A Study for the U.S. Department of the Interior,
Minerals Management Service

GULF OF MEXICO DEEP WATER DECOMMISSIONING STUDY

REVIEW OF THE STATE OF THE ART FOR REMOVAL OF GOM US OCS OIL & GAS FACILITIES IN GREATER THAN 400' WATER DEPTH
M09PC00004

Final Report

Conducted by

PROSERV OFFSHORE
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MMS M09PC00004

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EXECUTIVE SUMMARY

This study has been prepared for the Department of the Interior, Minerals Management Service (MMS) in response to their Request for Proposals (RFP) for specific areas of interest to the MMS Technology Assessment and Research (TA&R) Program, Oil Spill Response Research & Decommissioning as published in Broad Agency Announcement Solicitation Number M08PS00094.

The study provides a review of the state of the art and current practice in the removal and disposal of Gulf of Mexico (GOM) U.S. Outer Continental Shelf (OCS) oil and gas facilities in water depths greater than 400 feet (deep water). It also identifies and discusses the challenges and choices faced by the industry and regulatory authorities in dealing with the decommissioning of these facilities. The study also estimates the cost of decommissioning typical fixed and floating deep water facilities. The study is separated into the following Section areas of interest.

(1) Section 1 identifies the GOM major facility inventory by type and water depth, grouping and representative platform.
(2) Section 2 provides an assessment of methodology, technology and infrastructure and presents a synopsis of the major decommissioning tools, resources, limitations and future challenges.
(3) Section 3 provides an assessment of disposal options and their impact on state run reefing programs and assessment of the water depths that the programs are most effective.
(4) Section 4 presents A) deterministic cost data to determine estimated decommissioning liabilities for typical fixed, tethered and moored structures and associated pipelines and wells in the GOM, B) a conceptual removal method estimate and C) a discussion on deterministic and probabilistic estimating and a sample probabilistic cost estimate for platform removal.
(5) Section 5 Appendix presents the decommission cost estimates for the representative platforms used in this study, lists of Figures/Tables, acknowledgements, MMS Contract Work Scope, Glossary of Terms, explosive permit stipulations and fixed platform General Methodology & Assumption.

BACKGROUND

Currently, most offshore GOM platform decommissioning has been in water depths less than 400 ft. This study focuses on water depths >400 ft. There are currently 111 surface platforms in the GOM in water depths greater than 400 feet to ±8,000 feet, as shown in the Major Asset Table 0.1 below. For the purpose of this study surface platform includes a) fixed structures with legs anchored by piles to the seabed and includes compliant towers, b) Spars attached to the seabed by mooring lines and c) tensioned leg platforms attached to the seabed by tensioned steel tubes. A breakdown of the assets is provided in Section 1. The

Major Asset Table shows the range of costs included in this study for major facilities in the GOM.

Asset Type	Water Depth Range Ft.	Deck Weight Range 1000 st	Jacket / Hull Weight Range 1000 st	Count	Estimated Decommissioning Liability Range MM US$ Each (1)
Fixed Platform	400-1,754	.8 - 23	5,9 - 59	70	$6 - $79
Tensioned / Moored	1,500-8,000	2 - 59	2.8 - 60	41	<$10 - >$47
Pipelines					$0.8 - $3+
Platform Wells					$0.3 – 1.3
Dry Tree Subsea Wells					$4
Subsea Well & Template					$3 - $10+

Table 0.1 - GOM Major Asset Table

(1) Using current GOM proven technology for platform only exclusive of pipelines and wells

REVIEW OF PREVIOUS STUDIES

Most of the GOM facilities have deck weights in excess of 4,000 short tons (st) and jacket or hull weights in excess of 10,000 st. as shown in the Major Asset Table in this section. All of these platforms would set new size and depth records for decommissioning by a wide margin. A number of these platforms are approaching the end of their productive lives. A 1996 study conducted by the National Research Council titled "*An Assessment of Techniques for Removing Offshore Structures*" [1] provides historical and background information not repeated in this study. The previous TA&R project, "*State of the Art of Removing Large Platforms Located in Deep Water,*" [2] assessed the relevant technology for decommissioning similar facilities in the Pacific OCS region, the methodology which might be used, and the resulting costs.

The study proposed here would review and build on the previous work, updating it for advances in technology and for the current cost structure and different conditions of the GOM. In addition, this study will a) address the wide range of other types of structures that are used for deep water oil and gas production in the GOM, e.g., Tension Leg Platforms (TLPs), Spars and mono-hull vessels of varying descriptions and b) present decommissioning resources being developed or under consideration for development.

OBJECTIVES, ASSUMPTIONS, AND OVERALL APPROACH

The overall objective of this study is to examine the relevant issues pertaining to the GOM deep water major asset inventory and to quantify them in the context of determining the estimated decommission costs for a type of structure, using state-of-practice methodology and currently available technology and to probe where improvements in methodology and technology will present challenges. The following are the specific objectives:

1. Define / identify the major asset inventory in the GOM.

2. Group the inventory into typical types of structures and select a representative facility from within each group and provide a decommissioning cost estimate and a means of applying the estimate to other inventory within a group.

3. Conduct a methodology, technology and infrastructure assessment determining the major tasks and resource requirements for decommissioning, evaluating the tools and technology in relation to seabed severing methods, conventional and non-conventional lifting methods.

4. Determine the areas where improvements are needed and where the current technology and resources, including the available infrastructure, will be most challenged.

5. Provide an assessment of disposal options for each type of structure, considering removal and reuse and how disposal impacts reefing programs and at what water depths are the reefing programs most effective.

6. Determine the most important areas of uncertainty in the decommissioning processes for the deep water structures and develop cost estimates for each representative facility using probabilistic methods to capture the uncertainty.

7. This study considers using a 2000 ton or greater capacity derrick barge or crane vessel (DB) or a dynamically positioned semi-submersible crane vessel (SSCV) with greater than 5000 ton capacity. Crane vessels are presented in Section 2.

8. This study considered using the following removal methods:

   - In-Situ cutting and removing of the jackets in place onto cargo barges to transport for disposal.
   - Hopping the jackets into successively shallower water locations where sections are removed onto cargo barges to transport for disposal.

   The removal methods are also compared to conceptual removal methods with floatation bladders or with use of twin marine lifting vessels, both presented in Section 2 with estimated conceptual costs presented in Section 4.

DECOMMISSIONING COST INFLATION

INTERNATIONAL CONSTRUCTION INFLATION TRENDS

MMS requested that offshore inflation cost trends be added to this report. A study was conducted on the inflation factors and this section presents a summary of the results. A more in-depth study is provided in the Appendix Section 5.8.

To make a determination of the appropriate inflation factor to use for GOM OCS decommissioning project cost estimates we have evaluated construction trends internationally in the recent past. General inflation rates, construction inflation rates, and offshore vessel inflation rates were all analyzed in this study. It was concluded that a mean yearly inflation rate for derrick barges was the most accurate and influential factor in predicting future offshore decommissioning inflation rates.

A review of the various rates shows a wide range of variation by category and from year to year. We have reviewed the available inflation data and propose the following inflation factor of 3.36% for use offshore, as shown in Derrick Barge Average in "Average" column in Table 0.2.

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Derrick Barge Average (%)	14.30	0.002	3.90	7.84	0.03	7.17	5.69	6.73	1.52	13.89	15.20	0.47	3.36

Table 0.2 GOM OCS Decommissioning Projects Cost Adjustment Factor

Recent information received by derrick barge contractors indicates that the market costs for 2009 have decreased to an approximate level of $1,300 per st for decommissioning 4-pile and larger structures in the GOM. At the time of this study, back-up information was not available. See the Historical Graph in the Appendix Section 5.8.

CONCLUSIONS

The results of the study lead to the following conclusions:

1. Complete Removal In-Situ is the preferred method where the derrick barge has the lifting capacity to remove in a single lift. It will be less time consuming and demand more resources than the Hopping method. This assumes the use of the technology and methods that are readily available today. Technology currently under construction and future technology in the 20,000+ st lifting range will expand the number of platforms than can be removed in larger or single lift operations and flotation methods may prove viable for single lift jacket removal of all tonnages.
2. Complete removal In-Situ where the derrick barge does not have sufficient lifting capacity and the jacket must be cut up by divers and or ROV would not be the preferred method

due to the longer durations and human exposure risks required, especially when using divers for underwater cuts and removal.

3. The Hopping method where the top section of the jacket exposed above water is removed without the use of divers appears to be much safer in a relative sense, when compared to In-situ jacket removal.
4. Risk of accidents increase with water depth for both methods, but it increases much faster with the In-situ method.
5. The groupings and estimates in this study are a high-level snapshot in time with available information. Additional owner / operator data would be required to provide more specific groupings and estimates at a more precise level.
6. Technology is continuing to mature in the GOM with input from other areas such as the North Sea and Brazil, but will be a challenge for deep sea operations, especially where decommissioning operations were not considered in the design phase. See recommendations below.
7. Aquaculture may present an alternate use for non-producing platforms.
8. Disposal options are varied, from disposal at or near GOM ports to towing to foreign port. New flotation technology may provide for towing larger structures into shallower ports.
9. The cost to P&A accessible problem free wells are addressed in this study with the use of platform rigless methods and interventional vessels rigless methods. Cost to P&A subsea wells with the use of submersible drilling rigs are also included but the defining line of when drilling rigs are necessary would require data and analysis outside the scope of this study. See Recommendations in this Section for the collection of additional well data.
10. Well intervention vessels are providing an effective means to conduct rigless deepwater well abandonments. These vessels are designed to operate in water depths to 10,000 feet.

RECOMMENDATIONS

During the course of this study, the MMS requested that Proserv address gaps in MMS regulations or practices that exist with decommissioning operation for types of structures in the GOM. The following are some on the pertinent recommendations included in this study. Other recommendations are included in appropriate sections or in articles in the Appendix.

1. This recommendation is for other than fixed platforms. The regulations for removal of subsea structures should be expanded to clarify what is to be removed or may remain at what water depths. For the purpose of this study, it is assumed that subsea wells will be removed, subsea structures anchored to the seabed will remain in place and subsea structures that are attached to or stabbed over the anchored structure will be removed.

2. With the consideration in #1 above that anchored subsea structures may remain in place, the regulation requiring that all plugged wells be removed 15 feet below the mudline should be reviewed for deepwater subsea tree wells.[1] Removing this

requirement would greatly enhance the safety of decommissioning work and reduce the project costs. Additionally pipelines are not buried in deepwater and subsea equipment skids will be abandoned in situ, so it seems reasonable to leave the well casings below the mudline.

3. During well abandonment projects it is imperative that adequate seals are placed in the wellbore to permanently seal the well. This is a challenge in deepwater wells especially in subsea wet trees. The challenge is greatly increased for wellheads without access fittings to all casing annulus sections. Wellheads should be designed with full access to all casing strings which will reduce well decommissioning costs. [3] This is a condition for many subsea wells that may present problems for P&A operations.

4. Ideally all permeable zones above the production casing show should be sealed off with cement during the drilling of the well. For the most part it is easier and less expensive to seal off these zones during the well drilling operation than during a decommissioning project. [3]

5. The key challenge with cutting well conductors or any grouted structural member is being able to cut through the grout. The effectiveness of cutting multiple conductor pipes with grout in the annular areas is a factor of how much grout is in the annular area and if the pipes are concentric. Some cutting tools can sever grouted areas better than others. Inspection technology should be developed that will determine the extent of grout in the annulus and the orientation of the conductor pipes. This information would allow the decommissioning contractor to select the best cutting technique which would reduce the amount of time spent severing the conductors and less offshore human exposure.

6. Industry should place more emphasis during the initial design to design the facilities in consideration of how the facilities will be removed. The platforms and subsea structures should be designed so that it will be less costly and safer to remove these structures. Some techniques to reduce the time spent decommissioning the structures are:

   a. Eliminate the placement of grout in the top section of well conductors' annular spaces.
   b. Reduce the weight of mooring systems by utilizing non steel cables.
   c. Reduce the weight of subsea flowlines by utilizing non steel flowlines.
   d. Install lifting connections on the jacket that would be used during the jacket removal project.
   e. Design subsea trees with full ROV access to all annular spaces. This will enable testing and plugging work in all casing strings.

f. Continue subsea design efforts to provide universal connections which will minimize the number of access tools required to work on different manufacturers' subsea equipment.
g. Improve the functionality of the subsea equipment to allow more efficient decommissioning work.

7. Information should be gathered on subsea inventory. The inventory should be evaluated and categorized into quantities, types, sizes, weights. Gathering this information is even more critical as fields near depletion and interests are sold to other operators. It has been found that the well production and basic information may be in possession of the new owner but often design and installation drawings and procedures are not available. It may be unknown what subsea systems are ROV friendly or have been designed with decommissioning in mind. It may be unknown if systems are or have been maintained and documented to allow for smooth operation during decommissioning. This information would assist in decommission. It is recommended that all subsea systems address decommissioning and maintenance during the design phase, to assure proper operation of decommissioning systems in the future. Regulations on the transfer of data to new operators would assist in this endeavor.

8. Additional data would need to be gathered to access the decommissioning cost for wells that have downhole problems and or wells that would only be accessible with the use of a drilling rig or drilling rig vessel. These costs are not included in this study. Regulations requiring the collection, submittal and updating of this data and planed decommissioning method would assist in determining future liability.

9. Deepwater subsea operations would be more efficient with enhancements to camera and visualization technology. This is especially important in high silt, debris sensitive areas where it is critical that industry is provided high quality 3-D images. [3]

10. Subsea systems construction equipment is in limited supply. Standardized subsea rental systems should be available which would improve subsea decommissioning project cycle time and work performance. Since this equipment is long lead and high cost, perhaps an MMS sponsored group could facilitate this service. [3]

11. The Gulf of Mexico's oil and gas producing states rigs-to-reef program has been successfully utilized by the oil industry and we encourage the continuation of this program. Additional reef locations could be added to the program which would reduce the expense of transporting structures over long distances to existing reef sites. Ideally these new reef sites could be located at the location of the deepwater facilities. For instance for jackets that are partially removed, the portion of the jacket in water depths

>400 feet would not benefit the reefing community but the upper portion of the jacket left in place would be beneficial to the fish population. See Section 3 for Artificial Reef Programs and specifically Section 3.5 for research figures showing optimal water depths for reefing.

12. It is understood that a large portion of MMS's GOM facility records database was destroyed due to flooding from recent hurricanes. It would be useful to obtain the following missing platform data to complete the characteristics of each structure in the GOM as detailed in Section 1 of this report:

    a. Pile and or Skirt Pile configuration and diameter of piles for severing method
    b. Deck and jacket weights for HLV selection
    c. Are well trees dry or wet
    d. Number, type and diameter of mooring systems
    e. Installation methods and HLVs used
    f. Well records to document placement of annular cement sections

Section 1 –
DEEPWATER FACILITIES OVERVIEW

This section presents the Gulf of Mexico (GOM) inventory Major Assets

1.1 Background

The following surface facilities are currently installed or in the process of being installed in the GOM in water depths greater than 400 feet, as shown in Table 1.1:

Structure Type (Figure 1.1)	Units
Fixed Platforms Water Depth 400-600	41
Fixed Platforms, including Compliant Towers (CT) Water Depth 600 – 1700+	29
Classic Spar	3
Truss Spar	12
Cell Spar	1
MiniDOC Spar	2
Mini or New Generation Tension Leg Platform (MTLP)	6
Conventional Tension Leg Platform (TLP)	9
Semi Submersibles (Semi)	8
TOTAL	111

Table 1.1 GOM Major Assets

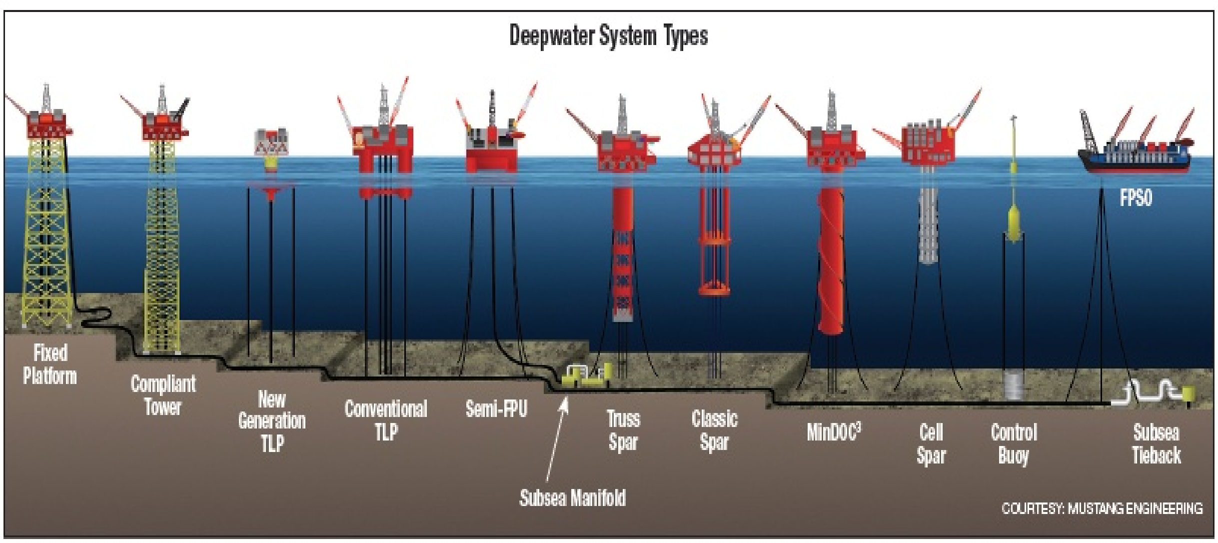


Figure 1.1 Deepwater System Types

1.2 GOM Asset Descriptions

The following descriptions are provided by the MMS website [4] {(http://www.gomr.mms.gov/homepg/offshore/deepwatr/options.html). Some of the information has been updated for this study.

Fixed Platform (FP) consists of a jacket (a tall vertical section made of tubular steel members supported by piles driven through the legs, through skirt pile sleeves or both and into the seabed) with a deck placed on top, providing space for crew quarters, a drilling rig, and production facilities. The fixed platform is economically feasible for installation in water depths up to 1,500 feet.

Compliant Tower (CT) consists of a narrow, flexible tower and a piled foundation that can support a conventional deck for drilling and production operations. Unlike the fixed platform, the compliant tower withstands large lateral forces by sustaining significant lateral deflections, and is usually used in water depths between 1,000 and 2,000 feet. The CT may or may not be supported with guyed wires anchored to the seabed.

Tension Leg Platform (TLP) consists of a floating structure held in place by vertical, tensioned tendons connected to the sea floor by pile-secured templates. Tensioned tendons provide for the use of a TLP in a broad water depth range with limited vertical motion. The larger TLP's have been successfully deployed in water depths approaching 5,000 feet. The TLP may be anchored to the seabed by neutrally buoyant steel tubular tendons or a combined chain and wire anchoring system to driven piles.

Mini-Tension Leg Platform (MTLP) is a floating mini-tension leg platform of relatively low cost developed for production of smaller deepwater reserves which would be uneconomic to produce using more conventional deepwater production systems. It can also be used as a utility, satellite, or early production platform for larger deepwater discoveries. The world's first Mini-TLP was installed in the Gulf of Mexico in 1998. MTLP are currently installed in water depths exceeding 4,000 feet. The MTLP may be anchored to the seabed by neutrally buoyant steel tubular tendons or a combined chain and wire anchoring system to driven piles.

SPAR Platform (SPAR) consists of a large diameter single or multi vertical cylinder(s) supporting a deck. It has a typical fixed platform topside (surface deck with drilling and production equipment), three types of risers (production, drilling, and export), and a hull which is moored using a taut catenary system of six to twenty lines anchored into the seafloor. SPAR's are presently used in water depths exceeding 7,000 feet. The SPAR may be anchored to the seabed by a combined chain and wire or chain and polyester line anchoring system to driven or suction piles. There are a number of SPAR designs per the Major Asset Table and Figure 1.1.

Floating Production System (FPS) consists of a semi-submersible unit which is equipped with drilling and production equipment. It is anchored in place with wire rope and chain, or can be dynamically positioned using rotating thrusters. Production from subsea wells is transported to the surface deck through production risers designed to accommodate platform motion. The FPS can be used in a range of water depths from 600 to 7,500 feet.

Subsea System (SS) ranges from single subsea wells producing to a nearby platform, FPS, or TLP to multiple wells producing through a manifold and pipeline system to a nearby or distant production facility. These systems are presently used in water depths greater than 5,000 feet.

Floating Production, Storage & Offloading System (FPSO) consists of a large tanker type vessel moored to the seafloor. An FPSO is designed to process and store production from nearby subsea wells and to periodically offload the stored oil to a smaller shuttle tanker. The shuttle tanker then transports the oil to an onshore facility for further processing. An FPSO may be suited for marginally economic fields located in remote deepwater areas where a pipeline infrastructure does not exist.

1.3 GOM Major Asset Inventory

There are currently 70 fixed platforms in the GOM in water depths from 400' and greater. There are 41 platforms in the depth range from 400' to 600' and the remainder 29 in >600'to the deepest to date in 1754' water depth. The majority of these facilities have jacket weights in excess of 10,000 st. Any of these platforms would set new size and depth records for decommissioning by a wide margin. A number of these platforms are approaching the end of their productive lives. Subsea inventory in the GOM is depicted in Sections 2 and 3, but a listing of the complete inventory in sufficient detail to estimate the decommissioning costs was not available for this study. See the Executive Summary Inventory and Section 2 - Information Availability. The previous TA&R project, "*State of the Art of Removing Large Platforms Located in Deep Water,*" [2] assessed the relevant technology for decommissioning similar facilities in the Pacific OCS region, the methodology which might be used, and the resulting costs. The study proposed here would review and build on the previous work, updating it for advances in technology and for the current cost structure and different conditions of the GOM. In addition, this study will address the wide range of other types of structures that are used and being developed for deep water oil and gas production in the GOM, e.g., Tension Leg Platforms (TLPs), Spars and mono-hull vessels of varying descriptions.

Tables 1.2 and 1.3 shows the GOM Major Asset Inventory sorted by Type / Block location and by water depth. The type in these tables refers to Fixed Platform, Spar, TLP, etc. Numerous public sources including MMS and other websites were visited to obtain information on the GOM major assets. Some of the sources of information provided conflicting data and the data believed to be more credible was used. It is believed that the most reliable information is used in this study. Input as to platform characteristics was requested from a number of Operators / Owners but was not made available for this study; therefore some of the platform data may be subject to revision.

TABLE 1.2 GOM Major Asset Inventory Sorted by Type and Block Location

Platform Location	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
Fixed Platforms						
EB 110 A – Tequila	660	848	9,999	8		8+4
EB 159 - Cerveza Ligera	925	7,400	14,991	4		4+8
EB 160 - Cerveza	935	1,798	26,000	8		8+16
EB 165 - Snapper	863	4,330	20,503	8		8+12
EC 373 A	443			4		
EC 381 A	446	1,020	4,000	4	4-48" & 4-92"	leg-skirt
EI 371 B	415					
EI 372 A PRO	414	950	3,972	8		48"
EI 384 A	431					
EI 397 A	472			3	leg	48"
EW 826 A	483	3,850	10,200	8	8-48" & 12-72"	leg-skirt
EW 873 - Lobster	774	4,500	16,535		Skirt	12
EW 910 A	549					
EW 947 A	477			4	4-48" & 4-54"	leg-skirt
GB 128 A – Enchilada	705	3,850		4	Skirt	8
GB 142 A	542	533	925	0	3-Skirt	3 - 72"
GB 172 B – Salsa	693	2,245	10,000	4	Skirt	8
GB 189 - Tick	718	2,000	11,023	4		4+8
GB 191 A	721	1,800	8,500	4		4+8
GB 236 A	682	8,100	13,228	8		8+12
GB 260 – Baldplate - CT	1647	2,400	57,267	4	Skirt	12 84"
GB 72 A	541					
GC 18 A	761	5,200	16,755	4		4+16
GC 19 A - Boxer	751	6,500	14,881			
GC 52 A	604					
GC 52 CCP	604					
GC 6 A	620	2,000	17,000		Skirt	8
GC 65 A - Bullwinkle	1348	2,300	54,427	12		12+32
GC 89 A – Cinnamon	670	3,261	6,000	3		3+4
HI A 371 A	430					
HI A 389 A	410	900	3,670	8		48"
HI A 582 D (CYRUS)	440			4		48"
HI A 589 A	477					
MC 109 A - Amberjack	1100	3,261	23,810	6		6+12
MC 148 A	651			4		4+12
MC 194 A - Cognac	1027	23,000	59,000	12	Skirt	24 84"
MC 20 A	480	1,845	8,600	8		48"
MC 21 B – Simba	667	1,197	9,025	4		4+8
MC 280 – Lena - CT	997	1,004	23,366			
MC 311 A	428					
MC 365 A – Corral	619	1,124	5,910	4		4+4
MC 397 Alabaster	476	1,290		4	4-72" & 4-72"	leg-skirt
MC 486 A	582					
MC 63 B	480					
MP 288 A	420					
SMI 205 A	437	1,400	4,120	8	4-skirt	48"
SMI 205 B	523	668	5,080	4	4-72" & 4-48"	leg-skirt
SP 49 C	400	638	4,400	4	1-96" & 4-84"	4-skirt
SP 52 A	531				3-skirt	72"
SP 83 A	467	892	4,279	0	4-skirt	
SP 89 B	456	900	5,447	8	8-48" & 4-60"	leg-skirt
SP 89 MC674 #3	422					
SP 93 A	446					
SP 93 B	450					

TABLE 1.2 GOM Major Asset Inventory Sorted by Type and Block Location – Continued

Platform Location	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
Fixed Platforms						
SS 332 A	438					
SS 332 B	438					
SS 354 A	464					
SS 358 A	419					
ST 308 A (Tarantula)	484					
ST 316 A	447			4	leg	48"
ST 317 A	460					
VK 780 A - Spirit	721		19,012			
VK 786 A – Petronius – CT	1754	7,850	43,000	12	Skirt	12 Piles
VK 817 A	671					
VK 823 A – Virgo	971		25,166			
VK 989 A - Pompano	1289	4,800	39,890	4	Skirt	12
VR 395 A	420					
VR 412 A	467					
WC 645A	432	850	1,100	8	leg	
WC 661 A	484	730	2,700	4	leg	
Fixed Platforms Count	70					
Classic Spar						
AC 25 A – Hoover	4825	17,210	35,831	12	Chain-wire-chain	Suction
GC 205 A – Genesis	2590	12,500	28,700	14	5.25in. Chain-wire-chain	8' OD Anchor
VK 826 A – Neptune Spar	1930	3,300	12,885	6	Chain-wire	48"OD Piles
Classic Spar Count	3					
Truss Spar						
AC 857 A – Perdido	7817	12,401	20,956	9	5.28" Chain & 9.68" polyster lines 2 Mi. each & Chain	18' OD Suction
EB 602 A – Nansen	3675	5,340	11,960	9		9 Piles
EB 643 A – Boomvang	3650	5,400	11,960	9		9 Piles
GB 668 A – Gunnison	3150	6,000	14,800			
GC 338 A – Front Runner	3330	6,300	14,100	9	Chain-wire-chain	
GC 641 A – Tahiti	4000	9,950	24,000			
GC 645 A – Holstein	4340	18,200	35,550	16	Chain-wire-chain	Suction
GC 680 A – Constitution	4970	10,770	14,800			
GC 782 A – Mad Dog	4420	10,500	20,800	11	polyester lines	Suction
MC 127 A – Horn Mountain	5400	8,200	6,200	9	Chain-wire-chain	
MC 582 A - Medusa	2223	6,000	12,900			
MC 773 A – Devils Tower	5610	9,465	13,188	9	Chain-5-7/8" wire Chain	Suction
Truss Spar Count	12					
Cell Spar						
GB 876 A – Red Hawk	5300	3,600	7,500	6	chain polyester lines	18' suction
Cell Spar Count	1					
MiniDOC Spar						
AT 63 A - Telemark (@MC942)	4450	10,021	17,938			
MC 942 A - Mirage	4000	10,021	17,938			
MiniDOC Spar Count	2					
MTLP						
EW 921 A – Morpeth	1700	3,000	2,850		steel tubular	84" Driven piles
EW 1003 A – Prince	1500	3,450		8	24" OD	
GC 254 A – Allegheny	3294	3,000	2,850			
GC 613 A – Neptune TLP	4232	3,200	5,900	6	36"ODX1.36"Wall	96"OD Piles
GC 653 A – Shenzi	4375	8,684	12,493	8	36" to 44"	
MC 243 A – Matterhorn	2850	5,500	4,500	6	32" neutrally buoyant steel tubular tendons	96" piles
MTLP Count	6					

TABLE 1.2 GOM Major Asset Inventory Sorted by Type and Block Location – Continued

Platform Location	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
TLP						
GB 426 A – Auger	2860	24,000	39,000	8	5-3/16" chain and 5" wire, 2 subm buoys	8 30t fluke
GB 783 A – Magnolia	4670	7,600	20,000	8	Chain-5" wire	fluke anchors
GC 158 A – Brutus	3300	11,500	14,500	12	32"ODX1.25"Wall	82"OD Piles
GC 184 A – Jolliet	1760	2,150	4,600			
GC 608 A – Marco Polo	4300	7,250	5,750	8	28"ODX1.25"Wall wire-chain	76"OD Piles
MC 807 A Mars	2933	7,200	15,650	12	28"ODX1.25"Wall	84"OD Piles
MC 809 A – Ursa	3800	22,400	28,600	16	32"ODX1.5"Wall	96"OD Piles
VK 915 A – Marlin	3236	5,512	9,000			
VK 956 A – Ram Powell	3216	8,100	11,000	12	28"ODX1.2"Wall	84"OD Piles
TLP Count	9					
FPS						
GC 29-1	1540					
FPS Count	0					
SEMI						
GB 388 A - Cooper	2097					
GC 787 A – Atlantis	7050	14,125	58,700		Chain-wire-chain	Suction
MC 474 A – Na Kika FPDS	6378	20,000	20,000	16	Chain-wire-chain Catenary	Suction
MC 650 A – Blind Faith	6480	7,400				
MC 711 A – Gomez	3000					
MC 734 A - Thunder Hawk	5724					
MC 778 A – Thunder Horse	6200	50,000	60,000	16	chain wire	Suction
MC 920 A – Independence	8000	10,250		12	9" Rope	
SEMI Count	8					

TABLE 1.3 GOM Major Asset Inventory Sorted by Water Depth

Platform Location	Type	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
SP 49 C	FP	400	638	4,400	4	1-96" & 4-84"	4-skirt
HI A 389 A	FP	410	900	3,670	8		48"
EI 372 A PRO	FP	414	950	3,972	8		48"
EI 371 B	FP	415					
SS 358 A	FP	419					
MP 288 A	FP	420					
VR 395 A	FP	420					
SP 89 MC674 #3	FP	422					
MC 311 A	FP	428					
HI A 371 A	FP	430					
EI 384 A	FP	431					
WC 645A	FP	432	850	1,100	8	leg	
SMI 205 A	FP	437	1,400	4,120	8	4-skirt	48"
SS 332 A	FP	438					
SS 332 B	FP	438					
HI A 582 D (CYRUS)	FP	440			4		48"
EC 373 A	FP	443			4		
EC 381 A	FP	446	1,020	4,000	4	4-48" & 4-92"	leg-skirt
SP 93 A	FP	446					
ST 316 A	FP	447			4	leg	48"
SP 93 B	FP	450					
SP 89 B	FP	456	900	5,447	8	8-48" & 4-60"	leg-skirt
ST 317 A	FP	460					
SS 354 A	FP	464					
SP 83 A	FP	467	892	4,279	0	4-skirt	
VR 412 A	FP	467					
EI 397 A	FP	472			3	leg	48"
MC 397 Alabaster	FP	476	1,290		4	4-72" & 4-72"	leg-skirt
EW 947 A	FP	477			4	4-48" & 4-54"	leg-skirt
HI A 589 A	FP	477					
MC 20 A	FP	480	1,845	8,600	8		48"
MC 63 B	FP	480					
EW 826 A	FP	483	3,850	10,200	8	8-48" & 12-72"	leg-skirt
TYPE DESCRIPTION							
Fixed Platforms	FP						
Classic Spar	ClaS						
Truss Spar	TS						
Cell Spar	CellS						
MiniDOC Spar	M/DocS						
Mini TLP	mtlp						
Tension Leg Platform	TLP						
Floating Production Storage	FPS						
Semi Submersable	SEMI						

TABLE 1.3 GOM Major Asset Inventory Sorted by Water Depth - Continued

Platform Location	Type	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
ST 308 A (Tarantula)	FP	484					
WC 661 A	FP	484	730	2,700	4	leg	
SMI 205 B	FP	523	668	5,080	4	4-72" & 4-48"	leg-skirt
SP 52 A	FP	531				3-skirt	72"
GB 72 A	FP	541					
GB 142 A	FP	542	533	925	0	3-Skirt	3 - 72"
EW 910 A	FP	549					
MC 486 A	FP	582					
GC 52 A	FP	604					
GC 52 CCP	FP	604					
MC 365 A – Corral	FP	619	1,124	5,910	4		4+4
GC 6 A	FP	620	2,000	17,000		Skirt	8
MC 148 A	FP	651			4		4+12
EB 110 A – Tequila	FP	660	848	9,999	8		8+4
MC 21 B – Simba	FP	667	1,197	9,025	4		4+8
GC 89 A – Cinnamon	FP	670	3,261	6,000	3		3+4
VK 817 A	FP	671					
GB 236 A	FP	682	8,100	13,228	8		8+12
GB 172 B – Salsa	FP	693	2,245	10,000	4	Skirt	8
GB 128 A – Enchilada	FP	705	3,850		4	Skirt	8
GB 189 - Tick	FP	718	2,000	11,023	4		4+8
GB 191 A	FP	721	1,800	8,500	4		4+8
VK 780 A - Spirit	FP	721		19,012			
GC 19 A - Boxer	FP	751	6,500	14,881			
GC 18 A	FP	761	5,200	16,755	4		4+16
EW 873 - Lobster	FP	774	4,500	16,535		Skirt	12
EB 165 - Snapper	FP	863	4,330	20,503	8		8+12
EB 159 - Cerveza Ligera	FP	925	7,400	14,991	4		4+8
EB 160 - Cerveza	FP	935	1,798	26,000	8		8+16
VK 823 A – Virgo	FP	971		25,166			
MC 280 – Lena - CT	FP	997	1,004	23,366			
MC 194 A - Cognac	FP	1027	23,000	59,000	12	Skirt	24 84"
MC 109 A - Amberjack	FP	1100	3,261	23,810	6		6+12
VK 989 A - Pompano	FP	1289	4,800	39,890	4	Skirt	12
GC 65 A - Bullwinkle	FP	1348	2,300	54,427	12		12+32
EW 1003 A – Prince	MTLP	1500	3,450		8	24" OD	
GB 260 – Baldplate - CT	FP	1647	2,400	57,267	4	Skirt	12 84"
EW 921 A – Morpeth	MTLP	1700	3,000	2,850		steel tubular	84" Driven piles
VK 786 A – Petronius – CT	FP	1754	7,850	43,000	12	Skirt	12 Piles
GC 184 A – Jolliet	TLP	1760	2,150	4,600			
VK 826 A – Neptune Spar	ClaS	1930	3,300	12,885	6	Chain-wire	48"OD Piles
GB 388 A - Cooper	SEMI	2097					
MC 582 A - Medusa	TS	2223	6,000	12,900			
TYPE DESCRIPTION							
Fixed Platforms	FP						
Classic Spar	ClaS						
Truss Spar	TS						
Cell Spar	CellS						
MiniDOC Spar	M/DocS						
Mini TLP	mtlp						
Tension Leg Platform	TLP						
Floating Production Storage	FPS						
Semi Submersable	SEMI						

TABLE 1.3 GOM Major Asset Inventory Sorted by Water Depth - Continued

Platform Location	Type	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile Tendons Legs	Pile / Tendon type	Pile type
GC 205 A – Genesis	ClaS	2590	12,500	28,700	14	5.25in. Chain-wire-chain	8' OD Anchor
MC 243 A – Matterhorn	MTLP	2850	5,500	4,500	6	32" neutrally buoyant steel tubular tendons	96" piles
GB 426 A – Auger	TLP	2860	24,000	39,000	8	5-3/16" chain and 5" wire, 2 subm buoys	8 30t fluke
MC 807 A Mars	TLP	2933	7,200	15,650	12	28"ODX1.25"Wall	84"OD Piles
MC 711 A – Gomez	SEMI	3000					
GB 668 A – Gunnison	TS	3150	6,000	14,800			
VK 956 A – Ram Powell	TLP	3216	8,100	11,000	12	28"ODX1.2"Wall	84"OD Piles
VK 915 A – Marlin	TLP	3236	5,512	9,000			
GC 254 A – Allegheny	MTLP	3294	3,000	2,850			
GC 158 A – Brutus	TLP	3300	11,500	14,500	12	32"ODX1.25"Wall	82"OD Piles
GC 338 A – Front Runner	TS	3330	6,300	14,100	9	Chain-wire-chain	
EB 643 A – Boomvang	TS	3650	5,400	11,960	9		9 Piles
EB 602 A – Nansen	TS	3675	5,340	11,960	9		9 Piles
MC 809 A – Ursa	TLP	3800	22,400	28,600	16	32"ODX1.5"Wall	96"OD Piles
GC 641 A – Tahiti	TS	4000	9,950	24,000			
MC 942 A - Mirage	M/DocS	4000	10,021	17,938			
GC 613 A – Neptune TLP	MTLP	4232	3,200	5,900	6	36"ODX1.36"Wall	96"OD Piles
GC 608 A – Marco Polo	TLP	4300	7,250	5,750	8	28"ODX1.25"Wall wire-chain	76"OD Piles
GC 645 A – Holstein	TS	4340	18,200	35,550	16	Chain-wire-chain	Suction
GC 653 A – Shenzi	MTLP	4375	8,684	12,493	8	36" to 44"	
GC 782 A – Mad Dog	TS	4420	10,500	20,800	11	polyester lines	Suction
AT 63 A - Telemark (@MC942)	M/DocS	4450	10,021	17,938			
GB 783 A – Magnolia	TLP	4670	7,600	20,000	8	Chain-5" wire	fluke anchors
AC 25 A – Hoover	ClaS	4825	17,210	35,831	12	Chain-wire-chain	Suction
GC 680 A – Constitution	TS	4970	10,770	14,800			
GB 876 A – Red Hawk	CellS	5300	3,600	7,500	6	chain polyester lines	18' suction
MC 127 A – Horn Mountain	TS	5400	8,200	6,200	9	Chain-wire-chain	
MC 773 A – Devils Tower	TS	5610	9,465	13,188	9	Chain-5-7/8" wire Chain	Suction
MC 734 A - Thunder Hawk	SEMI	5724					
MC 778 A – Thunder Horse	SEMI	6200	50,000	60,000	16	chain wire	Suction
MC 474 A – Na Kika FPDS	SEMI	6378	20,000	20,000	16	Chain-wire-chain Catenary	Suction
MC 650 A – Blind Faith	SEMI	6480	7,400				
GC 787 A – Atlantis	SEMI	7050	14,125	58,700		Chain-wire-chain	Suction
AC 857 A – Perdido	TS	7817	12,401	20,956	9	5.28" Chain & 9.68" polyster lines 2 Mi. each & Chain	18' OD Suction
MC 920 A – Independence	SEMI	8000	10,250		12	9" Rope	
TYPE DESCRIPTION							
Fixed Platforms	FP						
Classic Spar	ClaS						
Truss Spar	TS						
Cell Spar	CellS						
MiniDOC Spar	M/DocS						
Mini TLP	mtlp						
Tension Leg Platform	TLP						
Floating Production Storage	FPS						
Semi Submersable	SEMI						

1.4 GOM Major Asset Inventory Preliminary Grouping

The inventory was separated into similar platforms types, similar deck and jacket / hull tonnage, similar water depths and a representative platform was selected from each group as shown in Table 1.4. As noted above, some of the data was not available for this study. Fixed Platforms were further divided into preliminary groups considering the number of leg, piles, skirt piles and tonnage. Where more data was available, the grouping was more precise. Where data was unavailable, water depth was used. The platforms listed in **Bold Red** are the platforms selected as representative platforms. These platforms were selected on the basis of the best available information. See Executive Summary for MMS recommendations on collection of data. Because much of the platform data was unavailable for this study and the resulting groupings are preliminary, an alternate breakdown in platform decommission costs is provided in Section 4 along with the estimated costs for conductor removal, riser removal, pipeline abandonment and well P&A. Estimates are provided in Section 5, for the representative platforms.

TABLE 1.4 Platforms Grouped by Similar Characteristics – Facility Type, Water Depth

Platform Location	Type	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile or Tendon type	Pile type
Fixed Platforms						
EI 371 B	FP	415				
SS 358 A	FP	419				
MP 288 A	FP	420				
VR 395 A	FP	420				
SP 89 MC674 #3	FP	422				
MC 311 A	FP	428				
HI A 371 A	FP	430				
EI 384 A	FP	431				
SMI 205 A	FP	437	1,400	4,120	4-skirt	48"
SS 332 A	FP	438				
SS 332 B	FP	438				
SP 93 A	FP	446				
SP 93 B	FP	450				
ST 317 A	FP	460				
SS 354 A	FP	464				
VR 412 A	FP	467				
HI A 589 A	FP	477				
MC 63 B	FP	480				
EI 397 A	FP	472			leg	48"
HI A 582 D (CYRUS)	FP	440				48"
ST 316 A	FP	447			leg	48"
ST 308 A (Tarantula)	FP	484			leg	48"
WC 661 A	FP	484	730	2,700	leg	66"
SP 52 A	FP	531			3-skirt	72"
GB 142 A	FP	542	533	925	3-Skirt	3 - 72"
HI A 389 A	FP	410	900	3,670		48"
EI 372 A PRO	FP	414	950	3,972		48"
WC 645A	FP	432	850	1,100	leg	
SP 49 C	FP	400	638	4,400	1-96" & 4-84"	4-skirt
SP 83 A	FP	467	892	4,279	4-83" skirt	
EC 381 A	FP	446	1,020	4,000	4-48" & 4-92"	48"
MC 397 Alabaster	FP	476	1,290		4-72" & 4-72"	leg-skirt
EW 947 A	FP	477			4-48" & 4-54"	leg-skirt
SMI 205 B	FP	523	668	5,080	4-72" & 4-48"	leg-skirt
GB 72 A	FP	541				
EW 910 A	FP	549				
MC 486 A	FP	582				
GC 52 A	FP	604			4	
MC 365 A – Corral	FP	619	1,124	5,910	4	
GC 89 A – Cinnamon	FP	670	3,261	6,000	3	
VK 817 A	FP	671				
GC 6 A	FP	620	2,000	17,000	4	Skirt
MC 148 A	FP	651			4	
MC 21 B – Simba	FP	667	1,197	9,025	4	

TABLE 1.4 Platforms Grouped by Similar Characteristics – Facility Type, Water Depth - Continued

Platform Location	Type	Water Depth (ft)	Deck Weight (st)	Jacket Weight (st)	Pile or Tendon type	Pile type
Fixed Platforms						
MC 20 A	FP	480	1,845	8,600	8	48"
SP 89 B	FP	456	900	5,447	8-48" & 4-60"	leg-skirt
EW 826 A	FP	483	3,850	10,200	72"	leg-skirt
GC 52 CCP	FP	604			8	
EB 110 A – Tequila	FP	660	848	9,999	8	
GB 236 A	FP	682	8,100	13,228	8	
EW 873 - Lobster	FP	774	5,400	16,535	8	Skirt
GB 172 B – Salsa	FP	693	2,245	10,000	4	Skirt
GB 128 A – Enchilada	FP	705	3,850		4	Skirt
GB 189 - Tick	FP	718	2,000	11,023	4	
GB 191 A	FP	721	1,800	8,500	4	
GC 19 A - Boxer	FP	751	6,500	14,881		
GC 18 A	FP	761	5,200	16,755	4	Skirt
EB 159 - Cerveza Ligera	FP	925	7,400	14,991	4	
MC 280 – Lena - CT Guied	FP	997	1,004	23,366	4	
EB 165 - Snapper	FP	863	4,330	20,503	8	
EB 160 - Cerveza	FP	935	1,798	26,000	8	
MC 109 A - Amberjack	FP	1027	3,261	23,810	6	
VK 780 A - Spirit	FP	1036		19,012		
VK 823 A – Virgo	FP	1130		25,166		
VK 989 A - Pompano	FP	1289	4,800	39,890	4	Skirt
MC 194 A - Cognac	FP	1027	23,000	59,000	12	Skirt
GC 65 A - Bullwinkle	FP	1348		54,427	12	
GB 260 – Baldplate - CT	FP	1647	2,400	57,267	4	Skirt
VK 786 A – Petronius – CT	FP	1754	7,850	43,000		Skirt

TABLE 1.4 Platforms Grouped by Similar Characteristics – Facility Type, Water Depth - Continued

SPAR	ClaS	Water Depth (ft)	Deck Weight (st)	Hull Weight (st)	Tendons	
VK 826 A – Neptune Spar	ClaS	1930	6,000	12,885	6	Chain-wire
MC 582 A - Medusa	TS	2223	6,000	12,900		
GC 205 A – Genesis	ClaS	2590	12,500	28,700	14	5.25in. Chain-wire-chain
GB 668 A – Gunnison	TS	3150	6,000	14,800		
GC 338 A – Front Runner	TS	3330	6,300	14,100	9	Chain-wire-chain
EB 643 A – Boomvang	TS	3650	5,400	11,960	9	
EB 602 A – Nansen	TS	3675	5,340	11,960	9	
GC 641 A – Tahiti	TS	4000	9,950	24,000		
MC 942 A - Mirage	M/DocS	4000	10,021	17,938		
GC 645 a – Holstein	TS	4340	18,200	35,550	16	Chain-wire-chain
GC 782 A – Mad Dog	TS	4420	10,500	20,800	11	polyster lines
AT 63 A - Telemark (@MC942)	M/DocS	4450	10,021	17,938		
AC 25 A – Hoover	ClaS	4825	17,210	35,831	12	Chain-wire-chain
GC 680 A – Constitution	TS	4970	10,770	14,800		
GB 876 A – Red Hawk	CellS	5300	3,600	7,500	6	chain polyster lines
MC 127 A – Horn Mountain	TS	5400	8,200	6,200		
MC 773 A – Devils Tower	TS	5610	9,465	13,188	9	Chain-5-7/8" wire Chain
AC 857 A – Perdido	TS	7817	12,401	20,956	9	5.28" Chain & 9.68" polyster lines & Chain

MTLP		Water Depth (ft)	Deck Weight (st)	Hull Weight (st)	Tendons	Pile type
EW 921 A – Morpeth	MTLP	1700	3,000	2,850		steel tubular
EW 1003 A – Prince	MTLP	1500	3,450		8	
GC 254 A – Allegheny	MTLP	3294	3,000	2,850		
GC 613 A – Neptune TLP	MTLP	4232	3,200	5,900	6	36"ODX1.36"Wall
MC 243 A – Matterhorn	MTLP	2850	5,500	4,500	6	32" neutrally buoyant steel tubular tendons
GC 653 A – Shenzi	MTLP	4375	8,684	12,493	8	36" to 44"

TLP		Water Depth (ft)	Deck Weight (st)	Hull Weight (st)	Tendons	Pile type
GC 184 A – Jolliet	TLP	1760	2,150	4,600		
GB 426 A – Auger	TLP	2860	24,000	39,000	8	5-3/16" chain and 5" wire, 2 subm buoys
MC 807 A Mars	TLP	2933	7,200	15,650	12	28"ODX1.25"Wall
VK 956 A – Ram Powell	TLP	3216	8,100	11,000	12	28"ODX1.2"Wall
VK 915 A – Marlin	TLP	3236	5,512	9,000		
GC 158 A – Brutus	TLP	3300	11,500	14,500	12	32"ODX1.25"Wall
MC 809 A – Ursa	TLP	3800	22,400	28,600	16	32"ODX1.5"Wall
GC 608 A – Marco Polo	TLP	4300	7,250	5,750	8	28"ODX1.25"Wall wire-chain
GB 783 A – Magnolia	TLP	4670	7,600	20,000	8	Chain-5" wire

TABLE 1.4 Platforms Grouped by Similar Characteristics – Facility Type, Water Depth - Continued

SEMI	SEMI	**Water Depth (ft)**	**Deck Weight (st)**	**Hull Weight (st)**	**Tendons**	
GB 388 A - Cooper	*SEMI*	*2097*				
MC 711 A – Gomez	SEMI	3000				
MC 734 A - Thunder Hawk	SEMI	5724				
MC 778 A – Thunder Horse	SEMI	6200	50,000	60,000	16	chain wire
MC 474 A – Na Kika FPDS	SEMI	6378	20,000	20,000	16	Chain-wire-chain Catenary
MC 650 A – Blind Faith	SEMI	6480	7,400			
GC 787 A – Atlantis	SEMI	7050	14,125	58,700		Chain-wire-chain
MC 920 A – Independence	SEMI	8000	10,250		12	9" Rope

Section 2 –
METHODOLOGY, TECHNOLOGY & INFRASTRUCTURE ASSESSMENT

This section covers the following three areas:

- Provide an overview of the decommissioning methodology including the major tasks and resource requirements.
- Evaluate the technology available to conduct these decommissioning activities.
- Determine the areas where the current technology and resources will be most challenged.

To date, other than a few structures all decommissioning activities in the GOM have been on fixed jacketed structures in water depths <400 feet. As decommissioning activities move into deeper water and to tensioned and moored structures some of the current technology may prove to need modification or may prove inadequate. This section will focus the mature areas of development and present emerging developments.

For fixed structures, three removal alternatives were considered for each deepwater facility; Complete Removal, Partial Removal, and Reefing. The alternatives studied vary only in the method the jacket is removed. Site Clearance and Onshore Disposal depend on the removal alternative selected. The platform removal preparation, well plugging and abandonment (P&A), pipeline decommissioning, and topsides removal are the same for all three alternatives.

For tensioned and moored structures the complete removal options was considered except for subsea structures. See recommendation in the Executive Summary.

See Appendix section 5.7 for decommissioning methodology utilized for shallow water platform removals.

2.1 Decommissioning Work Activities

The project management/engineering component of a decommissioning program consists of the following phases:

- Decommissioning Planning
- Decommissioning Engineering
- Permitting
- Bidding
- Pre-job Meetings
- Offshore Work
- Project Closure

2.1.1 Decommissioning Planning

This is the initial phase of the decommissioning project. All information available for each platform to be decommissioned (structural drawings, installation records, process flow diagrams, pipeline maps, etc.) is first gathered and reviewed. Based on the information retrieved, an Approval for Expenditure (AFE) for each platform will be developed and submitted to the platform owner for approval. In cases where multiple platforms are to be decommissioned, this AFE will consider grouping the platforms to realize any economies of scale, and various types of removal scenarios (i.e., Complete Removal, Partial Removal, and Remote Reefing) are evaluated. In some instances different operators will join together to share the same deepwater equipment for a multiple platform decommissioning program. All assumptions made are noted on the AFE(s). Concurrently, a detailed project schedule is developed.

After the AFE(s) are approved, the platform(s) are inspected above and under water to appraise the overall platform condition, drilling and production deck dimensions, equipment location, padeyes, risers, etc. A detailed inspection punch list is submitted to and agreed upon with the platform owner prior to these inspections.

PROSERV recommends a pre-contracting underwater survey of the jacket and seafloor for larger and older platforms. The dive crew would survey the sea floor for debris that would hamper the platform removal and inspect the jacket for flooded and/or damaged members and conductors that are severed below the waterline.

For conventional steel-jacket platforms located in shallow depths in the Gulf of Mexico, PROSERV recommends a six-month lead-time for decommissioning planning. However, deepwater decommissioning planning requires a longer lead-time because of the limited availability of deepwater removal equipment. Therefore, a minimum of two years lead-time is recommended for planning the decommissioning of deepwater platforms. For complete removal, equipment contracting alone will require one to two years lead time, or more.

2.1.2 Decommissioning Engineering

Deck and jacket actual weights, the center of gravity, and the center of buoyancy are needed for the platforms and major subsea equipment. A lift analysis is developed by a structural engineer; all calculations are reviewed and approved by the project manager.

Additionally pipeline operators of connecting pipelines will be contacted to coordinate pipeline decommissioning activities.

2.1.3 Permitting

Permits required by the MMS for the decommissioning of offshore structures are as follows:
- Well P&A Sundry Notices and Procedures
- Pipeline Abandonment Permits
- Platform Removal Permits
- Reefing Permits (if applicable)
- Incidental Take Statement
- Site Clearance Verification Procedures

Each platform, well, and pipeline will require their specific permits. The project management group prepares all permits, along with any necessary attachments. The permit requests are submitted to the platform owner for review and approval. Once approved, the project management group submits the requisite number of copies to the appropriate MMS office for approval and issuance of permits.

2.1.4 Bidding

The client and the project management group work together to determine the manner by which bids will be developed to take advantage of the amount of work to maximize economies of scale.

The project management group prepares a suggested list of qualified contractors for each phase of the job; the platform owner then reviews, revises (if necessary) and approves the list. The bid books are prepared by the project management group and are submitted to the owner for approval. Once approved, the approved contractors are sent the Requests for Quotation (RFQs).

Proposals submitted based on these RFQs are reviewed by the project management group who develops a spreadsheet containing all contractors' rates. This spreadsheet, along with a recommendation for award, is sent to the platform owner for review and award of the work.

2.1.5 Pre-job Meetings

Prior to commencing any offshore work, pre-job meetings are conducted with each contractor, the project management group, and the platform owner's representatives. The goal of these meetings is to establish that all parties involved understand the Scope of Work, operational and safety procedures, reporting requirements, etc. The project management group is responsible for coordinating these meetings by contacting the parties involved, setting the time and location of the meeting, preparing the meeting agenda, and recording and distributing meeting notes.

2.1.6 Offshore Work

Members of the project management group can act as representatives for the platform owner during decommissioning operations. They select the proper mix of offshore supervisors (i.e., HLV supervisors, inspectors, diving superintendents, remotely operated vehicle (ROV) operators, intervention vessels supervisors, etc.) who will witness the offshore operations and report all activities to the project management group and the platform owner.

Platform Removal Preparation

An inspection of the platform is made, above and below water, to determine the condition of the platform and identify potential problems with the salvage. Depending on the water depth, divers or an ROV perform the underwater portion of the inspection.

All decommissioning work that can be performed prior to the arrival of the HLV is completed during the Platform Removal Preparation phase. All personnel and equipment are mobilized and housed in the existing platform quarters.

The crew flushes and cleans all facility piping and equipment that contained hydrocarbons. All modules to be removed separately from the deck are cut loose using oxygen-acetylene torches.

The piping, electrical, and instrumentation interconnections between modules are also cut. All work needed to prepare the modules for lifting, such as installing lifting eyes, etc., is done at this time.

Well Plugging and Abandonment (Well P&A)

PROSERV has assumed that all wells on each platform will be plugged and abandoned using either conventional rig-based P&A methods or using rigless techniques prior to cutting and removing the conductors. Platform well and subsea well P&A is presented in Section 4.

Pipeline Decommissioning

All pipelines connected to the platform are decommissioned. The decommissioning crew flushes the line by pumping (pushing) a cleaning plug (pig) through the line with seawater. Flush water is treated and injected downhole or discharged. Divers or an ROV will then expose the ends of the pipeline and cut the line above the riser bends or subsea manifolds and approximately ten feet out from the base of the jacket or at the seafloor below the tensioned or moored structure. For the pipeline at the base of the jacket, the cut section of the pipeline is removed and the pipeline is plugged and buried three feet below the mudline. For pipelines associated with tensioned and moored structures, the riser would be removed prior to the structure removal.

Conductor Removal

All conductors are completely removed up to 15 feet below the mudline. A combination of jacks and the platform's drilling ring and crane are used to pull the conductors. This work should be completed prior to the arrival of the heavy lift vessel (HLV). Removing conductors with jacks and a drilling rig generally follows the same methodology as removing conductors with jacks and a bullfrog crane. The jacks onboard may not be able to pull the combined weight if the conductor is grouted. The conductor is pulled upward until a 40-foot section is exposed. The rig is used until the jacks can pull the weight of the entire conductor. The conductor is cut using external mechanical cutters. The cut section is then removed by the drilling rig or platform crane and placed on the deck. The platform crane places the cut section on a workboat, cargo barge or on the deck away from the work area. This procedure (rig up, jack upward, cut and remove) is repeated until the entire conductor is removed.

Cargo Barge Mobilization

Cargo barges are outfitted at a fabrication yard with steel load spreaders to support the point loads of the recovered jacket, subsea equipment and/or deck. A tugboat tows each cargo barge to the offshore location.

Setting up the Heavy Lift Vessel

Deepwater decommissioning projects in less than 1,000 feet of water will utilize either a moored vessel or a dynamically positioned heavy lift vessel (HLV). Anchor-handling tugboats will set up the anchoring system for a moored HLV. This anchoring system holds the HLV in position during the platform removal process. The HLV's anchoring system consists of eight anchors, each connected to a mooring winch by a cable. Each anchor is equipped with a pendant wire that is long enough to reach from the seabed to the surface, where it is supported by a buoy. The anchor-handling tug picks up the anchors by securing the pendant wire and winching up the anchor. The anchor-handling tug then carries the anchor to the pre-established location. This process is repeated for each of the HLV's anchors. Pre-mooring piles may be installed at predetermined locations to prevent any unnecessary damage (anchor scars) to the seabed. Dynamically positioned HLVs are self propelled station keeping vessels and do not require assistance to remain on station.

Removing Deck and Modules

Topsides removal follows the installation process in reverse sequence. Some deck removals will require that modules are removed and placed on a cargo barge. The module is secured by welding pieces of steel pipe (or plate) from the module to the deck of the cargo barge. The deck section or support frames (cap trusses) are then removed by cutting the welded connections between the piles and the deck legs with oxygen-acetylene torches. All decks/cap trusses are removed in the same configuration as they were installed. Slings are attached to the deck/cap truss lifting eyes and to the HLV crane. The HLV's crane lifts the deck sections from the jacket. The deck is then seated in the load spreaders and secured by welding steel pipe from the deck legs to the deck of the cargo barge.

Disposing of Deck and Modules

The cargo barge transports the deck and modules to a Texas or Louisiana scrap yard. The modules may be lifted with cranes or skidded off the barge to the yard. Finally, the deck is skidded off the barge to the yard. All of the structural components and modules are cut into small pieces and disposed of as scrap unless the deck will be reused. The production equipment is salvaged for reuse whenever possible. See Section 3 for more details on disposal options.

Jacket / Hull Removal

Tensioned and moored structures are removed completely in similar methods and are presented in Section 3. Tensioned or moored structures are not candidates for partial removal. Spars could be considered for reefing removal. As ships are sunk off the Florida coast, other tensioned or moored hulls could be considered for reefing.

The alternatives studied by PROSERV vary only in the method the jacket is removed. The platform removal preparation, well P&A, pipeline decommissioning, and topsides removal are the same for all alternatives. The following explains the alternatives selected – Complete Removal, Partial Removal, and Remote Reefing.

Complete Removal Fixed Structures

The majority of GOM jackets are removed with explosives although non explosive removal techniques are now common.

When explosives are used during a platform removal, regulations require an observation for resident marine mammals prior to the detonation of explosive charges. Details on these requirements are listed in the Appendix section 5.6. It is recommended that the observation be conducted and completed prior to the HLV arrival.

Explosives are placed in the main pile and skirt piles at least 15 ft below the mudline. If the mud plug inside the piles is not deep enough to allow the explosive charge to be placed at the required depth, the mud plug is jet/air lifted.

A pre-blast aerial survey is conducted immediately prior to the explosive detonation. This survey is performed using a helicopter with a National Marine Fisheries Service (NMFS) observer onboard. This survey is to determine if there are marine mammals in the area. If marine mammals are found to near the platform, the explosive detonation is delayed. The detonation delay will last until the marine mammals are safely out of the area. Once the marine mammals have moved beyond the platform, the explosives are detonated and a post-blast aerial survey is conducted.

The jacket is then made buoyant to reduce the bottom weight. To maximize buoyancy, the water inside each pile is evacuated. Closure plates are then welded on the top of the piles. After the plates are installed, the water is evacuated from the legs using compressed air. A hose from an air compressor is connected to a valve on a closure plate welded to the top of each pile. The valve is opened and compressed air is forced into the piles. As the air pressure inside the pile increased, the water is forced out of the pile at the point where the pile was severed by the explosive charge. When all of the water is evacuated, air bubbles appear on the surface of the water near the jacket.

After deballasting the jacket, it is lifted off the sea floor by the HLV. The jacket will be loaded on a cargo barge if possible.

If the jacket is too large for loading on a cargo barge, the jacket will be towed to shallow water. The jacket is supported by the HLV's crane and swung to the stern of the HLV. Rope hawsers are passed around two of the jacket legs and secured to the stern of the HLV. The jacket is then boomed away from the stern of the HLV until the hawsers are tight. The rope hawsers keep the jacket from swinging and being pulled out of the boom radius by its movement through the water. The HLV's anchors are shifted and the jacket is towed to shallower water.

At the new location, the jacket is ballasted and set on the sea floor. The water depth at the new location is such that the horizontal elevation to be cut is several feet above the water. Welders set up scaffolds around the jacket legs and begin cutting the jacket legs. Additionally, the jacket is cut in half vertically to create two 4-leg sections. The diagonal braces running between each set of rows are also cut.

After the legs and piles have been cut and the diagonal braces removed, the jacket section is rigged, lifted, removed, and sea-fastened on a cargo barge. For an eight-leg jacket, two four-leg sections are removed at the bottom elevations. The cargo barge is then sent to the onshore disposal yard.

At times, the jacket is severed at each horizontal elevation because of its dimensions. The procedure mentioned above is repeated until the jacket is completely removed and placed on cargo barges. The jacket is deballasted, picked up, towed to shallower water, set, cut in two (vertically), and removed in sections. Each time the jacket is moved, the HLV's anchors are repositioned.

Partial Removal Fixed Structures

This scenario involves removing only the top section of the jacket. This section of the jacket will either be transported to shore for disposal or reefed in place or at an approved reef location.

Reefing the jacket on site for an eight-pile platform involves cutting the top portion of the jacket into two four-pile sections. All cuts are performed before the vessel (a large tug, approximately 12,000 hp) arrives on site to minimize the amount of time the tug is used. Additionally, rigging is setup in advance of the tugs arrival and is designed to release once the jacket section topples over.

After the jacket is segmented (braces cut) and jacket legs are severed (using either non explosive cutting methods [i.e., mechanical, abrasive, or diamond wire]), the tug arrives on site and hooks up its tow line to a sling attached to one of the jacket sections. The tug then pulls this section over, and it falls to the sea floor. This process is repeated for the other section.

Reefing Fixed Structures

After removing the topsides, the explosives are prepared and installed. Explosives are placed in the main pile and skirt piles at 15 ft below the mudline. If the mud plug inside the piles is not deep enough to allow the explosive charge to be placed at the required depth, the mud plug is jet/air lifted.

A pre-blast aerial survey is conducted just prior to the explosive detonation. This survey is performed using a helicopter with a National Marine Fisheries Service (NMFS) observer onboard. The explosives are detonated and a post-blast aerial survey is conducted. The HLV is demobilized at this time.

The jacket is then made buoyant to reduce the bottom weight. To maximize buoyancy, the water inside the piles is evacuated. Closure plates are welded on the top of each pile. After installing the plates, the water is evacuated from the legs using compressed air. A hose from an air compressor is connected to a valve on a closure plate welded to the top of the pile. The valve is opened and compressed air is forced into the piles. As the air pressure inside the pile is increased, the water is forced out of the pile at the point where the pile was severed by the explosive charge. When all of the water is evacuated, air bubbles appear on the surface of the water near the jacket.

Pull tugs tow the jacket to a designated remote reef site.

At the site, the jacket is lowered by ballasting the piles and the base is set on the sea floor. The jacket is left on its side at the reef location, and a marker buoy is placed on location above the jacket.

2.1.7 Project Closure

Site Clearance

This is the last task in the offshore decommissioning process. This procedure is divided into three phases: Surveying the work area (Reconnaissance), Inspecting and Cleaning Up the work area (Assessment/Remediation), and Re Inspecting the work area (Verification).

The Reconnaissance phase is generally performed before the decommissioning work begins and after the platform is removed. In each case, the procedures used to survey the area for debris are the same. A work boat carrying a survey crew with side scan sonar surveys the area to be cleared (work area) for potential obstructions 0.5 m or larger. From the center point of the work area, the workboat surveys a 1.5-mile radius in lines running from north to south and east to west. Spacing between the survey lines is generally 75 feet and swath coverage is 200%.

After the platforms are removed, the work site is re-surveyed to identify any debris that resulted from the decommissioning of the platform. The survey results are then compared with the pre-decommissioning survey. Any hit identified to be 0.5 m or larger is recorded and will be removed during the second phase.

The platform water depths should not restrict the use of the side scan sonar (SSS). At deeper depths, the cable controlling the SSS is made longer to allow it to be as close to the sea bed as necessary. Other bottom survey equipment such as a Mesotech or Magnetomer is available but is limited and may not be as effective as a SSS.

Mesotech can only survey a radius of 20 meters. This makes it unpractical to use because of the large areas to survey. The Magnetomer has a larger survey area but is limited to identifying only metal. Other non-metal debris will not be identified.

After the work area has been surveyed and the targets to be removed are identified. A dive boat with an ROV and/or dive crew is sent to assess the target and clean up the area. The debris is picked up either by divers or ROVs. Duration for this process will vary depending on the number of targets identified. In the Gulf of Mexico, generally older platforms have more targets that are identified and removed.

The Partial Removal and Remote Reefing alternatives require the location where the platform was installed to be surveyed, cleaned and verified. Since the platform is partially removed, site clearance and verification is required only in the 1.5-mile radius from the platform. This ensures the removal of any debris that may have fallen from the platform throughout the years.

The Complete Removal Scenario requires surveying, cleaning and trawling at each location the platform is set and cut. Each time the jacket is set on the bottom the jacket is cut and there is potential for debris to fall.

Project Closure

Each decommissioning phase requires a report be submitted to the MMS. These reports are submitted to the platform owner for review and approval. Once approved, the project management group submits the reports to the appropriate MMS office.

2.2 Decommissioning Technology

Introduction

This section reviews the different cutting methodologies considered in this study. PROSERV reviewed cutting techniques considered effective and applicable to offshore platform decommissioning. For any cutting technique to be effective, it must be:

- Safe
- Reliable
- Repeatable
- Flexible and adaptable under field conditions
- Environmentally sensitive
- Economical

The cutting techniques considered are grouped into two general categories: explosive and non-explosive. Available explosive methods are bulk charges, configured bulk charges, and shaped charges. Current non-explosive methods applicable to this study include diamond wire, guillotine saws, mechanical cutters, and abrasive slurry cutters. Non explosive methods are discussed in section 2.2.2.

2.2.1 Explosive Methods

Explosives have been used in deepwater facility projects. Remotely operated vehicles (ROVs), dynamically positioned vessels, wire line units, and detonation of multiple charges with delays enhance the effectiveness of explosives.

One example of new cutting technology is Halliburton's work [5] to develop novel cutting techniques which significantly reduces the quantity of explosive material required for certain cutting situations, particularly thicker wall tubular members. Proof of principle tests of internal and external cutting methods have been conducted at Jet Research Center in Alvarado, Texas, and Halliburton is now working toward the next stage of large-scale pilot testing.

Figure 2.1 Template removal – Explosives
(Photo courtesy of Demex International)

When discussing the use of explosives relative to deepwater platforms, a primary consideration is the final disposition of the platform. Present options for the disposal of these deepwater platforms include total removal, partial removal, remote reefing, or reuse of the structure. Additionally, the equipment used to perform the removal dictates explosive usage options. These operational considerations should be established before a specific course of action involving explosives is finalized. Government restrictions involving explosive usage offshore must also be addressed before final operating procedures are established.

The Gulf of Mexico has been the worldwide proving ground for platform removals. Figure 2.2 below details the type of platform removal techniques utilized for all removals during 1995 to 2005. The majority of the removals (67%) used explosives.

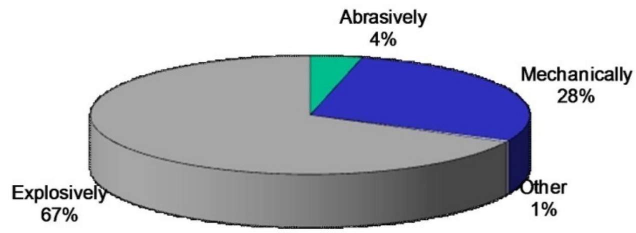


Figure 2.2 Distribution of GOM Platform Severing Techniques 1995 -2005

Explosives are widely used to decommission platforms because they are safe, reliable, and cost effective. The use of explosives reduces the amount of time divers are used during the cutting process, thereby minimizing human risk. Additionally, the cost of severing piles and conductors is generally less than 1% of the total platform removal cost. [6] Time is the driving cost factor when discussing severance; delays in vessel spreads are the primary reason for cost overruns. A failure in the complete severance of a pile or conductor is usually charged to the owner of the platform. These costs can be enormous, as time and material rates for large crane vessels can exceed $500,000 dollars per day.

Explosive Charge Types

Bulk Charges

Bulk charges are a single mass of explosive material detonated at a single point. The energy release from this type of charge is not well directed. Rather, bulk charges rely on the “brute strength” of the explosive to overcome the target material by a shattering and tearing effect.

Bulk charges are cylindrical in design. These charges vary in length and diameter to achieve the best fit for a wide range of typical offshore tubulars. Charge diameters range in size from 4” to 12”.

Smaller bulk charges can be arranged to create a larger diameter. This technique allows the technician to configure the cast explosive material for whatever conditions may arise. For instance, in some cases it might be advisable to use smaller charges in a circular ring configuration to maximize the explosive concentration and proximity to the target material as shown.

Double-Detonation Bulk Charges

The use of a double-detonation bulk charge creates more "cutting power" pound-for-pound than an ordinary bulk charge. Double detonating the bulk charge is accomplished by using instant non-electric detonators at opposite ends of the charge. This detonation creates a confluence of energy at the center of the charge, which is dissipated radially outward directly perpendicular into the target material. It is this directing of explosive energy that makes double-detonating bulk charges more effective.

Shock Wave Enhancement/Centralizing Devices

The shock wave enhancement (SWED) device combines the best features of bulk charges with the added benefit of extreme confinement. Centralizers are used to distribute the explosive energy evenly throughout the target area. Using increased confinement, multiple-point detonation, and the actual water inside of the tubular to direct energy; this device is the most reliable bulk explosive severance device available to date. The energy released by a bulk charge can be enhanced by the use of tamping or confinement. A bulk charge is used with a metal and/or concrete plug above the charge. The addition of this tamping increases the duration of the impulse that is released by the explosive towards the target material.

Shaped Charges

The most efficient use of explosives for severing is the shaped charge. The shaped charge uses the energy produced by the detonation to drive a liner at high velocity at the target. The liner striking it at this accelerated velocity then cuts the target.

Shaped charges have a multitude of manufacturing and design criteria that can drastically affect performance. The design criterion for shaped charges also requires knowledge of target specifications. Manufacturing of shaped charges can take many weeks and can cost five times as much as conventional bulk charges.

The various types of shaped charges are listed below.

Rotationally Symmetric (Conical)

This type of charge produces the greatest penetration of all shaped charges due to the 360 degrees of radial convergence forming the jet. Variation in the conical liner angle will result in varying properties of the jet. A small angle will produce a very small, deeply penetrating jet, while a large angle will produce a larger hole with shallower penetration.

Linear Charge

A *running* linear charge is a roof-shaped liner of a given length used to cut plates or sheets of metals or other materials. The horizontal velocity of the detonation contributes to penetrating effectiveness. It normally comes sheathed in lead in a coil form. Its length is limitless.

A simple cutting charge (or *non-running* linear charge) has a roof-shaped liner two- to three-times the liner width. The horizontal detonation velocity decreases the cutting effectiveness in this configuration. This charge would have much more explosive above the liner for the increased power required to cut and to provide a more uniform (flat) detonation wave into the liner.

Planar Symmetric Conical Charge

A regular rotationally symmetric shaped charge may be modified to cut in a linear fashion with the addition of massive confinement. The two opposite sides parallel to the central axis have 90 degrees of heavy steel plating affixed to the outside of the charge. This results in uneven collapse of the liner and a fan shape jet toward the target, producing a slit instead of a round hole.

Deepwater Issues

Explosives have been used in deepwater in a variety of applications. Primarily, the work conducted relative to offshore structures has been for wells. Conductor wells have been successfully severed in water depths exceeding 2,850 feet. Explosive charges have been set using divers, remotely operated vehicles (ROVs), atmospheric diving systems (ADSs), and off the end of drill pipes from drilling vessels (with the aid of underwater cameras).

Pile jetting is necessary in order to place the explosive device inside the pile 20 feet below the mudline. In deepwater this will present a challenge due to hydrostatic pressures encountered during the jetting operation. Techniques will have to be developed to accomplish this jetting if the jacket is completely removed. An alternative solution though more expensive would be an excavating around the pile to provide access for severing the pile externally.

Effect of Water Depth on Explosives & System Selection

The explosive selected for deepwater applications must be one which is not desensitized by water; components do not separate under pressure, and does not become more sensitive with the expected increase in hydrostatic pressure. This would rule out many of the binary explosive mixtures and blasting gels.

It may become necessary to place the detonator underwater. Most common detonators are not designed for use in water depths over 400 feet; however, seismic detonators can withstand depths of 5,000 feet or more. Factors to consider in detonator selection are:

- Metal shell material, diameter, and wall thickness (i.e., will the hydrostatic pressure to be encountered crush the detonator?).
- Method of sealing around the wires going into the detonator (i.e., will water be forced into the detonator housing, thereby desensitizing the initiating explosive?).
- In the case of non-electric detonators, the housing seal as well as the pressure rating of the shock tube are factors limiting most non-electric detonators to a maximum of 270 feet.
- Only resistorized electrical detonators should be used. With unresistorized electrical detonators, galvanic force from anodic jacket protection could provide energy required for detonation.

There are a number of initiation systems used, depending on the type detonator. These include:

- Common electric detonators can be initiated at the surface by almost any electrical means. This requires connecting two-conductor wires from the detonator to the place of initiation.
- Both remote and acoustical firing systems are available for electric detonators. In this type of initiation system, limiting factors are the distance from the detonator to the receiver and the distance between the receiver and the transmitter. System costs and deployment methods are problems with the acoustic system.

- Exploding bridge wire (EBW) systems require a firing module and a control unit. The maximum distance between the firing module and the EBW detonator is 300 feet; the maximum distance between the firing module and the control unit is 3,000 feet.
- Programmable detonators are now available for explosive use.

Cost Review

Deriving applicable cost matrixes for platform removals using explosives is difficult due to the high number of variables involved. These variables are especially relevant when obtaining cost figures for shaped charges. To obtain accurate numbers, these variables and the related constants must be identified to generate an accurate cost estimate formula.

Effect of Water Depth on Cost

The effect of water depth for charges that weigh under 100 pounds does not significantly change. These charges are lowered with rope, which is a minimal cost factor. The detonating cord is also a minimal cost component. Significant cost increases are relative to charge size and weight. Setting a standard Shock Wave Enhancement Device (SWED) device weighing less than 600 pounds only requires a ¼-inch wire cable. However, the larger the piles and the corresponding increase in charge weight would require larger cable, and increasing cable diameter to over 1 inch can have a significant effect on overall cost.

Cost Increase due to Target & Charge Diameter

When using a SWED-type device for large diameter piles, size and weight becomes relative – bigger is not necessarily better. The SWED devices are constructed with large-diameter plates in varying thickness. As plate diameter and thickness increases, costs escalate due to difficulties in machining and handling the device. Plate diameters over 6 feet are considered special order and require a long lead-time.

Shaped Charge Cost

The variables that affect cost increase exponentially when discussing shaped charges. However, of all the uses of explosives, the shaped charge has developed the most scientific and practical applications. Shaped charges can be used as precision devices.

General Assumptions

The following assumptions are made in order to properly analyze the use of explosives to sever piles during the removal process:

- Government weight restrictions are not a consideration for the explosive charges.
- Explosive charge weights are presented in a range, low to high.
- The cost of backup charges is not included in this study.
- Pipelines in the vicinity are not considered.
- National Marine Fisheries Service (NMFS) procedures will be followed.
- All government permits will be obtained.
- All explosive charges will be set internally to the piles.
- For the main piles, the deck will be removed or full access to piles otherwise obtained.
- Damaged stabbing guides are not considered.

- The explosive charges will not be set inside the stabbing guides.
- All piles will be jetted to at least 20' below the mud line.
- All piles will be gauged with a "dummy" charge of the same dimensions as the explosive charge.
- A crane or some other suitable means will be used to set the explosive charges.
- Total explosive charge weights will range between 6,000 and 12,000 pounds, which will require wire rope diameter to be between ¾ inches to 1-1/8 inches.
- Explosive charges will not be left in piles for over 1 week.
- Adequate time for manufacturing of charges and mobilization are not considered.
- **Safety** is the number-one priority.

Explosive Usage Permit Policy

Specific decommissioning regulations are found in the Code of Federal Regulations, Title 30 – Mineral Resources, Part 256 – Leasing of Sulfur or Oil and Gas in the Outer Continental Shelf. In order to remove a platform from OCS waters, a Structure Removal Application and Site Clearance Plan (30 CFR 250.143) must be submitted to the proper field office of the MMS.

There are basic regulations that must be followed when using explosives offshore. Appendix 5.6 has a chart that details the specific stipulations for different decommissioning projects. In general use of explosives in deep water has more mitigation requirements than in shallow water.

2.2.2 Non-Explosive Methods

Non-explosive methods presently used consist of diamond wire, guillotine saws, abrasive (slurry) cutters, mechanical cutters, and oxy-arc torch (diver cutting).

Diamond Wire Cutting

The diamond wire cutting system (DWCS [**Figures 2.3**]) is an external cutting tool that can be used to cut jacket legs, piles, and diagonal members above and under water. Divers or a remotely operated vehicle (ROV) can install the DWCS. The DWCS consists of a structural steel clamping unit and a diamond wire cutter.
The frame is designed to clamp on the member being cut. The cutting wire consists of a steel wire rope with a diameter of approximately ¼-inch onto which is threaded a series of steel rings approximately ¼-inch long. These rings are embedded with diamonds, and are separated by a spacer sleeve that places the rings 1-inch apart.

Figure 2.3 ROV Diamond Wire Tool

The cutting system is designed to allow the wire to rotate along the perimeter of the frame. The wire rotates about the pulley wheels. A ROV can be used to set the leg clamp and cutter in the proper position on the member to be cut. Once installed, the DWCS's wire speed, working pressure, and flow rate is controlled from the surface.

Diamond wire cutting has been used since the early 1990's in the North, Adriatic, and Red Seas. Since then, the DWCS has been used for the removal of offshore platforms, caissons, conductors, risers, etc. However, until recently, the DWCS had not been used in the Gulf of Mexico (GOM). It was last used in the GOM to externally cut 82" and 48" caissons installed in 120 feet of water. Cutting times were approximately 20 and 2.5 hours for the 82" and 48" caissons respectively.

The DWCS has many possible uses for deepwater platform decommissioning. The cutting system can be used to sever large platform legs and piles while divers sever the diagonal members. An ROV can be fitted with the cutting tool and sent down to cut the diagonal members at depths where divers cannot work safely. The same ROV configuration can be used to cut the pipeline ends.

Benefits of this cutting tool over other cutting methods are many. There seems to be no limitation in the size of the cut or material to cut, as long as the cutting tool can be fixed to the cut member. Water depth may not be an issue when using this tool; an ROV or diver wearing a hard suit can take and set the tool at the desired location. By-products generated by the DWCS are only the fine cuttings from the object being cut, minimizing damage to the environment.

Limitations of the DWCS are based on its external cutting design. If piles are to be severed below the mudline, jetting will need to be performed to allow the cutting device and frame to be attached to the pile. Additional jetting may be necessary depending on the size of the ROV or other subsea device being used to attach the unit. An additional limitation of the DWCS is its current control system.

Developments currently underway promise to overcome any limitations in the DWCS's present design. A sub-bottom cutter (SBC) is currently in development, which will facilitate cuts below the mudline. Additionally, a computerized cutting control system promises to provide faster cuts that are more successful in the near future.

Guillotine Saw

This is a hydraulically, electrically or pneumatically operated saw with a single blade that motions side to side, in the same way a basic hack saw operates, and is progressed forward by a simple worm gear mechanism through the material. The guillotine saw cutting system operates in a similar way to the diamond wire saw in that it can be operated from an ROV hydraulic power pack for deeper water operations or set by a diver in shallow water. As this is an external cutting method site clearance to 20ft below mud line will also be required.

The clamping mechanism is the similar to the methods adopted by the diamond wire saw but these are currently limited to a maximum diameter of 32”. Anything larger is considered too bulky as the mass of side to side motion performed by the saw during the cutting operation increases considerably. The maximum size is also limited by the length of the single blade, which can be prone to snapping if too long.

Traditionally the industry has elected to use diamond wire saws for large diameter cuts.

The benefit in using the guillotine saw is that the consumables (i.e. the blade) is very inexpensive in comparison to a diamond wire “loop” and is equally as easy and efficient to replace if broken.

Below is a photo (figure 2.4) of a guillotine saw.

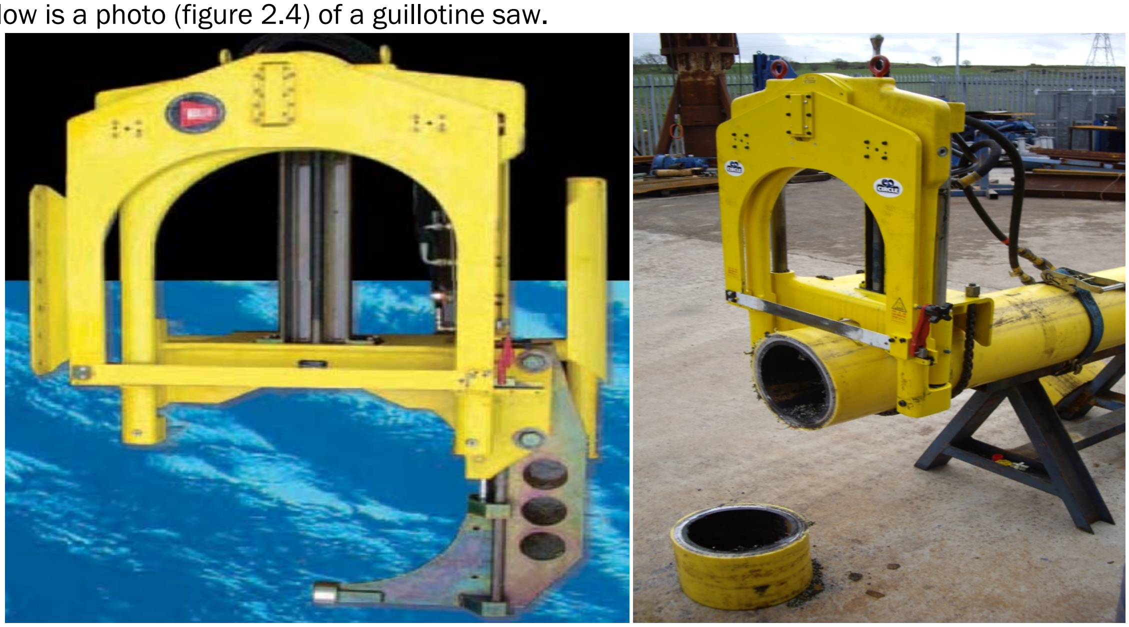


Figure 2.4 Guillotine Saw
(Courtesy of E H Wachs)

Abrasive Cutting

Abrasive cutting employs mechanisms that inject cutting materials into a water jet and abrasively wear away steel. There are two types presently in use: high volume-low pressure and low volume-high pressure. The first type of abrasive cutter disperses high volumes of sand or slag mixed with water volume (80 to 100 gallons/minute) at relatively low pressure (4,000 to 10,000 psi). A newly developed 15,000 psi system is available which is useful for multi string conductor cutting or adapted for other cutting applications.

An internal abrasive cutter (Figure 2.5) is spooled into the open pile to 15 feet below the mudline, after jetting out the mud plug to 20 feet below the mudline. Once the unit is in position, the centralizer arms are extended. The mixing units and pump are then started. Water is pressurized and forced through a hair-thin opening, producing a powerful water jet stream. Small particles of abrasive are added to the high velocity jet stream and the cutting begins.

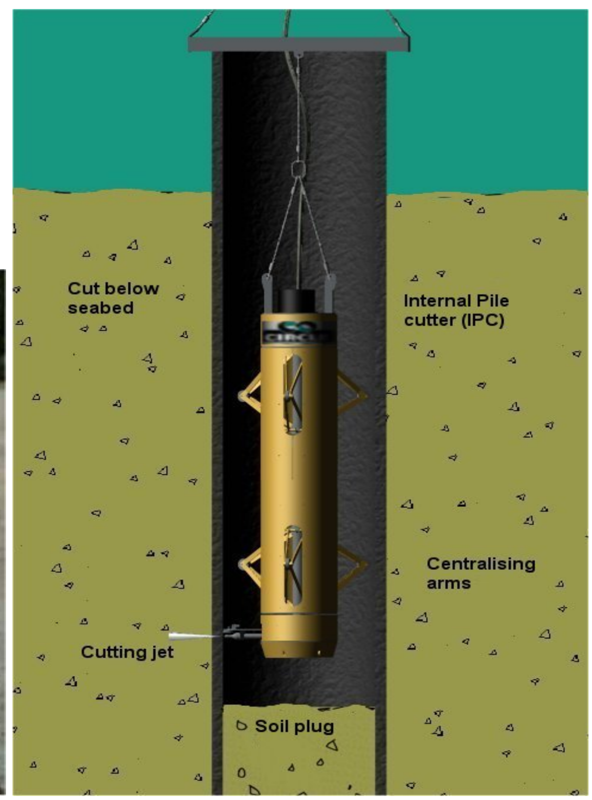


Figure 2.5 Water Abrasive Cutting c/w internal manipulators

The external abrasive cutting tool works on the same principle as the internal tool. Using the same feeding system, the external abrasive cutter is attached using a series of tracks that wrap around the member to be severed. This system must be attached by a diver, which limits the depth at which this system can be used safely.

Limitations for both the internal and external abrasive cutters include uneven cutting, and water depth limits. Limitations also include the minimum inside diameter that can be accessed approximately seven inches, combined with the outside diameter that can be cut. In shallow water depths, abrasive cutters have been proven to be an effective alternative to explosive pile severing. In some circumstances, conversations with abrasive jet contractors reveal the unsatisfactory use of these cutters in water depths greater than 600 feet. Improvements to the systems generally will eventually allow the abrasive cutters to work in deeper water depths.

There also exists the problem of verifying that the cut has been made when using an internal abrasive cutter. Unlike explosives, the conductor or pile often does not drop, confirming that the cut was successful. With an abrasive tool, the width of the cut is small and combined with the soil friction, a visual response generally does not occur. To verify the cut, the conductor is pulled with either the platform crane or hydraulic jacks. The lift force must overcome the conductor weight and the soil friction. At times, this force is many times more than the actual conductor weight. It is generally assumed that the cut is not successful if the conductor cannot be lifted with a force two times the conductor weight. The abrasive cutting tool is either re-deployed to make another complete run, or explosives are used to complete the cut.

Recent improvements in abrasive cutting technology have enabled development of a wellhead retrieval internal multi string cutting tool. [7] The figure 2.6 below details this tool.

Figure 2.6 Well Head Retrieval Tool
(Courtesy of NCA)

Mechanical Cutting

Mechanical cutting employs hydraulically actuated carbide-tipped tungsten blades to mill through tubular structures. This method has been used most successfully on small-diameter caissons with individual wells and shallow water well-protector platforms with vertical piles.

Figure 2.7 below illustrates how the internal mechanical cutting tool is lowered into an open pile. The power swivel is supported and connected to the top of the pile. The power swivel turns the drill string so that the milling blades are forced outward hydraulically to cut the pile or well; centralizers on the tool keep it concentric inside the pile or well.

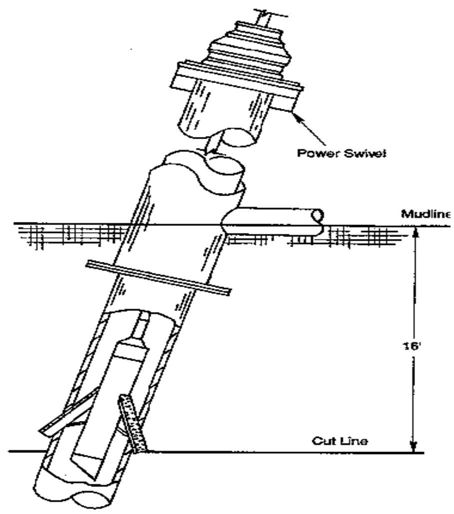


Figure 2.7 Mechanical Cutting Tool

Limitations for the mechanical cutter include uneven cutting (from lateral movement of uncemented strings), replacement of worn blades, larger lifting equipment necessary to set the system, and more time required to make each cut.

Hydraulic mechanical shears are also available as shown in the below figure 2.8.

Figure 2.8 Hydraulic Mechanical Shear and Debris Removal Equipment
(Photo courtesy of Conmaco)

2.2.3 Severing Conclusions

Several cutting techniques were reviewed in this section. Explosives are predictable, flexible, and reliable. Current industry practice primarily utilizes explosives to sever piles below the mudline at any water depth.

Abrasive and mechanical cutters are not as reliable as explosives to sever piles. Although they have been proven effective (generally on platforms located in relatively shallow water), deepwater simulation tests have demonstrated that there are a number of operational issues that need to be resolved for each of these alternative cutting methods. Additionally, there are more delays with these systems if they fail, and a complete cut during the first pass is less likely to occur than if explosives are used.

The DWCS is an alternative cutting tool that has great potential for deepwater use, specifically for severing jackets and pipelines. It is relatively easy to install (diver- and ROV-friendly) and current frame designs fit the pile sizes associated with the platforms included in this study. Although the DWCS might soon become a standard tool for efficiently severing piles, conductors, and pipelines, further testing is necessary before it can be considered a viable alternative cutting method for deepwater platform removals.

While some (or all) of these alternatives may someday provide a viable alternative to explosive pile severing, potential increases in cost and diver risk currently make these alternatives less attractive than explosives for the removal of deep facilities.

2.2.4 Deepwater Diving Suits

Introduction

Due to the extreme water depths focused on in this study, several new subsea technologies have been reviewed to provide alternative methods for assisting in pile severing and jacket cutting. These include advanced remotely operated vehicles (ROVs), hard-shelled diving suits, and directly operated vehicles (i.e., single-person submarines).

In order to safely deploy divers at water depths exceeding 400 feet, diving suits used must meet the challenges of handling deepwater pressures while allowing divers to efficiently perform work in the deepwater environment.

Oceaneering, Inc. is currently using systems like the WASP III hard suit (Figure 2.9) to perform work in deep water. The WASP is a proven tool for deploying divers at water depths exceeding 2,000 feet. The suit has been used in approximately 30 actual offshore operations in the Gulf of Mexico and in Brazil; the maximum water depth for these operations was 1033 fsw. These suits are rated for a maximum water depth of 2,200 fsw with a normal dive time of 6 hours.

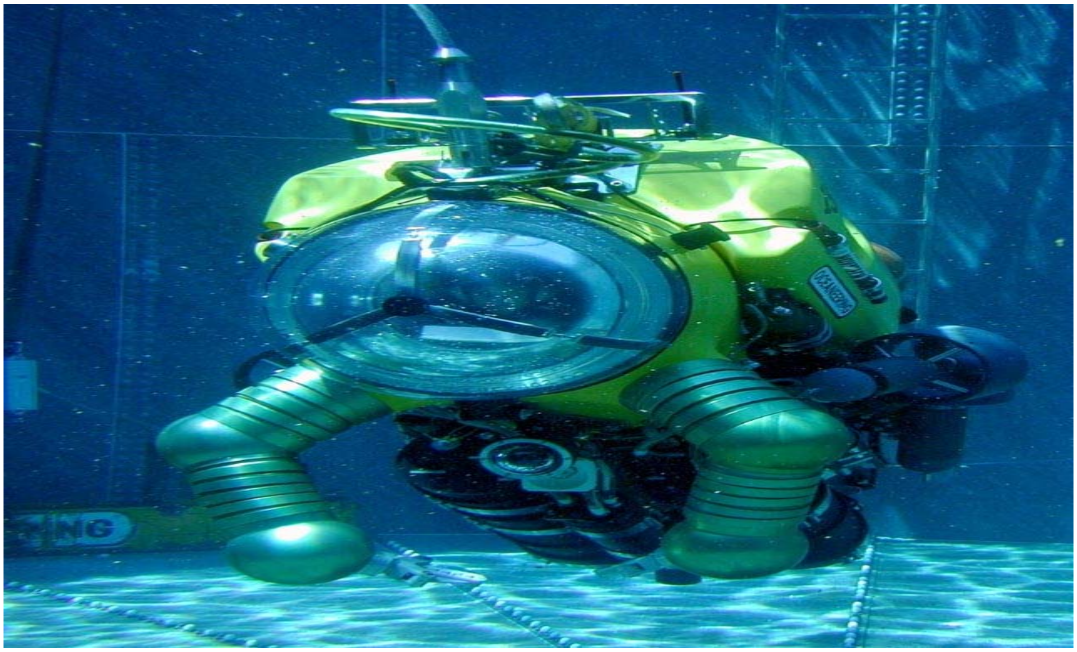


Figure 2.9 Oceaneering's WASP III One Atmosphere Suit
-Can operate at 2,200 ft subsea
(Photo courtesy of Oceaneering)

In order to minimize downtime, the WASP is operated in pairs to provide a "standby" diver in case one of the suits is in need of service or repair.

Advantages

- Ability to deploy divers in water depths up to 2,200 fsw
- Suit designed to kneel, lay down, and even work with the diver's head below his or her feet
- Has been used successfully in a number of deepwater operations

Disadvantages

- Extreme water depths still pose a threat to divers
- Divers unable to use fingers to manipulate items
- High fabrication, maintenance, and operations costs
- Highly skilled divers and above-water personnel needed to operate suit

2.2.5 Remotely Operated Vehicles

Remotely operated vehicles (ROVs) are proven tools for safely operating in marine environments. The increasing need to be able to use these machines at deeper and deeper water depths is driving the development of advanced ROVs that can be utilized in deepwater platform installations and removals.

The pile diameters associated with deepwater platforms are larger than shallow water platforms therefore, larger ROVs are necessary to handle equipment used to sever piles. Additionally, the pressure at these depths provides an additional challenge to ROV design.

Tasks needed to be performed at deeper water depths include:

- Valve operation
- Cutting steel and fiber cables or ropes
- Operation of disc grinders
- Attachment of external cutting tools
- Hot tapping
- High-pressure water jetting
- Removal of cuttings from well heads
- Make and break hydraulic connections
- Bathymetric surveys
- Trench profiles
- Sub-bottom pipe tracking
- Video observation and still photography
- Tool-skid carrying capabilities

A unit such as the SAI-250 ROV 0509 Innovator (Figure 2.10 below), manufactured and operated by Saipem America, is an example of an ROV which can currently operate in deepwater environments.

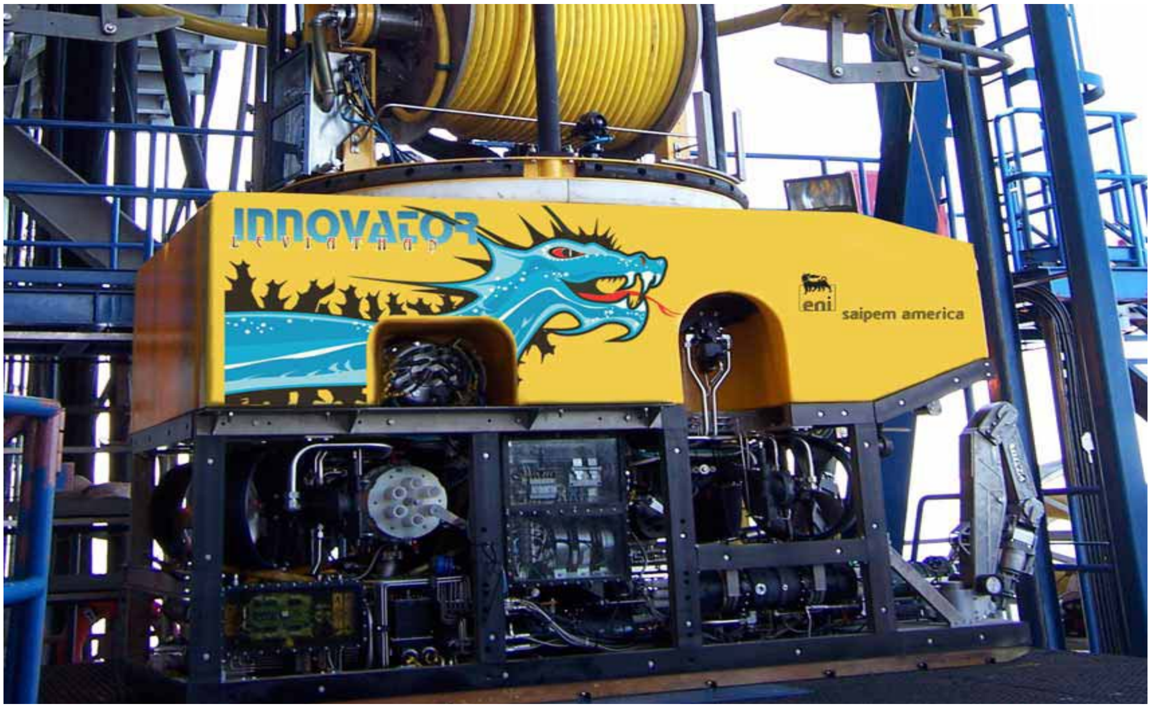


Figure 2.10 - Saipem 250 HP Working Class ROV

(Photo courtesy of Saipem America)

Advantages

- Safer deepwater operations- replaces divers in extreme water depths
- Can be fitted with cutting tool to sever pipelines or jacket members.
- Aid in installing external cutting tools.
- Not depth dependent
- Not dependent of dive time

Disadvantages

- High fabrication, maintenance, and operations costs
- Larger umbilical and more power required
- Observations of working conditions are dependent on remote cameras
- Technical challenges
  - Operators must be highly skilled to operate these ROVs
  - Control systems are complex
  - Tether may create problems
  - Access issues with the size of the ROV. Designers need to ensure that their structures and subsea equipment are designed “ROV friendly”.

2.2.6 Directly Operated Vehicles

As an alternative to ROVs or deploying divers in deepwater using hard-shelled diving suits, diving vessels (i.e., manned single-person controlled submarines) are currently being developed for deepwater operations. Also called directly operated vehicles (DOVs), these one-person submarines may someday prove to be useful in deepwater decommissioning operations.

To meet the demand for vessels of this type, Nuytco, Inc. has developed the Newtsub Deepworker 2000 a one atmosphere, single person, under-sea work vehicle. This vessel is designed to be completely tether less in normal operations and can be fitted with a fiber optic cable (approximately the size of a lead pencil in diameter) to transmit data to the surface. Because of its autonomous design, the Deepworker 2000 has very high power availability at the vehicle, coupled with directly operated, high performance manipulator capabilities. Additionally, this system can be deployed to a maximum water depth of up to 2,000 feet.

Advantages

- Operator can observe situations first-hand
- Self-powered
- No tether required
- Extreme water depths accessible to divers- up to 2,000 feet

Disadvantages

- Highly skilled divers and above-water personnel needed to operate vessel
- Use of manned system places personnel at risk
- High fabrication, operations, and maintenance costs
- Limited history of use in the oil and gas industry

2.2.7 Subsea Operations Conclusions

Remotely operated vehicles (ROVs) have been used successfully in a number of offshore operations for many years. Larger ROVs can provide the same key advantage of their shallow-water predecessors – decreasing the risk to human life. They can be fitted with a variety of cutting tools, assisting in external cuts at depths that are inaccessible to divers using conventional diving gear.

Hard-shelled diving suits and single-person diving vessels currently being developed and used can also be outfitted with these cutting tools and allow divers to access the depths defined as "deep water." While the major disadvantage of using these types of deepwater equipment is the fact that they still place human life at risk in deepwater environments, this fact is also their greatest advantage. They offer the ability to allow people to perform work first-hand at water depths exceeding 400 feet. An additional advantage of using the manned diving vessel is its ability to work without the constraints of a tether.

While these technologies are still young and relatively unproven, it is very likely that they will be used on deepwater platform decommissioning operations in the near future.

Deepwater subsea operations would be more efficient with enhancements to camera and visualization technology enabling more work conducted from ROV and diver-less systems. This is especially important in high silt, debris sensitive areas where it is critical that industry is provided high quality 3-D images.

Over 4000 subsea wells have been installed in the GOM as shown in Section 3 Figure 3.27. The newer subsea wells and supporting subsea structures have been designed as "ROV friendly" which will improve the cost efficiency of decommissioning projects. Many of the older subsea wells may prove more difficult for ROV decommissioning operations. Subtle changes to the hardware design and configuration can lead to step wise improvements in the intervention efficiency, and overall safety of the production operation and abandonment functionality. In summary, equipment can and should be optimized for late life and future subsea abandonment functionality.

For the purpose of this study, it is assumed that subsea wells will be removed, subsea structures anchored to the seabed will remain in place and subsea structures that are attached to or stabbed over the anchored structure will be removed.

2.2.8 Standard Heavy Lift Technologies

Introduction

The load weights associated with deepwater fixed and floating platform installations limit the number of heavy lift vessels (HLVs) that can be used to remove these facilities.

In addition to evaluating conventional HLVs, a review of alternative heavy lift vessels that are currently being developed is presented in Section 2.2.9. The need for larger HLVs is apparent as industry is installing more production facilities in deeper waters. Included are brief descriptions of each of these technologies, and an assessment of the potential to apply them to the removal of deepwater platforms.

A limited selection of heavy lift vessels (HLVs) working around the world today can perform the tasks required for removing deepwater platforms. As of January 2008, there were 59 heavy-lift vessels in the worldwide fleet with 100 ton (91 metric ton) capacity or greater, according to *Offshore*'s 2008 Worldwide Survey of Heavy Lift Vessels poster.

Figure 2.11 - Siapem 7000 and Heerema Thialf Semi-Submersible Crane Vessels

(Photo's courtesy of Saipem and Heerema)

Table 2.1 presents a summary of the heavy lift vessels available now, or in the near future, that can perform the lifts required.

Table 2.1 Heavy Lift Vessels Considered for Topsides/Jacket Removal

Largest crane vessels			
Vessel	Company	Capacity (mT)	Type
Pieter Schelte	Allseas	25000 (detail design ongoing)	Twin Hull
TML	SeaMetric	20000 (under construction)	Twin vessels
Thialf	Heerema	14200 (2 * 7100 tons)	Semi
Saipem 7000	Saipem	14000 (2 * 7000 tons)	Semi

Bottom Feeder	Versabar	10000 (under construction)	Dual Barges
Svanen	Ballast Nedam	8800	Catamaran
Hermod	Heerema	8165 (1 * 4536, 1 * 3629)	Semi
7500 Barge	ZPMC	8500	Monohull
Balder	Heerema	6350 (1 * 3629, 1 * 2722)	Semi
Borealis	Nordic	5000	Monohull
Oleg Strashnov	Seaway	5000	Monohull
Bottom Feeder	Versabar	4000	Twin barges
DB 50	J. Ray	3992	Monohull
Rambiz	Scaldis	3300	Catamaran
Asian Hercules II	Smit	3200	Monohull
DB 101	J. Ray	3185	Semi
DB 30	J. Ray	2800	Monohull
Sapura 3000	Acergy	2800	Monohull
Stanislav Yudin	Seaway	2500	Monohull

Cargo barge load capacity is limited although Heerema has constructed a large 750 foot long cargo barge as detailed in the figure 2.12 below. This barge can carry topside modules weighing 35,000 mT or a jacket weighing 40,000 mT.

Figure 2.12- Heerema H-851 Cargo Barge
(Drawing courtesy of Heerema)

2.2.9 Alternative Heavy Lift Technologies

The following section offers a review of alternative heavy-lift technologies currently being developed for offshore platform installations and removals.

Versabar Versatruss Lift System

Versatruss is a balanced, symmetrical, underside lift concept developed by Versabar that makes use of a truss formation to lift a heavy load. In application, this system employs three readily available components:

- Standard cargo barges, which provide the lifting platforms
- Steel A frames, which provide the structural support
- Hydraulic winches, which supply the lifting force

Booms and the deck structure form the upper portion of the truss; the lower segment is created by Versatruss rigging and a tension cord inserted between the platform legs (Figure 2.13). This arrangement results in an extremely efficient distribution of load into the deck.

Once attached to the deck, synchronized winches are engaged, causing the barges to move together and shortening the lower span of the truss. When this happens, the booms rotate on their heel pins, increasing the boom angle and generating vertical lift. The process is fully reversible at any time, with lifting or set-down taking a relatively short period of time.

Because of the basic nature of this system, it can be designed to accommodate very large topsides.

Once lifted, topsides can be:

- Towed to shore (or to another location if re-installation is the goal) in a catamaran configuration
- Lowered onto a cargo barge
- Lowered onto a cargo barge and unhooked from the Versatruss system

The Versatruss system has been used successfully in several topsides removal and installation projects. The largest of these lifts were the removal of a 1,225-ton deck from Amoco's Eugene Island 367 platform in August 1998 and the installation of 5,330 ton topsides for Chevron in Lake Maracaibo, Venezuela, in September 2000.

Figure 2.13- Versatruss Jacket Lifting System
• Topsides/Jacket Lifting Capacity: 20,000 Ton
(Photo courtesy of Versabar)

During the Lake Maracaibo platform installation project, planned Versatruss applications included the transportation and installation of jackets and topsides for three platforms. Although the topsides installations proved successful, during the transportation of the Versatruss jacket installation system to Venezuela, the system tore itself apart and was lost (*Offshore Engineer*, Oct 2000).

Versatruss has been effective in increasingly larger topsides removal and installation applications, but, to date, has no proven solution for the removal and/or transportation of jackets.

Versatruss Advantages

- Efficient – in principal, no upper limit to its capacity requirements
- By multi-sheaving the blocks, it is possible to minimize the winch and line-pull-load capacity
- Redundancy – multiple booms and multiple connection points allow for the loss of individual elements of the Versatruss system without a system failure
- Available – currently in use

Versatruss Disadvantages

- System requires extensive operational support
- Jacket removal methods have proven ineffective in the field.
- No accommodations; need support vessel(s) to accommodate personnel
- Practical application of the technology to date has been limited
- Weather limitations in the hook-up stage

Versatruss Conclusions

The Versatruss heavy lifting system is a proven, efficient method for removing and installing topsides. Multi-sheave blocks can minimize winch loads, and multiple booms and connection points give it redundancy not found in the other HLVs described in section 2.2.8 additionally, there is no theoretical limit to the load capacity of this system. However, the Versatruss system is not well suited for removing jackets. The kinematics of the system make it difficult to provide a jacket lifting capability that would be effective in practical applications that require lifting jackets out of the water. Therefore, for Complete Removals, another HLV will be needed. Nevertheless, the Partial Removal and Remote Reefing operations might significantly benefit from the use of the Versatruss system.

Versabar Bottom Feeder Lift Systems

The Bottom Feeder lift system was developed by Versabar. The design uses two cargo barges outfitted with a bridge truss that is used to lift jacket and decks (**Figure 2.14**) in a single lift. Consisting of twin 1,250 ton steel truss frames mounted on standard cargo barges and powered by four 200-ton winches (visible on the legs of the trusses at left), the Bottom Feeder specializes in recovering items from the sea floor. The retrieved items are loaded onto barges and transported to shore for salvage. The current system has a rated lift capacity of 4,000 tons and has performed fifty plus salvages related lifts in the Gulf of Mexico since 2008.

Figure 2.14- Versabar VB 4000 Bottom Feeder Lifting System
(Photo courtesy of Versabar)

Currently a larger Bottom Feeder is under construction and will be ready in 2010. This unit will be rated to handle 10,000 ton surface lifts with four 2,500 ton lift blocks. The blocks can be re-reeved as required to support sea bed lifting of 4,000 tons at around (-) 450 MSL. The main block lift height is approximately 180 feet above sea level. The unit will have ABS DPS3 class DP system (Kongsberg control system, Eight 1,000 HP Thrustmaster retractable, azimuthing thrusters). The Main hoists are also capable of each running 10,000 feet of 5-inch Samson Quantam-12 fiber rope. This will give the system a lifting/lowering capacity of 1,000 tons in 10,000 feet of water.

Bottom Feeder Advantages

- Single piece lift (removal and installation) of heavy topsides for conventional (non storm toppled) platforms.
- Heavy jacket removal and installation. The system may transport complete jackets to reef sites for toppling, or reverse upend jackets for removal to shore. For very large jackets the system can be used to support and transport jacket slices for disposal.
- Use of multiple lift blocks allows for lifting of decks/jackets which are highly out of level (up to 90 degrees) and with highly uncertain CoG or high CoG offset locations.
- High lift capacity at (-) 400 feet for continued toppled platform recovery.
- High capacity (1,000 tons) for future ultra deepwater (10,000 feet) installations and recoveries.

- DP system allows for station keeping in debris fields or deep water.
- System has proven to be as or more versatile than conventional derrick barge solutions.

Bottom Feeder Disadvantages

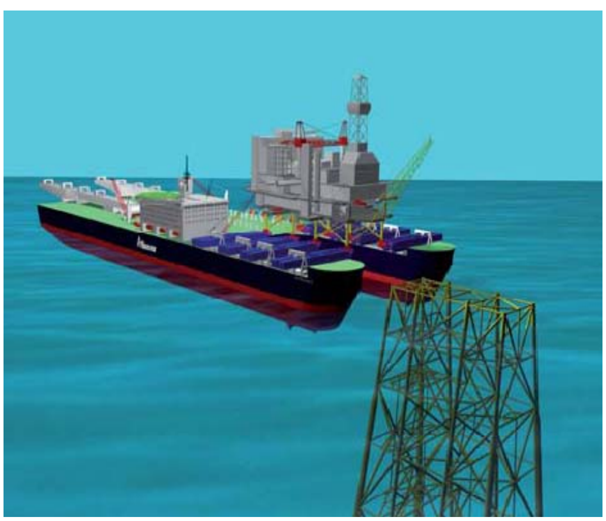
- This lifting system cannot operate in adverse sea states.
- The maximum size of the deck or jacket to be lifted is restricted by the distance between the two barge hulls.

Pieter Schelte Twin Tanker Lift System

The Pieter Schelte (Figure 2.15), designed by Excalibur Engineering, BV, is a platform removal and installation vessel formed by joining two large tankers together to form a stable platform. Topsides and jackets can be removed in discrete single lifts and transported to shore or to another location. Construction has not yet started for this lift system.

The design of the HLV ties together two large tankers at the stern, leaving the bow open to accept extremely large topsides. The vessel deballasts itself below the deck, raises (ballasts) to a point where the jacket can be secured to the vessel, and further ballasts to raise the topsides off the jacket.

The rear of the vessel includes a lifting arm that is raised above the jacket (once the topsides are removed and the piles have been severed). Once in position, rigging is lowered and attached to the top of the jacket, secured, and the jacket is raised to a point where it can be pulled over onto the jacket storage section of the Pieter Schelte. The vessel then moves to shore or to another offshore location for offloading and disposal or re-installation.



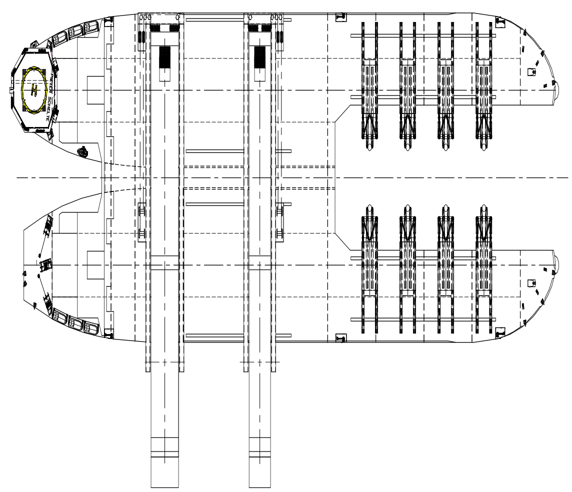


Figure 2.15 - Allseas Pieter Schelte Lifting System

- Topsides/Jacket Lifting Capacity: 48,000/25,000 mT

(Drawing courtesy of Allseas)

The Pieter Schelte can be used for decommissioning operations by lifting topsides up to 48,000 ton (approximately 53,000 short tons) and removing jackets up to 25,000 ton (approximately 28,000 short tons).

Pieter Schelte Advantages

- Minimum offshore preparation work on topsides facilities
  - Single piece lifting
  - No cleaning and separation of process facilities
- Minimum subsea cutting operations
  - Single-piece jacket removal up to 500 ft.
- Maximum safety to personnel
  - Very limited human activities offshore
- Maximum protection of the environment
  - Handling of hazardous materials only within the onshore dismantling yard
- Possible reuse of topsides and jackets

Pieter Schelte Disadvantages

- May have high maintenance costs
- May have higher day rate than other heavy lift alternatives.
- Jacket removal limited by lifting arm design (jacket complete removal in a single piece limited to 500 ft water depth)

Pieter Schelte Conclusions

The Pieter Schelte heavy lift vessel offers a good alternative to lifting the topsides in one unit. Unlike the HLV alternatives described to this point, the Pieter Schelte does not have to offload the topsides before lifting the first jacket section. Additionally, jacket cut sections could be skidded to the back of the vessel, allowing it to lift the remaining jacket portion to be immediately towed to shallow water to repeat the jacket removal process.

However, the Pieter Schelte will be a very expensive HLV to fabricate and maintain, and its day rate may potentially be higher than that of standard HLVs. Detail vessel design is ongoing and the vessel is currently scheduled to launch in 2013.

Buoyancy Bag Devices

Buoyancy bags, manufactured by companies like Seaflex Ltd., are inflatable subsea buoyancy systems that can be attached to jacket members, subsea equipment, conductors or pipelines. Once attached and inflated, these units can lift sections (or, in the case of jackets, potentially the entire structure) to the surface. The bags are offered in either open-bottom or fully enclosed configurations. These units can be connected to piles or conductors by using divers or remotely operated vehicles (ROVs).

These units have proven to be a successful lifting alternative in pipeline and platform removals. Current stock exceeds 3,000 ton lift capacity.

Buoyancy bags are inexpensive to fabricate and maintain. However weather conditions can create lifting variables that could potentially create difficulties for the jacket-handling vessels in raising the jacket. Movement created by underwater currents or uneven air expansion inside the bags could make it difficult to ensure that the jacket does not surface directly underneath the buoyancy bag-handling vessel or another on site vessel.

Controlled Variable Buoyancy System (CVBS)

The Controlled Variable Buoyancy System (CVBS) is a patented concept being developed to provide an innovative and cost effective means of offshore structure removal. It does this by providing buoyancy that is attached to strategic points on the structure. The magnitude of buoyant lift can be closely controlled throughout all stages of the removal operation.

The CVBS consists of groups of buoyancy chambers, clamps, inflatable air bags, pipe work, valves, and a sophisticated control system. A group of chambers equipped with clamps, local controls and piping systems is referred to as an Intelligent Buoyancy Unit (IBU).

An Intelligent Buoyancy Unit (IBU) consists of four 2.5m OD, 16m long shells (Figure 2.16). Three of the shells are perforated with a number of holes to allow water to flood freely in and out of the shell, and one of the shells is solid. The perforated shells have a domed end at the top fitted with an insert suitable for bolting on pipe work and valving.

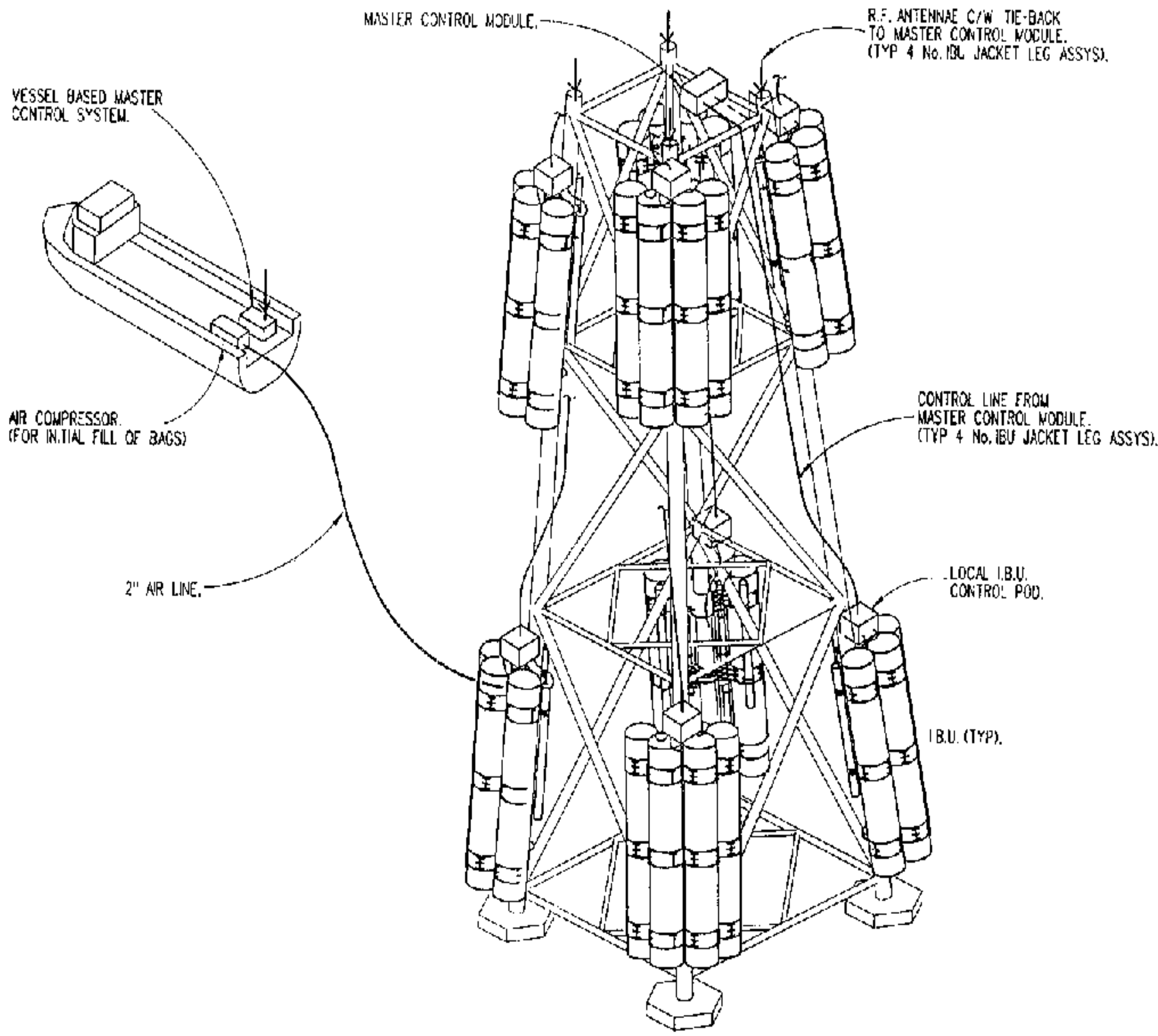


Figure 2.16- Control Variable Buoyancy System (CVBS)

The main bodies of the shells are 20mm thick and the domed ends are 40mm thick. The shell will be filament wound with continuous glass fiber reinforcement.

The GRP shells are held in position and connected to the jacket leg via 2 friction clamps, which are hinged to assist in the installation procedure. A steel band is fixed around the shell and is then connected into the main body of the clamp by means of stiffener plates. Each clamp has stud bolts that lock into position on closure. With the clamp closed, using a hydraulic cylinder, a work-class ROV will torque each of the studs thus securely fixing the unit to the leg.

The Control System consists of the following:

- **Master Control System (MCS)** – The Master Control System is located remotely onboard the Multi- Purpose Support Vessel (MSV) or Diving Support Vessel (DSV) and communicates with the Master Control Module via a radio telemetry link.
- **Master Control Module (MCM)** - The unit is located on the structure to be moved. It is PLC based and is connected to each of the IBU units. This allows the Master Control Module to control the IBU unit Inputs and Outputs, valve operations, reading pressure values, and valve operation status information.
- **Intelligent Buoyancy Unit (IBU)** Control Pods – These pods contain all the electronics necessary to control valve operations and to read back data from pressure transducers.

Buoyancy Bag Advantages

- Potentially inexpensive lifting alternative – no need for HLVs to remain on site after topsides are removed.
- Environmentally friendly

Buoyancy Bag Disadvantages

- Limited use in platform decommissioning
- Uncertainties exist regarding jacket surfacing logistics
- Maximum lifting weights limit the size of the jacket (or jacket section) that can be lifted (depending on size/number of bags or CVBSs used)

Buoyancy Bag Conclusions

While the Controlled Variable Buoyancy System (CBVS) might be able to overcome some of the challenges presented by buoyancy bags (i.e., better control over the lift), this technology has limited use in the field.

Buoyancy Tank Assemblies

Aker Solutions successfully deployed a new jacket removal method in 2008 to remove the DP2 jacket **(see Figure 2.17)** from Total's Frigg field in the Norwegian North Sea **[8]**. With the aid of buoyancy tanks, the jacket was floated clear of the seabed and towed ashore without major incident. The jacket was towed to shallow water and cut into pieces for disposal.

The patented re-floating technique thereby has proved itself as an attractive alternative to conventional heavy-lift methods to remove redundant jackets.

The eight-leg DP2 jacket, installed in 1986 by barge-launch and ballast into position, weighed around 9,000 metric tons (9,920 tons) and stood 123 m (404 ft) tall, with a footprint of 62 x 43 m (203 x 141 ft). Removal by heavy-lift would have meant cutting it into two or more pieces underwater.

Figure 2.17 Frigg DP2 Platform Removal

(Photo courtesy of Aker Solutions)

This re-floating method uses four buoyancy tank assemblies (BTAs), one attached to each corner leg. Each BTA consists of two cylindrical buoyancy tanks, each measuring 53 m (184 ft) long and 6.6 m (21.8 ft) in diameter, fixed together side by side. All tanks are divided into an upper and a lower compartment, with a series of valves allowing sea water entry during ballasting, and pumping in of pressurized air to expel water during deballasting.

On the upper end is an equipment and instrumentation room for implementing ballasting and de-ballasting, and for operating the clamps and pull-in jacks that attach the BTA to the jacket leg. Operations are controlled and powered remotely from a command vessel through an umbilical and hoses. These were connected directly to the BTA during the attachment operation, and via a manifold installed on the support vessel during the re-float and tow.

The overall height of each BTA is 65 m (213 ft), the weight in air is about 1,000 metric tons (1,102 tons). Total tank volume is 3,625 cu m (128,016 cu ft). The units were built and outfitted by Bladt Industrier in Denmark. The clamp systems and jacks were supplied by IHC, and the rubber elements by Trelleborg Viking in Norway – the latter were used as fenders and placed within the clamps and upper and lower guides to deflect loadings.

The first BTA was delivered to Aker Solutions for sea trials in 2008, and then returned to the yard for some modifications.

The mating operation to position a BTA to one of the corner legs without any damage to the integrity of the jacket was not easy, especially as a positioning accuracy of ±15 mm (0.6-in.) was required, and the weight of each assembly now included 3,000 metric tons (3,308 tons) of ballast water.

Each BTA (see Figure 2.18) was guided into position using lines attached to a vessel on either side; the offshore support vessel *Botnica*, acting as the command vessel, and Nordica. A pull-back line was attached to a small tug stationed behind the BTA.

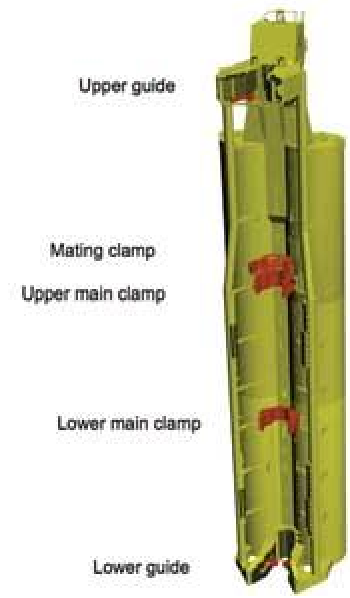


Diagram shows the buoyancy tank assembly. Each unit weighs 1,000 metric tons (1,102 tons) and stands 65 m (213 ft) high.

Figure 2.18 Buoyancy Tank Assembly

An upper and a lower guide at the top and bottom of each BTA directed the assembly into position on the leg. Contact first was made at the lower guide. As contact was achieved at each guide, the mating clamp automatically closed around the leg, reducing horizontal movement. Pull-in jacks were activated to further reduce movements.

The BTA now was de-ballasted until the firm contact of 600 metric tons (661 tons) uplift was established between it and a hinged bracket structure at the top of the leg – calculations indicated that the legs would not be able to take the bending moment generated by the BTAs during refloating, so a bracket was welded to each leg to take this loading.

The pull-in jacks now were operated again, pulling the BTA into the correct position, tight against the leg. By activating the two friction clamps in the mid-section of the BTA, the main holding force was established. The pull-in and friction clamps were operated from the command ship once the mating clamp closed.

Before re-floating began, the towing vessels attached lines to the jacket to ensure it remained stable. At this point, the jacket was held in place by just four of the original 20 piles, the others having been previously cut. With only 600 metric tons (661 tons) of buoyancy from each BTA before the last piles were cut, the jacket was resting firmly on the already cut piles – enough to hold it stable without causing any sudden movement when the final pile was severed.

Once the jacket was no longer fixed to the seabed, the BTAs were further de-ballasted to raise the deepest part of the platform to the towing height of 10 m (33 ft) above the seabed.

Buoyancy Tank Conclusions

The BTAs are available for re-use. With their dimensions, they could re-float jackets weighing between 6,000 and 18,000 metric tons (6,614 and 19,842 tons), depending on the floating capacity in the legs. Further, BTAs with different dimensions and lifting capacities also could be built. BTAs have been designed to operate in 10,000 feet of water depth.

SeaMetric International TML Lift System

An alternative heavy lift concept is being developed by Seametric International. SeaMetric currently has two multi-purpose heavy-lift vessels under construction in China. The vessels construction completion date has not been set by Seametric.

SeaMetric's new Twin Marine Lifter (TML) design (see Figure 2.19) is unique. It uses lifting arms rather than cranes, and will be able to lift 18,000-20,000 metric tons (19,842-22,046 tons) compared to the maximum lifting capacity of traditional heavy-left vessels at 14,000-15,000 metric tons (15,432-16,535 tons). Another factor that makes the TML system stand alone is the removable lifting arms.

Figure 2.19- Seametric International TML Lifting Barges

- Topsides/Jacket Lifting Capacity: 20,000 mT

(Drawing courtesy of Seametric)

The TML system will have a DP-3 capability and include both accommodation facilities and a helideck. It will operate at wave heights of 3-4.5 m (10-15 ft) with low dynamic loads.

The TML allows design of platform topsides for convenience of operation, not to fit within the crane's lifting range. The self propelled vessel (450 feet long) is designed for both removal and installation of platform topsides, jackets, subsea installations, boats, or similar objects.

With the global market for medium to large platforms (over 10,000 metric tons [11,023 tons]) estimated to be 30-35 installed per year and 30-40 removed per year from now forward, heavy-lift vessels are in high demand. Most of the heavy-lift vessels available would require multiple lifts to get the job done.

The market for removal or offshore installation over the next 20-30 years is at least 6,500 platforms worldwide, of which more than 1,000 weigh over 4,000 metric tons (4,409 tons), SeaMetric predicts.

The TML system is based on buoyancy and ballast tanks and lifting arms located on two identical vessels, each vessel being 140 x 40 x 10.85 m (459 x 131 x 35 ft).

The eight lifting arms weigh about 2,500 metric tons (2,856 tons), and are supported on a skid structure onboard the vessels. Each lifting arm is hinged to the skid structure over the center line of the vessel and is equipped with a buoyancy tank on the inside (between the barge and the object) and a ballast tank on the opposite side.

One TML with lifting arms is positioned on each side of the object to be lifted. The idea is to create a lift force by de-ballasting the buoyancy tanks and at the same time ballasting the ballast tanks. This is done by the use of seawater pumps.

2.2.10 Heavy Lift Conclusions

Many of the alternative heavy-lift technologies reviewed may someday prove to be safer, more cost-effective ways to remove topsides and jackets. The designed load capacities for many of these systems are more than adequate for the topsides associated with deepwater platforms. However, deepwater jacket removal tends to be problematic for all alternatives reviewed.

Only the Versatruss and Bottom Feeder alternative deck-lifting systems have been used successfully for offshore platform removal operations; the other systems are in various stages of development and testing. Additionally, the idea of considering any of these systems as the primary option for removing the deepwater platforms could potentially create scheduling problems if the systems are not available by the time these platforms are ready to be decommissioned.

As a result, the standard, proven heavy lift vessels included in Section 2.2.8 are the most reliable heavy lift options currently available.

2.2.11 Well Intervention Vessels/Systems

Decommissioning wellbores can be accomplished by several techniques. The well can be plugged and abandoned with a drilling rig or by a rigless equipment spread. The well work equipment can be set up on the deepwater facility, a self contained drilling rig or a well intervention vessel.

Industry has developed non rig well abandonment techniques that utilize a purpose built service vessel. These vessels which are called well intervention vessels (WIV) are very cost effective in decommissioning subsea wells compared to using a drilling rig. These vessels utilize wireline or coiled tubing to access the wellbore. Vessels are available that will be able to access and abandon subsea wells in water depths of 10,000 feet. Motion compensation devices or constant tension winch packages are critical to the successful use of these vessels in deepwater decommissioning projects. Prior to the development of these vessels operators used high day rate drilling rigs to abandon subsea wells.

Below is a drawing (see Figure 2.20) of Helix's Well Ops Q4000 well intervention vessel. This vessel has performed well intervention work in 6,500 feet in the GOM. The vessel's ROV is rated to operate at 10,000 feet. The multipurpose vessel provides a stable platform for a wide variety of tasks, including subsea completion decommissioning and coiled tubing deployment [9].

Figure 2.20 Q4000 Well Intervention Vessel
(Drawing courtesy of Helix Energy)

Another well intervention vessel the Olympic Intervention IV is chartered to Oceaneering International, Inc. The vessel will be capable of subsea hardware installation such as umbilical's, subsea trees, jumpers, flying leads and manifolds. The vessel can also perform inspection, repair and maintenance (IRM) projects and is capable of well intervention services including riserless wireline, coiled tubing, electric line, and plug and abandonment operations using the Subsea Intervention Lubricator (SILS®). Figure 2.21 below shows the SILS being used for the first time in a GOM well intervention.

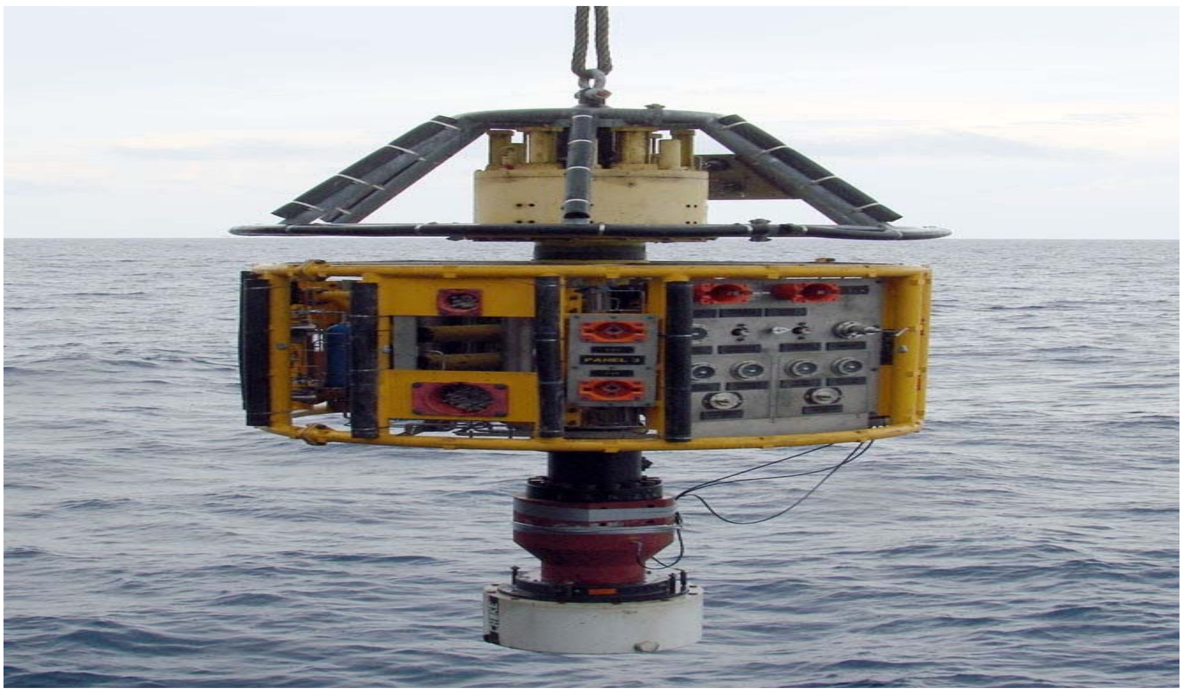


Figure 2.21 SILS Well Intervention System

(Courtesy of Oceaneering and Superior Energy)

The 312' DP-2 Olympic Intervention IV (see below) features two Oceaneering® Millennium® Plus ROV'S depth rated to 10,000 feet, a helideck, a 150-ton heave compensated crane, a large working moonpool, accommodations for 100 personnel and a satellite communications system for transmitting streaming video for real-time work observation by shore personnel.

Figure 2.22 Oceaneering Well Intervention Vessel
(Photo courtesy of Oceaneering)

Expro International Group is developing a lightweight subsea wireline intervention system. This follows project is called the AX-S. First tests of this system (see figure 2.23) will be conducted in 2010 in the North Sea. BP is a partner in this project.

The AX-S System will provide lightweight rig less well intervention services [9] that diagnose production problems and improve production from subsea wells. This system will also be able to provide well abandonment work on subsea wells.

The AX-S system is deployed onto a subsea tree with an active heave-compensated fiber winch from a mono hull vessel, and is remotely controlled from the surface like a ROV. It consists of an integrated set of pressure-contained subsea packages comprising well control, wireline tools, wireline winch and fluid injection functions.

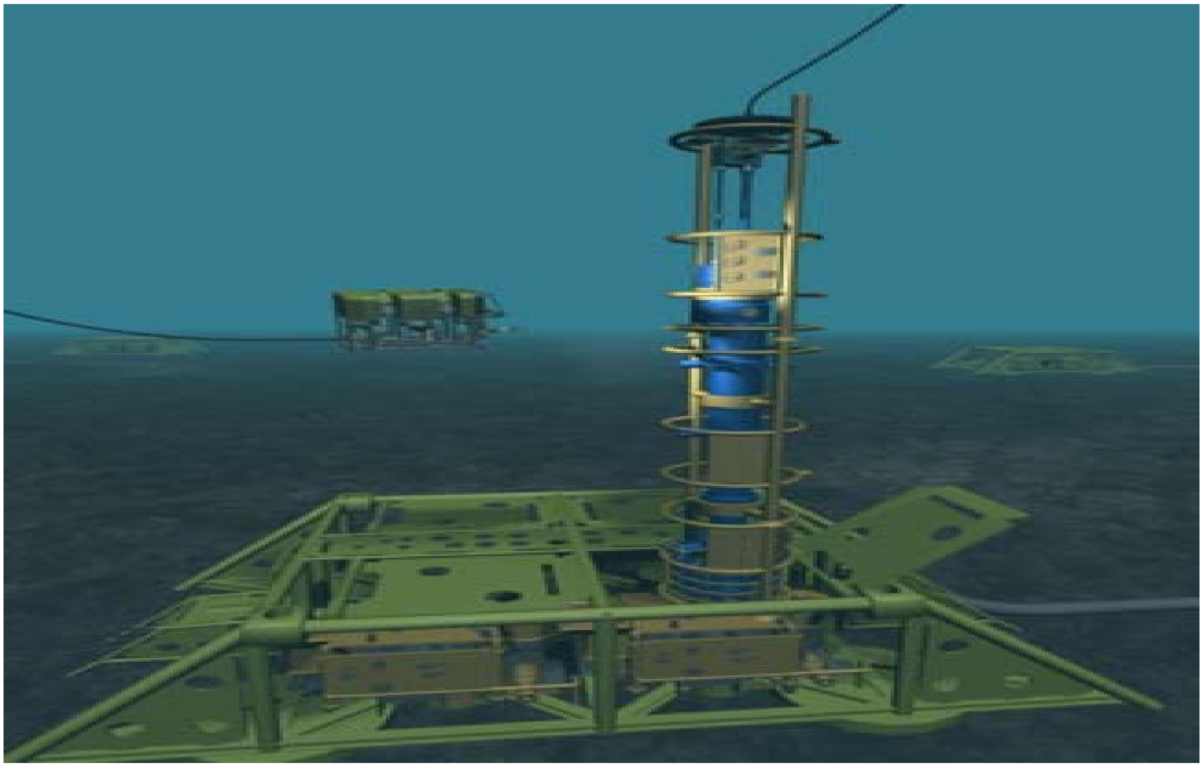


Figure 2.23 Expro Group AX-S Subsea Well Intervention System
(Photo courtesy of Expro)

If a purpose built well intervention vessel is unavailable a typical offshore supply and service vessel can be set up with well intervention equipment to perform the well decommissioning work. However the capabilities to perform well intervention are limited by the lifting capacity of the equipment and the weather capability of the deployment vessel.

2.3 Decommissioning Project Challenges

Introduction

This section presents the obstacles that may arise in decommissioning deepwater facilities. Carefully planning and managing the project can help mitigate these issues. However, there are instances where new methods and or technologies are needed to successfully accomplish the tasks. The decommissioning issues are presented by the cost components described in this report.

2.3.1 Platform Removal Preparation

Platform Removal Preparation is one of the first tasks in the decommissioning process. In planning for this phase, areas such as accommodations, air quality, and handling and disposing of cleaning fluids need to be addressed.

As simple as it may seem, accommodations may present logistical problems if the crews are not allowed to reside on the platform. Transporting crews from shore, or adjacent platforms, will require additional support vessels or helicopters that will add to the schedule and ultimately cost.

The fluids and agents used to purge and clean the vessels must be disposed properly. Most are water based and non-toxic. The fluids can be safely disposed by pumping them downhole into an injection well, or treating the fluids and discharging them overboard. Another solution is to contain them in Coast Guard approved tanks, transport the tanks to shore and dispose of the fluids properly. In some locations the approved onshore disposal sites are not very close to the shore base. Additional onshore disposal locations should be established in order to reduce transportation expense.

2.3.2 Conductor Removal

As stated in Section 3, it is recommended that the conductors are cut and removed prior to the Heavy Lift Vessel (HLV) arriving at the site. Cutting, pulling, removing and storing the conductor will require detailed planning. Most often the deepwater platforms will have more conductors than shallower water platforms. The number, length, weight and number of sections to handle make this phase a challenge.

The key challenge with cutting well conductors or any grouted structural member is being able to cut through the grout. The effectiveness of cutting multiple conductor pipes with grout in the annular areas is a factor of how much grout is in the annular area and if the pipes are concentric. Some cutting tools can sever grouted areas better than others. Inspection technology should be developed that will determine the extent of grout in the annulus and the orientation of the conductor pipes. This information would allow the decommissioning contractor to select the best cutting technique which would reduce the amount of time spent severing the conductors.

Cutting Conductor 15 Feet below the Mudline

Cutting the conductors with explosives will cause the cut point to flare out which may impede pulling it through the conductor guides. If the flared section cannot go through the guide, an ROV or a diver in a hard suit can cut it. Another solution is to use initially an abrasive or mechanical tool, in place of explosives, to cut the conductors internally below the mudline. The use of these tools is at times not effective which will require that explosives be used.

In addition, it is difficult to prove that the abrasive/mechanical cut was successful. When using explosives, the conductor drops as proof that it has been cut. This does not happen when using abrasive or mechanical cutting methods. To prove that it has been cut the conductors would have to be jacked up. The lack of proving a cut and untested depths makes an abrasive/mechanical cut secondary to an explosive cut.

Relaxing the 15 foot removal requirement would greatly enhance the safety of decommissioning work and reduce the time spent. Seafloor trawling activities do not occur in deepwater so the need to remove wells 15 feet below the mudline does not seem necessary. Additionally pipelines are not buried in deepwater and subsea equipment skids will be abandoned in situ.

Well Plugging and Abandonment

During well abandonment projects it is imperative that adequate seals are placed in the wellbore to permanently seal the well. This is a challenge in deepwater wells especially in subsea wet trees. The challenge is greatly increased for wellheads without access fittings to all casing annulus sections. Wellheads should be designed with full access to all casing strings which will reduce well decommissioning costs.

Another decommissioning cost savings well design factor is to place the production packer below the top of cement in the production casing. The packer should be placed far enough below to allow sufficient space for the cement plugs needed to eventually seal off the well.

Ideally all permeable zones above the production casing show should be sealed off with cement during the drilling of the well. For the most part it is easier and less expensive to seal off these zones during the well drilling operation than during a decommissioning project.

Pulling, Cutting, and Storing the Conductor

The platform crane will not be able to lift the entire conductor. For this reason, the combination of the platform crane or rental crane and jacks are assumed in this study. If the platform has a drilling rig on board the drilling rig could be used to remove the conductors.

Once the conductor is pulled, it is cut in 40-ft sections until it is completely removed. The external cuts can be made with a cutting torch or an external cutting tool (diamond wire, abrasive or mechanical.) Selecting the best method will depend on its reliability and ease of use.

Having cut the conductor in many 40-ft sections, storing and removing the sections should be coordinated with the support vessel. The platform may not have enough area to store the large numbers of conductor sections. The platform crane can offload to the support vessel, which can then take cut sections to nearby yard for storage

2.3.3 Pipeline/Flowline Abandonment

Pipeline abandonment issues for deepwater decommissioning are directly related to the size of the line and the depths in which they are installed. Most deepwater platforms will be several miles from the onshore processing facility. This results in a pipeline that has a relatively large volume to be cleaned. Technology has been implemented to flush pipelines in water depths over 8,000 feet.

Amount of Volume Pumped Through Each Line

The volume of water used to flush and purge the pipeline has to be disposed properly since it will have some hydrocarbons mixed with the flushing fluid. The fluids pushed through the line can be received at the terminating platform and processed. The separated product (water, gas, oil) can then be sent to shore. If the terminating platform cannot process the fluids, they could be pushed to the onshore facility for processing. A less expensive solution is to pump the fluids downhole through one of the injection or non-producing wells. As a last option, the flush fluids can be collected and oil separated from the flush water. The clean flush water can be discharged and the collected oil sent to shore in Department of Transportation approved tanks or in a storage barge. Once onshore the oil can be processed and either sold or sent to a disposal site.

Cutting and Plugging the Pipeline/Flowline at Water Depths

The pipeline will be cut at each end and plugged. Due to the great depths, the conventional method of sending a diver to cut and plug the pipeline will not be an option. The solution is an ROV or a hard suit equipped with a cutting tool. Once the pipeline end is cut the ROV can plug the line.

Removing the Pipeline/Flowline

Flowlines that are suspended from floating production systems present many removal challenges. These flowlines (i.e. risers, umbilical's, SCR, etc.) must be inspected prior to removal in order to know if there are any integrity concerns. This information must be incorporated into the removal procedures to prevent any environmental or safety incidents.

New non destructive inspection tools are now available that are helpful to plan for the removal of these flow line risers. Applus RTD UK Ltd has developed a subsea inspection system which is designed to ensure subsea equipment operational integrity. This system has integrated three technologies including ultrasonic phased array and time of flight diffraction (TOFD) techniques with alternating current field measurement (ACFM) which is an industry first.

Another new subsea inspection technology (See Figure 2.24) is available from flexible pipe specialist Flexlife using it patented scanning technology [10]. Flexlife has scanned numerous risers in the North Sea. Flexlife's ultrasonic scanning technology is the first to be able to successfully scan the annulus of flexible risers and flowlines in situ with 100% accuracy. The application can detect specific locations of any flooding and scan the armor wires around flexibles to an accuracy of 0.1mm. The tool is ROV-deployed and can operate down to 3,000 meters.

Figure 2.24 Flexlife UT Riser Scanner

(Photo courtesy of Flexlife)

2.3.4 Topsides Removal – All Scenarios

Topside removal as discussed in Section 3 follows the installation process in reverse. The main issue in this phase is to make sure that the platform is ready for the HLV, i.e., the drilling rig is removed, modules are ready for removal, and that there are no fluids in the processing equipment.

Industry should place more emphasis during the initial design to design the platform in consideration of how the platform will be removed. The platforms and subsea structures should be designed so that it will be less costly and safer to remove these structures. Some techniques to reduce the time spent decommissioning the structures are:

-Eliminate the placement of grout in the top section of well conductors' annular spaces.
-Reduce the weight of mooring systems by utilizing non steel cables.
-Reduce the weight of subsea flowlines by utilizing non steel flowlines.
-Install lifting connections on the jacket that would be used during the jacket removal project.
-Design subsea trees will full ROV access to all annular spaces. This will enable testing and plugging work in all casing strings.
-Continue subsea design efforts to provide universal connections which will minimize the number of access tools required to work on different manufacturers' subsea equipment.

Platform Removal – Complete Removal Scenario

From the initial rigging requirements through the cutting, handling, loading and disposing of the jacket sections, the whole jacket removal phase presents issues that must be carefully planned and managed.

Selecting Jacket Cut Points

Identifying where the jacket will be cut will drive the jacket removal method. The jacket sections will determine the tow route and the depths the jacket must be placed to make the horizontal cuts above the waterline. The size and number of cargo barges is dependent on the number and dimensions of the cut jacket section. In addition, the jacket has to be cut in such manner that the HLV (and ultimately the onshore yard) can handle. Jacket sections must also fit on the cargo barge and be sturdy enough to make the sea voyage.

Lifting the Jacket

The jacket will be rigged, lifted, and towed to shallow water for each horizontal cut. The HLV will have to rig to either pre-installed padeyes, use pile-gripping or leg gripping tools or rig to horizontal bracing that will support the weight lifted. Each lifting point will require a tool or rigging. A spreader frame can be used so that the HLV can handle the multiple tools with the crane. Other than compliant towers, for jackets with banter or bottom dimensions, distances from leg to leg, larger than top sections, the spreader frame design would have to be adjustable since the jacket's horizontal dimensions increase with lower jacket design elevations. Depending on the HLV used, the lower jack horizontal dimensions my exceed the boom out radius of the HLV when considering lifting in one piece and the lower sections of the jacket may need to be cut and lifted in smaller pieces.

Moving and Setting the Jacket

The jacket will be towed to the pre-determined location that has the required water depth that will allow the section above water to be cut. Anchor mooring should be installed prior to commencing the decommissioning. In addition, the location selected should have the contour so that the jacket is level.

Cutting the Jacket

The method described in Section 3 assumes that the jacket is cut above water with welders. This increases the welder's risk by working them outside a fixed environment. At all times the HLV should be holding the jacket. This method is deemed far safer than cutting the jacket in-place. Cutting the jacket in-place will require the use of external cutting tools such as a diamond wire or an external abrasive cutter. In addition, the external cutting tools will have to be assisted by divers or remotely operated vehicles (ROVs).

The size and number of cargo barges is dependent on the number and dimensions of the cut jacket section. In addition, the jacket has to be cut in such manner that the HLV and ultimately the onshore yard can handle. Jacket sections must also fit on the cargo barge and be sturdy enough to make the sea voyage.

Platform Removal – Partial Removal

Identifying the jacket cut points is an important issue in planning the Partial Removal method. Selecting the optimum location will minimize the diver's and cutting tool's onsite duration. The depth at which the jacket is cut should provide a minimum clearance of 85 feet to avoid placing a permanent lighted buoy as required by the U.S. Coast Guard.

Toppling forces for each section must be calculated to confirm that the tugs selected have the capacity to topple the jacket. Another critical task is verifying that the cuts have been made. A diver or ROV should verify that each steel member is completely cut.

Platform Removal – Remote Reefing

Remote Reefing will require several engineering analyses to accomplish this phase. A weight and buoyancy take-off should be calculated to determine the actual weight (jacket, internal piles, grout, marine growth, etc.) and buoyancy. These calculations will show the needed buoyancy required and the placement of buoyancy bags or tanks to upend and tow the jacket.

Rigging and towing the jacket must also be planned since a HLV will not be used. Padeyes can be pre-welded to the jacket during the Platform Removal Preparation phase.

The tow route should be selected during the engineering review. A bottom survey of the selected tow route should be completed prior to removing the jacket. This survey will identify any obstructions on the sea floor. A new tow route can be selected if the obstruction will hinder the safe towing of the jacket to the designated reef location.

Site Clearance/Verification

No major obstacles were identified for this decommissioning phase. The Complete Removal method requires that the platform site and any location where the jacket is cut be cleared. Any trash that is retrieved from the sea floor will need to be properly disposed.

2.3.5 Decommissioning Project Challenges

Offshore platform decommissioning is a challenge under any circumstances in terms of planning and executing the work in an environmentally sensitive, safe, and economical way. In the context of the large deepwater platforms, this is particularly true. Among the issues that must be faced are:

Local Infrastructure Logistics

The Gulf of Mexico oilfield support infrastructure is extensive although located over a wide area. The majority of the infrastructure is based in Louisiana but offshore operations stretch over an 800 mile area from the Texas/Mexico border to Alabama. This large geographic size increases transportation expense to support offshore operations.

Challenging Marine Environment

The Gulf of Mexico offshore environment is challenging in many aspects due to hurricanes, LOOP ocean currents, unstable seafloor conditions, sudden storm generated winds and waves, corrosive environment and active platform marine growth. These factors require implementation of special facility design and operational procedures to ensure safe offshore operations.

Limited Availability of Equipment

There are few derrick barges in existence today, worldwide, with lifting capacities in excess of 5,000 short tons. These are generally committed to projects years in advance. New heavy lift vessels are under construction but will not be available in the near term.

The US Customs and Border Protection agency has proposed changes in interpretation of the Jones Act which would severely limit the use of foreign flagged deepwater construction vessels in the GOM. The majority of the deepwater work vessels working in the GOM are foreign flagged.

This shortage of heavy lift equipment will drive innovations both technically and commercially.

Subsea systems construction equipment is in limit supply. Standardized subsea rental systems should be available which would improve subsea decommissioning project cycle time and work performance. Since this equipment is long lead and high cost, perhaps an MMS sponsored group could facilitate this service.

Environmental Regulation Constraints

The Gulf of Mexico has an established regulatory system with a wide variety of federal, state, and local agencies which enforce them. This has a direct impact on the application of decommissioning technologies and the resulting economics.

Depth Challenges

The industry has limited experience in applying decommissioning technologies at depths beyond 400 feet. New systems and procedures will likely be required for both explosive and non-explosive severing techniques. Safety concerns and water depth limitations will limit the use of divers and promote use of remotely-operated equipment. Industry is developing new remotely operated equipment, but more robust units with greater functionality will be required to decommission the deepest structures.

One segment of the decommissioning effort that has experienced the development of new technology is well abandonment. Rigless well interventions vessels are becoming available that will enable well P&A without the use of a conventional drill rig in water depths to 10,000 feet.

Limited Artificial Reef Locations

The Gulf of Mexico's oil and gas producing states rigs-to-reef program has been successfully utilized by the oil industry and we encourage the continuation of this program. Additional reef locations could be added to the program which would reduce the expense of transporting structures over long distances to existing reef sites. Ideally these new reef sites could be located at the location of the deepwater facilities. For instance for jackets that are partially removed, the portion of the jacket in water depths >400 feet would not benefit the reefing community but the upper portion of the jacket left in place would be beneficial to the fish population. See Section 3 for Artificial Reef Programs and specifically Section 3.5 for research figures showing optimal water depths for reefing.

Information Availability

It has been found during information gathering for this study and for other studies repeatedly over the years that the older the structure the less data is available. To compensate for missing data, decommissioning assumptions are often made based on current practices. Often, as fields near depletion and are sold to new operators, sometimes repeatedly, the production data is transferred but specifics on the hardware and maintenance are not available. As decommissioning moves into deeper water these assumptions become more critical and may not be based on current methods that are currently at water depths less than 400 feet. For example documenting cement volume and annular seals during the drilling phase along with recording any other measurements that would otherwise require testing during decommissioning, would significantly reduce the cost of a P &A operation. Documentation procedures will present a challenge moving forward as the GOM matures. See the Executive Summary Recommendations Section.

Section 3 – ASSESSMENT OF DISPOSAL OPTIONS

3.1. GENERAL REQUIREMENTS FOR MATERIAL DISPOSAL

There are a number of methods for disposing of production facilities removed from the deep water Gulf of Mexico. This section will present these disposal methods in general and then discuss in detail about how they apply to specific and unique production systems.

3.1.1. Scrap Yards

There are quite a number of steel scrap yards along the Gulf Coast that receive production equipment from offshore production facilities that are being decommissioned. Scrap steel recycling is a big business, as platforms, pipelines; floating production systems and subsea production systems are brought ashore. During the year 2007, scrap steel delivered to the dock in Morgan City, Louisiana was sold to scrap dealers for about $300 per ton. Offshore platforms are cut up into 2' x 5' pieces and loaded on barges for a trip up river to steel mills in Ohio, Pennsylvania, Indiana, etc. This scrap was sold to these steel mills in 2007 for about $500 per ton. The year 2008 saw a collapse in the scrap steel market, and scrap yards charged contractors $75 per ton to unload steel platforms. This was a negative market where decommissioning contractors had to pay the scrap yard to take it off of their hands. Now in year 2009 scrap steel is bringing $0 to $100 per ton at the dock in Morgan City, and it brings about $250 when delivered up river at the steel mill for melt down into new steel. The scrap steel must be graded to eliminate galvanized steel, stainless steel, copper and plate must be graded.

An average volume of offshore platforms are being brought onshore to the scrap yards this year. Some scrap from the Gulf of Mexico goes to China, India, South Korea and Turkey, but the export market is way down in 2009 due to the recession. Southern Recycling on the water front in Morgan City, Louisiana has been in the platform recycling business for over 40 years, and they have been recycling since 1902. Their web site is at www.sorec-emr.com Pictures of this scrap yard are shown in Figures 3.1 & 2. Their 400 ton lift capacity crane unloads offshore platforms in large pieces, which are then cut up by their crew into the 2' x 5' pieces for shipment to the steel mills. Southern Recycling places some high value offshore platforms in storage with their joint venture partner Allison Marine for possible reuse as an offshore production platform. The draft requirements of this site would require the deep water structures to be cut up offshore and placed on barges. Use of floatation devices and floating the jackets to the site is not an option. You can see these resale platforms at www.AllisonMarine.net under Used Equipment.

Scrap Value Reporting

The estimates were developed in a manner that satisfies the reporting and audit requirements of Financial Accounting Standards Board (FASB) Statement of Financial Accounting Standards No. 143, "Accounting for Asset Retirement" (SFAS 143); i.e., what a willing 3rd party would consider in today's costs with no future adjustments. By this standard, scrap credit values must be treated separately from decommissioning costs. Credit for scrap in not included in this study. Certainly, there may some value for processing, production and compression equipment, but the sale of such is generally ignored in the GOM. Typically in the GOM, the derrick barge contractor takes possession of the structure when they place it on the cargo barge and realize any profit or debit from the salvage.

Figure 3.1 Southern Scrap Yard Morgan City

Figure 3.2 Southern Scarp Yard

(Photo courtesy of Southern Scrap)

There are numerous other sites along the gulf coast of varying sizes that could be used as scrap facilities, but Southern Recycling would be better suited to handle the jacket tonnage included in this study. The Gulf Marine Fabricators facility in Ingleside, Tx. though not configured as a scrap facility could also be used as a disposal site or a site to reconfigure jackets for further use. See Figures 3.3 & 4. The draft requirements would allow use of floatation devises and floating the jackets to their deep water facility for some of the jackets included in this study. For the larger ones, this would not be an option. For example, the Bullwinkle structure in 1348’ water depth has a jacket base dimension of 300’ X 350’ and even partially submerged using floatation devices, the structure would exceed the 45’ minimum channel draft.

Figure 3.3 Gulf Marine Fabricators Yard

(Photo courtesy of Gulf Marine)

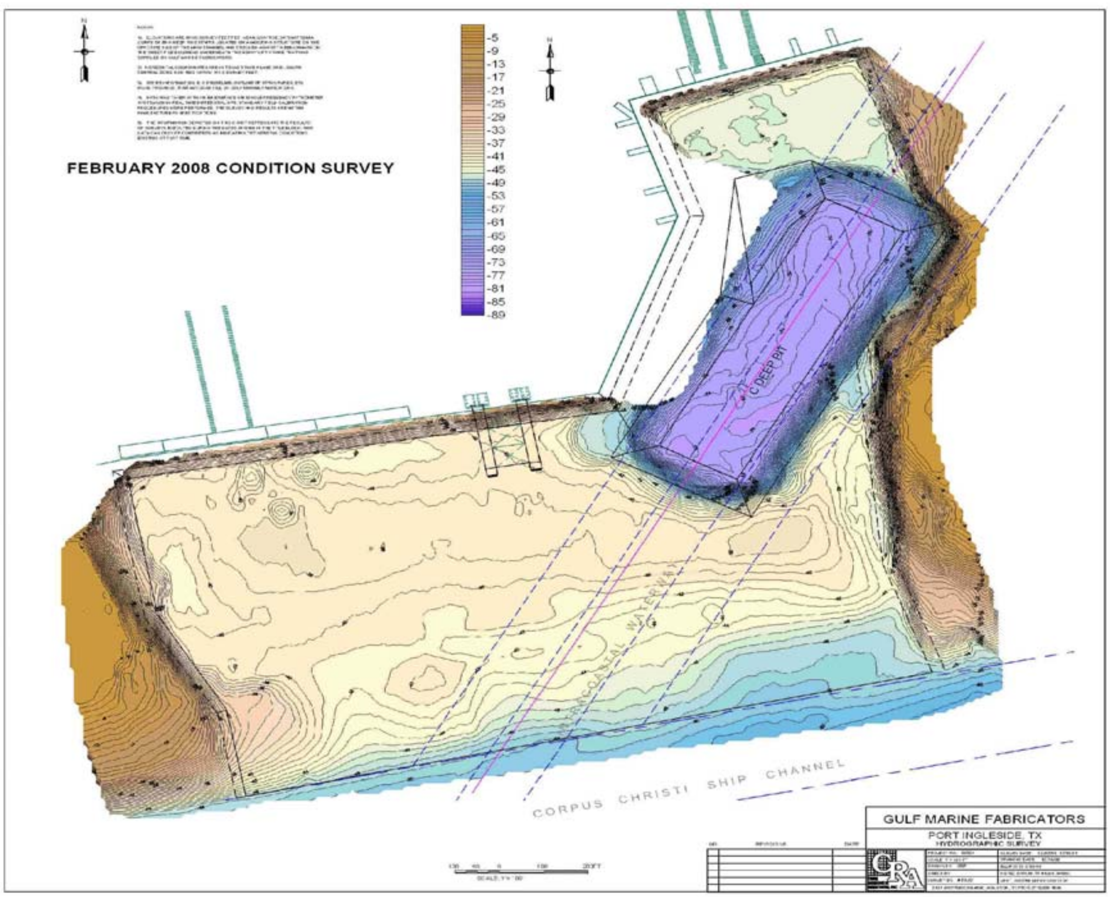


Figure 3.4 Gulf Marine Fabricators

(Drawing courtesy of Gulf Marine Fabricators)

3.1.2. Reefing

Many large offshore platform jacket sections are placed in designated artificial reef locations in the Gulf of Mexico offshore Texas, Louisiana, Mississippi, Alabama and Florida. Permits are required for placing jackets in these locations by each state reefing commission, the MMS, the U S Coast Guard and the U S Army Corp of Engineers. These artificial reefs create under water habitat for fish. This increases fish populations for sport and commercial fishing and support an infrastructure of numerous recreational diving ventures.

For fixed structures shown in Figures 3.5 through 3.7, the decks would normally be removed and taken to shore for disposal. The jackets would be candidates for possible reefing. Tethered and moored structures in Figures 3.8 through 3.11 would normally be removed and transported to shore, except the hulls on Spar platforms shown in Figures 3.5 and 3.10 could be considered as possible candidates for reefing.

The state programs are presented in detail in the Reefing section later in this report and the effective reefing communities are discussed in Section 3.5.

3.1.3. Reuse of Production Facilities

There is an increasing trend towards salvaging and reusing all types of offshore production facilities. This includes:

- Well Protector Platforms
- Production Platforms
- Tension Leg Platforms
- Semisubmersible Production Units
- Spars
- Floating Production Storage & Offloading Systems (FPSO)
- Subsea Wells
- Subsea Pipelines & Umbilicals

These systems are shown in the following diagrams so that we can better understand how they are installed, decommissioned or reused.

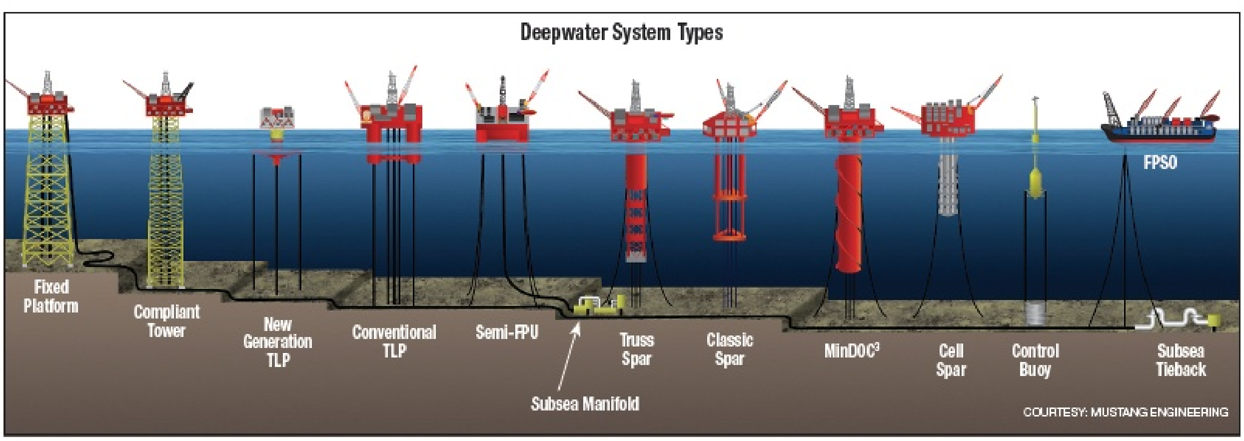


Figure 3.5 Deepwater System Types

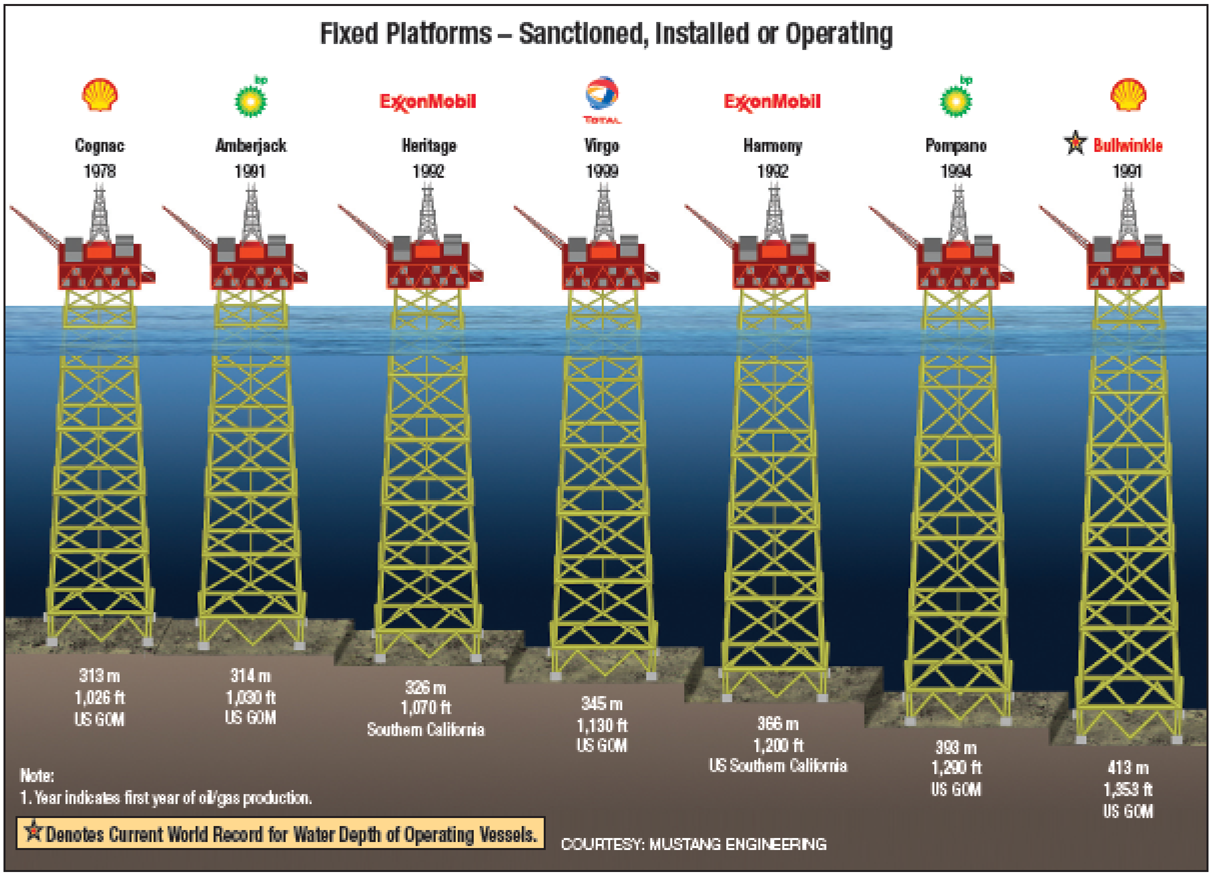


Figure 3.6 Deepwater Fixed Platforms

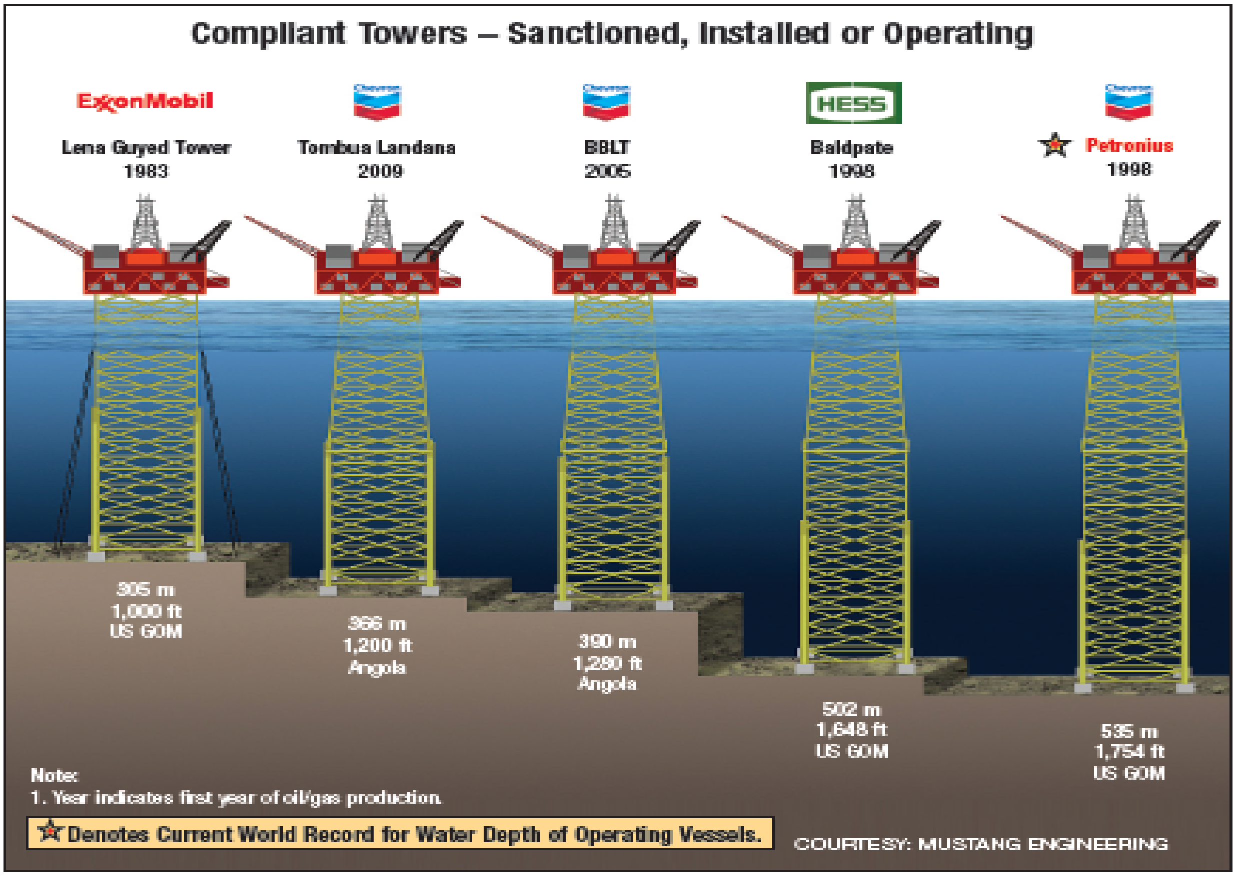


Figure 3.7 Compliant Towers

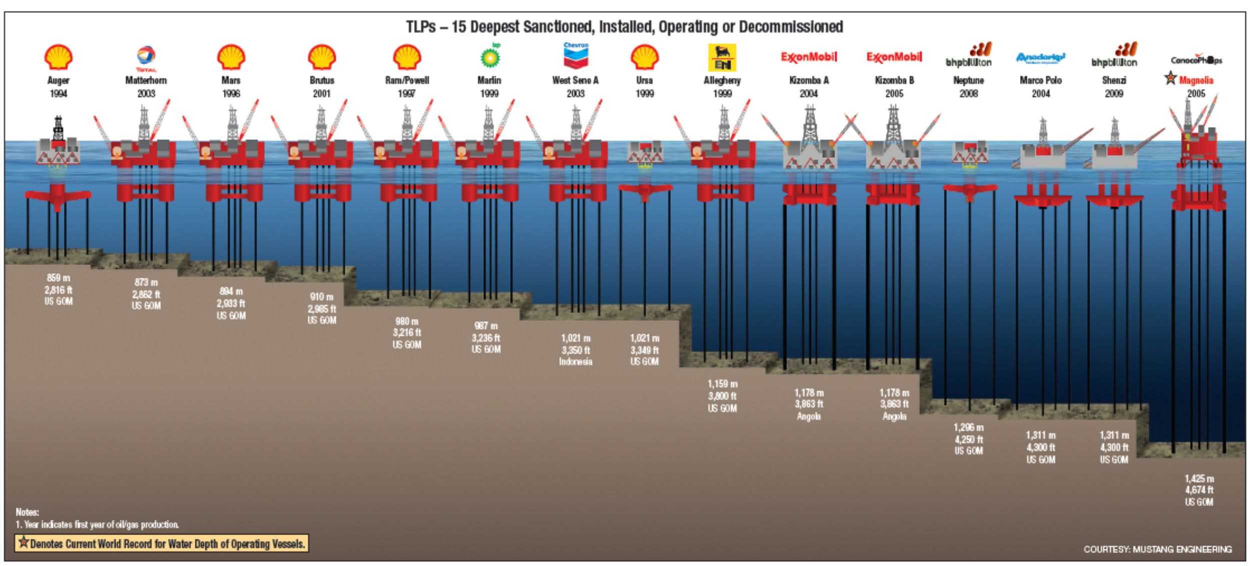


Figure 3.8 TLP's

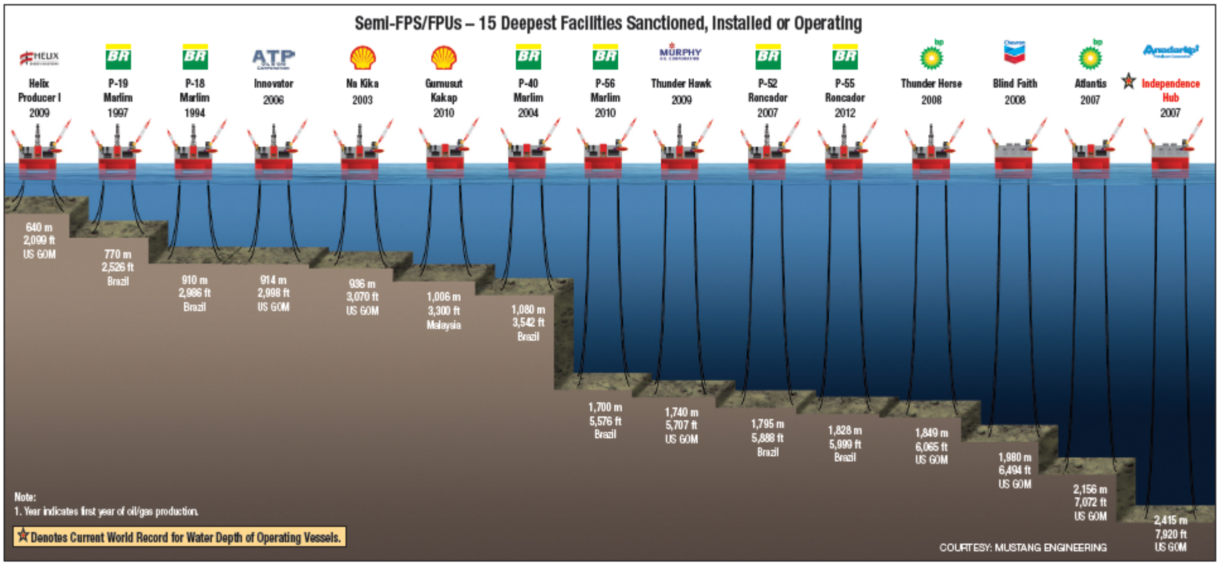


Figure 3.9 Semisubmersible Facilities

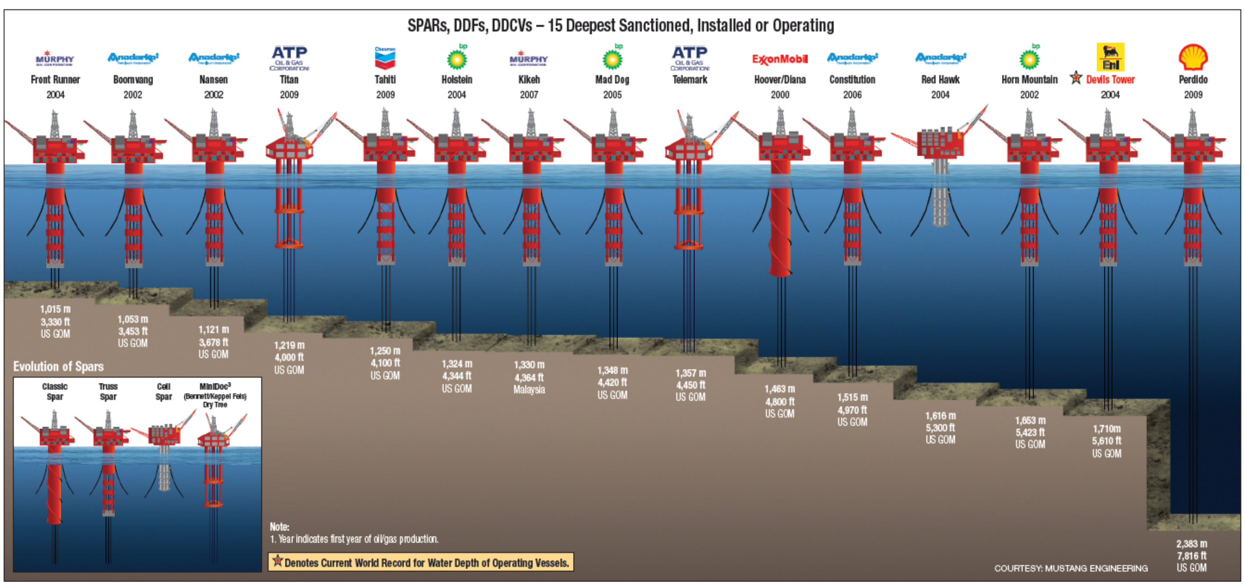


Fig 3.10 SPAR's

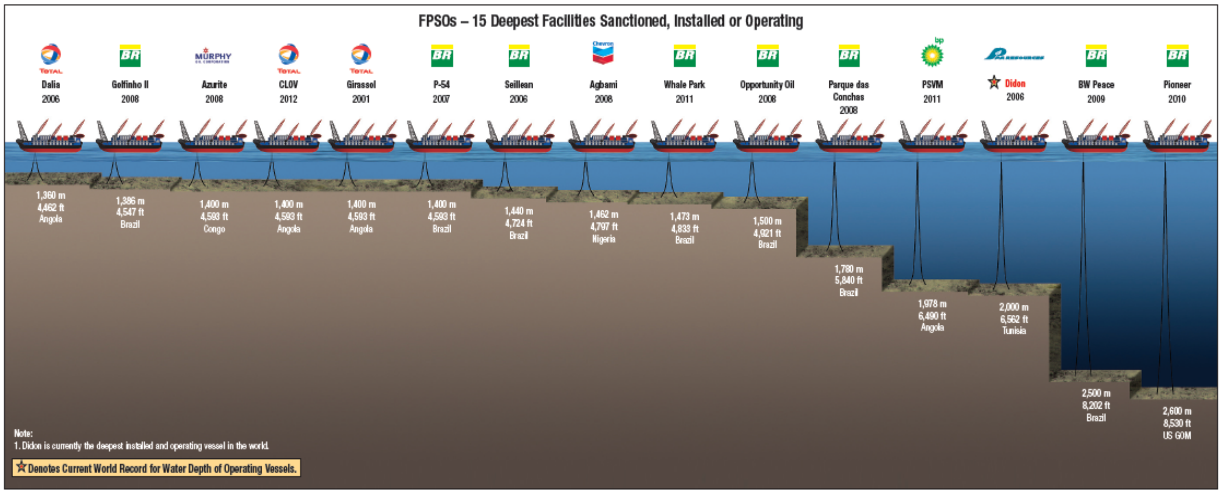


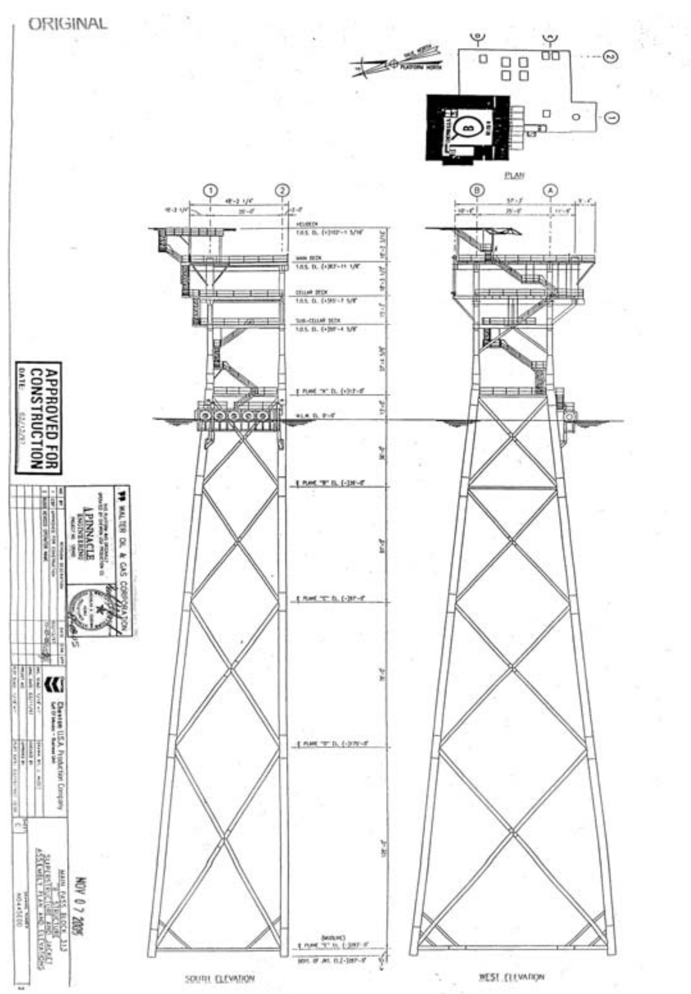
Figure 3.11 FPSO's

3.2. SPECIFIC DISPOSAL REQUIREMENTS FOR STRUCTURES

3.2.1. Fixed Jacket Platforms

Generic fixed platform decommissioning methodology and assumptions are presented in Section 5 of this report.

Figure 3.12 Typical 4-Pile Platform



This section presents typical fixed platform decommissioning methods and options, including several conceptual methods, and possible disposal options and the options selected to provide cost estimates in this study. Estimated decommissioning costs are presented in Section 4.

Offshore well protector platform and production platform decks and jackets are typically dismantled offshore using decommissioning crews. First they thoroughly clean the deck section and the production equipment inside and out. This means cleaning and removing any petroleum or chemical residue from the piping, production separators, test separators, heater treaters, glycol units, pumping units, compressors, etc. This cleaning frequently takes a week or more, depending on the size and complexity of the production deck. All of the wells are plugged and abandoned according to MMS guidelines, and the conductor pipes are cut off with abrasives or explosives a minimum of 15 feet below the mud line. Pipelines in federal waters are flushed thoroughly, disconnected and the ends are buried three feet Below Mud Line (BML) typically under sand bags or concrete type mats.

Next a derrick barge moves along side of the platform and removes any equipment that may interfere with the rigging configuration that will be use to remove the deck. The derrick barge rigs to the deck, severs the deck from the jacket with torches and lifts off the well protector or production deck section sets it on a cargo barge. Lift Boat derrick barges are used in shallow water for removing small deck sections with relatively small 75- 100 ton capacity cranes. This study is dedicated to deep water over 400 feet with large platforms, so large floating derrick barges are required for heavy lifts. A derrick barge is usually held in place with a 4 to 8 anchor spread mooring system, 2" or larger woven wire cables and 25,000 pound anchors set several thousand feet out from the barge. The decks are typically lifted off in one piece for 4-pile decks or cut up into sections for removal for 8-pile or larger decks. The decision to cut the deck into smaller sections will be dependent on the lifting capacity of the derrick barge selected. For heaver lifts in the 5,000 st and larger range, a Dynamically Positioned Semi Submersible Crane Vessel (SSCV) is used. See the pictures of a typical Lift Boat, Anchored Derrick Barge and SSCV in figures 3.13 through 3.15.

3.2.2. Lift Boats

Figure 3.13 Lift Boats typical water depths <250 ft.

3.2.3. Derrick Barge

Figure 3.14 Anchored Derrick Barge

Figure 3.15 Heerema SSCV Thialf
(Photo courtesy of Heerema)

Fixed Platform Removal Options

After the deck sections of a platform have been removed, the jacket must be removed either in a single lift or in multiple lifts. The number of lifts is dependent on the lifting capacity of the crane barge selected. For cost estimating purposes in this study, multiple lifting methods with various crane barges were evaluated to determine the most economical method. The following are removal options for jackets:

1. Complete Removal in a single lift
2. Cut jacket into smaller sections in place (in-situ) and remove
3. Deballast the jacket and tow the jacket to consecutively shallower water locations where the top sections are removed until the bottom section can be removed
4. Tow the jacket to a reef site and place the jacket on the seabed
5. Topple the jacket in-situ as a reef
6. Removing the top 85' of the jacket and leaving the bottom section in-situ as a reef
7. Cutting the top 85' of the jacket off, placing it on the seabed next to the jacket and leaving the jacket as a reef

Removal methods 1 and 3 are considered in the scope of this study for cost estimating purposes. Removal methods are discussed in Section 5.7 of this study. Estimated decommissioning costs are presented in Section 4. Additional conceptual methods are presented in Section 5.7 and conceptual decommissioning comparison costs are presented in Section 4.

Bullwinkle is the deepest conventional fixed platform at 1300+ feet of water in the Gulf of Mexico. The jacket piling and well conductors would be internally cut off 15 feet below the mud line using abrasives or explosives. The conductors are severed and removed either prior to the derrick barge arrival or during the platform removal operations. The jacket platform is typically lifted out of the water and placed on board an ocean going cargo barge for transport to a shore based steel scrap yard for recycling. The piling and well conductor pipe are also taken to the scrap yard.

An alternative to a conventional fixed jacket type platform is the compliant tower which has a long slender jacket in deep water with guide wires for side sway horizontal stability, like a television tower on land. The Petronius compliant tower stands in 1754 feet of water in the Gulf of Mexico. An alternative to the conventional derrick barge is the VERSABUILD catamaran lifting barge in that is quite active in the Gulf of Mexico for removing hurricane damaged wreckage from the ocean floor. VERSABUILD's "Bottom Feeder" is currently rated at 4,000 st. as shown in Figure 3.16. It typically picks up decks and jackets sections that lie on the ocean floor after a hurricane. VERSABUILD is currently constructing a similar lifting system to be rated at 10,000 st. as shown in Figures 3.17 to 3.19.

Figure 3.16 Versabar Bottom Feeder

(Photo and Drawings courtesy of Versabar)

Figure 3.17 Versabar 10,000 ton Bottom Feeder

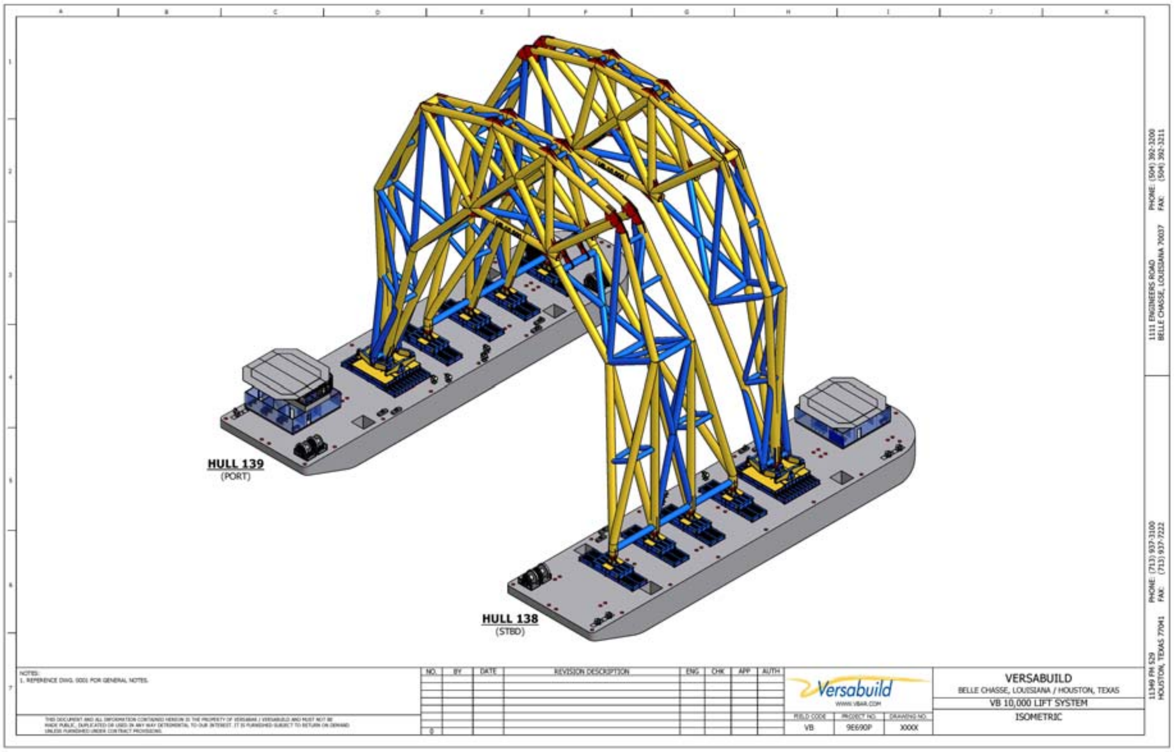


Figure 3.18 10,000 ton Bottom Feeder

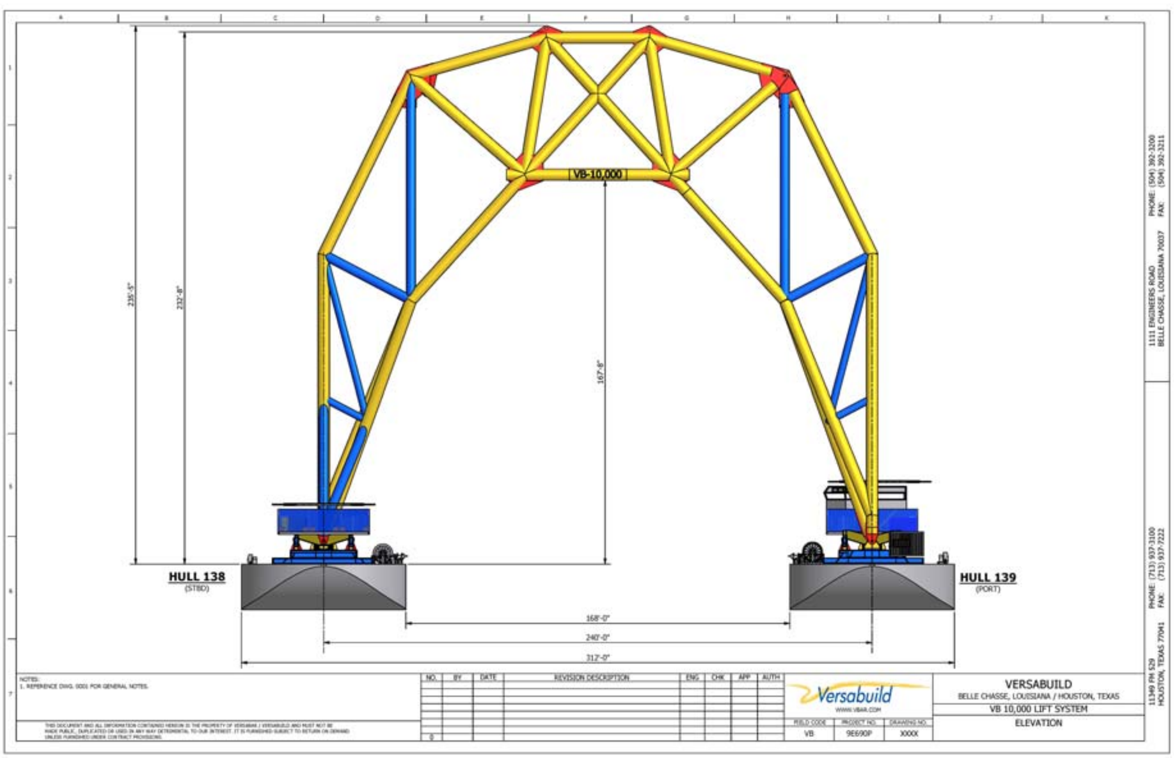
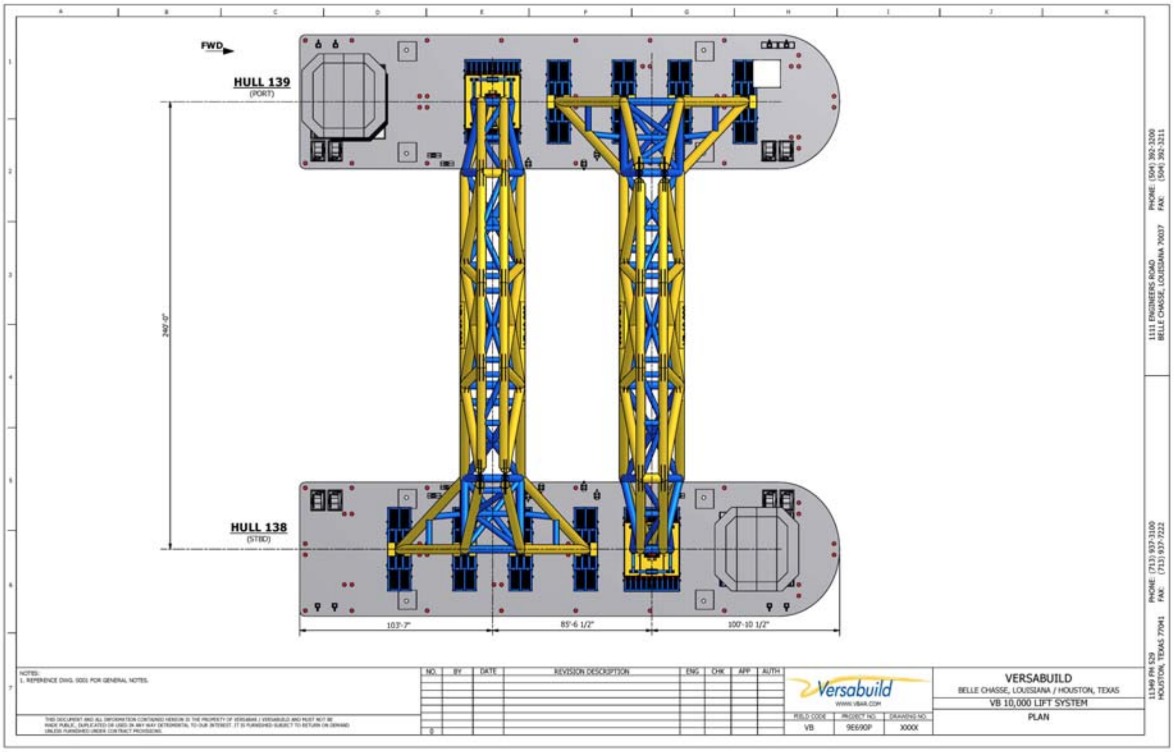


Figure 3.19 Versabar Bottom Feeder



The disposal method used for cost estimating purposes in this study was complete removal the deck and jacket to cargo barges that are transported to a GOM shore scraping facility. Other options for removal are presented in Section 5.7.

An alternative to bringing deep water jackets to shore for recycling is to reef them in designated reef sites in water depths from approximate 200 to 400 feet depending on the jacket base dimensions to maintain a minimum 85 feet navigation clearance to the surface. Production decks are generally not reefed due to potential chemical residues. Placing the jackets in designated reef sites or Special Artificial Reef Sites (SARS) increases fish populations for sport and commercial fishing. All states bordering the Gulf of Mexico have reefing programs, and this is covered in detail in the REEFING section of this report.

Removal Using Conceptual Methods

Floatation Devices

Floatation devises have recently been used in the North Sea to remove the Frigg DP2 platform. This is discussed in greater detail in Section 2. Similar devices could be developed for use in the GOM.

As an alternative, in lieu of using heavy lift vessels, deep water jackets could be removed with floatation devices where the jacket is rotated to the horizontal position and transported to a shallow water location of the Texas coast were bottom conditions would allow the jacket to be placed on the seabed. This method is presented in Section 2 with estimated conceptual costs presented in Section 4. The jacket could then be cut up by divers using various severing methods, including explosives, sheers, mechanical, etc. and placed on cargo barges with the use of smaller crane vessels than would be necessary for offshore severing and removal. The lifting capacity required would be dependent on the size and tonnage that the jacket is sectioned into.

Twin Marine Lifting Vessels

At the time of this report, SeaMetric has advertised that they are building a Twin Marine Lifting Vessel system that well have a lifting capacity of 19,842-22,046 tons without the height and width restrictions that are inherent with crane heavy lift vessels. This method could allow the jackets to be transported by the twin system or by placed on cargo barges and transported to a shore facility for refurbishment or disposal. Some of the challenges here would be:

- Engineering the correct rigging, attachment points and lifting sequence
- Configuring a multi cargo barge layout for the jacket for the larger dimensioned jackets in the GOM
- Assessing transportation routes to handle jacket / barge dimensions

This SeaMetric lifting system is presented in Section 2 with estimated conceptual costs presented in Section 4.

3.2.4. Tension Leg Platforms

There are quite a few Tension Leg Platforms (TLP) in the Gulf of Mexico. The Magnolia TLP, owned by Conoco Phillips, floats in 4670 feet of water is the deepest to date. These floating production systems have buoyant hulls containing a drilling / work over rig, production facilities, utilities and crew quarters. Oil and gas production is pipelined to shore just like a jacket or compliant tower platform. You can see sketches of various TLPs in the pictures in this section. The buoyant main hull has several hollow columns that extend well below the water line. Ballast water can be added or subtracted from these columns to adjust the tension in the vertical tension legs that tie the buoyant hull to the ocean floor. So far one TLP has been lost in a hurricane in the Gulf of Mexico and one has been decommissioned. For the purpose of this study, it is assumed that the driven piles or suction piles anchoring the structure to the seabed will remain in place, but the chain, cable and or steel tubulars connecting to the TLP will be removed. The upper chain sections were estimate removed with the HLV during hull removal. Providing the TLP has sufficient storage capacity, the chains could also be lifted with the TLPs mooring system. Cables were estimate removed with anchor handling vessels with twin wench spools. The tendons were estimated removed with the HLV but could also be removed by spooling on a pipelay barge. The risers were estimated removed with the HLV but could also be removed by spooling on a pipelay barge.

Figure 3.20 TLP

The basic method for removing a TLP is as follows:

- Plug and abandon all of the wells
- Flush the pipelines to shore, disconnect and bury the ends
- Shut down, decommission and clean all top sides production equipment
- Remove the drilling rig
- Ballast down the hull to slacken the tension leg tendons
- Disconnect the tendons from the hull
- Drop these tendons to the ocean floor
- Disconnect/ cut tendons loose from anchorage at the ocean floor with Remotely Operated Vehicle (ROV)
- Retrieve the tendons using an ROV and a dynamically positioned derrick barge
- The deballasted buoyant hull can then be floated and towed to near shore for reuse or scrapping
- The tension legs extend well below the water line so it cannot be docked easily
- Docking at Ingleside, Texas is a potential decommissioning location
- A TLP could be dry towed on a barge to Mexico, China, Korea, India for scrap

Figure 3.21 Conventional TLP

The MiniTLP (MTLP) is of an alternate design as shown in figure 3.22. The typical hull is a single column with three radial tapering pontoons that are anchored to the seabed by neutrally buoyant steel tubular tendons. Some of the hulls were installed with the use of installation aids on the pontoons. Where the aids are removed, this will present a challenge as the aids will need to be re-fabricated and installed or an alternate means of removal will need to be presented. For the purpose of this study, it is assumed that the, fluke anchors, driven piles or suction piles anchoring the structure to the seabed will remain in place, but the chain, cable and or steel tubulars connecting to the MTLP will be removed.

Figure 3.22 Mini TLP

The basic method for removing a MTLP is as follows:

- Plug and abandon all of the wells
- Flush the pipelines to shore, disconnect and bury the ends
- Shut down, decommission and clean all top sides production equipment
- Remove the drilling rig and remove the deck
- Ballast down the hull to slacken the tension leg tendons
- Disconnect the tendons from the hull
- Drop these tendons to the ocean floor
- Disconnect/ cut tendons loose from anchorage at the ocean floor with Remotely Operated Vehicle (ROV)
- Retrieve the tendons using an ROV and a dynamically positioned derrick barge
- The hull can then be floated or placed on a cargo barge and transported to near shore for reuse or scrapping
- Docking at Ingleside, Texas is a potential decommissioning location
- A MTLP could be dry towed on a barge to Mexico, China, Korea or India for scrap

Figure 3.23 TLP Installation

3.2.5. Semisubmersible Production Units

The SEMISUBMERSIBLE PRODUCTION UNIT is basically a floating drilling and production hull similar to a semi-submersible drilling unit. Its anchor lines connect it to the ocean floor in deep water, extending out diagonally to ocean floor anchors for horizontal stability. These units are currently operating in a water depth range of 2000 to 8000 feet. The INDEPENDENCE HUB floats in 7920 feet of water in the Gulf of Mexico. These units can be towed away to a shipyard in the vertical position for decommissioning. Photo below is INDEPENCENCE towed to installation. For the purpose of this study, it is assumed that the piles anchoring the structure to the seabed will remain in place, but the chain and cable connecting to the SEMI will be removed. The upper chain sections were estimate removed with the HLV during hull removal. Providing the TLP has sufficient storage capacity, the chains could also be lifted with the TLPs mooring system. Cables were estimate removed with anchor handling vessels with twin wench spools. The risers were estimated removed with the HLV but could also be removed by spooling on a pipelay barge.

Figure 3.24 Independence Hub Semi

Steps for decommissioning include:

- Plug and abandon all of the wells
- Flush the pipelines to shore, disconnect and bury the ends
- Shut down, decommission and clean all top sides production equipment
- Keep the drilling rig on board
- Slacken the tension in the anchor lines by reeling out the anchor winches
- Disconnect/ cut anchor lines loose from anchorage at the ocean floor with an ROV
- Retrieve the anchor lines using anchor winches on board
- The buoyant hull can then be floated to a ship yard for reuse or scrapping

3.2.6. SPARS

The SPAR is basically a floating drilling and production deck attached to a long slender column that extends far below the ocean surface. Vertical tendons connect it to the ocean floor in deep water, with guide wires extending out diagonally to ocean floor anchors for horizontal stability. There are several types of Spars as shown in Figure 3.5. The Shell PERDIDO Truss Spar floats in 7816 feet of water in the Gulf of Mexico. SPARs will be more difficult to decommission than a TLP, because they cannot be towed away in the vertical position for decommissioning. The deck will be removed and the hull will have to be deballasted, rotated horizontally and placed on a cargo barge(s) for the smaller <14,000 tons hulls and transported for reuse or scrap. For hulls greater that the lifting capacity of the current HLV fleet, the hull will need to be towed deballasted and towed horizontally to a scrap or reuse facility. For the purpose of this study, it is assumed that the piles anchoring the structure to the seabed will remain in place, but the chain and cable connecting to the Spar will be removed. The upper chain sections were estimate removed with the HLV during hull removal. Providing the TLP has sufficient storage capacity, the chains could also be lifted with the TLPs mooring system. Cables were estimate removed with anchor handling vessels with twin wench spools. The risers were estimated removed with the HLV but could also be removed by spooling on a pipelay barge.

Steps for decommissioning include:

- Plug and abandon all of the wells
- Flush the pipelines to shore, disconnect and bury the ends
- Shut down, decommission and clean all top sides production equipment
- Remove the drilling rig
- Remove the deck section
- Ballast down the hull to slacken the tension leg tendons
- Disconnect the vertical and diagonal tendons from the hull
- Drop these tendons to the ocean floor
- Disconnect/ cut tendons loose from anchorage at the ocean floor with an ROV
- Retrieve the tendons using an ROV and a dynamically positioned derrick barge
- The buoyant hull can then be upended and towed in the horizontal position floated to a reef site or near shore for reuse or scrapping
- The hull extends well below the water line so it cannot be docked easily
- Docking at Ingleside, Texas is a potential decommissioning location
- A SPAR could be dry towed on a barge to Mexico, China, Korea, India for scrap

3.2.7. Floating Production Storage & Offloading Systems (FPSO)

FPSOs have been producing offshore around the world since the 1970s. These are typically 25 year old oil tanker ships that have been converted to production units by adding oil production facilities on the

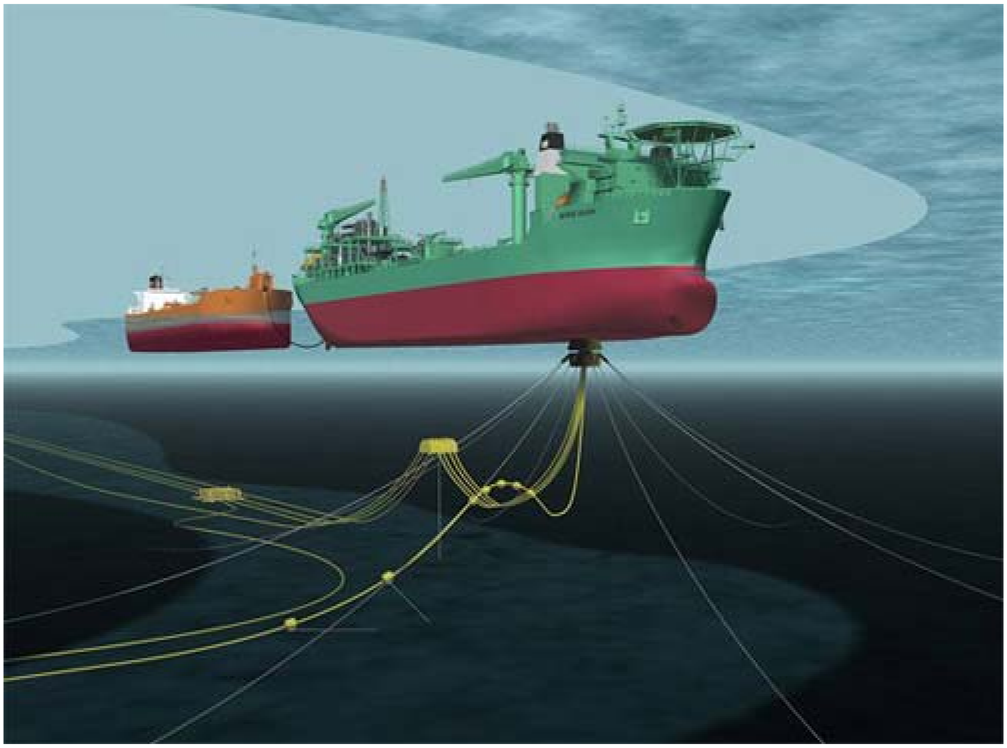


Figure 3.25 FPSO

(Courtesy of Petrobras America)

main deck of the ship. The ships are spread moored or turret moored over a remote offshore oil field. These units usually produce in isolated offshore areas where there is no market for oil and gas within pipeline range. The oil, gas and water production are separated with the on board production facilities. The oil is stored in the oil storage tanks in the ship, with an inert nitrogen blanket over the oil. Water is separated out of the production train and small amounts of oil are separated out of the water with a hydro-cyclone to about 15 to 25 parts per million (ppm). The cleaned water is then dumped overboard into the ocean, or the water may be re-injected back into the oil reservoir. The natural gas is separated from the oil and water production and it is used to fuel electrical generators on board the FPSO ship. Excess gas that is not used in the generators is usually flared. Gas production cannot be flared in the Gulf of Mexico, except for a short term well test. This is why FPSOs are not used in the Gulf of Mexico. No flaring! Oil and gas production must go to a shore based market. There are no FPSOs currently operating in the Gulf of Mexico, but Petrobras plans to introduce the first one (see figure 3.25) in 2011.

FPSOs have a high re-use and may be used to produce 3-4-5 fields in a production life of 20-25 years. They are usually self propelled and easy to move from one location to the next. There are quite a few operating offshore West Africa. They are quite easy to be modified or adapted from one oil field to the next. Therefore they are not often decommissioned. They can be easily scrapped by bringing them to dock side.

3.2.8. Subsea Wells & Tie Backs

Central offshore production facilities frequently gather production from far reaches of an oil and gas reservoir with isolated vertical wells, rather than by slant hole drilling from the central facility. Vertical wells may be drilled many miles away from the central facility and production is gathered with a series of subsea pipelines and electro hydraulic well control umbilicals as shown in Figures 3.26 and 3.28. Each well has a tree on the ocean floor and it is remotely controlled by the umbilical from the central facility. The control umbilicals are used to transmit hydraulic control fluids, chemicals, and electrical power signals to operate and monitor subsea wells and manifolds for the development of the oil field. Mechanical intervention with the subsea well tree is done with the use of a Remotely Operated Vehicle (ROV) and is discussed further in Section 2. Likewise a floating drilling rig can be moved directly over the subsea well to re-enter the well.

When the field is depleted and no longer economic, then a work over rig can plug and abandon the well and remove the well tree, with the assistance of an ROV as needed. The subsea well head tree must be decommissioned and removed above the template. The deep water template can be left in place nearly flush with the sea floor. The trees are frequently reconditioned in a repair shop and put out on another well. They are highly reusable. Otherwise they can be cut up for scrap steel. Trees up to 15,000 psi operating pressure are in use.

Over 4000 subsea wells have been installed in the GOM as shown in Figure 3.27. The newer subsea wells and supporting subsea structures have been designed as ROV friendly. Many of the older subsea wells may prove more difficult for ROV decommissioning operations. For the purpose of this study, it is assumed that subsea wells will be removed, subsea structures anchored to the seabed will remain in place and subsea structures that are attached to or stabbed over the anchored structure will be removed.

3.2.9. Subsea Pipelines & Control Umbilical’s

Subsea pipelines and control umbilicals that tie a subsea well tree back to a central production facility are abandoned by:

- Shut in the well
- Flush the pipeline with sea water pumped from the central production facility to the tree and returned to the central production facility in a pipeline loop
- Disconnect the pipeline from the subsea tree
- Plug and bury the pipeline end with sand bags or concrete type mats
- Disconnect, plug and bury the pipeline with sand bags or concrete type mats at the central production facility
- Disconnect and reel in the control umbilical and recondition it for reuse
- Flush, disconnect, plug and bury the umbilical ends with sand bags or concrete type mats and leave the umbilical in-situ would be an option with approval, if not reused

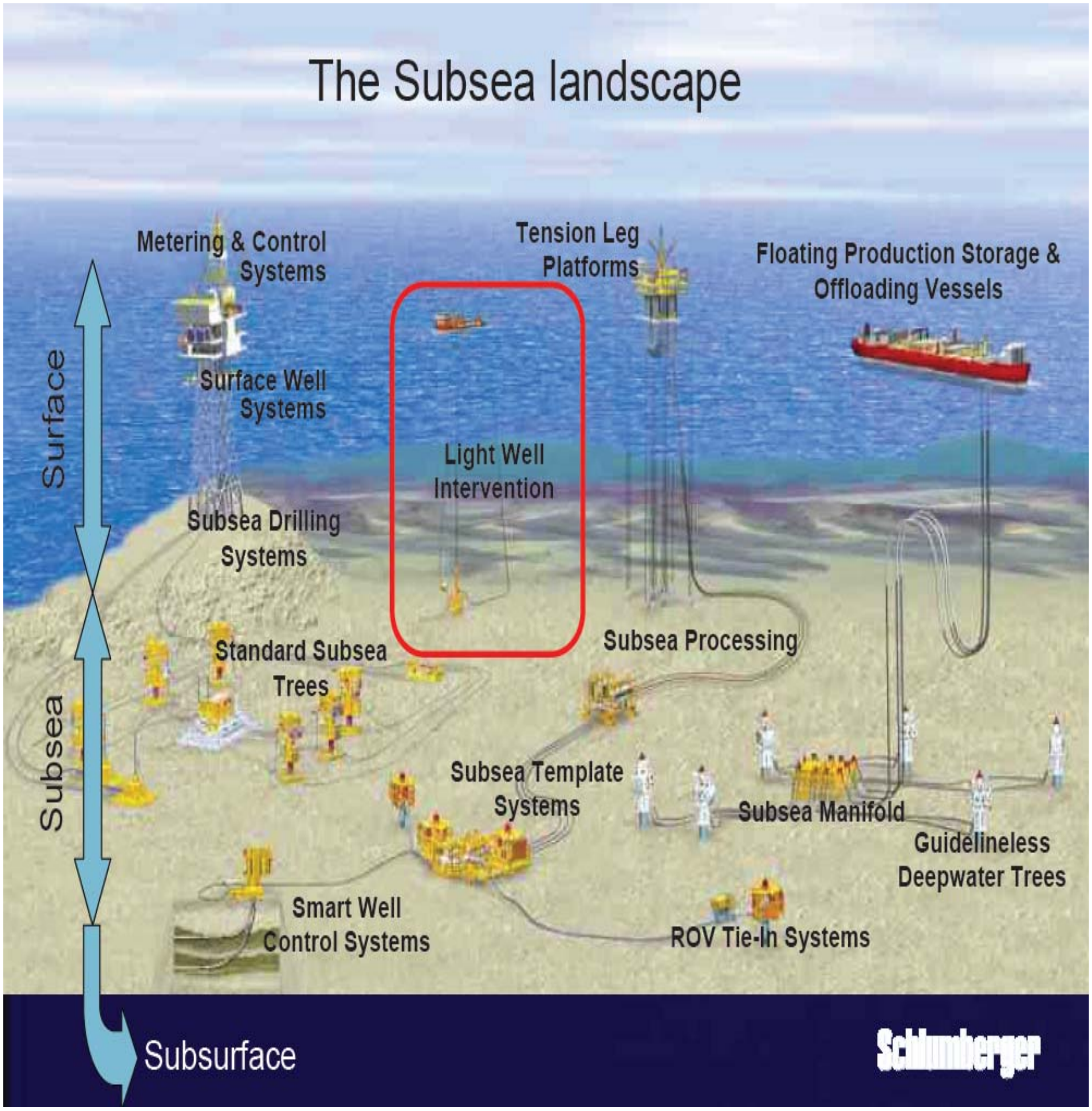
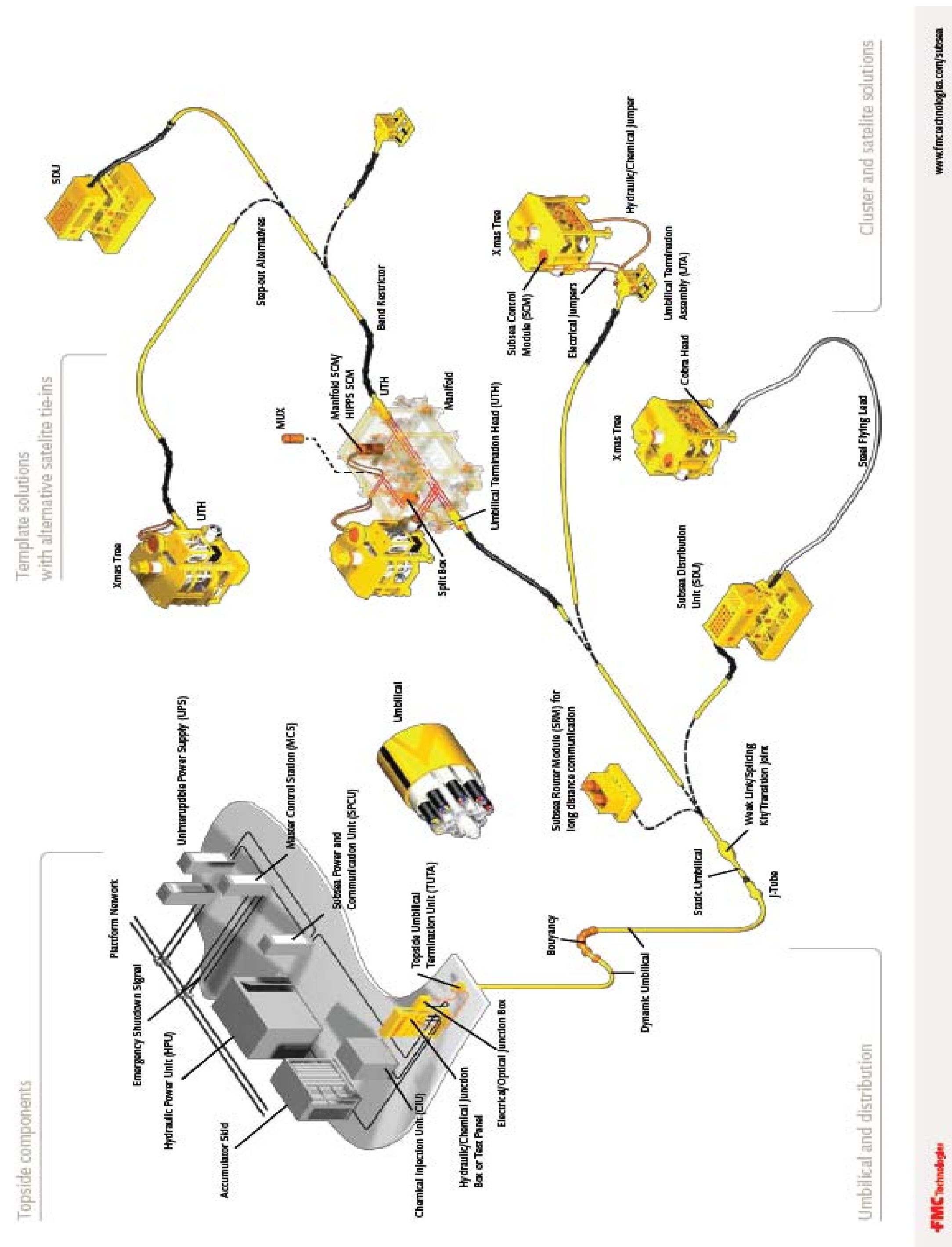


Figure 3.26 The Subsea Landscape
(Drawing courtesy of Schlumberger)

Figure 3.27 Growth in Subsea Developments
(Drawing courtesy of Schlumberger)

Figure 3.28 Subsea Templates

(Drawing courtesy of FMC)



3.3. REMOVAL & REUSE OPTIONS

There are a number of options for the reuse of offshore production facilities, rather than scraping them. Some of the Mobil Offshore Production Systems (MOPU) has been reused on 4 or 5 different fields over a 25 year life of the system. The capital cost per location steadily drops as facilities are reused, and the construction and installation time goes from a year or two to several months. Recycling makes good sense.

3.3.1. Platforms

Conventional jacket type platforms have been reused for many years in the Gulf of Mexico, but that is in steep decline as shallow water fields are becoming depleted. Major oil companies sell off depleted offshore fields to smaller independent producers who squeeze the last drops out of the fields, at their lower operating costs. The majors want to get rid of the decommissioning liability. Some of the smaller independents go bankrupt over the cost of decommissioning production facilities in totally depleted uneconomic fields. Shallow water fields have been depleted, so the market is drying up for reuse of these platforms. There are nearly 2000 jacket platforms that are due to come out of federal waters in the Gulf of Mexico. There is a market for reuse of jacket platforms in international locations where reserves are plentiful in shallow shelf waters. West Africa has plentiful reserves in shallow water, so platforms from the Gulf of Mexico can be reconditioned and modified for relocation to places like Nigeria, Equatorial Guinea, Gabon, Angola, etc. There are a few Compliant Towers that are specialized and unique for their specific locations, and they would probably head to the scrap yard. These structures could also be candidates for the reefing programs. Towing these deep water structures to the shallower water depths that would benefit a reef community would only be economical where the towing resource is by other than the HLV resource. Flotation bladders and tow tugs would be an option that would need to be developed.

3.3.2. Tension Leg Platforms

TLPs are fairly easy to reuse in the Gulf of Mexico or international locations out to perhaps 5000 feet of water. Change in water depth for relocation involves changing the length of the tendons and installation of anchoring systems on the new location. Reuse of a TLP on multiple fields is economically much more attractive than scraping.

3.3.3. Semisubmersibles

These units have a market for reuse in the Gulf of Mexico out to perhaps 8000 feet of water, and 10000 feet on some international locations with milder storm criteria than the Gulf of Mexico. Like the TLP, they can be towed to a new location, with adjustments to their mooring system.

3.3.4. SPARS

These are more difficult to reuse, because they are difficult to move around. The long slender under water column cannot be towed around in the vertical position. It has to first have the drilling and production deck cut off and then the hull must be deballasted and then rotated into the horizontal and loaded on a very large ocean going cargo barge or a submersible cargo barge or left in a semisubmersible position for towing. The anchor lines and sea floor anchoring systems can be modified for the new relocation. SPARS can be reused out to 8000 or 10000 feet of water. This is an expensive piece of equipment, so it is a wasted investment to send it to a scrap yard. Also it is difficult to get this huge long slender column physically into a scrap yard. A possible option in the GOM would be a facility in Ingleside, Tx. area. These structures could also be candidates for the reefing programs but present the same economical considerations as fixed platforms above.

Deballasting on these structures may present challenges. Where the ballast on these structures is other than water, for instance a barite slurry or iron ore that sets up in solid form, the ballast compartment would need to be separated from the Spar. This would need to be performed in a controllable procedure either offshore or, preferably safer and more economically feasible, in shallow water.

3.3.5. Floating Production Storage & Offloading Systems (FPSO)

FPSOs are deployed on many international locations, but so far they have not been used in the Gulf of Mexico, because flaring of natural gas is not allowed here. A typical FPSO is a 25 year old retired oil tanker that has been converted into an FPSO for an additional 20-25 years of production service as an FPSO. They are comparatively easy to relocate from one field to another. Their 8 anchor spread mooring or turret mooring system can be picked up and relocated to the next field. FPSOs often produce 4-5 fields in their life. They would have to be in really bad shape to consider a one way trip to the scrap yard. They usually go into a ship yard to replace some hull steel; modify production equipment, general repairs, painting and class recertification between assignments.

3.3.6. Subsea Well Heads

Subsea well heads/ trees and supporting subsea structures are routinely decommissioned and removed from their initial location. They are sent to their manufacturer's shop for reconditioning and then reused on the next location. They can be reused in the Gulf of Mexico and internationally. The newer deep water units are ROV friendly so that a diver is not required for normal intervention tasks.

3.3.7. Subsea Pipelines & Umbilical's

Rarely is subsea pipelines reused. They are usually flushed with sea water, disconnected and the ends buried/ abandoned in place either three feet below mud line or with sand bags or concrete type mats. Occasionally small diameter flow lines have been reeled up and relocated to a new location. Electro hydraulic umbilical control cables are more frequently retrieved reeled up, reconditioned, tested, recertified and reused.

3.4. REEFING PROGRAMS

There are artificial reefing programs in place across the Gulf of Mexico for improvement of sport and commercial fisheries. Decommissioned offshore production facilities are thoroughly cleaned and then they can be placed in designated reef locations, under permit from the states. There are reefing programs offshore:

- Texas
- Louisiana
- Mississippi
- Alabama
- Florida

Reef locations are generally in water depths ranging from 100 to 300 feet as shown in fish concentration vs. water depths figures below. There must be sufficient clearance above the top of the reef so that there is no interference with the draft of large cargo ships, cruise liners, commercial and sport fishing boats. This is currently regulated at a minimum of 85 feet clearance from the top of the reef structure to the surface unless special wavers are granted. Fisheries are benefitted most in this 100 to 300 feet water depth range, where there is optimum sunlight, oxygen and nutrients. A general overview presentation of Artificial Reefs is presented in the Appendix Section 5.10. Details of each state's reefing program are presented below.

The major differences in state programs is that the Louisiana program has designated reef planning areas and has authorized special artificial reef sites (SARS) outside of these areas. Texas does not have designated reef planning areas but exercises control over where platforms are reefed by geographical proximity. Where operators have received authorization to reef their facility, all other operators within a specified distance to this reefed platform wishing to apply for reef authorization will be required to transport their jacket to this reef site. All applicants outside of this specified distance area will need to apply for reefing at their location. Mississippi and Alabama have programs similar to Texas. Florida's reefing program does not have any oil and gas facilities in reef sites.

A conclusion of effective reefing communities is provided in Section 3.5. An alternate to the reefing program is presented in Section 3.6.

3.4.1. Texas

This section is presented in a separate report as an Appendix Section.

3.4.2. Louisiana

This section is presented in a separate report as an Appendix Section.

3.4.3. Mississippi

This section is presented in a separate report as an Appendix Section.

3.4.4. Alabama

This section is presented in a separate report as an Appendix Section.

3.4.5. Florida

This section is presented in a separate report as an Appendix Section.

3.5. EFFECTIVE REEFING COMMUNITIES

The purpose of reefing is to create under water habitat that will increase ocean fish populations for sport fishing, scuba diving and commercial fishing. The increase in fish populations strengthens our economy by creating jobs in the tourism business and in commercial fishing. It supplies an economical source of sea food to the market place. Additionally financial contributions by an oil and gas company to the state to obtain a reefing permit help support state government programs. The oil and gas industry see it as an economical alternative for decommissioning offshore production facilities, as opposed to finding a reuse for the facilities in another location, or recycling the steel through an onshore domestic or foreign scrap yard.

Fish prefer shallow water versus deep water habitat, because they have more sun light, oxygen and nutrients there. The graphs in our reefing section show that mean fish density decreases as water depth increases. Shallower is better. Deck sections with production equipment will be taken to shore based scrap yards for steel recycling which removes chemical contamination, but platform jacket sections are good candidates for reefing. Generally, platform jackets can be reefed by:

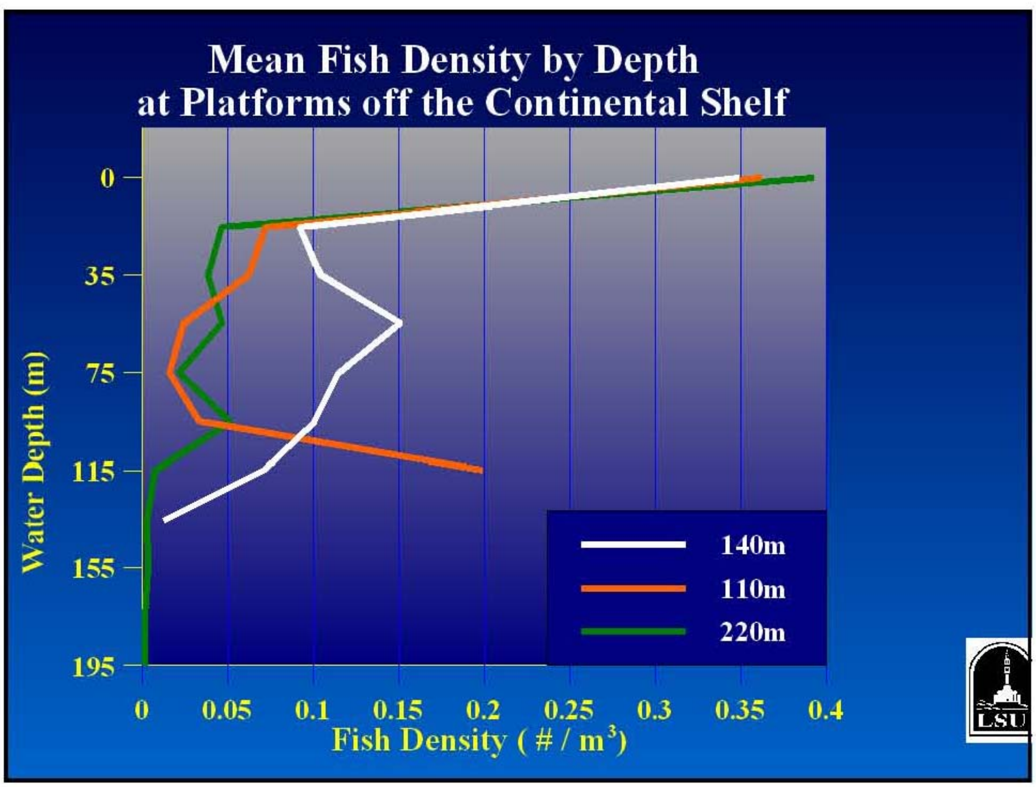
- Tow to designated reef site and lay down in a single piece
- Topple the jacket in place. See the comment below for toppling
- Partial removal of the top of the jacket

Reefs must allow at least 85 feet of clearance below the ocean surface to allow for clearance of ocean going ships, freighters, tankers, cruise ships, commercial fishing boats, yachts, sport fishing boats, etc. This means that waters below 85 feet depth are required to accommodate the jacket members sticking up off of the bottom. A good water depth range for platform reefs is 100 to 200 feet of water. In general, water depth of 300 feet (See Figures below) would probably be the outer limit for a reef, but jackets placed in deeper water depths could benefit the reefing community, for that portion of the jacket that is in the optimal range. For example, the Bullwinkle jacket has a base 300 feet by 350 feet. To obtain the 85 feet navigation clearance, the jacket would be placed in 385 feet or greater water depth with most or a portion of the jacket in the desired reefing water depth.

Onsite reefing single piece toppling below would not be an option, as the water depths of >400 feet included in this study are beyond the beneficial water depths for reef communities. Partial removal of structures as shown below would be beneficial to the reefing community for that portion of the jacket that is in the 100-300 foot range but the typical distance to the jacket's deepwater location would be outside the normal travel distance that most sporting activities would consider.

A normal rule of thumb would be towing a jacket with a HLV to a nearby reef site for a distance of <10 nautical miles may be economical. Each jacket would need to be evaluated and the cost of complete removal vs., tow to a reef site removal compared. Towing these deepwater jackets on the HLV hook to the optimal water depth for reefing communities far exceeds the optimal and economical distance.

A "Rig-to-Reef" reefing program (RTR) has been ongoing in the GOM for the past 21 years. Prior to the program, removal of platforms from the GOM resulted in the loss of valuable reef and fishery habitat. Researchers report fish densities to be 20 to 50 times higher at oil and gas platforms than in nearby open water, down to approximately 100 m, as can be seen by the Fish Density Figure below, from a Louisiana State University (LSU) study, a substantial fish density exists around platforms to at least this depth.



Fish Density Study of Offshore Platforms

3.6. ALTERNATIVE TO PLATFORM REMOVAL

An alternative to platform removal is the use of Aquaculture.

The National Aquaculture Act (NAA), enacted in 1980, established a national policy of encouraging development of aquaculture in the United States.

Virtually every coastal country in the world, including the GOM, is either moving into or actively engaged in the area of Fish Farming (a.k.a. Aquaculture and Mariculture), in inshore and offshore waters. These countries have either government agencies, industries and or organizations controlling or pursuing these endeavors. The list of species grown in production for world consumption or for research is just as staggering, i.e., to name a few: salmon, halibut, flounder, trout, tilapia, abalone, shrimp, oysters, grouper, red snapper, kingfish, scallops, cod, cobia and even alligators and crocodiles. Science and the world media are focusing ever more in this area. See examples of recent or ongoing aquaculture below.

Examples of Recent or Ongoing Aquaculture

Shell Oil Fish Farming

The company has been running a demonstration fish farm since 1982 on eight hectares at Ogbe-Ijoh, Nigeria, 35 kilometers east of Warri. The farm keeps tilapia and catfish, researching farming techniques and selectively breeding desirable characteristics including fast growth.

Staff trained in aquaculture help people establish their own fish farms advising on site selection, pond design and breeding techniques. Fish 'fingerlings' bred at the Shell farm are given away to new farmers starting up and sold at a subsidized rate to others. The farm supports some 90 fish farmers in the area and distributed more than 150,000 'fingerlings' to them in 1994.

A second fish farm was established in Iko Town in 1993 and started producing 'fingerlings' in late 1994, and a third is expected to be ready in November in 1995. Already these two projects have helped establish 11 fish farms. A fourth onshore farm is planned for Buguma Creek Field, and a fish processing plant in Iko Town was completed in 1996.(8)

Shell Oil supports the Marine Habitat Program, a $5 MM cooperative grant effort between Shell Oil Company and the National Fish and Wildlife Foundation to create a fund for conservation of the GOM marine and estuarine environment.(9)

Grace Oil

The Magnuson–Stevens Act includes a provision allowing for permits for offshore fish farming operations that are "experimental." Hubbs–Seaworld Research Institute in San Diego submitted a permit application on February 12, 2004 to use a decommissioned oil platform 10 miles offshore to build an experimental fish farm. The operation proposes to produce up to 300 tons of cod, halibut, abalone, tuna and striped bass annually. Profits from the sale of these fish would be used for marine research.

Section 4 – DECOMMISSIONING OPTIONS & COSTS

Contents

This Section presents cost data to determine estimated decommissioning liabilities for typical fixed, tethered and moored structures and associated pipelines and wells in the GOM.

The following are accounted for in the cost data:

- Project Management & Engineering
- Heavy Lift Vessel mobilization
- Cargo Barge Mobilization
- Well P&A
- Platform Removal Preparation
- Pipeline Abandonment
- Conductor Removal
- Platform Removal
- Site Clearance and Verification
- Onshore Disposal

BACKGROUND

Section 1, Tables 1.2 and 1.3 shows the Gulf of Mexico (GOM) Major Asset Inventory sorted by Type / Block location and by water depth, respectively. Numerous public sources including MMS and other websites were visited to obtain information on the GOM major assets. Some of the sources of information provided conflicting data and the data believed to be more credible was used. It is believed that the most reliable information is used in this study. Input as to platform characteristics was requested from a number of Operators / Owners but was not made available for this study. As such there are many gaps in available data.

The inventory was separated into similar type platforms in similar water depth and a representative platform was selected from each group as shown in Section 1, Table 1.4. For platforms where data was available, such as number of piles and or skirt piles, deck and jacket weights, etc., the platform was placed in the appropriate group. For other platforms were only the water depth was known, the platform was placed in a group with similar water depth. This is one of the areas where MMS could collect and make available general characteristics of the platforms in its inventory. The deterministic decommissioning cost for the complete removal of each representative platform was estimated and is provided in this section. Deterministic costs are the cost that we believe would most likely occur. Following the deterministic cost is a discussion of deterministic and probabilistic modeling and a sample cost comparison.

All costs in this section are estimates based on information, durations and resource costs available at the time of this study.

ESTIMATED COSTS

The estimates were developed in a manner that satisfies the reporting and audit requirements of Financial Accounting Standards Board (FASB) Statement of Financial Accounting Standards No. 143, "Accounting for Asset Retirement" (SFAS 143); i.e., what a willing 3rd party would consider in today's costs with no future adjustments. By this standard, scrap values must be treated separately from decommissioning costs. Credit for scrap is not included in this study. See Section 3, Scrap Yards, Scrap Value Reporting.

The cost estimates have been developed with the objective of producing P50 estimates, i.e., costs that have a 50% chance of being exceeded. Put another way, we have attempted to estimate the "average" or "median" cost. In general, we expect the cost estimate accuracy to within ±20%, with the assumptions stated in Section 2 and in Section 5.7. PROSERV has taken a conventional approach to decommissioning based on what is known and by use of industry standard decommissioning assumptions. However, a potential increase or decrease in decommissioning costs may be driven by changes in resources used, resource cost and duration elements at any given facility and by the possibility of sharing resources between locations decommissioned in the same time period. Based on experience, PROSERV considers these changes to be a possibility, but not easily quantifiable.

The costs included in this study are a snapshot-in-time, based on available information and resources economically selected for use. All costs in this section are estimated assuming trouble free operations and have not considered sharing of resources or using new emerging technology. All resources are assumed to be available in the GOM and costs for mobilization outside of the GOM are not included.

The intent of this section is not to identify a decommissioning cost for a specifically named platform but rather to identify the costs for a type of platform in a particular water depth and provide the opportunity for the viewer to obtain similar cost conclusions. Therefore, where costs are included, the platform names / locations have been omitted. Since each platform in the GOM will have different quantities of wells and pipelines, the costs are provided separately on a per unit basis. Backup data for the representative platform deterministic estimates is provided in the Appendix, Section 5. Probabilistic estimates are discussed in Section 4.7. The representative platform deterministic decommissioning costs are presented in the following format:

4.1 Fixed platforms decommissioning costs
Platform only without conductors
Conductors severing and removal

4.1 Fixed Platforms Decommissioning Costs

FIXED PLATFORMS

Table 4.1 shows representative fixed platforms (PLTF) selected for use in this study. The Pile Column is descriptive of the type of platform leg, leg pile and or skirt pile configuration. See Note Examples at the bottom of the table. Other than water depth, the type of platform listed in the Table 4.1 for a type of leg and pile and or skirt pile configuration for fixed platform are shown in increasing water depths in the GOM. The most economical heavy lift vessel Derrick Barge or Semi Submersible Lift Vessel - SSCV (DB Column) was selected on the basis of the lifting capacity required for the platform's complete removal using the removal method selected and listed in the method column.

Proserv maintains an extensive database on many but not all the fixed platforms in the GOM. For the representative platforms, the deck and jacket weights for the most part were known or reasonable assumptions were made based on similar type of platforms in similar water depths from Proserv's database and the appropriate derrick barge was selected. Several estimates were developed for a number of the representative platforms to determine the appropriate derrick barge selection and the most economical decommissioning method used. For instance, one 8-pile jacket was estimated to require a 4000 st derrick barge to remove the platform In-Situ in a single lift. An alternate study was conducted to determine if it was feasible to use a 2000 st derrick barge and cut the jacket vertically between rows 2 & 3 using divers and lift the jacket in two sections. Because of the increased duration of the diving intensive cutting and the additional lift, the costs increased by 32%. Another comparison was estimating an 8-pile jacket in approximately 500 feet water depth that would require a lift capacity greater than 10,000 st. This jacket was also estimated removed using a 4000 st derrick barge by repeatedly hopping the jacket to shallower water depths and removing the upper sections by cutting in above the water line until the bottom section could be removed. The greater removal duration required for the hopping was offset by the lower cost for the derrick barge. The hopping method generated a 15% savings. This would be true for the large day rate difference for the larger derrick barges but not so for the smaller derrick barges. Only the most economical removal method estimated is included for each representative platform. The two methods of determining decommissioning cost that were found to be most economical were 1) removal In-Situ in a single lift or 2) removal by use of the hopping to shallower water method. See Section 3.2 Fixed Platform Removal Options for other methods.

Table 4.1 shows there is considerable fluctuation in the leg / pile / skirt pile configuration in the 400-500 feet rage but generally increases in proportion to the deeper ranges. This fluctuation in platform configuration impacts the decommissioning cost as shown in Figure 4.1 but the fluctuation is smoothed out using a trend line. Costs include platform preparation, deck and jacket removal and site clearance. Conductor, pipeline and well decommissioning costs are presented in later sections of Section 4. The reader can use the estimated representative platform cost and apply the cost to the platforms in the group or he can use the normalized tables and figures included in this section.

	Water Depth ft.	Pile	DB	Method	# Cond uctors	Cost w/ Conductors	Cost w/o Conductors
1	400	4L-1P-4SP	DB4K	Tow to Shallow	6	$6,794,943	$6,020,616
2	410	8P-12SP	DB4K	Situ	5	$5,544,182	$4,581,874
3	446	4P4S	DB4K	Situ	5	$8,430,101	$6,734,501
4	480	8P-12SP	SSCV	Situ	18	$13,038,260	$10,230,640
5	483	8P-12SP	DB4K	Tow to Shallow	19	$20,518,220	$17,920,870
6	484	4P	DB2K	Tow to Shallow	2	$4,933,951	$4,638,561
7	523	4P4S	DB2K	Tow to Shallow	7	$8,640,382	$7,396,079
8	619	4P4S	DB4K	Tow to Shallow	8	$10,249,430	$8,707,836
9	622	4L-8SP	DB4K	Tow to Shallow	16	$11,780,440	$9,122,286
10	693	4L-8SP	DB4K	Tow to Shallow	3	$10,988,250	$10,246,070
11	774	8P-12SP	SSCV	Tow to Shallow	24	$15,143,860	$10,021,430
12	863	8P-12SP	SSCV	Tow to Shallow	26	$45,369,260	$39,186,120
13	925	4P-8SP	DB4K	Tow to Shallow	14	$30,350,280	$26,559,480
14	935	8P-16SP	SSCV	Tow to Shallow	21	$40,495,860	$34,910,432
15	1027	12L-24SP	SSCV	Tow to Shallow	62	$86,445,920	$63,470,620
16	1100	6P-24SP	SSCV	Tow to Shallow	34	$54,881,968	$43,519,160
17	1300	12L-32SP	SSCV	Tow to Shallow	29	$89,750,768	$78,508,472

Table 4.1 Representative Fixed Platforms

Note Examples: Pile: 4L-1P-4SP = 4-leg platform with 1-Center Pile and 4-Skirt Piles
Pile: 4P4S = 4 leg platform with 4-leg piles and 4-Skirt Piles

Representative platform characteristics data was available for platforms up to 1300 feet. Current fixed platforms in the GOM are installed in water depths in excess of 1700 feet. Decommission costs for the Representative Platforms are shown graphically in Figure 4.1 to 1300 feet with trend lines projected to 1700+ feet. The Artificial Trend line is with conductors for the representative platform and would not be descriptive of the all the platforms in the representative group. It is included here to show the major impact that the cost of conductor severing and removal can have on the cost of decommissioning platforms. The lower labeled Trend line is without conductors and would be representative of the platforms in the group. Representative platforms were selected for all fixed GOM platforms except for the compliant towers in 1600+ feet water depths. Platform characteristics and installation information was not available to estimate these platforms. As an alternate the Trend line in Figure 4.1 should be used. In Table 4.1 and Figure 4.1, piles and or skirt piles ≤60 inch diameter were severed with explosives and piles >60 inch in diameter were severed abrasively. The fixed platforms have all been estimated removed and placed on cargo barges and transported to an onshore facility. Cost is included for the cargo barge usage during offloading. No dock charges or crane charges have been included. See Section 3 for information on improvements in technology.

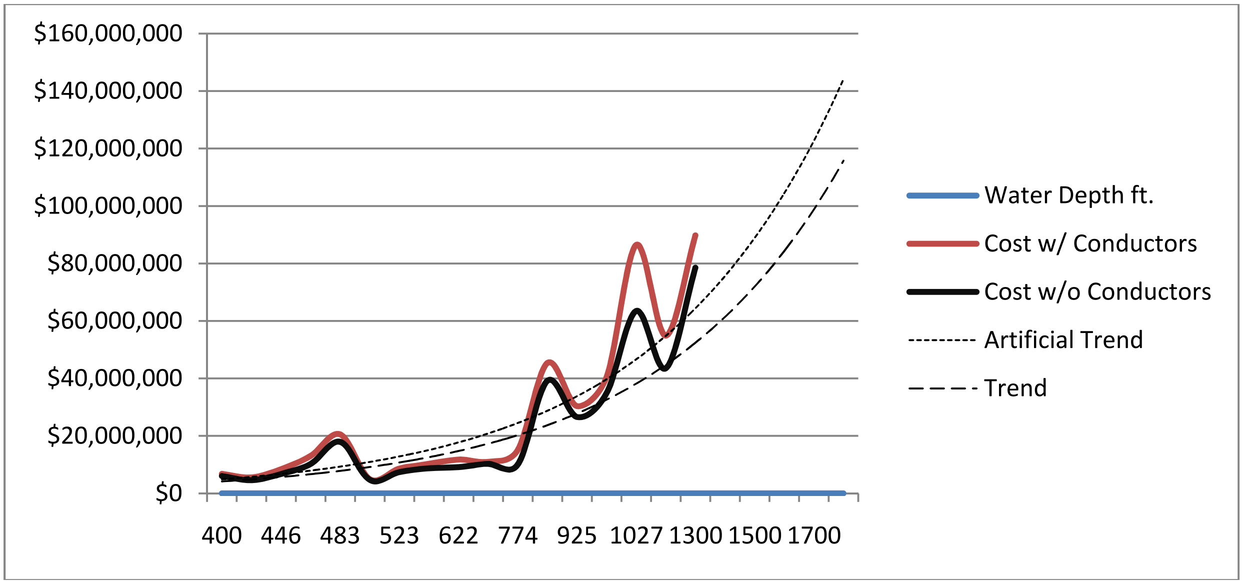


Figure 4.1 Estimate Decommissioning Cost w/and w/o Conductors

CONDUCTOR SEVERING AND REMOVAL

The deeper the water depth, the more costly the conductors are to remove, as more sections are required to be cut and removed in deeper water. Because conductor severing and removal can be a major cost in water depths included in this study and is dependent on the number of conductors, water depth and the removal method selected, costs are shown for both with and without conductors in Figure 4.1 with a further breakdown in conductor cost below.

Aside from the number of conductors and water depth, cost drivers in conductor removal are the number of conductors, the method of severing and the method of removal. For a platform with few conductors the costs for the mobilization of resources and to set up and rig down the equipment must be allocated to the conductors increasing the cost per conductor, whereas for a platform with many conductors the allocation of these costs are small per conductor. The two most common conductor severing options used in the GOM are explosive severing and abrasive severing. Several comparisons between explosive and abrasive operations conducted during the platform removal phase are provided in Figures 4.2 and 4.3.

Example Block	EC Area			
Water Depth ft.	224			Includes standby and pre/post
Piles	4	42"		
Cond	4	30"		
Comparison	**Explosive**	**Abrasive**	**Delta +%**	
Hours to sever	15	38		Does not include mob/demob of abrasive spread for total of 62 hrs.
Total Work Exposure Hours	1865	2081	11.6%	
PLTF Cost	3408108	4018630	17.9%	

Table 4.2 Sever Method Comparison Severing w/Derrick Barge

Derrick Barge	Severing Method	Task Durations	Cost*
DB 1700	Explosive	4251	$ 6,062,260
DB 1700	Abrasive	4494	$ 6,954,753
Delta +%		**6%**	**15%**
*Does not include the following:			
Engineering Typ. 8%			
Weather GOM Typ. 20%			
Work Contingency or extra work Typ. 15%			
See estimates in appendix for breakdown in costs and durations.			

Table 4.3 Sever Method Comparison Severing w/Derrick Barge

The figures above show that though the actual duration to sever abrasively is more than double the duration to sever explosively, the work exposure hours to the platform removal project using abrasive severing is between 6%-12% longer in duration than explosive and overall platform removal costs using abrasives increased between 15% and 18% over explosives. Using explosives are faster and less expensive, but there is always the possibility that the conductors will flare out from the detonation and get stuck when being pulled through the conductor guides. The key here is that the severing in the comparisons above was performed during the derrick barge operations with the higher cost of the derrick barge spread and with the higher lifting capacity of the derrick barge to overcome the possibility of excessive flaring. Abrasive severing would be the preferred method to eliminate flaring, but takes longer in duration, thus driving up costs.

To minimize these costs the majority of representative platforms in Table 4.1 were estimated with the conductors severed abrasively and removed with casing jacks prior to the derrick barge arrival. Though removal with casing jacks generally takes longer that removal with a derrick barge, the reduction in work spread is more economical especially for large number of conductors in deeper water where typically a larger and more costly derrick barge or heavy lift vessel (HLV) would be required. Figure 4.2 provides a breakdown of the abrasive severing and casing jack removal costs for a number of conductors by water depth. As shown, the allocation of costs per conductor is higher per the number of conductors and the per unit cost is higher for deeper water depths. For larger numbers of conductors, the cost per water depth is higher but the difference in cost per unit negligible. The reader can extrapolate and apply these costs to the platform removal costs.

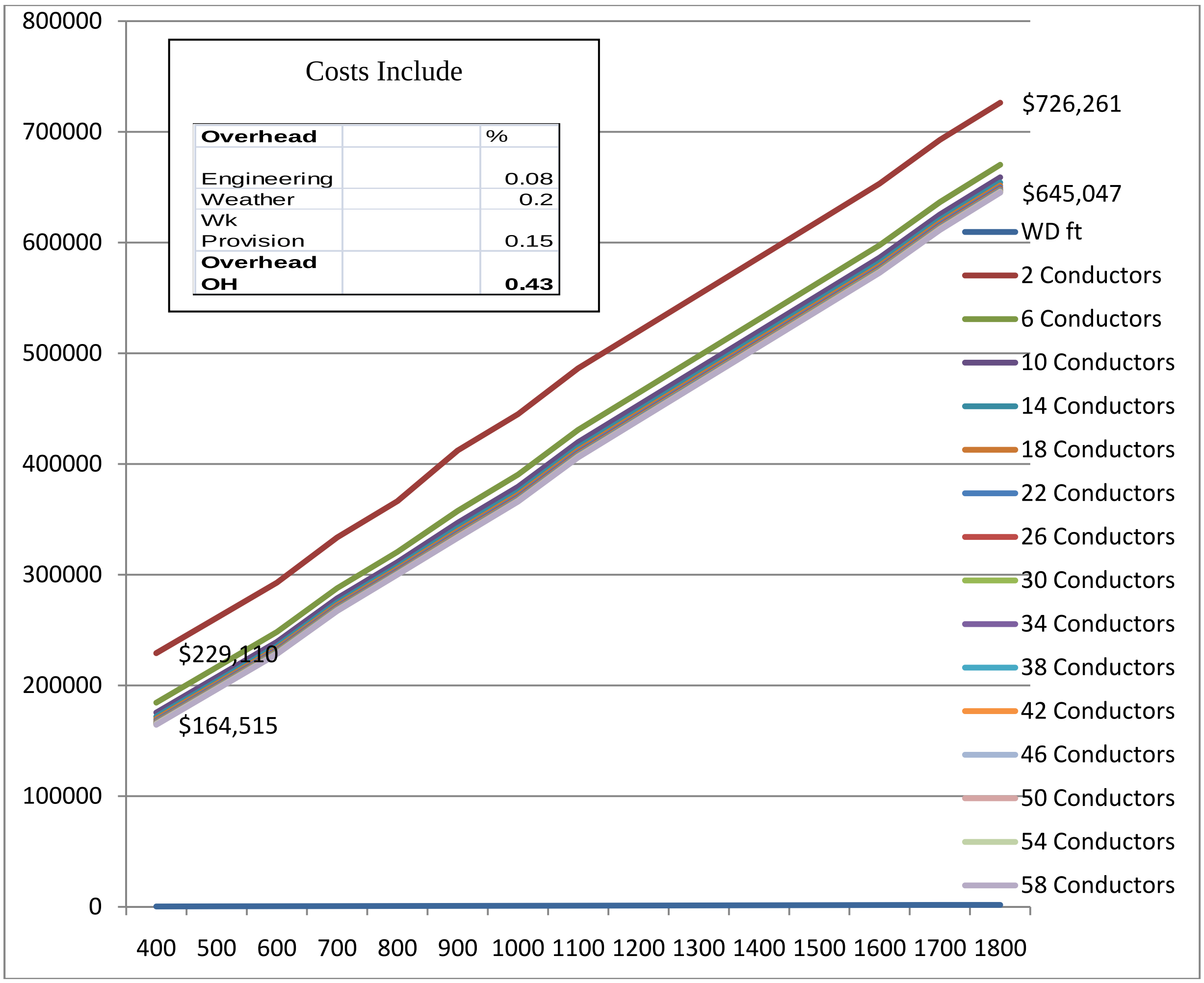


Figure 4.2 Total cost for Conductor- Abrasive Severing and Removal with Casing Jacks Normalized per foot of WD ft.

The gap between 2 conductors and 6 conductors is attributed to the fact that all the mobilization, demobilization, set up and rig down cost are allocated to two only 2 conductors, whereas the greater the number of conductors the lower the allocation per conductor. As the number of conductors per platform increases the difference in cost per conductor decreases until the curves appear to merge.

PIPELINE and UMBILICAL ABANDONMENT

Pipelines

All pipelines are abandoned with the pipeline flushed, the ends severed, plugged and buried with sand bags or concrete type mats and the line left in place (in–situ). The challenges in deepwater pipeline abandon are discussed further in Section 2 and general abandonment methodology is presented in the appendix Section 5.7.

The variables in pipeline abandonment in order of cost impact are:

1. Type of vessel required for abandonment
2. Pipeline termination point – Riser-to-Riser or Riser-to-Subsea Tie-in (SSTI)
3. Flushing volume (pipeline diameter and length flushed at 2.5 X one volume)
4. Water depth
5. Mobilization and demobilization distance

Though there are exceptions, the following are typical types of vessels utilized in pipeline abandonment for the GOM fixed platform water depths. Each type of vessel as listed is consecutively more expensive to operate.

- Anchored 4-point dive boats (4PDB) are used in water depths <400' to approximately 500 feet, using a rule-of-thumb 7:1 anchor cable length to water depth ratio. The limiting factor is the length of anchor cable typically onboard. Using a lower anchor cable ratio, a water depth of 600+ feet would be a typical upper limit.
- Dynamically positioned dive boats (DPDB) can operate in all water depths but are typically used where subsea tie-ins are involved or where water depths are from 600 feet to approximately 1000 feet, that being the upper range of saturation diving. DPDBs are also used in shallower water depths where there is a lot of bottom debris or where there are several or more pipelines located in the area.
- Dynamically positioned deep sea intervention type vessels (DSI) with remotely operated vehicle (ROV) capability can operate in all water depths but are typically used in water depths >1000 feet.

As described above, the pipeline termination point may be better suited to a particular vessel, under a variable of conditions. As described, the vessels vary per location and depth requirements, but most of the tasks in pipeline abandonment are the same for a given type of abandonment; i.e., pipelines that start and end at a platform riser have the similar tasks and pipelines that have a platform riser at one end and end in a SSTI at the other have similar abandonment tasks. The major variable that changes is the flushing duration. The pipeline flushing volume (length multiplied by the pipeline diameter multiplied by the number of times the pipeline is flushed) at a predetermined gallon per minute rate provides the flushing duration. Water depth affects the duration and cost of diving operations and to a lesser extent mobilization costs increases for deeper platforms.

Pipeline decommissioning costs were estimated from the representative platforms. Flushing volumes, water depth, mobilization distance and vessel spread requirements were evaluated. It was determined that the two variables flushing volume and vessel spread can be used to determine a reasonable decommission costs. The following five PIPELINE SPREAD USAGE configurations, where applicable, were evaluated, grouped, placed in tabular and graph format as shown in Table 4.4 and Figures 4.3 through 4.7.1:

PIPELINE SPREAD USAGE

- 4-Point Dive boat (4PDB) for riser to riser in depths 400-500 feet
- 4-Point Dive boat (4PDB) SSTI for riser to SSTI in depths 400-500 feet
- DP Dive boat (DPDB) for riser to riser in depths >500 to <1000 feet
- DP Dive boat (DPDB) SSTI for riser to SSTI in depths >500 to <1000
- Diving Surface Intervention Vessel (DSI) SSTI for depths >1000 feet

Pipeline costs estimates include 8% for engineering, 20% contingency for weather and 15% for project work contingency which adds a total of 43% to the project costs.

	Water Depth ft.	Mob Distance Nm	Pipeline Diameter in	Length ft.	Volume 1000cuft.	Decom. Cost	Dive Vessel
1	400	137	4	6160	1	$871,826	4PDB
3	446	122	6	101713	20	$980,068	4PDB
3	446	122	8	194110	68	$1,287,956	4PDB
3	446	122	16	67266	94	$1,404,745	4PDB
1	400	137	6	4884	1	$1,115,536	4PDB-SSTI
2	410	200	10	74250	40	$1,814,937	4PDB-SSTI
5	483	100	12	120000	94	$2,554,483	4PDB-SSTI
9	622	75	6	42375	8	$1,207,983	DPDB
10	693	96	12	14217	11	$1,173,191	DPDB
9	622	75	10	22707	12	$1,247,214	DPDB
10	693	96	14	13611	15	$1,192,076	DPDB
11	774	110	8	66706	23	$1,738,753	DPDB
12	863	193	12	49106	39	$1,910,969	DPDB
9	622	75	4	56586	5	$1,576,304	DPDB-SSTI
8	619	110	12	46503	37	$1,607,715	DPDB-SSTI
14	935	181	12	68774	54	$2,098,081	DPDB-SSTI
17	1300	100	4	64962	6	$1,910,650	DSI-SSTI
16	1000	119	8	17713	6	$2,443,825	DSI-SSTI
16	1000	119	8	36959	13	$2,458,871	DSI-SSTI
15	1027	157	12	39673	31	$2,977,249	DSI-SSTI

Table 4.4 Pipeline Decommissioning Cost per Volume

SSTI cost is dependent on water depth at SSTI location. The decommissioning costs in Table 4.4 are shown graphically in Figures 4.3 through 4.7.1.

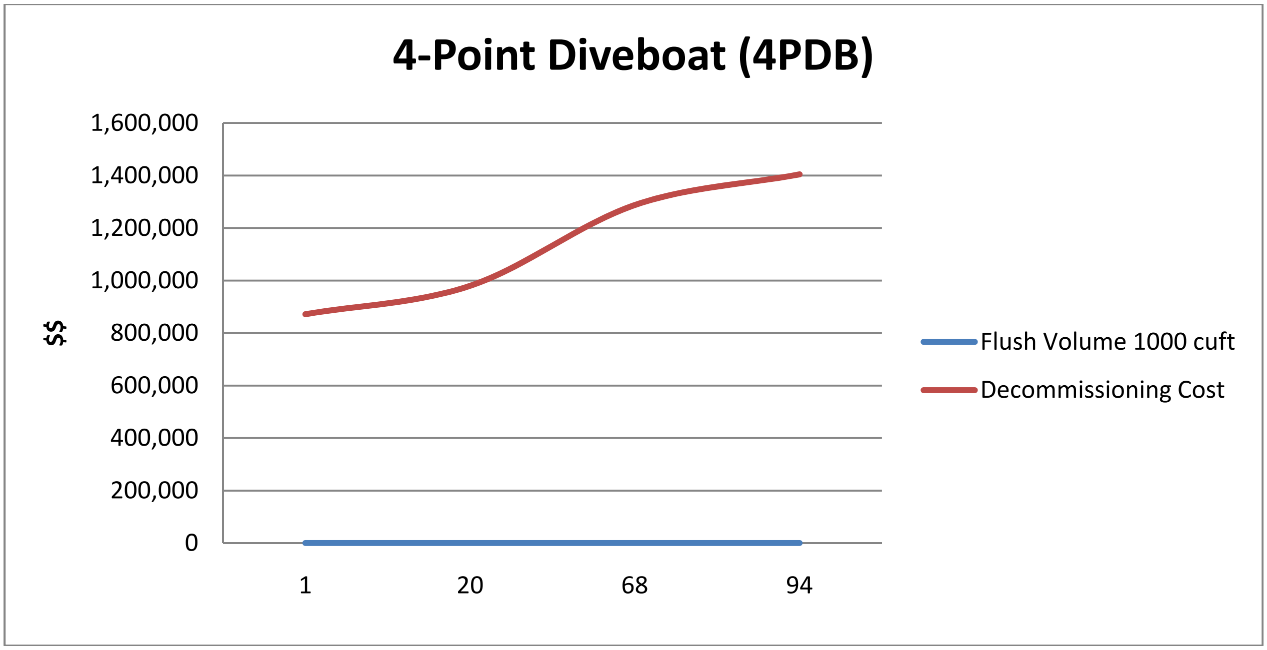


Figure 4.3 Pipeline Decommissioning Cost per Volume per Spread

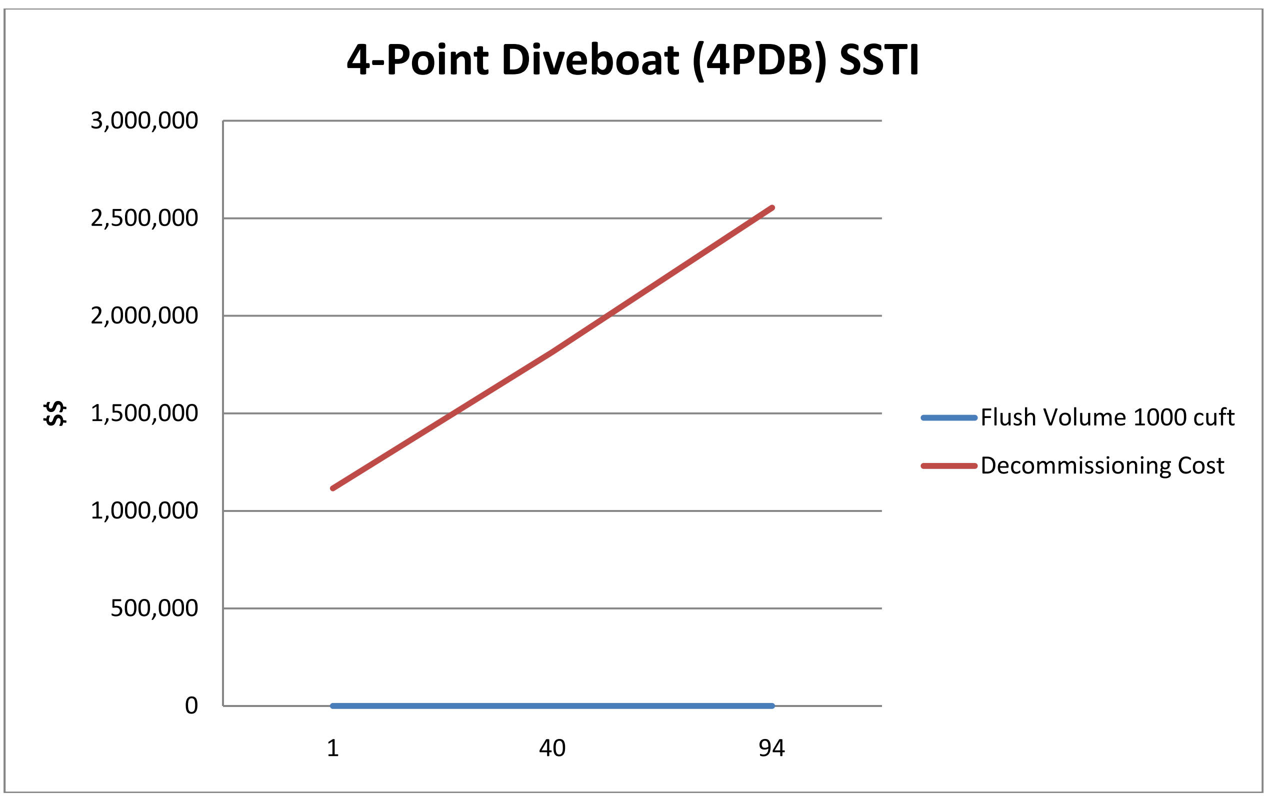


Figure 4.4 Pipeline Decommissioning Cost per Volume per Spread

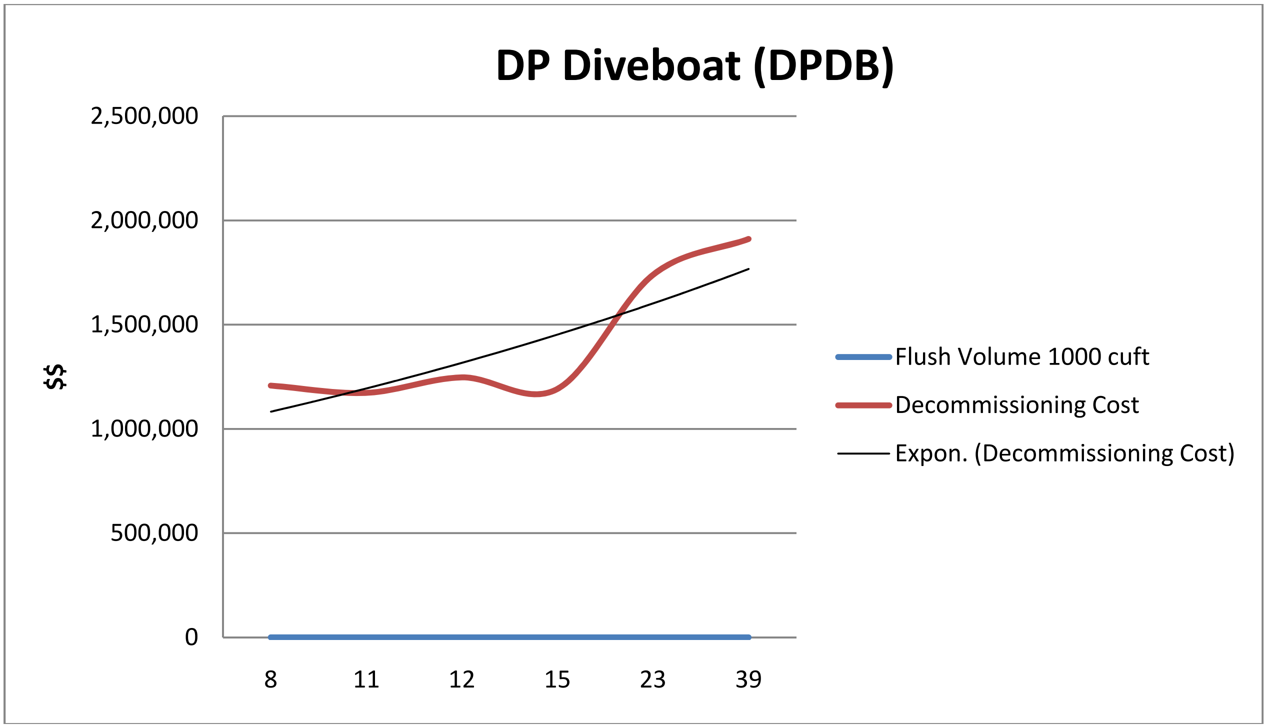


Figure 4.5 Pipeline Decommissioning Cost per Volume per Spread

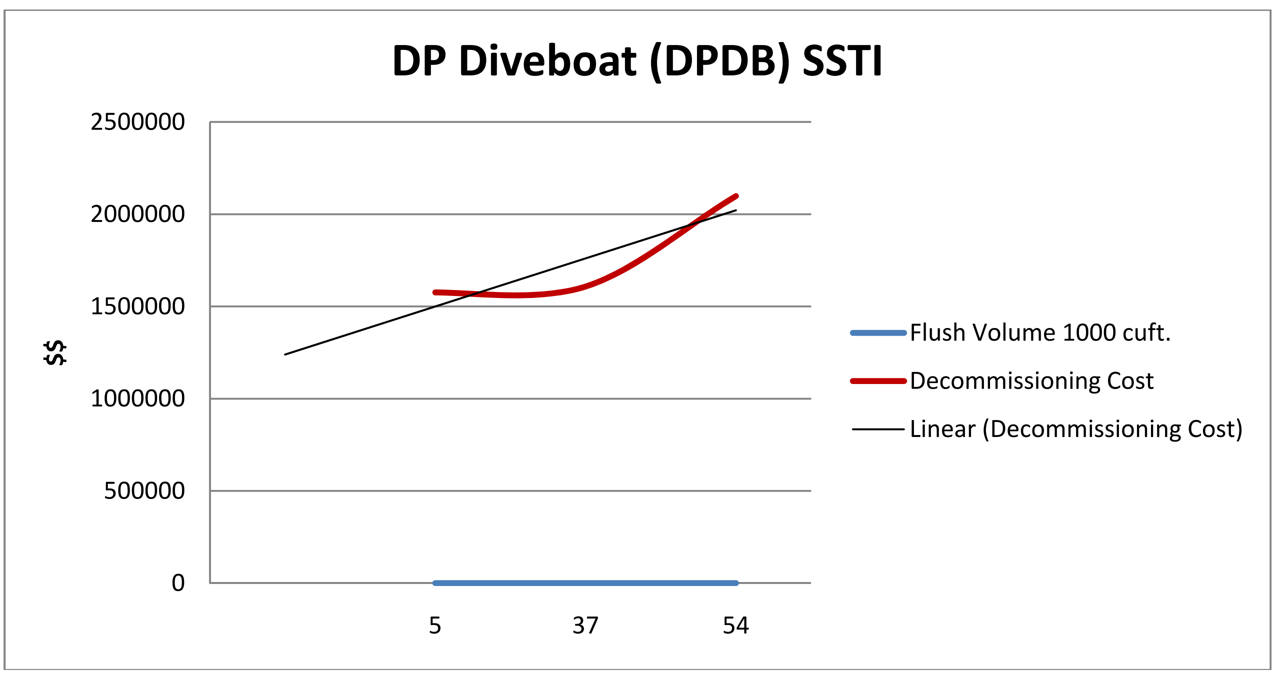


Figure 4.6 Pipeline Decommissioning Cost per Volume per Spread

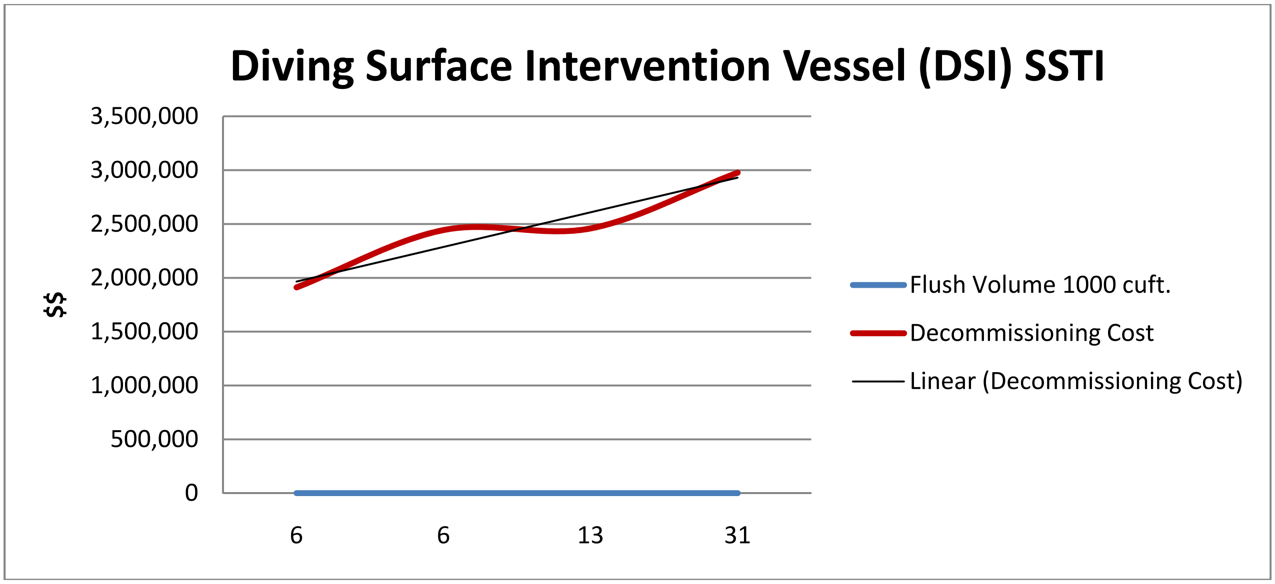


Figure 4.7.1 Pipeline Decommissioning Cost per Volume per Spread

Umbilical Abandonment

For the purpose of this study, it is assumed that all umbilicals are flushed of chemicals and removed. As in pipeline abandonment, depending on water depth and umbilical length different removal spreads can be used. Because the majority of umbilicals in the GOM will be in deeper water at various lengths this section focuses on the use of an anchor handling vessel (AHSV) and ROV spread performing the tasks in Figure 4.7.2. The cost per umbilical per foot of length and water depth is estimated in Figure 4.7.3 and graphed in Figure 4.7.4 with an average cost plotted using a solid line.

Task
Umbilical Line Removal
Generic 2.5" diameter
Flush Umbilical
Locate Umbilical line at Host
Cut umbilical and attach to cable spool on AHSV
Spool umbilical
Locate and Cut umbilical at termination point
Relocate AHSV to next Umbilical
Work Contingency
Weather Dow ntime

Figure 4.7.2 Umbilical Removal Tasks

Estimated Umbilical Removal Cost per Length and Water Depth						
Nautical Mil	1	2	3	5	10	20
400' WD	13.3	7.5	5.6	4.0	2.8	$2.26
1000' WD	17.4	9.6	6.9	4.8	3.3	$2.46
2000' WD	19.9	10.8	7.8	5.3	3.5	$2.59
4000' WD	24.3	13.0	9.2	6.2	3.9	$2.81
6000' WD	27.9	14.8	10.4	6.9	4.3	$2.99
8000' WD	32.3	17.0	11.9	7.8	4.7	$3.21
10000' WD	36.7	19.2	13.4	8.7	5.2	$3.43
Average	28.2	15.0	10.5	7.0	4.3	3.0

Figure 4.7.3 Umbilical Removal Costs

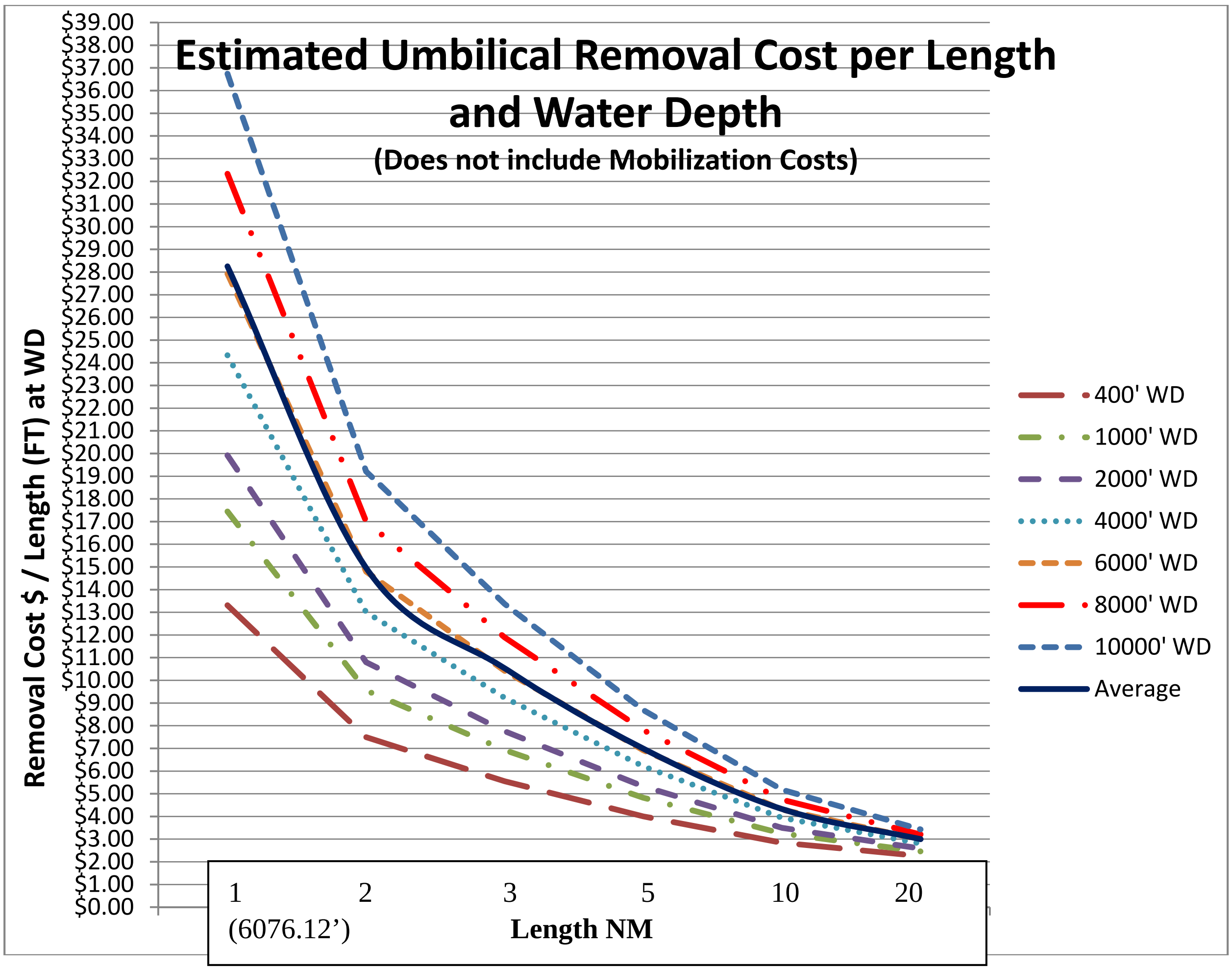


Figure 4.7.4 Umbilical Removal Costs Graphed

WELL P&A

For the purpose of this study, it was assumed that the well casings were grouted to the surface and the 9 5/8 and smaller strings were pulled during T&A operations and the remainder pulled during conductor severing and removal operations, as discussed earlier in this study. The wells were estimated as typical trouble free wells plugged using rigless methods. Predicting the percent or cost of problem wells per platform without evaluating current well bore schematics and well history is outside the scope of this study. Operators would need to confirm if wells can be accessed with rigless methods or will require other methods. The estimates here are approximately 25% conservative and include the work provision, weather and engineering percentages as discussed earlier in this section. It was calculated that the typical platform crane of 25 tons was insufficient to pull the 9 5/8 on platforms in water depths >400 feet. All stings were estimate pulled with casing jacks. The typical T&A spread and operation durations are shown in Table 4.5. Problem free accessible dry tree wells are estimated in this section. See the Executive Summary for recommendations on well data collection.

FIXED PLATFORM									
T&A equipment and personnel per day*	$22,512	Casing jack / day				P&A Platform Support Equip.	Support Vessel X2	**Casing Jack Spread /Day**	**Total Spread / Day**
Consumables per well	$17,000	Tons	Rental	Jacking Specialist 24 hr		per Day	per Day		
Subtotal	$39,512	300	$1,500	$2,200	$3,700	$6,000	$18,000	**$3,700**	**$50,212**
Assumed freeboard ft	78					$250	$750		
Cut bml for surface plug ft	450								
String cut length ft	40								
Duration per cut&pull hr	1.5								
Typical T&A hr	60								
Ratio T&A to Cut and pull	60:40								
% T&A	60								
% Cut and pull	40								
% pull w/jacks	50								
T&A and cut & pull w/o jacks hr	48								
* Using 10K psi pump @ 24 hr / day									
Well count*	60								
Work Provision %	15								
Weather %	20								
Engineering %	8								

Table 4.5 Well T&A Basic Parameters

The cost to T&A dry tree wells at water depths from 400 to 5000 feet were estimated for a platform with 60 wells as shown in Table 4.6. Fixed platforms have dry tree wells in water depths from 400 feet to <1800 feet. TLPs have dry tree wells in water depths from 1500 feet to >4600 feet. The costs were then estimated at well count intervals from 1 to 60 wells and then normalized to one well per foot of water depth as shown in Figure 4.8.

	Typ. Strings to pull during T&A 7" @ 29#/ft or 9-5/8" @ 53.50 #/ft (Assumes 13"+26"+30" grouted and pulled during PLTF Prep)												
Water Depth Ft.	Dia in.	#/'	ft.	tons	Mob /Demob hrs each	Setup & Rig down hrs each	T&A per well hrs w/50% cut and pull	Added T&A hours per water depth per well	Pull /Cut per well hrs	Total cost per well w/o Setup & Mob /Demob	Total cost per platform wells	Total cost per platform wells w/Work Provision, Engineering and Weather	Total cost per platform normalized to 1 well
400	9-5/8	53.5	928	24.8	30	12	48	14	35	$219,940	$13,372,152	$19,122,177	$318,703
500	9-5/8	53.5	1028	27.5	31	12	48	15	39	$230,401	$14,003,986	$20,025,700	$333,762
600	9-5/8	53.5	1128	30.2	32	12	48	16	43	$240,862	$14,635,821	$20,929,224	$348,820
700	9-5/8	53.5	1228	32.8	33	12	48	17	47	$251,323	$15,267,655	$21,832,747	$363,879
800	9-5/8	53.5	1328	35.5	34	12	48	18	50	$259,691	$15,773,959	$22,556,762	$375,946
900	9-5/8	53.5	1428	38.2	35	12	48	19	54	$270,152	$16,405,794	$23,460,285	$391,005
1000	9-5/8	53.5	1528	40.9	36	12	48	20	58	$280,613	$17,037,628	$24,363,808	$406,063
1100	9-5/8	53.5	1628	43.5	37	12	48	21	62	$291,074	$17,669,462	$25,267,331	$421,122
1200	9-5/8	53.5	1728	46.2	38	12	48	22	65	$299,443	$18,175,767	$25,991,346	$433,189
1300	9-5/8	53.5	1828	48.9	39	12	48	23	69	$309,903	$18,807,601	$26,894,869	$448,248
1400	9-5/8	53.5	1928	51.6	40	12	48	24	73	$320,364	$19,439,435	$27,798,393	$463,307
1500	9-5/8	53.5	2028	54.2	41	12	48	25	77	$330,825	$20,071,270	$28,701,916	$478,365
1600	9-5/8	53.5	2128	56.9	42	12	48	26	80	$339,194	$20,577,574	$29,425,931	$490,432
1700	9-5/8	53.5	2228	59.6	43	12	48	27	84	$349,655	$21,209,408	$30,329,454	$505,491
1800	9-5/8	53.5	2328	62.3	44	12	48	28	88	$360,115	$21,841,243	$31,232,977	$520,550
1900	9-5/8	53.5	2428	64.9	44	12	48	29	92	$370,576	$22,468,893	$32,130,517	$535,509
2000	9-5/8	53.5	2528	67.6	44	12	48	30	95	$378,945	$22,971,013	$32,848,548	$547,476
2100	9-5/8	53.5	2628	70.3	44	12	48	31	99	$389,406	$23,598,663	$33,746,088	$562,435
2200	9-5/8	53.5	2728	73.0	44	12	48	32	103	$399,867	$24,226,313	$34,643,627	$577,394
2300	9-5/8	53.5	2828	75.6	44	12	48	33	107	$410,327	$24,853,963	$35,541,167	$592,353
2400	9-5/8	53.5	2928	78.3	44	12	48	34	110	$418,696	$25,356,083	$36,259,198	$604,320
2500	9-5/8	53.5	3028	81.0	44	12	48	35	114	$429,157	$25,983,733	$37,156,738	$619,279
2600	9-5/8	53.5	3128	83.7	44	12	48	36	118	$439,618	$26,611,383	$38,054,277	$634,238
2700	9-5/8	53.5	3228	86.3	44	12	48	37	122	$450,079	$27,239,033	$38,951,817	$649,197
2800	9-5/8	53.5	3328	89.0	44	12	48	38	125	$458,447	$27,741,153	$39,669,848	$661,164
2900	9-5/8	53.5	3428	91.7	44	12	48	39	129	$468,908	$28,368,803	$40,567,388	$676,123
3000	9-5/8	53.5	3528	94.4	44	12	48	40	133	$479,369	$28,996,453	$41,464,927	$691,082
3100	9-5/8	53.5	3628	97.0	44	12	48	41	137	$489,830	$29,624,103	$42,362,467	$706,041
3200	9-5/8	53.5	3728	99.7	44	12	48	42	140	$498,198	$30,126,223	$43,080,498	$718,008
3300	9-5/8	53.5	3828	102.4	44	12	48	43	144	$508,659	$30,753,873	$43,978,038	$732,967
3400	9-5/8	53.5	3928	105.1	44	12	48	44	148	$519,120	$31,381,523	$44,875,577	$747,926
3500	9-5/8	53.5	4028	107.7	44	12	48	45	152	$529,581	$32,009,173	$45,773,117	$762,885
3600	9-5/8	53.5	4128	110.4	44	12	48	46	155	$537,950	$32,511,293	$46,491,149	$774,852
3700	9-5/8	53.5	4228	113.1	44	12	48	47	159	$548,410	$33,138,943	$47,388,688	$789,811
3800	9-5/8	53.5	4328	115.8	44	12	48	48	163	$558,871	$33,766,593	$48,286,228	$804,770
3900	9-5/8	53.5	4428	118.4	44	12	48	49	167	$569,332	$34,394,243	$49,183,767	$819,729
4000	9-5/8	53.5	4528	121.1	44	12	48	50	170	$577,701	$34,896,363	$49,901,799	$831,697
4100	9-5/8	53.5	4628	123.8	44	12	48	51	174	$588,162	$35,524,013	$50,799,338	$846,656
4200	9-5/8	53.5	4728	126.5	44	12	48	52	178	$598,622	$36,151,663	$51,696,878	$861,615
4300	9-5/8	53.5	4828	129.1	44	12	48	53	182	$609,083	$36,779,313	$52,594,417	$876,574
4400	9-5/8	53.5	4928	131.8	44	12	48	54	185	$617,452	$37,281,433	$53,312,449	$888,541
4500	9-5/8	53.5	5028	134.5	44	12	48	55	189	$627,913	$37,909,083	$54,209,988	$903,500
4600	9-5/8	53.5	5128	137.2	44	12	48	56	193	$638,374	$38,536,733	$55,107,528	$918,459
4700	9-5/8	53.5	5228	139.8	44	12	48	57	197	$648,834	$39,164,383	$56,005,067	$933,418
4800	9-5/8	53.5	5328	142.5	44	12	48	58	200	$657,203	$39,666,503	$56,723,099	$945,385
4900	9-5/8	53.5	5428	145.2	44	12	48	59	204	$667,664	$40,294,153	$57,620,638	$960,344
5000	9-5/8	53.5	5528	147.9	44	12	48	60	208	$678,125	$40,921,803	$58,518,178	$975,303

Using typical platform crane at 25 st and typical largest string to pull during T&A (9-5/8"), at 400' WD the crane capacity is exceeded and therefore casing jacks are necessary for all platform P&A >400' WD (A leap frog could also be installed for when some of the string is removed - saving time)

Table 4.6 Dry Tree Well T&A

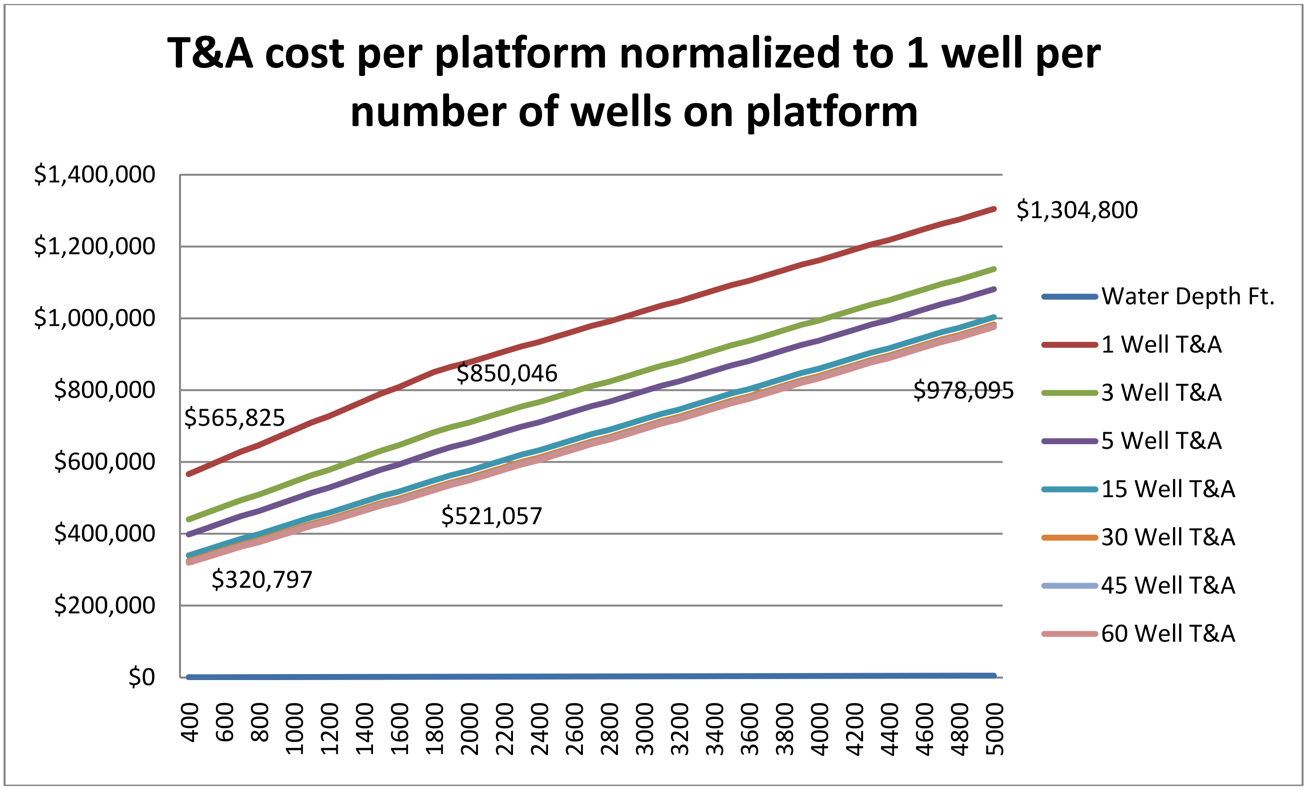


Figure 4.8 T&A cost per well

The costs were then evaluated by water depth and number of wells as shown in Figure 4.9.

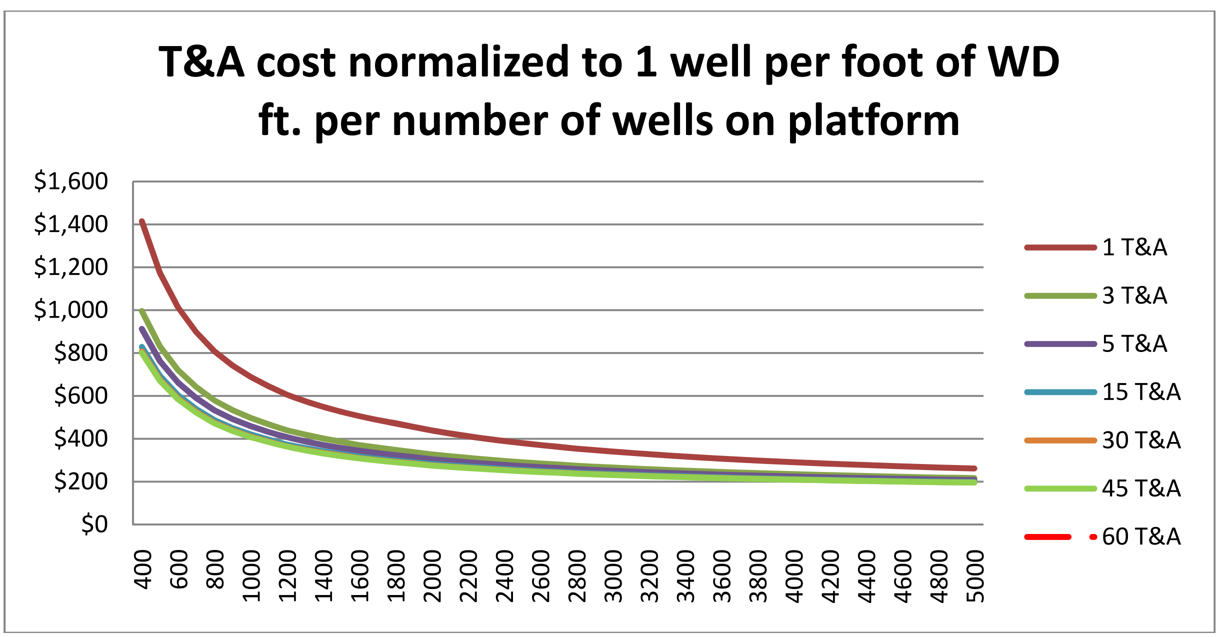


Figure 4.9 T&A cost per foot of WD

The gap between one well and three wells is attributed to the fact that for a single well, all the mobilization, demobilization, set up and rig down cost are allocated to one well, whereas the greater the number of wells the lower the allocation per well. As the number of well per platform increases the difference in cost per well decreases until the curves appear to merge.

Table 4.6 only shows costs for a platform with 60 wells. Well P&A costs for platforms with other well counts in varying water depths can be obtained from either Figures 4.8 or 4.9. For example the cost of 60 platform wells in 1800 feet in Table 4.6 is $31 MM. Using Figure 4.8 at 1800 feet the 60 well curve shows $521K. Multiplying this times 60 equals $31 MM. Using Figure 4.9 at 1800 feet the 60 well curve shows a cost per well under $300 per feet of water depth. Using $290 multiplied by the water depth of 1800 feet and further multiplying by the number of wells 60 equals $31 MM.

PLATFORM COST SUMMATION

In order to calculate the total project decommissioning cost Figure 4.1 would be used to determine the base platform decommissioning cost, Figure 4.2 would be used to add the conductor severing and removal cost based on the number of conductors and the water depth. The next step is to determine the volume of each pipeline and the appropriate chart to use from Figures 4.3 through 4.7, depending on the PIPELINE SPREAD USAGE above. The volume of each line can be determined from length and diameter listed in MMS databases. The last step would be to determine the well abandonment costs depending on the water depth and number of wells to plug from Figure 4.8 or 4.9.

CONCEPTUAL FIXED PLATFORM REMOVAL COSTS

A number of conceptual alternate removal methods are presented in Sections 2 and 3 of this study. Information has been received and or assumed for two of these methods in sufficient detail to provide a conceptual only comparison. A representative platform in approximately 700-800 feet water depth was selected and estimated with each of these methods and compared to the complete removal estimate cost for the platform only.

The two conceptual resources and methods selected for the complete removal comparison were:

1. Removal with Floatation Devices in the GOM. See Section 2.2.9.
2. Removal with SeaMetric's new Twin Marine Lifter (TML) design. See Section 2.2.9.

The two methods were selected because of possible viability past the conceptual stage. A similar version of the floatation method was recently employed in the North Sea and engineer / designers are studying similar applications in the GOM but have declined to provide information on their concept.

Floatation devices have no upward limitations on lifting capacity as larger devices can be installed if more lift is required. SeaMetric TML uses lifting arms rather than cranes, and according to SeaMetric will be able to lift 18,000-20,000 metric tons (19,842-22,046 tons) compared to the maximum lifting capacity of traditional heavy-left vessels (HLV) at 14,000-15,000 metric tons (15,432-16,535 tons).

Both of these methods would allow for removal of a larger platform inventory from the GOM, including the lighter tonnage moored and tensioned facilities. SeaMetric has announced that it currently has the TML vessels under construction.

Comparison Floatation Devices vs. HLV

The fixed platform selected for this cost comparison was an 8 pile 12 skit pile platform in 863 feet water depth. The platform weight was estimated at 20,000 st and Proserv estimated that the removal cost by hopping to shallower water depths with conventional HLVs is $30 MM. See Section 5.1 FIXED PLATFORM Jacket Only Comparison Cost Estimate.

The same jacket was estimated by a third party engineering firm using floatation devices developed and recently used in the North Sea. The cost to remove the jacket is estimated at $60 MM before outside services are deducted.

Item	Description	Estimated Cost (+/- 40%)
1	Manufacturing & testing of Buoyancy units (over 4 Jobs)	$16,000,000
2	Preparation of Buoyancy Units at Stord, Norway	$5,000,000
3	Transport of Buoyancy Tanks & Equipment to Site in GOM	$4,000,000
4	Onshore Mobilization Operations in GOM	$3,000,000
5	Mobilization, operation & demobilization of full subsea cutting spread (diamond wire saw)	$1,200,000
6	Offshore Operations including installation of buoyancy system, cutting of legs, tow to reverse upending area, reverse up-ending, trimming	$12,000,000
7	Offshore towing to disposal location	$3,000,000
8	Inshore trimming for entry to disposal area	$8,000,000
9	Tow to disposal area	$4,000,000
10	Demobilization of Buoyancy tanks, two MSV's and two Tugs	$4,000,000
	TOTAL	$60,200,000 (+/- 40%)

For a comparison of a reusable system in the GOM, the costs for services outside of the GOM were removed for a total decommissioning cost using floatation devices of $36.2 MM.

The reader is reminded that the estimate here is derived from methods and durations designed and actually used in the harsher and stricter regulated environment of the North Sea. This shows that this method and estimate is comparable and it is believed that as the technology, methods and durations are refined and established in the GOM, the prices will decrease to a level below current conventional lifting technology.

See Section 5.1 Conceptual Decommissioning Removal Methods for the complete estimate. See Section 2 for a further description of this method.

Comparison TML vs. HLV

Offshore Magazine article "SeaMetric develops new heavy-lift vessel", April 1, 2008 informs that the TML can install a medium-size platform including a topside of 5,000 tons and a jacket at 3,000 tons for about $24 MM. This equates to $3000 / ton for installation.

Conventional removal of the 8P-12SP jacket with HLVs discussed above was estimated at $30 MM with 20,000 tons. This equates to a removal cost of $1500 per ton. This presents an installation to removal cost ration of 2:1 ($3000:$1500) for this jacket. Using the $24 MM quoted above at the 2:1 ratio would project a removal cost using the TML of $12 MM. This would be a substantial savings over costs $30 MM using current HLVs.

See Section 2 for a further description of this method.

4.2 Spar Decommissioning Costs

Platform preparation and deck removal
Mooring system removal
Hull removal

Preparation costs

The Spar deck was installed on the hull after hull installation and the deck is estimated removed offshore. Platform preparation is performed offshore and would be dependent on the extent of production equipment and whether the facility is primarily a gas, oil or both facility and would be estimated on a per facility or similar facility basis. Spar platform preparation is presented in Table 4.7 and without further information could be estimated on a deck tonnage basis. With a Representative Spar deck weight of 17,210 st. and estimated preparation cost including 8% engineering costs would be $918,000 or $53.4 /per st.

Task	Hours	Days	Cost
Platform Removal Prep			
Flush, Purge and Clean Facilities, Tanks and Vessels	24		$32,699
Prepare Modules for Removal	96		$130,796
Prepare Mooring Anchors	504		$686,679
Platform Removal Prep Subtotal	***624***	***26***	***$850,174***

Table 4.7 Spar Platform Removal Prep

Pipelines and Wells

The variables are the number of pipelines and wells. The Figure 4.7 can be used for pipeline abandonment (flushed with the ends cut, plugged and buried). Pipeline risers would be removed with a similar spread and procedure as removal of the TLP platform tubular tendons estimated below. The same cost of $78 per riser per foot of water depth can be used.

For problem free accessible dry tree wells, Figures 4.8 and 4.9 can be used. Subsea wells and associated structures to be removed is estimated at $9.8 MM per well if a drilling rig is necessary and $3 MM per well if the well is problem free and accessible with a deep sea intervention vessel, as shown in Section 5.1 Subsea Wells and Template. Drilling rigs would be necessary where the well is not accessible with an intervention vessel. The wells were estimated as typical trouble free wells plugged using rigless methods. Predicting the percent or cost of problem wells per platform without evaluating current well bore schematics and well history is outside the scope of this study. Operators would need to confirm if wells can be accessed with rigless methods or will require other methods. See the Executive Summary for recommendations on well data collection. Dry tree subsea wells that are accessible and problem free are estimated at $3.7 MM per well, as shown in 5.1 Dry Tree Subsea Well Estimate.

Deck Removal Costs

The primarily cost driver in deck removal is the HLV selected for deck removal and is dependent on the weight and configuration of the deck. As shown in Section 1 Table 1.4 the SPAR deck tonnages range from 3600 st to 18,000+ st. Where a 5000 st or less HLV is used the decommissioning cost is estimated at $20 MM and where >5000 st HLV is used the decommissioning cost is estimated at $29 MM, as shown in Tables 4.8 and 4.9, respectively.

Task	Hours	Days	Cost
SPAR Topsides Removal			
Cargo Barge Grillage and Tie-dow n Material	0		$400,000
Mobilize SSCV (DP type vessel) 5000 st	24		$581,900
Set-up DP SSCV vessel	4		$96,983
Mobilize Cargo Barges for Equipment and Deck	33		$32,340
Rig & Remove Topside Equipment	180		$4,540,650
Rig & Remove Deck	360		$9,081,300
Demobilize Cargo Barges w ith Equipment and Deck	33		$32,340
DeMobilize SSCV (DP type vessel)	24		$581,900
Work Contingency			$2,057,840
Weather Dow ntime			$2,743,787
Sub Total	658	27	$20,149,040

Table 4.8 Deck Removal using HLV 5000 st or less

Task	Hours	Days	Cost
SPAR Topsides Removal			
Cargo Barge Grillage and Tie-dow n Material	0		$400,000
Mobilize SSCV 7000 (DP type vessel)	24		$852,300
Set-up DP SSCV vessel	4		$142,050
Mobilize Cargo Barges for Equipment and Deck	33		$32,340
Rig & Remove Topside Equipment	180		$6,568,650
Rig & Remove Deck	360		$13,137,300
Demobilize Cargo Barges w ith Equipment and Deck	33		$32,340
DeMobilize SSCV (DP type vessel)	24		$852,300
Work Contingency			$2,977,200
Weather Dow ntime			$3,969,600
Sub Total	658	27	$28,964,080

Table 4.9 Deck Removal using HLV >5000 st

Platform and Mooring System

Platform preparation, mooring line disconnection and towing are estimated at $6.5 MM for a SPAR in 5000 feet water depth as shown in Table 4.10.

Task	Hours	Days	Cost
SPAR Hull Removal/Tow			
Route Survey	48		$30,000
Mobilize DB2000, cargo barge and tug	24		$212,720
Mobilize Tugs (4-12000 HP)	48		$280,000
Secure Tow Tugs to top of DDCV	6		$88,180
Ballast to relieve tension on Mooring lines	24		$352,720
Sever lower chain from mooring system. Sever lower chain from cable and remove chain @ 8 hours each	96		$1,410,880
Remove Mooring lines from Hull, by rigging to upper cable/chain connections. ROV sever upper chain from cable. Move away from Hull and lower cable to mudline @ 8 hours per line.	96		$1,410,880
Prepare Hull for transportation	48		$705,440
Release DDCV from Derrick Barge to Tow Tugs	4		$58,787
Demobilize Derrick Barge accounted for under Template Abandonment	0		$0
Tow DDCV to Onshore Location	48		$280,000
Demobilize Tow Tugs	24		$140,000
Work Contingency			$650,533
Weather Downtime			$867,377
DDCV Hull Removal/Tow Sub Total	442	18	$6,487,517

Table 4.10 Deck SPAR Hull Disconnect and Removal

The anchor chain / cable or polyester line mooring assemblies would be severed from the pile system and removed and, for the purpose of this study, the pile system would be allowed to remain in place. The chains are removed during the hull removal operation above and the cables are removed as described below. The mooring system estimated in Table 4.10 consisted of 12 lines. The cost is broken down to a hull removal cost of $3.7 MM exclusive of the chain mooring system and a chain mooring severing and removal cost of $2.8 MM. At 12 mooring lines, this would generate a severing cost of $235,000 per mooring line or $49 per line per foot of water depth. This would be applicable to all SPARs in the GOM.

An anchor handling vessel with ROV would mobilize and hook up to two mooring cables, reel the cables onboard, demobilize and unreal the cables at a shore facility. The process would be repeated until all 12 lines are removed for a total cost of $8.5 MM including the percents below.
The mooring system removal costs above do not include:

Work Contingency 8%
Work Contingency 15%
Weather Downtime 20%

The mooring cable line removal for this representative SPAR breaks down to $401,000 per cable line for this platform and or $83 per mooring line per feet of water depth. The $83 would be applicable to other Spars in the GOM.

Costs for removal of two mooring cables are shown in Table 4.11.

Task	Hours	Days	Cost
Mooring Line Removal			
Mobilize Anchor Handling Supply Vessel (AHSV)	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301

Table 4.11 SPAR Mooring Cable Removal

Cost Summation

Pipeline abandonment cost	Figure 4.7	Adjustable per volume and vessel used and number of lines
Umbilical Removal	Figure 4.7.4	
Riser Removal		Adjustable at $78 per riser per foot of water depth.
Dry tree Well P&A	Figures 4.8 and 4.9	
Dry tree subsea Well P&A	$3.7	
Subsea Well P&A and structure	$9.8 – Rig $3 - Rigless	
Deck removal costs	$20 for <5000 st $29 for ≥5000 st	Fixed per deck tonnage
Hull removal cost exclusive of the mooring system	$3.7 MM	Fixed
Mooring Chain disconnect and removal		Adjustable at $49 per line per foot of water depth.
Mooring cable or polyester line removal cost		Adjustable at $83 per mooring line per feet of water depth

Engineering cost	8% of total exclusive of disposal	Fixed
Disposal cost	$150 ton	Fixed
Site Clearance	1% of total exclusive of disposal	Fixed

Table 4.12 Spar Decommissioning Cost Summary

See Section 5.1 for the representative SPAR estimate.

4.3 Mini TLP (MTLP) & TLP decommissioning costs

Platform preparation
Pipeline Abandonment
Well P&A
Deck Removal (MTLP Only)
Hull removal
Mooring system removal

MTLP were assumed unstable to support the deck weight after the mooring system is severed. MTLP decks are assumed removed offshore.

TLP were assumed stable to support the deck tonnage after the mooring systems are severed. All TLP decks are estimated removed with the hull and transported to a shore facility.

Preparation costs

Platform preparation performed would be dependent on the extent of production equipment and whether the facility is primarily a gas, oil or both facility and would be estimated on a per facility or similar facility basis. TLP platform preparation is presented in Table 4.13c and without further information could be estimated on a cost per deck tonnage basis. Assuming a TLP deck weight of 8,100 st. the estimated preparation cost including engineering costs would be $877,000 or $108 /per st.

Pipelines and Wells

The variables are the number of pipelines and wells. The Figure 4.7 can be used for pipeline abandonment (flushed with the ends cut, plugged and buried). Pipeline risers would be removed with a similar spread and procedure as removal of the platform tubular tendons estimated below. The same cost of $78 per riser per foot of water depth can be used.

For problem free accessible dry tree wells, Figures 4.8 and 4.9 can be used. Subsea wells and associated structures to be removed is estimated at $9.8 MM per well if a drilling rig is necessary and $3 MM per well if the well is problem free and accessible with a deep sea intervention vessel, as shown in Section 5.1 Subsea Wells and Template. Drilling rigs would be necessary where the well is not accessible with an intervention vessel. The wells were estimated as typical trouble free wells plugged using rigless methods. Predicting the percent or cost of problem wells per platform without evaluating current well bore schematics and well history is outside the scope of this study. Operators would need to confirm if wells can be accessed with rigless methods or will require other methods. See the Executive Summary for recommendations on well data collection. Dry tree subsea wells that are accessible and problem free are estimated at $3.7 MM per well, as shown in 5.1 Dry Tree Subsea Well Estimate.

Platform and Mooring System

MTLP were assumed unstable to support the deck weight after the mooring system is severed. MTLP decks are assumed removed offshore. Removal costs would be dependent of deck tonnage. The primarily cost driver in deck removal is the HLV selected for deck removal and is dependent on the weight and configuration of the deck. As shown in Section 1 Table 1.4 the MTLP deck tonnages range from 3000 st to 8,600+ st. Where a 5000 st or less HLV is used, the MTLP deck removal decommissioning cost is estimated at $1.4 MM and where a >5000 st HLV is used the deck removal decommissioning cost is estimated at $4.3 MM, as shown in Tables 4.13a & b.

TLP were assumed stable to support the deck tonnage after the mooring systems are severed. All TLP decks are estimated removed with the hull and transported to a shore facility. Platform preparation could be performed near shore or offshore. Data for shore platform preparation was not available. Conservatively, offshore costs are included here.

Platform preparation, tendon disconnection and removal and deck and hull removal are estimated at $10 MM for a MTLP in 1700 feet water depth with a deck <5000 st per Tables 4.13a and 4.13c and 13.9 MM for a MTLP in 2900 feet water depth with a deck >5000 st. as shown in the combined costs of Tables 4.13b and c.

Platform preparation, tendon disconnection and removal and deck / hull towing are estimated at $20.2 MM for a TLP in 3000+ feet water depth as shown in Table 4.13d.

Task	Hours	Days	Cost
MTLP Deck Removal			
Mobilize Derrick Barge Spread (DB4000 & CB 400)	24		$320,360
Rig up to deck	6		$80,090
Sever, Remove Deck & Seafasten	36		$480,540
Demobilize Derrick Barge Spread	24		$320,360
Work Contingency	5		$72,081
Weather Dow ntime	7		$96,108
Platform Removal Subtotal	***103***	***4***	***$1,369,539***

Table 4.13a MTLP <5000 st Deck Removal

Task	Hours	Days	Cost
MTLP Deck Removal			
Mobilize Derrick Barge Spread (SSCV 7000 & CB 400)	24		$858,680
Rig up to Deck	8		$286,227
Sever, Remove Deck & Seafasten	48		$1,717,360
Demobilize Derrick Barge Spread	24		$858,680
Work Contingency	7		$257,604
Weather Downtime	10		$343,472
Platform Removal Subtotal	***121***	***5***	***$4,322,023***

Table 4.13b MTLP >5000 st Deck Removal

Task	Hours	Days	Cost
MTLP Removal			
Route Survey	48		$30,000
Mobilize Derrick Barge DB 2000	24		$213,720
Mobilize 3 Tow Tugs	24		$105,000
Mobilize Cargo Barges	36		$141,120
ROV Sever and Remove 3 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 8 hours each	26		$363,630
Secure TLP to Derrick Barge	6		$85,560
Secure Tow Tugs to TLP	6		$85,560
ROV Sever and Remove 3 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 8 hours each	26		$363,630
Release TLP to Tow Tugs	4		$57,040
Tow TLP to Onshore Location	192		$2,737,920
Demobilize Cargo Barge	36		$141,120
Demobilize Derrick Barge	24		$213,720
Work Contingency	46		$554,001
Weather Downtime	61		$738,668
Platform Removal Subtotal	***558***	***23***	***$5,830,689***
Onshore Disposal			
Offload Modules	120	120	$30,000
Dispose of Material			$877,500
Onshore Disposal Subtotal	***120***	***120***	***$907,500***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$36,164
Site Clearance Subtotal	***120***	***5***	***$337,534***
Project Management and Engineering (8% of the Total)			***$740,589***

Table 4.13c MTLP Preparation, Tendon & Hull Disconnect and Removal

The tubular tendon mooring assemblies would be severed from the pile system and removed and, for the purpose of this study, the pile system would be allowed to remain in place. The mooring system estimated in Table 4.13c consisted of 6 tendons. The cost is broken down to a hull removal cost of $5.9 MM exclusive of the tendon costs and a tendon severing and removal cost of $684,000. At 6 tendons, this would generate a severing and removal cost of $114,000 per tendon for this platform or $67 per tendon per foot of water depth. The $67 cost would be applicable to all MTLPs in the GOM. The hulls will be towed to a scrap or refurbishment facility. See Section 5.1 for the representative MTLP estimate.

Task	Hours	Days	Cost
Platform Removal Prep			
Flush, Purge and Clean Facilities, Tanks and Vessels	101		$123,342
Prepare Modules for Removal	60		$73,273
Replace Tension Units for Tendons	504		$615,489
Platform Removal Prep Subtotal	***665***	***28***	***$812,104***
TLP Removal			
Route Survey	48		$30,000
Mobilize Derrick Barge DB 2000	24		$213,720
Mobilize 4 Tow Tugs	24		$140,000
Mobilize Cargo Barges	36		$141,120
ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
Secure TLP to Derrick Barge	6		$94,310
Secure Tow Tugs to TLP	6		$94,310
ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
Release TLP to Tow Tugs	4		$62,873
Tow TLP to Onshore Location	192		$3,017,920
Demobilize Cargo Barge	36		$141,120
Demobilize Derrick Barge	24		$213,720
Work Contingency	67		$943,100
Weather Downtime	90		$628,733
Platform Removal Subtotal	***749***	***31***	***$8,738,847***
Onshore Disposal			
Offload Modules	120	120	$300,000
Dispose of Material			$8,400,000
Onshore Disposal Subtotal	***120***	***120***	***$8,700,000***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$36,164
Site Clearance Subtotal	***120***	***5***	***$337,534***
Project Management and Engineering (8% of the Total)			***$1,649,464***

Table 4.13d TLP Preparation, Deck, Tendon & Hull Disconnect and Removal

The tubular tendon mooring assemblies would be severed from the pile system and removed and, for the purpose of this study, the pile system would be allowed to remain in place. The mooring system estimated in Table 4.13d consisted of 12 tendons. The cost is broken down to a deck / hull removal cost of $6.5 MM exclusive of the tendon costs and a tendon severing and removal cost of $3.0 MM. At 12 tendons, this would generate a severing and removal cost of $251,500 per tendon for this platform or $78 per tendon per foot of water depth. The $78 cost would be applicable to all TLPs in the GOM. The hulls will be towed to a scrap or refurbishment facility. See Section 5.1 for the representative TLP estimate.

Cost Summation

Pipeline abandonment cost	Figure 4.7	Adjustable per volume and vessel used and number of lines
Umbilical Removal	Figure 4.7.4	
Riser Removal		Adjustable at $78 per riser per foot of water depth.
Dry tree Well P&A	Figures 4.8 and 4.9	
Dry tree subsea Well P&A	$3.7	
Subsea Well P&A and structure	$9.8 – Rig $3 - Rigless	
Deck removal costs (For MTLP)	$1.4 for <5000 st $4.3 for ≥5000 st	Fixed per deck tonnage
Hull removal cost exclusive of the mooring system	$5.9 MM MTLP $6.5 MM TLP	Fixed
Mooring Tendon disconnect and removal		Adjustable at $67 and $78 per tendon per foot of water depth, for MTLP and TLP, respectively
Engineering cost	8% of total exclusive of disposal	Fixed
Disposal cost	$150 ton	Fixed
Site Clearance	1% of total exclusive of disposal	Fixed

Table 4.14 MTLP & TLP Decommissioning Cost Summary

4.4 SEMI decommissioning costs

Decommissioning is similar to all SEMIs. The following tasks are employed:

Platform preparation
Pipeline Abandonment
Well P&A
Mooring system removal
Hull removal

Platform Preparation

Since the deck is an integral part of the structure, platform preparation can be performed dockside or offshore. The SEMI Platform preparation in this study is estimated to be performed onshore. To date, these large structures have not been decommissioned and appropriate onshore preparation costs have not been established, but it is assumed the onshore costs would be lower because marine assets would not be required during preparation operations. An estimate of the representative Spar and TLP platform offshore preparation is presented in those sections above. The representative SEMI structure here has an estimated 20,000 st deck weight. Using the Spar for similar deck weight deck preparation cost of $53 /st would be appropriate for offshore preparation.

Pipelines and Wells

The variables are the number of pipelines and wells. The Figure 4.7 can be used for pipeline abandonment (flushed with the ends cut, plugged and buried). Pipeline risers would be removed with a similar spread and procedure as removal of the TLP platform tubular tendons estimated above. The same cost of $78 per riser per foot of water depth can be used.

Problem free accessible subsea wells and associated structures to be removed is estimated at $9.8 MM per well if a drilling rig is necessary and $3 MM per well if the well is problem free and accessible with a deep sea intervention vessel, as shown in Section 5.1 Subsea Wells and Template. Drilling rigs would be necessary where the well is not accessible with an intervention vessel. The wells were estimated as typical trouble free wells plugged using rigless methods. Predicting the percent or cost of problem wells per platform without evaluating current well bore schematics and well history is outside the scope of this study. Operators would need to confirm if wells can be accessed with rigless methods or will require other methods. See the Executive Summary for recommendations on well data collection. Dry Tree Subsea wells are estimated at $3.7 MM per well, as shown in 5.1 Dry Tree Subsea Well Estimate.

Platform and Mooring System

Platform preparation, mooring line disconnection and towing are estimated at $6 MM for a SEMI in 6000+ feet water depth as shown in Table 4.15.

Task	Hours	Days	Cost
Platform Removal Prep & Removal			
Mobilize Tugs (4-12000 HP)	48		$280,000
Prepare facilities for tow .	168		$286,867
Mobilize DB2000, cargo barge and tug	24		$198,520
Secure Tow Tugs to top of Hull	6		$84,630
Ballast to relieve tension on Mooring lines	24		$338,520
Sever low er chain from mooring system. Sever low er chain from cable and remove chain @ 8 hours each	128		$1,805,440
Remove Mooring lines from Hull, by rigging to upper cable/chain connections. ROV sever upper chain from cable. Move aw ay from Hull and low er cable to mudline @ 8 hours per line.	128		$1,805,440
Demobilize DB2000, cargo barge and tug	24		$198,520
Tow facilities to Ingleside facility	93		$542,500
Mothball facilities onshore	168		$205,163
Demobilize Tugs	48		$280,000
Platform Removal Prep Subtotal	***763***	***26***	***$6,025,600***

Table 4.15 SEMI Platform Severing and Chain and Hull Removal

The anchor chain / cable or polyester mooring assemblies would be severed from the pile system and removed and, for the purpose of this study, the pile system would be allowed to remain in place. The chains are removed during the hull removal operation and the cables are removed as described below. The mooring system estimated in Table 4.15 consisted of 16 lines. The cost is broken down to a hull removal cost of $2.4 MM and a chain mooring line severing and removal cost of $3.6 MM. At 16 mooring lines, this would generate a severing cost of $225,700 per mooring line or $35 per line per foot of water depth. This would be applicable to all SEMIs in the GOM.

Cost for removal of two mooring cables are shown in Table 4.16

Task	Hours	Days	Cost
Mooring Line Removal			
Mobilize Anchor Handling Supply Vessel (AHSV)	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from low er chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266

Table 4.16 Semi Mooring Line Removal

An anchor handling vessel with ROV would mobilize and hook up to two mooring cables, reel the cables onboard, demobilize and unreal the cables at a shore facility. The process would be repeated until all 16 lines are removed for a total cost of $3.4 MM including the percents below.
The above costs do not show:

Work Contingency 8%
Work Contingency 15%
Weather Downtime 20%

Mooring line removal costs for this representative SEMI are estimated to cost $441,000 per cable line or $68 per mooring line per feet of water depth. This cost would be applicable to other SEMIs in the GOM.

Cost Summation

Asset	Driver	Fixed or Adjustable
Pipeline abandonment cost	Figure 4.7	Adjustable per volume and vessel used and number of lines
Umbilical Removal	Figure 4.7.4	
Riser Removal		Adjustable at $78 per riser per foot of water depth.
Dry tree subsea Well P&A	$3.7	
Subsea Well P&A and structure	$9.8 – Rig $3 - Rigless	
Hull removal cost exclusive of the mooring system	$2.4 MM	Fixed
Mooring Chain disconnect and removal		Adjustable at $35 per line per foot of water depth.
Mooring cable or polyester line removal cost		Adjustable at $68 per mooring line per feet of water depth
Engineering cost	8% of total exclusive of disposal	Fixed
Disposal cost	$150 ton	Fixed
Site Clearance	1% of total exclusive of disposal	Fixed

Table 4.17 SEMI Decommissioning Cost Summary

4.5 FPSO structure decommissioning

There are currently no FPSO's in the GOM. Internationally there many types FPSO designs, with some permanently secured with mooring lines, permanently secured to single point mooring (SPM) systems that allow the vessel to rotate with environmental conditions. Information received during this study indicated that Petrobras will install the first FPSO in the GOM. The FPSO will be moored to a detachable SPM, allowing it to detach and demobilize during inclement weather. See Section 3 for a depiction of the FPSO. The FPSO will disconnect from the SPM and demobilize under its own power. Topside decommissioning will be performed onboard.

Pipelines and Wells

The variables are the number of pipelines and wells. Figure 4.7 can be used for pipeline abandonment (flushed with the ends cut, plugged and buried). Pipeline risers would be removed with a similar spread and procedure as removal of the TLP platform tubular tendons estimated above. The same cost of $78 per riser per foot of water depth can be used.

Problem free accessible subsea wells and associated structures to be removed is estimated at $9.8 MM per well if a drilling rig is necessary and $3 MM per well if the well is problem free and accessible with a deep sea intervention vessel, as shown in Section 5.1 Subsea Wells and Template. Drilling rigs would be necessary where the well is not accessible with an intervention vessel. The wells were estimated as typical trouble free wells plugged using rigless methods. Predicting the percent or cost of problem wells per platform without evaluating current well bore schematics and well history is outside the scope of this study. Operators would need to confirm if wells can be accessed with rigless methods or will require other methods. See the Executive Summary for recommendations on well data collection. Dry Tree Subsea wells are estimated at $3.7 MM per well, as shown in 5.1 Dry Tree Subsea Well Estimate.

Platform Mooring System

The platform SPM mooring system would be removed similar to the SEMI mooring system with costs allocated per mooring line per feet of water depth as described in SEMI above.

4.6 Subsea structure decommissioning

Consideration for subsea structures, wells, manifolds, jumpers, etc., would be to remove everything to 15 feet below the mudline or leave selected structures in place. For the purpose of this study, it was agreed that removal would be required for wells and structures that are stabbed over or attached above anchored templates, but the anchored template would be allowed to remain in place. Subsea structures with wells would be removed during well P&A operations. The Major Asset Inventory for the GOM is provided in Section 1 but the subsea inventory was not available at the time of this study. See the intro to GOM Inventory in Section 1. An example of subsea template removal is provided in Table 4.18. An engineering cost would be added. An 8% engineering cost is used in this study for a total template removal cost of $323,000. Further study in the subsea inventory would be needed to capture Section 1 Recommendations.

Task	Hours	Days	Cost
Template Abandonment			
Remove all flow lines and umbilical lines from the wells to the maninfold.Remove flow lines from manifold to flow line Tie-in base. Remove Tie-in bases from flow lines, plug and cover end of flow lines	72	3	$239,160
Work Contingency			$35,874
Weather Downtime			$23,916
Template Abandonment	***72***	3	***$298,950***

Table 4.18 Example Subsea Template Removal

4.7 Probabilistic Decommissioning Cost

This section focuses on determining the estimated decommissioning costs on a probabilistic basis for a selected example platform. The platform selected from Table 4.1 for the probabilistic modeling is a 12 leg 32 skirt pile platform, identified as platform 12P-32SP. The costs included in Table 4.1 were derived on a deterministic basis as described below.

Deterministic estimates address static "most likely" values for the elements of cost such as task duration and spread rates. This is the value that a knowledgeable contractor would expect to occur most of the time. Probabilistic modeling addresses the possible variance in these values. This leads to a cost estimate result that is best described in a "distribution", as compared to the single number of a deterministic estimate. The starting point for the probabilistic estimate was the individual task durations and work spread rates (cost elements) used to derive the deterministic estimate above. The values used in the deterministic estimate were assumed to be the "most probable" values of each element for the purposes of establishing a Triangular Probability Distribution Function (PDF). This type of PDF is commonly used for construction (in this case destruction) cost estimates because they can be described by three variables: an assumed Maximum, Minimum and Most Likely value.

The probabilistic cost estimates were derived by selecting a deterministic estimate, in this cast the platform identified as 12L-32SP, and building a project "model" in which probability distribution functions (PDF's) are assigned to all task durations and spread rates (cost elements), starting with the most likely/probable (the "modal") value which would be used in a deterministic estimate. A Triangular Distribution is assumed for all cost elements. The decommissioning project "model" is then simulated repeatedly until convergence and a smooth distribution is achieved in the resulting output. This is accomplished with 1500 iterations, or individual outcome scenarios, for the project using a Latin Hypercube method of individual value selection. This is similar to Monte Carlo random value selection, but converges to the desired distribution faster.

If the distribution were symmetrical, the Mode and Median (Mean or P50) would be the same. Unfortunately, in most construction-type projects the individual cost elements have more opportunity for increase than for decrease. It is important to note in this context that the ranges used in this study were derived independently by the developers of the original deterministic estimate, but after that work was completed.

The Cumulative Distribution Function (CDF) for Total Gross Cost is shown in Figure 4.10 below. The P10 and P90 values are US$ 65.38 MM and US$ 69.56 MM, respectively. It is noted that the estimated deterministic cost is approximately a P19 number. The deterministic cost is shown to be somewhat optimistic. This results from the individual cost element PDF's often being skewed in the direction of a cost increase, as noted above. If all cost element PDF's were symmetrical, we would expect the deterministic and probabilistic P50 costs to be equal.

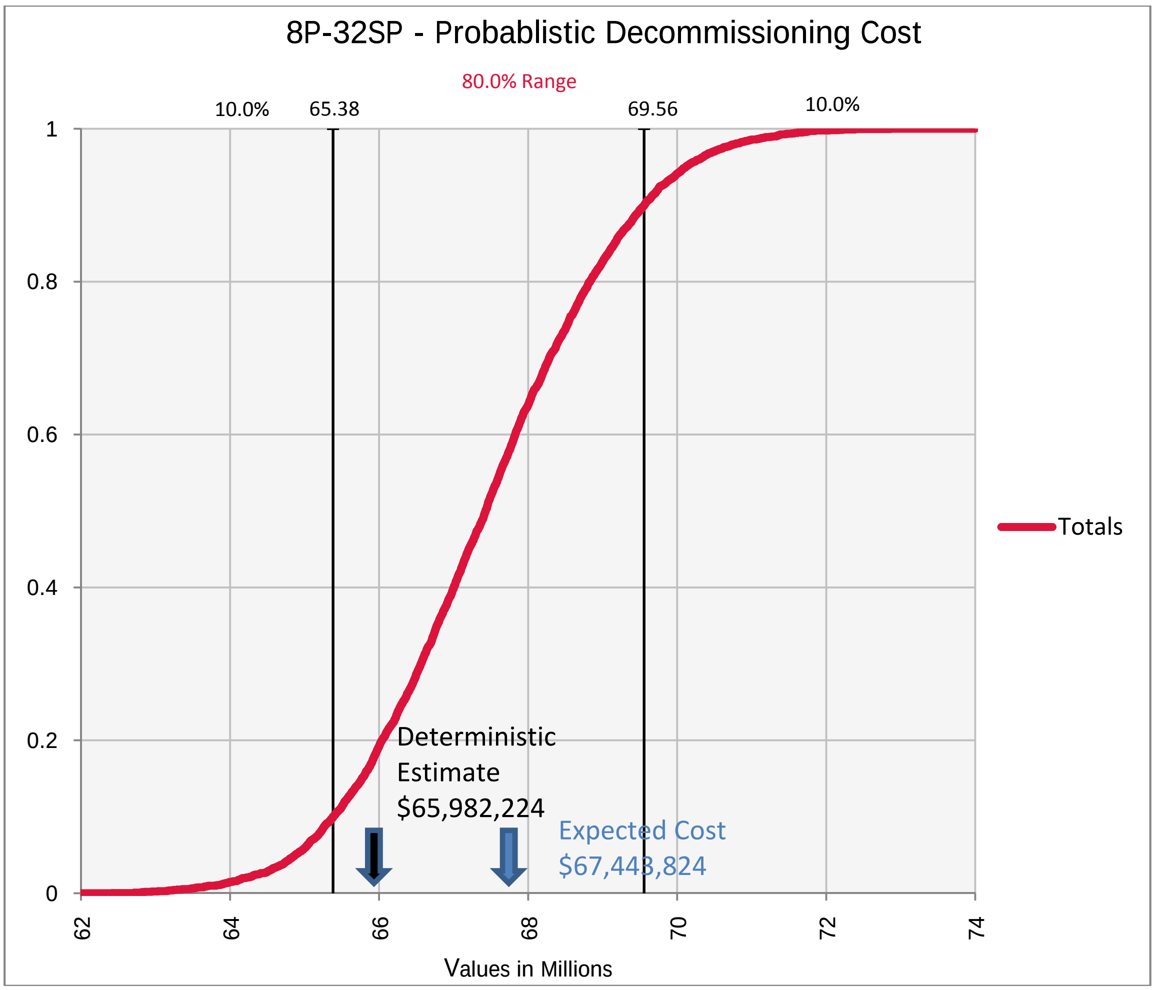


Figure 4.10 CDF for Total Gross Cost for 12L-32SP*

*Costs for variables in Table 4.19 have been removed from the probabilistic model. Operator / Owner overhead costs are not included in the scope of this study.

Overhead		%
Engineering		0.08
Weather		0.2
Wk Provision		0.15
Overhead OH		**0.43**

Table 4.19 Overhead costs.

Section 5 –
APPENDIX

5.1 Decommissioning Cost Estimates

5.1.1 Representative Platform Cost Estimates

5.1.2 FIXED PLATFORM Representative Cost Estimates

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4L-1P-4SP
400 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4L-1P-4SP - 400 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Explosive Charges	Added extra time on some tasks for mudslide area	☐	0.00	0.00%	$19,200.00	0.28%
Mobilize Work Boat	Includes manual calc for casing jacks and specialists	☑	16.70	0.67%	$22,857.40	0.34%
Standby for Daylight Det.		☑	8.00	0.32%	$11,001.30	0.16%
Pre/Post Detonat'n Survey		☑	1.00	0.04%	$1,375.20	0.02%
Sever Conductors- Explosive		☑	4.48	0.18%	$35,992.78	0.53%
Remove Conductors	includes rig up and down	☑	314.80	12.66%	$432,902.50	6.37%
Platform Removal Preparation		☐	504.00	20.26%	$504,000.00	7.41%
Demob Work Boat		☑	16.70	0.67%	$22,857.40	0.34%
Mobilize DB 4000		☐	19.57	0.79%	$271,925.15	4.00%
Mobilize CB 240 & Tug		☐	35.40	1.42%	$37,364.00	0.55%
Mobilize CB 300 & Tug	two	☐	35.40	1.42%	$97,384.00	1.43%
Setup Derrick Barge		☑	6.75	0.27%	$93,791.25	1.38%
Cut Deck/Equip/Misc		☑	6.00	0.24%	$87,330.00	1.28%
Remove Equipment		☑	5.00	0.20%	$72,775.00	1.07%
Remove 4 Pile Deck		☑	12.00	0.48%	$174,660.00	2.57%
Jet/Airlift Pile Mud Plug		☑	5.25	0.21%	$76,413.75	1.12%
Jet/Air Skrt Pile Mud Plg		☑	30.80	1.24%	$448,294.00	6.59%
Mobilize Abrasive Cutting Spread		☑	16.70	0.67%	$18,787.50	0.28%
Sever Piles- Abrasive		☑	8.00	0.32%	$179,190.00	2.64%
Demob Abrasive Cutting Spread		☑	16.70	0.67%	$18,787.50	0.28%
Demob CB 240 & Tug		☐	35.40	1.42%	$23,364.00	0.34%
Install Closure Plates		☑	8.00	0.32%	$111,160.00	1.63%
Deballast Piles or Jkt Lg		☑	8.00	0.32%	$111,160.00	1.63%
Lift/Secure Jkt for Tow		☑	6.00	0.24%	$83,370.00	1.23%
Pick Up DB Anchors		☑	6.75	0.27%	$93,791.25	1.38%
Tow Jckt to Shallow Water		☑	20.00	0.80%	$277,900.00	4.09%
Setup Derrick Barge		☑	6.75	0.27%	$93,791.25	1.38%
Set Jacket on Bottom		☑	2.00	0.08%	$27,790.00	0.41%
Cut Jacket		☑	12.00	0.48%	$178,500.00	2.62%
Remove Jacket - Meth 3		☑	21.70	0.87%	$322,787.50	4.75%
Remove Jacket - Meth 3		☑	21.70	0.87%	$322,787.50	4.75%
Demob CB 300 & Tug	two	☐	35.40	1.42%	$69,384.00	1.02%
Pick Up DB Anchors		☑	6.75	0.27%	$93,791.25	1.38%
Demob DB 4000		☐	19.57	0.79%	$278,425.15	4.09%
Site Clearance - with Trawler		☐	0.00	0.00%	$35,800.00	0.53%
Site Clearance Verify		☐	0.00	0.00%	$14,400.00	0.21%
Offload CB 240		☐	384.00	15.44%	$77,600.00	1.14%

MMS
Platform Decommission Task Information

4L-1P-4SP - 400 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Offload CB 300		☐	624.00	25.09%	$167,920.00	2.47%
		Task Total	2281.27	91.72%	$5,010,610.63	73.68%
		Misc. Work Provision (15.00%)	88.28	3.55%	$512,076.70	7.53%
		Weather Contingency (20.00%)	117.71	4.73%	$682,768.90	10.04%
		Consumables			$194,000.00	2.85%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$400,848.80	5.89%
		Total:	2487.26	100.00%	$6,800,305.03	100.00%

MMS
Platform Decommission Resources Breakdown
4L-1P-4SP - 400 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$25,875.00	0.38%
Cargo Barge 240	$3,600.00	per Day per Barge	$57,600.00	0.85%
Cargo Barge 300	$4,920.00	per Day per Barge	$127,920.00	1.88%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$90,981.00	1.34%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$193,060.00	2.84%
CB Damage Deduct	$20,000.00	per Cargo Barge	$60,000.00	0.88%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$29,832.00	0.44%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	3.71%
Derrick Barge 4000	$10,500.00	per Hour per barge	$2,442,195.00	35.91%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$736,147.35	10.83%
Expl Charge - Cond	$3,200.00	per Conductor	$19,200.00	0.28%
Expl Technician	$95.00	per Hour	$34,359.60	0.51%
Helicopter Trips	$6,500.00	per Round Trip	$6,500.00	0.10%
Manual Calculation	$0.00	Independently Calculated	$55,543.30	0.82%
Nets (Heavy Duty, Non-Repairable)	$5,000.00	ea	$15,000.00	0.22%
Nets (Heavy Duty, Repairable)	$2,600.00	ea	$20,800.00	0.31%
Nets (Non-Repairable)	$2,200.00	ea	$6,600.00	0.10%
Nets (Repairable)	$1,300.00	ea	$7,800.00	0.11%
NMFS Observers (2)	$126.00	per Hour	$45,571.68	0.67%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$53,750.00	0.79%
Pipeline Survey	$230.00	per Hour	$53,495.70	0.79%
Rig Up CB 240	$14,000.00	per Barge	$14,000.00	0.21%
Rig Up CB 300	$14,000.00	per Barge	$28,000.00	0.41%
Trawler	$416.00	per Hour	$0.00	0.00%
Work Boat	$500.00	per Hour	$634,380.00	9.33%

8P-12SP
410 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

8P-12SP - 410 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Explosive Charges		☐	0.00	0.00%	$107,200.00	1.93%
Mobilize Work Boat	Includes manual calc for casing jacks and specialists	☑	23.00	0.96%	$45,045.50	0.81%
Standby for Daylight Det.		☑	8.00	0.33%	$15,668.00	0.28%
Pre/Post Detonat'n Survey		☑	1.00	0.04%	$8,458.50	0.15%
Sever Conductors- Explosive		☑	3.90	0.16%	$7,638.15	0.14%
Remove Conductors	includes rig up and down	☑	265.00	11.02%	$519,002.50	9.36%
Platform Removal Preparation		☐	504.00	20.95%	$546,000.00	9.85%
Demob Work Boat		☑	23.00	0.96%	$45,045.50	0.81%
Mobilize DB 4000		☐	28.57	1.19%	$409,794.12	7.39%
Mobilize CB 240 & Tug		☐	48.00	2.00%	$45,680.00	0.82%
Mobilize CB 400 & Tug		☐	48.00	2.00%	$62,000.00	1.12%
Setup Derrick Barge		☑	6.75	0.28%	$95,283.00	1.72%
Cut Deck/Equip/Misc		☑	4.64	0.19%	$68,560.64	1.24%
Remove Equipment		☑	3.00	0.12%	$44,328.00	0.80%
Remove 8 Pile Deck		☑	9.35	0.39%	$138,155.61	2.49%
Demob CB 240 & Tug		☐	48.00	2.00%	$31,680.00	0.57%
Jet/Airlift Pile Mud Plug		☑	35.00	1.45%	$494,060.00	8.91%
Standby for Daylight Det.		☑	8.00	0.33%	$112,928.00	2.04%
Pre/Post Detonat'n Survey		☑	1.00	0.04%	$20,616.00	0.37%
Sever Piles- Explosive		☑	4.84	0.20%	$68,321.44	1.23%
Remove Jacket - Meth 3		☑	21.70	0.90%	$325,283.00	5.87%
Demob CB 400 & Tug		☐	48.00	2.00%	$48,000.00	0.87%
Pick Up DB Anchors		☑	6.75	0.28%	$94,432.50	1.70%
Demob DB 4000		☐	28.57	1.19%	$406,194.30	7.33%
Mobilize Dive Spread		☐	23.00	0.96%	$131,629.00	2.37%
Site Clearance Verify		☐	48.00	2.00%	$274,704.00	4.95%
Offload CB 180		☑	0.00	0.00%	$20,000.00	0.36%
Offload CB 240		☐	384.00	15.96%	$77,600.00	1.40%
Offload CB 400		☐	624.00	25.94%	$182,240.00	3.29%
		Task Total	2257.07	93.82%	$4,445,547.75	80.18%
		Misc. Work Provision (15.00%)	63.74	2.65%	$318,424.00	5.74%
		Weather Contingency (20.00%)	84.99	3.53%	$424,565.30	7.66%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%

MMS
Platform Decommission Task Information

8P-12SP - 410 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$355,643.80	6.41%
		Total:	2405.80	100.00%	$5,544,180.85	100.00%

MMS
Platform Decommission Resources Breakdown
8P-12SP - 410 Ft. WD

Resource Used	Unit Cost		Cost	
Cargo Barge 180	$3,000.00	per Day per Barge	$0.00	0.00%
Cargo Barge 240	$3,600.00	per Day per Barge	$57,600.00	1.04%
Cargo Barge 400	$6,240.00	per Day per Barge	$162,240.00	2.93%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$74,573.40	1.35%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$117,700.00	2.12%
CB Damage Deduct	$20,000.00	per Cargo Barge	$60,000.00	1.08%
Decomm Platform	$0.00	Calculated from tables	$482,941.67	8.71%
Derrick Barge 4000	$10,500.00	per Hour per barge	$1,660,785.01	29.96%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$500,608.04	9.03%
Dive Boat	$900.00	per Hour	$63,900.00	1.15%
Dive Serv - Basic	$0.00	Calculated from tables	$224,715.00	4.05%
Dive Serv - Suppl	$0.00	Calculated from tables	$112,393.00	2.03%
Expl Charge - Cond	$3,200.00	per Conductor	$16,000.00	0.29%
Expl Charge - Piling	$11,400.00	per Pile	$91,200.00	1.64%
Expl Technician	$95.00	per Hour	$45,796.65	0.83%
Helicopter Trips	$6,500.00	per Round Trip	$26,000.00	0.47%
Manual Calculation	$0.00	Independently Calculated	$49,934.58	0.90%
NMFS Observers (2)	$126.00	per Hour	$53,556.30	0.97%
Pipeline Survey	$230.00	per Hour	$36,379.10	0.66%
Rig Up CB 240	$14,000.00	per Barge	$14,000.00	0.25%
Rig Up CB 400	$14,000.00	per Barge	$14,000.00	0.25%
Side Scan Sonar	$75.00	per Hour	$5,325.00	0.10%
Work Boat	$500.00	per Hour	$575,900.00	10.39%

4P4S

446 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P4S - 446 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Explosive Charges		☐	0.00	0.00%	$16,000.00	0.19%
Mobilize CB 300 & Tug		☐	32.33	1.48%	$45,683.40	0.54%
Platform Removal Preparation		☐	504.00	23.07%	$504,000.00	5.98%
Mobilize DB 4000		☐	17.38	0.80%	$249,646.20	2.96%
Mobilize CB 400 & Tug		☐	32.33	1.48%	$46,330.00	0.55%
Setup Derrick Barge		☑	6.75	0.31%	$95,283.00	1.13%
Cut Deck/Equip/Misc		☑	4.64	0.21%	$70,045.44	0.83%
Remove Equipment		☑	2.00	0.09%	$30,192.00	0.36%
Remove 4 Pile Deck		☑	9.35	0.43%	$141,147.61	1.67%
Jet/Airlift Pile Mud Plug		☑	18.00	0.82%	$271,728.00	3.22%
Jet/Air Skrt Pile Mud Plg		☑	30.80	1.41%	$464,956.80	5.52%
Pre/Post Detonat'n Survey		☑	1.00	0.05%	$21,596.00	0.26%
Mobilize Abrasive Cutting Spread		☑	15.16	0.69%	$17,055.00	0.20%
Sever Piles- Abrasive		☑	71.27	3.26%	$1,242,070.58	14.73%
Demob Abrasive Cutting Spread		☑	15.16	0.69%	$17,055.00	0.20%
Standby for Daylight Det.		☑	8.00	0.37%	$120,768.00	1.43%
Sever Conductors- Explosive		☑	3.90	0.18%	$58,874.40	0.70%
Remove Conductors (DB 2/4000)		☑	63.20	2.89%	$946,104.00	11.22%
Cut Jacket	at -50 ft elev	☑	31.50	1.44%	$471,555.00	5.59%
Remove Jacket - Meth 1	Top section	☑	13.75	0.63%	$205,837.50	2.44%
Demob CB 300 & Tug		☑	32.33	1.48%	$31,683.40	0.38%
Rig Jacket Underwater		☑	9.75	0.45%	$146,152.50	1.73%
Remove Jacket - Meth 3		☑	21.70	0.99%	$323,221.50	3.83%
Demob CB 400 & Tug		☐	32.33	1.48%	$32,330.00	0.38%
Pick Up DB Anchors		☑	6.75	0.31%	$93,791.25	1.11%
Demob DB 4000		☐	17.38	0.80%	$247,995.10	2.94%
Offload CB 300		☐	696.00	31.86%	$162,680.00	1.93%
Offload CB 400		☐	312.00	14.28%	$101,120.00	1.20%
Site Clearance Verify		☐	48.00	2.20%	$85,200.00	1.01%
		Task Total	2056.76	94.15%	$6,260,101.68	74.26%
		Misc. Work Provision (15.00%)	54.75	2.51%	$715,367.60	8.49%
		Weather Contingency (20.00%)	73	3.34%	$953,823.40	11.31%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

4P4S - 446 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$500,808.10	5.94%
		Total:	2184.51	100.00%	$8,430,100.78	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
4P4S - 446 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$63,493.75	0.75%
Cargo Barge 300	$4,920.00	per Day per Barge	$142,680.00	1.69%
Cargo Barge 400	$6,240.00	per Day per Barge	$81,120.00	0.96%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$315,628.59	3.74%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$96,110.00	1.14%
CB Damage Deduct	$20,000.00	per Cargo Barge	$40,000.00	0.47%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	2.99%
Derrick Barge 4000	$10,500.00	per Hour per barge	$3,539,759.88	41.99%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,066,984.84	12.66%
Dive Boat	$900.00	per Hour	$43,200.00	0.51%
Expl Charge - Cond	$3,200.00	per Conductor	$16,000.00	0.19%
Expl Technician	$95.00	per Hour	$27,672.55	0.33%
Helicopter Trips	$6,500.00	per Round Trip	$19,500.00	0.23%
NMFS Observers (2)	$126.00	per Hour	$19,619.46	0.23%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$86,000.00	1.02%
Pipeline Survey	$230.00	per Hour	$77,537.60	0.92%
Rem. Operated Vehicle	$800.00	per Hour	$38,400.00	0.46%
Rig Up CB 300	$14,000.00	per Barge	$14,000.00	0.17%
Rig Up CB 400	$14,000.00	per Barge	$14,000.00	0.17%
Side Scan Sonar	$75.00	per Hour	$3,600.00	0.04%
Work Boat	$500.00	per Hour	$302,795.00	3.59%

8P-12SP
480 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - 480 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Explosive Charges		☐	0.00	0.00%	$148,800.00	1.14%
Mobilize Work Boat	Includes manual calc for casing jacks and specialists	☑	23.00	0.61%	$45,045.47	0.35%
Standby for Daylight Det.		☑	8.00	0.21%	$15,667.97	0.12%
Pre/Post Detonat'n Survey		☑	1.00	0.03%	$8,458.53	0.06%
Sever Conductors- Explosive		☑	11.44	0.30%	$22,548.57	0.17%
Remove Conductors	includes rig up and down	☑	912.40	24.20%	$1,786,935.48	13.71%
Platform Removal Preparation		☐	504.00	13.37%	$546,000.00	4.19%
Demob Work Boat		☑	23.00	0.61%	$45,045.47	0.35%
Mobilize DB 2000		☐	28.57	0.76%	$309,799.12	2.38%
Mobilize CB 300 & Tug		☑	48.00	1.27%	$61,040.00	0.47%
Mobilize CB 400 & Tug	two CBs	☐	48.00	1.27%	$124,000.00	0.95%
Setup Derrick Barge		☑	6.75	0.18%	$71,658.00	0.55%
Cut Deck/Equip/Misc		☑	4.64	0.12%	$53,805.44	0.41%
Remove Equipment		☑	4.00	0.11%	$46,384.00	0.36%
Remove 8 Pile Deck		☑	9.35	0.25%	$108,422.60	0.83%
Demob CB 300 & Tug		☐	48.00	1.27%	$47,040.00	0.36%
Jet/Airlift Pile Mud Plug		☑	35.00	0.93%	$371,560.00	2.85%
Standby for Daylight Det.		☑	8.00	0.21%	$84,928.00	0.65%
Pre/Post Detonat'n Survey		☑	1.00	0.03%	$17,116.00	0.13%
Sever Piles- Explosive		☑	4.84	0.13%	$51,381.44	0.39%
Cut Jacket	Vertically	☑	234.33	6.22%	$2,692,451.62	20.65%
Pick Up DB Anchors		☑	6.75	0.18%	$70,807.50	0.54%
Demob DB 2000		☐	28.57	0.76%	$303,485.15	2.33%
Mobilize SSCV		☐	25.00	0.66%	$508,050.00	3.90%
Setup Derrick Barge		☑	6.75	0.18%	$135,418.55	1.04%
Remove Jacket - Meth 3		☑	21.70	0.58%	$457,045.41	3.51%
Remove Jacket - Meth 3		☑	21.70	0.58%	$457,045.41	3.51%
Demob CB 400 & Tug		☐	48.00	1.27%	$48,000.00	0.37%
Pick Up DB Anchors		☑	6.75	0.18%	$135,418.55	1.04%
Demob SSCV		☐	25.00	0.66%	$508,050.00	3.90%
Mobilize Dive Spread		☐	23.00	0.61%	$95,220.00	0.73%
Site Clearance Verify		☐	48.00	1.27%	$198,720.00	1.52%
Offload CB 300		☐	384.00	10.19%	$98,720.00	0.76%
Offload CB 400	two CBs	☐	672.00	17.83%	$214,720.00	1.65%
		Task Total	3280.54	87.02%	$9,888,788.26	75.84%
		Misc. Work Provision (15.00%)	209.76	5.56%	$1,010,728.00	7.75%
		Weather Contingency (20.00%)	279.68	7.42%	$1,347,637.00	10.34%

MMS
Platform Decommission Task Information

8P-12SP - 480 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$791,103.00	6.07%
		Total:	3769.98	100.00%	13,038,256.26	100.00%

MMS
Platform Decommission Resources Breakdown
8P-12SP - 480 Ft. WD

Resource Used	Unit Cost		Cost	
Cargo Barge 300	$4,920.00	per Day per Barge	$78,720.00	0.60%
Cargo Barge 400	$6,240.00	per Day per Barge	$174,720.00	1.34%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$111,710.20	0.86%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$421,730.00	3.23%
CB Damage Deduct	$20,000.00	per Cargo Barge	$60,000.00	0.46%
Decomm Platform	$0.00	Calculated from tables	$864,990.04	6.63%
Derrick Barge 2000	$7,000.00	per Hour per barge	$2,602,600.00	19.96%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,515,085.42	11.62%
Dive Boat	$900.00	per Hour	$63,900.00	0.49%
Dive Serv - Basic	$0.00	Calculated from tables	$224,715.00	1.72%
Expl Charge - Cond	$3,200.00	per Conductor	$57,600.00	0.44%
Expl Charge - Piling	$11,400.00	per Pile	$91,200.00	0.70%
Expl Technician	$95.00	per Hour	$125,596.65	0.96%
Helicopter Trips	$6,500.00	per Round Trip	$39,000.00	0.30%
Manual Calculation	$0.00	Independently Calculated	$151,047.80	1.16%
NMFS Observers (2)	$126.00	per Hour	$136,204.74	1.04%
Pipeline Survey	$230.00	per Hour	$110,101.00	0.84%
Rig Up CB 300	$14,000.00	per Barge	$14,000.00	0.11%
Rig Up CB 400	$14,000.00	per Barge	$28,000.00	0.21%
Side Scan Sonar	$75.00	per Hour	$5,325.00	0.04%
SSCV	$16,667.00	per Hour	$1,781,702.41	13.67%
Work Boat	$500.00	per Hour	$1,230,840.00	9.44%

8P-12SP

483 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - 483 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Explosive Charges		☐	0.00	0.00%	$288,800.00	1.41%
Mobilize Work Boat	Includes manual calc for casing jacks and specialists	☑	13.00	0.31%	$25,460.33	0.12%
Standby for Daylight Det.		☑	8.00	0.19%	$15,667.97	0.08%
Pre/Post Detonat'n Survey		☑	1.00	0.02%	$8,458.53	0.04%
Sever Conductors- Explosive		☑	12.02	0.29%	$23,541.19	0.11%
Remove Conductors	includes rig up and down	☑	962.20	22.89%	$1,671,822.52	8.15%
Platform Removal Preparation		☐	504.00	11.99%	$546,000.00	2.66%
Demob Work Boat		☑	13.00	0.31%	$25,460.33	0.12%
Mobilize DB 4000		☐	14.29	0.34%	$205,059.55	1.00%
Mobilize CB 400 & Tug	two	☐	28.00	0.67%	$84,000.00	0.41%
Setup Derrick Barge		☑	9.75	0.23%	$135,476.25	0.66%
Mobilize CB 300 & Tug		☑	28.00	0.67%	$41,440.00	0.20%
Cut Deck/Equip/Misc		☑	4.64	0.11%	$69,020.00	0.34%
Remove Equipment		☑	6.00	0.14%	$89,250.00	0.43%
Remove 8 Pile Deck		☑	9.35	0.22%	$139,081.26	0.68%
Demob CB 300 & Tug		☐	28.00	0.67%	$27,440.00	0.13%
Jet/Airlift Pile Mud Plug		☑	35.00	0.83%	$486,325.00	2.37%
Jet/Air Skrt Pile Mud Plg		☑	277.20	6.59%	$3,851,694.13	18.77%
Mobilize Abrasive Cutting Spread		☑	13.00	0.31%	$14,625.00	0.07%
Sever Piles- Abrasive		☑	137.96	3.28%	$2,152,047.21	10.49%
Demob Abrasive Cutting Spread		☑	13.00	0.31%	$14,625.00	0.07%
Install Closure Plates		☑	9.00	0.21%	$125,055.00	0.61%
Deballast Piles or Jkt Lg		☑	10.00	0.24%	$138,950.00	0.68%
Lift/Secure Jkt for Tow		☑	6.00	0.14%	$83,370.00	0.41%
Pick Up DB Anchors		☑	9.75	0.23%	$135,476.25	0.66%
Tow Jckt to Shallow Water		☑	6.67	0.16%	$92,679.65	0.45%
Set Jacket on Bottom		☑	2.00	0.05%	$27,790.00	0.14%
Setup Derrick Barge		☑	9.75	0.23%	$135,476.25	0.66%
Cut Jacket	Cut horizintally at approx. -160 ft elevation	☑	30.00	0.71%	$416,850.00	2.03%
Remove Jacket - Meth 3	Remove top section	☑	21.70	0.52%	$323,221.50	1.58%
Cut Jacket	Cut vertically between rows 2 & 3	☑	110.69	2.63%	$1,538,037.51	7.50%
Remove Jacket - Meth 3		☑	21.70	0.52%	$323,221.50	1.58%
Remove Jacket - Meth 3		☑	21.70	0.52%	$323,221.50	1.58%
Demob CB 400 & Tug		☐	28.00	0.67%	$28,000.00	0.14%
Pick Up DB Anchors		☑	9.75	0.23%	$135,476.25	0.66%
Demob DB 4000		☐	14.29	0.34%	$205,059.55	1.00%
Mobilize Dive Spread		☐	13.00	0.31%	$74,399.00	0.36%

MMS
Platform Decommission Task Information
8P-12SP - 483 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Site Clearance Verify		☐	48.00	1.14%	$274,704.00	1.34%
Offload CB 300		☐	384.00	9.14%	$98,720.00	0.48%
Offload CB 400		☐	696.00	16.56%	$220,960.00	1.08%
		Task Total	3569.41	84.91%	14,615,962.23	71.23%
		Misc. Work Provision (15.00%)	271.77	6.47%	$1,884,423.00	9.18%
		Weather Contingency (20.00%)	362.37	8.62%	$2,512,564.00	12.25%
		Consumables			$336,000.00	1.64%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$1,169,277.00	5.70%
		Total:	4203.55	100.00%	20,518,226.23	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-12SP - 483 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$102,475.01	0.50%
Cargo Barge 300	$4,920.00	per Day per Barge	$78,720.00	0.38%
Cargo Barge 400	$6,240.00	per Day per Barge	$180,960.00	0.88%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$74,470.20	0.36%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$149,100.00	0.73%
CB Damage Deduct	$20,000.00	per Cargo Barge	$60,000.00	0.29%
Decomm Platform	$0.00	Calculated from tables	$882,711.64	4.30%
Derrick Barge 4000	$10,500.00	per Hour per barge	$8,160,495.01	39.77%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$2,459,806.45	11.99%
Dive Boat	$900.00	per Hour	$54,900.00	0.27%
Dive Serv - Basic	$0.00	Calculated from tables	$193,065.00	0.94%
Dive Serv - Suppl	$0.00	Calculated from tables	$96,563.00	0.47%
Expl Charge - Cond	$3,200.00	per Conductor	$60,800.00	0.30%
Expl Charge - Piling	$11,400.00	per Pile	$228,000.00	1.11%
Expl Technician	$95.00	per Hour	$4,466.90	0.02%
Helicopter Trips	$6,500.00	per Round Trip	$19,500.00	0.10%
Manual Calculation	$0.00	Independently Calculated	$155,587.80	0.76%
NMFS Observers (2)	$126.00	per Hour	$5,924.52	0.03%
Pile Abrasive Cut 7 to 48 inches	$2,486.00	per Cut	$19,888.00	0.10%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$60,000.00	0.29%
Pipeline Survey	$230.00	per Hour	$178,753.70	0.87%
Rig Up CB 300	$14,000.00	per Barge	$14,000.00	0.07%
Rig Up CB 400	$14,000.00	per Barge	$28,000.00	0.14%
Side Scan Sonar	$75.00	per Hour	$4,575.00	0.02%
Work Boat	$500.00	per Hour	$1,343,200.00	6.55%

4P

484 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

4P - 484 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	16.00	0.70%	$26,979.00	0.55%
Sever Conductors- Abrasive		☐	8.71	0.38%	$24,630.72	0.50%
Remove Conductors	includes rig up and down	☐	115.60	5.09%	$194,921.20	3.95%
Demob Work Boat		☐	16.00	0.70%	$26,979.00	0.55%
Route Survey to Reef Site		☐	48.00	2.11%	$38,640.00	0.78%
Platform Removal Preparation		☐	504.00	22.21%	$504,000.00	10.21%
Mobilize DB 2000		☐	18.57	0.82%	$199,535.15	4.04%
Mobilize CB 240 & Tug		☐	34.00	1.50%	$36,440.00	0.74%
Mobilize CB 400 & Tug		☐	34.00	1.50%	$48,000.00	0.97%
Setup Derrick Barge		☑	6.75	0.30%	$70,166.25	1.42%
Cut Deck/Equip/Misc		☑	4.64	0.20%	$51,295.20	1.04%
Remove Equipment		☑	3.00	0.13%	$33,165.00	0.67%
Remove 4 Pile Deck		☑	9.35	0.41%	$103,364.25	2.09%
Demob CB 240 & Tug		☐	34.00	1.50%	$22,440.00	0.45%
Jet/Airlift Pile Mud Plug		☑	18.00	0.79%	$187,110.00	3.79%
Mobilize Abrasive Cutting Spread		☑	16.00	0.70%	$18,000.00	0.36%
Sever Piles- Abrasive		☑	28.72	1.27%	$373,854.40	7.58%
Demob Abrasive Cutting Spread		☑	16.00	0.70%	$18,000.00	0.36%
Install Closure Plates		☑	5.00	0.22%	$56,975.00	1.15%
Deballast Piles or Jkt Lg		☑	5.00	0.22%	$56,975.00	1.15%
Lift/Secure Jkt for Tow		☑	6.00	0.26%	$68,370.00	1.39%
Tow Jckt to Shallow Water		☑	12.00	0.53%	$136,740.00	2.77%
Cut Jacket		☑	18.00	0.79%	$205,110.00	4.16%
Remove Jacket - Meth 3		☑	21.70	0.96%	$247,271.50	5.01%
Remove Jacket - Meth 3		☑	21.70	0.96%	$247,271.50	5.01%
Demob CB 400 & Tug		☐	34.00	1.50%	$34,000.00	0.69%
Pick Up DB Anchors		☑	6.75	0.30%	$70,166.25	1.42%
Demob DB 2000		☐	18.57	0.82%	$199,535.15	4.04%
Mobilize Dive Spread		☐	16.00	0.70%	$91,568.00	1.86%
Site Clearance Verify		☐	48.00	2.11%	$274,704.00	5.57%
Offload CB 240		☐	384.00	16.92%	$77,600.00	1.57%
Offload CB 400		☐	672.00	29.61%	$194,720.00	3.95%
		Task Total	2200.06	96.94%	$3,938,526.57	79.83%
		Misc. Work Provision (15.00%)	29.79	1.31%	$291,575.20	5.91%
		Weather Contingency (20.00%)	39.72	1.75%	$388,766.90	7.88%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%

MMS
Platform Decommission Task Information

4P - 484 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$315,082.10	6.39%
		Total:	2269.57	100.00%	$4,933,950.77	100.00%

MMS
Platform Decommission Resources Breakdown
4P - 484 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$135,643.75	2.75%
Cargo Barge 240	$3,600.00	per Day per Barge	$57,600.00	1.17%
Cargo Barge 400	$6,240.00	per Day per Barge	$174,720.00	3.54%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$56,093.40	1.14%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$157,400.00	3.19%
CB Damage Deduct	$20,000.00	per Cargo Barge	$40,000.00	0.81%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$9,944.00	0.20%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	5.11%
Derrick Barge 2000	$7,000.00	per Hour per barge	$1,426,250.00	28.91%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$644,868.75	13.07%
Dive Boat	$900.00	per Hour	$57,600.00	1.17%
Dive Serv - Basic	$0.00	Calculated from tables	$202,560.00	4.11%
Dive Serv - Suppl	$0.00	Calculated from tables	$101,312.00	2.05%
Helicopter Trips	$6,500.00	per Round Trip	$13,000.00	0.26%
Manual Calculation	$0.00	Independently Calculated	$24,099.00	0.49%
Pile Abrasive Cut 49 to 69 inches	$5,000.00	per Cut	$43,000.00	0.87%
Pipeline Survey	$230.00	per Hour	$57,902.50	1.17%
Prep Crew	$407.00	per Hour	$63,618.17	1.29%
Rig Up CB 240	$14,000.00	per Barge	$14,000.00	0.28%
Rig Up CB 400	$14,000.00	per Barge	$14,000.00	0.28%
Side Scan Sonar	$75.00	per Hour	$8,400.00	0.17%
Work Boat	$500.00	per Hour	$384,515.00	7.79%

4P4S

523 Ft. WD

MMS
Platform Decommission Task Information
4P4S - 523 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	23.00	0.70%	$50,282.00	0.58%
Sever Conductors- Abrasive		☐	30.49	0.92%	$101,460.68	1.17%
Remove Conductors	includes rig up and down	☐	434.60	13.16%	$950,108.20	11.00%
Demob Work Boat		☐	23.00	0.70%	$50,282.00	0.58%
Route Survey to Reef Site		☐	48.00	1.45%	$38,640.00	0.45%
Platform Removal Preparation		☐	504.00	15.26%	$504,000.00	5.83%
Mobilize DB 2000		☐	28.57	0.87%	$303,485.15	3.51%
Mobilize CB 240 & Tug	2 barges	☐	48.00	1.45%	$91,360.00	1.06%
Mobilize CB 400 & Tug		☐	48.00	1.45%	$62,000.00	0.72%
Setup Derrick Barge		☑	6.75	0.20%	$70,166.25	0.81%
Cut Deck/Equip/Misc		☑	4.64	0.14%	$48,232.80	0.56%
Remove Equipment		☑	3.00	0.09%	$33,165.00	0.38%
Remove 4 Pile Deck		☑	9.35	0.28%	$103,364.25	1.20%
Demob CB 240 & Tug		☐	48.00	1.45%	$31,680.00	0.37%
Jet/Airlift Pile Mud Plug		☑	18.00	0.55%	$187,110.00	2.17%
Jet/Air Skrt Pile Mud Plg		☑	30.80	0.93%	$320,166.00	3.71%
Set Charges in Skirt Piles		☑	11.55	0.35%	$120,062.25	1.39%
Mobilize Abrasive Cutting Spread		☑	23.00	0.70%	$25,875.00	0.30%
Sever Piles- Abrasive		☑	53.68	1.63%	$678,281.60	7.85%
Demob Abrasive Cutting Spread		☑	23.00	0.70%	$25,875.00	0.30%
Install Closure Plates		☑	5.00	0.15%	$55,275.00	0.64%
Deballast Piles or Jkt Lg		☑	5.00	0.15%	$55,275.00	0.64%
Lift/Secure Jkt for Tow		☑	6.00	0.18%	$66,330.00	0.77%
Pick Up DB Anchors		☑	6.75	0.20%	$74,621.25	0.86%
Tow Deck to Shallow Water		☑	13.33	0.40%	$147,363.15	1.71%
Setup Derrick Barge		☑	6.75	0.20%	$74,621.25	0.86%
Set Jacket on Bottom		☑	2.00	0.06%	$22,110.00	0.26%
Cut Jacket		☑	12.00	0.36%	$132,660.00	1.54%
Remove Jacket - Meth 3		☑	21.70	0.66%	$239,893.50	2.78%
Demob CB 240 & Tug		☑	48.00	1.45%	$31,680.00	0.37%
Install Closure Plates		☑	5.00	0.15%	$51,975.00	0.60%
Deballast Piles or Jkt Lg		☑	5.00	0.15%	$51,975.00	0.60%
Lift/Secure Jkt for Tow		☑	6.00	0.18%	$62,370.00	0.72%
Tow Jckt to Shallow Water		☑	13.33	0.40%	$138,565.35	1.60%
Cut Jacket		☑	18.00	0.55%	$187,110.00	2.17%
Remove Jacket - Meth 3		☑	21.70	0.66%	$247,271.50	2.86%
Remove Jacket - Meth 3		☑	21.70	0.66%	$247,271.50	2.86%
Demob CB 400 & Tug		☐	48.00	1.45%	$48,000.00	0.56%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

4P4S - 523 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Pick Up DB Anchors		☑	6.75	0.20%	$70,166.25	0.81%
Demob DB 2000		☐	28.57	0.87%	$303,485.15	3.51%
Mobilize Dive Spread		☐	23.00	0.70%	$131,629.00	1.52%
Site Clearance Verify		☐	48.00	1.45%	$274,704.00	3.18%
Offload CB 240		☐	744.00	22.53%	$151,600.00	1.75%
Offload CB 400		☐	624.00	18.90%	$182,240.00	2.11%
		Task Total	3159.01	95.68%	$6,843,788.08	79.21%
		Misc. Work Provision (15.00%)	61.17	1.85%	$535,324.80	6.20%
		Weather Contingency (20.00%)	81.56	2.47%	$713,766.40	8.26%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$547,503.00	6.34%
		Total:	3301.74	100.00%	$8,640,382.28	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
4P4S - 523 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$381,731.25	4.42%
Cargo Barge 240	$3,600.00	per Day per Barge	$111,600.00	1.29%
Cargo Barge 400	$6,240.00	per Day per Barge	$162,240.00	1.88%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$186,700.80	2.16%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$139,400.00	1.61%
CB Damage Deduct	$20,000.00	per Cargo Barge	$60,000.00	0.69%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$34,804.00	0.40%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	2.92%
Derrick Barge 2000	$7,000.00	per Hour per barge	$2,596,440.00	30.05%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,173,961.79	13.59%
Dive Boat	$900.00	per Hour	$63,900.00	0.74%
Dive Serv - Basic	$0.00	Calculated from tables	$224,715.00	2.60%
Dive Serv - Suppl	$0.00	Calculated from tables	$112,393.00	1.30%
Helicopter Trips	$6,500.00	per Round Trip	$13,000.00	0.15%
Manual Calculation	$0.00	Independently Calculated	$78,794.00	0.91%
Pile Abrasive Cut 7 to 48 inches	$2,486.00	per Cut	$19,888.00	0.23%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$40,000.00	0.46%
Pipeline Survey	$230.00	per Hour	$96,351.60	1.12%
Prep Crew	$407.00	per Hour	$208,013.63	2.41%
Rig Up CB 240	$14,000.00	per Barge	$28,000.00	0.32%
Rig Up CB 400	$14,000.00	per Barge	$14,000.00	0.16%
Side Scan Sonar	$75.00	per Hour	$8,925.00	0.10%
Work Boat	$500.00	per Hour	$836,930.00	9.69%

4P4S
619 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P4S - 619 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	14.00	0.45%	$30,606.00	0.30%
Sever Conductors- Abrasive		☐	32.33	1.04%	$110,454.56	1.08%
Remove Conductors	includes rig up and down	☐	574.40	18.46%	$1,255,733.80	12.25%
Demob Work Boat		☐	14.00	0.45%	$30,606.00	0.30%
Platform Removal Preparation		☐	504.00	16.19%	$504,000.00	4.92%
Mobilize DB 4000		☐	15.71	0.50%	$224,790.45	2.19%
Mobilize CB 300 & Tug	Deck, Equipment & Conductors	☐	30.00	0.96%	$43,400.00	0.42%
Mobilize CB 300 & Tug	Piles & First Jacket Section	☐	30.00	0.96%	$43,400.00	0.42%
Mobilize CB 240 & Tug	Second Jacket Section	☐	30.00	0.96%	$33,800.00	0.33%
Mobilize CB 300 & Tug	Third Jacket Section	☐	30.00	0.96%	$33,800.00	0.33%
Setup Derrick Barge	DP vessel-Set up time	☑	4.00	0.13%	$57,580.00	0.56%
Remove Equipment		☑	8.00	0.26%	$119,000.00	1.16%
Cut Deck/Equip/Misc		☑	12.00	0.39%	$178,500.00	1.74%
Remove 4 Pile Deck		☑	9.35	0.30%	$139,081.26	1.36%
Demob CB 300 & Tug		☐	30.00	0.96%	$29,400.00	0.29%
Jet/Air Skrt Pile Mud Plg		☑	30.80	0.99%	$427,966.00	4.18%
Jet/Airlift Pile Mud Plug		☑	18.00	0.58%	$250,110.00	2.44%
Mobilize Abrasive Cutting Spread		☑	14.00	0.45%	$15,750.00	0.15%
Sever Piles- Abrasive	Skirt & Main Piles	☑	4.00	0.13%	$143,080.00	1.40%
Demob Abrasive Cutting Spread		☑	14.00	0.45%	$15,750.00	0.15%
Remove Piles from Jackt Legs (DB 2/4000)		☑	56.98	1.83%	$847,577.50	8.27%
Install Closure Plates		☑	8.00	0.26%	$119,000.00	1.16%
Deballast Piles or Jkt Lg		☑	5.00	0.16%	$74,375.00	0.73%
Route Survey to Reef Site	To shallow water	☐	24.00	0.77%	$19,320.00	0.19%
Lift/Secure Jkt for Tow		☑	6.00	0.19%	$89,250.00	0.87%
Tow Jckt to Shallow Water		☑	4.67	0.15%	$69,466.25	0.68%
Setup Derrick Barge	DP vessel-setup time	☑	4.00	0.13%	$59,500.00	0.58%
Cut Jacket		☑	18.00	0.58%	$267,750.00	2.61%
Remove Jacket - Meth 2	Jacket Section 1	☑	26.50	0.85%	$394,187.50	3.85%
Demob CB 300 & Tug		☐	30.00	0.96%	$29,400.00	0.29%
Bottom Clean Up		☑	15.40	0.49%	$213,983.00	2.09%
Lift/Secure Jkt for Tow		☑	6.00	0.19%	$83,370.00	0.81%
Tow Jckt to Shallow Water		☑	7.33	0.24%	$101,850.35	0.99%
Setup Derrick Barge	DP vessel-setup time	☑	4.00	0.13%	$55,580.00	0.54%
Cut Jacket		☑	18.00	0.58%	$261,990.00	2.56%
Remove Jacket - Meth 2	Jacket Section 2	☑	26.50	0.85%	$385,707.50	3.76%
Demob CB 240 & Tug		☐	30.00	0.96%	$19,800.00	0.19%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P4S - 619 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Remove Jacket - Meth 3	Jacket Section 3	☑	21.70	0.70%	$322,787.50	3.15%
Demob CB 300 & Tug		☐	30.00	0.96%	$29,400.00	0.29%
Bottom Clean Up		☑	12.00	0.39%	$166,740.00	1.63%
Demob DB 4000		☐	15.71	0.50%	$224,790.45	2.19%
Site Clearance Verify	Includes Mob/Demob	☐	96.00	3.08%	$100,800.00	0.98%
Offload CB 300	3 barges	☐	840.00	26.99%	$232,200.00	2.27%
Offload CB 240		☐	264.00	8.48%	$59,600.00	0.58%
		Task Total	2988.38	96.02%	$7,915,233.11	77.23%
		Misc. Work Provision (15.00%)	53.13	1.71%	$728,989.80	7.11%
		Weather Contingency (20.00%)	70.85	2.28%	$971,986.40	9.48%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$633,218.60	6.18%
		Total:	3112.36	100.00%	10,249,427.91	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
4P4S - 619 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$416,706.25	4.07%
Cargo Barge 240	$3,600.00	per Day per Barge	$39,600.00	0.39%
Cargo Barge 300	$4,920.00	per Day per Barge	$172,200.00	1.68%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$88,770.00	0.87%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$323,596.00	3.16%
CB Damage Deduct	$20,000.00	per Cargo Barge	$80,000.00	0.78%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$39,776.00	0.39%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	2.46%
Derrick Barge 4000	$10,500.00	per Hour per barge	$3,755,325.01	36.64%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,131,962.25	11.04%
Dive Boat	$900.00	per Hour	$86,400.00	0.84%
Helicopter Trips	$6,500.00	per Round Trip	$13,000.00	0.13%
Manual Calculation	$0.00	Independently Calculated	$97,853.00	0.95%
Pile Abrasive Cut 49 to 69 inches	$5,000.00	per Cut	$40,000.00	0.39%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$43,000.00	0.42%
Pipeline Survey	$230.00	per Hour	$87,779.50	0.86%
Prep Crew	$407.00	per Hour	$258,335.11	2.52%
Rig Up CB 240	$14,000.00	per Barge	$28,000.00	0.27%
Rig Up CB 300	$14,000.00	per Barge	$28,000.00	0.27%
Side Scan Sonar	$75.00	per Hour	$16,200.00	0.16%
Work Boat	$500.00	per Hour	$916,730.00	8.94%

4L-8SP

622 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4L-8SP - 622 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	10.50	0.20%	$22,955.00	0.19%
Sever Conductors- Abrasive		☐	69.68	1.35%	$231,883.76	1.97%
Remove Conductors	includes rig up and down	☐	1132.80	21.95%	$2,476,489.59	21.00%
Demob Work Boat		☑	10.50	0.20%	$5,250.00	0.04%
Platform Removal Preparation		☐	504.00	9.77%	$252,000.00	2.14%
Mobilize DB 4000		☐	10.71	0.21%	$149,993.55	1.27%
Mobilize CB 240 & Tug	3 Cargo Barges	☐	23.00	0.45%	$87,540.00	0.74%
Mobilize CB 300 & Tug		☑	23.00	0.45%	$36,540.00	0.31%
Mobilize CB 400 & Tug	2 Cargo Barges	☑	23.00	0.45%	$74,000.00	0.63%
Mobilize Work Boat		☐	10.50	0.20%	$8,452.50	0.07%
Route Survey to Reef Site		☐	48.00	0.93%	$38,640.00	0.33%
Demob Work Boat		☐	10.50	0.20%	$8,452.50	0.07%
Setup Derrick Barge		☑	3.00	0.06%	$41,685.00	0.35%
Cut Deck/Equip/Misc		☑	4.64	0.09%	$67,535.20	0.57%
Remove 4 Pile Deck		☑	9.35	0.18%	$146,608.01	1.24%
Remove Equipment		☑	6.00	0.12%	$89,250.00	0.76%
Demob CB 240 & Tug		☑	23.00	0.45%	$15,180.00	0.13%
Sever Piles- Abrasive	Sever Skirt Piles	☑	46.14	0.89%	$822,022.79	6.97%
Demob Work Boat		☐	10.50	0.20%	$18,361.00	0.16%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.59%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.71%
Tow Jckt to Shallow Water		☑	6.00	0.12%	$83,370.00	0.71%
Setup Derrick Barge		☑	6.75	0.13%	$93,791.25	0.80%
Cut Jacket	First cut	☑	18.00	0.35%	$261,990.00	2.22%
Remove Jacket - Meth 1		☑	13.75	0.27%	$200,131.25	1.70%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.59%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.71%
Tow Jckt to Shallow Water		☑	6.00	0.12%	$83,370.00	0.71%
Setup Derrick Barge		☑	6.75	0.13%	$93,791.25	0.80%
Cut Jacket	Second cut	☑	18.00	0.35%	$261,990.00	2.22%
Remove Jacket - Meth 1		☑	13.75	0.27%	$200,131.25	1.70%
Demob CB 240 & Tug		☐	23.00	0.45%	$22,540.00	0.19%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.59%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.71%
Tow Jckt to Shallow Water		☑	6.00	0.12%	$83,370.00	0.71%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

4L-8SP - 622 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Setup Derrick Barge		☑	6.75	0.13%	$93,791.25	0.80%
Cut Jacket	Third Cut	☑	18.00	0.35%	$267,750.00	2.27%
Remove Jacket - Meth 1		☑	13.75	0.27%	$204,531.25	1.73%
Demob CB 300 & Tug		☐	23.00	0.45%	$22,540.00	0.19%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.59%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.71%
Tow Jckt to Shallow Water		☑	6.00	0.12%	$83,370.00	0.71%
Setup Derrick Barge		☑	6.75	0.13%	$93,791.25	0.80%
Cut Jacket	Fourth Cut	☑	18.00	0.35%	$268,110.00	2.27%
Remove Jacket - Meth 1		☑	13.75	0.27%	$204,806.25	1.74%
Demob CB 400 & Tug		☐	23.00	0.45%	$23,000.00	0.20%
Remove Jacket - Meth 1		☑	13.75	0.27%	$204,806.25	1.74%
Demob CB 400 & Tug		☑	23.00	0.45%	$23,000.00	0.20%
Pick Up DB Anchors		☑	0.00	0.00%	$0.00	0.00%
Demob DB 4000		☐	10.71	0.21%	$148,815.45	1.26%
Offload CB 300		☐	312.00	6.05%	$183,960.00	1.56%
Mobilize Work Boat		☑	10.50	0.20%	$6,405.00	0.05%
Site Clearance Verify		☑	48.00	0.93%	$29,280.00	0.25%
Demob Work Boat		☑	10.50	0.20%	$6,405.00	0.05%
Offload CB 240	3 Cargo Barges	☑	1056.00	20.47%	$218,400.00	1.85%
Offload CB 400	2 Cargo Barges	☑	624.00	12.09%	$202,240.00	1.71%
		Task Total	4398.28	85.24%	$9,151,595.60	77.60%
		Misc. Work Provision (15.00%)	326.46	6.33%	$818,395.90	6.94%
		Weather Contingency (20.00%)	435.28	8.44%	$1,091,195.00	9.25%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$732,127.70	6.21%
		Total:	5160.02	100.00%	11,793,314.20	100.00%

MMS
Platform Decommission Resources Breakdown
4L-8SP - 622 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$799,356.25	6.78%
Cargo Barge 240	$3,600.00	per Day per Barge	$158,400.00	1.34%
Cargo Barge 300	$4,920.00	per Day per Barge	$63,960.00	0.54%
Cargo Barge 400	$6,240.00	per Day per Barge	$162,240.00	1.38%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$111,863.40	0.95%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$104,615.00	0.89%
CB 400 & Tug	$1,000.00	per Hour per Barge/Tug	$137,500.00	1.17%
CB Damage Deduct	$20,000.00	per Cargo Barge	$220,000.00	1.87%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$79,552.00	0.67%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	2.14%
Derrick Barge 4000	$10,500.00	per Hour per barge	$3,636,150.01	30.83%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,096,039.49	9.29%
Manual Calculation	$0.00	Independently Calculated	$189,276.00	1.60%
Mesotech Sonar	$110.00	per Hour	$8,768.10	0.07%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$129,000.00	1.09%
Pipeline Survey	$230.00	per Hour	$95,519.00	0.81%
Prep Crew	$407.00	per Hour	$497,956.35	4.22%
Rig Up CB 240	$14,000.00	per Barge	$42,000.00	0.36%
Rig Up CB 300	$14,000.00	per Barge	$14,000.00	0.12%
Rig Up CB 400	$14,000.00	per Barge	$28,000.00	0.24%
Side Scan Sonar	$75.00	per Hour	$5,175.00	0.04%
Work Boat	$500.00	per Hour	$1,320,225.00	11.19%

4L-8SP

693 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4L-8SP - 693 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Platform Removal Preparation		☐	504.00	11.28%	$252,000.00	2.09%
Mobilize DB 4000		☐	13.71	0.31%	$192,008.55	1.59%
Mobilize CB 300 & Tug	6 Cargo Barges	☐	27.20	0.61%	$243,936.00	2.02%
Mobilize Work Boat		☐	12.60	0.28%	$10,143.00	0.08%
Route Survey to Reef Site		☐	48.00	1.07%	$38,640.00	0.32%
Demob Work Boat		☐	12.60	0.28%	$10,143.00	0.08%
Setup Derrick Barge		☑	3.00	0.07%	$41,685.00	0.35%
Cut Deck/Equip/Misc		☑	4.64	0.10%	$69,020.00	0.57%
Remove Equipment		☑	4.50	0.10%	$66,937.50	0.55%
Remove 4 Pile Deck		☑	9.35	0.21%	$139,081.26	1.15%
Demob CB 300 & Tug		☑	27.20	0.61%	$26,656.00	0.22%
Mobilize Abrasive Cutting Spread		☑	12.60	0.28%	$14,175.00	0.12%
Sever Conductors- Abrasive		☑	13.07	0.29%	$211,227.40	1.75%
Remove Conductors (DB 2/4000)		☑	55.44	1.24%	$1,062,507.59	8.80%
Demob CB 300 & Tug		☐	27.20	0.61%	$26,656.00	0.22%
Sever Piles- Abrasive	Sever Skirt Piles	☑	68.75	1.54%	$1,161,625.05	9.62%
Demob Abrasive Cutting Spread		☑	12.60	0.28%	$14,175.00	0.12%
Install Closure Plates		☑	5.00	0.11%	$69,475.00	0.58%
Deballast Piles or Jkt Lg		☑	5.00	0.11%	$69,475.00	0.58%
Lift/Secure Jkt for Tow		☑	6.00	0.13%	$83,370.00	0.69%
Tow Jckt to Shallow Water		☑	6.00	0.13%	$83,370.00	0.69%
Setup Derrick Barge		☑	6.75	0.15%	$93,791.25	0.78%
Cut Jacket	First cut	☑	18.00	0.40%	$267,750.00	2.22%
Remove Jacket - Meth 1		☑	13.75	0.31%	$204,531.25	1.69%
Install Closure Plates		☑	5.00	0.11%	$69,475.00	0.58%
Deballast Piles or Jkt Lg		☑	5.00	0.11%	$69,475.00	0.58%
Lift/Secure Jkt for Tow		☑	6.00	0.13%	$83,370.00	0.69%
Tow Jckt to Shallow Water		☑	6.00	0.13%	$83,370.00	0.69%
Setup Derrick Barge		☑	6.75	0.15%	$93,791.25	0.78%
Cut Jacket	Second cut	☑	18.00	0.40%	$267,750.00	2.22%
Remove Jacket - Meth 1		☑	13.75	0.31%	$204,531.25	1.69%
Demob CB 300 & Tug		☐	27.20	0.61%	$26,656.00	0.22%
Install Closure Plates		☑	5.00	0.11%	$69,475.00	0.58%
Deballast Piles or Jkt Lg		☑	5.00	0.11%	$69,475.00	0.58%
Lift/Secure Jkt for Tow		☑	6.00	0.13%	$83,370.00	0.69%
Tow Jckt to Shallow Water		☑	6.00	0.13%	$83,370.00	0.69%
Setup Derrick Barge		☑	6.75	0.15%	$93,791.25	0.78%
Cut Jacket	Third Cut	☑	18.00	0.40%	$267,750.00	2.22%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4L-8SP - 693 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Remove Jacket - Meth 1		☑	13.75	0.31%	$204,531.25	1.69%
Demob CB 300 & Tug		☐	27.20	0.61%	$26,656.00	0.22%
Install Closure Plates		☑	5.00	0.11%	$69,475.00	0.58%
Deballast Piles or Jkt Lg		☑	5.00	0.11%	$69,475.00	0.58%
Lift/Secure Jkt for Tow		☑	6.00	0.13%	$83,370.00	0.69%
Tow Jckt to Shallow Water		☑	6.00	0.13%	$83,370.00	0.69%
Setup Derrick Barge		☑	6.75	0.15%	$115,155.00	0.95%
Cut Jacket	Fourth Cut	☑	18.00	0.40%	$267,750.00	2.22%
Remove Jacket - Meth 1		☑	13.75	0.31%	$204,531.25	1.69%
Demob CB 300 & Tug		☐	27.20	0.61%	$26,656.00	0.22%
Cut Jacket		☑	30.54	0.68%	$454,282.50	3.76%
Remove Jacket - Meth 1		☑	13.75	0.31%	$248,050.00	2.05%
Demob CB 300 & Tug		☐	27.20	0.61%	$26,656.00	0.22%
Demob DB 4000		☐	13.71	0.31%	$233,892.60	1.94%
Offload CB 300		☐	2928.00	65.56%	$720,240.00	5.96%
Mobilize Work Boat		☑	12.60	0.28%	$7,686.00	0.06%
Site Clearance Verify		☑	48.00	1.07%	$29,280.00	0.24%
Demob Work Boat		☑	12.60	0.28%	$7,686.00	0.06%
		Task Total	4266.46	95.53%	$8,896,771.19	73.65%
		Misc. Work Provision (15.00%)	85.6	1.92%	$1,059,373.00	8.77%
		Weather Contingency (20.00%)	114.13	2.56%	$1,412,498.00	11.69%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$711,741.70	5.89%
		Total:	4466.19	100.00%	12,080,383.89	100.00%

MMS
Platform Decommission Resources Breakdown
4L-8SP - 693 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$101,537.50	0.84%
Cargo Barge 300	$4,920.00	per Day per Barge	$600,240.00	4.97%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$560,187.60	4.64%
CB Damage Deduct	$20,000.00	per Cargo Barge	$120,000.00	0.99%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$14,916.00	0.12%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	2.09%
Derrick Barge 4000	$10,500.00	per Hour per barge	$4,960,830.01	41.07%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,495,335.94	12.38%
Dive Serv - Basic	$0.00	Calculated from tables	$283,742.24	2.35%
Mesotech Sonar	$110.00	per Hour	$9,560.10	0.08%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$129,000.00	1.07%
Pipeline Survey	$230.00	per Hour	$125,501.80	1.04%
Rig Up CB 300	$14,000.00	per Barge	$84,000.00	0.70%
Side Scan Sonar	$75.00	per Hour	$5,490.00	0.05%
Work Boat	$500.00	per Hour	$154,430.00	1.28%

8P-12SP

774 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - 774 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Fab Deck Padeyes	4 - Trunnions	☐	0.00	0.00%	$120,000.00	0.79%
Platform Removal Preparation		☐	840.00	17.09%	$784,000.00	5.18%
Mobilize Work Boat		☐	14.00	0.28%	$11,270.00	0.07%
Route Survey to Reef Site		☐	24.00	0.49%	$19,320.00	0.13%
Demob Work Boat		☐	14.00	0.28%	$11,270.00	0.07%
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	14.00	0.28%	$31,481.00	0.21%
Sever Conductors- Abrasive		☐	96.98	1.97%	$337,403.36	2.23%
Remove Conductors	includes rig up and down	☐	1931.20	39.29%	$4,342,625.38	28.68%
Demob Work Boat		☐	14.00	0.28%	$31,481.00	0.21%
Mobilize DB 4000		☐	15.71	0.32%	$229,837.30	1.52%
Mobilize CB 300 & Tug		☐	30.00	0.61%	$43,400.00	0.29%
Mobilize CB 300 & Tug		☐	30.00	0.61%	$43,400.00	0.29%
Mobilize CB 300 & Tug		☐	30.00	0.61%	$43,400.00	0.29%
Mobilize CB 300 & Tug		☐	30.00	0.61%	$43,400.00	0.29%
Setup Derrick Barge		☑	6.75	0.14%	$98,010.00	0.65%
Cut Deck/Equip/Misc		☑	7.00	0.14%	$101,640.00	0.67%
Remove Equipment		☑	12.00	0.24%	$186,000.00	1.23%
Remove 4 Pile Deck		☑	9.35	0.19%	$144,925.01	0.96%
Demob CB 300 & Tug		☐	30.00	0.61%	$29,400.00	0.19%
Sever Piles- Abrasive	12 Skirt Piles	☑	103.13	2.10%	$1,626,447.56	10.74%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.46%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.46%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.55%
Tow Jckt to Shallow Water		☑	3.00	0.06%	$41,685.00	0.28%
Setup Derrick Barge		☑	6.75	0.14%	$93,791.25	0.62%
Cut Jacket	Cut @ 212' EL.	☑	12.00	0.24%	$178,500.00	1.18%
Remove Jacket - Meth 3		☑	21.70	0.44%	$322,787.50	2.13%
Install Closure Plates		☑	5.00	0.10%	$69,475.00	0.46%
Deballast Piles or Jkt Lg		☑	5.00	0.10%	$69,475.00	0.46%
Lift/Secure Jkt for Tow		☑	6.00	0.12%	$83,370.00	0.55%
Tow Jckt to Shallow Water		☑	5.33	0.11%	$74,060.35	0.49%
Setup Derrick Barge		☑	6.75	0.14%	$93,791.25	0.62%
Cut Jacket	Cut @ 565' EL.	☑	14.00	0.28%	$208,250.00	1.38%
Remove Jacket - Meth 3		☑	21.70	0.44%	$322,787.50	2.13%
Demob CB 300 & Tug		☐	30.00	0.61%	$29,400.00	0.19%
Remove Jacket - Meth 3	Remaining Section	☑	21.70	0.44%	$322,787.50	2.13%
Demob CB 300 & Tug		☐	30.00	0.61%	$29,400.00	0.19%
Pick Up DB Anchors		☑	6.75	0.14%	$93,791.25	0.62%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

8P-12SP - 774 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Demob DB 4000		☐	15.71	0.32%	$220,018.55	1.45%
Mobilize Dive Spread		☐	14.00	0.28%	$102,270.00	0.68%
Site Clearance Verify		☐	48.00	0.98%	$350,640.00	2.32%
Offload CB 300		☐	1272.00	25.88%	$1,403,800.00	9.27%
		Task Total	4813.51	97.94%	12,611,110.74	83.28%
		Misc. Work Provision (15.00%)	43.49	0.88%	$653,084.10	4.31%
		Weather Contingency (20.00%)	57.98	1.18%	$870,778.90	5.75%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$1,008,889.00	6.66%
		Total:	4914.98	100.00%	15,143,862.74	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-12SP - 774 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$1,381,325.00	9.12%
Cargo Barge 300	$4,920.00	per Day per Barge	$1,303,800.00	8.61%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$316,001.00	2.09%
CB Damage Deduct	$20,000.00	per Cargo Barge	$100,000.00	0.66%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$119,328.00	0.79%
Decomm Platform	$0.00	Calculated from tables	$490,000.00	3.24%
Derrick Barge 4000	$10,500.00	per Hour per barge	$3,373,965.01	22.28%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,213,239.40	8.01%
Dive Boat	$900.00	per Hour	$55,800.00	0.37%
Dive Serv - Suppl	$0.00	Calculated from tables	$196,230.00	1.30%
Manual Calculation	$0.00	Independently Calculated	$445,505.00	2.94%
Mesotech Sonar	$110.00	per Hour	$3,456.20	0.02%
New Padeyes/Trunions	$10,000.00	per Lifting Eye	$120,000.00	0.79%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$129,000.00	0.85%
Pipeline Survey	$230.00	per Hour	$85,865.90	0.57%
Prep Crew	$407.00	per Hour	$836,865.23	5.53%
Rig Up CB 300	$14,000.00	per Barge	$56,000.00	0.37%
Side Scan Sonar	$75.00	per Hour	$8,550.00	0.06%
Work Boat	$500.00	per Hour	$2,376,180.00	15.69%

8P-12SP
863 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

8P-12SP - 863 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	22.34	0.24%	$50,234.88	0.11%
Sever Conductors- Abrasive		☐	113.23	1.23%	$383,888.36	0.85%
Remove Conductors		☐	0.00	0.00%	$0.00	0.00%
Remove Conductors	includes rig up and down	☐	2350.80	25.59%	$5,286,165.63	11.65%
Demob Work Boat		☐	22.34	0.24%	$50,234.88	0.11%
Route Survey to Reef Site		☐	48.00	0.52%	$38,640.00	0.09%
Fab Deck Padeyes		☐	0.00	0.00%	$80,000.00	0.18%
Fab Explosive Charges		☐	0.00	0.00%	$228,000.00	0.50%
Platform Removal Preparation		☐	504.00	5.49%	$294,000.00	0.65%
Mobilize Work Boat		☐	21.10	0.23%	$10,550.00	0.02%
Mobilize DB 2000		☐	25.86	0.28%	$373,159.80	0.82%
Mobilize CB 300 & Tug		☐	44.20	0.48%	$23,061.00	0.05%
Setup Derrick Barge		☑	6.75	0.07%	$97,402.50	0.21%
Cut Deck/Equip/Misc		☑	5.50	0.06%	$84,755.00	0.19%
Remove Equipment		☑	24.00	0.26%	$369,840.00	0.82%
Remove 4 Pile Deck	In two sections	☑	18.50	0.20%	$285,085.00	0.63%
Demob CB 300 & Tug		☐	44.20	0.48%	$43,316.00	0.10%
Jet/Air Skrt Pile Mud Plg	Jet/airlift 10-100' sections	☑	66.25	0.72%	$955,987.50	2.11%
Mobilize Abrasive Cutting Spread		☑	22.34	0.24%	$25,132.50	0.06%
Sever Piles- Abrasive		☑	145.50	1.58%	$2,472,252.50	5.45%
Demob Abrasive Cutting Spread		☑	22.34	0.24%	$25,132.50	0.06%
Install Lifting Appurtenances	First cut prep	☑	14.00	0.15%	$202,020.00	0.45%
Pick Up DB Anchors		☑	6.75	0.07%	$97,402.50	0.21%
Demob DB 2000		☐	25.86	0.28%	$373,159.80	0.82%
Mobilize SSCV		☑	24.17	0.26%	$857,914.15	1.89%
Setup Derrick Barge		☑	6.75	0.07%	$239,591.25	0.53%
Mobilize CB 300 & Tug		☑	44.20	0.48%	$57,316.00	0.13%
Deballast Piles or Jkt Lg	First cut prep	☑	4.00	0.04%	$141,980.00	0.31%
Lift/Secure Jkt for Tow	Lift Jkt +/-160'	☑	6.00	0.07%	$212,970.00	0.47%
Pick Up DB Anchors		☑	6.75	0.07%	$239,591.25	0.53%
Tow Jckt to Shallow Water	Tow to +/-775 WD	☑	6.00	0.07%	$212,970.00	0.47%
Setup Derrick Barge		☑	6.75	0.07%	$239,591.25	0.53%
Set Jacket on Bottom		☑	2.00	0.02%	$70,990.00	0.16%
Cut Jacket	Cut above -155 elevation	☑	40.00	0.44%	$1,459,000.00	3.22%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.23%	$756,856.25	1.67%
Demob CB 300 & Tug		☐	44.20	0.48%	$43,316.00	0.10%
Mobilize CB 300 & Tug		☐	44.20	0.48%	$57,316.00	0.13%
Install Lifting Appurtenances		☑	14.00	0.15%	$496,930.00	1.10%

MMS
Platform Decommission Task Information
8P-12SP - 863 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Deballast Piles or Jkt Lg		☑	4.00	0.04%	$141,980.00	0.31%
Lift/Secure Jkt for Tow	Lift Jkt +/-240'	☑	6.00	0.07%	$212,970.00	0.47%
Pick Up DB Anchors		☑	6.75	0.07%	$239,591.25	0.53%
Tow Jckt to Shallow Water	Tow to +/-535 WD	☑	6.00	0.07%	$212,970.00	0.47%
Setup Derrick Barge		☑	6.75	0.07%	$239,591.25	0.53%
Set Jacket on Bottom		☑	2.00	0.02%	$70,990.00	0.16%
Cut Jacket	Cut above +/-390 elev.	☑	40.00	0.44%	$1,459,000.00	3.22%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.23%	$756,856.25	1.67%
Demob CB 300 & Tug		☑	44.20	0.48%	$43,316.00	0.10%
Mobilize CB 300 & Tug		☐	44.20	0.48%	$57,316.00	0.13%
Install Lifting Appurtenances		☑	14.00	0.15%	$496,930.00	1.10%
Deballast Piles or Jkt Lg		☑	4.00	0.04%	$141,980.00	0.31%
Lift/Secure Jkt for Tow	Lift Jkt +/-265'	☑	6.00	0.07%	$212,970.00	0.47%
Pick Up DB Anchors		☑	6.75	0.07%	$239,591.25	0.53%
Tow Jckt to Shallow Water	Tow to +/-270 WD	☑	10.00	0.11%	$354,950.00	0.78%
Setup Derrick Barge		☑	6.75	0.07%	$239,591.25	0.53%
Set Jacket on Bottom		☑	2.00	0.02%	$70,990.00	0.16%
Cut Jacket	Cut above -650 elevation	☑	40.00	0.44%	$1,459,000.00	3.22%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.23%	$756,856.25	1.67%
Demob CB 300 & Tug		☑	44.20	0.48%	$43,316.00	0.10%
Mobilize CB 300 & Tug		☐	44.20	0.48%	$57,316.00	0.13%
Install Lifting Appurtenances		☑	7.00	0.08%	$248,465.00	0.55%
Lift/Secure Jkt for Tow	Lift Jkt +/-200'	☑	6.00	0.07%	$212,970.00	0.47%
Pick Up DB Anchors		☑	6.75	0.07%	$239,591.25	0.53%
Tow Jckt to Shallow Water	Tow to +/-125 WD	☑	34.00	0.37%	$1,206,830.00	2.66%
Setup Derrick Barge		☑	6.75	0.07%	$239,591.25	0.53%
Pick Up DB Anchors		☑	6.75	0.07%	$239,591.25	0.53%
Demob SSCV		☑	24.17	0.26%	$857,914.15	1.89%
Mobilize DB 2000		☐	25.86	0.28%	$211,793.40	0.47%
Setup Derrick Barge	Set-up alongside Row 1	☑	6.75	0.07%	$55,282.50	0.12%
Cut Jacket	Cut and Remove braces Row 1&2 at -650 elev	☑	6.00	0.07%	$55,020.00	0.12%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev-(-)785	☑	36.20	0.39%	$331,954.00	0.73%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev	☑	4.68	0.05%	$42,915.60	0.09%
Cut Jacket	Cut and Remove A&B leg to -785 elev	☑	20.00	0.22%	$183,400.00	0.40%
Cut Jacket	Cut and Remove braces Row 3&4 at -650 elev	☑	6.00	0.07%	$55,020.00	0.12%
Pick Up DB Anchors	Move alongside Row 4	☑	3.75	0.04%	$34,387.50	0.08%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev-(-)785	☑	36.20	0.39%	$331,954.00	0.73%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev	☑	4.68	0.05%	$42,915.60	0.09%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - 863 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Cut Jacket	Cut and Remove A4&B4 leg to -785 elev	☑	20.00	0.22%	$183,400.00	0.40%
Cut Jacket	Cut and Remove Conductor Bay at -650 elev	☑	4.65	0.05%	$42,640.50	0.09%
Cut Jacket	Cut and Remove Conductor Bat at -713 elev.	☑	4.30	0.05%	$39,431.00	0.09%
Cut Jacket	Cut and Remove legsA2&A3 to -713 elev	☑	4.30	0.05%	$39,431.00	0.09%
Cut Jacket	Cut and Remove legsA2&A3 to -785 elev	☑	10.00	0.11%	$91,700.00	0.20%
Cut Jacket	Cut and Remove legsB2&B3 to -785 elev	☑	10.00	0.11%	$91,700.00	0.20%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev	☑	3.47	0.04%	$31,819.90	0.07%
Cut Jacket	Cut braces rows 3&4 -860 elev	☑	8.85	0.10%	$81,154.50	0.18%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev to -935 elev	☑	21.10	0.23%	$193,487.00	0.43%
Cut Jacket	Cut and Remove braces rows 3&4 -860 elev	☑	24.60	0.27%	$225,582.00	0.50%
Rig Jacket Underwater	Secure A4 and B4 legs and skirt piles to DB	☑	4.00	0.04%	$36,680.00	0.08%
Cut Jacket	Cut and Remove braces -785 elev	☑	15.25	0.17%	$139,842.50	0.31%
Remove Jacket - Meth 3	Remove A4 leg and skirt pile cluster	☑	23.60	0.26%	$216,412.00	0.48%
Remove Jacket - Meth 3	Remove B4 leg and skirt pile cluster	☑	23.60	0.26%	$216,412.00	0.48%
Remove Jacket - Meth 1	Removing rows 3&$ -935 elev	☑	16.70	0.18%	$153,139.00	0.34%
Pick Up DB Anchors	Move alongside Row 1	☑	3.75	0.04%	$34,387.50	0.08%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	8.85	0.10%	$81,154.50	0.18%
Cut Jacket	Cut and remove braces rows 1&2 -785 to -860 elev	☑	21.10	0.23%	$193,487.00	0.43%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	24.60	0.27%	$225,582.00	0.50%
Cut Jacket	Cut braces rows 1&2 -785 elev	☑	3.47	0.04%	$31,819.90	0.07%
Cut Jacket	Cut and remove braces rows 1&2 -860 elev	☑	15.25	0.17%	$139,842.50	0.31%
Remove Jacket - Meth 3	Remove A1 leg and skirt pile cluster	☑	23.60	0.26%	$216,412.00	0.48%
Remove Jacket - Meth 3	Remove B1 leg and skirt pile cluster	☑	23.60	0.26%	$216,412.00	0.48%
Remove Jacket - Meth 1	Remove Row 1&2 bracing	☑	16.70	0.18%	$153,139.00	0.34%
Cut Jacket	Cut conductor bay at -855 elev	☑	8.50	0.09%	$77,945.00	0.17%
Cut Jacket	Cut conductor bay at -785 elev	☑	3.50	0.04%	$32,095.00	0.07%
Remove Jacket - Meth 3		☑	23.60	0.26%	$216,412.00	0.48%
Remove Jacket - Meth 3		☑	23.60	0.26%	$216,412.00	0.48%
Pick Up DB Anchors		☑	6.75	0.07%	$61,897.50	0.14%
Demob DB 2000		☐	25.86	0.28%	$237,136.20	0.52%
Offload CB 300		☐	3336.00	36.32%	$703,880.00	1.55%
Site Clearance		☐	240.00	2.61%	$117,840.00	0.26%
Site Clearance		☐	240.00	2.61%	$117,840.00	0.26%
		Task Total	8687.62	94.58%	33,889,944.98	74.70%
		Misc. Work Provision (15.00%)	213.18	2.32%	$3,757,767.00	8.28%
		Weather Contingency (20.00%)	284.23	3.09%	$5,010,357.00	11.04%
		Consumables			$0.00	0.00%

MMS
Platform Decommission Task Information

8P-12SP - 863 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$2,711,196.00	5.98%
		Total:	9185.03	100.00%	45,369,264.98	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-12SP - 863 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$1,686,806.25	3.72%
Cargo Barge 300	$4,920.00	per Day per Barge	$692,941.00	1.53%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,105,939.80	2.44%
CB Damage Deduct	$20,000.00	per Cargo Barge	$20,000.00	0.04%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$129,272.00	0.28%
Decomm Platform	$0.00	Calculated from tables	$294,000.00	0.65%
Derrick Barge 2000	$7,000.00	per Hour per barge	$6,413,680.00	14.14%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,364,399.84	3.01%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$513,770.30	1.13%
Dive Serv - Basic	$0.00	Calculated from tables	$2,145,680.09	4.73%
Expl Charge - Piling	$11,400.00	per Pile	$228,000.00	0.50%
Manual Calculation	$0.00	Independently Calculated	$543,553.00	1.20%
New Padeyes/Trunions	$10,000.00	per Lifting Eye	$80,000.00	0.18%
Pile Abrasive Cut 49 to 69 inches	$5,000.00	per Cut	$80,000.00	0.18%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$129,000.00	0.28%
Pipeline Survey	$230.00	per Hour	$110,190.70	0.24%
Prep Crew	$407.00	per Hour	$1,021,044.99	2.25%
Rem. Operated Vehicle	$800.00	per Hour	$271,176.00	0.60%
Rig Up CB 300	$14,000.00	per Barge	$70,000.00	0.15%
Side Scan Sonar	$75.00	per Hour	$39,600.00	0.09%
SSCV 7000	$32,100.00	per Hour	13,837,989.00	30.50%
Suppl. Welding Crew	$0.00	Calculated from tables	$274,872.00	0.61%
Trawler	$416.00	per Hour	$199,680.00	0.44%
Work Boat	$500.00	per Hour	$2,638,350.00	5.82%

4P-8SP

925 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P-8SP - 925 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	23.90	0.35%	$53,742.80	0.18%
Sever Conductors- Abrasive		☐	60.97	0.91%	$206,709.04	0.68%
Remove Conductors		☐	0.00	0.00%	$0.00	0.00%
Remove Conductors	includes rig up and down	☐	1421.20	21.11%	$3,195,805.38	10.53%
Demob Work Boat		☐	23.90	0.35%	$53,742.80	0.18%
Route Survey to Reef Site		☐	48.00	0.71%	$38,640.00	0.13%
Fab Deck Padeyes		☐	0.00	0.00%	$40,000.00	0.13%
Platform Removal Preparation		☐	504.00	7.49%	$270,000.00	0.89%
Mobilize Work Boat		☐	23.90	0.35%	$11,950.00	0.04%
Mobilize DB 2000		☐	29.86	0.44%	$336,372.90	1.11%
Mobilize CB 300 & Tug		☐	49.80	0.74%	$24,209.00	0.08%
Setup Derrick Barge		☑	6.75	0.10%	$76,038.75	0.25%
Cut Deck/Equip/Misc		☑	4.64	0.07%	$56,816.80	0.19%
Remove Equipment		☑	24.00	0.36%	$293,880.00	0.97%
Remove 4 Pile Deck		☑	9.35	0.14%	$114,490.75	0.38%
Demob CB 300 & Tug		☐	49.80	0.74%	$48,804.00	0.16%
Jet/Air Skrt Pile Mud Plg		☐	123.20	1.83%	$1,387,848.00	4.57%
Pick Up DB Anchors		☑	6.75	0.10%	$76,038.75	0.25%
Demob DB 2000		☐	29.86	0.44%	$336,372.90	1.11%
Mobilize DB 4000		☐	29.86	0.44%	$440,882.90	1.45%
Mobilize Abrasive Cutting Spread		☑	23.90	0.35%	$26,887.50	0.09%
Sever Piles- Abrasive		☑	86.18	1.28%	$1,495,400.19	4.93%
Demob Abrasive Cutting Spread		☑	23.90	0.35%	$26,887.50	0.09%
Mobilize CB 300 & Tug		☑	49.80	0.74%	$62,804.00	0.21%
Install Lifting Appurtenances	First Cut Prep	☑	7.00	0.10%	$103,355.00	0.34%
Deballast Piles or Jkt Lg	First Cut Prep	☑	2.00	0.03%	$29,530.00	0.10%
Lift/Secure Jkt for Tow	First Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Pick Up DB Anchors	First Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Tow Jckt to Shallow Water	First Cut Prep	☑	6.67	0.10%	$98,482.55	0.32%
Setup Derrick Barge	First Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Set Jacket on Bottom	First Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Cut Jacket	Cut above -25 elev	☑	18.00	0.27%	$283,410.00	0.93%
Remove Jacket - Meth 3	Place Jacket piece on Cargo Barge	☑	26.00	0.39%	$409,370.00	1.35%
Demob CB 300 & Tug		☐	49.80	0.74%	$48,804.00	0.16%
Mobilize CB 300 & Tug		☐	49.80	0.74%	$62,804.00	0.21%
Install Lifting Appurtenances	Second Cut Prep	☑	7.00	0.10%	$103,355.00	0.34%
Deballast Piles or Jkt Lg	Second Cut Prep	☑	2.00	0.03%	$29,530.00	0.10%
Lift/Secure Jkt for Tow	Second Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P-8SP - 925 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Pick Up DB Anchors	Second Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Tow Jckt to Shallow Water	Approx 610' WD	☑	6.67	0.10%	$98,482.55	0.32%
Setup Derrick Barge	Second Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Set Jacket on Bottom	Second Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Cut Jacket	305' Elevation	☑	24.00	0.36%	$377,880.00	1.25%
Remove Jacket - Meth 3	Place Jacket on Cargo Barge	☑	26.50	0.39%	$417,242.50	1.37%
Demob CB 300 & Tug		☑	49.80	0.74%	$48,804.00	0.16%
Mobilize CB 300 & Tug		☐	49.80	0.74%	$62,804.00	0.21%
Install Lifting Appurtenances	Third Cut Prep	☑	7.00	0.10%	$103,355.00	0.34%
Deballast Piles or Jkt Lg	Third Cut Prep	☑	2.00	0.03%	$29,530.00	0.10%
Lift/Secure Jkt for Tow	Third Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Pick Up DB Anchors	Third Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Tow Jckt to Shallow Water	Approx 430' WD	☑	10.00	0.15%	$147,650.00	0.49%
Setup Derrick Barge	Third Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Set Jacket on Bottom	Third Cut Prep	☑	8.00	0.12%	$118,120.00	0.39%
Cut Jacket	Cut above -535' Elevation	☑	36.50	0.54%	$574,692.50	1.89%
Remove Jacket - Meth 3	Place Jacket on Cargo Barge	☑	26.50	0.39%	$417,242.50	1.37%
Demob CB 300 & Tug		☑	49.80	0.74%	$48,804.00	0.16%
Mobilize CB 300 & Tug		☐	49.80	0.74%	$62,804.00	0.21%
Install Lifting Appurtenances	Fourth Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Deballast Piles or Jkt Lg	Fourth Cut Prep	☑	5.00	0.07%	$73,825.00	0.24%
Lift/Secure Jkt for Tow	Fourth Cut Prep	☑	6.00	0.09%	$88,590.00	0.29%
Pick Up DB Anchors	Fourth Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Tow Jckt to Shallow Water	Approx -285' WD	☑	10.00	0.15%	$147,650.00	0.49%
Setup Derrick Barge	Fourth Cut Prep	☑	6.75	0.10%	$99,663.75	0.33%
Set Jacket on Bottom	Fourth Cut Prep	☑	8.00	0.12%	$118,120.00	0.39%
Cut Jacket	Cut above 680' Elevation	☑	36.00	0.53%	$566,820.00	1.87%
Remove Jacket - Meth 3	Place Jacket Piece on Cargo Barge	☑	21.70	0.32%	$341,666.50	1.13%
Demob CB 300 & Tug		☐	49.80	0.74%	$48,804.00	0.16%
Mobilize CB 300 & Tug		☐	49.80	0.74%	$62,804.00	0.21%
Install Lifting Appurtenances		☑	6.00	0.09%	$88,590.00	0.29%
Lift/Secure Jkt for Tow		☑	6.00	0.09%	$88,590.00	0.29%
Pick Up DB Anchors		☑	6.75	0.10%	$99,663.75	0.33%
Tow Jckt to Shallow Water	Approx 100' WD	☑	6.67	0.10%	$98,482.55	0.32%
Setup Derrick Barge		☑	6.75	0.10%	$99,663.75	0.33%
Set Jacket on Bottom		☑	10.00	0.15%	$147,650.00	0.49%
Pick Up DB Anchors		☑	6.75	0.10%	$99,663.75	0.33%
Demob DB 4000		☐	29.86	0.44%	$440,882.90	1.45%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
4P-8SP - 925 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize DB 2000		☐	29.86	0.44%	$244,553.40	0.81%
Setup Derrick Barge		☑	6.75	0.10%	$55,282.50	0.18%
Cut Jacket	Braces	☑	172.00	2.55%	$1,577,240.00	5.20%
Cut Jacket	Cut-925 Braces Underwater	☑	80.00	1.19%	$733,600.00	2.42%
Cut Jacket	Cut-861 Braces Underwater	☑	44.00	0.65%	$403,480.00	1.33%
Cut Jacket	Cut-805 Braces Underwater	☑	22.00	0.33%	$201,740.00	0.66%
Cut Jacket	Cut vertical braces Underwater	☑	76.50	1.14%	$701,505.00	2.31%
Cut Jacket		☑	6.90	0.10%	$63,273.00	0.21%
Remove Piles from Jackt Legs		☑	94.40	1.40%	$865,648.00	2.85%
Remove Piles from Jackt Legs	Remove Dummy Leg Sections	☑	47.20	0.70%	$432,824.00	1.43%
Remove Jacket - Meth 3	Remove Jacket Pieces	☑	45.00	0.67%	$412,650.00	1.36%
Pick Up DB Anchors		☑	6.75	0.10%	$55,282.50	0.18%
Demob CB 300 & Tug		☐	49.80	0.74%	$48,804.00	0.16%
Demob DB 2000		☐	29.86	0.44%	$244,553.40	0.81%
Offload CB 300	Manual Calculation	☐	1680.00	24.95%	$888,000.00	2.93%
Site Clearance		☐	168.00	2.50%	$82,488.00	0.27%
Site Clearance		☐	168.00	2.50%	$82,488.00	0.27%
		Task Total	6250.26	92.84%	23,384,103.55	77.05%
		Misc. Work Provision (15.00%)	206.67	3.07%	$2,183,765.00	7.20%
		Weather Contingency (20.00%)	275.57	4.09%	$2,911,686.00	9.59%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$1,870,728.00	6.16%
		Total:	6732.50	100.00%	30,350,282.55	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
4P-8SP - 925 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$1,039,968.75	3.43%
Cargo Barge 300	$4,920.00	per Day per Barge	$778,209.00	2.56%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,361,210.20	4.49%
CB Damage Deduct	$20,000.00	per Cargo Barge	$120,000.00	0.40%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$69,608.00	0.23%
Decomm Platform	$0.00	Calculated from tables	$270,000.00	0.89%
Derrick Barge 2000	$7,000.00	per Hour per barge	$6,269,410.00	20.66%
Derrick Barge 4000	$10,500.00	per Hour per barge	$6,167,280.00	20.32%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$2,600,902.03	8.57%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$588,485.80	1.94%
Manual Calculation	$0.00	Independently Calculated	$331,493.00	1.09%
New Padeyes/Trunions	$10,000.00	per Lifting Eye	$40,000.00	0.13%
Pile Abrasive Cut 49 to 69 inches	$5,000.00	per Cut	$40,000.00	0.13%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$86,000.00	0.28%
Pipeline Survey	$230.00	per Hour	$11,040.00	0.04%
Prep Crew	$407.00	per Hour	$622,697.76	2.05%
Rem. Operated Vehicle	$800.00	per Hour	$657,416.00	2.17%
Rig Up CB 300	$14,000.00	per Barge	$84,000.00	0.28%
Side Scan Sonar	$75.00	per Hour	$28,800.00	0.09%
Suppl. Welding Crew	$0.00	Calculated from tables	$444,897.00	1.47%
Trawler	$416.00	per Hour	$139,776.00	0.46%
Work Boat	$500.00	per Hour	$1,632,910.00	5.38%

8P-16SP
935 Ft. WD

MMS
Platform Decommission Task Information
8P-16SP - 935 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	21.10	0.24%	$47,447.20	0.12%
Sever Conductors- Abrasive		☐	91.46	1.05%	$310,074.72	0.77%
Remove Conductors		☐	0.00	0.00%	$0.00	0.00%
Remove Conductors	includes rig up and down	☐	2119.80	24.28%	$4,766,723.63	11.77%
Demob Work Boat		☐	21.10	0.24%	$47,447.20	0.12%
Route Survey to Reef Site		☐	48.00	0.55%	$38,640.00	0.10%
Fab Deck Padeyes		☐	0.00	0.00%	$80,000.00	0.20%
Platform Removal Preparation		☐	504.00	5.77%	$294,000.00	0.73%
Mobilize Work Boat		☐	21.10	0.24%	$10,550.00	0.03%
Mobilize DB 2000		☐	25.86	0.30%	$291,312.90	0.72%
Mobilize CB 300 & Tug		☐	44.20	0.51%	$23,061.00	0.06%
Setup Derrick Barge		☑	6.75	0.08%	$76,038.75	0.19%
Cut Deck/Equip/Misc		☑	5.50	0.06%	$67,347.50	0.17%
Remove Equipment		☑	24.00	0.27%	$293,880.00	0.73%
Remove 4 Pile Deck	In two sections	☑	18.50	0.21%	$226,532.50	0.56%
Demob CB 300 & Tug		☐	44.20	0.51%	$43,316.00	0.11%
Jet/Air Skrt Pile Mud Plg	Jet/airlift 10-100' sections	☑	66.25	0.76%	$746,306.30	1.84%
Demob DB 2000		☐	25.86	0.30%	$291,312.90	0.72%
Pick Up DB Anchors		☑	6.75	0.08%	$76,038.75	0.19%
Mobilize SSCV	Mob/Demob from Rotterdam	☐	22.63	0.26%	$798,046.95	1.97%
Pre/Post Detonat'n Survey		☑	1.00	0.01%	$41,765.00	0.10%
Setup Derrick Barge		☑	6.75	0.08%	$238,038.75	0.59%
Mobilize Abrasive Cutting Spread		☑	21.10	0.24%	$23,737.50	0.06%
Sever Piles- Abrasive		☑	4.84	0.06%	$428,127.60	1.06%
Demob Abrasive Cutting Spread		☑	21.10	0.24%	$23,737.50	0.06%
Mobilize CB 300 & Tug		☑	44.20	0.51%	$57,316.00	0.14%
Install Lifting Appurtenances	First cut prep	☑	14.00	0.16%	$493,710.00	1.22%
Deballast Piles or Jkt Lg	First cut prep	☑	4.00	0.05%	$141,060.00	0.35%
Lift/Secure Jkt for Tow	Lift Jkt +/-160'	☑	6.00	0.07%	$211,590.00	0.52%
Pick Up DB Anchors		☑	6.75	0.08%	$238,038.75	0.59%
Tow Jckt to Shallow Water	Tow to +/-775 WD	☑	6.00	0.07%	$211,590.00	0.52%
Setup Derrick Barge		☑	6.75	0.08%	$238,038.75	0.59%
Set Jacket on Bottom		☑	2.00	0.02%	$70,530.00	0.17%
Cut Jacket	Cut above -155 elevation	☑	40.00	0.46%	$1,449,800.00	3.58%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.24%	$752,083.75	1.86%
Demob CB 300 & Tug		☐	44.20	0.51%	$43,316.00	0.11%
Mobilize CB 300 & Tug		☐	44.20	0.51%	$57,316.00	0.14%
Install Lifting Appurtenances		☑	14.00	0.16%	$493,710.00	1.22%

MMS
Platform Decommission Task Information
8P-16SP - 935 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Deballast Piles or Jkt Lg		☑	4.00	0.05%	$141,060.00	0.35%
Lift/Secure Jkt for Tow	Lift Jkt +/-240'	☑	6.00	0.07%	$211,590.00	0.52%
Pick Up DB Anchors		☑	6.75	0.08%	$238,038.75	0.59%
Tow Jckt to Shallow Water	Tow to +/-535 WD	☑	6.00	0.07%	$211,590.00	0.52%
Setup Derrick Barge		☑	6.75	0.08%	$238,038.75	0.59%
Set Jacket on Bottom		☑	2.00	0.02%	$70,530.00	0.17%
Cut Jacket	Cut above +/-390 elev.	☑	40.00	0.46%	$1,449,800.00	3.58%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.24%	$752,083.75	1.86%
Demob CB 300 & Tug		☑	44.20	0.51%	$43,316.00	0.11%
Mobilize CB 300 & Tug		☐	44.20	0.51%	$57,316.00	0.14%
Install Lifting Appurtenances		☑	14.00	0.16%	$493,710.00	1.22%
Deballast Piles or Jkt Lg		☑	4.00	0.05%	$141,060.00	0.35%
Lift/Secure Jkt for Tow	Lift Jkt +/-265'	☑	6.00	0.07%	$211,590.00	0.52%
Pick Up DB Anchors		☑	6.75	0.08%	$238,038.75	0.59%
Tow Jckt to Shallow Water	Tow to +/-270 WD	☑	10.00	0.11%	$352,650.00	0.87%
Setup Derrick Barge		☑	6.75	0.08%	$238,038.75	0.59%
Set Jacket on Bottom		☑	2.00	0.02%	$70,530.00	0.17%
Cut Jacket	Cut above -650 elevation	☑	40.00	0.46%	$1,449,800.00	3.58%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	0.24%	$752,083.75	1.86%
Demob CB 300 & Tug		☑	44.20	0.51%	$43,316.00	0.11%
Mobilize CB 300 & Tug		☐	44.20	0.51%	$57,316.00	0.14%
Install Lifting Appurtenances		☑	7.00	0.08%	$246,855.00	0.61%
Lift/Secure Jkt for Tow	Lift Jkt +/-200'	☑	6.00	0.07%	$211,590.00	0.52%
Pick Up DB Anchors		☑	6.75	0.08%	$238,038.75	0.59%
Tow Jckt to Shallow Water	Tow to +/-125 WD	☑	34.00	0.39%	$1,199,010.00	2.96%
Setup Derrick Barge		☑	6.75	0.08%	$238,038.75	0.59%
Demob SSCV		☑	22.63	0.26%	$798,046.95	1.97%
Mobilize DB 2000		☐	25.86	0.30%	$211,793.40	0.52%
Setup Derrick Barge	Set-up alongside Row 1	☑	6.75	0.08%	$55,282.50	0.14%
Cut Jacket	Cut and Remove braces Row 1&2 at -650 elev	☑	6.00	0.07%	$55,020.00	0.14%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev-(-)785	☑	36.20	0.41%	$331,954.00	0.82%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev	☑	4.68	0.05%	$42,915.60	0.11%
Cut Jacket	Cut and Remove A&B leg to -785 elev	☑	20.00	0.23%	$183,400.00	0.45%
Cut Jacket	Cut and Remove braces Row 3&4 at -650 elev	☑	6.00	0.07%	$55,020.00	0.14%
Pick Up DB Anchors	Move alongside Row 4	☑	3.75	0.04%	$34,387.50	0.08%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev-(-)785	☑	36.20	0.41%	$331,954.00	0.82%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev	☑	4.68	0.05%	$42,915.60	0.11%
Cut Jacket	Cut and Remove A4&B4 leg to -785 elev	☑	20.00	0.23%	$183,400.00	0.45%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-16SP - 935 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Cut Jacket	Cut and Remove Conductor Bay at -650 elev	☑	4.65	0.05%	$42,640.50	0.11%
Cut Jacket	Cut and Remove Conductor Bat at -713 elev.	☑	4.30	0.05%	$39,431.00	0.10%
Cut Jacket	Cut and Remove legsA2&A3 to -713 elev	☑	4.30	0.05%	$39,431.00	0.10%
Cut Jacket	Cut and Remove legsA2&A3 to -785 elev	☑	10.00	0.11%	$91,700.00	0.23%
Cut Jacket	Cut and Remove legsB2&B3 to -785 elev	☑	10.00	0.11%	$91,700.00	0.23%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev	☑	3.47	0.04%	$31,819.90	0.08%
Cut Jacket	Cut braces rows 3&4 -935 elev	☑	8.85	0.10%	$81,154.50	0.20%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev to -935 elev	☑	21.10	0.24%	$193,487.00	0.48%
Cut Jacket	Cut and Remove braces rows 3&4 -935 elev	☑	24.60	0.28%	$225,582.00	0.56%
Rig Jacket Underwater	Secure A4 and B4 legs and skirt piles to DB	☑	4.00	0.05%	$36,680.00	0.09%
Cut Jacket	Cut and Remove braces -785 elev	☑	15.25	0.17%	$139,842.50	0.35%
Remove Jacket - Meth 3	Remove A4 leg and skirt pile cluster	☑	23.60	0.27%	$216,412.00	0.53%
Remove Jacket - Meth 3	Remove B4 leg and skirt pile cluster	☑	23.60	0.27%	$216,412.00	0.53%
Remove Jacket - Meth 1	Removing rows 3&$ -935 elev	☑	16.70	0.19%	$153,139.00	0.38%
Pick Up DB Anchors	Move alongside Row 1	☑	3.75	0.04%	$34,387.50	0.08%
Cut Jacket	Cut braces rows 1&2 -935 elev	☑	8.85	0.10%	$81,154.50	0.20%
Cut Jacket	Cut and remove braces rows 1&2 -785 to -935 elev	☑	21.10	0.24%	$193,487.00	0.48%
Cut Jacket	Cut braces rows 1&2 -935 elev	☑	24.60	0.28%	$225,582.00	0.56%
Cut Jacket	Cut braces rows 1&2 -785 elev	☑	3.47	0.04%	$31,819.90	0.08%
Cut Jacket	Cut and remove braces rows 1&2 -935 elev	☑	15.25	0.17%	$139,842.50	0.35%
Remove Jacket - Meth 3	Remove A1 leg and skirt pile cluster	☑	23.60	0.27%	$216,412.00	0.53%
Remove Jacket - Meth 3	Remove B1 leg and skirt pile cluster	☑	23.60	0.27%	$216,412.00	0.53%
Remove Jacket - Meth 1	Remove Row 1&2 bracing	☑	16.70	0.19%	$153,139.00	0.38%
Cut Jacket	Cut conductor bay at -935 elev	☑	10.80	0.12%	$99,036.00	0.24%
Cut Jacket	Cut conductor bay at -855 elev	☑	8.50	0.10%	$77,945.00	0.19%
Cut Jacket	Cut conductor bay at -785 elev	☑	3.50	0.04%	$32,095.00	0.08%
Remove Jacket - Meth 3		☑	23.60	0.27%	$216,412.00	0.53%
Remove Jacket - Meth 3		☑	23.60	0.27%	$216,412.00	0.53%
Pick Up DB Anchors		☑	6.75	0.08%	$61,897.50	0.15%
Demob DB 2000		☐	25.86	0.30%	$237,136.20	0.59%
Offload CB 300		☐	3336.00	38.21%	$703,880.00	1.74%
Site Clearance		☐	240.00	2.75%	$117,840.00	0.29%
Site Clearance		☐	240.00	2.75%	$117,840.00	0.29%
		Task Total	8291.20	94.96%	30,434,861.95	75.16%
		Misc. Work Provision (15.00%)	188.61	2.16%	$3,268,377.00	8.07%
		Weather Contingency (20.00%)	251.47	2.88%	$4,357,835.00	10.76%
		Consumables			$0.00	0.00%

MMS
Platform Decommission Task Information
8P-16SP - 935 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$2,434,789.00	6.01%
		Total:	8731.28	100.00%	40,495,862.95	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-16SP - 935 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$1,437,812.50	3.55%
Cargo Barge 300	$4,920.00	per Day per Barge	$692,941.00	1.71%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,116,523.80	2.76%
CB Damage Deduct	$20,000.00	per Cargo Barge	$20,000.00	0.05%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$104,412.00	0.26%
Decomm Platform	$0.00	Calculated from tables	$294,000.00	0.73%
Derrick Barge 2000	$7,000.00	per Hour per barge	$5,372,780.00	13.27%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,964,104.10	4.85%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$523,382.30	1.29%
Helicopter Trips	$6,500.00	per Round Trip	$6,500.00	0.02%
Manual Calculation	$0.00	Independently Calculated	$488,250.00	1.21%
New Padeyes/Trunions	$10,000.00	per Lifting Eye	$80,000.00	0.20%
Pile Abrasive Cut 49 to 69 inches	$5,000.00	per Cut	$80,000.00	0.20%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$172,000.00	0.42%
Pipeline Survey	$230.00	per Hour	$11,040.00	0.03%
Prep Crew	$407.00	per Hour	$917,158.24	2.26%
Rem. Operated Vehicle	$800.00	per Hour	$143,576.00	0.35%
Rig Up CB 300	$14,000.00	per Barge	$70,000.00	0.17%
Side Scan Sonar	$75.00	per Hour	$39,600.00	0.10%
SSCV 7000	$32,100.00	per Hour	14,159,310.00	34.96%
Suppl. Welding Crew	$0.00	Calculated from tables	$230,262.00	0.57%
Trawler	$416.00	per Hour	$199,680.00	0.49%
Work Boat	$500.00	per Hour	$2,311,530.00	5.71%

12L-24SP
1027 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
12L-24SP - 1027 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Platform Removal Preparation		☐	504.00	2.94%	$294,000.00	0.34%
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	18.70	0.11%	$42,050.40	0.05%
Sever Conductors- Abrasive		☑	250.54	1.46%	$871,645.30	1.01%
Remove Conductors	includes rig up and down	☑	6831.60	39.83%	15,361,991.00	17.77%
Demob Work Boat		☐	18.70	0.11%	$42,050.40	0.05%
Mobilize CB 300 & Tug	14 Cargo Barges	☐	39.40	0.23%	$736,568.00	0.85%
Mobilize SSCV		☐	19.63	0.11%	$666,045.90	0.77%
Mobilize Work Boat		☐	18.70	0.11%	$15,053.50	0.02%
Route Survey to Reef Site		☐	48.00	0.28%	$38,640.00	0.04%
Demob Work Boat		☐	18.70	0.11%	$15,053.50	0.02%
Setup Derrick Barge		☑	6.75	0.04%	$229,027.50	0.26%
Cut Deck/Equip/Misc	Sever Deck in Two sections	☑	96.50	0.56%	$3,368,815.00	3.90%
Remove Equipment		☑	12.50	0.07%	$436,375.00	0.50%
Remove 8 Pile Deck	Remove Section 1	☑	9.35	0.05%	$326,408.50	0.38%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Remove 8 Pile Deck	Remove Section 2	☑	9.35	0.05%	$326,408.50	0.38%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Mobilize Abrasive Cutting Spread		☑	18.70	0.11%	$80,223.00	0.09%
Sever Piles- Abrasive		☑	206.26	1.20%	$7,819,579.10	9.05%
Demob Abrasive Cutting Spread		☑	18.70	0.11%	$21,037.50	0.02%
Install Closure Plates		☑	6.00	0.03%	$203,580.00	0.24%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	First Cut -75	☑	15.00	0.09%	$523,650.00	0.61%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☑	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Second Cut -165	☑	15.00	0.09%	$523,650.00	0.61%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%

MMS
Platform Decommission Task Information
12L-24SP - 1027 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Third Cut -255	☑	20.00	0.12%	$698,200.00	0.81%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Fourth Cut -345	☑	20.00	0.12%	$698,200.00	0.81%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Fifth Cut -520	☑	20.00	0.12%	$698,200.00	0.81%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Sixth Cut -635	☑	24.00	0.14%	$837,840.00	0.97%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Seventh Cut -870	☑	24.00	0.14%	$837,840.00	0.97%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%

MMS
Platform Decommission Task Information
12L-24SP - 1027 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Install Closure Plates		☑	13.00	0.08%	$441,090.00	0.51%
Deballast Piles or Jkt Lg		☑	15.00	0.09%	$508,950.00	0.59%
Lift/Secure Jkt for Tow		☑	6.00	0.03%	$203,580.00	0.24%
Tow Jckt to Shallow Water		☑	4.00	0.02%	$135,720.00	0.16%
Setup Derrick Barge		☑	6.75	0.04%	$235,642.50	0.27%
Cut Jacket	Eighth Cut -990	☑	36.00	0.21%	$1,256,760.00	1.45%
Remove Jacket - Meth 3		☑	21.70	0.13%	$757,547.00	0.88%
Demob CB 300 & Tug		☐	39.40	0.23%	$38,612.00	0.04%
Mobilize Dive Spread		☑	18.70	0.11%	$37,774.00	0.04%
Cut Jacket	Cut remainder of jacket into four pieces	☑	80.00	0.47%	$2,857,600.00	3.31%
Demob Dive Spread		☑	18.70	0.11%	$37,774.00	0.04%
Remove Jacket - Meth 3	Remove bottom section 1	☑	9.00	0.05%	$306,990.00	0.36%
Demob CB 300 & Tug		☑	39.40	0.23%	$38,612.00	0.04%
Remove Jacket - Meth 3	Remove bottom section 2	☑	9.00	0.05%	$314,190.00	0.36%
Demob CB 300 & Tug		☑	39.40	0.23%	$38,612.00	0.04%
Remove Jacket - Meth 3	Remove bottom section 3	☑	9.00	0.05%	$314,190.00	0.36%
Demob CB 300 & Tug		☑	39.40	0.23%	$38,612.00	0.04%
Remove Jacket - Meth 3	Remove bottom section 4	☑	9.00	0.05%	$314,190.00	0.36%
Demob CB 300 & Tug		☑	39.40	0.23%	$38,612.00	0.04%
Demob SSCV		☐	19.63	0.11%	$666,045.90	0.77%
Offload CB 300		☐	4488.00	26.17%	$1,200,040.00	1.39%
Mobilize Work Boat		☑	18.70	0.11%	$15,053.50	0.02%
Site Clearance Verify		☑	48.00	0.28%	$38,640.00	0.04%
Demob Work Boat		☑	18.70	0.11%	$15,053.50	0.02%
		Task Total	14142.71	82.46%	61,446,146.99	71.08%
		Misc. Work Provision (15.00%)	1289.2	7.52%	$8,607,464.00	9.96%
		Weather Contingency (20.00%)	1718.93	10.02%	11,476,620.00	13.28%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$4,915,692.00	5.69%
		Total:	17150.84	100.00%	86,445,922.99	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
12L-24SP - 1027 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$4,602,000.00	5.32%
Cargo Barge 300	$4,920.00	per Day per Barge	$920,040.00	1.06%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,837,264.80	2.13%
CB Damage Deduct	$20,000.00	per Cargo Barge	$280,000.00	0.32%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$308,264.00	0.36%
Decomm Platform	$0.00	Calculated from tables	$294,000.00	0.34%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$59,185.50	0.07%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$104,486.00	0.12%
Dive Boat	$900.00	per Hour	$105,660.00	0.12%
Manual Calculation	$0.00	Independently Calculated	$1,542,568.00	1.78%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$387,000.00	0.45%
Pipeline Survey	$230.00	per Hour	$322,637.10	0.37%
Prep Crew	$407.00	per Hour	$2,897,652.60	3.35%
Rem. Operated Vehicle	$800.00	per Hour	$1,904,112.00	2.20%
Rig Up CB 300	$14,000.00	per Barge	$196,000.00	0.23%
Side Scan Sonar	$75.00	per Hour	$12,810.00	0.01%
SSCV 7000	$32,100.00	per Hour	38,345,697.00	44.36%
Work Boat	$500.00	per Hour	$7,326,770.00	8.48%

6P-24SP
1100 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
6P-24SP - 1100 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	14.90	0.17%	$33,504.80	0.06%
Sever Conductors- Abrasive		☐	137.39	1.59%	$477,992.48	0.87%
Mobilize CB 300 & Tug		☑	31.80	0.37%	$45,164.00	0.08%
Remove Conductors	includes rig up and down	☐	3757.20	43.47%	$8,448,690.00	15.39%
Platform Removal Preparation		☐	408.00	4.72%	$651,156.00	1.19%
Mobilize SSCV		☐	20.00	0.23%	$2,887,157.00	5.26%
Demob Work Boat		☐	14.90	0.17%	$33,504.80	0.06%
Setup Derrick Barge		☑	6.75	0.08%	$229,770.00	0.42%
Cut Deck/Equip/Misc		☑	4.64	0.05%	$162,492.80	0.30%
Remove Equipment		☑	8.00	0.09%	$280,160.00	0.51%
Remove 6 Pile Deck		☑	16.00	0.19%	$560,320.00	1.02%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize Abrasive Cutting Spread		☑	14.90	0.17%	$16,762.50	0.03%
Sever Piles- Abrasive		☑	103.13	1.19%	$3,701,010.45	6.74%
Demob Abrasive Cutting Spread		☑	14.90	0.17%	$16,762.50	0.03%
Mobilize CB 300 & Tug		☐	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	first cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Set Jacket on Bottom		☑	6.00	0.07%	$210,120.00	0.38%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 1		☑	13.75	0.16%	$481,525.00	0.88%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☐	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	second cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 1		☑	13.75	0.16%	$481,525.00	0.88%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☐	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	third cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%

MMS
Platform Decommission Task Information
6P-24SP - 1100 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☐	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	fourth cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☐	31.80	0.37%	$34,988.00	0.06%
Install Closure Plates	fifth cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☑	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	sixth cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☑	31.80	0.37%	$45,164.00	0.08%
Install Closure Plates	seventh cut	☑	5.00	0.06%	$175,100.00	0.32%
Deballast Piles or Jkt Lg		☑	5.00	0.06%	$175,100.00	0.32%
Lift/Secure Jkt for Tow		☑	12.00	0.14%	$420,240.00	0.77%
Tow Jckt to Shallow Water		☑	10.00	0.12%	$350,200.00	0.64%
Setup Derrick Barge		☑	6.75	0.08%	$236,385.00	0.43%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
6P-24SP - 1100 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☑	31.80	0.37%	$31,164.00	0.06%
Mobilize CB 300 & Tug		☑	31.80	0.37%	$45,164.00	0.08%
Mobilize CB 300 & Tug		☑	31.80	0.37%	$45,164.00	0.08%
Cut Jacket		☑	18.00	0.21%	$630,360.00	1.15%
Remove Jacket - Meth 2		☑	26.50	0.31%	$928,030.00	1.69%
Demob CB 300 & Tug		☐	31.80	0.37%	$31,164.00	0.06%
Demob CB 300 & Tug		☑	31.80	0.37%	$31,164.00	0.06%
Demob SSCV		☐	20.00	0.23%	$680,800.00	1.24%
Offload CB 300		☐	2496.00	28.88%	$5,316,800.00	9.69%
Mobilize Work Boat		☐	14.90	0.17%	$11,994.50	0.02%
Site Clearance		☐	120.00	1.39%	$96,600.00	0.18%
Demob Work Boat		☑	14.90	0.17%	$11,994.50	0.02%
		Task Total	8430.26	97.54%	45,653,981.33	83.19%
		Misc. Work Provision (15.00%)	152.04	1.76%	$3,982,624.00	7.26%
		Weather Contingency (6.00%)	60.81	0.70%	$1,593,050.00	2.90%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$3,652,318.00	6.65%
		Total:	8643.11	100.00%	54,881,973.33	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
6P-24SP - 1100 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$2,535,825.00	4.62%
Cargo Barge 300	$4,920.00	per Day per Barge	$5,116,800.00	9.32%
CB 240 & Tug	$660.00	per Hour per Barge/Tug	$20,988.00	0.04%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,215,778.20	2.22%
CB Damage Deduct	$20,000.00	per Cargo Barge	$200,000.00	0.36%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$169,048.00	0.31%
Decomm Platform	$0.00	Calculated from tables	$447,156.00	0.81%
Manual Calculation	$0.00	Independently Calculated	$850,284.00	1.55%
Mesotech Sonar	$110.00	per Hour	$86,489.70	0.16%
Pile Abrasive Cut 7 to 48 inches	$2,486.00	per Cut	$9,944.00	0.02%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$64,500.00	0.12%
Pipeline Survey	$230.00	per Hour	$215,296.10	0.39%
Prep Crew	$407.00	per Hour	$1,597,226.33	2.91%
Rem. Operated Vehicle	$800.00	per Hour	$1,258,032.00	2.29%
Rig Up CB 240	$14,000.00	per Barge	$14,000.00	0.03%
Rig Up CB 300	$14,000.00	per Barge	$126,000.00	0.23%
Side Scan Sonar	$75.00	per Hour	$11,235.00	0.02%
SSCV 7000	$32,100.00	per Hour	27,445,624.00	50.01%
Work Boat	$500.00	per Hour	$4,269,755.00	7.78%

12L-32SP

1300 Ft. WD

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
12L-32SP - 1300 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Platform Removal Preparation		☐	504.00	3.72%	$252,000.00	0.28%
Mobilize Work Boat	Manual calc for casing jacks and specialists	☐	13.00	0.10%	$29,774.00	0.03%
Sever Conductors- Abrasive		☑	117.19	0.86%	$412,592.08	0.46%
Remove Conductors	includes rig up and down	☐	4078.20	30.10%	$9,340,437.00	10.41%
Demob Work Boat		☐	13.00	0.10%	$29,774.00	0.03%
Mobilize CB 300 & Tug	17 Cargo Barges	☐	28.00	0.21%	$704,480.00	0.78%
Mobilize SSCV		☐	12.50	0.09%	$424,125.00	0.47%
Mobilize Work Boat		☐	13.00	0.10%	$10,465.00	0.01%
Route Survey to Reef Site		☐	48.00	0.35%	$38,640.00	0.04%
Demob Work Boat		☐	13.00	0.10%	$10,465.00	0.01%
Setup Derrick Barge		☑	6.75	0.05%	$229,027.50	0.26%
Cut Deck/Equip/Misc	Cut Deck in Two Sections	☑	48.00	0.35%	$1,675,680.00	1.87%
Remove Equipment		☑	96.50	0.71%	$3,368,815.00	3.75%
Remove 8 Pile Deck		☑	12.00	0.09%	$418,920.00	0.47%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Remove 8 Pile Deck		☑	12.00	0.09%	$418,920.00	0.47%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Mobilize Abrasive Cutting Spread		☑	13.00	0.10%	$14,625.00	0.02%
Sever Piles- Abrasive	32 Skirt Piles	☑	275.01	2.03%	10,113,475.60	11.27%
Demob Abrasive Cutting Spread		☑	13.00	0.10%	$14,625.00	0.02%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	24.00	0.18%	$814,320.00	0.91%
Lift/Secure Jkt for Tow		☑	20.00	0.15%	$678,600.00	0.76%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	First Cut to -75	☑	12.50	0.09%	$436,375.00	0.49%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☑	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket		☑	21.00	0.15%	$733,110.00	0.82%
Remove Jacket - Meth 3	Second Cut to -165	☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%

MMS
Platform Decommission Task Information

12L-32SP - 1300 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Third Cut to -255	☑	15.00	0.11%	$523,650.00	0.58%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Fourth Cut to -345	☑	17.00	0.13%	$593,470.00	0.66%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Fifth Cut to -520	☑	20.00	0.15%	$698,200.00	0.78%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Sixth Cut to -670	☑	21.00	0.15%	$733,110.00	0.82%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Seventh Cut to -835	☑	28.00	0.21%	$977,480.00	1.09%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
12L-32SP - 1300 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Install Closure Plates		☑	13.00	0.10%	$441,090.00	0.49%
Deballast Piles or Jkt Lg		☑	15.00	0.11%	$508,950.00	0.57%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Eighth Cut to -990	☑	15.00	0.11%	$523,650.00	0.58%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Ninth Cut to -1140	☑	20.00	0.15%	$698,200.00	0.78%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Tenth Cut to -1284	☑	20.00	0.15%	$698,200.00	0.78%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Lift/Secure Jkt for Tow		☑	6.00	0.04%	$203,580.00	0.23%
Tow Jckt to Shallow Water		☑	6.00	0.04%	$203,580.00	0.23%
Setup Derrick Barge		☑	6.75	0.05%	$235,642.50	0.26%
Cut Jacket	Eleventh Cut to -1284	☑	20.00	0.15%	$698,200.00	0.78%
Remove Jacket - Meth 3		☑	21.70	0.16%	$757,547.00	0.84%
Demob CB 300 & Tug		☐	28.00	0.21%	$27,440.00	0.03%
Mobilize Dive Spread		☑	13.00	0.10%	$26,260.00	0.03%
Cut Jacket	Cut Jacket into four sections with Divers	☑	100.00	0.74%	$3,572,000.00	3.98%
Demob Dive Spread		☑	13.00	0.10%	$26,260.00	0.03%
Remove Jacket - Meth 3	Remove Remainder of Jacket	☑	9.00	0.07%	$314,190.00	0.35%
Demob CB 300 & Tug		☑	28.00	0.21%	$27,440.00	0.03%
Remove Jacket - Meth 3	Remove Remainder of Jacket	☑	9.00	0.07%	$314,190.00	0.35%
Demob CB 300 & Tug		☑	28.00	0.21%	$27,440.00	0.03%
Remove Jacket - Meth 3	Remove Remainder of Jacket	☑	9.00	0.07%	$314,190.00	0.35%
Demob CB 300 & Tug		☑	28.00	0.21%	$27,440.00	0.03%
Remove Jacket - Meth 3	Remove Remainder of Jacket	☑	9.00	0.07%	$314,190.00	0.35%
Demob CB 300 & Tug		☑	28.00	0.21%	$27,440.00	0.03%
Demob SSCV		☐	12.50	0.09%	$424,125.00	0.47%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
12L-32SP - 1300 Ft. WD

Task	Note	Contingency	Task Hours		Task Cost	
Offload CB 300		☐	5952.00	43.93%	$1,560,160.00	1.74%
Mobilize Work Boat		☑	13.00	0.10%	$7,930.00	0.01%
Site Clearance Verify		☑	48.00	0.35%	$29,280.00	0.03%
Demob Work Boat		☑	13.00	0.10%	$7,930.00	0.01%
		Task Total	12894.10	95.17%	65,982,224.68	73.52%
		Misc. Work Provision (15.00%)	280.64	2.07%	$7,924,276.00	8.83%
		Weather Contingency (20.00%)	374.18	2.76%	10,565,700.00	11.77%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$5,278,578.00	5.88%
		Total:	13548.92	100.00%	89,750,778.68	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
12L-32SP - 1300 Ft. WD

Resource Used	Unit Cost		Cost	
Abrasive Cutter Spread	$625.00	per Hour	$2,826,500.05	3.15%
Cargo Barge 300	$4,920.00	per Day per Barge	$1,220,160.00	1.36%
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,645,371.00	1.83%
CB Damage Deduct	$20,000.00	per Cargo Barge	$340,000.00	0.38%
Conductor Abrasive Cut 7" to 48"	$2,486.00	per Cut	$144,188.00	0.16%
Decomm Platform	$0.00	Calculated from tables	$252,000.00	0.28%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$112,140.00	0.12%
Dive Boat	$900.00	per Hour	$113,400.00	0.13%
Manual Calculation	$0.00	Independently Calculated	$1,090,525.00	1.22%
Mesotech Sonar	$110.00	per Hour	$8,140.00	0.01%
Pile Abrasive Cut 70 to 96 inches	$5,375.00	per Cut	$473,000.00	0.53%
Pipeline Survey	$230.00	per Hour	$370,923.30	0.41%
Prep Crew	$407.00	per Hour	$1,718,105.33	1.91%
Rem. Operated Vehicle	$800.00	per Hour	$2,420,336.00	2.70%
Rig Up CB 300	$14,000.00	per Barge	$238,000.00	0.27%
Side Scan Sonar	$75.00	per Hour	$5,550.00	0.01%
SSCV 7000	$32,100.00	per Hour	48,557,991.00	54.10%
Work Boat	$500.00	per Hour	$4,445,895.00	4.95%

5.1.3 FIXED PLATFORM Jacket Only Comparison Cost Estimates

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8P-12SP
WD 863
Jacket Only

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Route Survey to Reef Site		☐	48.00	2.75%	$38,640.00	0.13%
Mobilize SSCV		☑	24.17	1.38%	$857,914.15	2.86%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Mobilize CB 300 & Tug		☑	44.20	2.53%	$57,316.00	0.19%
Deballast Piles or Jkt Lg	First cut prep	☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-160'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-775 WD	☑	6.00	0.34%	$212,970.00	0.71%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above -155 elevation	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☐	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	14.00	0.80%	$496,930.00	1.66%
Deballast Piles or Jkt Lg		☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-240'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-535 WD	☑	6.00	0.34%	$212,970.00	0.71%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above +/-390 elev.	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☑	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	14.00	0.80%	$496,930.00	1.66%
Deballast Piles or Jkt Lg		☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-265'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-270 WD	☑	10.00	0.57%	$354,950.00	1.18%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above -650 elevation	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☑	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	7.00	0.40%	$248,465.00	0.83%
Lift/Secure Jkt for Tow	Lift Jkt +/-200'	☑	6.00	0.34%	$212,970.00	0.71%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information

8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-125 WD	☑	34.00	1.95%	$1,206,830.00	4.02%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Demob SSCV		☑	24.17	1.38%	$857,914.15	2.86%
Mobilize DB 2000		☐	25.86	1.48%	$211,793.40	0.71%
Setup Derrick Barge	Set-up alongside Row 1	☑	6.75	0.39%	$55,282.50	0.18%
Cut Jacket	Cut and Remove braces Row 1&2 at -650 elev	☑	6.00	0.34%	$55,020.00	0.18%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev-(-)785	☑	36.20	2.07%	$331,954.00	1.11%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev	☑	4.68	0.27%	$42,915.60	0.14%
Cut Jacket	Cut and Remove A&B leg to -785 elev	☑	20.00	1.14%	$183,400.00	0.61%
Cut Jacket	Cut and Remove braces Row 3&4 at -650 elev	☑	6.00	0.34%	$55,020.00	0.18%
Pick Up DB Anchors	Move alongside Row 4	☑	3.75	0.21%	$34,387.50	0.11%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev-(-)785	☑	36.20	2.07%	$331,954.00	1.11%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev	☑	4.68	0.27%	$42,915.60	0.14%
Cut Jacket	Cut and Remove A4&B4 leg to -785 elev	☑	20.00	1.14%	$183,400.00	0.61%
Cut Jacket	Cut and Remove Conductor Bay at -650 elev	☑	4.65	0.27%	$42,640.50	0.14%
Cut Jacket	Cut and Remove Conductor Bat at -713 elev.	☑	4.30	0.25%	$39,431.00	0.13%
Cut Jacket	Cut and Remove legsA2&A3 to -713 elev	☑	4.30	0.25%	$39,431.00	0.13%
Cut Jacket	Cut and Remove legsA2&A3 to -785 elev	☑	10.00	0.57%	$91,700.00	0.31%
Cut Jacket	Cut and Remove legsB2&B3 to -785 elev	☑	10.00	0.57%	$91,700.00	0.31%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev	☑	3.47	0.20%	$31,819.90	0.11%
Cut Jacket	Cut braces rows 3&4 -860 elev	☑	8.85	0.51%	$81,154.50	0.27%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev to -935 elev	☑	21.10	1.21%	$193,487.00	0.65%
Cut Jacket	Cut and Remove braces rows 3&4 -860 elev	☑	24.60	1.41%	$225,582.00	0.75%
Rig Jacket Underwater	Secure A4 and B4 legs and skirt piles to DB	☑	4.00	0.23%	$36,680.00	0.12%
Cut Jacket	Cut and Remove braces -785 elev	☑	15.25	0.87%	$139,842.50	0.47%
Remove Jacket - Meth 3	Remove A4 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 3	Remove B4 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 1	Removing rows 3&$ -935 elev	☑	16.70	0.96%	$153,139.00	0.51%
Pick Up DB Anchors	Move alongside Row 1	☑	3.75	0.21%	$34,387.50	0.11%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	8.85	0.51%	$81,154.50	0.27%
Cut Jacket	Cut and remove braces rows 1&2 -785 to -860 elev	☑	21.10	1.21%	$193,487.00	0.65%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	24.60	1.41%	$225,582.00	0.75%
Cut Jacket	Cut braces rows 1&2 -785 elev	☑	3.47	0.20%	$31,819.90	0.11%
Cut Jacket	Cut and remove braces rows 1&2 -860 elev	☑	15.25	0.87%	$139,842.50	0.47%
Remove Jacket - Meth 3	Remove A1 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%

MMS
Platform Decommission Task Information

8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Remove Jacket - Meth 3	Remove B1 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 1	Remove Row 1&2 bracing	☑	16.70	0.96%	$153,139.00	0.51%
Cut Jacket	Cut conductor bay at -855 elev	☑	8.50	0.49%	$77,945.00	0.26%
Cut Jacket	Cut conductor bay at -785 elev	☑	3.50	0.20%	$32,095.00	0.11%
Remove Jacket - Meth 3		☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 3		☑	23.60	1.35%	$216,412.00	0.72%
Pick Up DB Anchors		☑	6.75	0.39%	$61,897.50	0.21%
Demob DB 2000		☐	25.86	1.48%	$237,136.20	0.79%
		Task Total	1365.76	78.18%	21,139,604.65	70.50%
		Misc. Work Provision (15.00%)	163.39	9.35%	$3,065,516.00	10.22%
		Weather Contingency (20.00%)	217.85	12.47%	$4,087,354.00	13.63%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$1,691,168.00	5.64%
		Total:	1747.00	100.00%	29,983,642.65	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-12SP - WD 863 feet

Resource Used	Unit Cost		Cost	
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,015,583.80	3.39%
Derrick Barge 2000	$7,000.00	per Hour per barge	$4,040,890.00	13.48%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,364,399.84	4.55%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$513,770.30	1.71%
Pipeline Survey	$230.00	per Hour	$110,190.70	0.37%
Rig Up CB 300	$14,000.00	per Barge	$56,000.00	0.19%
Side Scan Sonar	$75.00	per Hour	$3,600.00	0.01%
SSCV 7000	$32,100.00	per Hour	13,837,989.00	46.15%
Suppl. Welding Crew	$0.00	Calculated from tables	$173,181.00	0.58%
Work Boat	$500.00	per Hour	$24,000.00	0.08%

5.1.4 SPAR PLATFORM Representative Cost Estimates

Task	Days	Cost
Complete Removal		
Well P&A Separate Estimate		$0
Subsea North & Central Template Abandonment	3	$298,950
Topside Decommissioning/Platform Removal Prep	35	$1,144,465
Pipeline Decommissioning	15	$4,045,967
*Conductor Removal **	0	$0
Platform Removal	66	$37,457,531
Onshore Disposal	120	$4,293,600
Site Clearance	5	$319,452
Project Management and Engineering	0	$3,804,797
		$51,364,763

* Conductor removal is performed during Well P&A

Task	Hours	Days	Cost
Well P&A Separate Estimate			
2 Template Abandonment			
Remove all flow lines and umbilical lines from the wells to the maninfold. Remove flowlines from manifold to flow line Tie-in base. Remove Tie-in bases from flow lines, plug and cover end of flow lines	72	3	$239,160
Work Contingency			$35,874
Weather Downtime			$23,916
Template Abandonment (Northern and Central Diana)	***72***	3	***$298,950***
Platform Removal Prep			
Flush, Purge and Clean Facilities, Tanks and Vessels	240		$326,990
Prepare Modules for Removal	96		$130,796
Prepare Mooring Anchors	504		$686,679
Platform Removal Prep Subtotal	***840***	***35***	***$1,144,465***
Pipeline Abandonment			
Gas Pipeline			
Flush, Clean and Cut			
Mobilize DSV	18		$59,790
Flush PL	105		$348,775
Cut PL Riser	4		$13,287
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Relocate to opposite End	6		$19,930
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$71,250
Weather Downtime			$47,500
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$118,412
Spread Subtotal	161	7	$771,950
Pipeline Riser Removal			
Set up on DP	6		$46,550
Disconnect and remove Riser	25		$190,079
Work Contingency			$35,494
Weather Downtime			$23,663

Spread Subtotal	31	1	$295,786
Gas Pipeline			
Flush, Clean and Cut			
Flush PL	130		$431,817
Cut PL Riser	4		$13,287
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$80,717
Weather Downtime			$53,811
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$142,118
Spread Subtotal	162	7	$814,756
Pipeline Riser Removal			
Set up on DP	6		$46,550
Disconnect and remove Riser	25		$190,079
Work Contingency			$35,494
Weather Downtime			$23,663
Spread Subtotal	31	1	$295,786
Oil Pipeline			
Flush, Clean and Cut			
Flush PL	24		$79,720
Cut PL Riser	4		$13,287
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Relocate to opposite End	6		$19,930
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$30,892
Weather Downtime			$20,594
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$98,412
Spread Subtotal	62	3	$355,841
Pipeline Riser Removal			
Set up on DP	6		$46,550
Disconnect and remove Riser	25		$190,079
Work Contingency			$35,494
Weather Downtime			$23,663
Spread Subtotal	31	1	$295,786
Oil Pipeline			
Flush, Clean and Cut			
Flush PL	24		$79,720
Cut PL Riser	4		$13,287
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,902
Weather Downtime			$18,601

Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$98,412
Spread Subtotal	56	2	$330,929
Pipeline Riser Removal			
Set up on DP	6		$46,550
Disconnect and remove Riser	25		$190,079
Work Contingency			$35,494
Weather Downtime			$23,663
Spread Subtotal	31	1	$295,786
Oil Pipeline			
Flush, Clean and Cut			
Flush PL	15		$49,825
Cut PL Riser	4		$13,287
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$23,418
Weather Downtime			$15,612
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$98,412
Spread Subtotal	47	2	$293,560
Pipeline Riser Removal			
Set up on DP	6		$46,550
Disconnect and remove Riser	25		$190,079
Work Contingency			$35,494
Weather Downtime			$23,663
Spread Subtotal	31	1	$295,786
Pipeline Decommissioning Subtotal	***370***	***15***	***$4,045,967***
Conductor Removal (Done with Well P&A)	***0***		***$0***
DDCV Topsides Removal			
Cargo Barge Grillage and Tie-down Material	0		$400,000
Mobilize SSCV (DP type vessel)	24		$852,300
Set-up DP SSCV vessel	4		$142,050
Mobilize Cargo Barges for Equipment and Deck	33		$32,340
Rig & Remove Topside Equipment	180		$6,568,650
Rig & Remove Deck	360		$13,137,300
Demobilize Cargo Barges with Equipment and Deck	33		$32,340
Demobilize SSCV (DP type vessel)	24		$852,300
Work Contingency			$2,977,200
Weather Downtime			$3,969,600
Sub Total	658	27	$28,964,080
DDCV Hull Removal/Tow			
Route Survey	48		$30,000

Mobilize DB2000, cargo barge and tug	24		$212,720
Mobilize Tugs (4-12000 HP)	48		$280,000
Secure Tow Tugs to top of DDCV	6		$88,180
Ballast to relieve tension on Mooring lines	24		$352,720
Sever lower chain from mooring system. Sever lower chain from cable and remove chain @ 8 hours each	96		$1,410,880
Remove Mooring lines from Hull, by rigging to upper cable/chain connections. ROV sever upper chain from cable. Move away from Hull and lower cable to mudline @ 8 hours per line.	96		$1,410,880
Prepare Hull for transportation	48		$705,440
Release DDCV from Derrick Barge to Tow Tugs	4		$58,787
Demobilize Derrick Barge accounted for under Template Abandonment	0		$0
Tow DDCV to Onshore Location	48		$280,000
Demobilize Tow Tugs	24		$140,000
Work Contingency			$650,533
Weather Downtime			$867,377
DDCV Hull Removal/Tow Sub Total	442	18	$6,487,517
Mooring Line Removal			
Mobilize Anchor Handling Supply Vessel (AHSV)	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	17		$57,218
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	15		$50,301
Demobilize AHSV	24		$83,000
Work Contingency 15%			$102,993
Weather Downtime 20%			$137,324
AHSV Sub Total	487	20	$2,005,934
Sub Total DDCV & Mooring Removal			$8,493,451

Platform Removal Subtotal	***1,587***	***66***	***$37,457,531***
Onshore Disposal			
Offload Modules	120	120	$300,000
Dispose of Material			$3,993,600
Onshore Disposal Subtotal	***120***	***120***	***$4,293,600***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$18,082
Site Clearance Subtotal	***120***	***5***	***$319,452***
Project Management and Engineering (8% of the Total)			***$3,804,797***
Platform Total			**$51,364,763**
Total Hours Derrick Barge, Multi-Service Vessel and Dive Vessels On Site	**2,719**	**113**	

5.1.5a MTLP PLATFORM Representative Cost Estimates

Deck <5000 st

Task	Days	Cost
Complete Removal		
Well P&A Separate Estimate		$0
Topside Decommissioning/Platform Removal Prep	28	$812,104
Deck Removal	4	$1,369,539
Pipeline Decommissioning	10	$0
*Conductor Removal **	0	$0
Platform Removal	23	$5,830,689
Onshore Disposal	120	$907,500
Site Clearance	5	$337,534
Project Management and Engineering	0	$740,589
		$9,997,955

* Conductor removal is performed during Well P&A

Task	Hours	Days	Cost
Platform Removal Prep			
Flush, Purge and Clean Facilities, Tanks and Vessels	101		$123,342
Prepare Modules for Removal	60		$73,273
Replace Tension Units for Tendons	504		$615,489
Platform Removal Prep Subtotal	***665***	***28***	***$812,104***

Task	Hours	Days	Cost
MTLP Deck Removal			
Mobilize Derrick Barge Spread (DB4000 & CB 400)	24		$320,360
Rig up to deck	6		$80,090
Sever, Remove Deck & Seafasten	36		$480,540
Demobilize Derrick Barge Spread	24		$320,360
Work Contingency	5		$72,081
Weather Downtime	7		$96,108
Platform Removal Subtotal	***103***	***4***	***$1,369,539***

Task	Hours	Days	Cost
MTLP Removal			
Route Survey	48		$30,000
Mobilize Derrick Barge DB 2000	24		$213,720
Mobilize 3 Tow Tugs	24		$105,000
Mobilize Cargo Barges	36		$141,120
ROV Sever and Remove 3 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 8 hours each	26		$363,630
Secure TLP to Derrick Barge	6		$85,560
Secure Tow Tugs to TLP	6		$85,560
ROV Sever and Remove 3 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 8 hours each	26		$363,630
Release TLP to Tow Tugs	4		$57,040
Tow TLP to Onshore Location	192		$2,737,920
Demobilize Cargo Barge	36		$141,120
Demobilize Derrick Barge	24		$213,720
Work Contingency	46		$554,001

Weather Downtime	61		$738,668
Platform Removal Subtotal	***558***	***23***	***$5,830,689***
Onshore Disposal			
Offload Modules	120	120	$30,000
Dispose of Material			$877,500
Onshore Disposal Subtotal	***120***	***120***	***$907,500***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$36,164
Site Clearance Subtotal	***120***	***5***	***$337,534***
Project Management and Engineering (8% of the Total)			***$740,589***
Platform Total			**$9,997,955**
Total Hours Derrick Barge, Multi-Service Vessel and Dive Vessels On Site	384	**16**	

5.1.5b TLP PLATFORM Representative Cost Estimates

Task	**Days**	**Cost**
Complete Removal		
Well P&A Separate Estimate		$0
Topside Decommissioning/Platform Removal Prep	28	$812,104
Pipeline Decommissioning	10	$2,029,814
*Conductor Removal **	0	$0
Platform Removal	31	$8,738,847
Onshore Disposal	120	$8,700,000
Site Clearance	5	$337,534
Project Management and Engineering	0	$1,649,464
		$22,267,762

* Conductor removal is performed during Well P&A

Task	**Hours**	**Days**	**Cost**
Well P&A Separate Estimate			$0
Pipeline Abandonment			

Task	**Hours**	**Days**	**Cost**
Oil Pipeline			
Flush, Clean and Cut			
Mobilize DSV	18		$66,356
Mobilize CB	33		$32,340
Flush PL	42		$154,830
Cut PL Riser	4		$14,746
Plug PL End	3		$11,059
Bury PL Ends	5		$18,432
Relocate to opposite End	6		$22,119
Cut PL & retrieve 5' Section	12		$44,237

Plug PL End	3		$11,059
Bury PL Ends	5		$18,432
Work Contingency			$59,041
Weather Downtime			$78,722
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$88,906
Spread Subtotal	131	5	$620,278
Pipeline Riser Removal			
Set up on DP	6		$68,120
Disconnect and remove Riser	25		$278,157
Work Contingency			$51,942
Weather Downtime			$69,255
Spread Subtotal		0	$467,474

Task	Hours	Days	Cost
Gas Pipeline			
Flush, Clean and Cut			
Flush PL	33		$121,652
Cut PL Riser	4		$14,746
Plug PL End	3		$11,059
Bury PL Ends	5		$18,432
Relocate to opposite End	6		$22,119
Cut PL & retrieve 5' Section	12		$44,237
Plug PL End	3		$11,059
Bury PL Ends	5		$18,432
Demobilize CB	33		$32,340
Work Contingency			$39,260
Weather Downtime			$52,347
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$88,906
Spread Subtotal	104	4	$474,589
Pipeline Riser Removal			
Set up on DP	6		$68,120
Disconnect and remove Riser	25		$278,157
Work Contingency			$51,942
Weather Downtime			$69,255
Spread Subtotal		0	$467,474
Pipeline Decommissioning Subtotal	***235***	***10***	***$2,029,814***
Conductor Removal (Done with Well P&A)	***0***	***0***	***$0***

Task	Hours	Days	Cost
Platform Removal Prep			
Flush, Purge and Clean Facilities, Tanks and Vessels	101		$123,342
Prepare Modules for Removal	60		$73,273
Replace Tension Units for Tendons	504		$615,489
Platform Removal Prep Subtotal	***665***	***28***	***$812,104***
TLP Removal			
Route Survey	48		$30,000
Mobilize Derrick Barge DB 2000	24		$213,720
Mobilize 4 Tow Tugs	24		$140,000
Mobilize Cargo Barges	36		$141,120

ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
Secure TLP to Derrick Barge	6		$94,310
Secure Tow Tugs to TLP	6		$94,310
ROV Sever and Remove 4 Tendons From TLP at 400 ft hour and load on Cargo Barge @ 16 hours each	64		$1,005,973
Release TLP to Tow Tugs	4		$62,873
Tow TLP to Onshore Location	192		$3,017,920
Demobilize Cargo Barge	36		$141,120
Demobilize Derrick Barge	24		$213,720
Work Contingency	67		$943,100
Weather Downtime	90		$628,733
Platform Removal Subtotal	***749***	***31***	***$8,738,847***
Onshore Disposal			
Offload Modules	120	120	$300,000
Dispose of Material			$8,400,000
Onshore Disposal Subtotal	***120***	***120***	***$8,700,000***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$36,164
Site Clearance Subtotal	***120***	***5***	***$337,534***
Project Management and Engineering (8% of the Total)			***$1,649,464***
Platform Total			**$22,267,762**
Total Hours Derrick Barge, Multi-Service Vessel and Dive Vessels On Site	537	**22**	

5.1.6 SEMI Representative Cost Estimate

Task	**Days**	**Cost**
Complete Removal		
Well P&A Separate Estimate		$0
Topside Decommissioning/Platform Prep & Removal	26	$9,416,987
Pipeline Decommissioning	88	$17,474,633
*Conductor Removal **	0	$0
Onshore Disposal	120	$6,300,000
Site Clearance	5	$319,452
Project Management and Engineering	0	$2,680,886
		$36,191,958

* Conductor removal is performed during Well P&A

Task	Hours	Days	Cost
Well P&A Separate Estimate			***$0***

Task	Hours	Days	Cost
Platform Removal Prep & Removal			
Mobilize Tugs (4-12000 HP)	48		$280,000
Prepare facilities for tow.	168		$286,867
Mobilize DB2000, cargo barge and tug	24		$198,520
Secure Tow Tugs to top of Hull	6		$84,630
Ballast to relieve tension on Mooring lines	24		$338,520
Sever lower chain from mooring system. Sever lower chain from cable and remove chain @ 8 hours each	128		$1,805,440
Remove Mooring lines from Hull, by rigging to upper cable/chain connections. ROV sever upper chain from cable. Move away from Hull and lower cable to mudline @ 8 hours per line.	128		$1,805,440
Demobilize DB2000, cargo barge and tug	24		$198,520
Tow facilities to Ingleside facility	93		$542,500
Mothball facilities onshore	168		$205,163
Demobilize Tugs	48		$280,000
Platform Removal Prep Subtotal	***763***	***26***	***$6,025,600***

Task	Hours	Days	Cost
Mooring Line Removal			
Mobilize Anchor Handling Supply Vessel (AHSV)	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000

Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cables	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Mobilize AHSV	24		$83,000
Locate and rig to 2 Mooring Cable	2		$6,917
Separate cable from lower chain and spool up cable on AHSV	21		$71,182
Demobilize AHSV to Unspooling Site	24		$83,000
Unspool Drums	19		$64,266
Demobilize AHSV	24		$83,000
Work Contingency 8%			$203,993
Work Contingency 15%			$382,487
Weather Downtime 20%			$254,991
AHSV Sub Total	***737***	***30***	***$3,391,387***

Pipeline Abandonment

Oil line

Flush, Clean and Cut			
Mobilize DSV	18		$59,790
Mobilize Cargo Barge	33		$32,340
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Relocate to opposite End	6		$19,930
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$32,885
Weather Downtime			$43,846
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	117	5	$501,503

Pipeline Riser Removal			
Mobilize DB 2000	36		$252,000
Mobilize Cargo Barge	36		$35,280
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$130,298
Weather Downtime			$116,274
Spread Subtotal	143	3	$1,115,224

Oil line

Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608

Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	60	3	$362,537
Oil line			
Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$138,118
Spread Subtotal	60	3	$387,243
Oil line			
Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$138,118
Spread Subtotal	60	3	$387,243
Oil line			
Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$138,118
Spread Subtotal	60	3	$387,243
Pipeline Riser Removal at Host from Ariel Well 1			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Gas line			
Flush, Clean and Cut			

Flush PL	15		$49,825
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,404
Weather Downtime			$18,269
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	55	2	$341,777
Pipeline Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Gas line			
Flush, Clean and Cut			
Flush PL	15		$49,825
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,404
Weather Downtime			$18,269
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	55	2	$341,777
Oil line			
Flush, Clean and Cut			
Flush PL	14		$46,503
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$26,906
Weather Downtime			$17,937
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	54	2	$337,625
Gas line			
Flush, Clean and Cut			
Flush PL	14		$46,503
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965

Bury PL Ends	5		$16,608
Work Contingency			$26,906
Weather Downtime			$17,937
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	54	2	$337,625
Oil line			
Flush, Clean and Cut			
Flush PL	16		$53,147
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,902
Weather Downtime			$18,601
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	56	2	$345,929
Oil line			
Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$138,118
Spread Subtotal	60	3	$387,243
Pipeline Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Gas line			
Flush, Clean and Cut			
Flush PL	16		$53,147
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,902
Weather Downtime			$18,601
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	56	2	$345,929
Pipeline Riser Removal at Host			

Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Oil line			
Flush, Clean and Cut			
Flush PL	20		$66,433
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$29,895
Weather Downtime			$19,930
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$138,118
Spread Subtotal	60	3	$387,243
Pipeline Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Oil line			
Flush, Filter, Clean and Cut			
Mobilize Multi Service Vessel	48		$362,332
Flush PL	161		$1,215,322
Demobilize Multi Service Vessel	48		$362,332
Cut PL Riser	12		$90,583
Plug PL End	3		$22,646
Bury PL Ends	5		$37,743
Cut PL & retrieve 5' Section	12		$90,583
Plug PL End	3		$22,646
Bury PL Ends	5		$37,743
Work Contingency			$281,940
Weather Downtime			$187,960
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$118,118
Spread Subtotal	249	10	$2,829,947
Pipeline Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715

Gas Lift

Flush, Clean and Cut

Flush PL	15		$49,825
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$27,404
Weather Downtime			$18,269
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	55	2	$341,777
Gas Lift Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Gas Lift Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	71	3	$726,715
Gas Lift Riser Removal at Host			
Set up on DP	6		$49,130
Disconnect and remove Riser	65		$532,242
Demobilize DB 2000	36		$252,000
Demobilize Cargo Barge	36		$35,280
Work Contingency			$87,206
Weather Downtime			$58,137
Spread Subtotal	143	3	$1,013,995
Gas Lift			
Flush, Clean and Cut			
Flush PL	18		$59,790
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$28,899
Weather Downtime			$19,266
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	58	2	$354,233
Gas Lift			
Flush, Clean and Cut			
Flush PL	18		$59,790
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608

Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$28,899
Weather Downtime			$19,266
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	58	2	$354,233
Gas Lift			
Flush, Clean and Cut			
Flush PL	18		$59,790
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Work Contingency			$28,899
Weather Downtime			$19,266
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	58	2	$354,233
Gas Lift			
Flush, Clean and Cut			
Flush PL	18		$59,790
Cut PL Riser	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Cut PL & retrieve 5' Section	12		$39,860
Plug PL End	3		$9,965
Bury PL Ends	5		$16,608
Demobilize DSV	18		$59,790
demobilize CB	33		$32,340
Work Contingency			$28,899
Weather Downtime			$19,266
Fixed price items (Burial Mats, Ball grab tools, Plugs, Cut charge)			$113,412
Spread Subtotal	109	5	$446,363
Pipeline Decommissioning Subtotal	***2,125***	***88***	***17,474,633***
Conductor Removal (Done with Well P&A)	***0***		***$0***
Onshore Disposal			
Offload Modules	120	120	$300,000
Dispose of Material			$6,000,000
Onshore Disposal Subtotal	***120***	***120***	***$6,300,000***
Site Clearance			
Mob Vessels to Site	24		$60,274
Side Scan at Platform Location	24		$60,274
Inspect and Clean up	48		$120,548
Demob Vessels from Site	24		$60,274
Weather Downtime			$18,082

Site Clearance Subtotal	***120***	***5***	***$319,452***
Project Management and Engineering (8% of the Total)			***$2,680,886***
Platform Total			**$36,191,958**
Total Hours Derrick Barge, Multi-Service Vessel and Dive Vessels On Site	**2,516**	**105**	

5.1.7 Conceptual Decommissioning Removal Methods

5.1.7.1 Floatation Device Estimate

The fixed platform identified as 8P-12SP in 863 feet water was estimated conventionally using a HLV and is shown here and is followed by an estimate by a third party engineering firm using floatation devices.

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8P-12SP
WD 863
Jacket Only

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Task Information
8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Route Survey to Reef Site		☐	48.00	2.75%	$38,640.00	0.13%
Mobilize SSCV		☑	24.17	1.38%	$857,914.15	2.86%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Mobilize CB 300 & Tug		☑	44.20	2.53%	$57,316.00	0.19%
Deballast Piles or Jkt Lg	First cut prep	☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-160'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-775 WD	☑	6.00	0.34%	$212,970.00	0.71%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above -155 elevation	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☐	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	14.00	0.80%	$496,930.00	1.66%
Deballast Piles or Jkt Lg		☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-240'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-535 WD	☑	6.00	0.34%	$212,970.00	0.71%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above +/-390 elev.	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☑	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	14.00	0.80%	$496,930.00	1.66%
Deballast Piles or Jkt Lg		☑	4.00	0.23%	$141,980.00	0.47%
Lift/Secure Jkt for Tow	Lift Jkt +/-265'	☑	6.00	0.34%	$212,970.00	0.71%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-270 WD	☑	10.00	0.57%	$354,950.00	1.18%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Set Jacket on Bottom		☑	2.00	0.11%	$70,990.00	0.24%
Cut Jacket	Cut above -650 elevation	☑	40.00	2.29%	$1,459,000.00	4.87%
Remove Jacket - Meth 1	Place Jkt section on CB	☑	20.75	1.19%	$756,856.25	2.52%
Demob CB 300 & Tug		☑	44.20	2.53%	$43,316.00	0.14%
Mobilize CB 300 & Tug		☐	44.20	2.53%	$57,316.00	0.19%
Install Lifting Appurtenances		☑	7.00	0.40%	$248,465.00	0.83%
Lift/Secure Jkt for Tow	Lift Jkt +/-200'	☑	6.00	0.34%	$212,970.00	0.71%

MMS
Platform Decommission Task Information

8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Tow Jckt to Shallow Water	Tow to +/-125 WD	☑	34.00	1.95%	$1,206,830.00	4.02%
Setup Derrick Barge		☑	6.75	0.39%	$239,591.25	0.80%
Pick Up DB Anchors		☑	6.75	0.39%	$239,591.25	0.80%
Demob SSCV		☑	24.17	1.38%	$857,914.15	2.86%
Mobilize DB 2000		☐	25.86	1.48%	$211,793.40	0.71%
Setup Derrick Barge	Set-up alongside Row 1	☑	6.75	0.39%	$55,282.50	0.18%
Cut Jacket	Cut and Remove braces Row 1&2 at -650 elev	☑	6.00	0.34%	$55,020.00	0.18%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev-(-)785	☑	36.20	2.07%	$331,954.00	1.11%
Cut Jacket	Cut and Remove braces row 1&2 -650 elev	☑	4.68	0.27%	$42,915.60	0.14%
Cut Jacket	Cut and Remove A&B leg to -785 elev	☑	20.00	1.14%	$183,400.00	0.61%
Cut Jacket	Cut and Remove braces Row 3&4 at -650 elev	☑	6.00	0.34%	$55,020.00	0.18%
Pick Up DB Anchors	Move alongside Row 4	☑	3.75	0.21%	$34,387.50	0.11%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev-(-)785	☑	36.20	2.07%	$331,954.00	1.11%
Cut Jacket	Cut and Remove braces row 3&4 -650 elev	☑	4.68	0.27%	$42,915.60	0.14%
Cut Jacket	Cut and Remove A4&B4 leg to -785 elev	☑	20.00	1.14%	$183,400.00	0.61%
Cut Jacket	Cut and Remove Conductor Bay at -650 elev	☑	4.65	0.27%	$42,640.50	0.14%
Cut Jacket	Cut and Remove Conductor Bat at -713 elev.	☑	4.30	0.25%	$39,431.00	0.13%
Cut Jacket	Cut and Remove legsA2&A3 to -713 elev	☑	4.30	0.25%	$39,431.00	0.13%
Cut Jacket	Cut and Remove legsA2&A3 to -785 elev	☑	10.00	0.57%	$91,700.00	0.31%
Cut Jacket	Cut and Remove legsB2&B3 to -785 elev	☑	10.00	0.57%	$91,700.00	0.31%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev	☑	3.47	0.20%	$31,819.90	0.11%
Cut Jacket	Cut braces rows 3&4 -860 elev	☑	8.85	0.51%	$81,154.50	0.27%
Cut Jacket	Cut and Remove braces rows 3&4 -785 elev to -935 elev	☑	21.10	1.21%	$193,487.00	0.65%
Cut Jacket	Cut and Remove braces rows 3&4 -860 elev	☑	24.60	1.41%	$225,582.00	0.75%
Rig Jacket Underwater	Secure A4 and B4 legs and skirt piles to DB	☑	4.00	0.23%	$36,680.00	0.12%
Cut Jacket	Cut and Remove braces -785 elev	☑	15.25	0.87%	$139,842.50	0.47%
Remove Jacket - Meth 3	Remove A4 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 3	Remove B4 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 1	Removing rows 3&$ -935 elev	☑	16.70	0.96%	$153,139.00	0.51%
Pick Up DB Anchors	Move alongside Row 1	☑	3.75	0.21%	$34,387.50	0.11%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	8.85	0.51%	$81,154.50	0.27%
Cut Jacket	Cut and remove braces rows 1&2 -785 to -860 elev	☑	21.10	1.21%	$193,487.00	0.65%
Cut Jacket	Cut braces rows 1&2 -860 elev	☑	24.60	1.41%	$225,582.00	0.75%
Cut Jacket	Cut braces rows 1&2 -785 elev	☑	3.47	0.20%	$31,819.90	0.11%
Cut Jacket	Cut and remove braces rows 1&2 -860 elev	☑	15.25	0.87%	$139,842.50	0.47%
Remove Jacket - Meth 3	Remove A1 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%

MMS
Platform Decommission Task Information
8P-12SP - WD 863 feet

Task	Note	Contingency	Task Hours		Task Cost	
Remove Jacket - Meth 3	Remove B1 leg and skirt pile cluster	☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 1	Remove Row 1&2 bracing	☑	16.70	0.96%	$153,139.00	0.51%
Cut Jacket	Cut conductor bay at -855 elev	☑	8.50	0.49%	$77,945.00	0.26%
Cut Jacket	Cut conductor bay at -785 elev	☑	3.50	0.20%	$32,095.00	0.11%
Remove Jacket - Meth 3		☑	23.60	1.35%	$216,412.00	0.72%
Remove Jacket - Meth 3		☑	23.60	1.35%	$216,412.00	0.72%
Pick Up DB Anchors		☑	6.75	0.39%	$61,897.50	0.21%
Demob DB 2000		☐	25.86	1.48%	$237,136.20	0.79%
		Task Total	1365.76	78.18%	21,139,604.65	70.50%
		Misc. Work Provision (15.00%)	163.39	9.35%	$3,065,516.00	10.22%
		Weather Contingency (20.00%)	217.85	12.47%	$4,087,354.00	13.63%
		Consumables			$0.00	0.00%
		Waste Disposal			$0.00	0.00%
		Structure & Equipment Disposal			$0.00	0.00%
		Offloading			$0.00	0.00%
		Storage / Scrapping			$0.00	0.00%
		Reef Donation			$0.00	0.00%
		Cost of Engineering (8.00%)			$1,691,168.00	5.64%
		Total:	1747.00	100.00%	29,983,642.65	100.00%

TWACHTMAN SNYDER & BYRD, INC.

MMS
Platform Decommission Resources Breakdown
8P-12SP - WD 863 feet

Resource Used	Unit Cost		Cost	
CB 300 & Tug	$980.00	per Hour per Barge/Tug	$1,015,583.80	3.39%
Derrick Barge 2000	$7,000.00	per Hour per barge	$4,040,890.00	13.48%
Dive Basic Spread Saturation	$3,165.00	Per Hour	$1,364,399.84	4.55%
Dive Basic Spread- Mixed Gas	$890.00	Per Hour	$513,770.30	1.71%
Pipeline Survey	$230.00	per Hour	$110,190.70	0.37%
Rig Up CB 300	$14,000.00	per Barge	$56,000.00	0.19%
Side Scan Sonar	$75.00	per Hour	$3,600.00	0.01%
SSCV 7000	$32,100.00	per Hour	13,837,989.00	46.15%
Suppl. Welding Crew	$0.00	Calculated from tables	$173,181.00	0.58%
Work Boat	$500.00	per Hour	$24,000.00	0.08%

"Conceptual Level Planning & Cost Estimate for Removal of a Jacket in 700+ feet of Water in the GOM Using New Buoyancy Lifting Technology"

Submitted to:

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Job No: Proserv- 01-09

9th October 2009

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ENGINEERING
SERVICES

Document Control Sheet

Project Title: Conceptual Level Planning & Cost Estimate for Removal of a Jacket in 700 feet of Water in the GOM Using New Buoyancy Lifting Technology

Proposal Number: Proserv-01-09

Client: PROSERV OFFSHORE

5					
4					
3					
2	Revisednafter operational clarifications	09/10/2009	BT	CQV	BT
1	Issued to Client	07/10/2009	BT	CQV	BT
Revisions		Date	Orig.	Chk.	Appr.

Document Title: Conceptual Level Planning & Cost Estimate for Removal of a Jacket in 700+ feet of Water in the GOM Using New Buoyancy Lifting Technology	REL Document No. PROSERV-01-09-PROPOSAL-REV 0

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1 Proposed Work Scope

The objective of this work is to provide a conceptual level cost estimate for the removal of a jacket located in 700+ feet of water in the GOM. Proserv Offshore have requested the following:

1. The development of the general specifications for, fabrication time, and estimated cost of a re-useable buoyancy tank system capable of refloating a jacket in approximately 700+ ft water depth. Proserv Offshore will provide REL with a set of general arrangement drawings. It is required that the buoyancy system is capable of rotating and floating the jacket horizontally.

2. Supply of a sketch or drawing of the above system that Proserv Offshore can use in their report.

3. A write-up describing how the system would work and the limitations it might have with respect to extending it to deep water. Proserv Offshore have consider the removal of compliant towers out to about 1800 ft.

Input Data Required:
The following input information and data was requested but the information was not available at short notice .

1. A full set of as-built jacket drawings and a jacket weight report.
2. The installation manuals for the jacket specifically with any barge launch details, load-out and ballasting calculations and the number, location and size of the additional buoyancy tanks used for the launch and up-ending of the jacket.
3. Jacket load-out and launch photographs would be very useful.
4. Jacket piling details, weights and sizes.
5. Details of any drill cutting of shell mounds blocking access to the lower jacket area.
6. Other information requests may follow after the received information has been reviewed.

Input Data Received:
Two documents were received from Preserve Offshore:
SKMBT_60009091609360
SKMBT_60009091609361
These documents contained basic information and drawings on the The fixed platform identified as 8P-12SP platform.

Rider on the engineering level of this work:
Please note that the engineering undertaken for this very brief scope will be highly conceptual and its findings should be used and interpreted with caution. Substantial engineering, planning and verification would be required before to verify the application of the reusable buoyancy to the refloating of a jacket located in 700 ft water.

METHODOLOGY FOR THE total removal of the fixed platform identified as 8P-12SP

Input Data Received

The 8P-12SP jacket, is an eight legged structure arranged in a rectangular grid (Figure 2.01). The jacket is primarily constructed of tubular members with all the members except the 4 outer jacket legs designed to remain sealed against flooding throughout the life of the jacket. The outer jacket legs were designed to be flooded progressively during upending and final ballasting operations.

There will be numerous assumptions made during the following work and all of the assumptions are listed in Section 2.2.

The principal dimensions and weights of the jacket used are:

- Number of legs: 8
- Water Depth: 863 feet
- Height: 876 feet
- Base : 239' 8" x 310' 7"
- Top: 162' 6" x 92' 6"
- Jacket weight (short tons): 20,400

Assumptions
The following assumptions have been made during this highly conceptual evaluation.

Technical Assumptions:
1. The weight and dimensions of the jacket are as stated in Section 2.1
2. Jacket weight includes the 4 main piles and the grout weight
3. All conductors and risers have been removed
4. The jacket has been cut free at the mud line (4 main & 16 skirt piles)
5. Marine growth has been estimated as 5% of the jacket weight
6. All boat landings, large bumpers etc have been removed
7. Any shell /drill cuttings mounds will not affect the removal of the jacket
8. The jacket is structurally sound. There are no flooded or damaged members and the 4 main jacket legs (A1, A4, B1 and B4) can be used as buoyancy tanks.
9. The jacket structure can take loading imposed by the buoyancy tanks during the lifting, refloat, towing and docking operations.
10. The jacket removal operations will take place in suitable weather conditions

Costing Assumptions:

1. The cost of the transport of the buoyancy tanks and equipment from Norway to the GOM is included in the per weight cost.
2. The timings and manhours are based minimal engineering time and planning. Need to do a detailed study to verify.

Description of the removal of the 8P-12SP a jacket with buoyancy

The jacket weighs an estimated 20,400 short tons. An allowance of 5% of jacket weight has been added for marine growth bringing the total jacket lift weight to 21,420 short tons. See Table 2.1 below.

Items	Short Tons	Metric Tons
Jacket Weight	20,400	18507
Marine Growth (5%)	1,020	925
Total Jacket Weight	**21,420**	**19,432**

Table 2.1: Estimated Total Jacket Weight

The buoyancy removal system is an add-on system that eliminates the need to use any of the original installation equipment or systems. There are two types of buoyancy units proposed for the jacket removal, passive buoyancy units (PBU's) in which the available buoyancy from each unit is fixed and remains unchanged throughout the operation and intelligent buoyancy units (IBU's) in which the buoyancy can be remotely inflated or deflated to suit operational requirements. Once the jacket is stable on the surface the IBU's can be remotely inflated or deflated to suit the tow configuration or to ballast the jacket out of the water to enable it to be taken into shallow water for further deconstruction. The passive buoyancy units (PBU's) will remain sealed during the removal operations as a pressurized unit. In Table 2.2 an estimate of the weights and the buoyancy required to remove the East Breaks 165A

Weights		Metric Tons
	Jacket weight	19,432
	Weight of 16 Buoyancy Tanks	10,400
	Total weight to be Lifted	**29,832**
Buoyancy		
	Jacket Buoyancy (estimated 40%)	7,773
	Buoyancy tanks (16)	24,000
	Total Buoyancy	**31,773**
	Reserve Buoyancy	6%

Table 2.2: Estimated Buoyancy Requirement

A quick preliminary estimate (see Table 2.2) indicates that in addition to some 7,773 mt supplied the jacket's inherent buoyancy, a further 24,000 mt will have to be generated by the buoyancy tanks.

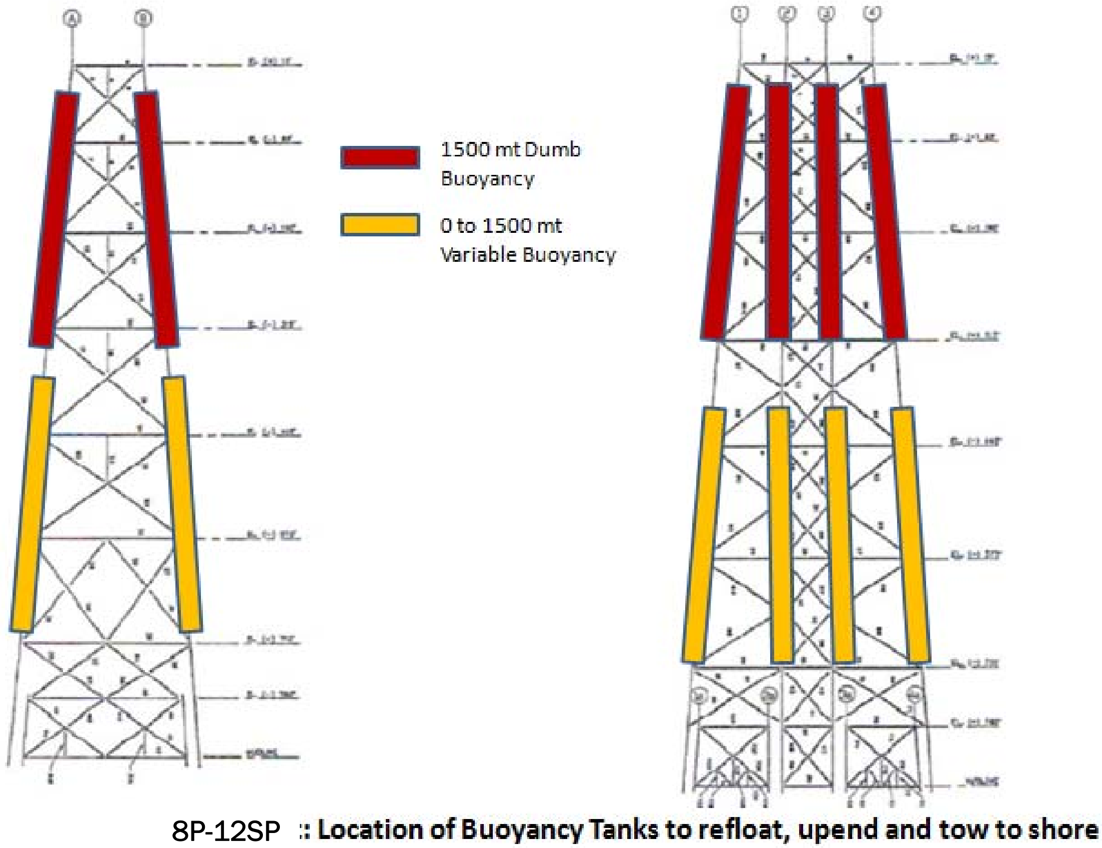

Figure 2.1: Approximate Location of the 16 Additional Buoyancy Tanks on the 8P-12SP
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2009)

In Figure 2.1 there are two types of buoyancy tanks shown, the red tanks are the passive buoyancy units (PBU's), in which the available buoyancy from each unit is fixed and remains unchanged throughout the operation. The yellow buoyancy tanks are the intelligent buoyancy units (IBU's), in which the buoyancy can be remotely inflated or deflated to suit operational requirements. Sequencing the yellow IBU is the key to the up-ending of the jacket base and bringing the jacket back to the surface.

Typical operational sequences showing the use of PBU's and IBU's for the controlled removal of a jacket into towing position are shown in Figure 2.2 and Figure 2.3.

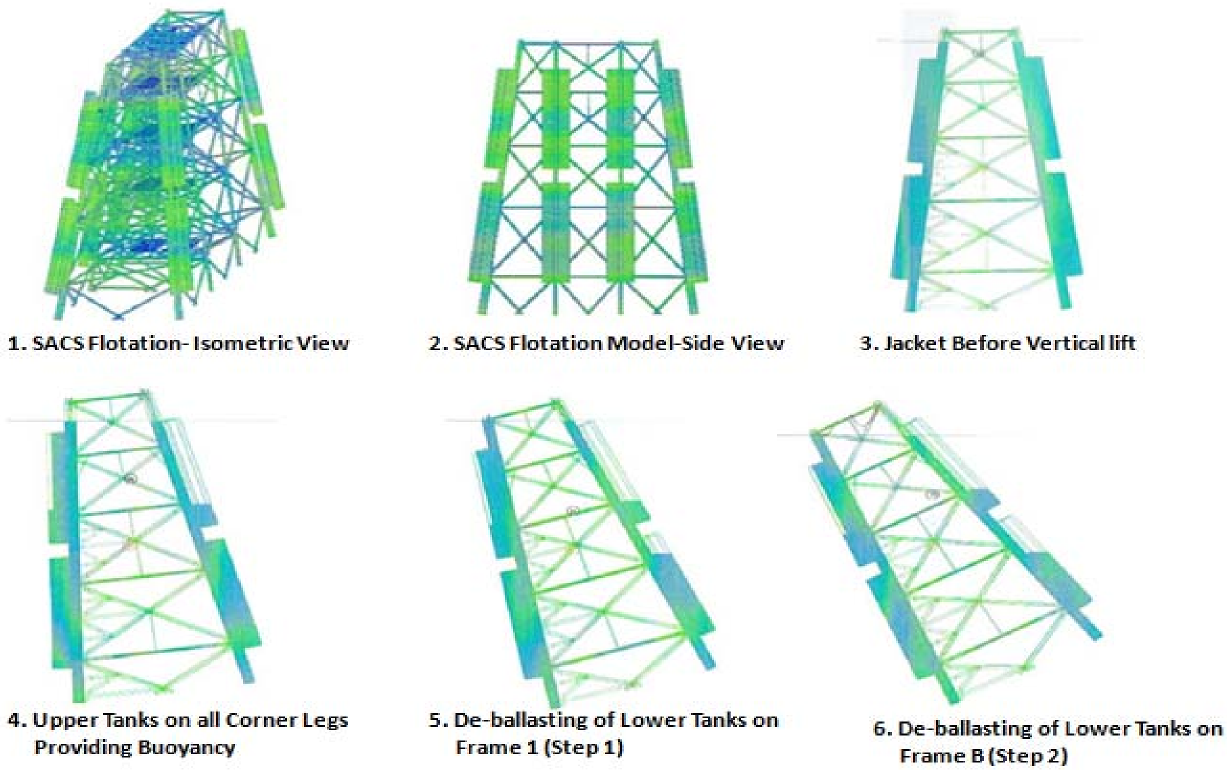

Figure 2.2: SACS Simulation Showing the Removal of a Jacket Using PBU & IBU Buoyancy- Part 1
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2000)

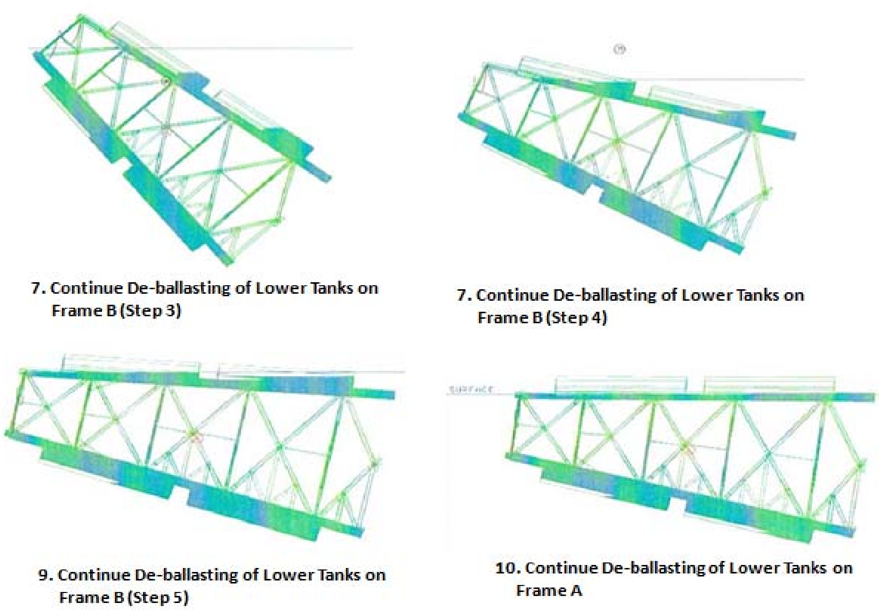

Figure 2.3: SACS Simulation Showing the Removal of a Jacket Using PBU & IBU Buoyancy- Part 3
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2000)

Attachment of Buoyancy System: removal of the Frigg DP2 Jacket

A reusable buoyancy tank system was designed for removal the DP2 Jacket. Each of the buoyancy tanks can be shortened or extended depending on the lifting capacity required.

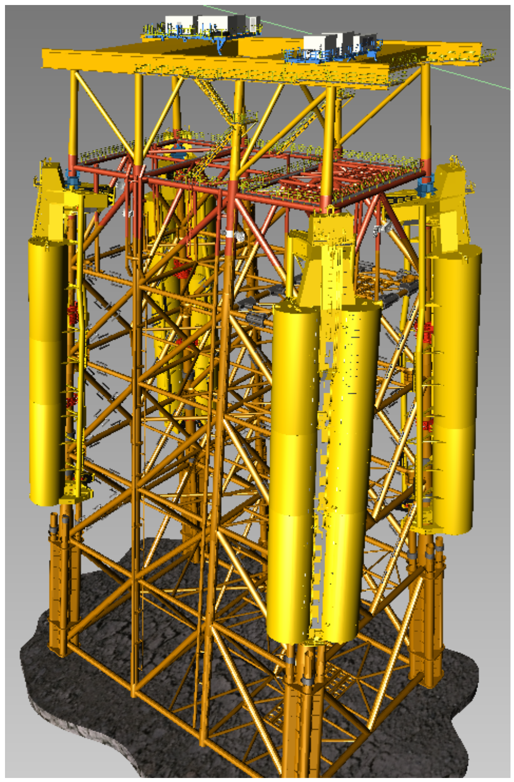

Figure 2.4: Aker Solutions Buoyancy system attached to Frigg DP2 Jacket
(Ref: Aker Solutions, Stavanger & Stord 2008)

INSTALLATION OF THE BTA'S ON THE DP2 JACKET

Two 50 tonne bollard-pull tugs were used to tow the BTA's to site. On arrival at site the control of the BTA's was transferred to the installation vessels. The installation vessels were the multipurpose support vessels MSV Botnica and MSV Nordica. These vessels have a Mark III dynamic positioning systems which was used during the operation.

Figure 2.5: Towing Buoyancy Tank Assembly to site
(Ref: Aker Solutions, Stavanger & Stord 2008)

The two MSV's are attached to the BTA as shown in Figure 2.6 below and umbilical's for controlling the de-ballasting operation were attached. As the BTA's were towed in a horizontal position an upending operation was required to get the BTA to the installation draft before the pull-in operation could begin. The ballasting sequence of the BTA is shown in Figure 2.7.

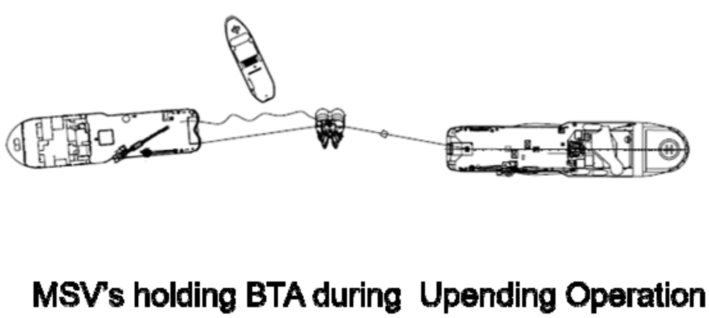

Figure 2.6: Positioning & Holding BTA
(Ref: Aker Solutions, Stavanger & Stord 2008)

When the BTA is ready to be installed, the pull-in and hold-back wires are attached to each side of the BTA. To avoid snap-loads the wires are attached to high-speed constant tension winches. When the pull-in operation begins the installation vessels, using their DP systems, slowly approached the jacket leg until the BTA was 3 meters from the jacket. Further pull-in and positioning will be performed by the constant tension winches and the hold-out tug which controls the hold-back wire.

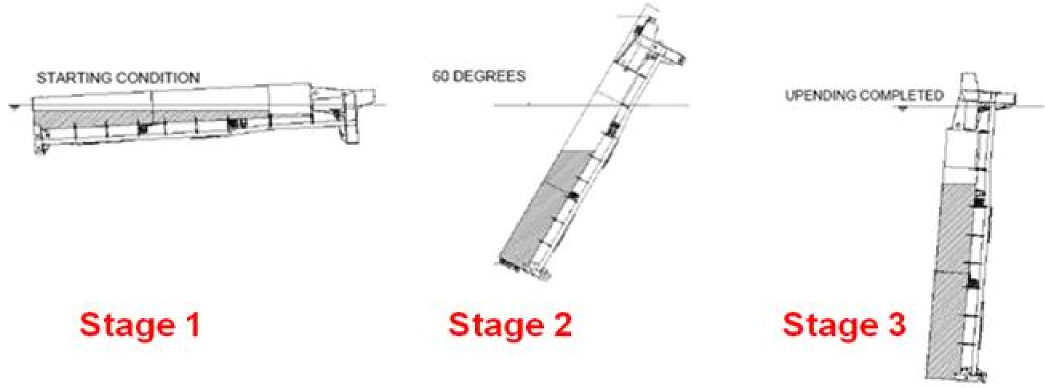

Figure 2.6: BTA Upending Operation
(Ref: Aker Solutions, Stavanger & Stord 2008)

The lower guide enters the jacket leg first and during this operation an observation ROV is monitoring the mating of the BTA and the jacket. When the lower guide is in contact with the jacket leg, the winches on the main installation vessels then pulled the BTA further into the jacket, so the upper guides also engage the jacket.

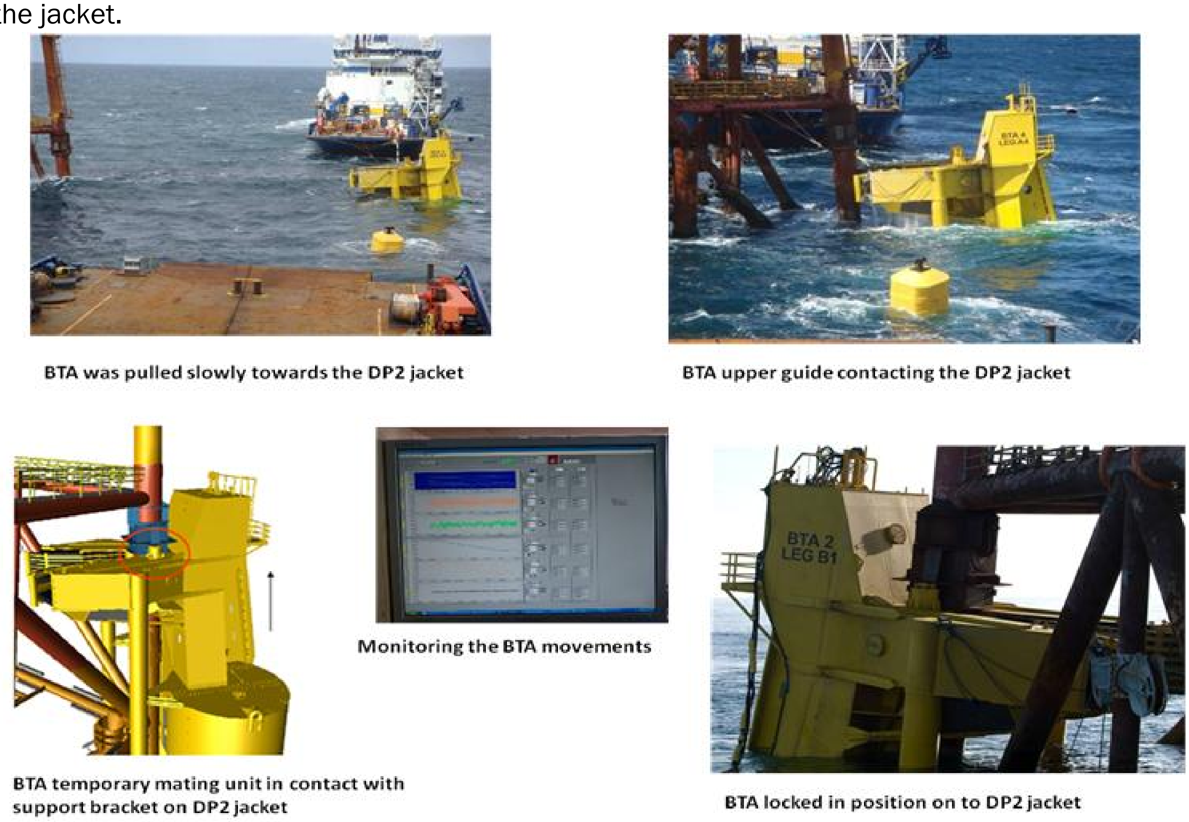

Figure 2.6: Attaching BTA to DP2 Jacket
(Ref: Aker Solutions, Stavanger & Stord 2008)

Cost Estimate of the removal of 8P-12SP a jacket with buoyancy

This rough cost for the removal of the 8P-12SP jacket includes the following:

DURATION: The estimated duration of items is 50 (+/- 40%) working days.

COST: see rough breakdown below:

Item	Description	Estimated Cost (+/- 40%)
1	Manufacturing & testing of Buoyancy units (over 4 Jobs)	$16,000,000
2	Preparation of Buoyancy Units at Stord, Norway	$5,000,000
3	Transport of Buoyancy Tanks & Equipment to Site in GOM	$4,000,000
4	Onshore Mobilization Operations in GOM	$3,000,000
5	Mobilization, operation & demobilization of full subsea cutting spread (diamond wire saw)	$1,200,000
6	Offshore Operations including installation of buoyancy system, cutting of legs, tow to reverse upending area, reverse up-ending, trimming	$12,000,000
7	Offshore towing to disposal location	$3,000,000
8	Inshore trimming for entry to disposal area	$8,000,000
9	Tow to disposal area	$4,000,000
10	Demobilization of Buoyancy tanks, two MSV's and two Tugs	$4,000,000
	TOTAL	$60,200,000 (+/- 40%)

Alternative removal method for 8P-12SP a jacket with buoyancy

The jacket could be removed in two main sections, which would reduce the towing draft depending on where the jacket was cut. This would enable the jacket to be brought much closer to port. <u>This approach would require detailed work to compare it with the jacket removed in one lift with the buoyancy.</u>

The principals to the approached are illustrated in Figures 2.7 to 2.9 below.

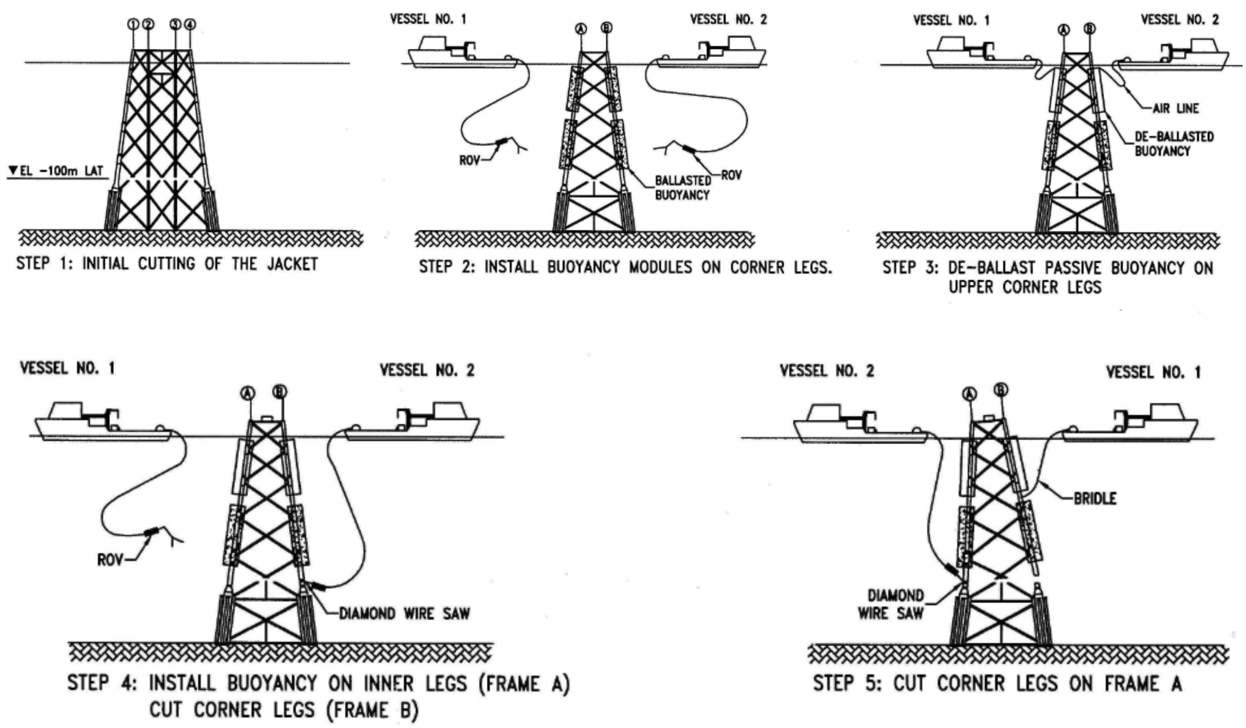

Figure 2.7: Total Removal of Jacket 8P-12SP using Buoyancy-Part 1
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2009)

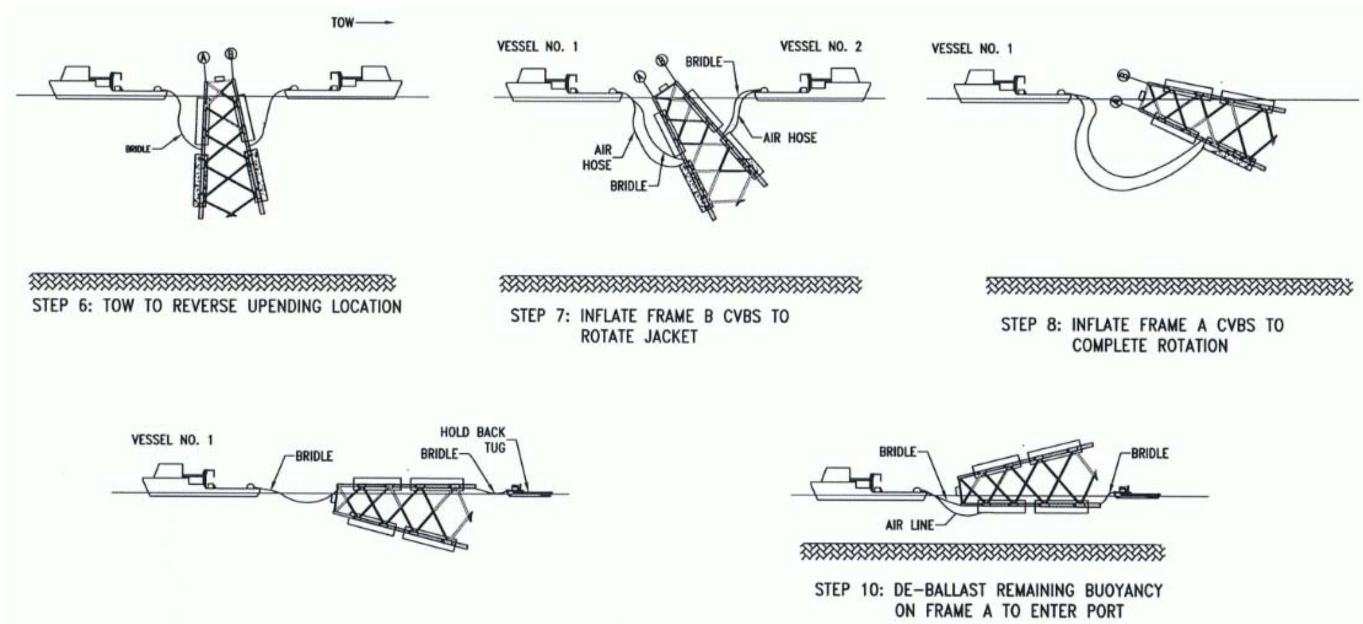

Figure 2.8: Total Removal of Jacket 8P-12SP using Buoyancy-Part 2
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2009)

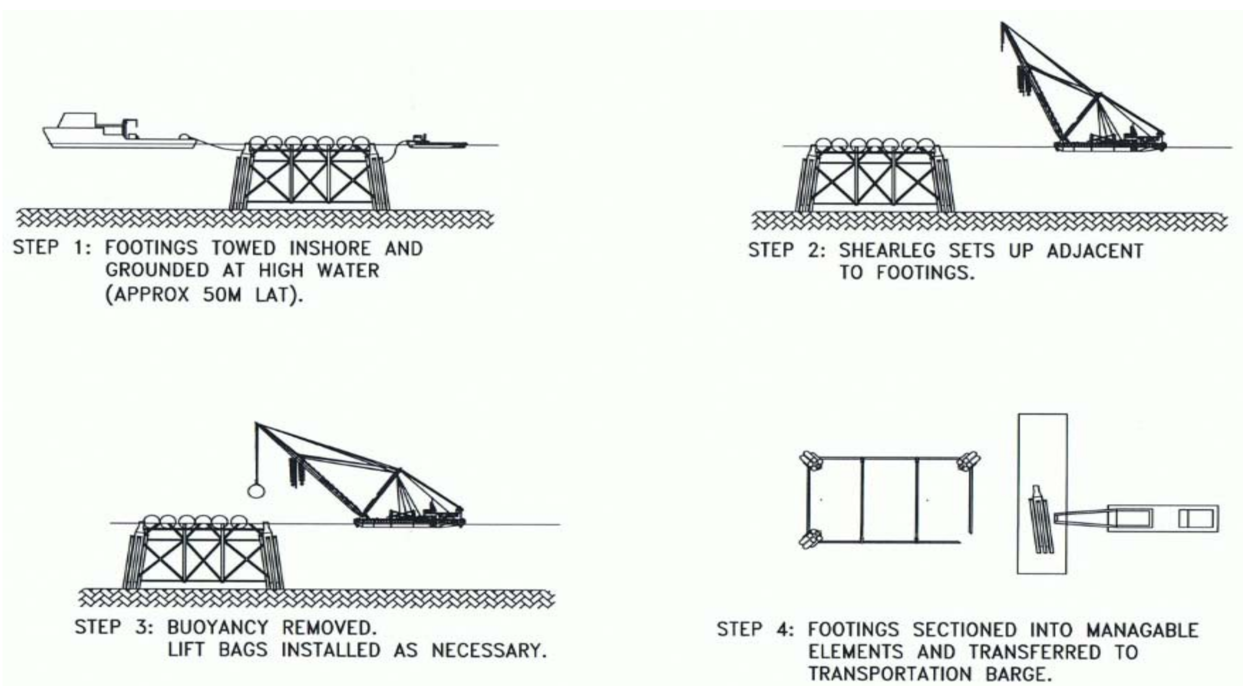

Figure 2.9: Total Removal of Jacket 8P-12SP using Buoyancy-Part 3
(Ref: Reverse Engineering Ltd, Dr. Brian Twomey 2009)

Conclusions

The 8P-12SP jacket can be removed using buoyancy as discussed in this paper, but much more engineering is required to verify this approach. This merits further investigation.

A second alternative method for the total removal of the 8P-12SP, jacket in two main pieces using buoyancy was presented. This merits further investigation.

Significant cost savings can be realized by using the buoyancy for multiple projects in the same region.

5.1.7.2 Comparison TML vs. HLV Estimates

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5.1.10 Pipelines

See Section 4 Figures 4.3 through 4.7.

5.1.11 Dry Tree Platform Wells

See Section 4 Figures 4.9 and 4.9.

5.1.12 Dry Tree Subsea Wells

Dry Tree - Subsea Well P&A Cost Estimate					
P&A Crew & Platform & Semi-Submersible Rigs					
P&A Crew & Equip.	Spreadrate	$20,000			
Platform Rig	Spreadrate	$50,000			
Semi-Submersible Rig	Spreadrate	$400,000			
	Number of Wells	11			
	Tasks	**HRS**	**TBW**	**TOTAL**	**Cost ($)**
	Tie onto casing string and attempt to pressure up / chart test	1	1	2	
	Attempt to inject down tubing into perforations	1	1	2	
	Bullhead cement down tubing	4	1	5	
P&A Crew & Equip.	Wait on cement (done offline)	0	0	0	
	RIH with perf guns on wireline and punch holes in tubing above packer	3	1	4	
	Circulate cement plug on top of packer	4	1	5	
	Wait on cement (done offline)	0	0	0	
	RIH and cut tubing above plug	3	1	4	
	Total Well Work (hrs)			22	
	Well Work Costs Per Well				**18,333**
	Mob/ Demob				
	Mob/ Demob			**40**	
	Costs Per Well				**3,030**
	Work Contingency (15%)				**2,750**
	Weather Contingency (15%)				**2,750**
	SubTotal for Wells P&A / well				**26,864**

Dry Tree Subsea Wells Continued

	ND Tree	3		3	
	POOH with tubing	40		40	
Platform Rig	Circulate cement plug above liner top (on way out with tubing)	4		4	
	Wait on cement (done while pulling tubing)	0	0	0	
	POOH and LD 10-3/4" Production Riser	20		20	
	Total Well Work (hrs)			67	
	Well Work Costs Per Well				**139,583**
	Mob/ Demob				
	Mob/ Demob			**192**	
	Costs Per Well				**36,364**
	Work Contingency (15%)				**20,938**
	Weather Contingency (15%)				**20,938**
	SubTotal for Wells P&A / well				**217,822**
	Run BOP and Drilling Riser	24		24	
	Set 10-3/4" wear bushing and test BOP's	15		15	
	Make gauge ring and Junk basket run	4		4	
	Set 8-5/8" drillguns (approx. 6000') perf.& sqz. Into 10-3/4"x 16" annu	10		10	
Semi-Submersible	Dump cement on top of Retainer	2		2	
	WOC	12		12	
	Cut and Pull 10-3/4" casing	20		20	
	Set 13-5/8" drillguns (approx. 3600') perf & sqz. Into 13-5/8" x 20" anr	10		10	
	Spot surface plug on top of retainer	2		2	
	Move to next well	6		6	
	Total Well Work (hrs)			105	
	Well Work Costs Per Well				**1,750,000**
	Mob/ Demob				
	Mob/ Demob Rig and handle anchors			300	
	Costs Per Well				**454,545**
	Work Contingency (15%)				**262,500**
	Weather Contingency (15%)				**262,500**
	Total Anchor Handling				1,000,000
	Anchor Handling/ Well				**90,909**
	SubTotal for Wells P&A / well				**3,729,545**
	GRAND TOTAL PER WELL				**$3,974,231**

5.1.13 Subsea Wells and Template

SEMI-SUBMERSIBLE DRILL RIG				
**////////// ESTIMATE **				
P&A SUPPORT SERVICES				
Semi-Submersible Rig option --				
Some Crossover Fabrication may be required.				
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Tree Tools				
Lease Tree Running Tool	1	Lump Sum	$170,000.00	$170,000.00
Refurbish Tools	1	Lump Sum	$60,000.00	$60,000.00
Cross-Over Connections Fab.	1	Lump Sum	$25,000.00	$25,000.00
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Tree Controls				
Mobilization	1	Lump Sum	$8,000.00	$8,000.00
Well Work	144	hrs	$502.00	$72,288.00
Demobilization	1	Lump Sum	$8,000.00	$8,000.00
Dockside Standby	1	day	$1,725.00	$1,725.00
Subtotal				$345,013.00
WELL # 1 ESTIMATE	--			**$9,791,287.50**
Next, the Conventional Semisubmersible Drill Rig is mobilized in order to perform the P&A work and remove the template.				
Each Anchor Handling Vessel will Include the following costs in the Dayrate				
Anchor Handling Vessel / Tug	$23,000.00	/ Day	(Vessel, Lube, Crew, & Food)	
Fuel Cost	$3,000.00	/ Day	(Fuel)	
Anchor Handling Equipment	$2,500.00	/ Day	(Tool Box, Chaser Wire, Spooling Units, etc.)	
Anchor Handling Crew	$7,008.00	/ Day	(6 AHV Specialists + Half Coordinator Cost)	
	$35,508.00	Anchor Handling Vessel Spread Day Rate / Vessel		
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Anchor Handling Vessel #1				
Mobilization to Grand Isle	0.25	days	$35,508.00	$8,877.00
Retrieve Anchors at Grand Isle	2	days	$35,508.00	$71,016.00
Tow Rig to Template Location	3	days	$35,508.00	$106,524.00
Set Anchor Spread	1.75	days	$35,508.00	$62,139.00
Demobilization	1.25	days	$35,508.00	$44,385.00
Re-mobilization	1.25	days	$35,508.00	$44,385.00
Recover Anchor Spread	1.5	days	$35,508.00	$53,262.00
Tow Rig back to Grand Isle Area	3	days	$35,508.00	$106,524.00
Set Anchors at Grand Isle	1.5	days	$35,508.00	$53,262.00
Final Demobilization from GI	0.25	days	$35,508.00	$8,877.00

Subsea Wells and Template continued

Anchor Handling Vessel #2				
Mobilization to Grand Isle	0.25	days	$35,508.00	$8,877.00
Retrieve Anchors at Grand Isle	2	days	$35,508.00	$71,016.00
Tow Rig to Template Location	3	days	$35,508.00	$106,524.00
Set Anchor Spread	1.75	days	$35,508.00	$62,139.00
Demobilization	1.25	days	$35,508.00	$44,385.00
Re-mobilization	1.25	days	$35,508.00	$44,385.00
Recover Anchor Spread	1.5	days	$35,508.00	$53,262.00
Tow Rig back to Grand Isle Area	3	days	$35,508.00	$106,524.00
Set Anchors at Grand Isle	1.5	days	$35,508.00	$53,262.00
Final Demobilization from GI	0.25	days	$35,508.00	$8,877.00
AHV Crew Consummables	1	Lump Sum	$10,800.00	$10,800.00
AHV Crew Transportation	1	Lump Sum	$16,000.00	$16,000.00
AHV Crew Dock Charges	1	Lump Sum	$1,600.00	$1,600.00
Surveyor & Equip. Services	1	Set-Ups	$11,500.00	$11,500.00
Subtotal				$1,158,402.00

The Drill Rig will Include the following costs in the Dayrate:			
Rig	$400,000.00	/ Day	(Bare Rental of Rig)
Catering, Meals & Lodging	$280.00	/ Day	(to cover 7 additional men)
Fuel Cost	$3,250.00	/ Day	(Fuel)
	$403,530.00	Rig Spread Day Rate	

[Inclusive of 35-man Crew, 18-3/4" BOP, Mud Pumps, Communications, and Medic]

DESCRIPTION	DURATION	UNITS	RATE	ESTIMATED COST
Semi-Submersible Drill Rig				
Retrieve Anchors at Grand Isle	2	days	$403,530.00	$807,060.00
Tow Rig to Template Location	3	days	$403,530.00	$1,210,590.00
Set Anchor Spread	1.75	days	$403,530.00	$706,177.50
Well #1 Work	6	days	$403,530.00	$2,421,180.00
Remove Template	1.5	days	$403,530.00	$605,295.00
Recover Anchor Spread	1.5	days	$403,530.00	$605,295.00
Tow Rig back to Grand Isle Area	3	days	$403,530.00	$1,210,590.00
Set Anchors at Grand Isle	1.5	days	$403,530.00	$605,295.00
Subtotal				$8,171,482.50

DESCRIPTION	DURATION	UNITS	RATE	ESTIMATED COST
Miscellaneous				
E-Line / Slick Line Mob	1	Lump Sum	$1,500.00	$1,500.00
E-Line / Slick Line Unit	14	days	$1,500.00	$21,000.00
E-Line / Slick Line Demob	1	Lump Sum	$1,500.00	$1,500.00
CTU Tech. Travel & Freight	1	Lump Sum	$3,500.00	$1,750.00
Coiled Tubing Unit	14	days	$4,260.00	$59,640.00
Twin-Bore Completion Riser	14	days	$700.00	$9,800.00
Cementing Unit	14	days	$1,300.00	$18,200.00
Cement	200	sacks	$15.00	$3,000.00
Subtotal				$116,390.00
Explosive Services included in Misc. / Company Provided Services				

Subsea Wells and Template continued

DEEP SEA INTERVENTION VESSEL				
///////// ESTIMATE \\\\\\\\\				
P&A SUPPORT SERVICES				
Deep Sea Intervention Vessel (DSI) - option				
Some Crossover Fabrication may be required.				
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Tree Tools				
Lease Tree Running Tool	1	Lump Sum	$170,000.00	$170,000.00
Refurbish Tools	1	Lump Sum	$60,000.00	$60,000.00
Cross-Over Connections Fab.	1	Lump Sum	$25,000.00	$25,000.00
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Tree Controls				
Mobilization	1	Lump Sum	$8,000.00	$8,000.00
Well Work	144	hrs	$502.00	$72,288.00
Demobilization	1	Lump Sum	$8,000.00	$8,000.00
Dockside Standby	1	day	$1,725.00	$1,725.00
Subtotal				$345,013.00
WELL # 1 ESTIMATE	--			**$3,050,204.00**
The The Intervention Vessel will Include the following costs in the Dayrate:				
Deep Sea Intervention Vessel (DSI)	$175,008.00	/ Day	(Bare Rental)	
Catering, Meals & Lodging	$280.00	/ Day	(to cover 7 additional men)	
Fuel Cost	$3,250.00	/ Day	(Fuel)	
	$178,538.00	Rig Spread Day Rate		
[Inclusive of 35-man Crew, 18-3/4" BOP, Mud Pumps, Communications, and Medic]				
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
DSI				
Mobilize DSI	3	days	$178,538.00	$535,614.00
Set up	1	days	$178,538.00	$178,538.00
Well #1 Work	6	days	$178,538.00	$1,071,228.00
Remove Template	1.5	days	$178,538.00	$267,807.00
Demobilize	3	days	$178,538.00	$535,614.00
Subtotal				$2,588,801.00
DESCRIPTION	**DURATION**	**UNITS**	**RATE**	**ESTIMATED COST**
Miscellaneous				
E-Line / Slick Line Mob	1	Lump Sum	$1,500.00	$1,500.00
E-Line / Slick Line Unit	14	days	$1,500.00	$21,000.00
E-Line / Slick Line Demob	1	Lump Sum	$1,500.00	$1,500.00
CTU Tech. Travel & Freight	1	Lump Sum	$3,500.00	$1,750.00
Coiled Tubing Unit	14	days	$4,260.00	$59,640.00
Twin-Bore Completion Riser	14	days	$700.00	$9,800.00
Cementing Unit	14	days	$1,300.00	$18,200.00
Cement	200	sacks	$15.00	$3,000.00
Subtotal				$116,390.00
Explosive Services included in Misc. / Company Provided Services				

5.2 List of Figures/Tables

5.3 References/Acknowledgements

[1] Marine Board National Research Council, "An Assessment of Techniques for Removing Offshore Structures", Washington DC 1996

[2] Byrd, R.C. and E.R. Velazquez, "State of the art of removing large platforms located in deep water," *OTC 12972*, MMS Study TSB project #1435, Houston, TX, May 2001.

[3] Brian Saucier, "Subsea Abandonment in Deepwater a "Subsea Perspective"", The Cross Group report submitted Oct 2009

[4] MMS OCS Report 2008-013, "Deepwater GOM 2008: America's Offshore Energy Future", New Orleans May 2008

[5] Mike Freak, "Explosives technology for decommissioning applications", The Oil & Gas UK Southern North Sea Decommissioning Conference, May 2009

[6] Gary DeMarsh, "Explosive technology report", Demex September 2009

[7] Senior, Eric A.; Svein Solversen, "Cost-effective removal of subsea exploration wellheads: Wellhead Picker, DP MSV proven in field. (PRODUCTION OPERATIONS)." Offshore. 2008.

[8] Brian Toomey, "New Lifting Technology Report", Reverse Engineering October 2009

[9] Kurt Hurzeler, "Advances enable rigless intervention", The American Oil and Gas Reporter, June 2009

[10] Kliewer, Gene, "Subsea wireline intervention system in development. (SUBSEA/SURFACE/SYSTEMS)." Offshore. 2008.

[11] Subsea World, "Subsea Company Completes Major Projects Using New Scanning Technology", subseaworld.com Sept 2009

Additional materials such as company brochures, product fact sheets, presentations, etc., were provided by the following companies:

- Aker Solutions
- Allseas
- Cal Dive
- Conmaco
- Demex International
- E H Wachs

- Expro Group
- FMC
- Fugro
- Halliburton
- Heerema
- Helix
- Interact Activity Management
- Marin Subsea
- McDermott
- Norse Cutting & Abandonment
- Oceaneering
- Oilstates
- Rotork
- Saipem America
- Seametric International
- Seaway Heavy Lifting
- Superior Energy Services
- TSMarine
- Tetra
- Versabar
- Weatherford

5.4 MMS Contract Work Scope

The overall goal of the project will be to examine the relevant issues and to quantify them in the context of industry practice, available technology, current regulations, and cost. The following specific goals will be pursued:

1. Define the types of structures to be considered, considering fixed and floating structures.
2. Review the methodology and technology currently available and identify needs for new technology, if any.
3. Evaluate the current decommissioning infrastructure and identify future needs.
4. Assess the impact on deep water decommissioning of related programs such as the State run artificial reef programs.
5. Identify and describe the decommissioning options currently available for deep water facilities, areas of uncertainty (risk) and the likely cost of decommissioning typical fixed and floating structures.

TECHNICAL APPROACH

The proposed detailed scope of work for the project is described in Cost-Time-Resource (CTR) sheets 100 through 500 which are attached. These list the planned work objectives, scope, assigned personnel and their estimated work effort and the cost. The scope of work is summarized as follows:

CTR 100 - Project Mobilization & Initial Assessment

1. Review the relevant previous studies.
2. Determine the current inventory of deep water facilities in the GOM.

3. Select representative facilities for detailed evaluation. These will include typical versions of the various types of floating structures (Spars, TLPs, mono-hull vessels, etc.) and a range of fixed platforms.

CTR 200 - Methodology, Technology & Infrastructure Assessment

1. With reference to the representative deep water structures, conduct an initial assessment of decommissioning requirements, including the development of the major tasks and resource requirements.
2. Evaluate these requirements and the available tools, technology, and general resources available to carry out the decommissioning process. Examples of issues which will be considered are:
   - Explosive and non-explosive methods for severing conductors.
   - Explosive and non-explosive methods for severing piles.
   - Explosive and non-explosive methods for severing members in open water.
   - Diver operations in severing members in deep water.
   - ROV operations in severing members in deep water.
   - Conventional heavy lift vessels (derrick barges) in deep water lift.
   - Non-conventional lift methods, e.g., Versatruss, Offshore Shuttle, external buoyancy, etc., in deep water applications.
3. Determine the areas where improvements are needed and where the current technology and resources, including the available infrastructure, will be most challenged.

CTR 300 - Assessment of Disposal Options

1. In light of the results of CTRs 100 and 200 tasks, determine the general requirements for material disposal.
2. Determine the specific disposal requirements for each representative structure selected.
3. Determine options for reuse and removal of facilities and their impacts.
4. Determine how the State-run reefing programs impact material disposal.
5. Determine the water depth limits of effective reefing communities.

CTR 400 - Define Decommissioning Options & Cost

1. In light of the results of previous CTRs tasks, determine decommissioning plans for the representative structures, including the alternatives that are considered practical, in sufficient detail to develop cost estimates.
2. Determine the most important areas of uncertainty in the decommissioning processes for the deep water structures.
3. Develop cost estimates using probabilistic methods to capture the uncertainty.

CTR 500 - Documentation and Final Project Meeting
1. Document the work of CTRs 100 to 400 in a draft Final Report
2. Conduct a final report.
3. Address MMS comments and issue two (2) Final Reports; one (1) proprietary version and one (1) public version.

5.5 Glossary of Terms

Abandonment
A term generally used synonymously with decommissioning.

Anchor
A heavy hooked instrument which, when lowered to the seabed, holds a vessel in place by its connecting cable.

Anchor Buoy
A barrel shaped buoy through which the anchor pendant wire passes. The buoy holds the eye free end of the anchor pendant wire above the water surface. The pendant wire is used by the anchor handling tug to set and retrieve anchors.

Anchor Handling Tug (Resource)
A tug equipped with a winch to lift a derrick barge's anchors. It is also used as the derrick barge's tow tug.

Anchor Pile
A section (20 - 50 ft.) of large diameter (30 - 48 in.) pipe, with an anchor chain attached to it, driven below the seabed to a predetermined depth, usually 20 feet or more. Anchor piles are used to moor drilling rig tenders, other vessels or terminal mooring buoys. Anchor piles are normally installed in a pattern or system consisting of 6 to 8 anchor piles.

Annulus
The space between the inside face of an outer casing string and the outside face of the next smaller casing string.

Arc Gouging
The use of an electrical arc and compressed air to cut steel.

Artificial Reef
A disused structure emplaced in a designated area either in situ or other designated site. Intended as an enhanced marine habitat for animals and plants.

Assistant Derrick Barge Standby (Task)
The standby or idle period between the assist derrick barge's arrival at the platform location and the commencement of its work.

Barge Damage Deductible (Resource)
The deductible for a typical cargo barge hull insurance policy.

Bell Guides
See "Conductor Guides".

Blasting Cap
See "Detonator".

Blasting Machine
A mechanical or battery operated device used to electronically ignite a detonator.

Bottom Clean Up (Task)
The removal of debris by divers from the sea floor.

Bottom Time (B.T.)
The amount of time during a dive that is spent working on bottom.

Brent Spar
A cylindrical oil storage and loading buoy operated by Shell UK Exploration and Production on behalf of Shell and Esso.

Bring In Cargo Barge (Task)
The process of maneuvering and securing the cargo barge alongside the derrick barge.

Buoy
A float of any type used as a marker.

Caisson
A large diameter pipe driven into the seafloor through which well casings run. The purpose of

the caisson is to protect and support the well casings. The caisson may have a small deck.

Cargo Barge (Resource)
A flat deck barge used to transport platform components, equipment modules and other cargo.

Casing
Steel pipe placed in an oil or gas well as drilling progresses to prevent the wall of the hole from caving in during drilling and to provide a means of extracting petroleum if the well is productive.

Casing String
Pipe inside an oil or gas well conductor installed during the drilling operations often cemented to the conductor.

Closure Plates
Plates welded into the tops of piles or jacket legs to seal them so that water can be evacuated using compressed air.

Coil Tubing (CTU)
Rig-like unit with continuous length of pipe on a big coil. Used to service wells. Can perform many of the functions of a drilling rig, but is much smaller and less expensive.

Communication
The movement of a substance (hydrocarbons, water, cement) from one position to another.

Concrete Gravity Base Structure
A concrete substructure which is not fixed into the seabed by piles but resists wind and wave force by its own bulk and weight.

Conductor or Drive Pipe
A large diameter pipe driven into the seafloor to protect the surface casing and to protect against a shallow gas blowout.

Conductor Guides
Guides built into the jacket and deck, during fabrication, used to install the conductors in their correct location.

Consumable Items (Resource)
Items used in the course of a typical project, the cost of which is not covered by the contract or the schedule of rates.

Continental Shelf
The seabed and subsoil beyond the territorial water over which a country has sovereign rights for the purpose of exploring for and exploiting natural resources.

Crew Boat (Resource)
A small fast boat used to transport personnel and supplies to and from the job site to shore.

Critical Path
The sequence of events that determine the duration of a project.

Cut Deck Legs, Equipment and Miscellaneous (Task)
The cutting of all equipment, miscellaneous piping and the deck leg to pile splices to allow lifting the equipment from the deck and the deck from the jacket.

Cut Jacket
The cutting of all braces necessary to remove the jacket in two or more sections. If a jacket is so large that its weight will exceed the capacity of the derrick barge, or if it is not structurally sound, it may have to be cut and removed in pieces. If this is required, the members to be cut above the surface would be cut by welders in the conventional manner and those members below

water would be cut by divers using the Oxy-arc method.

Deballast Piles (Task)
The displacement of water inside the piles with compressed air to reduce the on-bottom weight of the jacket by causing it to be more buoyant.

Deck
The platform superstructure which supports drilling, wellhead, and/or production equipment.

Decommissioning
The process of deciding how best to shut down operations at the end of a field's life, then closing the wells, cleaning, making the installation safe, removing some or all of the facilities and disposing or reusing them.

Decommission Pipeline (Task)
The process of flushing a pipeline with water to purge it of hydrocarbons. After the pipeline is flushed, a pig is run using water and the pipeline is left filled with water.

Decommission Platform (Task)
A two phase operation, performed prior to the arrival of the derrick barge spread, to prepare the platform for salvage. The first phase is to make the environment safe for burning and welding. The second phase is to do any work which does not require, or will facilitate, the derrick barge operation.

Deep Water Disposal
Offshore disposal of a structure by emplacement at licensed, designated deep water sites.

Demobilize Assist Derrick Barge (Task)
The movement of the assist derrick barge from the platform location to its point of origin.

Demobilize Cargo Barges (Task)
The movement of a cargo barge and its tow tug from the platform location to the disposal contractor's yard.

Demobilize Derrick Barge (Task)
The movement of the derrick barge from the platform location to its point of origin.

Depth Pay
Premium paid to divers that dive below 50 feet, increasing at each 50 foot interval. Depth pay is paid once in 24 hours for the divers' deepest dive.

Derrick Barge (Resource)
A barge (floating construction plant/camp) equipped with a revolving crane, a mooring system and crew quarters.

Detonation
The setting off of an explosive charge.

Detonator
A device or small quantity of explosives used for detonating high explosives.

Disposal Contractor
Contractor that will dispose of the platform components (scrap dealer).

Diving Services (Resource)
Services of a diving contractor used during a salvage or construction project. Dive boats are either four point anchor moored (4PDB) or dynamically positioned (DPDB).

Dolphins
A cluster of piling at the entrance to, or alongside, a dock or wharf for service as a fender, alongside of which boats may be moored.

Drive Pipe or Conductor

A large diameter pipe driven into the seafloor to protect the surface casing and to protect against a shallow gas blowout.

Dumping
A term sometimes used for offshore disposal.

E&P Forum
The Oil Industry International Exploration and Production Forum, a global association of the oil and natural gas exploration and production industry.

Electric Line Unit
A piece of equipment that allows work to be performed in an oil or gas well.

Emplacement
Regulated lowering of a platform in a designated disposal area, principally a designated artificial reef area.

Explosive Charges (Resource)
High explosives and their sized containers used to sever conductors and piles.

Explosive Magazine
A portable container used to transport explosive charges and equipment from the explosive contractors facility to the job site.

Fabricate Deck Padeyes (Task)
Replacement deck lifting padeyes are fabricated for decks cut into sections and for decks whose padeyes are no longer safe for the lift. These padeyes are fabricated at the decommissioning contractor’s facility. The contractor would install these padeyes during its decommissioning.

Fabricate Explosive Charges (Task
The assembly of high explosives in properly sized containers. The explosive charges container is sized to fit the internal diameter of either the pile or conductor pipe. The quantity of explosive material is determined based on the size and type of material to be severed (steel, cement, etc.). This work is performed at the explosive contractor's facility then packages for shipment.

Flame Cutting
The cutting of steel using a controlled flame and oxygen

Flame Washing
The use of a controlled flame and oxygen to remove metal.

Flared Conductor
See "Flared Pile".

Flared Pile
The outward spreading (mushrooming) of the metal above the area where the pile is explosive severed.

Gang Way
A portable access walkway used to span the gap between the platform and the derrick barge.

Gas Free
Free of explosive or poisonous gas. A safe working area.

Grout
Cement slurry used between concentric structural members. Grout was used to secure one member to another.

Grouted Pile
The annular region between the pile outside wall and the inside wall of a jacket leg or sleeve is filled with grout. The grout may be several feet deep or fill the length of the jacket leg.

Grout Plug
A plug of cement/water mix placed in a pile extending above and below the mudline to strengthen the platform, sometimes with reinforcing bar cages.

Hand Jet

High pressure water nozzle used by divers to move soil on the seabed.

Helideck
A pad to land helicopters on an offshore vessel or platform.

In-Water Decompression (IWD)
The time a diver must spend in the water decompressing at specific depths enroute to the surface.

In-situ
In the original position, on site.

Jacket
The portion of a platform extending from the seabed to the surface used as a template for pile driving and as a lateral bracing for the pile.

Jet/Airlift
A device used to remove the pile mud plug. High pressure water breaks up the mud plug and expanding air lifts the particles to the surface.

Jet/Airlift Mud Plugs (Task)
The removal of the soil from inside the piles using a jet/airlift system.

Injection Rate
The rate fluids can be injected into the production formation and the pressure required to inject the fluids; example 10 barrels per minute at a pressure of 4200 pounds per square inch.

Inspector (Resource)
A representative of the oil company required to be present during all phases of the platform removal when work is being performed. His function is to observe the work and maintain a daily log of activities, to verify that the work is performed in accordance with the specifications and to verify extra contractual work.

Installation
A generic term for an offshore platform or drilling rig (but excluding pipelines).

Install Closure Plates (Task)
Placing and welding prefabricated steel plates in the tops of piles or jacket legs so that the water inside can be evacuated by compressed air.

International Maritime Organization
The United Nations body charged with shipping safety and navigation issues.

Lifting Block
A block, containing one or more sheaves, connected to the crane boom by wire rope that is used to lift and lower loads.

Lifting Capacity
The weight a crane can lift at a given boom radius or angle.

Lifting Eyes
See "Padeyes".

Load Spreader
A pad of wood, steel, etc. Normally placed on a cargo barge to distribute a concentrated load over a larger area.

London Convention
An international treaty signed by more than 70 nations governing disposal of substances at sea.

Magnetometer
An electrical device towed by a boat over a location to locate metal objects, i.e. pipelines, wellheads, wrecks, and similar ferrous objects.

Marine Growth
Sea life (e.g. barnacles) attached to hard objects submerged in the sea.

Members
The structural pieces or components that make up a jacket or deck structure.

Mobilize Assist Derrick Barge (Task)
The movement of the assist derrick and its tow/anchor handling tug boat from its point of origin to the platform location.

Mobilize Cargo Barge (Task)
The movement of a cargo barge and its tug boat from their point or origin to the platform location.

Mobilize Derrick Barge (Task)
The movement of a derrick barge and its tow/anchor handling tug boat from its point or origin to the platform location.

Mosaic
Number of pictures making up a big picture.

Mud Plug
The soil (mud, clay, sand) inside an open ended pile that has been driven into the seabed.

Mudline (M.L.)
The elevation of the natural seabed.

North East Atlantic
The sea area to which OSPAR Conventions apply, This is defined as westwards to the east coast of Greenland, eastwards to the continental North Sea coast, south to the Straits of Gibraltar, and north to the North Pole. This maritime area does not include the Baltic or Mediterranean seas.

North Sea
The sea bounded primarily by the coasts of Great Britain, Norway, Denmark, Belgium, Germany, Sweden, France and the Netherlands.

OD
Outside diameter.

Off-Load Cargo Barge (Task)
The removal of all sea fastening and the platform components from the cargo barge at the disposal contractor's yard.

Offshore
Operations carried out in the ocean as opposed to on land.

Operator
The company both solely or in a joint venture which manages the operation of oil and gas production for itself or on behalf of the partners.

Oslo Commission
See "Osparcom".

Osparcom
The Oslo and Paris Commission which regulates pollution from offshore and onshore sources in the North East Atlantic.

Oxy Acetylene Torch
A device using oxygen and acetylene to cut steel.

Oxy-Arc Torch
A device using oxygen and an electrical arc to cut metal, usually underwater.

Padeyes
A plate with a hole cut in it that is attached to a structure which allows a shackle connection for lifting the structure.

Paris Commission
See "Osparcom".

Pendant Wire
The cable connected to the head of an anchor used by the anchor handling tug to raise or lower the anchor. The free end is held at the water surface by a buoy.

Pick Up Assist Derrick Barge Anchors (Task)
The retrieval of the assist derrick barge's anchors at the end of its portion of the project.

Pick Up Derrick Barge Anchors (Task)
The retrieval of the derrick barge anchors at the end of the project.

Pig
A plug, forced through a pipeline by liquid or gas, used to clean the pipe's interior or separate different fluid mediums.

Pile
Steel pipe driven into the seabed to secure and support an offshore structure.

Pile Driving Hammer
A steam, diesel or hydraulically operated impact hammer used to drive piles into the seabed.

Pipeline
A conduit of steel pipe extending from platform to platform or platform to shore used to transport oil and/or gas.

Pipeline Abandonment (Task)
The cutting and plugging of a pipeline that is to be abandoned in place. Prior to the jacket removal and after the pipeline decommissioning is completed; the pipeline is cut and abandoned in place using a diving crew. The diving is performed from the derrick barge or a dive boat prior to the derrick barge arriving on location.

Pipeline Surveying Services (Resource)
The services of a surveying contractor and his equipment or mark pipelines and other submerged objects to avoid interference with derrick barge anchor placement.

Platform
A structure secured to the seabed and extending above water for the production of oil and gas.

Processing Facilities
Part of the topsides that treat oil and gas, remove impurities and pump the product into pipelines to shore.

Production Casing
A pipe set in the well after it is drilled. The tubing is inside the production casing.

Production Formation
The sub strata in which hydrocarbons are present. Where the oil and gas enters the tubing to be transported to the surface.

Recycling
Removal of an installation or parts of an installation to shore where they are separated into different materials and melted down or reprocessed to be reused.

Remove Conductors (Task)
The removal of the conductors from the jacket and placing them on a cargo barge. The conductor guides in the jacket cannot support the weight of the conductors; therefore they must be removed prior to the removal of the jacket.

Remove Deck (Task)
The lifting of the deck from the jacket and placement of it on a cargo barge.

Remove Equipment (Task)
The lifting, placing and sea fastening on a cargo barge, of all equipment removed from the deck.

Remove Jacket (Task)
The lifting of the jacket from the seafloor and placement of it on a cargo barge for transport to shore.

Remove Piles from Jacket Legs (Task)
The removal of the piles from the jacket to reduce the jacket's lift weight.

Rig
The derrick or mast, drawworks, and attendant surface equipment of a drilling or work over unit.

Rigless Abandonment
P&A without a rig.

Rig Up Cargo Barge (Resource)
The installation of protective pads to prepare a cargo barge for receiving the salvaged platform components.

Rigs to Reefs
A national policy in the US enshrined in legislation, promoting the conversion of disused platforms into artificial reefs for marine lift at designated sites.

Riser
The portion of a pipeline that rises from the seabed to the water surface, supported by the platform jacket.

Riser Bend
The section of the riser that turns the pipeline from horizontal to vertical.

Salvage Contingency
An allowance of 15% of the estimated on site derrick barge spread work time to account for unforeseen factors which will increase the time required to perform the work. Examples of items to be covered by this contingency are as follows:

1. Conductor flaring
   In the process of explosively severing the conductors, flaring of the cut ends occurs. This flaring will not allow the conductor to pass through the conductor bell guide framing in the jacket resulting in divers having to cut the flared end. This will require one hour of bottom time per conductor plus in water decompression time as determined by the dive tables for the applicable water depth.
2. Pile flaring
   As in the case of conductor flaring described above, flaring of the pile ends also occurs. Additional time is required to trim the pile ends, eliminating the flared obstruction.

Sea Buoy
The first buoy encountered when approaching the entrance of a river or port from sea.

Sea fasten
The securing by welding of platform components or cargo to the cargo barge for transport at sea.

Set Up Derrick Barge (Task)
The placement of the derrick barge's mooring anchors on the seafloor around the platform location at pre-selected positions. The derrick barge will be positioned alongside the platform using its mooring system. A walkway will be placed between the derrick barge and the platform.

Sever Conductors (Task)
Cutting the conductors using high explosives.

Sever Piles (Task)
Cutting the piles using high explosives.

Shackle
A "U" shaped device with a removable pin or bolt across the end used to connect a sling or cable to a pad eye.

Shaped Charge
An explosive charge designed to focus its blast onto a very small area, used to cut very thick materials.

Shim

Curved steel plates wedged between and welded to the jacket leg and pile, used to tie the jacket and piles together at the top of the jacket leg.

Shoe
A piece of equipment installed on the end of the casing when it is run into the well bore (i.e. that point in which the casing ends).

Side-scan Sonar
Radar like device used to determine shapes in the water on the sea floor.

Skirt Pile
A steel pipe driven into the seafloor that passes through a sleeve attached to the jacket. The sleeve and skirt pile extend from the mudline up 50 to 100 feet along the jacket leg. The annular region between the pile and sleeve is filled with grout. The purpose of a skirt pile is to secure and support offshore structures.

Slick line
A machine with a hydraulically controlled spool of wire used for setting and retrieving safety valves, lugs, gas lift valves, and running bottom hole pressures. Slicklines are also used for a variety of other jobs such as recovering lost tools and swedging out tubing. Slick line wire generally ranges in size from .072 inches to .108 inches.

Sling
Usually a wire rope of a given length with a loop formed on each end, used for lifting loads.

Spreader Bar
A pipe or beam arrangement used to spread the slings to keep them from damaging the load while lifting.

Spreader Frame
See "Spreader Bar".

Spud Barge
A derrick barge moored by dropping pipe or beam spuds into the seabed.

Stakeholders
All the parties having an interest in an issue, including among others corporate shareholders, regulators, employees, community groups, the public at large.

Stiff leg Barge
A derrick barge with a crane that does not revolve and which may or may not boom up and down.

Stops
Metal plates welded to the sides of a pile to hold the pile at a desired elevation in the jacket leg.

Subsea Tie In (SSTI)
Point where a branch pipeline ties into a main pipeline on the seabed.

Survey Location for Pipelines (Task)
The locating and buoying of pipelines around a platform. A survey boat and crew are mobilized to the location to locate and mark, with buoys, all pipelines within a 4000 foot radius of the platform to enable the derrick barge(s) to place its anchors safely.

Tension Leg Platform (TLP)
A floating platform anchored to the sea bed by long steel pipes (tension legs). The tension legs keep the platform from moving up and down on the waves.

Tonne
1000 Kilograms - a common weight unit used in offshore structure design and construction; also used as a measure for oil (approx. 1200 liters).

Toppling

Controlled "tipping over" of the platform (generally but not always without topsides) from its vertical position to resting horizontally on the seabed.

Topsides
The facilities which contain the plant for processing oil and gas and accommodations.

Tow Tug (Resource)
A tug boat used to tow a barge, either a cargo barge or derrick barge. It may also be used as an anchor handling tug by the derrick barge.

Tubing String
The smallest diameter pipe suspended in a well. The hydrocarbon product flows to the surface inside the tubing.

Trunk Line, Explosives
A detonation cord that connects all the explosive charges so they may be detonated in a group.

Walk Way
See "Gang Way".

Weather Contingency (Task)
An allowance of 6% of the estimated onsite derrick barge spread work time to account for lost time due to weather.

Well
The holes drilled through the seabed into the reservoir where oil or gas is trapped, often two thousand or more meters below the seabed. The hole is lined with piping which extends up through conductors onto the platform deck.

Well Head
The well head sits on top of the drive pipe. Casing and tubing strings are suspended from the well head. Valves on the well head allow the entrance to the tubing and the casing annuli.

Wire Rope
Steel wire formed into a cable.

Wood Piles
Wooden (timber) piles driven into the seabed to support equipment offshore.

5.6 Explosive Permit Stipulations

Explosive-Severance Scenarios for Platform, Well, and Pipeline Decommissionings

Blasting Category	Configuration (Charge wt/ placement)	Species Delineation Zone	Mitigation Scenario	Impact Zone Radius	Pre-Det Surface Survey (min)	Pre-Det Aerial Survey (min)	Pre-Det Acoustic Survey (min)	Post-Det Surface Survey (min)	Post-Det Aerial Survey (min)	Post-Post-Det Aerial Survey (Yes/No)
Very-Small	BML *(0-10 lb)*	Shelf (<200 m)	A1	261 m (856 ft)	60	N/A	N/A	30	N/A	No
		Slope (>200 m)	A2		90	N/A	N/A	30	N/A	No
	AML *(0-5 lb)*	Shelf (<200 m)	A3	293 m (961 ft)	60	N/A	N/A	30	N/A	No
		Slope (>200 m)	A4		90	N/A	N/A	30	N/A	No
Small	BML *(>10-20 lb)*	Shelf (<200 m)	B1	373 m (1,224 ft)	90	30	N/A	N/A	30	No
		Slope (>200 m)	B2		90	30	N/A	N/A	30	No
	AML *(>5-20 lb)*	Shelf (<200 m)	B3	522 m (1,714 ft)	90	30	N/A	N/A	30	No
		Slope (>200 m)	B4		90	30	N/A	N/A	30	No
Standard	BML *(>20-80 lb)*	Shelf (<200 m)	C1	631 m (2,069 ft)	90	30	N/A	N/A	30	No
		Slope (>200 m)	C2		90	30	120	N/A	30	No
	AML *(>20-80 lb)*	Shelf (<200 m)	C3	829 m (2,721 ft)	90	45	N/A	N/A	30	No
		Slope (>200 m)	C4		90	60	150	N/A	30	Yes
Large	BML *(>80-200 lb)*	Shelf (<200 m)	D1	941 m (3,086 ft)	120	45	N/A	N/A	30	No
		Slope (>200 m)	D2		120	60	180	N/A	30	Yes
	AML *(>80-200 lb)*	Shelf (<200 m)	D3	1,126m (3,693ft)	120	60	N/A	N/A	30	No
		Slope (>200 m)	D4		150	60	210	N/A	30	Yes
Specialty	BML *(>200-500 lb)*	Shelf (<200 m)	E1	1,500 m (4,916 ft)	150	90	N/A	N/A	45	No
		Slope (>200 m)	E2		180	90	270	N/A	45	Yes
	AML *(>200-500 lb)*	Shelf (<200 m)	E3	1,528 m (5,012 ft)	150	90	N/A	N/A	45	No
		Slope (>200 m)	E4		180	90	270	N/A	45	Yes

5.7 Fixed Platform General Methodology & Assumptions

This section provides an illustrated description of the general methodology involved in the decommissioning of fixed offshore platforms. Some of the removal methods in this section are noted for general information only and were not included in this study.

Based on Proserv's knowledge and experience in the construction and decommissioning of offshore structures, the tasks, time, and resources required to decommission the facilities in question were identified.

Decommissioning efforts are based on the assumption that a knowledgeable contractor will use the most efficient technology and equipment available at this time. The decommissioning costs for each task is determined from actual cost data obtained from Proserv's files and rental rate schedules issued by various contractors providing this service.

The decommissioning estimates are based on platform information provided by the client and/or researched from Proserv's files and the MMS facilities database. Where information was not available, Proserv made an assumption based on previous experience and other estimates developed. Estimates were developed using Proserv's proprietary Decommissioning software. See Section 4, for a description of the cost estimates and Section 5.1 for the representative platform estimates.

All pipelines in federal waters were estimated as abandoned in-place (flushed, cut, tube-turns removed and the ends plugged and buried) and pipelines in state water, if any, were estimated as complete removal (flush, cut, remove). The well P&A estimates were assumed to be carried out using a rigless method and generic trouble free wells in accordance with MMS requirements. The cost to cut and remove the conductors is included in the platform removal section of each estimate. All conductors were cut and removed prior to derrick barge arrival or during the derrick barge operations as specified on each estimate.

METHODOLOGY

Platform Well P&A. Once all production ceases from the platform, the wells will be plugged and abandoned. The crew mobilizes and sets up on the platform. Once the equipment is onboard and rigged up, diagnostics (establish injection rates & wireline surveys) are made to determine each well status. Having finished the diagnostics work, the well is ready for P&A. Squeeze all perforations with cement. Set intermediate plugs. Cut and remove the tubing +/- 300-ft below the mudline. If the production / surface casing annulus are not grouted, then a cement plug is set to isolate the casing. A CIBP is set above the point the tubing is cut. A 200-ft balance plug is set above the CIBP and tested. Once tested, all strings are cut at 15' below the mudline.

The well P&A estimates assume operations proceed without significant problems or complications. Should wellbore conditions change over the well life or should complications arise during the well P&A operation, actual costs could increase significantly over the estimates contained herein.

General platform components. The basic components of an offshore platform (from the top) are the helideck, equipment, deck, jacket, pipelines, and piles (Figure 1). Note, all figures in this section are for general discussion purposes only and are not representative of all the fixed structures estimated in this study.

Platform decommissioning. All work that can be performed prior to the arrival of the derrick barge is done during the decommissioning phase. All personnel and equipment are mobilized to the platform on a work boat. The decommissioning crew will be housed in the existing quarters or temporary quarters.

In this phase, the crew flushes all piping and equipment which contained hydrocarbons. All equipment that will be removed separately from the deck is cut loose using oxygen-acetylene torches. The piping, electrical, and tubing interconnections between equipment are also cut. All work needed to prepare the components for lifting (such as installing lifting eyes etc.) is completed at this phase.

Any pipelines connected to the platform are decommissioned at this time. The decommissioning crew flushes the line by pumping (pushing) a cleaning plug (called a "pig") through the line with seawater (Figure 2). Divers will then expose the pipeline and cut the line approximately ten feet out from the base of the jacket. The severed end of the pipeline is then plugged and buried three feet below the mudline (Figure 3). The other end of the pipeline is also exposed, cut, plugged and buried.

Conductor Removal. All conductors are completely removed a minimum of 15 feet below the mudline. Conductors may be severed below the mudline during the decommissioning phase or during the platform removal operations. During the platform removal operations the conductors are severed explosively during the derrick barge operation (Figure 4) or the conductors can be severed during the decommissioning using an abrasive cutting spread (Figure 5). Once the conductor has been severed below the mudline it pulled upward with a crane until a 40-foot section is exposed. The conductor is cut using external mechanical cutters. The cut section is then removed and placed on a workboat (or away from the work area). This procedure (pulled upward, cut and remove) is repeated until the entire conductor is removed.

Mobilizing. Cargo barges are outfitted at a fabrication yard with steel pads (load spreaders) to support the point loads of the jacket and deck. More than one cargo barge may be outfitted depending on the size of the deck and jacket. A tug boat then tows each cargo barge to the offshore location. Another tug boat moves the derrick barge (with its crew and equipment) to the offshore location (Figure 6).

Setting up derrick barge. When the derrick barge arrives on site, the derrick barge's anchor handling tug boat sets up the anchoring system. This anchoring system holds the derrick barge in position during the platform removal process. The derrick barge's anchoring system consists of eight anchors, each connected to a mooring winch by a cable. Each anchor is equipped with a pendant wire that is long enough to reach from the seabed to the surface where it is supported by a buoy (Figure 7). The anchor handling tug picks up the anchors by securing the pendant wire and winching up the anchor. The anchor handling tug then carries the anchor to the desired location. This process is repeated for each of the derrick barge's anchors.

Removing deck and equipment. Each piece of equipment that is on the top deck of the platform is removed and placed on a cargo barge. The equipment is secured by welding pieces of steel pipe (or plate) from the equipment to the deck of the cargo barge (Figure 8).

The deck is then removed by cutting the welded connections between the piles and the deck legs with oxygen-acetylene torches. Depending on the size of the deck, it may be cut into sections for removal. Slings are attached to the deck lifting eyes and to the derrick barge crane. The derrick barge's crane lifts the deck (or deck sections) from the piles. The platform deck is then seated in the load spreaders and secured by welding steel pipe from the platform's deck legs to the deck of the cargo barge (Figure 9).

Removing the deck and equipment (disposals of deck and equipment onshore). The cargo barge transporting the deck and equipment moves to the onshore fabrication yard. The equipment is lifted with cranes from the barge to the yard. The conductors are lifted with cranes from the barge to the yard. Finally, the deck is skidded off the barge into the yard. All of the structural components and equipment are cut into small pieces and disposed of as scrap.

Severing piles. A jetting process is necessary to clear the mud plug to allow the explosive charges to be placed fifteen feet below the mudline. The mud plug was formed when the piles were driven in the sea floor. The mud plug must be jetted from each pile.

After the mud plug is jetted from each pile, explosive charges are placed and detonated in each of the piles (Figure 10). Explosives were used for pile diameters 60" and smaller. Abrasive pile severing was use for pile diameters >60". The piles may be removed from the jacket legs if they are not grouted to reduce the lift weight. This is dependent on the derrick barge lifting capacity.

In-situ. The jacket can be completely removed in place (in-situ). If the derrick barge selected is capable of lifting the jacket in a single lift, the jacket is then removed from its position on the seabed and placed on a cargo barge as described below.

If the jacket weight is greater than the derrick barge lifting capacity, the jacket must be removed in several or more sections. The jacket can be cut up vertically and or horizontally underwater by divers or remotely operated vehicles (ROV) into sections that are each then removed by the derrick barge. This option presents higher risks to divers than the jacket hopping method presented below. To minimize diving exposure this method is not used in this study.

Jack Hopping. If the jacket weight is greater than the derrick barge lifting capacity, the jacket must be removed in several or more sections. The jacket can be deballasted, lifted off the seabed as high as the derrick barge can lift considering the lifting configuration, secured to the derrick barge, towed to shallower water and set on the seabed (Hopping), where the top section is cut horizontally above the waterline and removed to a cargo barge. If the remaining jacket weight is greater than the derrick barge lifting capacity and the jacket must be cut horizontally at lower jacket elevations, the hopping method is repeated until the bottom section can be removed. Where the bottom section weight is greater than the derrick barge lifting capacity, the bottom section is cut up by divers and removed by the derrick barge to cargo barges.

Conceptual Removal Methods. Several conceptual removal methods have been visited in this study. Removal with external floatation devices has been used successfully in the North Sea to vertically float a jacket from its installation site to a disposal site. OE August 2009. This study visits using external floatation devices in the GOM to float a jacket horizontally to either a reef site or to an onshore scraping facility. SeaMetric International AS's states "SeaMetric International AS has developed the Twin Marine Lifter (TML) system for installation and removal of very heavy objects like platform topside and jackets with weights up to 20.000 tonnes. Section 4 of this study presents conceptual cost for use of these two systems.

Setting the jacket on cargo barge (disposal of jacket onshore). After severing the main piles, the jacket is lifted, set and secured onto cargo barges (Figure 11). The cargo barge transporting the jacket travels to a fabrication yard. Skid rails and winches are rigged up, and the jacket is skidded off the barge into the yard. The jacket is cut into small pieces and disposed of as scrap.

Towing and toppling the jacket at a remote reef site (disposal of jacket at remote reef site). This removal method is for information only and was not include in the scope of this study. If the jacket is to be disposed of at a remote reef location, the derrick barge rigs, lifts and secures the jacket (Figure 12). The jacket is then towed on the hook to the reef site. At the site, the derrick barge sets the jacket on the seafloor vertically. The derrick barge then topples the jacket creating an artificial reef site. A reef donation is included in the decommissioning estimate.

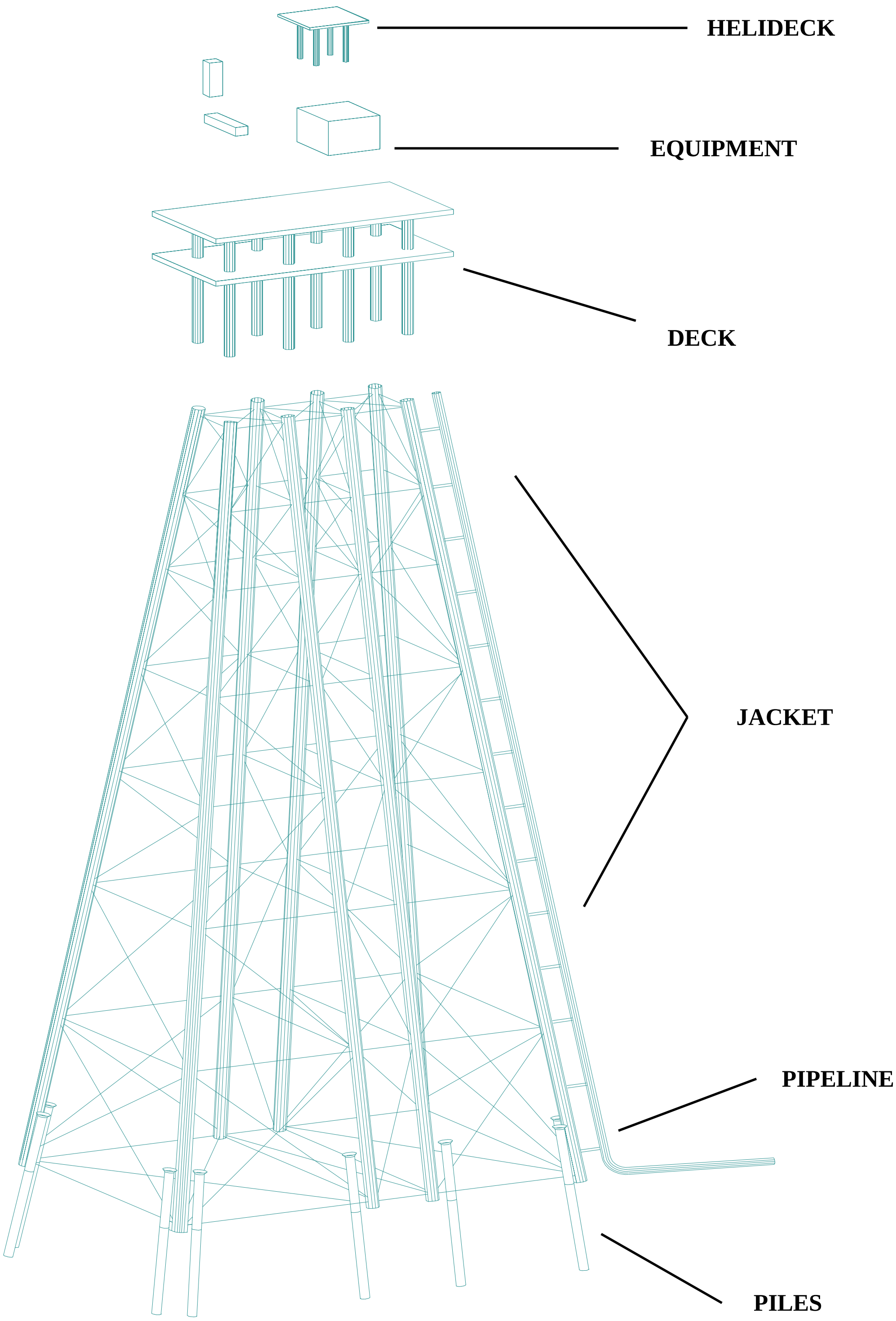
Toppling jacket in place (in-situ). This removal method is for information only and was not include in the scope of this study. If the jacket is to be toppled in place (in-situ), the derrick barge or a specially equipped pull barge topples the jacket to create an artificial reef (Figure 13). The piles and conductors remain in the jacket as part of the reef. A reef donation is added to the decommissioning estimate.

Partial removal in place (in-situ). This removal method is for information only and was not include in the scope of this study. This method considers cutting the jacket at (-) 85 below the waterline, a depth commonly accessed by commercial divers (Figure 14). Since explosives are not used, the local marine life is not affected; in fact, a major portion of the habitat is maintained. A reef donation is added to the decommissioning estimate.

Clearing the site. After the platform is removed, the area is cleared of debris by using specially equipped trawlers with nets, commonly called "Gorilla Nets". The trawlers remove all debris from around the platform site and send the debris to shore for disposal.

The graphical representations below are for general reference only and may not be indicative of all the facilities included in this study.

FIGURE 1 - GENERAL PLATFORM COMPONENTS



PLATFORM DECOMMISSIONING

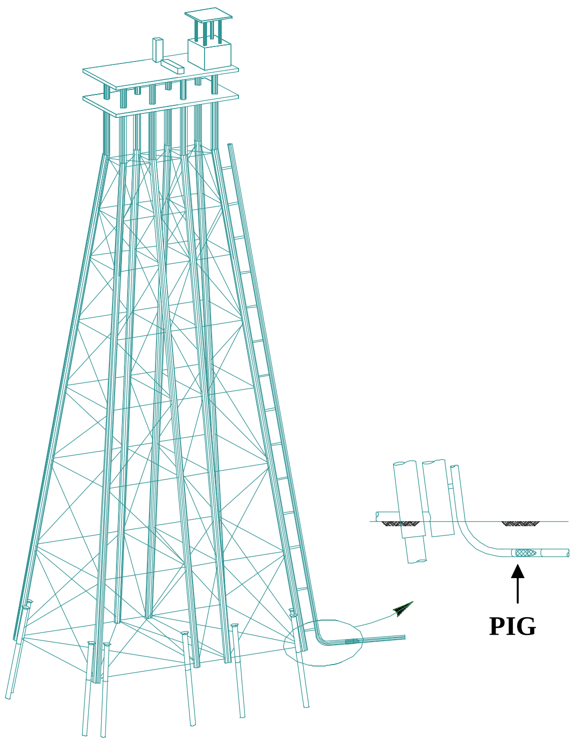


FIGURE 2

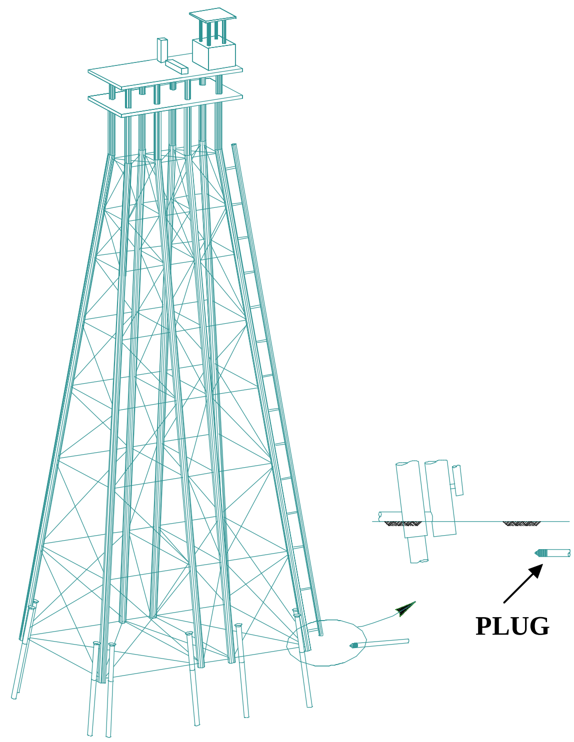
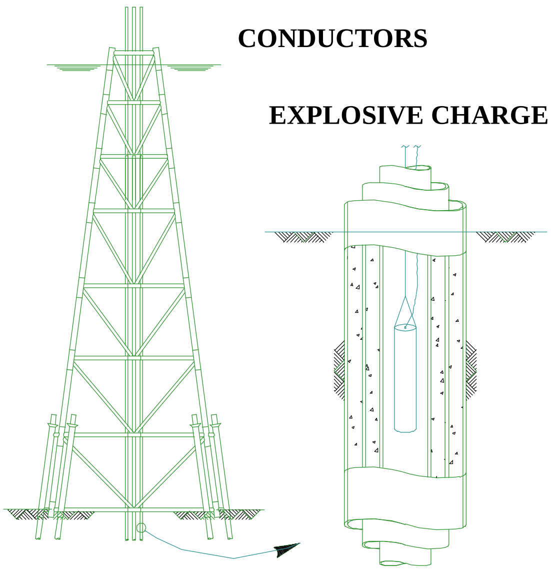


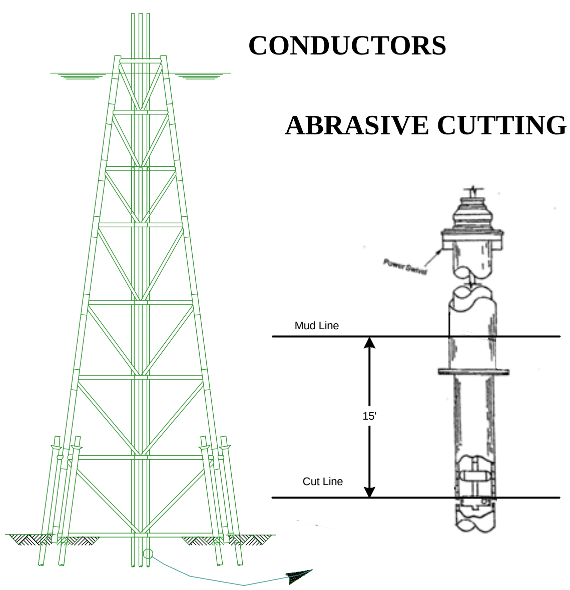
FIGURE 3

FIGURE 4 – Conductor Cutting Explosively



Explosive Charges set inside the Conductors to Sever (-)15' Below the Mudline

FIGURE 5 – Conductor Cutting - Abrasively.



Abrasive Cutters Placed inside the Conductors to Sever (-)15' Below the Mudline

MOBILIZING

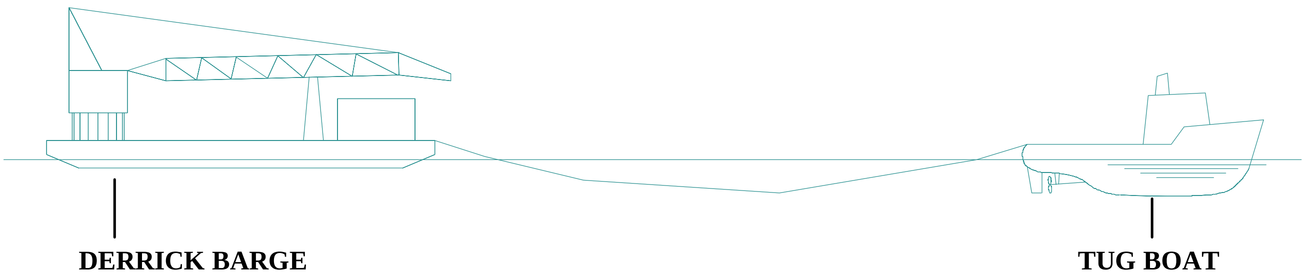


FIGURE 6

SETTING UP DERRICK BARGE

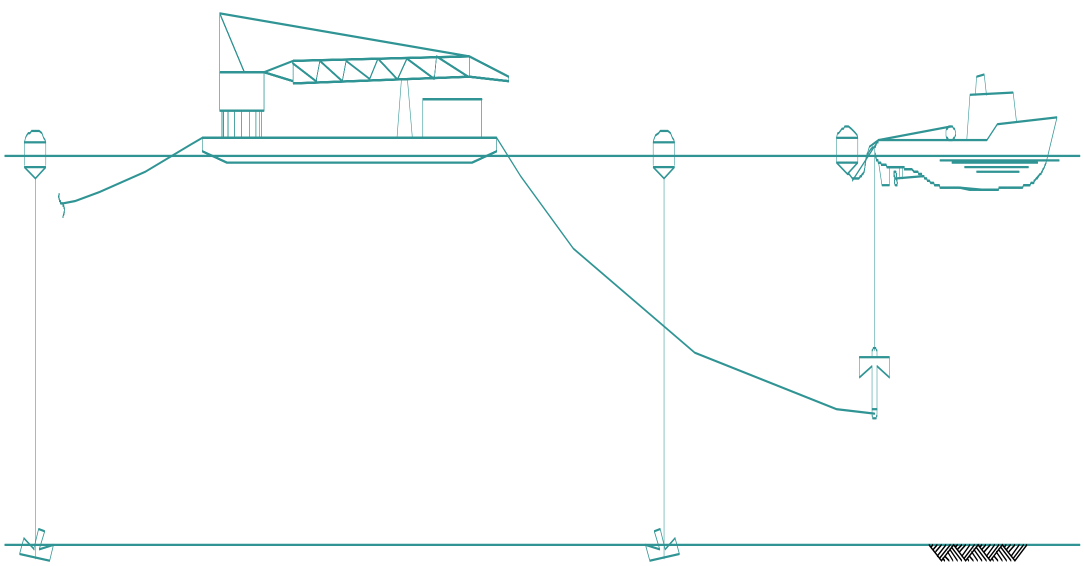


FIGURE 7

REMOVING DECK AND EQUIPMENT

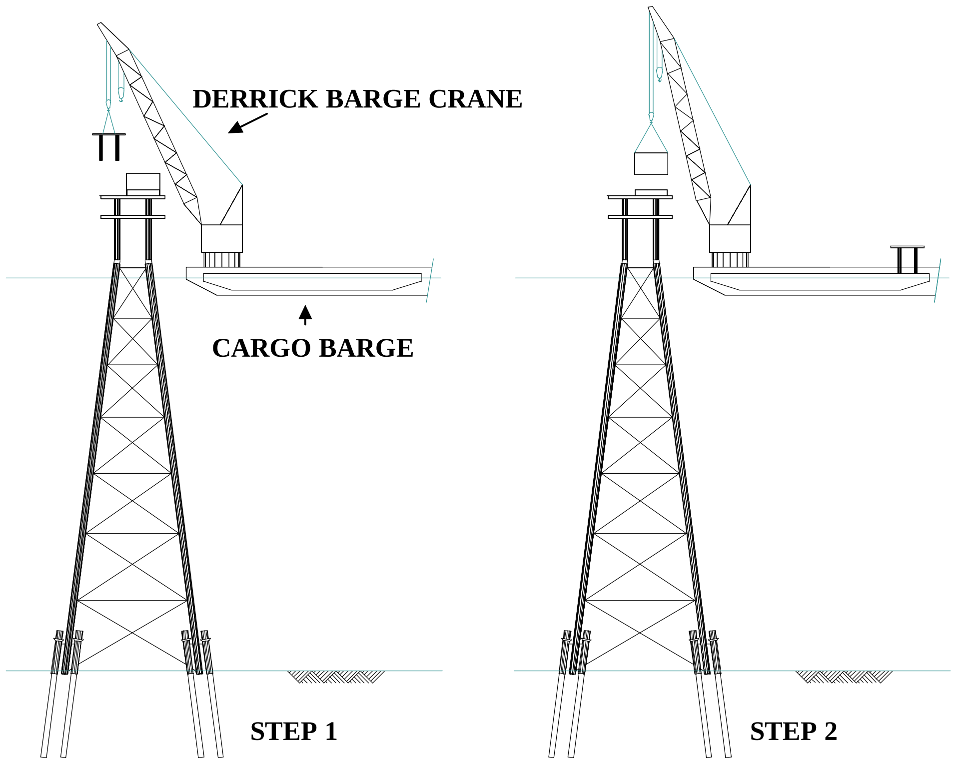


FIGURE 8

REMOVING DECK AND EQUIPMENT (Continued)

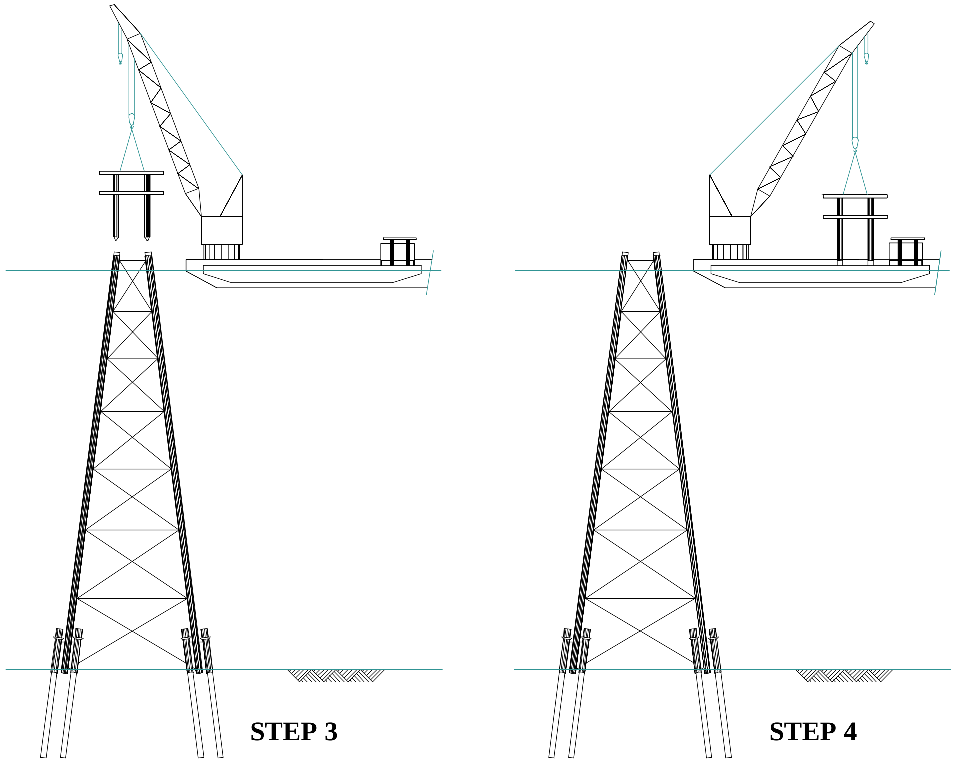


FIGURE 9

FIGURE 10 - SEVERING THE PILES

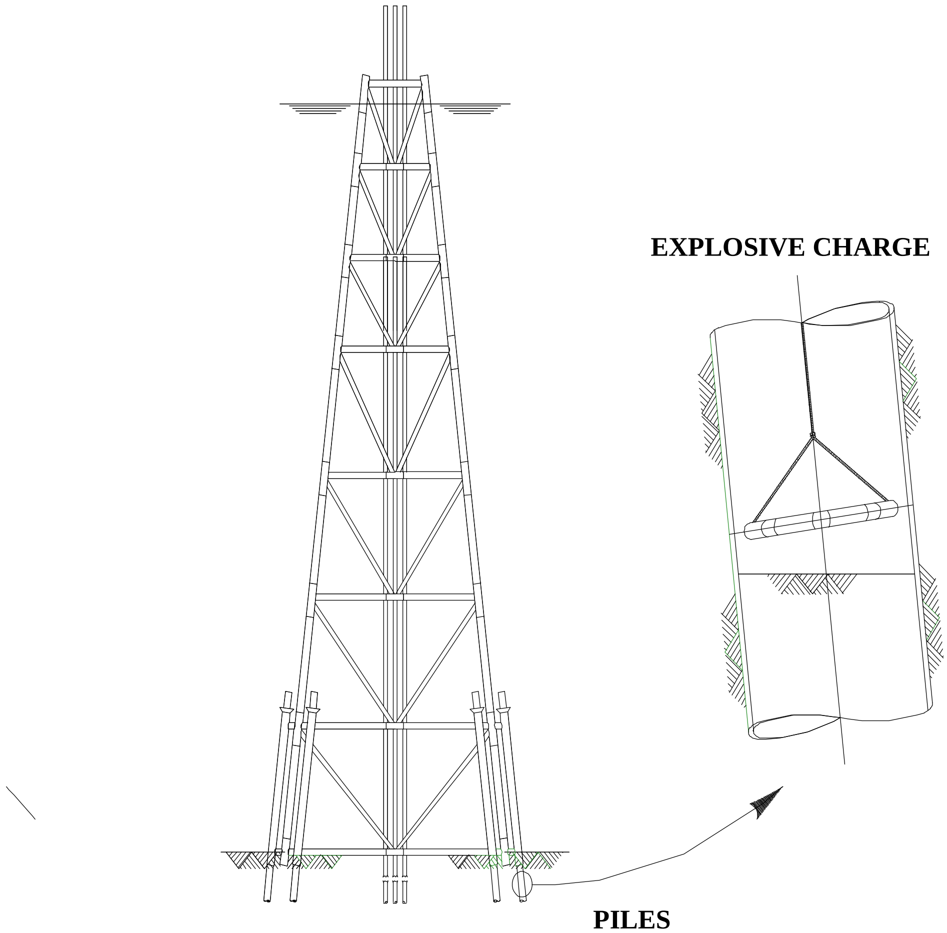
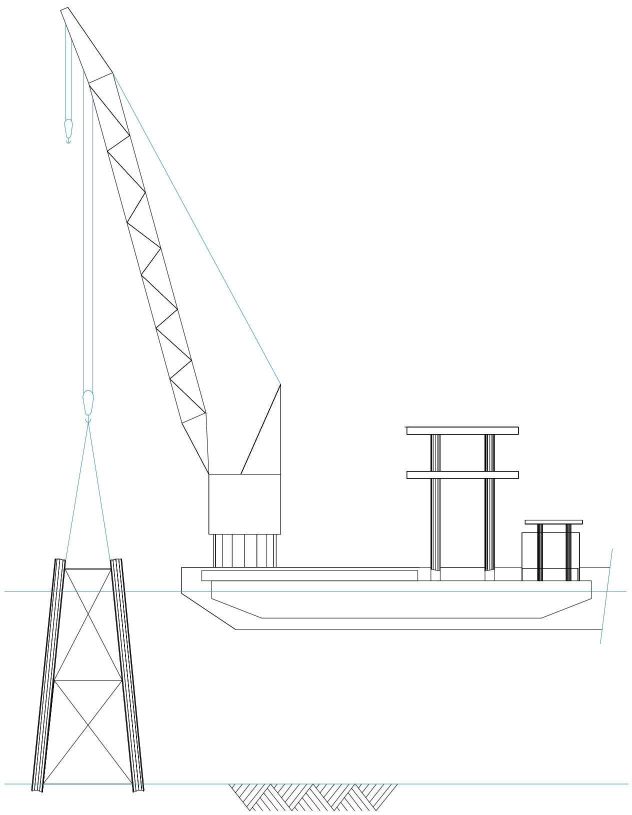
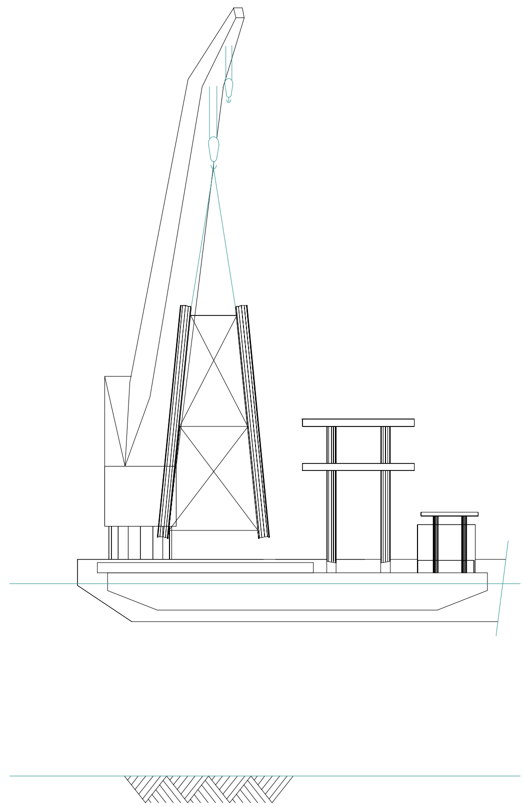


FIGURE 11 - SETTING JACKET ON CARGO BARGE



Lift Jacket from Seafloor



Set Jacket on Cargo Barge

FIGURE 12 - TOWING AND TOPPLING THE JACKET AT A REMOTE REEF SITE

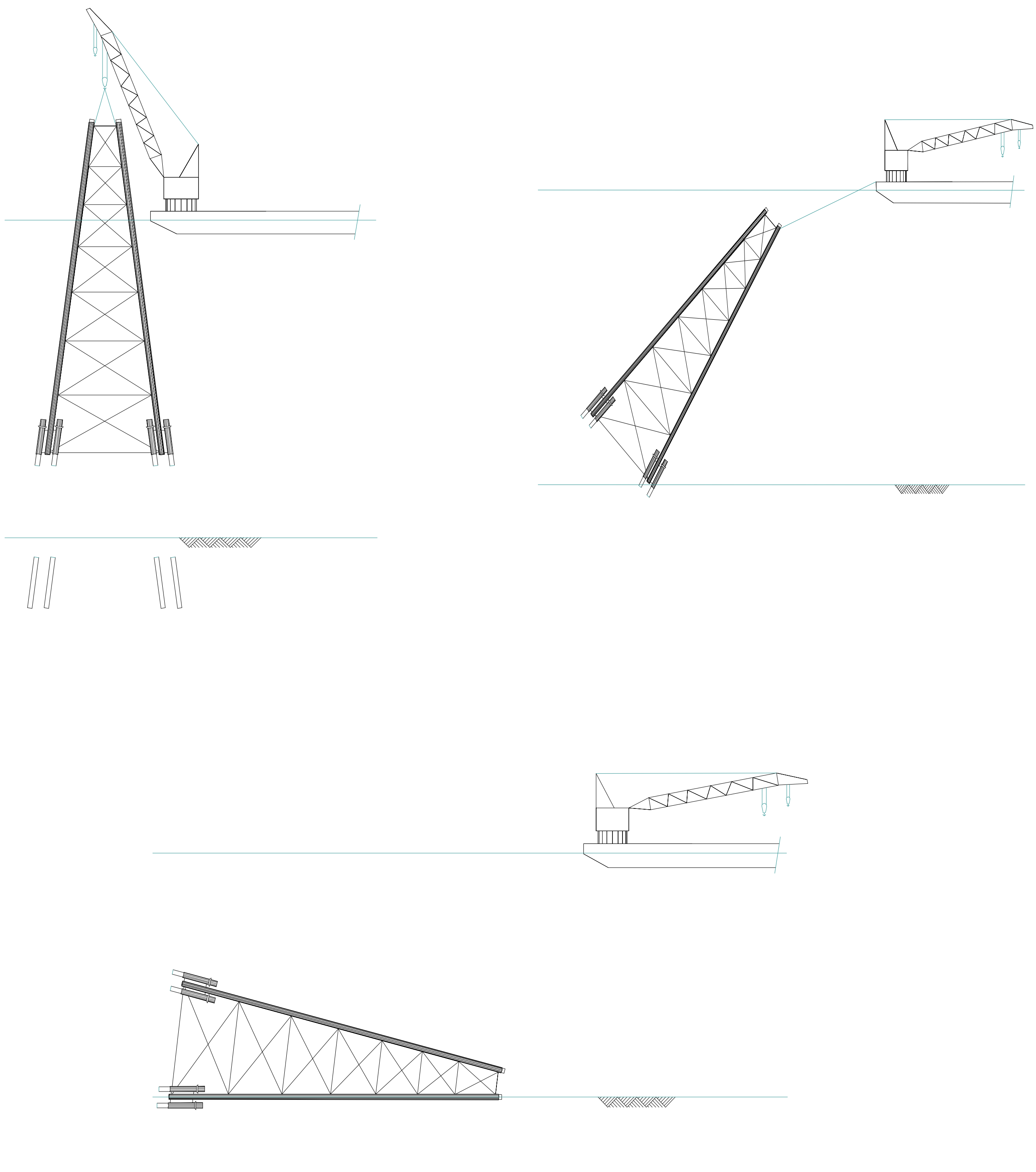
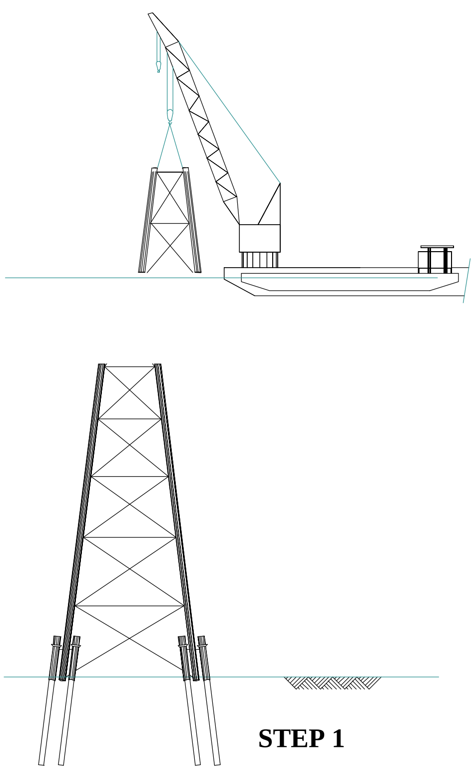
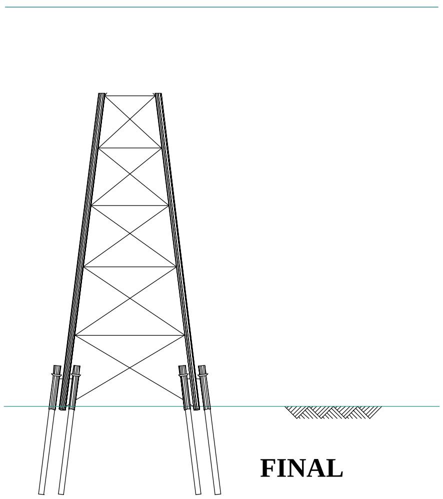


FIGURE 14 - PARTIAL REMOVAL IN PLACE (IN SITU)



Cut and Lift the Top 85' Section of the Jacket

Placing the Top 85' Section of Jacket on the Cargo Barge



Remainder of Jacket Abandoned In-Place

DECOMMISSIONING ASSUMPTIONS

The "Standard Assumptions" for platform decommissioning are as follows:

1. All work will be performed during the summer work season between May 15th and September 15th.
2. Mobilization times are estimated from the Eugene Island sea buoy.
3. The current guidelines for the use of explosives are assumed.
4. Hourly rates for construction and diving spreads are developed from offshore contractors published rates.
5. No allowances have been made for the presence of sea turtles or marine mammals.
6. No allowances have been made for the presence of NORM or hazardous waste disposal.
7. Platform Wells are plugged and abandoned using rigless techniques unless otherwise noted.
8. The conductors will be severed and removed prior to derrick barge arrival or during the derrick barge operations as noted in each estimate.
9. Pipeline are pigged, flushed, plugged and abandoned in situ in federal waters.
10. Site clearance and verification is in accordance with the current NTL.
11. Operator's internal overhead or other costs are not included.
12. Engineering & Project Management cost of 8% (company or other) is included.
13. Work Contingency of 15% is included.

14. Weather allowance of 20% is included, consisting of 14% for regular weather and 6% for named tropical storms.

5.8 International Construction Inflation Trends

MMS requested that offshore inflation trends be added to this report. A study was conducted on the inflation factors and this section presents the results.

To make a determination of the appropriate inflation factor to use for POCS decommissioning project cost estimates we have evaluated construction trends internationally in the recent past.

General Construction Inflation

Over the past ten years the U.S. Consumer Price Index (CPI) has seen an almost steady rise of 34% compared to 1996 levels for an average annual rate of 2.96%. (1) General Construction rates, shown in Figure 5.8.1, have increased faster than the CPI since 2003. Construction rates have increased by 36% from 2003 levels for an average annual rate of 7.99%, which is 16% higher than the 15% CPI rise since 2003.

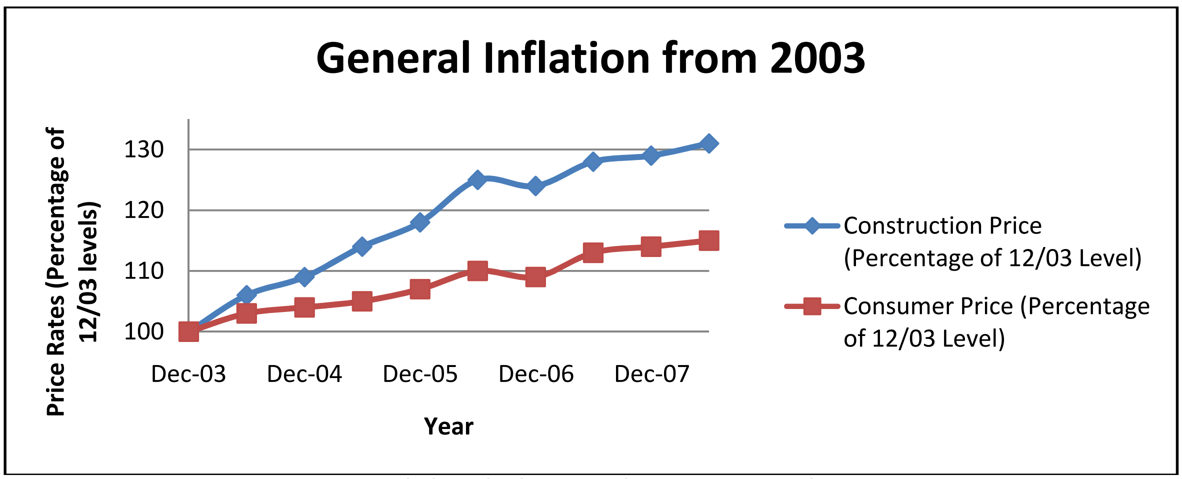


Figure 5.8.1 U.S. General Construction Inflation (2)

Heavy construction has shown a greater increase in cost since 2003 primarily due to energy costs involved in operating heavy machinery. Figure 5.8.2 shows a 41% increase in heavy construction costs, 26% higher than the CPI values, for an average annual rate of 8.97%.

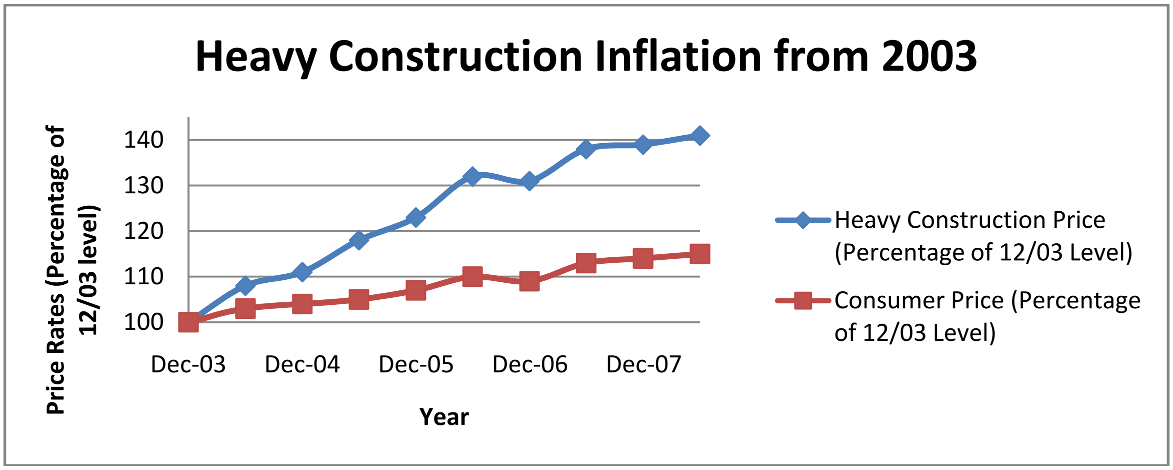


Figure 5.8.2 Heavy Construction Price Rates vs. Year. (2)

Many factors contributed to this higher rate inflation in heavy construction, including #2 diesel, concrete, gypsum, copper mill, and steel mill product prices. All of these factors, most notably #2 diesel fuel, showed a higher normalized price increase compared to the CPI since 2003 as shown in Figure 5.8.3.

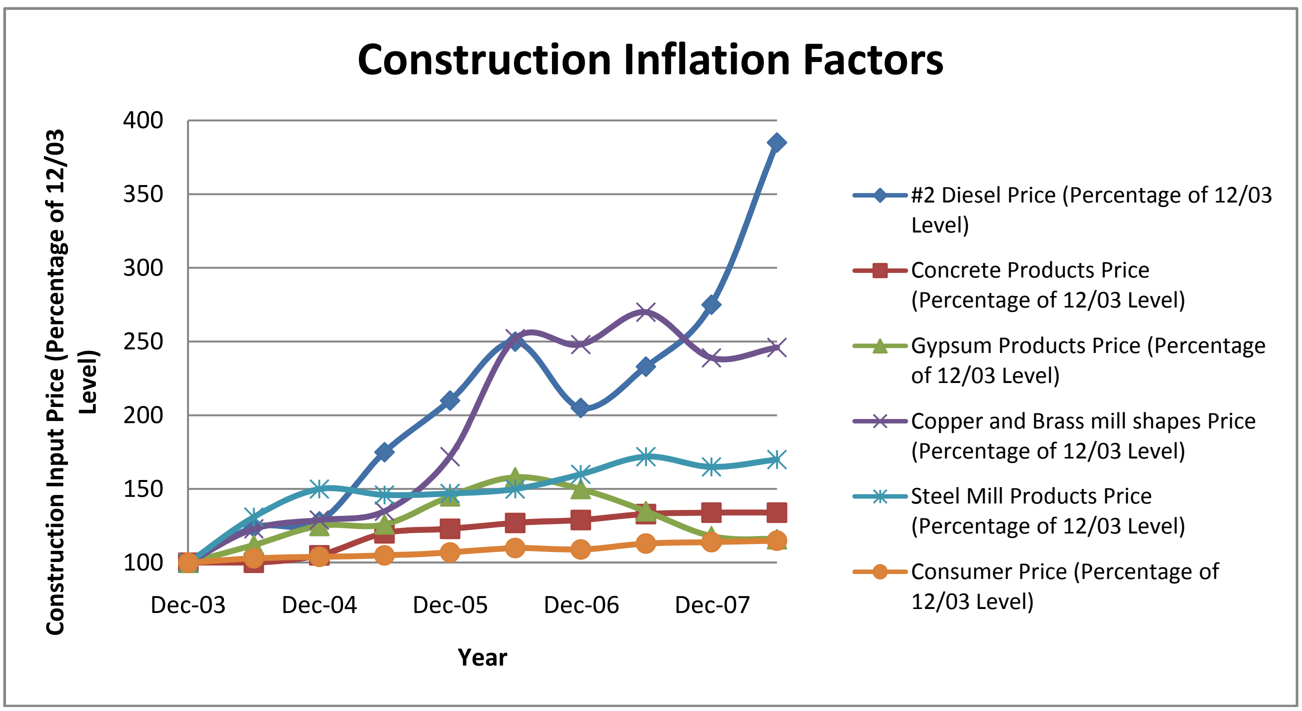


Figure 5.8.3 Construction Inflation Factors. (2)

Offshore vessel rates provide a strong correlation to overall offshore construction prices and therefore are a good indicator of offshore construction prices used in Proserv

Offshore's inflation rate recommendation for POCS decommissioning projects. Offshore vessel rates in Figure 5.8.4 show an overall trend of staying below CPI from 1996 to 2008, but since 2003 rates are shown to be rising significantly faster than the CPI in Figure 5.8.5. A major factor in this recent trend is the increase of #2 diesel fuel at a rate 170% higher than the CPI since 2003 (see Figure 5.8.3 above). (2) The general offshore vessel rate trend, excluding lift boats, has shown an annual average increase of 14.2% since 2003.

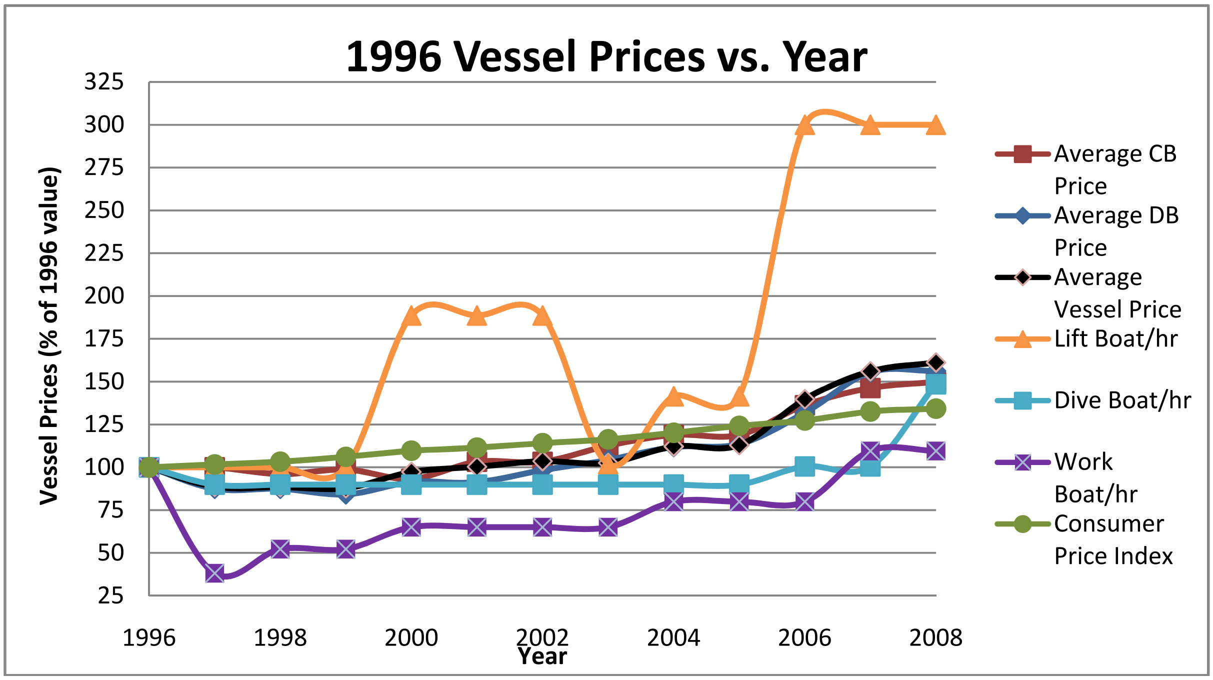


Figure 5.8.4. Offshore Vessel Prices Normalized to 1996. (3)

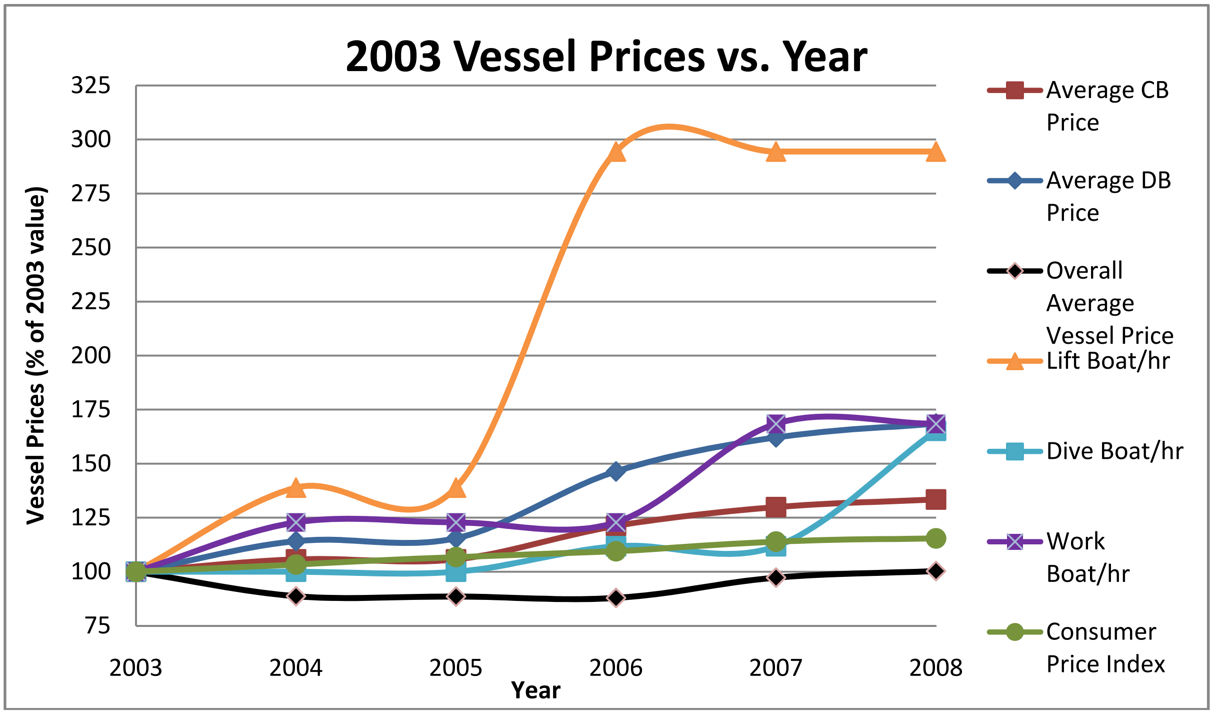


Figure 5.8.5. Offshore Vessel Prices Normalized to 2003. [3]

Table 5.8.1 shows the general construction rates for the U.S., Singapore, and India, as compiled by the U.S. Central Intelligence Agency (CIA).

Year	US	Singapore	India
2004	2.7%	0.5%	3.8%
2005	3.4%	1.7%	4.2%
2006	3.2%	0.4%	4.2%
2007	2.9%	1.0%	5.3%
2008	2.7%	4.4%	5.9%
Cumulative	15.8%	8.2%	25.7%

Table 5.8.1 Comparative General Construction Inflation Rates[2]

Recommended Inflation Rate for the GOM OCS Decommissioning Projects

A review of the various rates shows a wide range of variation by category and from year to year. We have reviewed the available inflation data and propose the following inflation factor of 3.357% for use offshore, as shown in Derrick Barge Average in “Average” column in Table 5.8.2

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Derrick Barge Average (%)	14.305	0.002	-3.905	7.840	-0.031	7.172	5.686	6.734	1.524	13.892	15.198	0.474	3.357

Table 5.8.2 GOM OCS Decommissioning Projects Cost Adjustment Factor

Inflation References

1. www.cia.gov
2. http://www.agc.org/galleries/econ/AGC_CIA08_webFinal.pdf
3. Proserv Offshore's "PAES" Rates Database

Figure 5.8.6 shows the historical decommissioning cost for offshore platforms in the GOM. Recent information received by derrick barge contractors indicates that the market costs for 2009 have decreased to an approximate level of $1,300 per st for decommissioning 4-pile and larger structures in the GOM. At the time of this study, back-up information was not available.

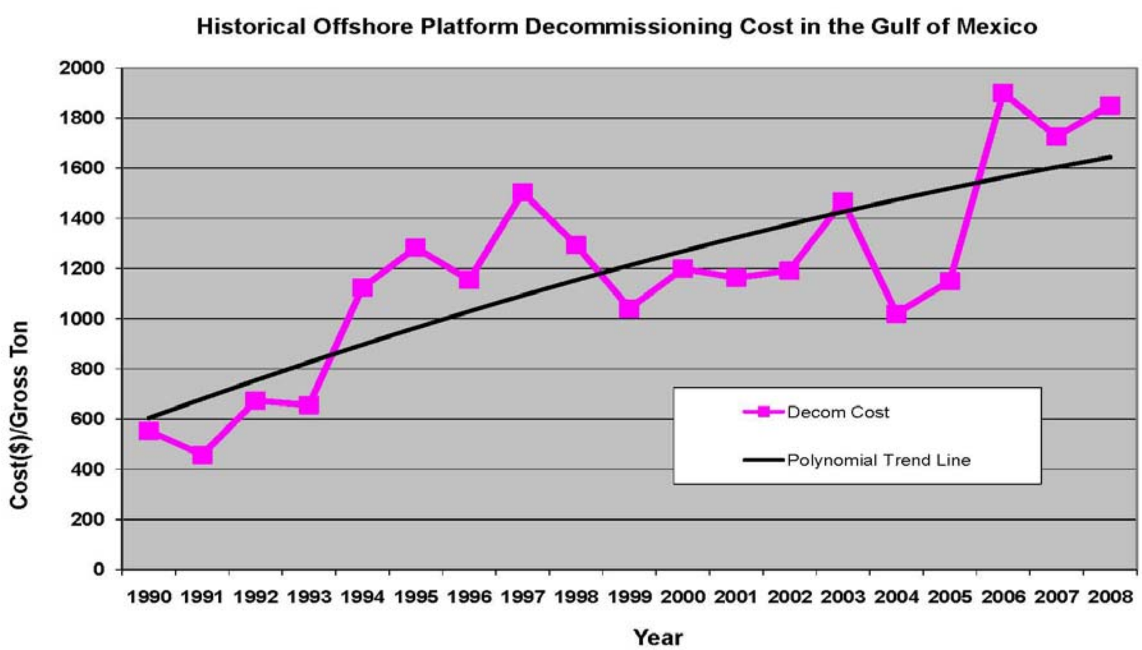


Figure 5.8.6 GOM Decommissioning Historical Costs

5.9 Crossmar Subsea Report Submittal

Title: Subsea Abandonment in Deepwater a "Subsea Perspective"
Drafted by: Brian Saucier, (Subsea Systems Engineer & Business Development Lead)
October 1, 2009

Background:

Cross Group was solicited by Pro-Serve to provide subsea system related information specific to deepwater subsea field abandonment in the GOM. Deepwater subsea fields are typically comprised of a template/manifold structure, subsea trees, control umbilical and UTA (umbilical termination assembly), pipelines/PLETs (Pipeline End Terminations), and well/flow-line jumper assemblies. Accessibility to the tubing is typically achieved via Drilling/SSTT riser systems, Open water Intervention riser systems, or Rig-less Riser packages. Each system will require interface with the vessel or MODU. The Subsea equipment is typically diver- less and requires specific design functionality and allow for ROV installation and future abandonment.

The purpose of this document is to provide supportive information to Pro-Serve related to some of the challenges and technology gaps that may be in the industry related to deepwater Subsea field abandonment. In addition, the document may also serve to highlight new or novel technologies (*Patented Technology reference USPTO # 72197490 and/or # 7565931*) that could be applied to benefit future installation and developments in the future aimed towards reduction of intervention, maintenance and abandonment OPEX, and allow overall improvement to abandonment process.

As point of reference the abandonment/ recovery of the subsea tree , well /flow line jumper and control umbilical / flying lead are fairly routine operations , since the majority of this equipment is design to be recovered in event a failure should occur. The unique aspects of the subsea abandonment program include, but not limited to the following:

- Venting and management of the casing annuli within Subsea wellhead system
- Removal / recovery of the manifold support base or template structure. (Note: Early designs installed a larger foundation to support the manifold in soft soil environments. This was prior to the development and application of ROV suction piles which are used today
- Selection / application of the Intervention riser system or Rig-less Intervention package. The deployment and controls for such a system need to be carefully selected for suitability with DP Vessels without compromise to well control risks and DP events.
- Deeper water will require large control umbilical and/or EH Mux systems. Controls for the tree and intervention package require critical planning and upfront engineering.

- Motion compensation devices or constant tension winch packages are critical to the successful deployment and recovery of packages from a smaller vessel.
- Recovery of the template foundation support structures will require jetting and cutting operations in selected cases.

Conclusions:

- Improved Subsea Hardware design and valve packaging and configuration would offer improved functionality during intervention and abandonment for future. Consideration of such functionality should be considered in the initial stages of design without compromise to HSE.
- Data Management which reconciles all pertinent data of the subsea system to allow faster response time and updated tool management. This shall include data library (Cross wIMS system) allowing real time tracking and availability via the web.
- Integrate hardware, procedures and methods with Installation and Intervention contractor for lower cost solutions. Industry should improve inter-relationships and foster closer ties between the vessel owners and manufacturing companies of subsea equipment to improve efficiency.
- Improvements shall be made on jetting and soil removal processes and procedures/methods for deepwater applications. This combined with submerged object surveys. Acoustic technology exists but is limited to depth of investigation and resolution of image. Perhaps other forms of technology could be applied and researched.
- Improvements in technology to cut /severe large tubular member cutting strategies and techniques – Diver less applications.
- Improvement on plastic modeling and simulation of downed platform members to improve accuracy and development of the optimized cut / removal strategies. Such software exists, but can be improved or simulated.
- Continue to push deepwater "rig less" P&A systems and technology, controls and applications with numerous spin off technologies. Continued development of e line wire technology to allow for conventional slick line pack off (style) designs to be used subsea. In addition, improved controls and well control safety provisions built into the PLC logic and linked to DP vessel should be considered.
- Push for deepwater lowering solutions with light weight, high strength rope verse heavy wire rope solutions and the associated reeler systems to operate and deploy this type of rope.
- Industry to foster and promote alliances and relationships in offering integrated tooling management solutions to improve readiness and shorter cycle time approach to performing intervention and, well abandonment. The high cost to capitalize tools for abandonment is something that could be shared across a regional area.
- Conduct improved camera and visualization technology enabling more work conducted from ROV and diver-less system. Such technology improvements to promote 3D visualization in high silt, debris sensitive areas.

- Work to integrate new hardware and contingency solutions, for example, secondary release mechanisms related to various subsea equipment components to ensure recovery later in field life. Such contingencies shall be routinely designed into connectors, valves, and other diver less systems. Many of the systems are not debris tolerate therefore causing high cost and problems at the abandonment phase. Appropriate ROV accessibility studies and simulation on the design stage to allow for future access and intervention for abandonment.
- Work towards modular, light weight subsea equipment (manifolds, trees, etc) alternatives such to open the field for more vessels for conducting the work both during installation, maintenance and recovery / abandonment. By adopting integrated design solutions with the installation contractor will provide optimized solution for installation, intervention and abandonment.
- Build out standardized rental systems for reeler, flexible hoses and umbilicals. Since this equipment is long lead and high cost, perhaps MMS sponsorship / group could be considered for such an offering to allow for improved cycle time and work performance.
- Establish improved policy and guidelines for station keeping management and systems. DP3 offers full redundancy and especially important during any form of well access, re-entry or abandonment in lower risks and reducing pollution events. This is a critical interface with any DSV/MSV with the Intervention package control system. The mating of the logic and well control shut down sequences are key to the success in conducting such operations from which to manage well control risks.

Technology

- Abandonment of Subsea trees, well /flow line jumpers and interconnection umbilical(s) are fairly routine and should not be a cause of concern technically. The challenge is to do this work with a lower cost vessel, hence the push in industry towards DP type MSV/DSVs with large cranes, towers, moon pool (s), and accommodations. With the MSV/ DSV vessels, will require light duty intervention packages to be deployed (i.e. Rig less systems). Such systems will be cross functional to allow for live well intervention and well kill/abandonment operations via DP Vessel. The key to success will be the integration of such packages on the vessel and seamless operability that will be required to achieve low cost solutions.
- Due to the soft soil conditions in the GOM and shallow gas hazards, Production Manifolds in the mid 90s were installed with a bottom supported structure or template. Typically the manifold can be recovered, OR at least an attempt should be made, however the supportive template structure is the real challenge. This will be an abandonment challenge since effects of long term subsidence may require extensive jetting and soil removal. Tools and technology exist for such an operation but may not be economically feasible at such depths and with extensive ROV time to achieve. Today the production manifold systems are being installed with ROV suction piles larger piles to handle high bending loads in soft soil environments, resulting in easier recovery of the manifold system. Such systems will involve greater planning

- Technology Improvements: Clustered Production manifold configuration has been typically constant over the past 20 years. However, novel patents have been developed in this area to improve the system functionality, improve life of field maintenance and intervention using smaller, lower cost vessels. The challenge is to mold and shift the design of subsea equipment and systems to allow for ease of installation, maintenance and abandonment. The following patents and technology has been developed to achieve this goal:
  - *USPTO # 7219740: Well Production and Multi-purpose Intervention Access Hub*
  - *USPTO # 7565931: Dual Bore Well Jumper*
    - This technology (both patents above) can offer a single intervention access hub to Subsea Manifolds and provide single connection point to well test and unload multiple wells with a single connection. Thus allowing for (1) mooring configuration to be achieved in the field and prevent handling anchors / pile over live flow lines.
    - The dual bore well jumper technology can offer both production and Tubing/production casing annulus monitoring at the production manifold. This would improve operations during abandonment and allow for single connection to be made to manage annulus pressure during the life of well. Well serviceability, injection, well stimulation and abandonment phases will benefit from the reconfiguration of the SS manifold system.
    - Re-configuration of existing SS hardware designs, and incorporation of this technology will provide the following
      - Enable fluid conduit to all wells from single hub for production/well testing and serviceability
      - System capability to embed backup chokes, chemical injection modules or other equipment to wells without disruption in production.
      - Improve risks due to not having to trip drilling riser or pull anchors multiple times for each well operations
      - Fluid circulation and “high rate” access to the Prod/Tubing annuli
      - Allow for active management of annulus pressure, especially on HTHP wells, when shut in for storm or other extended delay.
      - Improve barrier control to the environment due to the Dual Tube design and configuration
      - Improve flow assurance within the well jumper design

- Hardware Reconfiguration: Subtle changes to the hardware design and configuration can lead to step wise improvements in the intervention efficiency, and overall safety of the production operation and abandonment functionality. Reconfiguration could also provide redundancy to the overall production startup operations and allow for “initial failure modes” that routine occur with subsea projects over the first 0 – 2 years of operation. Pre-planning such failures into the system design with backup contingencies could greatly improve production choke points and improve revenue with short down time durations.

- Software and Data Management: Cross has developed a web based project information resource (wIMS – web enabled Information Management System) that provides a resource to the planning and field abandonment process by offering overall project data management services. This technology can assist operators and MMS to understand the scope, specialized tools and equipment readiness for conducting abandonment operations. The system is securely partitioned and can be project customized for security considerations. The goal is to collect updated information on the project, tools, procedures, photos, etc that would allow for a more rapid efficient response to the project either during the intervention phase or the abandonment phase. Benefits of such a system include:
    - Tracking and management of certification readiness
    - Photo Library
    - Training and group understanding – (e.g.: ROV or Diver accessibility)

Subsea Vessel and Intervention Equipment Factors

Related to Subsea Abandonment cost and methods, the type of vessel (DSV/MSV or MODU) and the type of intervention equipment used either open water intervention riser, Subsea Test Tree systems, or Rig-less Intervention packages will be overall cost driver to the project. Recently industry push to build light duty intervention vessel with moon pool, motion compensation cranes / towers have enabled the rig less intervention equipment market to expand and allow for overall lower cost of abandonment to be realized.

System related interfaces between the intervention equipment and the vessel are key to the overall success of the project in terms of weather risks, operability and safety. Integrated planning and equipment customization will the vessel will aid in reducing risks and provide lower cost solutions. Well bore status, configuration, pressure, fluids, and equipment reliability will impact the overall cost and related scope of the Subsea abandonment project.

In summary, equipment can and should be optimized for late life and future subsea abandonment functionality. Integration with vessel and intervention equipment will allow and provide lower cost solutions to optimize production and life of field support and maintenance. Development of new technology, methods and development of service / client –operator relationships will provide a seamless transition between production, intervention/maintenance and abandonment phases.

5.10 Presentation on Artificial Reefing Programs

Presentation Outline

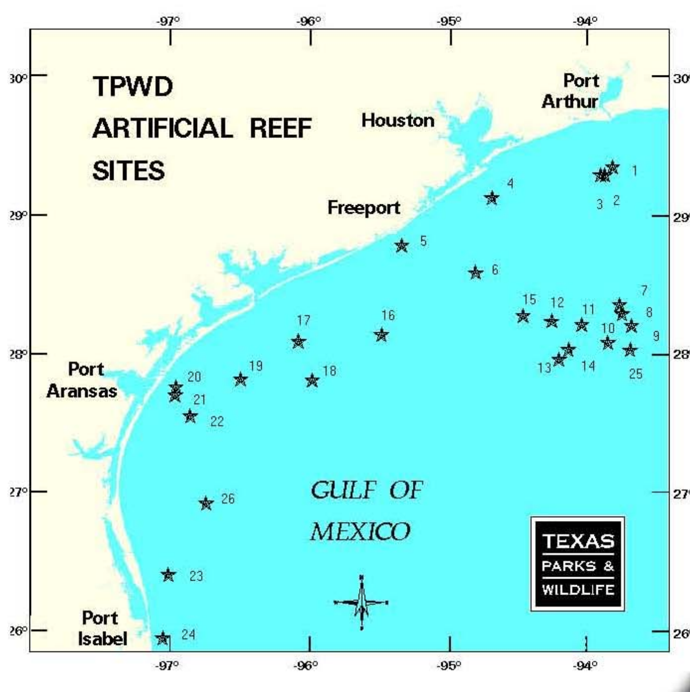
- Evolution of Artificial Reef Programs
- Legislation Authorizing the Programs
- How the Programs Work in Practice
- Benefits Derived from the Programs
- Gulf of Mexico O&G Activities

Evolution of Artificial Reefs Programs - Federal

- Before the 1980's done on *ad hoc* basis
- 1983 - MMS announced its support for the concept of the conversion of selected obsolete O&G facilities to artificial reefs to enhance recreational and fishing opportunities
- 1984 - National Fishing Enhancement Act - promote and facilitate efforts to increase fish population
- 1985 - National Artificial Reef Plan - provides guidance and criteria for planning, setting, designing and managing

Evolution of Artificial Reef Programs - State

- 1986 - Louisiana Fishing Enhancement Act
- 1986 - Louisiana Artificial Reef Program
- 1989 - Texas Artificial Reef Act
- 1990 - Texas Artificial Reef Program
- 1999 – Mississippi
- 1987 – Alabama Artificial Reef Program
- 1982 – Florida Artificial Reef Program

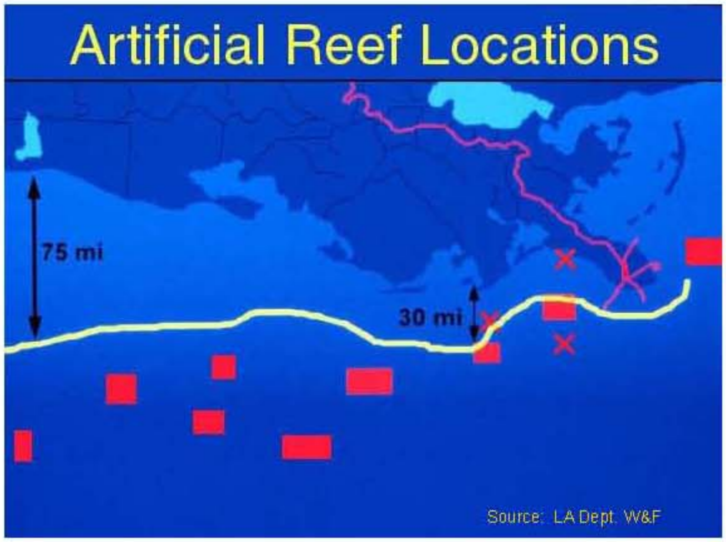


Texas Artificial Reef Facts

- 2,320 Acres
- 58 Established Reef sites
- 97 donations to date
- $5.1 million contributed to Texas Artificial Reef Fund

Texas Reef Program Donations

Donation Type	Quantity
Barges	6
Liberty Ships	13
Concrete Anchors	22
Platform Components	97
Reef Balls	134
Concrete Culverts	47



Louisiana Artificial Reef Facts

- 19,434 Acres in 9 planning areas
- 28 Established reef sites
- 272 Platform Components Donated
- Other Reef Programs
  - Deepwater Artificial Reef Site Program
  - Special Artificial Reef Program
- $41 million contributed to Louisiana Artificial Reef Fund

Louisiana Artificial Reef Program

Donation Type	Quantity
Armored Personnel Carriers	40
Reef Balls	1200
Platform Components	272

Mississippi Artificial Reef Program

Donation Type	**Quantity**
Barges	31
Boats (Tugs, Shrimp,etc)	17
Armored Personnel Carriers	47
Concrete Culverts	2423
Platform Components	10

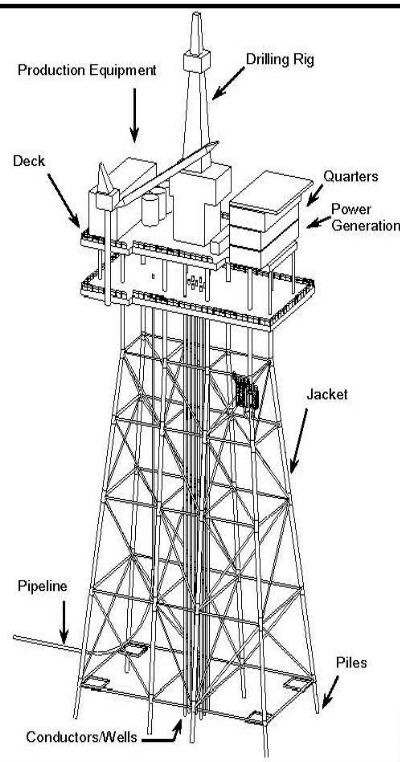
Alabama Artificial Reef Program

Donation Type	Quantity
Barges	43
Liberty Ships	5
Military Tanks	83
Platform Components	4
Concrete Pipe	9
Tugs	2
Ships	1

How the Program Works in Practice

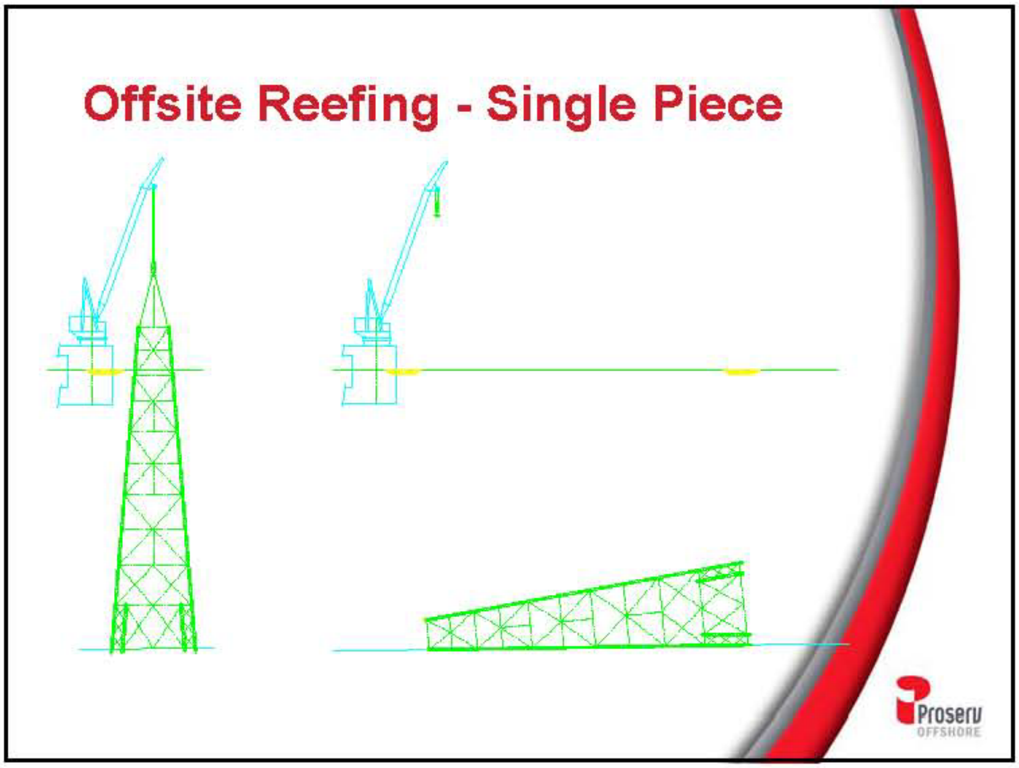
- Reefing Alternatives
- Permitting
- Field Work
- Post job

Platform Components

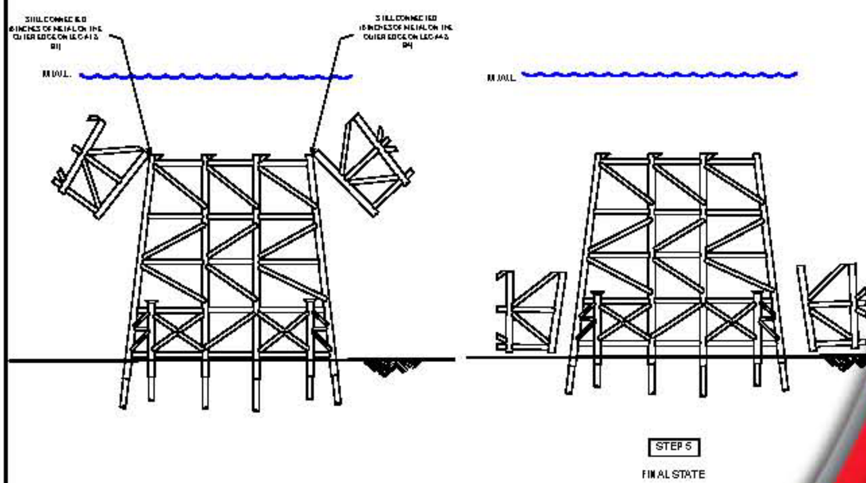


Reefing Alternatives

- Deck is removed and sent to shore
- Jacket
  - Tow-to-Reef Site
  - Topple in-place
  - Partial Removal


Offsite Reefing - Single Piece
Proserv
OFFSHORE

Partial Removal

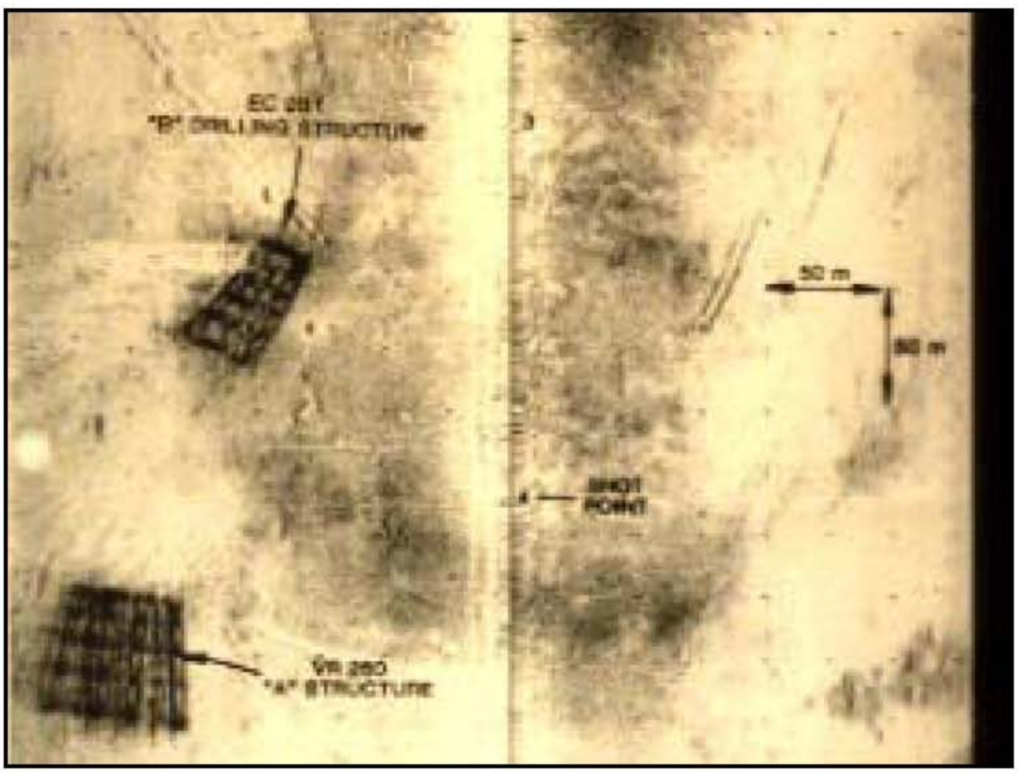


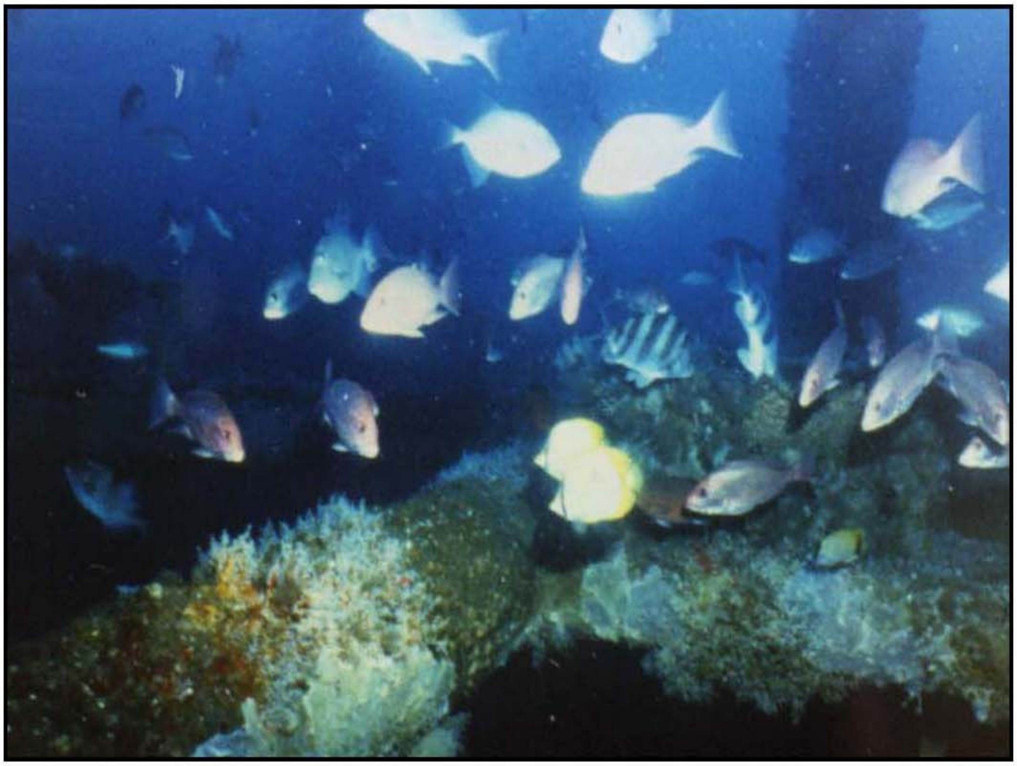
Permitting

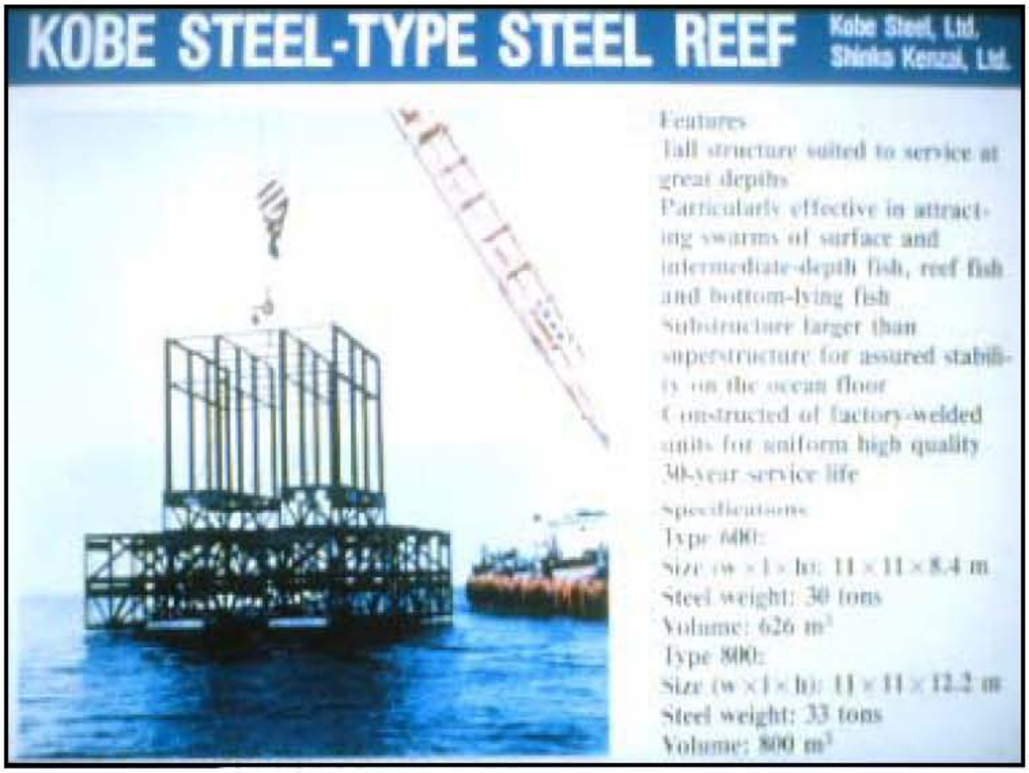
- Operator proposes reef candidate to the State
- State submits permit to US Army Corps of Engineers
- The COE reviews application (submits to other pertinent agencies such as MMS)
- COE approves reef permit
- MMS reviews removal permit applications considering the reef option,
  - may deny reef permit

Field Work

- Contractor decommissions platform
- The structure is placed on the reef site
- Final location and orientation is noted
- Buoy is placed and maintained until it is charted (if new reef site)







Post Job

- Operators submits to the State
  - Reef donation (50% savings)
  - Certified plan showing placement and clearance
- State issues a certificate of Acceptance
  - State accepts title to the reef donation
  - State accepts liability

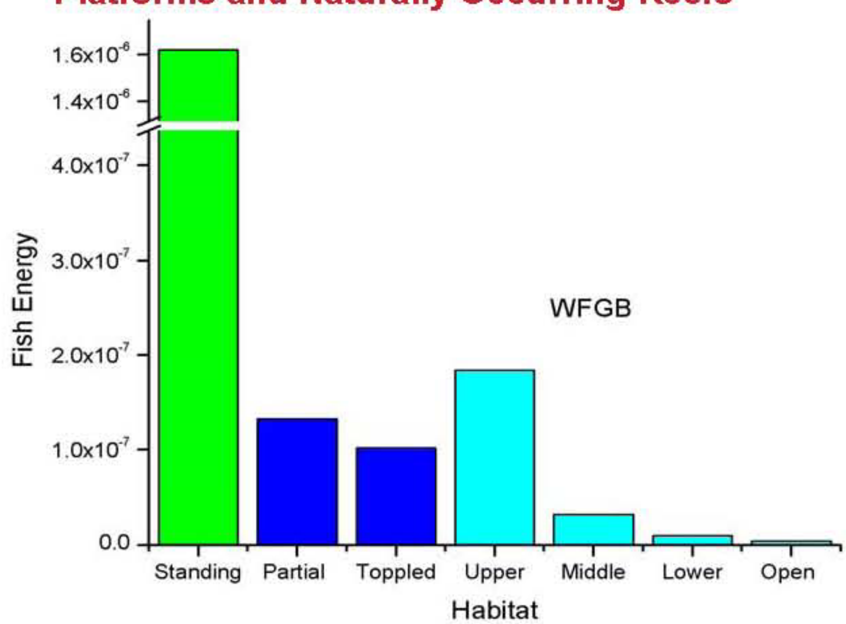
Benefits Derived from the Program

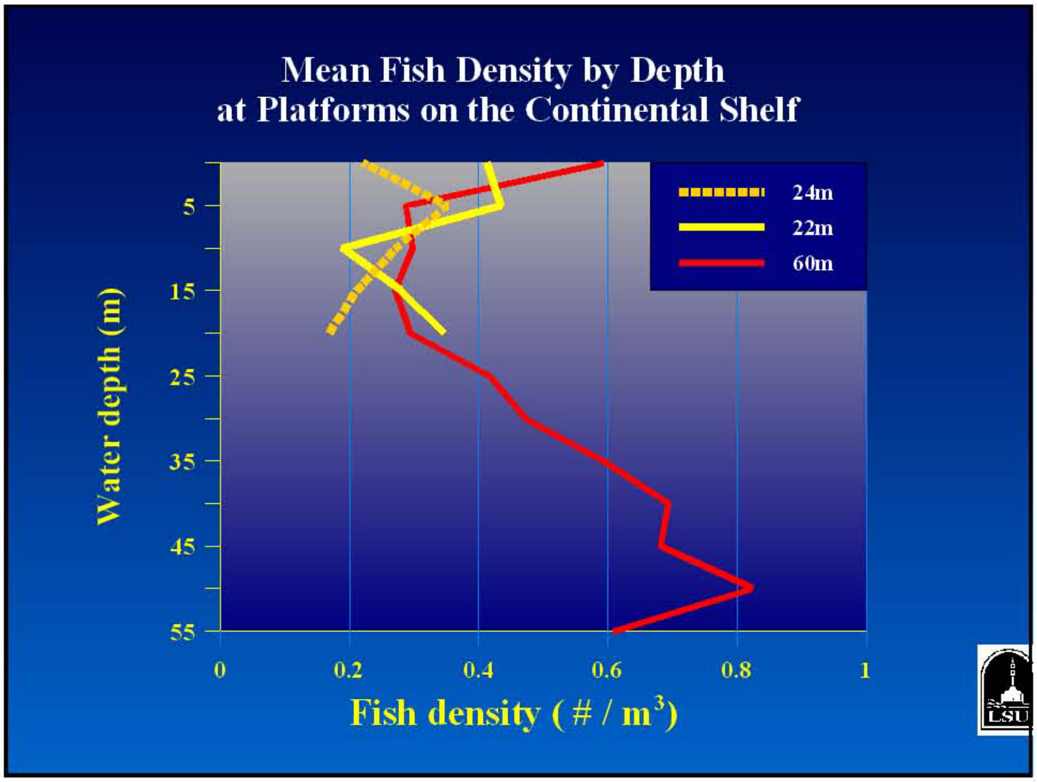
- Meets the goal set out by the 1985 National Artificial Reef Plan
- Funds research programs
- Maintains and continues promoting enhancement of reef sites
- Financial Contributions
  - TX, LA, MS & AL total contributions in the millions and increasing on an annual basis

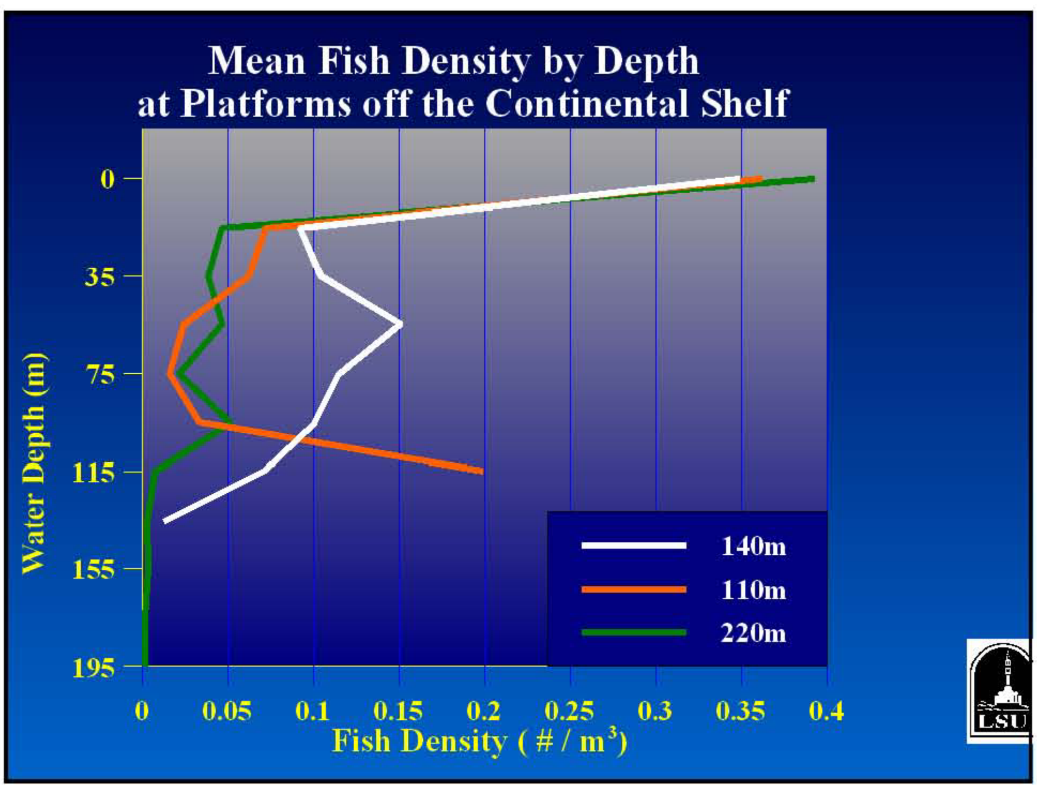
Scientific Support

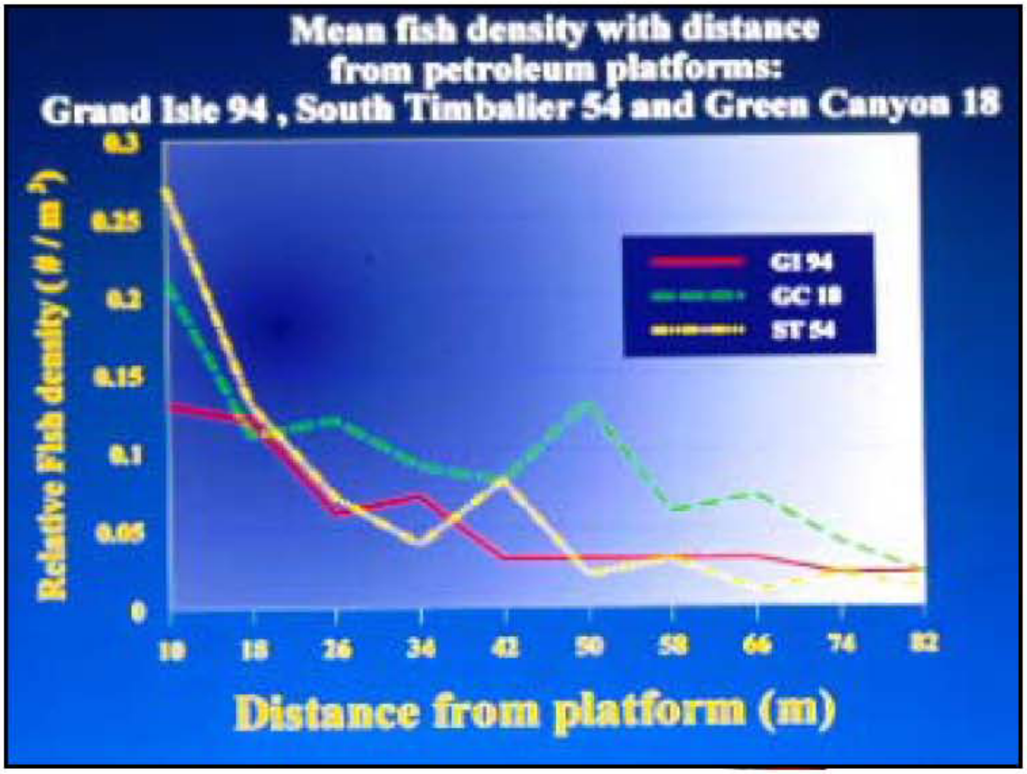
- Louisiana State University
  - Dr. Charles Wilson
  - Relative fish concentration
- University of California at Santa Barbara
  - Dr. Milton Love
  - Identifying/quantifying fish species

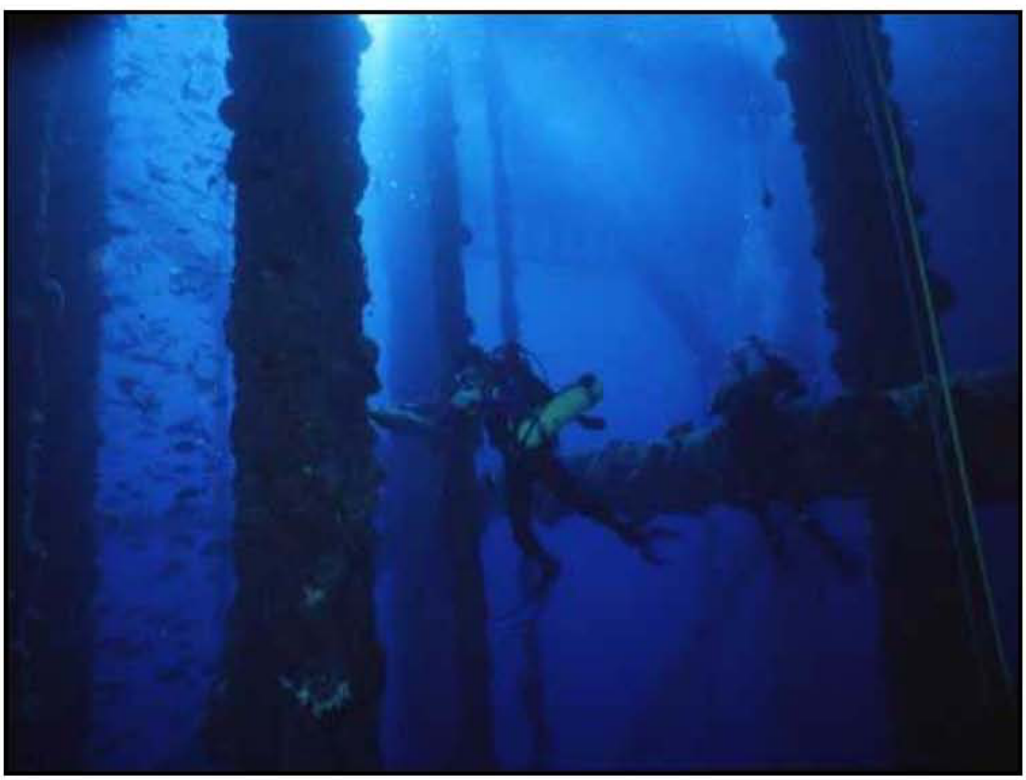
Relative Concentration of Fish on Offshore Platforms and Naturally Occurring Reefs

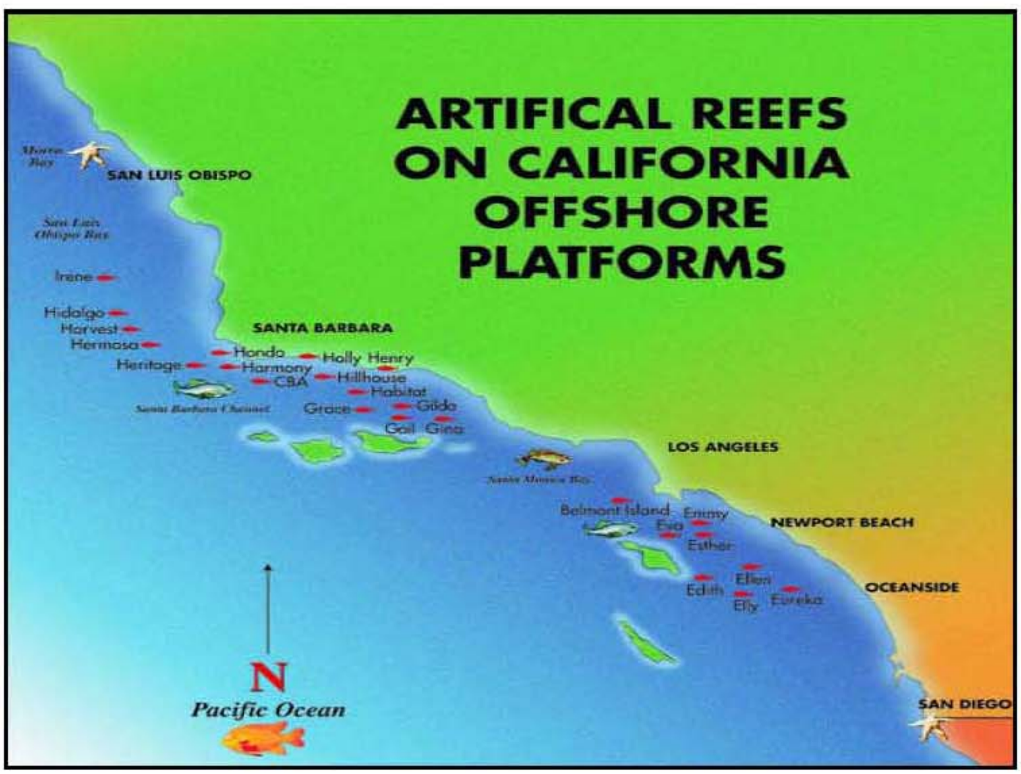



Mean Fish Density by Depth
at Platforms on the Continental Shelf
24m
22m
60m
Water depth (m)
5
15
25
35
45
55
0
0.2
0.4
0.6
0.8
1
Fish density (# / m3)
LSU


Mean Fish Density by Depth
at Platforms off the Continental Shelf
140m
110m
220m
Water Depth (m)
0
35
75
115
155
195
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
Fish Density (# / m3)
LSU

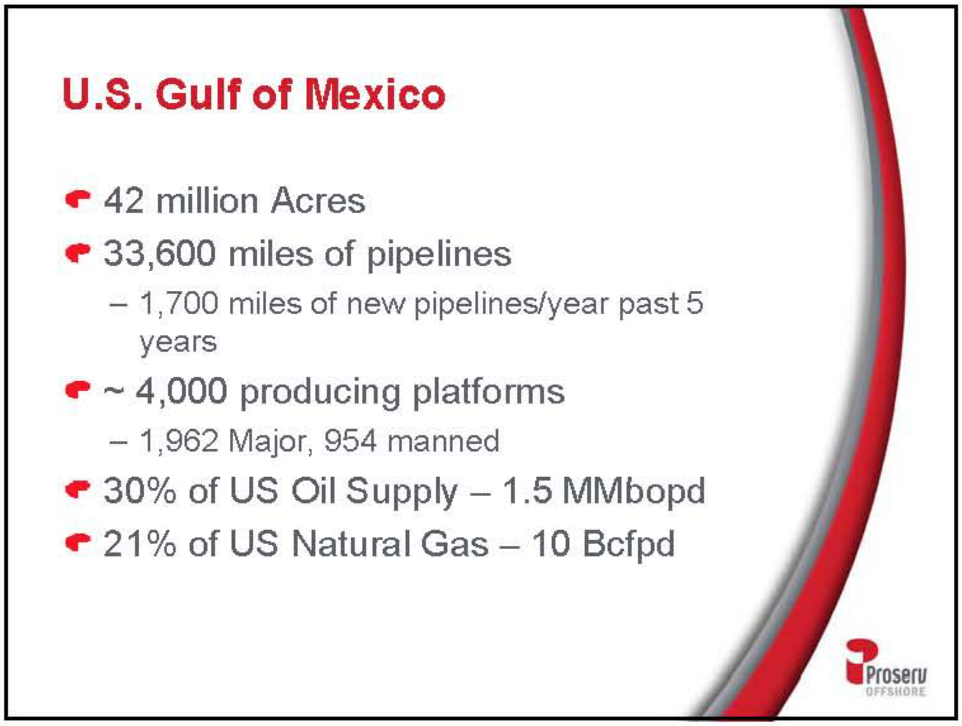

Mean fish density with distance
from petroleum platforms:
Grand Isle 94 , South Timbalier 54 and Green Canyon 18
Relative Fish density (# / m²)
0.3
0.25
0.2
0.15
0.1
0.05
0
GI 94
GC 18
ST 54
10
18
26
34
42
50
58
66
74
82
Distance from platform (m)

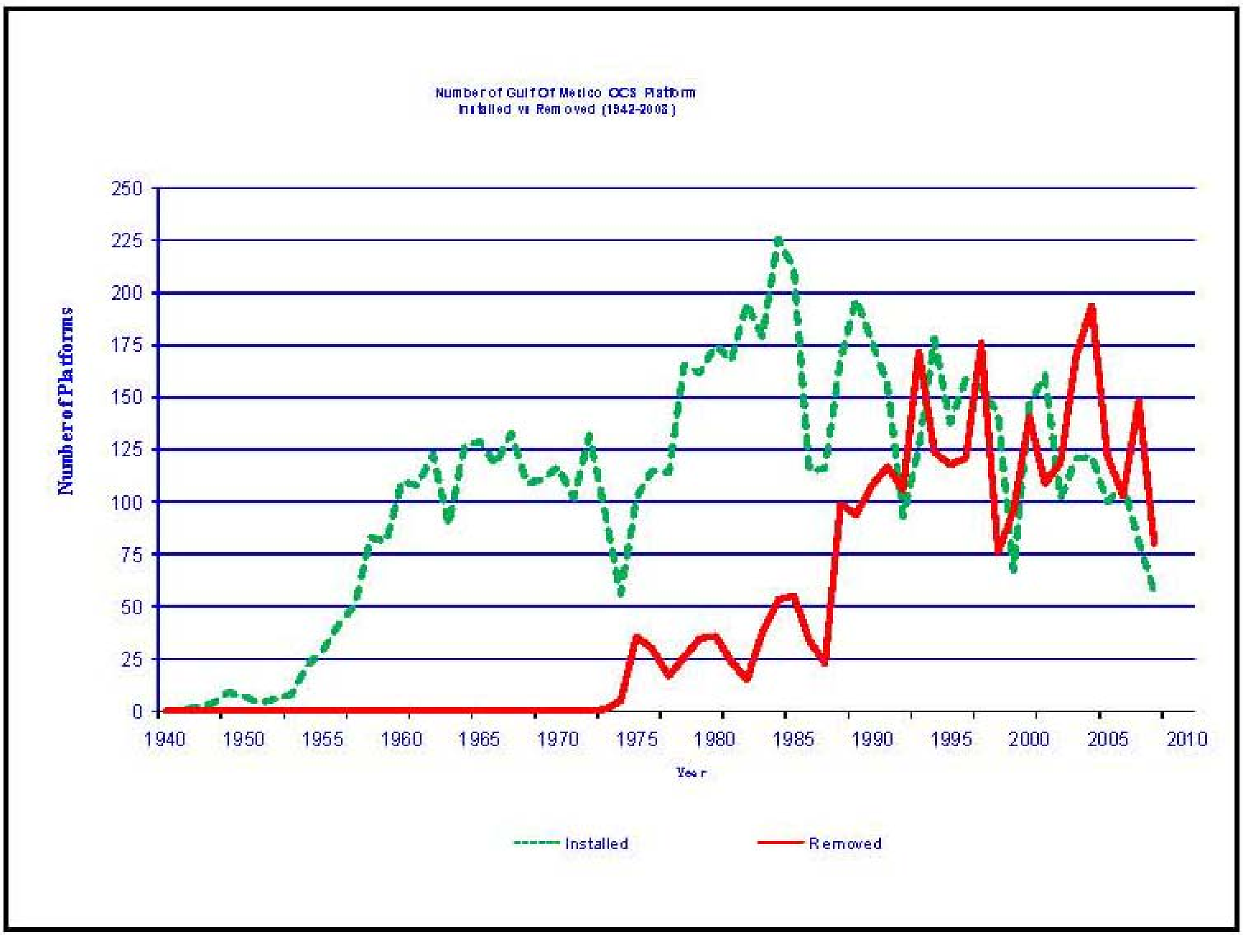


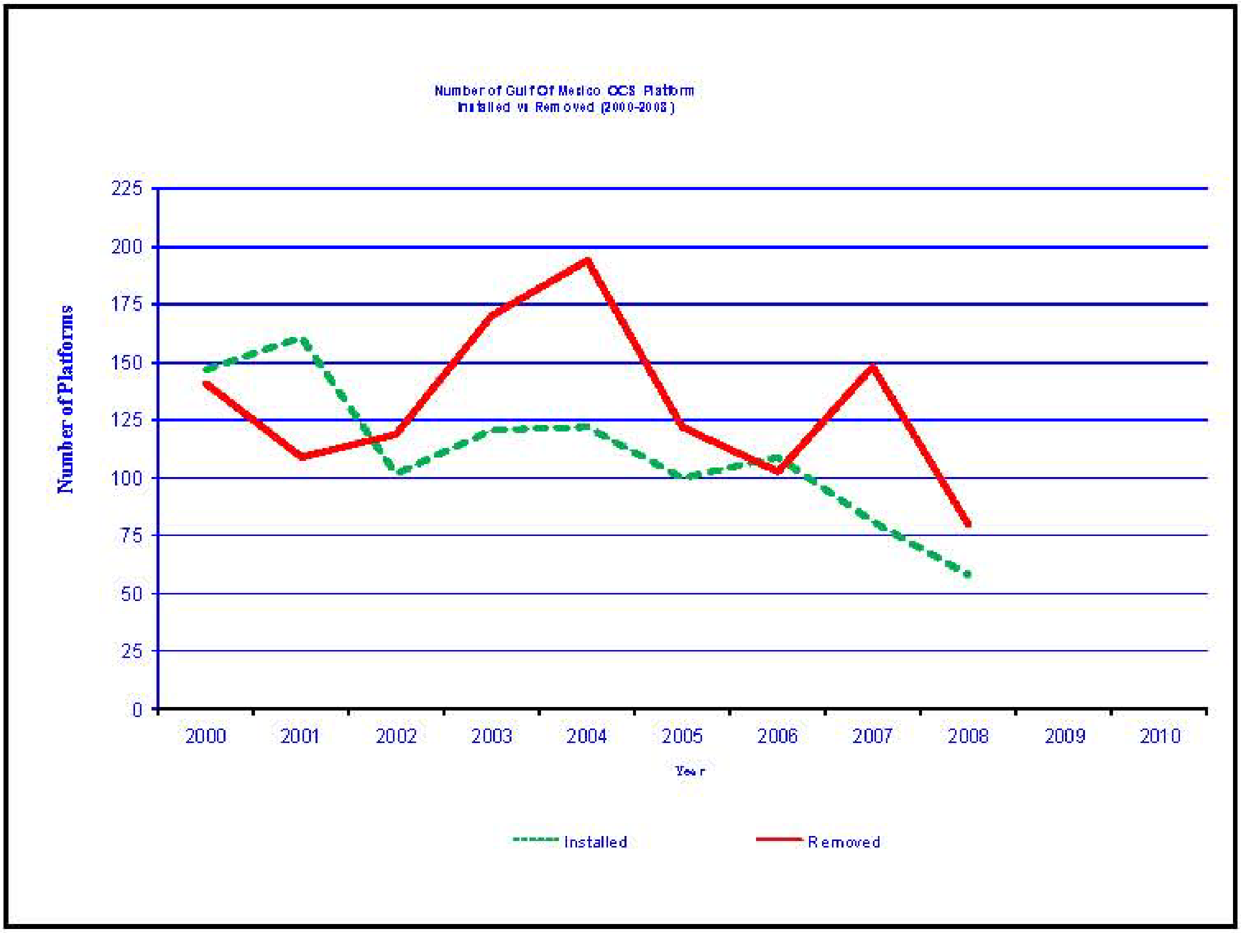

ARTIFICAL REEFS ON CALIFORNIA OFFSHORE PLATFORMS
SAN LUIS OBISPO
Irene
Hidalgo
Harvest
Hermosa
Heritage
SANTA BARBARA
Hondo
Harmony
CBA
Holly
Henry
Hillhouse
Habitat
Grace
Gilda
Gail
Gina
LOS ANGELES
Belmont Island
Emmy
Eva
Esther
NEWPORT BEACH
Edith
Ellen
Elly
Eureka
OCEANSIDE
N
Pacific Ocean
SAN DIEGO

UCSB Marine Science Institute

- Platforms provide habitat for most rockfish species that is better than or equal to natural reefs.
- Some platforms harbor higher densities of young rock fish, adult rock fish, deepwater rock fish than do most all natural reefs

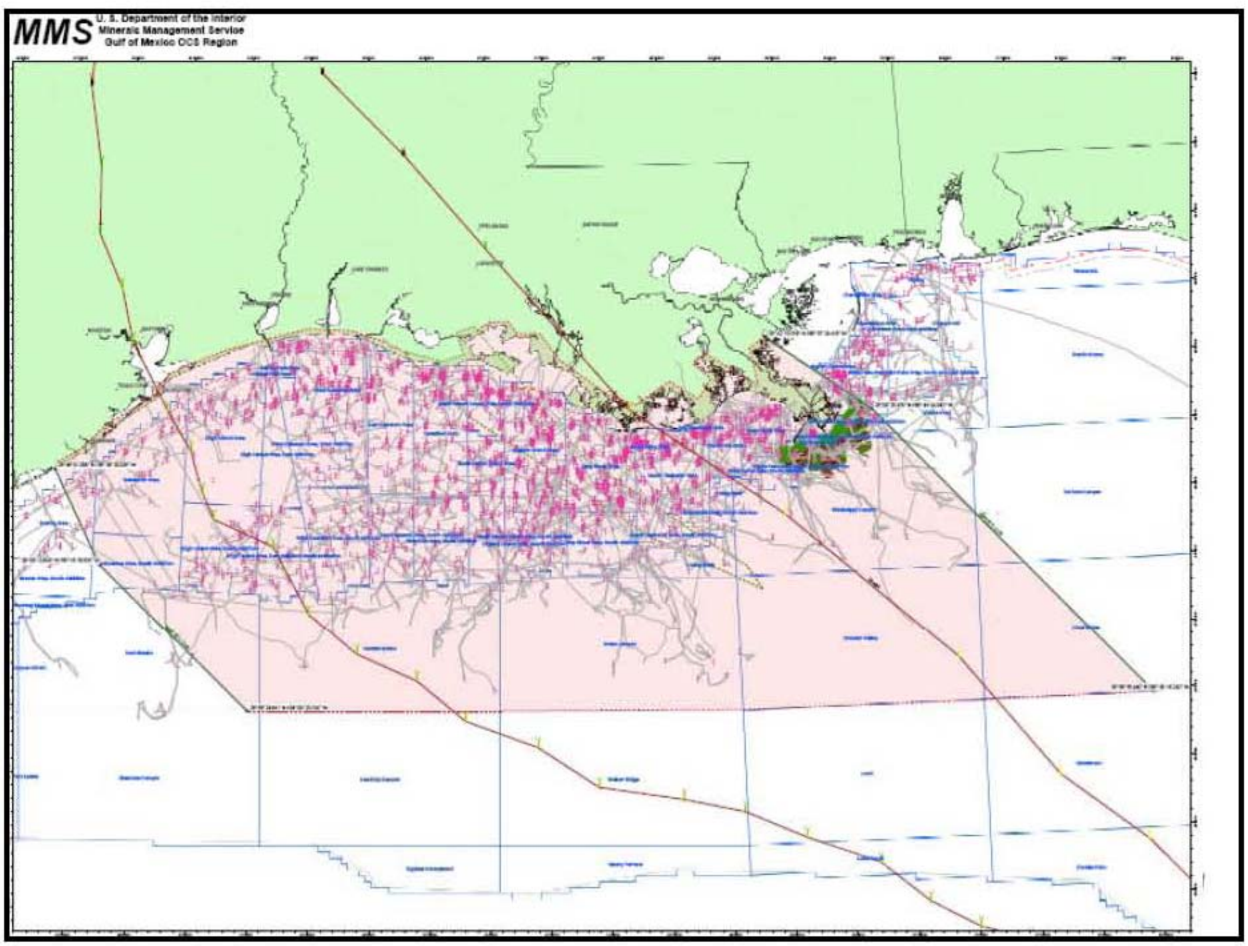

U.S. Gulf of Mexico
42 million Acres
33,600 miles of pipelines
– 1,700 miles of new pipelines/year past 5 years
~ 4,000 producing platforms
– 1,962 Major, 954 manned
30% of US Oil Supply – 1.5 MMbopd
21% of US Natural Gas – 10 Bcfpd
Proserv
OFFSHORE


Number of Gulf Of Mexico OCS Platform
Installed vs Removed (1942-2008)
Number of Platforms
250
225
200
175
150
125
100
75
50
25
0
1940
1950
1955
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
Year
Installed
Removed


Number of Gulf Of Mexico OCS Platform
Installed vs Removed (2000-2008)
Number of Platforms
225
200
175
150
125
100
75
50
25
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
Year
Installed
Removed


Since 2005 – Hurricane Recovery Work
Recovery from Hurricanes Katrina & Rita
167 platforms damaged/destroyed, approximately 551 pipelines damaged
Major Operators have P&A'd wells & abandoned pipelines
Decks being removed from the bottom
Proserv
OFFSHORE


07/11/2008


MMS
U. S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

Hurricane Damage Summary

Year	Hurricane	# Platforms Effected / #Damaged / #Destroyed	Pipeline Incidents
1992	Andrew	700 /65 / 22	480
2002	Lili	800 /17 / 2	120
2004	Ivan	150 / 31 / 7	168
2005	Katrina & Rita	3,050 / 52 /115	542
2008	Gustav & Ike	2,127/135/54	9