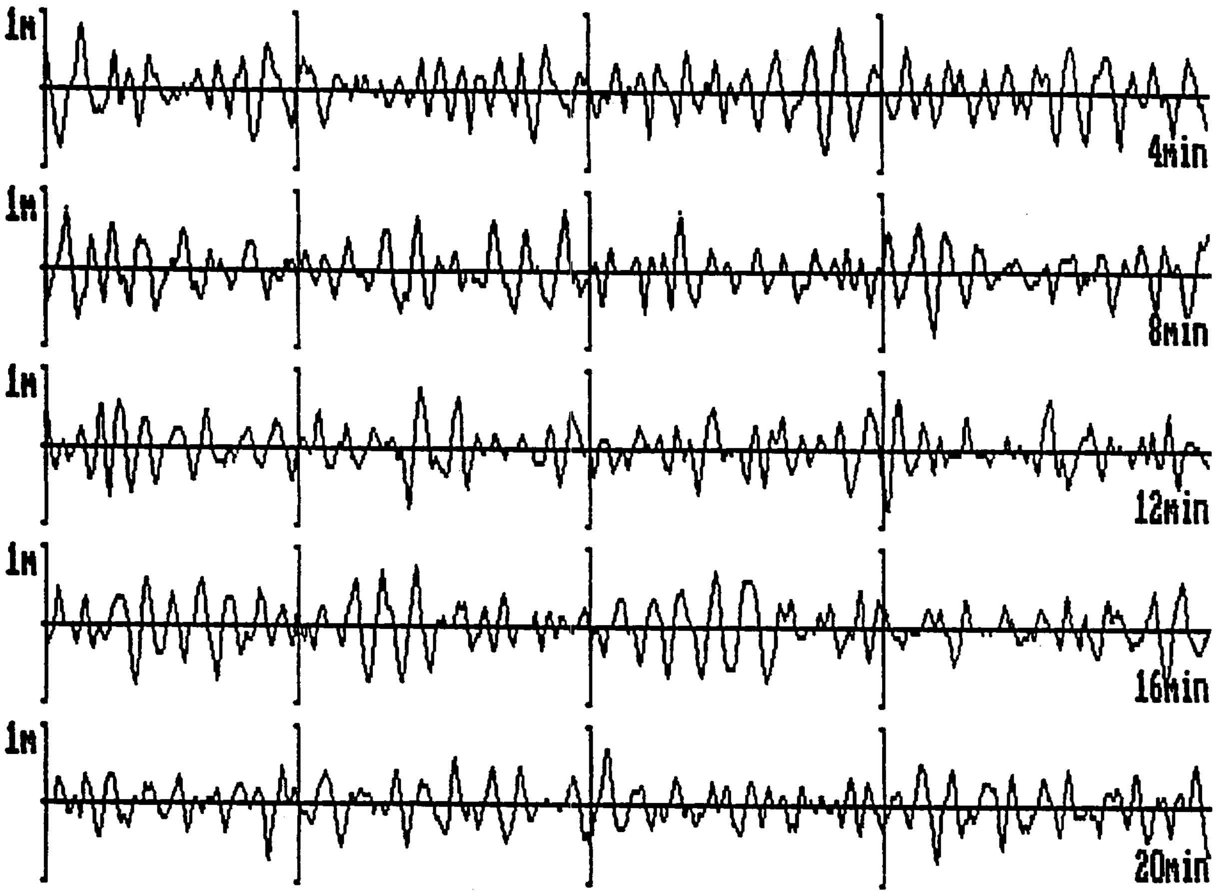
SITE : NOBE	Significant Wave Height	Hs (m)	1.18
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.99
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	6.67
	Good Data Received	(%)	81.6

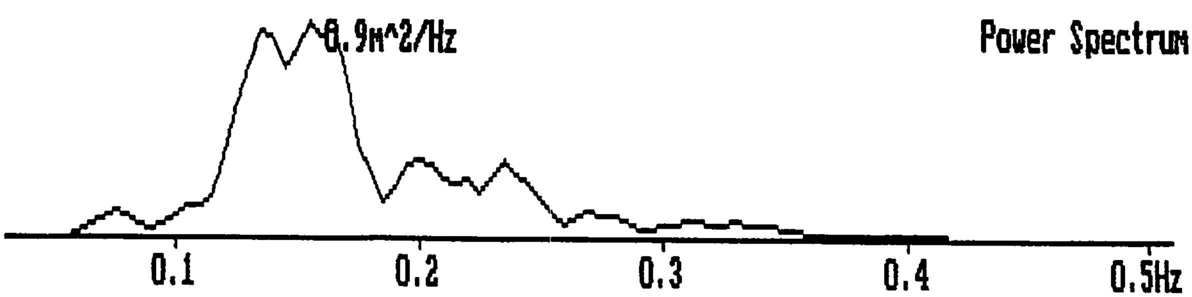




Wave Data Station
Report for the 20 minute period commencing 07:38 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs	(m)	1.12
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm	(m)	1.67
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp	(s)	6.67
	Good Data Received		(%)	100.0

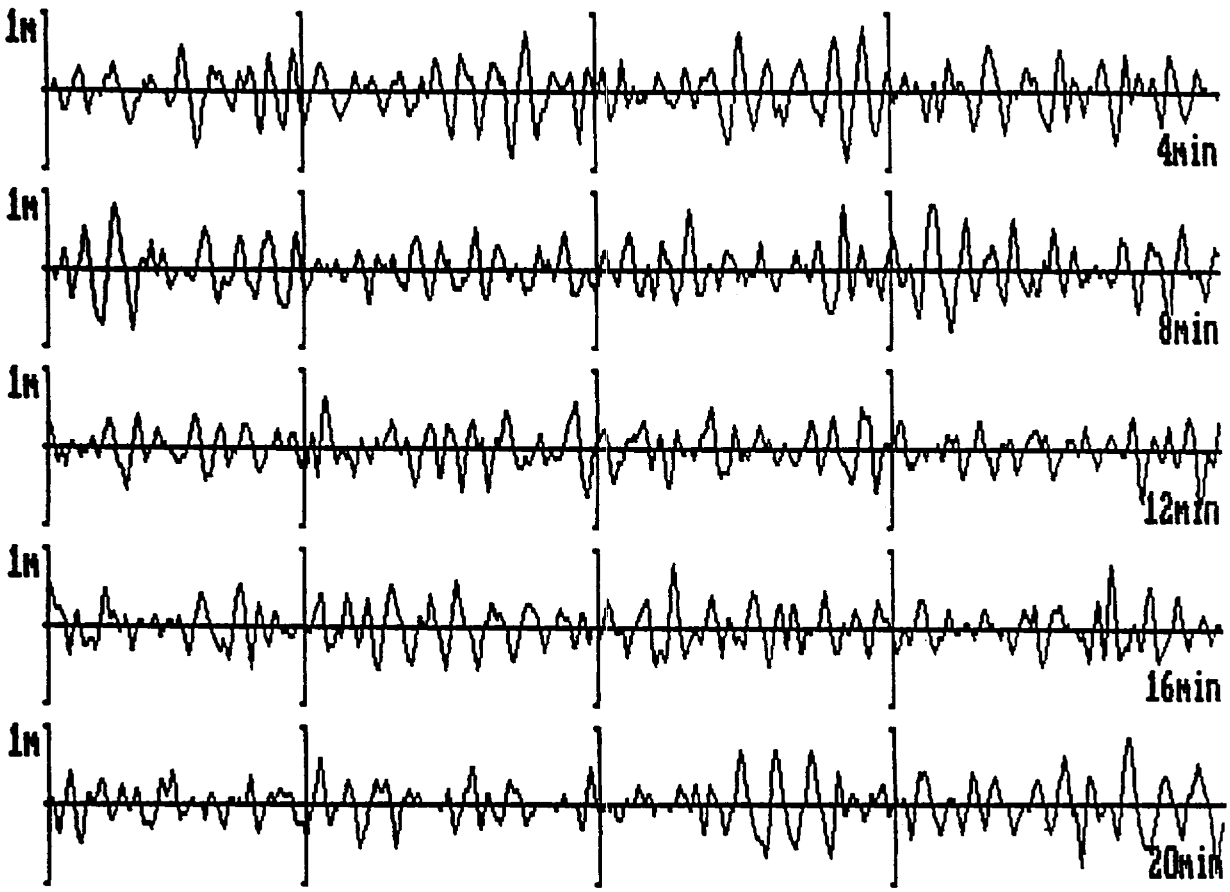


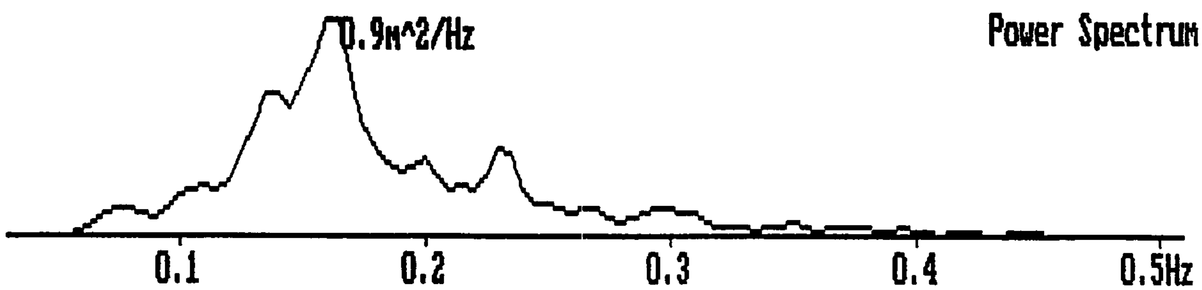


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 08:38 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs (m)	1.09
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.77
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	6.45
	Good Data Received	(%)	100.0



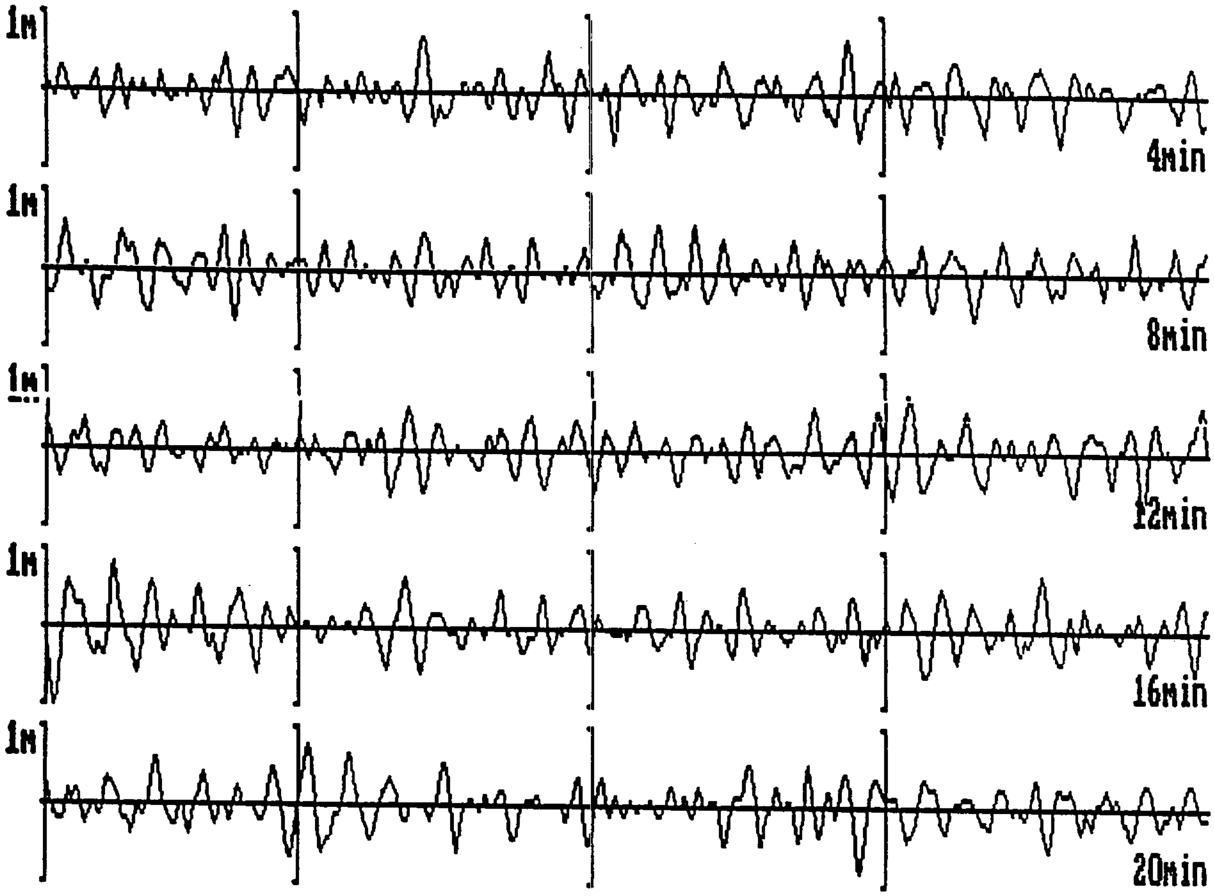


Seaconsult

Wave Data Station

Report for the 20 minute period commencing 11:37 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs (m)	1.03
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.63
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	7.14
	Good Data Received	(%)	100.0

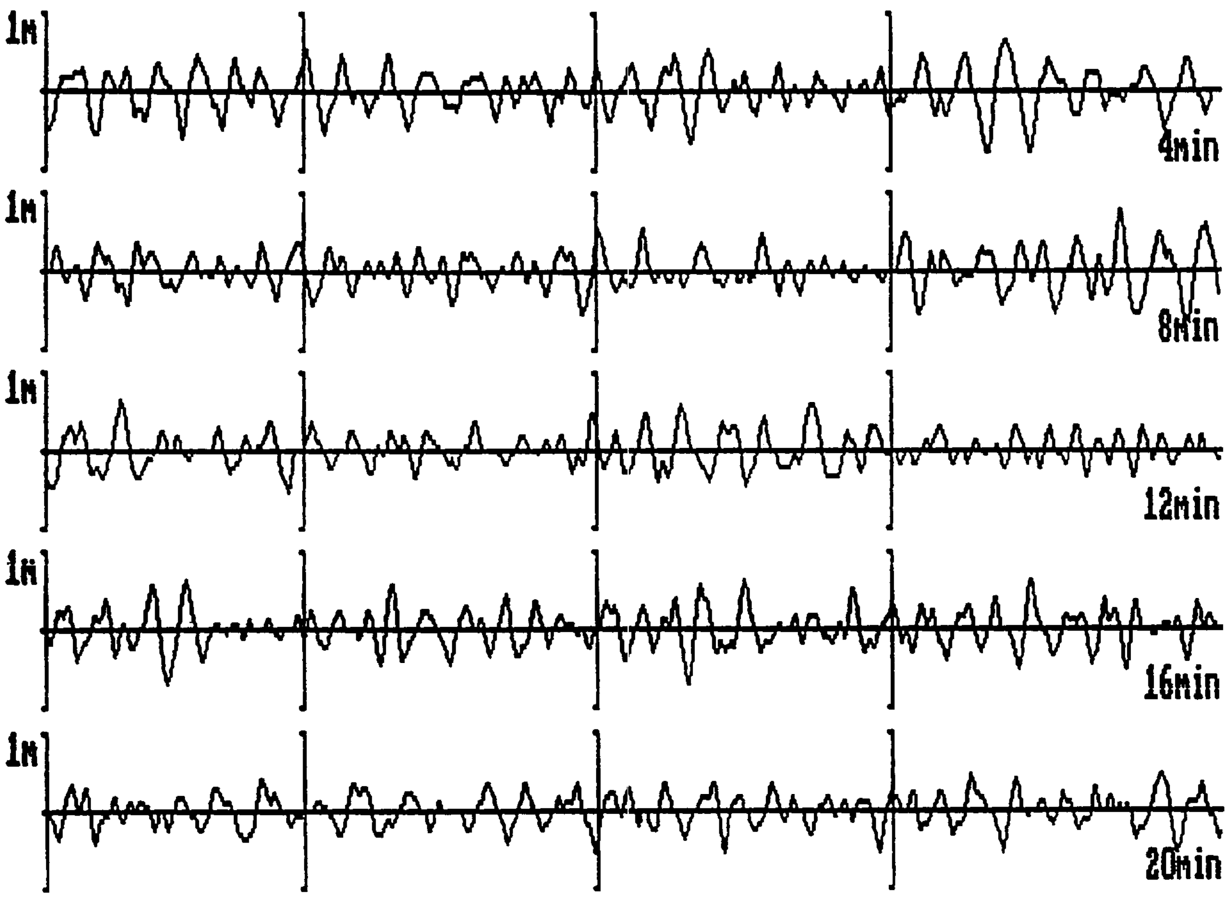


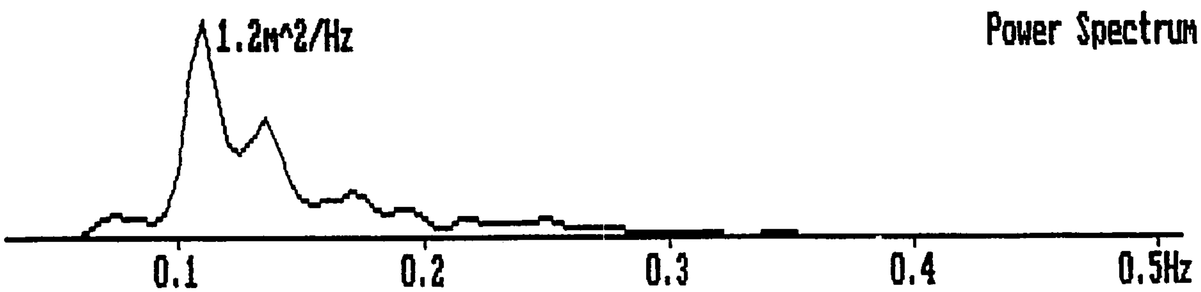
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 13:38 07/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.96
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.47
OPERATOR	: D.Dickins & M.Henry	Peak Period	Tp (s)	9.52
		Good Data Received	(%)	100.0



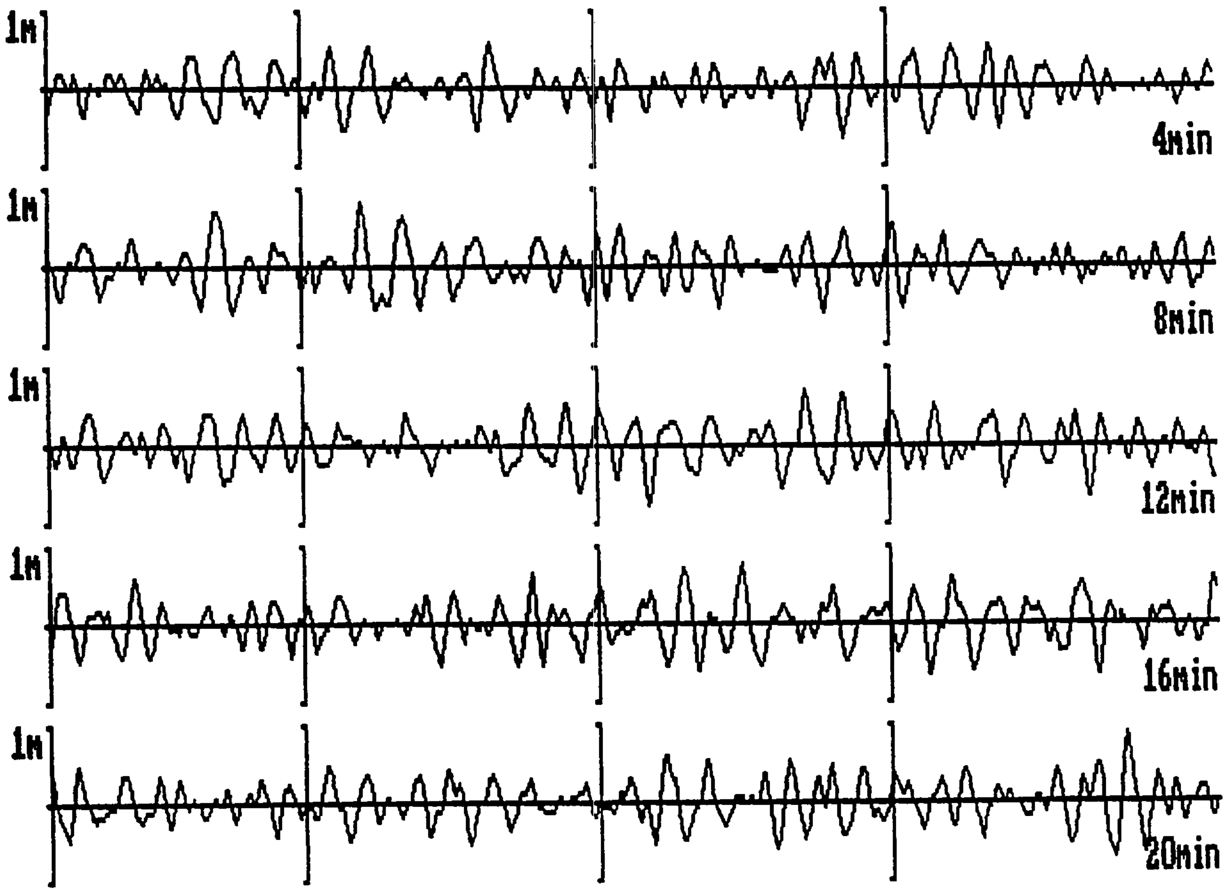


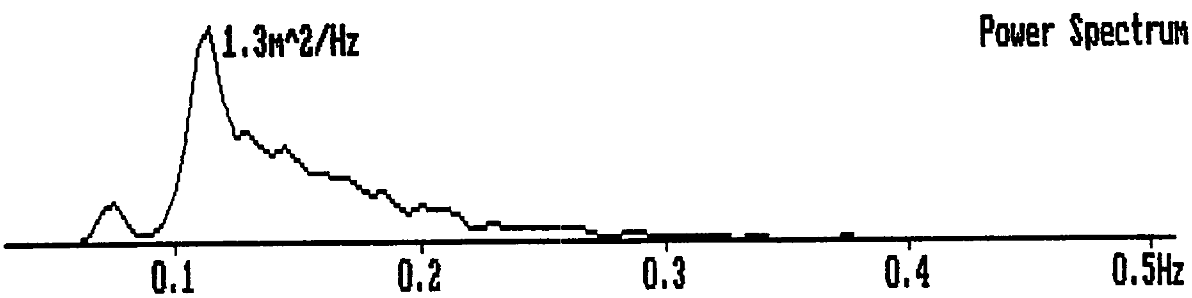
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 14:38 07/08/1993 UTC

SITE : NODE	Significant Wave Height	Hs (m)	1.06
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.63
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	9.09
	Good Data Received	(%)	100.0



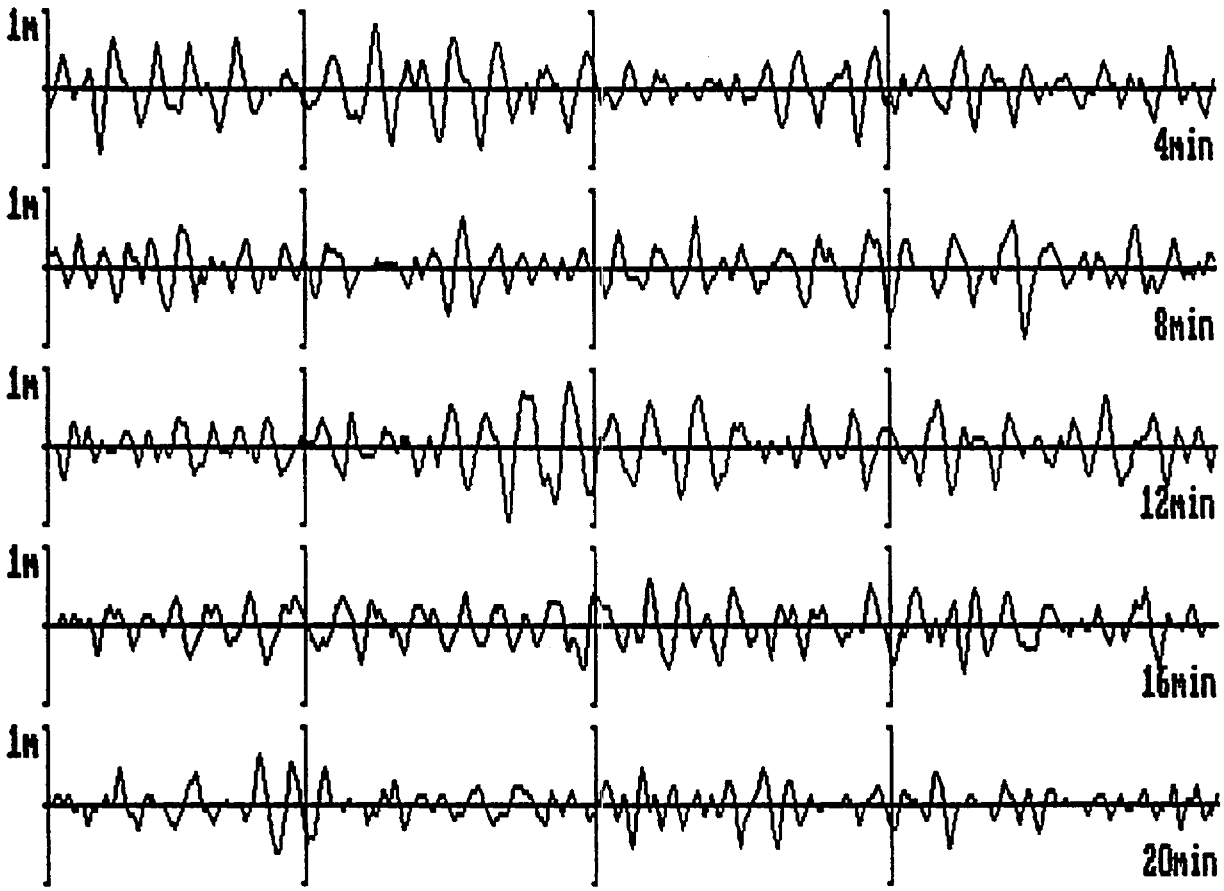


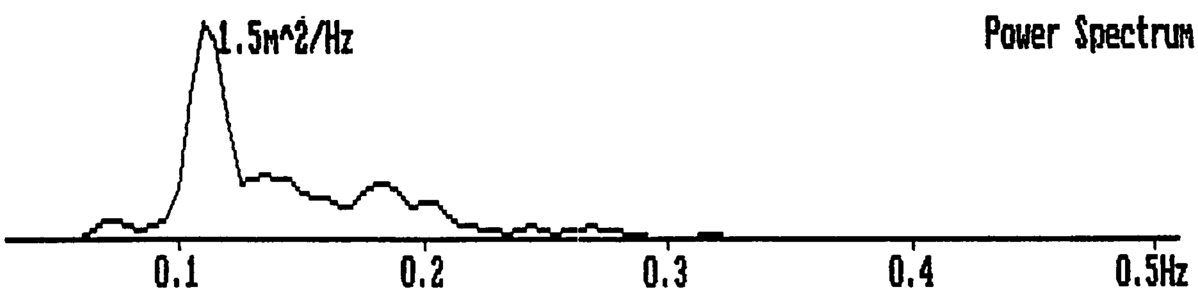
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 15:38 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs	(m)	1.03
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm	(m)	1.72
OPERATOR : D.Dickins & M.Henry	Peak Period	Tp	(s)	9.52
	Good Data Received		(%)	100.0

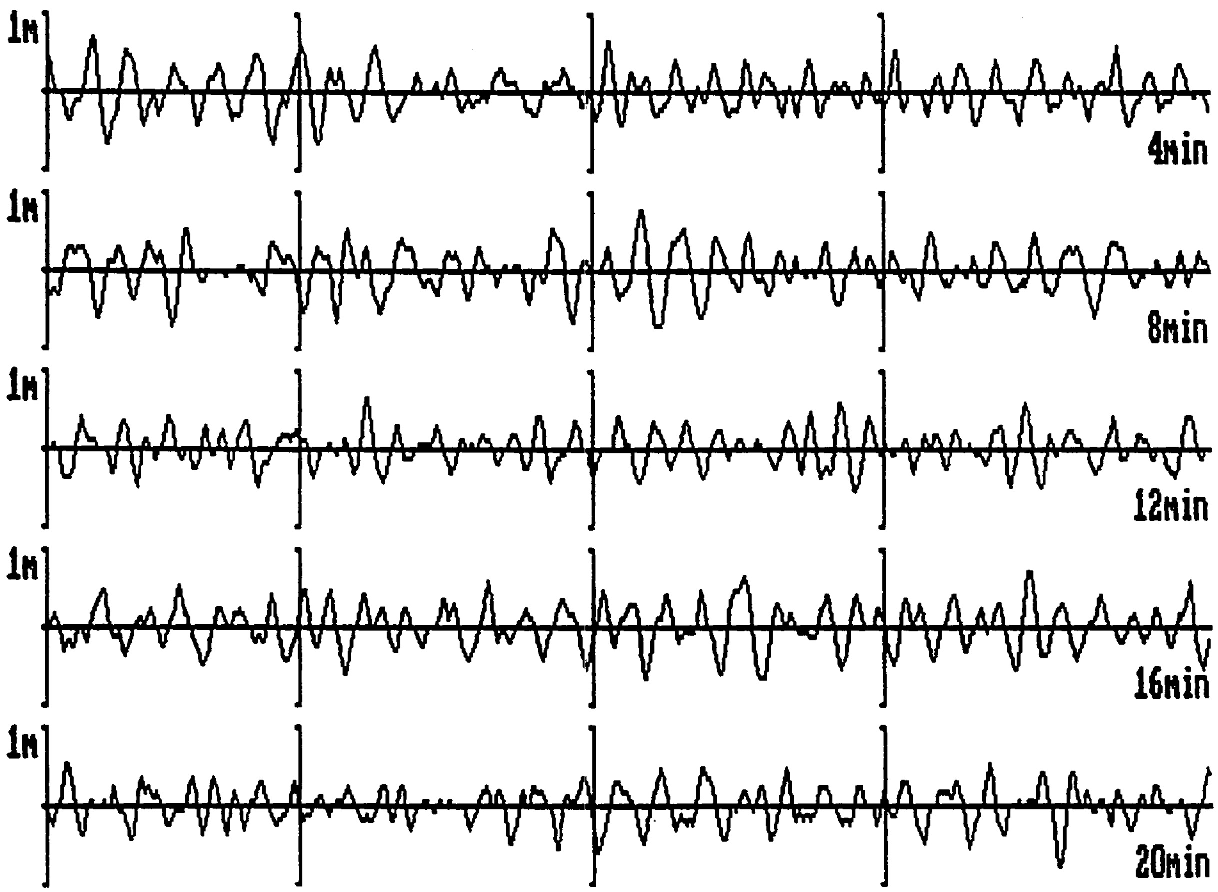


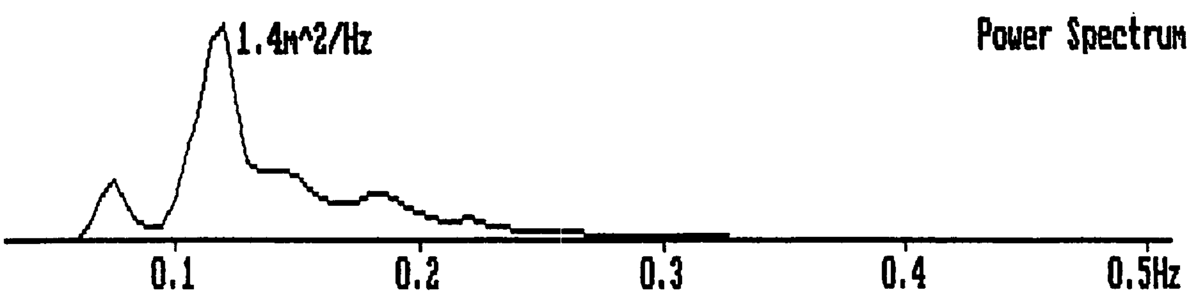


Wave Data Station

Report for the 20 minute period commencing 16:38 07/08/1993 UTC

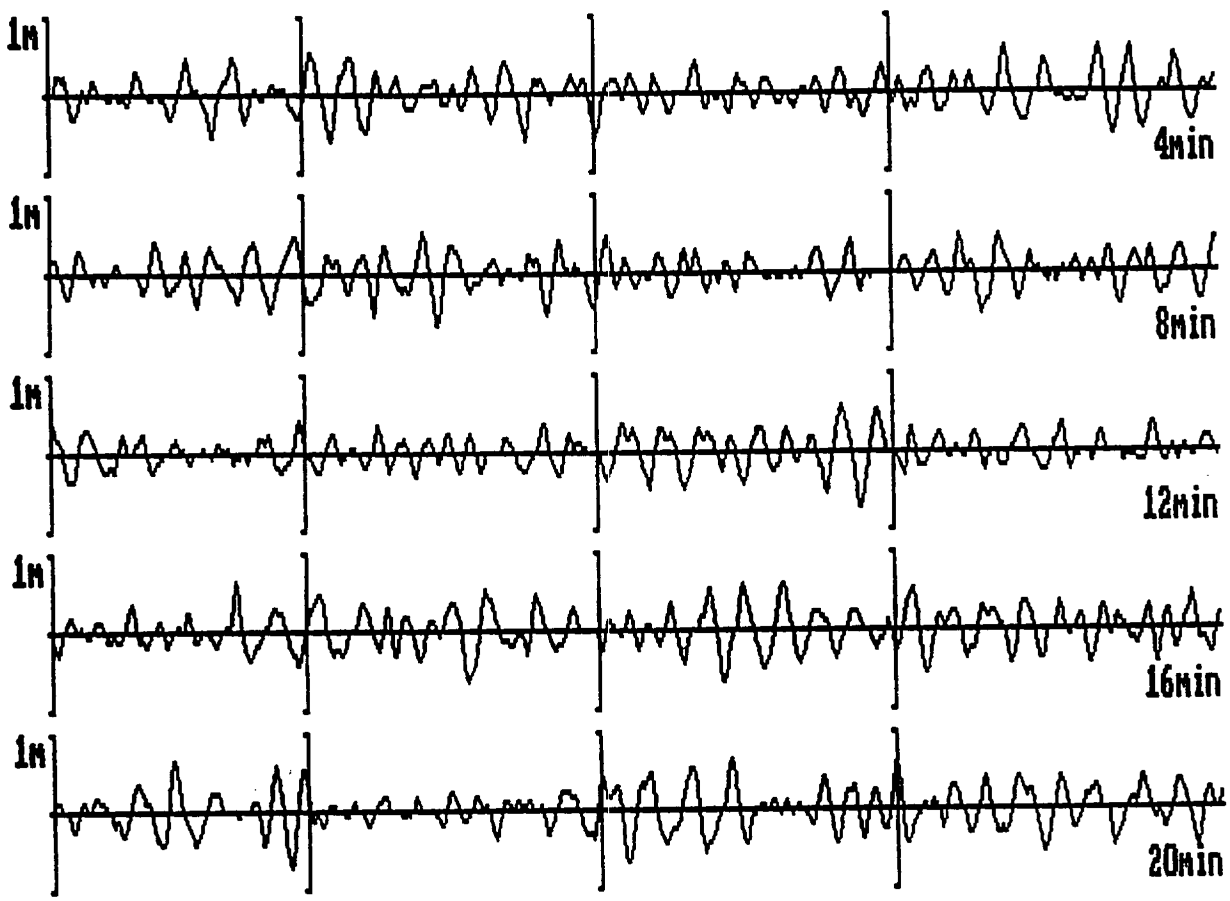
SITE : NOBE	Significant Wave Height	Hs (m)	1.05
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.30
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	8.70
	Good Data Received	(%)	100.0

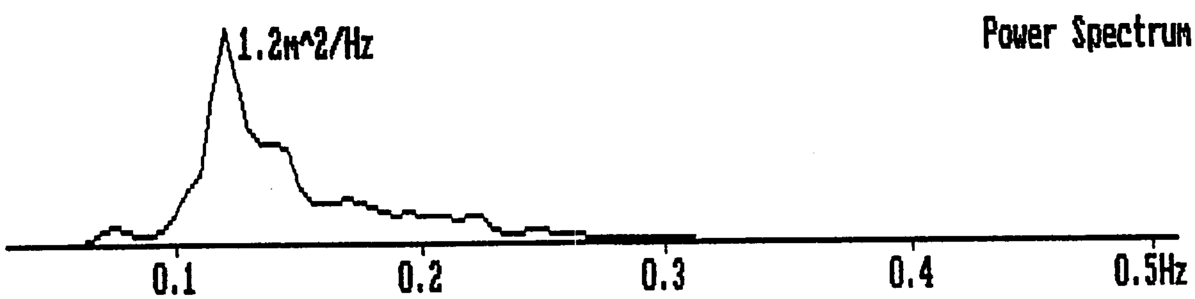




Wave Data Station
Report for the 20 minute period commencing 17:38 07/08/1993 UTC

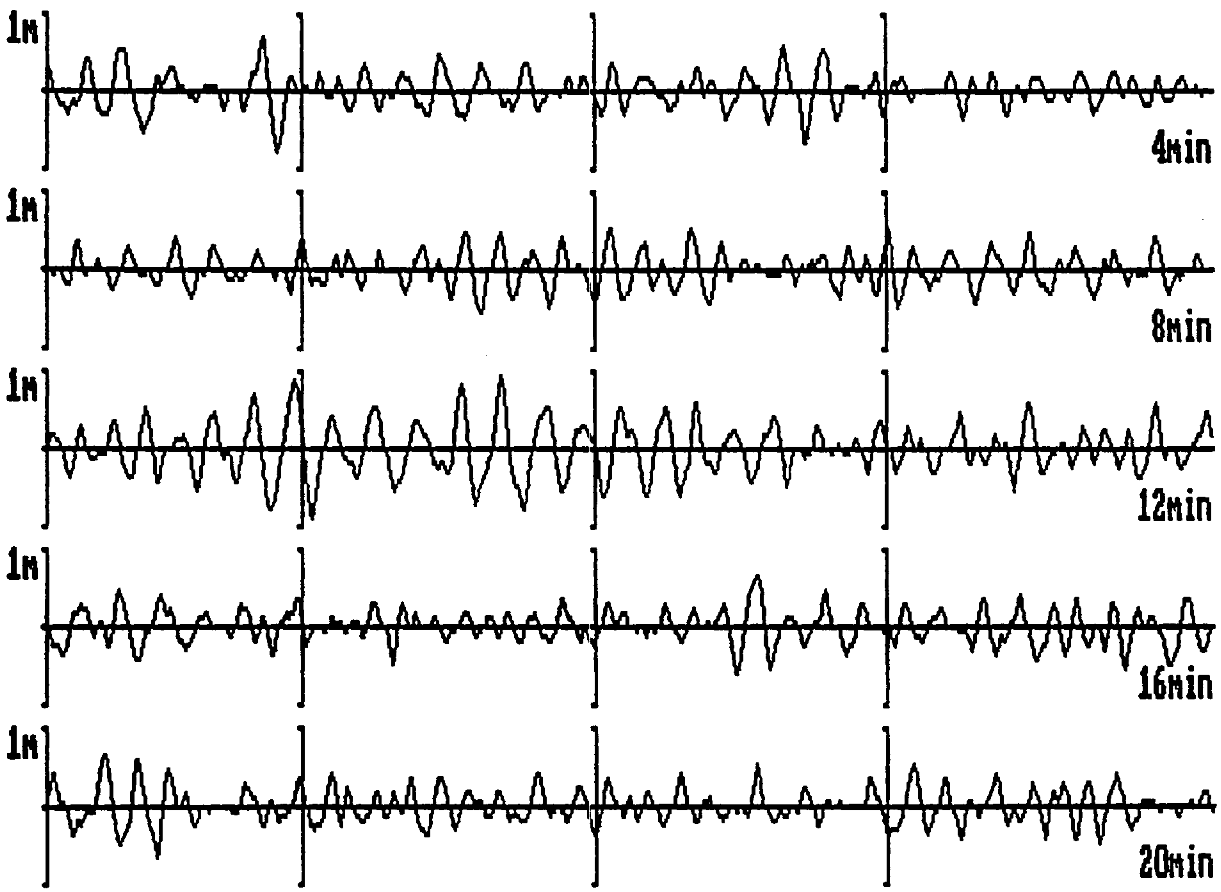
SITE : NOBE	Significant Wave Height	Hs (m)		0.94
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)		1.31
OPERATOR : B.Dickins & M.Henry	Peak Period	Tp (s)		8.70
	Good Data Received		(%)	100.0

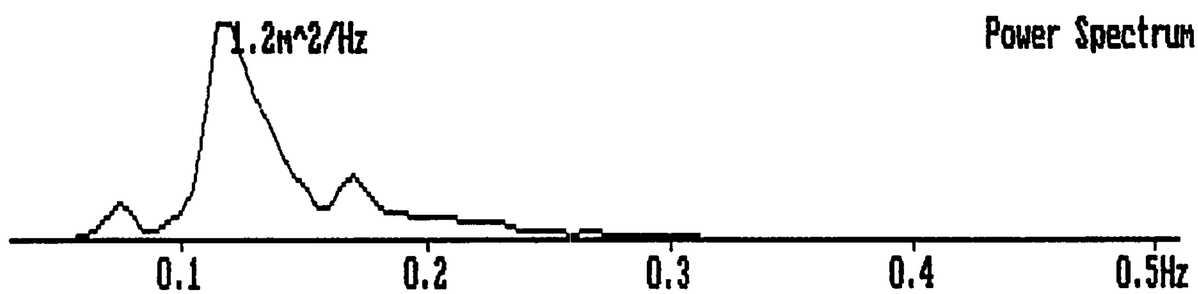




Wave Data Station
Report for the 20 minute period commencing 18:38 07/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	1.00
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.70
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	9.09
		Good Data Received	(%)	100.0



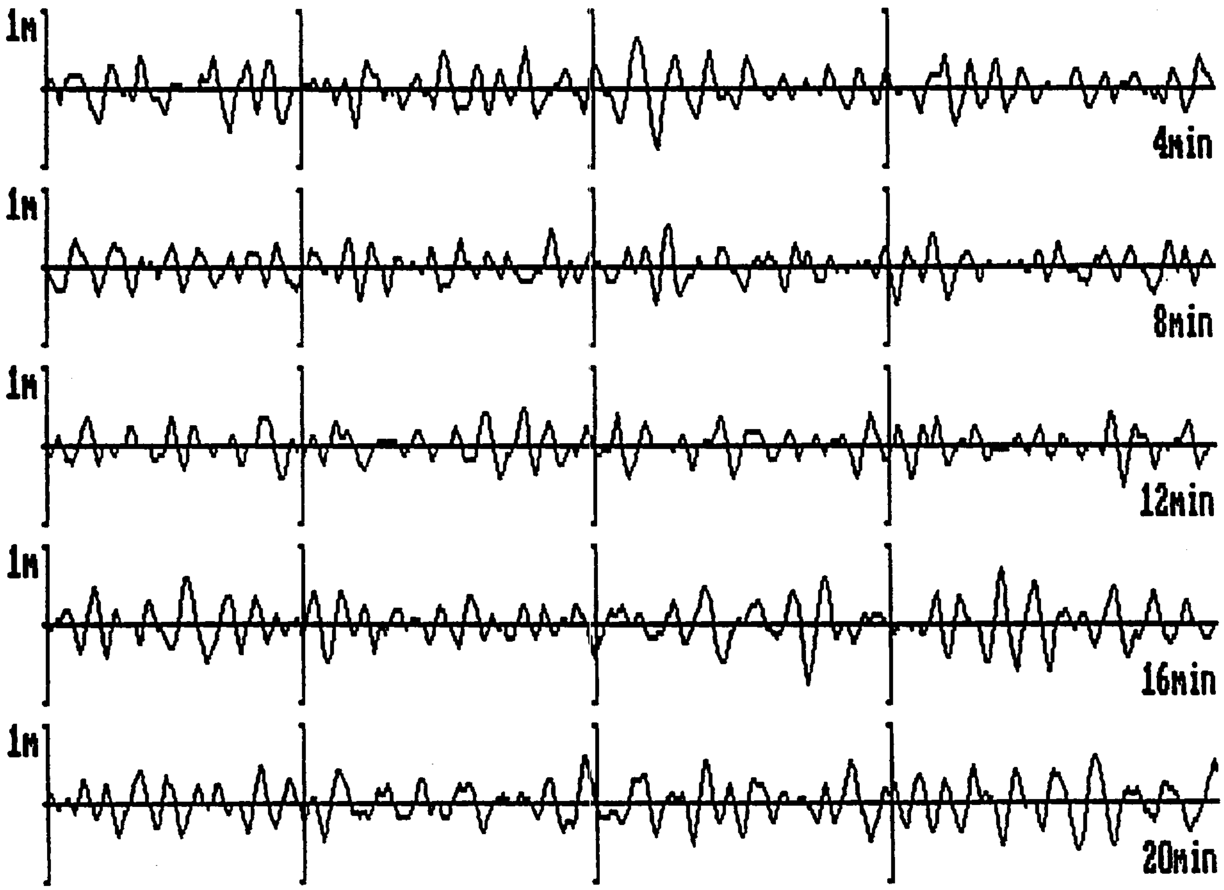


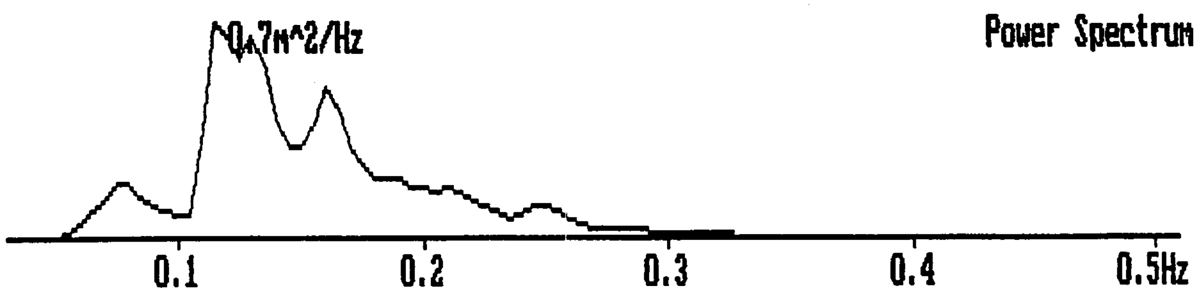
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 19:38 07/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs	(m)	0.92
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm	(m)	1.37
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp	(s)	9.09
		Good Data Received		(%)	100.0



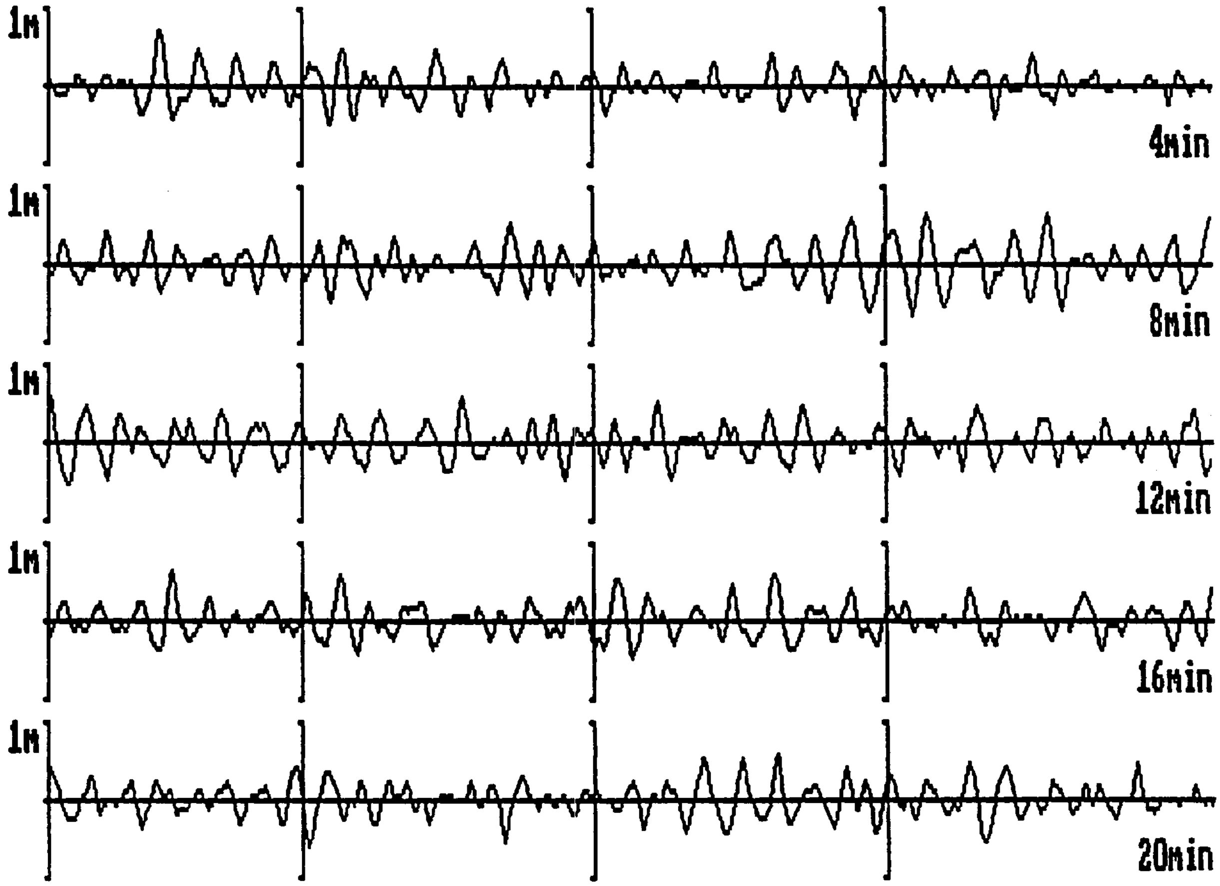


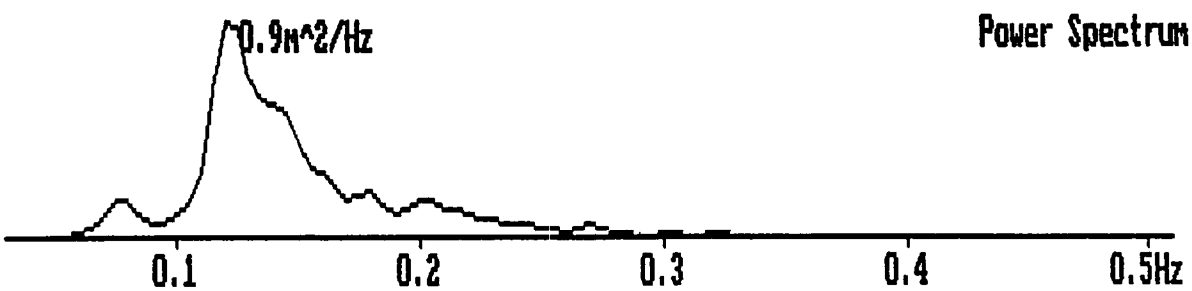
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 20:38 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs	(m)	0.89
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm	(m)	1.30
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp	(s)	8.70
	Good Data Received		(%)	100.0

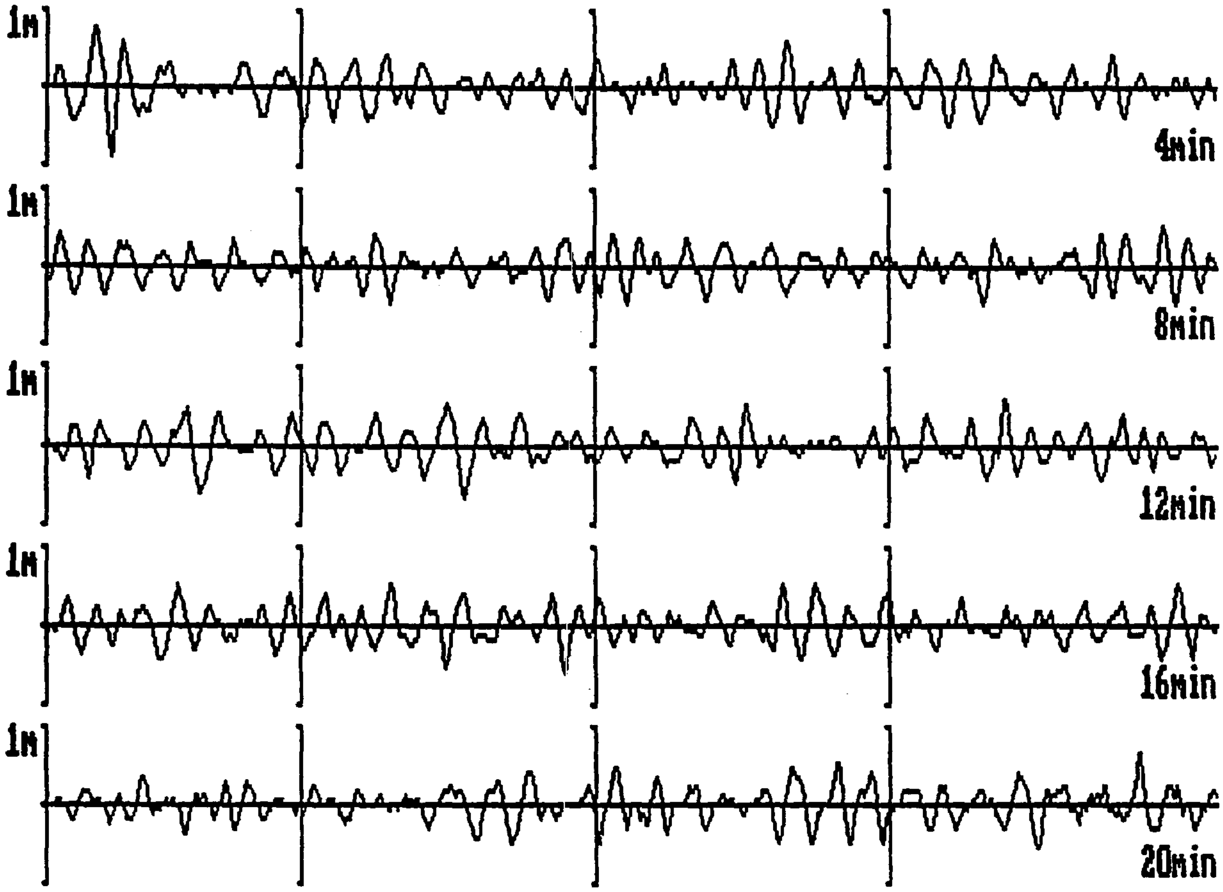


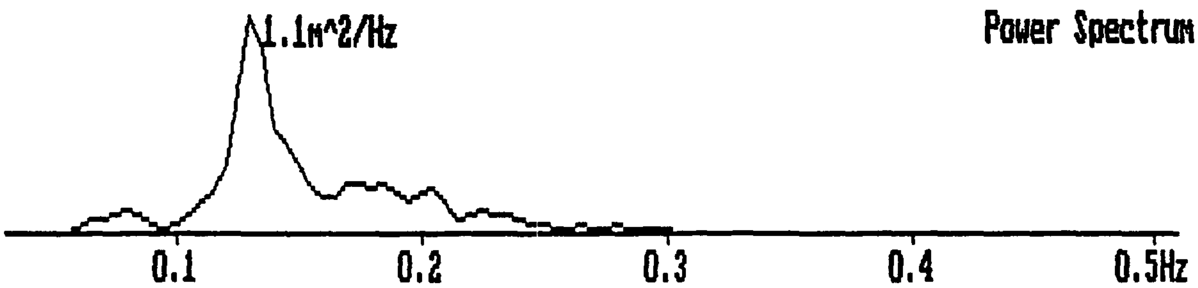


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 21:37 07/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs	(m)	0.89
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm	(m)	1.53
OPERATOR : B.Dickins & N.Henry	Peak Period	Tp	(s)	8.00
	Good Data Received		(%)	99.0





AES NOMAD BUOY RECORD

0100 Aug 7 to 1800 Aug 8, 1993

SHIP ID	F L G	DDHH	Lat LL.L	Long LLL.L	Wind (knots) DDFF/MX	Vsby (nm) VSBY	WX wwWW	Air Tmp TT	Dew Tmp tt	Sea Tmp SS	Pres hPa PPPP	Pres Tend appp	Dir Spd DsV	Sig Wv (m)	F c E
44143		0818	47.6N	052.1W	0312/14			12		11	0189	7004	HT	0.9	
44143		0817	47.6N	052.1W	0406/08			12		11	0192	7003	HT	0.9	
44143		0816	47.6N	052.1W	0810/10			12		11	0189	7013	HT	1.1	
44143		0815	47.6N	052.1W	0812/14			12		11	0193	7010	HT	1.0	
44143		0814	47.6N	052.1W	0812/14			12		11	0195	7004	HT	0.9	
44143		0813	47.6N	052.1W	1008/10			12		11	0202	7001	HT	0.9	
44143		0809	47.6N	052.1W	1408/08			12		11	0219	2008	HT	0.7	
44143		0808	47.6N	052.1W	0302/04			12		11	0222	2002	HT	0.7	
44143		0807	47.6N	052.1W	2002/02			12		11	0218	7005	HT	0.8	
44143		0806	47.6N	052.1W	1204/06			12		11	0211	7013	HT	0.7	
44143		0805	47.6N	052.1W	1306/08			12		11	0220	7006	HT	0.7	
44143		0804	47.6N	052.1W	0802/04			12		11	0223	7006	HT	0.7	
44143		0803	47.6N	052.1W	1102/02			12		11	0224	7001	HT	0.7	
44143		0802	47.6N	052.1W	0000/00			12		11	0226	2008	HT	0.7	
44143		0801	47.6N	052.1W	2602/02			12		11	0229	2015	HT	0.7	
44143		0800	47.6N	052.1W	2002/02			12		11	0225		HT	0.7	
44143		0723	47.6N	052.1W	0000/02			13		11	0218	2005	HT	0.7	
SHIP ID	F L G	DDHH	Lat LL.L	Long LLL.L	Wind (knots) DDFF/MX	Vsby (nm) VSBY	WX wwWW	Air Tmp TT	Dew Tmp tt	Sea Tmp SS	Pres hPa PPPP	Pres Tend appp	Dir Spd DsV	Sig Wv (m)	F c: El
44143		0722	47.6N	052.1W	3302/04			13		11	0214	2002	HT	0.8	
44143		0721	47.6N	052.1W	3202								HT		
44143		0720	47.6N	052.1W	3302/02			13		11	0213	2005	HT	0.9	
44143		0719	47.6N	052.1W	0000/02			13		11	0212	2004	HT	0.9	
44143		0718	47.6N	052.1W	1702/04			13		11	0210	2001	HT	0.9	
44143		0717	47.6N	052.1W	1402/02			13		11	0208	4000	HT	0.9	
44143		0716	47.6N	052.1W	1302/02			14		11	0208	7001	HT	1.0	
44143		0715	47.6N	052.1W	0702/02			14		11	0209	2006	HT	1.0	
44143		0714	47.6N	052.1W	0000/02			14		11	0208	2008	HT	1.0	
44143		0713	47.6N	052.1W	2202/04			12		10	0209	2013	HT	1.0	
44143		0712	47.6N	052.1W	2604/04			12		10	0203	2011	HT	1.0	
44143		0711	47.6N	052.1W	2704/06			11		10	0200	2014	HT	1.0	
44143		0710	47.6N	052.1W	2606/06			11		10	0196	2015	HT	1.1	
44143		0709	47.6N	052.1W	2108/10			11		10	0192	2012	HT	1.0	
44143		0708	47.6N	052.1W	1908/10			11		10	0186	2010	HT	1.1	
44143		0707	47.6N	052.1W	2206/08			11		10	0181	2003	HT	1.3	
44143		0706	47.6N	052.1W	2012/12			12		10	0180	2003	HT	1.3	
SHIP ID	F L G	DDHH	Lat LL.L	Long LLL.L	Wind (knots) DDFF/MX	Vsby (nm) VSBY	WX wwWW	Air Tmp TT	Dew Tmp tt	Sea Tmp SS	Pres hPa PPPP	Pres Tend appp	Dir Spd DsV	Sig Wv (m)	F: c(EE
44143		0705	47.6N	052.1W	2110/12			12		10	0176	4000	HT	1.4	
44143		0704	47.6N	052.1W	1914/14			12		10	0178	2003	HT	1.4	
44143		0703	47.6N	052.1W	1910/10			12		10	0177	2007	HT	1.4	
44143		0702	47.6N	052.1W	1812/14			12		10	0176	2015	HT	1.5	
44143		0701	47.6N	052.1W	2012/14			13		10	0175	2020	HT	1.5	
44143		0700	47.6N	052.1W	1916/17			12		10	0170	2022	HT	1.6	

SHP >

DAY hour (UTC)

APPENDIX C

Site Records - August 12 Burns

- VHF Waverider Output (Seaconsult)
- TSK Onboard Wave Height Meter Output
- ARGOS Waverider Output (Seaconsult)
- AES Buoy Hourly Reports

The following products are included in an annotated summary table for your use:

Frequency Domain (Spectral Analysis)

H_s	Significant Wave Height.
T_p	Peak Period.
T_z	Mean Wave Period.

Time Domain (Upcrossing Analysis)

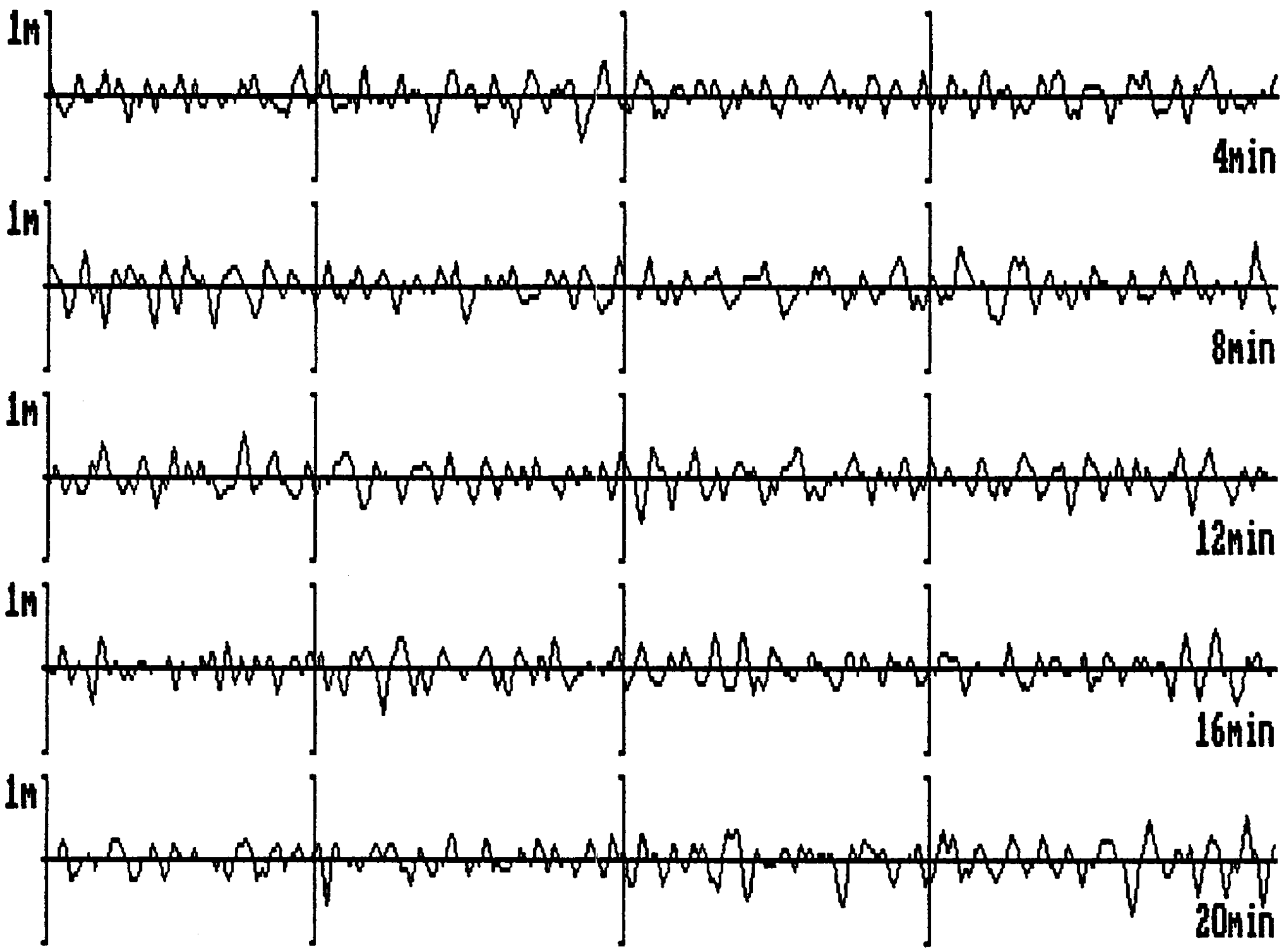
All waves are defined by successive upcrossings of the x axis.

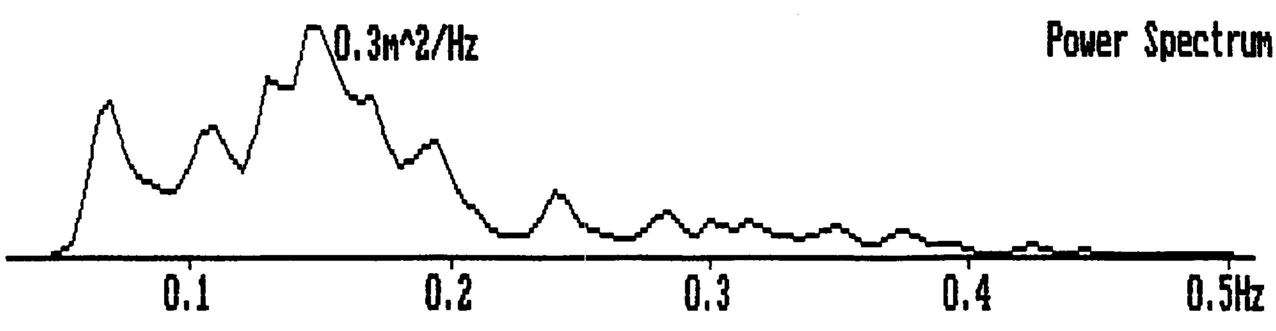
H_3	Significant Wave Height. Average height of the 1/3 largest waves in an hourly sample.
T_3	Significant Wave Period. Average period of the 1/3 largest waves in an hourly sample.
H_{max}	Maximum Wave Height. Height of the largest single wave in an hourly sample.
T_{max}	Maximum Wave Period. Largest separation of upcrossings in an hourly sample. This does not necessarily correspond to the H_{max} wave.
MCS	Maximum Combined Sea. The separation between the highest peak and the lowest trough in an hourly sample.
H_{10}	Average height of the 1/10 largest waves in an hourly sample.
H_a	Average Wave Height of an hourly sample.
T_a	Average Wave Period of an hourly sample.

Seaconsult

Wave Data Station
Report for the 20 minute period commencing 08:38 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.72
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.15
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	6.90
		Good Data Received	(%)	100.0

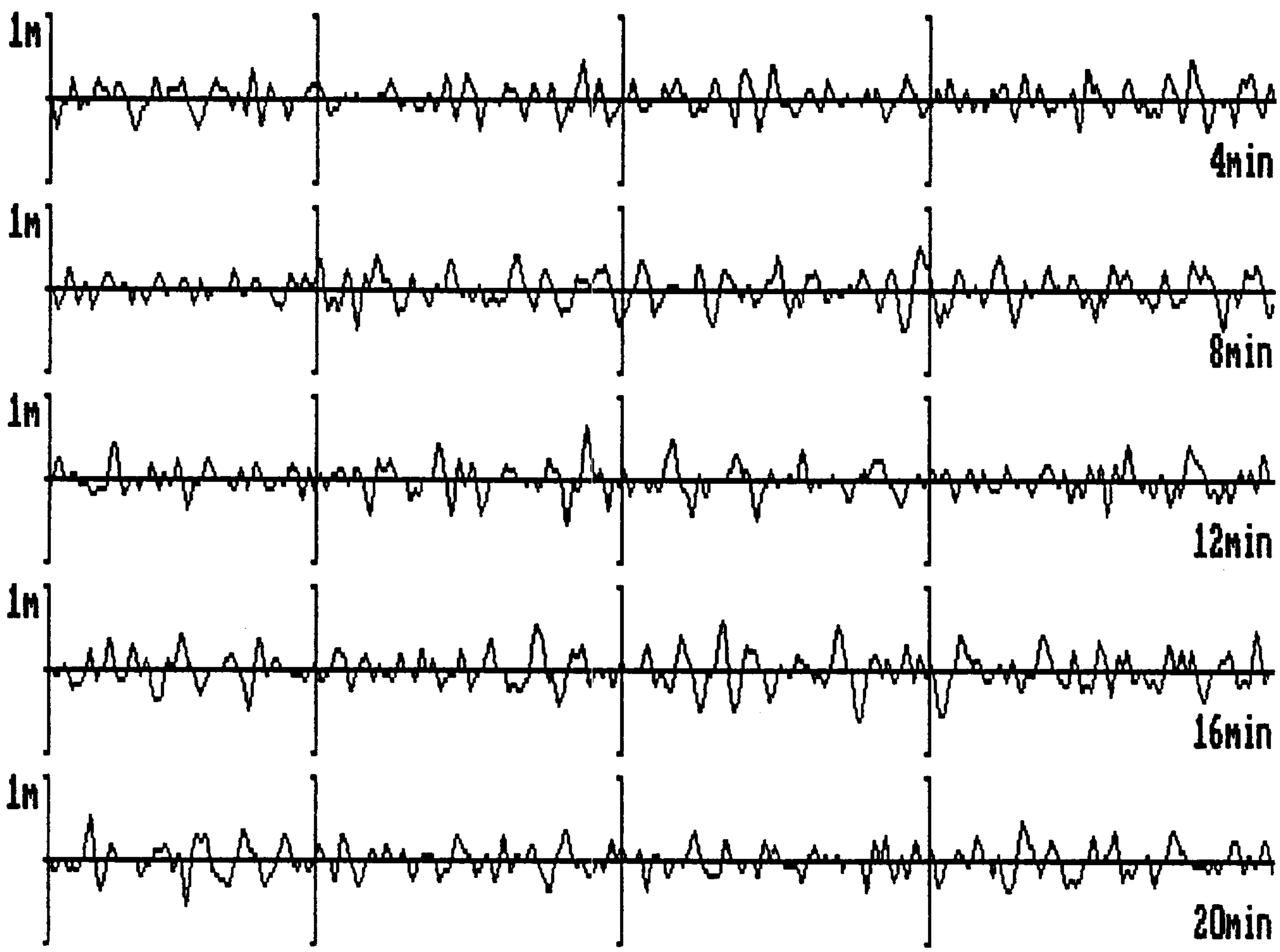


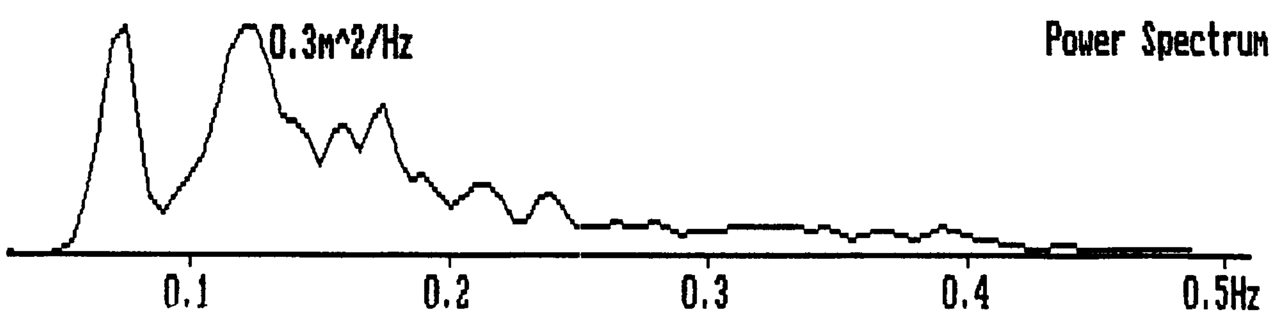


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 09:37 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.75
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.21
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	8.33
		Good Data Received	(%)	100.0

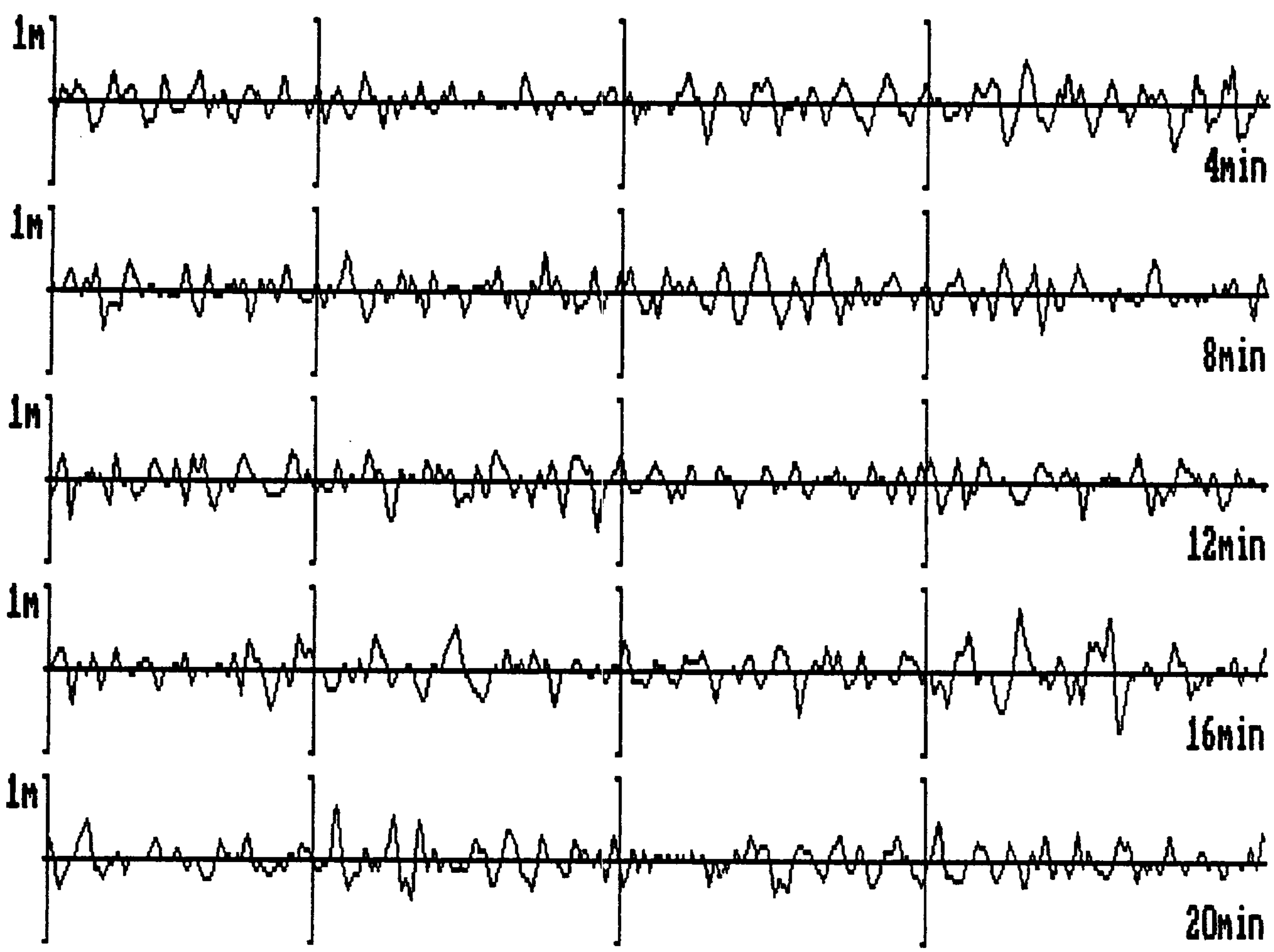


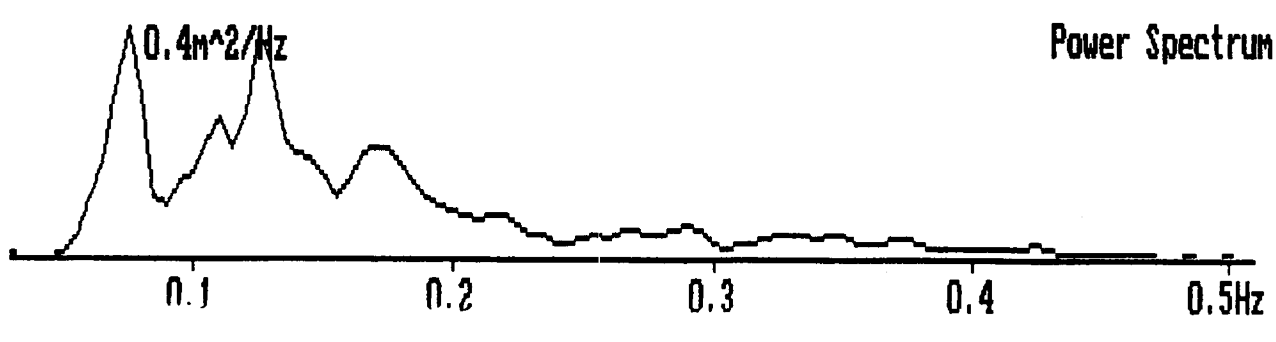


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 10:37 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.76
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.28
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	14.29
		Good Data Received	(%)	98.7



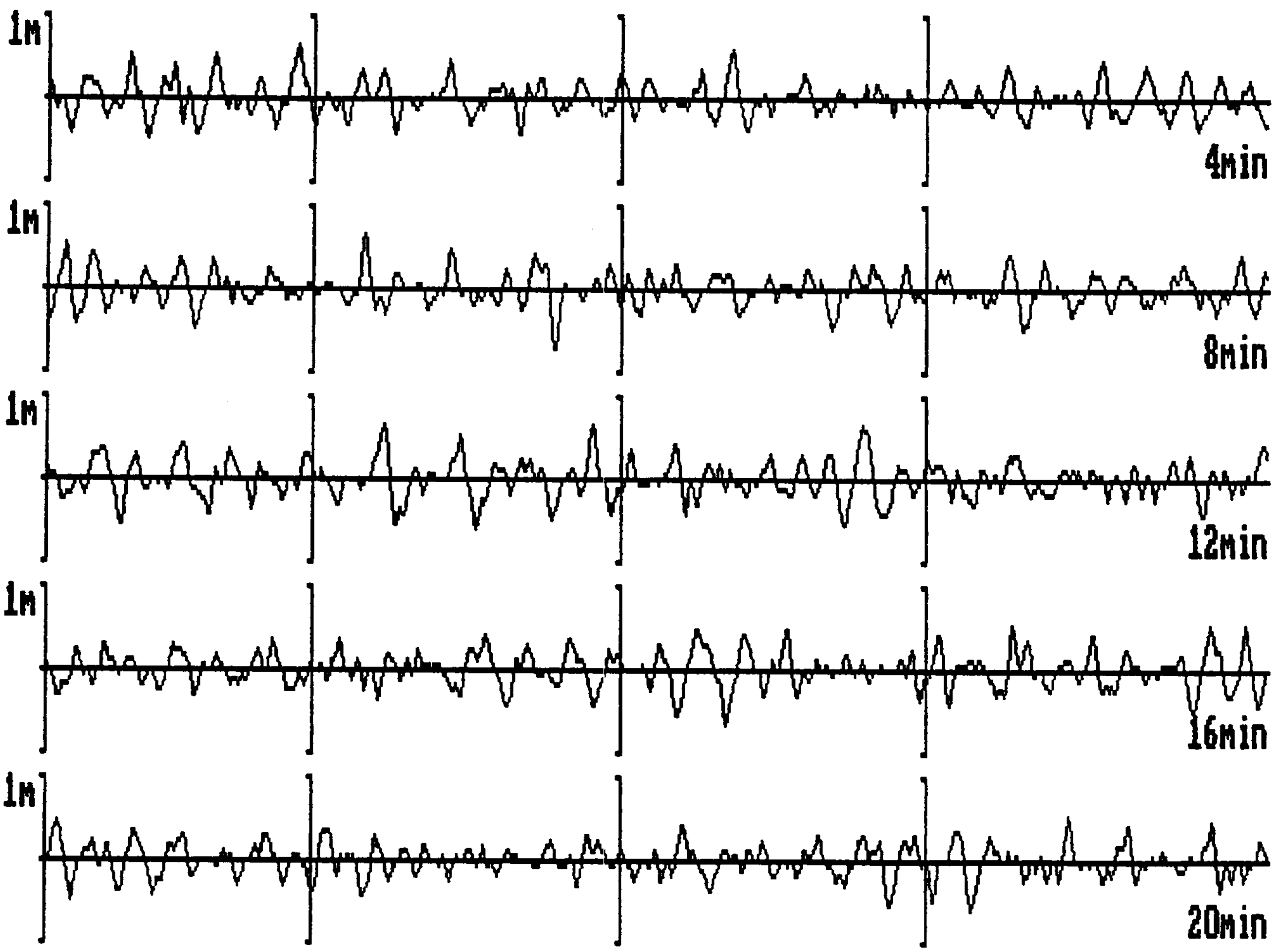


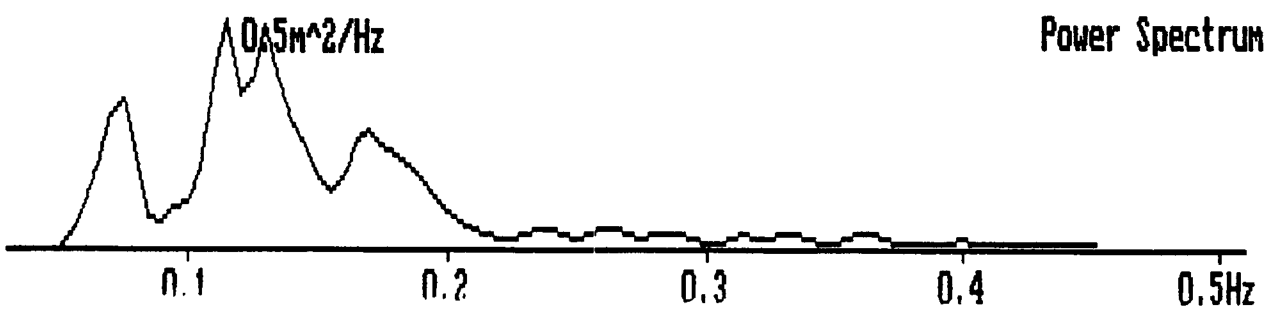
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 11:37 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.84
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.20
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	9.09
		Good Data Received	(%)	99.6



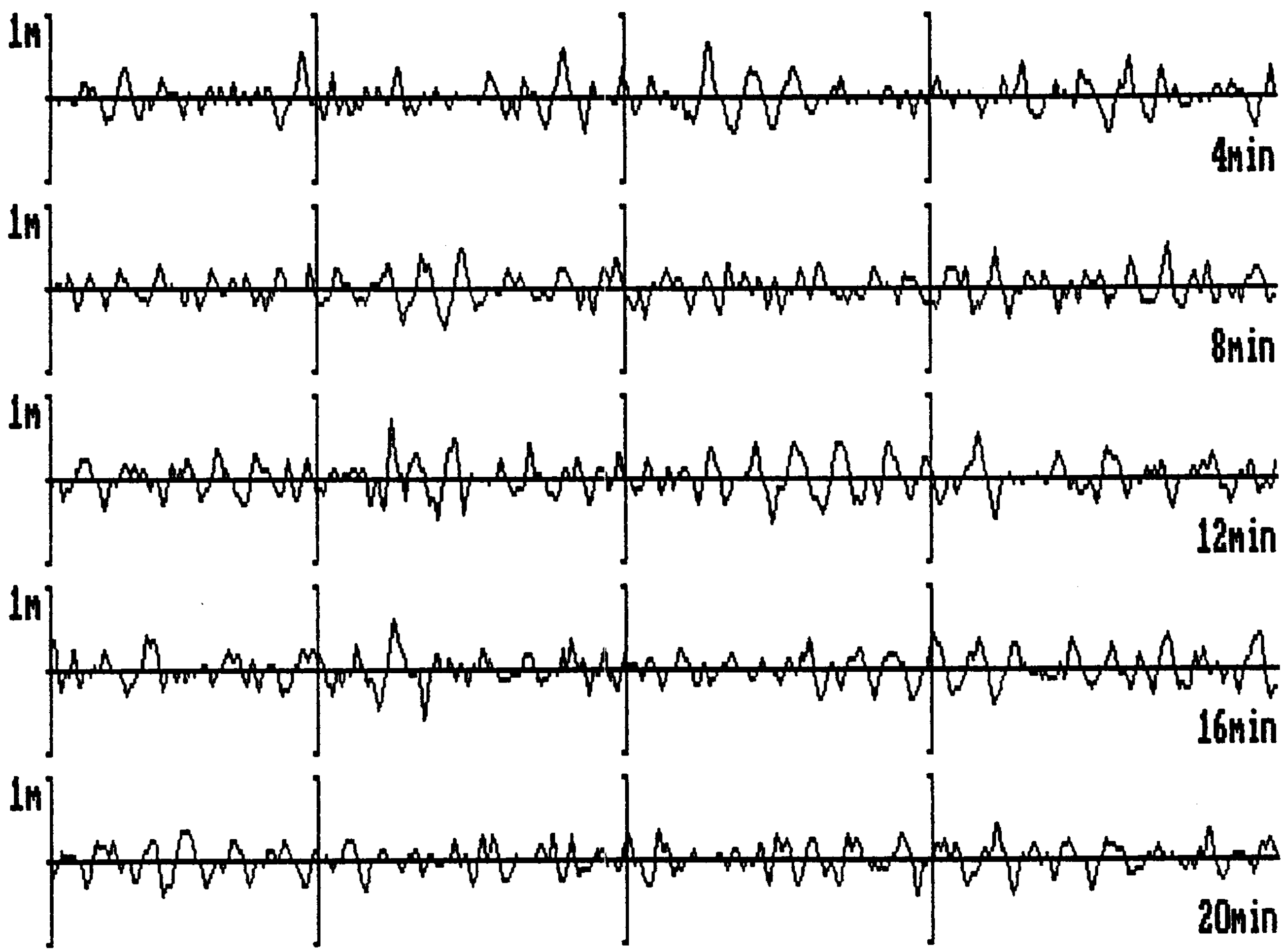


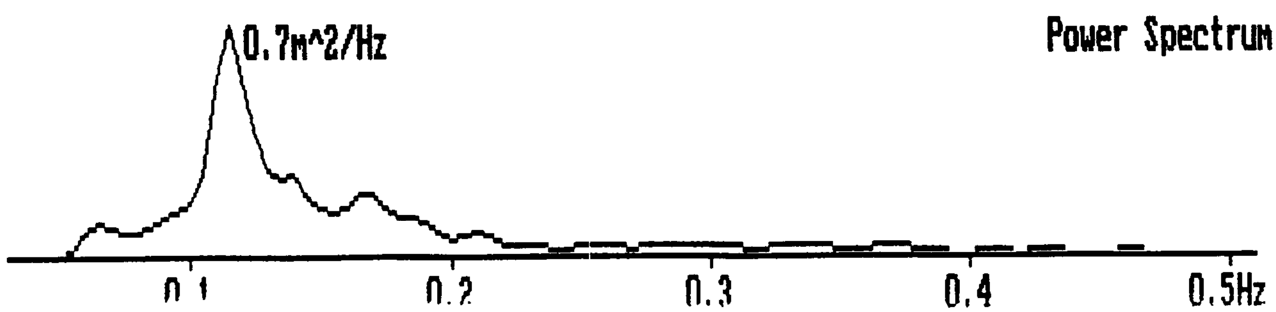
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 12:37 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.75
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.09
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	9.09
		Good Data Received	(%)	98.5

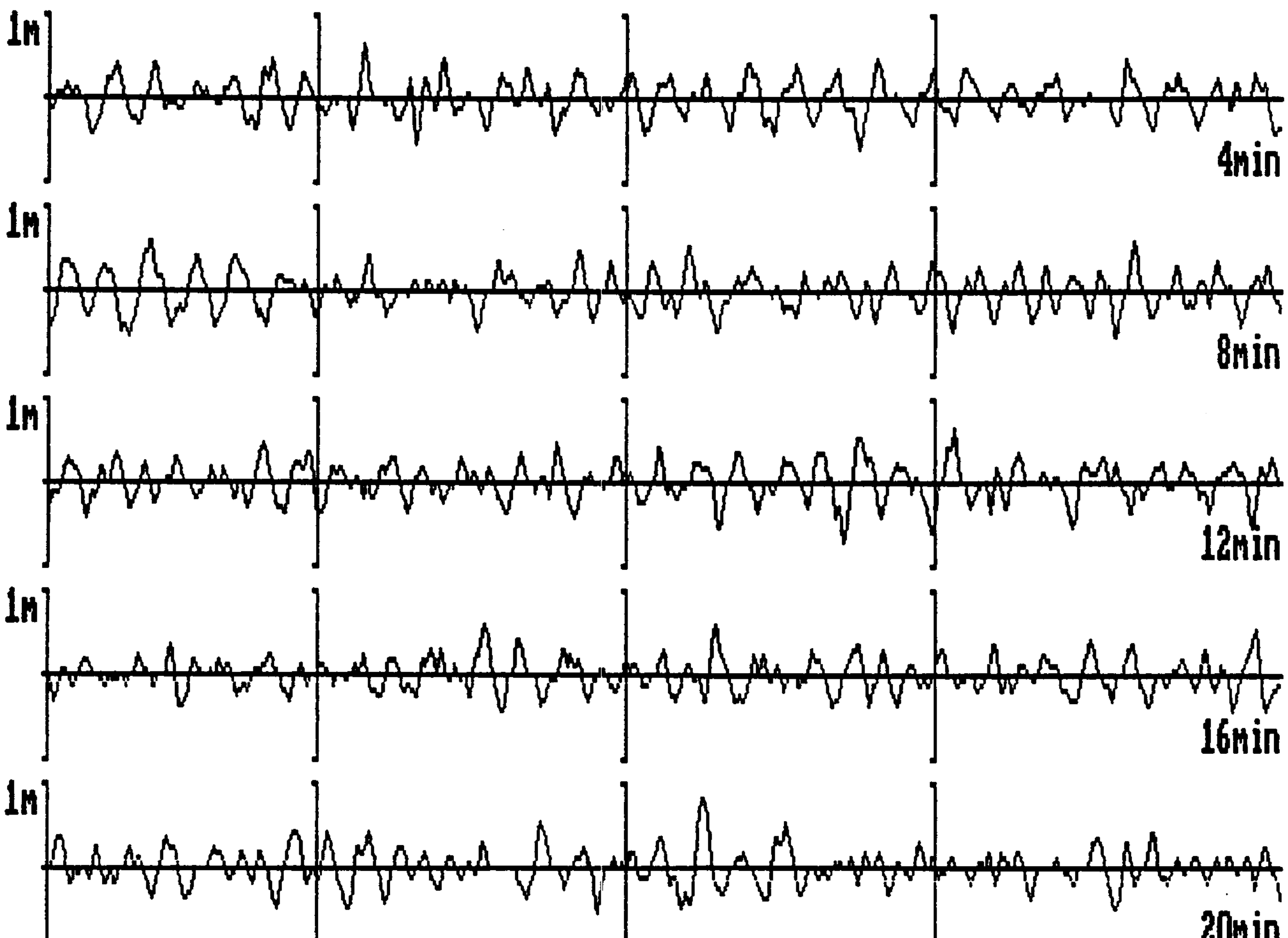


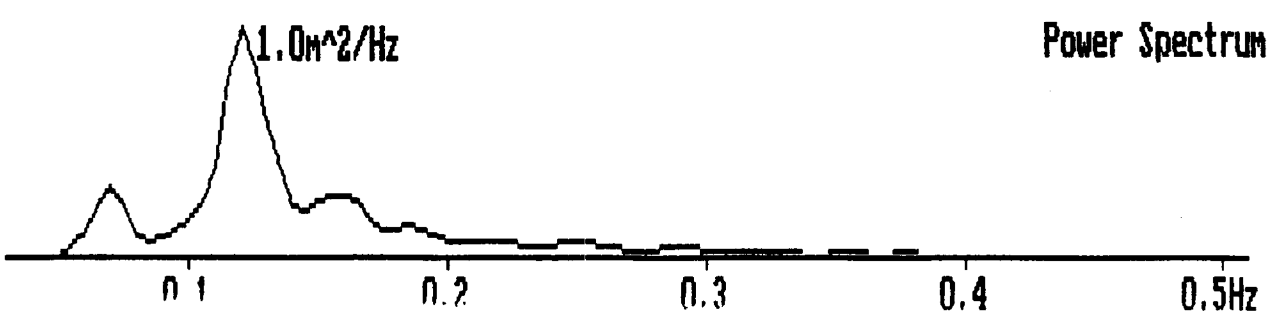


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 13:36 12/08/1993 UTC

SITE : NOBE	Significant Wave Height	Hs (m)	0.88
STATION : CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.40
OPERATOR : D.Dickins & N.Henry	Peak Period	Tp (s)	8.70
	Good Data Received	(%)	99.0

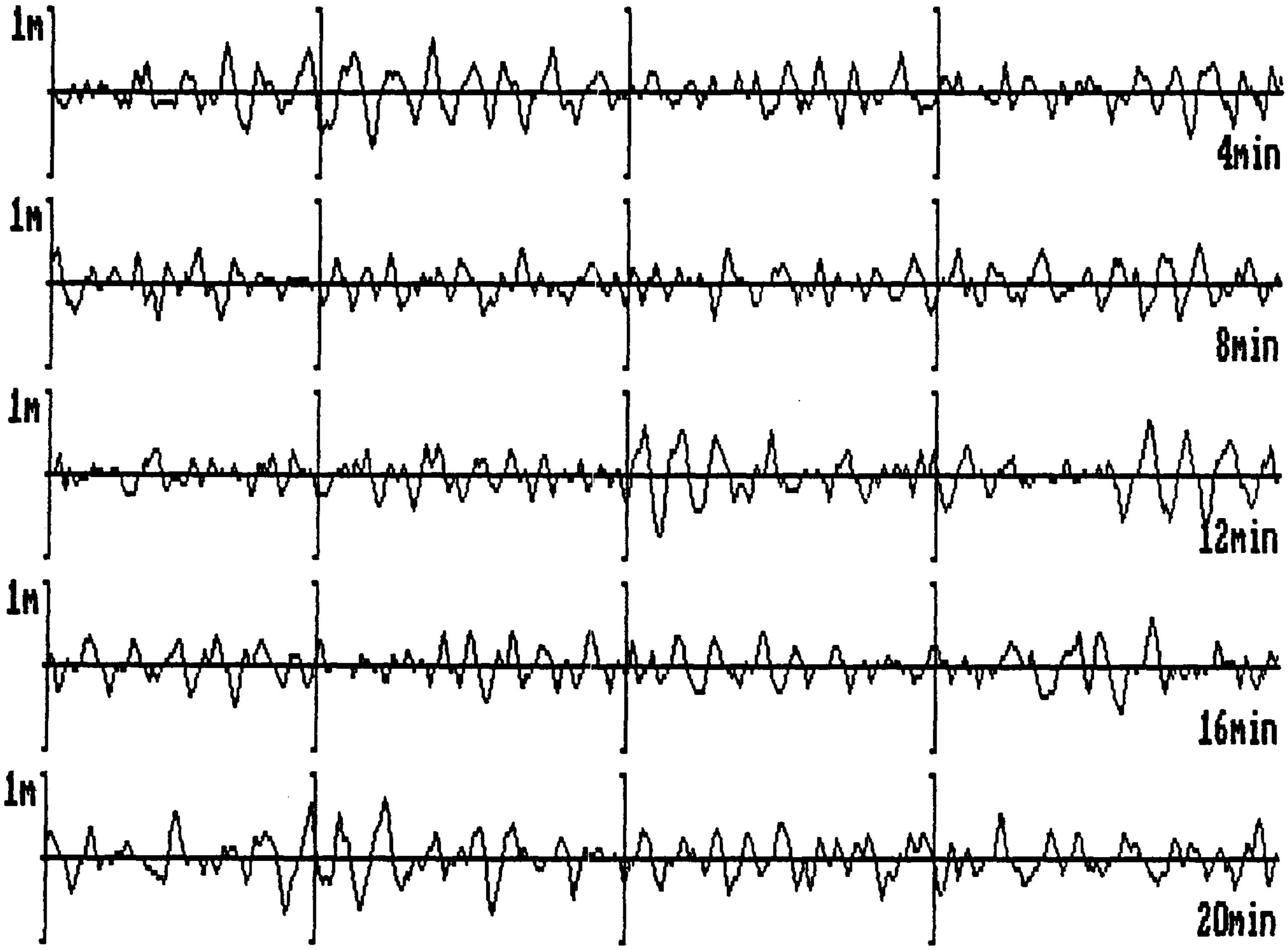


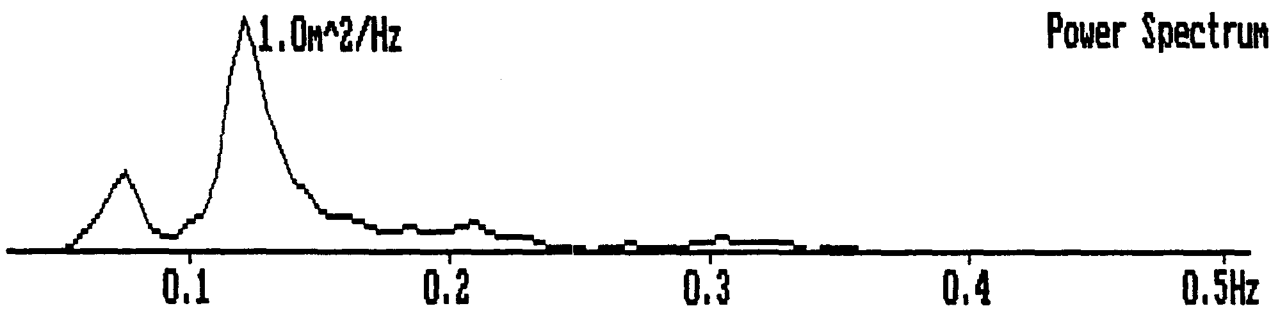


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 14:36 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.86
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.38
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	8.70
		Good Data Received	(%)	99.6

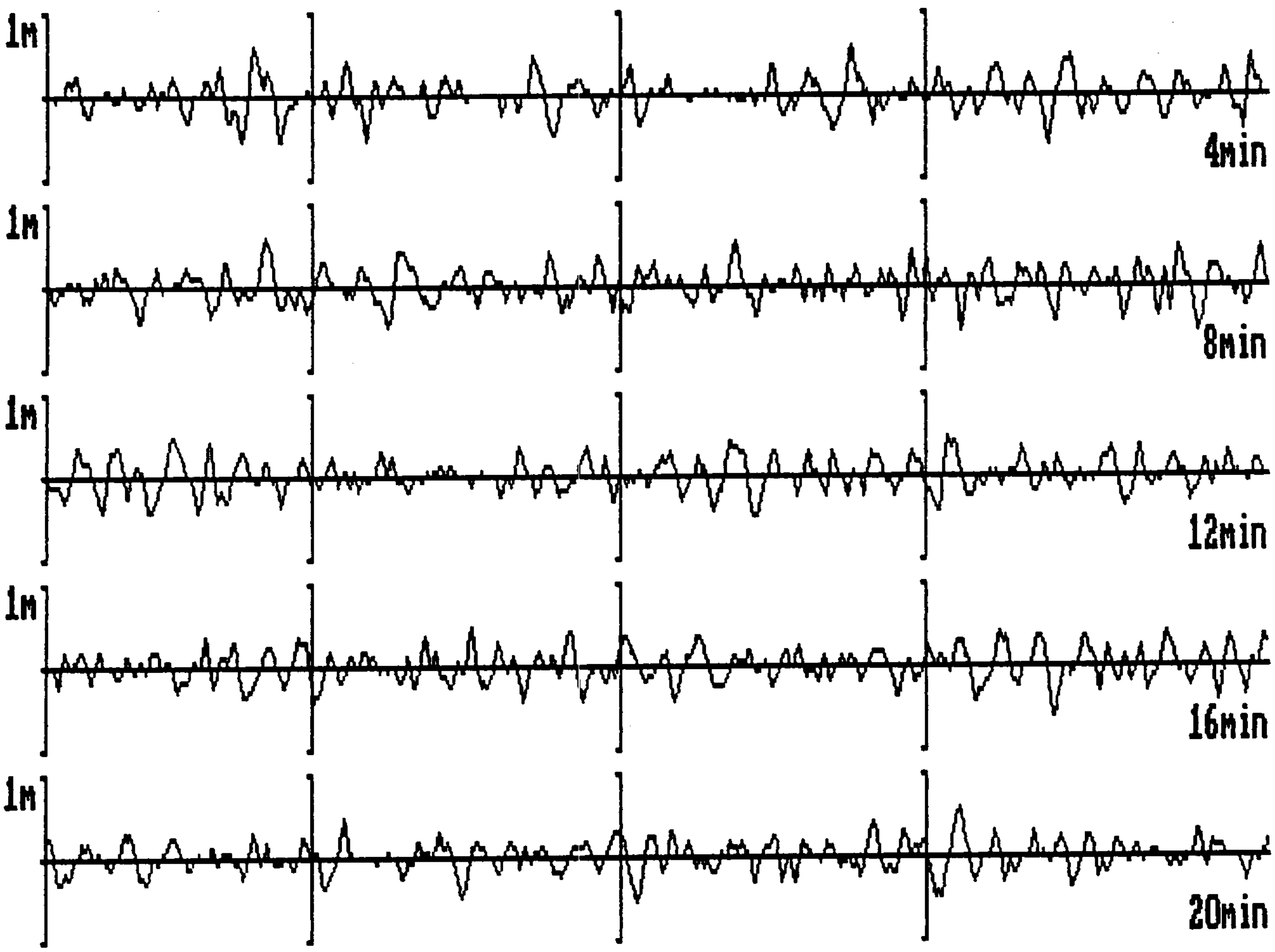




Seaconsult

Wave Data Station
Report for the 20 minute period commencing 15:36 12/08/1993 UTC

SITE : NOBE		Significant Wave Height	Hs (m)	0.80
STATION : CCGS ANN HARVEY		Maximum Wave Height	Hm (m)	1.19
OPERATOR : D.Dickins & N.Henry		Peak Period	Tp (s)	9.52
		Good Data Received	(%)	99.3

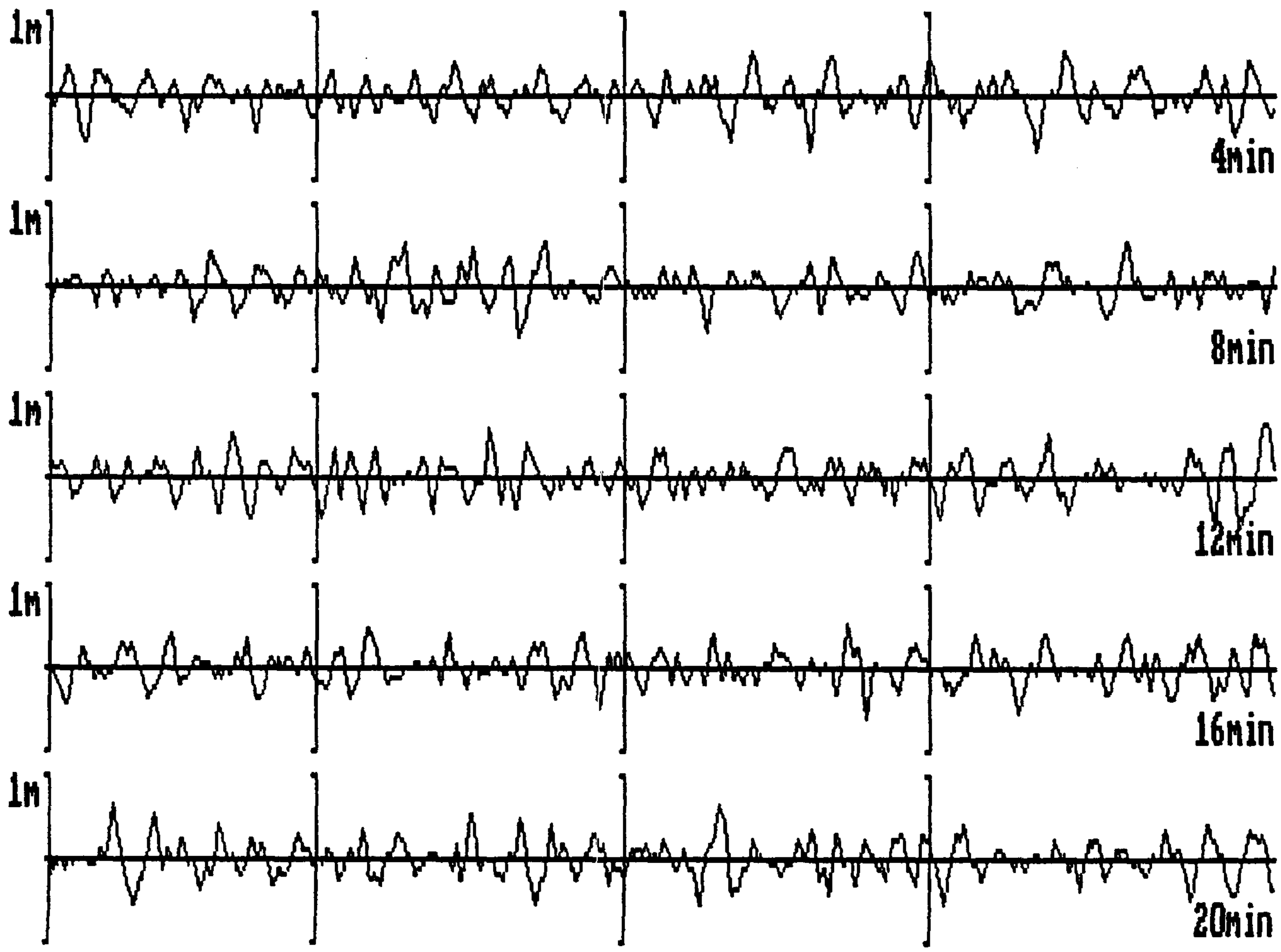


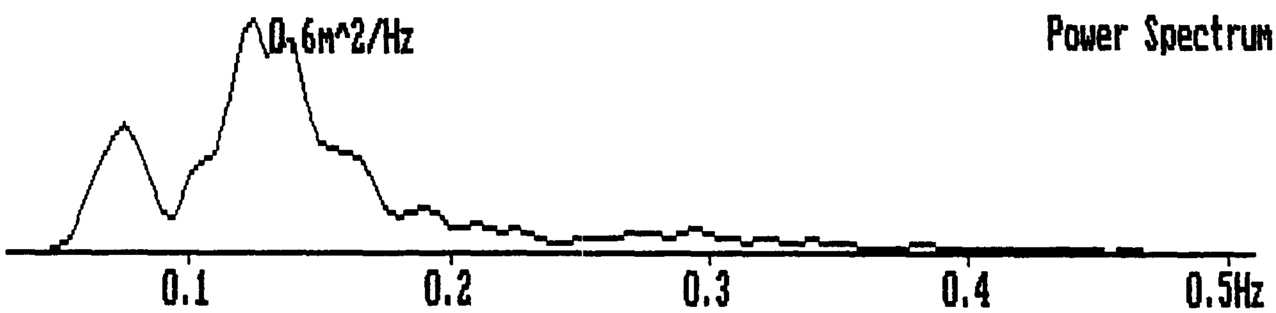
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 16:36 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.85
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.34
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	8.33
		Good Data Received	(%)	99.8



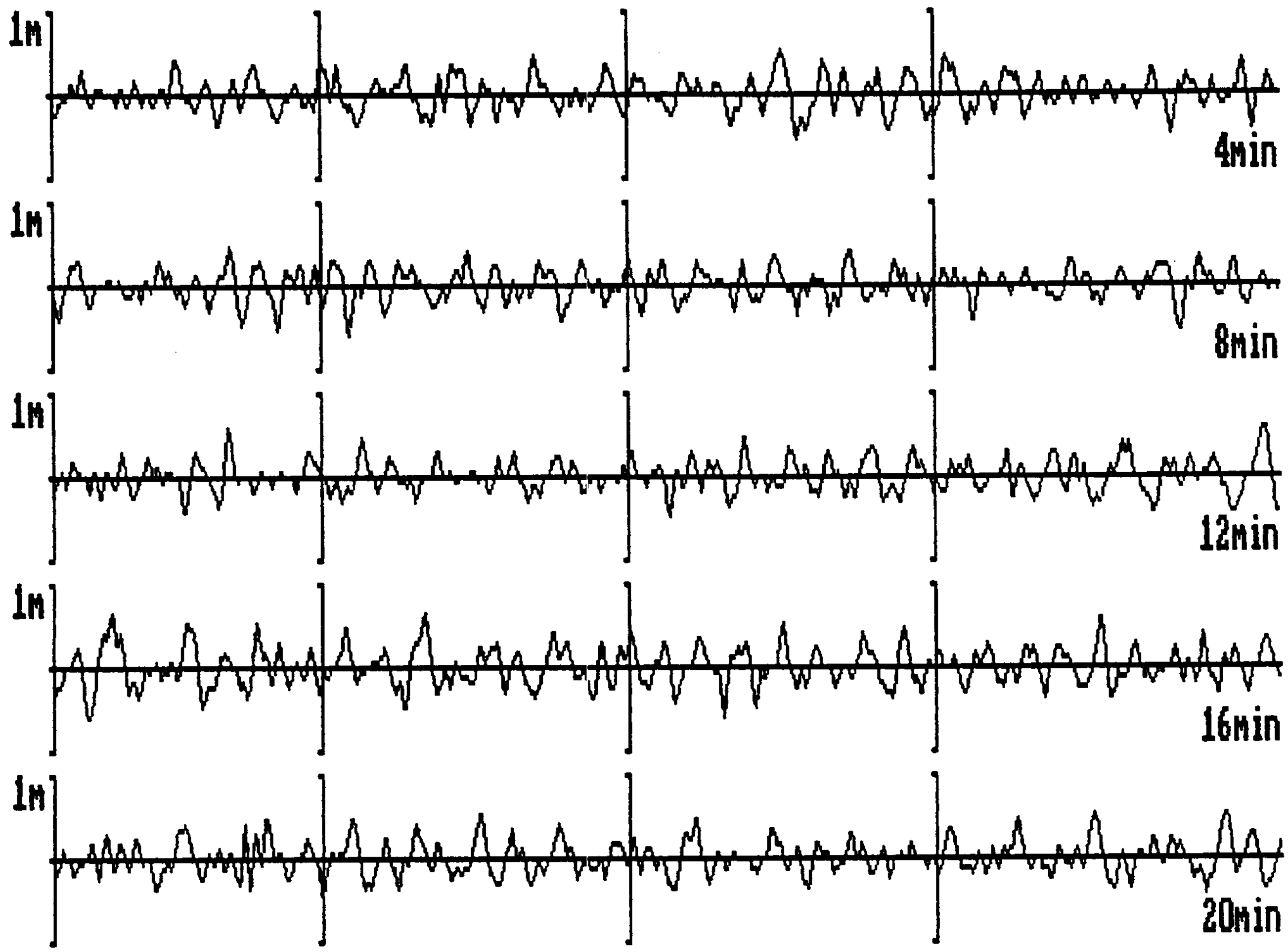


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 17:36 12/08/1993 UTC

SITE : NOBE
STATION : CCGS ANN HARVEY
OPERATOR : D.Dickins & N.Henry

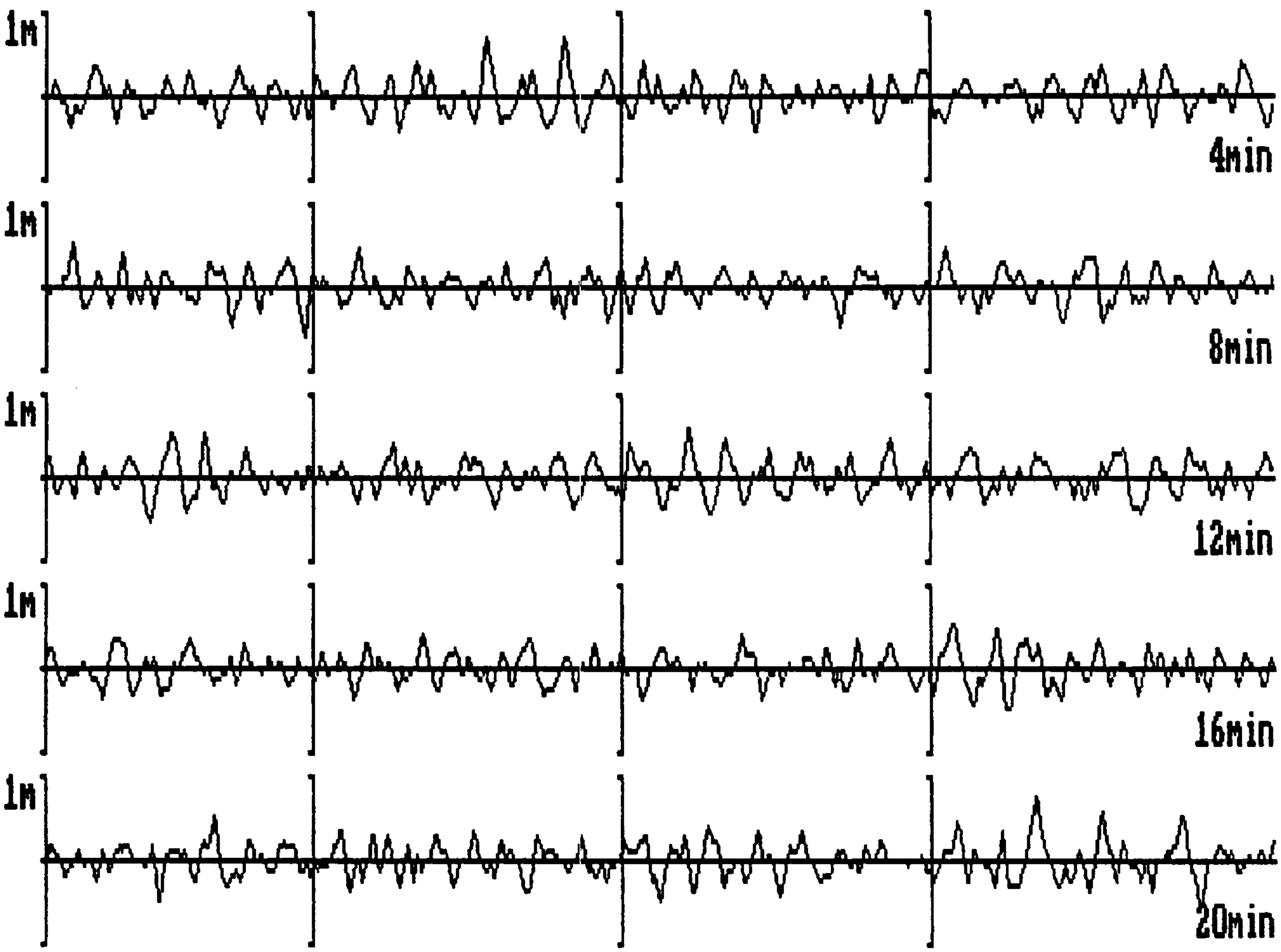
Significant Wave Height	Hs (m)	0.84
Maximum Wave Height	Hm (m)	1.31
Peak Period	Tp (s)	8.33
Good Data Received	(%)	99.8

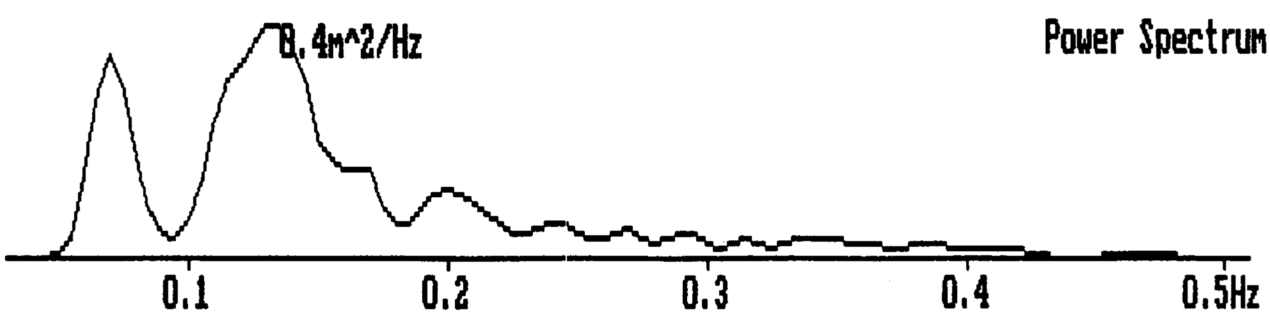


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 18:36 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.80
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.13
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	8.00
		Good Data Received	(%)	100.0



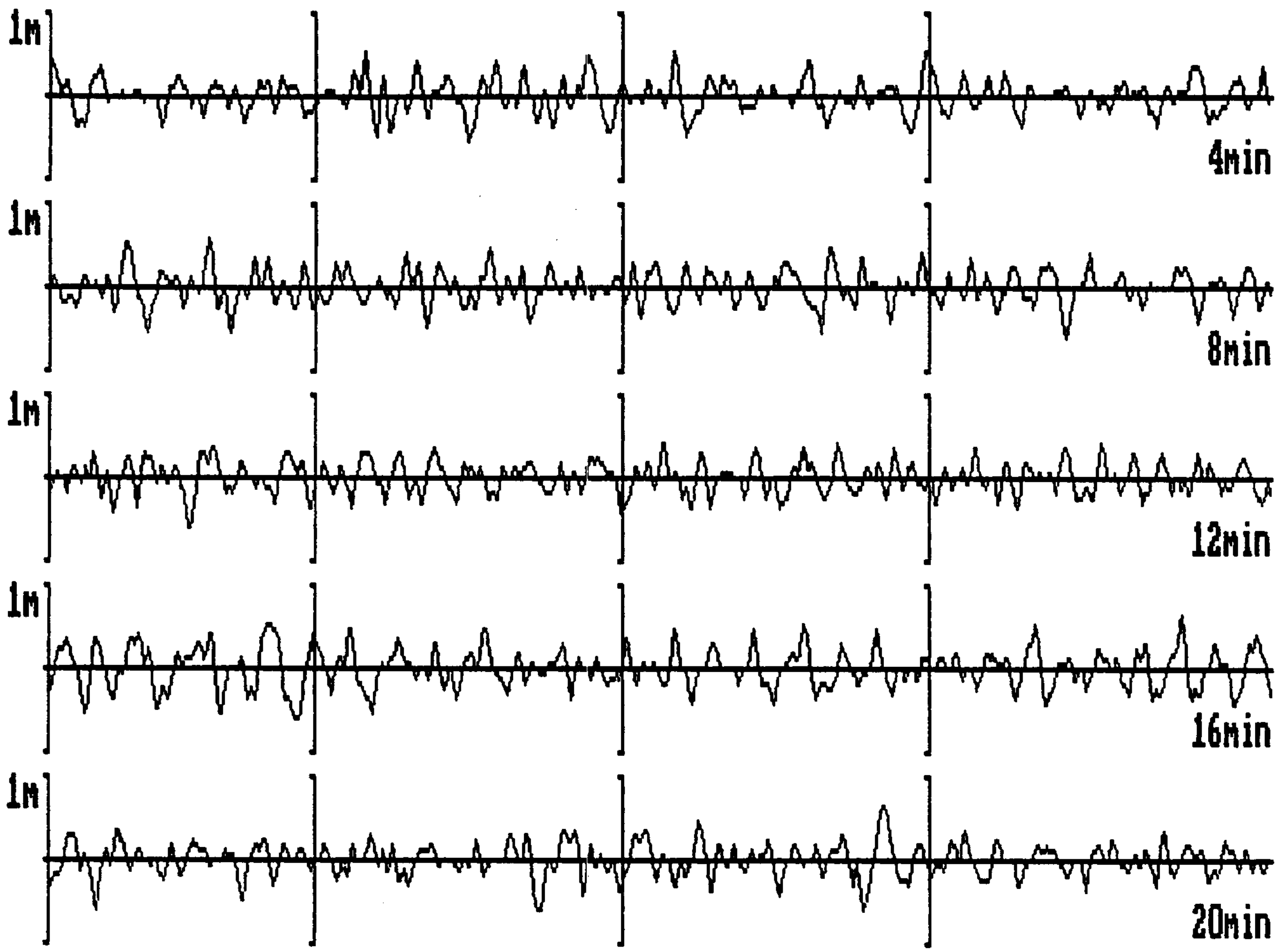


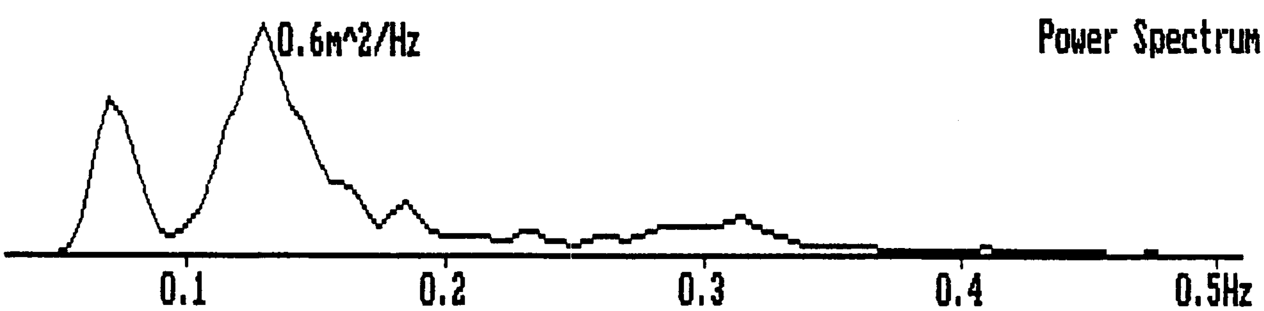
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 19:36 12/08/1993 UTC

SITE	: NOBE	Significant Wave Height	Hs (m)	0.85
STATION	: CCGS ANN HARVEY	Maximum Wave Height	Hm (m)	1.29
OPERATOR	: D.Dickins & N.Henry	Peak Period	Tp (s)	8.00
		Good Data Received	(%)	100.0



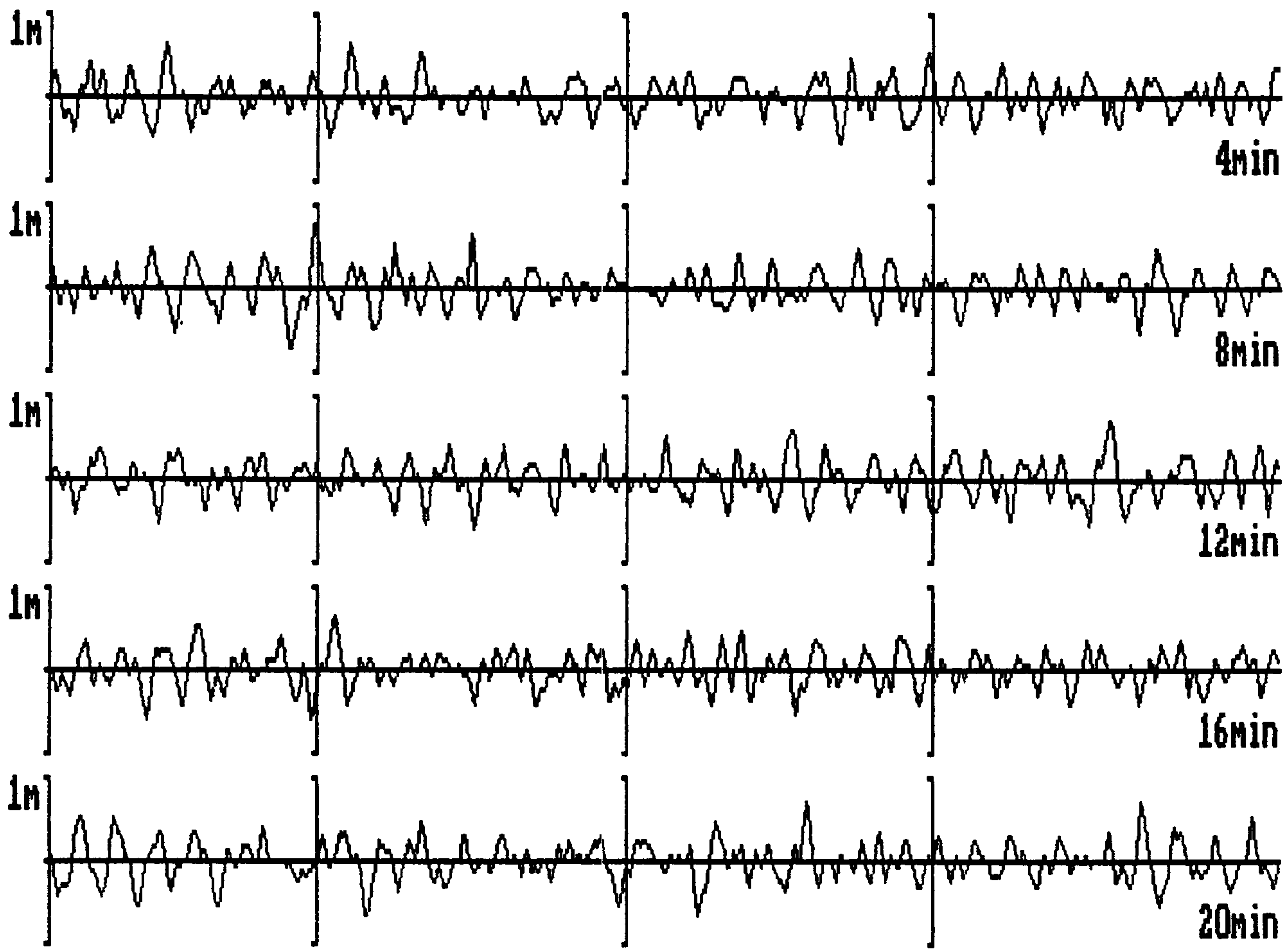


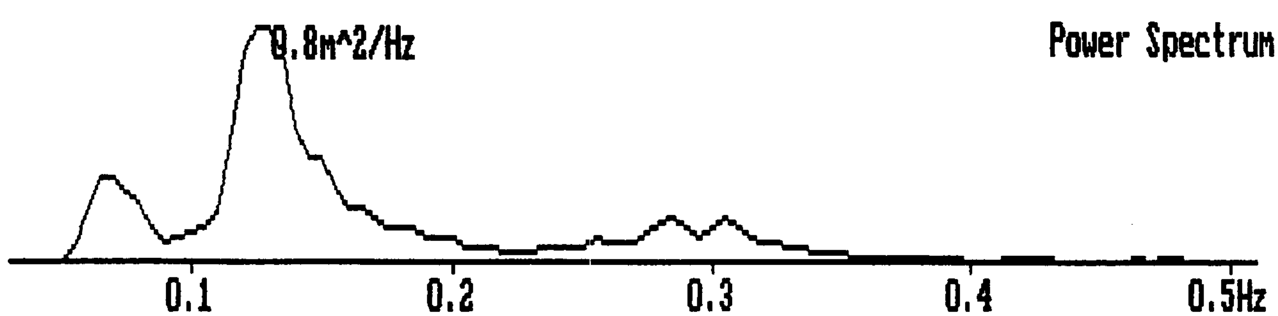
Seaconsult

Wave Data Station

Report for the 20 minute period commencing 20:36 12/08/1993 UTC

SITE : NOBE		Significant Wave Height	Hs (m)	0.92
STATION : CCGS ANN HARVEY		Maximum Wave Height	Hm (m)	1.52
OPERATOR : D.Dickins & N.Henry		Peak Period	Tp (s)	8.33
		Good Data Received	(%)	99.9

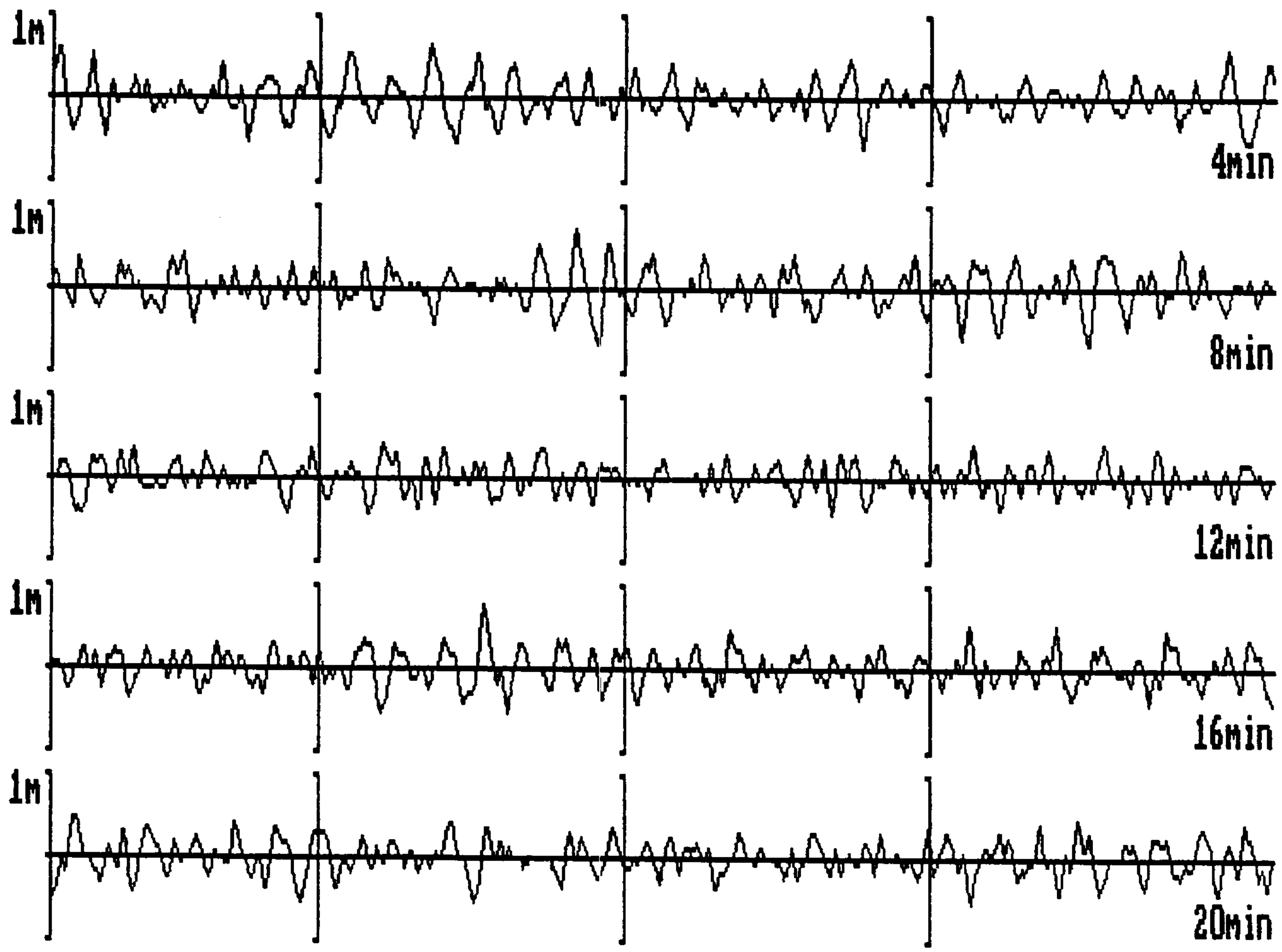


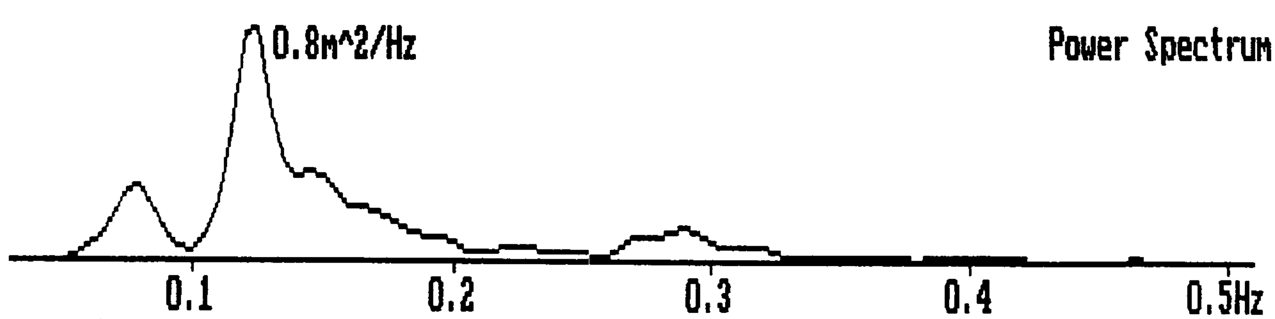


Seaconsult

Wave Data Station
Report for the 20 minute period commencing 21:36 12/08/1993 UTC

SITE : NOBE		Significant Wave Height	Hs (m)	0.86
STATION : CCGS ANN HARVEY		Maximum Wave Height	Hm (m)	1.25
OPERATOR : D.Dickins & N.Henry		Peak Period	Tp (s)	8.33
		Good Data Received	(%)	100.0





Data Calculated by TSK Remote Wave Height Software from 0740 to 1540 (Local Time), August 12, 1993

Time	Wave Height (metres)				Period (seconds)			
	Avg.	Max.	$H^1/_{10}$	Sig.	Avg.	Max.	$H^1/_{10}$	Sig.
0741	0.51	1.25	0.91	0.75	4.41	6.51	6.31	5.77
0800	0.53	1.45	0.93	0.77	4.80	7.50	6.40	6.38
0820	0.56	1.15	0.96	0.81	4.76	4.50	6.10	5.89
0843	0.53	1.13	0.97	0.80	4.68	5.00	6.12	6.03
0905	0.50	1.15	0.88	0.74	4.49	6.50	6.17	5.81
0925	0.54	1.22	0.96	0.80	4.63	6.00	6.00	6.12
0945	0.60	1.35	1.06	0.88	4.78	6.00	6.71	6.13
1007	0.58	1.45	1.05	0.86	4.88	6.00	6.52	6.08
1030	0.53	1.17	0.93	0.79	4.60	6.50	6.02	6.08
1050	0.59	1.23	1.00	0.85	4.63	7.00	6.02	5.90
1120	0.56	1.38	1.01	0.84	4.71	5.50	6.60	5.88
1140	0.61	1.39	1.10	0.91	4.95	5.50	6.71	6.13
1200	0.59	1.35	1.08	0.88	5.10	5.00	7.07	6.67
1220	0.54	1.27	1.00	0.82	4.86	7.00	6.24	6.02
1240	0.56	1.21	0.96	0.80	4.89	6.00	6.83	6.18
1300	0.58	1.30	1.04	0.87	5.10	6.00	6.38	6.56
1320	0.58	1.17	1.02	0.85	5.07	7.00	6.46	6.13
1340	0.55	1.25	0.99	0.83	5.12	5.50	6.50	6.24
1400	0.58	1.47	1.05	0.88	4.93	6.50	6.26	6.04
1420	0.61	1.40	1.06	0.89	5.16	6.50	6.31	6.33
1440	0.62	1.30	1.08	0.90	5.26	6.00	6.48	6.30
1500	0.58	1.22	1.00	0.85	5.01	6.50	5.95	6.08
1520	0.59	1.27	0.98	0.84	5.05	6.50	6.21	6.13
1540	0.60	1.21	1.05	0.89	5.16	7.50	6.48	6.53

Date UTC	Wspd	hs	hsea	hswell	tp	tsea	tswell	Gmo	G3
11AUG 06	2.06	0.91	0.40	0.81	14.25	28.57	6.45	8.37	7.67
11AUG 07	1.03	0.86	1.69	0.00	6.49	28.57	6.45	31.60	29.78
11AUG 08	2.06	0.89	0.28	0.82	6.08	28.57	6.45	8.13	7.67
11AUG 09	2.06	0.84	0.28	0.78	6.91	28.57	6.45	7.67	7.22
11AUG 10	2.06	0.81	0.28	0.75	7.12	28.57	7.14	7.44	7.00
11AUG 11	1.03	0.89	1.69	0.00	6.70	28.57	6.45	32.53	30.68
11AUG 12	2.58	0.81	0.00	0.81	6.08	28.57	5.88	4.76	4.34
11AUG 13	2.58	0.84	0.00	0.85	6.49	28.57	6.45	4.91	4.62
11AUG 14	2.58	0.81	0.00	0.81	6.91	28.57	6.45	4.76	4.48
11AUG 15	2.58	0.79	0.00	0.77	6.70	28.57	6.45	4.62	4.21
11AUG 16	2.58	0.77	0.00	0.76	6.08	28.57	5.88	4.48	4.08
11AUG 17	2.58	0.74	0.00	0.72	6.49	28.57	6.45	4.34	4.08
11AUG 18	2.58	0.72	0.00	0.70	6.08	28.57	5.88	4.21	3.94
11AUG 19	2.58	0.81	0.00	0.79	6.08	28.57	5.88	4.76	4.62
11AUG 20	5.15	0.72	0.36	0.56	14.25	5.00	6.45	1.05	0.99
11AUG 21	5.15	0.81	0.37	0.63	14.25	5.00	15.38	1.19	1.09
11AUG 22	5.15	0.74	0.32	0.57	13.31	5.00	6.45	1.09	1.05
12AUG 00	5.15	0.70	0.37	0.51	13.31	5.00	12.50	1.02	0.95
12AUG 01	5.15	0.74	0.36	0.53	14.25	5.00	6.45	1.09	1.02
12AUG 02	5.15	0.77	0.38	0.57	14.25	5.00	15.38	1.12	1.02
12AUG 03	5.15	0.77	0.35	0.57	6.08	5.00	6.45	1.12	1.05
12AUG 04	4.12	0.74	0.29	0.63	13.31	4.08	6.45	1.70	1.54

Press any key for more

Date UTC	Wspd	hs	hsea	hswell	tp	tsea	tswell	Gmo	G3
12AUG 05	5.15	0.74	0.38	0.58	6.49	5.00	6.45	1.09	0.99
12AUG 06	4.12	0.77	0.31	0.63	6.29	4.08	6.45	1.75	1.59
12AUG 07	3.09	0.72	0.14	0.67	6.08	2.86	7.14	2.92	2.74
12AUG 08	4.12	0.77	0.30	0.65	13.31	4.08	12.50	1.75	1.59
12AUG 09	4.12	0.74	0.26	0.66	14.25	4.08	9.09	1.70	1.54
12AUG 10	3.09	0.74	0.15	0.70	8.28	2.99	8.00	3.02	2.74
12AUG 11	4.12	0.70	0.26	0.60	13.31	4.08	15.38	1.59	1.44
12AUG 12	4.12	0.81	0.27	0.76	8.28	3.64	8.00	1.86	1.70
12AUG 13	4.12	0.79	0.25	0.73	7.96	4.08	8.00	1.81	1.70
12AUG 14	4.12	0.84	0.25	0.79	7.96	4.08	8.00	1.92	1.86
12AUG 15	4.12	0.84	0.28	0.78	8.28	4.08	8.00	1.92	1.81
12AUG 16	4.12	0.84	0.26	0.78	7.96	4.08	8.00	1.92	1.81
12AUG 17	4.12	0.84	0.29	0.76	7.96	3.64	8.00	1.92	1.75
12AUG 18	5.15	0.84	0.33	0.71	7.43	5.00	7.14	1.23	1.12
12AUG 19	4.12	0.79	0.32	0.68	7.96	3.12	8.00	1.81	1.75
12AUG 20	6.19	0.86	0.46	0.66	8.28	5.88	8.00	0.88	0.83
12AUG 21	6.19	0.81	0.47	0.58	7.64	5.88	8.00	0.83	0.75
12AUG 22	7.22	0.89	0.60	0.40	7.96	7.14	12.50	0.66	0.61
12AUG 23	6.19	0.94	0.54	0.68	8.28	5.88	8.00	0.96	0.88
13AUG 01	5.15	0.81	0.48	0.63	7.96	3.85	8.00	1.19	1.12
13AUG 02	4.12	0.79	0.38	0.66	7.43	3.85	15.38	1.81	1.64
13AUG 03	3.09	0.79	0.16	0.75	7.64	2.99	8.00	3.21	2.92

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ARGOS WAVERIDER OUTPUT

UTC = local + 2.5 h

Date	UTC	hs	ha	h3	h10	hmax	mcs	tp	tz	ta	t3	tm
12AUG	00	0.70	0.43	0.65	0.79	1.17	1.46	13.31	4.76	4.27	5.98	12.0
12AUG	01	0.74	0.45	0.70	0.86	1.20	1.29	14.25	4.66	4.36	5.98	12.6
12AUG	02	0.77	0.47	0.70	0.89	1.05	1.26	14.25	4.86	4.56	6.08	12.5
12AUG	03	0.77	0.45	0.72	0.89	1.20	1.71	6.08	4.96	4.56	6.29	11.5
12AUG	04	0.74	0.45	0.67	0.86	1.23	1.32	13.31	4.86	4.56	6.18	12.3
12AUG	05	0.74	0.45	0.67	0.84	1.32	1.39	6.49	4.86	4.46	6.08	9.6
12AUG	06	0.77	0.45	0.70	0.86	1.05	1.32	6.29	4.76	4.76	6.39	13.3
12AUG	07	0.72	0.43	0.67	0.86	1.05	1.26	6.08	4.96	4.76	6.49	11.8
12AUG	08	0.77	0.45	0.70	0.86	1.36	1.36	13.31	5.17	4.86	6.60	13.0
12AUG	09	0.74	0.43	0.67	0.81	1.11	1.26	14.25	5.27	5.06	7.01	15.4
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12AUG	11	0.70	0.41	0.63	0.77	0.97	1.08	13.31	5.17	5.06	6.91	11.8
12AUG	12	0.81	0.47	0.74	0.94	1.71	2.00	8.28	5.47	5.06	7.01	13.1
12AUG	13	0.79	0.49	0.74	0.91	1.11	1.26	7.96	5.37	5.27	7.33	11.0
12AUG	14	0.84	0.53	0.81	1.02	1.36	1.56	7.96	5.88	5.67	7.54	10.9
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12AUG	17	0.84	0.47	0.77	0.99	1.36	1.56	7.96	5.37	4.66	6.80	10.4
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12AUG	21	0.81	0.47	0.74	0.94	1.67	1.75	7.64	5.17	4.66	6.60	13.9

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13AUG	01	0.81	0.49	0.77	0.97	1.29	1.39	7.96	4.76	4.66	6.08	13.9
13AUG	02	0.79	0.49	0.72	0.89	1.11	1.36	7.43	4.66	4.66	5.98	13.
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13AUG	04	0.77	0.47	0.70	0.89	1.11	1.32	14.25	4.76	4.56	6.18	13.1
13AUG	05	0.74	0.45	0.67	0.86	1.75	1.75	13.31	4.76	4.46	5.98	10.9
13AUG	06	0.77	0.45	0.70	0.86	1.29	1.71	14.25	5.17	4.66	6.49	12.6
13AUG	07	0.74	0.47	0.70	0.84	1.14	1.29	13.31	5.17	5.17	6.80	11.8
13AUG	08	0.70	0.41	0.61	0.77	0.97	1.20	12.50	5.06	4.86	6.08	12.3
13AUG	09	0.74	0.45	0.67	0.86	1.14	1.46	13.31	5.37	5.17	7.12	15.8

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SHIP ID	FLG	DDHH	Lat LL.L	Long LLL.L	Wind (knots) DDFF/MX	Vsby (nm) VSBY	WX wwWW	Air Tmp TT	Dew Tmp tt	Sea Tmp SS	Pres hPa PPFF	Pres Tend appp	Dir Spd DsV	S W (
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44143		1200	47.6N	052.1W	1710/14			8		11	0310	7006	HT	O.

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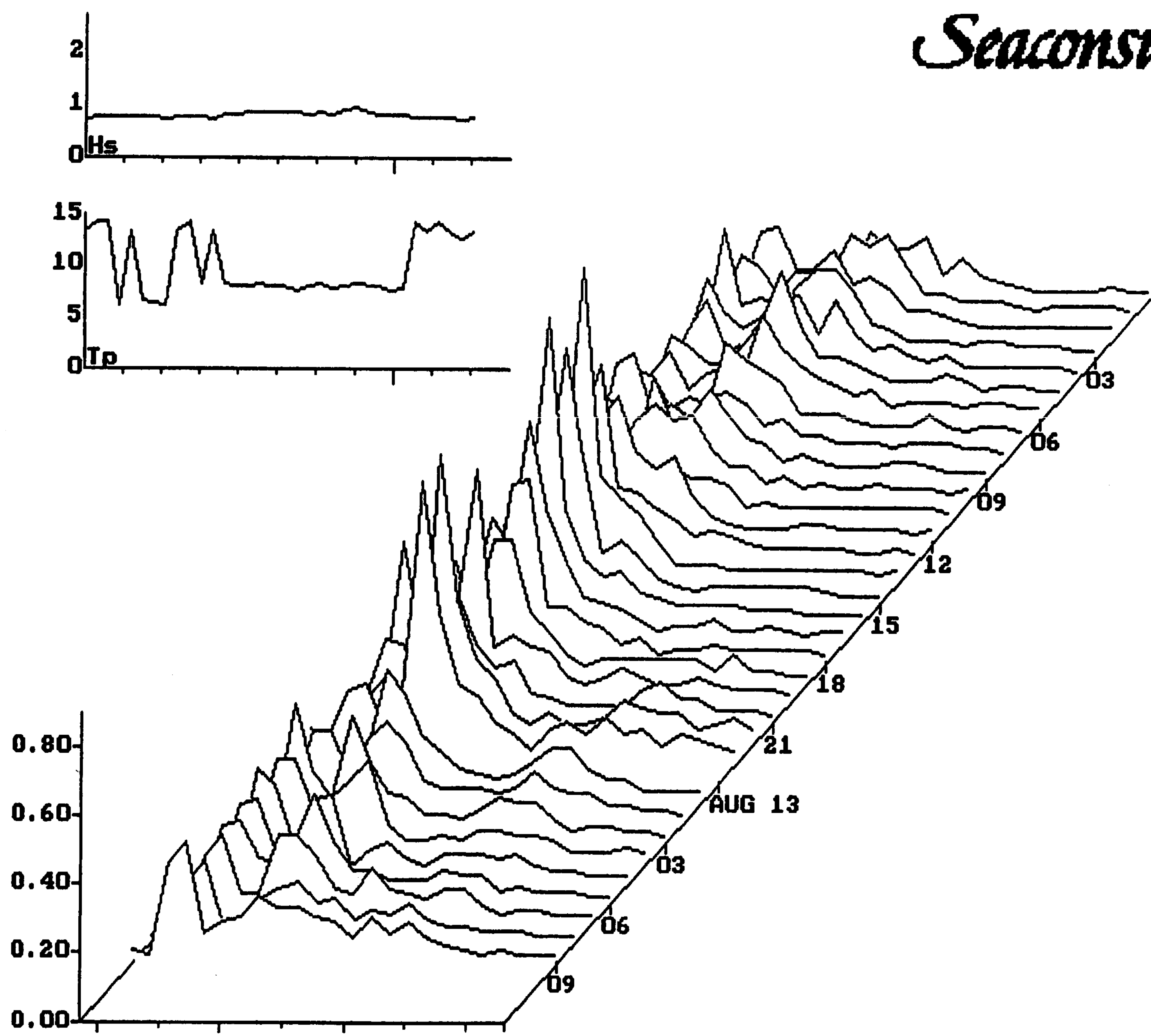
UTC = local time + 2.5 h



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Appendix C

Volatile Hydrocarbon Exposure Monitoring
NOBE 93

Volatile Hydrocarbon Exposure during In-Situ Burning of Crude Oil at Sea

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ABSTRACT

In-situ burning (the controlled combustion of oil on water) is one of four major categories of offshore oil spill response options. Other response options include natural dispersion without intervention, mechanical cleanup using booms and skimmers, and enhanced dispersion using chemical dispersants. Personal exposure of response workers (and other personnel) to volatile hydrocarbons and benzene was monitored as part of the Newfoundland Offshore Burn Experiment (NOBE), a major oil spill combustion trial organized by Environment Canada and sponsored by over 25 governmental and private organizations from Canada and the United States. Benzene and total petroleum hydrocarbons were monitored using organic vapor monitors and charcoal tubes and analyzed by gas chromatography. Benzene and total petroleum hydrocarbon exposures were generally very low during the *in-situ* burning experiments (over 95% of the determinations were below the analytical limit of detection, which was usually less than 0.1 ppm). *In-situ* burning of unweathered crude oil at an accidental oil spill could be associated with higher exposure to benzene and other volatile hydrocarbons than at NOBE if: (1) the crude had a higher natural benzene content than the Alberta Sweet Mixed Blend used at NOBE, (2) was less weathered than the oil in this study, or (3) had a larger evaporating crude surface area. Under the conditions of this experiment, the *in-situ* burning process itself did not appear to present a significant benzene exposure risk to spill response personnel. Nevertheless, good hygienic practice at

an accidental oil spill would use air monitoring in the decision process regarding use of respiratory protection for response personnel.

INTRODUCTION

Industrial hygiene is a key aspect of a successful response to a hazardous material emergency. Rosenblum and Birkner[1] reviewed the role of the industrial hygienist in several aspects of emergency response and cleanup operations including: planning, personnel training and drills, hazard evaluation, personal protective equipment, exposure monitoring, decontamination principles, and compliance with regulations (U.S. regulatory review). Although every hazardous material emergency is a special situation, industrial hygiene planning for emergency responses would be expected to improve with experience, or with the shared experience of others. This report presents exposure measurements for benzene and volatile hydrocarbons during an experimental *in-situ* burn of crude oil at sea.

Offshore oil spill response options generally fall into four major categories: natural dispersion (no intervention), mechanical cleanup (typically using booms and skimmers), enhanced dispersion using chemical dispersants, and *in-situ* burning (the controlled combustion of spilled oil on water). Under good conditions, *in-situ* burning can consume 2-3 mm (depth) of spilled oil per minute with removal efficiencies of 95 - 98%[2]. Because *in-situ* burning has the potential to remove oil from the marine environment much faster than mechanical cleanup procedures[3], a major emphasis of recent research has been the evaluation of burning efficiency and assessment of the practicality of *in-situ* burning as a spill response tool[4].

Some industrial hygiene considerations for *in-situ* burning are similar to those of other spill response options. Depending on the initial composition of the crude oil, weather and sea state, and time since release, on-scene responders may be exposed to hydrogen sulfide gas and volatile hydrocarbons including benzene as the crude oil evaporates. *In-situ* burning of freshly spilled oil would be expected to reduce the volume of the spilled oil by converting much of the mass to carbon dioxide, water, and other combustion products (i.e., sulfur and nitrogen oxides, carbon gases (CO_2, CO), and particulate matter which may contain adsorbed polycyclic aromatic hydrocarbons (PAHs)[5,6]). Although dependent on weather and position with respect to the spill, response personnel on the water would probably have a greater potential for inhalation exposure to the non-buoyant evaporating hydrocarbon plume than from the buoyant *in-situ* burning smoke plume.

As a relatively minor part of the Newfoundland Offshore Burn Experiment (NOBE, described below), the personal exposure of response workers (and other personnel) to volatile hydrocarbons and benzene was monitored using passive organic vapor monitors. Measurement of response worker personal exposure to particulate matter or combustion products was not attempted due to the logistical difficulty of deploying dozens of personal air sampling pumps, and because combustion product concentrations were measured by other investigators on vessels and in the smoke plume as a principle objective of NOBE.

OVERVIEW OF NEWFOUNDLAND OFFSHORE BURN EXPERIMENT

NOBE was an oil spill combustion trial organized by Environment Canada and sponsored by over 25 governmental and private organizations from Canada and the United States. NOBE was a major experiment which involved hundreds of scientific and operations personnel, four ships, sixteen boats, one fixed and several rotary wing aircraft. The principle objectives[7] of NOBE were to:

- measure the physical characteristics and chemical emissions during full-scale *in-situ* burning of crude oil at sea for comparison with previous laboratory and medium scale experimental studies. This would test the effects of experimental scale on burning efficiency and emissions.
- collect data on composition of evaporative and smoke plumes and water quality effects of full-scale *in-situ* burning to enable evaluation of environmental effects for spill response planning purposes.

In addition, NOBE was expected to provide useful information on the logistics and practical implementation of full-scale *in-situ* burning at sea.

The experiment was conducted on August 12, 1993, offshore over the Grand Banks in a designated 34 km^2 (10 square nautical mile) area closed to boat and air traffic (location 47°40' north latitude, 52° west longitude). The location was 42 km (25 nautical miles) east of St. John's, Newfoundland, Canada. The timing (between August 5 and 15) and location of the experiment were selected to minimize possible ecological damage and interference with the fishery. The experiment was contingent on environmental conditions (wind speed < 15 knots, wave height < 1 m, visibility > 4 km, ceiling > 300 m) and minimization of impact on birds and marine mammals (as confirmed by aerial surveillance prior to each experiment).

Two experiments were planned and conducted, each consisting of the controlled discharge and ignition of up to 50m^3 of crude oil into a fire-resistant boom. After about 10% of the oil had been discharged into the fire-resistant boom (approximately ten minutes), the oil was ignited using a Helitorch (TM) ignition device suspended from a hovering helicopter. (48.3 m^3 of crude oil were used for first burn experiment, 28.9 m^3 for the second burn). Alberta Sweet Mixed Blend crude oil was selected because its properties were mid-range and representative of many crude oils. It was also the reference crude used by Environment Canada and others in previous laboratory experiments, and was readily available. The crude had been sparged to simulate partial weathering (approx. 4%). The crude density was 0.839, viscosity 10 cp, flash point < 17°C, benzene content < 0.1 weight per cent (wt %)[8]. (Alberta Sweet Mixed Blend has a natural benzene content of about 0.4 wt %. At the time of the study, the benzene content of the crude was unknown, but was assumed to be less than 0.4 wt %).

Air and water sampling near the fire and air sampling in the smoke plume was conducted from remote controlled boats, remote controlled helicopters and a remote controlled submersible boat deployed beneath the slick. Downwind of the fireboom, a tethered blimp, conventional helicopters, fixed-wing aircraft and surface vessels were platforms for air and water sampling systems. A secondary oil containment boom and recovery system (skimmer, sorbent, tankage) capable of recovering 100% of the discharged oil was towed behind the fire boom.

The vessel arrangement for the experiment is presented in Figure 1. Of the twenty vessels and three aircraft involved in the experiment, most were involved in scientific data collection, surveying for wildlife, towing the backup containment boom, and monitoring the condition of the fireboom. Only three vessels and helicopter CCG 360 which ignited the oil were directly engaged in typical *in-situ* burning activities. The 68 m (224 ft) Canadian Coast Guard (CCG) ship *Sir Wilfred Grenfell* towed the fireboom at low speed using 50 m (150 ft) towing lines and was the crude oil discharge vessel. Two 6.4 m (21 ft) outboard powered open motorboats (Boston Whalers (TM) CCG 203 and CCG 204) assisted in towing the fireboom. Table 1 lists the tasks and designations of all vessels and aircraft in the experiment.

METHOD

Monitoring Strategy

A relatively simple personal monitoring strategy employing organic vapor monitors (Model 3500, 3M Corp.) was used to measure personal exposure to benzene and volatile hydrocarbons. The passive organic vapor monitors were selected because they were simple for response personnel to use and were of acceptable accuracy[9-11]. It was expected that over one hundred personal air samples would be collected and active sampling with pumps and charcoal tubes would have been impractical. (Active sampling was used for a small subset of the population, as described below).

Each vessel coxswain and aircraft pilot received personal monitoring packages for at least one-half of each crew (half the deck crew on the two ships). Each personal monitoring package was a waterproof plastic bag which contained one or two organic vapor monitors (in the original sealed packing) and one data sheet for each monitor. The data sheet explained the purpose of the study, provided simple written instructions on use of the organic vapor monitors, and requested the following information:

- serial number of the organic vapor monitor
- vessel or aircraft identification
- start and stop time of monitoring
- description of work activity
- list of possible chemical exposures (e.g., gasoline, diesel fuel, solvents, tobacco smoke)

Proper use of the monitor was demonstrated to each coxswain, and as many of the crew members who were present as possible. Two critical instructions were emphasized: (1) record the start and stop times, and (2) put the monitors on at least thirty minutes prior to the discharge of crude oil.

One hundred four organic vapor monitors were deployed during the one-day experiment (two burns). For vessels in the "hot zone" (downwind of the fireboom), each sampling package contained two organic vapor monitors. Personnel in the hot zone were instructed to use one monitor for the first burn, and the other for the second. Personnel on other vessels and aircraft were generally issued one monitor for both burns. Sampling packages (monitors and data sheets) were collected after the experiment or the next day and prepared for transport following the manufacturer's recommendations. Some monitors were returned by mail (in the original packaging), and a few of these had the white wind screen instead of the plastic shipping cap over the sorbent bed.

Five active sampling packages were also deployed for personal monitoring. Each package contained a battery powered personal air sampling pump (Gilian GilAir) which had been calibrated the evening before the experiment using a bubble flowmeter (Gilian Gilibrator) with calibration traceable to the National Institute of Standards and Technology. Each package also contained two data sheets and two charcoal tubes (SKC Inc.) installed in a tube holder with removable plastic end caps installed, written instructions and data sheet, and a belt. Each person using the pump and tube was instructed in its use. At the conclusion of the experiment (or the next day), the pumps were collected and calibrations were checked. (One pump failed during the first burn, the other four pumps had acceptable post-sampling calibrations).

On the day of the experiment, coxswains were instructed by radio to start personal monitoring about thirty minutes before the initial discharge of oil. Coxswains were reminded by radio to collect the monitors and record the end of sampling time after the burns were completed.

<u>Analytical Strategy</u>

Of the 104 organic vapor monitors deployed, 77 (74%) were returned and 72 had sufficient documentation to be useful. Fifty-one monitors (70%) were submitted for analysis. Where more than two monitors per burn were returned for a vessel, at least two (selected at random) per burn were analyzed. A small number of the monitors returned from the observation vessels were analyzed (observation vessels were generally cross-wind to the oil).

Samples and field blanks were submitted for analysis to the Exxon Biomedical Sciences Industrial Hygiene Laboratory, an AIHA accredited industrial hygiene laboratory. Organic vapor monitors and charcoal tubes were desorbed with carbon disulfide and analyzed by gas chromatography (flame ionization detection) following standard methods[12]. Results for benzene and total petroleum hydrocarbons (as n-hexane equivalents) were reported. The limit of detection was 1 μg per monitor.

Quality Assurance

Raw data and final reports were reviewed for completeness, consistency and accuracy by quality assurance personnel. Randomly chosen personnel monitoring field data sheets were reviewed for completeness, checked for start/stop sampling times and total sample collection volumes. An audit of the raw data included a review of the laboratory analytical request forms and computer log-in validation reports (sample chain-of-custody), sample designations and sample volumes, chromatography (samples and standards), instrument calibration data, and the computer acquisition report data for all samples and standards. The final analytical reports for all samples were reviewed for completeness and consistency against the analytical laboratory raw data.

RESULTS

As shown in Table 1, benzene and total petroleum hydrocarbon exposures were generally very low during the *in-situ* burning experiments. In 59 of 61 determinations, benzene was below the analytical limit of detection (which was generally less than 0.1 ppm). Total petroleum hydrocarbon exposures were also low, except for five samples from four vessels (two of which corresponded to detectable benzene measurements). A full hydrocarbon scan (shown in Table 2) and chromatograms were requested for these five samples.

Chromatograms were inspected by an experienced analyst who observed that the sample from vessel CCG 218 had an chromatographic profile similar to that of gasoline light ends; the sample from vessel CCG 211 was similar to that of an unleaded gasoline (headspace); the sample from vessel CCG 214 was unfamiliar to the analyst; the sample from vessel CCG 216 appeared similar to a branded hydrocarbon solvent.

DISCUSSION

Alberta Sweet Mixed Blend is not a crude with a naturally high benzene content, and the simulated weathering further reduced the concentration of volatile hydrocarbons of principal industrial hygiene interest. (An assay of the crude following the experiment[8] indicated benzene and ethylbenzene were < 0.1 wt %, and toluene and xylenes < 0.2 wt %). However, the experiments at NOBE provided conditions for evaporation of the remaining benzene and volatile hydrocarbons during the interval prior to ignition, and during the oil burns. Since only about one-third to one-half of the surface of the crude pool was burning (an estimate as viewed from an observation vessel), a portion of the spilled oil was subject to further evaporative weathering during the experiments. (The oil combustion was generally confined to the thickest oil layer which was nearest the apex of the towed fireboom). Although there was potential for personnel exposure to benzene and volatile hydrocarbons, measured exposures were very low. Low exposures were probably due to several factors: (1) the low benzene and volatile hydrocarbon content of the crude oil, (2) personnel generally (but not always) avoided the region downwind of the fireboom, and (3) the evaporating crude oil plume was probably drawn into the warmer combustion plume. The combustion plume was buoyant, rising from the water surface at an angle from the horizon of between 20 and 70 degrees (an estimate as viewed from an observation vessel).

Benzene exposures were low, even on boats closest to the fireboom. The highest benzene measurement (0.886 ppm) was on CCG 211, a gasoline powered boat 150 M downwind of the fireboom which tended remote controlled gasoline powered helicopters. As described above, the sample chromatogram from CCG 211 was similar to that of the headspace of unleaded gasoline. Vessel CCG 211 and an identical vessel (CCG 207) which was performing a similar task, were both powered by gasoline outboard motors. The activity diary for CCG 211 did not reveal whether gasoline or helicopter fuel transfer (or other direct contact) occurred. Benzene exposure was below the limit of detection for CCG 207 which tended the other remote-controlled helicopter and was closer (50 M downwind) to the fireboom. It is likely that the benzene exposure on CCG 211 was associated with boat or remote-controlled helicopter fuel or operation, rather than to *in-situ* burning, *per se*.

In-situ burning of unweathered crude oil at an accidental oil spill could be associated with higher exposures to benzene and other volatile hydrocarbons than at NOBE if: (1) the crude had a higher natural benzene content than Alberta Sweet Mixed Blend, (2) was less weathered than the oil in this study, or (3) had a larger evaporating crude surface area. Although these results suggest that the *in-situ* burning process itself does not appear to present a significant benzene exposure risk to spill response personnel, good hygienic practice at an accidental oil spill would use air monitoring in the decision process regarding use of respiratory protection for response personnel. The experiment was not designed to test agreement between active (pump and tube) versus passive (organic vapor monitor); however, the methods appeared to yield equivalent results, and the organic vapor monitors appeared to be well-suited to the task due to their simplicity.

ACKNOWLEDGEMENT

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TABLE 1: PERSONAL EXPOSURE MONITORING RESULTS

TASK	VESSEL/AIRCRAFT	LOCATION	TWA Benzene Concentration[A], ppm			Tot. Petrol. Hydrocarbons Conc.[B], mg/M^3		
			Burn 1	Burn 2	Burns 1&2	Burn 1	Burn 2	Burns 1&2
Supply and Oil Discharge Vessel; fireboom tow vessel	CCGS Sir Wilfred Grenfell	On deck and afterdeck (200 M ahead of fireboom apex)	–	–	< 0.02 < 0.02 < 0.02	–	–	2.4 0.64 0.64
		In wheelhouse (200 M ahead of fireboom apex)	–	–	< 0.02 < 0.02	–	–	1.2 1.4
Tend & Assist Tow Fireboom	CCG 203 21' Whaler, Gasoline	175 M ahead of fireboom apex, port side	< 0.1^C	< 0.09	–	0.726	1.18	–
	CCG 204 21' Whaler, Gasoline	175 M ahead of fireboom apex, stbd side	–	–	–	–	–	–
Fireboom Monitoring	CCG 218 22' Whaler, Gasoline	Adjacent to fireboom apex, roaming	< 0.05	–	0.058	34.6	–	26.9
Control EPA ROV Submersible	CCG 208 36' Sea Truck	Close in & adjacent to fireboom apex, port side aft	< 0.05 < 0.05	< 0.1 < 0.05	–	< 0.2 1.82	< 0.4 1.16	–
Tender to Remote Control Sampling Boats	CCG 215 36' Sea Truck	50 M aft of fireboom apex, port side	< 0.05 < 0.08	–	–	< 0.2 0.85	–	–
	CCG 216 36' Sea Truck	100 M aft of fireboom apex, port side	< 0.02^D	< 0.03^D	< 0.05	< 0.06^D	< 0.11^D	90.45
Tender to Remote Control Helicoptors	CCG 207 26' Sea Truck, Gasoline	50 M aft of fireboom apex, stbd side	–	–	< 0.04 < 0.02	–	–	6.97 5.63
	CCG 211 26' Sea Truck, Gasoline	150 M aft of fireboom apex, stbd side	< 0.02^D	< 0.03^D	0.886 < 0.04	4.22^D	1.72^D	92.39 3.47
Tender to NIST blimp	CCG 210 36' Sea Truck	150 M dead astern (aft) of fireboom apex	< 0.06 < 0.06	< 0.09 < 0.1	–	1.71 0.93	9.6 9.92	–
Surface Sampling Vessel	CCG 205 22' Whaler, Gasoline	200 M astern and to port of fireboom apex	–	–	< 0.02	–	–	5.24
Backup boom towing vessels	CCG 214 46'	250 M dead astern of fireboom apex, port side	< 0.03^D < 0.05 < 0.1	< 0.03^D < 0.1	< 0.02	< 0.09^D 7.46 37.71	4.01^D 10.73	2.34

TABLE 1. PERSONAL EXPOSURE MONITORING RESULTS (Cont'd)

TASK	VESSEL/AIRCRAFT	LOCATION	TWA Benzene Concentration[A], ppm			Tot. Petrol. Hydrocarbons Conc.[B], mg/M^3		
			Burn 1	Burn 2	Burns 1&2	Burn 1	Burn 2	Burns 1&2
Backup boom towing vessels	CCG 212 46'	250 M dead astern of fireboom apex, stbd side	< 0.05 < 0.05	< 0.09 < 0.09	< 0.03	< 0.2 0.31	0.39 < 0.3	7.41
Oil recovery vessel with skimmer & bladder tank	CCG 208 36 ' Sea Truck	350 M astern of fireboom apex; stbd side of backup boom	< 0.05 < 0.05	< 0.1 < 0.05	–	<0.2 1.82	< 0.4 1.16	–
Downwind air sampling	CCG 206 42' Cape Islander	380 M astern of fireboom apex, 33 M dead astern of backup boom apex	–	–	< 0.02 < 0.02	–	–	0.37 0.23
Command Vessel	CCGS Ann Harvey	Port of fireboom apex	–	–	< 0.05 < 0.02	–	–	< 0.2 1.26
Intervessel transport, first aid (Fast Response Crafts)	CCG 238 (FRC)	Roaming	–	–	< 0.02	–	–	0.56
	CCG 243 (FRC)	Roaming	< 0.06 < 0.06	< 0.1 < 0.1	–	1.03 < 0.2	4.38 0.69	–
Observation Vessels	MV Casaco	Stbd of fireboom apex	–	–	< 0.03 < 0.02	–	–	0.66 < 0.1
	MV Beinir	100 M aft and to stbd of fireboom apex	< 0.03	< 0.08	< 0.02	1.45	1.73	0.71
Wildlife/Spotter Helicopter	CCG 305	In flight, roaming	–	–	< 0.04	–	–	0.49
Oil Ignition, Video Helicopter	CCG 360	In flight, roaming	< 0.1	< 0.1	–	2.27	2.05	–

Notes to Table 1

A Time-weighted average benzene concentration measured using Model 3500 organic vapor monitors.

B Time-weighted average total petroleum hydrocarbon concentration, measured using Model 3500 organic vapor monitors, expressed as n-hexane equivalent concentration.

C Benzene concentrations which were below the analytical limit of detection (ALD) are indicated thus: < (ALD)

D Time-weighted average benzene concentration measured using air sampling pump and sorbent tube.

Table 2: Hydrocarbon Scan for Samples with Total Petroleum Hydrocarbon Concentrations above 15 mg/M^3

Substance	Time-Weighted Average Concentration, ppm				
	CCG 211	CCG 214	CCG 216	CCG 218-1	CCG 218-2
isobutane	0.464	< 0.1[A]	< 0.06[A]	0.387[A]	0.274[A]
n-butane	1.496	< 0.1	< 0.06	1.357	0.938
isopentane	2.76	0.108	< 0.05	1.385	1.026
n-pentane	1.841	< 0.1	< 0.05	1.419	0.985
2-methylpentane	1.487	< 0.09	< 0.05	0.694	0.486
3-methylpentane	0.754	< 0.09	< 0.05	0.32	0.228
n-hexane	1.239	< 0.1	< 0.05	0.772	0.549
methylcyclopentane	0.747	< 0.1	< 0.05	0.542	0.386
benzene	0.886	< 0.1	< 0.05	< 0.05	0.058
cyclohexane	0.313	< 0.1	< 0.05	0.34	0.235
3-methylhexane	0.48	< 0.1	< 0.05	0.198	0.151
iso-octane	0.369	< 0.09	< 0.05	0.291	0.21
heptane	0.549	< 0.1	0.089	0.341	0.251
toluene	2.328	0.38	0.152	0.151	0.197
3-methylheptane	0.289	< 0.09	< 0.05	< 0.05	< 0.03
n-octane	0.291	0.136	0.322	0.19	0.157
ethyl benzene	0.515	0.123	0.134	< 0.05	0.052
xylenes (o-,m-,p-)	2.352	0.829	0.655	0.122	0.307
nonane	0.113	0.086	0.584	< 0.04	0.047
cumene	0.083	< 0.09	< 0.05	< 0.05	< 0.03
propyl benzene	0.122	< 0.08	0.204	< 0.04	< 0.02
p-m ethyltoluene	0.514	0.375	0.392	< 0.04	0.115
1,3,5 trimethylbenzene	0.237	0.208	0.526	< 0.04	< 0.03
o-ethyltoluene	0.171	0.126	0.364	< 0.04	< 0.03
1,2,4 trimethyl benzene	0.765	0.679	1.125	< 0.05	0.068
decane	0.065	0.271	1.14	< 0.04	0.038
n-undecane	0.056	0.516	1.441	< 0.04	0.029
dodecane	0.064	1.271	0.847	< 0.03	< 0.02
tetradecane	< 0.01[A]	< 0.05	0.222	< 0.02	< 0.01
hexadecane	< 0.01	< 0.04	< 0.02	< 0.02	< 0.01
1,1,1 trichloroethane	< 0.02	< 0.07	< 0.03	< 0.03	< 0.02
Total Petrol Hydrocarbons as n-hexane equivalents	26.21 mg/m^3	10.703 mg/m^3	25.663 mg/m^3	9.823 mg/m^3	7.634 mg/m^3

A Substance concentrations which were below the analytical limit of detection (ALD) are indicated thus: < (ALD)

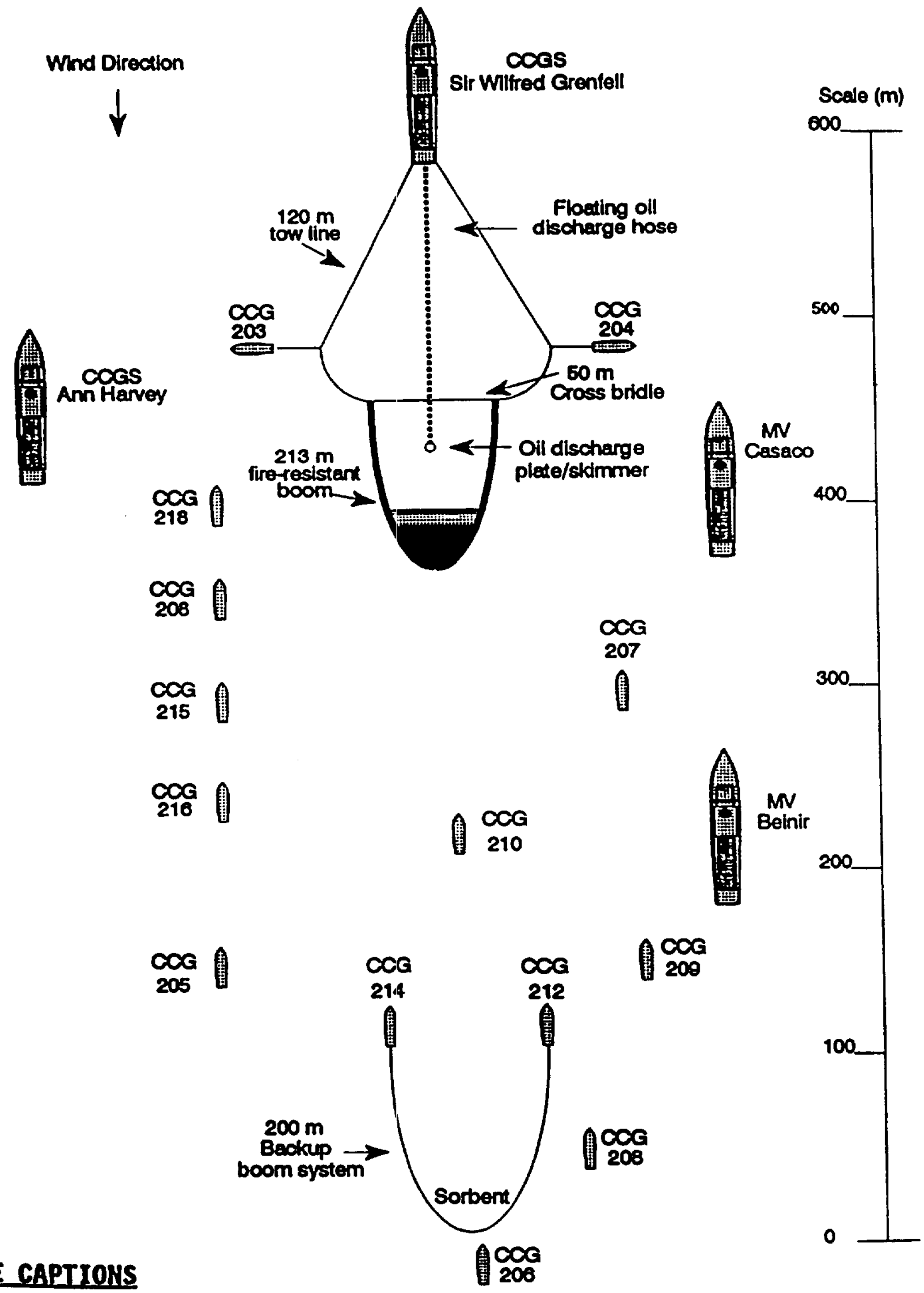

FIGURE CAPTIONS

Figure 1 Vessel arrangement at time of oil ignition for the Newfoundland Oil Burn Experiment. (Source: Newfoundland Offshore Burn Experiment Committee. Newfoundland Offshore Burn Experiment. Environment Canada, June 1993)

Appendix D

3M Fireboom Performance NOBE 93

Appendix D

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1. Final Statement on Boom Failure
   NOBE Management Committee

2. NOBE Summary Report -- Boom Performance
   Alan A. Allen

3. 3M Report on the Condition of the Fireboom following the NOBE 93 Burn,
   T.J. Gennrich and R.L. Vick, 3M

Final Statement on Boom Failure

(prepared by NOBE Management Committee)

Final Statement on Boom Failure

Near the end of burn two, a flotation log broke free from boom section 7, located to the left of the centre of the fire area. Since the burn was nearly complete, oil pumping was stopped to ensure that further failures did not result in the release of oil. At the time, the log release was noted and the boom section continued to float in position and contain oil. It should be noted that no release of oil occurred, although the primary burn and oil containment were in the adjacent section.

The flotation logs are normally held in place by two methods: stainless steel wire mesh and ceramic Nextel fabric. Examination of the failed boom section showed that the Nextel fabric was absent, as it was on adjacent sections. This is consistent with the observations after the first burn, at which time it was noted that the Nextel fabric was absent or depleted from much of the boom in the burn zone. It was further noted that this particular section was constructed from pieces of steel wire mesh rather than from the standard one piece. It is not known how this defect contributed to the overall failure of the boom section and this cannot be determined.

The steel wire mesh is the main structural element of the boom. The main structural failure was assessed as being the brittle fracture of the steel wire mesh. The wire mesh around the failed flotation logs did show signs of embrittlement.

NOBE Summary Report - Boom Performance

by Alan A. Allen

NOBE SUMMARY REPORT -- BOOM PERFORMANCE

Alan A. Allen, Spiltec

November, 1993

*The following Summary Report represents a consolidation of the author's observations, opinions and preliminary calculations involving the use of the **3M Fire Boom** during the Newfoundland Offshore Burn Experiment (NOBE) in August, 1993. Topics addressed include:*

- *DEPLOYMENT, TOWING & RECOVERY*
- *OIL CONTAINMENT CAPABILITY*
- *PERFORMANCE DURING COMBUSTION*
- *GENERAL OBSERVATIONS*

DEPLOYMENT, TOWING & RECOVERY

Deployment -- The deployment of the 3M Fire Boom involved a standard over-the-stern, straight-line pull of 700 feet (213.4 meters) of boom from the deck of the 224-foot CCGS Sir Wilfred Grenfell. Early on the morning of August 12, 1993, the 3M Fire Boom (18-inch flotation with 24-inch skirt) was pulled by a single small vessel into seas that consisted of a 2- to 3-foot (0.6- to 0.9-meter) swell with light wind chop. The deployment time was approximately 8 minutes.

The Fire Boom, consisting of 14 50-foot (15.2-meter) sections, each section consisting of 7 segments, was labeled as shown in Figure 1. The boom was towed into a standard U-configuration, and a 150-foot (45.7-meter) bridle was placed 100 feet (30.5 meters) back from the leading ends of the boom. The bridle, when fully extended, allowed 500 feet (152.4 meters) of the boom to be held in a U-configuration with a swath-to-boom length ("gap") ratio of 0.3. The towing bridles, connected at the leading ends of sections 1 and 14 could then be pulled sideways to widen the opening forward of the bridle as necessary. The flared-out boom sections (#'s 1,2, 13 & 14) in Figure 2 were pulled sideways to the direction of travel by two Boston Whalers, while the Sir Wilfred Grenfell took the major strain on the primary tow lines.

It should also be noted that Figure 2 indicates 6 progressively larger zones (Zones I through VI) within the 3M Fire Boom U-configuration.

Figure 1

Fire Boom Identification Layout

Newfoundland Offshore Burn Experiment

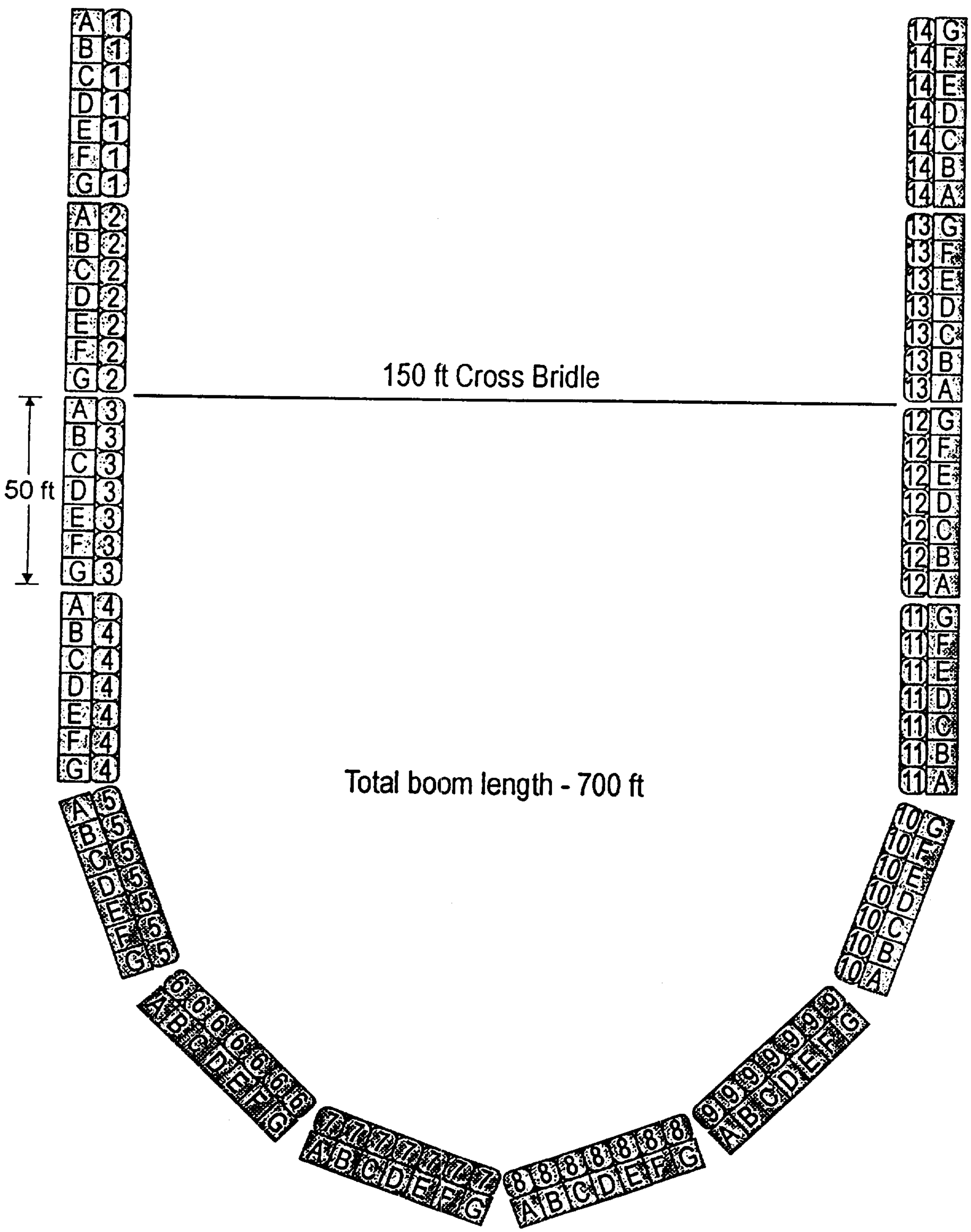
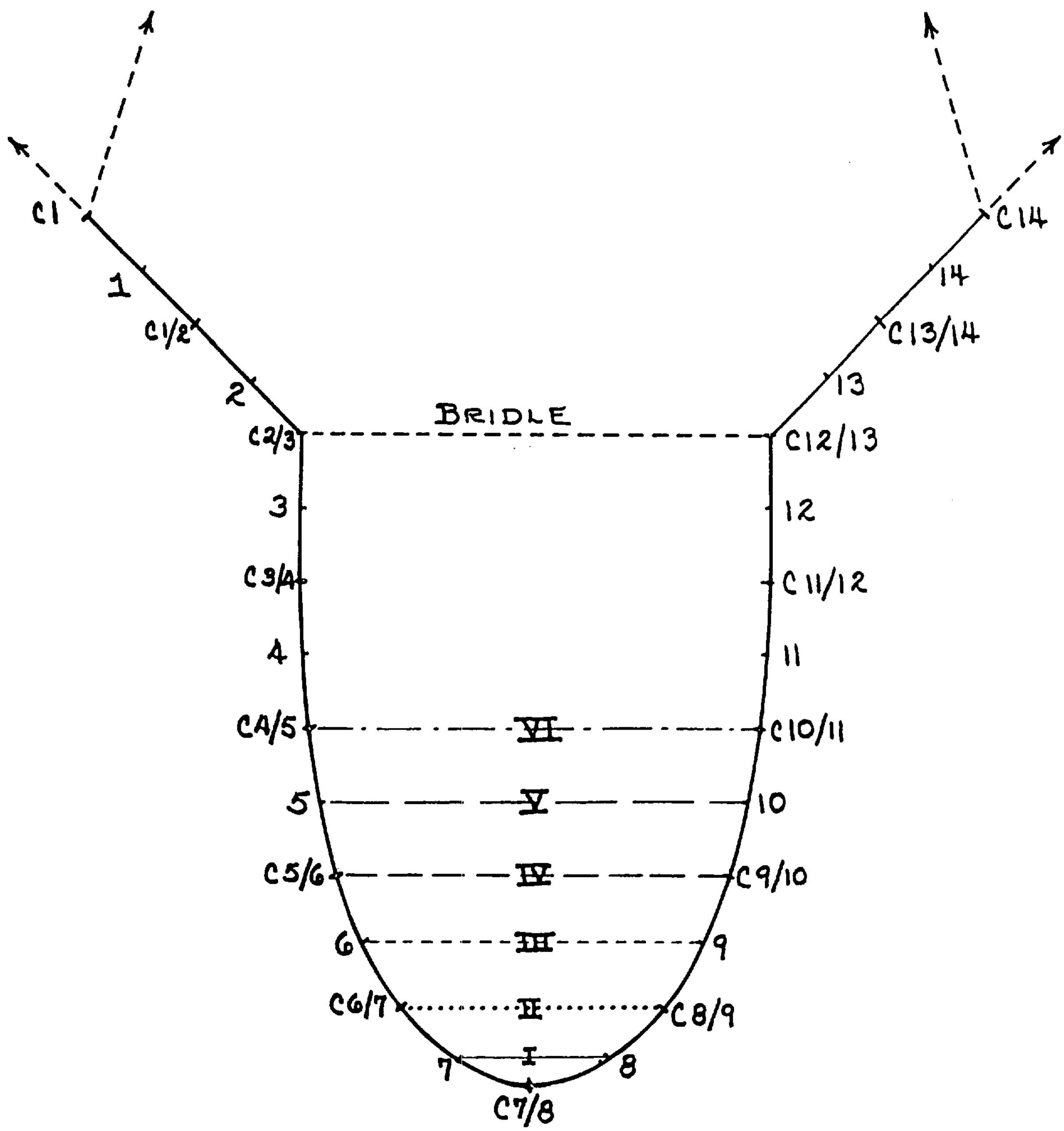


Figure 2

Fire Boom Section, Connector & Zonal Designations

(Drawn to Scale)



The zones in Figure 2 were selected based on their ease of detection associated with various boom connection plates (designated with a "C"). The zones reflect approximate areas (measured from the apex forward) as follows:

Zone	Area (sq. ft)	Area (sq. m)
VI	12,950	1,203
V	9,450	878
IV	6,200	576
III	3,450	320
II	1,325	123
I	325	30

These areas facilitated the estimation of oil holding capacities and potential oil elimination rates based on average oil thickness (for holding capacity) and known crude oil burn rates of typically 0.07 gallons/minute/sq. foot (2.8 liters/minute/sq. meter) for the rate of elimination. These zones will be used in latter discussions.

The deployment operations went smoothly owing to the practice runs held prior to the burns on August 12th. Only one supervisor and a few deckhands were needed to coordinate the deployment of the Fire Boom and to ensure that it did not snag on any equipment or other obstructions on deck. There was good radio communication between all personnel on the vessels involved; and well-trained seamen were able to complete all on-water rigging and line-handling requirements without difficulty.

Towing & Wave-Riding Characteristics -- The 3M Fire Boom performed as expected with respect to its ability to maintain an adequate freeboard, and to follow the action of waves while the boom was slack and while it was under tension (i.e., being towed). Prior to the release of oil the Fire Boom had a freeboard of typically 15 to 16 inches (approx. 38 to 41 centimeters). This freeboard indicated that about 83% to 89% of the boom's flotation component was above water.

Under tow, the Fire Boom retained its favorable freeboard and wave-riding characteristics, demonstrating good heave and roll response in reaction to wind, waves and currents. Measurements in the lee of the boom indicated that the towing speed was maintained at approximately 1/2 to 2/3 of a knot. The average position of the water-line and the orientation of the skirt during the passage of the highest waves (approximately 1 1/2 meters) indicated that the Fire Boom would have desirable oil-holding characteristics under tow with light-to-moderate seas.

As with most comparably sized booms, the 3M Fire Boom was still vulnerable to the occasional splashing of water (and potentially, oil) over its segments in the downstream apex of the U-configuration. Because of the weight of its fire-resistant flotation core (yielding a reserve buoyancy-to-weight ratio of about 4.2), there was a slight tendency for steep-sided, short-period, wind-waves to splash up and over the boom. This effect was minimal, and, of course, would be reduced further by the dampening effects of thick oil later in the experiment.

Recovery -- Upon completion of the two burns, the 3M Fire Boom that had not been exposed to fire looked and behaved as it did prior to combustion of the contained oil. The outer sacrificial layer and all lift points were in place and capable of supporting a normal recovery operation. As is discussed in the section on **PERFORMANCE DURING COMBUSTION**, the sections of boom that had been exposed directly to the fire had their sacrificial outer PVC coverings and plastic lift-points burned away. The upstream tow-lines and bridles, as well as all wire lift points at each connector were still in good shape and capable of supporting a routine boom recovery operation.

Some unexpected thermal degradation in a portion of one boom section (see **PERFORMANCE DURING COMBUSTION**) did result in the weakening and parting of portions of the boom's stainless steel knitted mesh well above the water line. During recovery of the boom the below-water components (skirt and ballast/tension member) were as strong as ever, and capable of supporting the boom during its recovery back onboard the Sir Wilfred Grenfell. The significance of secondary tension members (as were used in two experimental sections during these burns) is currently being examined by 3M with respect to the importance of those members during towing and recovery operations. It is apparent that the provision of additional tension members not only helps in handling and distributing loads during towing, but in maintaining the structural integrity of the boom during recovery. This is especially important during recovery if the above-water portions of such booms are exposed to severe thermal degradation.

OIL CONTAINMENT CAPABILITY

Entrainment/Drainage -- One of the most common modes of failure for booms anchored in a current or towed (to induce a current) involves the passage of oil beneath the boom. Depending upon the nature of the oil and the magnitude of the currents moving beneath the boom, oil may break away from the upstream portions of the contained slick and pass under the boom (commonly called "entrainment"). Oil may also slip under the boom due to a heavy concentration and deepening of the oil adjacent to the boom (i.e., "drainage" failure). During NOBE, it was difficult to determine the exact contribution of either of these phenomena since they could not be observed from above the water, and because the EPA-sponsored, remote-controlled submarine normally operated in waters outside the containment area.

The author has not seen the underwater video tapes as of this date; however, conversations with EPA representatives that were on location suggest that there were times when noticeable amounts of oil did pass beneath the Fire Boom. It is quite conceivable that these subsurface releases were associated with the higher-than-normal oil discharge rates that took place sporadically during Burn #1. Recent data provided by Environment Canada indicate that seven separate discharges of oil were conducted following ignition of the first burn. An assessment of the burn areas observed and photographed/taped during these discharges (compared with the known oil discharge rates) suggests that the nominal holding capacity of the U-configuration was very likely exceeded at times during the burn.

It is the author's opinion that even prior to the ignition, there may have been brief periods when small amounts of oil escaped beneath the boom because of excessive current (> 3/4 knot) and because of the effects of wind concentrating the oil against the apex of the boom. It is possible that the currents recorded in the immediate lee of the boom prior to oil discharge were lower than the actual boom towing speed because of eddies induced behind the boom. It is conceivable that the actual towing speed for the boom was 1 1/2 to 2 times faster than the recorded average speed of 1/2 knot measured directly downstream of the boom's apex. The effects of such water movement, together with the sporadic rapid buildup of oil within the boom and the effects of 10-knot winds (gusting to 15 to 17 knots), could easily account for the periodic movement of oil beneath the boom.

It is important to note that in spite of the apparent passage of some oil beneath the boom, the amount actually released was quite small compared to the overall discharge (and therefore, collection) rate. A few times a temporary sheen approaching a swath width of 100 feet (approx. 30 meters) was observed downstream of the boom. This rare occurrence would have accounted for less than a tenth of a U.S. gallon per minute (less than 0.4 liters per minute) as the loss rate from the boom. Following ignition, the volumes of oil discharged ahead of the boom increased substantially. During such surges, it is possible that some oil was entrained beneath the boom. If such entrainment did occur, it is interesting that very little oil was evident on the surface downstream of the burn. The observations of personnel in the air and on the surface, together with the amounts of oil collected in the conventional backup boom, suggest that a very small percentage of the original volume escaped the containment/burn operation.

Splashover -- Prior to the ignition of oil in Burn #1 it was noted that a small amount of crude oil did splash up and over a few segments of boom sections 7 and 8. At these locations the waves within the U-configuration were propagating at nearly right angles to the "face" of each boom segment. The amount of oil within the boom was relatively small (typically between Zones I & II in areal coverage), and there was little, if any, noticeable dampening of the short-period wind-waves by the oil. The small amount of oil that did manage to splash up off the surface landed on the boom causing a minor amount of staining on the outer PVC covering of the boom's top and down-stream surfaces. Prior to ignition during both burns, it is likely that less than half of a gallon (at most, 1 to 2 liters) of oil could have been lost due to splashover.

During the combustion phase of each burn there was an increase in the amount of unburned or partially burned oil splashed over the Fire Boom. As in all previous burn tests observed by the author, the material deposited on the water outside the boom typically consisted of isolated droplets of oil and frothy patties of burn residue. The amount of such oil/residue was difficult to determine from the author's vantage point; however, occasional inspections directly downstream of the fire (and immediately below the smoke plume) indicated that most splashover material seemed to collect and be drawn in toward the back (down-stream) side of the boom. The results of such accumulation (possibly augmented by some oil entrainment/drainage below the boom) occasionally resulted in the burning of surface oil outside and immediately downstream of the boom's apex.

The burning of oil/residue adjacent to, but immediately outside, the boom's apex, was most noticeable when the accumulations of oil within the boom were at their maximum concentrations, and the resulting fire within the U-configuration extended over unusually large areas. Burn areas approaching those of Zones III and IV inside the U-configuration (i.e., areas approaching 400 to 500 sq. meters or more) frequently involved brief but intense burns of floating oil out several feet (1 to 2 meters) from the apex of the boom. The existence of this natural collection zone immediately downstream of the boom has been noticed during actual spill events with towed booms and with booms secured across moving bodies of water. The importance of such accumulation, and the apparent ability to sustain combustion over it, suggests that minor losses due to entrainment and/or splashover may (under certain conditions) be tolerable. Future investigations might be aimed at the identification and evaluation of conditions that lead to such accumulation and of ways to take advantage of such phenomena (e.g., the optimum positioning of multiple booms).

Submergence & Planing -- Other failure modes associated with the loss of contained oil include "submergence" (or the removal of freeboard by diving), and "planing" (the flattening of a boom's skirt out behind its flotation). Submergence is normally induced by excessive currents along with a relatively low reserve buoyancy. The 3M Fire Boom' reserve buoyancy was more than adequate for the range of towing speeds encountered during the Newfoundland exercises. There was no noticeable reduction in freeboard during either burn because of submergence.

The planing of a boom may result from strong winds and currents moving in opposite directions. Such planing will normally occur if the bottom tension member is either too long or improperly positioned on the boom, or if the boom has been designed with inadequate ballasting. At no time during the burns off Newfoundland did the 3M Fire Boom show any signs of planing.

Structural Failure -- During one of the practice sessions conducted with the 3M Fire Boom damage occurred to one section when the boom got caught on a deck obstruction while being deployed over the stern of the Sir Wilfred Grenfell. Portions of several other sections also received minor damage during some of the recovery operations. In all cases, damaged components could be repaired easily or replaced. As handling techniques improved and personnel became familiar with the Fire Boom, damage during deployment and recovery was eliminated. The need for certain design modifications became evident during these early deployment operations, and 3M is currently considering such improvements for future boom configurations.

During both oil collection phases of NOBE there were no structural failures that resulted in the release of contained oil. However, by the end of the first burn (approximately 1 1/2 hours long) and especially during the latter part of the second burn (approximately 1 1/4 hours long), there were signs of damage resulting from the combined effects of high temperature, salt water and the flexing of materials due to wave action. These thermally induced effects are described in the next section.

PERFORMANCE DURING COMBUSTION

BURN #1:

Boom Performance -- There were no noticeable changes in the 3M Fire Boom's towing and wave-riding characteristics throughout the first burn. The U-configuration was maintained with a constant 150-foot (45.7-meter) opening as illustrated in Figures 1 and 2. As oil accumulated within the apex of the boom (nearly out to the edge of Zone II) prior to ignition, there were no significant losses of oil over or under the boom. The ability of the boom to retain this oil holding capacity remained the same as the oil was ignited and as additional oil was pumped to the U-configuration following ignition.

It is the author's understanding that crude oil was pumped at higher-than-planned flow rates (believed to approach 1,000 liters/min. or about 264 US gal/min.) over 7 intervals of several minutes each following ignition. These sporadic releases, and the propagation of flame upwind to the oil discharge point, resulted in exposures of the fire boom to flame as far forward as section 12. There were often prolonged exposures of several minutes where sections 6 through 12 were directly exposed to burning oil. In these regions of the U-configuration the outer sacrificial PVC covering of the boom and its fabric/plastic hand-holds were melted away within a few minutes. As in previous burns the release of small amounts of captured air within the boom's flotation logs then allowed the boom to settle slightly, giving up about 1 to 2 inches (2 1/2 to 5 centimeters) of its freeboard. By the end of the first burn (approximately 1 1/2 hours), the fire boom still had a freeboard of 12 to 14 inches (30 5 to 35.5 centimeters) or about 85% of its starting (pre-burn) freeboard.

Throughout the first burn there were brief periods when oil appeared to accumulate immediately adjacent to the downstream side of the U-configuration's apex. As discussed earlier, any such accumulation remained small, and it was rapidly ignited. Rarely did any such burning appear to extend any farther than a few feet (about 1 meter) from the boom. It is believed that such minor releases outside the boom were a result of the combined effects of entrainment, splashover and combustion-induced splatter. Such accumulations appeared to remain in close proximity to the boom's apex by the combined influences of thermally-induced winds toward the fire and near-surface eddies created by the passage of the boom through the water. As a result of this phenomenon, there would occasionally be a release of frothy burn residue (a few centimeters to a few 10's of centimeters in diameter, and a few millimeters thick) away from the burn site and back into the conventional boom downstream.

As the first burn neared its completion, it was apparent that between sections 6 and 9 there were signs of thermal stress upon the fire boom's ceramic fabric between flotation logs. The stainless steel inner and outer components were in good shape as were the ceramic fabrics covering the flotation logs. However, between segments (or flotation logs) where the stresses associated with wave action were the greatest, the ceramic fabric appeared to have some small openings well above the waterline. These openings were not large enough, nor were they close enough to the surface of the oil, to be of concern as potential leakage points.

Upon completion of the first burn a closer examination of these flex points revealed that the Nextel ceramic fabric had indeed suffered some embrittlement. Between some segments (exposed to the greatest heat) small patches of ceramic fiber had been removed several inches (10 to 20 centimeters) above the waterline. All ceramic fabric and stainless steel components elsewhere along the boom were in good condition. Portions of the sacrificial PVC covering were melted away a few inches (typically 5 to 10 centimeters) below the waterline in the apex of the boom configuration; however, there were no signs of oil leakage at any of these locations. It was noted, in fact, that heavy, sticky burn residue clinging to the surface of the boom would have eliminated (or at least helped reduce) any movement of oil through the boom had there been any significant leak points.

Efficiency of Burn -- The efficiency with which oil was removed from the contained area in burn #1 can be estimated by 1) multiplying the average burn areas (sq. feet) experienced throughout the burn by the durations (in minutes) of those burns and by a nominal burn rate for relatively fresh crude oil (i.e., 0.07 gallons/minute/sq. foot), and 2) simply subtracting the amount of oil and burn residue left upon completion of the burn from the amount pumped out forward of the U-configuration.

The first approach is, of course, very difficult without accurate data on the areal coverage of the fire throughout the burn. Recognizing that this approach is, at best, extremely rough, it is estimated that during the most intense periods of burning (approximately 25 to 30 minutes) involving burn areas that were comparable to Zones III & IV, it would have been possible to eliminate approximately 7,000 to 8,000 U.S. gallons (26.5 to 30.3 cubic meters) of oil. During most of the remainder of Burn #1, the average burn area was noted to be comparable to that of Zone II; and, therefore, could easily have involved the elimination of nearly 4,000 to 5,000 U.S. gallons (15.1 to 18.9 cubic meters). The total amount of oil eliminated (using this approach) could have been between 41.6 and 49.2 cubic meters. Obviously this approach (involving a highly variable burn of 48.3 cubic meters) cannot be used to estimate the efficiency of burn where prior experiences have suggested that the efficiency of burn will likely be between 90% and 99 %. This approach, however, does indicate that the areas and durations of burn do support prior experiences with respect to high elimination rates and efficiencies.

The second approach involves estimates of the amount of oil and burn residue left upon completion of the burn as observed by the author and others in the same CCG vessel (#218). The amount of burn residue left within the 3M Fire Boom upon completion of the burn involved approximately 75 to 90 U.S. gallons (or about 0.3 cubic meters). The amount of oil and/or burn residue captured within the backup RO Boom was estimated at about the same volume. Even allowing for oil/residue stuck on or within the fire boom or escaping containment, it is unlikely that much more than 1 to 2 cubic meters could have remained unburned out of the original 48.3 cubic meters. The efficiency of burn could therefore be placed at approximately 96% to 98 %.

BURN #2:

Boom Performance -- During the second burn the 3M Fire Boom behaved very much as it did during the first burn. There were no noticeable changes in freeboard nor in the way the boom responded to wind and wave conditions. Even though there were signs of thermal stress on the ceramic fabric between certain segments in the apex of the boom, the boom was able to contain oil during the initial collection phase and then during the ignition/combustion phase.

Oil was released at a more steady and eventually at a slower rate, so that the resulting burn was more uniform in size throughout most of the burn. The leading edge of the burn area was constrained within sections 6 and 9, resulting in an average burn area that was between Zones II and III on Figure 2. The average burn area of about 2,000 square feet (or 186 square meters) did still involve the intermittent release of oil (3 separate post-ignition discharges). This caused an occasional rapid increase in burn area and, undoubtedly, a thickening of the oil layer within the U-configuration. Underwater video coverage will hopefully reveal any change in the boom's ability to contain such surges of oil.

During the burn there were occasional releases of oil (with combustion) immediately downstream and adjacent to the apex of the fire boom U-configuration as in Burn #1. These were typically small in area and short in duration. However, nearly 1 hour into the second burn, a flotation log from section 7 was observed floating on the water downstream from the burn. Shortly after its release, it was decided to discontinue the discharging of any more oil. The oil that was already in the boom continued to burn normally; however, it was noted that oil would periodically be pushed out through the opening in the boom. The oil that was released continued to burn immediately behind the apex of the boom with random narrow bands of burning oil stretching downstream several 10's of feet (perhaps about 10 meters). Inspection of the burn residue during this latter part of the burn indicated a less efficient burn (as would be expected) with increased amounts of oil/burn residue drifting back toward the RO Boom.

As the oil burned out within the fire boom it was observed that an additional flotation log had worked free and was trapped within the apex of the boom. The two segments that had broken free were 7D and 7G. It is interesting to note that the release of floats from the boom took place in one of two new sections of boom that had been constructed specifically for experimentation at the Newfoundland burn trials. These two sections had mid-tension cables attached just below the boom's waterline, and there were some steps taken during their construction that involved a rather minor alteration of prior fabrication procedures. As indicated earlier, the 3M Company (Ceramic Materials Department) will be addressing the results their inspection of the damaged fire boom back in St. Paul. That report should be provided to Environment Canada sometime within the next week or two.

As noted during Burn #1, the Nextel ceramic fabric had shown signs of deterioration between some segments of the boom. This same weakening of the fabric continued into Burn #2, resulting in the removal of portions of the fabric well above the waterline. The ceramic fabric below, at and slightly above the waterline was still flexible and capable of holding oil on the upstream side of the boom. Oil and burn residue did cling to the stainless steel wire mesh over these flotation-separation flex-points adding to the boom's general ability to contain oil for combustion.

Efficiency of Burn -- The same techniques used in Burn #1 were used to determine the approximate burn efficiency during Burn #2. Using an average burn area of about 2,000 square feet (186 square meters) over the duration of intense burning one can show that about 7,000 to 8,000 U.S. gallons (26.5 to 30.3 cubic meters) could have been consumed during Burn #2. With an estimated discharge of 28.9 cubic meters it is not possible to identify the actual efficiency of burn by this approach. However, if previous burn rates for crude oil are applicable for NOBE, then their appears to be a good correlation between data obtained in this burn and the usual high elimination rates and efficiencies measured in the past.

Observations following completion of Burn #2 revealed a relatively small amount of burn residue within the fire boom (no doubt, because of the smaller volume of oil discharged and the release of two flotation logs). It was estimated that no more than 0.1 cubic meter remained within the boom. The amount clinging to or remaining within the boom did not appear to be substantially different than the amount observed in Burn #1.

The amount of oil/burn residue collected downstream in the RO Boom, however, was at least 3 to 4 times larger than the amount observed following the first burn. After considering the dimensions of the contained oil and witnessing the cleanup operations that followed, it was felt that the amount of oily residue escaping the burn had to be at least 1 to 2 cubic meters. Even with the unexpected reduction in burn efficiency at the end of the second burn, the overall efficiency would have still been between 93% and 96 %.

GENERAL OBSERVATIONS

It is quite satisfying to be a part of such a well-planned and highly organized project as NOBE. The overall objectives were met and an enormous amount of data were collected that should answer many of the key questions regarding the implementation and effects of in-situ burning. While there are many observations that could be made regarding the general outcome of NOBE, this section will simply address those that pertain to the performance of the 3M Fire Boom.

Boom Testing:

The fire boom handled well with respect to its deployment, wave-riding characteristics, oil containment capability and its resistance to thermal stress during Burn #1 and most of Burn #2. Having survived numerous burn tests in fresh and salt water environments under static and relatively calm-water conditions, this project provided the first opportunity to test the boom under realistic wave conditions at sea. The boom had survived many of the earlier tests for periods of 24 hours of continuous burning, and in one case for as much as 48 hours of continuous burning. Since there had been many efforts to secure permission to burn with the boom under open-water conditions, and all requests for experimentation had been turned down in the U.S., it was especially satisfying to use the 3M Fire Boom in this set of experiments off Canada. The only other at-sea tests involved relatively short burns (1/2 hour off Spitsbergen and 1 1/4 hour in Prince William Sound), and these burns of crude oil were in very calm water conditions.

The NOBE experience has emphasized the need to conduct future fire boom tests under realistic environmental conditions including the effects of bending, twisting, compressing and pulling upon all boom components while exposed to splashing salt water, burning oil, and high temperatures (1,000 ^{o}C or more). Because of the different effects of these stresses upon various components of the 3M Fire Boom (as experienced off Newfoundland), it is now possible to direct specific efforts toward known weaknesses of the boom. More realistic laboratory/tank tests can now be conducted on materials and boom components in preparation for future in-situ experimental and accidental spills.

Operations:
There were many valuable lessons learned of an operational nature during the NOBE program. The overall simplicity of in-situ burning was demonstrated in spite of the complexity of an experimental burn of this size. The equipment needed to carry out a safe and efficient burn under most conditions would be logistically simple to deploy and operate. The utility of the Heli-torch for ignition, and the ease with which fire boom can be used to concentrate oil for sustained combustion were demonstrated.

Training:
The requirements for the training of personnel to conduct in-situ burning are certainly unique; however, they are no more complicated than most training programs for the mechanical removal of oil or the application of chemical dispersants. Safety and the avoidance of potentially harmful exposures to operating personnel, the public and sensitive natural resources would, of course, be the focus of any thorough training program as it was during NOBE. These experimental burns demonstrated the ease with which onsite personnel can avoid such harmful exposures.

Wind Effects:
The effects of wind were observed and measured as they influenced the transport and dispersion of the burn's smoke plume. Also important, however, were the effects of wind in reducing the area of the oil contained within the fire boom and, therefore, the rate at which oil could be eliminated. In these experimental burns the rate

and direction of the tow was fixed and held constant with respect to the wind and sea conditions. In a real-world situation, there would be situations where the burns could be conducted with towing speeds and directions (relative to the wind) so that burn areas could be optimized to reduce entrainment and splashover, and to increase the burn area and oil elimination rates. In some cases, a simple slowing of the tow vessels to a speed that would barely maintain headway would be enough to keep the oil contained while the burn area was maximized. The increased burn times during NOBE were not because of reduced "burn rates", but because of reduced "burn areas" (and therefore reduced elimination rates). The burn times were also longer because of the tendency for fire to creep upwind toward the oil discharge point, thus necessitating the periodic shut-down of the oil supply.

Temporary Containment in Lee of Boom:
The effects of drag-induced eddies in the lee of booms in currents has been known and used to advantage for a long time. Their significance, however, has not been so nicely demonstrated before as they were during NOBE. Possibly with the additional effects of thermally-induced winds toward the fire, such eddies seemed to hold significant quantities of oil adjacent to the fire boom long enough for them to be ignited and burned. Such secondary "containment" and burning strongly suggests that an additional loop of fire boom (or several loops) downstream of the primary burn area could significantly enhance the entrapment and burning of any oil that might escape the primary boom. Experimentation should be conducted to determine the optimum size and spacing of such booms.

3M Report on the Condition of the FireBoom following the NOBE 93 Burn

by T.J. Gennrich and R.L. Vick, 3M

3M Report on the Condition of the FireBoom following the NOBE 93 Burn

Objective

To examine portions of FireBoom returned from the Newfoundland Offshore Burn Experiment (NOBE) to assess the effects of open-ocean burn stresses on FireBoom components.

Discussion

After reviewing still and video photography of the NOBE tests, we determined that two flotation logs were released from segments 7D and 7G (see Figure 1). A fifty-foot boom section consists of seven individual segments about seven feet long. This area is at the apex of the boom configuration and the area of most intense exposure during the burns. Environment Canada reported measuring temperatures of 1600 to 1800°F (870 to 980°C) for most of the burn period (see Figure 2). Previous 3M tank tests showed that intermittent peak temperatures may reach in excess of 2000°F (1090°C), although thermocouple data are not consistently reliable under these conditions for extended periods.

A closer look at the temperature data shows an unexpected result: the temperature increased with vertical distance above the waterline. It was previously believed that the hottest spot of the fire would be just above the waterline. These results also coincide with data from previous tank tests of different diameter booms. The peak temperatures during the fire testing of 18" booms were several hundred degrees higher than those of 12" booms, which in turn were higher than those of 8" booms. Consequently, 18" FireBoom is exposed to harsher thermal stress than the smaller booms and, therefore, will have lower resistance to extended periods of exposure.

The affected boom was one of two, fifty-foot sections of FireBoom made specially for these tests. The boom had two modifications to standard design: 1) the Nextel fabric forming the log pocket was made by overlapping and sewing together two narrow sections to form a single wider fabric; and 2) a secondary tension member was added consisting of two 1/4" diameter wire cables fastened to the boom connectors and stiffeners just below and on either side of the log pocket.

Prior to the actual burns, the boom had been deployed and retrieved during an earlier attempt which was cancelled due to adverse weather. Observers reported that the boom was handled harshly in the process and portions of the boom later required repairs on site.

After completion of the tests, the boom was retrieved and brought to shore for disposal. During this process, the boom was subjected to considerable additional post-burn stress. This combination of factors made it difficult to determine to what extent and at which point in time before, during, or after the tests any specific damage had occurred.

In addition, it should be emphasized that the combined thermal and mechanical stresses to which FireBoom is exposed causes some expected deterioration of the component materials. However, the loss of flotation log segments constitutes a catastrophic failure which had not occurred in any previous tests. Therefore, material analyses were performed to identify mechanisms of component degradation that permitted the logs to escape.

Results

The boom was visually inspected in St. Paul by A. Allen, T. Gennrich, J. Pearce, and B. Vick. The boom was heavily soiled with crude oil and burned oil residue making it difficult to handle and to clearly inspect components. We were able to confirm that the flotation logs released had come from the previously identified boom segments. In these segments, the Nextel fabric was substantially missing above the water line over most of the segment length. Even with significant fabric loss, the flotation logs should be held in place by the log pocket outer wire mesh. Although most of this mesh was present, it was severely degraded with embrittled arm and torn open over most of the length. With both of these log pocket components failed, there was nothing to contain the flotation logs.

In adjacent segments, the mesh was still intact but also degraded and embrittled to a lesser degree. Some holes were observed but the mesh was not torn open. In some areas, much of the Nextel fabric layer was missing. The wire in the log mesh was weakened but still intact. In the areas adjacent to the vertical stiffeners, most of the Nextel was missing, although the wire mesh was flexible. Fabric remnants (2-3") extending from underneath the stiffeners were still flexible. In many areas where the fabric was missing, the reinforcing wire filaments remained. Interestingly, the boom condition was fairly uniform on both sides. It was difficult to tell which was the front or back side relative to the fire. This is an indication of how intense the fire was in the apex of the boom.

Various component samples were soaked in mineral spirits to remove soluble oil residues and heated to 1112°F (600°C) to remove the organic char layer. This process produced an interesting result. Samples that were fairly rigid and brittle became flexible after the char was removed. This suggests that the embrittling was caused by the formation of the char layer and not by chemical degradation of the underlying fabric.

Conclusions

1. Two flotation log segments were lost during the test as a result of mechanical failure of the log pocket components, i.e., stainless steel wire mesh and Nextel fabric. The wire mesh was embrittled and torn open. The Nextel fabric was substantially missing above the water line. It is unknown whether the fabric was missing when the log pocket failed or if it also simply tore open and the fragments were lost in subsequent handling during retrieval.

2. It was not possible to determine if damage to the boom by handling during the first cancelled trial contributed to pocket failure. One of the missing logs came from a damaged segment and one did not.

3. The wire mesh (SS type 309) was embrittled due to a phase change and grain growth that occurred as a result of exposure to temperatures above 1470°F (800°C) near the top of the boom. The wire mesh is the primary mechanical component of the boom above the water line and is expected to prevent log pocket failure. Other alloys should significantly increase mesh durability.

4. The Nextel fabric did not show signs of chemical degradation resulting in loss of flexibility. Instead, embrittlement was a result of various sodium-based salts or fluxes which combined with oil residues to form crusty, brittle deposits within the fabric weave structure.

5. The loss of fabric in the log pockets was accelerated by the abrasive action of the layers of wire mesh immediately above and under the fabric layer. This effect was not noted in static tests. However, loss of fabric high above the water line will not directly result in loss of flotation or in loss of oil containment.

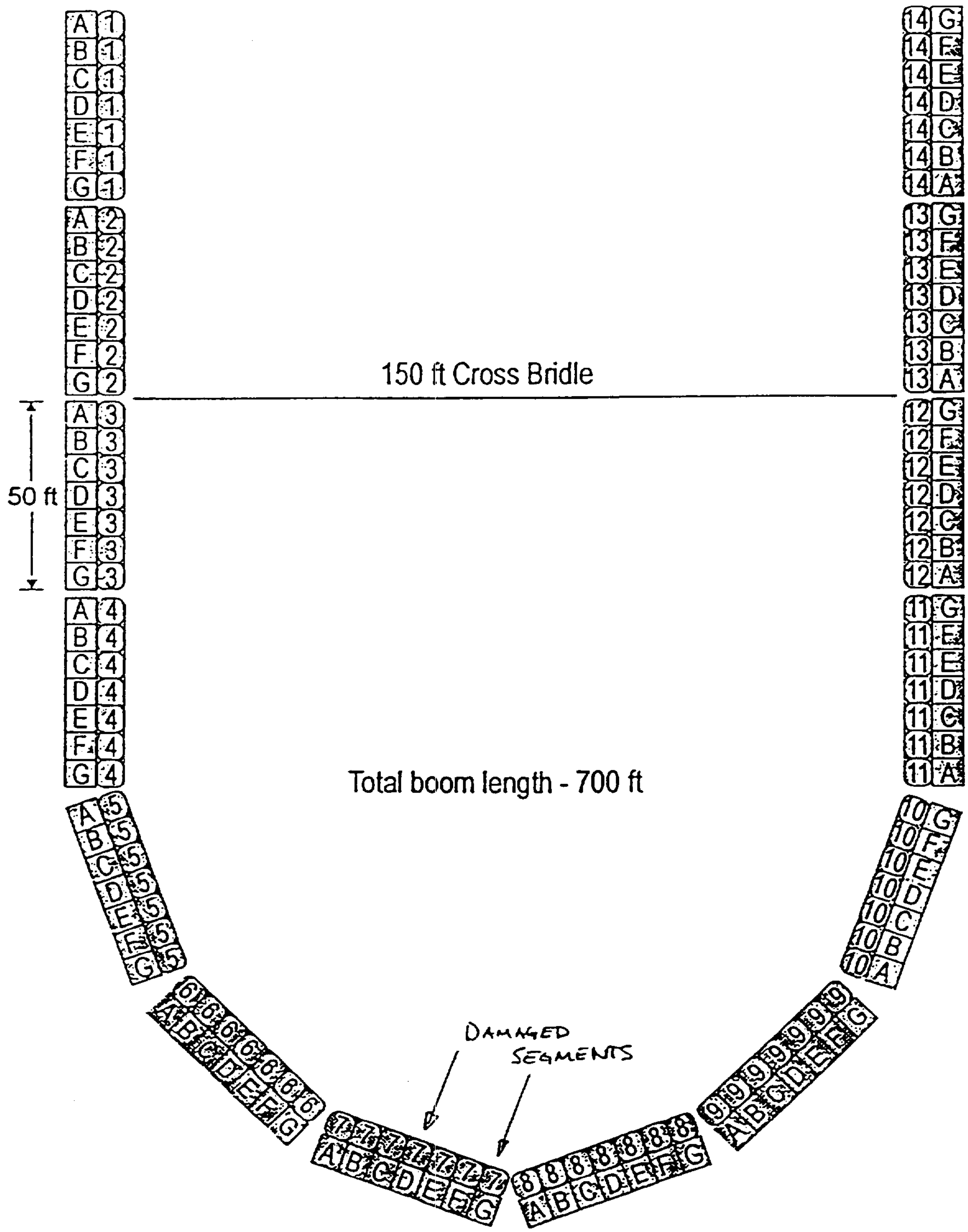
6. The failed boom section had two major modifications not previously tested: wire cable secondary tension members and seamed pocket fabric. Neither modification seemed to influence the loss of flotation. The cable did not appear to have contributed to the pocket opening. Similarly, the seamed fabric could not have caused the mesh opening but may have permitted more substantial fabric loss in the affected areas.

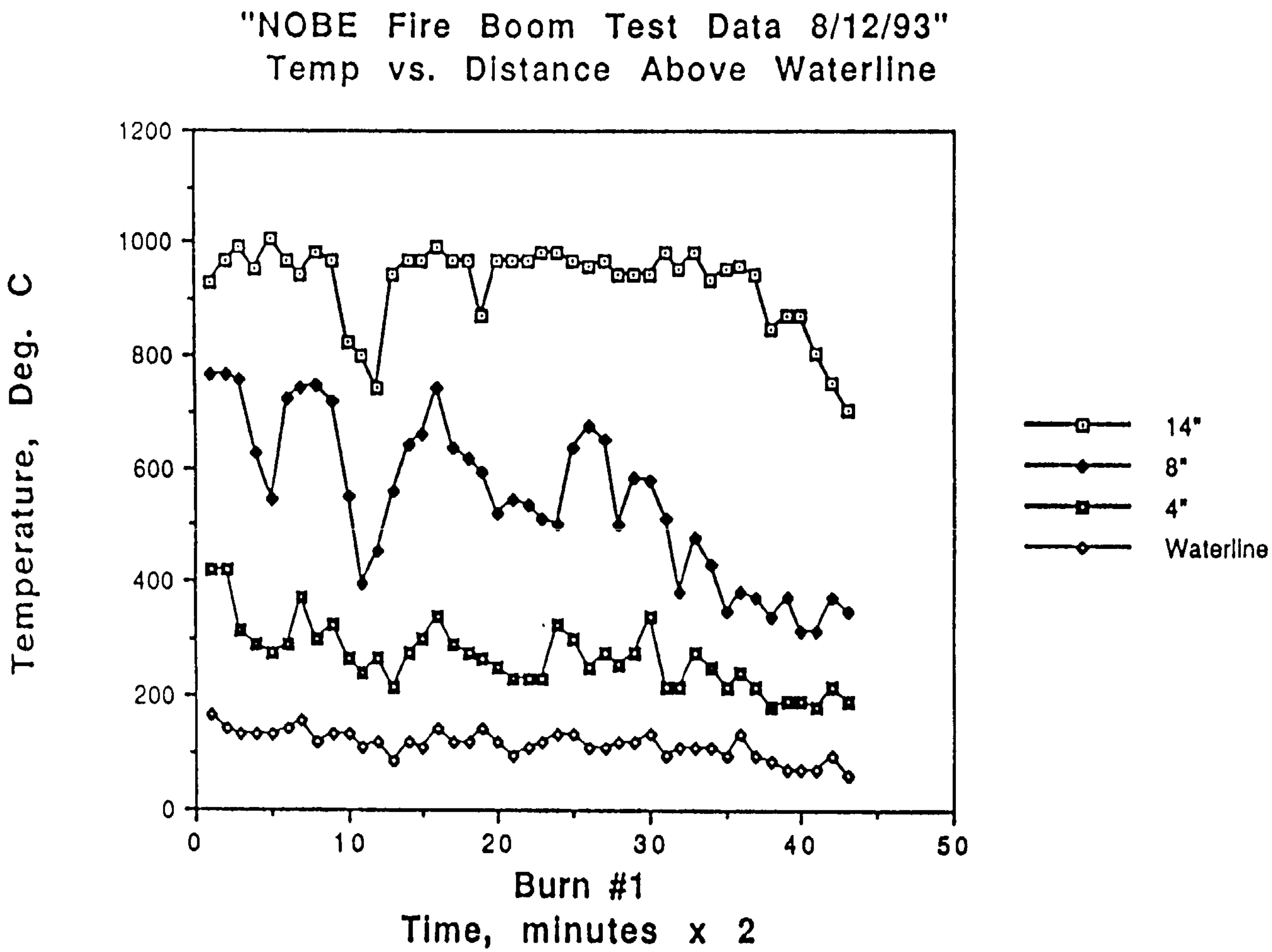
7. The open areas observed on either side of the vertical stiffeners between flotation logs were probably a combined result of (4) and (5) above. This is an area where movement of the fabric relative to the mesh and stiffeners is the greatest. Fabric near the stiffeners was still flexible and not filled with char deposits.

8. There was an increasing vertical temperature gradient in this and previous tests. As a result, 18" diameter FireBoom is exposed to higher temperatures at the top of the boom than are smaller diameter booms. Therefore, the expected durability of the smaller booms is greater.

Fire Boom Identification Layout

Newfoundland Offshore Burn Experiment




"NOBE Fire Boom Test Data 8/12/93"
Temp vs. Distance Above Waterline
Temperature, Deg. C
1200
1000
800
600
400
200
0
0
10
20
30
40
50
Burn #1
Time, minutes x 2
14"
8"
4"
Waterline

Appendix E

History, Timing, Position of Vessels NOBE 93

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	Elapsed Time (min)	Source	BURN # 1
2:45		Sir Wilfred Grenfell -GP & TF	Vessels departed St. John's for the test site; weather conditions were favourable
2:55		CCG218	CCG 218 departed small boat harbour, stood by off Grenfell
3:00		Sir Wilfred Grenfell	Leaving dock
3:00		Ann Harvey	Underway
3:05		CCG218	Cool with scattered clouds, calm in harbour
3:26		Ann Harvey	Safety note to ships issued
3:30		Beinir	Underway
3:40		Casaco	Leave dock
4:10		CCG205	Cloud over, sunny, wind approx. 8 to 10 knots, 0.5 m swell, 0.2 m wind waves
6:00		Sir Wilfred Grenfell	Sir Wilfred Grenfell arrives on station
6:02		CCG218	On location with Sir Wilfred Grenfell, CCG 214, CCG 212, CCG 203 and ourselves CCG 218
6:02		CCG218	Low clouds, approx. 50% coverage, 2-3 ft swell with light wind chop, visibility 10 m, ceiling 1500 ft, 48°F-air, 45°F-water
6:03		Sir Wilfred Grenfell	Sir Wilfred Grenfell starting to inflate Ro-Boom
6:05		CCG218	2 to 3 ft ht. swell with light wind chop, visibility 10 m, ceiling 1500 ft, fair patches, air temp. = 48°F, water temp. = 45°F
6:14		CCG218	Smoke bomb released and Grenfell oriented into wind
6:15		Sir Wilfred Grenfell -GP & TF	Arrival at 47°44.91' N, 52°02.41' W and deployment of booms
6:15		CCG216 / CCG218 / Ann Harvey	Deployment of Ro-Boom initiated
6:20		CCG205	Grenfell reports Ro-Boom starting out
6:30		Beinir	Sir Wilfred Grenfell appears to be on test site and deploying Ro-Boom
6:40		Sir Wilfred Grenfell	Last section inflated of Ro-Boom, hooking up bridle
6:45		CCG218	Air - 48°F, water - 45°F
6:45		Sir Wilfred Grenfell / CCG218 / Ann Harvey	Ro-Boom deployed completely, in water
6:46		Ann Harvey	Ro-Boom fully deployed
6:47		CCG216	Back-up boom in water
6:47		CCG205	Ro-Boom deployed
6:48		Sir Wilfred Grenfell	Start deployment of 3M Fireboom, first boom sections coupled together
6:49		Ann Harvey	Noted fishing vessel transiting zone
6:50		Beinir	Ro-Boom deployed by 6:50
6:50		Beinir	Starting deployment of Fireboom
6:50		Pat / slide	Begin deployment of Fireboom
6:52		CCG218	Ann Harvey on location with 206, 203, 210, 208, 205
6:53		Sir Wilfred Grenfell	Ann Harvey arrives with her fleet
6:54		Sir Wilfred Grenfell	Tow line on Fireboom across to tow boat, slight sag on padeye near tow rope
6:54		Sir Wilfred Grenfell / CCG214	CCG 214 takes on line from 3M Fireboom off stern of Sir Wilfred Grenfell
6:55		Sir Wilfred Grenfell	First sections of 3M boom over stern of Sir Wilfred Grenfell
6:55		CCG205 / Ann Harvey	Fireboom starts deployment
6:55		CCG218 / CCG214	Fireboom first section in water
7:00		Ann Harvey	Ann Harvey arrived on scene
7:00		Beinir	Scattered clouds, visibility >10 mi, ceiling over 300 m, air temp. = 11°C, swells on order at 1 m, 0.3 m waves, no white-caps, wind estimated 6 to 8 knots
7:02		Sir Wilfred Grenfell	Ann Harvey and convoy on station directly astern of Sir Wilfred Grenfell
7:03		Sir Wilfred Grenfell / CCG218	All Fireboom in water
7:03		CCG218	Complete deployment of Fireboom; section numbered 1-14; inspection after deployment reveals a vertical tear at 5G inside of U of PVC layer; sections 7 and 8 have external tension member installed; apex is set at section # 7; initial free board at mid-segment = 15 to 16 in, at connectors = 19 to 20 in

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
7:04		Ann Harvey	SSW 7 to 11 knot
7:05		Ann Harvey	SSW 7 to 11 knots
7:05		CCG205 / Ann Harvey	Fireboom deployed
7:07		Sir Wilfred Grenfell	Tow boat releases Fireboom tow line. Fireboom secure at 300 ft astern of Sir Wilfred Grenfell
7:09		Sir Wilfred Grenfell	Fireboom completely deployed
7:11		Ann Harvey	Begin off loading seatruck and personnel transfers
7:11		Ann Harvey	Waverider 0.7 m, microwave 1.0 m, patches low clouds and fog, wind light 160 to 180° < 5 knots
7:12		Sir Wilfred Grenfell	Begin assembling hoses and pump on stern of Sir Wilfred Grenfell
7:14		CCG218	CCG 218 completed putting out 3 marker buoys (50 m apart)
7:15		CCG205	Started assembly of discharge hose
7:15		Pat / slide	Completed deploying Fireboom
7:16		CCG218	Ann Harvey deploying small sample vessels
7:17		Sir Wilfred Grenfell	Setting up hose on deck
7:19		CCG218	Float marker deployed astern of Fireboom. All vessels will form-up as deployed
7:20		Casaco	Arrives on site
7:20		CCG218	CCG 218 tied at apex of Fireboom and setting-up current meter
7:21		Ann Harvey	Ann Harvey begins transferring staff to various boats
7:21		Ann Harvey	Smoke bomb in water
7:21		CCG218	Current meter deployed off CCG 218, 0.35 current reading
7:22		CCG218	First sea truck CCG 215 off Ann Harvey
7:23		Ann Harvey	CCG 215 away
7:23		Ann Harvey	Waverider 0.7, microwave 0.1
7:24		Ann Harvey	CCG 212 and CCG 214 have Ro-Boom deployed and in position
7:24		CCG218	Observer vessels on location
7:24		Sir Wilfred Grenfell	Smoke orange bomb deployed off starboard side of Sir Wilfred Grenfell
7:25		Ann Harvey	CCG 215 deployed from Ann Harvey
7:25		Ann Harvey	CCG 214 and CCG 212 have Ro-Boom deployed and in position
7:25		CCG218	Current noted at about 0.3 to 0.4 knot
7:26		Ann Harvey	Smoke flare set by Grenfell, set from south, wind light and variable
7:29		Ann Harvey	CCG 211 away
7:30		Sir Wilfred Grenfell -GP & TF	Position check ... 47°44.55'N, 52°02.55'W
7:31		CCG218	Carl Froud picked-up by CCG 205 to be transferred to 211
7:32		Ann Harvey	CCG 211 deployed from Ann Harvey
7:32		Sir Wilfred Grenfell	Oil hose deployed on deck and attached to pump. Floats attached to oil hose
7:34		CCG218	Fireboom starting to be towed by the Sir Wilfred Grenfell
7:35		CCG208	Ro-Boom deployed, Fireboom deployed, test tows being performed
7:36		CCG218	Towing speed reported at 0.25
7:40		Ann Harvey	CCG 207 away
7:45		CCG218	Section G-5 observed to be damaged to PVC layer
7:47		CCG218	Noted a vertical tear in the PVC at section 5G on the inside of the U-configuration of the Fireboom
7:48		CCG207	CCG 207 launched from Ann Harvey
7:48		Ann Harvey	Merv to CCG OPS confirming 8:30 start of oil discharge
7:49		Ann Harvey	CCG 218 away
7:50		Ann Harvey	CCG 216 deployed from Ann Harvey
7:50		CCG218	Standing by Ann Harvey deploying small vessels
7:51		CCG218	Aircraft mobilised out of St. John's airport for wildlife over flight
7:53		Ann Harvey	Ann Harvey to CCG OPS ... aircraft have been ordered
7:53		Ann Harvey	Pod of birds along side of Sir Wilfred Grenfell, terns?
7:55		CCG208	CCG 208 in position alongside Fireboom
7:57		CCG218 / Ann Harvey	NIST blimp begins deployment for 1000 ft.
7:57		CCG208	CCG 208 on position along side of Fireboom

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
7:58		Ann Harvey	All aircraft confirm ETA 8:30
7:58		Ann Harvey	Wind 180° 5 to 7 knots
7:59		Ann Harvey	All aircraft confirmed
7:59		CCG218	Remote control sampling vessels deploying off Ann Harvey
8:00	-150	CCG211	Time not specified for weather report ..... 2 to 3 ft seas, choppy, 12° or so, clear low clouds 50%, 5 to 10 k wind
8:03	-147	Ann Harvey	First of sampling boats being deployed
8:04	-146	Ann Harvey	First sample boat in water
8:06	-144	Sir Wilfred Grenfell	Five passengers away on CCG 203
8:09	-141	Ann Harvey	Wind 170° 8 knots
8:11	-139	Ann Harvey	Ann Harvey course 190°
8:11	-139	Ann Harvey	Visibility 20 m, ceiling estimated 1000 ft
8:13	-137	Ann Harvey	Second sampling boat over the side
8:14	-136	Ann Harvey	Helicopter overhead...wildlife
8:15	-135	Ann Harvey	H/C overhead
8:20	-130	CCG218	Standing by helicopter for wildlife survey
8:21	-129	Ann Harvey	Third sampling boat deployed
8:21	-129	Ann Harvey	Dracon being inflated
8:22	-128	Ann Harvey	Wind 5 to 6 m/sec, ceiling 600 ft broken
8:25	-125	Sir Wilfred Grenfell / Ann Harvey	Coast Guard helicopter making overflights
8:25	-125	Beinir	Conditions for ocean dumping permit have been met
8:26	-124	Ann Harvey	U of Wash AA/C on scene
8:27	-123	Martine	SUMMA/Convair - EPS-53 - before burn 1
8:27	-123	Sir Wilfred Grenfell	University of Washington plane on station, circling around flotilla
8:29	-121	Ann Harvey	Helicopter landing on Ann Harvey
8:29	-121	Ann Harvey	Fourth sampling boat away
8:29	-121		Ceiling 290 m measured, NIST alt wind 9.5 m.sec, wind on surface SE
8:30	-120	Sir Wilfred Grenfell -GP & TF	Position check ... 47°43.92'N, 52°03.08'W. P. Ryan provided aerial report on wildlife, all OK. Observed 6 gulls to starboard at 1/4 mi (my observation)
8:30	-120	CCG211	C9 orange for first burn
8:30	-120	Ann Harvey	Surface wind 160°, 8 Knot, max 10 Knot
8:30	-120	CCG218	2 to 3 feet swell, light wind, choppy, ceiling 1500 ft, clouds/sunny, 55°F air, wind 5 to 10
8:30	-120	CCG218	CCG 218 standing by Ann Harvey, it continues to deploy remote control sampling boats
8:30	-120	Beinir	Wildlife surveillance helicopter completed survey and landed on Ann Harvey at 8:30
8:30	-120	CCG208	Bird survey completed, AM Helo lands on Ann Harvey
8:31	-119	Ann Harvey	Wind SE 9.5 m/sec...blimp ceiling 290 m
8:32	-118	Ann Harvey	ODCA staff indicate conditions OK, limited wildlife in the area
8:32	-118	Ann Harvey	Last sample boat deployed
8:33	-117	Ann Harvey	All permit conditions go
8:33	-117	Ann Harvey	Tow picked up on Fireboom
8:33	-117	CCG215	NOAA aircraft spotted
8:35	-95	CCG218 / Ann Harvey	Heli 306 off Ann Harvey for wildlife survey
8:35	-95	CCG208	Time check, 7:11:52 = 8:35, add 1hr 24min
8:35	-95	Sir Wilfred Grenfell	Time checked and adjusted
8:36	-114	Sir Wilfred Grenfell	Time check
8:36	-114	Sir Wilfred Grenfell	Boats begin to separate 3M boom
8:37	-113	CCG218	Datalogger for current meter on, 0.4 reading
8:37	-113	Sir Wilfred Grenfell	Spreading Fireboom
8:37	-113	Sir Wilfred Grenfell	Chopper in air from Ann Harvey
8:37	-113	Sir Wilfred Grenfell	C-131 approx. 1 to 2 mi downwind
8:38	-112	Ann Harvey / CCG218	CCG 203 & 204 in position and towing Fireboom
8:40	-110	Martine	SUMMA/Convair - EPS-132 - before burn 1

NOBE 93 ..... Burn - Fireboom - Ro-Boom

Time (hh:mm)	Elapsed Time (min)	Source	BURN # 1
8:40	-110	Ann Harvey	Bird scare FRC making sweep of immediate area
8:40	-110	CCG218	FRC deployed for wildlife hassling
8:41	-109	CCG208	Deploying hose off the Sir Wilfred Grenfell
8:42	-108	Sir Wilfred Grenfell	Ready OK to deploy hose, hose over edge
8:43	-107	Ann Harvey	Sir Wilfred Grenfell deploying LAY hose
8:43	-107	Sir Wilfred Grenfell	Oil hose over stern of Sir Wilfred Grenfell
8:44	-106	Ann Harvey	Oil hose being deployed
8:44	-106	Ann Harvey	Tim ODCA , everything OK
8:45	-105	Sir Wilfred Grenfell	Adjusting Ro-Boom to pattern
8:46	-104	Ann Harvey	Press H/C 3 mi out
8:47	-103	CCG218	CCG 218 still at apex of Fireboom, boom in open position
8:47	-103	CCG218	Smoke bomb in
8:47	-103	CCG218	Aircraft on location
8:47	-103	Ann Harvey	KOV press helicopter in area
8:47	-103	Sir Wilfred Grenfell	Hose deployed
8:48	-102	CCG218	Oil discharge hose deployed off Sir Wilfred Grenfell
8:48	-102	Sir Wilfred Grenfell	Smoke signal on water to check wind
8:48	-102	Ann Harvey	Smoke flare for set-up, wind dead ahead
8:49	-101	Ann Harvey	Fireboom deployed well with reference to wind
8:49	-101	CCG218	Current meter reading at 0.28
8:49	-101	Sir Wilfred Grenfell	Smoke bomb deployed off stern of Sir Wilfred Grenfell, sorbent pads deployed on stern of Sir Wilfred Grenfell
8:50	-100	CCG208	Smoke drifting 160° off stern Sir Wilfred Grenfell; Fireboom not in line with wind direction, slightly askew
8:53	-97	Ann Harvey	Recording 0.28 knot at apex of Fireboom
8:53	-97	Sir Wilfred Grenfell	Sir Wilfred Grenfell adjusting speed up to compensate for current approx. 0.28 k
8:54	-96	CCG218	Towing at 0.52
8:55	-95	CCG218	Heli 360 reports marker drop ahead of the Sir Wilfred Grenfell
8:56	-94	Ann Harvey	MESSER H/C off
8:56	-94	Ann Harvey	Begin oil discharge
8:57	-93	Sir Wilfred Grenfell	Sir Wilfred Grenfell pump power pack started
8:57	-93	Sir Wilfred Grenfell	Second helicopter lifts off stern of Ann Harvey
8:58	-92	Ann Harvey	Helicopter preparing to deploy smoke flares
8:58	-92	Sir Wilfred Grenfell	Three bales of Sorbent deployed in Ro-Boom
9:00	-90	Sir Wilfred Grenfell	Power pack reported OK
9:01	-89	Ann Harvey	MESS H/C on board
9:01	-89	Sir Wilfred Grenfell	CCG 218 reports 0.5 knots
9:03	-87	Ann Harvey	Realigning formation to align with smoke flares
9:04	-86	Sir Wilfred Grenfell	Frame # 14, boom
9:05	-85	CCG218	CCG 205 alongside Fireboom to install thermocouples
9:05	-85	Ann Harvey	Getting helitorch ready
9:05	-85	Ann Harvey	Merv completed check with analytical staff
9:10	-80	Ann Harvey	H/C 305 all in position, Helitorch operational
9:10	-80	Ann Harvey	Speed of boom 0.5 knots
9:11	-79	Ann Harvey	AH instruments: wind 12.1 knots, gusts to 17
9:11	-79	Ann Harvey	Helitorch ready, will standby for 20 minutes
9:15	-75	Sir Wilfred Grenfell -GP & TF	Position check ... 47°43.27'N, 52°03.54'W
9:15	-75	Sir Wilfred Grenfell-GP & TF	Clear conditions, winds and sea conditions OK
9:16	-74	CCG215	Awaiting thermistor attachment on Fireboom
9:18	-72	Sir Wilfred Grenfell	Bringing some hose aboard
9:18	-72		Partly cloudy, 56°F, winds 5 to 10 knots visibility 10 mi, light wind chop, 2 to 3 ft. swell
9:20	-70	Sir Wilfred Grenfell	Still attaching thermistors onto 3M boom
9:22	-68	Ann Harvey	Last thermistor on
9:23	-67	Ann Harvey	Merv instructs staff to deploy sample boats

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
9:25	-65	Ann Harvey	Merv, SUMMA sampler to standby, staff to put on passive badges; badges open on Ann Harvey
9:25	-65	Casaco	Badges open
9:26	-64	Ann Harvey	Put on badges now
9:26	-64	Ann Harvey	Wind 10.6 knots, gusts 17, 165°
9:28	-62	Ann Harvey	Wind 11.1 knot, gusts 17 from South
9:29	-61	Casaco	Release oil AM, 500 L, Casaco about 80 yds away, problem with flow meter
9:30	-60	CCG218	Thermocouples in place (6A=#5, 6G=#2, 7e=#8, 8C=#4, 9A=#6, 9G=#7)
9:30	-60	CCG218	Buoys in place
9:30	-60	CCG218	Discharge hose in place
9:30	-60	Beinir	Started discharge of oil, 500 L to start
9:30	-60	Sir Wilfred Grenfell	OK to discharge 500 L oil test
9:31	-59	Sir Wilfred Grenfell	Discharging 500 L of oil
9:31	-59	CCG215	Test of discharge system on Grenfell
9:31	-59	CCG211	First discharge
9:31	-59	CCG210	Pump problem, no discharge
9:31	-59	CCG218	Free board mid-segment = 15 to16 in, free board connectors = 19 to 20 in; towing head to wind; towing estimated at 0.5 knots; light splash over at apex; small amount of entrainment at apex; winds reported 10 knots by Sir Wilfred Grenfell; clear skies; 2 to 3 ft swell
9:31	-59	CCG218	CCG 218 cut loose from Fireboom, handed in markers, in full deployment
9:31	-59	CCG205	Free board mid-segments = 15 to 16 in, at connectors = 19 to 20 in; no excessive heave; towing head to wind; towing speed 0.5 knots; entrainment at apex; no obvious potential loss point; light splash over at apex
9:31	-59	Ann Harvey	Discharge order for 500 L oil
9:32	-58	CCG218	OPS reports ready to discharge
9:32	-58	Sir Wilfred Grenfell	Oil begins to be pumped into hose
9:33	-57	Sir Wilfred Grenfell	Pumping stopped, no oil is going past last pump on stern of Sir Wilfred Grenfell
9:34	-56	Sir Wilfred Grenfell	No flow reported by Sir Wilfred Grenfell deck
9:35	-55	CCG218	Start pumping; Sir Wilfred's deck reports no flow through hose
9:35	-55	Ann Harvey	No flow to meter on Sir Wilfred Grenfell
9:38	-52	CCG218	Sir Wilfred Grenfell deck crew working at problem, reports flow meter jammed
9:40	-50	CCG205	Problem with pumping oil from Grenfell, flowmeter problem
9:40	-50	Sir Wilfred Grenfell	Both hoses disconnected from the flow meter on stern of Sir Wilfred Grenfell, coast guard personnel Nick Vanderkoy working on flow meter, some oil leaked from hose when disconnected, but it was absorbed by sorbent pads, maybe 1 gal of crude went onto the sorbent pad
9:41	-49	Sir Wilfred Grenfell	Ready to try flow again
9:41	-49	CCG216	Attempt test discharge of oil, something clogging pump
9:41	-49	Ann Harvey	Piece jammed in pump or flow meter
9:44	-46	Ann Harvey	10 minutes delay to clean flow meter
9:45	-45	CCG215	Pump on Grenfell jammed, being repaired
9:45	-45	CCG208	PUFF attempt failed by pump jam
9:45	-45	CCG218	Several attempts to pump oil have failed, they believe something is jammed in the main pump
9:47	-43	Sir Wilfred Grenfell	Smoke canister deployed off Sir Wilfred Grenfell
9:47	-43	Sir Wilfred Grenfell	Coast guard personnel use air wrench to re-assemble flow meter, additional length of oil hose added to hose of stern of Sir Wilfred Grenfell and new connector attached to flow meter

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
9:50	-40	CCG218	We asked Nick V. to try to let out app. 30 to 40 ft of discharge hose to get well past crossbridle
9:50	-40	Ann Harvey	Pump cleared
9:52	-38	CCG205	Flowmeter fixed, flow to start
9:52	-38	CCG214 / Ann Harvey	Wind SE at 10 knots, smoke flare deployed
9:53	-37	Ann Harvey	Smoke for alignment
9:54	-36	Ann Harvey	Putting more oil hose out to move end onto boom
9:54	-36	CCG208	Wind SSE, 10 Knot
9:55	-35	Sir Wilfred Grenfell -GP & YF	Position check... 47°42.65'N, 52°03.92'W.
9:55	-35	Beinir	Blockage in discharge hose caused delay, finally cleared at 9:55
9:55	-35	Beinir	Wind approx. 10 Knot, SSE, 1 m swell, 0.3 m waves
9:55	-35	CCG208	Smoke bomb deployed, plume variable, lateral/parallel to water surface, dispersion occurring at 10 m from bomb
9:55	-35	Sir Wilfred Grenfell	Ready to try and put oil into hose, hose is inflated, oil leaking from connection where oil comes from tank to first hose connection, sorbent pads lashed around connector, maybe 1 to 2 gal leaked onto sorbent pads, none on decking
9:56	-34	Ann Harvey	Oil can be seen in and on Fireboom
9:56	-34	CCG205	Start 500 L of oil discharge
9:56	-34	CCG205	Oil visible at discharge point
9:56	-34	CCG214	500 L reported discharged into Fireboom
9:56	-34	CCG216	100 L test pump began
9:56	-34	Sir Wilfred Grenfell	500 L discharge
9:56	-34	Ann Harvey	Begin 500 L pump
9:57	-33	CCG218	Oil visible at discharge point
9:57	-33	Sir Wilfred Grenfell	400 L reported now
9:58	-32	CCG211	500 L of oil out
9:58	-32	CCG205	500 L of oil discharge completed
9:58	-32	Sir Wilfred Grenfell	500 L out; CCG 218 reported oil 100 ft from apex
9:58	-32	Sir Wilfred Grenfell	500 L, pump stopped
9:58	-32	CCG216	500 L of test oil pumped out
9:58	-32	Ann Harvey	500 L out, pump stopped
9:59	-31	CCG215	500 L test oil in boom
9:59	-31	CCG210	First oil for pump test
9:59	-31	CCG205	Oil 100 ft from apex
10:00	-30	CCG218	Oil begins to collect in apex of Fireboom
10:00	-30	CCG208	Starboard side of boom coated by Puff test; staining very noticeable on 3M Boom
10:00	-30	CCG360	Airborne 360, splash over Fireboom
10:00	-30	Sir Wilfred Grenfell	Pumping stopped, sorbent pads removed from leaking connection and band clamps being installed where hose meets connection of ships tank
10:01	-29	CCG205	Oil begins to collect in apex; oil thickness measured = > 6 in, oil thickness calculates (x 0.45) = 2.7
10:02	-28	Ann Harvey	Refuelling helicopter, estimate 10 minutes, other will pick up helitorch
10:02	-28	Ann Harvey	Slight sheen in wind, 160°, 8 to 10 knots
10:02	-28	Ann Harvey	Sir Wilfred Grenfell meter erroneously set at 0
10:04	-26	CCG218	Light sheen observed aft off Fireboom
10:04	-26	Sir Wilfred Grenfell	Band clamps attached and sorbent pads lashed over the connector
10:05	-25	Sir Wilfred Grenfell	Apex of Fireboom noticeably black with oil
10:06	-24	CCG211	Smell of oil, fairly strong
10:06	-24	CCG218	Released in apex of Fireboom (initial 1000 gal)
10:06	-24	CCG218	500 L/min discharged, oil line in apex 7C to 8D
10:06	-24	Sir Wilfred Grenfell	Additional band clamps being attached to hose connections
10:07	-23	Ann Harvey	Husky 1 = Washington, WLW = photo at 5000 ft
10:07	-23	Ann Harvey	CCG 360 = torch, CCG 305 = observer, KOV = VIP

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
10:09	-21	CCG214	Can smell oil from Fireboom or possibly exhaust from sea truck up forward
10:09	-21	Casaco	Oil released after delay
10:11	-19	Ann Harvey	305 Huey away
10:12	-18	Ann Harvey	CCG 305 taking off
10:12	-18	Sir Wilfred Grenfell	OK to discharge 4500 L
10:12	-18	Ann Harvey	Begin full discharge order Merv to OPS
10:13	-17	CCG214	Oil being discharged, faint smell
10:13	-17	Sir Wilfred Grenfell	Oil being pumped into oil distribution hose again, oil begins being pumped into apex of Fireboom
10:13	-17	Sir Wilfred Grenfell	SUMMA 1A open, no hiss
10:13	-17	Ann Harvey	Turn on SUMMA 1A to all vessels
10:13	-17	Ann Harvey	CCG 360 hooks on helitorch
10:15	-15	CCG210	Resume pumping oil for pump test
10:15	-15	CCG208	First large discharge initiated
10:15	-15	CCG208	Water surface inside boom changing in area of discharge outlet
10:15	-15	CCG208	No odours except Helo fumes
10:16	-14	Ann Harvey	Oil very apparent in boom
10:16	-14	Ann Harvey	Problems with oil discharge readings
10:17	-13	Ann Harvey	Helitorch ready to lift off
10:17	-13	CCG305	See drawing for oil in Fireboom
10:17	-13	Sir Wilfred Grenfell	Noticeable oil inside Fireboom
10:18	-12	Sir Wilfred Grenfell	Helicopter and Helitorch lift off Ann Harvey and make practice pass over Fireboom, 3 of them
10:18	-12	Sir Wilfred Grenfell	SUMMA 1A off
10:18	-12	Ann Harvey	Turn off SUMMA 1A to all vessels
10:18	-12	Ann Harvey	360 away with helitorch
10:19	-11	CCG218 / Ann Harvey	Pumping shut down
10:19	-11	CCG215	Helitorch lifted off
10:19	-11	CCG218	No odours whatsoever except oil fumes from generator
10:20	-10	CCG305	See drawing for oil in Fireboom
10:20	-10	CCG210	Observed light sheen around CCG 210
10:20	-10		Minor entrainment continues down stream of apex. Minor splash over at times, no leakage
10:20	-10	CCG218	Helitorch off Ann Harvey
10:20	-10	Ann Harvey	Pump shut down
10:20	-10	Ann Harvey	Switch to SUMMA 1B
10:22	-8	Ann Harvey	Some sheen noted behind Fireboom
10:23	-7	CCG215	Helitorch lit test
10:23	-7	Sir Wilfred Grenfell	Small boat taking oil and water samples from apex of Fireboom
10:23	-7	Sir Wilfred Grenfell	Helicopter circling ready to light fire
10:24	-6	Ann Harvey	CCG 205 taking sample at apex
10:25	-5	CCG205	Initial 1000 gal released to apex
10:26	-4	CCG205	CCG 205 at apex of Fireboom
10:27	-3	CCG210	Stop pumping, malfunction of meter
10:27	-3	CCG305	See drawing for oil in Fireboom
10:28	-2	CCG305	See drawing for oil in Fireboom
10:28	-2	CCG208	CCG 208 on port side of Fireboom
10:28	-2	Sir Wilfred Grenfell	Discharge from Helitorch, no ignition
10:28	-2	Sir Wilfred Grenfell	Wave slopped oil over boom at apex
10:29	-1	Sir Wilfred Grenfell	Wave slopped oil over apex of Fireboom
10:29	-1	CCG205	Prior to burn, during sampling, evidence of some splash over at apex
10:29	-1	Ann Harvey	Order to light, drop too far forward
10:30	**0**	**Sir Wilfred Grenfell / CCG218 / CCG205**	**IGNITION on Second Pass; helitorch with 55 gal; 2 to 3 minutes to big flames**
10:30	0	Sir Wilfred Grenfell	Position ... 47°42.22'N, 52°04.54'W

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	Elapsed Time (min)	Source	BURN # 1
10:30	0	CCG218	Within 1 minute was the time at start of sustained combustion very rapid spread of flames
10:30	0	Casaco	Ignition plume at 30° to water surface
10:30	0	CCG215	Another attempt at ignition, oil lit
10:30	0	Ann Harvey	BURN!!!
10:31	1	CCG211	Second try, ignition of oil
10:31	1	Ann Harvey	Some oil burning outside Fireboom
10:31	1	CCG215	Helitorch returned to ignite other oil patch on east (port) side of boom
10:31	1	Sir Wilfred Grenfell	Dumping excess fuel from helitorch
10:32	2	Sir Wilfred Grenfell	Helicopter releases remaining load of Napalm into boom as oil ignites
10:33	3	Ann Harvey / CCG205	Sustained combustion app. 1 m^2; some oil burning outside boom
10:33	3	CCG215	Some smoke at sea level
10:33	3	Sir Wilfred Grenfell	Oil pumping resumes oil going into boom to feed fire
10:34	4	Ann Harvey	Second SUMMA turned on
10:34	4	Sir Wilfred Grenfell	Oil flowing
10:34	4	Ann Harvey / CCG211 / CCG215	Burn behind Fireboom, 25% leakage; plume directly above CCG 211; two separate fires burning, port being small
10:34	4	Ann Harvey	Burn behind boom, 25% leakage
10:34	4	Ann Harvey	Full helitorch dump
10:35	5	Sir Wilfred Grenfell / CCG212	Flames 40 ft, 10 to 20 m; little oil sheen
10:35	5	CCG218	Size and intensity of burn variable due to discharge rate, discharge started and stopped throughout burn
10:35	5	Ann Harvey	Helicopter lands with torch
10:36	6	Sir Wilfred Grenfell / CCG216	Flames spreading back to discharge line; fire appears to have gone over boom
10:37	7	Sir Wilfred Grenfell	Stopped oil pumping
10:38	8	CCG205 / Ann Harvey	Some fire reported AFT D12 of Fireboom; approx. 25% leakage from Fireboom
10:38	8	CCG218	Stop pump
10:39	9	Martine	SUMMA/Convair - EPS-27 - smoke, 1 mi DW, 1000 ft alt.
10:39	9	CCG211 / Ann Harvey / Sir Wilfred Grenfell	Plume is lower and very thick; boiling right side of Fireboom; small pool burning upwind of main pool
10:39	9	Ann Harvey	Boiling right side of boom
10:40	10	Sir Wilfred Grenfell	Flame appears to be downwind of Fireboom on starboard side
10:40	10	Sir Wilfred Grenfell	Pumping stops
10:41	11	CCG211 / Ann Harvey	Plume smaller; heavy oil in track behind Fireboom
10:42	12	Sir Wilfred Grenfell	Pumping again with approx. 15 m hose pulled on board
10:43	13	CCG205	Pumping resumed at slower rate
10:43	13	CCG211 / Sir Wilfred Grenfell / Ann Harvey	Strong smell of oil and burnt plastic reported by CCG 211, plume smaller; noticeable oil between burn and discharge plate, but flames not moving upwind this time
10:43	13	Ann Harvey	Oil or soot noted behind boom trailing down by sample boat and down into recovery boom
10:43	13	Sir Wilfred Grenfell	Pumping resumes, oil feeds into the fire
10:44	14	Sir Wilfred Grenfell	Oil not burning is 5 to 10 m wide, approx. 20 m from flames
10:45	15	Sir Wilfred Grenfell/205	Flames moving upwind rapidly; burning nicely
10:46	16	CCG211 / Sir Wilfred Grenfell	Smoke darker; flames all the way to discharge plate
10:46	15	Sir Wilfred Grenfell	Stopped oil pump, flames all the way up to discharge plate again
10:47	17	CCG215	See what appears to be residue to starboard of CCG 215
10:48	18	Sir Wilfred Grenfell	Pumping stops, fire too close to edge of flame
10:49	19	Ann Harvey	Husky 1 reports plume above clouds approx. 1 mi
10:49	19	Sir Wilfred Grenfell	Small pool of flames at discharge plate
10:50	20	Sir Wilfred Grenfell	OK to put hose back down and start pumping
10:50	20	CCG205 / Ann Harvey	Item like residue reported coming AFT of Fireboom; heavy brown oil behind Fireboom
10:51	21	Sir Wilfred Grenfell	Pumping again

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
10:52	22	CCG211	Plume seems lower
10:53	23	Sir Wilfred Grenfell	Slight sheen reported between booms, some black tarry material moving down from Fireboom
10:53	23	Sir Wilfred Grenfell	Pumping resumes, oil discharged into boom
10:54	24	Ann Harvey	WLW report 3 mi to north plume at 3000 ft
10:54	24	Sir Wilfred Grenfell	Difficult to tell if sheen between booms, water colour varies, but smoke blocks sun and clouds also
10:55	25	CCG211 / Sir Wilfred Grenfell / CCG212	Burn still going though reduced; fire much reduced in intensity and area; oil sheen thickening with residue
10:56	26	Martine	SUMMA/Convair - EPS-151 - above cloud layer
10:56	26	Sir Wilfred Grenfell	Fire intensity increasing rapidly, flames 5 to10 m
10:57	27	Ann Harvey	Heavy oil loss, approx. 15 to 25%
10:57	27	Ann Harvey	Towing 0.2 to 0.3 knots
10:57	27	Ann Harvey	Continuing pumping
10:58	28	CCG215	Plume looks to be dissipating over secondary boom
10:59	29	Ann Harvey	Winds 160° 8 knots,
10:59	29	Ann Harvey	More leakage from Fireboom
10:59	29	Ann Harvey	Pump rate 130 L/min, higher causes high leakage, 10 m^3 so far, oil leaks heavily at 300 L/min
11:00	30	Sir Wilfred Grenfell -GP & TF	Position check ... 47°41.73'N, 52°04.54'W
11:00	30	CCG212	Clumps of oil reported by CCG 212
11:00	30	CCG205	Went into heavy residue, pack about 30 ft long and 15 ft wide, picked up a lot of samples of this residue, might have been burned PVC fabric residue; all being caught in Ro-Boom. Catching heavy residue noticed by CCG 205
11:00	30	Sir Wilfred Grenfell	Deck reports 110 L/min
11:02	32	CCG218	300 L/min pump rate
11:02	32	CCG360 / Pat / slide	Slight sheen passing Ro-Boom, 1 meter wide; residue on water surface floating back into Ro-Boom
11:02	32	Pat / slide	Residue on water surface floating back into Ro-Boom
11:03	33	Sir Wilfred Grenfell	SUMMA 1B opened, most opened approx. 33 minutes ago (Sir Wilfred Grenfell-Young)
11:03	33	Ann Harvey	At 200 L/min fire moves up to discharge plate, will slow pump rate down
11:03	33	Ann Harvey	Report that Ro-Boom in good location to recover lost oil
11:03	33	Ann Harvey	Wind on AH 7.8 to 9.1 knots, max 17 knot from 165° SSE
11:03	33	Ann Harvey	Pump rate increased to 200 L/min
11:04	34	Sir Wilfred Grenfell	Pumping stops, fire near end of hose, some hose being pulled in onto Sir Wilfred Grenfell
11:05	35	Sir Wilfred Grenfell	Oil fire back up to discharge plate
11:08	38	Martine	SUMMA/Convair - EPS-6 - above cloud layer
11:09	39	Pat / slide	No residue visible behind Ro-Boom
11:09	39	Ann Harvey	Approx. 12 fulmars on starboard beam
11:10	40	Ann Harvey	Residue being contained, approx. 2 to 3 barrels in Fireboom
11:10	40	Sir Wilfred Grenfell	Putting hose back in. Pumping resumes
11:11	41	Pat / slide	No residue or sheen visible behind Ro-Boom
11:12	42	Pat / slide	Only sheen visible behind Ro-Boom was caused by diesel engines of CCG 205
11:14	44	CCG215	CCG 215 200 m from boom, saw burn residue
11:14	44	Sir Wilfred Grenfell / Pat / slide	Large pool of oil front of flames approx. 1/2 of 50,000 L discharge; no oil on sorbent
11:15	45	Sir Wilfred Grenfell	Relay turn off SUMMA 1B
11:15	45	Sir Wilfred Grenfell	My SUMMA will continue since I started late (Sir Wilfred Grenfell-Young)
11:15	45	Sir Wilfred Grenfell	Flames coming back to discharge plate

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
11:15	45	Sir Wilfred Grenfell	Pumping stops, oil hose being pulled in onto stern of Sir Wilfred Grenfell, coast guard personnel removed 1 section of hose and reattached it to the flow meter
11:15	45	Ann Harvey	Approx. 50% discharge, estimate total burn would be 1.5 hours; shut off SUMMA 1B
11:15	45	Ann Harvey	Shut off SUMMA 1B
11:16	46	Sir Wilfred Grenfell	Pulling hose aboard. Will remove 1 section that has largely been kept on deck.
11:17	47	Sir Wilfred Grenfell	ATT: Close SUMMA 1B, (not mine, Young); approx. 32 min remaining on my SUMMA (11:49) (Young)
11:19	49	CCG305	See drawing of Fire line
11:20	50	Sir Wilfred Grenfell	Pumping resumed, oil being discharged into boom
11:22	52	Pat / slide	Residue on water surface floating into Ro-Boom
11:23	53	Sir Wilfred Grenfell / CCG211	Fire spreading upwind to discharge, pump stopped; plume and burn seem smaller
11:23	53	Pat / slide	Residue on surface of water floating into Ro-Boom
11:24	54	Sir Wilfred Grenfell	Violent flare-up, flames 20 m high
11:24	54	Sir Wilfred Grenfell	Pumping stops, hose pulled in, away from fire
11:24	54	Pat / slide	Residue on surface of water floating into Ro-Boom; minimal sheen
11:25	55	CCG211 / Sir Wilfred Grenfell	Plume base seems larger; several violent bursts on starboard edge
11:26	56	Sir Wilfred Grenfell	Putting hose back in
11:27	57	Martine	SUMMA/Convair - EPS-22 - smoke, 3 mi DW
11:27	57	CCG305	Visual over back-up boom
11:27	57	Sir Wilfred Grenfell	Pumping
11:27	57	CCG211 / CCG214	Definite brown slick behind Fireboom; slick of thick residue has drifted to the mouth of back-up boom, beside CCG 214
11:28	58	Sir Wilfred Grenfell	Pumping resumes
11:28	58	CCG305	Slick of thick residue had drifted to the mouth of back-up boom beside CCG 214; photo of back-up boom with residue slick and CCG 205 taking samples
11:29	59	Sir Wilfred Grenfell	17 m^3 remain
11:30	60	CCG212	17 m^3 of oil burned
11:30	60	Ann Harvey	17 m^3 of oil left to burn, CCG OPS = source
11:31	61	Sir Wilfred Grenfell	Stopped pumping
11:32	62	CCG211	Large flames and smoke
11:32	62	CCG211	Sky is cloudless except for plume
11:32	62	Sir Wilfred Grenfell	Pumping stops
11:32	62	Sir Wilfred Grenfell	Pumping resumes
11:33	63	CCG305	See drawing of fire line
11:36	66	Sir Wilfred Grenfell	Pumping resumes
11:37	67	CCG215	4/5 of oil burned
11:37	67	CCG305	Plume angle 45° at surface
11:37	67	Ann Harvey	10 m^3 left on board, 40 m^3 pumped so far
11:38	68	Ann Harvey	Seas 1.4 m max over 20 min
11:38	68	Ann Harvey	HUSKY 1, 15 mi downwind at 2200 ft in plume
11:39	69	Sir Wilfred Grenfell	Flames burning back, violent, 20 m high
11:40	70	CCG206	Observed wind shift, documented with slides
11:40	70	CCG218	Was told that approx. 10 m^3 was still left to burn
11:40	70	Sir Wilfred Grenfell	Pumping stops
11:41	71	CCG208	Pumping completed
11:42	72	CCG205	Pumping stopped, 50,000 L discharged
11:42	72	CCG205	Fire receding
11:43	73	Martine	SUMMA/Convair - GVRD 430 - smoke, 20 mi DW
11:43	73	Ann Harvey	Wave 0.88 m, max 1.4 m, peak period 8.7 sec, Ave period 5.2 sec
11:43	73	Ann Harvey	48.75 metric tonnes discharged complete, 50,000 L
11:44	74	CCG215	Fog completely lifted, cloudless sky for last 1/2 hour

NOBE 93 ..... Burn - Fireboom - Ro-Boom

Time (hh:mm)	Elapsed Time (min)	Source	BURN # 1
11:44	74	CCG305	Fireboom surface burned off back to 6E on port side, 12 bright fluorescent sections unburned on exterior surface (viewed from port side)
11:44	74	Sir Wilfred Grenfell	Pump power pack stopped
11:45	75	CCG305	Starboard side all burned interior surface except for 5 sections from crossbridle (12b/c)
11:45	75	CCG305	Pumping is completed for Burn # 1
11:45	75	Sir Wilfred Grenfell -GP & TF	Oil discharge ceased, estimated 45 m^3
11:49	79	Sir Wilfred Grenfell	SUMMA 1B Sir Wilfred Grenfell (Young) closed, 45 min total sampling time
11:50	80	CCG218 / CCG205	Major part of burn substantially reduced in area; end of intense burning, photographed sludge in Ro-Boom
11:50	80	Pat / slide	CCG 205 in apex of Ro-Boom, estimate 2 barrels of residue, excluding sorbent boom
11:50	80	Ann Harvey	WLW returning to base for refuel, will return for second burn
11:55	85	Beinir	Final release of oil
11:57	87	CCG305	Fire extend 10 sections back on port side 7D to 8E
11:56	86	CCG218	Burn continuing, very low
11:59	89	CCG305	See drawing of fire line
12:00	90	CCG214 / CCG211	Burn slowing down; burn very small, almost out
12:01	91	Ann Harvey	Smoke turning grey
12:02	92	Ann Harvey	ODCA inspector in FRC to inspect Ro-Boom and escaped oil
12:02	92	Beinir	Fire burned until 12:02
12:03	93	Sir Wilfred Grenfell	Fire almost out, 2 isolated patches burning
12:03	93	CCG215	Fire nearly out
12:04	**94**		**END OF BURN**
12:04	94	CCG205	Fire completely out
12:04	94	CCG215	Fire out
12:04	94	Sir Wilfred Grenfell	Visible flames gone, all white smoke, one spot 5m starboard from apex still flaming
12:04	94	CCG210	10,000 L
12:04	94	Sir Wilfred Grenfell	Fire out, estimate smoke plume 3 to 4 mi in length, dissipating rapidly
12:04	94	Sir Wilfred Grenfell	Outer covering of Fireboom burned off
12:04	94	Sir Wilfred Grenfell	The sea conditions at the end of the first burn had increased to a mild swell, no white caps
12:05	95	CCG214	Burn over
12:05	95	Ann Harvey	Burn over
12:05	95	Ann Harvey	Some oil still apparent in apex of boom
12:06	96	CCG218	Flame out on floating oil
12:06	96	CCG218	Small flame in small piece of fabric between two segments
12:06	96	CCG211	Burn out
12:08	98	CCG305	Landed on helideck of Ann Harvey
12:09	99	CCG205	CCG 218 reports 20 x 3 ft residue patch in Fireboom
12:10	100	CCG305	Fire out
12:10	100	Ann Harvey	Thick residue 20 x 3 ft in apex
12:12	102	Sir Wilfred Grenfell	Position ... 47°40.87'N, 52°05.16'W
12:16	106	CCG215	Globs of burn residue visible downwind of boom
12:29	119	CCG208	ROV re-deployed to under apex of burn area, large black blob present, BAU of burned oil which is larger than boom, could be just excessive coating of inner basket of boom fabric burned through at connectors
12:40	130	CCG205	Inspection...Nextel has many holes between floats; wire intact; Nextel holes seem to be 3 to 5 in above water line; flexing of floats seems to have the effect of causing the Nextel to crack and open; Nextel around floats looks good; wave motion seems to cause the float movement, that is flexing between float Nextel ... NOT A GOOD FEATURE ... connectors look OK; skirt and chain area look OK

NOBE 93 ..... Burn - Fireboom - Ro-Boom			
Time (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN # 1**
12:42	132	Pat / slide	Paula collecting samples at apex of Fireboom
12:50		Sir Wilfred Grenfell -GP & TF	Position check ... 47°40.52'N, 52°05.64'W
Notes		CCG305	Numbering of Fireboom not discernible from helicopter, counted flotation chambers instead. Burn # 1 there was a long narrow slick of residue 5 to 10 m wide that drifted back into the back-up boom (plus sheen, extensive area)
Notes		CCG305	As far as the Fireboom itself, nothing visible from air except covering burned off until gross failure at end of second burn; the only thing that got past back-up boom was sheen
Notes		CCG218	Burned off sacrificial PVC layer = mid 6 section to mid 12 sections; C 6/7 to C 9/10 showed obvious damage or unusual stress due to fire; fire board is approx. 12 to 14 in; no damage temperature recorded of sensing equipment; no oil or burn residue clinging to below-water components of Fireboom
Notes		CCG218	Melted sacrificial PVC material was observed below between 4 and 5 in; connectors had little damage and overall tension member, bridle, etc... looked good. See diagram for MAX flame area (reached more than once) and AVE burn area; maximum flame height 80 to 100 ft
Notes		CCG218	See diagram for burn residue area. Burn residue is estimated at 6 x 30 ft and 1 in thick, carbon residue is observed in centered area on boom surface; estimate of burn residue left inside the Fireboom (or clinging to downstream side of boom or entrained prior to collection) 2 to 3 barrels
Notes		CCG205	Burn residue estimated at 6 x 20 ft and 2 in thick. Carbon residue heavy on backside, clean on burn side; maximum estimated flame height 100 to 125 ft; oil or burn residue clinging to below-water; only at apex heavy residue area; connectors look OK; skirt and chain area OK
Notes		Beinir	Wind blew smoke about 20° away from axis of procession; oil back burned to discharge point; some patches of oil burned outside boom; burn area looks to be approx. 50 ft deep (15+ m); smoke seems to be visible perhaps 2+ km downdrift; smoke 10 ft (150 to 200 m); Beinir captain should have been instructed to move out from under smoke plume; oil was discontinued because fire travelled upwind towards discharge hose; final release of oil at 11:55; burned until 12:06
Notes		Casaco	No marine life, only 2 birds observed at burn site; lost one helicopter and one boat sampler remote; no fumes smell from spilled oil during experiment
NOTES		Martine	The SUMMAs on the Convair were pressurised to +30 for the test, only starting times are available. Length of time and volumes are not available. Positions are given (should be compared to the background taken); all final pressures are +30, all volumes are unknown
NOTES		Casaco	Gerry Payne (DFO) will operate SUMMA canisters, given stop-watch and report to EC after experiment Aug. 7, 93
NOTES		Casaco	AUG. 7, 93 ..... Received 10 volatile hydrocarbon badges and distributed them to use aboard Casaco; recovered only 8 badges, 2 missing
NOTES		Martine	SUMMA - EPS-233 - background - ship exhaust, 2 mi DW of ships Aug. 7, 94
NOTES		Martine	SUMMA - REAC 141 - Burn 1(A) - 6:00 min - 3
NOTES		Martine	SUMMA - REAC 173 - Burn 1(A) - 5:03 min - 2.53 L
NOTES		Martine	SUMMA/Casaco - CV-1 - REAC 185 - Burn 1 (A) - 4:23 min - 2.19 L
NOTES		Martine	SUMMA/Casaco - CV-2 - REAC 211 - Burn 1 (A) - 4:23 min - 2.19 L
NOTES		Martine	SUMMA - REAC 166 - Burn 1(B) - 43:55min - 3.51 L
NOTES		Martine	SUMMA - REAC 172 - Burn 1(B) - 46:15min - 3.7 L
NOTES		Martine	SUMMA/Casaco - CV-1 - ESD 18 - Burn 1 (B) - 45:16 min - 3.62 L
NOTES		Martine	SUMMA/Casaco - CV-2 - REAC 214 - Burn 1 (B) - 45:16 min - 3.62 L

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
13:00	-66	CCG218	Fireboom burnt from section 6A (port side) to cross bridle on the starboard side (section 13); in the starboard corner of the apex and up to about #10 there were places with torn internal Nextel fabric; the S.S. wire was fine and core flotation fine; PVC below water was fine; definite thermal stress was apparent on Nextel fabric with parting in places above water between segments; some parting may be due (at least in part) to handling improperly prior to the experiment, but there is definite thermal and mechanical degradation to the point of opening through Nextel in between floats
13:00	-66	CCG208	Boats re-assembled to proper positions
13:04	-62	Sir Wilfred Grenfell	Decide boom OK for second burn
13:05	-61	Pat / slide	CCG 205 estimate 1 barrel of residue in apex of Fireboom
13:10	-56	CCG205	2 segments of # 12 (old style), all of # 11 (old style), all of # 10, 9, 8,7 and # 6 burned (6B,C,D,E only partially burned due to some left crosswinds during burn)
13:15	-51	CCG218	Deploy marker buoys and ready for burn # 2
13:15	-51	Ann Harvey	Estimate 2 barrels of viscous oil left on Fireboom
13:16	-50	Ann Harvey	Estimate 2 barrels of residue
13:17	-49	CCG215	Clear skies, light winds, some high cirrus
13:20	-46	Ann Harvey	140° 8knots
13:20	-46	Ann Harvey	FRC inspection... some sheen and 6 in patches of burned oil observed. Generally very little oil noted, went down approx. 300 ft below boom. Some light sheen, small patches of heavy oil back of Ro-Boom
13:20	-46	Casaco	Leave station
13:24	-42	CCG218	Deploy current meter, reading 0.4 to 0.5
13:25	-41	CCG205	Announcement that we are going ahead with second burn; helicopter off Ann Harvey
13:26	-40	CCG305	Off for second wildlife scan; start 47'39.9N, 52'05.6W, heading 100°
13:26	-40	CCG305	Sheen visible behind back-up boom, extensive area
13:26	-40	Ann Harvey	Wind 8 to 10 knots, max 17 knots, from 155°
13:26	-40	CCG218	Current meter 0.5
13:26	-40	CCG218	Buoys pick-up
13:26	-40	Ann Harvey	Huey away, second wildlife scan
13:28	-38	CCG305	Left turn 47'40.7N, 52'03.1W, heading 005° magnetic
13:29	-39	CCG305	One bird on water
13:29	-39	CCG305	Flight over sheen slick, 100 to 300 ft wide ... 47'43.19N & 52'05.4W one end of sheen slick
13:30	-36	Ann Harvey	Wildlife survey underway
13:30	-36	Ann Harvey	DC-3 returned
13:31	-35	Ann Harvey	Six cables outside box, however Gordon says OK to proceed
13:35	-31	CCG305	One bird flying
13:35	-31	CCG305	Other end of slick ... 47'41N & 52'06.17W
13:37	-29	CCG305	47'39.4N, 52'05.6W
13:37	-29	Ann Harvey	Helitorch OK
13:40	-26	CCG207	Smoke cloud from Burn # 1 still visible on horizon, Video tape # 3
13:40	-26	CCG305	Finish wildlife scan: saw a total of 13 birds between Pierre, Ryan and I
13:45	-21	CCG305	Landed on Ann Harvey, drop off wildlife observer
13:46	-20	CCG218	Free board mid-segment = 12 to 14 in, connectors = 12 to 14 in; boom performs as for burn #1, no excessive roll; towing into the wind (10 knots wind); no change observed in skirt orientation; estimate towing speed at 0.5 knots; potential oil loss between segments above water line at apex; no change in sea or weather conditions from first burn
13:46	-20	Sir Wilfred Grenfell	Doing freeboard measurements on boom
13:46	-20	Ann Harvey	Huey on board, drop off bird man
13:47	-19	Sir Wilfred Grenfell	Using same length of discharge hose as during later part of first burn.

NOBE 93 ..... Burn - Fireboom - Ro-boom

Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 2
13:47	-19	Sir Wilfred Grenfell	Two orange smoke bombs deployed upwind of Grenfell, 1 to 2 km wind sweeping across direction of Sir Wilfred Grenfell
13:47	-19	Ann Harvey	Wildlife survey completed, Pierre back on Ann Harvey, only a couple birds in area, no problem to proceed
13:48	-18	CCG305	Lift off Ann Harvey, check alignment ... OK
13:49	-17	Ann Harvey	Smoke flares deployed, flow 180°
13:50	-16	Ann Harvey	MES H/C pick helitorch
13:51	-15	Ann Harvey	CCG 360 off deck
13:51	-15	Sir Wilfred Grenfell	Waiting for helitorch lift-off
13:52	-14	Sir Wilfred Grenfell	Helitorch airborne
13:52	-14	Sir Wilfred Grenfell	Start discharge 5000 L to boom
13:52	-14	CCG205	Begin second burn discharge
13:52	-14	CCG218	Start discharge and test Helitorch
13:52	-14	CCG218	Oil visible at discharge point, estimated time 13:52
13:52	-14	CCG215	Helitorch lift off
13:53	-13	Sir Wilfred Grenfell	Discharge reported started
13:53	-13	Ann Harvey	Starting discharge of oil into Fireboom
13:54	-12	Sir Wilfred Grenfell	Open SUMMA 2A
13:54	-12	CCG208	Discharge begun
13:54	-12	CCG215	Discharge started
13:54	-12	Ann Harvey	Helitorch away
13:54	-12	Ann Harvey	Discharge 5000 L
13:54	-12	Ann Harvey	Open SUMMA 2A
13:55	-11	CCG211	Oil discharge begun
13:55	-11	Sir Wilfred Grenfell	Oil begins to be released in Fireboom
13:56	-10	Ann Harvey	Problem with fitting on discharge line on Grenfell
13:57	-9	Ann Harvey	Starting discharge again, oil observed at end of hose
13:58	-8	CCG210	Oil on
13:59	-7	CCG205	First oil into boom, 2000 L
13:59	-7	Ann Harvey	2000 L discharged at 1000 L/min
13:59	-7	Sir Wilfred Grenfell	2000 L dumped
14:00	-6	Martine	SUMMA/Convair - EPS-223 - pre-burn, background, no ship exhaust
14:00	-6	CCG205 / Ann Harvey	Pumping at 1000 L/min.
14:00	-6	Sir Wilfred Grenfell	Helicopter and helitorch making practice pass over boom
14:00	-6	Sir Wilfred Grenfell	3000 L dumped
14:01	-5	CCG205	4000 L into boom
14:01	-5	CCG215	3000 L discharged
14:01	-5	Sir Wilfred Grenfell	SUMMA 2A closed
14:01	-5	Sir Wilfred Grenfell	4000 L into boom
14:01	-5	Ann Harvey	Close SUMMA 2A
14:01	-5	Ann Harvey	150° 7 knots 9 knots max
14:02	-4	CCG218	Oil begins to collect in apex, estimated time 14:02
14:02	-4	Sir Wilfred Grenfell	Oil visible in apex of Fireboom
14:03	-3	CCG205	5000 L into boom
14:03	-3	Ann Harvey / Sir Wilfred Grenfell	Oil apparent in apex of Fireboom some oil passing under Fireboom
14:03	-3	Sir Wilfred Grenfell	Apex slightly off center of prior burn, unburnt new bright orange near apex of Fireboom
14:03	-3	Sir Wilfred Grenfell	Pumping stopped
14:04	-2	Ann Harvey	5000 L released into Fireboom
14:04	-2	Pat / slide	Helitorch dropping gelled gasoline
14:04	-2	Sir Wilfred Grenfell	Helitorch coming
14:05	-1	CCG205 / Ann Harvey	Helitorch operation
14:05	-1	Pat / slide	Start of fire
14:05	-1	Sir Wilfred Grenfell	Drop ignition
14:06	**0**	**Sir Wilfred Grenfell / CCG218 / Ann Harvey**	**IGNITION for BURN # 2**

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
14:06	0	CCG218	Oil in apex of Fireboom; pump at 833 L/min; helitorch with 55 gal; 2 minutes approx. to start of sustained combustion
14:06	0	CCG215	Attempted ignition, did work (but slowly)
14:06	0	Sir Wilfred Grenfell	Napalm released, slow ignition on first pass
14:07	1	Ann Harvey	Ignition
14:07	1	CCG211	Flames increasing
14:07	1	Sir Wilfred Grenfell	Flames up
14:08	2	Sir Wilfred Grenfell	Position ... unknown, not logged
14:08	2	Beinir	Wind 8 to 10 knots, 1 m swell, 0.3 m waves
14:08	2	Beinir	Ignition, good alignment of procession
14:08	2	Sir Wilfred Grenfell	Burning well
14:08	2	Ann Harvey	Helicopter moves up to north to empty
14:09	3	CCG215	Fire fully involved
14:09	3	Sir Wilfred Grenfell	SUMMA 2B open (estimate close 14:54:30)
14:10	4	Sir Wilfred Grenfell -GP & TF	Position check ... 47°40.29'N, 52°06.01'W
14:10	4	Sir Wilfred Grenfell	Slick fully involved in flames, all boats and aircraft excellent position
14:10	4	CCG208	Ignition burn 2, ignition 30 sec to start of burn
14:10	4	CCG305	Ignition, plume 35° estimated, a lot flatter, light sheen between Fireboom and back-up boom
14:11	5	Ann Harvey	Fire behind boom, equal amounts in and behind
14:11	5	Sir Wilfred Grenfell	Oil distribution hose fully extended into water in preparation to resume pumping
14:11	5	Ann Harvey	Pumping started, continuous
14:12	6	CCG215	Smoke dissipating around secondary boom
14:12	6	Sir Wilfred Grenfell	Pumping resumed
14:13	7	Martine	SUMMA/Convair - EPS-226 - smoke, 2 mi DW, 1000 ft alt.
14:15	9	CCG208	Burn is over boom by 5 to 10 m, heavy residual stringer in water, stringer 1 to 2 m wide
14:16	10	Sir Wilfred Grenfell	It looks like everyone is much braver this burn, many sampling boats are a lot closer to the flames to get samples
14:16	10	Sir Wilfred Grenfell / Ann Harvey	Pump rate 833 L/min
14:18	12	Ann Harvey	9 m^3 released
14:18	12	CCG305	Burning behind Fireboom
14:19	13	Sir Wilfred Grenfell	Smoke plume holding together further downwind than in first burn
14:20	14	CCG218	Initial 1000 gal released in apex of Fireboom
14:20	14	Ann Harvey	Request reduction of pump rate due to boom damage and leaking
14:21	15	Ann Harvey / CCG305	Fair amount of oil burning outside behind boom
14:21	15	Sir Wilfred Grenfell	Can see outer coverage of boom beginning to burn, boom is maintaining integrity and oil
14:21	15	Ann Harvey	Pumping stopped, 12.5 m^3 pumped into boom total, sounding tank
14:22	16	CCG208	Sizzling and cracking fire burn 1/2 of section 4 of boom, flames at 45° downwind of ignition point
14:22	16	Sir Wilfred Grenfell	Pumping of oil into boom stopped, pulling some sections of hose onto Sir Wilfred Grenfell to prevent it catching fire
14:22	16	Sir Wilfred Grenfell	Hose pump stopped, How long???
14:23	17	CCG215	Fire spilling outside boom, small slick burning downwind
14:23	17	Sir Wilfred Grenfell	Violent burning 20 m+ high, plume rising 300 to 500 ft (100 to 150 m) angling NE slightly
14:24	18	Martine	SUMMA/Convair - EPS-220 - smoke, 2 mi DW, 1000 ft alt.
14:24	18	CCG205	12.5 m^3 pumped
14:24	18	Sir Wilfred Grenfell	Smoke plume keeping integrity vs first burn
14:24	18	Sir Wilfred Grenfell	There should be excellent downwind sampling by University of Washington plane
14:25	19	CCG211	Same twin plume configuration as first burn
14:25	19	CCG215	Appears that plume extends 2000 m downwind
14:26	20	CCG305	No visible oil leakage from back-up boom, considerable residue inside

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 2
14:26	20	CCG205	208 reports small leakage through Fireboom
14:27	21	CCG208	Trail in view at bottom is oil feed (from ROV)
14:30	24	CCG205	Merv ordered to resume pumping at 550 L/min
14:30	24	CCG218	Reduce pump rate; stop pumping
14:30	24	CCG218	Flame height 80 to 100 ft, light entrainment was observed
14:30	24	CCG218	Thermal degradation of Fireboom was very apparent
14:30	24	CCG218	SSE 10 knots, low swell, sunny
14:30	24	Beinir	Appears that at least some segments no longer were intact at joint
14:30	24	Sir Wilfred Grenfell	Oil distribution hose extended into the boom, resuming pumping oil into boom
14:31	25	Ann Harvey	Resuming pumping at 550 L/min
14:32	26	Martine	SUMMA/Convair - AB 02 - smoke, 2 mi DW, 1000 ft alt
14:32	26	Sir Wilfred Grenfell	Pumping again 550 L/min.
14:33	27	Ann Harvey	Some oil and blobs migrating behind boom, not serious
14:33	27	CCG211	Burn seem to be getting smaller
14:33	27	Sir Wilfred Grenfell	Some small blobs of oil carried over Fireboom
14:33	27	Sir Wilfred Grenfell	U W C-131 in plume
14:33	27	Ann Harvey	Smoke bomb deployed
14:34	28	CCG305	Bit of oil leaking behind back-up boom, 1 to 2 m narrowing to point, slick is 10 m long
14:34	28	Ann Harvey	One bad section, 0.5 knots, little leakage at 500 L/min
14:34	28	CCG205	CCG 208 reports seeing blobs or something coming out aft of boom, of the opinion it is from the boom
14:35	29	Ann Harvey	Wind SSE at 10 knots, slight sea, slow swell
14:35	29	CCG208	Oil escaping through the joints, burn outside equal to inside of burn, angle of burn 25 to 30° from origin to water surface; plume rise >300 m
14:35	29	Pat / slide	No sheen or residue visible between Fireboom and Ro-Boom
14:36	30	Pat / slide	View into apex by CCG 205, minimal residue visible
14:37	31	Ann Harvey	Little bit of oil coming off back of boom
14:37	31	Pat / slide	No sheen visible near CCG 214
14:38	32	Pat / slide	14:38 to 14:59 - CCG 205 collected 7 L or residue from the apex of Ro-Boom, after burn #2
14:38	32	Ann Harvey	Boom still intact all the way across
14:38	32	Ann Harvey	Fireboom still intact all the way across
14:40	34	Sir Wilfred Grenfell	More even burn this time; oil is evenly flowing into boom, steady rate evenly distributed flames in apex
14:41	35	Ann Harvey	Pumping stopped again
14:41	35	Ann Harvey	Approx. 2 barrels heavy residue in Ro-Boom
14:41	35	CCG205	No visible sheen front of Ro-Boom, but globs of residue present in a swath approx. 20 ft wide
14:41	35	Ann Harvey	Oil burning outside and behind boom
14:41	35	Ann Harvey	Have been sampling for 1/2 hour, will continue for 1/4 hour more
14:42	36	Sir Wilfred Grenfell	Pumping stopped, some sections of the oil distribution hose being pulled in, fire moving up slowly
14:42	36	Ann Harvey	Shut pump down momentarily, too much oil in boom
14:43	37	Ann Harvey	Ro-Boom 4 knots flyby across Ann Harvey bow, only sorbent left in boom
14:43	37	Sir Wilfred Grenfell / Ann Harvey	18 m^3 pumped
14:45	39	CCG305	Looking good, there seems to be much less sheen and residue than burn 1; one part of top section is gone
14:47	41	CCG208	Plume splits at 30 m height each leg spiralling different, left leg CC, right leg CCWK
14:47	41	CCG208	Pumping ceased and started, 550 L/min (OPS CTR)
14:47	41	Ann Harvey	Will start pumping again, combination of pump rate, stopping and starting release, and increase wind resulting in less oil lost from boom
14:47	41	CCG212	No clumps of oil as with first burn

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 2
14:47	41	Sir Wilfred Grenfell	Oil distribution hose extended
14:48	42	Sir Wilfred Grenfell	Pumping resumes, target 550 L/min
14:48	42	Sir Wilfred Grenfell	Very good burn, continuous flames, smoke plume still maintaining integrity
14:49	43	Sir Wilfred Grenfell	Discharge hose dead centre of boom
14:50	44	CCG205	Residue front of Ro-Boom picked up, like mud, lies approx. 1 in thick on fine net pick-up device
14:50	44	CCG215	Fire looks like it's going out
14:52	46	CCG205	All residue globs being caught by Ro-Boom
14:52	46	Ann Harvey	Fireboom skirt still intact
14:52	46	Ann Harvey	Boom skirt still intact
14:53	47	CCG215	Fire building again
14:53	47	Sir Wilfred Grenfell	SUMMA 2A closed (maybe should have read 2B)
14:55	49	Pat / slide	No visible residue in the Ro-Boom from apex view
14:55	49	Beinir	Detached segment of Fireboom seen at app. 14:55
14:56	50	CCG215	Fire building
14:58	52	Martine	SUMMA/Convair - EPS-100 - smoke, 9mi DW
14:58	52	CCG218	Continue pumping, 23,500 L discharge
14:58	52	CCG205	Residue in Ro-Boom inspected, estimate 3 to 4 barrels
14:58	52	Pat / slide	No sheen or residue visible on port side of Ro-Boom
14:58	52	Pat / slide	CCG 205 located behind and port side of Ro-Boom; plume directly overhead
14:59	53	Ann Harvey	Behind back-up boom no sign of any sheen or oil
15:00	54	Sir Wilfred Grenfell	Fire is still stable, continuous flames, smoke plume still maintaining integrity
15:00	54	CCG218	Still burning, approx. 23.5 m^3 out now
15:00	54	Ann Harvey	Piece of Fireboom broke off, Fireboom no longer holding fire, more fire outside than inside
15:00	54	Ann Harvey	50% of oil discharged into boom
15:00	54	CCG208	23,500 L discharged
15:01	55	CCG218	Log breaks free, within minutes second log noticed inside U configuration
15:01	55	CCG218	Boom section failed and is broken lose, flames
15:01	55	CCG218	Flotation log broke lose
15:02	56	CCG205	OPS announced 50% of oil out
15:02	56	Sir Wilfred Grenfell	Still a nice steady burn
15:02	56	CCG215	Spot boom section floating by boat 1, pumping stopped
15:02	56	Sir Wilfred Grenfell	Pumping of oil stopped
15:03	57	CCG208	Section of Fireboom parted from main portion
15:03	57	CCG205	CCG 208 reports section of Fireboom missing, fire outside of Fireboom
15:03	57	Ann Harvey	Piece of top part of boom broke away, however skirt intact,
15:03	57	Ann Harvey	Stop pumping, oil being released and burning behind boom
15:04	58	CCG210	Oil stop
15:04	58	CCG208	Under water video of space left by vagrant boom
15:04	58	CCG305	Oil escaping Fireboom
15:05	59	CCG205	Decision made to stop pumping
15:05	59	Ann Harvey	Oil and fire staying in area of boom, will let fire burn out and end experiment
15:05	59	Beinir	Command team decided to suspend oil discharge
15:06	60	CCG208	Pumping ceased
15:06	60	Sir Wilfred Grenfell	Abort, may have boom failure, will let burn out
15:07	61	CCG211	Fireboom failed, abort
15:07	61	Sir Wilfred Grenfell	Fire is outside of boom
15:07	61	Sir Wilfred Grenfell	Pumping discontinued
15:08	62	CCG215	Small amount escaped boom and is burning
15:08	62	CCG305	Fireboom reported failed

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
15:09	63	Ann Harvey	Virtually no containment, all oil seems to be burning even though outside Fireboom
15:09	63	Sir Wilfred Grenfell	28,900 L pumped
15:10	64	Sir Wilfred Grenfell -GP & TF	Position check ... 47°40.31'N, 52°06.10'W
15:10	64	Ann Harvey	Moving out of formation to recover Blimp
15:12	66	CCG218	End of intense burning
15:13	67	CCG215	Believe I can spot missing piece of boom, port side quite near upwind side of fire
15:13	67	Sir Wilfred Grenfell	Fire size decreasing
15:13	67	Sir Wilfred Grenfell	A couple of sections of Fireboom appear to be sunken at apex of boom, no visible oil loss
15:13	67	Sir Wilfred Grenfell	One section of Fireboom at port side is missing/sunk
15:15	69	CCG215	Fire getting smaller
15:16	70	CCG215	Spot another HOLE in boom, 3 sections closer to apex, fire very small now
15:18	72	Martine	SUMMA/Convair - EPS-24 - below smoke, 15 mi DW, 200 ft
15:18	72	Ann Harvey	Two broken sections of boom apparent
15:18	72	CCG215	See smoke residue within 20 m off fire
15:18	72	Ann Harvey	Two broken sections of Fireboom apparent
15:18	72	CCG218	Fireboom section failed and is broken lose, flames
15:18	72	CCG218 / Ann Harvey	A total of 79 tons of oil was burned in 2 hours
15:19	**73**	**Sir Wilfred Grenfell / CCG218**	**END OF BURN; Several sections of Fireboom sunken, still maintaining integrity**
15:19	73	Sir Wilfred Grenfell / CCG218	Fire almost out; all fire out
15:19	73	Sir Wilfred Grenfell	Flames out, only white smoke
15:19	73	CCG210 / Ann Harvey	Flames out
15:19	73	Sir Wilfred Grenfell	Several sections of boom sunken, boom still maintaining integrity
15:19	73	Ann Harvey	FRC with ODCA and wildlife inspectors on board, off for inspection
15:20	74	Ann Harvey	Air starboard - 15.5°C, port - 12.5°C, wind 10.2 Knot, gusts 17 knots, 165°
15:20	74	CCG208	Flame out
15:20	74	CCG208	Second section broken out, floating inside boom
15:20	74	Ann Harvey	Fire out
15:20	74	Ann Harvey	Two top sections failed along lead edge of Fireboom, not apex, possibly handling damage
15:20	74	CCG208	Second section broken out, floating inside Fireboom
15:20	74	CCG215	Fire out
15:20	74	Sir Wilfred Grenfell	Fire out
15:21	75	Beinir	From visual observation of residue collected in the Ro-Boom, it appears that a total of about 100 L of residue remained after the test, estimate based on length (3M segments assume 10 m, width approx. 1 m, thickness approx. 1 cm). During the burn, the length of the burn area (in direction of travel of the procession) appeared to vary between about 5 to 10 m, most of the time
15:22	76	Sir Wilfred Grenfell	Position ... 47°40.57'N, 52°05.75'W
15:22	76	CCG305	Fire is out
15:23	77	Sir Wilfred Grenfell	Smoke plume slowly dissipating, plume extends further downwind than first test
15:27	81	Ann Harvey	306 H/C propwash blowing oil out of Fireboom
15:28	82	Martine	SUMMA/Convair - GRVD 433 - cross-section of plume, 6 mi DW, 1100 ft alt.
15:28	82	Casaco	Collected all dosimeter badges
15:29	83	Sir Wilfred Grenfell	Coast guard personnel begin to take down oil distribution hoses and flow meter
15:29	83	Sir Wilfred Grenfell	Begin recovery of Fireboom
15:30	84	Sir Wilfred Grenfell	Pulling in hose and boom, port side boom first

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
15:30	84	Ann Harvey	Sea at beginning 0.85 m, 1.24 m max, 8.33 sec peak, end 1736Z, SS 0.84 m, 1.31 max, 8.33 sec peak period, 5.20 sec Ave
15:30	84	Ann Harvey	Practically no oil left in the water
15:32	86	Martine	SUMMA/Convair - EPS-163 - cross-section of plume, 6 mi DW, 1400 ft alt.
15:38	92	Martine	SUMMA/Convair - ESD 20 - cross-section of plume, 6 mi DW, 1700 ft alt
15:40	94	Sir Wilfred Grenfell	Oil hoses disconnected from flow meter, most thermistors recovered from Fireboom
15:40	94	CCG305	Position for end of sheen at 15:40 is (very light sheen) 47'43.94N and 52'05.68W; 220° magnetic heading back towards flotilla, sheen is 200 to 350 ft wide
15:41	95	Ann Harvey	Approx. 2 barrels heavy residue in Ro-Boom
15:43	97	CCG305	End of sheen at Fireboom position = 47'40.8N & 52'06.12W heading 195 magnetic
15:43	97	Ann Harvey	Only sorbent left in boom
15:44	98	Sir Wilfred Grenfell	Flow meter secured, sorbent pads being placed in plastic bags, no oil visible on deck of Sir Wilfred Grenfell
15:45	99	CCG205	7B and 7G segments came out of Fireboom, one was captured in apex of Fireboom and one was picked up by CCG 205 ahead of the Ro-Boom
15:46	100	Sir Wilfred Grenfell	Spreader removed, oil hose capped
15:50	104	CCG205	Fireboom inspected after failure, some sections which were near the apex still look OK, section 7 looks bad with 2 floats missing
15:58	112	Ann Harvey	Total dumps 77.2 m^3, burn 1 = 48.3 m^3, burn 2 = 28.9 m^3
15:59	113	Ann Harvey	One patch of burned oil residue
16:06	120	Sir Wilfred Grenfell	Oil being purged from distribution hose into holding tank
16:10	124	Martine	SUMMA/Convair - REAC 223 - old smoke, 1500 ft, 12 mi DW
16:10	124	CCG305	Land on deck of Ann Harvey to pick up wildlife observer
16:15	129	Sir Wilfred Grenfell	Back flushed hose onto starboard oil tank
16:19	133	Ann Harvey	Another float section broke loose from Fireboom during straight line towing
16:19	133	Ann Harvey	PH 1 filters black
16:20	134	Sir Wilfred Grenfell	Oil distribution hose being pulled onto reel pack, fittings and floats being stored
16:23	137	Martine	SUMMA/Convair - EPS-164 - background after Burn
16:29	143	Sir Wilfred Grenfell	Oil distribution hose and floats secured
16:32	146	CCG305	Depart Ann Harvey for wildlife scan, begin 020° magnetic heading, 47'42.48N, 52'05.31W; turn left at (near Wx buoy) 47'44.54N, 52'05.42W, 215° magnetic heading, 175 ft altitude
16:33	147	CCG305	Corner of sheen slick at 47'42.81N & 52'06.15W come to heading 190° magnetic to position 47'40.70N and 52'05.50W, right turn
16:34	148	Martine	SUMMA/Convair - REAC 224 - background, after burn
16:44	158	CCG305	Pierre saw 1 kittiwake and 1 fulmar
17:35		Casaco	Return to dock
20:00		Sir Wilfred Grenfell	Fireboom recovered
Notes		CCG218	Detailed inspection of boom with photos and video conducted following cool down. Three logs released from flotation prior to recovery. Thermocouples were removed. Nextel fabric was embrittled and burned through in numerous places between flotation logs; S.S. mesh was sufficiently heated and flexed between logs that 3 logs eventually broke from the Fireboom

NOBE 93 ..... Burn - Fireboom - Ro-boom			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
Notes		CCG218	After 2 1/2 hours of burning the 3M Fireboom was suffering significant thermal stress in the apex area. Maximum estimated wave height 80 to 100 ft, inspection of boom started at 15:25; burn of sacrificially PVC layer = mid 6 sections to mid 12 sections; damage at 15:01 flotation log broke lose, burn residue 6 in x 35 ft x 1 in thick; carbon residue noted in apex area
Notes		CCG218	Free board at numerous locations reduces to estimated 12 to 14 in; no damage temperature to recording or sensing equipment; no oil or burn residue clinging to below-water components of boom, below water line melted point was 4 to 5 in, connectors-tension members-bridle, etc. good in all areas; estimated burn residue left inside Fireboom 3 to 4 barrels
Notes		CCG305	Only sheen behind Fireboom after second burn and 2 flotation logs
Notes		CCG208	Recovery of residue, sausage boom sections, 10 boxes of oil snare used, residual has consistence and appearance of bunker, approx. 2800-4000 L of residue remaining from both burns, residue not completely removed due to onset of fog, but recovery was being accomplished, marker buoys placed in debris, collapsible tank 2/3 full of oil debris. Three sections of Fireboom on board
Notes		CCG360	2 successful burns, 3M Boom failed at end of second burn, caused from stress??, solution = top cable, trained burn team only; ignition successful on both burns
Notes		Beinir	Total amount of oil burned = 79 t; total burning time about 2.5 hours
Notes		CCG305	Begin transect for wildlife observation on the way back to St-John's; 16:47 = 2 birds on water, fulmars or shearwater; speed 102 knots; 16:48 1 shearwater; 16:52 noddy (fulmar); 16:56 2 flying from underneath too far back for ID; 1 mi off St-John's 10 birds kittiwakes, hearing gulls and kittiwakes, many 50+ on red cliff at 16:58 and down at St-John's airport at 17:01
Notes		Martine	SUMMA - REAC 66 - Burn 2 (A) - 3:09 L
Notes		Martine	SUMMA - REAC 191 - Burn 2(A) - 6:25 min - 3.21 L
Notes		Martine	SUMMA/Casaco - CV-1 - REAC 144 - Burn 2 (A) - 6:39 min - 3.33 L
Notes		Martine	SUMMA/Casaco - CV-2 - REAC 168 - Burn 2 (A) - 6:39 min - 3.33 L
Notes		Martine	SUMMA - ESD 1 - Burn 2 (B) - 44:44 min - 3.58 L
Notes		Martine	SUMMA - REAC 192 - Burn 2(B) - 44:20 min - 3.55 L
Notes		Martine	SUMMA/Casaco - REAC 165 - Burn 2 (B) - 44:25 min - 3.55 L
Notes		Martine	SUMMA/Casaco - REAC 213 - Burn 2 (B) - 44:25 min - 3.55 L

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 1
5:30		Convair	Ground power on to aircraft to warm up gas instruments
7:46		Convair	Aircraft engine start
7:59		Convair	Departed St. John's. Visibility at the burn site is good with a broken stratus cloud deck between 400 and 800 ft above mean sea level (MSL)
8:21 to 10:06		Convair	Two background samples were collected about 1 mi downwind of the backup boom; several passes were made at several levels about 1 mi downwind in order to get background data on the plumes of the various ships in the area; ship plumes were observed visually and detected at 400 ft MSL (just below cloud base), but were neither seen nor detected above the clouds
8:12 to 8:19		Convair	Descent from 450 to 500 ft for temperature sounding; cloud tops at 800 ft, bases approximately 450 ft
8:21 to 8:45		Convair	First background samples, ship plumes detected
8:21		Convair	First BAG, 1 mi downwind, 400 ft PUF sample number NFP3, cumulative volume 1207 L Quartz filters sample number NFQ2, cumulative volume 114 L PM3.5 sample number NF3, cumulative volume 108 L PM10 filters sample number NF4. cumulative volume 116 L Summas sample number ... none
8:27		Convair	Second bag PUF sample number NFP3, cumulative volume 2250 L Quartz filters sample number NFQ2, cumulative volume 180 L PM3.5 sample number NF3, cumulative volume 200 L PM10 filters sample number NF4. cumulative volume 220 L Summas sample number EPS-53, final pressure 30 PSI
8:33		Convair	Third bag PUF sample number NFP3, cumulative volume 3128 L Quartz filters sample number NFQ2, cumulative volume 248 L PM3.5 sample number NF3, cumulative volume 328 L PM10 filters sample number NF4. cumulative volume 343 L Summas sample number ... none
8:33		Convair	Fourth bag PUF sample number NFP3, cumulative volume 3998 L Quartz filters sample number NFQ2, cumulative volume 304 L PM3.5 sample number NF3, cumulative volume 428 L PM10 filters sample number NF4, cumulative volume 445 L Summas sample number EPS-132
8:40 to 8:45		Convair	Sounding from 100 to 2,000 ft
8:45		Convair	Fifth bag PUF sample number NFP3, cumulative volume 4973 L Quartz filters sample number NFQ2, cumulative volume 361 L PM3.5 sample number NF3, cumulative volume 540 L PM10 filters sample number NF4, cumulative volume 561 L Summas sample number ... none
9:35		Convair	Crosswind pass 1 mi downwind of ships at 800 ft; no ship plumes at this level
9:54 to 10:06		Convair	Second background samples at 400 ft; 2 mi downwind
9:54		Convair	First bag PUF sample number ... none Quartz filters sample number NFQ3, cumulative volume 158 L PM3.5 sample number NF5, cumulative volume 330 L PM10 filters sample number NF6, cumulative volume 349 L Summas sample number ... none
10:06		Convair	Second bag PUF sample number ... none Quartz filters sample number NFQ3, cumulative volume 366 L

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 1
			PM3.5 sample number NF5, cumulative volume 558 L
			PM10 filters sample number NF6, cumulative volume 586 L
			Summas sample number ... none
10:30 to 10:33		Convair	Sounding from 200 to 1500 ft
10:30			Fire ignited, plume rose immediately above cloud tops; when the burn began (about 10:30), the smoke plume was observed to rise quickly above the cloud desk; it is therefore believed to have been free of contamination from the surrounding ship plumes
10:39		Convair	An additional bag sample was collected 1 mi downwind for determination of emission factors (EF's) at that location
			PUF sample number ... none
			Quartz filters sample number NFQ4, cumulative volume 325 L
			PM3.5 sample number NF7, cumulative volume 300 L
			PM10 filters sample number NF8, cumulative volume 315 L
			Summas sample number EPS-27, final pressure 30 PSI
10:46		Convair	Second plume pass
10:53		Convair	Third plume pass, bag filled but missed plume, aborted bag
10:56 to 11:08		Convair	To obtain a concentrated smoke sample for a PUF, to get a good measure of the PAH content of the smoke, three successive bag samples were collected using the aircraft 2.5 m^3 grab-bag sampling system
			smoke samples collected, 1 mi downwind for PUF sample
10:56		Convair	First bag
			PUF sample number NFP4, cumulative volume 870 L
			Quartz filters sample number NFQ5, cumulative volume 109 L
			PM3.5 sample number NF9, cumulative volume 100 L
		Convair	PM10 filters sample number NF10, cumulative volume 111 L
			Summas sample number EPS-151, final pressure 30 PSI
11:02		Convair	Second bag
			PUF sample number NFP4, cumulative volume 1718 L
			Quartz filters sample number NFQ5, cumulative volume 228 L
			PM3.5 sample number NF9, cumulative volume 207 L
			PM10 filters sample number NF10, cumulative volume 232 L
			Summas sample number ... none
11:08		Convair	Third bag
			PUF sample number NFP4, cumulative volume 2655 L
			Quartz filters sample number NFQ5, cumulative volume 360 L
			PM3.5 sample number NF9, cumulative volume 326 L
			PM10 filters sample number NF10, cumulative volume 366 L
			Summas sample number EPS-6
11:16 to 11:21		Convair	Sounding from 200 to 4,000 ft, burn about half over
11:22 to 11:23		Convair	LIDAR cross section from 4,000 ft; we then climbed to 4000 ft MSL and made a pass over the plume to get a LIDAR cross-section at the 1 mi downwind location; passes through the plume were then made at about 3, 5, 9, 11, 15 and 20 mi downwind to measure the dilution of the smoke. During these passes single bag samples were collected (for Quartz, PM3.5, PM10 and Summa canisters) at 3 and 20 mi downwind
11:27		Convair	Smoke sample collected, 3 mi downwind, 1 bag
			PUF sample number ... none
			Quartz filters sample number NFQ6, cumulative volume 281 L
			PM3.5 sample number NF11, cumulative volume 255 L
			PM10 filters sample number NF12, cumulative volume 264 L
			Summas sample number EPS-22, final pressure 30 PSI
11:29		Convair	Plume pass 5 mi downwind
11:32		Convair	Plume approximately 9 mi downwind
11:34		Convair	Plume pass approximately 11 mi downwind
11:39		Convair	Plume pass approximately 15 mi downwind

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 1
11:43		Convair	Smoke sample collected approximately 20 mi downwind, 1 bag PUF sample number ... none Quartz filters sample number NFQ7, cumulative volume 339 L PM3.5 sample number NF15, cumulative volume 341 L PM10 filters sample number NF16, cumulative volume 331 L Summas sample number GVRD430, final pressure 30 PSI
11:47 to 11:57		Convair	LIDAR pass along plume centerline at 4,000 ft; after the 20 mi downwind sample, we climbed to 4000 ft and made a pass along the plume centerline to obtain LIDAR profiles of the plume
11:58		Convair	Since the burn was now nearly complete, we returned to St. John's to refuel in time to be ready for the second burn
12:16		Convair	Engines off
NOTES		Convair	The plume from the first burn exhibited an interesting dispersion pattern; most of the smoke rose to a level between 800 and 2,000 ft MSL and flowed northward driven by the low-level southerly winds; however, six large puffs of smoke rose above the main body of the plume, reaching a height of about 4,000 ft. At this level, the winds were westerly and the puffs sheared off and moved to the east while the main plume continued northward

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	**Elapsed Time (min.)**	**Source**	**BURN # 2**
13:27		Convair	Engines on
13:36		Convair	Take off
13:50		Convair	We arrived at the burn site; the plume from the first burn could still be observed visually in the distance out to the NE horizon; since ignition was imminent, only collected one background bag sample for a Summa canister (more background samples were collected after the burn)
14:00		Convair	Background sample Summas sample number EPS-223, final pressure 30 PSI
14:08		Convair	Fire ignited
14:13 to 14:24		Convair	After ignition we collected the first smoke sample at a point 2 mi downwind, concentrating on collecting three bags for a good PUF sample and an additional single bag for emission factor measurements
14:13		Convair	First bag PUF sample number NFP5, cumulative volume 840 L Quartz filters sample number NFQ10, cumulative volume 107 L PM3.5 sample number NF17, cumulative volume 104 L PM10 filters sample number NF18, cumulative volume 136 L Summas sample number EPS-226, final pressure 30 PSI
14:19		Convair	Second bag PUF sample number NFP5, cumulative volume 1748 L Quartz filters sample number NFQ10, cumulative volume 223 L PM3.5 sample number NF17, cumulative volume 215 L PM10 filters sample number NF18, cumulative volume 294 L Summas sample number ... none
14:24		Convair	Third bag PUF sample number NFP5, cumulative volume 2580 L Quartz filters sample number NFQ10, cumulative volume 330 L PM3.5 sample number NF17, cumulative volume 316 L PM10 filters sample number NF18, cumulative volume 438 L Summas sample number EPS-220, final pressure 30 PSI
14:32		Convair	Second smoke sample, 2 mi downwind for EF's, 1 bag PUF sample number ... none Quartz filters sample number NFQ11, cumulative volume 300 L PM3.5 sample number NF19, cumulative volume 292 L PM10 filters sample number NF20, cumulative volume 412 L Summas sample number AB02, final pressure 30 PSI
		Convair	we then climbed to 5,000 ft for several LIDAR cross section measurements of the plume at 2, 3 and 5 mi downwind, and a LIDAR run along the length of the plume centerline
14:38 to 14:39		Convair	LIDAR cross section approximately 2 mi downwind
14:41 to 14:42		Convair	LIDAR cross section approximately 5 mi downwind
14:44 to 14:45		Convair	LIDAR cross section approximately 3 mi downwind
14:46 to 14:51		Convair	LIDAR run along plume centerline
14:58		Convair	Single bag samples were collected (for Quartz and Teflon filters and Summa canisters) at 9 mi downwind PUF sample number ... none Quartz filters sample number NFQ12, cumulative volume 323 L PM3.5 sample number NF21, cumulative volume 315 L PM10 filters sample number NF22, cumulative volume 457 L Summas sample number EPS-100, final pressure 30 PSI
15:06 to 15:12		Convair	Continuous in plume sampling along centerline
15:18		Convair	Single bag samples were collected (for Quartz and Teflon filters and Summa canisters) at 15 mi downwind;

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 2
			smoke sample, 1 bag, 15 mi downwind at 200 ft (below smoke). Nothing detectable above background; PUF sample number ... none Quartz filters sample number NFQ13, cumulative volume 268 L PM3.5 sample number NF23, cumulative volume 259 L PM10 filters sample number NF24, cumulative volume 382 L Summas sample number EPS-24, final pressure 30 PSI
15:28 to 15:38		Convair	Cross section sample for fluxed at 6 mi downwind
		Convair	We then sampled at three levels in the smoke at 6 mi downwind for cross-sectional measurements of fluxes in the plume
15:28		Convair	First bag at 1100 ft PUF sample number NFP6, cumulative volume 683 L Quartz filters sample number NFQ14, cumulative volume 109 L PM3.5 sample number NF25, cumulative volume 106 L PM10 filters sample number NF26, cumulative volume 157 L Summas sample number GVRD433, final pressure 20 PSI
15:32		Convair	Second bag at 1400 ft PUF sample number NFP6, cumulative volume 1402 L Quartz filters sample number NFQ14, cumulative volume 213 L PM3.5 sample number NF25, cumulative volume 206 L PM10 filters sample number NF26, cumulative volume 305 L Summas sample number EPS-163, final pressure 30 PSI
15:38		Convair	Third bag at 1700 ft PUF sample number NFP6, cumulative volume 2220 L Quartz filters sample number NFQ14, cumulative volume 332 L PM3.5 sample number NF25, cumulative volume 320 L PM10 filters sample number NF26, cumulative volume 472 L Summas sample number #11568, final pressure 30 PSI
15:39 to 15:47		Convair	Sounding up to 6000 ft
15:50 to 15:58		Convair	LIDAR run along plume centerline; another LIDAR run along the plume centerline was then made at 6,000 ft, followed by a return pass in the smoke down the center of the plume for continuous in-situ measurements
16:02 to 16:10		Convair	Continuous sampling in smoke along plume centerline; finally, a smoke sample was collected at 1,500 ft and 12 mi downwind, and several bags were collected for background concentrations out of the smoke
16:10		Convair	Smoke sample at 1500 ft, 12 mi downwind PUF sample number ... none Quartz filters sample number NFQ15, cumulative volume 291 L PM3.5 sample number NF27, cumulative volume 277 L PM10 filters sample number NF28, cumulative volume 411 L Summas sample number #13592, final pressure 30 PSI
16:23 to 16:38		Convair	Background sample out of smoke
16:23		Convair	First bag PUF sample number NFP7, cumulative volume app. 1000 L Quartz filters sample number NFQ16, cumulative volume app. 120 L PM3.5 sample number NF29, cumulative volume app. 115 L PM10 filters sample number NF30, cumulative volume app. 170 L Summas sample number EPS-164, final pressure 30 PSI
16:27		Convair	Second bag PUF sample number NFP7, cumulative volume app. 1300 L Quartz filters sample number NFQ16, cumulative volume app. 240 L PM3.5 sample number NF29, cumulative volume app. 230 L PM10 filters sample number NF30, cumulative volume app. 360 L Summas sample number ... none

NOBE 93 ..... University of Washington Flight 1617 (Convair)			
Time (hh:mm)	Elapsed Time (min.)	Source	BURN # 2
16:34		Convair	Third bag PUF sample number NFP7, cumulative volume 2040 L Quartz filters sample number NFQ16, cumulative volume 368 L PM3.5 sample number NF29, cumulative volume 354 L PM10 filters sample number NF30, cumulative volume 525 L Summas sample number #13600
16:38		Convair	Fourth PUF sample number NFP7, cumulative volume 2933 L Quartz filters sample number NFQ16, cumulative volume 481 L PM3.5 sample number NF29, cumulative volume 462 L PM10 filters sample number NF30, cumulative volume 684 L Summas sample number ... none
16:40		Convair	head to St. John's

Nobe 93 ..... History for the Casaco

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1
7:25			Arrives on site
9:25			Badges open
			The Casaco had 2 set of SUMMAs (duplicates) set-up back to back ... CV-1 and CV-2
			SUMMA - CV-1 - REAC 185 - Burn 1 (A) - 4:23 min - 2.19 L (M)
			SUMMA - CV-2 - REAC 211 - Burn 1 (A) - 4:23 min - 2.19 L (M)
			SUMMA - CV-2 - REAC 214 - Burn 1 (B) - 45:16 min - 3.62 L (M)
			SUMMA - CV-1 - ESD 13 - Burn 1 (B) - 45:16 min - 3.62 L (M)

NOBE 93 ..... Remote Control Helicopter # 1

Time Table (hh:mm)	Elapsed Time (min)	Source	BURN 1
8:23	-127		SUMMA on for blank in flight
8:29	-121		SUMMA off for blank in flight
8:30	-120		Heli 1 landed
8:56	-94	211	Heli up
10:02	-28		Heli 04 off deck, 30 samples on
10:07	-23		30 samples off
10:08	-22		Landed, motor quit
10:30	**0**		**IGNITION**
11:31	61	AH	Mini H/C finished sampling, ? which one
12:04	**94**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 1

Time Table (hh:mm)	Elapsed Time (min)	Source	BURN 2
14:06	**0**		**IGNITION**
14:33	27	215	Small helicopter about 5 m off water (now black)
15:19	**73**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 2			
Time Table (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN 1**
10:30	**0**		**IGNITION**
10:48	18		CCG 211 Heli up, 40 m high just below plume
10:52	22		Plume seems lower, heli still in same relative position
12:04	**94**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 2			
Time Table (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN 2**
14:06	**0**		**IGNITION**
15:19	**73**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 3

Time Table (hh:mm)	Elapsed Time (min)	Source	BURN 1
8:30	-120		Heli 2 up for sample run (4 min 14 sec)
8:56	-94	211	Heli up
10:30	**0**		**IGNITION**
10:34	4		Heli up, plume directly above us
10:39	9		Plume is lower and very thick, heli 20 m under plume
10:41	11		Heli down, plume smaller
10:55	25		Heli down
11:03	33	AH	Heli on deck
11:06	36		CCG 211 Heli up, within edge of plume and just below, 40 m high
11:17	47	211	Heli down; body of helicopter = very black residue on white swabs
11:31	61		Finished sampling for first burn
12:04	**94**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 3

Time Table (hh:mm)	Elapsed Time (min)	Source	BURN 2
14:06	**0**		**IGNITION**
15:19	**73**		**END OF BURN**

NOBE 93 ..... Remote Control Helicopter # 4			
Time Table (hh:mm)	**Elapsed Time (min)**	**Source**	**BURN 1**
8:22	-128		Launched from CCG 207
8:23	-127		Sample on (SUMMA for blank in flight)
8:35	-115	210	Weather profile concluded, 47°44.05N, 52°02.985W
8:55	-95		Background gas sample (2) ... 12:20
10:30	**0**		**IGNITION**
12:04	**94**		**END OF BURN**

NOBE 93 ..... CCG 203

Time (hh:mm)	Elapsed Time (min.)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
6:02		CCG218	On location with Grenfell, CCG 214, CCG 212, CCG 218							
8:06	-144		Away with 5 passengers							
8:36	-114		Begin to separate 3M boom							
8:37	-113		Spreading fireboom (Sir Wilfred Grenfell)							
8:38	-112		In position and towing fireboom							

NOBE 93 ..... CCG 204

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
8:36	-114		Begin to separate 3M boom							
8:37	-113		Spreading fireboom (Sir Wilfred Grenfell)							
8:38	-112		In position and towing fireboom							
9:17	-73			002/aerial	tied to CCG 215					
9:24	-66			005/aerial	61			60		
10:17	-13			007/aerial	76			80		
10:38	8			012/aerial	under plume					
10:42	12			016/aerial	under plume					
10:48	18			020/aerial	291	38	163	83	8	33
10:48	18			021/aerial	299	21	124	85	4	24
10:52	22			023/aerial	at side of CCG 215 until the end of the burn					

NOBE 93 ..... CCG 205

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
3:05		CCG205	Off deck							
3:10		CCG205	In place in formation and underway							
8:10	-140	Pat / slide	8:10 to 10:30							
8:10	-140	Pat / slide	**Removed 3 bails of sorbent boom from CCG 214; assembled boom and deployed it in apex of Ro-Boom; obtained 3 thermocouple probes from CCG 218							
8:10	-140	Pat / slide	Al Allen transferred to CCG 205 from CCG 218, placed probes on starboard side of Fireboom, placed remaining 3 probes on port side of Fireboom. Al Allen returned to CCG 218							
8:10	-140	Pat / slide	Collected approx. 13 L of oil/water at apex of Fireboom ... sample separated into individual components on 9/2/93 at ESD = 10 L water and 3 L oil; measured thickness of oil layer in Fireboom							
8:10	-140	Pat / slide	Thickness of oil layer in FB: reading was 15.2 cm (6 in) X correction factor 0.45 = 6.8 cm (2.7 in), the entire thickness sample was oil, there was no water layer present, thus the minimum thickness was 6.8 cm (2.7 in)							
8:22	-128	Pat / slide	CCG 203 taxied Paula and Pat to CCG 205							
9:05	-85		Alongside boom to install thermocouples							
9:34	-56	CCG205	Chores completed							
10:23	-7	Sir Wilfred Grenfell	Oil sample being taken (no CCG #)							
10:24	-6	Ann Harvey	CCG 205 taking samples at boom apex							
10:30	**0**		**IGNITION**							
10:30	0	Pat / slide	10:30 to 11:02							
10:30	0	Pat / slide	CCG 205 located in front of Ro-Boom and tow vessels; located between fire and Ro-Boom on port side of Fireboom; collected samples of residue from surface of the water approx. 1 L of residue							
10:33	3	Pat / slide	CCG 205 approx. same position as it was at 10:30							
10:38	8			013 / aerial	391	219	376	68	33	58
10:42	12			016 / aerial	372	65	192	75	10	30
10:42	12			017 / aerial	378	99	235	75	15	36
10:44	14	Pat / slide	Minimal sheen visible on slide between Fireboom and Ro-Boom, sampling done from port to starboard side							

NOBE 93 ..... CCG 205

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
10:48	18			020 / aerial	442	77	247	85	10	33
10:48	18			021 / aerial	351	34	162	87	6	27
10:51	21	Pat / slide	CCG 205 located in line with apex of Fireboom, in front of Ro-Boom							
10:52	22			023 / aerial					under plume	
10:52	22			024 / aerial					under plume	
10:56	26			029 / aerial	533	0	116	95	0	13
10:56	26			030 / aerial	538	38	155	91	4	17
11:00	30	CCG205	Went into heavy residue - pack about 30 ft long and 15 ft wide, picked up a lot of samples of this residue might have been burned PVC fabric residue all being caught in the Ro-Boom	033 / aerial	612	11	197	94	1	19
11:09	39			036 / aerial	440	243	368	78	32	50
11:09	39	Pat / slide	11:09 to 11:14							
11:09	39	Pat / slide	CCG 205 located on port side of Ro-Boom even with boom apex, behind Ro-Boom							
11:12	42	Pat / slide	11:22 to 11:26 - (PAT/slide)							
11:12	42	Pat / slide	CCG 205 located in from of Ro-Boom; .... CCG 205 located behind Ro-Boom ... CCG 205 located in front of Ro-Boom between CCG 214 and CCG 212							
11:23	53	040 / aerial	5° from left edge of plume	040 / aerial	485	42	127	103	5	15
11:23	53	Pat / slide	CCG 205 located in front of apex of Ro-Boom in line with CCG 214 and CCG 212							
11:26	56	Pat / slide	11:26 to 11:47 - (PAT/slide)							
11:26	56	Pat / slide	CCG 205 located on port side of fire boom behind Ann Harvey							
11:27	57	CCG206	Burn # 1 instrument off							
11:28	58	CCG305	Taking samples							
11:29	59	Ann Harvey	Finished sampling							
11:32	62	043 / aerial	39° from left edge of plume	043 / aerial	363	242	301	71	39	49
11:38	68	Pat / slide	CCG 205 is located on port side of Fireboom, in line with apex of Fireboom							
11:39	69	046 / aerial	55° from left edge of plume	046 / aerial	169	206	228	65	75	85
11:39	69	Pat / slide	CCG 205 located on port side of Fireboom, beside CCG 208							
11:40	70	Pat / slide	CCG 205 same location as for 11:39							

NOBE 93 ..... CCG 205

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
11:42	72	Pat / slide	CCG 205 located directly port side of CCG 215 and CCG 216							
11:45	75	Pat / slide	CCG 205 located on port side of Fireboom, behind Ann Harvey							
11:46	76	051 / aerial	30° from left edge of plume	051 / aerial	222	137	200	69	36	54
11:50	80	Pat / slide	11:50 to 11:53							
11:50	80	Pat / slide	CCG 205 in apex of Ro-Boom							
11:55	85	Pat / slide	CCG 205 located on port side of Fireboom and well behind, in line with sample boats							
11:57	87	Pat / slide	CCG 205 located along side of CCG 215							
12:01	91	Pat / slide	CCG 205 located directly behind apex of Fireboom even with sample boats							
12:04	**94**		**END OF BURN**							
12:10	100	Pat / slide	12:10 to 12:50 ..... CCG 205 collected approx. 7 L of residue from apex of Fireboom							
12:40	130	CCG205	Boom inspected during residue sampling operation, Nextel has many holes between floats, wire is intact, Nextel holes seem to be 3 to 5 in above water-line; flexing of floats seems to have the effect of causing the Nextel to crack and open, Nextel around floats looks good, wave motion seems to cause the float movement, that is flexing between float Nextel, NOT A GOOD FEATURE							
12:42	132	Pat / slide	Paula collecting residue samples, located at apex of Fireboom							
.....	.....	CCG205	Burn residue estimated at 6 ft x 20 ft and 2 in thick, carbon residue was heavy on backside, clean on burn side. Maximum estimated flame height = 100 to 125 ft; oil or burn residue clinging to below-water only at apex, heavy residue area; connectors look OK, skirt and chain area look OK							

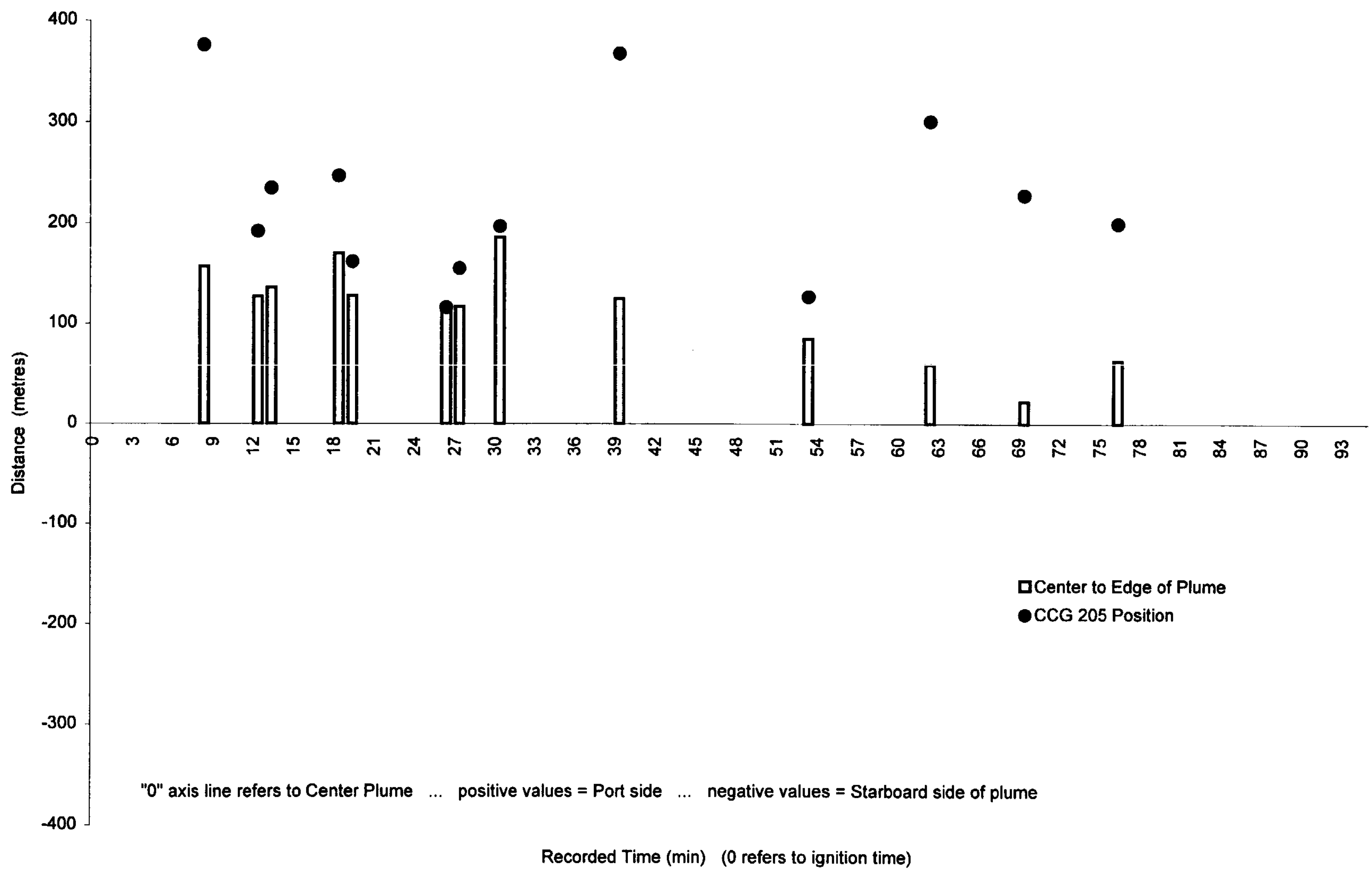
NOBE 93 ..... CCG 205

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
13:05	-61	Pat / slide	CCG 205 estimate 1 barrel of residue in apex of Fireboom							
13:25	-41	CCG 205	Announcement that we are going ahead with second burn							
13:40	-26	CCG 205	Preparations for second burn							
13:51	-15			055 / aerial	304			78		
13:58	-8			057 / aerial	398			80		
13:58	-8	Pat / slide	CCG 205 located near CCG 212; Pat's slides from 13:58 to 14:26; CCG 205 located on port side of Fireboom in line with sampling boats							
14:02	-4			060 / aerial	342			79		
14:04	-2	Pat / slide	Helitorch over Fireboom; CCG 205 located on port side of Fireboom beside sample boats							
14:05	-1	Pat / slide	View of start of fire and plume							
14:05	-1			062 / aerial	169			72		
14:06	**0**		**IGNITION**							
14:07	1	Pat / slide	CCG 205 located on port side of Fireboom, in line with apex of Fireboom and sampling boats							
14:10	4	065 / aerial	10° from left edge of plume	065 / aerial	168	29	80	60	10	28
14:15	9	068 / aerial	30° from left edge of plume	068 / aerial	155	80	119	55	30	45
14:19	13	071 / aerial	28° from left edge of plume	071 / aerial	181	69	107	58	22	35
14:26	20	Pat / slide	14:26 to 14:38							
14:26	20	Pat / slide	CCG 205 located in front of Ro-Boom; examined water and surface for sheen; collected 4L of residue from water surface between Fireboom and Ro-Boom.							
14:28	22	074 / aerial	51° from left edge of plume	074 / aerial	124	107	135	39	51	66
14:34	28	077 / aerial	25° from left edge of plume	077 / aerial	188	81	121	55	25	38
14:35	29	Pat / slide	No sheen/residue visible between Fireboom and Ro-Boom, CCG 205 located in front of Ro-Boom between CCG 221 and CCG 214							
14:36	30	Pat / slide	View of surface sampling							
14:37	31	Pat / slide	No sheen visible near surface sampling							
14:38	32	Pat / slide	14:38 to 14:59							

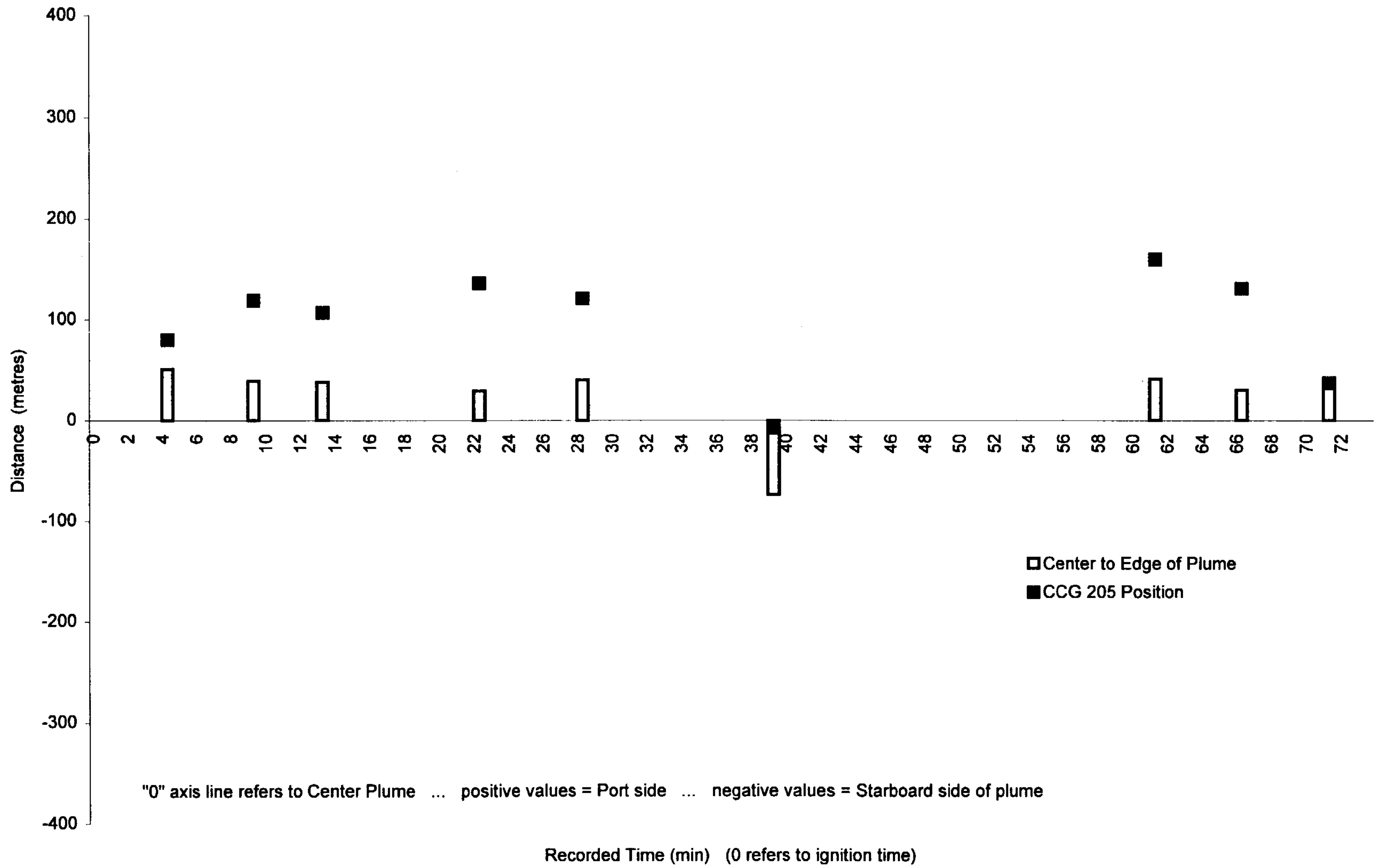
NOBE 93 ..... CCG 205

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
14:38	32	Pat / slide	Examined surface of water for sheen on both sides and behind Ro-Boom; view of surface sampling; CCG 205 located near starboard side of CCG 214							
14:40	34	Pat / slide	14:40 to 14:59 ... CCG 205 located on starboard side of Ro-Boom							
14:41	35	CCG 205	Surface samples taken in front of Ro-Boom							
14:45	39			081 / aerial	314	66	-8	100	12	-2
14:50	44	CCG 205	Residue in front of Ro-Boom picked up, looks like mud, lies about 1 in thick on fine net pick-up device							
14:55	49	Pat / slide	CCG 205 located at apex of Ro-Boom, no residue is visible in the boom from this angle							
14:58	52	Pat / slide	CCG 205 located behind and on port side of Ro-Boom, plume overhead							
15:07	61	092 / aerial	52° away from left edge of plume	092 / aerial	136	119	160	18	52	72
15:12	66			094 / aerial	183	101	131	58	32	42
15:17	71	097 / aerial	1° (under plume) from left edge of plume	097 / aerial	300	-5	37	95	-1	7
15:19	**73**		**END OF BURN**							
15:20	74		(time ???, estimated immediately after Burn 2) CCG 205 collected 7 L of residue from the apex of Ro-Boom							
16:30	144		Approx. 16:30, returned to Sir Wilfred Grenfell							
.....			Sample # 16 - 2 days later: 0.3 L of residue collected from sides of remote controlled sample boats, collected 8/14/93							

NOBE 93 ... BURN 1 ... CCG 205 ... Surface Sampling Vessel
MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... CCG 205 ... Surface Sampling Vessel
MOVEMENT OVER TIME



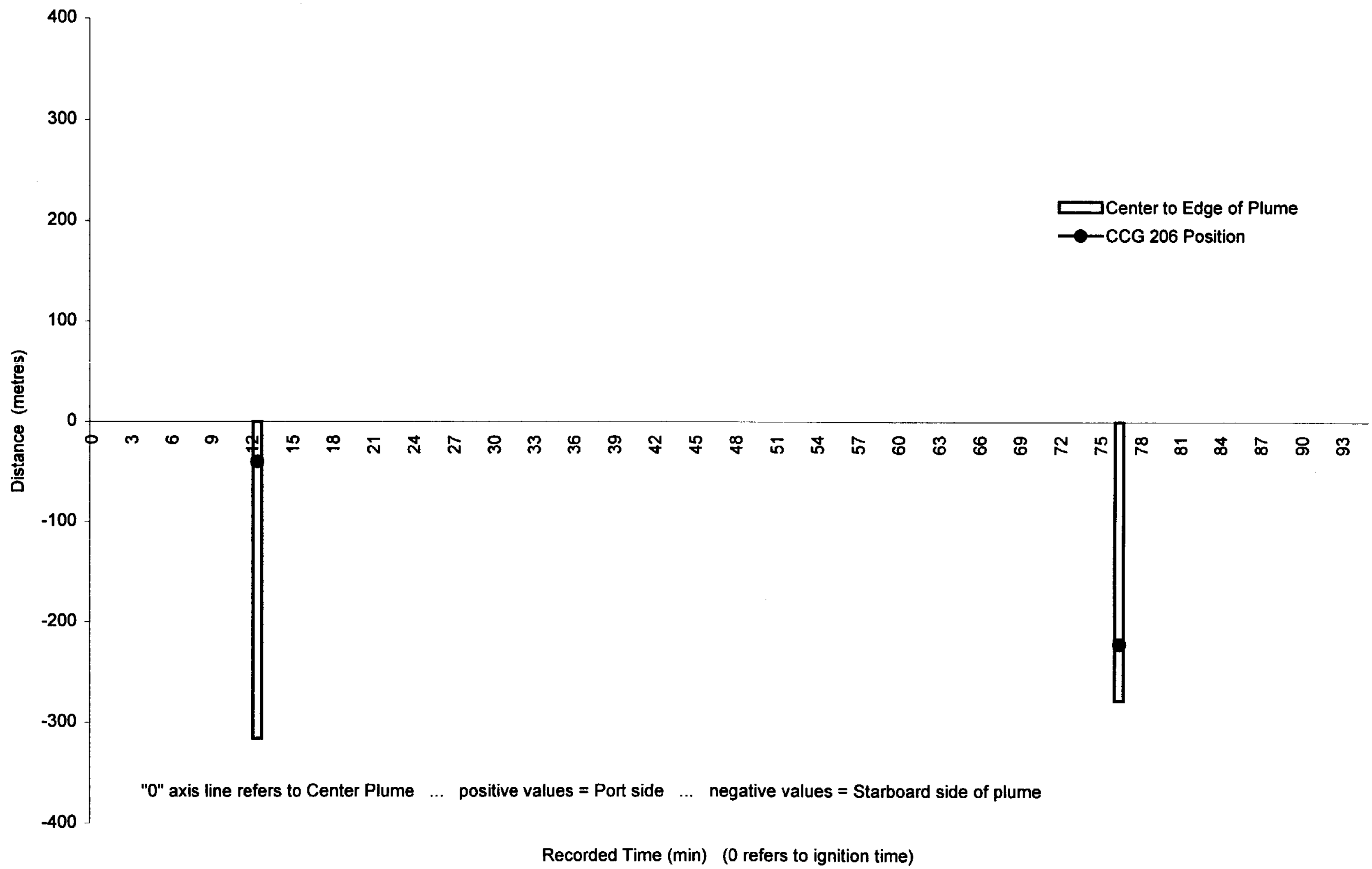
NOBE 93 ..... CCG 206

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
3:06		CCG206	Departed dock							
5:58		CCG208	CCG 206 ahead of CCG 208 at 150 m							
5:58		CCG206	Arrived on station and began to set up air monitoring equipment							
8:09	-141	CCG206	Pumps and air equipment set up							
8:10	-140	Sir Wilfred Grenfell	CCG 206 instruments ready to go							
9:00	-90	CCG206	Started setting up air monitoring equipment							
9:17	-73	002 / aerial	192 m to apex of Ro-Boom	002 / aerial	660			100		
9:17	-73	003 / aerial	194 m to apex of Ro-Boom	003 / aerial	658			105		
9:24	-66	005 / aerial	175 m to apex of Ro-Boom	005 / aerial	670			105		
10:05	-25	Sir Wilfred Grenfell	CCG 206 reports smelling oil							
10:08	-22		Helicopter 04 landed, motor quit							
10:14	-16	CCG206	Start of evaporation study							
10:17	-13	007 / aerial	132 m to apex of Ro-Boom	007 / aerial	655			103		
10:19	-11	CCG206	End of evaporation study							
10:38	8	012 / aerial	Under plume	012 / aerial	Under plume			Under plume		Under plume
10:38	8			013 / aerial				Under plume		
10:42	12			015 / aerial				Not in photo		
10:42	12			016 / aerial				Under plume		
10:42	12	017 / aerial	18° from right edge of plume; 295 m to apex of Ro-Boom	017 / aerial	907	276	-40	108	18	-3
10:43	13	CCG207	Launched 02							
10:48	18			020 / aerial				Under plume		
10:48	18	021 / aerial	Under plume	021 / aerial	Under plume			Under plume		
10:52	22			023 / aerial				Under plume		
10:52	22			024 / aerial				Under plume		
10:56	26			029 / aerial				Under plume		
10:56	26			030 / aerial				Not in photo		
11:00	30			033 / aerial				Under plume		
11:02	32	Pat / slide	CCG 206 located on port side of fire boom in front of Ro-Boom							
11:09	39	036 / aerial		036 / aerial				Under plume		
11:15	45	CCG206	SUMMA 1B off							
11:23	53	039 / aerial	Under plume	039 / aerial	Under plume			Under plume		
11:23	53	040 / aerial	332 m to apex of Ro-Boom	040 / aerial						
11:27	57	CCG206	Burn 1, instruments off							
11:29	59	Ann Harvey	CCG 206 finished sampling							
11:32	62			043 / aerial				Under plume		
11:39	69			046 / aerial				Under plume		
11:46	76	051 / aerial	3° (under plume) from right edge of plume; 603 m to apex of Ro-Boom	051 / aerial	1061	56	-222	122	3	-12

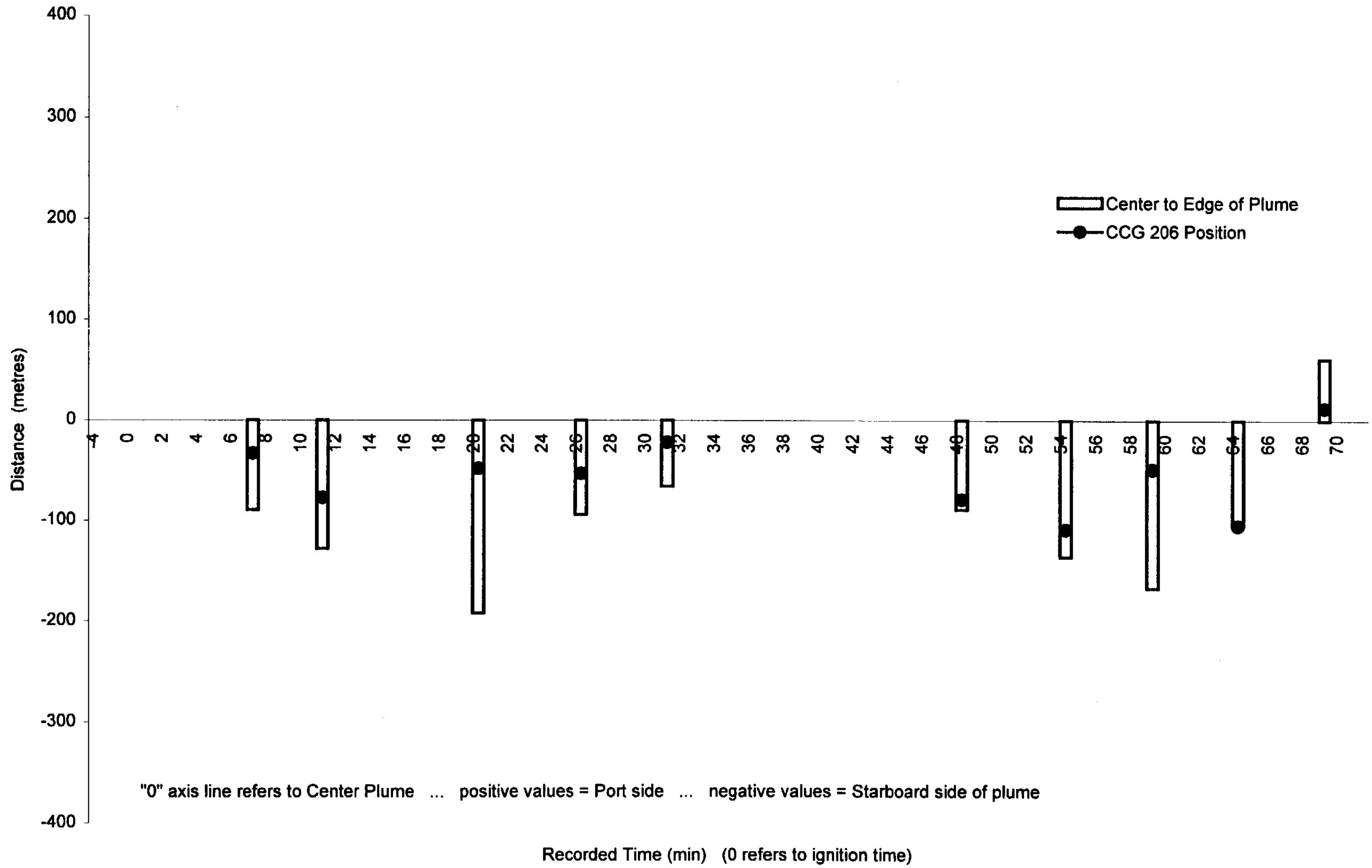
NOBE 93 ..... CCG 206

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
13:51	-15			055 / aerial	510			103		
13:54	-12	CCG206	Open SUMMA 2A							
13:58	-8	058 / aerial	150 m starboard of Ro-Boom; 205 m from apex of Ro-Boom; Ro-Boom at 75 deg	058 / aerial				Not in photo		
14:01	-5	CCG206	Closed SUMMA 2A							
14:02	-4	060 / aerial	277 m from apex of Ro-Boom	060 / aerial	453			112		
14:05	-1			062 / aerial	501			110		
14:06	0	CCG206	All pumps on							
14:10	4	065 / aerial	Under plume	065 / aerial	Under plume			Under plume		
14:15	9	068 / aerial	6° (under plume) from right edge of plume	068 / aerial	583	56	-33	97	6	-3
14:19	13	071 / aerial	5° from right edge of plume	071 / aerial	588	51	-77	95	5	-8
14:28	22	074 / aerial	15° (under plume) from right side of plume; 73 m from apex of Ro-Boom	074 / aerial	553	144	-48	95	15	-5
14:34	28	077 / aerial	5° (under plume) from right side of plume	077 / aerial	471	41	-53	100	5	-7
14:39	33	078 / aerial	5° from right side of plume	078 / aerial	499	44	-22	100	5	-3
14:51	45	CCG206	SUMMA off							
14:56	50	085 / aerial	1° (under plume) from right edge of plume	085 / aerial	567	10	-79	92	1	-8
15:02	56	088 / aerial	3° (under plume) from right edge of plume	088 / aerial	627	27	-109	88	3	-10
15:07	61	092 / aerial	12° (under plume) from right edge of plume	092 / aerial	591	118	-49	91	12	-5
15:12	66	094 / aerial	On the right edge of plume	094 / aerial	502	0	-105	104	0	-12
15:17	71	097 / aerial	5° (under plume) from left edge of plume; 103 m from apex of Ro-Boom	097 / aerial	559	-49	12	100	-5	1
15:19	73	CCG206	Sampling secured							

NOBE 93 ... BURN 1 ... CCG 206 ... DOWNWIND STATION MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... CCG 206 ... DOWNWIND STATION
MOVEMENT OVER TIME



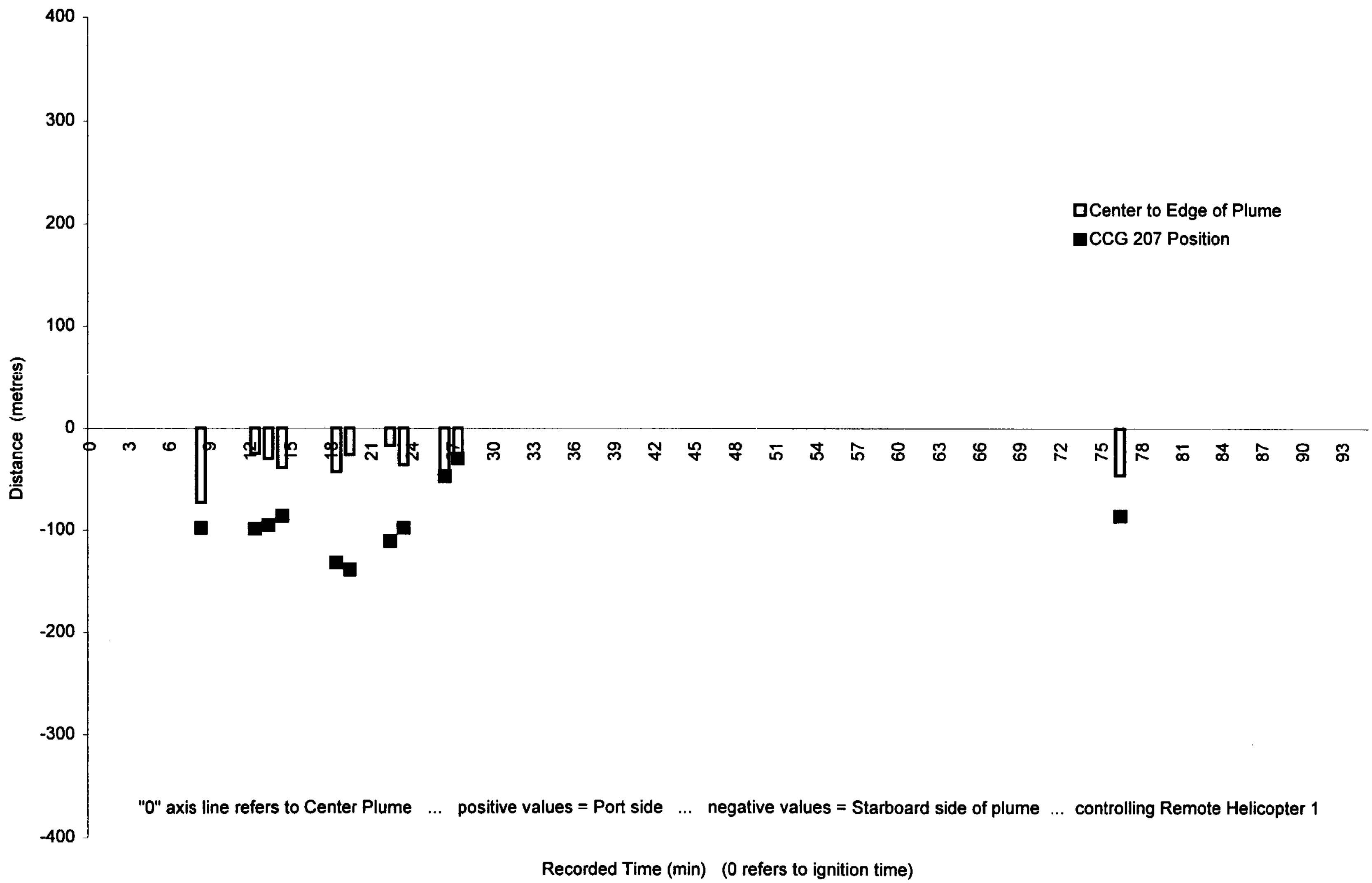
NOBE 93 ..... CCG 207

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
7:48		CCG207	CCG 207 launched from Ann Harvey							
8:22	-128	CCG207	Launch R/C helicopter							
8:23	-127	CCG207	Sample on (SUMMA) for blank in flight							
8:29	-121	CCG207	Sample off (SUMMA) for blank in flight							
8:30	-120	CCG207	Helicopter landed							
8:48	-102	Ann Harvey	6 temp probes on CCG 207 and CCG 216 need to be transferred to boom							
9:17	-73			002 / aerial	101			125		
9:17	-73			003 / aerial	100			132		
9:24	-66			005 / aerial	150			130		
9:27	-63	CCG207	Badges open							
10:02	-28	CCG207	Helicopter 04 off deck; 30 samples on							
10:04	-26	Ann Harvey	Mini helicopter in air (no I.D.)							
10:06	-24	CCG211	Remote helicopter up							
10:07	-23	CCG207	30 samples off							
10:08	-22	CCG207	R/C helicopter # 4 landed, motor on 04 quit							
10:17	-13			007 / aerial	141			133		
10:38	8	012 / aerial	Under plume	012 / aerial	Under plume			Under plume		Under plume
10:38	8	013 / aerial	15° right of edge of plume	013 / aerial	98	-25	-98	185	-15	-60
10:42	12	015 / aerial	48° from right edge of plume	015 / aerial	92	-74	-99	168	-48	-65
10:42	12	016 / aerial	40° from right edge of plume	016 / aerial	95	-65	-95	170	-40	-60
10:42	12	017 / aerial	35° from right edge of plume	017 / aerial	90	-47	-86	170	-30	-58
10:43	13	CCG207	Launched R/C helicopter # 02							
10:45	15	CCG211	CCG 207 R/C helicopter up and near base of plume							
10:48	18	020 / aerial	53° from right edge of plume	020 / aerial	100	-89	-132	193	-53	-83
10:48	18	021 / aerial	70° from right edge of plume	021 / aerial	98	-113	-139	200	-70	-90
10:52	22	023 / aerial	65° from right edge of plume	023 / aerial	83	-94	-111	189	-69	-84
10:52	22	024 / aerial	45° from right edge of plume	024 / aerial	81	-62	-98	185	-45	-75
10:56	26	029 / aerial	0°, on right edge of plume	029 / aerial	113	0	-47	128	0	-24
10:56	26	030 / aerial	0°, on right edge of plume	030 / aerial	115	0	-30	120	0	-15
11:00	30			033 / aerial				Under plume		
11:03	33	Ann Harvey	Remote helicopters both on deck now							
11:09	39			036 / aerial				Under plume		
11:09	39	CCG207	On							
11:15	45	CCG207	# 02 landed 20 sec later; off							
11:23	53	040 / aerial	Under plume	040 / aerial	Under plume			Under plume		
11:31	61	Ann Harvey	Mini H/C finished sampling							
11:32	62			043 / aerial				Under plume		
11:34	64	CCG207	On							
11:39	69			046 / aerial				Under plume		
11:40	70	CCG207	Off							
11:46	76	051 / aerial	15° from right edge of plume	051 / aerial	154	-40	-86	155	-15	-33

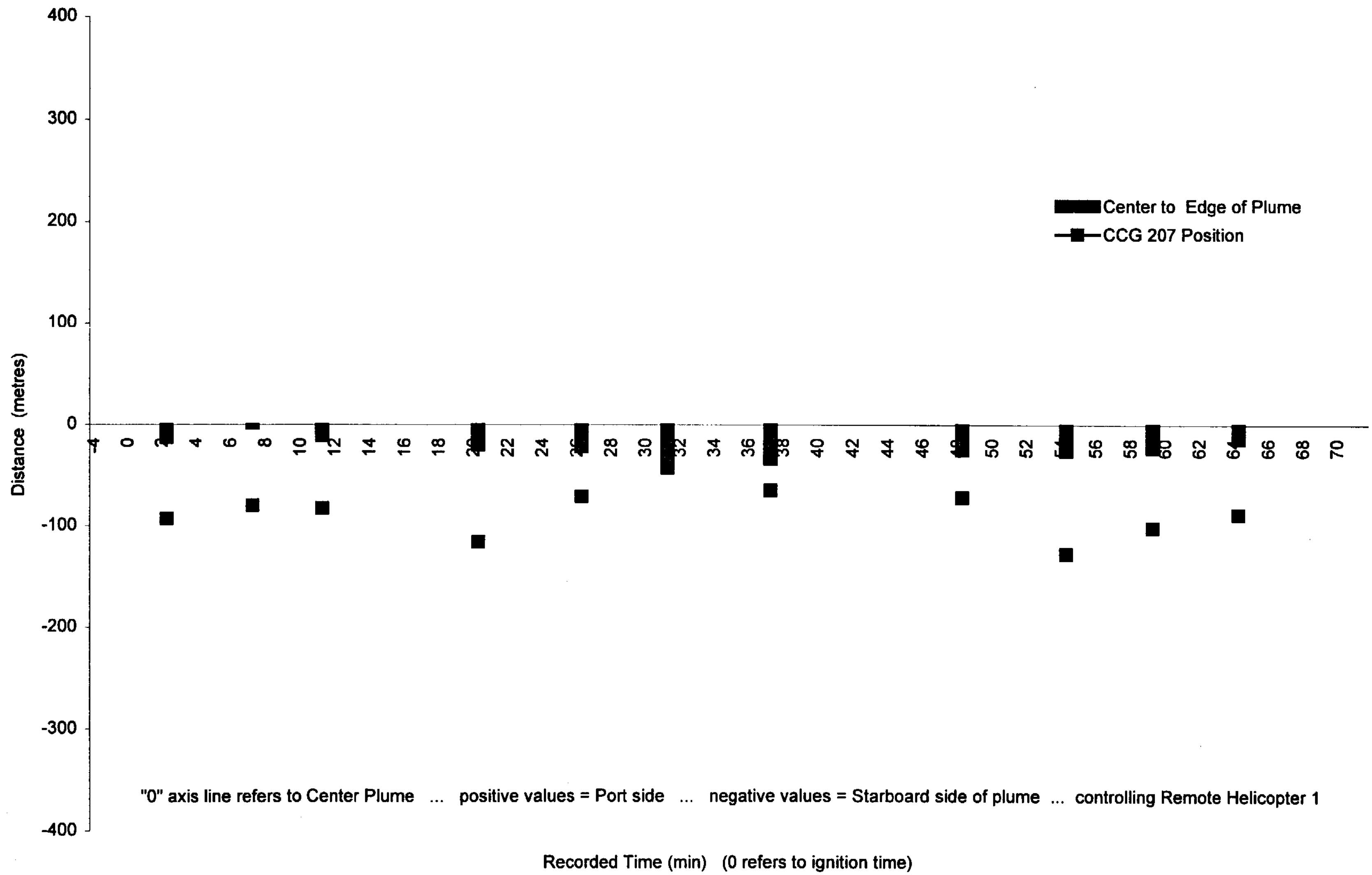
NOBE 93 ..... CCG 207

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex of FB (m)	To Edge of Plume (m)	To Middle of Plume (m)	From Axis (deg)	To Edge of Plume (deg)	To Middle of Plume (deg)
13:40	-26	CCG207	Badges							
13:51	-15			055 / aerial	141			110		
13:58	-8			057 / aerial	154			125		
14:02	-4			060 / aerial	145			125		
14:05	-1			062 / aerial	117			125		
14:10	4	065 / aerial	64° from right edge of plume	065 / aerial	71	-75	-93	169	-64	-82
14:14	8	CCG207	On							
14:15	9	068 / aerial	75° from right edge of plume	068 / aerial	62	-76	-80	175	-75	-80
14:19	13	071 / aerial	55° from right edge of plume	071 / aerial	72	-67	-83	165	-55	-70
14:20	14	CCG207	Off							
14:28	22	074 / aerial	Under plume	074 / aerial	88	-91	-116	193	-63	-83
14:28	22	CCG207	On							
14:34	28	077 / aerial	20° from right edge of plume	077 / aerial	128	-44	-71	125	-20	-33
14:34	28	CCG207	Landed 15 sec later; off							
14:39	33	078 / aerial	0°, on the edge of right side of plume	078 / aerial	166	0	-43	120	0	-15
14:43	37	CCG207	On							
14:45	39	081 / aerial	10° from the edge of plume	081 / aerial	150	-26	-65	130	-10	-25
14:49	43	CCG207	In the smoke (helicopter???); off							
14:53	47	CCG207	On							
14:56	50	085 / aerial	20° from right edge of plume	085 / aerial	120	-42	-72	130	-20	-35
15:02	56	088 / aerial	43° from right edge of plume	088 / aerial	133	-97	-128	143	-43	-58
15:07	61	092 / aerial	34° from right edge of plume	092 / aerial	128	-74	-102	141	-34	-47
15:07	61	CCG211	Fireboom failed, abort, ground all helicopters							
15:12	66	094 / aerial	49° from right edge of plume	094 / aerial	84	-70	-89	169	-49	-64
15:17	71			097 / aerial	126			195		

NOBE 93 ... BURN 1 ... CCG 207 ... MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... CCG 207 ... MOVEMENT OVER TIME

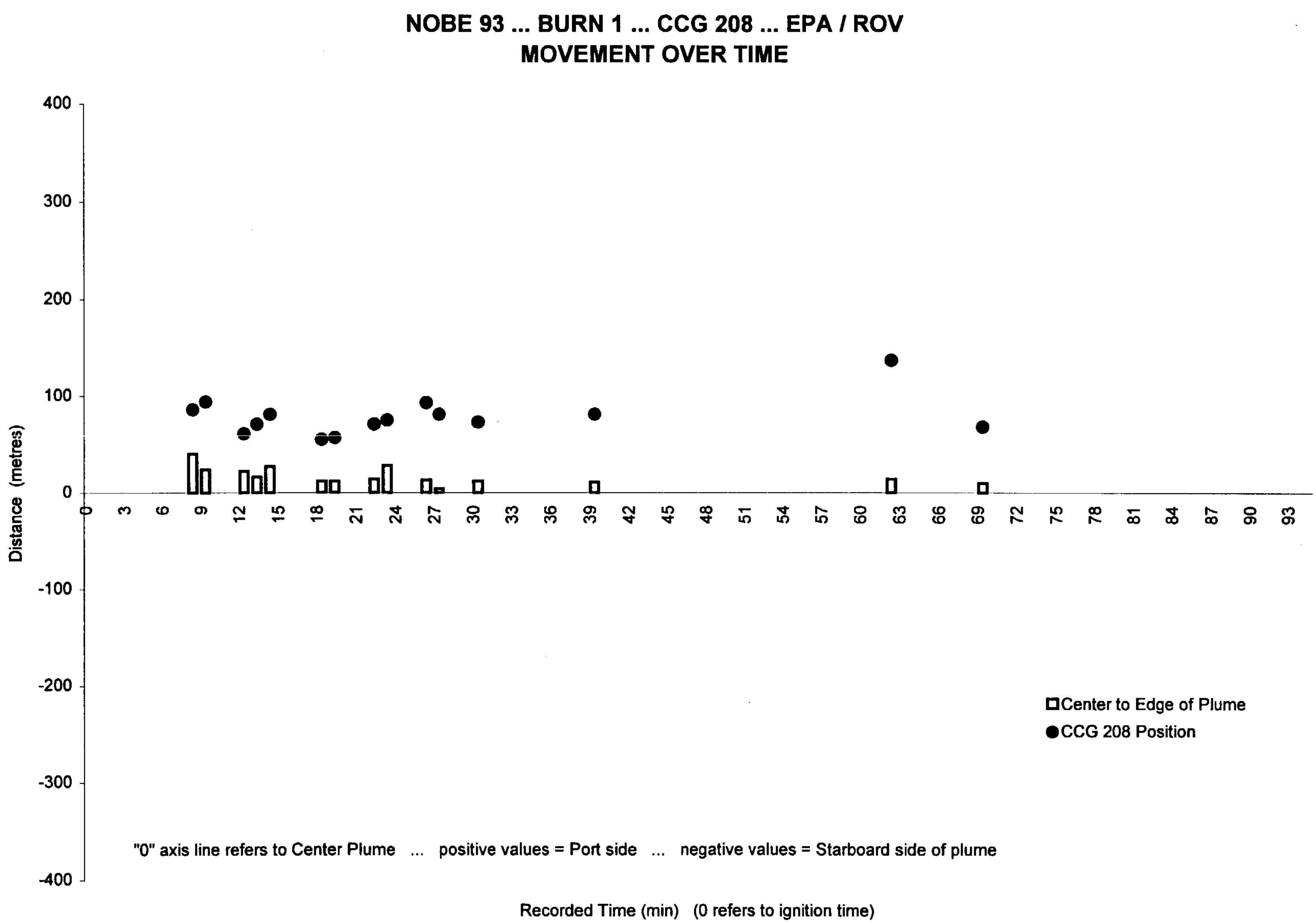


NOBE 93 ..... CCG 208

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
7:55			In position along side fireboom							
9:14	-76	Ann Harvey	ROV operational							
9:17	-73	002 / aerial	40 m port side of bridle	002 / aerial	78			315		
9:17	-73	003 / aerial	37.5 m to bridle tie	003 / aerial	81			315		
9:24	-66			005 / aerial	77			337		
9:26	-64		Badges open							
9:45	-45		Puff attempt foiled by pump jam							
10:00	-30		Puff test initiated, starboard of boom coated by PUFF test							
10:17	-13			007 / aerial	80			345		
10:28	-2	CCG208	ROV in ready state							
10:33	3	CCG208	ROV behind fire on surface approaching slick residue							
10:38	8	012 / aerial	60° from left edge of plume	012 / aerial	50	46	86	35	55	120
10:38	8	013 / aerial	70° from left edge of plume	013 / aerial	61	70	94	30	70	100
10:39	9	Ann Harvey	ROV observed near and in fire							
10:41	11	Pat / slide	ROV approaching 208							
10:42	12	015 / aerial	33° from left edge of plume	015 / aerial	69	39	61	48	33	53
10:42	12	016 / aerial	50° from left edge of plume	016 / aerial	71	55	71	45	45	60
10:42	12	017 / aerial	45° from left edge of plume	017 / aerial	71	54	81	45	45	70
10:48	18	020 / aerial	60° from left edge of plume	020 / aerial	43	43	55	20	60	80
10:48	18	021 / aerial	70° from left edge of plume	021 / aerial	42	45	57	25	65	85
10:50	20		ROV approaching burnt port side							
10:51	21	CCG215	CCG 215 even, recovering # 4 on port side							
10:52	22	CCG208	ROV behind burn 40 m in/under slick							
10:52	22	023 / aerial	50° from left edge of plume	023 / aerial	62	57	71	30	55	70
10:52	22	024 / aerial	45° from left edge of plume	024 / aerial	62	47	75	35	45	75
10:56	26	CCG208	Another launch to port side of boom, screen showing oil							
10:56	26	029 / aerial	90° from left edge of plume	029 / aerial	57	80	93	0	90	110
10:56	26	030 / aerial	90° from left edge of plume	030 / aerial	54	77	81	5	90	98
11:00	30	033 / aerial	65° from left edge of plume	033 / aerial	57	61	73	35	65	80
11:02	32	CCG208	ROV under apex, burn past boom							
11:03	33	CCG208	ROV out of burn							
11:07	37	CCG208	ROV, another approach to port side of unburnt portion							
11:09	39	036 / aerial	80° from left edge of plume	036 / aerial	49	70	81	20	90	110
11:09	39	CCG208	ROV under fire, oil particles under water							
11:10	40	CCG208	Flag ablaze, ROV being hauled out							
11:14	44	CCG208	ROV redeployed to boom, port side							
11:16	46	CCG208	ROV at boom, all in fire							
11:19	49	CCG208	ROV run finished							
11:23	53	040 / aerial	125° from right edge of plume	040 / aerial	71			340		
11:24	54	CCG208	ROV being wiped and cleaned							
11:27	57	CCG208	Congealing?, cascading?, under boom							
11:32	62	043 / aerial	95° from left edge of plume	043 / aerial	83	123	137	15	95	110
11:39	69	046 / aerial	75° from left edge of plume	046 / aerial	45	58	68	30	80	98
11:39	69	CCG208	ROV fitted with new flag, deployed to boom section # 6							
11:41	71	Pat / slides	ROV approaching CCG 208							
11:46	76	051 / aerial	7.5 m port side of fireboom	051 / aerial	35			305		
12:19	109	CCG208	Passive samplers canned							
12:24	114	CCG208	Redeployed to under burn area under apex of boom, black blob present, band of burned oil which is larger than boom, could be just excessive coating of inner basket of boom fabric burned through at connectors							

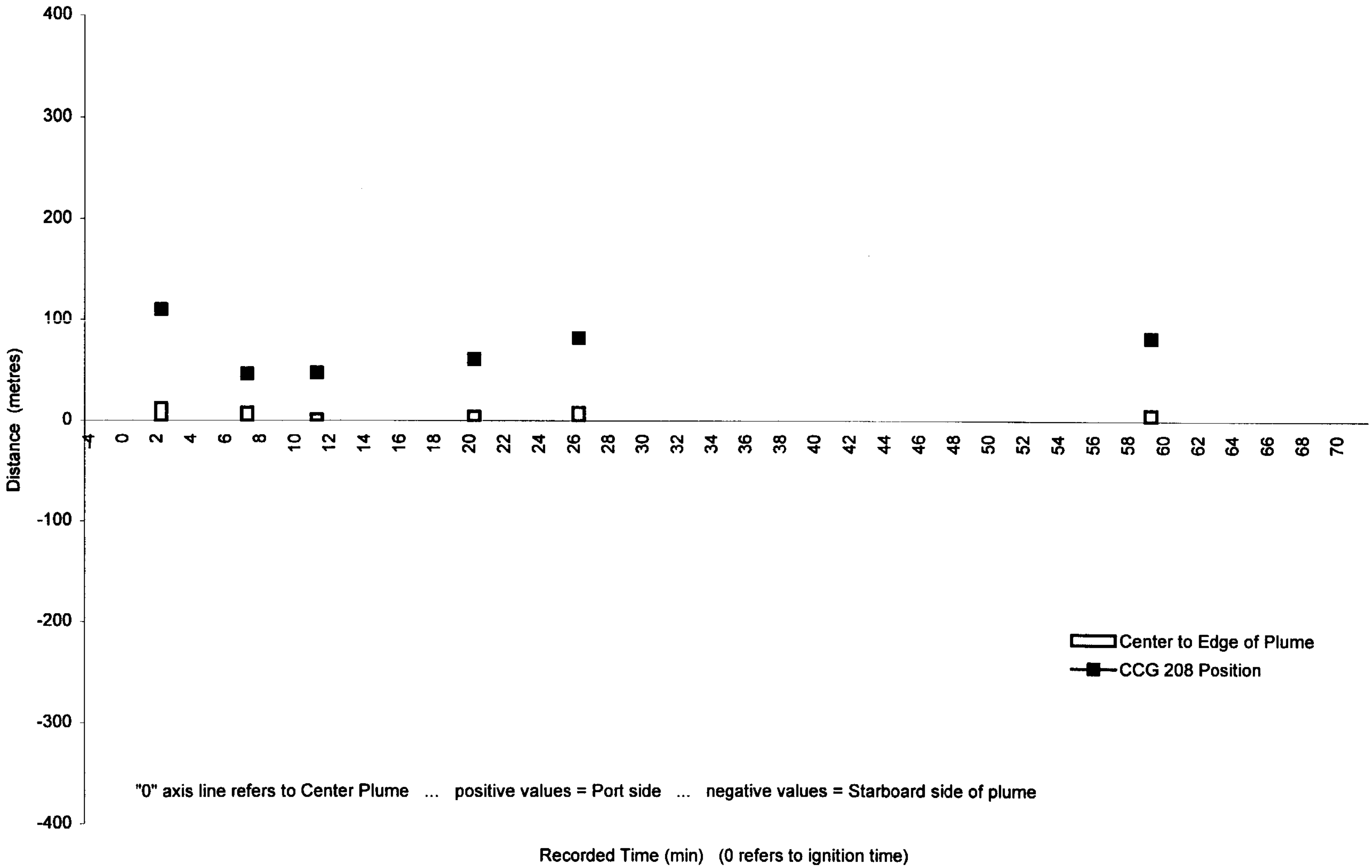
NOBE 93 ..... CCG 208

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:50	-16	CCG208	Passive collectors initiated							
13:51	-15			055 / aerial	216			290		
13:58	-8			057 / aerial	157			295		
14:02	-4			060 / aerial	140			295		
14:05	-1			062 / aerial	144			295		
14:10	4	065 / aerial	75° from left edge of plume	065 / aerial	76	93	110	-5	75	93
14:11	5	CCG208	CCG 208 repositioning to port side of burn							
14:13	7	Sir Wilfred Grenfell	ROV in position next to fire							
14:15	9	068 / aerial	40° from left edge of plume	068 / aerial	48	33	46	45	40	58
14:19	13	071 / aerial	65° from left edge of plume	071 / aerial	39	41	47	20	65	75
14:22	16	CCG208	30 to 35 m port of burn, ROV under fire looking upward							
14:28	22	074 / aerial	70° from left edge of plume	074 / aerial	49	52	61	25	65	78
14:28	22	CCG208	ROV is downwind from burn 30 m coming up on burn							
14:30	24	CCG215	Spot sub antenna 10 m from boom downwind							
14:33	27	CCG208	Retrieving ROV							
14:34	28	077 / aerial	45° from left edge of plume	077 / aerial	82	69	82	30	50	60
14:39	33			078 / aerial	41			325		
14:45	39			081 / aerial	53			340		
14:47	41	CCG208	ROV documents pumping commencing, 550 L/min							
14:56	50			085 / aerial	41			10		
15:02	56			088 / aerial	61			5		
15:07	61	092 / aerial	75° from left edge of plume	092 / aerial	62	71	82	15	70	83
15:12	66			094 / aerial	53			320		
15:17	71			097 / aerial	33			320		
15:19	73		Passive samplers completed							



NOBE 93 ... BURN 1 ... CCG 208 ... EPA / ROV
MOVEMENT OVER TIME
400
300
200
100
0
-100
-200
-300
-400
Distance (metres)
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60
63
66
69
72
75
78
81
84
87
90
93
Center to Edge of Plume
CCG 208 Position
"0" axis line refers to Center Plume ... positive values = Port side ... negative values = Starboard side of plume
Recorded Time (min) (0 refers to ignition time)

NOBE 93 ... BURN 2 ... CCG 208 ... EPA / ROV
MOVEMENT OVER TIME



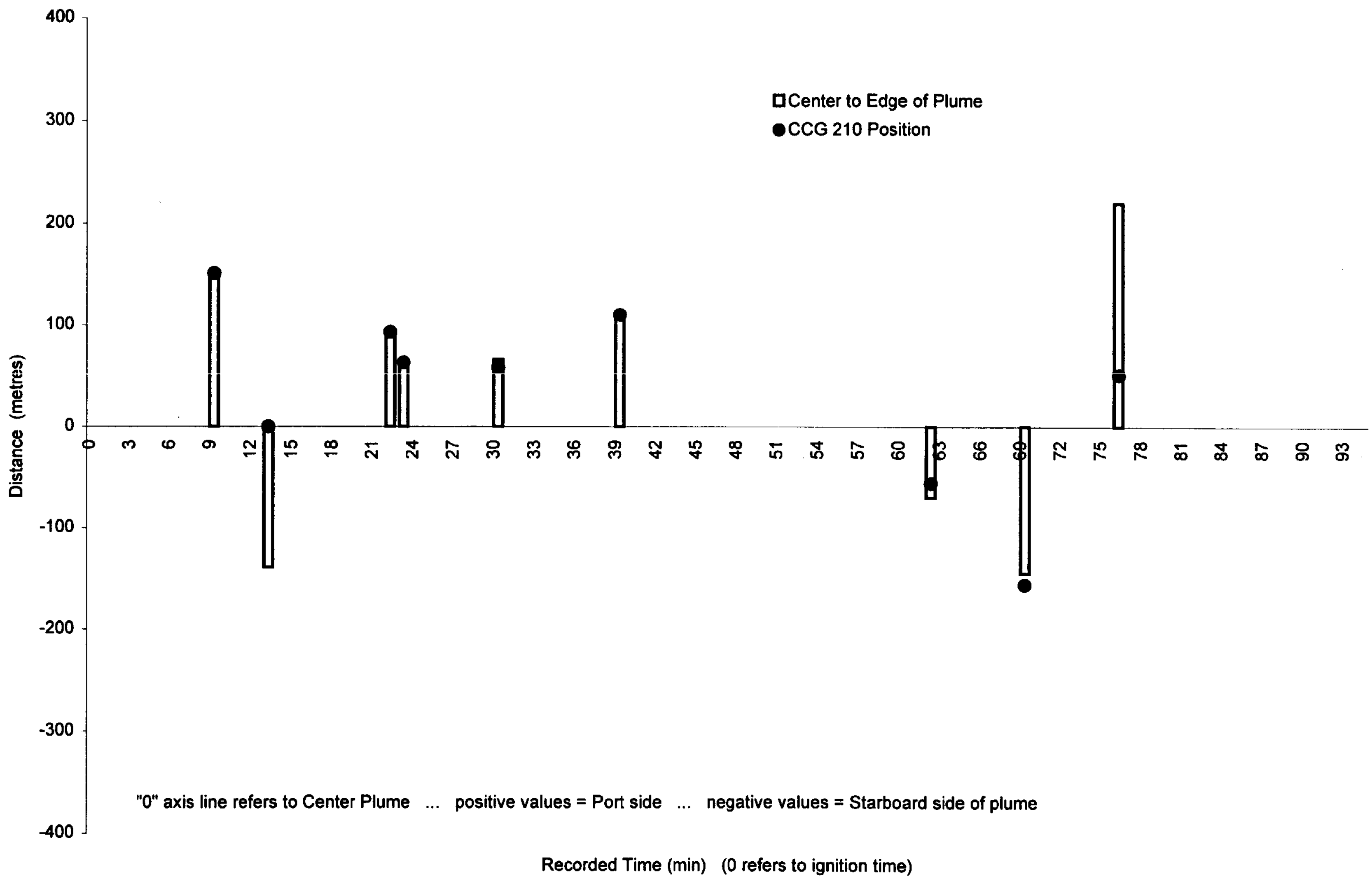
NOBE 93 ..... CCG 210

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	CCG210	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)	BLIMP	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
7:55		Sir Wilfred Grenfell	Blimp inflated and clears the deck of CCG 210. To be deployed at 1000 ft														
7:57		Ann Harvey	Blimp inflated and confirmed at 1000 ft														
8:00	-150	Sir Wilfred Grenfell	Blimp deployed														
8:22	-128	Ann Harvey	Blimp at 200 m, wind at alt = 5 to 6 m/sec, ceiling 600 ft broken														
8:29	-121	Ann Harvey	Ceiling 290 m measured, NIST alt wind 9.5 m/sec, SE on surface														
8:31	-119	Ann Harvey	Blimp ceiling 290 m														
8:35	-115	CCG210	Weather profile ... 47'44.05N, 52'02.985W, concluded at 8:35														
8:55	-95	CCG210	Background gas sample (2)														
9:17	-73	002 / aerial	Maybe 210 ???	002 / aerial	174			82									
9:17	-73	003 / aerial		003 / aerial	171			90									
9:24	-66	005 / aerial		005 / aerial	175			85									
10:17	-13	007 / aerial	No blimp deployed	007 / aerial	187			95									
10:20	-10	CCG210	Observed light sheen around CCG 210														
10:35	5	CCG210	First package, pump on														
10:37	7	CCG215	NIST balloon in plume; package in smoke														
10:38	8	012 / aerial	Under plume	012 / aerial	Under plume			Under plume		Under plume							
10:38	8	013 / aerial	Bow under plume	013 / aerial	332	0	151	98	0	26							
10:41	11	CCG211															
10:42	12	016 / aerial	0°, on the edge of left side of plume	016 / aerial	400	139	0	105	20	0	017 / aerial	402	140	-18	115	20	-3
10:43	13	CCG211	Helicopter down, plume smaller														
10:47	17	Ann Harvey	Blimp deployed under plume through smoke														
10:48	18	020 / aerial	Strong oil smell and burnt plastic	020 / aerial				Under plume			020 / aerial	342	-89	30	105	-15	5
10:48	18	021 / aerial									021 / aerial	342	-89	30	105	-15	5
10:51	21	CCG215	CCG 215 even with NIST blimp boat, recovering # 4 sample boat on port side of CCG 215														
10:52	22	023 / aerial		023 / aerial	357	0	93	95	0	15	023 / aerial	492	-21	107	98	-3	13
10:52	22	024 / aerial	0°, on the edge of left side of plume	024 / aerial	362	0	63	98	0	10	024 / aerial	400	-21	45	99	-3	7
10:55	25																
10:56	26	029 / aerial									029 / aerial	175	0	53	90	0	18
10:56	26	030 / aerial		030 / aerial				Under plume			030 / aerial	259	-5	48	95	-1	11
11:00	30	033 / aerial	3° (under plume) from left edge of plume	033 / aerial	161	-8	58	98	-3	21	033 / aerial	161	-34	33	107	-12	12
11:07	37	CCG215	CCG 215 now abeam (port) of NIST blimp boat, 50 m from plume														
11:09	39	036 / aerial	0°, on the edge of the left side of plume	036 / aerial	384	0	110	112	0	17	036 / aerial	418	-15	113	112	-2	16
11:23	53	040 / aerial		040 / aerial				Under plume			040 / aerial	399	-10	59	109	-2	9
11:27	57	CCG210	First package out of smoke														
11:29	59	CCG210	First package pump off, 2 filters and 2 gas bags														
11:32	62	043 / aerial	2° (under plume) from right edge of plume	043 / aerial	400	14	-56	128	2	-8	043 / aerial	410	36	-36	125	5	-5
11:39	69	046 / aerial	0°, on the edge of the right side of plume	046 / aerial	617	-11	-156	132	-1	-15	046 / aerial	641	-11	-151	131	-1	-14
11:46	76	051 / aerial	13° (under plume) from the left edge of plume	051 / aerial	774	-169	51	108	-13	4	051 / aerial						
12:40	130	CCG210	200 to 400 m from fire, blimp 175 m high														

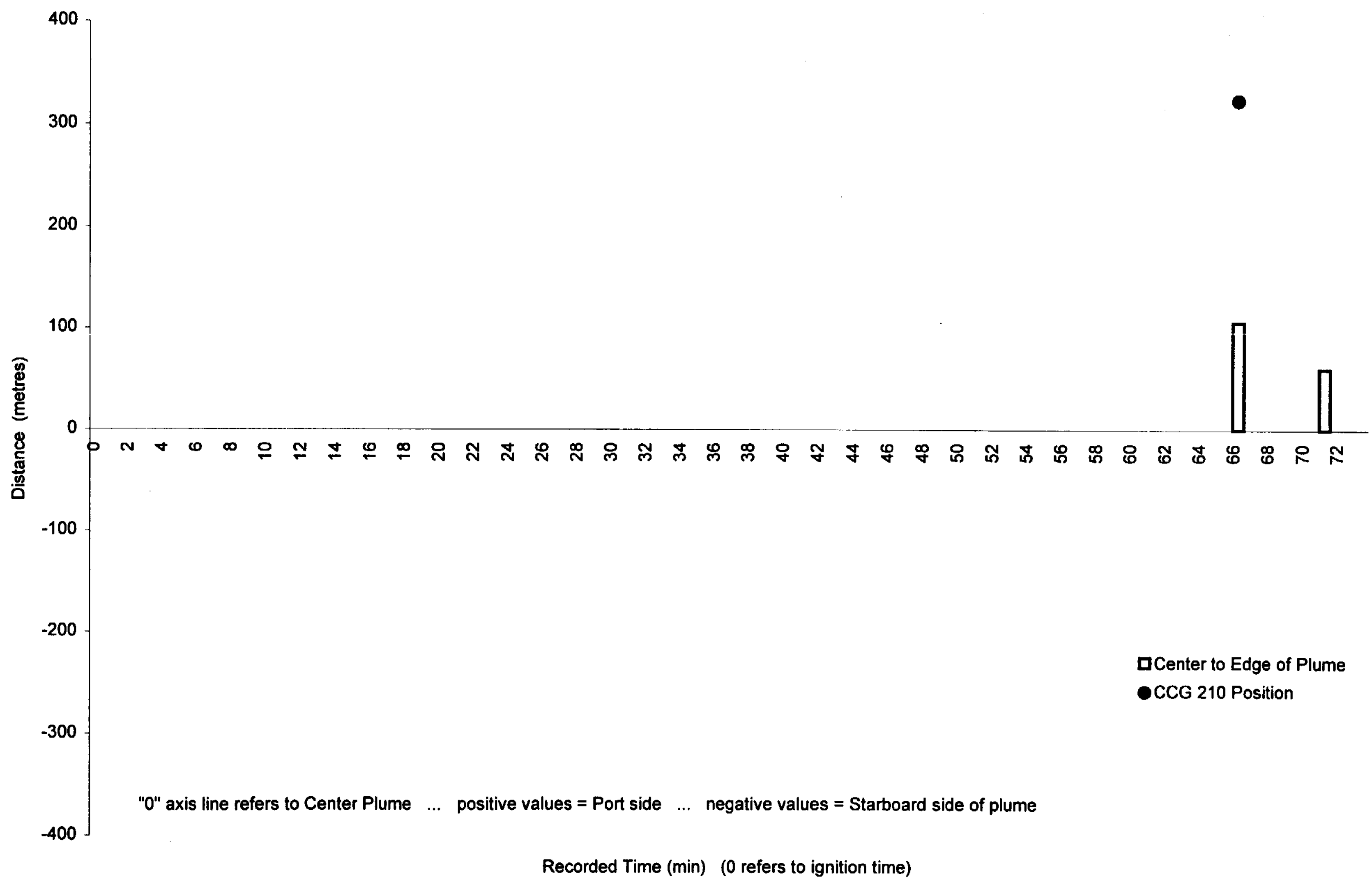
NOBE 93 ..... CCG 210

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	CCG210	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)	BLIMP	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:51	-15	055 / aerial	Blimp not in use (055/aerial)	055 / aerial	237			85									
14:02	-4	060 / aerial	Blimp on CCG 210 (060/aerial)	060 / aerial	241			95									
14:05	-1	062 / aerial		062 / aerial	184			95									
14:10	4	065 / aerial	Under plume	065 / aerial	Under plume			Under plume									
14:10	4	CCG210	Second package pump on														
14:10	4	Ann Harvey	Blimp being released														
14:13	7	CCG210	Second package in smoke														
14:15	9	068 / aerial									068 / aerial	261	-55	2	92	-12	1
14:19	13	071 / aerial									071 / aerial	270	-24	35	85	-5	8
14:28	22	074 / aerial	Under plume for both boat and blimp	074 / aerial	Under plume			Under plume			074 / aerial						
14:31	25	Sir Wilfred Grenfell	SWG notes blimp in plume														
14:34	28	077 / aerial									077 / aerial	389	-51	17	93	-8	3
14:55	49	Ann Harvey	Moved blimp under plume into heavier plume														
14:56	50	085 / aerial									085 / aerial	488	-43	32	83	-5	4
15:02	56	088 / aerial									088 / aerial	416	-55	44	74	-9	6
15:07	61	092 / aerial									092 / aerial	518	-113	68	78	-13	8
15:10	64	CCG210	Second package out of smoke														
15:12	66	094 / aerial	20° from left edge of plume	094 / aerial	627	218	324	65	20	30	094 / aerial	683	208	325	65	18	28
15:13	67	CCG210	Second package pump off														
15:17	71	097 / aerial	CCG 210, 40° from left edge of plume, Blimp on CCG 210	097 / aerial	746	511	571	55	40	45							
15:23	77	Ann Harvey	Will fly blimp one more time for weather check														

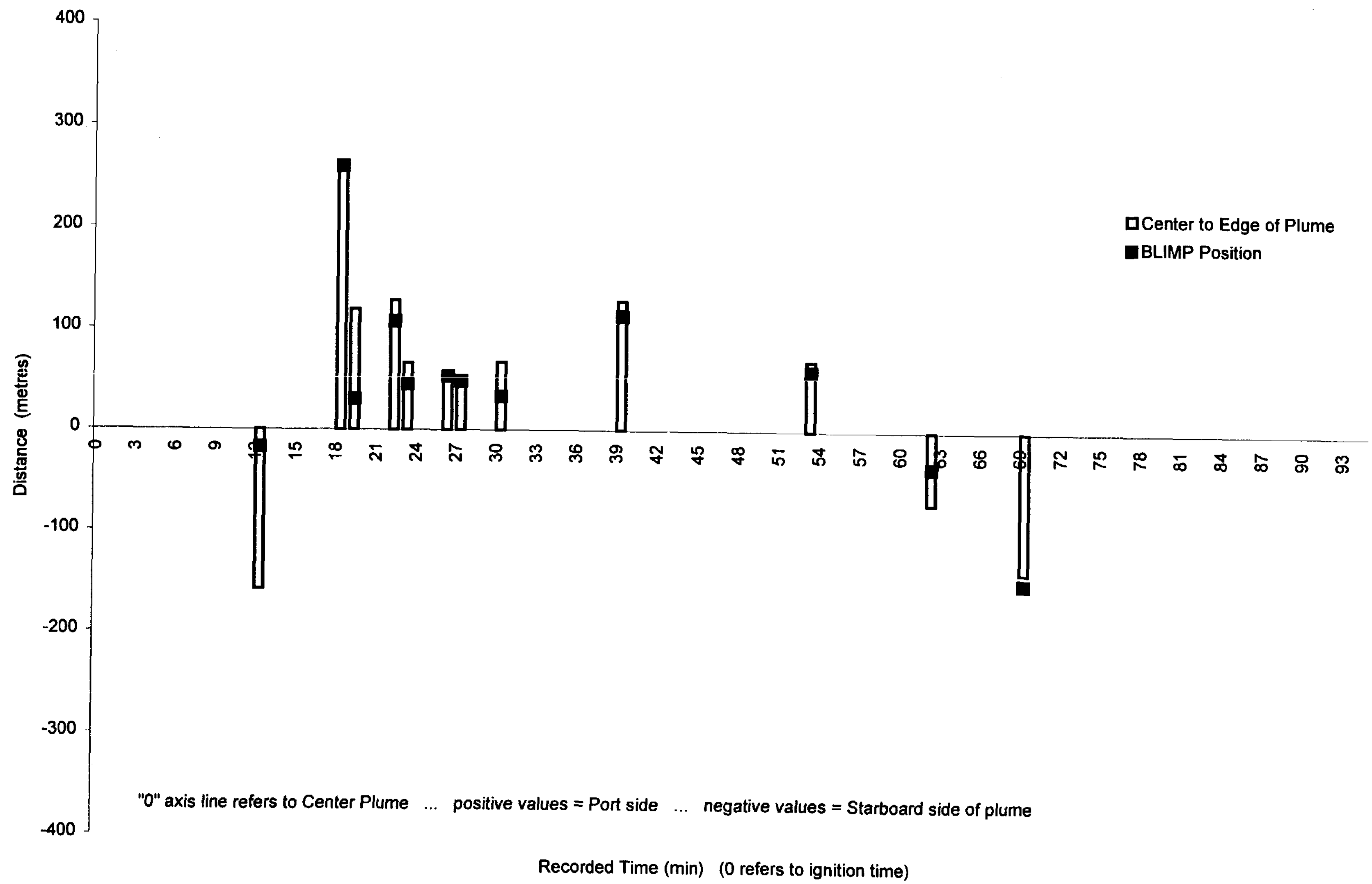
NOBE 93 ... BURN 1 ... CCG 210... MOVEMENT OVER TIME



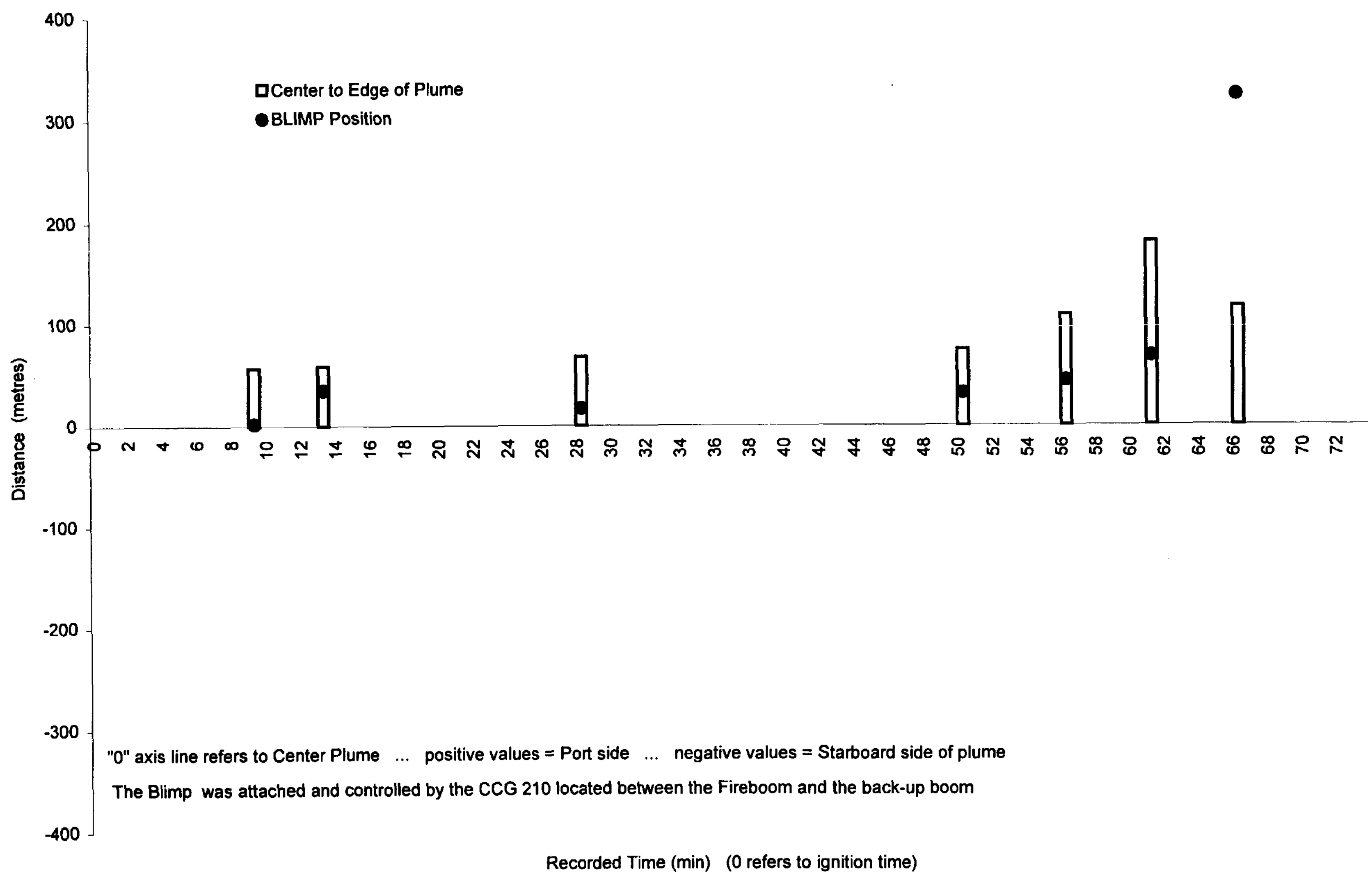
NOBE 93 ... BURN 2 ... CCG 210... MOVEMENT OVER TIME



NOBE 93 ... BURN 1 ... BLIMP... MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... BLIMP ... MOVEMENT OVER TIME



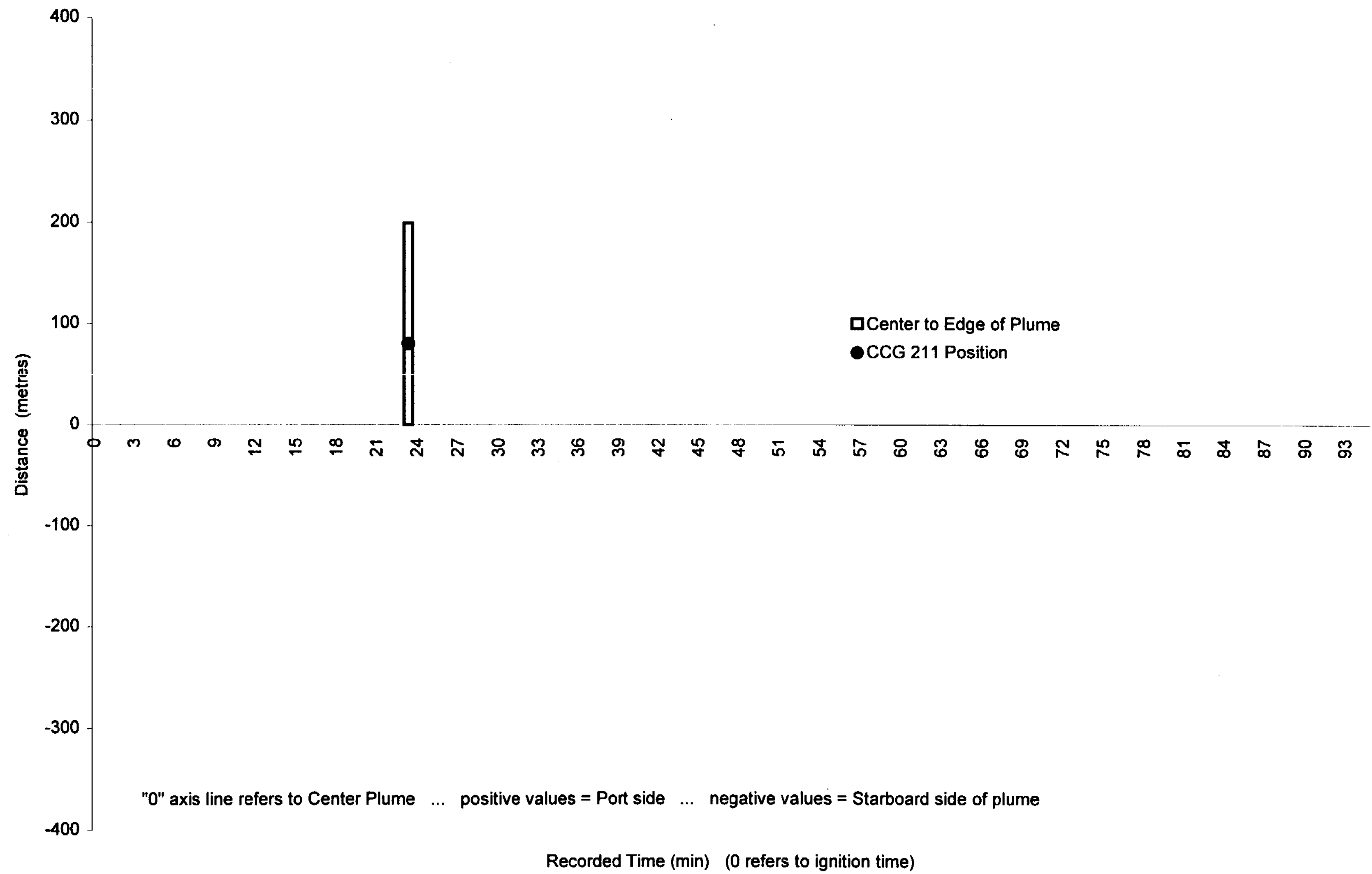
NOBE 93 ..... CCG 211

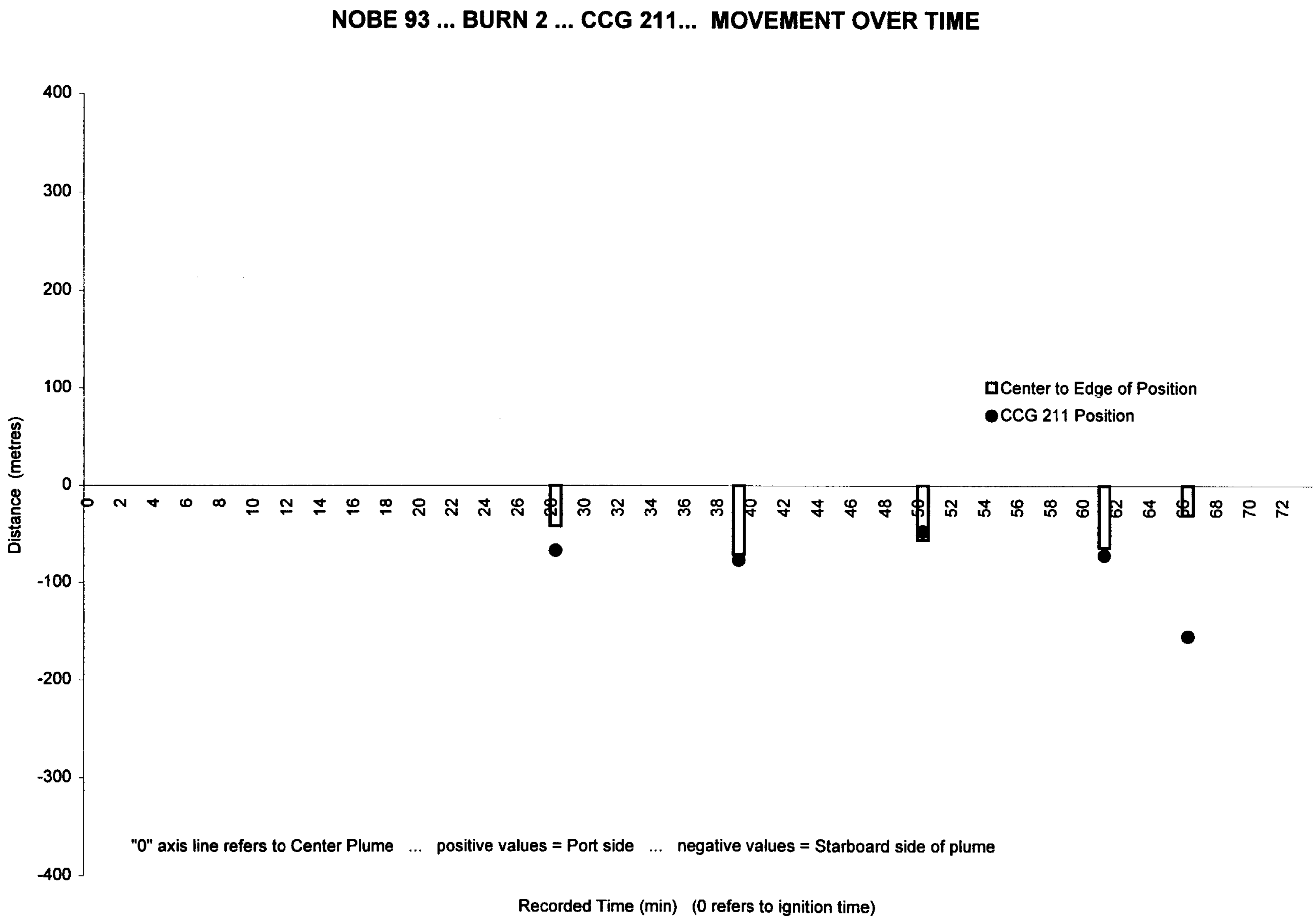
Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis(deg)	To Edge Plume (deg)	To Middle Plume (deg)
7:31		CCG218	Carl Froud picked up by CCG 205 to be transferred to CCG 211							
8:30	-120	CCG211	In air for sample run (4 min 14 sec)							
8:56	-94	CCG211	2 helicopters up							
9:17	-73			002 / aerial	252			95		
9:17	-73			003 / aerial	243			102		
9:24	-66			005 / aerial	228			105		
9:27	-63	CCG211	Badges open, pump on							
10:04	-26	Ann Harvey	Mini helicopter in air (no I.D.)							
10:06	-24	CCG211	Smell oil fairly strong, CCG 207 R/C helicopter up							
10:17	-13			007 / aerial	283			103		
10:34	4	CCG211	Plume directly above us, helicopter up							
10:38	8	012 / aerial	Under plume	012 / aerial	Under plume			Under plume		Under plume
10:39	9	CCG211	Plume is lower and very thick, our helicopter 20 m under plume							
10:40	10									
10:41	11	CCG211	Helicopter down, plume smaller							
10:42	12	016 / aerial	Maybe CCG 211 ???	016 / aerial	400	139	0	105	20	0
10:42	12	017 / aerial	Under plume	017 / aerial	Under plume			Under plume		
10:43	13	CCG211	Strong oil smell and burnt plastic							
10:48	18			020 / aerial				Under plume		
10:48	18	CCG211	Helicopter up, 40 m high just below plume							
10:52	22			024 / aerial	457	-119	80	105	-15	10
10:52	22	CCG211	Plume seen lower, helicopter still in same relative position							
10:55	25	CCG211	Helicopter down							
10:56	26			030 / aerial				Under plume		
11:00	30			033 / aerial				Under plume		
11:03	33	Ann Harvey	Remote helicopters both on deck now							
11:06	36	CCG211	Helicopter up, within edge of plume and just below 40 m high							
11:09	39			036 / aerial				Under plume		
11:17	47	CCG211	Helicopter down							
11:23	53	040 / aerial	Under plume	040 / aerial	Under plume			Under plume		
11:27	57	CCG211	Removing film of plume from blades and body of helicopters, very black residue on white swabs							
11:31	61	CCG211 / Ann Harvey	Finished sampling for first burn							
11:32	62			043 / aerial				Under plume		
11:39	69			046 / aerial				Under plume		
11:46	76	051 / aerial	Under plume	051 / aerial	Under plume			Under plume		

NOBE 93 ..... CCG 211

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis(deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:51	-15			055 / aerial	259			95		
13:55	-11	CCG211	Problem with air sampling pump on R/C helicopter, battery?							
13:58	-8		CCG 205 located near CCG 212 (PAT/slide)							
13:58	-8			057 / aerial	271			105		
14:02	-4			060 / aerial	266			109		
14:03	-3	CCG211	One dolphin dead ahead of CCG 211, no further sightings							
14:05	-1			062 / aerial	231			109		
14:05	-1	CCG211	Switching to back-up chopper							
14:10	4	064 / aerial	Under plume	064 / aerial	Under plume			Under plume		
14:11	5	CCG211	Helicopter up and sampling, 18 m high, plume is low							
14:17	11	CCG211	Helicopter down, charcoal sampler barely on to sample pipe, question as to whether air passed through it or not							
14:19	13	071 / aerial	Under plume	071 / aerial	Under plume			Under plume		
14:25	19	CCG211	Helicopter up, underneath plume 20 m high							
14:28	22	074 / aerial	Under plume	074 / aerial	Under plume			Under plume		
14:33	27	CCG215	Small helicopter about 5 m off water (now black) (which one???)							
14:33	27	CCG211	Helicopter down							
14:34	28	077 / aerial	6° from right edge of plume	077 / aerial	241	-25	-67	111	-6	-16
14:39	33	078 / aerial	Under plume	078 / aerial	Under plume			Under plume		
14:45	39	081 / aerial	1° from right edge of plume	081 / aerial	339	-6	-77	110	-1	-13
14:47	41	CCG211	Helicopter up, 3 m within plume and just under it, 20 m high							
14:55	49	CCG211	Helicopter down							
14:56	50	085 / aerial	2° (under plume) from right edge of plume	085 / aerial	334	9	-47	93	2	-8
15:02	56	088 / aerial	Under plume	088 / aerial	Under plume			Under plume		
15:07	61	CCG211	Fireboom failed, abort, ground all helicopters							
15:07	61	092 / aerial	2° from right edge of plume	092 / aerial	243	-8	-72	112	-2	-17
15:12	66	094 / aerial	39° from right edge of plume	094 / aerial	187	-125	-155	149	-39	-49
15:17	71			097 / aerial	72			165		

NOBE 93 ... BURN 1 ... CCG 211... MOVEMENT OVER TIME





NOBE 93 ... BURN 2 ... CCG 211... MOVEMENT OVER TIME
Center to Edge of Position
CCG 211 Position
Distance (metres)
400
300
200
100
0
-100
-200
-300
-400
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
"0" axis line refers to Center Plume ... positive values = Port side ... negative values = Starboard side of plume
Recorded Time (min) (0 refers to ignition time)

NOBE 93 ..... CCG 212

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
6:02		218	On location with Grenfell, CCG 214, CCG 203, CCG 218							
7:23			Towing Ro-Boom							
7:24		Ann Harvey	Have Ro-Boom deployed and in position							
8:45	-105	Sir Wilfred Grenfell	Adjusting Ro-Boom to pattern							
10:14	-16	CCG212	Open SUMMA 1A							
10:19	-11	CCG212	Close 1A SUMMA							
10:25	-5	CCG212	Open SUMMA 1B							
11:17	47	CCG212	Close 1B SUMMA							

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:55	-11	CCG212	Open 2A SUMMA							
14:00	-6	CCG212	Close 2A SUMMA							
14:06	0	CCG212	Open 2B SUMMA							
14:54	48	CCG212	Close 2B (47 min 25 sec) SUMMA							

NOBE 93 ..... CCG 214

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
2:50		CCG214	CCG 214 departs dock with 6 people							
6:02		CCG218	On location with Grenfell, CCG 212, CCG 203, CCG 218							
6:03		CCG214	CCG 214 on site							
6:54		CCG214	Takes on line from fireboom off stern of Sir Wilfred Grenfell							
7:23			Towing Ro-Boom							
7:24		Ann Harvey	Have Ro-Boom deployed and in position							
8:45	-105	Sir Wilfred Grenfell	Adjusting Ro-Boom to pattern							
9:04	-86		Took background							
9:25	-65		Boat 4 deployed							
9:56	-34	CCG214	Badges on by Christopherson							
10:09	-21	CCG214	Can smell oil from fireboom or possibly exhaust from sea truck up forward							
10:13	-17	CCG214	Turn On SUMMA 1A on bow of CCG 214							
10:13	-17	CCG214	Turn on pump to green charcoal tube (benzene)							
10:19	-11	CCG214	Turn Off SUMMA 1A, elapsed time: 5 min 13 sec							
10:31	1	CCG214	Turned on SUMMA 1B							
11:17	47	CCG214	Turned off SUMMA 1B, elapsed time: 46 min 09 sec							
12:08	98	CCG214	Put benzene badge back in can and capped							
12:08	98	CCG214	Secured pump to green charcoal tube (benzene) and cap green tube							

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:25	-41	CCG214	Set-up for second burn; badges on							
13:54	-12	CCG214	Turned on pump to orange charcoal tube (benzene)							
13:54	-12	CCG214	Opened SUMMA 2A							
14:01	-5	CCG214	Close SUMMA 2A, elapsed time: 6 min 24 sec							
14:09	3	CCG214	Open SUMMA 2B							
14:54	48	CCG214	Close SUMMA 2B, elapsed time: 44 min 46 sec							
15:28	82	CCG215	Boat 1 alongside							
15:29	83	CCG215	PUF sample black							
15:30	84	CCG214	Remove badge and recap in aluminium cap							
15:30	84	CCG214	Shut off pump to orange charcoal tube (benzene), cap orange tube							

NOBE 93 ..... CCG 215

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
8:10	-140	CCG215	Personnel ferried to CCG215, good day, light winds							
8:25	-125	CCG215	Brought # 1 alongside, antenna damaged and trailing in water							
8:30	-120	CCG215	Antenna righted							
8:33	-117	CCG215	NOAA aircraft spotted							
8:34	-116	CCG215	Boat 4 brought alongside							
8:38	-112	CCG215	Martine's checking boat 4							
8:39	-111	CCG215	Removed plug from air sampling train on starboard side of boat # 4							
8:44	-106	CCG215	Martine is checking port side of boat 4							
8:46	-104	CCG215	Plugs pulled port side, R/C # 4							
8:48	-102	CCG215	Cross check to other sample boat							
8:50	-100	CCG215	Rob setting up DAG system, almost done							
8:53	-97	CCG215	PS-1 # 1 and 2 on							
8:54	-96	CCG215	PS-1 # 7 (48)							
8:58	-92	CCG215	PS-1 # 8 (56)							
8:59	-91	CCG215	Boat ready							
9:03	-87	CCG215	CCG 215 about 75 m from boom							
9:04	-86	CCG215	Took background							
9:06	-84	CCG215	H2O samples ... boat # 4							
9:16	-74	CCG215	Awaiting thermistor attachment on Fireboom							
9:17	-73			002 / aerial	82			68		
9:17	-73			003 / aerial	122			75		
9:24	-66	CCG215	Boat 4 ready for deployment	005 / aerial	76			70		
9:25	-65	CCG215	Boat 4 deployed, Rob has power							
9:29	-61	CCG215	Boat 4 in position							
9:30	-60	CCG215	**Start of ... Pre-ignition ... for burn 1**							
9:31	-59	CCG215	Test of discharge system on Grenfell							
9:34	-56	CCG215	Bow line # 1 snapped, boat recovered							
9:39	-51	CCG215	Boat 4 about 60 m behind boom							
9:45	-45	CCG215	Pump on Sir Wilfred Grenfell jammed, being repaired							
9:53	-37	CCG215	Boat 4 approx. 60 m from boom							
9:59	-31	CCG215	500 L test oil in boom							
10:02	-28	CCG215	CCG 215 120 m from boat # 4							
10:09	-21	CCG215	CCG 215 70 m from # 4 boat							
10:12	-18	CCG215	Burn 1 evaporation period							
10:13	-17	CCG215	Moving boats closer to boom, # 4 50 m from boom							
10:14	-16	CCG215	Bank 1 on							
10:16	-14	CCG215	Both signals on (sigmas probably (m))							
10:17	-13	CCG215	Bank 1 on for 400s	007 / aerial	119			53		
10:19	-11	CCG215	Helicopter lifted off							
10:20	-10	CCG215	CCG 215 50 m off port beam of sample boat # 4; smell of hydrocarbons							

NOBE 93 ..... CCG 215

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
10:23	-7	CCG215	Helitorch lit (test)							
10:28	-2	CCG215	Helitorch on, no visible flame on slick							
10:29	-1	CCG215	**END of ... Pre-ignition for burn 1**							
10:30	0	CCG215	**IGNITION** ... Another attempt at ignition, oil lit							
10:30		CCG215	Sample boat # 4 reverse, Martine in control, plume approx. 150 m downwind; instruments on							
10:31	1	CCG215	Helitorch returned to ignite another oil patch on east (port) side of boom							
10:32	2	CCG215	Rob returned, trying to recover boat control							
10:33	3	CCG215	Boat # 4 still abeam to fire at 100 m downwind; some smoke at sea level							
10:34	4	CCG215	Two separate fires burning, port being small							
10:35	5	CCG215	Plume over NIST boat extending downwind							
10:36	6	CCG215	Small boats together approx. 120 m downwind; moved across plume to recover boat # 4							
10:37	7	CCG215	NIST balloon in plume							
10:38	8	CCG215	Recovering Boat # 4 alongside of CCG 212; we are close to one small helicopter immediately downwind	012 / aerial	326	40	207	88	7	37
10:38	8			013 / aerial	371	81	239	88	13	38
10:41	11	CCG215	Sigmas on .... which boat ????							
10:42	12	CCG215	Smoke dissipating overhead; moving back to port of boom; plume extends backwards; recovered boat; moving back to position	016 / aerial				Under clouds		
10:42	12	CCG215		017 / aerial	378	-17	123	93	-3	19
10:45	15	CCG215	Untieing # 4 boat after moving abeam of other sampling boat # 2							
10:46	16	CCG215	Rob controlling boat and it is moving back to position (# 4 ?)							
10:47	17	CCG215	See what appears to be residue to starboard of CCG 215; sample # 4 boat 100 m to side of plume							
10:48	18	CCG215	Recovering # 4, boat not responding to computer	020 / aerial	297	26	154	85	5	30
10:51	21	CCG215	Even with NIST blimp boat, recovering # 4 on port side of CCG 215							
10:52	22	CCG215	12° from left edge of plume	023 / aerial	407	85	190	83	12	27
10:52	22	CCG215	10° from left edge of plume	024 / aerial	418	73	190	85	10	26
10:55	25	CCG215	Attempting to go under plume with sampling boat and CCG 215							
10:56	26	CCG215	10° from left edge of plume	029 / aerial	459	80	189	83	10	24
10:56	26	CCG215	16° from left edge of plume	030 / aerial	471	131	232	79	16	29
10:58	28	CCG215	300 m from boom, 100 m to port (CCG 215); plume seems to be dissipating over secondary boom							
11:00	30	CCG215	20° from left edge of plume	033 / aerial	406	141	252	78	20	36
11:03	33	CCG215	Sigmas on							
11:07	37	CCG215	Now abeam (port) of NIST blimp boat, 50 m from plume							

NOBE 93 ..... CCG 215

Time (hh:mm)	Elapsed time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
11:08	38	CCG215	CCG 215 preparing boat # 1 as motor in # 4 appears cooked (cord tangled); port side filters removed, samples checked; turned boat # 1							
11:09	39	CCG215	25° from left edge of plume	036 / aerial	249	108	181	85	25	43
11:14	44	CCG215	CCG 215 200 m from boom, saw burn residue							
11:15	45	CCG215	Bank 1 off							
11:17	47	CCG215	PS-1 # 2 (60)							
11:20	50	CCG215	PS1 # 1 (44)							
11:21	51	CCG215	CCG 215 about 100 m behind plume and 50 m to port							
11:22	52	CCG215	Launched boat # 1							
11:23	53	CCG215	26° from left edge of plume; all instruments on # 4 turned off	040 / aerial	178	80	125	79	26	41
11:24	54	CCG215	Boat # 1 20 m port of plume, 125 m astern of boom; all instruments "0n" for boat # 1							
11:25	55	CCG215	Boat # 1 nearly in line, 100 m from boom to starboard							
11:27	57	CCG215	Moving boat (# 1) to port							
11:30	60	CCG215	Moving boat (# 1) to starboard to align with plume							
11:32	62	CCG215	Sample boat # 1 In line about 100 m behind boom	043 / aerial	136	113	134	61	49	59
11:33	63	CCG215	Some smoke impinging on # 1							
11:36	66	CCG215	Martine removing SUMMAS from boat # 4							
11:37	67	CCG215	4/5 of oil burned							
11:39	69	CCG215	25° from left edge of plume	046 / aerial	153	105	153	70	40	60
11:42	72	CCG215	Smoke elevated slightly, no smoke impinging on # 1							
11:43	73	CCG215	Sigmas on (???boat 1)							
11:44	74	CCG215	CCG 215 50 m from boat #1 on port side, 60 m from boom; fog completely lifted, cloudless sky for last 1/2 hour							
11:46	76	CCG215	boat # 1 now 100 m from boom	051 / aerial	139	86	125	69	36	54
11:48	78	CCG215	Martine still removing samples from boat # 4							
11:52	82	CCG215	XO 6 boat # 4							
11:55	85	CCG215	PS- # 8, final reading 54							
11:58	88	CCG215	Martine is wrapping stack from boat # 4							
12:00	90	CCG215	Martine reports residue on her hands							
12:02	92	CCG215	Residue on bow rope of boat # 4; PS-1 # 7 (46) final reading							
12:03	93	CCG215	Fire nearly out							
12:09	99	CCG215	All instruments off except for water sampler							
12:11	101	CCG215	Bringing boat alongside CCG 215							
12:12	102	CCG215	Bow of # 1 covered with burn residue							
12:16	106	CCG215	Globs of burn residue visible downwind of boom							
12:48	138	CCG215	Martine is getting # 1 ready, fresh PUF sampler arrived via CCG 203							

NOBE 93 ..... CCG 215

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:05	-61	CCG215	Started generator to charge Moose's video batteries							
13:14	-52	CCG215	PS 1 # 1 (48)							
13:17	-49	CCG215	Clear skies, light winds, some high cirrus							
13:19	-47	CCG215	PS 1 # 1, burn 2, start at 48							
13:34	-32	CCG215	Burn 2, Boat # 1, SUMMA A, restrictor 80 reused from burn 1A							
13:36	-30	CCG215	Boat 1 burn 1 EXO 1							
13:47	-19	CCG215	PS 1 # 2 post burn 1 (54)							
13:48	-18	CCG215	PS 1 # 2 pre-burn 2 (60)							
13:51	-15			055 / aerial	137			50		
13:52	-14	CCG215	Helitorch lift off							
13:53	-13	CCG215	Boat # 1 ready							
13:54	-12	CCG215	Discharge started							
13:55	-11	CCG215	Boat #1 cast off, CCG 215 50 m astern of boom 50 m to port							
13:56	-10	CCG215	Boat # 1 under power							
13:58	-8	CCG215	Datalogger bank 1 on	057 / aerial	149			60		
13:59	-7	CCG215	Sigmas on							
14:00	-6	CCG215	Boat # 1 75 m downwind from boom							
14:01	-5	CCG215	3000 L discharge							
14:02	-4	CCG215	Boat # 1 50 m downwind from boom	060 / aerial	118			70		
14:04	-2	CCG215	Smell hydrocarbon; Bank 1off							
14:05	-1			062 / aerial	108			69		
14:06	**0**	CCG215	IGNITION for BURN 2; attempted ignition, did work (but slowly)							
14:08	2	CCG215	Boat # 1 50 m from boom downwind							
14:09	3	CCG215	Fire fully involved; instrument on, PS-1 is on, bank 3							
14:10	4	CCG215	Smoke impinging on boat 1, 50 m downwind of boom	065 / aerial	122	42	83	50	20	40
14:11	5	CCG215	Boat # 1 not quite under plume, Rob moving to plume							
14:12	6	CCG215	Smoke dissipating around secondary boom							
14:13	7	CCG215	CCG 215 60 m downwind, 50 m to port; boat # 1 50 m downwind slightly abeam							
14:14	8	CCG215	Boat #1 now aligned							
14:15	9	CCG215	Sun under plume, feels like eclipse	068 / aerial	112	21	50	69	11	26
14:17	11	CCG215	Boat #1 approx. 30 m downwind, CCG 215 20 m to port							
14:18	12	CCG215	Moving boat #1 closer, 20 to 25 m astern of boom, almost in fire, <10 m away							
14:19	13			071 / aerial	67	18	41	65	15	35
14:20	14	CCG215	Moving back CG about 30 m from fire							
14:23	17	CCG215	Fire spilling outside boom, small slick burning downwind (does this mean oil quite thick?)							
14:24	18	CCG215	Boat #1 50 to 60 m downwind (astern) of boom							
14:25	19	CCG215	Appears that plume extends 2000 m downwind							

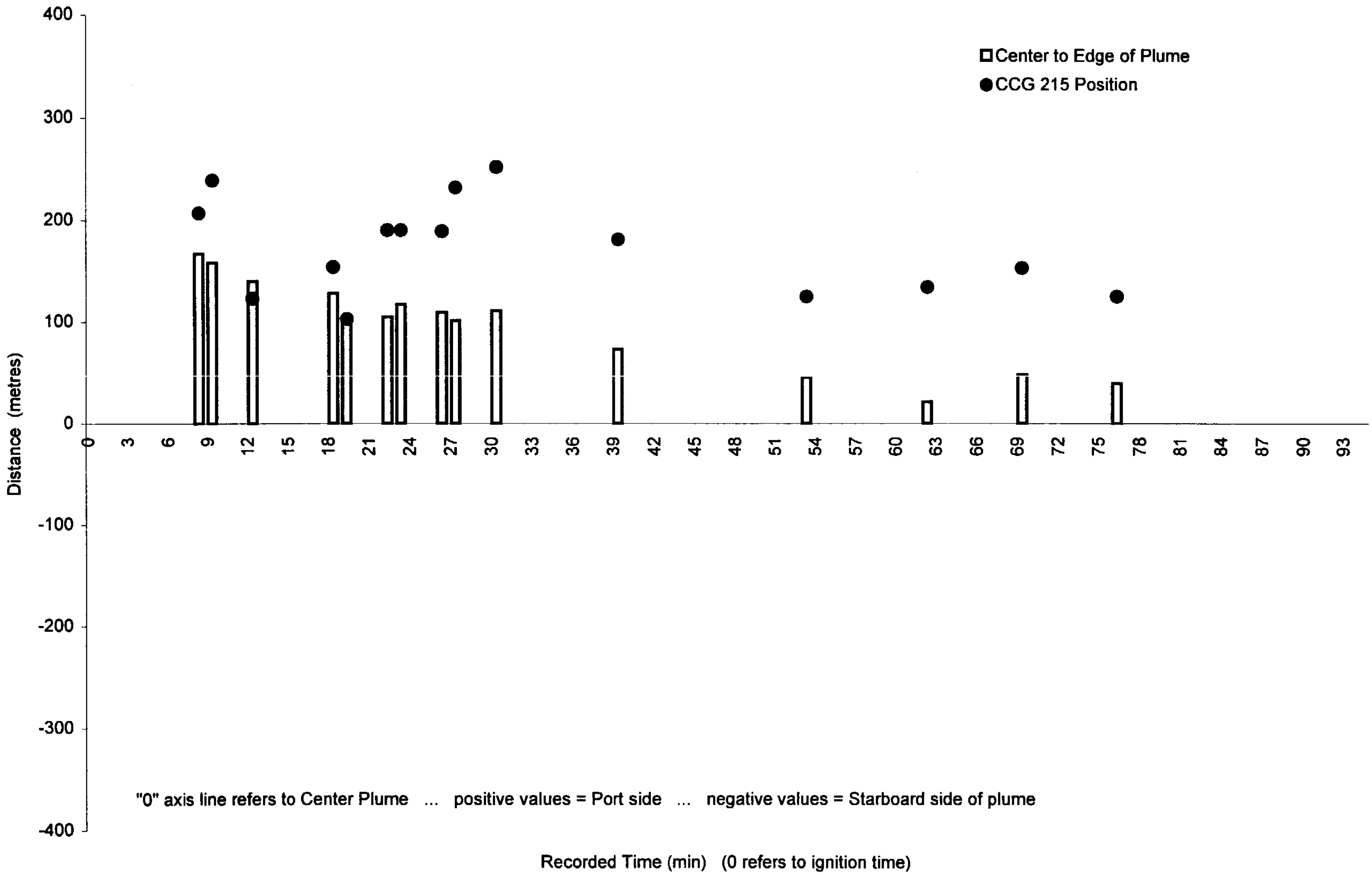
NOBE 93 ..... CCG 215

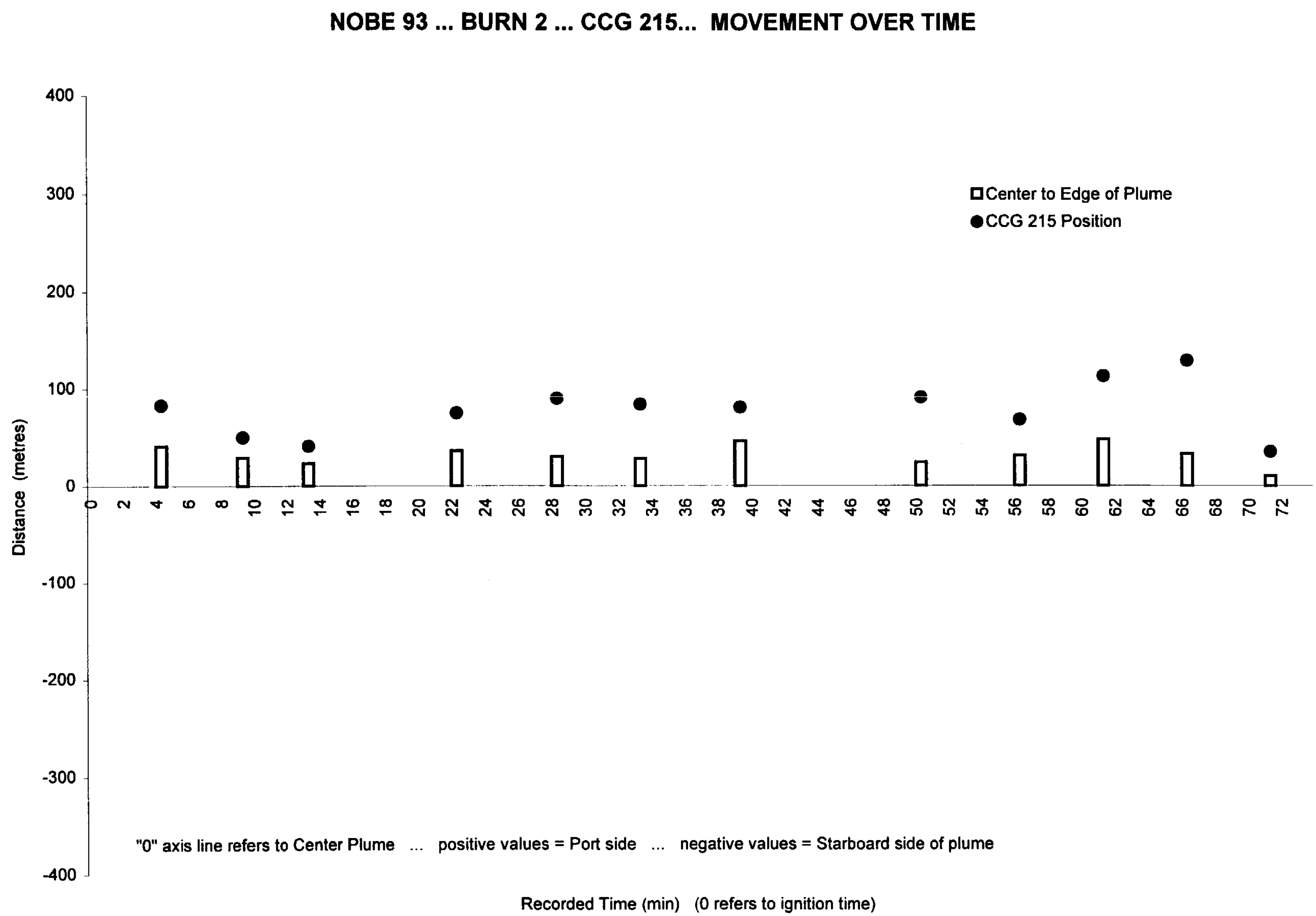
Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
14:26	20	CCG215	Boat # 1 #1 50 m downwind of fire, smoke impinging on sampler							
14:27	21	CCG215	Merv radioed to have Rob move boat back							
14:28	22			074 / aerial	107	39	75	69	21	41
14:29	23	CCG215	Boat # 1 turned abeam (starboard) side							
14:30	24	CCG215	Spot sub antenna 10 m from boom downwind							
14:31	25	CCG215	Boat 1 now in line							
14:32	26	CCG215	Sample boat 1 60 m downwind							
14:33	27	CCG215	Small helicopter about 5 m off water (now black)							
14:34	28	CCG215	25° from left edge of plume	077 / aerial	140	60	90	55	25	38
14:35	29	CCG215	Boats are drifting to port, also boat #1 is about 100 m behind fire							
14:38	32	CCG215	Boat # 1 is about 70 m boom downwind, but aligned							
14:39	33	CCG215	Boat # 1 is 50 m downwind of burn	078 / aerial	112	56	84	61	29	44
14:42	36	CCG215	Boat # 1 70 m downwind of plume, plume extends farther (apparently)							
14:45	39			081 / aerial	135	35	81	65	15	35
14:46	40	CCG215	Boat # 1 now about 50 m from fire, but has slid to port; turn on sigmas							
14:50	44	CCG215	Fire looks like it is going out							
14:52	46	CCG215	Boat # 1 is 50 m downwind of fire							
14:53	47	CCG215	Fire building again							
14:56	50	CCG215	Fire building, boat # 1 is 50 to 60 m downwind; instruments off except datalogger	085 / aerial	99	67	91	40	40	55
14:58	52	CCG215	Bank 3 off							
15:00	54	CCG215	Sigma on							
15:01	55	CCG215	Boat # 1 is 50 m from fire							
15:02	56	CCG215	Spot boom section floating by boat # 4, pumping stopped	088 / aerial	122	37	68	53	18	33
15:04	58	CCG215	Boat 1 abeam (starboard) to fire							
15:05	59	CCG215	Instruments off except datalogger							
15:07	61	CCG215	25° from left edge of plume	092 / aerial	151	65	113	55	25	44
15:08	62	CCG215	Small amount of oil escaped boom and is burning							
15:11	65	CCG215	Boat # 1 is 100 m downwind of boom							
15:12	66	CCG215	41° from left edge of plume	094 / aerial	137	96	129	49	41	56
15:13	67	CCG215	Believe I can spot missing piece of boom, port side quite near upwind side of fire							
15:15	69	CCG215	Fire getting smaller; boat # 1 is 70 m from boom							
15:16	70	CCG215	Spot another hole in boom, 3 sections closer to apex, sample boats out of alignment, fire very small							
15:17	71	CCG215	20° from left edge of plume	097 / aerial	73	25	35	75	20	28
15:18	72	CCG215	See some residue within 20 m of fire							

NOBE 93 ..... CCG 215

Time (hh:mm)	Elapsed time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
15:20	74	CCG215	Fire out							
15:25	79	CCG215	Sigma on							
15:28	82	CCG215	Boat 1 alongside							
15:29	83	CCG215	PUF sample black; PS 1 # 1 post pressure 40							
15:30	84	CCG215	TIME ???? PS 1 # 2 post pressure 48							
Notes		Martine	Boat # 4 used in first burn; 10 to 15 minutes into burning it malfunctioned, boat # 2 then takes its place closest to the fire and # 4 is behind # 2							
Notes		Martine	Approx. 30 minutes later # 4 is recovered and # 1 is sent to replace it. For the rest of burn 1, we have # 2 closest to the fire and # 1 is behind. For burn # 2, boat # 1 is closest to the fire and # 2 is behind; this is for the duration of the second burn							

NOBE 93 ... BURN 1 ... CCG 215... MOVEMENT OVER TIME




NOBE 93 ... BURN 2 ... CCG 215... MOVEMENT OVER TIME
Center to Edge of Plume
CCG 215 Position
Distance (metres)
400
300
200
100
0
-100
-200
-300
-400
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
"0" axis line refers to Center Plume ... positive values = Port side ... negative values = Starboard side of plume
Recorded Time (min) (0 refers to ignition time)

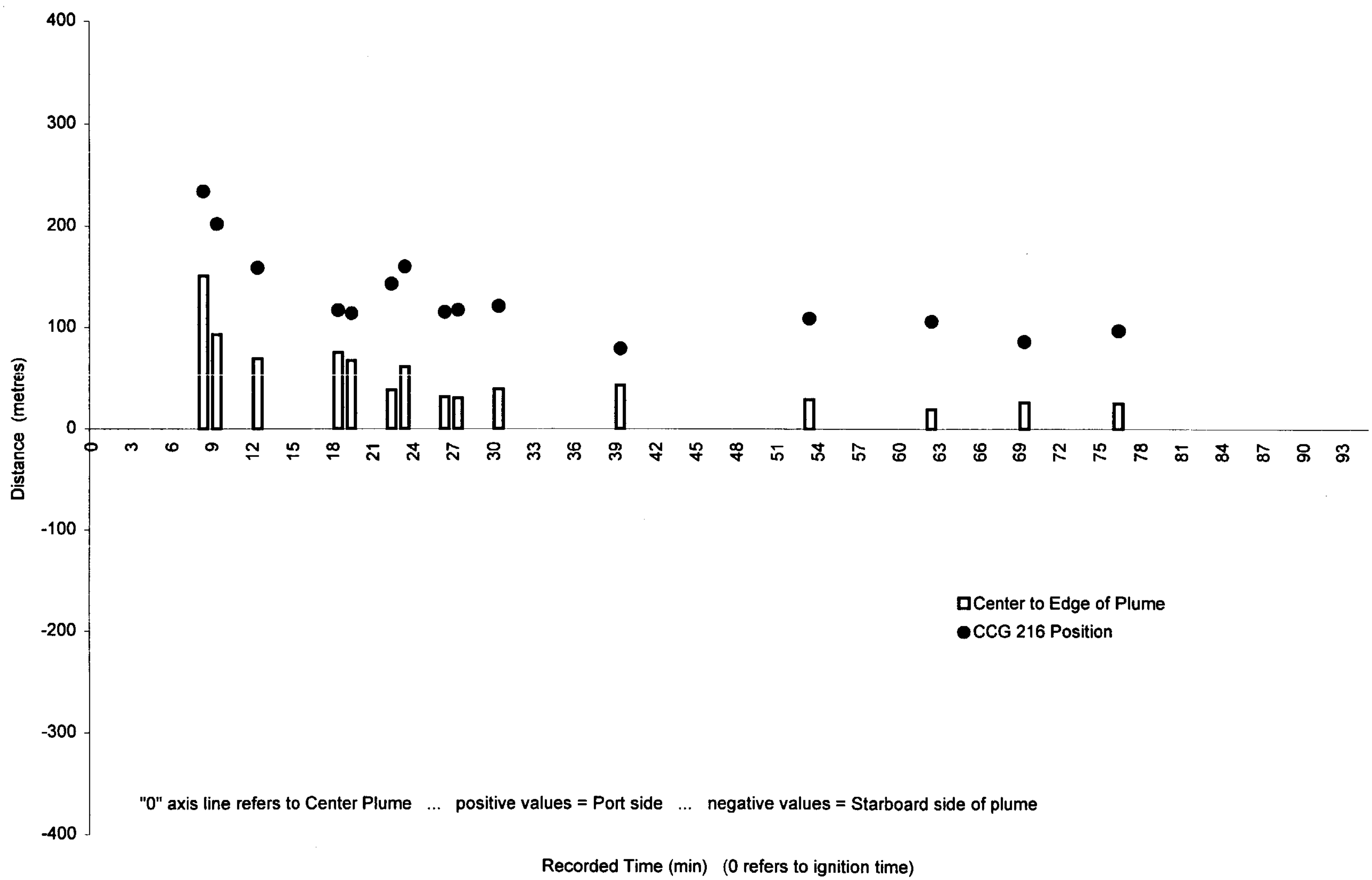
NOBE 93 ..... CCG 216

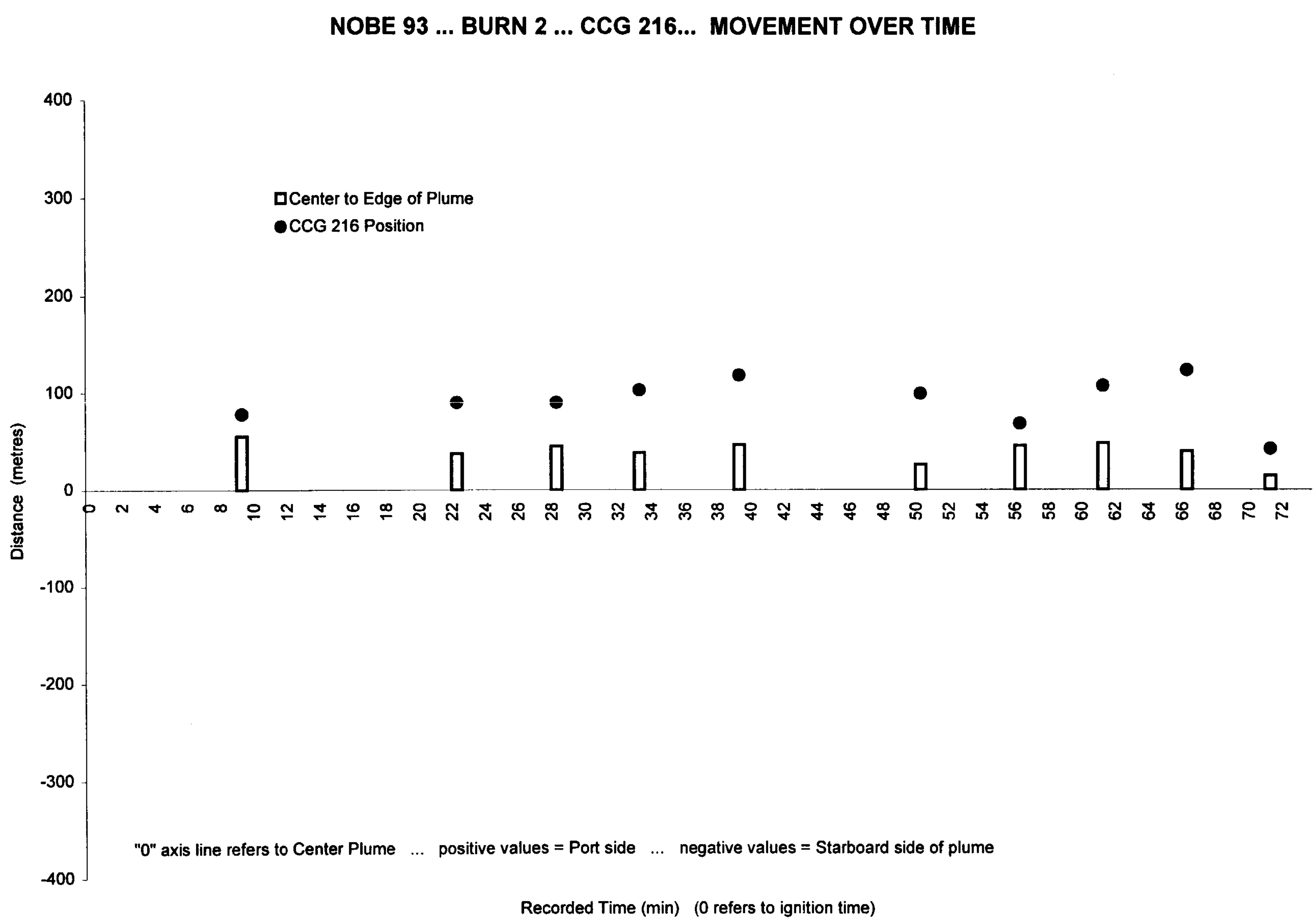
Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
1:30		CCG216	Meet in lobby							
2:01		CCG216	Departed hotel for CG base							
2:15		CCG216	Arrived base							
3:00		CCG216	Depart base on board CCG 212							
6:15		CCG216	Began deployment of back-up boom from Sir Wilfred Grenfell							
6:47		CCG216	Back-up boom in the water							
8:20	-130	CCG216	Both remote sampling boats along side CCG 216							
9:17	-73			002 / aerial	119			80		
9:17	-73			003 / aerial	90			90		
9:24	-66			005 / aerial	127			70		
9:30	-60	CCG216	Launched boat # 2							
9:31	-59	CCG216	Attached badge, started pump, R/C # 2							
9:41	-49	CCG216	Attempt test discharge of oil, same thing, cloggy pump							
9:56	-34	CCG216	100 L test pump began							
9:58	-32	CCG216	500 L of test oil pumped out							
10:14	-16	CCG216	R/C # 2 75 m from fireboom							
10:17	-13			007 / aerial	151			63		
10:18	-12	CCG216	Both SUMMAs opened, R/C # 2							
10:36	6	CCG216	100 m from fire, fire appears to have gone over boom							
10:38	8			012 / aerial	193	83	234	65	25	75
10:38	8			013 / aerial	210	109	202	65	30	58
10:40	10	CCG216	Plume approx. 50 m over head of sample vessel							
10:42	12			016 / aerial				Under clouds		
10:42	12			017 / aerial	208	90	159	65	25	45
10:48	18			020 / aerial	163	42	117	65	15	42
10:48	18			021 / aerial	159	47	114	63	17	42
10:52	22			023 / aerial	157	105	143	51	39	54
10:52	22			024 / aerial	155	99	160	53	38	63
10:56	26	CCG216	R/C # 2 approx. 100 m from fire, plume approx. 25 m	029 / aerial	130	84	115	53	38	53
10:56	26			030 / aerial	127	87	117	50	40	55
11:00	30			033 / aerial	123	82	121	61	39	59
11:05	35	CCG216	R/C # 2 approx. 25 m from burn, smoke plume approx. 10 m overhead							
11:09	39			036 / aerial	103	36	79	80	20	45
11:23	53			040 / aerial	88	80	109	51	54	77
11:32	62			043 / aerial	86	87	106	49	61	76
11:39	69			046 / aerial	84	60	86	68	42	62
11:42	72	CCG216	CCG 205 located directly port side of CCG 215 and CCG 216							
11:46	76			051 / aerial	85	72	97	50	50	70
12:04	**94**	CCG216	**END OF BURN; turned off Gilian R/C # 2**							

NOBE 93 ..... CCG 216

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:51	-15			055 / aerial	141			60		
13:54	-12	CCG216	R/C # 3 launched from CCG 216							
13:57	-9	CCG216	Started Gilian pump							
13:58	-8			057 / aerial	186			65		
14:02	-4			060 / aerial	166			78		
14:05	-1			062 / aerial	145			73		
14:06	0	CCG216	Second burn, R/C # 2 150 m from flame, smoke plume 20 m overhead							
14:10	4	CCG216	Under plume	065 / aerial	Under plume			Under plume		
14:15	9			068 / aerial	162	23	78	72	8	28
14:28	22	CCG216	21° from left edge of plume	074 / aerial	146	53	90	69	21	36
14:34	28	CCG216	15° from left edge of plume	077 / aerial	173	45	90	65	15	30
14:39	33	CCG216	25° from left edge of plume	078 / aerial	151	65	103	65	25	40
14:45	39	CCG216	23° from left edge of plume	081 / aerial	184	72	118	68	23	38
14:56	50			085 / aerial	154	73	99	53	28	38
15:02	56			088 / aerial	173	23	68	63	8	23
15:07	61			092 / aerial	189	59	107	62	18	33
15:12	66			094 / aerial	173	84	123	62	28	42
15:17	71			097 / aerial	108	28	42	80	15	23

NOBE 93 ... BURN 1 ... CCG 216... MOVEMENT OVER TIME




NOBE 93 ... BURN 2 ... CCG 216... MOVEMENT OVER TIME
Center to Edge of Plume
CCG 216 Position
Distance (metres)
400
300
200
100
0
-100
-200
-300
-400
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64 66 68 70 72
"0" axis line refers to Center Plume ... positive values = Port side ... negative values = Starboard side of plume
Recorded Time (min) (0 refers to ignition time)

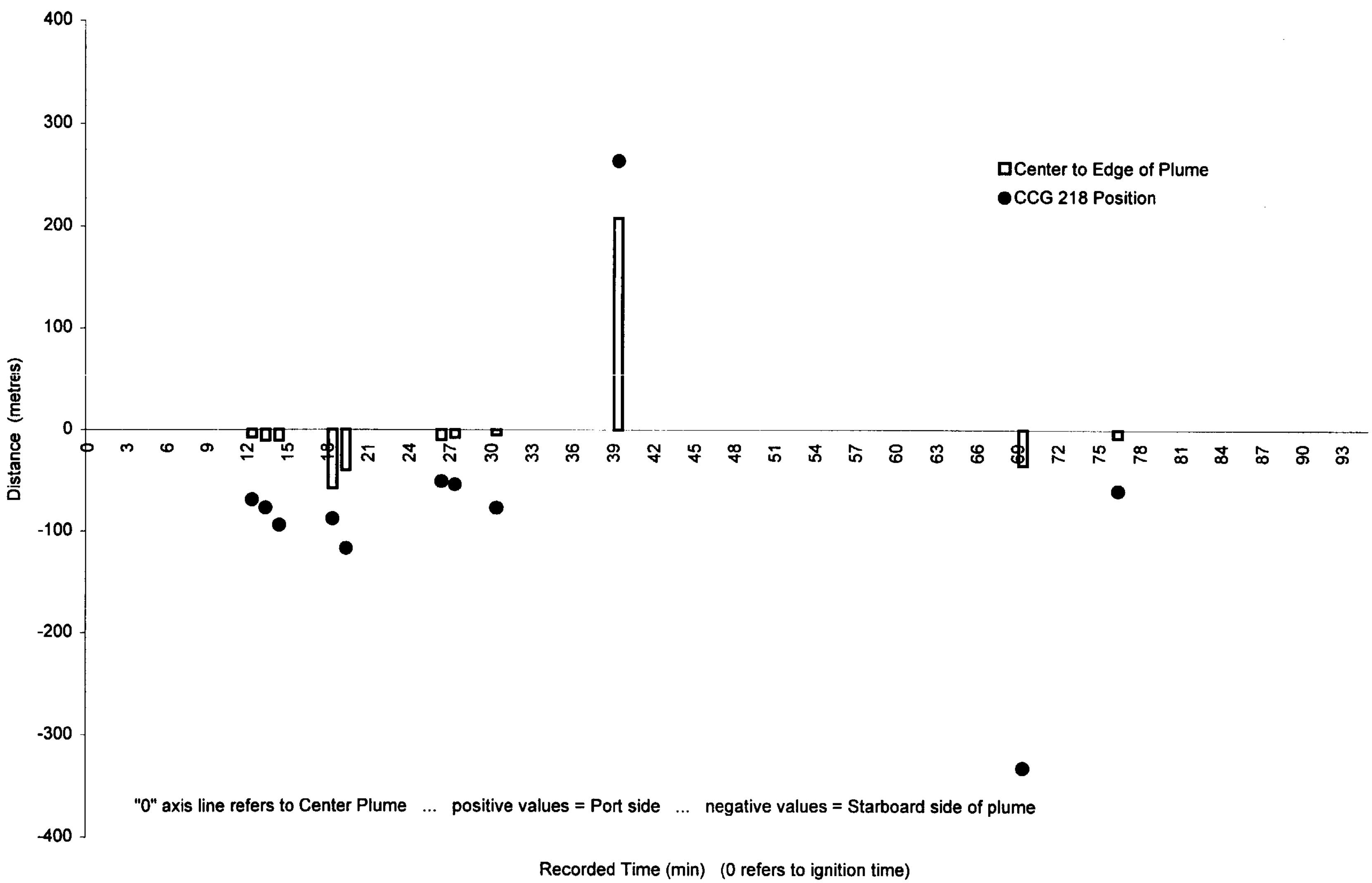
NOBE 93 ..... CCG 218

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
2:55		CCG218	Departed small boat harbour, stood by off Grenfell							
3:01		CCG218	Underway astern of Sir Wilfred Grenfell							
3:05		CCG218	Grenfell underway, us behind							
6:02		CCG218	On location with Grenfell, CCG 214, CCG 212, CCG 203 and ourselves CCG 218							
6:14		CCG218	Smoke bomb released and Sir Wilfred Grenfell oriented into wind							
7:14		CCG218	Completed putting out 3 buoys 50 m apart							
7:20		CCG218	Tying up to apex of fireboom and setting-up current meter							
7:47		CCG218	Noted a vertical tear in the PVC at section 5G on the inside of the U configuration							
8:47	-103	CCG218	Still at apex, smoke bombs in							
9:17	-73			002 / aerial	14			90		
9:17	-73	003 / aerial	At apex of fire-boom	003 / aerial	11			90		
9:24	-66	005 / aerial	At apex of fire-boom	005 / aerial	12			95		
9:31	-59	CCG218	CCG 218 cut lose from Fireboom, handed in markers							
10:17	-13			007 / aerial	32			100		
10:42	12	015 / aerial	95° from right edge of plume	015 / aerial	41	-61	-69	215	-95	-113
10:42	12	016 / aerial	70° from right edge of plume	016 / aerial	57	-66	-77	190	-70	-85
10:42	12	017 / aerial	85° from right edge of plume	017 / aerial	61	-83	-94	205	-85	-100
10:48	18	020 / aerial	15° from right edge of plume	020 / aerial	115	-30	-88	155	-15	-45
10:48	18	021 / aerial	30° from right edge of plume	021 / aerial	112	-77	-117	165	-40	-63
10:52	22			023 / aerial	287			252		
10:52	22			024 / aerial	308			255		
10:56	26	029 / aerial	65° from right edge of plume	029 / aerial	38	-41	-51	195	-65	-85
10:56	26	030 / aerial	65° from right edge of plume	030 / aerial	42	-46	-54	185	-65	-80
11:00	30	033 / aerial	100° from edge of plume	033 / aerial	47	-72	-77	215	-100	-110
11:09	39	036 / aerial	3° from left edge of plume	036 / aerial	800	56	264	101	4	19
11:39	69	046 / aerial	89° from right edge of plume	046 / aerial	202	-297	-332	235	-95	-111
11:46	76	051 / aerial	80° from right edge of plume	051 / aerial	42	-52	-60	205	-75	-90
12:09	99	CCG218	Reports 20 x 3 ft residue patch in boom							

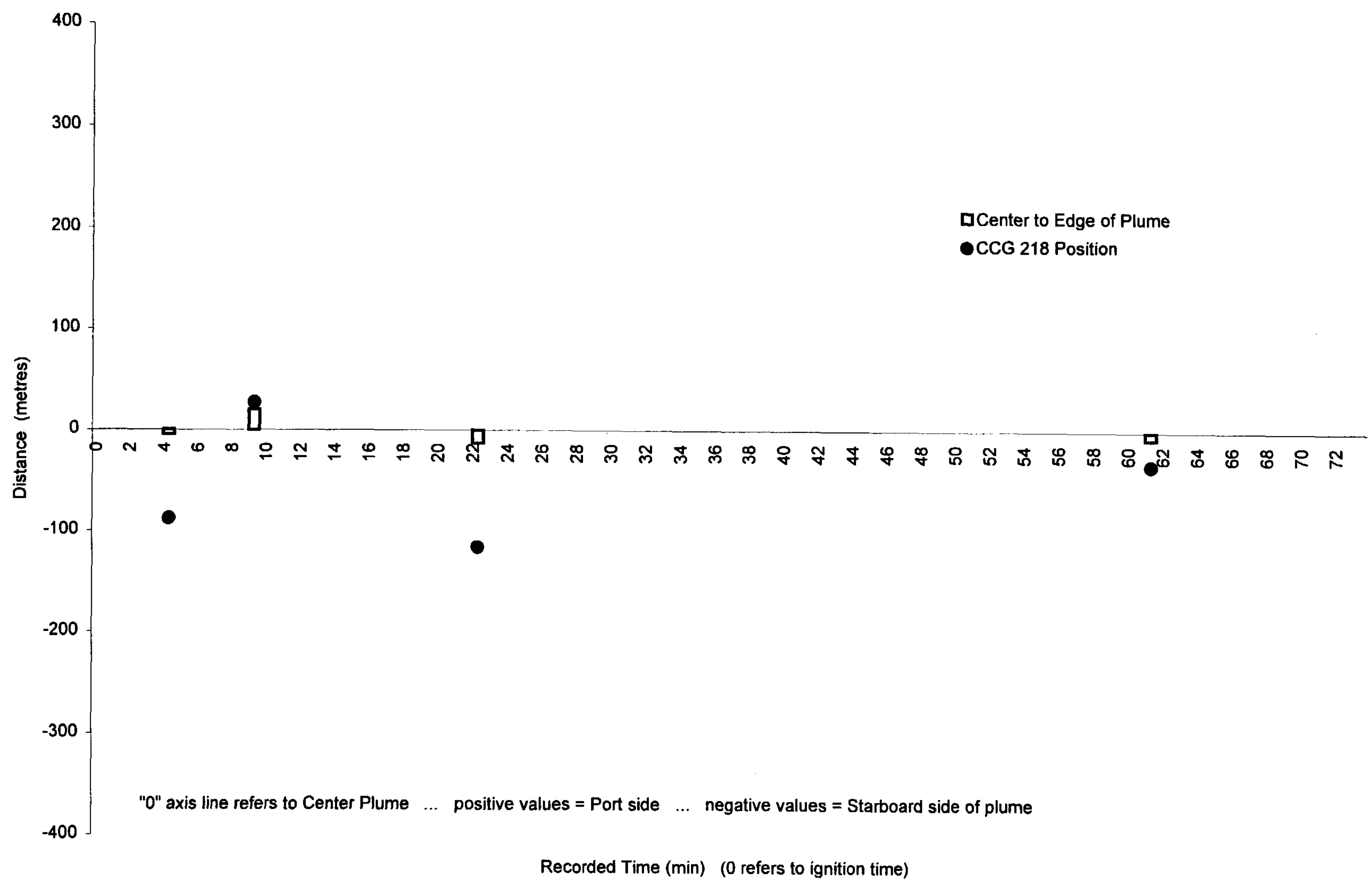
NOBE 93 ..... CCG 218

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:00	-66	CCG218	Continuing inspection of boom							
13:15	-51	CCG218	Deploy marker buoys and ready for burn # 2							
13:24	-42	CCG218	Deploy current meter, reading 0.4 to 0.5							
13:26	-40	CCG218	Buoy pick-up							
13:51	-15	055 / aerial	At apex of fireboom	055 / aerial	21			90		
13:58	-8			057 / aerial	112			212		
14:02	-4			060 / aerial	92			209		
14:05	-1			062 / aerial	127			235		
14:10	4	065 / aerial	110° from right edge of plume	065 / aerial	51	-83	-88	210	-110	-120
14:15	9	068 / aerial	1 (under plume) from left edge of plume	068 / aerial	79	7	27	85	5	20
~~14:16~~	~~10~~	~~CCG215~~	~~CCG 218 moved upwind of sampling boats~~							
14:19	13			071 / aerial	70			215		
14:28	22	074 / aerial	80° from right edge of plume	074 / aerial	80	-103	-116	195	-80	-93
14:34	28			077 / aerial	304			215		
14:39	33			078 / aerial	83			199		
14:45	39			081 / aerial	72			239		
14:56	50			085 / aerial	113			179		
15:02	56			088 / aerial	66			215		
15:07	61	092 / aerial	40° from right edge of plume	092 / aerial	38	-26	-34	150	-40	-53
15:12	66			094 / aerial	62			200		
15:17	71			097 / aerial	29			220		

NOBE 93 ... BURN 1 ... CCG 218... MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... CCG 218... MOVEMENT OVER TIME



NOBE 93 ..... Remote Control boat # 1

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
8:25	-125	Ann Harvey	Antenna broken, alongside CCG 215, stern mast broken in water on sampling boat							
8:30	-120		Antenna righted							
9:17	-73			002 / aerial	Not in use					
9:17	-73			003 / aerial	Not in use					
9:24	-66			005 / aerial	Not in use			Not in use		
10:17	-13			007 / aerial	Not in use			Not in use		
10:38	8			012 / aerial	Not in use			Not in use		Not in use
10:38	8			013 / aerial	Not in use			Not in use		
10:42	12			015 / aerial	Not in use			Not in use		
10:42	12			016 / aerial	Not in use			Not in use		
10:42	12			017 / aerial	Not in use			Not in use		
10:48	18			020 / aerial	Not in use			Not in use		
10:48	18			021 / aerial	Not in use			Not in use		
10:52	22			023 / aerial	Not in use			Not in use		
10:52	22			024 / aerial	Not in use			Not in use		
10:56	26			029 / aerial	Not in use			Not in use		
10:56	26			030 / aerial	Not in use			Not in use		
11:00	30			033 / aerial	Not in use			Not in use		
11:08	38	CCG215	CCG 215 preparing boat # 1							
11:09	39			036 / aerial	Not in use			Not in use		
11:21	51	Sir Wilfred Grenfell	Launching second boat							
11:22	52	CCG215	Launched boat # 1							
11:23	53			040 / aerial	161	39	74	91	14	27
11:24	54	CCG215	20 m port of plume, 125 m astern of boom; all instruments on							
11:25	55	CCG215	100 m from boom to starboard							
11:27	57		Moving to port							
11:30	60	CCG215	Moving to starboard to align with plume							
11:32	62	CCG215	In line about 100 m behind boom							
11:32	62			043 / aerial	95	17	53	95	10	33
11:33	63	CCG215	Some smoke impinging on # 1							
11:42	72	CCG215	Smoke elevated slightly, no smoke impinging on # 1							
11:44	74	CCG215	CCG 215 50 m from boat # 1 on port side, 60 m from boom							
11:46	76	CCG215	# 1 100 m from boom							
11:46	76			051 / aerial	108	23	60	88	12	32
12:09	99	CCG215	All instruments off except for water sampler							
12:11	101	CCG215	Bringing boat alongside CCG 215							
12:12	102	CCG215	Bow covered with burn residue							
12:48	138	CCG215	Getting # 1 ready, fresh PUF sampler arrived via CCG 203							

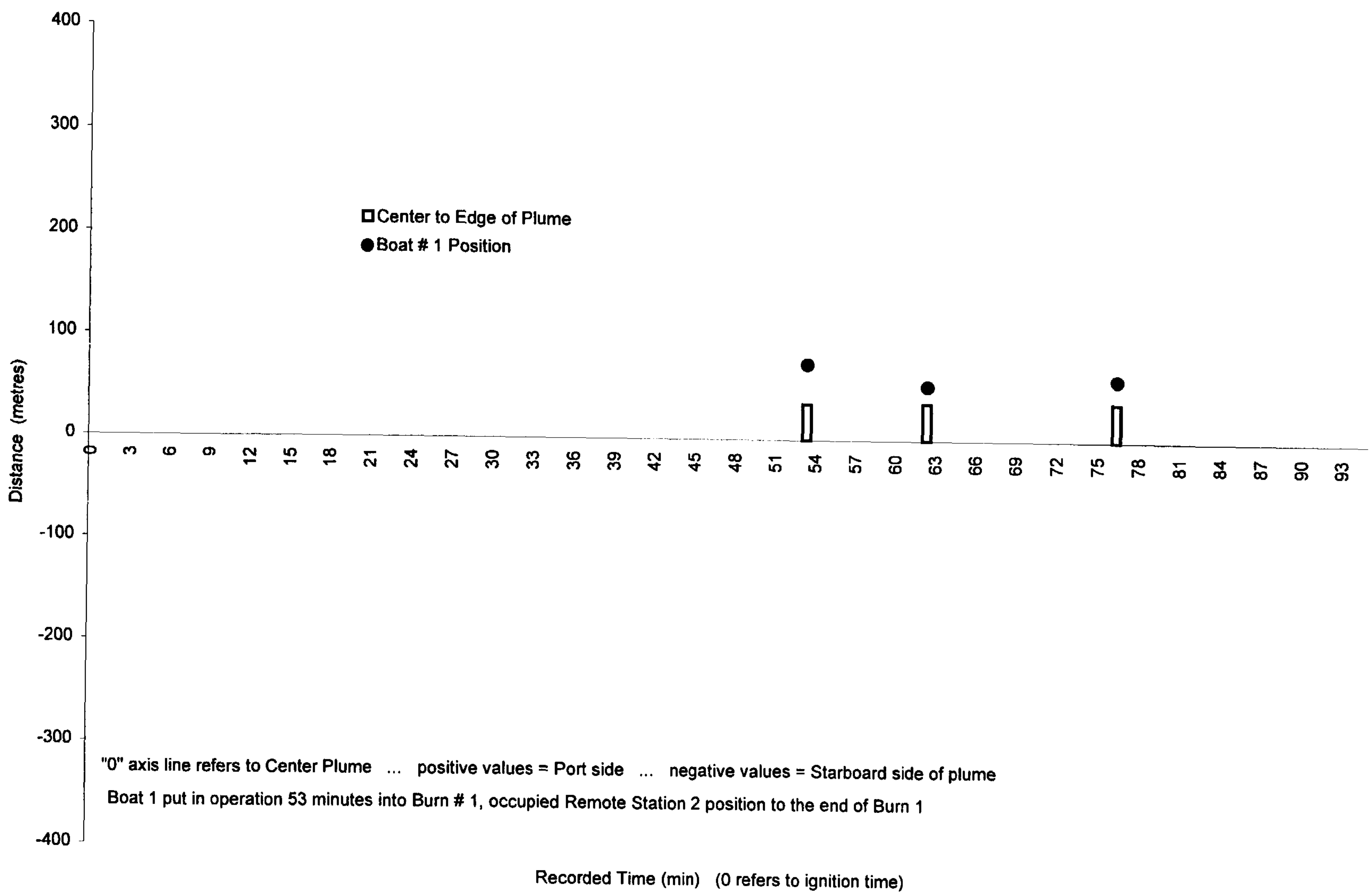
NOBE 93 ..... Remote Control boat # 1

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:34	-32	CCG215	Boat # 1 SUMMA restrictor 80 reused from burn 1A							
13:36	-30	CCG215	Boat 1 burn 1 EXO 1							
13:51	-15			055 / aerial	Not in use			Not in use		
13:55	-11	CCG215	#1 cast off, CCG 215 50 m astern of boom 50 m to port							
13:58	-8			057 / aerial	118			70		
13:58	-8	CCG215	Datalogger bank 1 on							
13:59	-7	CCG215	Sigmas on							
14:00	-6	CCG215	75 m downwind from boom							
14:02	-4			060 / aerial	70			95		
14:02	-4	CCG215	50 m downwind from boom							
14:04	-2	CCG215	Bank 1 off							
14:05	-1			062 / aerial	60			80		
14:08	2	CCG215	50 m from boom downwind							
14:09	3	CCG215	PS-1 on, bank 3 on							
14:10	4			065 / aerial	Under plume			Under plume		
14:10	4	CCG215	Smoke impinging on boat 1, 50 m downwind of boom							
14:11	5	CCG215	Not quite under plume, moving to plume							
14:13	7	CCG215	50 m downwind slightly abeam							
14:14	8	CCG215	Now aligned							
14:15	9			068 / aerial	Under plume			Under plume		
14:17	11	CCG215	Approx. 30 m downwind, CCG 215 20 m to port							
14:18	12	CCG215	Moving # 1 closer, 20 to 25 m astern of boom, almost in fire, <10 m away							
14:19	13			071 / aerial	Under plume			Under plume		
14:24	18	CCG215	50 to 60 m downwind (astern) of boom							
14:26	20	CCG215	# 1 50 m downwind of fire, smoke impinging on sampler							
14:28	22			074 / aerial	Under plume			Under plume		
14:29	23	CCG215	Turned abeam (starboard) side							
14:31	25	CCG215	Boat 1 now in line							
14:32	26	CCG215	Boat 1 60 m downwind							
14:34	28			077 / aerial	Under plume			Under plume		
14:35	29	CCG215	Boats are drifting to port, also # 1 about 100 m behind fire							
14:38	32	CCG215	Boat 1 about 70 m boom downwind, but aligned							
14:39	33			078 / aerial	Under plume			Under plume		
14:39	33	CCG215	Boat 1 50 m downwind of burn							
14:42	36	CCG215	# 1 70 m downwind of plume, plume extends farther apparently							
14:45	39			081 / aerial	Under plume					

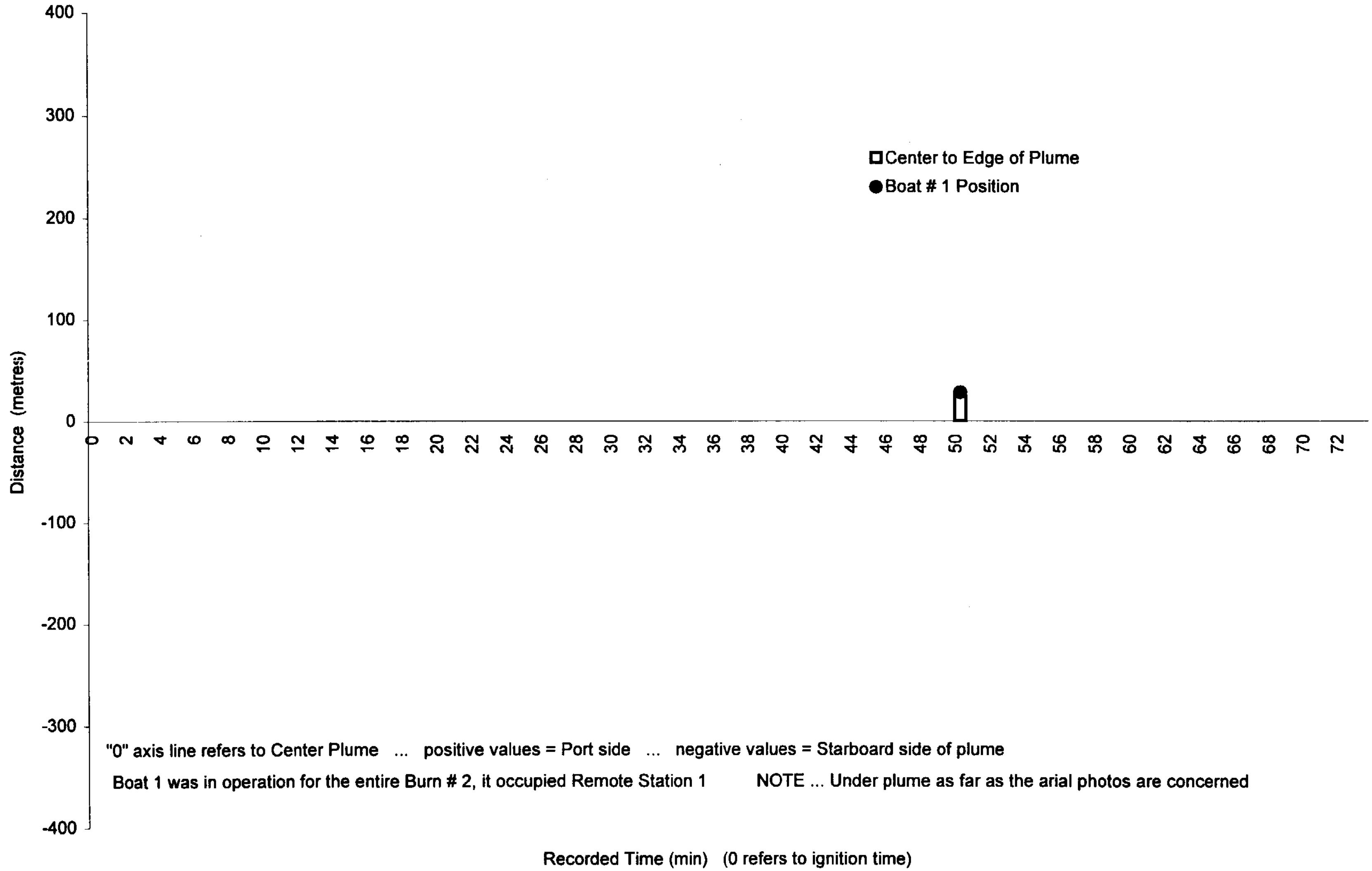
NOBE 93 ..... Remote Control boat # 1

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
14:46	40	CCG215	Turn on sigmas, # 1 now about 50 m from fire, but has slid to port							
14:50	44	CCG215	Fire looks like its going out							
14:52	46	CCG215	Boat 1 50 m downwind of fire							
14:53	47	CCG215	Fire building again							
14:56	50			085 / aerial	94	3	28	78	2	17
14:56	50	CCG215	Fire building; boat 1 50 to 60 m downwind							
14:58	52	CCG215	Bank 3 off							
15:00	54	CCG215	Sigmas on							
15:01	55	CCG215	Boat 1 50 m from fire							
15:02	56			088 / aerial	Under plume			Under plume		
15:04	58	CCG215	Boat 1 abeam (starboard) to fire							
15:05	59	CCG215	Instruments off except datalogger							
15:07	61			092 / aerial	Under plume			Under plume		
15:11	65	CCG215	Boat 1 100 m downwind of boom							
15:12	66			094 / aerial	Under plume			Under plume		
15:15	69	CCG215	Boat 1 70 m from boom							
15:16	70	CCG215	Sample boats out of alignment							
15:17	71			097 / aerial	Under plume			Under plume		
15:20	74	CCG215	Sigma on							
15:28	82	CCG215	Boat 1 alongside							
15:29	83	CCG215	PUF sample black							

NOBE 93 ... BURN 1 ... Remote Control BOAT # 1 ... MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... Remote Control BOAT # 1 ... MOVEMENT OVER TIME



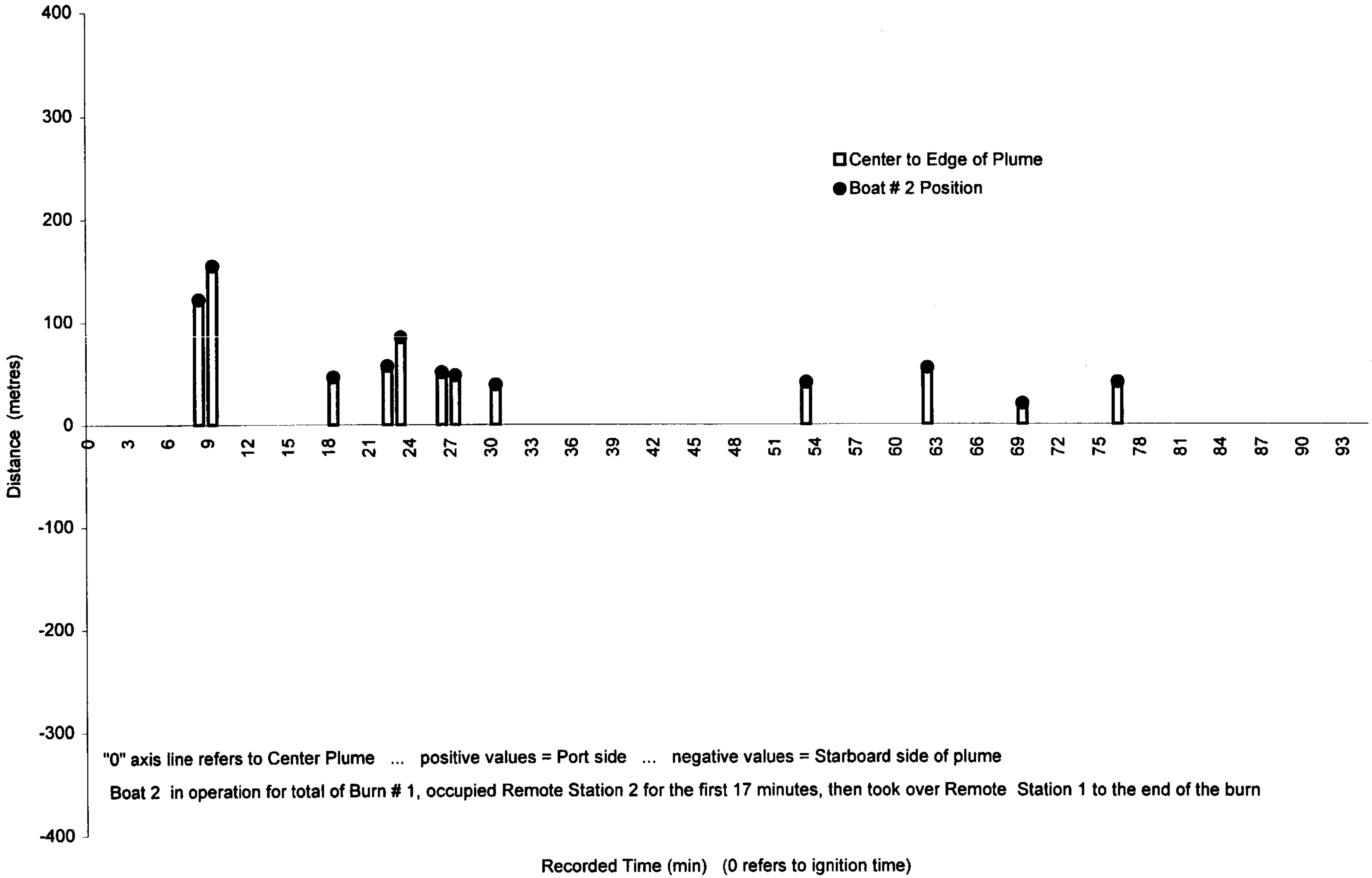
NOBE 93 ..... Remote Control boat # 2

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
7:59			Starting to deploy sample boats of Ann Harvey							
8:20	-130	CCG216	Boat alongside CCG 216							
9:17	-73			002 / aerial	Not in use					
9:17	-73			003 / aerial	Not in use					
9:24	-66			005 / aerial	Not in use			Not in use		
9:30	-60	Ann Harvey	Sample boats in position							
9:30	-60	CCG216	Launched boat # 2							
10:14	-16	CCG216	R/C # 2 75 m from fireboom							
10:17	-13			007 / aerial	132			85		
10:18	-12	CCG216	Both SUMMAs opened							
10:36	6	CCG216	100 m from fire							
10:36	6		With # 4 sample boat approx. 120 m downwind							
10:38	8			012 / aerial	193	17	155	90	5	48
10:38	8			013 / aerial	210	27	122	90	8	34
10:40	10	CCG216	Plume approx. 50 m overhead of sample vessel (# 2)							
10:42	12			015 / aerial	Not in photo			Not inphoto		
10:42	12			016 / aerial	Under plume			Under plume		
10:42	12			017 / aerial	Under plume			Under plume		
10:48	18			020 / aerial	Under plume			Under plume		
10:48	18			021 / aerial	117	0	46	85	0	23
10:52	22			023 / aerial	109	38	57	70	20	30
10:52	22			024 / aerial	117	30	85	70	15	43
10:56	26			029 / aerial	92	19	51	78	12	32
10:56	26			030 / aerial	92	24	48	75	15	30
10:56	26	CCG216	R/V # 2 approx.100 m from fire, plume approx. 25 m overhead							
11:00	30			033 / aerial	83	-4	39	83	-3	28
11:05	35	CCG216	R/C # 2 approx. 25 m from burn, smoke plume approx. 10 m overhead							
11:09	39			036 / aerial	Under plume			Under plume		
11:23	53			040 / aerial	74	19	41	90	15	33
11:32	62			043 / aerial	65	17	55	85	15	50
11:39	69			046 / aerial	57	0	29	110	0	20
11:46	76			051 / aerial	69	18	41	85	15	35
12:04	94	CCG216	Turned off Gilian pump							

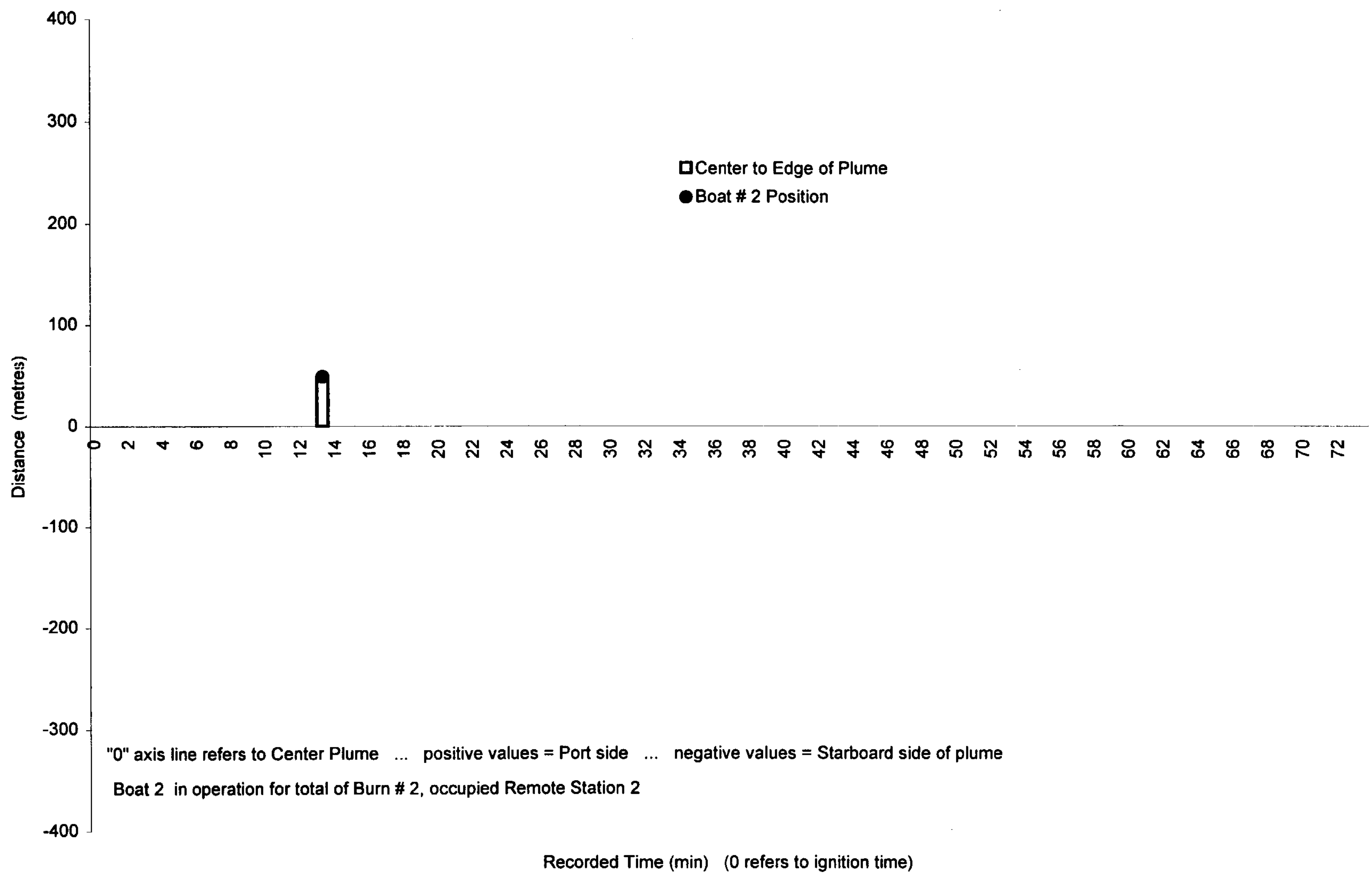
NOBE 93 ..... Remote Control boat # 2

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:51	-15			055 / aerial	Not in use			Not in use		
13:54	-12	CCG216	Launched R/C # 2							
13:57	-9	CCG216	Started Gilian pump							
13:58	-8			057 / aerial	179			88		
14:02	-4			060 / aerial	145			100		
14:05	-1			062 / aerial	105			100		
14:06	0	CCG216	R/C # 2 150 m from flame, smoke plume 20 m overhead							
14:10	4			065 / aerial	Under plume			Under plume		
14:15	9			068 / aerial	Under plume			Under plume		
14:19	13			071 / aerial	140	0	49	78	0	20
14:28	22			074 / aerial	Under plume			Under plume		
14:34	28			077 / aerial	Under plume			Under plume		
14:39	33			078 / aerial	Under plume			Under plume		
14:45	39			081 / aerial	Under plume			Under plume		
14:56	50			085 / aerial	Under plume			Under plume		
15:02	56			088 / aerial	Under plume			Under plume		
15:07	61			092 / aerial	Under plume			Under plume		
15:12	66			094 / aerial	Under plume			Under plume		
15:17	71			097 / aerial	Under plume			Under plume		

NOBE 93 ... BURN 1 ... Remote Control BOAT # 2 ... MOVEMENT OVER TIME



NOBE 93 ... BURN 2 ... Remote Control BOAT # 2 ... MOVEMENT OVER TIME



NOBE 93 ..... Remote Control boat # 4

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
7:59			Starting to deploy sample boats of Ann Harvey							
9:17	-73			002 / aerial	Not in use					
9:17	-73			003 / aerial	Not in use					
9:24	-66			005 / aerial	61			60		
9:25	-65		Boat # 4 deployed							
9:29	-61		In position							
9:30	-60	Ann Harvey	Sample boats in position							
9:39	-51		Boat # 4 about 60 m from boom							
9:53	-37		Boat # 4 app. 60 m from boom							
10:02	-28		120 m from CCG 215							
10:09	-21		70 m from CCG 215							
10:12	-18	CCG215	Evaporation period							
10:13	-17		Boat 50 m from boom							
10:14	-16		Bank # 1 on (Summa and DNPH...Martine)							
10:15	-15	Martine	(-15) Sigma - 350 mL - 200 m DW							
10:16	-14		Both signals on (sigmas probably...Martine)							
10:17	-13			007 / aerial	69			80		
10:20	-10		CCG 215 50 m off port beam of # 4							
10:30	0	CCG215	Instruments on (should be good for other sampling boat ... Martine)							
10:32	2	CCG215	Rob trying to regain boat control							
10:33	3	CCG215	Still abeam of fire, downwind							
10:36	6	CCG215	With # 2 sample boat approx. 120 m downwind, CCG 215 moving across plume to recover # 4							
10:37	7	CCG215	Moving across plume to recover sample boat # 4							
10:38	8			012 / aerial	Under plume			Under plume		Under plume
10:38	8			013 / aerial	Under plume			Under plume		
10:38	8	CCG215	Even with CCG 212, being recovered by CCG 215							
10:38	8	Ann Harvey	Lost control of sample boat							
10:39	9	CCG211	R/C boat dead ????							
10:41	11	CCG215	Sigmas 0n							
10:42	12			015 / aerial	Not in photo			Not in photo		
10:42	12			016 / aerial	Under plume			Under plume		
10:42	12			017 / aerial	Not in use			Not in use		
10:45	15	CCG215	CCG 215 is untying # 4 boat after moving abeam of other sampling boat # 2							
10:46	16	CCG215	Boat moving back to position							
10:47	17	CCG215	100 m to side of plume							
10:48	18	CCG215	CCG 215 recovering # 4, not responding to computer							
10:48	18			020 / aerial	291	38	163	83	8	33
10:48	18			021 / aerial	299	21	124	81	4	24

NOBE 93 ..... Remote Control boat # 4

Time (hh:mm)	Elapsed Time (min)	Source	BURN 1	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
10:51	21	CCG215	CCG 215 recovering # 4 on port side, even with NIST boat (NIST boat is 362 m from apex, 0 m from edge of plume, 63 m from middle of plume)							
10:52	22			023 / aerial	Not in use			Not in use		
10:52	22			024 / aerial	Not in use			Not in use		
10:56	26			029 / aerial	Not in use			Not in use		
10:56	26			030 / aerial	Not in use			Not in use		
11:00	30		Sigmas on	033 / aerial	Not in use			Not in use		
11:08	38	CCG215	Motor appears cooked, port side fillers removed, samplers checked							
11:09	39			036 / aerial	Not in use			Not in use		
11:23	53			040 / aerial	Not in use			Not in use		
11:23	53	CCG215	Everything turned off (should be good for other sampling boat ... Martine)							
11:32	62			043 / aerial	Not in use			Not in use		
11:36	66	CCG215	Martine recovering SUMMAs from boat # 4							
11:39	69			046 / aerial	Not in use			Not in use		
11:46	76			051 / aerial	Not in use			Not in use		
11:48	78	CCG215	Martine still recovering samples form # 4							
11:52	82	CCG215	XO6 boat # 4 (Exotox 6 removed ... Martine)							
11:58	88	CCG215	Martine wrapping stack from boat # 4							
12:02	92	CCG215	Report residue on bow rope of # 4							

NOBE 93 ..... Remote Control boat # 4

Time (hh:mm)	Elapsed Time (min)	Source	BURN 2	Source	To Apex F-B (m)	To Edge Plume (m)	To Middle Plume (m)	From Axis (deg)	To Edge Plume (deg)	To Middle Plume (deg)
13:51			Back to Ann Harvey between burns Boat # 4 used in first burn; 10 to 15 min into burning it malfunctioned, boat # 2 then takes its place closest to the fire and # 4 is behind # 2 Approx. 30 min later # 4 is recovered and # 1 is sent to replace it. For the rest of burn 1, we have # 2 closest to the fire and # 1 is behind For burn # 2, boat # 1 is closest to the fire and #2 is behind; this is for the duration of the second burn NOTE... sampling throughout the entire time until recovered for last time	055 / aerial	On the Ann Harvey			On the Ann Harvey		

NOBE 93 ... BURN 1 ... Remote Control BOAT # 4 ... MOVEMENT OVER TIME