OFFSHORE PIPELINE SYSTEMS

ASSESSMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

Prepared for

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

MARCH 3, 1849

DRAFT

J P KENNY

JOB No : 80295.1
APRIL 1995

OFFSHORE PIPELINE SYSTEMS

ASSESSMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

Prepared for

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Washington, DC 20240

DRAFT

MARCH 3, 1849

J P KENNY

JOB No : 80295.1
APRIL 1995

ASSESSMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

Table of Contents

Section One: INTRODUCTION

Section Two: SUMMARY AND CONCLUSIONS

Section Three: OFFSHORE SAFETY SYSTEMS

Section Four: RELIABILITY ANALYSIS APPROACH

Section Five: SYSTEM MODELING AND ANALYSIS RESULTS

Section Six: SAFETY EQUIPMENT FAILURE DATA BASE

Section Seven: SAFETY SYSTEM ASSESSMENT

Section Eight: REFERENCES

ACKNOWLEDGMENTS

Appendix I: SURVEY LETTERS AND QUESTIONNAIRE

Appendix II: RESPONSES TO THE SURVEY

Section One

INTRODUCTION

Section One

INTRODUCTION

On Monday, August 24th, 1992, Hurricane Andrew crossed the Florida peninsula. During the afternoon and night of Tuesday, August 25th, the eye of the storm passed through one of the most intensively developed oil and gas areas of the Outer Continental Shelf (OCS). In the early hours of Wednesday, August 26th, the eye of the storm reached landfall just West of Morgan City, Louisiana, then turned North into the state and by evening dissipated to a tropical storm.

According to National Hurricane Center data, upon reaching the OCS oil and gas fields Hurricane Andrew was a category - 4 storm, sustaining winds of 140 miles per hour with gusts reaching 160 miles per hour and creating significant wave heights estimated at 35 to 40 feet (Ref.3).

The United States Department of the Interior - Minerals Management Service (MMS) have commissioned J P KENNY International, Inc. to give an assessment on the performance of certain safety and pollution control devices during Hurricane Andrew's siege in the Gulf of Mexico.

The report includes the procedures and the results of the safety system performance assessment and analysis, and the report is organized as follows:

- Section Two presents the summary of the work and conclusions of the performance assessment.
- Section Three outlines the offshore safety systems analyzed in the study.
- Section Four describes the theoretical approach of the basic reliability analyses techniques used to evaluate the work.
- Section Five presents the method used to model the offshore safety systems, with reliability calculations included.

- Section Six outlines the offshore safety equipment failure data base and the survey conducted to collect the first-hand information.

- Section Seven discusses operating philosophy, its impact on reliability and the types of damage caused by Hurricane Andrew. This section also introduces two other pipeline safety measures utilized by the oil and gas industry.

- Section Eight lists the references used in the report.

Section Two

SUMMARY AND CONCLUSIONS

DRAFT

Section Two

SUMMARY AND CONCLUSIONS

2.1 SUMMARY

General

The seventy five mile wide path of the hurricane passed through the Gulf of Mexico in a north westerly direction, effecting approximately 4525 completed wells. This represents 29% of the total wells in operation and provides a significant data based from which to initiate this study.

The purpose of this study is to quantify the reliability of the offshore safety and pollution control devices commonly used by the Gulf of Mexico oil and gas operators during Hurricane Andrew.

General information and valve performance data was obtained through a survey conducted among the oil and gas companies with ownership of, or operation responsibilities for platforms and pipelines in the Gulf of Mexico.

The basic information necessary and the extent of the data collection were agreed upon between the MMS and J P KENNY. A simple survey questionnaire was developed and distributed to forty four (44) oil and gas operators. Only nineteen (19) responded with the first hand information of equipment failure. The survey questionnaire asked each operator to identify; field location, production type and performance of each of the five (5) types of valve described in Section Three, during Hurricane Andrew. The replies are summarized as follows:

- 13 area locations reported activation of safety systems.
- Within these 13 area locations, 2698 valves were activated to the closed position during the storm, the break down details are:
    - 716 Sub-Surface Safety Valves (SSSV) with 0 failure

- 729 Master Surface Valves (MSSV) with 5 failures
- 460 Wing Surface Valves (WSSV) with 0 failure
- 415 Pipeline Shut Down Valves (SDV) with 0 failure
- 378 Pipeline Check Valves (FSV) with 0 failure

Hurricane Andrew generated extraordinary environmental impacts on the offshore facilities. These impacts and associated damage to the facilities and safety systems were analyzed. The current hurricane emergency procedures required by MMS had been reviewed, and the resulted overall system reliability was assessed.

The application of subsea ESD systems and pipeline break away joint assemblies were discussed to enhance the study and cover these areas of current technology.

Analysis Results

The failure rates for each offshore safety and pollution control device scheme were calculated utilizing the database established from the survey information. The results are summarized and presented in Table 2.1.

SAFETY SYSTEM	FAILURE/NUMBER REPORTED	FAILURE RATE *(fph)* *(failures per hour)*
Sub-Surface Safety Valve	0/716	0.0
Master Surface Safety Valve	5/729	0.0005
Wing Surface Safety Valve	0/460	0.0
Pipeline Shut Down Valve	0/415	0.0
Pipeline Check Valve	0/378	0.0

Table 2.1

SUMMARY OF OFFSHORE SAFETY DEVICES
FAILURE DURING HURRICANE ANDREW

The five (5) MSSV failures were disclosed in the South Timbalier field, an area directly in the path of the eye of Hurricane Andrew. This location reported more valve actuations than any other field location. The results from the survey also revealed more MSSV closures than any other valve, which can possibly contribute to a higher failure rate.

2.2 CONCLUSIONS

The following conclusions have been reached based on the safety systems assessment and reliability analysis:

- The current hurricane emergency operating philosophy, which is required by MMS policy, to curtail oil production and significant gas production before hurricane reaches the facilities, dramatically increase the overall safety of the offshore production.
- The offshore safety systems including SSSV, MSSV, WSSV, FSV and SDV, plus the emergency operating procedures required by MMS safety regulations, are proved to be adequate for the natural disaster such as Hurricane Andrew.
- Minimum damage was caused directly by Hurricane Andrew to the offshore safety and pollution control devices, and no uncontrolled flow from the production wells were reported.
- SSSVs prevented the uncontrolled flow from the production wells when the surface safety systems were damaged by Hurricane Andrew.
- Damage of the offshore safety and pollution control devices resulted from the structural integrity damage of the offshore facilities, and these devices are most likely the MSSV.

Section Three

OFFSHORE SAFETY SYSTEMS

Section Three

OFFSHORE SAFETY SYSTEMS

3.1 INTRODUCTION

This section of the report presents detailed descriptions of offshore safety systems widely used in Gulf of Mexico. The locations of the systems in the production flow stream are illustrated in Figure 3.1. These systems include:

- Sub-Surface Safety Valve (SSSV) or downhole safety valve;
- Master Surface Safety Valve (MSSV);
- Wing Surface Safety Valve (WSSV);
- Pipeline Shut Down Valve (SDV);
- Pipeline Check Valve (FSV).

These offshore safety and pollution control systems can be divided into three applications, categorized by the function and the physical location of the valves. They are sub-surface safety valves, surface safety systems and pipeline safety systems. The logistic relationship diagram is shown in Figure 3.2.

3.2 SUB-SURFACE SAFETY VALVE (SSSV)

SSSV is defined as a device installed in a well, below the wellhead, with the design function to prevent uncontrolled well flow when actuated.

All tubing installations, open to a hydrocarbon bearing zone, which are capable of natural flow are required to be equipped with a SSSV (Ref.4). The valve is situated in the well, between 100 feet to 200 feet below the sea floor (see Figure 3.1). Most SSSV's are sized for tubing diameters of 4-inch to 7-inch.

SSSVs are located in the wellbore and are therefore isolated from possible damage by fire, collision, or sabotage. They are designed to be operational when needed most - in catastrophes; but they are more difficult to maintain than surface valves, because of their location in the wellbore and positioning below surface level. SSSVs are recommended for use in conjunction with surface safety valves.

A typical SSSV, as shown in Figure 3.3, closes automatically upon loss of hydraulic line pressure. The core of the SSSV is the flapper closure mechanism. The flapper is held open by the inner tubing which is positioned by hydraulic pressure supplied from platform in normal production. In case of emergency, the flapper is actuated by releasing the hydraulic pressure and the pre-compressed spring lifts the tubing to allow the closure of the flapper.

There are two types of SSSVs, tubing-retrievable (Figure 3.4) and wireline-retrievable (Figure 3.5). Tubing-retrievable valves have larger bores through the valve for less flowing pressure drop and allow wireline work through the valve without having to retrieve the valve. Since the tubing-retrievable valve is a part of the tubing string and requires a workover rig for retrieval, maintenance is more expensive. Wireline-retrievable valves are located in special landing nipples that are part of the tubing string, and they can be retrieved for maintenance with lower cost wireline methods. The must, however, be removed before any wireline tools can be run through the tubing.

There are many factors that should be considered in the selection of SSSVs, and these are addressed in Reference 5. Selection is beyond the scope of the study, however, general selection procedures diagrams are shown in Figure 3.6.

3.3 MASTER SURFACE SAFETY VALVE (MSSV)

A MSSV is the automatic wellhead valve assembly that will close upon loss of power supply. They will also be closed under routine alarm conditions, only during catastrophic conditions would both MSSVs and SSSVs close.

The MSSV on the Christmas tree is usually the second valve in the flow stream. It is usually in the vertical run, as shown in Figure 3.7. Its inner diameter equals the tubing inner diameter, usually 4-inches to 7-inches.

Most MSSV are reverse-acting production gate valves with piston type actuators. A typical gate valve is shown in Figure 3.8, this option is fitted with a manual actuator. Actuator pressure against the lower stem area moves the gate to the up/closed position. Control pressure applied to the piston pushes the gate to the down/open position. Usually a spring is used to close the valve if actuator pressure is not present.

Large-ratio pneumatic actuators are used because the larger ratio permits use of lower control pressure. A Low pressure control system actuator can be simpler and more reliable. The control pressures of these systems are generally 250 psi or less.

Low-ratio hydraulic actuators (as shown in Figure 3.9) are used, if there is limited space available or where the MSSV is to be controlled by the same system that controls the SSSV. For these systems, the actuators control pressures are generally slightly greater than the shut-in pressure of the production well.

3.4 WING SURFACE SAFETY VALVE (WSSV)

A WSSV is situated at the stream outlet at the Christmas tree; it is usually the second safety valve on the surface as a backup to the MSSV. It is usually in the horizontal run, as shown in Figure 3.7.

Surface safety valves are usually actuated by the flowline pressure sensors, emergency shut down systems, fire loop systems, or sensors on downstream process components. The WSSV is the primary valve for production control of the well and would normally be used to temporarily shut in the well. It is also used to isolate the Christmas Tree from the flowline during workover operations.

The inner diameter of the WSSV is the same as that of master surface safety valve, normally 4-inches to 7-inches.

3.5 PIPELINE SHUT DOWN VALVE (SDV)

Nearly all platforms are equipped with automatically controlled SDVs valves on pipelines and flowlines feeding or leaving the platform. They usually are located on the top of the risers on the sub-cellar deck of the platform. The intent of these valves is to allow isolation of the platform from any flammable product in the pipeline in the event of a platform accident. In offshore operations, it frequently is desirable to shut in the wells by simply blocking the flowline rather than operating the subsea MSSVs or SSSVs unnecessarily. The SDVs are commonly operated first in the event of a subsea well shut-in, and last on start-up to avoid cutting out seafloor valve by closing or opening them unnecessarily against a flowing stream. The SDVs are far more accessible and maintainable than the subsea tree valves due to their platform location.

Two types of SDVs are generally used offshore, ball valves and gate valves. Both valves have superior track records offshore. In comparison, the use of gate valves offshore is normally limited to smaller bore sizes, while ball valves range in all sizes, including 30-inch and greater.

Ball valves have a rotating ball with a hole to allow straight-through flow when the valve is in the open position, and shuts off the flow when the ball is rotated through 90° to the flow. The hole diameter can be less than the pipeline's internal diameter, but is generally the same as the adjoining pipeline to ensure free passage of pigging tools. Ball valves may be all-welded, top-entry or end-entry.

Ball valves have good sealing properties if the seal is in good condition. Soft seals can provide total sealing but can be damaged by debris between the ball and the seal and wear out with frequent operation. Now metal-to-metal seated valves are available, but require higher actuation torque forces to operate the valve and may not seal as tightly as new soft seals. Metal-to-metal seal ball valves have the decisive advantage in subsea use of longevity. Controlled closure of ball valves has the added benefit of avoiding pressure surges, particularly in oil lines.

With all-welded valves, the valve ball and seals are contained within a fully welded construction outer shell (see Figure 3.10). Special welding and cooling techniques are utilized to ensure no damage occurs to the ball or soft seals during the welding process. Hence, provided the sealing and capping arrangements are robustly designed, the pressure containing integrity of the pipeline system can be guaranteed.

The main advantages of this design are:

- Its inherent strength;
- It is relatively cheap to produce;

- It has no potential leak paths in the body construction;
- It represents the minimum size and weight compared to other valve types.

The main disadvantage is that it is not possible to gain access to the ball, stem and seals for inspection or maintenance operations, being necessary to return them to the workshop for refurbishment, which may not prove practical or economic.

Top entry valves (see Figure 3.12), considerably heavier than the all-welded type, provide access to valve internals without springing or cutting the pipe. Thus, insitu maintenance is possible. Top-entry valves are typically more expensive than the all-welded valves.

The bodyshell of the end-entry valve is comprised of two or three bolted sections (see Figure 3.11). The valve design relies on the seals at the bolted section joints to ensure the pressure retaining integrity of the valve body within the pipeline system. These sections may, however, be unbolted once the valve has been removed from the pipeline, to allow maintenance or replacement of the internal trim components. A weakness of end-entry valves is the number of potential leak paths.

Gate valves are recognized as having an excellent track record in the industry. For offshore application, gate valves (see Figure 3.13) have been extensively installed on production manifolds and well head completions, for valve sizes generally 6-inch and below. Large bore gate valves have generally been limited to surface facilities and onshore pipelines due to practical limitations of size. The space envelope required to accommodate a gate valve mechanism is large in comparison to ball valve systems, and as a consequence, large gate valves have not been used extensively offshore. From an installation point of view, the more balanced shape and smaller space envelope of a ball valve is always the preferred choice.

3.6 PIPELINE CHECK VALVE (FSV)

FSVs have much simpler flow control mechanisms, as they do not have a control system. They are kept open by the flow and will close if the flow stops or reverses. Two commonly used FSV are swing and ball types, as shown in Figure 3.14 and 3.15.

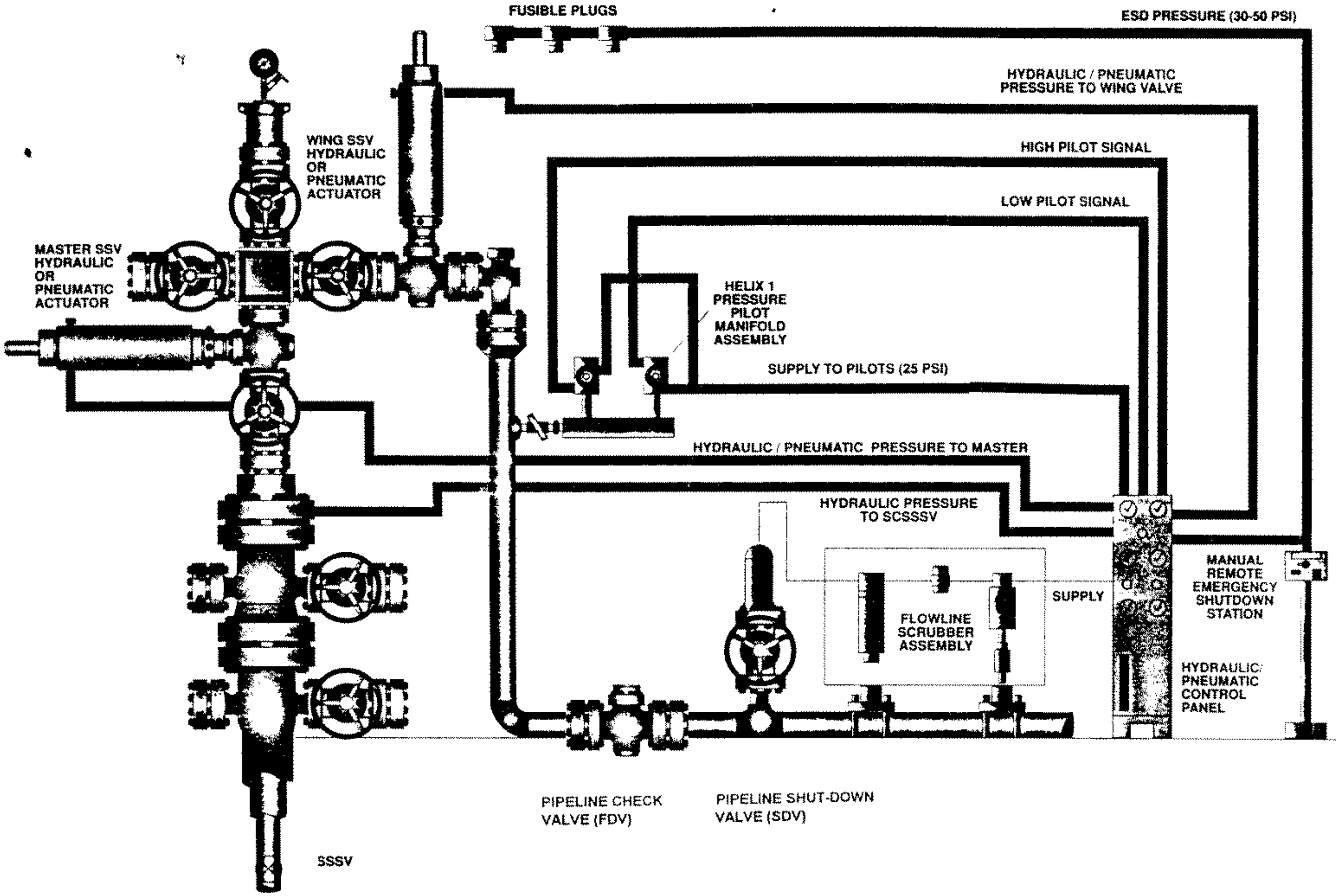
FSVs are required within platform risers of pipelines in the Gulf of Mexico. The do, however, have a limited application in subsea pipelines, because they are not designed primarily for complete shut-off or isolation. One application for FSVs is in conjunction with load limiting pipeline joints. Load limiting pipeline joints are installed in a pipeline to prevent excessive loads, possibly caused by a mud slide or an anchor snagging on the pipeline, being transferred to the local structure to which the pipeline is connected, such as a subsea production template. The pipeline 'fails' at the joint at a preset load, but the check valve installed at the joint prevents spillage and environmental pollution.

A more usual application is at subsea pipeline tee connections. A FSV is installed in the branch line to ensure no backflow of product from the main metered export line flows up the branch line, in the event of loss of pressure in the branch line.

Some operators are also giving consideration to the application of FSVs for subsea ESD systems. In this application the FSV, located subsea at a fixed distance from the installation, provides a temporary mass flow barrier in case of an emergency, until the system can be positively shut down. This FSV barrier should minimize the hazard and also prevent ingress of water into the main pipeline.

FSVs are generally full-opening clapper swing check valve, providing a full bore for pigging. A conduit or line contoured clapper may be supplied to provide a smooth continuous through conduit bore shape to the valve when the clapper is in the retracted horizontal position. This design aids the passage of sphere pigs or other short length pigs through the valve, ensuring they do not get "hung-up" in the body cavity.

To facilitate and improve commissioning operations in subsea pipeline systems, it may be required to either backflow through a FSV or send a pig in the opposite direction to the normal FSV operation, typically for dewatering a section of the pipeline system. For this contingency, a lock open clapper arrangement would generally be provided. This arrangement would require a ROV or diver operated lever attached to the external part of the clapper shaft with a locking device to retain the clapper in a fixed, open position.



J P KENNY

PROJECT

ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

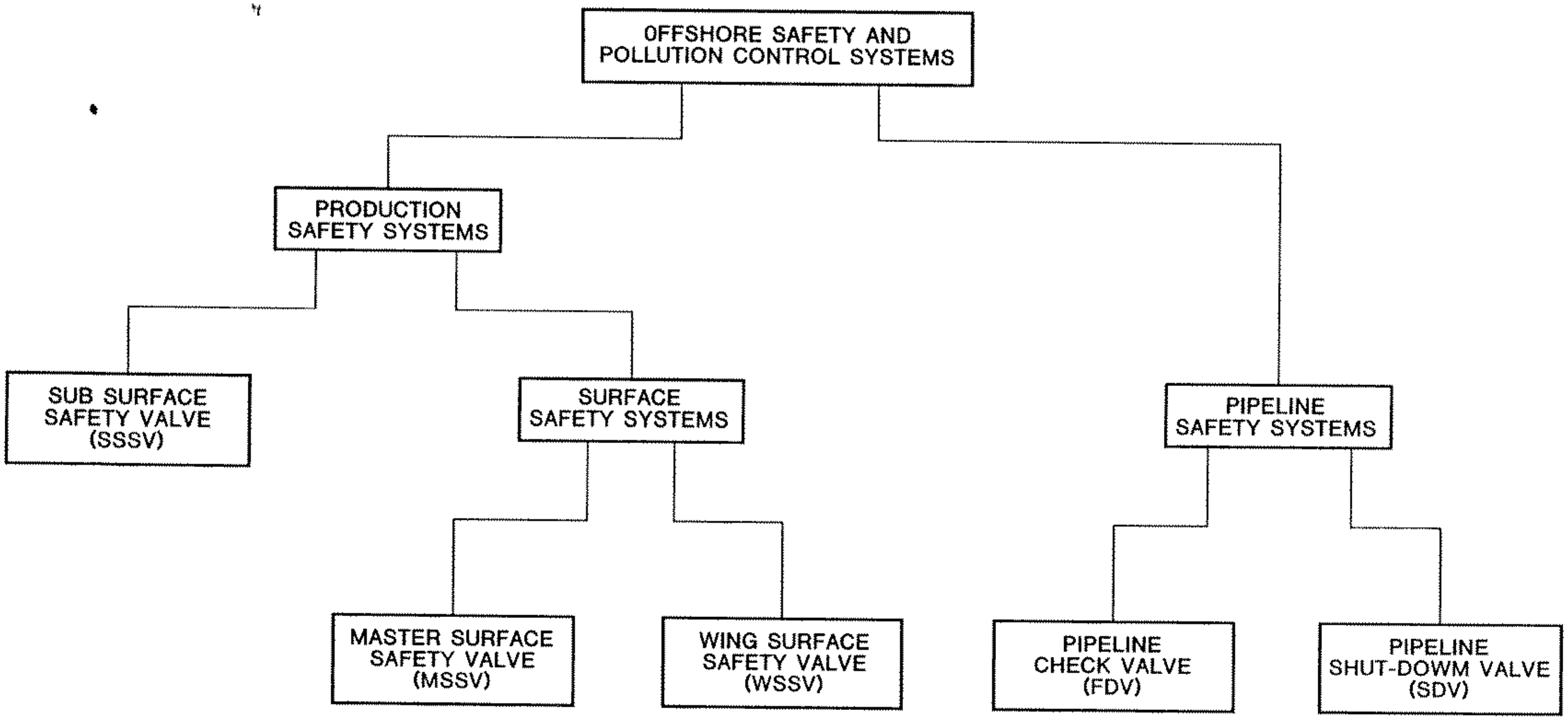
TITLE

TYPICAL OFFSHORE SAFETY SYSTEMS

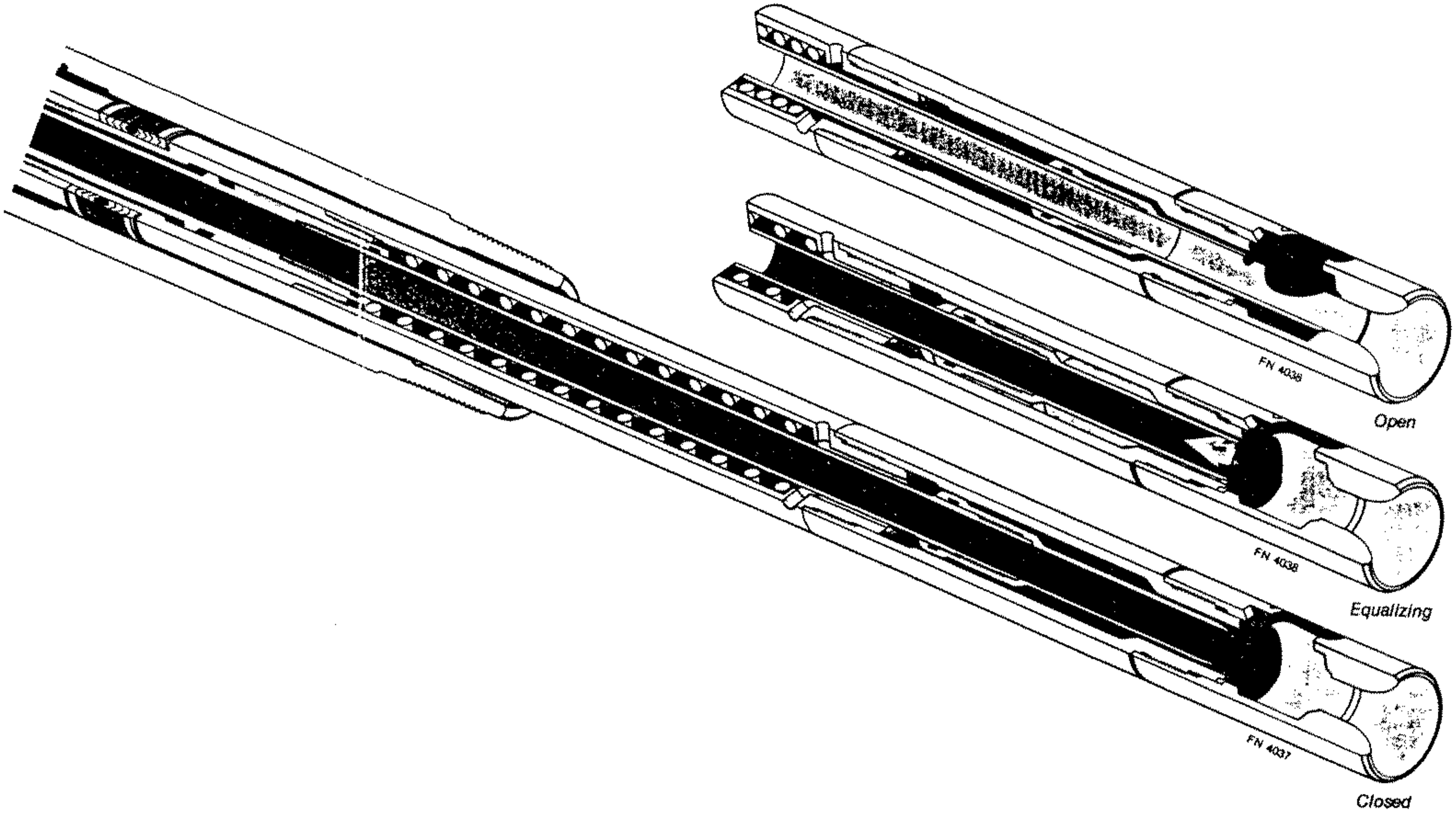
JOB NO
80295.1

FIGURE NO
3.1

80295027 03/02/95



J P KENNY JPK	PROJECT ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW	CLIENT MINERALS MANAGEMENT SERVICES U.S. Department of the Interior	JOB NO 80295.1
		TITLE LOGISTIC DIAGRAM OF OFFSHORE SAFETY SYSTEMS	FIGURE NO 3.2



J P KENNY

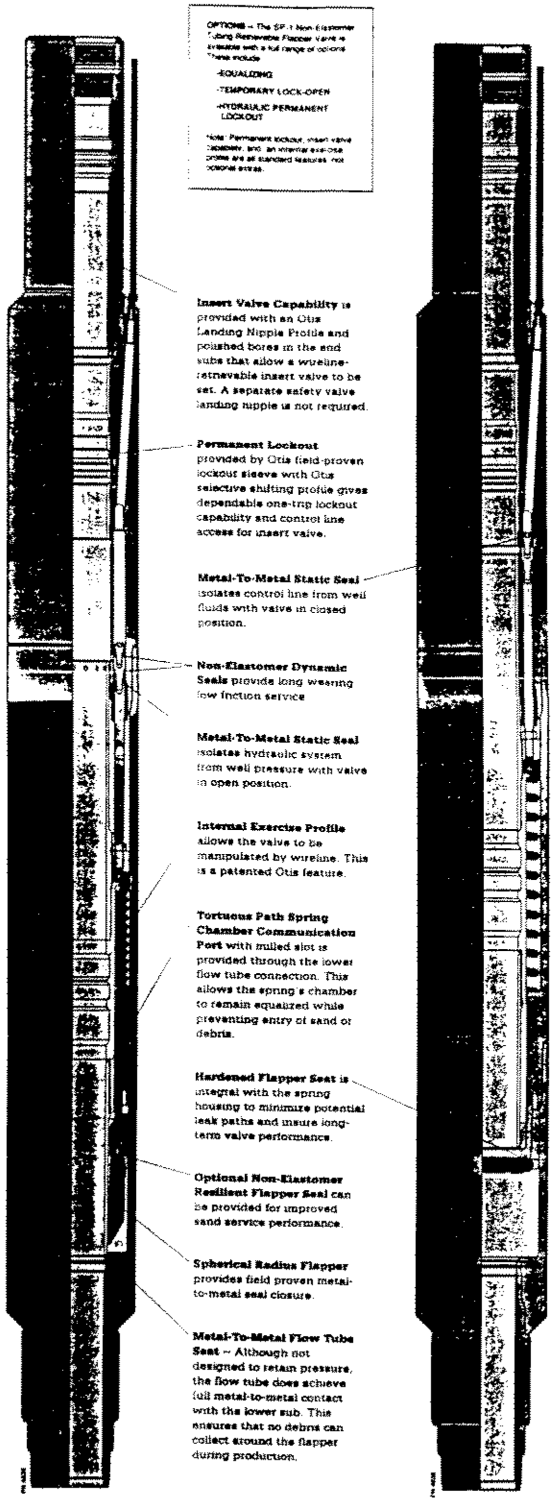
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
SUB-SURFACE SAFETY VALVE

JOB NO
80295.1

FIGURE NO
3.3



OPTIONS -- The SP-1 Non-Elastomer Tubing Retrievable Flapper Valve is available with a full range of options. These include:

- -EQUALIZING
- -TEMPORARY LOCK-OPEN
- -HYDRAULIC PERMANENT LOCKOUT

Note: Permanent lockout, insert valve capability, and an internal exercise profile are all standard features, not optional extras.

Insert Valve Capability is provided with an Otis Landing Nipple Profile and polished bores in the end subs that allow a wireline-retrievable insert valve to be set. A separate safety valve landing nipple is not required.

Permanent Lockout provided by Otis field-proven lockout sleeve with Otis selective shifting profile gives dependable one-trip lockout capability and control line access for insert valve.

Metal-To-Metal Static Seal isolates control line from well fluids with valve in closed position.

Non-Elastomer Dynamic Seals provide long wearing low friction service

Metal-To-Metal Static Seal isolates hydraulic system from well pressure with valve in open position.

Internal Exercise Profile allows the valve to be manipulated by wireline. This is a patented Otis feature.

Tortuous Path Spring Chamber Communication Port with milled slot is provided through the lower flow tube connection. This allows the spring's chamber to remain equalized while preventing entry of sand or debris.

Hardened Flapper Seat is integral with the spring housing to minimize potential leak paths and insure long-term valve performance.

Optional Non-Elastomer Resilient Flapper Seal can be provided for improved sand service performance.

Spherical Radius Flapper provides field proven metal-to-metal seal closure.

Metal-To-Metal Flow Tube Seat -- Although not designed to retain pressure, the flow tube does achieve full metal-to-metal contact with the lower sub. This ensures that no debris can collect around the flapper during production.

J P KENNY

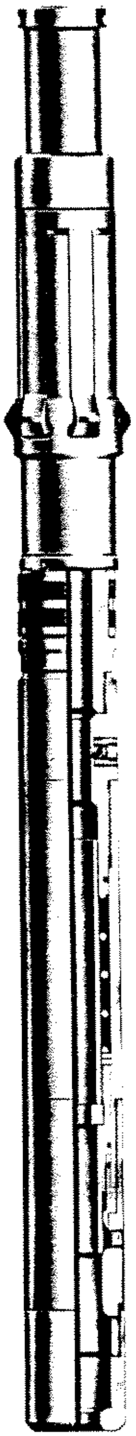
CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

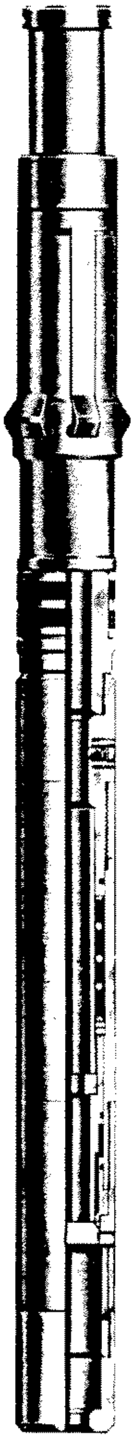
TUBING - RETRIEVABLE SSSV

FIGURE NO. 3.4

80295029 03/02/95



Open



Closed

J P KENNY

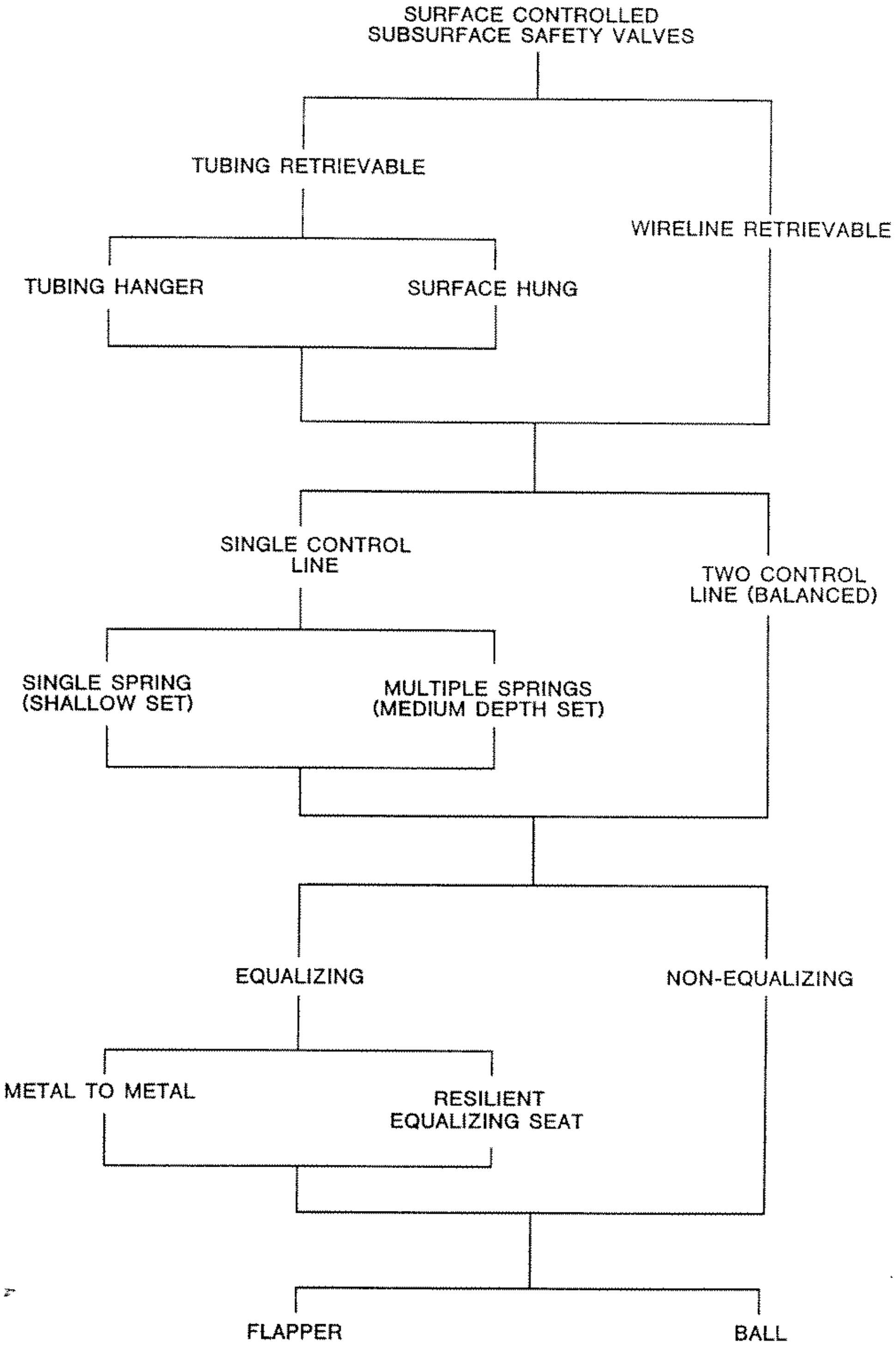
CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

WIRELINE - RETRIEVABLE SSSV

FIGURE NO.
3.5



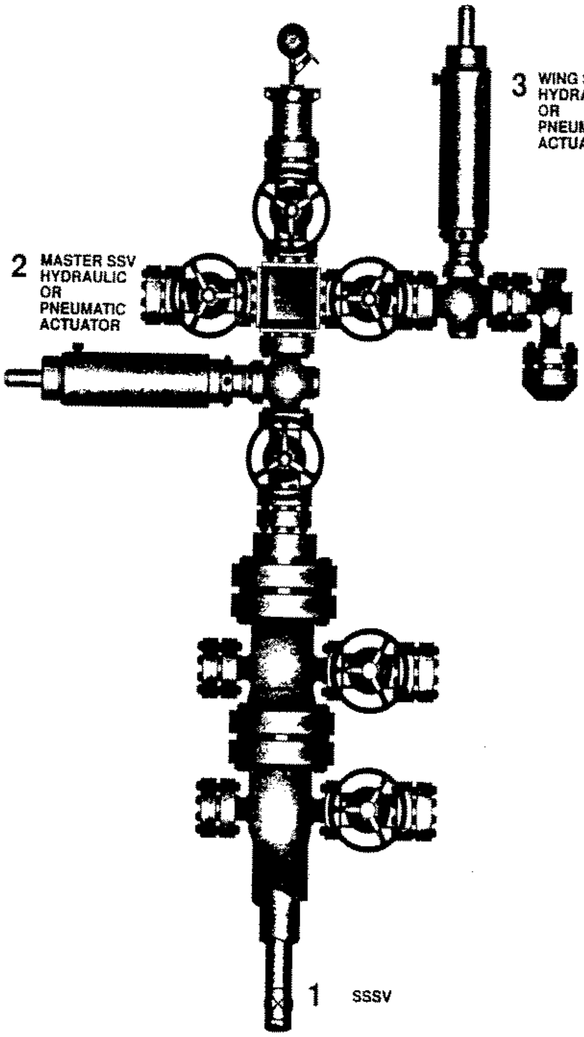
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

SURFACE CONTROLLED
SUBSURFACE SAFETY VALVE DESIGN OPTIONS

FIGURE NO. 3.6



1) **Subsurface Safety Valve Tubing or Wireline Valves.**

2) **Surface Safety Valve Upper Master Valve.**

3) **Surface Safety Valve Outer Wing Valve.**

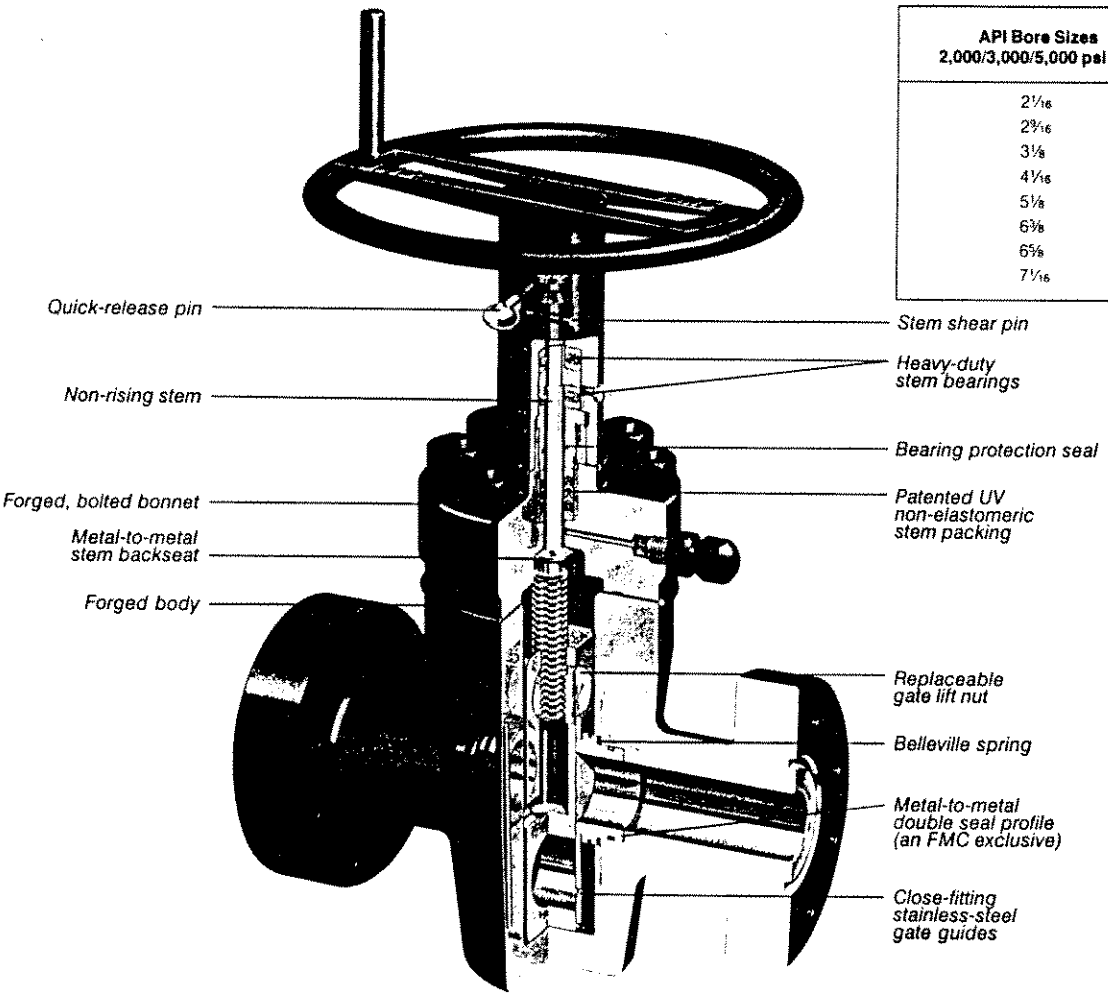
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

PRODUCTION SAFETY SYSTEMS

FIGURE NO. 3.7



API Bore Sizes 2,000/3,000/5,000 psi WP
2 1/16
2 9/16
3 1/8
4 1/16
5 1/8
6 3/8
6 5/8
7 1/16

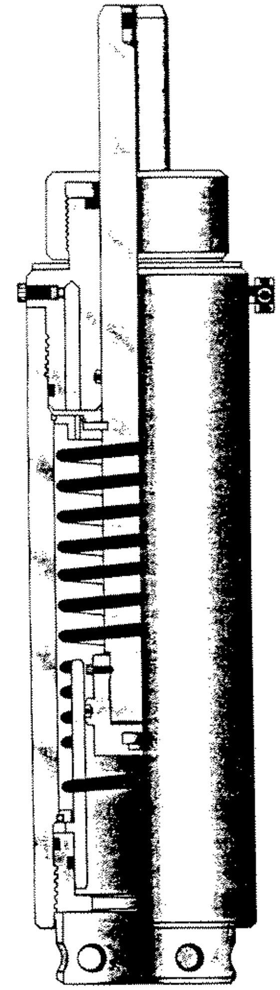
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

TYPICAL GATE VALVE

FIGURE NO. 3.8



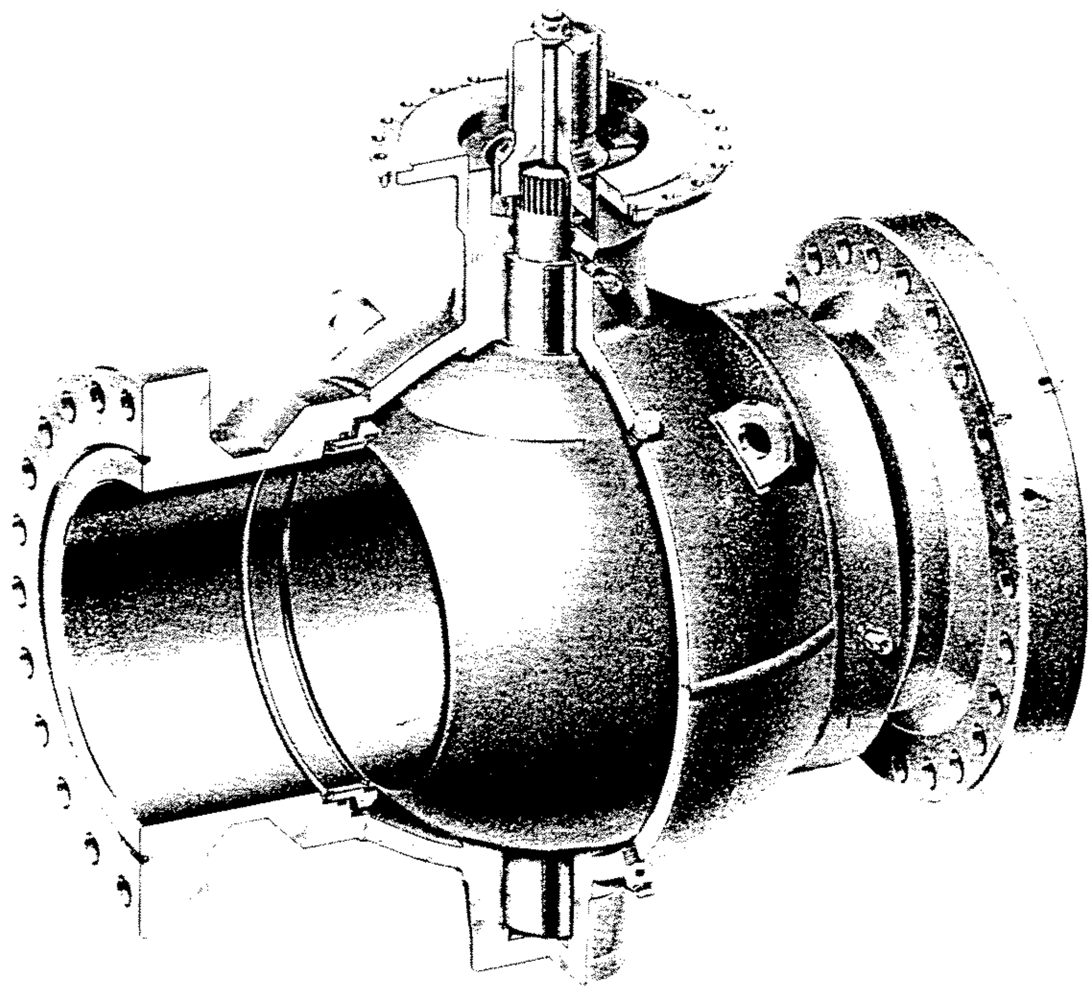
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

TYPICAL HYDRAULIC ACTUATOR

FIGURE NO. 3.9



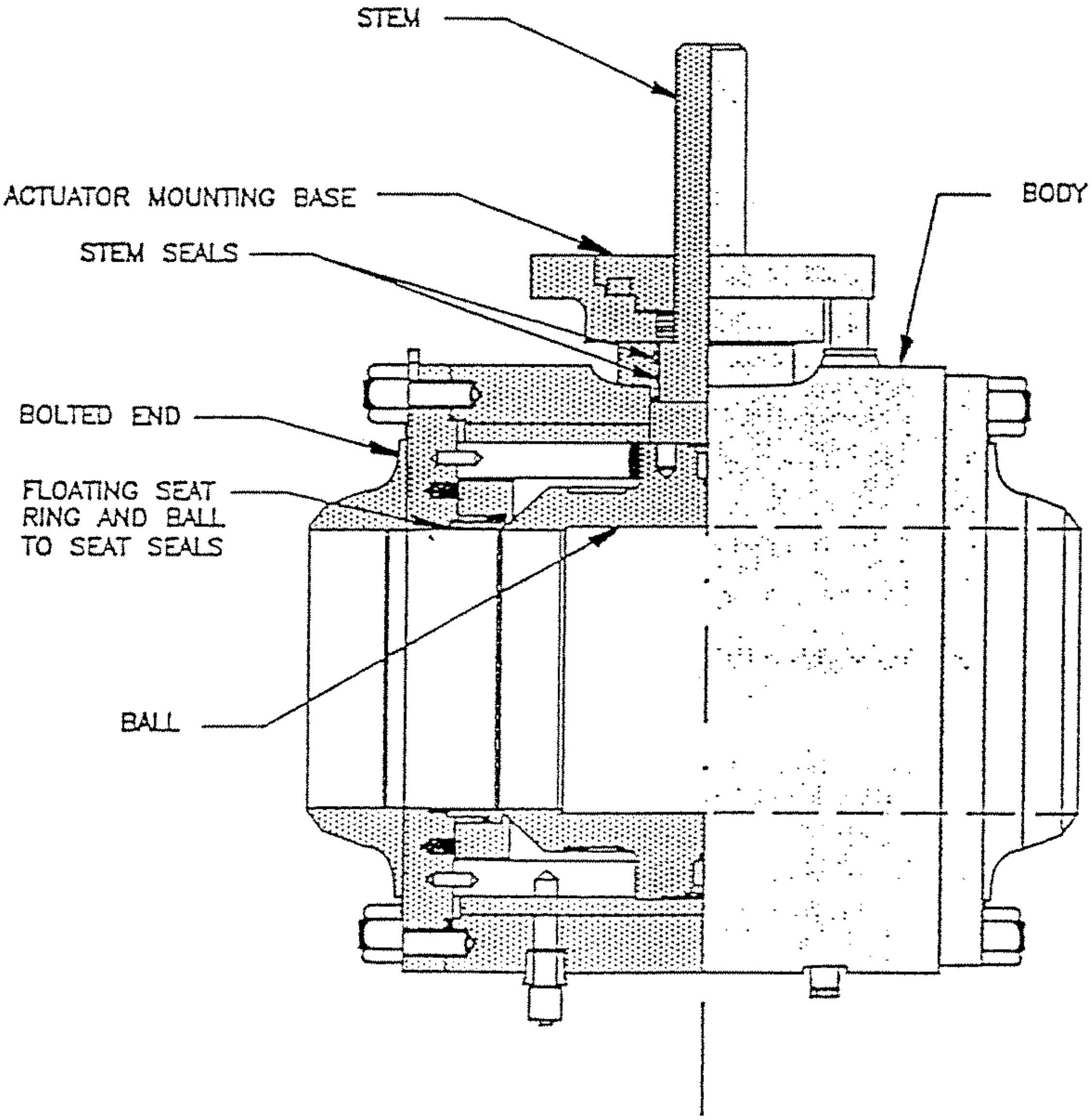
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

ALL WELDED BALL VALVE

FIGURE NO. 3.10



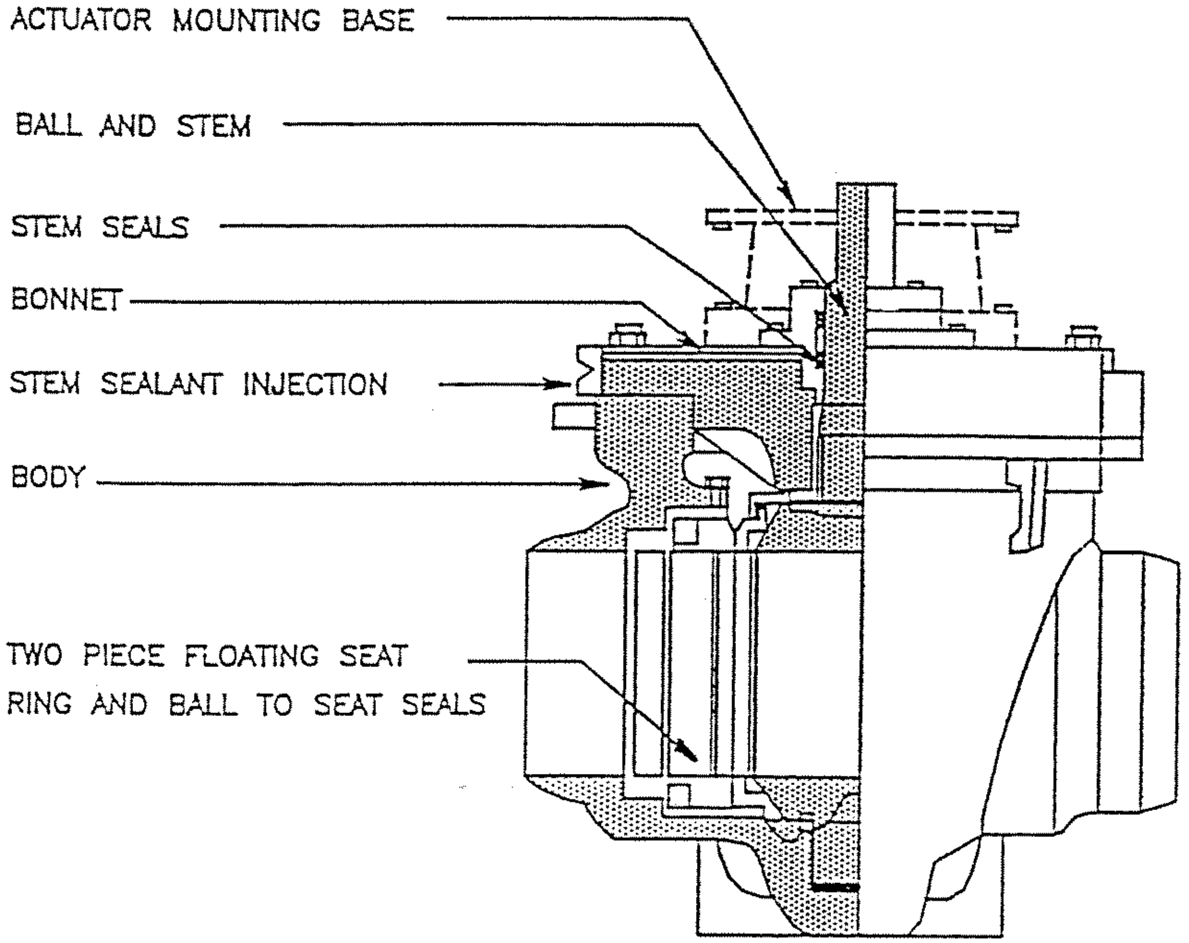
J P KENNY

CLIENT **MINERALS MANAGEMENT SERVICES**
U.S. Department of the Interior

JOB NO. 80295.1

END ENTRY BALL VALVE

FIGURE NO. 3.11



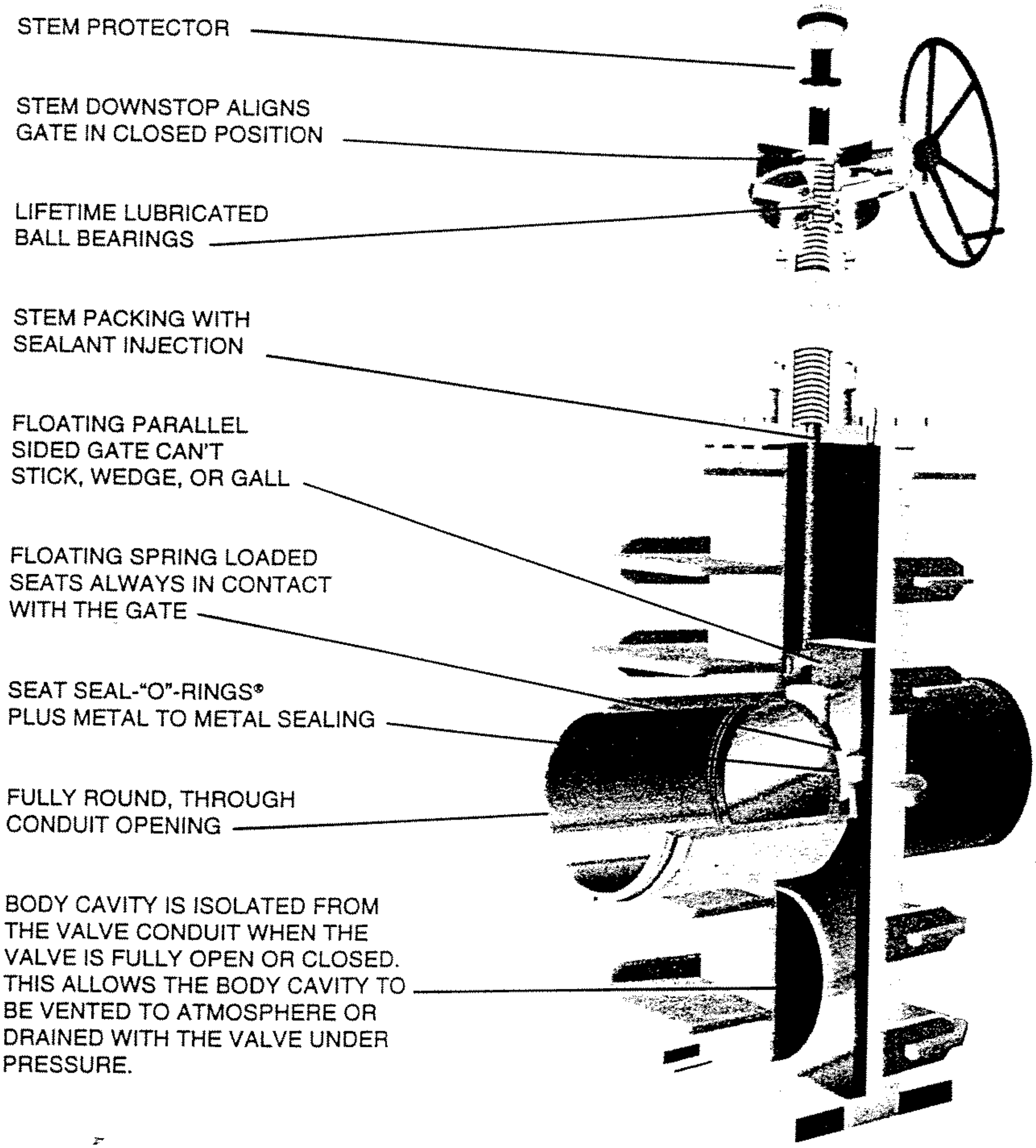
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

TOP ENTRY BALL VALVE

FIGURE NO. 3.12



80295063 03/17/95

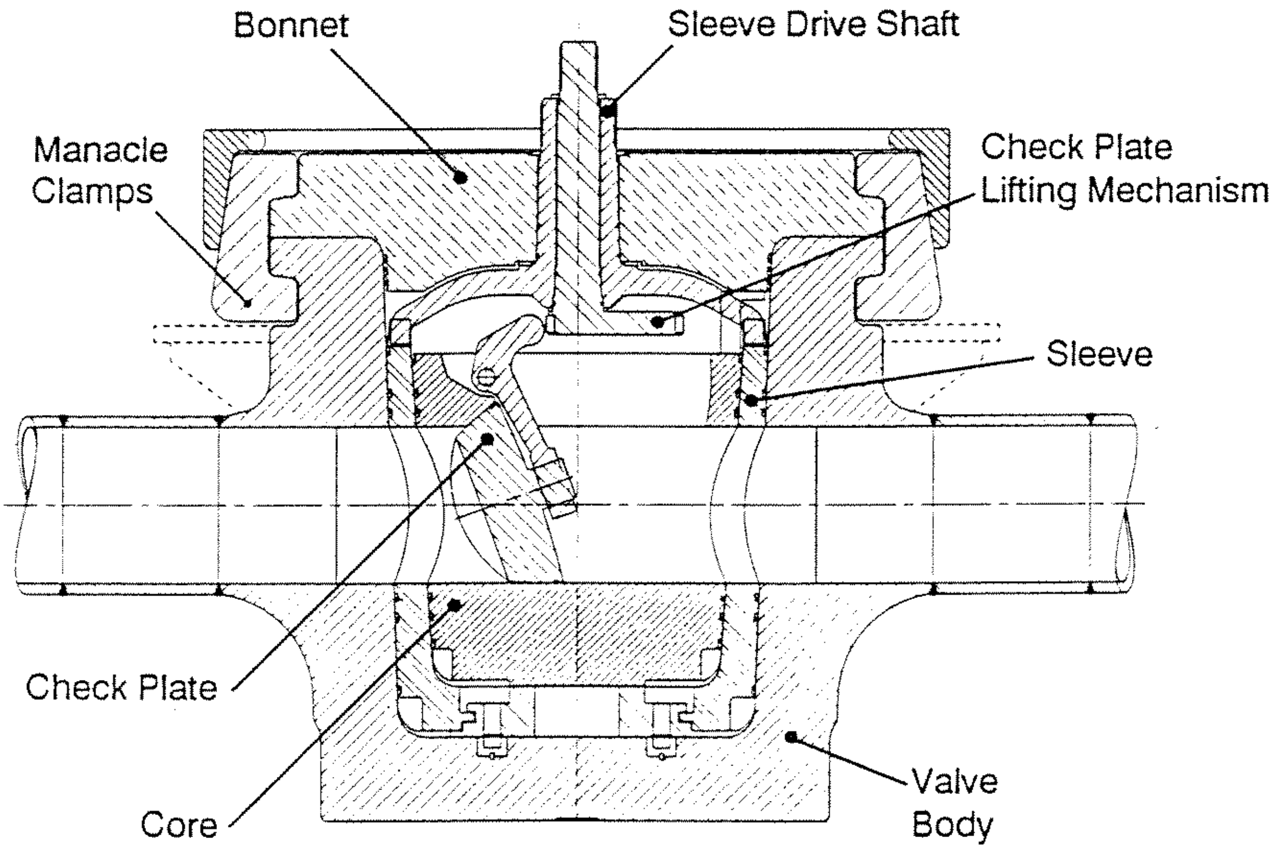
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

THROUGH CONDUIT GATE VALVE

FIGURE NO. 3.13



J P KENNY

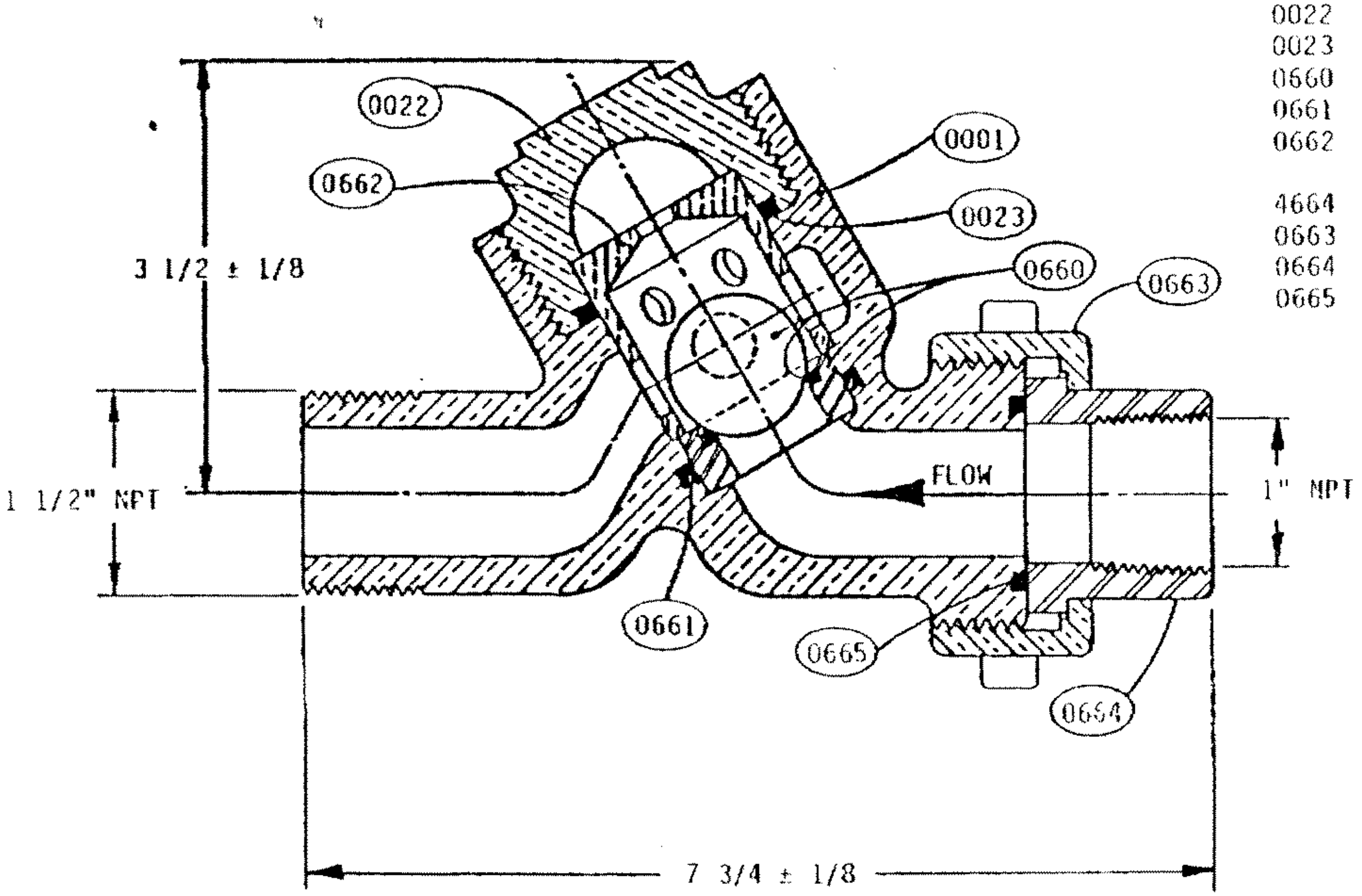
CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

SWING CHECK VALVE

FIGURE NO.
3.14



0001	BODY
0022	COVER
0023	O-RING
0660	BALL/SEAT/O-RING ASSY
0661	O-RING
0662	CAGE
4664	TAIL SUB ASSY
0663	UNION NUT
0664	TAIL SUB
0665	O-RING

J P KENNY

PROJECT

ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE

BALL CHECK VALVE

JOB NO

80295.1

FIGURE NO

3.15

Section Four

SYSTEM RELIABILITY ANALYSIS

Section Four

SYSTEM RELIABILITY ANALYSIS

4.1 INTRODUCTION

This section of the report describes the basic theory of the reliability assessment. A general discussion of basic reliability analysis techniques is presented with reference to the work carried out for this report.

Further information on how the techniques are applied and the results are given in Section 5.0 of this report.

4.2 DEFINITIONS

The primary aim of a reliability analysis is to assess, in a quantitative fashion, the probability that the system under consideration will function as intended. Before further consideration of the reliability techniques which may be used, the following terminology used in the report is defined:

Failure: The termination of the ability of an item or a system to perform a required function.

Design Failure: A failure due to inadequate design of an item.

Manufacturing Failure: A failure due to non-conformity during manufacture to the design of an item or to specified manufacturing processes.

Aging Failure: A failure whose probability of occurrence increases with the passage of time as a result of processes inherent in the item.

Time to First Failure: Total time duration of operating time of an item, from the instant it is first put in an up state, until failure.

Time between Failures: The time duration between two consecutive failures of a repaired item.

Useful Life: Under given conditions the time interval beginning at a given instant of time, and ending when the failure intensity becomes unacceptable or when the item is considered unrepairable as a result of a fault.

Early Failure Period: That early period, if any, in the life of an item, beginning at a given instant of time and during which the instantaneous failure intensity for a repaired items or the instantaneous failure rate for a non-repaired item is considerably higher than that of the subsequent period.

Constant Failure Rate Period: The period, if any, in the life of a non-repaired item during which the failure rate is approximately constant.

Wear-out Failure Period: That final period, if any, in the life of an item during which the instantaneous failure intensity for a repaired item or the instantaneous failure rate for a non-repaired item is considerably higher than that of the preceding period.

Failure Rate: The rate at which failure occur as a function of time, as a function of demands or as function of both. In this report the failure rate is expressed as the expected number of failures per item, in a given time interval and a given number of operations. These interpretations of definition imply the assumption that the failure rate is constant; i.e. independent of time. The failure rate is expressed as failures per million item hours per demand.

Number of Demands: The total number of times an item is required to perform its required function during the period of the event data surveillance.

Operational Time: The period of time during which an active item performs its intended function, i.e. the accumulated time is service during the period of the event data surveillance.

Population: The total number of items of one particular type is service during the period of the event data surveillance.

4.3 RELIABILITY ANALYSIS

The basic measurements associated with reliability are Failure Rate, Mean Life and Probability of Survival. As defined in previous Section, failure rate is the number of failures per unit time. There are these fundamental conditions, each requiring a different procedure for calculating the failure rate (Ref.1).

1. Failures are repaired and replaced. All units are examined for the same amount of time. The equation is:

$$\lambda = f / \ nt$$

Where:

$\lambda = fph =$ failures per hour
f = total number of failures
t = examine period in hours
n = number of units

2. Failures are not repaired and replaced and a log of actual test times is kept for each failure the equation is:

$$\lambda = f / \ (\Sigma t_f + \Sigma t_g)$$

Where:

$\lambda = fph =$ failures per hour
Σt_f = sum of the failure times
Σt_g = sum of the times for the good parts

3. Failures are not repaired and replaced and no log is kept for each failure time. Since no actual times to failures are known, it is necessary to estimate them. The procedure is to calculate the average number of survivors (s) for the test period. This is equivalent to assuming that all failures lasted exactly half the test period. The equations are:

$$\bar{s} = \frac{s_1 + s_2}{2}$$

Where:

$\bar{s}$ = the average number of survivors
s_1 = the number of good units at the start of the test period
s_2 = the number of good units at the end of the test period

and

$$\lambda = f / \bar{s}\mathrm{t}$$

or

$$\lambda = 2f / t(s_1 + s_2)$$

Mean life can be either Mean Time To First Failure (MTTF) or Mean Time Between Failures (MTBF). MTTF is used for critical systems where no failures can be tolerated, such as safety systems, while MTBF is used for all other systems.

Mean life is the reciprocal of failure rate and so can be calculated using the reciprocal of any one of the preceding three failure rate formulas or by just taking the reciprocal of the failure rate once it has been calculated from one of those formulas. The symbols for mean, besides MTBF, is $\bar{m}$. The mean life formulas are:

$$\bar{m} = nt / f$$

$$\bar{m} = \left(\Sigma t_f + \Sigma t_g\right) / f$$

$$\bar{m} = t\left(s_1 + s_2\right) / 2f$$

$$\bar{m} = 1 / \lambda$$

The probability of survival is defined as the probability of zero failures. Obviously, given enough time, all things must fail. Therefore, the probability of survival (P_s or

R_s) or its equivalent the probability of zero failures (P_o), must have an associated time period.

4.4 RELIABILITY DISTRIBUTIONS

Three distributions are basically used in reliability work to describe the behavior of a component with time ie. to assess the component failure rate. For example, the so called bathtub curve, shown in Figure 4.1, is widely quoted in reliability literature. The curve expresses three regimes, for a component:

- (Early failure period) design failure, manufacture failure, or infant mortality is usually due to such factors as defective equipment, incorrect installation etc.;
- (Constant failure rate period) constant failure, or so called random failure, often caused by random fluctuations of load which exceed the design strength of the equipment, or, exhibited by equipment containing a number of components which are individually exhibiting different failure distribution;
- (Wear out failure period) a self explanatory wear out phase.

EARLY FAILURE PERIOD - THE NORMAL DISTRIBUTION

Early failure period, or break-in time failures occur because these are usually some parts that are substandard. As these weak components fail one by one, the failure rate decrease until it stabilizes at a constant rate. The normal distribution is commonly used for this stage. The normal distribution function (Ref.1), as shown in Figure 4.2, is given by:

$$f(t) = \frac{1}{\sigma\sqrt{2\pi}} e^{-(t-\mu)^2/2\sigma^2}$$

Where:

μ = mean
σ^2 = variance
σ = standard deviation

The probability that is less or equal to some particular value t_o is given by

$$P(t_o) = \frac{1}{\sigma\sqrt{2\pi}} \int_{-\infty}^{t_o} e^{-(x-\mu)^2/2\sigma^2} dx$$

The reliability to t_o is

$$R_s(t_o) = 1 - P(t_o)$$

Which is the area under the right-hand tail above the specified time (t_o) in Figure 4.3.

WEAR-OUT FAILURE PERIOD - THE WEIBULL DISTRIBUTION

After normal life expectancy, the components begin to wear out and so the distribution of wear-out failures begins.

In the last few years, the Weibull distribution has become increasingly favored by reliability engineers for the wear-out period (Ref.1). Weibull distributions have three parameters (scale, shape, and location) and can be made to take on any desired form by simply changing one or more of these three values. The Weibull as applied to reliability, is considerably more complex than either the exponential or the normal distribution. The Weibull reliability formula is:

$$R = e^{-(T/\phi)\beta}$$

Where:

T = mission time
β = Weibull slope
ϕ = characteristic life

The Weibull failure rate formula is:

$$\lambda = (\beta / \phi)(T / \phi)^{\beta - 1}$$

CONSTANT FAILURE RATE PERIOD - THE POISSON FORMULA

The most common used distribution model for reliability is Poisson distribution (Ref.1). The equation is:

$$P(c) = \frac{(np)^c}{c!} e^{-np}$$

Where:

$P(c)$ = probability of c defects or failures
c = number of defects or failures that can be tolerated
p = fraction defective
n = the sample size
np = average number of defects or failures

For the work carried out in this study, it can be argued that the wear in period of the components takes place during system commissioning. Furthermore, the majority of the components are highly reliable and have been shown to function successfully over a long period. The onset of the wear out period can be considered not to have taken place during the design life of the system. In addition rigorous maintenance and inspection procedures should ensure potentially unreliable components are replaced before they wear out.

A constant failure rate for the system components can therefore be justified.

In addition, the adoption of an alternative assumption requires data to define the distribution. For the components in this system, failure data available is based on constant failure rate assumptions and a constant failure rate is adopted in accordance with common practice for reliability work of this nature.

The exponential distribution characterizes the use of a constant failure rate *(R)* in that, for any component:

$$R = \exp(-\lambda t)$$

This is also called the exponential failure law, as shown in Figure 4.4.

Since λ is equal to the reciprocal of the mean life ($\lambda = 1/\overline{m}$) an alternate form of the above equation is:

$$R = \exp\left(-t / \overline{m}\right)$$

The exponential failure law can be found from the Poisson tables by using the *c=o* column and equating λt with *np* or by the use of a modern hand calculator. Since this law is just the first term of the Poisson distribution (the probability of no failures for a stated time) as shown in figure 4.4.

4.5 RELIABILITY PREDICTION

The purpose of this section is to explain the use of static models in predicting the reliability of complex systems.

A static system is defined as that system where the failure of one component has no effect on the probability of any other component failing.

RELIABILITY OF SERIES SYSTEMS

A series system (Ref.1), as shown in Figure 4.5 is defined as a complex system of independent units connected together, or interrelated in such a way that the entire system will fail if any one of the units fail. Thus, the system can be no better than its weakest component. A chain can be no stronger than its weakest link, or success of all the components is required to allow system success:

$$R_s = R_1 x R_2 x R_3 \ ....R_n \quad \text{or}$$

$$R_s = \prod_{i-i}^{n} R_i$$

Where:

R_s= probability of the system functioning as intended for the time intended under the condition specified

R_i = probability that the *ith* component of the system will function properly for the time intended under the conditions specified

n = number of the components forming the system.

This product rule can be expressed by failure rates λi as follows:

$$R_s = \prod_{i=1}^{n} R_i = \prod_{i=1}^{n} e^{-\lambda it}$$

$$= e^{-(\lambda_1 t + \lambda_2 t + \lambda_3 t + \cdots \lambda_n t)}$$

$$= e^{-t\sum_{i=1}^{n} \lambda i} = e^{-t\lambda s}$$

$$\lambda_s = \sum_{i=1}^{n} \lambda_i$$

λ_i =failure rate that the *ith* component of the system.

Special case, where component are identical or equivalent, the component reliabilities are equal to each other, then

$$R_s = (R_c)^n = e^{-n\lambda ct}$$

Where:

R_c = component reliability

λ_c = component failure rate

RELIABILITY OF PARALLEL SYSTEM

A parallel system, as shown in Figure 4.6, is defined as a complex set of interrelated components connected in such a way that redundant, or standby part can take over the function of a failed part to save the system; that is, there is more than one means of accomplishing a given task. Parallel systems are often called redundant systems or standby systems. Redundancy, in reliability, refers to the use of more than one part for the same function (to take over in case the first part fails). The reliability of a parallel system consisting of n components is calculated as follows (Ref.1):

$$R_s = 1 - \prod_{i=1}^{n}(1 - R_i)$$

or

$$R_s = 1 - \prod_{i=1}^{n} U_i$$

Where:

U_i = unreliability of the *ith* component of the system, which is $U_i = 1 - R_i$

RELIABILITY OF SERIES-PARALLEL SYSTEMS

The series-parallel systems (Ref.1), as shown in Figure 4.7, are the complex static systems include both series and parallel components. Reliability for these systems is determined by computing the reliabilities separately using the rules that apply to either series or parallel systems, level by level, until the entire system is completed. The steps are:

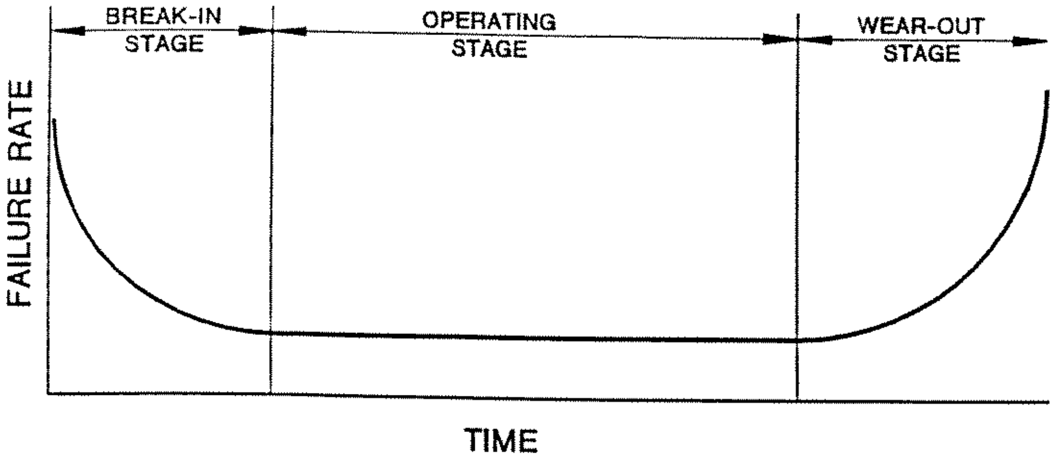
1. Separate all subsystems and categorize them as series or parallel.

2. Calculate the reliability of each parallel subsystem.

3. Calculate the reliability of each series subsystem.

4. Use each series and/or parallel subsystem as if each are units in a large, higher-level subsystem and calculate the reliability as before.

5. Continue level by level until the system is complete.



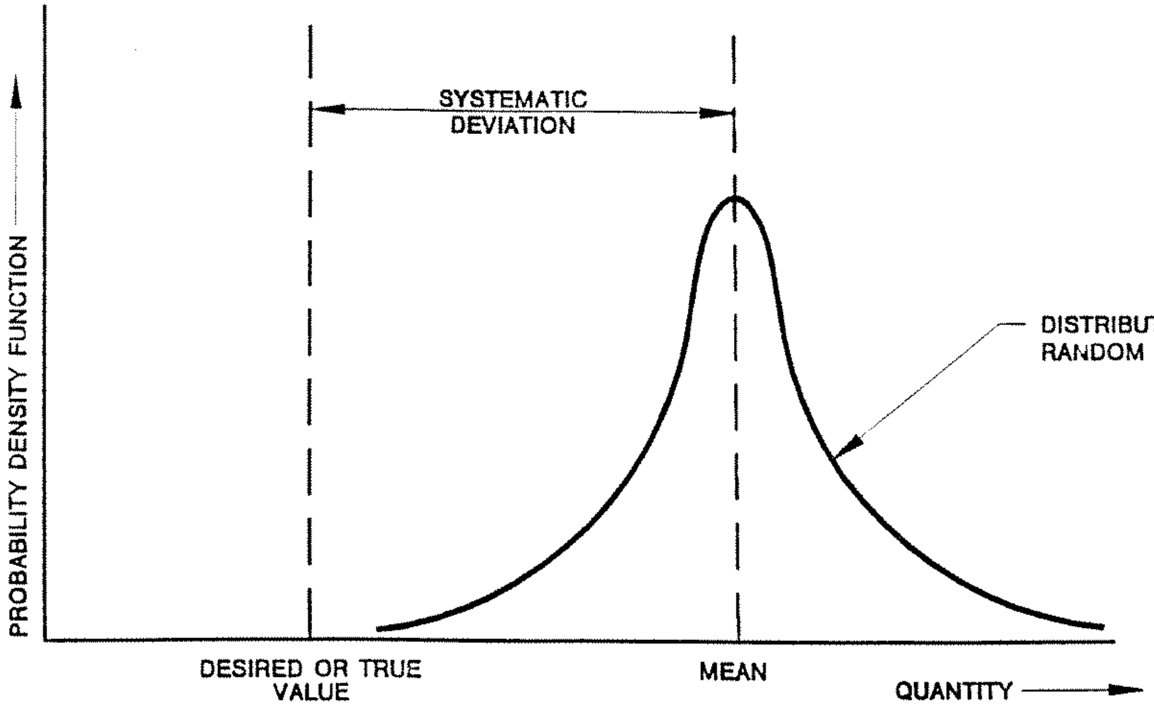
J P KENNY

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

BATH TUB CURVE
FAILURE RATE AS A FUNCTION OF AGE

FIGURE NO.
4.1



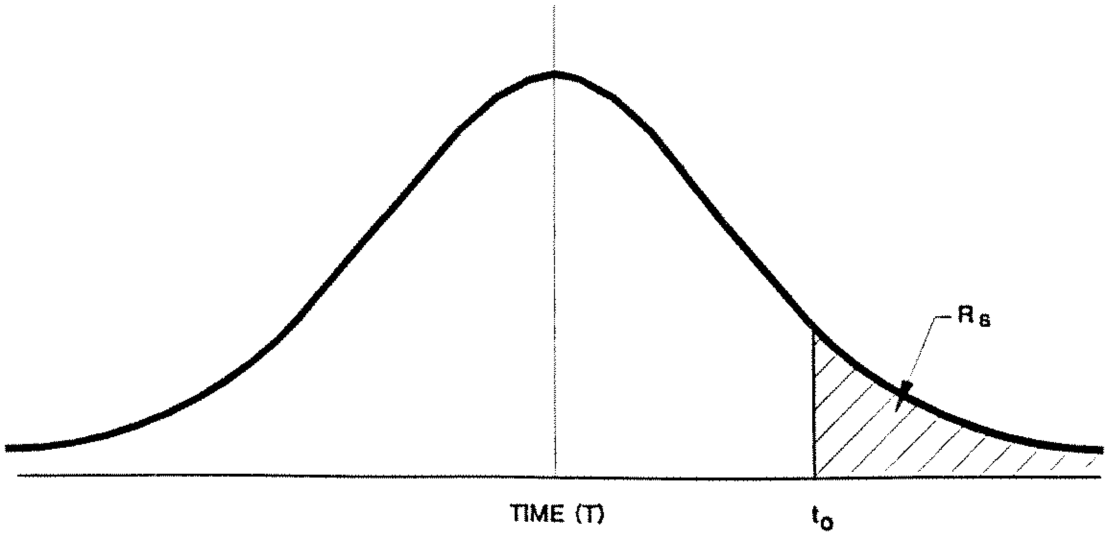
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

THE NORMAL DISTRIBUTION

FIGURE NO. 4.2

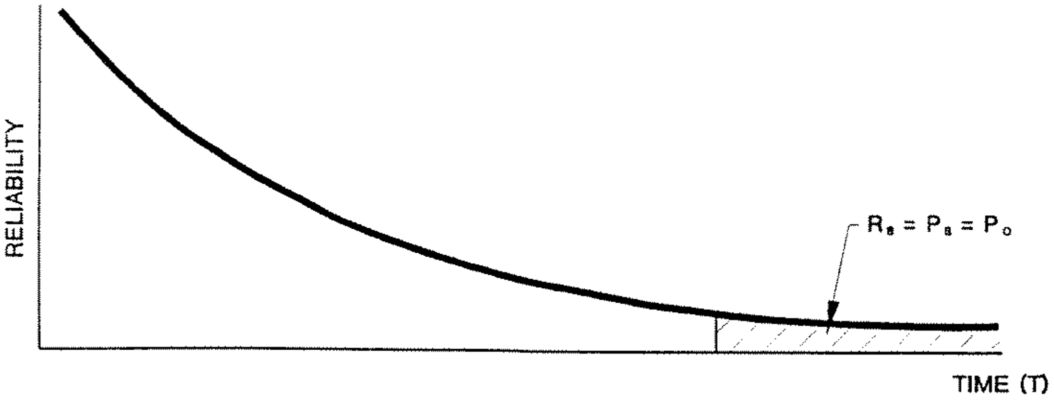


CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

RELIABILITY OF NORMAL DISTRIBUTION

FIGURE NO. 4.3



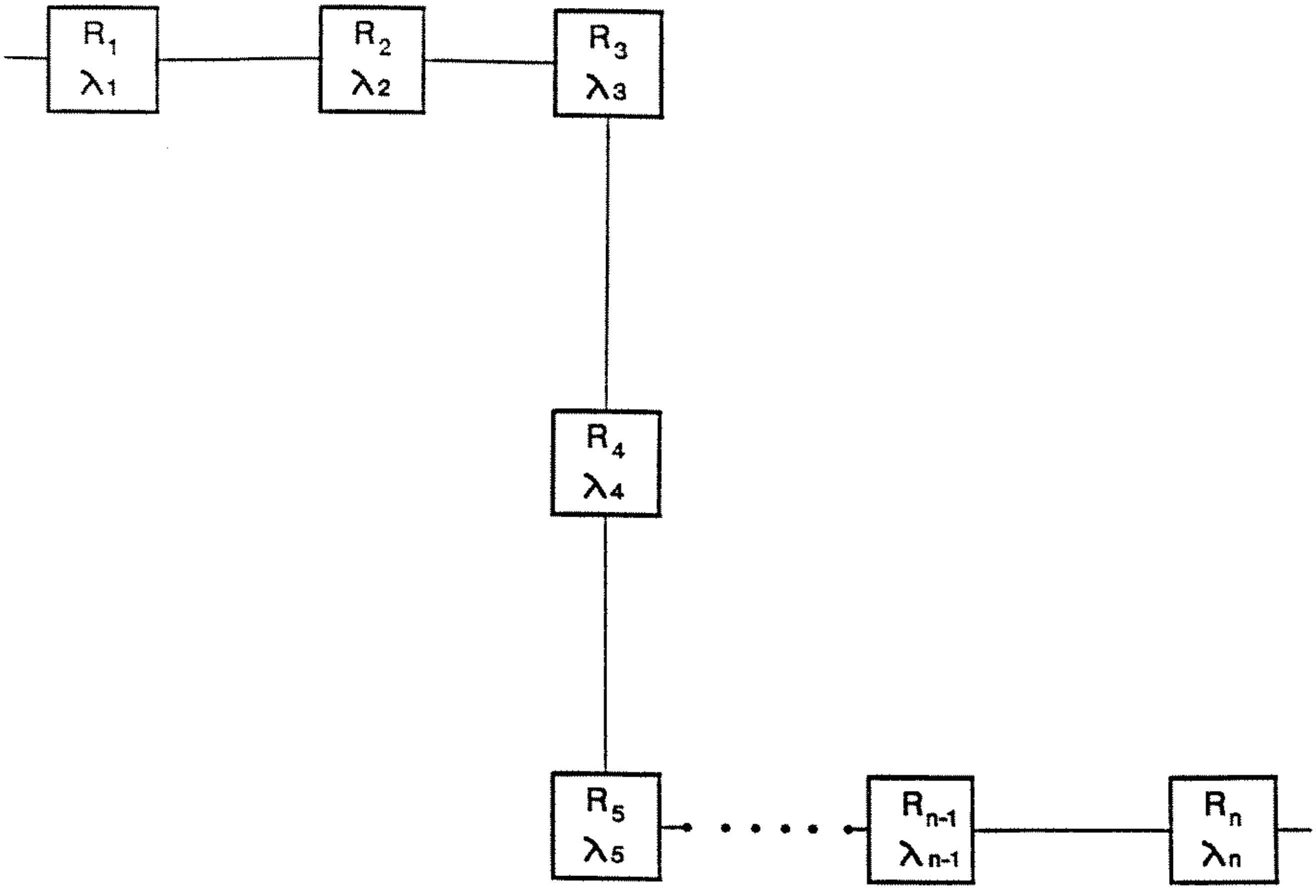
J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

EXPONENTIAL FAILURE LAW

FIGURE NO. 4.4



J P KENNY

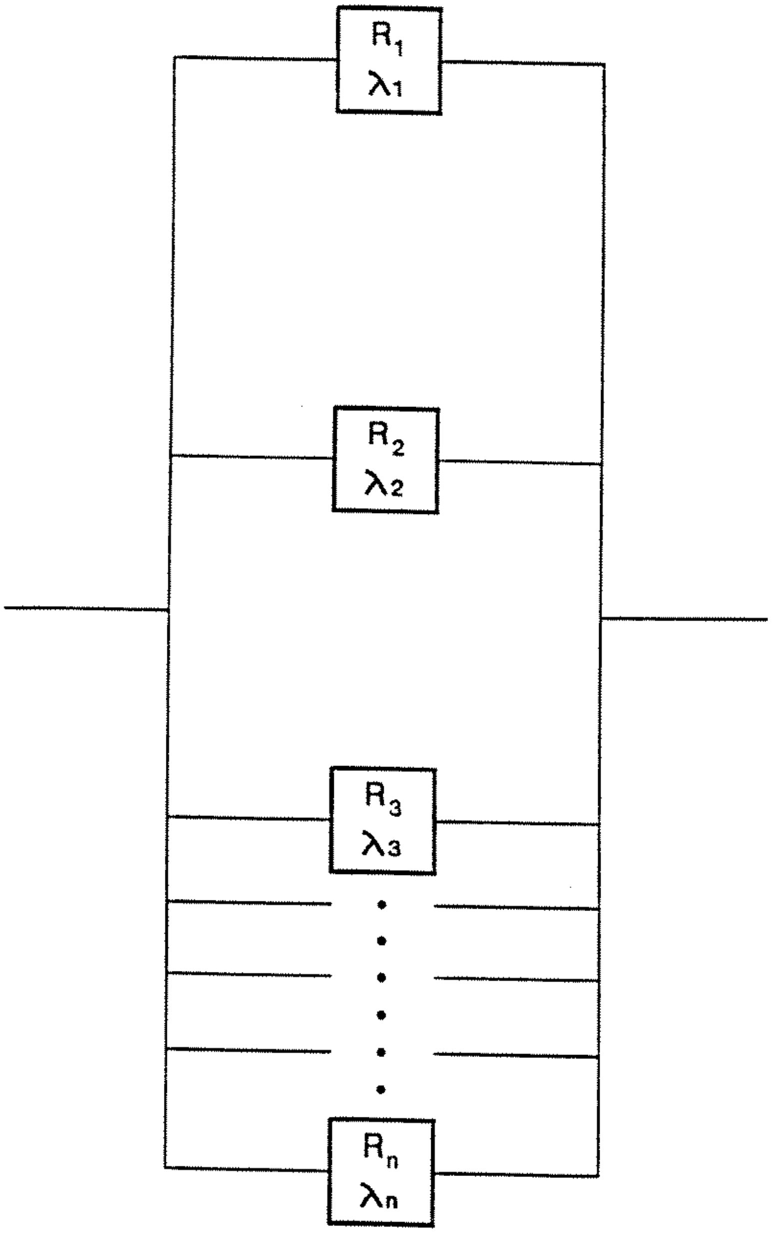
CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

SERIES SYSTEM

FIGURE NO. 4.5

80295006 6/30/94



J P KENNY

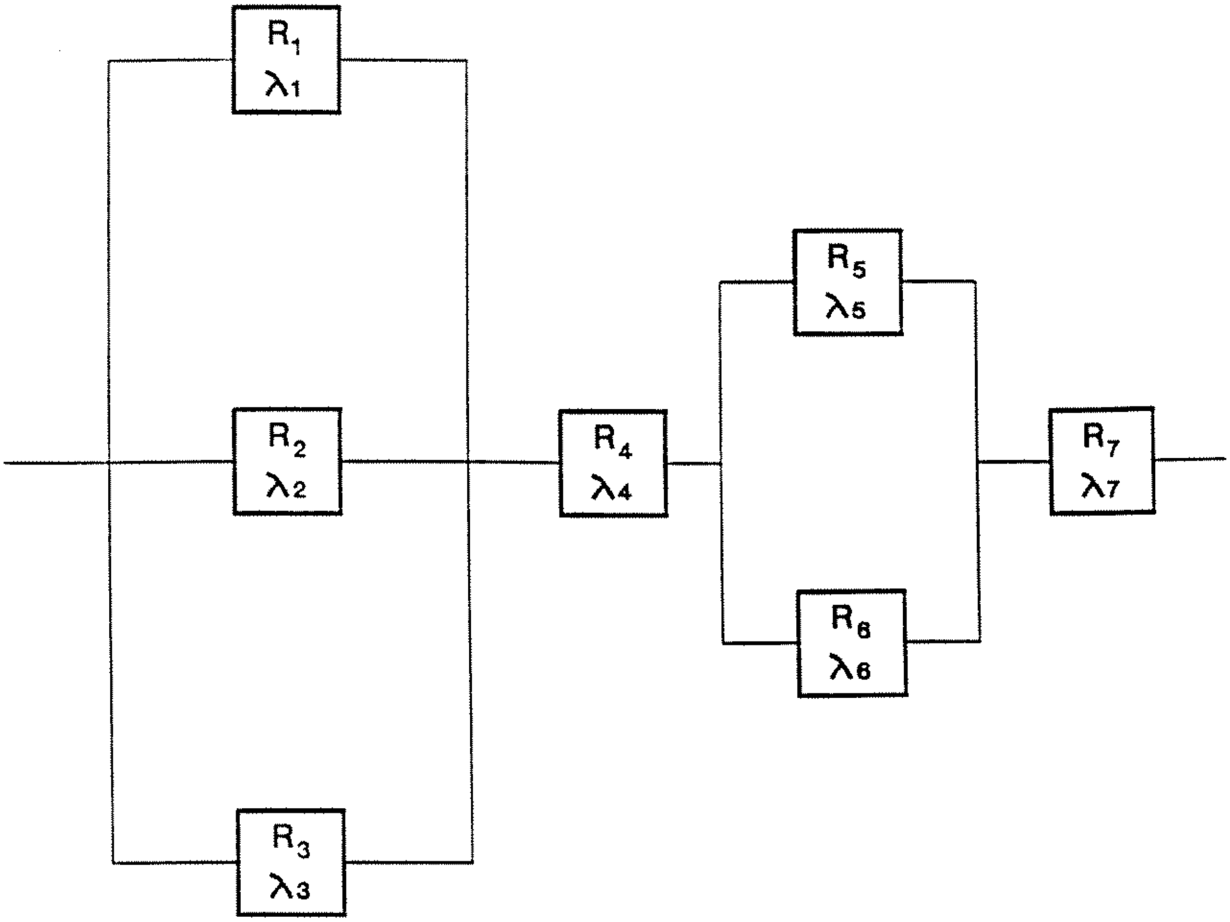
CLIENT **MINERALS MANAGEMENT SERVICES**
U.S. Department of the Interior

JOB NO.
80295.1

PARALLEL SYSTEM

FIGURE NO.
4.6

80295007 6/30/94



J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

SERIES - PARALLEL SYSTEM

FIGURE NO. 4.7

80295008 6/30/94

Section Five

SYSTEM MODELING AND ANALYSIS RESULTS

DRAFT

Section Five

SYSTEM MODELING AND ANALYSIS RESULTS

5.1 INTRODUCTION

This section of the report presents the method used to model the offshore safety systems and lists the underlying assumptions made with regard to system operation. The reliability model with boundary for the cases analyzed are defined and graphically presented.

The sources of data used for component failure are obtained through the survey and summarized into a data base in Section 6.0.

5.2 ASSUMPTIONS

The following assumptions are made with regard to the operation of the safety systems:

- No human error in operation of the system;
- Third party damage to any of the components is not addressed;
- Breakdown of a readily repairable component is noticed immediately;
- The umbilical failure rate is outside the scope of the work and is assumed zero;
- The systems are only operated within design life, or the constant failure rate period of their lives. Early failures caused by faulty manufacture are assumed to be discovered during testing and commissioning, and the wear out failures are assumed not to happen in their design lives.
- The reliability of equipment is generic, and it is assumed to be independent of the manufacturers or brands.

5.3 DESCRIPTION OF THE PHYSICAL SYSTEMS

Five offshore safety system schemes are analyzed. These schemes are as follows:

- Scheme 1 - A spring-loaded wireline or tubing retrievable Sub-Surface Safety Valve (SSSV) within production well (Figure 5.1).
- Scheme 2 - A single actuated Master Surface Safety Valve (MSSV) with monitoring and command unit (Figure 5.2).
- Scheme 3 - A single actuated Wing Safety Valve (WSSV) with monitoring and command unit (Figure 5.3).
- Scheme 4 - A single actuated Pipeline Shut Down (SDV) valve with monitoring and control unit (Figure 5.4).
- Scheme 5 - A single non actuated Pipeline Check Valve (FSV) (Figure 5.5).

5.4 SYSTEMS FAILURE RATE CALCULATION

Failures reported during Hurricane Andrew were not repaired and replaced during the time of the storm and no log is kept for each failure time. Since actual times to failures were not recorded, the failure rate has to be determined by estimating those times. The procedure (illustrated in section 4.3(3)) to estimate time is to calculate the average number of survivors (s) for the storm period, which is equivalent to assuming that all failures lasted exactly half the storm. The calculations to each scheme are:

Scheme 1

Sub-Surface Safety Valve (SSSV)

Average number of survivors $(\bar{s}) = \frac{s_1+s_2}{2}$

Where:

s_1 = 716 good units at the start of Hurricane Andrew
s_2 = 716 good units at the end of Hurricane Andrew

$$\bar{s} = (716+716)/2$$
$$\bar{s} = 1432/2$$
$$\bar{s} = 716 \quad \textit{number of survivors (average)}$$

$$\text{Failure Rate } (\lambda) = f/\bar{s}\, t$$

Where:

$f = 0$ number of failures reported
$\bar{s} = 716$ valves reported operational
$t = 14$ hours

$$\lambda = 0/716 \text{ x } 14$$
$$\lambda = 0/10024$$
$$\lambda = 0.0 \quad \textit{failures per hour}$$

<u>Scheme 2</u>

Master Surface Safety Valve (MSSV)

$$\text{Average number of survivors } (\bar{s}) = \frac{s_1+s_2}{2}$$

Where:

s_1 = 729 good units at the start of Hurricane Andrew
s_2 = 724 good units at the end of Hurricane Andrew

$$\bar{s} = (729+724)/2$$
$$\bar{s} = 1453/2$$
$$\bar{s} = 726.5 \quad \textit{number of survivors (average)}$$

Failure Rate (λ) = f/$\bar{s}$ t

Where:

f = 5 number of failures reported
$\bar{s}$ = 726.5 valves reported operational
t = 14 hours

λ = 5/726.5 x 14
λ = 5/10171
λ = 0.0005 *failures per hour*

Scheme 3

Wing Surface Safety Valve (WSSV)

$$\text{Average number of survivors } (\bar{s}) = \frac{s_1+s_2}{2}$$

Where:

s_1 = 460 good units at the start of Hurricane Andrew
s_2 = 460 good units at the end of Hurricane Andrew

$\bar{s}$ = (460+460)/2
$\bar{s}$ = 920/2
$\bar{s}$ = 460 *number of survivors (average)*

Failure Rate (λ) = f/$\bar{s}$ t

Where:

f = 0 number of failures reported
$\bar{s}$ = 460 valves reported operational
t = 14 hours

$$\lambda = 0/460 \times 14$$
$$\lambda = 0/6440$$
$$\lambda = 0.0 \textit{ failures per hour}$$

Scheme 4

Pipeline Shut Down Valve (SDV)

Average number of survivors $(\bar{s}) = \frac{s_1+s_2}{2}$

Where:

s_1 = 415 good units at the start of Hurricane Andrew
s_2 = 415 good units at the end of Hurricane Andrew

$$\bar{s} = (415+415)/2$$
$$\bar{s} = 830/2$$
$$\bar{s} = 415 \textit{ number of survivors (average)}$$

Failure Rate $(\lambda) = f/\bar{s}\,t$

Where:

$f = 0$ number of failures reported
$\bar{s}$ = 415 valves reported operational
t = 14 hours

$$\lambda = 0/415 \times 14$$
$$\lambda = 0/5810$$
$$\lambda = 0.0 \textit{ failures per hour}$$

Scheme 5

Pipeline Check Valves (FSV)

Average number of survivors $(\bar{s}) = \frac{s_1+s_2}{2}$

Where:

s_1 = 378 good units at the start of Hurricane Andrew
s_2 = 378 good units at the end of Hurricane Andrew

$$\bar{s} = (378+378)/2$$
$$\bar{s} = 756/2$$
$$\bar{s} = 378 \text{ \textit{number of survivors (average)}}$$

Failure Rate $(\lambda) = f/\bar{s}\,t$

Where:

$f = 0$ number of failures reported
$\bar{s} = 378$ valves reported operational
$t = 14$ hours

$$\lambda = 0/378 \times 14$$
$$\lambda = 0/5292$$
$$\lambda = 0.0 \text{ \textit{failures per hour}}$$

5.5 SYSTEMS FAILURE RATE ASSESSMENT

The reliability of each system calculated is not considered to be very dependable, because there is not enough failure information with surveillance time during Hurricane Andrew that can be collected from the operators in Gulf of Mexico. The reasons for this are related to the nature of the industry and can be categorized as follows:

- Failures and service records are politically sensitive to operators and manufacturers and are not made public;

- There is no government regulation requiring operators to report every safety device failure unless the failure causes environmental damage;

- There is technical difficulty and a huge amount of work required to gather this information;

- The total amount of equipment is small, which means the population sample size is small. Statistical estimations techniques give large uncertainties when small samples are used;

- The time period being evaluated (14 hours) is too short to assess the historical performance of the systems;

- The equipment is reliable so there are very few failures. This means that the sample of failures is a small proportion of an already small population of survivors;

- Few failures are reported. Those that are often do not indicate the exact failure mode;

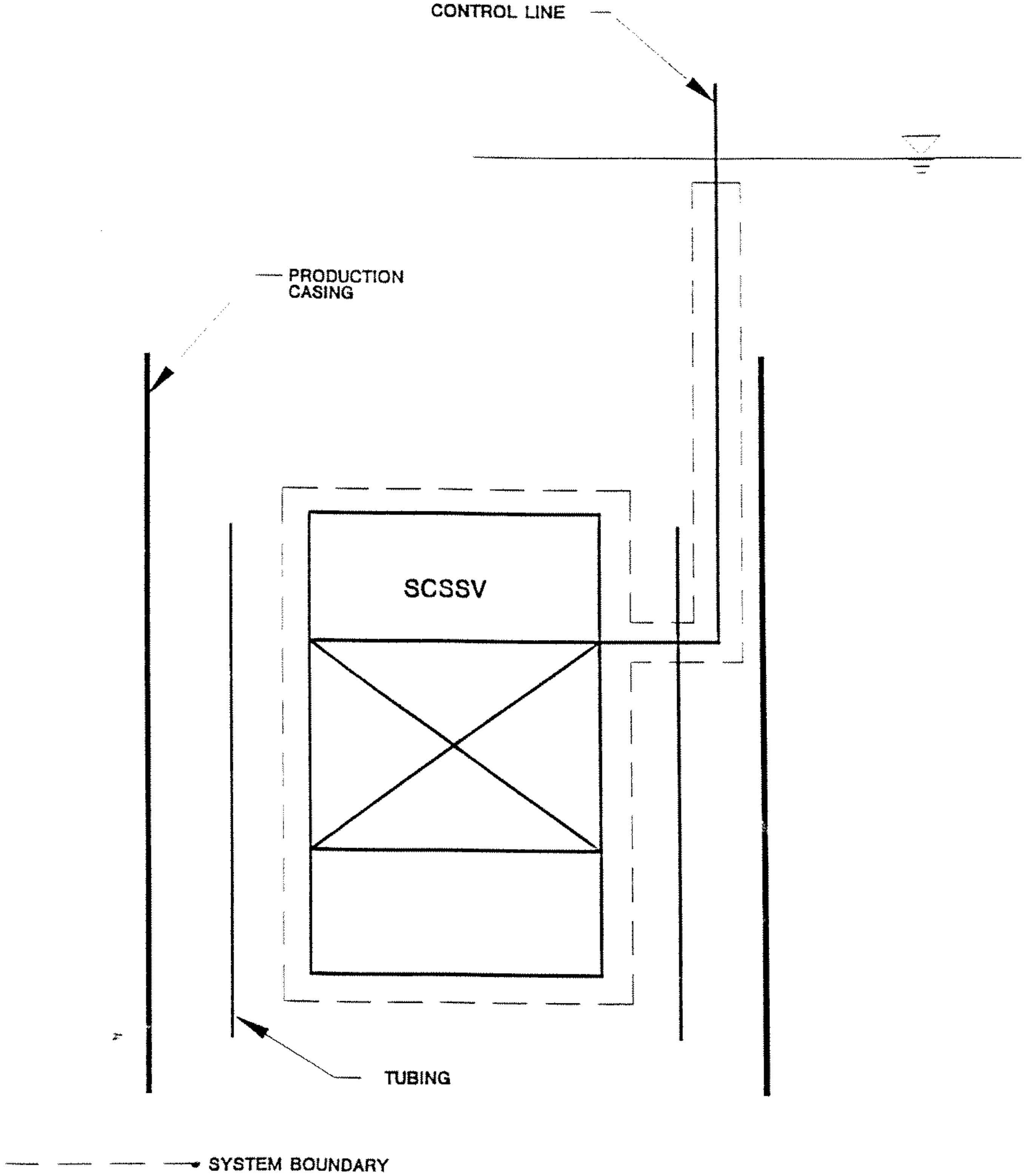
- Equipment is different on each installation, some equipment is in prototype form while some incorporates improvement from production and service feedback. Data may not, therefore, be comparable.

5.6 OREDA - OFFSHORE RELIABILITY DATA

OREDA is the best known and one-of-the-kind offshore reliability data base established by DET NORSKE VERITAS INDUSTRI NORGE A/S, DNV TECHNICA. The relevant safety device reliability data are presented in Figures 5.6, 5.7, 5.8 and 5.9.

The activities leading up to the OREDA work started in 1980. The pre-project period commenced from Autumn 1981 and consisted of: (1) studying existing reliability data banks, both successful and some which failed; (2) the development of approach, methods of collections and analysis of data, and the format for presentation; and (3) discussions/meetings with the industry. The study reached completion in 1982 which resulted in several case studies proving the feasibility of an operational program. The project moved into the operational phase in the beginning of 1983, and was managed by a steering committee, which was composed of members representing operating companies. Each company contributed funds to support the project. Data was collected from installations located in Norwegian and UK sector of the North Sea, as well as from installations in the Adriatic Sea. The publication of the OREDA-84 handbook marked the end of initial stage of work.

Phase II and III of the OREDA project focused on process equipment, and improving the quality of failure data with the help of more operators joining the project. There were 10 (ten) operators in total at the time of publication of OREDA-92, including, Statoil; AGIP; BP; Norsk Hydro; Saga; Shell; Total; Elf; Exxon and Phillips. The operators participation is essential for the OREDA project.



J P KENNY

CLIENT

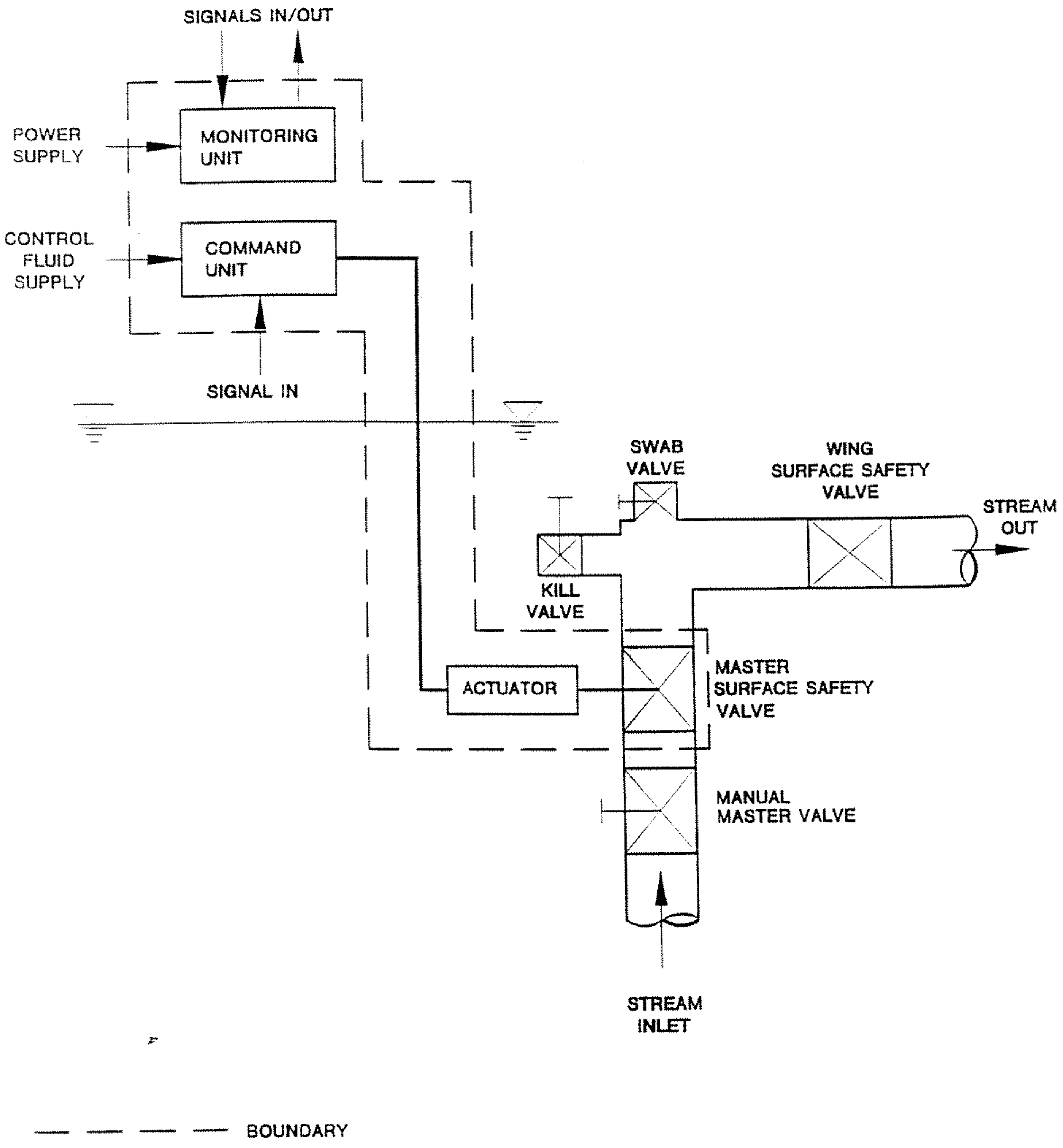
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

SURFACE CONTROLLED
SUBSURFACE SAFETY VALVE RELIABILITY MODEL

FIGURE NO.
5.1

80295011 7/01/94



J P KENNY

CLIENT

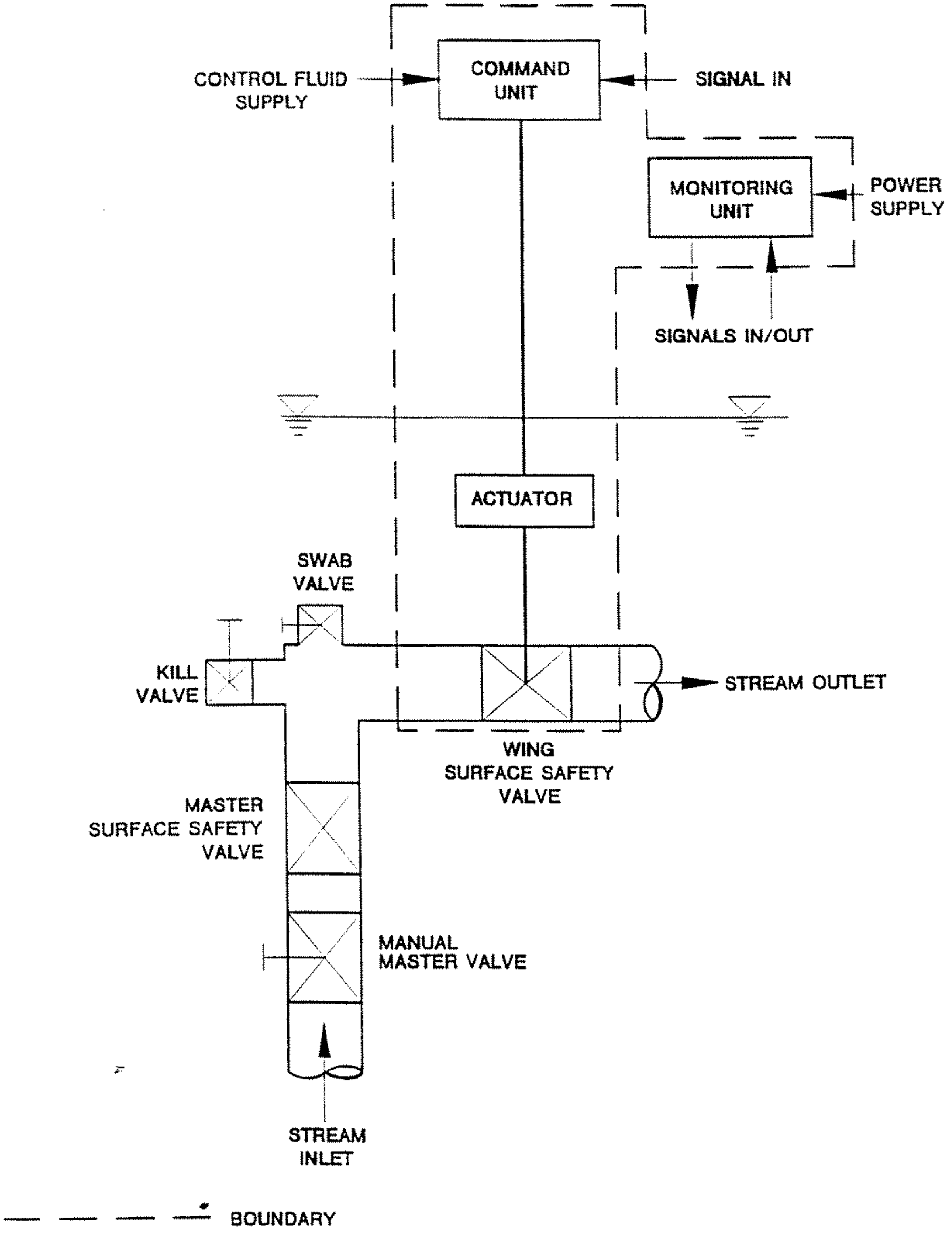
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

MASTER SURFACE SAFETY VALVE RELIABILITY MODEL

FIGURE NO.
5.2

80295013 7/05/94



J P KENNY

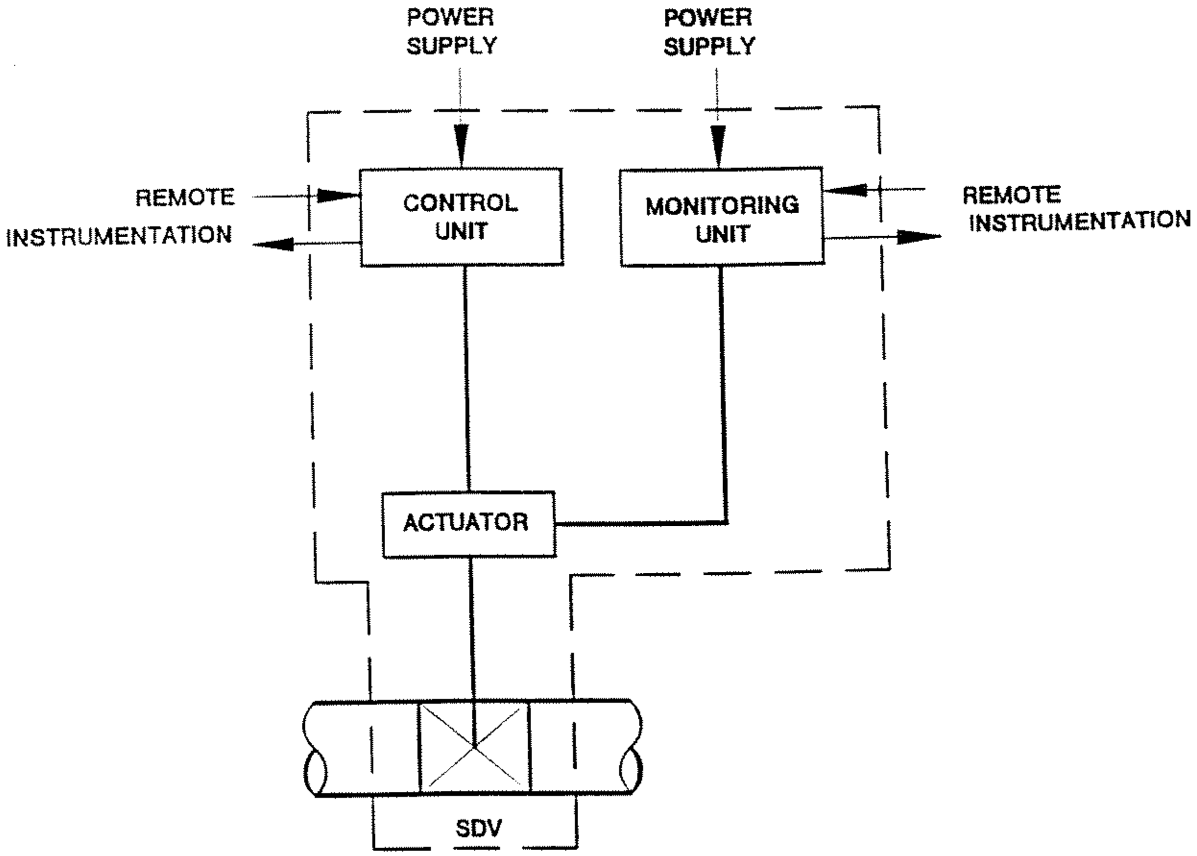
CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

WING SURFACE SAFETY VALVE
RELIABILITY MODEL

FIGURE NO. 5.3

80295014 7/05/94



— — — — BOUNDARY

J P KENNY

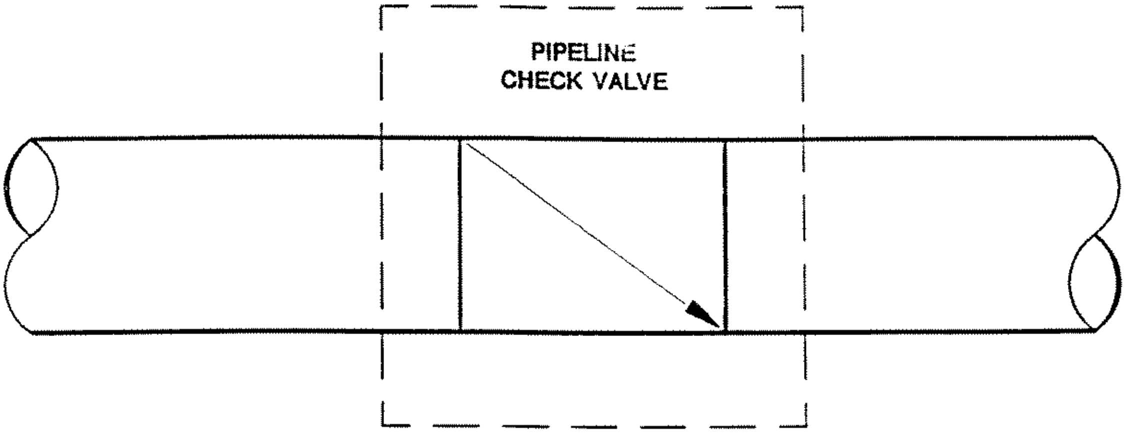
CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

PIPELINE SHUT DOWN VALVE
RELIABILITY MODEL

FIGURE NO. 5.4

80295015 7/05/94



— — — — BOUNDARY

J P KENNY

CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

PIPELINE CHECK VALVE
RELIABILITY MODEL

FIGURE NO.
5.5

80295012 7/05/94

Population	Installation	Safety Device
48	2	*Sub-Surface Safety Valve*

Failure mode	No. of failures	Failure rate (per 10e6 hours)		
		Lower	Mean	Upper
Critical	**20**	**7.3**	**11**	**16**
Delayed operation	10	0	5.5	15
Internal leakage	8	2.2	4.4	8
Unknown	2	0.2	1.1	3.5
Unknown	**17**	**0.6**	**9.4**	**14**
Faulty indication	3	0	1.7	5.3
Unknown	14	1.3	7.7	16
All modes	**37**	**11**	**20**	**31**

J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

OREDA
RELIABILITY OF SUB-SURFACE SAFETY VALVE

FIGURE NO. 5.6

Population	Installation	Safety Device
275	19	*Master Surface Safety Valve*

Failure mode	No. of failures	Failure rate (per 10e6 hours)		
		Lower	Mean	Upper
Critical	**119**	**8.8**	**30**	**52**
Failed to close	9	0.56	1.8	3.5
Failed to open	4	0.032	1.3	3.6
Unknown	106	5.7	27	49
Degraded	**101**	**11**	**26**	**42**
Delayed operation	3	0.15	0.51	1.3
Internal leakage	9	0.82	1.5	2.7
Unknown	89	7.7	24	40
Incipient	**30**	**0.93**	**3.3**	**6.1**
Faulty indication	18	0.024	1	3.5
Unknown	12	0.055	2.3	5
All modes	**250**	**23**	**59**	**96**

J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

OREDA
RELIABILITY OF MASTER SURFACE SAFETY VALVE

FIGURE NO. 5.7

Population	Installation	Safety Device			
201	13	*Wing Surface Safety Valve*			
Failure mode	**No. of failures**	**Failure rate (per 10e6 hours)**			
		Lower	**Mean**	**Upper**	
Critical	**18**	**1.4**	**5.9**	**11**	
Failed to close	5	0	1.3	3.4	
Failed to open	8	0.4	2.5	5.2	
Unknown	5	0	2.1	5.4	
Degraded	**60**	**12**	**20**	**28**	
Delayed operation	30	2.5	12	22	
Internal leakage	8	0.33	2.6	5.5	
External leakage	10	0	2.2	7.9	
Unknown	12	1.6	2.8	4.6	
Incipient	**21**	**0**	**14**	**30**	
Faulty indication	21	0	14	30	
All modes	**99**	**25**	**40**	**55**	

J P KENNY

CLIENT MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO. 80295.1

OREDA
RELIABILITY OF WING SURFACE SAFETY VALVE

FIGURE NO. 5.8

Population	Installation	Safety Device			
322	12	*Shut Down Valve*			
Failure mode		**No. of failures**	**Failure rate (per 10e6 hours)**		
			Lower	**Mean**	**Upper**
Critical		**64**	**6.46**	**9.17**	**12.29**
External leakage		2	0.09	0.28	0.85
Faulty indication		4	0.25	0.56	1.26
Failed to close		27	2.77	3.81	5.24
Failed to open		15	1.36	2.12	3.26
Internal leakage		1	0.03	0.14	0.63
Overhaul		2	0.09	0.28	0.85
Significant external leakage		1	0.02	0.14	0.65
Seepage		1	0.03	0.14	0.63
Significant internal leakage		7	0	1.12	2.64
Spurious operation		3	0.17	0.43	1.06
Unknown		1	0.02	0.14	0.65
Degraded		**19**	**1.94**	**2.95**	**4.4**
Delayed operation		1	0.02	0.16	0.71
External leakage		6	0.47	0.93	1.79
Faulty indication		2	0.09	0.31	0.95
Internal leakage		9	0.67	1.4	2.56
Unknown		1	0.02	0.16	0.71
Incipient		**51**	**5.78**	**7.69**	**10.01**
External leakage		12	0.79	1.63	2.88
Faulty indication		10	0.85	1.58	2.73
Internal leakage		19	1.83	2.93	4.45
Other modes		1	0.02	0.16	0.71
Seepage		5	0.37	0.77	1.58
Unknown		4	0.26	0.63	1.42
Unknown		**17**	**0.95**	**2.22**	**3.91**
Faulty indication		9	0.49	1.11	2.11
Overhaul		4	0.14	0.5	1.24
Unknown		4	0.15	0.6	1.43
All modes		**151**	**17.23**	**22.03**	**27.26**

J P KENNY

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO.
80295.1

OREDA
RELIABILITY OF SHUT DOWN VALVE

FIGURE NO.
5.9

Section Six

SAFETY EQUIPMENT FAILURE DATA BASE

DRAFT

Section Six

SAFETY EQUIPMENT FAILURE DATA BASE

6.1 INTRODUCTION

This section of the report describes the data base and collection approach chosen to analyze failures of the offshore safety and pollution control devices during Hurricane Andrew.

Generally, this information, (ie. failures, mistakes, misuses, etc.) is not information oil and gas companies normally disclose to outside parties. For the purpose of privacy, all information obtained has been kept with the utmost confidentiality in mind, rendering all data anonymous and only using generic data to analyze and publish.

6.2 DATA BASE COLLECTION APPROACH

The basic information necessary for the production of the study depends solely on the participation of the individual oil companies. The extent of the data collection was agreed upon by the MMS and J P KENNY, after extensive communication with the Offshore Operators Committee (OOC) and with individual oil companies owning or operating platforms and pipelines throughout the Gulf of Mexico. The initial data requested was adjusted during the data collection process according to the experience gained about availability of failure data information within each company.

A simple questionnaire (found in Appendix I) was developed and distributed, along with a survey letter, to forty four (44) oil and gas operating companies in the Gulf of Mexico. The survey included questions in the following areas: field location, production type and performance of Sub-Surface Safety Valves (SSSV), Master Surface Safety Valves (MSSV), Wing Surface Safety Valves (WSSV), Pipeline Shut Down Valves (SDV), and Pipeline Check Valves (FSV) during Hurricane Andrew.

In addition, the number of valves actuated to the closed position during the Hurricane, which of those particular valves failed due to the storm and the number of completions in which a SSSV prevented uncontrolled flow due to valve failure or damage were analyzed. Details of each failure were also requested but only as general information and not to be included in with published data.

6.3 DATA BASE RESULTS

The data base was accumulated by J P KENNY International, Inc. These results were obtained by the cooperation of the oil and gas companies throughout the Gulf of Mexico, (results illustrated on Figures 6.2-6.18). Despite the previously assumed hesitation of oil and gas companies participation:

- 19 of the companies contacted reported information.
- 12 area locations were reported (10 of which were on the path of Hurricane Andrew, as shown on Hurricane Andrew damage survey map (Figure 6.1), found at the end of this section.).
- 2698 valves reported actuated to the closed position during the storm (Figure 6.4).

  - 716 Sub-Surface Safety Valves (SSSV)
  - 729 Master Surface Safety Valves (MSSV)
  - 460 Wing Surface Safety Valves (WSSV)
  - 415 Pipeline Shut Down Valves (SDV)
  - 378 Pipeline Check Valves (FSV)

The population of completed wells existing in the Gulf of Mexico during Hurricane Andrew was 15,742 wells. 29% of these wells were in the path of the storm (see Figure 6.1). Out of all 4,525 wells directly affected by the storm, operators responded the survey with approximately 2,700 valves actuated, an estimated 17% of all valves in the path of Hurricane Andrew (see Figure 6.2).

South Timbalier reported five (5) MSSV failures while no other valve, of any kind, failed in any other locations. Two areas, Ship Shoal and South Timbalier, reported activation of twelve (12) SSSV that prevented uncontrolled flow due to other damage, eleven (11) of which occurred in South Timbalier and one (1) in the Ship Shoal area (see Figure 6.3). These two areas accounted for 45% of the reported actuated valves with an identified location and were in direct contact with the most intensified section of the storm, as illustrated in Figure 6.19 (Ref.3). The details of the safety systems performance data are presented as follows:

EUGENE ISLAND

- 277 valves actuated;
  - 36 SSSVs;
  - 44 MSSVs;
  - 0 WSSVs;
  - 106 SDVs;
  - 91 FSDs.
- 0 valve failures reported;
- No uncontrolled flow reported.

The eye of Hurricane Andrew passed through Eugene Island at the coast of Louisiana before the storm went on shore. This area ranked third in reported valves actuated (see Figure 6.5) and was 1 out of 4 of the areas hit with the most intensified section of the storm.

EWING BANK

- 59 vales actuated;
  - 19 SSSVs;
  - 19 MSSVs;
  - 19 WSSVs;
  - 0 SDVs;
  - 2 FSDs.
- 0 valve failures reported;
- No uncontrolled flow reported.

The eye of Hurricane Andrew entered the outer continental shelf at the Ewing Bank field location. Ewing Bank was another area which the severe part of the Hurricane passed through. Due to the early stages of the storm, Hurricane Andrews strength was not at full capacity and the damage was minimal in this area. (see Figure 6.6).

GRAND ISLE

- 27 valves actuated;
  - 8 SSSVs;
  - 8 MSSVs;
  - 0 WSSVs;
  - 6 SDVs;
  - 5 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

Grand Isle laid on the outside edge of the storm as it passed through. Reported valves actuated were minimal as well as the damages. (see Figure 6.7).

MAIN PASS

- 10 valves actuated;
  - 2 SSSVs;
  - 2 MSSVs;
  - 2 WSSVs;
  - 2 SDVs;
  - 2 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

Main pass is on the eastern coast of Louisiana and was not in the path of Hurricane Andrew. Ten valve actuators were reported in this area (see Figure 6.8). Results in this area are not necessarily effects from the Hurricane but could be considered as data in calculating reliability of a safety system.

MISSISSIPPI CANYON

- 123 valves actuated;
  - 41 SSSVs;
  - 41 MSSVs;
  - 34 WSSVs;

  - 2 SDVs;
  - 5 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

A reported six (6) platforms in the Mississippi Canyon were in the effected zone of Hurricane Andrew (Ref. 3). It is estimated that the eye of the storm was 25 miles from Mississippi Canyon and caused minimal damage in this area. Over one hundred valves were reported actuated but the area contained no failures (see Figure 6.9).

MOBIL

- 4 valves reported actuated;
  - 1 SSSV;
  - 1 MSSV;
  - 1 WSSV;
  - 0 SDV;
  - 1 FSV.
- 0 valve failures reported;
- No uncontrolled flow reported.

Mobil is an area off the eastern coast of Louisiana, just south of the Alabama coast line, which was not affected by Hurricane Andrew. Only one well was reported (see Figure 6.10) actuated.

SHIP SHOAL

- 348 valves actuated;
  - 84 SSSVs;
  - 91 MSSVs;
  - 81 WSSVs;
  - 56 SDVs;
  - 36 FSVs.
- 0 valve failures reported;
- 1 SSSV valve prevented uncontrolled.

Ship Shoal is among the most devastated areas struck by Hurricane Andrew. A reported 12 platforms of 171 were severely damaged (Ref. 3). The majority of this area was directly in the path of the storm but with 348 valves actuated no valve failure were reported (see Figure 6.11).

SOUTH MARSH ISLAND

- 232 valves actuated;
  - 50 SSSVs;
  - 50 MSSVs;
  - 0 WSSVs;
  - 66 SDVs;
  - 66 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

The North end of South Marsh Island was in the affected zone of Hurricane Andrew. Over two hundred valves were reported actuated with no valve failures presented (see Figure 6.12).

SOUTH PASS

- 8 valves reported;
  - 3 SSSVs;
  - 4 MSSVs;
  - 0 WSSVs;
  - 0 SDVs;
  - 1 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

South Pass was outside the storm area. South Pass is located 50 miles northeast of the path of Hurricane Andrew. The hurricane had minimal effect in this area which is illustrated by the number of reported valves actuated (see Figure 6.13).

SOUTH PELTO

- 22 valves actuated,
  - 7 SSSVs ,
  - 7 MSSVs;
  - 7 WSSVs;
  - 1 SDVs;
  - 1 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

South Pelto is a small area which was approximately 15 miles North of Hurricane Andrew's direct path. Due to the size of area the number of valve actuations was minimal. But this area did encounter the severity of the storm . (see Figure 6.14)

SOUTH TIMBALIER

- 337 valves actuated;
  - 141 SSSVs;
  - 130 MSSVs;
  - 41 WSSVs;
  - 19 SDVs;
  - 26 FSVs.
- 5 valve failures reported;
- 11 SSSV's prevented uncontrolled flow.

South Timbalier was the most affected area in the path of Hurricane Andrew. The storm was at its most intensified while traveling through South Timbalier. The total amount of valves actuated was the largest reported per area. Five (5) MSSV failures were reported which yielded a failure rate of 0.0029 fpg for the area (see Figure 6.15).

VERMILION

- 64 valves actuated;
  - 14 SSSVs;
  - 14 MSSVs;

  - 0 WSSVs;
  - 18 SDVs;
  - 18 FSVs.
- 0 vale failures reported;
- No uncontrolled flow reported.

The Vermilion area is the area just west of the path of Hurricane Andrew. The affects of the storm were not major in this area. There were no reported damages of any proportions in this area (Ref. 3). The valves actuated were precautionary in the event the storm reached the area (see Figure 6.16)

WEST CAMERON

- 4 valves actuated;
  - 1 SSSV;
  - 1 MSSV;
  - 1 WSSV;
  - 0 SDV;
  - 1 FSV.
- 0 valve failures reported;
- No uncontrolled flow reported.

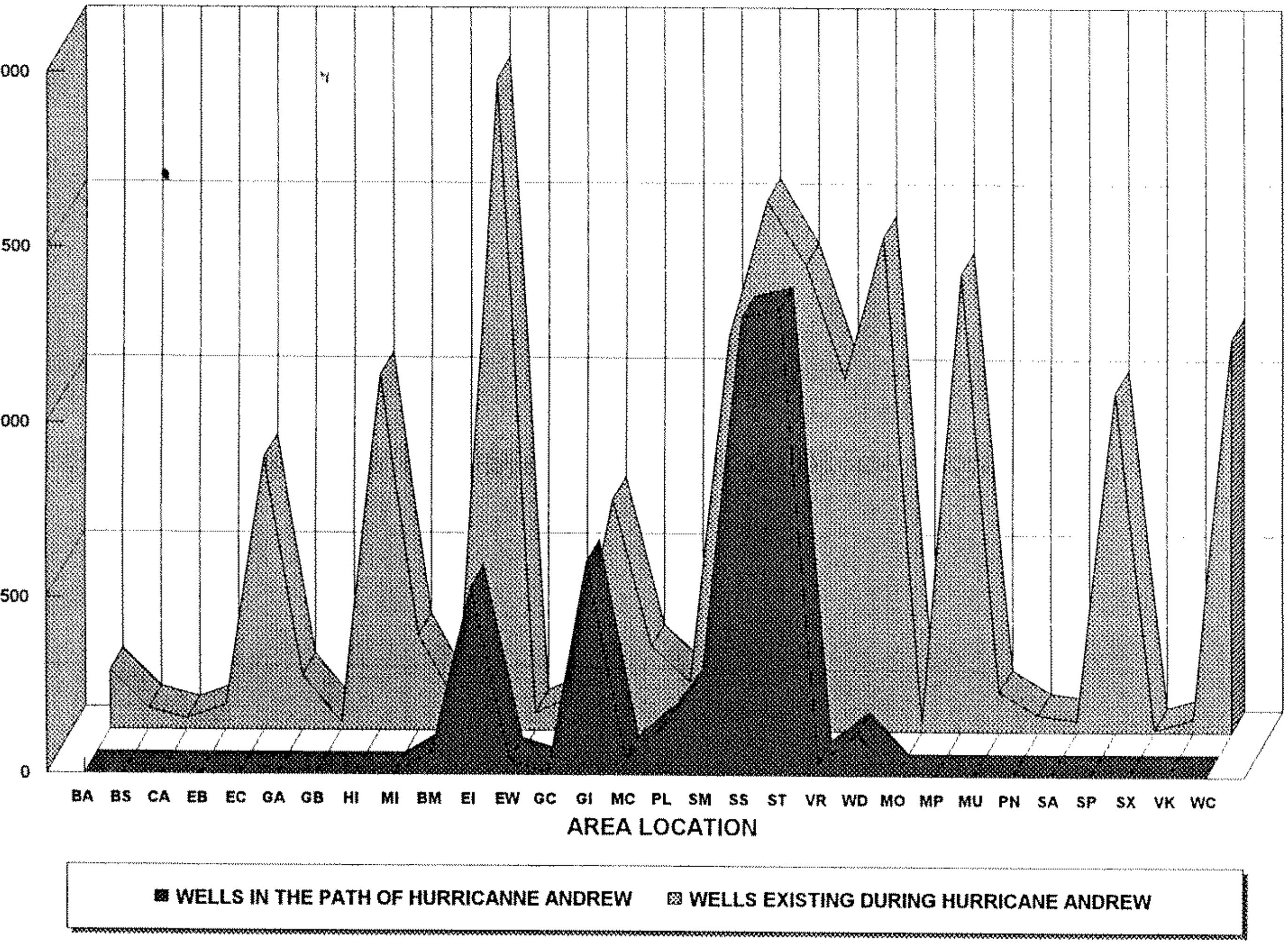
West Cameron is another area not directly in the affected area of Hurricane Andrew. West Cameron is located two areas west of the storm path. This area reported the lowest total of valves actuated with 4 (see Figure 6.17).

OTHER

- 1162 valves actuated;
  - 309 SSSVs;
  - 317 MSSVs;
  - 274 WSSVs;
  - 139 SDVs;
  - 123 FSVs.
- 0 valve failures reported;
- No uncontrolled flow reported.

Other locations are defined as any valve reported which did not designate an area location. No failures or uncontrolled flows were reported without a location designated (see Figure 6.18), even though over one thousand valves were reported being actuated.

Wing Surface Safety Valve (WSSV) data obtained from the questionnaire is minimal. After the meeting between MMS and OOC on July 28, 1994 (Appendix I, letter of MMS, dated August 30, 1994), it was determined that the terminology "Wing Surface Safety Valve (WSSV)" was misunderstood by the industry and the valves variety of applications in the industry was also interpreted differently. Therefore, the data obtained from our survey has an inaccurate account of WSSV's due to the above mentioned assessments.



AREA LOCATIONS

BA	BRAZOS AREA
BS	BRENTON SOUND
CA	CHANDELEUR
EB	EAST BREAKS
EC	EAST CAMERON
GA	GALVESTON AREA
GB	GARDEN BANKS
HI	HIGH ISLAND
MI	MATAGORDA ISLAND
BM	BAY MARCHAND
EI	EUGINE ISLAND
EW	EWING BANK
GC	GREEN CANYON
GI	GRAND ISLE
MC	MISSISSIPPI CANYON
PL	SOUTH PELTO
SM	SOUTH MARSH ISLAND
SS	SHIP SHOAL
ST	SOUTH TIMBALIER
VR	VERMILION
WD	WEST DELTA
MO	MOBILE
MP	MAIN PASS
MU	MUSTANG ISLAND
PN	NORTH PADRE ISLAND
SA	SABINE PASS
SP	SOUTH PASS
SX	SABINE PASS (TEXAS)
VK	VIOSCA KNOLL
WC	WEST CAMERON

J P KENNY

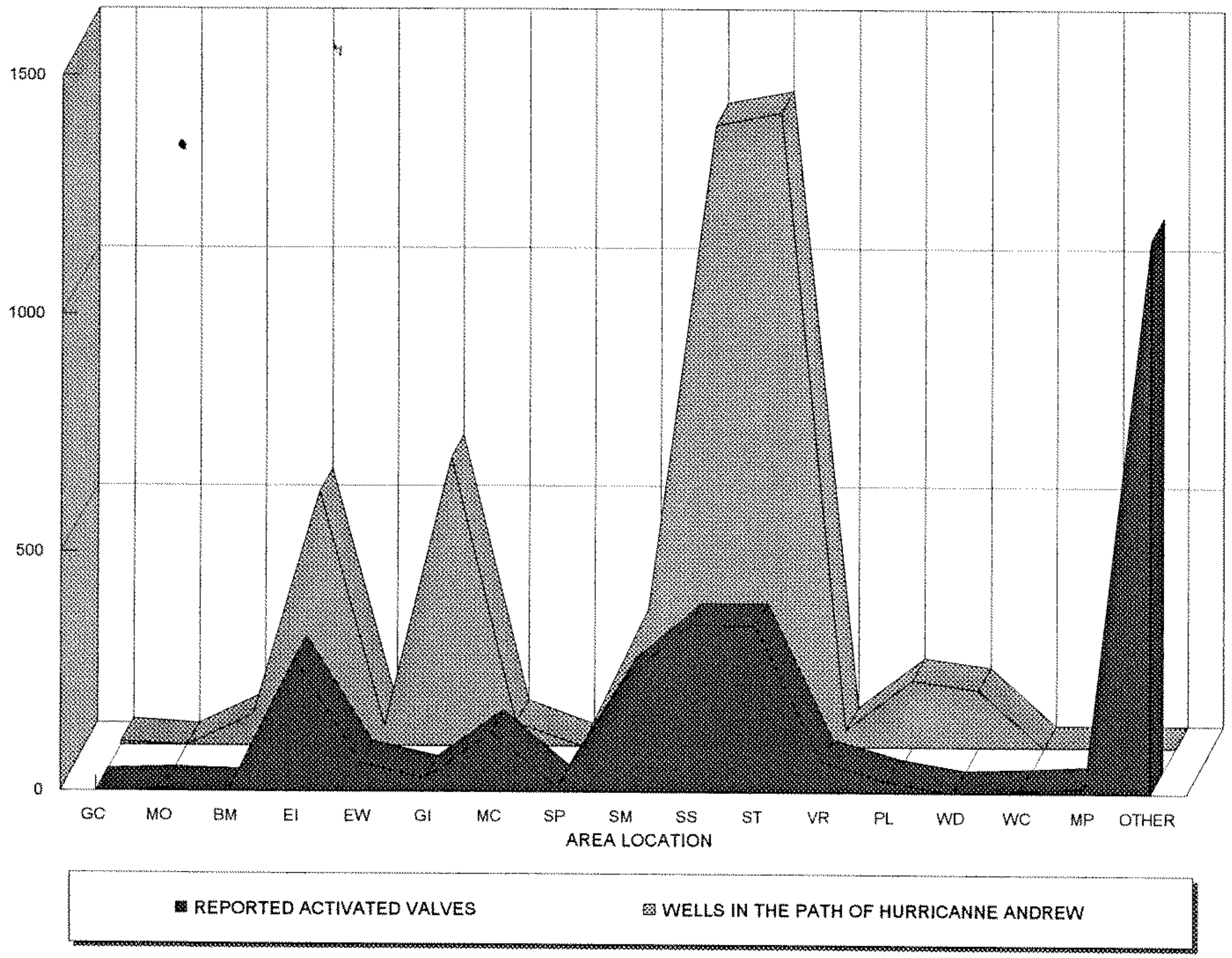
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
WELLS EXISTING DURING HURRICANE ANDREW VS
WELLS IN PATH OF HURRICANE ANDREW

JOB NO
80295.1

FIGURE NO
6.1



AREA LOCATIONS

BM	BAY MARCHAND
EI	EUGINE ISLAND
EW	EWING BANK
GC	GREEN CANYON
GI	GRAND ISLE
MC	MISSISSIPPI CANYON
PL	SOUTH PELTO
SM	SOUTH MARSH ISLAND
SS	SHIP SHOAL
ST	SOUTH TIMBALIER
VR	VERMILION
WD	WEST DELTA
MO	MOBILE
MP	MAIN PASS
WC	WEST CAMERON
OTHER	Denotes reported valves actuated with an unidentified area location.

J P KENNY

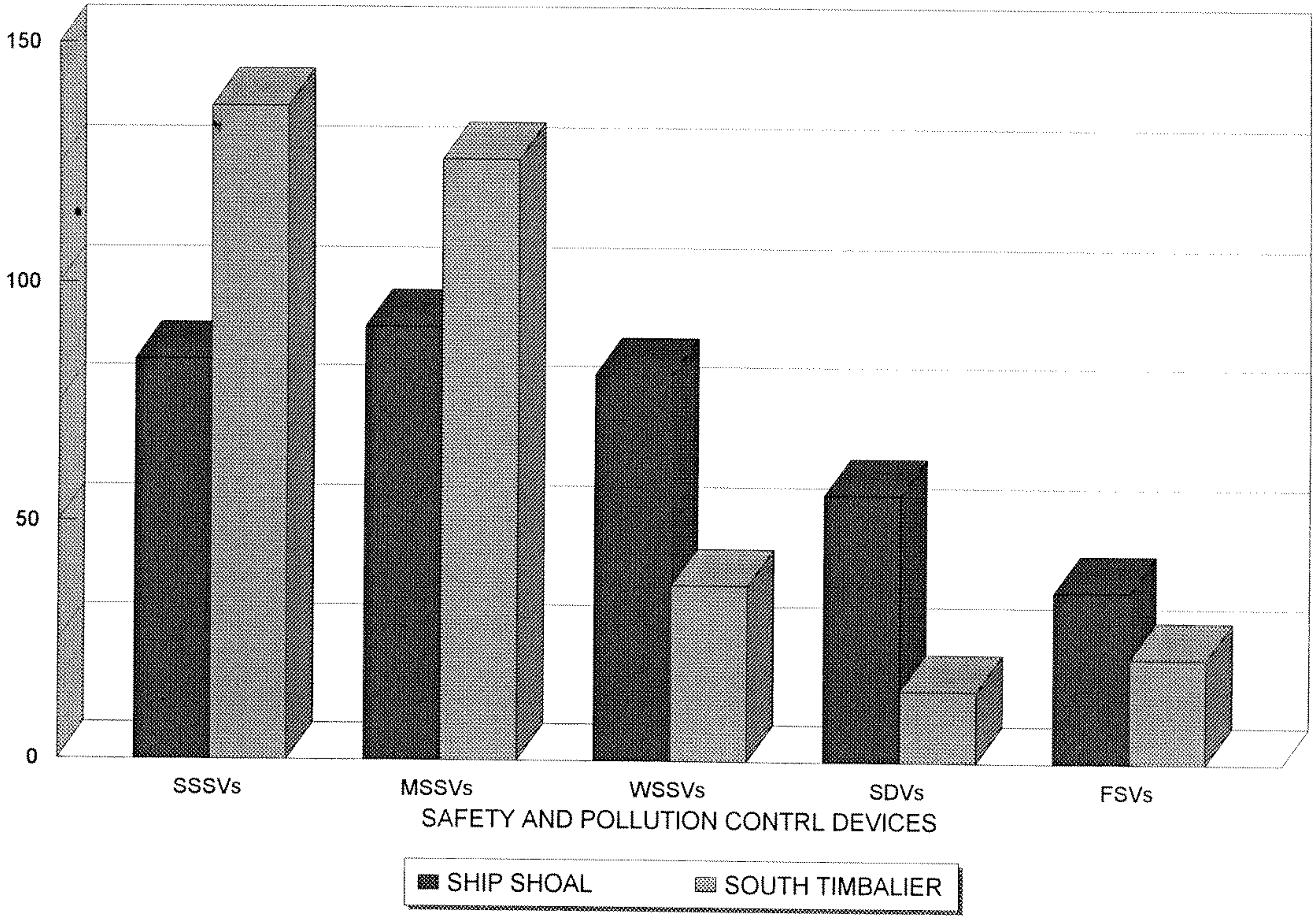
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

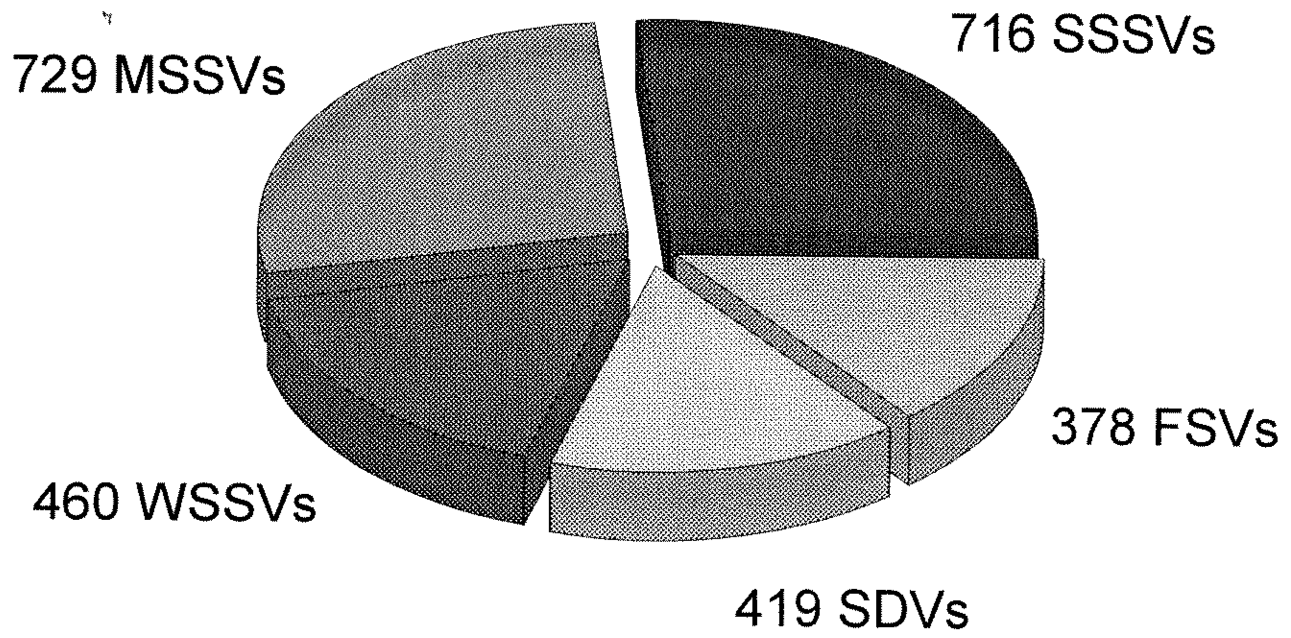
TITLE
WELLS IN PATH OF HURRICANE ANDREW VS
REPORTED ACTIVATED VALVES

JOB NO.
80295.1

FIGURE NO.
6.2



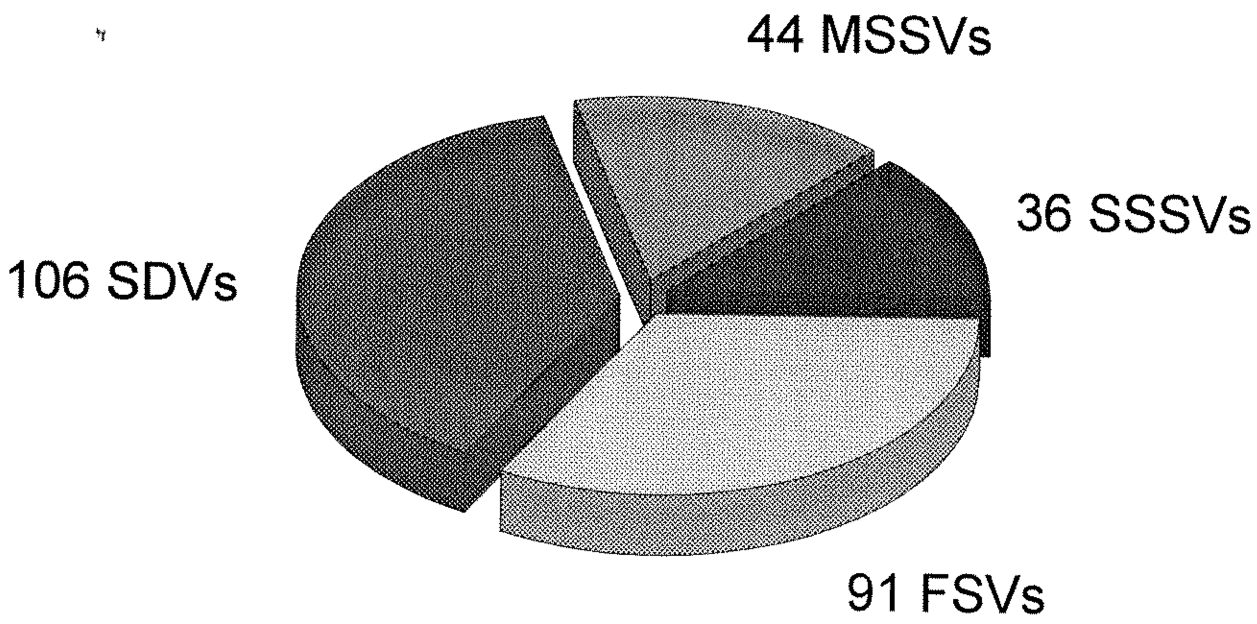
J P KENNY	PROJECT ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW	CLIENT MINERALS MANAGEMENT SERVICES U.S. Department of the Interior	JOB NO. 80295.1
		TITLE AREAS MOST AFFECTED BY HURRICANE ANDREW REPORTED SAFETY VALVES ACTIVATED	FIGURE NO. 6.3



5 - MSSV FAILURES; FAILURE RATE - 0.0005 fph

11 - SSSVs PREVENTED UNCONTROLLED FLOW

J P KENNY JPK	PROJECT ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW	CLIENT MINERALS MANAGEMENT SERVICES U.S. Department of the Interior	JOB NO 80295.1
		TITLE GULF OF MEXICO - HURRICANE ANDREW REPORTED SAFETY VALVES ACTIVATED	FIGURE NO 6.4



0 - FAILURES

J P KENNY

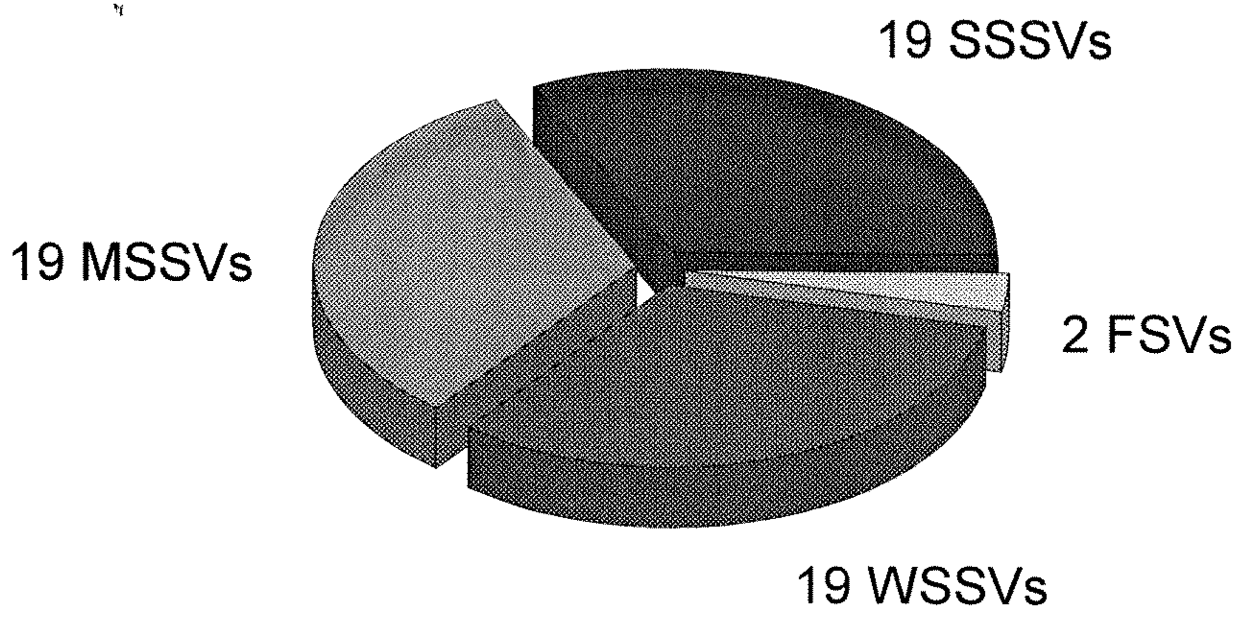
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
EUGENE ISLAND
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.5



0 - FAILURES

J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

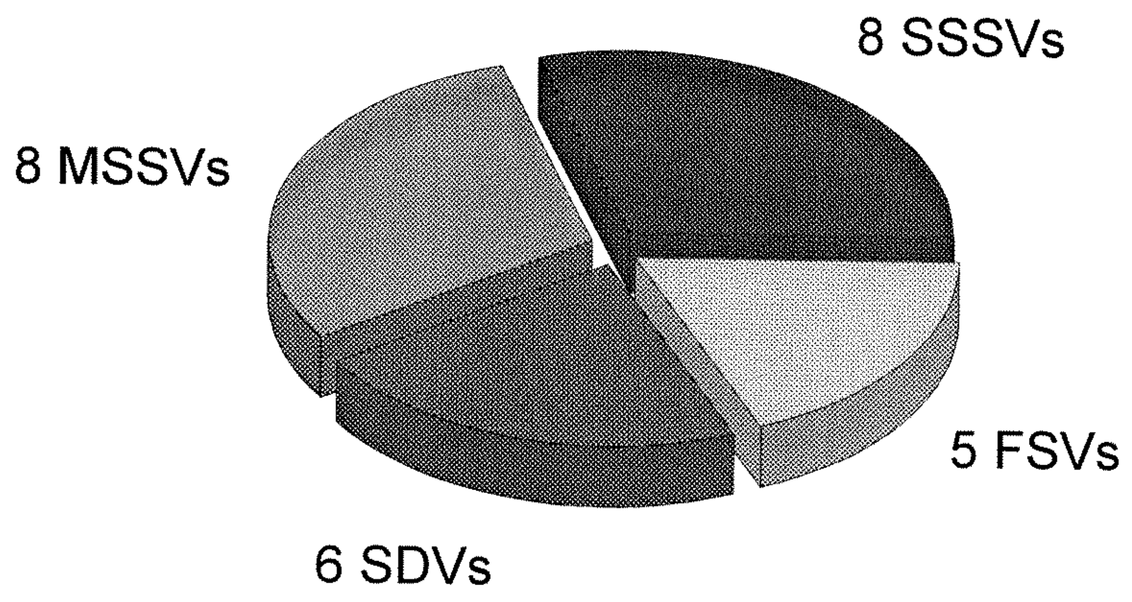
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
EWING BANK
REPORTED SAFETY VALVES ACTIVATED

JOB NO.
80295.1

FIGURE NO.
6.6

80295051 03/17/95



0 - FAILURES

J P KENNY

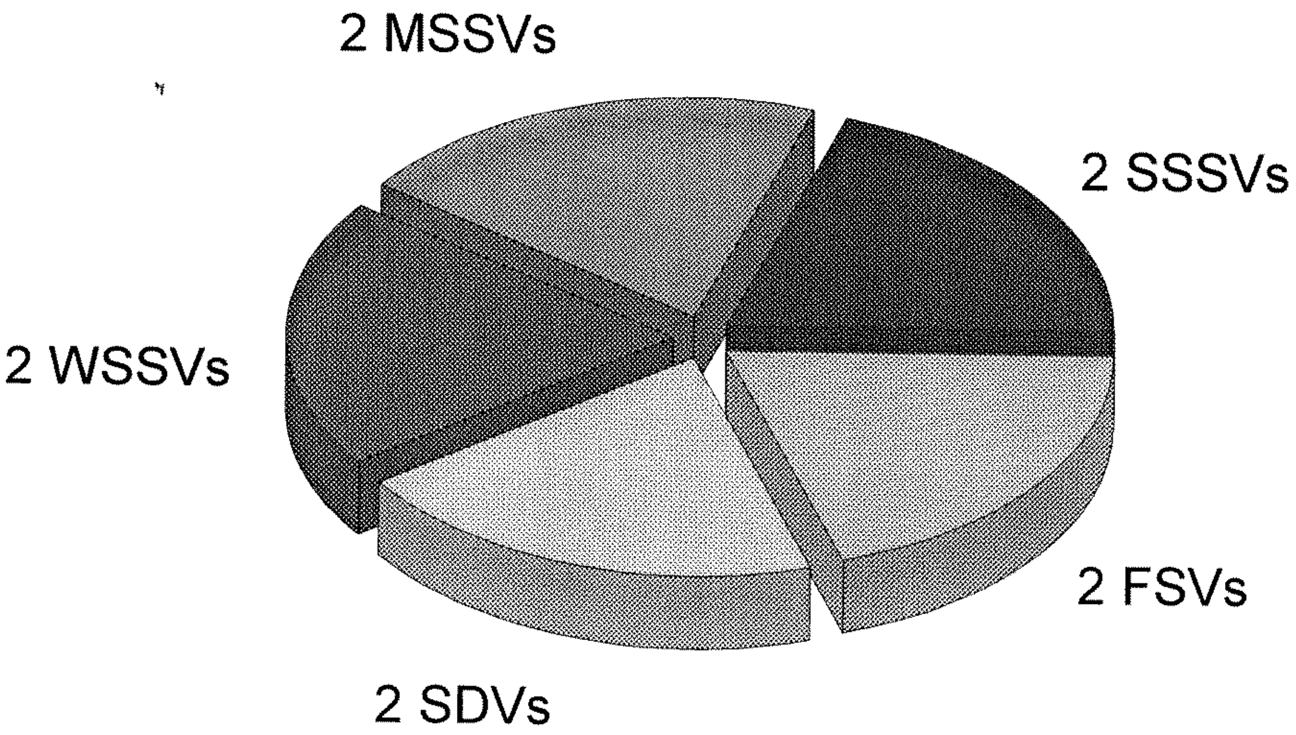
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
GRAND ISLE
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.7



0 - FAILURES

J P KENNY

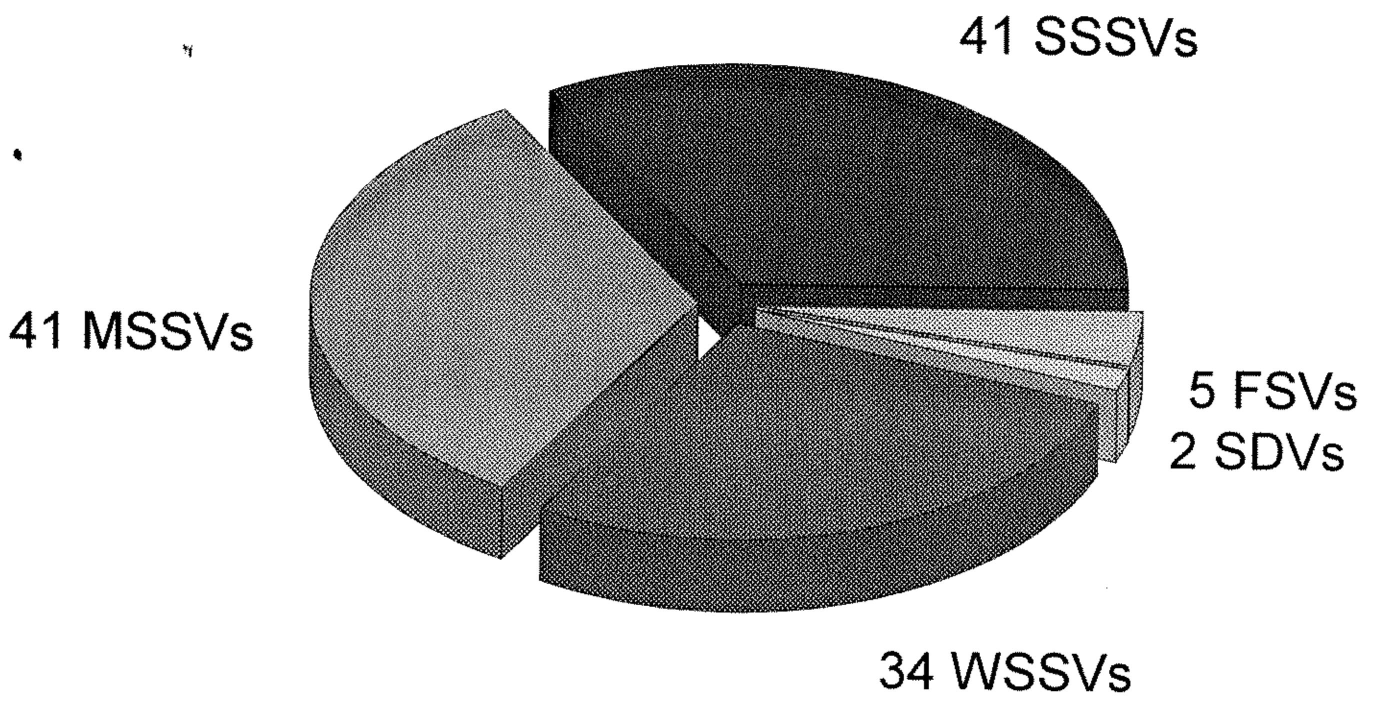
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
MAIN PASS
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.8



0 - FAILURES

J P KENNY
JPK

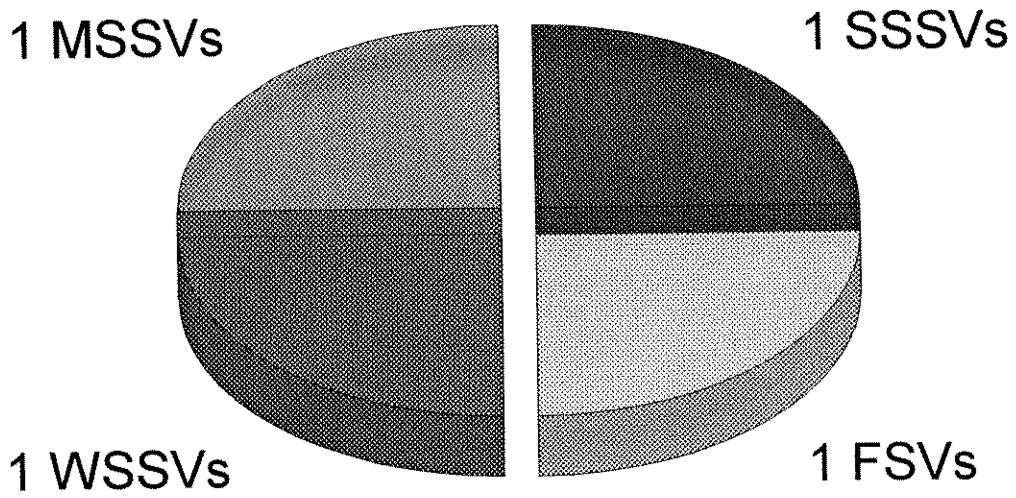
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
MISSISSIPPI CANYON
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.9



0 - FAILURES

J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

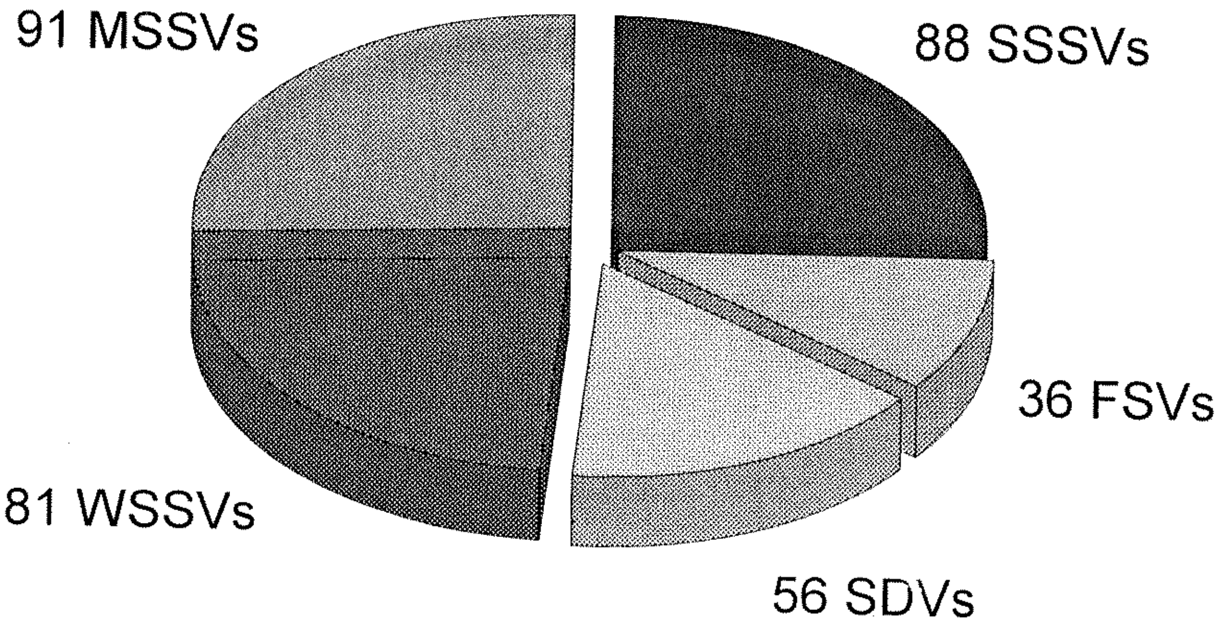
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
MOBIL
REPORTED SAFETY VALVES ACTIVATED

JOB NO.
80295.1

FIGURE NO.
6.10

80295055 03/17/95



0 - FAILURES

J P KENNY

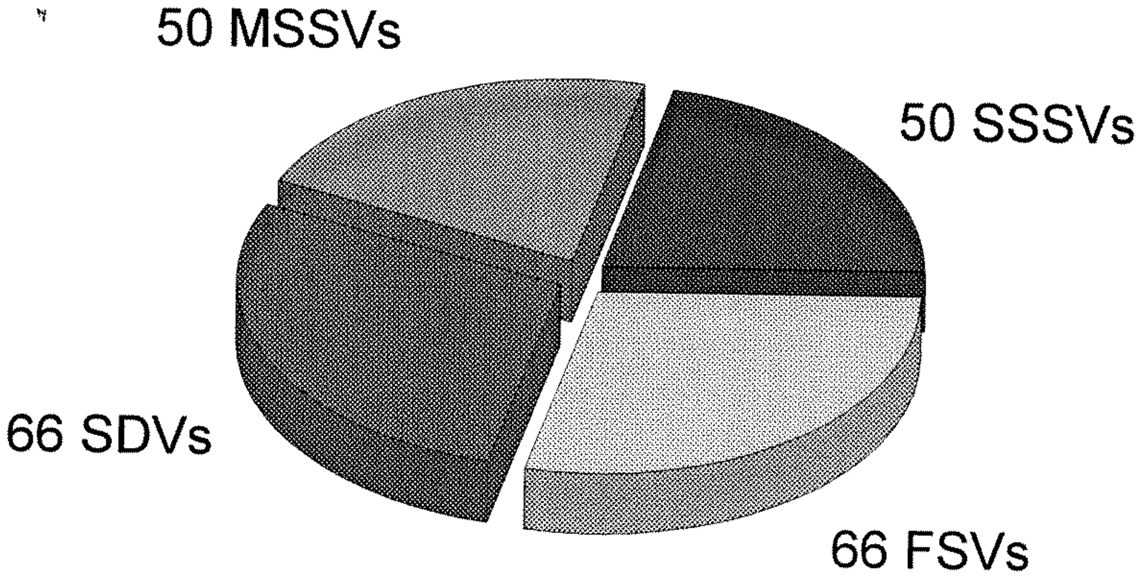
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

SHIP SHOAL
REPORTED SAFETY VALVES ACTIVATED

80295.1

6.11



0 - FAILURES

J P KENNY

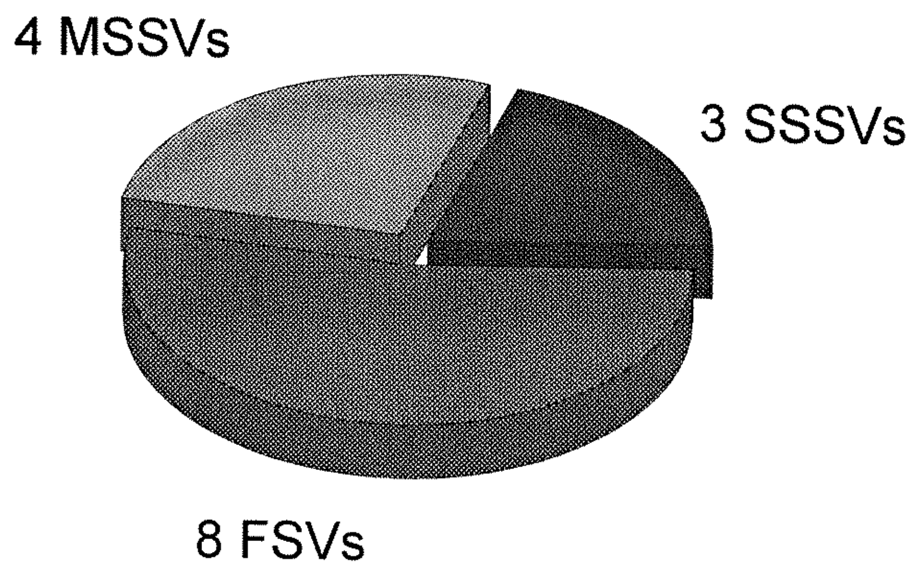
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
S. MARSH ISLAND
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.12



0 - FAILURES

J P KENNY

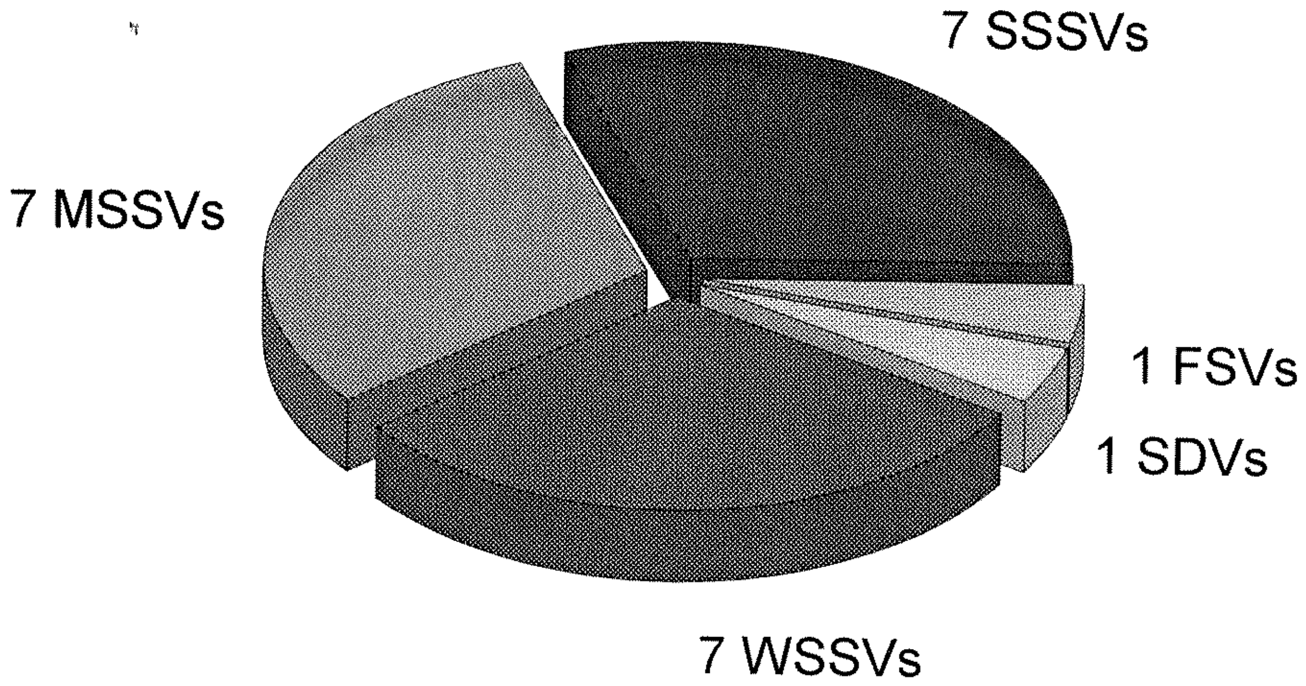
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
SOUTH PASS
REPORTED SAFETY VALVES ACTIVATED

JOB NO.
80295.1

FIGURE NO.
6.13



0 - FAILURES

J P KENNY

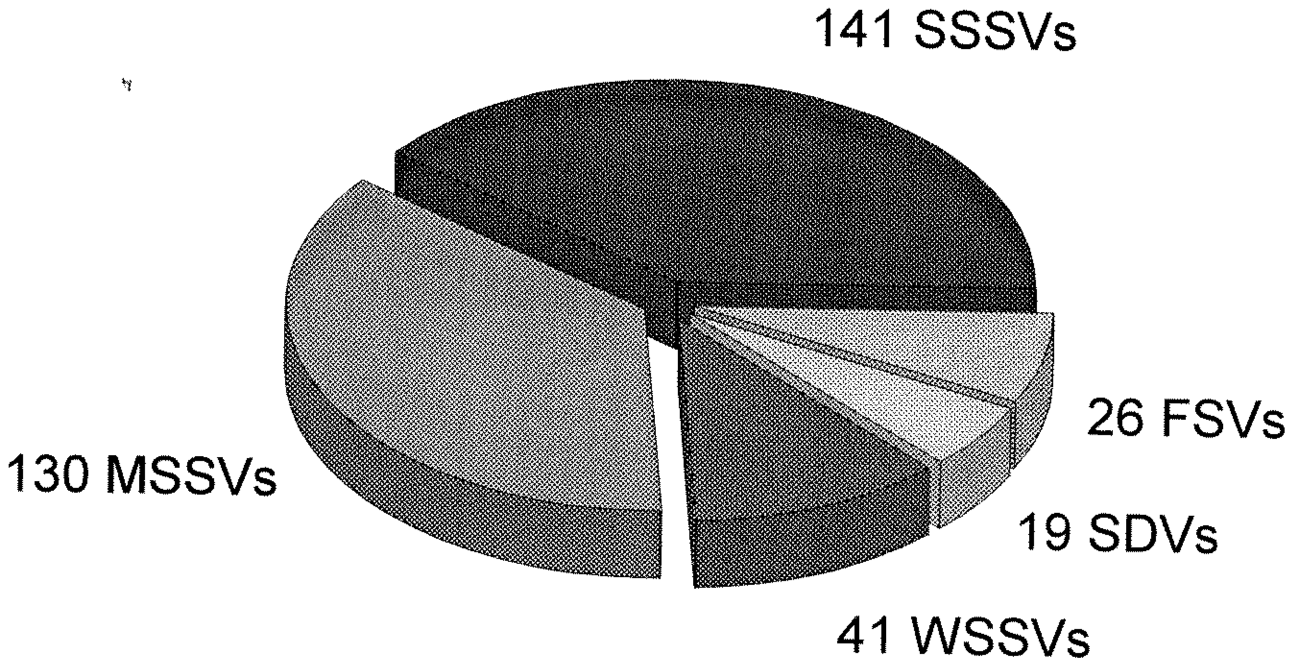
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

JOB NO
80295.1

TITLE
SOUTH PELTO
REPORTED SAFETY VALVES ACTIVATED

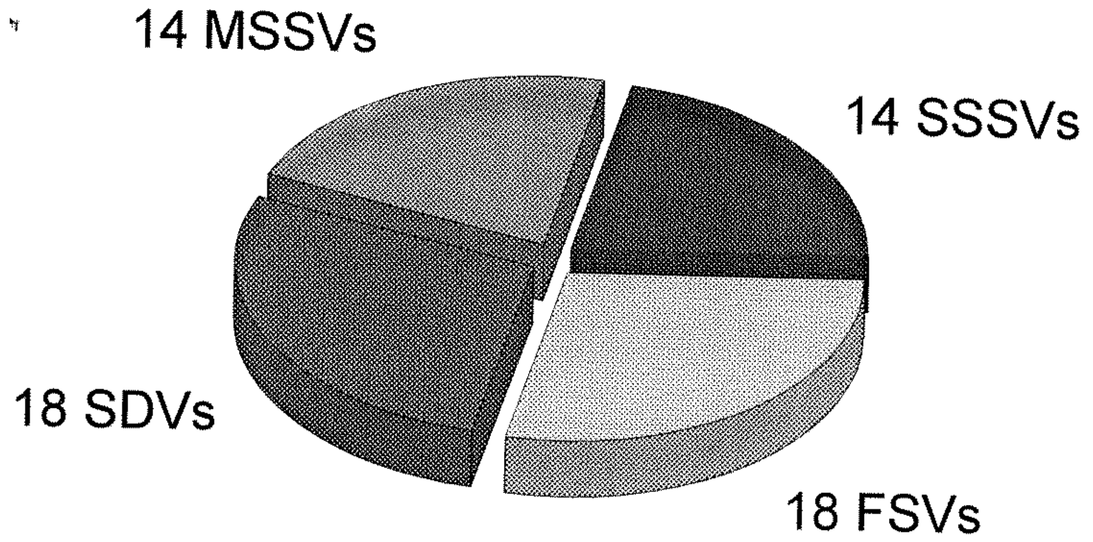
FIGURE NO
6.14



5 - MSSV FAILURES

11 - SSSVs PREVENTED UNCONTROLLED FLOW

J P KENNY JPK	PROJECT ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW	CLIENT MINERALS MANAGEMENT SERVICES U.S. Department of the Interior	JOB NO 80295.1
		TITLE SOUTH TIMBALIER REPORTED SAFETY VALVES ACTIVATED	FIGURE NO 6.15



0 - FAILURES

J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

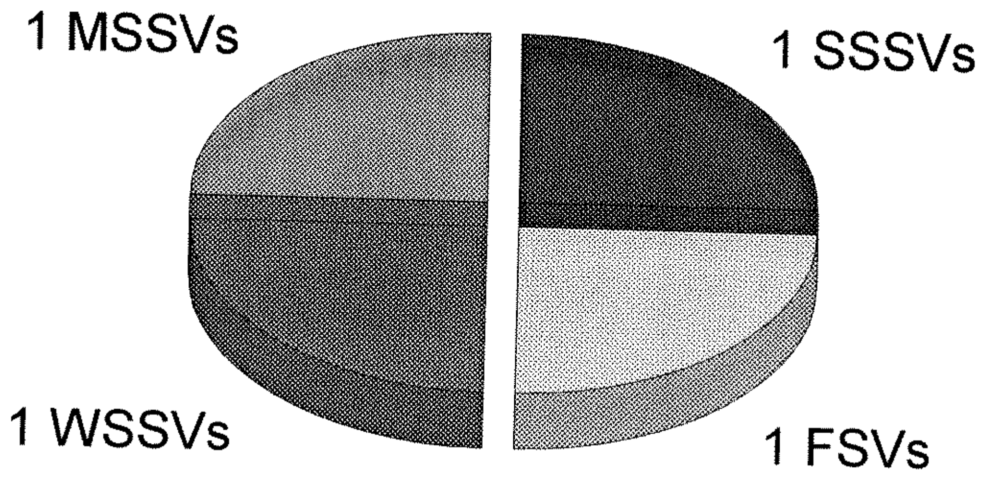
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
VERMILION
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.16

FSVs



0 - FAILURES

J P KENNY

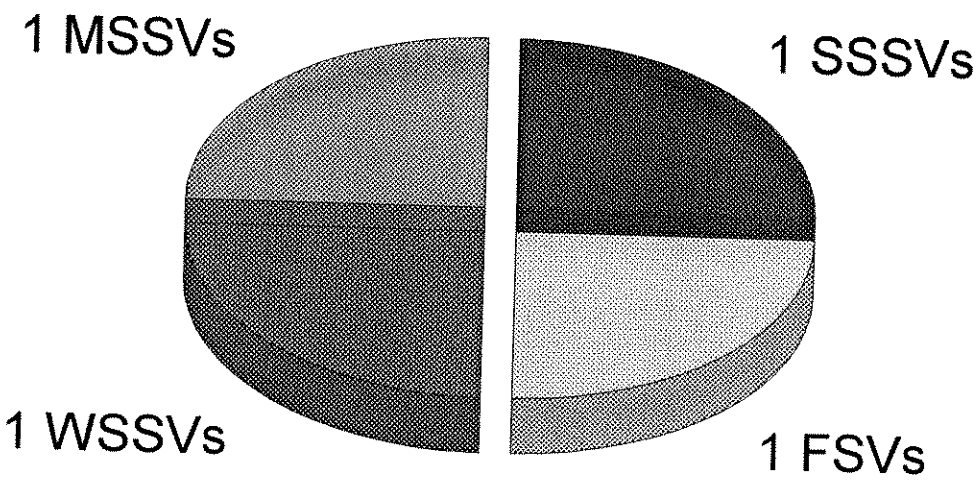
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
WEST CAMERON
REPORTED SAFETY VALVES ACTIVATED

JOB NO
80295.1

FIGURE NO
6.17



0 - FAILURES

OTHER - Denotes reported valves actuated with an unidentified area location.

J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

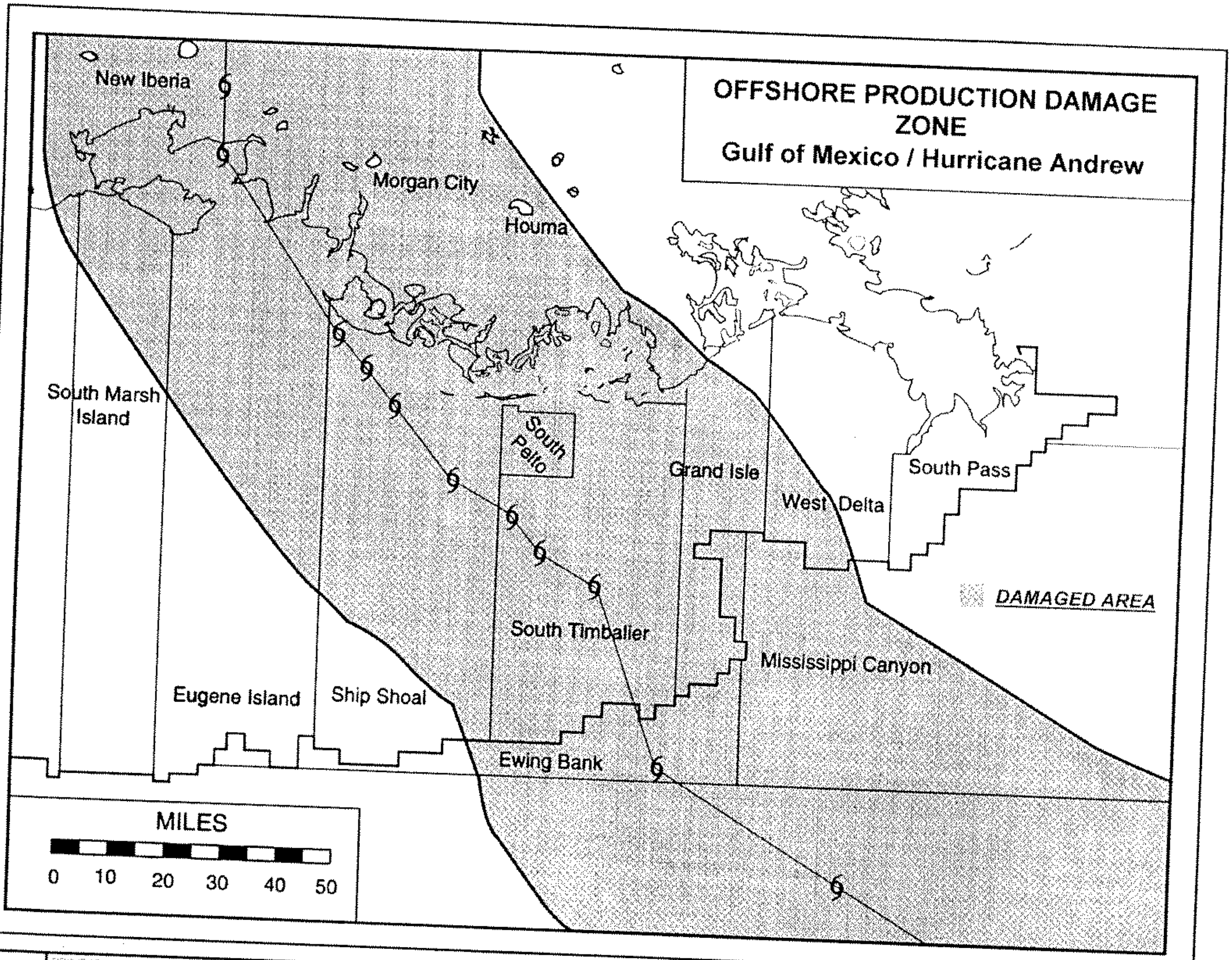
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
OTHER
REPORTED SAFETY VALVES ACTIVATED

JOB NO.
80295.1

FIGURE NO
6.18

OFFSHORE PRODUCTION DAMAGE ZONE
Gulf of Mexico / Hurricane Andrew



J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
HURRICANE ANDREW DAMAGE SURVEY

JOB NO.
80295.1

FIGURE NO.
6.19

80295016 05/10/95

Section Seven

SAFETY SYSTEM ASSESSMENT

DRAFT

Section Seven

SAFETY SYSTEM ASSESSMENT

7.1 INTRODUCTION

This section of the report presents the current operating philosophy of the offshore oil and gas industry, and the effect of the philosophy on the reliability of the safety systems. It also discusses the types of damage caused by Hurricane Andrew to the offshore facilities and the damage to the safety systems.

Two other offshore pipeline safety measurements are outlined. They are subsea ESD valves and pipeline break away joint which are not regulatory required but utilized by some oil and gas industry.

7.2 OPERATING PHILOSOPHY AND OVERALL SYSTEM RELIABILITY

The overall offshore safety systems reliability is greatly dependent on the emergency operating procedures set up for natural disasters. Unlike most natural disasters, such as earthquake, lightening and mudslides, etc., and human error, which arrive abruptly and unannounced, but hurricanes generally do allow some leadtime. It usually takes several days for a hurricane born and to reach the oil and gas areas of the Outer Continental Shelf (OCS).

The common operating philosophy adopted by the oil and gas industry, which is also required by MMS policy (Ref. 7) for hurricane is to curtail oil production and significant gas production, pump away oil that is stored offshore, actuate all safety systems, depressurize oil pipelines and shut-down pipeline ESD valves. For those remote control systems that automate gas platform by controlling well and equipment flows from shore stations are allowed for continued gas production until the approach of the hurricane is imminent.

These precautionary operating philosophy and measures dramatically increase the overall safety of the offshore production by adding the active redundant safety valve into the flowstream, as shown in Figure 7.1.

The reliability of the active systems, according to the reliability of parallel systems consisting of η components, can be calculated as follows:

$$R_s = 1 - \prod_{i=1}^{\eta}(1 - R_i)$$

For simplicity of the calculation, assuming the reliabilities of SSSV, MSSV, WSSV, and SDV are same and equal to 0.80 or:

$$R_1 = R_2 = R_3 = R_4 = 0.80$$

Then all overall reliability of the offshore production systems after all valves actuated is:

$$R_s = 1 - (1 - 0.80)(1 - 0.80)(1 - 0.80)(1 - 0.80)$$

$$R_x = 1 - 1.6x10^{-3} = 0.9984$$

The results and comparisons of the reliabilities of the overall systems and each safety valves are shown in Figure 7.2.

The high reliability of the offshore production systems can be credited for the zero pollution from well flow during Hurricane Andrew. In other words, the current industry operating philosophy plus the government safety regulation are proved to be adequate for the natural disaster such as hurricane.

7.3 TYPES OF DAMAGE CAUSED BY HURRICANE ANDREW

Minimum damage was caused directly by Hurricane Andrew to the offshore safety and pollution control devices, and no uncontrolled flow from the production wells were reported in the survey.

As the most damaging natural disaster in the Gulf of Mexico, hurricanes generate extraordinary environmental impacts on the offshore structures. These impacts are usually associated with the following environmental phenomenon:

- High speed winds with gusts;
- High waves generated by the energy of high winds;
- Mudslide caused by energy disturbance of the high waves.

The direct damage to offshore facilities caused by the impacts of hurricane is the structural integrity. The types of the damage caused by Hurricane Andrew such as platforms, satellite wells, mobile offshore units and pipelines to these facilities can be summarized as:

Platforms, Satellite Wells (or Caissons) and Superstructures

- Platforms were completely toppled;
- Platforms were leant with jacket members damaged;
- Topside damage including bent or missing handrails, stairs, deck grating, communications equipment, broken windows, water soaking, and dislodging of loose items;
- Platforms burned out by the fire started from gas leaking from riser;
- Structure collapsed onto sea floor.

Mobile Offshore Units

- Mobile units were set adrift either with broken chains or dragging its loose anchors, then grounded.

Pipelines, Service Lines and Risers

- Pipelines were moved from the original locations;
- Pipelines and risers were broken away from platforms because of platform leaning or toppling;
- Pipelines and risers were buckled;
- Pipelines and risers were punctured by foreign objects;
- Pipelines were broken apart at pipeline break away joints caused by mudslide.

The damage of the safety and pollution control devices is found to be secondary and was resulted from the structural integrity damage of the offshore facilities. The only safety systems damage found in the survey is that:

- MSSV were damaged because the conductors and platforms were toppled or leaned.

7.4 OTHER SAFETY MEASURES

This section presents two other offshore pipeline safety measures, which were not included in the survey and data base, but they are used widely by oil and gas industry for some special applications. They are subsea ESD systems and pipeline break-away joint assembly.

Subsea ESD Systems

The primary purpose of installing and ESD valve is to safeguard the lives of personnel working on the platform, protection of the platform, and to minimize the risk of production loss, in case of accidental damage to the riser or the pipeline within the vicinity of the platform, leading to leakages and fire.

Leaks due to pipe rupture can be a serious hazard to the platform and its personnel whether it is subsea or above water. Ruptures above water level lead to jets, and their effect on platform safety depends on the degree of their confinement. A small rupture in a pipeline above water, close to the riser, could cause the riser to fail due to the heat transfer between an impinging jet flame and the riser pipe. This depends on the direction and intensity of the jet, hydrocarbon inventory and the release duration. The jet flame can similarly impinge on the platform structural components. Consequences due to ruptures above the riser ESD valves can, in general, be controlled by careful design and by well defined, and well rehearsed, emergency procedures. Gas leaks in general are potentially much more dangerous than oil leaks.

The consequences of rupture in the riser below sea level are normally passive. A gas leak of this type does not ignite immediately, but could form a gas cloud leading to an explosion and fire, depending on the supply of gas. Oil leaks, from below sea level, in risers are generally not as hazardous as gas leaks, but can create considerable environmental damage. By careful design of the riser and other facilities surrounding the riser, damage to the platform and risk to personnel can be minimized.

Consequences to the platform of leaks due to rupture in the pipeline decrease as the distance of the leak source from the platform increases. An oil leak will, in general, not be a fire risk if detected in time and steps are taken to limit the inventory and to disperse the oil. An oil spill onto the water, whether on fire or not, can become a serious environmental hazard, and could present a potential fire source to manned facilities.

Gas leaking from a rupture in the pipeline will rise to the surface as a plume, and will be generally released to the atmosphere from a circular area, as shown in Figure 7.3. This gas can be easily ignited and poses a serious risk to the platform, depending on its rate of escape, its distance from the platform and the available inventory. When the gas burns backwards towards the leak, a "pool" fire will form which dies when the gas concentration at the sea surface falls below the ignitable limit.

A heat load of 10 kW/m^2 is normally regarded as the fatality threshold for humans, and temperature increase in structural steel members in excess of its critical value could lead to structural failure due to loss of load bearing capacity. Structural steel loses significant strength within the temperature range of 300°C to 400°C, depending on steel composition. The mechanisms and consequences of leaks should be investigated for each installation and steps taken to cut fire risks. The main defense against the consequences of topsides leaks is provided by riser ESD valves.

There are no statutory regulations requiring operators of existing or new pipelines to install subsea ESD valves. However, some operators have selected to install these systems, primarily on gas pipelines. The consequences of a hydrocarbon leak for the platform depend on the distance of the leak source from the platform, the size of the rupture, wind direction, the combustion temperature of platform materials and the hydrocarbon inventory.

By the introduction of subsea ESD valves, the inventory available to fuel the fire can be limited so as to minimize the damage to the platform and loss of life. It is emphasized that the primary emergency shut down is by platform based riser ESD valve; the subsea ESD valve provides a backup capability for minimizing the available fuel for any topside fire should the riser ESD valve fail to operate or the riser is ruptured on the pipeline side of the riser ESD valve.

Installation of a subsea ESD valve system is by no means cheap. However, the cost of installation and maintenance of such a system must be viewed in the context of overall field development investment, safety and maximization of long term financial benefits by achieving the planned life of the production facility.

Different aspects of design of a subsea ESD valve system include location, configuration, component selection, controls and protection.

The location of subsea ESD valves is important to the effectiveness of the system. The location is dictated by the following considerations:

- Effective radiation area of "pool" fire;
- Time for product evacuation through a rupture and other outlets such as the flare for gas after subsea ESD valve is shut;
- Control system operation;
- Protection of subsea ESD valve system;
- Installation and maintenance.

Considering product inventory, subsea ESD valve should be as close to the platform as possible but outside the estimated area of a pool fire. However, locations less than 300 feet from the platform are not recommended due to the following reasons:

- "Pool" fires may endanger the platform;
- The installation and maintenance may be complicated;
- The subsea ESD system may itself be endangered due to dropped objects and debris caused by some accident occurring on the platform, attendant supply boat or maintenance vessel.

Some operators have considered locating the ESD valve 4,500 feet from the platform. The major advantage is that the location is well away from the platform and thus convenient for installation and maintenance. However, this location has major disadvantages:

- The subsea ESD valve and associated control umbilical are exposed to the activities of other sea users, e.g., fishing and shipping;

- A substantial amount of product can be trapped in a 4,500 feet long pipeline section and this could feed a platform fire for sufficient time to have serious consequences;
- Closure time of the ESD valve may be in excess of 1 minute.

The subsea ESD valve should be within 1,500 feet of the platform, with the preferred distance being between 450 and 1,000 feet. This should be established by risk analysis for the particular platform. The reasons for this choice are:

- A zone of 500 meters around the platform is generally designated as an "exclusion zone" and thus protected from fishing and other third-party activities;
- It is outside the reach of dropped objects and debris from the platform or other attendance vessels;
- "Pool" fires resulting from ruptures in the pipeline far side of the closed ESD valve are not likely to endanger the platform;
- The amount of hydrocarbons trapped in the pipeline/riser between the ESD valve and platform is significantly reduced compared to 4,500 feet;
- The ESD valve closure times are 5-20 seconds;
- The installation of the ESD valve can be carried out at a safe distance from the platform.

Valve selection for subsea ESD duty is dictated by:

- Suitability of all materials for subsea environment;
- Rapid closure;
- Minimum maintenance;
- Ease of maintenance and minimum production downtime;
- In situ maintenance, if possible;
- Facility for pigging operations.

Of the different types of valves available, ball, check and gate are probably the most suitable for subsea ESD service.

The subsea ESD valve system may comprise one or more valves. If more than one valve is used, only one valve is normally performing the ESD duty; the other valves are primarily used for maintenance purposes. The ESD system may combine different types of valves, i.e., ball, check and gate.

A single valve is cheaper in terms of procurement, fabrication and installation. If a standard type of ball or check valve is used, the pipeline will need to be flooded during valve maintenance requiring cleaning, dewatering and possibly drying before the pipeline is recommissioned. By using the latest generation of valves, it is possible to maintain the valve internals without flooding the pipeline or depressurizing the pipeline. But safety authorities may not allow hydrocarbon storage or production at high pressure with only a single barrier. Furthermore, the pipeline is without subsea ESD facility during valve maintenance.

Two valve systems are recommended with one valve performing the ESD function while the other is normally used for maintenance purposes. If required, the system can be designed to allow for conversion of the maintenance valve to an ESD valve without a major expense. Depending on the type of valves, the ESD valve can be maintained either without flooding the pipeline at all or only partially flooding the pipeline, thus minimizing maintenance time and associated financial penalties.

PIPELINE BREAK-AWAY JOINT ASSEMBLY

A pipeline break away joint assembly is a specially designed connector that would separate at pre-determined loads to prevent damage to platforms, risers, underwater wellheads, attached pipelines or subsea manifolds. By controlling the separation of a pipeline, with the application of break away joint, costly damage to offshore structures and environmental pollution can be prevented, and the location of the separations is predetermined.

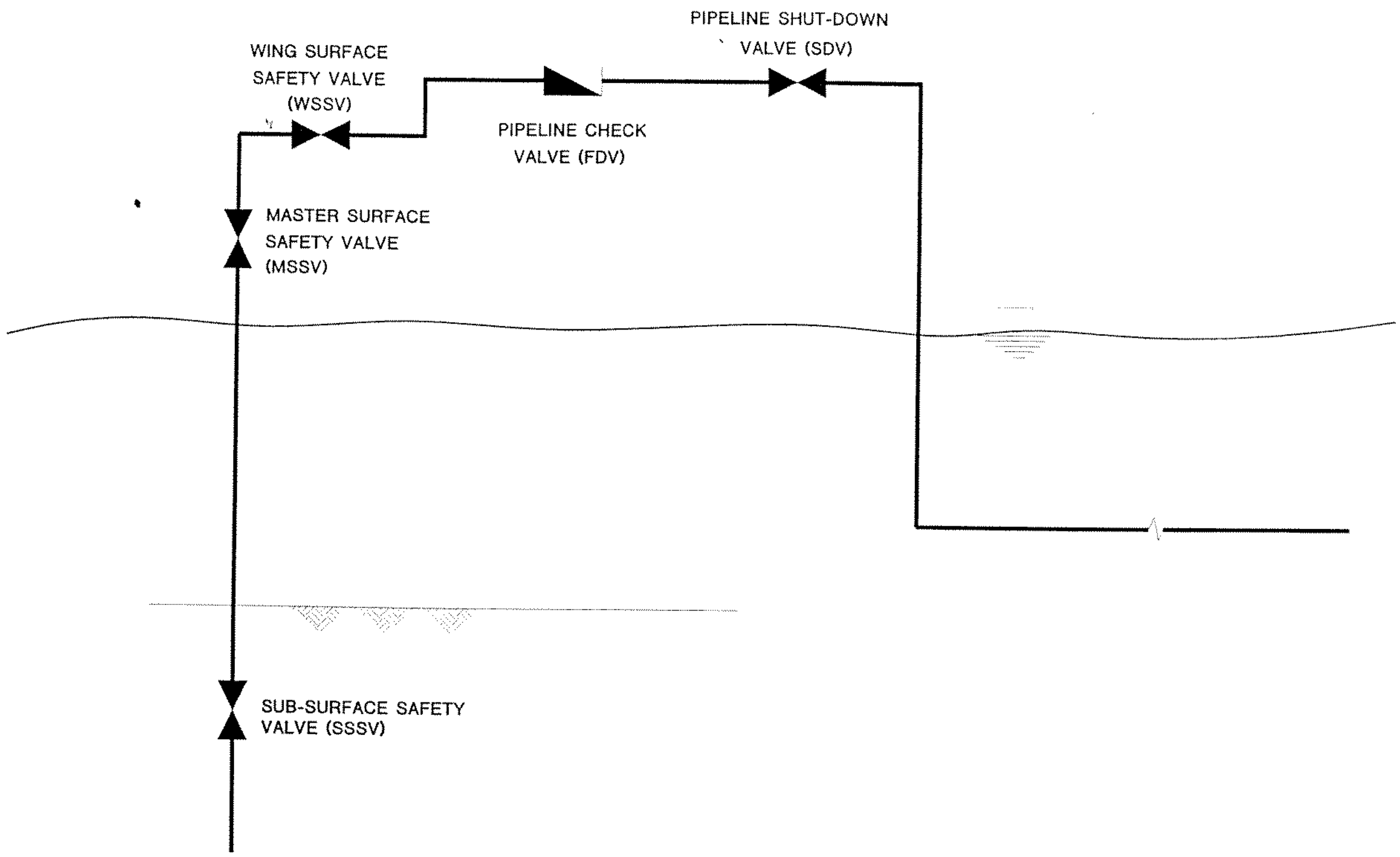
The break away joint is designed to "balance" thrust effects of internal pressure. The load at which the joint separates is thus independent of pipeline pressure.

Separation of the joint into two pieces is controlled either shear pins mechanisms (HydroTech Systems, Figure 7.4) or mechanical release system (Big Inch Systems, Marine Systems, Figure 7.5). Both systems have been shown to be precise and reliable.

The two break away joint assembly configurations are shown in Figure 7.6 and 7.7. Once a sufficient external load is applied to the pipeline and to the release mechanism, the inner sleeve will begin to separate from the exterior body. As the sleeve is withdrawn. The two portions of the pipeline are then free. Check valves flanged upstream and downstream of the joint will immediately close upon joint separation and loss of line pressure to prevent a significant loss of pipeline contents.

Once the ends of the separated line are retrieved, the break away joint can be re-dressed and re-used.

These systems were proved to be reliable and useful to prevent environmental pollution for the pipelines located in mudsliding area during Hurricane Andrew.



J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW

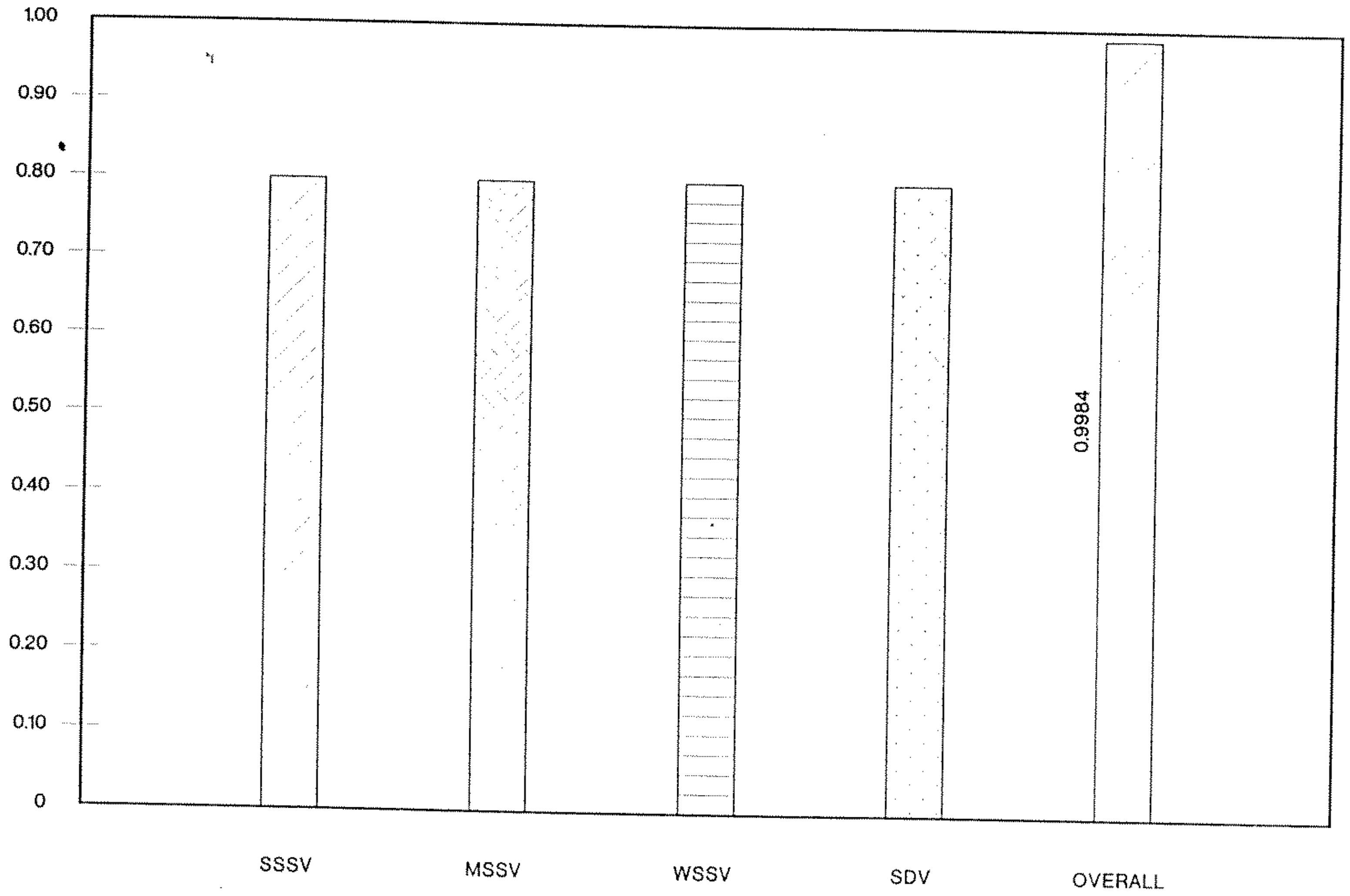
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
OFFSHORE SAFETY SYSTEMS ACTUATED FOR HURRICANE ANDREW

JOB NO
80295.1

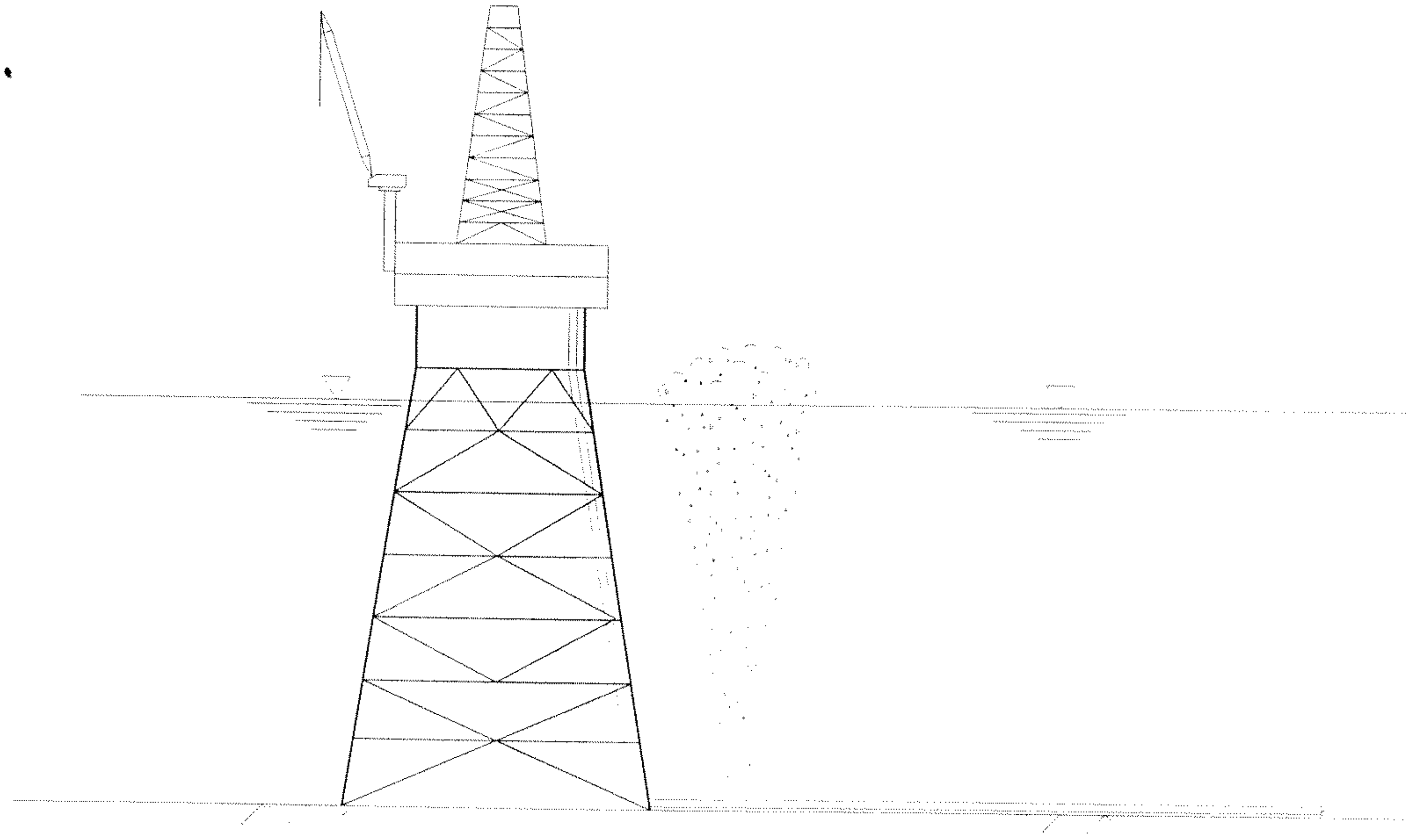
FIGURE NO
7.1

80295043 03/08/95



J P KENNY	PROJECT ASSESMENT OF THE PERFORMANCE OF OFFSHORE SAFETY AND POLLUTION CONTROL DEVICES IN THE AFTERMATH OF HURRICANE ANDREW	CLIENT MINERALS MANAGEMENT SERVICES U.S. Department of the Interior	JOB NO 80295.1
		TITLE RELIABILITY OF EACH VALVE VS OVERALL SYSTEM	FIGURE NO 7.2

80295044 03/08/95



J P KENNY

PROJECT

ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT

MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE

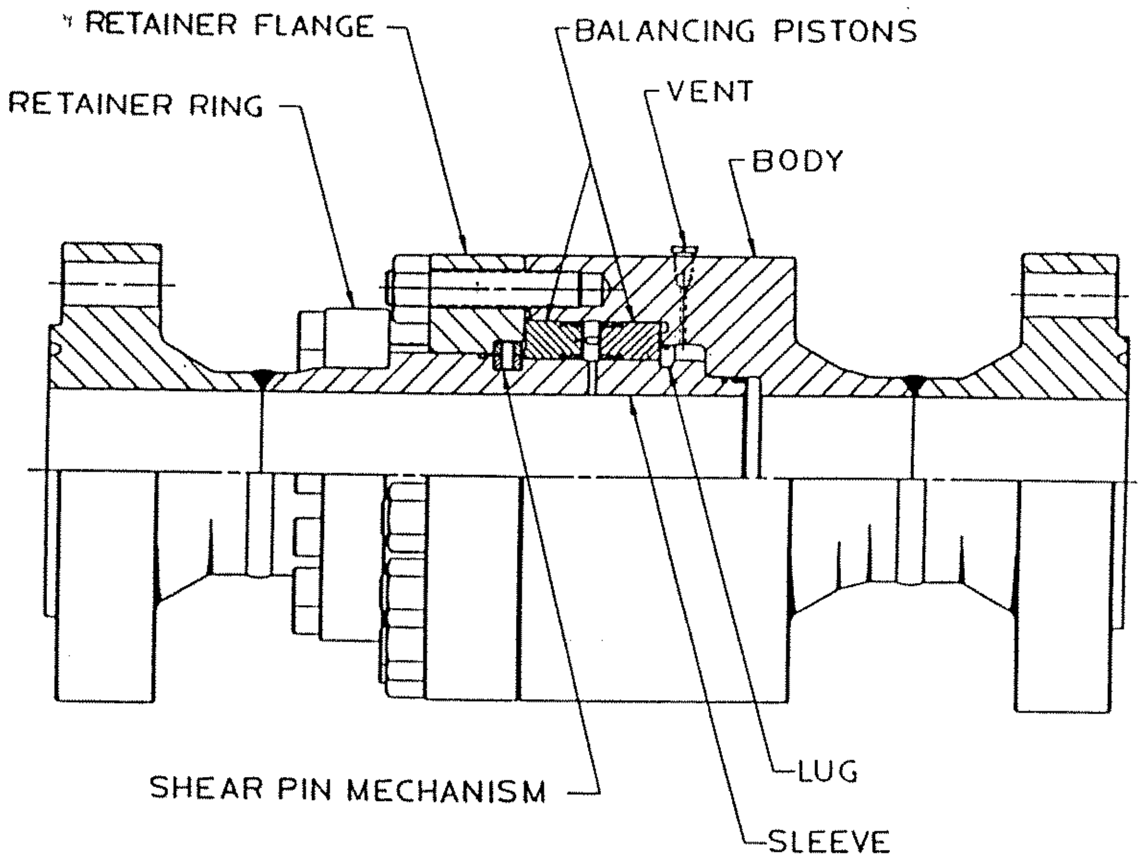
SUBSEA PIPELINE RUPTURE
POOL FIRE

JOB NO

80295.1

FIGURE NO

7.3



J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

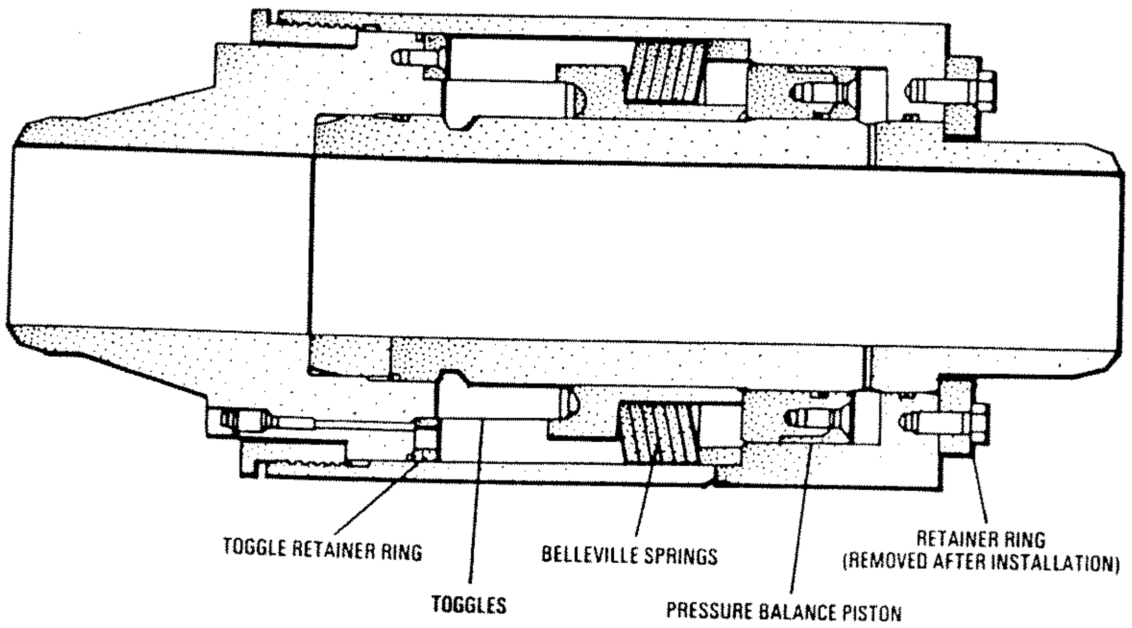
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
HYDROTECH SYSTEMS, INC.
PRESSURE BALANCE SAFETY JOINT

JOB NO
80295.1

FIGURE NO
7.4

80295039 03/08/95



J P KENNY

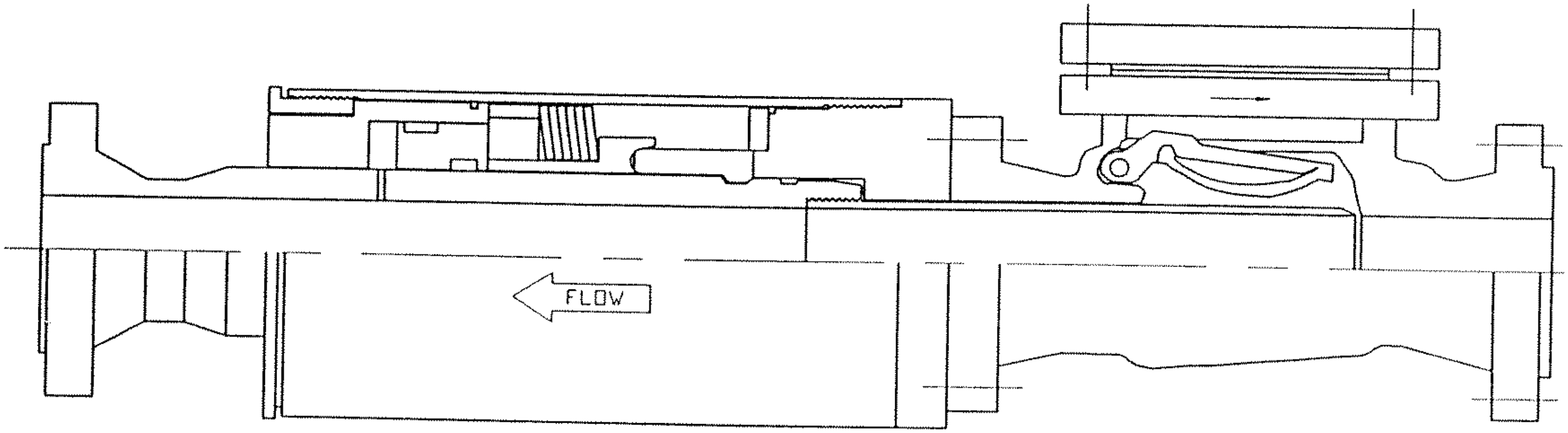
PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
BIG INCH MARINE SYSTEM, INC.
LOAD LIMITING CONNECTOR

JOB NO
80295.1

FIGURE NO
7.5



J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

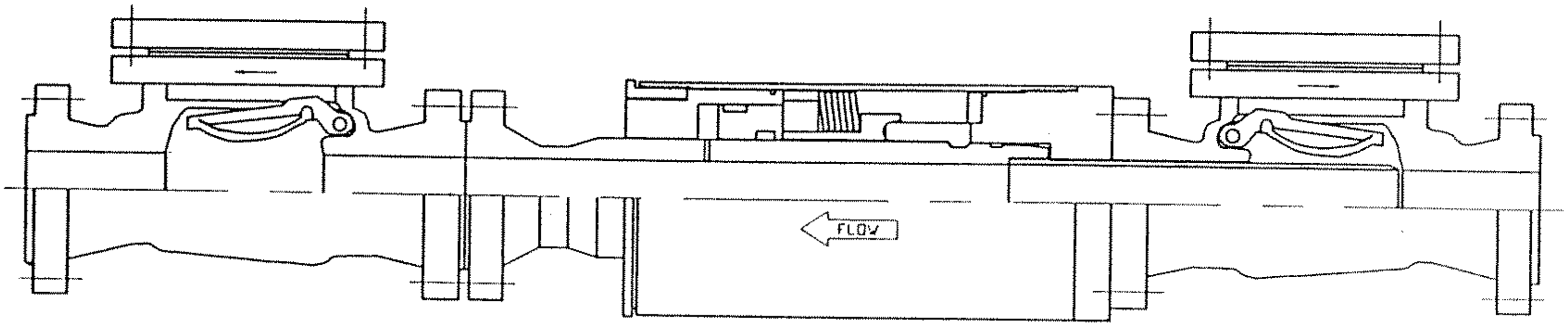
CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
BREAK AWAY JOINT ASSEMBLY I

JOB NO
80295.1

FIGURE NO
7.6

80295041 03/08/95



J P KENNY

PROJECT
ASSESMENT OF THE PERFORMANCE
OF OFFSHORE SAFETY AND POLLUTION
CONTROL DEVICES IN THE AFTERMATH
OF HURRICANE ANDREW

CLIENT
MINERALS MANAGEMENT SERVICES
U.S. Department of the Interior

TITLE
BREAK AWAY JOINT ASSEMBLY II

JOB NO
80295.1

FIGURE NO
7.7

8029504_ 03/08/95

Section Eight

REFERENCES

Section Eight

REFERENCES

1. Doty, Leonard A., "Reliability for the Technologies", Industrial Press Inc.

2. OREDA Manager, DNV Technica, "OREDA-92, Offshore Reliability Data Handbook," 2nd edition, OREDA Participants, 1982.

3. Daniels, Gerald R., "Hurricane Andrew's Impact on Natural Gas and Oil Facilities on the Outer Continental Shelf", November 1993, prepared for U.S. Department of the Interior-Minerals Management Service.

4. Department of Transportation, "Code of Federal Regulations", Volume 49, Parts 178 to 199, Office of the Federal Register National Archives and Records Administration, 1993.

5. American Petroleum Institute, "Recommended Practice for Design, Installation, Repair and Operation of Sub-surface Safety Valve Systems", RP 14B, 3rd edition, API, 1990.

6. Howard B. Bradley, "Petroleum Engineering Handbook", 2nd edition, Society of Petroleum Engineers, 1987.

7. The Letter to Lessees and Operators (LTL) dated April 4, 1991, sent by D.J. Bourgeois Regional Supervisor Field Operations, MMS Gulf of Mexico OCS Region.

ACKNOWLEDGMENTS

ACKNOWLEDGMENTS

Special acknowledgments are due Mr. Warren Williamson, Petroleum Engineer of Pipeline Unit of MMS, Gulf of Mexico OCS Region, for his unfailing support of this project; and Dr. Charles Smith, Contracting Officer's Technical Representative of MMS Engineering and Technology Division, Herndon, Virginia, for his review, comments and project supervision. The J P KENNY International, Inc. also wishes to thank Mr. Alexander Alvarado of MMS Gulf of Mexico OCS Region and all those operators who have provided the first hand survey data.

JPK

APPENDIX I

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

TAKE PRIDE IN AMERICA

In Reply Refer To: MS 5232

JUL 18 1994

Gentlemen:

We are seeking your assistance in collecting data for a study that J P Kenny Inc. is undertaking for Minerals Management Service (MMS). The purpose of the study is to analyze the performance of the following offshore safety and pollution control devices during Hurricane Andrew:

- Surface-controlled subsurface safety valves (SSSV)
- Master and wing surface safety valves (SSV)
- Pipeline shutdown valves (SDV)
- Pipeline check valves (FSV)

Details of the activation and failure of these devices during Hurricane Andrew are needed. Your company has the experience and may have data that is pertinent to the above study. If you wish to provide information for the benefit of the study, we invite you to complete the enclosed survey forms. Our schedule calls for J P Kenny Inc. to begin development of the database for the study by mid-August 1994. Therefore, we respectfully request that you submit your information to J P Kenny, Inc., 5100 Westheimer, Suite 400, Houston, Texas 77056, prior to August 15, 1994.

Please be assured that information collected from each participating company will be kept confidential by rendering it anonymous. Only generic data will be analyzed and published.

Should you require any further information or assistance, please contact either Mr. Lang Fu of J P Kenny Inc. at (713) 871-8850 or Mr. Warren Williamson of MMS at (504) 736-2874.

Your assistance and contribution is very much appreciated.

Sincerely,

William H. Martin

William H. Martin
Acting Regional Supervisor
Field Operations

Enclosures

Amoco Pipeline Company
Attention: Mr. L. C. Bennington
One Mid-America Plaza
Oakbrook Terrace, IL 60181-4723

Amoco Production Company
Attention: Mr. Harty Van
Post Office Box 50879
New Orleans, LA 70150-0879

Apache Corporation
Attention: Gulf Coast Regulatory
2000 Post Oak Blvd., Suite 100
Houston, TX 77056-4400

Aquila Energy Resources
Attention: Mr. Richard Brainard
10370 Richmond Avenue, Suite 700
Houston, TX 77042-4137
Houston, TX 77042-4137

BP Exploration and Oil Inc.
Attention: Mr. W. A. Sears
Post Office Box 4587
Houston, TX 77210-4587

BP Exploration Inc.
Attention: Ms. A. Laplante
Post Office Box 4587
Houston, TX 77210-4587

Brooklyn Union Exploration
Company, Inc.
Attention: Mr. G. Ross Frazer
1331 Lamar Street, Suite 1065
Houston, TX 77010-3027

CanadianOxy Offshore Production
Attention: Mr. Larry D. McRae
12790 Merit Dr., Suite 800 LB-94
Dallas, TX 77251-1270

Century Offshore Management
Corporation
Attention: Mr. Paul S. Horvath
3900 N.Causeway Blvd. Suite 1400
Metairie, LA 70002-1746

Chevron Pipe Line Company
Attention: Ms. Peggy Campiere
Post Office Box 740339
New Orleans, LA 70174-0339

Chevron U.S.A. Inc.
Attention: Mr. J. H. Daniel
Post Office Box 61590
New Orleans, LA 70161-1590

Chevron U.S.A. Inc.
Attention: Mr. D. L. Bucklin
Post Office Box 39100
Lafayette, LA 70593-9100

Chevron U.S.A. Inc.
Attention: Mr. B. H. Hunley
935 Gravier Street
New Orleans, LA 70112-1697

Chevron U.S.A. Production
Company
Attention: Mr. T. R. Brown
935 Gravier Street
New Orleans, LA 70112

CNG Producing Company
Attention: Ms. Yvonne Abadie
CNG Tower, 1450 Poydras Street
New Orleans, LA 70112-6000

Express Acquisition Company
Attention: Mr. Roland B. Sledge
1221 Lamar St., Suite 1600
Houston, TX 77010-3039

Exxon Company, U.S.A.
Attention: Mr. T. S. Brooks
Post Office Box 61707
New Orleans, LA 70161-1707

Exxon Pipeline Company
Attention: Mr. P. Saltaformaggio
Post Office Box 15609
Baton Rouge, LA 70895-5609

Flash Gas and Oil, Inc.
Attention: Mr. Steven G. Haller
Post Office Box 187
Mandeville, LA 70470-0187

Four Star Oil & Gas Company
Attention: Mr. R. J. Savoy
Post Office Box 61050
New Orleans, LA 70161-1050

Gas Transportation Corporation
Attention: Mr. William Krutzer
Post Office Drawer 4803
Monroe, LA 71211-0803

Gulfstream Resources, Inc.
Attention: Mr. J. C. Garrett
3850 North Causeway Boulevard
Suite 830
Metairie, LA 70002

Hall-Houston Oil Company
Attention: Ms. Kathy Camp
700 Louisiana St., Suite 2100
Houston, TX 77002-2729

Kerr-McGee Corporation
Attention: Mr. Cary V. Bradford
Post Office Box 39400
Lafayette, LA 70593-9400

Koch Industries, Inc.
Attention: Mr. C. C. McCampbell
Post Office Box 2256
Wichita, KS 67201-2256

Maxus Exploration Company
Attention: Mr. Tom Becnel
717 North Harwood, Suite 3231
Dallas, TX 75201-6510

Mobil Exploration & Production
U.S. Inc.
Attention: Mr. Gary F. Wadge
1250 Poydras Building
New Orleans, LA 70113-1892

Murphy Exploration & Production
Company
Attention: Mr. Ken G. Soyez
Post Office Box 61780
New Orleans, LA 70161-1780

NERCO Oil & Gas, Inc.
Attention: Mr. Dennis H. Cowan
Post Office Box 770909
Houston, Texas 77215-0909

Northern Natural Gas Company
Attention: Mr. Johnny McGee
Post Office Box 1188
Houston, TX 77251-1188

Offshore Energy Development
Corporation
Attention: Mr. David Strassner
Post Office Box 9738
The Woodlands, TX 77387-9738

Pennzoil Petroleum Company
Attention: Mr. J. C. Gilmore
Post Office Box 51843
Lafayette, LA 70505-1843

Samedan Oil Corporation
Attention: Ms. Annalisa Taylor
350 Glenborough, Suite 240
Houston, Texas 77067-3299

Shell Offshore Inc.
Attention: Mr. Peter Velez
Post Office Box 61933
New Orleans, LA 70161-1933

SONAT Exploration Company
Attention: Ms. Julie Ward
Post Office Box 4792
Houston, TX 77210-4792

Southern Natural Gas Company
Attention: Mr. Jeff Dye
Post Office Box 2563
Birmingham, AL 35202-2563

Tennessee Gas Pipeline Company
Attention: Mr. O. O. Jones
1115 Regal Row
Houma, LA 70360-6026

Texaco Exploration and
Production Inc.
Attention: Mr. Rick J. Savoy
Post Office Box 60252
New Orleans, LA 70160

Texaco Pipeline Inc.
Attention: Mr. C. J. Blanchard
Post Office Box 42130
Houston, TX 77242-2130

The Stone Petroleum Corporation
Attention: Mr. H. A. McKissack
Post Office Box 52807
Lafayette, LA 70505-2807

Transcontinental Gas Pipe Line
Corporation
Attention: Mr. Charles Pittmann
Post Office Box 1396
Houston, TX 77251-1396

Trunkline Gas Company
Attention: Mr. Billy Andrews
Post Office Box 1642
Houston, TX 77251-1642

Union Oil Company of California
Attention: Mr. D. E. Thompson
14141 Southwest Freeway
Sugarland, TX 77047-1947

Union Oil Company of California
Attention: Joseph D. Falgout
Post Office Box 39200
Lafayette, LA 70593-9200

Union Pacific Resources Company
Attention: Mr. J. R. Carter, Jr.
Post Office Box 7
Mail Station 3407
Fort Worth, TX 76101-0007

Wayman W. Buchanan, Inc.
Attention: Mr. Glenn Fleming
One Allen Center, Suite 1100
Houston, TX 77002

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

In Reply Refer To: MS 5232

AUG 30 1994

THE SAME LETTER WAS SENT TO THE ATTACHED LIST.

Gentlemen:

On July 18, 1994, this office sent out a request for assistance in collecting data for a study that J P Kenny Inc. is undertaking for Minerals Management Service (MMS). The purpose of the study is to analyze the performance of certain safety and pollution control devices during Hurricane Andrew.

On July 28, 1994, a meeting was held between representatives of the MMS and the Offshore Operators Committee (OOC) to discuss the information requirements of the study. After hearing the concerns of the OOC, we agreed to withdraw our request for information concerning the performance of "wing valves" and to define "master valve" and "failure." We, therefore, request that you not answer Questions Nos. 9 and 10 on the questionnaire that refer to the "wing valve."

Also, for this study, the term "master valve" refers to the first (required) surface safety valve (SSV) on the wellhead.

The definition of "failure" should be taken from the recommended practices (RP) of the American Petroleum Institute (API). The API RP 14B defines a failure of a subsurface safety valve (SSSV) as any condition of the SSSV system that prevents it from performing the design function of preventing uncontrolled well flow, i.e., inability to close due to breakage, erosion, corrosion, or fouling.

The API RP 14C and RP 14D define failure of safety devices as the improper performance of a device or equipment item that prevents completion of its design function.

If you have already submitted a completed survey to J P Kenny Inc., you should check your responses to determine if these clarifications affect the information submitted. Any changes should be reported to Mr. Lang Fu of J P Kenny Inc. at (713) 871-8850.

Any questions should be directed to either Mr. Lang Fu or Mr. Warren Williamson of MMS at (504) 736-2874.

Sincerely,

(Org. Sgd.) Donald C. Howard

Donald C. Howard
Regional Supervisor
Field Operations

bcc: Mr. Lang Fu, J P Kenny, Inc., 5100 Westheimer, Suite 400, Houston, Texas
77056
Mr. Vernard Henley, Exxon Company, U.S.A., Post Office Box 61707,
New Orleans, Louisiana 70161-1707
1502-01 General File (MS 5232)

WWilliamson:amm:8/25/94:OOC-JPK.LTR

Amoco Production Company
Attention: Mr. Harty Van
Post Office Box 50879
Orleans, LA 70150-0879

BP Exploration Inc.
Attention: Ms. A. Laplante
Post Office Box 4587
Houston, TX 77210-4587

Century Offshore Management
Corporation
Attention: Mr. Paul S. Horvath
3900 N.Causeway Blvd. Suite 1400
Metairie, LA 70002-1746

Chevron U.S.A. Inc.
Attention: Mr. D. L. Bucklin
Post Office Box 39100
Lafayette, LA 70593-9100

Express Acquisition Company
Attention: Mr. Roland B. Sledge
1221 Lamar St., Suite 1600
Houston, TX 77010-3039

Flash Gas and Oil, Inc.
Attention: Mr. Steven G. Haller
Post Office Box 187
Mandeville, LA 70470-0187

Gulfstream Resources, Inc.
Attention: Mr. J. C. Garrett
3850 North Causeway Boulevard
Suite 830
Metairie, LA 70002

Koch Industries, Inc.
Attention: Mr. C. C. McCampbell
Post Office Box 2256
Wichita, KS 67201-2256

Murphy Exploration & Production
Company
Attention: Mr. Ken G. Soyez
Post Office Box 61780
New Orleans, LA 70161-1780

ffshore Energy Development
Corporation
Attention: Mr. David Strassner
Post Office Box 9738
The Woodlands, TX 77387-9738

Apache Corporation
Attention: Gulf Coast Regulatory
2000 Post Oak Blvd., Suite 100
Houston, TX 77056-4400

Brooklyn Union Exploration
Company, Inc.
Attention: Mr. G. Ross Frazer
1331 Lamar Street, Suite 1065
Houston, TX 77010-3027

Chevron Pipe Line Company
Attention: Ms. Peggy Campiere
Post Office Box 740339
New Orleans, LA 70174-0339

Chevron U.S.A. Inc.
Attention: Mr. B. H. Hunley
935 Gravier Street
New Orleans, LA 70112-1697

Exxon Company, U.S.A.
Attention: Mr. T. S. Brooks
Post Office Box 61707
New Orleans, LA 70161-1707

Four Star Oil & Gas Company
Attention: Mr. R. J. Savoy
Post Office Box 61050
New Orleans, LA 70161-1050

Hall-Houston Oil Company
Attention: Ms. Kathy Camp
700 Louisiana St., Suite 2100
Houston, TX 77002-2729

Maxus Exploration Company
Attention: Mr. Tom Becnel
717 North Harwood, Suite 3231
Dallas, TX 75201-6510

NERCO Oil & Gas, Inc.
Attention: Mr. Dennis H. Cowan
Post Office Box 770909
Houston, Texas 77215-0909

Pennzoil Petroleum Company
Attention: Mr. J. C. Gilmore
Post Office Box 51843
Lafayette, LA 70505-1843

Aquila Energy Resources
Attention: Mr. Richard Bra
10370 Richmond Avenue, Suit
Houston, TX 77042-4137
Houston, TX 77042-4137

CanadianOxy Offshore Produc
Attention: Mr. Larry D. Mc
12790 Merit Dr., Suite 800
Dallas, TX 77251-1270

Chevron U.S.A. Inc.
Attention: Mr. J. H. Danie
Post Office Box 61590
New Orleans, LA 70161-1590

CNG Producing Company
Attention: Ms. Yvonne Abad
CNG Tower, 1450 Poydras Str
New Orleans, LA 70112-6000

Exxon Pipeline Company
Attention: Mr. P. Saltafor
Post Office Box 15609
Baton Rouge, LA 70895-560

Gas Transportation Corporat
Attention: Mr. William Kru
Post Office Drawer 4803
Monroe, LA 71211-0803

Kerr-McGee Corporation
Attention: Mr. Cary V. Br
Post Office Box 39400
Lafayette, LA 70593-9400

Mobil Exploration & Product
U.S. Inc.
Attention: Mr. Gary F. Wa
1250 Poydras Building
New Orleans, LA 70113-189

Northern Natural Gas Compa
Attention: Mr. Johnny McG
Post Office Box 1188
Houston, TX 77251-1188

Samedan Oil Corporation
Attention: Ms. Annalisa T
350 Glenborough, Suite 240
Houston, Texas 77067-3299

Shell Offshore Inc.
Attention: Mr. Peter Velez
Post Office Box 61933
Orleans, LA 70161-1933

SONAT Exploration Company
Attention: Ms. Julie Ward
Post Office Box 4792
Houston, TX 77210-4792

Southern Natural Gas Compan
Attention: Mr. Jeff Dye
Post Office Box 2563
Birmingham, AL 35202-2563

Tennessee Gas Pipeline Company
Attention: Mr. O. O. Jones
1115 Regal Row
Houma, LA 70360-6026

Texaco Exploration and Production Inc.
Attention: Mr. Rick J. Savoy
Post Office Box 60252
New Orleans, LA 70160

Texaco Pipeline Inc.
Attention: Mr. E. R. Murra
Post Office Box 5080
Bellaire, TX 77402

The Stone Petroleum Corporation
Attention: Mr. H. A. McKissack
Post Office Box 52807
Lafayette, LA 70505-2807

Transcontinental Gas Pipe Line Corporation
Attention: Mr. Charles Pittmann
Post Office Box 1396
Houston, TX 77251-1396

Trunkline Gas Company
Attention: Mr. Billy Andre
Post Office Box 1642
Houston, TX 77251-1642

Union Oil Company of California
Attention: Joseph D. Falgout
Post Office Box 39200
Lafayette, LA 70593-9200

Union Pacific Resources Company
Attention: Mr. J. R. Carter, Jr.
Post Office Box 7
Mail Station 3407
Fort Worth, TX 76101-0007

Wayman W. Buchanan, Inc.
Attention: Mr. Glenn Flemi
One Allen Center, Suite 110
Houston, TX 77002

March 3, 1995

Gentlemen:

On July 18, and August 30, 1994, this office sent out requests for assistance in collecting data for a study that J P KENNY International, Inc. is undertaking for the Minerals Management Service (MMS). The purpose of the study is to analyze the performance of certain safety and pollution control devices during Hurricane Andrew, and thereby reinforce the adequacy of the currently adopted systems.

At this time, we have not received a response from your company in regards to this study. Our study is the first of its kind and only benefits the industry if we have accurate and complete data to analyze. Your response is important and your cooperation will be greatly appreciated and very helpful in determining the performance of the safety systems currently installed in the Gulf of Mexico.

Please be assured that information collected from such participating company will be kept confidential by rendering it anonymous. Only generic data will be analyzed and published.

Should you require any further information or assistance, please contact either Mr. Lang Fu of J P KENNY International, Inc. at (713) 871-8850 or Mr. Warren Williamson of MMS at (504) 736-2874.

Your assistance and contribution is very much appreciated.

Sincerely,

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: ____________________

2. Field locations: ____________________

3. Type production: ______/______/______/______

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: __________

5. Number of SSSV failures during Hurricane Andrew: __________

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: __________

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: __________

8. Number of MSSV failures during Hurricane Andrew: __________

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: __________

10. Number of WSSV failures during Hurricane Andrew: __________

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: __________

12. Number of SDV failures during Hurricane Andrew: __________

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: __________

14. Number of FSV failures during Hurricane Andrew: __________

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ______________________________
- Field Name: ______________________________
- Type of valve: ______________________________
- Working pressure (psig): ______________________________
- Size of the valve or tubing (inch): ______________________________
- Date of last commissioning (month/year): ______________________________
- Mode of failure: ______________________________
- Correction made (replaced/repaired): ______________________________

APPENDIX II

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Aquila Energy Resources Corporation
2. Field locations: Ship Shoal Block 58, OCS-G
3. Type production: oil, gas, Condensate, Water

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 4 SCSSV/0 SSSV
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 6
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 5
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

~~N/A~~ 2

11. Number of SDV's activated during Hurricane Andrew: ~~CHECK VALVES ONLY~~
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: ~~2~~ 4
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

LIST OF THE OFFSHORE STRUCTURES DAMAGED DURING HURRICANE ANDREW FOR

AQUILA ENERGY RESOURCES

AREA	BLOCK	STRUCTURE NAME	DAMAGE DESCRIPTION	Is this structure a PRODUCTION FACILITY?	Was this facility actively producing, before it was shutdown for Hurricane Andrew?
SHIP SHOAL	58	A	Well protection structure leaning 8 degrees. Heliport toppled on production equipment.	YES / NO Yes	YES / NO yes
				If " NO ", STOP.	If " YES ", please complete the attached questionaire.

JPK

J P KENNY International, Inc.

5100 Westheimer
Suite 400
Houston, Texas 77056

Tel: (713) 871-8850
Fax: (713) 871-0434
Telex: 6718537

March 14, 1995

Kerr-McGee Corporation
Attn: Mr. Cary V. Bradford
P.O. Box 39400
Lafayette, LA. 70593-9400

Gentlemen:

On July 18, and August 30, 1994, Minerals Management Service (MMS) New Orleans office sent out requests for assistance in collecting data for a study that J P Kenny International, Inc. is undertaking for the MMS. The purpose of the study is to analyze the performance of certain safety and pollution control devices during Hurricane Andrew, and thereby reinforce the adequacy of the currently adopted systems.

At this time, we have not received a response from your company in regards to this study. Our study is the first of its kind and only benefits the industry if we have accurate and complete data to analyze. Your response is important and your cooperation will be greatly appreciated and very helpful in determining the performance of the safety systems currently installed in the Gulf of Mexico.

Please be assured that information collected will be kept confidential by rendering it anonymous. Only generic data will be analyzed and published

A list of platforms damaged and the survey questionnaires are attached. Should you require any further information or assistance, please contact either Mr. Lang Fu of J P Kenny International, Inc. at (713) 871-8850 or Mr. Charles Smith of MMS at (703) 787-1559.

Your assistance and contribution is very much appreciated.

Sincerely,

LANG FU

Lang Fu

Enclosures

HJM damon ltr

LIST OF THE OFFSHORE STRUCTURES DAMAGED DURING HURRICANE ANDREW FOR

KERR-MCGEE CORPORATION

AREA	BLOCK	STRUCTURE NAME	DAMAGE DESCRIPTION	Is this structure a PRODUCTION FACILITY?	Was this facility actively producing, before it was shut down for Hurricane Andrew?
SOUTH TIMBALIER	34	#2 / #3	Extensive machanical damage to platform Structure removed	YES / [✓ NO]	[✓ YES] / NO
				If " NO ", STOP.	**If " YES ", please complete the attached questionaire.**

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Kerr-McGee Corp.

2. Field locations: South Timbalier 34

3. Type production: / / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 4

5. Number of SSSV failures during Hurricane Andrew: NONE

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 4

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 4

8. Number of MSSV failures during Hurricane Andrew: NONE

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 4

10. Number of WSSV failures during Hurricane Andrew: NONE

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 4

12. Number of SDV failures during Hurricane Andrew: NONE

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 4

14. Number of FSV failures during Hurricane Andrew: NONE

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: ______
- Working pressure (psig): ______
- Size of the valve or tubing (inch): ______
- Date of last commissioning (month/year): ______
- Mode of failure: ______
- Correction made (replaced/repaired): ______

J P KENNY International, Inc.

5100 Westheimer
Suite 400
Houston, Texas 77056

Tel: (713) 871-8850
Fax: (713) 871-0434
Telex: 6718537

RECEIVED
MAR [illegible] 1995

WESTERN GULF/
MOBILE BAY
FAC. ENGR.

March 14, 1995

Mobil Exporation & Production U.S. Inc.
Attn: Mr. Gary F. Wadge
1250 Poydras Building
New Orleans, LA. 70113-1892

Gentlemen:

On July 18, and August 30, 1994, Minerals Management Service (MMS) New Orleans office sent out requests for assistance in collecting data for a study that J P Kenny International, Inc. is undertaking for the MMS. The purpose of the study is to analyze the performance of certain safety and pollution control devices during Hurricane Andrew, and thereby reinforce the adequacy of the currently adopted systems.

At this time, we have not received a response from your company in regards to this study. Our study is the first of its kind and only benefits the industry if we have accurate and complete data to analyze. Your response is important and your cooperation will be greatly appreciated and very helpful in determining the performance of the safety systems currently installed in the Gulf of Mexico.

Please be assured that information collected will be kept confidential by rendering it anonymous. Only generic data will be analyzed and published

A list of platforms damaged and the survey questionnaires are attached. Should you require any further information or assistance, please contact either Mr. Lang Fu of J P Kenny International, Inc. at (713) 871-8850 or Mr. Charles Smith of MMS at (703) 787-1559.

Your assistance and contribution is very much appreciated.

Sincerely,

LANG FU

Lang Fu

Enclosures

LF\HJM\damon.ltr

LIST OF THE OFFSHORE STRUCTURES DAMAGED DURING HURRICANE ANDREW FOR

MOBIL EXPLORATION & PRODUCTION

AREA	BLOCK	STRUCTURE NAME	DAMAGE DESCRIPTION	Is this structure a PRODUCTION FACILITY?	Was this facility actively producing, before it was shutdown for Hurricane Andrew?
SOUTH PELTO	9	#4 / #8	Platform leaning 5 degrees	[✓ YES] / NO	YES / [✓ NO]
SOUTH PELTO	9	#9	Platform leaning underwater	[✓ YES] / NO	[✓ YES] / NO
SOUTH PELTO	10	17	Platform leaning 12 degrees	[✓ YES] / NO	[✓ YES] / NO
SOUTH PELTO	10	18	Platform leaning ~~12 degrees~~ underwater	[✓ YES] / NO	[✓ YES] / NO
SHIP SHOAL	72	A	Platform destroyed	YES / [✓ NO]	YES / NO
				If " NO ", STOP	If " YES ", please complete the attached questionaire.

S. Pelto wells all self supporting caisson

SS 72 "A" – no production, just a pipeline junction.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Mobil Exploration & Producing U.S.
2. Field locations: South Pelto 10
3. Type production: Oil & gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 4 *
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 0
8. Number of MSSV failures during Hurricane Andrew: 0

Note: All valves on the trees were closed prior to the storm.

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 0
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: ________
12. Number of SDV failures during Hurricane Andrew: ________

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: ________
14. Number of FSV failures during Hurricane Andrew: ________

Fill out Form B for details of each failure.

* PL 9 #9 was a dual well

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ______________________
- Field Name: ______________________
- Type of valve: ______________________
- Working pressure (psig): ______________________
- Size of the valve or tubing (inch): ______________________
- Date of last commissioning (month/year): ______________________
- Mode of failure: ______________________
- Correction made (replaced/repaired): ______________________

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: The Stone Petroleum Corp
2. Field locations: South Pelto Blk. 23
3. Type production: Oil / Gas / H_2O / Flowing & G/L

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 3
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 3
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 3
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

"NO Value failures"

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ______
- Field Name: ______
- Type of valve: ______
- Working pressure (psig): ______
- Size of the valve or tubing (inch): ______
- Date of last commissioning (month/year): ______
- Mode of failure: ______
- Correction made (replaced/repaired): ______

LIST OF THE OFFSHORE STRUCTURES DAMAGED DURING HURRICANE ANDREW FOR

THE STONE PETROLEUM

AREA	BLOCK	STRUCTURE NAME	DAMAGE DESCRIPTION	Is this a structure a PRODUCTION FACILITY?	Was this facility actively producing, before it was shutdown for Hurricane Andrew?
SOUTH PELTO	23	CA	Major damage to wellhead	YES / NO	[✓ YES] / NO
				If " NO ", STOP.	If " YES ", please complete the attached questionaire.

SAMEDAN OIL CORPORATION
350 GLENBOROUGH, SUITE 240
HOUSTON, TEXAS 77067-3299
(713) 876-6250

October 28, 1994

JP KENNY, INC.
5100 Westheimer, Suite 400
Houston, Tx. 77056

Attn: Mr. Lang Fu

Gentlemen:

Enclosed please find completed survey forms for Samedan Oil Corporation as requested by the Minerals Management Service for Offshore Safety Devices.

If further information is required, please call the undersigned at (713) 876-6229.

Sincerely,

Samedan Oil Corporation

Pam a Tullos
Pam A. Tullos
Division Regulatory Coordinator

PT/jm

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SAMedAN oiL CoRpoRATioN
2. Field Location: ST 172-A
3. Type Production: GAS / Cond / WATER /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 2 used AS Plugs 2 Closed Before STor
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 2closed Before STor
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A
10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1 CLosed Before STor
12. Number of SDV failures during Hurricane Andrew: 0

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 2
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SAMEDAN Oil CORPORATION
2. Field Location: S.T. 147 A
3. Type Production: GAS / Cond. / WATER /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 1 closed BeforeSt
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1 closed Before Storm
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 0 N/A
10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: N/A
12. Number of SDV failures during Hurricane Andrew: N/A

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SAmedAN OiL CORPORATION
2. Field Location: S.J. 172 B
3. Type Production: GAS / Cond / WATER /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 6- Used AS Plugs ALLclosed years Before STORM
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 6- ALLclosed years Before STORM
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A
10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: N/A
12. Number of SDV failures during Hurricane Andrew: N/A

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SAMedAN Oil CorporATion
2. Field Location: S.T. 186-B
3. Type Production: GAS / Cond / WATER /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 2·Closed well Before ST
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 2closed well Befor STOe
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A
10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: N/A
12. Number of SDV failures during Hurricane Andrew: N/A

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Samedan Oil Corporation

2. Field Location: S.T. 192-D

3. Type Production: Gas / Cond / Water /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 1 closed Before Storm

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1 closed Before Storm

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: N/A

12. Number of SDV failures during Hurricane Andrew: N/A

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Samedan oil Corporation
2. Field Location: S.T. 195-A
3. Type Production: GAS / Cond / Water /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 3-Plugs 2-Closed Before storm
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 2 closed Before storm
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A
10. Number of WSSV failure during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: N/A
12. Number of SDV failures during Hurricane Andrew: N/A

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SAmedAN OiL CorporATioN
2. Field Location: S.T. 196 A
3. Type Production: GAS / Cond / oiL / WATER

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 3-Pluged 4-Closed Before STor
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 4 Closed Befor storm
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 2-Closed Before Stor
10. Number of WSSV failure during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 2-Closed Before Stor
12. Number of SDV failures during Hurricane Andrew: 0

Pipline Check Valve (FSV)

13. Number of FSV installations or population: 2
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Samedan Oil Corporation
2. Field Location: S.T. 196-B
3. Type Production: Gas / Cond / Water /

Subsurface Safety Valve (SSSV)

4. Numbers of SSSV's activated during Hurricane Andrew: 1 Closed Before Storm
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1 closed Before Storm
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valves (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 1 closed Before Ston
10. Number of WSSV failure during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 4
12. Number of SDV failures during Hurricane Andrew: 0

Pipline Check Valve (FSV)

13. Number of FSV installations or population: N/A
14. Number of FSV failures during Hurricane Andrew: N/A

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Amoco Production Company

2. Field locations: HI 537 (oil), WC 294 (gas), EC 222 (gas), EC 185 (gas), EC 261 (gas), VR 315 (gas)

3. Type production: SM 38 (gas), SM 260 (gas), EI 208 (oil & gas), EI 273 (gas), EI 322 (gas), EI 224 (gas), SS 176 (gas), SP 1 (gas), ST 161 (g WD 90 (oil&gas), SS 84 (gas), EI 196 (gas), EI 300 (gas)

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 142

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 142

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 142

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 30

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 30

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Post-It™ brand fax transmittal me

To LANG FU

Co.

It.

Fax # (713) 871-0434

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Union Oil Company of California
2. Field locations: Ship Shoal 208
3. Type production: Gas / Oil / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 32
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 1

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 38
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 38
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 32
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 15
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: UNOCAL

2. Field locations: SHIP SHOAL 269

3. Type production: OIL / GAS / /

	A	B	C	Total
Subsurface Safety Valve (SSSV)				
4. Number of SSSV's activated during Hurricane Andrew:	6	10	2	18
5. Number of SSSV failures during Hurricane Andrew:	0	0	0	0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage:		0		0
Master Surface Safety Valve (MSSV)				
7. Number of MSSV's activated during Hurricane Andrew:	5	10	2	17
8. Number of MSSV failures during Hurricane Andrew:	0	0	0	0
Wing Surface Safety Valve (WSSV)				
9. Number of WSSV's activated during Hurricane Andrew:	5	10	2	17
10. Number of WSSV failures during Hurricane Andrew:	0	0	0	0
Pipeline Shut Down Valve (SDV)				
11. Number of SDV's activated during Hurricane Andrew:	2	3	1	6
12. Number of SDV failures during Hurricane Andrew:	0	0	0	0
Pipeline Check Valve (FSV)				
13. Number of FSV installations or population:	3	4	1	8
14. Number of FSV failures during Hurricane Andrew:	0	0	0	0

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SOUTHERN NATURAL GAS COMPANY

2. Field locations: MAIN PASS, BRETON SOUND, SOUTH PASS, WEST DELTA

3. Type production: NATURAL GAS / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 0

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 0

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 0

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 0

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

SEE COMMENT ON FORM B

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ______
- Field Name: ______
- Type of valve: ______
- Working pressure (psig): ______
- Size of the valve or tubing (inch): ______
- Date of last commissioning (month/year): ______/______
- Mode of failure: ______
- Correction made (replaced/repaired): ______

TO OUR KNOWLEDGE, NO SUCH VALVES WERE NEEDED TO ACTIVATE DURING HURRICANE ANDREW ON COMPANY FACILITIES. ANY PLATFORMS OR PIPELINES THAT NEEDED TO BE ISOLATED WERE DONE SO MANUALLY BEFORE THE AUTOMATIC VALVES WOULD HAVE ACTIVATED.

Shell Offshore Inc.
An affiliate of Shell Oil Company

One Shell Square
PO Box 61933
New Orleans LA 70161

LANG?

September 9, 1994

J P Kenny, Inc.
5100 Westheimer
Suite 400
Houston, TX 77056

Gentlemen:

SUBJECT: HURRICANE ANDREW STUDY
MINERALS MANAGEMENT SERVICE (MS 5232)
OFFSHORE SAFETY DEVICES

The Minerals Management Service letters dated July 18 and August 30, 1994, requested we send to you the enclosed forms for the Hurricane Andrew Study.

Very truly yours,

Petey Velez

P. K. Velez
Manager Regulatory Affairs
E&P - Shelf Division

MJM

Enclosures

cc: w/o Enclosures
Minerals Management Service
Regional Supervisor
Field Operations (MS 5232)
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: EUGENE ISLAND 100

3. Type production: Oil / Gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 4

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 4

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 17

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 14

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: EUGENE ISLAND 128
3. Type production: Oil , GAS , ,

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 3
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 3
8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 20
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 16
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: EUGENE ISLAND 136

3. Type production: Oil / GAS / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 1

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: -0-

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: -0-

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: EUGENE ISLAND 188

3. Type production: Oil / GAS / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 8

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (SSV)

7. Number of SSV's activated during Hurricane Andrew: 8

8. Number of SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 40

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 32

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: SHIP SHOAL 189

3. Type production: Oil / GAS / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 3

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 3

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: -0-

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: -0-

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: SHIP SHOAL 259
3. Type production: Oil / Gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 6
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 6
8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 3
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 2
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: SOUTH TIMBALIER 300
3. Type production: Oil / Gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 12
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (SSSV)

7. Number of SSSV's activated during Hurricane Andrew: 12
8. Number of SSSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: SOUTH TIMBALIER 301

3. Type production: Oil / GAS / / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 7

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 7

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: SOUTH TIMBALIER 292
3. Type production: Oil / GAS / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 1
8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: SOUTH TIMBALIER 295
3. Type production: Oil / Gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 12
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (SSV)

7. Number of SSV's activated during Hurricane Andrew: 12
8. Number of SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

✓

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: SOUTH TIMBALIER 26

3. Type production: Oil / Gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 15

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 15

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 6

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 5

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**
2. Field locations: MISSISSIPPI CANYON 311
3. Type production: Oil , Gas , ,

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 7
5. Number of SSSV failures during Hurricane Andrew: -0-
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 7
8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~Wing Surface Safety Valve (WSSV)~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: **SHELL OFFSHORE INC.**

2. Field locations: GRAND ISLE 76

3. Type production: Oil , GAS , ,

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 8

5. Number of SSSV failures during Hurricane Andrew: -0-

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: -0-

~~Master~~ Surface Safety Valve (~~M~~SSV)

7. Number of ~~M~~SSV's activated during Hurricane Andrew: 8

8. Number of ~~M~~SSV failures during Hurricane Andrew: -0-

~~**Wing Surface Safety Valve (WSSV)**~~

~~9. Number of WSSV's activated during Hurricane Andrew:~~

~~10. Number of WSSV failures during Hurricane Andrew:~~

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 6

12. Number of SDV failures during Hurricane Andrew: -0-

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 5

14. Number of FSV failures during Hurricane Andrew: -0-

Fill out Form B for details of each failure.

Texaco Exploration and Production Inc
Offshore Division

P O Box 60252
New Orleans LA 70160

September 9, 1994

Mr. Lang Fu
J P Kenny, Inc.
5100 Westheimer, Suite 400
Houston, Texas 77056

Re: **DOI - MINERALS MANAGEMENT SERVICE**
J P Kenny/MMS Offshore Safety Device
Statistics Resulting from Hurricane
Andrew Survey and Study

Dear Mr. Fu:

In response to the Minerals Management Service (MMS) letters dated July 18, 1994 and August 30, 1994, Texaco Exploration and Production Inc. and Four Star Oil and Gas Company submit the attached data survey forms. The data being collected is for your use in an MMS funded study of the performance of offshore safety and pollution control devices during Hurricane Andrew.

Should you have any questions, please contact Mr. Vince Cottone at (504) 595-1471.

Yours very truly,

R. J. Savoy

R. J Savoy
EH&S Manager

vfc VFC:

Attachments

cc w/o Attachments: Mr. Warren Williamson (MS 5232)
Minerals Management Service
1201 Elmwood Park Boulevard
New Orleans, LA 70123-2394

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Texaco Exploration and Production, Inc.

2. Field locations: South Pass 54 "A" OCS-G-1606

3. Type production: oil /condensate / gas / water

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 3

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 4

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Texaco Exploration and Production, Inc.

2. Field locations: South Marsh Island 240-E OCS-G-0310

3. Type production: condensate/ gas / water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 6

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 6

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: Flowline - 6
Pipeline - 1

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: Flowline - 6
Pipeline - 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Texaco Exploration and Production, Inc.

2. Field locations: South Timbalier 200 "A" OCS-G-4464

3. Type production: condensate / gas / water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 5

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 5

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Texaco Exploration and Production, Inc.

2. Field locations: Vermilion 31 "A" OCS-G-2868

3. Type production: oil / condensate / gas / water

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 14

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 14

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: Flowlines - 14
Pipelines - 4

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: Flowlines - 14
Pipelines - 4

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Texaco Exploration and Production, Inc.

2. Field locations: South Marsh Island 217 "A" OCS-G-0310

3. Type production: oil / condensate / gas / water

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 44

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 44

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: Flowline - 44
Pipeline - 15

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: Flowline - 44
Pipeline - 15

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Four Star Oil & Gas Company

2. Field locations: Ship Shoal 26 "A" OCS-G-1441

3. Type production: condensate/ gas / water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 0

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 0

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: N/A

10. Number of WSSV failures during Hurricane Andrew: N/A

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 0

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): N/A
- Field Name: N/A
- Type of valve: N/A
- Working pressure (psig): N/A
- Size of the valve or tubing (inch): N/A
- Date of last commissioning (month/year): N/A /
- Mode of failure: N/A
- Correction made (replaced/repaired): N/A

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ____________________
- Field Name: ____________________
- Type of valve: ____________________
- Working pressure (psig): ____________________
- Size of the valve or tubing (inch): ____________________
- Date of last commissioning (month/year): __________/__________
- Mode of failure: ____________________
- Correction made (replaced/repaired): ____________________

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: CHEVRON U.S.A. PRODUCTION COMPANY

2. Field locations: SOUTH TIMBALIER BLOCK 52, 111, 131, 135 + 176 FIELDS

3. Type production: OIL / GAS / WATER / CONDENSATE

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 85
Many wells shut-in prior to Hurricane Andrew

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 7

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 74

8. Number of MSSV failures during Hurricane Andrew: * 5
Lost 3 Platforms during Hurricane Andrew, 19 Wells (mostly duals)
no leaks from tubing.

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 37

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 0

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

* OCS-G 1241 #12 caisson (Wells 14, 14D, 15, 15D + 12) was toppled over during Hurricane Andrew and sustained heavy damage.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ______________________________
- Field Name: ______________________________
- Type of valve: ______________________________
- Working pressure (psig): ______________________________
- Size of the valve or tubing (inch): ______________________________
- Date of last commissioning (month/year): ____________/____________
- Mode of failure: ______________________________
- Correction made (replaced/repaired): ______________________________

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: The Houston Exploration Co.
2. Field locations: SMI - E.I La. Offshore
3. Type production: GAS , COND , ,

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 7
5. Number of SSSV failures during Hurricane Andrew: ______
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 7
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 7
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 2
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Chevron USA Production Company
2. Field locations: South Pass & West Delta
3. Type production: Oil , Gas , ,

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 124
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 124
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 108
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 84
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 71
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): None for South Pass/West Delta
- Field Name: ______
- Type of valve: ______
- Working pressure (psig): ______
- Size of the valve or tubing (inch): ______
- Date of last commissioning (month/year): ______ / ______
- Mode of failure: ______
- Correction made (replaced/repaired): ______

BP EXPLORATION

BP Exploration Inc.
P.O. Box 4587
Houston, Texas 77210-4587

BP Plaza
200 WestLake Park Boulevard
Houston, Texas 77079

(713) 560-8500

August 12, 1994

J. P. Kenny, Inc.
5100 Westheimer, Suite 400
Houston, Texas 77056

Re: MMS Survey: Activation of Offshore Safety and Pollution Control Devices During Hurricane Andrew

To whom it may concern,

BP Exploration submits the attached survey forms in response to the July 18, 1994 letter, sent by MMS, requesting details of the activation and failure of offshore safety and pollution control devices during Hurricane Andrew.

Seven BP-operated offshore platforms were shut in due to Hurricane Andrew. All safety devices were activated per BP Exploration Emergency Evacuation Plan. As indicated on the attached forms, all safety and pollution control devices were properly activated, preventing uncontrolled flow of hydrocarbons.

If there are any questions please do not hesitate to contact me at 713-560-3173 or Lana LeBlanc at 713-560-4468.

Sincerely,

J. S. McMullan
Production Manager

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.
2. Field locations: MOBILE 821-A
3. Type production: Gas / Condensate / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 1
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.

2. Field locations: MAIN PASS 99-2

3. Type production: Gas / Condensate / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 1

10. Number of WSSV failures during Hurricane Andrew: 0

4" Gathering Line*
XXXXXXXX Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1

12. Number of SDV failures during Hurricane Andrew: 0

4" Gathering Line*
XXXXXXXX Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

*4" Gathering Line tied into Production. Facilities at Main Pass 100.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.
2. Field locations: MAIN PASS 100-A
3. Type production: Gas / Condensate / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 1
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.

2. Field locations: WEST CAMERON 143-2

3. Type production: Gas / Condensate / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 1

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 1

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 1

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 1

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.

2. Field locations: EWING BANK 826-A

3. Type production: Oil / Gas / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 19

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 19

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 19

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 2

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

✓

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.

2. Field locations: MISSISSIPPI CANYON 20-A

3. Type production: Oil / Gas / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 18

5. Number of SSSV failures during Hurricane Andrew: 0

6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 18

8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 18

10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0

12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 2

14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

✓

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: BP EXPLORATION & OIL, INC.
2. Field locations: MISSISSIPPI CANYON 109-A
3. Type production: Oil / Gas / Water /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 16
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 16
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 16
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 1
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 2
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Sonat Exploration Company
Gulf Coast Region
4 Greenway Plaza
Post Office Box 4792
Houston TX 77210 4792
713 940 4000

SONAT EXPLORATION

Larry

August 9, 1994

J. P. Kenny, Inc.
5100 Westheimer, Suite 400
Houston, Texas 77056

Re: MS 5232

Gentlemen:

Enclosed please find the completed survey Form A - Offshore Safety Devices Statistics.

If you need further information, please contact me at (713) 940-4027.

Sincerely,

M. J. Simon
Operations Manager

:kd

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: SONAT EXPLORATION CO.
2. Field locations: EC231, EC46, SS225, MU739
3. Type production: OIL / GAS / Condensate

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 36
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 44
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 17
10. Number of WSSV failures during Hurricane Andrew: 0

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 24
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 20
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: CHEVRON USA
2. Field locations: Chevron Pipe Line Co. N/A (Don't operate any fields)
3. Type production: / / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 0
5. Number of SSSV failures during Hurricane Andrew: ______
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: ______

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 0
8. Number of MSSV failures during Hurricane Andrew: ______

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: 0
10. Number of WSSV failures during Hurricane Andrew: ______

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 0
12. Number of SDV failures during Hurricane Andrew: ______

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: (See note)
14. Number of FSV failures during Hurricane Andrew: ______

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ____________________
- Field Name: ____________________
- Type of valve: ____________________
- Working pressure (psig): ____________________
- Size of the valve or tubing (inch): ____________________
- Date of last commissioning (month/year): __________ / __________
- Mode of failure: ____________________
- Correction made (replaced/repaired): ____________________

Chevron Pipe Line Company shut down all operations prior to Hurricane Andrew, therefore no safety devices were activated. Pressure tests were done on all systems prior to re-start.

A Coflexipe line separated @ W.D. 109 structure due to pipeline movement during s/d but the reverse check valve closed & no oil was released. This system is operated by Chevron USA for Chevron Pipe Line Company

√

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: TENNESSEE GAS PIPELINE CO.
2. Field locations: NUMEROUS THROUGHOUT OFFSHORE LA
3. Type production: NATURAL GAS TRANSMISSION VIA PIPELINE

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: NA
5. Number of SSSV failures during Hurricane Andrew: NA
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage:

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: NA
8. Number of MSSV failures during Hurricane Andrew: NA

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: NA
10. Number of WSSV failures during Hurricane Andrew: NA

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: NONE
12. Number of SDV failures during Hurricane Andrew: NONE

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: ONE AT EVERY TIE-IN
14. Number of FSV failures during Hurricane Andrew: NONE

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): NONE
- Field Name: "
- Type of valve: "
- Working pressure (psig): "
- Size of the valve or tubing (inch): "
- Date of last commissioning (month/year): / "
- Mode of failure: "
- Correction made (replaced/repaired): "

OUR AFFECTED PIPELINES ARE NORMALLY SHUT IN BY THE SOURCE PRODUCER WHEN HE SHUTS IN FOR A HURRICANE.

ALL LATERAL LINES HAVE CHECK VALVES WHERE THEY TIE INTO THE TRUNK LINE.

WE ~~ONLY~~ PRIMARILY HAUL NATURAL GAS – WE ARE NOT A PRODUCER.

✓

United States Department of the Interior

Minerals Management Service
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Form A - OFFSHORE SAFETY DEVICES STATISTICS

1. Operator: Gulfstream Resources
2. Field locations: EI 89 & EI 205
3. Type production: Oil / gas / /

Subsurface Safety Valve (SSSV)

4. Number of SSSV's activated during Hurricane Andrew: 11
5. Number of SSSV failures during Hurricane Andrew: 0
6. Number of completions in which an SSSV prevented uncontrolled flow due to surface safety valve failure or damage: 0

Master Surface Safety Valve (MSSV)

7. Number of MSSV's activated during Hurricane Andrew: 11
8. Number of MSSV failures during Hurricane Andrew: 0

Wing Surface Safety Valve (WSSV)

9. Number of WSSV's activated during Hurricane Andrew: —
10. Number of WSSV failures during Hurricane Andrew: _____

Pipeline Shut Down Valve (SDV)

11. Number of SDV's activated during Hurricane Andrew: 4
12. Number of SDV failures during Hurricane Andrew: 0

Pipeline Check Valve (FSV)

13. Number of FSV installations or population: 4
14. Number of FSV failures during Hurricane Andrew: 0

Fill out Form B for details of each failure.

Form B - DETAILS OF EACH FAILED OFFSHORE SAFETY DEVICE

- Device (SSSV/MSSV/WSSV/SDV/FSV): ____________________
- Field Name: ____________________
- Type of valve: ____________________
- Working pressure (psig): ____________________
- Size of the valve or tubing (inch): ____________________
- Date of last commissioning (month/year): __________/__________
- Mode of failure: ____________________
- Correction made (replaced/repaired): ____________________

PENNZOIL EXPLORATION AND PRODUCTION COMPANY
POST OFFICE BOX 51843 • LAFAYETTE, LOUISIANA 70505-1843 • (318) 269-4200

August 1, 1994

J. P. Kenny, Inc.
5100 Westheimer, Suite 400
Houston, TX 77056

Attention: Mr. Lang Fu

Gentlemen:

We are in receipt of the Minerals Management Services July 18, 1994, memo requesting data in relation to offshore safety and pollution control devices during Hurricane Andrew.

Pennzoil does not have any automation in which these devices were activated during the storm. Our wells were manually shut-in when our personnel abandoned the structures prior to the storm. Therefore, we do not have any data to contribute to the study.

If there are any questions, please contact me at (318) 269-4325.

Yours very truly,

Francis W. Broussard

Francis W. Broussard
Division Production Superintendent
Offshore Division

FWB/lht