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Decommissioning Cost Update for Removing Pacific OCS Region Offshore Oil and Gas Facilities, January 2010, Volume 1

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Proserv Offshore

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6	Ryan J. Rittmueller	Victor R. Agafitei	Robert C. Byrd	Jan. 29th, 2010

Executive Summary

This report was prepared for the Minerals Management Service (MMS) by Proserv Offshore (Proserv), formerly Twatchtman, Snyder and Byrd (TSB), which has been in business since 1987 and during that period has managed the decommissioning of over 300 offshore oil and gas platforms in the Gulf of Mexico, and conducted technical and engineering studies and cost assessments for decommissioning oil and gas platforms located on the federal Outer Continental Shelf (OCS) offshore California. This report updates a previous report prepared independently by the MMS entitled "Offshore Facility Decommissioning Costs, Pacific OCS Region" that was issued in September 2004.

The MMS procured the services of Proserv to develop updated benchmark costs for decommissioning Pacific OCS Region (POCSR) oil and gas facilities to guide its decisions on supplemental bonds. Pursuant to OCS oil and gas regulations [30 CFR 256.53 (a) and (b)], the Regional Director of the MMS has the authority to require additional security in the form of a supplemental bond, based on a calculation of the potential decommissioning liability and an evaluation of the lessee's ability to carry out present and future decommissioning obligations. The purpose of the supplemental bond is to protect the U.S. Government from incurring financial losses by ensuring sufficient funds are set aside to cover the full cost of decommissioning by another party (e.g. a private decommissioning contractor) in the event the current operator/lessee becomes financially insolvent and is unable to carry out its contractual obligations under the lease. This report is one of the inputs MMS uses in making a determination on whether a lessee is required to obtain a supplemental bond to cover its decommissioning obligations.

For this study, Proserv conducted a review of state of the art technology for decommissioning POCSR oil and gas facilities and developed benchmark costs for decommissioning the facilities utilizing conventional technology that is commonly used and has proven to be successful. The Proserv cost assessment is specific to Pacific Region operations and included a review of the availability and capability of derrick barges (DB's) in the region (west coast of U.S.), support vessel services, well plugging and abandonment services, abrasive, mechanical and explosive cutting services, disposal options, and site clearance services. Proserv also collected and evaluated cost information from local vendors, to the extent they were available, that provide well plugging and abandonment services and other decommissioning related services, and developed equipment and labor costs (spread costs) for conducting these operations. In those cases where local/regional decommissioning services are not readily available, Proserv estimated the mobilization and demobilization cost and day-rate cost of the services, developed spread costs for the operations, and prepared decommissioning cost estimates using this information.

This Proserv report covers operator compliance with OCS oil and gas regulations (30 CFR 250 and 256) for permanent plugging of wells; removal of well conductors and platform jackets to 15 feet below the mudline; decommissioning and removal of platform decks and jackets; decommissioning and removal of pipelines and power cables; site clearance; and other lease and permit requirements.

The report assumes that POCSR platforms will be completely removed and transported to shore for disposal. The decommissioning costs presented in the report were developed by Proserv based on information obtained from MMS files, oil and gas operators, third party contractors and Proserv's own decommissioning project experience. Proserv reviewed the platform decommissioning scenario developed by the MMS for its 2004 cost report and determined that the scenario developed by MMS is reasonable and appropriate given the age and size of platforms, water depths, and their geographic locations. The revised decommissioning scenario represents Proserv's best professional judgment regarding the platforms to be removed during each project and the type of DB required to make the heavy lifts in a safe and efficient manner. The scenario assumes six decommissioning projects will be conducted during the 2015-2030 time period, and that 2-6 platforms will be removed during each project to minimize the high cost of mobilizing/demobilizing DB's from the Gulf of Mexico, North Sea, or Asia. The sequence and timing of the projects could differ markedly however, due to economic, technological and other factors.

The MMS is planning to update of the cost report every five years to incorporate new information that results from advances in technology or changes in market conditions, and Federal, State and Local regulatory requirements. The Proserv report includes historical information on inflationary trends in U.S. economy and onshore and offshore construction industry that MMS will consider in determining whether to update the cost estimates annually between the five-year update intervals. More frequent updates may be required if unanticipated advances in technology occur or if there is a significant change in regulatory requirements.

The Proserv report estimates costs for each phase of the decommissioning process: Project Management, Engineering and Planning, Permitting and Regulatory Compliance, Platform Preparation, Well Plugging and Abandonment, Conductor Removal, Mobilization and Demobilization of DB's, Structure Removal, Pipeline and Power Cable Decommissioning, Materials Disposal, and Site Clearance.

Platform decommissioning costs can vary widely due to factors such as location and type (complexity) of the facility, number of structures to be removed, water depth and weight associated with the structure, the number and depth of wells and conductors, removal method, and transportation and disposal options. Although water depth and weight (size) are key variables in determining the decommissioning costs for any particular activity, other factors may have significant impact on the decommissioning cost.

The costs of mobilizing and demobilizing a DB can also vary widely depending on the origin of the DB and the number of platforms that are being decommissioned as a group. This cost of mobilizing and demobilizing a DB will be very high in POCSR due to fact that such vessels are currently stationed in the North Sea, Gulf of Mexico, or Asia. It is very unlikely that DB's having a 500 ton or greater lift capability would be stationed in the POCSR unless there was a strong and prolonged market demand for such vessels. This situation is not considered likely to change in the foreseeable future.

Where available locally, resource rates for decommissioning services were estimated as coming from the POCSR. Certain equipment and services however are not available in the POCR and therefore have been estimated as if they were being mobilized from outside California.

Table E.1 shows the estimated decommissioning cost for each of the 23 OCS platforms and the total cost for decommissioning all of the platforms. Figure E.1 shows a percentage breakdown of total decommissioning costs for the POCSR. Figure E.2 is a map showing the location of POCSR platforms and pipelines. Maps showing the platforms that are projected to be decommissioned during each project are included in Appendix 1.

Table E.1. Platform Decommissioning Costs (2009 Dollars)

Platform	Decommissioning Cost
Platform A	$25,595,019
Platform B	$30,548,957
Platform C	$23,683,643
Edith	$29,178,537
Ellen	$35,919,110
Elly	$21,360,859
Eureka	$94,234,596
Gail	$88,839,896
Gilda	$42,788,799
Gina	$12,022,672
Grace	$41,645,339
Habitat	$28,653,889
Harmony	$155,913,807
Harvest	$88,278,478
Henry	$18,621,649
Heritage	$149,600,043
Hermosa	$80,351,462
Hidalgo	$67,918,547
Hillhouse	$26,025,227
Hogan	$34,453,019
Hondo	$91,690,506
Houchin	$33,027,029
Irene	$32,645,792
Total POCSR	$1,252,996,877

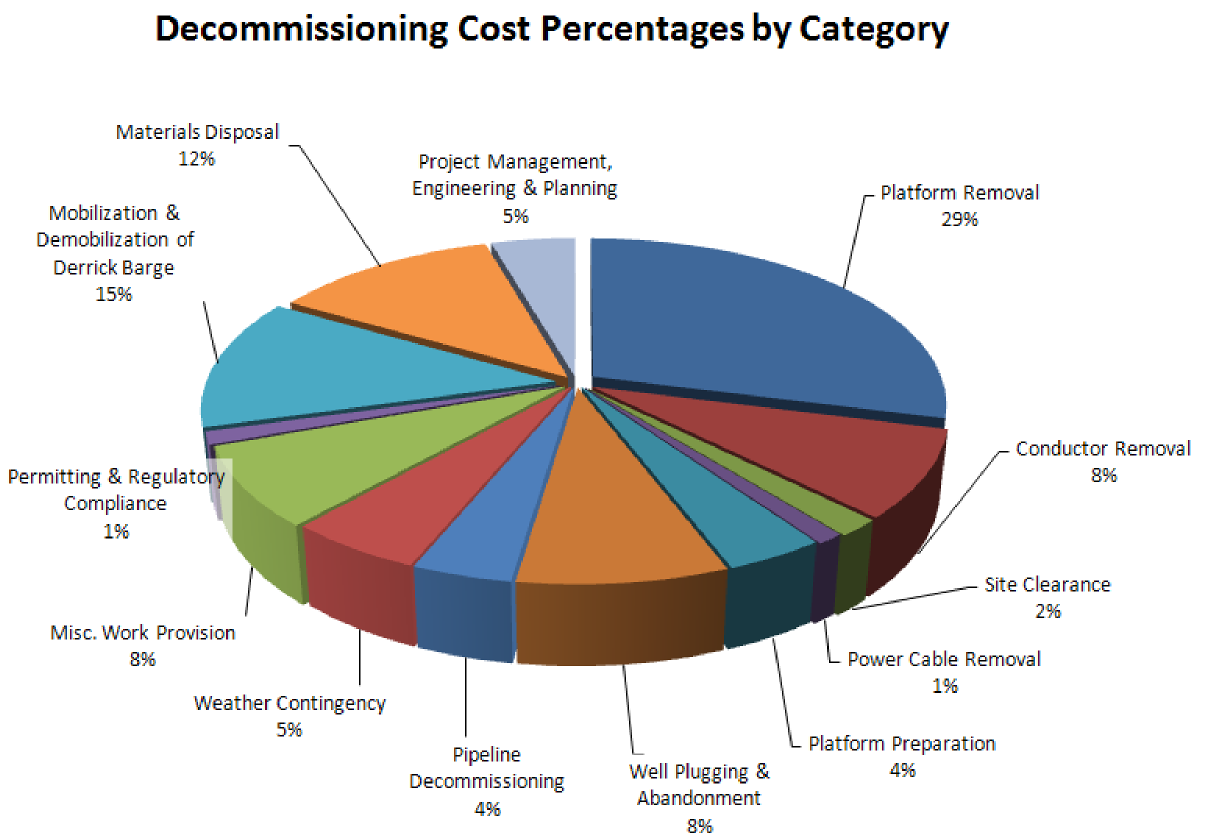

Figure E.1. Decommissioning Cost Percentages by Category

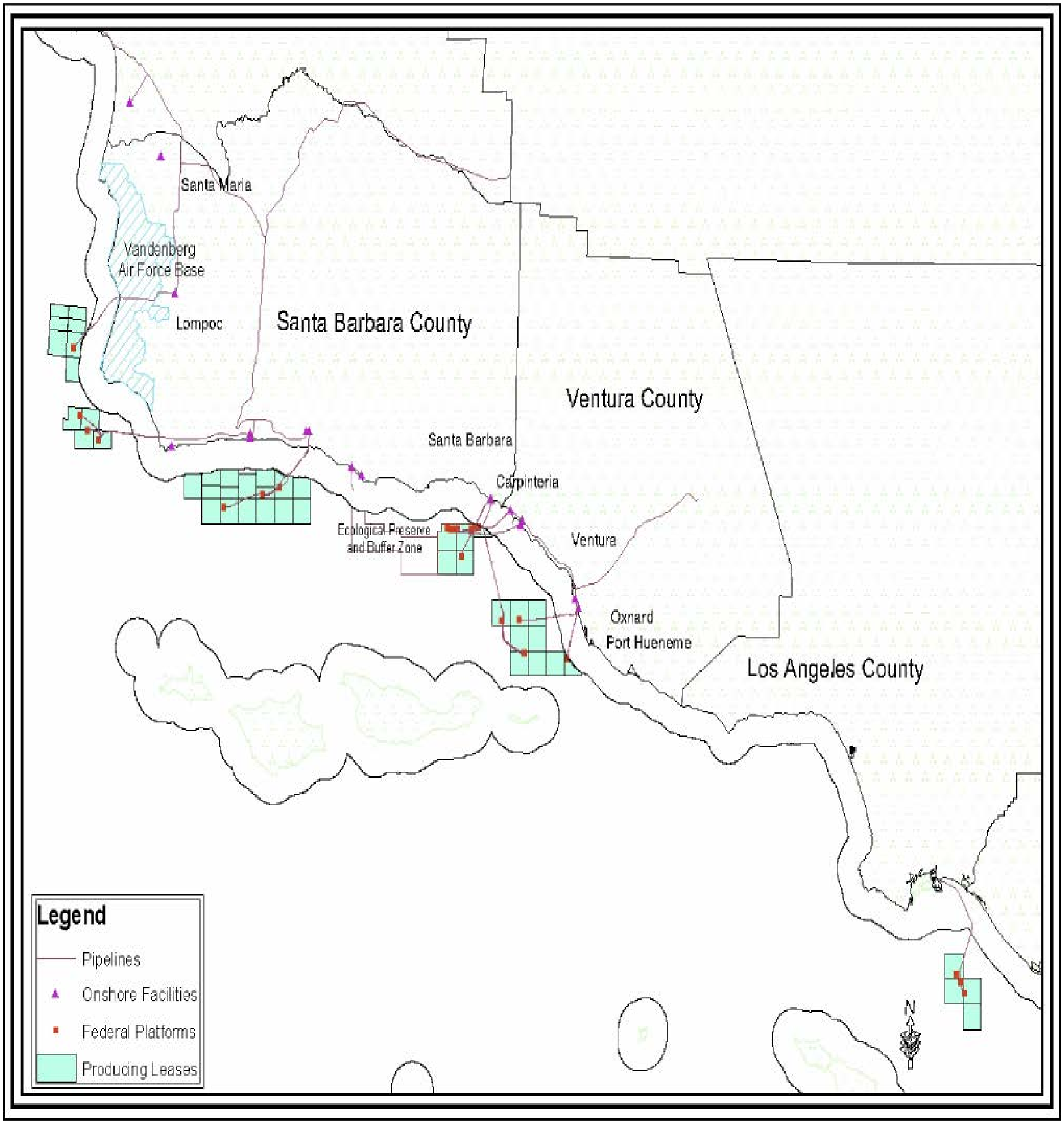

Figure E.2. Federal Platforms and Pipelines in the Pacific OCS Region

Section 1: Introduction

This report was prepared for the Minerals Management Service (MMS) by Proserv Offshore (Proserv). The report updates the decommissioning cost estimates for Pacific OCS Region (POCSR) oil and gas facilities presented in a 2004 report prepared independently by the MMS entitled "Offshore Facility Decommissioning Costs, Pacific OCS Region." This document describes the assumptions and methodology Proserv used in developing the cost estimates for decommissioning POCSR oil and gas facilities and presents a summary of the costs for each phase of the decommissioning process. Volume 2 of the report provides detailed information showing how the costs were estimated.

For this study, Proserv reviewed state of the art technology for decommissioning POCSR oil and gas facilities and developed benchmark costs for decommissioning the facilities utilizing conventional technology that is commonly used and has proven to be successful. The Proserv cost assessment is specific to POCSR operations and included a review of the availability and capability of derrick barges (DB's) in the region (west coast of U.S.), support vessel services, well plugging and abandonment services, abrasive, mechanical and explosive cutting services, disposal options, and site clearance services. Proserv also collected and evaluated cost information from local vendors, to the extent they were available, that provide well plugging and abandonment services and other decommissioning related services, and developed equipment and labor costs (spread costs) for conducting these operations. In those cases where local/regional decommissioning services are not readily available, Proserv estimated the mobilization and demobilization cost and day-rate cost of the services, developed spread costs for the operations, and prepared decommissioning cost estimates using this information. The information presented in this report was obtained from previous technical decommissioning studies published by the MMS, industry sources, and Proserv's own historical decommissioning project data from the POCSR and the Gulf of Mexico Region.

Decommissioning experience in the POCSR is very limited, as is information on costs. To date, only seven relatively small structures have been decommissioned; all were located in State waters. The most recent project occurred in 1996 when Chevron removed Platforms Hope, Heidi, Hilda, and Hazel. The four platforms were located in water depths ranging from 100 to 140 feet and their total combined weight approximated 12,000 tons. In a news release dated April 17, 1996, Chevron reported that the cost of the final phase of dismantling and removing the four platforms was approximately $19 million. This cost did not include the costs to permanently plug 134 wells on the platforms. Local media coverage and industry journal articles reported that the total project cost ranged between $35 million and $40 million.

Proserv has compiled a significant amount of technical and cost data on platforms that have been decommissioned in the Gulf of Mexico. The majority of this data covers platforms that were located in water depths of less than 200 feet. From 200 to about 400 feet, there is less data available because fewer decommissioning projects have occurred in these water depths. Beyond a water depth of about 400 feet, the experience and data decline to the point where industry estimates and our cost estimates are based primarily on projections. It is clear, however, that decommissioning costs will rise steeply as decommissioning activities move from shallow water near shore to deeper water environments farther offshore.

Relative to the Gulf of Mexico, the POCSR has a high percentage of large deepwater structures. Of the 23 platforms, 14 (61%) are located in water depths exceeding 200 feet. Moreover, 8 (35%) of the POCSR platforms are located in water depths that exceed 400 feet. The removal weight for individual platforms ranges from about 1,100 to nearly 70,000 tons. Table 1.1 provides information on water depth, weight, year installed, and field/unit for each of the 23 Pacific OCS platforms.

Each step in the decommissioning process is discussed individually in the sections that follow: Project Management, Engineering and Planning, Permitting and Regulatory Compliance, Platform Preparation, Well Plugging and Abandonment, Conductor Removal, Mobilization and Demobilization of Derrick Barges, Platform Removal, Pipeline and Power Cable Decommissioning, Materials Disposal, and Site Clearance.

The appendices include detailed specifications for the offshore facilities in the POCSR, estimated decommissioning cost for each platform, and detailed cost tables for selected decommissioning elements. Also included in the appendices are maps of the decommissioning projects used to determine the costs for this report and information on trends in general inflation, heavy construction inflation, and derrick barge and vessel costs.

Table 1.1. Pacific OCS Region Platforms

Platform	Water Depth (ft)	Estimated Removal Weight (tons)*	Year Installed**	Field/Unit
A	188	3,457	1968	Dos Cuadras
B	190	3,457	1968	Dos Cuadras
C	192	3,457	1977	Dos Cuadras
Edith	161	8,038	1983	Beta/Beta
Ellen	265	9,600	1980	Beta/Beta
Elly	255	9,400	1980	Beta/Beta
Eureka	700	29,000	1984	Beta/Beta
Gail	739	29,993	1987	Sockeye/Santa Clara
Gilda	205	8,042	1981	Santa Clara/Santa Clara
Gina	95	1,006	1980	Hueneme/Pt. Hueneme
Grace	318	8,390	1979	Santa Clara/Santa Clara
Habitat	290	7,564	1981	Pitas Point/Pitas Point
Harmony	1,198	65,089	1989	Hondo/Santa Ynez
Harvest	675	29,040	1985	Pt. Arguello/Pt. Arguello
Henry	173	2,832	1979	Carpinteria
Heritage	1,075	56,196	1989	Pescado/Santa Ynez
Hermosa	603	27,330	1985	Pt. Arguello/Pt. Arguello
Hidalgo	430	21,050	1986	Pt. Arguello/Pt. Arguello
Hillhouse	190	3,100	1969	Dos Cuadras
Hogan	154	3,672	1967	Carpinteria
Hondo	842	23,550	1976	Hondo/Santa Ynez
Houchin	163	4,227	1968	Carpinteria
Irene	242	7,100	1985	Pt. Pedernales/Pt. Pedernales Tranquillon Ridge/Tranquillon Ridge

* Weight consists of Jacket, Deck and Pile Weight

** Year Installed Date is the jacket installation launch date.

Section 2: Pacific Region Decommissioning Equipment and Services Market

The market for offshore decommissioning equipment and services is very limited in California relative to the Gulf of Mexico (GOM) where approximately 3,200 offshore structures have been decommissioned to date and more than 100 oil and gas structures are removed annually. As noted in Section 1, the most recent decommissioning project occurred in 1996 when Chevron removed four small platforms from State waters. Due to the lack of offshore oil and gas related construction and decommissioning activity in the POCSR, DB operators and other contractors who provide decommissioning services in the U.S. are concentrated in the GOM. This includes large offshore construction companies such as Manson Construction Company which during the past decade have transferred DB's (e.g. the DB 500 Wotan which removed the Chevron 4-H Platforms) and other equipment from the POCSR to the GOM and overseas locations to take advantage of the strong market that exists for offshore construction and decommissioning services in those areas. Specialty decommissioning services such as abrasive cutting and rig-less well plugging and abandonment (P & A) services are also concentrated in the GOM, North Sea, and Asia, where they provide services to the offshore oil and gas industry. For this study, Proserv has assumed that DB's will be mobilized from outside the POCSR. Proserv has also assumed that rig-less well P & A equipment and crews and abrasive cutting services will be mobilized from the GOM to support decommissioning operations. Mobilization of equipment and services from other regions was also considered but trucking and air fare costs were determined to be much higher from those areas. Vessels and equipment that are available locally include crew boats, small workboats, tugs and cargo barges, and survey vessels. Proserv developed its decommissioning costs estimates using local vendor rates where possible.

Factors Considered in Selecting Derrick Barges

One of the most important steps in the decommissioning process involves selecting a DB that has the lifting capability necessary to dismantle the platform in a safe, efficient, and cost effective manner. The selection process is influenced by the characteristics of the structure to be removed, including the water depth, deck module weight, jacket weight, and equipment weight. Structure removal is most efficiently and safely performed when decks can be removed using the reverse installation method (as described in Section 11). In this method, platform preparation time and the number of lifts are significantly reduced compared to small piece removal which requires more engineering analysis and more cutting to create smaller lift packages. The advantages associated with reverse installation also apply to jacket removal because the number of jacket cuts, lifts and diver submersion times are significantly reduced. Safety is one of the foremost considerations in selecting the type of DB to remove a platform. The reverse installation method has inherent safety advantages relative to small piece removal due to the reduced number of crane lifts required to dismantle a platform. This fact is underscored by MMS reports that show that there were more than 300 crane related accidents in the GOM, POCSR, and Alaska OCSR between 1995 and 2006. These accidents resulted in 104 injuries and 11 fatalities, nearly a quarter of all OCS fatalities over that time-period (Offshore Engineer, September 11, 2007). Due to the importance of safety considerations, there is strong preference within the oil and gas industry to contract DB's that have extensive decommissioning experience and an excellent safety record.

For this study, Proserv determined that DB's having a maximum lift capability of 500 tons, 2,000 tons and 4,000 tons will be required to remove the 23 platforms located on the OCS offshore California. These DB's have the capability to remove the platforms using the reverse installation method and are the most likely DB of choice based on standard industry practice, particularly considering the safety considerations described above.

For this study, Proserv conducted a detailed analysis of other DB's including those based locally which typically have a maximum full revolving load capacity of approximately 350 tons or less. These DB's have historically operated in inland and near shore waters and have not been used to install or decommission any oil and gas platforms offshore California. Additionally, they do not have berthing capacity to accommodate offshore workers. Proserv has concluded that any cost savings resulting from reduced day rates and localized mob/demob times are likely to be offset by the added expense of dismantling in smaller pieces and the costs associated with transport of crew between shore and the DB for each shift change. Given the priority industry places on safety considerations, experience, and operating efficiency, Proserv considers it highly unlikely that such a DB will be selected to decommission POCSR platforms, particularly if the current operator is unable to meet its decommissioning obligations and another party, such as the federal government, has to step in and secure the services of a private contractor to manage and oversee the project. Such a contractor will likely follow standard industry practice in selecting the DB to do the work.

Proserv also considered lift boats and special purpose vessels that are typically used to decommission caissons or minimal structures in shallow waters in the GOM. Proserv determined that these boats and vessels do not have the desired capability required to remove the POCSR platforms in an efficient and cost effective manner.

Dynamic Positioning Dive Vessels

For this study, Proserv has determined that a dynamic positioning class 2 (DP2) dive vessel will be required to support the equipment and divers needed to decommission the jackets and pipelines located in waters greater than 200 ft. The DP2 system automatically controls a vessels heading and position using its propellers and thrusters, together with wind and motion sensors. The DP2 dive vessel will be mobed from southeast Asia, as these vessels are not available locally. The mob/demob time will be 100 days total.

Rig-less Well Plugging and Abandonment

Although well service contractors exist in the POCSR, most provide only conventional well P & A services that use rigs and cranes. For this study, Proserv considered both rig and rig-less methods for well P & A and determined that rig-less methods would be the most economical method (see Section 8). Rig-less plugging and abandonment services will be performed by specialty subcontractors, which are not available in the POCSR. It is assumed that rig-less crew and equipment will be mobilized/demobilized from the nearest available location, the GOM.

Cutting Services

Many decommissioning contractors offer basic cutting services as part of their services package, but subcontractors are usually sought when: decommissioning operations are performed in deep water; involve complicated severing scenarios such as conductor or pile severing; or require specialty severing methods such as explosive, abrasive, diamond wire, or mechanical saw severing. Diamond wire cutting is most often used in downed or damaged platform decommissioning, is limited to external cutting, and is usually more expensive than the other specialty cutting services mentioned. Mechanical cutting services, which are generally limited to conductors, are provided in an entirely different way than either abrasive cutting or diamond-wire cutting. The latter two services are provided as an essentially complete and self contained cutting service. In the case of mechanical cutting, the equipment and services required are generally provided piecemeal by several suppliers. For example, mechanical cutting tool suppliers generally do not provide the pumps (and operators) required to perform the cutting. Mechanical cutting is generally provided by a contractor who will hire the individual equipment and services necessary to perform the work. This is generally less efficient (and more expensive) than other methods, and therefore is not likely to be used in the POCSR. In the past decade, abrasive cutting technology has become more competitive and is now widely used in the GOM. Proserv has assumed abrasive cutting methods will be used for POCSR decommissioning projects. Since the GOM is the nearest location available relative to the POCSR, abrasive spreads are assumed to be mobilized/demobilized from there.

Section 3: Decommissioning Cost Assumptions and Scenario

This section provides a description of the decommissioning cost assumptions and scenario used in this report to estimate decommissioning costs for POCSR platforms and associated pipelines and power cables. The decommissioning scenario assumes that the platforms will be completely removed and the materials transported to shore for recycling or disposal. The decommissioning costs were developed by Proserv based on information obtained from MMS files, oil and gas operators, consultants, and technical decommissioning studies funded by MMS and others.

Proserv reviewed the platform decommissioning scenario developed by the MMS for its 2004 cost report and determined that the scenario developed by MMS is reasonable and appropriate given the age and size of platforms, water depths, and geographic location of the platforms. The revised decommissioning scenario represents Proserv's best professional judgment regarding the platforms to be removed during each project and the type of DB required to make the heavy lifts in a safe and efficient manner. The scenario assumes six decommissioning projects will be conducted during the 2015- 2030 time period, and that 2-6 platforms will be removed during each project to minimize the high cost of mobilizing/demobilizing DB's from the Gulf of Mexico, North Sea, and Asia. The sequence and timing of the projects could differ markedly however, due to economic, technological and other factors.

Decommissioning Cost Assumptions

- Costs are estimated in 2009 U.S. Dollars.
- Conventional state-of-the-art technology (reverse installation using DB's) will be used to remove platforms.
- A total of six OCS decommissioning projects are projected to be conducted during 2015-2030; all of the POCSR oil and gas platforms (23 facilities) will be removed during this period.
- During each project a total of 2-6 platforms will be decommissioned using DB's mobilized from the Gulf of Mexico, North Sea or Asia.
- Platforms will be completely removed and transported to shore for disposal.
- Explosives will not be used during the decommissioning process.
- For pipelines routed to shore, pipeline segments will be removed from the 200 foot water depth level to the State Tidelands boundary (3 miles from shore); pipeline segments between platforms on the OCS will be decommissioned in place; OCS pipeline segments in greater than 200 feet of water will be decommissioned in place.
- Power cables will be completely removed from the OCS to the State Tidelands boundary.
- No salvage or resale value has been considered for the structures, pipelines or power cables that are removed.
- One DB mobilization/demobilization cost is included for each of the six projects.
- The roundtrip mobilization/demobilization times for derrick barges (DB's) are: 100 days for a DB having a 500 or 2,000 ton maximum lift capability (DB 500, DB 2000) mobilized from southeast Asia; and 200 days for DB having a 4,000 ton maximum lift capability (DB 4000) mobilized from the Gulf of Mexico or North Sea.

- The weather contingency downtimes for demolition operations are: 15% for the Point Arguello area, 10% for the Santa Barbara Channel area, and 5% for the South Coast area.

- No downtime is assumed due to the presence of whales or marine mammals.

- A general contingency (provisional work) of 15% is applied to all phases of the decommissioning process except project management, engineering and planning, permitting and regulatory compliance, and mobilization and demobilization of the DB's, to cover unanticipated problems and cost overruns.

- Project Management, Engineering & Planning costs are estimated to be 8% of the total cost of the project excluding costs associated with DB mob/demob, permitting and regulatory compliance, materials disposal, weather and provisional work allowances.

Scope of Cost Analysis

This section provides a listing of the items that are included in the cost estimates developed by Proserv for this report. Also listed are items for which costs were not estimated.

Costs Included

- Project Management, Engineering and Planning
- Permitting and Regulatory Compliance
- Platform Preparation
- Well Plugging and Abandonment
- Conductor Removal
- Mobilization and Demobilization of DB's
- Platform Removal
- Pipeline and Power Cable Decommissioning
- Materials Disposal
- Site Clearance
- Provisional Work and Weather Contingency Factors

Costs Not Included

- Decommissioning of pipelines and power cables on State Tidelands.
- Decommissioning of onshore pipelines and power cables.
- Decommissioning of associated marine terminals and piers.
- Decommissioning of associated onshore oil and gas processing facilities.
- The costs of remediating any potential impacts from shell mounds: such costs could include requirements to cap or remove shell mounds, requirements for offsite restoration to offset any adverse impacts of shell mounds that are left in place, or requirements to compensate commercial trawlers for the loss of fishing grounds.

Decommissioning Scenario

This section describes the six decommissioning projects that are projected to be conducted during 2015-2030 (see Table 3.1.) As noted above, a total of two to six platforms are expected to be removed during each project. For each project, a DB is assumed to be mobilized from the Gulf of Mexico, North Sea, or Asia. The DB's projected to be used have lift capabilities of 500 tons, 2,000 tons, and 4,000 tons. The type of DB selected for each project was determined based on the size (total weight) of each individual platform included in the project, the projected maximum lift packages, and oceanographic considerations. A number of factors were considered in developing the projects, including the size, age and geographic location of the platforms, remaining oil and gas reserves, water depth, and company operators/ownership. For each project, the DB mobilization/demobilization (mob/demob) costs are allocated evenly among platforms.

Project I – Eastern Santa Barbara Channel

- Platforms Hogan and Houchin are projected to be removed during 2015-2020.
- A DB with a lift capability of 500 tons will be mobilized from Asia.
- The estimated mob/demob time is 100 days.

Project II – South Coast (Los Angeles/Orange County)

- Platforms Eureka, Elly, Ellen and Edith are projected to be removed during 2015- 2020.
- A DB with a lift capability of 2,000 tons will be mobilized from Asia.
- The estimated mob/demob time is 100 days.

Project III – Eastern Santa Barbara Channel

- Platforms A, B, C, Henry, Hillhouse and Gina are projected to be removed during 2015-2020.
- A DB with a lift capability of 2,000 tons will be mobilized from Asia.
- The estimated mob/demob time is 100 days.

Project IV – Eastern Santa Barbara Channel

- Platforms Gilda, Irene and Habitat are projected to be removed during 2015-2020.
- A DB with a lift capability of 2,000 tons will be mobilized from Asia.
- The estimated mob/demob time is 100 days.

Project V – Southern Santa Barbara Channel/Santa Maria Basin

- Platforms Gail, Grace, Hermosa, Harvest and Hidalgo are projected to be removed during 2020-2025.
- A DB (dynamically positioned mono-hull) with a lift capability of 4,000 tons will be mobilized from the Gulf of Mexico or North Sea.
- The estimated mob/demob time is 200 days.

Project VI – Western Santa Barbara Channel

- Platforms Hondo, Harmony, and Heritage are projected to be removed during 2025-2030.
- A DB (dynamically positioned mono-hill) with a lift capability of 4,000 tons will be mobilized from the

Gulf of Mexico or North Sea.

- The estimated mob/demob time is 200 days.

Table 3.1. Projected Decommissioning Projects

Platform	Year Installed	Water Depth (feet)	Deck Weight (tons)	Jacket Weight* (tons)	Projected Removal Timeframe	Projected DB Lift Capability (tons)
Project I – Eastern Santa Barbara Channel						
Hogan	1967	154	2,259	1,263	2015-2020	500
Houchin	1968	163	2,591	1,486	2015-2020	500
Project II – South Coast (Los Angeles/Orange County)						
Eureka	1984	700	8,000	19,000	2015-2020	2,000
Elly	1980	255	4,700	3,300	2015-2020	2,000
Ellen	1980	265	5,300	3,200	2015-2020	2,000
Edith	1983	161	4,134	3,454	2015-2020	2,000
Project III – Eastern Santa Barbara Channel						
A	1968	188	1,357	1,500	2015-2020	2,000
B	1968	190	1,357	1,500	2015-2020	2,000
C	1977	192	1,357	1,500	2015-2020	2,000
Henry	1979	173	1,371	1,311	2015-2020	2,000
Hillhouse	1969	190	1,200	1,500	2015-2020	2,000
Gina	1980	95	447	434	2015-2020	2,000
Project IV – Santa Barbara Channel/Southern Santa Maria Basin						
Gilda	1981	205	3,792	3,220	2015-2020	2,000
Irene	1985	242	2,500	3,100	2015-2020	2,000
Habitat	1981	290	3,514	2,550	2015-2020	2,000
Project V – Santa Barbara Channel/Southern Santa Maria Basin						
Gail	1987	739	7,693	18,300	2020-2025	4,000
Grace	1979	318	3,800	3,090	2020-2025	4,000
Hermosa	1985	603	7,830	17,000	2020-2025	4,000
Harvest	1985	675	9,024	16,633	2020-2025	4,000
Hildalgo	1986	430	8,100	10,950	2020-2025	4,000
Project VI – Western Santa Barbara Channel						
Hondo	1976	842	8,450	12,200	2025-2030	4,000
Harmony	1989	1,198	9,839	42,900	2025-2030	4,000
Heritage	1989	1,075	9,826	32,420	2025-2030	4,000

* Jacket Weight is the weight of the jacket only and does not include the weight of the deck, conductors or piles.

Section 4: Decommissioning Methodology

This section describes the methodology on which the decommissioning costs in this report are based. The methodology is consistent with the cost assumptions previously described and with MMS decommissioning requirements (30 CFR Parts 250 and 256) and standard industry practice.

Well Plugging and Abandonment

- All unplugged wells will be permanently plugged and abandoned (P & A) consistent with MMS requirements.
- Rig-less methods will be used to P & A wells.
- Rig-less equipment and crews will be mobed/demobed from the Gulf of Mexico.
- This work will be completed prior to arrival of the DB.

Conductor Removal

- All conductors will be removed to a depth 15 feet below the original mudline.
- Abrasive cutting methods will be used to sever the conductors below the mudline.
- Casing jacks will be used to make the initial lift to confirm that conductors have been completely severed below the mudline.
- Casing jacks will be used to pull the conductors.
- Abrasive or torch cutting methods will be used to cut the conductors into 40-foot-long segments.
- A rental crane will place the cut sections on a workboat for transport to an onshore disposal site.

Platform Preparation

- A platform inspection, above and below the water line, will be conducted to determine the condition of the platform and identify potential problems that would affect removal procedures. The inspection will be conducted by divers or remotely operated vehicles (ROVs).
- All piping and equipment on the platform that contained hydrocarbons will be flushed and cleaned. All industrial wastes will be removed from the platforms prior to decommissioning.
- All modules to be removed separately from the deck will be detached from the platform structure using oxygen-acetylene cutting torches.
- The piping, electrical, and instrumentation connections between modules will also be cut.
- Modules and captrusses (support frames) will be prepared for removal; new padeyes and lift supports will be installed; welds around bearing joints will be removed; and external equipment obstructing module lifts will be removed.
- It is assumed that 50% of the number of padeyes necessary for making the deck structure lifts must be fabricated and installed.

- Diving crews will use 10,000 psi water blasters to remove marine growth from the jacket to a water depth of approximately 100 feet; the dive spread will be set up on the platform; this work will be completed prior to the arrival of the DB.
- The remaining marine growth attached to the deeper jacket sections will be removed after the DB places the sections on the cargo barges or at the offloading facility/scrap yard; topside or onshore crews will use high-pressure water blasters to remove the marine growth.

Pipeline Decommissioning

- All pipelines will be flushed and cleaned.
- Divers or an ROV will then expose the ends of the pipeline and cut the line above the riser bend and approximately 100 feet from the base of the jacket.
- Pipelines will be evaluated by MMS on a case-by-case basis during the permitting process to determine whether they will be approved to be left in place or required to be partially or totally removed. For this study, Proserv estimated pipeline removal cost based on the following assumptions: (a) for pipelines routed to shore, pipeline segments will be removed from the 200 foot water depth level to the State Tidelands boundary; (b) pipeline segments between platforms on the OCS will be decommissioned in place; (c) OCS pipeline segments in greater than 200 feet of water depth will be decommissioned in place.
- Pipelines remaining in place (those in water depths greater than 200 feet) will be required to be sealed using mechanical-type plugs or inflatable plumber's plugs and their ends buried 3 feet below the mudline, or covered with protective mats (e.g. articulated concrete mats).
- Pipeline segments that are removed will be cut into 30 to 40 foot segments on the crane barge, and then loaded on to cargo barges for transport to shore, where they will be transported by truck to recycling facilities or a disposal site.
- A small crane barge will be mobilized from the southern California area to remove pipelines.

Power Cable Decommissioning

- Power cables will be completely removed from the OCS.
- A local workboat mobilized from the Port of Los Angeles or Long Beach will be used to pull up cable and cut into sections
- The power cables will be transported to shore by cargo barge and taken to a disposal site.

Mobilization and Demobilization of Vessels

- Dynamically positioned DB's, dive vessels, and anchor handling tugs will be mobilized from the Gulf of Mexico, North Sea or Asia.
- Cargo barges will be mobilized from the Ports of Los Angeles or Long Beach.
- Cargo barges will be outfitted at a fabrication yard with steel pads (load spreaders) to support the point loads of the deck modules and jacket sections.
- Local crew boats, workboats, support vessels and non-dynamically positioned dive boats will be

utilized to the maximum extent possible.

Topsides Removal

- Topside modules will be removed (reverse installation) and placed on cargo barges.
- The deck section or support frames (captrusses) will be removed by cutting the welded connections between the piles and the deck legs with oxygen-acetylene torches.
- Slings will be attached to the deck/captrusses lifting eyes and to the DB crane.
- The DB crane will lift the deck sections from the jacket and position the sections in load spreaders.
- The deck sections will be secured by welding steel pipe from the deck legs to the deck of the cargo barge.

Topsides Transport and Onshore Disposal

- Tugboats and cargo barges will transport the topside modules and deck structures to an offloading facility/scrap yard located at the Port of Los Angeles or Long Beach.
- The modules will be lifted off the cargo barges by dockside cranes or skidded off the barge.
- All of the structural components will be cut into small pieces and scrapped.
- Non-metallic materials (cement, plastics, wood, etc.) will be transported to shore for disposal in a landfill.

Jacket Removal

- Jackets will be sectioned in situ (in place) and removed by a DB.
- Piles and skirt piles will be severed 15 feet below the original mudline by abrasive cutting tools.
- Divers or ROVs will be deployed to sever structural members and section the jackets.
- Saturation diving techniques will be required below 150 foot water depths.

Jacket Transport and Onshore Disposal

- Tugboats and cargo barges will transport the jacket sections to an onshore offloading facility/scrap yard located at the Port of Los Angeles or Long Beach.
- The jacket sections will be lifted off the barges by dockside cranes or skidded off the barge.
- The jacket sections will be cut into small pieces and transported to a scrap yard.

Site Clearance

- Site clearance and verification shall be in accordance with MMS requirements (30 CFR 250.1700-1754) and procedures described in the site clearance section of this report.

- The seafloor impacted as a result of oil and gas exploration, development, production, and decommissioning operations will be restored to a condition that ensures the area has been cleared of all obstructions to other activities.

- Site clearance procedures will include the following elements:

  1. Pre-decommissioning high resolution side-scan sonar survey (SSS).
  2. Post-decommissioning high resolution SSS
  3. ROV/diver target identification and recovery of obstructions
  4. Test-trawling

- The pre-decommissioning SSS will cover all areas of the lease where operations occurred, including pipeline and power cable routes, and anchoring and mooring locations to identify any potential oil and gas related obstructions.

- The post-decommissioning SSS will cover all areas where decommissioning activities occurred to identify debris and obstructions resulting from decommissioning operations.

- A dive/ROV boat will be deployed to inspect and retrieve debris or obstructions identified during the SSS surveys.

- Test trawling will be conducted to verify that all potential obstructions have been cleared from the OCS lease(s).

Section 5: Project Management, Engineering and Planning

The project management, engineering and planning phase of the decommissioning process typically begins two to three years before production ceases and involves (1) a review of contractual obligations, (2) engineering analysis, (3) operational planning, and (4) contracting. The first step involves conducting a detailed review of all records and decommissioning requirements including lease, operating, production/unit, pipeline, and production sales agreements. A detailed engineering analysis is also conducted of drilling records, as-built drawings, construction reports, maintenance records and inspection reports. Field inspections are done to verify the structural integrity of the platform and examine the present condition of the wellheads and equipment. Based on this information, detailed engineering plans are developed for plugging and abandoning the wells, severing the conductors and piles, removing the topsides and jacket, and disposing of the materials. Concurrently, a comprehensive survey of decommissioning vessels and equipment is made to determine their availability and cost. Bids are then solicited and contractors selected.

Due to the limited availability of DB's, contracting for such vessels is typically done two to three years in advance. Although some engineering functions can be conducted in-house if expertise exists, many steps in the decommissioning process require specialized expertise and the operator/lessee must contract for this expertise. These steps include the selection of mechanical, abrasive, or explosive cutting services, civil engineering services to design and prefabricate the modules for individual lifts, and diving services. In addition, the services of firms having project management and engineering expertise specific to decommissioning are often secured to manage the complex logistics of the overall project.

Cost Assumptions

The costs of project management, engineering and planning for decommissioning an offshore structure can vary widely, depending on the type of structure, its size and water depth, removal procedures, and transportation and disposal options. For this study, project management, engineering and planning costs are estimated to be 8% of the total decommissioning cost excluding DB mob/demob, permitting and regulatory compliance, materials disposal, weather and provisional work allowances. The 8% figure represents the average cost for projects that have been managed by Proserv during the past 20 years. The cost information was obtained from Proserv's in-house data base that compiles annual cost data on oil and gas platform decommissioning projects in the Gulf of Mexico. POCSR cost percentages are expected to be comparable.

Cost Estimates

The range of costs for the engineering and planning cost component is shown in Table 5.1. The costs range from a low of approximately $0.5 million to a high of approximately $6.9 million. The 8% cost figure is calculated from total decommissioning cost excluding DB mob/demob, permitting and regulatory compliance, materials disposal, and weather and provisional work allowances.

Table 5.1. Project Management, Engineering and Planning Costs

Platform	Cost Factor %	Decommissioning Cost*	Total Costs
A	0.08	$15,477,149	$1,238,172
B	0.08	$18,876,015	$1,510,081
C	0.08	$14,083,286	$1,126,663
Edith	0.08	$16,375,723	$1,310,058
Ellen	0.08	$20,868,927	$1,669,514
Elly	0.08	$9,927,366	$794,189
Eureka	0.08	$61,388,779	$4,911,102
Gail	0.08	$51,302,561	$4,104,205
Gilda	0.08	$24,284,922	$1,942,794
Gina	0.08	$6,172,255	$493,780
Grace	0.08	$21,645,883	$1,731,671
Habitat	0.08	$14,196,205	$1,135,696
Harmony	0.08	$86,080,740	$6,886,459
Harvest	0.08	$49,447,844	$3,955,828
Henry	0.08	$10,573,075	$845,846
Heritage	0.08	$84,056,788	$6,724,543
Hermosa	0.08	$44,242,737	$3,539,419
Hidalgo	0.08	$37,101,181	$2,968,095
Hillhouse	0.08	$15,910,292	$1,272,823
Hogan	0.08	$18,669,886	$1,493,591
Hondo	0.08	$50,362,614	$4,029,009
Houchin	0.08	$17,430,022	$1,394,402
Irene	0.08	$16,777,879	$1,342,230
Total	-	-	$56,420,171

*Includes Platform Removal, Conductor Removal, Site Clearance, Power Cable Removal, Platform Prep and Marine Growth Removal, Well P&A, and Pipeline Abandonment Costs.

Section 6: Permitting and Regulatory Compliance

This section describes permitting requirements and associated costs for the decommissioning of POCSR oil and gas platforms, pipelines and power cables. The cost estimate for permitting and regulatory compliance assumes the platforms will be completely removed and the projects will not generate any significant or controversial environmental issues that would extend the environmental review process and result in delays in obtaining permit approvals from regulatory agencies. Such issues could include proposals to convert an offshore platform to an artificial reef or controversy regarding the fate of shell mounds which if removed could release deleterious materials in the marine environment, or if left in place could pose a hazard to commercial trawlers.

Permitting and regulatory compliance costs are incurred in obtaining the necessary Federal, State, and local permits required to conduct decommissioning operations and prepare the environmental documentation to satisfy the requirements of the California Environmental Quality Act (CEQA) and the National Environmental Policy Act (NEPA). The costs to satisfy special environmental mitigation requirements that typically are placed on the project by regulatory agencies are also included in this cost component. Examples include marine mammal protection measures, air emission mitigation measures, commercial fishermen preclusion agreements, and pre- and post- decommissioning biological surveys. For decommissioning projects offshore California, these costs can be significant.

Federal agencies that have regulatory authority over various aspects of decommissioning projects include the MMS, National Marine Fisheries Service, U.S. Army Corps of Engineers, U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency, U.S. Coast Guard, and the U.S. Department of Transportation, Office of Pipeline Safety. State and local agencies having regulatory jurisdiction over decommissioning operations in California include the California Coastal Commission, California State Lands Commission, California Department of Fish and Game, California Division of Oil, Gas and Geothermal Resources, California State Fire Marshal, County Planning and Resource Management Departments, and local Air Pollution Control Districts.

Regulatory Agency Jurisdiction

The decommissioning of a Federal OCS oil and gas platform(s) will involve the removal of the structure and associated offshore oil and gas pipelines and power cables that connect the platforms and onshore processing facilities and electrical grids. The project may also involve the decommissioning of an associated onshore processing facility if it is the only facility servicing those platform(s). The three agencies that have primary regulatory jurisdiction over such a project are the MMS, which regulates oil and gas activities on the Federal OCS, the California State Lands Commission (CSLC) which has authority over State Tidelands located within 3 miles from the coastline, and various State and local agencies which regulate onshore oil and gas operations. In addition, there are a number of other agencies that issue permits for decommissioning related activities. Such agencies include the U.S. Army Corps of Engineers, the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration (NOAA Fisheries), U.S. Coast Guard, Environmental Protection Agency, California Coastal Commission, California Department of Fish and Game, and County Air Pollution Control Districts and Planning and Development Departments. Tables 6.2 and 6.3 list the major regulatory agencies and their permitting requirements and authority.

Permitting Process

The process of obtaining all of the permits necessary to conduct decommissioning operations is a complex and challenging process that typically requires a minimum of 2 to 3 years to complete. Due to the numerous permits required and the complexity of the process, companies that have decommissioned offshore oil and gas facilities have historically contracted with local consulting firms that have the technical, environmental and regulatory expertise required to navigate through the regulatory framework. The first step in the process involves preparing an Execution Plan that provides a detailed description of proposed project activities, the associated equipment and personnel requirements, and the schedule for completing the activities. The Execution Plan is prepared to support the application process needed to secure permits from Federal, State and local regulatory agencies. During this phase of the process, environmental baseline information is collected and field surveys are conducted to evaluate the project site.

Once the Execution Plan and project application packages are deemed complete by the MMS and the lead State and/or local agency (CSLC and/or a County Planning and Development Department), the agencies will conduct a joint environmental review of the project pursuant to the National Environmental Policy Act (NEPA) and the California Environmental Quality Act (CEQA). To coordinate the process and minimize duplication of effort, the MMS and the lead CEQA agency generally prepare a joint Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the project. The EIS/EIR analyzes the environmental impacts of the project and describes mitigation measures proposed by the project applicant or recommended by agencies to eliminate or minimize those impacts. Upon completion, the draft EIS/EIR is circulated for public and agency review, including review by the California Coastal Commission (CCC) which must issue a Coastal Development Permit (CDP) for any activities that could impact the coastal zone. Following action by the CCC, the MMS and the lead CEQA agency and can proceed with approving the project by respectively issuing a Record of Decision (ROD) and Notice of Determination (NOD) for the project.

Cost Assumptions

The factors considered in developing cost estimates for permitting and regulatory compliance for this report are described below. The factors were selected based on input received from and gas companies and consulting firms that have been involved in previous oil and gas decommissioning projects offshore California.

(1) Execution Plan: The project applicant, with assistance provided by a consulting firm, will prepare an Execution Plan that provides a detailed description of proposed project activities, the associated equipment and personnel requirements, and the schedule for completing the activities.

(2) Data Collection and Field Surveys: The project applicant will contract with a consulting firm that will compile existing baseline environmental information and conduct field surveys to evaluate the project site and identify the presence of any sensitive marine species and habitats that could potentially be impacted by decommissioning operations. The field surveys will include pre- and post construction surveys. Such surveys were required by regulatory agencies for previous decommissioning projects conducted offshore California.

(3) NEPA and CEQA Documents: The project applicant will be required to fund the preparation of EIS/EIR. Upon submission of an application package that is deemed complete, the MMS and lead CEQA agency will oversee the preparation of an EIS/EIR that will be conducted by a third party (consulting firm) selected by the agencies.

(4) Agency Processing Fees and Staff Time: The project applicant will be responsible for covering these expenses. Federal, State and local regulatory agencies in California impose fees for processing applications or require applicants to reimburse the agencies for staff time required to review and process permits.

(5) Environmental Mitigation Requirements: The project applicant will be responsible for mitigating impacts to air quality and commercial fishermen who would be precluded from fishing in the area where decommissioning operations are conducted. This mitigation involves payments to fishermen for lost catch and fees paid the local air pollution control districts for technology demonstration projects and other air quality improvement programs. Regulatory agencies have also required project applicants to prepare Wildlife Protection Plans and post trained marine mammal observers to monitor decommissioning operations to ensure protection of whales and other marine mammals. Such requirements were imposed by regulatory agencies on Chevron when it decommissioned Platforms Hope, Heidi, Hilda and Hazel in State waters in 1996.

(6) Mitigation Monitoring and Compliance: The project applicant, with the assistance of a consultant, will

develop and implement a Mitigation Monitoring and Compliance Plan for the project Regulatory agencies require project applicants to develop and implement these plans to ensure that environmental mitigation measures and other conditions placed on the project by the approving authorities are satisfied by the project applicant. The monitoring activities are typically performed by consultants and regulatory agency personnel. Monitoring plans were developed and implemented by Chevron and other companies for previous decommissioning projects conducted offshore California.

Cost Estimates

Table 6.1 provides a breakdown of the cost estimates for permitting and regulatory compliance that were developed for this study based on the cost assumptions described above. The costs are shown on a per project basis. The costs have been apportioned equally among the number of platforms projected to be removed each decommissioning project in developing the individual platform cost estimates presented in this report.

Table 6.1. Permitting and Regulatory Compliance Costs

Cost Factors	Cost Per Project
1. Execution Plan Preparation	$100,000
2. Data Collection and Field Surveys	$60,000
3. Prepare NEPA and CEQA Documents (EIS/EIR)	$2,000,000
4. Agency Processing Fees and Staff Time	
• Application Fees	$50,000
• Agency Staff Time	$65,000
• Applicant Consultant Support	$50,000
5. Environmental Mitigation Requirements	
• Mitigation Fees (Air and Fisheries)	$100,000
• Marine Mammal Monitoring	$65,000
6. Mitigation Monitoring and Compliance	$65,000
Total Cost Per Project	$2,555,000

Table 6.2. Federal Permitting Requirements Applicable to Decommissioning Projects

(Source: Padre Associates, Inc. with modifications)

Agency	Permit/Approval	Regulated Activity	Review Period	Authority
Federal Agencies				
Minerals Management Service	Lead NEPA agency. DPP Amendment and termination of pipeline right-of-way	Addresses final disposition of all OCS related facilities.	12 to 16 months to complete NEPA review and project component decommissioning procedures.	30 CFR 250 and 256 MMS NTL No. 2009-P04
US Army Corps of Engineers (ACOE)	Section 404 permit	Discharge of dredged or fills material into waters of the U.S. during construction. Jurisdictional waters include territorial seas, tidelands, rivers, streams and wetlands.	3-4 months including certification of NEPA/CEQA document	Section 404 Clean Water Act (33 USC 1344)
ACOE	Section 10 permit	Structures or work in or affecting navigable waters of the U.S. Review and issuance concurrent with Section 404.	3-4 months including certification of NEPA/CEQA document	Section 10 of the Rivers and Harbors Act (33 USC 403)
United States Fish & Wildlife Service (USFWS)	Endangered Species Act (ESA). Section 7 consultation	Impacts to federally-listed and species proposed for listing.	Conducted concurrently with MMS Permit	16 USCA 1513 50 CFR Section 17
National Oceanic & Atmospheric Administration (NOAA Fisheries)	ESA, Section 7 for steelhead, if present. Marine Mammal Protection Act Essential Fish Habitat Assessment	Impacts to federally-listed and species proposed for listing. Protection of Marine Mammals including impacts associated with explosives use. Managed Marine Fish Resources.	Conducted concurrently with MMS Permit	16 USCA 1513 50 CFR Section 17
United States Coast Guard (USCG)	Navigation consultation Notice to Mariners	Activities that may affect navigable waters	Unspecified	33 CFR

Table 6.3. State and Local Permitting Requirements Applicable to Decommissioning Projects

(Source: Padre Associates, Inc.)

Agency	Permit/Approval	Regulated Activity	Review Period	Authority
State of California Agencies				
California State Lands Commission (CSLC)	Lead agency for CEQA documentation. Pipeline lease agreement termination.	Review of environmental impacts in area of jurisdiction. Removal of components in State Territorial Waters.	6-12 months for certification of CEQA document. Lease termination agreement.	CEQA California Public Resources Code Section 6500.
California Coastal Commission (CCC)	Coastal Development Permit/Federal Consistency	Any development within designated coastal zone.	2-3 month review process, partially concurrent with CEQA review.	California Coastal Act Coastal Zone Management Act
California Department of Fish and Game	Explosives Use Approval and State Endangered Species Consultation. Section 1601	Activities in our effecting State Waters resources. Onshore activities effecting onshore resources including streams and wetlands.	2-3 month review process, partially concurrent with CEQA review.	CEQA Section 1601 State Endangered Species Act
Regional Water Quality Control Board (RWQCB)	Section 401 certification	Discharges that may affect surface and ground water quality.	Concurrent with ACOE review and approval.	Clean Water Act (CWA) Porter-Cologne State Water Quality Act (1969)
Ventura and Santa County Air Pollution Control Board (APCD)	Air quality emissions review; Permit to Operate/Authority to Construct (PTO/ATC) and Portable Engine Permits	Air emission outputs associated with project decommissioning activities.	6 month review process concurrent with CEQA review.	1990 Clean Air Act CEQA review

Section 7: Platform Preparation

Platform preparation includes the procedures associated with shutting down and preparing the facility for removal. Normally a crew paid on a day rate prepares the structure for decommissioning after the wells have been permanently plugged and abandoned. Above water and below water inspections are generally conducted to determine the condition of the structure and to identify any problems to removal. Divers and/or remotely operated vehicles (ROV's) assist in the inspections. On the surface, the work includes the flushing/cleaning and degassing/purging of tanks, processing equipment and piping, disposal of residual hydrocarbons, removal of platform equipment, cutting of piping and cables between deck modules, separation of modules into individual units, installation of padeyes for deck module lifting, removal of obstructions to lifting, and structural reinforcement. Below the water surface, the jacket can be prepared to aid in jacket facilities removal, including the removal of marine growth from the structure.

The key factors affecting the cost of platform preparation include structure size and complexity, topsides equipment (especially the amount of processing equipment), and age of the facility. The costs can vary widely depending on the type of facility, removal procedures, and transportation and disposal options.

For this study, Proserv assumed that marine growth will be removed from the structure, including the conductors and boat landings, by divers down to approximately 100 feet below the ocean surface. This will remove most of the heavy, hard marine growth. The balance of the marine growth will be removed at the offloading facility/scrap yard or by topside crews on the DB using high-pressure water blasters and/or fixed firewater monitors (nozzles) once the jacket or jacket section is on the deck of the barge. The in-water cleaning operations will be completed with the dive equipment set up on the platform to eliminate the need and added cost that would be incurred if the operations were conducted from a dedicated dive vessel.

Range of Costs and Assumptions

Proserv has reviewed past Technology Assessment and Research Program studies funded by MMS, other studies conducted by various companies and contractors, and technical publications to develop the platform preparation costs. We also consulted with engineering firms that conduct such cost studies and a company that conducts marine growth cleaning operations. Table 7.1 shows Proserv's cost estimate of the number of days and platform preparation spread rate, marine growth removal cost, and total cost that would be required to prepare each of the 23 POCSR platforms for decommissioning as described above, including removing the marine growth from each structure. We assumed that a platform removal preparation spread would consist of a utility boat, helicopter use (1 trip/3 days), a preparation crew and materials and supplies. A higher spread rate and cost, due to a larger platform preparation crew and more equipment, was assumed for the larger, more complex topside structures based upon previous cost studies.

Table 7.1. Platform Preparation Costs

Platform	Platform Prep. Days	Prep. Spread Rate	Prep. Cost	Marine Growth Removal	Total Cost*
A	19	$26,000	$494,000	$463,710	$957,710
B	19	$26,000	$494,000	$463,710	$957,710
C	19	$26,000	$494,000	$463,710	$957,710
Edith	18	$26,000	$468,000	$695,564	$1,163,564
Ellen	20	$26,000	$520,000	$695,564	$1,215,564
Elly	46	$26,000	$1,196,000	$695,564	$1,891,564
Eureka	31	$53,000	$1,643,000	$985,383	$2,628,383
Gail	43	$53,000	$2,279,000	$985,383	$3,264,383
Gilda	44	$26,000	$1,144,000	$695,564	$1,839,564
Gina	22	$26,000	$572,000	$173,891	$745,891
Grace	35	$26,000	$910,000	$695,564	$1,605,564
Habitat	39	$26,000	$1,014,000	$695,564	$1,709,564
Harmony	59	$53,000	$3,127,000	$1,738,911	$4,865,911
Harvest	55	$53,000	$2,915,000	$985,383	$3,900,383
Henry	31	$26,000	$806,000	$463,710	$1,269,710
Heritage	55	$53,000	$2,915,000	$1,391,129	$4,306,129
Hermosa	55	$53,000	$2,915,000	$985,383	$3,900,383
Hidalgo	47	$53,000	$2,491,000	$811,492	$3,302,492
Hillhouse	32	$26,000	$832,000	$463,710	$1,295,710
Hogan	19	$26,000	$494,000	$463,710	$957,710
Hondo	50	$53,000	$2,650,000	$985,383	$3,635,383
Houchin	19	$26,000	$494,000	$463,710	$957,710
Irene	35	$26,000	$910,000	$695,564	$1,605,564
Total	-	-	$31,777,000	$17,157,256	$48,934,256

* Total Cost includes both Platform Prep. Cost plus Marine Growth Removal Cost.

Section 8: Well Plugging and Abandonment

Requirements

One of the major cost components of a decommissioning project is the plugging and abandonment of platform wells. Regulations for well plugging and abandonment are found in Subpart Q of 30 CFR 250 and are summarized below:

- All wells shall be abandoned in a manner to assure downhole isolation of hydrocarbon zones, protection of freshwater aquifers, clearance of sites so as to avoid conflict with other uses of the OCS, and prevention of migration of formation fluids within the wellbore or to the seafloor.

Procedures

Planning and operations are two distinct phases in the well plugging process. The planning and actual abandonment process entails: data collection (including review of existing well design encompassing degree of deviation, maximum angles, and dog leg severities, past performance, and present geological and reservoir conditions), preliminary inspection (including inspection of wellhead and tree to verify that valves and gauges are operational, with repairs made as necessary), selection of abandonment methods(s) (including consideration of using either rig methods, rig-less methods, or coiled tubing methods, or a combination of these three methods), and submittal of an application for MMS approval.

For this study, Proserv investigated plugging and abandoning wells using both a contracted platform rig, and rig-less techniques, and has determined that rig-less methods are significantly more economic. The rig-less method has therefore been used in developing the well plugging and abandonment cost estimates.

Developed in the 1980's, rig-less methods are now used in the majority of the plugging and abandonment jobs in the Gulf of Mexico, and in Proserv's opinion are most likely to be used in the POCSR based on the scenario described in the Executive Summary. A small rental crane would be contracted to provide assistance with rig-less equipment spread set-up and breakdown, as well as tool, cement, and equipment handling assistance during plugging and abandonment operations. In the rig-less method, a load spreader spans the top of a conductor, providing a base to launch tools, plugs, and other equipment downhole. This load spreader is the primary economic savings mechanism because the plugging process will take slightly less time than with a rig methods, and the load spreader is significantly cheaper and can be set-up and broken down quicker than a platform rig.

The actual well abandonment operation involves: well entry preparations (including setting-up load spreaders, installation of back pressure valve, and the nippling-up and testing of blowout prevention equipment), use of slick line unit (including confirmation of the presence or absence of wellbore obstructions, verification of measured depths, and the pulling of downhole safety valves), filling the well with fluid (including establishing an injection rate into open perforations, and pressuring-up the tubing and annulus to verify integrity), removal of downhole equipment (including the pulling of pumps and tubing strings), cleaning out the wellbore (utilizing casing scrapers and a variety of special purpose fluids), plugging open-hole and perforated intervals(s) at the bottom of the well (including squeeze cementing, setting cast-iron bridge plugs, or the placement of cement plugs), plugging casing stubs (where casing has been cut and recovered), plugging of annular space (using squeeze cementing techniques), placement of a surface plug, and placement of fluid between plugs. Regardless of the technique used, plugs must be tagged to ensure proper placement and/or pressure-tested to verify integrity. Figure 8.1 provides a schematic view of the typical wellbore configuration.

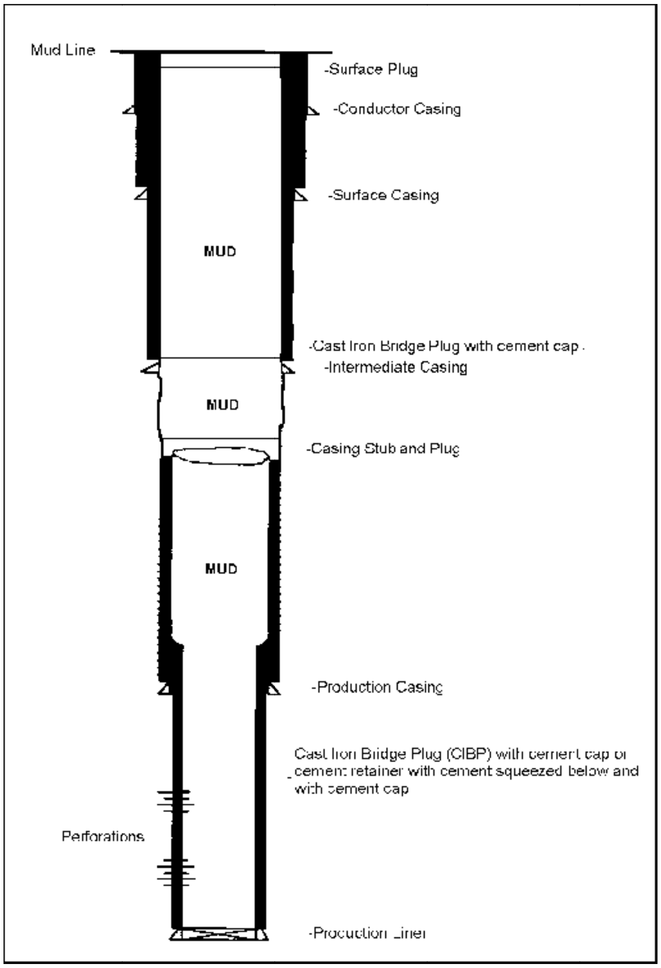

Figure 8.1. Schematic View of the Typical Wellbore Configuration

Cost Factors

The primary factors in determining costs to plug wells are the time required to complete the operation, which depends on the difficulty of each well, and the number of wells per platform. The difficulty of each plugging and abandonment procedure is tied to the complexity of the well. For this study, the following four cost categories are used in estimating well plugging and abandonment costs. Appendix 6 provides a breakdown of number of wells in each cost category by platform.

- A low cost well will be a straightforward well without deviation problems or sustained annular pressures, and without pumps. A well of this type could be plugged in three days.

- A medium low cost well would be more complex with mid-range horizontal displacements with deviations less than 50° at the surface casing shoe. A medium low cost well could have minor complications such as stuck pipe or short-term milling or fishing operations. A medium low cost well can be plugged in four days.

- A medium high cost well could have high deviations between 50° and 60° at the surface casing shoe or extended reach wells. They may contain electric submersible pumps or sucker rod pumps. A medium high cost well would have greater operational difficulties and time delays due to hydrogen sulfide concerns, longer fishing or milling operations. A medium high cost well would take five days to plug.

- A high cost well could have high deviations with greater than 60° maximum angles, severe dog legs or extended reach. A high cost well can have operational difficulties including sustained annular pressures, parted casing, long term fishing or milling work, repeated trips in and out of the hole, etc. A high cost well would take eight days or longer to plug.

Well depth is a less significant cost factor than well complexity. Deeper wells involve longer tripping times and may include additional cement volumes. Measured depths of productive intervals for wells in the POCSR range from less than 1,000 feet to more than 17,000 feet.

Service and supply companies are highly competitive and offer substantial discounts (up to 35%) for multiple well packages. Costs associated with plugging of wells in all four well categories are based on multiple-well price packages, and represent the lowest daily unit costs for some goods and services.

Rig-less spreads are not anticipated to be available in the POCSR, so equipment and crew have been assumed to be mob/demobed to Los Angeles by land for the spreads and by airline for the crew. Then spreads and crew are mob/demobed to/from the platform via boat. The average cost of plugging each well by complexity category is shown in Table 8.1. There are 748 wellbores that require plugging and abandonment in the POCSR. Table 8.2 shows well plugging and abandonment costs by platform and the total cost for plugging and abandoning all POCSR wells. Detailed well plugging and abandonment cost information is presented in Volume 2.

Table 8.1. Average Well Plugging and Abandonment Costs by Well Type

Well Type (Level of Complexity)	Average Cost/Well
Low cost well (3 days to plug and abandon)	$96,489
Med low cost well (4 days to plug and abandon)	$128,652
Med high cost well (5 days to plug and abandon)	$160,815
High cost well (8+ days to plug and abandon)	$257,304

Assumptions:

1. Costs do not include cost of conductor removal.

2. All costs include shipment and airfare associated with mob/demob of rig-less equipment from GOM.

Table 8.2. Well Plugging and Abandonment Costs Per Platform (Rig-less Well P & A)

Platform	Wells to P&A	**Average Well Depth (ft)**	Rigless P&A Costs
A	52	2,500	$5,239,064
B	57	2,500	$5,724,556
C	38	2,500	$3,900,336
Edith	18	4,500	$2,087,428
Ellen	61	6,700	$7,095,344
Elly	0	0	$0
Eureka	50	6,500	$6,209,484
Gail	24	8,400	$3,436,768
Gilda	63	7,900	$7,880,044
Gina	12	6,000	$1,510,000
Grace	28	-	$4,314,044
Habitat	20	12,000	$2,656,668
Harmony	34	11,900	$7,068,992
Harvest	19	10,000	$3,729,068
Henry	23	2,500	$2,469,672
Heritage	48	10,300	$10,241,356
Hermosa	13	9,500	$2,540,036
Hidalgo	14	10,700	$2,983,104
Hillhouse	47	2,500	$4,779,384
Hogan	39	5,400	$5,108,704
Hondo	28	12,700	$5,145,272
Houchin	36	5,100	$4,781,272
Irene	24	9,800	$4,191,736
Average per well:	-	6,814	$137,824
Average per platform:	33	6,814	$4,482,275
Total:	748	-	$103,092,332

Assumptions:

1. Costs do not include cost of conductor removal.
2. All costs include shipment and airfare associated with mob/demob of rig-less equipment from GOM.

Section 9: Conductor Removal

Requirements

Regulations for conductor removal and well plugging and abandonment are found in Subpart Q of 30 CFR 250, in subsections 250.1710 - 1723 and are summarized below.

- All platform components including conductor casings shall be removed by the lessee to a depth of at least 15 feet below the ocean floor or to a depth approved by the Regional Supervisor based upon the type of structure or ocean-bottom conditions.

Procedures

Conductor casing removal combines three distinct procedures: severing, pulling/sectioning, and offloading. Severing of the conductor casings requires the use of explosive, mechanical, or abrasive cutting methods. For this study, Proserv has estimated costs using abrasive cutting methods because this method is commonly used and is likely to be the preferred in the POCSR due to environmental considerations. Proserv has also determined that the most economic method for pulling the conductors is a casing jack removal method. Alternatives considered for pulling the conductors included platform rig and derrick barge removal methods, but both alternatives, although shorter in duration, resulted in significantly higher cost due to expensive derrick barge or platform rig rental rates. In the casing jack removal method, casing jacks are utilized to make the initial lift to confirm that conductors have been completely severed prior to pulling. Pulling the conductor and casings entails using the casing jacks to raise the conductors which are unscrewed or cut into 40 feet-long segments. Offloading involves utilization of a rental crane to lay down each conductor casing segment in a platform staging area, offloading sections to a boat, and offloading at a port. The conductors are then transported to an onshore disposal site as described in the Materials Disposal section of this report.

Cost Assumptions and Factors

For this study, Proserv has assumed that explosives will not be used to sever conductors. The use of explosives was deemed unnecessary due to the advances that have been made in abrasive cutting technology and the fact that abrasive cutting is now the most commonly used method to cut conductors. The use of explosives offshore California was also considered to be problematic due to presence of whales and other sensitive marine mammals. Although Proserv has not considered the use of explosives in developing costs for this study, it has included cost information on explosives use in Volume 2 of this report.

The primary factors in determining conductor casing removal costs are water depth and number of conductors per platform. Water depths in the POCSR range from 95 feet to 1,198 feet. The number of conductors to be removed from each platform in the POCSR ranges from 12 to 64.

The cost to plug the wells and to remove the conductors is essentially the same regardless of whether all wells are plugged before any of the conductors are removed, or if individual conductors are removed immediately after each well is plugged.

Conductor casings are assumed to be coated with marine growth which will be removed as they are pulled. Conductors extend approximately 65 feet above the water line to the wellhead on the platform. It is also assumed that the conductors and casing have cemented annuli and will therefore have to be removed in conjunction with one another. The average size of the conductors is assumed to be 24 inches in outside diameter and the average weight of the conductors, casing and cement is 400 pounds per foot. Disposal costs are not included in these estimates but are included in the Materials Disposal Section. Complete cost estimates of casing jack removal methods can be found in Volume 2. Average conductor removal cost was found to be $259 per foot. Table 9.1 shows conductor data and removal costs by platform.

Table 9.1 Total Conductor Removal Costs (Using Casing Jacks)

Platform	Water Depth (ft)	Conductor Count	Conductor Length (ft)	Total Conductor Length (ft)	Total Cost
A	188	55	268	14,740	$4,157,409
B	190	57	270	15,390	$4,329,792
C	192	43	272	11,696	$3,316,694
Edith	161	23	241	5,543	$1,650,362
Ellen	265	64	345	22,080	$5,910,614
Elly	257	0	0	0	$0
Eureka	700	60	780	46,800	$11,450,280
Gail	739	24	819	19,656	$4,862,948
Gilda	205	64	285	18,240	$5,063,282
Gina	95	12	175	2,100	$739,207
Grace	318	36	398	14,328	$3,811,997
Habitat	290	20	370	7,400	$2,065,538
Harmony	1,198	52	1,278	66,456	$15,845,720
Harvest	675	25	755	18,875	$4,751,731
Henry	173	24	253	6,072	$1,803,662
Heritage	1,075	49	1,155	56,595	$13,578,128
Hermosa	603	16	683	10,928	$2,840,279
Hidalgo	430	14	510	7,140	$1,958,236
Hillhouse	192	52	272	14,144	$3,984,545
Hogan	154	39	234	9,126	$2,711,575
Hondo	842	28	922	25,816	$6,340,742
Houchin	163	36	243	8,748	$2,588,012
Irene	242	24	322	7,728	$2,234,321
Total:	-	817	-	409,601	$105,995,074

Section 10: Mobilization and Demobilization of Derrick Barges

Mobilization and demobilization (mob/demob) costs cover the transit time required to bring a DB to the project site and return the DB to its point of origin. In the POCSR, the infrastructure required to support decommissioning operations is severely lacking. There are currently no DB's having a rotating lift capability exceeding 350 tons stationed in southern California that have the capability to remove deepwater platforms. The DB's possessing this type of capability will likely be mobilized to southern California from the North Sea, Gulf of Mexico, Southeast Asia or other distant locations. It is very unlikely that DB's having this type of heavy lift capability will be stationed permanently in southern California unless there was a strong and prolonged market demand for such vessels. This situation is not likely to change in the foreseeable future.

Cost Assumptions

This report assumes DB's having 500, 2,000 and 4,000 ton lift capabilities will be mobilized from Southeast Asia, the North Sea, or the Gulf of Mexico. The factors considered in selecting the DB's to be used for each of the projects are discussed in Sections 2 and 11 of this report. The mob/demob time for DB's having lift capabilities of 500 and 2,000 tons is estimated to be 100 days round trip. These DB's would likely be mobilized from Southeast Asia. The mob/demob time for DB's having 4,000 ton lift capabilities is estimated to be 200 days round trip. These DB's would likely be mobilized from the North Sea or Gulf of Mexico.

Proserv determined day rate costs for the DB's by reviewing recent bids for projects currently underway or completed in the past 2009 summer working season in the Gulf of Mexico, Asia, and the North Sea. The costs were obtained from an annual market survey of DB's conducted by Proserv. The current day rates for the DB's that are projected to be used are shown in the table below. The costs shown include the costs for fuel, crew, and the DB's accompanying anchor handling tug. Due to decreased resources required in mob/demob, the day rates have been reduced to 90% of the normal daily operating rate of the DB.

Range of Costs

The mob/demob costs for the DB's projected to be used to remove POCSR platforms are shown in Table 10.1. The costs range by project from $3.1 million to $15.1 million per platform. The calculation was made by taking the day rate of the DB, multiplying that figure by the mob/demob time (100 or 200 days), multiplying by a 90% mob/demob operating cost factor, and dividing by the number of platforms that would be removed during the project.

Table 10.1. Derrick Barge Mob/Demob Cost

Project	DB Lift Capability	Mob/Demob Cost Calculation	Cost Per Platform
Project I	500 ton	$ 156,000 x 100 days x 90% / 2 platforms	$7,020,000
Project II	2,000 ton	$ 204,000 x 100 days x 90% / 4 platforms	$4,590,000
Project III	2,000 ton	$ 204,000 x 100 days x 90% / 6 platforms	$3,060,000
Project IV	2,000 ton	$ 204,000 x 100 days x 90% / 3 platforms	$6,120,000
Project V	4,000 ton	$252,000 x 200 days x 90% / 5 platforms	$9,072,000
Project VI	4,000 ton	$252,000 x 200 days x 90% / 3 platforms	$15,120,000

Section 11: Platform Removal

MMS regulations on the decommissioning of OCS platforms are found in 30 CFR 250.1700 through 1754.

The depth of removal requirements for platforms and other facilities are at 30 CFR 250.1728 and are as follows:

- Unless the Regional Supervisor approves an alternate depth under (b) of this section, you must remove all platforms and other facilities (including templates and pilings) to at least 15 feet below the mudline.

For this report, Proserv has assumed that platforms and other structures will be removed to a depth of 15 feet below the ocean floor (or mudline) and that sections will be removed in the reverse order in which they were installed. Figures 11.1 and 11.2 provide schematics representative of typical platform deck and jacket configurations.

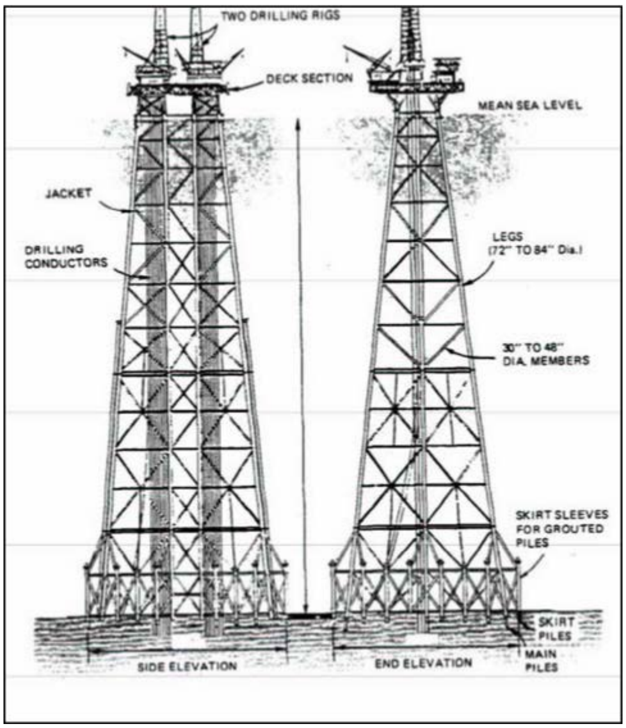

Figure 11.1. Deepwater Platform

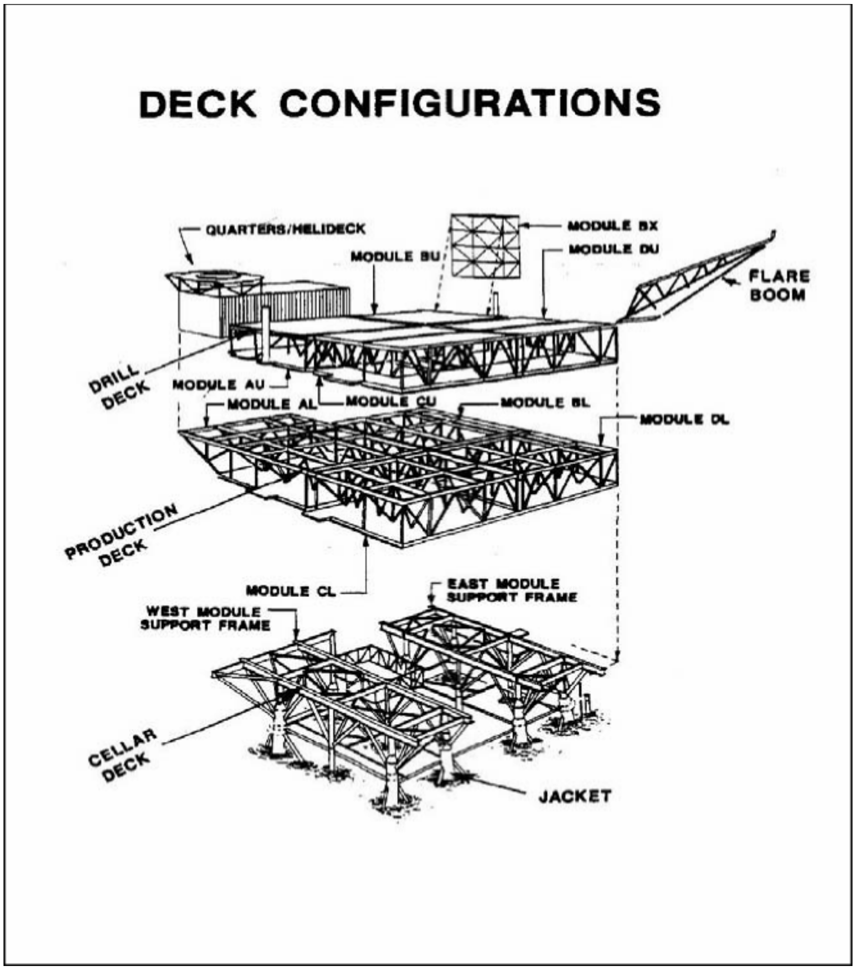

Figure 11.2. Deck Configurations

Deck/Topside Removal

The platform demolition process begins with the removal of the topsides. Topsides can vary significantly in size, functionality and complexity, so we have identified a range of decommissioning options. The diversity and range of complexity suggest that no one option is likely to be the most appropriate in all cases. In the POCSR, platforms have topside facilities that range in weight from approximately 447 to almost 10,000 tons. Generally between 6 and 17 lifts were required to install these topsides. The largest lift for the modules or the modular support structures during installation was approximately 2,000 tons.

Topsides may be integrated, modular, or hybrid in design. Integrated topside refers to a system where the process facilities are installed in the deck structure in the fabrication yard. Integrated facilities are usually installed by a single offshore lift. A modular design is used for larger topsides where the deck structure is subdivided into modules that can be lifted by the derrick barge. The modules are typically supported on the jacket by a modular support frame. Many of the very large topsides use a combined approach.

Topsides can be removed by any of the following methods:

- Remove in one piece

- Remove groups of modules together
- Remove in reverse order of installation
- Remove in small pieces

Removal of the entire topsides in one piece requires a DB with sufficient lifting capacity, or a large specialized decommissioning vessel, or an alternative heavy lift technology such as the Versatruss lifting system, GM Heavy Lift Vessel, or other innovative lifting systems. One piece removal is more practical for small platforms. Although topsides may be able to be removed in one piece, this may not be practicable if the offloading site is not large enough to accommodate large pieces or the lift capability of the cranes at the offloading site or scrap yard is limited.

The removal of combined modules is another method that can be used to remove the topsides. The advantage of this method is that it reduces DB time since fewer lifts are needed. Additional strengthening to allow for combined lifting will probably be needed. The position of the modules on the platform and their weight will dictate whether or not combined removal is possible and which modules may be lifted at one time.

Reverse installation is one of the most common methods used to remove topsides. This involves dismantling the topsides in the reverse order in which they were installed. If the topsides were installed as modules, they would be removed as modules. If they were not installed as modules, topside structural components would be removed in the reverse order that they were installed.

Removal of the topsides by cutting them into small pieces is another method of removal. In this method the topsides are dismantled using mechanical and other cutting devices along with platform cranes, temporary deck mounted cranes, or other cranes on a small DB. The time required to remove a platform using this method is much longer than that required for reverse installation. Consequently, any savings in costs that result from using a smaller, less expensive DB can be largely offset or exceeded due to the additional DB time required. Due to the potential for limited cost savings and safety considerations (see discussion in Section 2) it is generally common practice within the industry to employ a DB that has capability to remove the platform in a much more expeditious manner using the reverse installation method.

Jacket Removal

The removal of the jacket is typically the most costly phase in the demolition process, due to the large and expensive equipment that is required for the lifting and removal operations. Some of the major considerations that have to be made when evaluating the cost of removal are the weight and size of the structure, the oceanographic conditions of the area where the platforms are located, the heavy lifting method used, the method of cutting the main piles and skirt piles, piling access for the cutting operations, diving requirements, water depth, tie-down and transportation considerations of each removed component, and the planned disposition of the salvaged equipment and structure. Extensive saturation diving can add greatly to the cost of any removal project. Jacket removal is initiated after bottom cuts have been made below the mudline on the piles. The entire jacket is removed in sections or as a single lift. Single lifting of the jacket is not likely except for the smaller structures located in less than 200 feet water depth.

In the POCSR, platform jacket weights range from approximately 400 tons to almost 43,000 tons. The platforms are located in 95 to 1,198 feet of water, respectively. Appendix 3 lists the projected weight that will be required to be removed when the POCSR platforms are decommissioned. These numbers are only approximate as additional modifications (i.e., deck extensions, equipment additions or removals, etc.) have been made at many facilities. The jacket and conductor weights are the weights projected to be removed assuming the jacket legs, piles and conductors will be removed to a depth of 15 feet below the mudline. Much of this information was obtained from the MMS which compiled information from its files on design, installation, load-out, or fabrication reports, installation manuals, operator correspondence, seismic analyses, etc. A deck and jacket specification table in Appendix 4 details the background information that Proserv obtained from MMS records and used for this report. In some cases in this specification table, not all the information and numbers for every block in the table were available for each platform. Proserv used its best professional judgment concerning which numbers to use in the various sections of this decommissioning cost report.

Since the DB is usually the highest cost item on location, the use of less expensive support equipment to minimize the heavy lifting equipment time is often justifiable. Reducing the DB time is one of the best ways to reduce overall removal costs. Heavy lifting equipment must be evaluated for its lifting capability at the required working radius and oceanographic conditions in which it is to operate, and also for its height capability. Safety must always be the prime consideration in any removal project. Deepwater structures present much greater challenges for complete removal. The immense weight and extreme water depth of many of the structures on the west coast places a one piece removal outside the limits of current proven and demonstrated technology. A method known as progressive transport or jacket hopping was considered by some operators and Proserv at one time, but because of the difficulty in the POCSR of clearing large areas of the ocean floor to set down the jacket and reset the DB anchors, this method appears unlikely to be used on the west coast. Jacket hopping, however, would reduce the risk to divers as less diving time would be needed compared to in-situ dismantlement. In the hopping method, the structure would be rigged up and lifted after severing the piles. The jacket would be winched vertically off the bottom and moved into shallower water and set down. The upper portion of the jacket would then be cut and the rigging reattached underwater for another lift. The process is repeated until the structure is completely removed. It may be possible to re-float the jacket or use additional buoyancy assist to remove some of the deepwater structures, but the technology is still in very early stages of testing.

Alternative heavy lift vessels/systems are being considered for lifting the large jackets such as Versabuild, Seametric TML vessel and various buoyancy systems, such as the Control Variable Buoyancy System (CVBS). These approaches are in various stages of development and may eventually be proposed to decommission these large structures.

The most common method of jacket removal is dismantlement in place (in-situ) in which the jacket is cut (with divers using cutting torches, abrasive cutting, or other systems) into manageable lift packages (sections). For this study, Proserv has assumed that platform jackets will be cut into sections that range in size from 300 to 1,600 tons for removal using DB's that have respective lift capabilities of 500, 2,000, and 4,000 tons.

For platforms located in less than 200 feet of water, Proserv has assumed a single lift with the 2,000 ton DB after the topsides are removed. We are making the assumption that Platforms Hogan and Houchin would be removed using a 500 ton DB, as the operator has only 2 platforms and it would be more costly to use a larger DB. If a 500 ton DB is used to remove these platforms, the jackets would be cut in-situ into sections weighing less than 300 tons for removal.

Cutting Method

Piles can be cut using explosives, mechanical means, abrasive technology, or torches. The bottom cut required to remove the jacket must be clean to allow for a safe lift from the surface. A barge making such a lift at sea may exceed its lift capability if an incomplete cut left the load secured to the sea floor. The use of torches by divers poses risks due to the hazardous nature of diving operations and the hazards faced by divers who enter excavated areas to make cuts 15 feet below the mudline. For this study, Proserv has assumed that explosives will not be used to sever piles. The use of explosives was deemed unnecessary due to the advances that have been made in abrasive cutting technology and the fact that abrasive cutting is now the most commonly used cutting method. The use of explosives offshore California was also considered to be problematic due to presence of whales and other sensitive marine mammals. Although Proserv has not considered the use of explosives in developing costs for this study, it has included cost information on explosives use in Volume 2 of this report.

Range of Costs and Assumptions

Proserv has determined that reverse installation is the most likely method of platform removal on the west coast for the foreseeable future. For this study, Proserv has assumed that topsides will be decommissioned using this method.

Based upon the sizes and weights of the structures, the number of modules, the number of lifts needed and other factors, as described above, including the maximum weights of the lifts that will be needed, we believe all the POCSR platforms can be removed using DB's having lift capabilities of 500, 2,000, and 4,000 tons. The platform removal costs were developed using the costs shown for these DB's in Section 10.

In addition to the DB, cargo barges, and anchor-handling tug costs, Proserv has included costs for diver support, survey and other required vessels and equipment, including ROV and abrasive cutting equipment spreads, which are detailed in Volume 2. We assumed that in most cases topside module removal would take approximately 0.5 days per module. Topsides that do not have modules would take longer and be cut up into manageable pieces for removal.

The cost of cargo barges to transport the deck and jacket sections depends on barge size, mob/demob time of the cargo barges and accompanying tugs, and the amount of transported material. Cargo barges and accompanying tugs are assumed to be mobed/demobed from the Ports of Los Angeles and Long Beach. Details of deck and jacket transportation, and offloading times can be found in Volume 2.

The information presented in Volume 2 includes details on the rates and durations that were used to estimate decommissioning costs for each of the projects. The platform deck and jacket removal costs for each of the 23 platforms are shown in Table 11.1. Volume 2 shows the cost calculations for each platform by decommissioning project including contingencies for provisional work, weather delays, and project management, engineering and planning costs.

Table 11.1. Platform, Deck and Jacket Decommissioning Costs

Platform Name	Water Depth (ft)	Estimated Removal Weight (tons)*	Platform Removal Cost
A	188	3,457	$3,847,788
B	190	3,457	$3,847,787
C	192	3,457	$3,917,124
Edith	161	8,038	$9,371,983
Ellen	265	9,600	$5,938,404
Elly	255	9,400	$6,682,058
Eureka	700	29,000	$30,425,645
Gail	739	29,993	$34,281,481
Gilda	205	8,042	$5,544,795
Gina	95	1,006	$1,675,329
Grace	318	8,390	$7,561,210
Habitat	290	7,564	$5,640,962
Harmony	1,198	65,089	$50,482,244
Harvest	675	29,040	$33,076,224
Henry	173	2,832	$3,351,684
Heritage	1,075	56,196	$46,946,110
Hermosa	603	27,330	$30,083,441
Hidalgo	430	21,050	$24,621,842
Hillhouse	190	3,100	$4,021,370
Hogan	154	3,672	$8,086,753
Hondo	842	23,550	$30,029,870
Houchin	163	4,227	$7,845,027
Irene	242	7,100	$5,996,669
Total	-	-	$363,275,800

*Weight consists of Jacket, Deck and Pile Weight

Section 12: Pipeline and Power Cable Decommissioning

Requirements

The MMS regulations for pipeline and power cable decommissioning are found at 30 CFR 250.1750 – 250.1754. The regulations allow an operator to decommission a pipeline or power cable in place if the MMS determines that the pipeline or power cable "does not constitute a hazard (obstruction) to navigation and commercial fishing operations, unduly interfere with other uses of the OCS, or have adverse environmental effects." If the MMS determines that the pipeline or power cable is an obstruction, it must be removed per the regulations at 30 CFR 250.1752.

Procedures

Since 1990, the POCSR has required pipeline operators to conduct biennial ROV pipeline surveys to assess a pipeline's external integrity and to monitor 3rd party impacts. The surveys have verified that the majority of pipelines historically have not been obstructions and could therefore be decommissioned in place. However, a decision on the final disposition of a specific pipeline or power cable cannot be made until a thorough technical and environmental review is conducted during the decommissioning permitting process.

To decommission a pipeline in place, the pipeline must first be cleaned by flushing water through the pipeline. The pipeline is then disconnected from the OCS platform, and filled with sea water. The cut end is plugged and buried at least 3 feet below the seafloor or covered with protective concrete mats. In addition to cutting and burying the ends, all pipeline valves/fittings, pipeline crossings and spanned areas that could unduly interfere with other uses of the OCS must be removed from the pipeline.

Cost Factors

Detailed cost estimates for pipelines and power cables using a workboat removal method are shown in Volume 2. The factors used to calculate the cost estimates are based on information provided by MMS and Proserv.

The pipeline cost estimates assume that all project vessels (small crane barge, etc.) would be available locally except for a DP2 dive vessel which would need to be mobilized from Asia. DP2 Dive Vessels are not available locally, but will be necessary for deepwater operations (water depths exceeding 200 feet) due to the difficulty of anchoring in deep water. For this study, Proserv has assumed that a DP2 dive vessel will be mobilized to southern California for each of the deepwater platform removal projects and that costs will be apportioned equally among all platforms in a project.

The costs incurred during the decommissioning operations reflect hourly rates for vessels and diver-related services. The two factors which have the greatest influence on the cost estimates are the water depth and the number of obstructions per pipeline that would have to be removed.

For this study, Proserv developed costs based on the following assumptions: for pipelines routed to shore, pipeline segments will be removed from the 200 foot water depth level to the State Tidelands boundary; pipeline segments between platforms on the OCS will be decommissioned in place; OCS pipeline segments in greater than 200 feet of water depth will be decommissioned in place.

The estimated costs rely on data input values for: 1) mobilization/demobilization, 2) daily rate for on-site operations, and 3) estimated time to complete the decommissioning activity. Below is a description of the type of work included in each of the data input values.

The mobilization/demobilization cost includes the mobilization/demobilization of the diving support vessel, diving system equipment, small crane barge(s), and any required third party equipment needed; planning and engineering; pigging and testing the pipeline(s); mooring installation/removal; and miscellaneous equipment or work needed.

The on-site daily rate includes 24-hour diving operations from a diving support vessel, 24-hour barge with crane, tug and construction crew, materials barge for transport and onshore support and project management.

The estimated time to complete a pipeline decommissioning is based on the number of risers and pipeline sections that would need to be cut out, rigged and lifted to a barge. The time is also dependent on the water depth in which the work is to take place. Tables 12.1 and 12.2 show the originating and terminating locations of each pipeline, and the pipeline decommissioning costs.

Power cables on the OCS will be completely removed to the State Tidelands boundary. Table 12.3 shows the estimated costs using local vessels and equipment. The cables would be cut using an ROV and then pulled onto a workboat before being placed on a cargo barge for transport to shore. Proserv has assumed diving services will not be required. Proserv also investigated the use of a cable reel barge to perform the power cable removal operations. Although there is considerable time saved by using a cable removal vessel, the cost to mobilize a vessel from other areas is so great that it is far more economical to use equipment available locally. Recycling of the power cables is highly unlikely; therefore no credit for recycling has been included.

Table 12.1. OCS Pipeline Specifications

From	Pipeline		To	
Platform	I.D.	Type	Platform	Onshore Facility
C	6" 8" 6"	Oil/Water Gas Water (Inj)	B	
B	12" 12" 8"	Oil/Water Gas Water		Rincon
A	12" 12" 8"	Oil/Water Gas Water	Reference Note (2)	
Hillhouse	8" 8" 6"	Oil Gas Spare	A	
Henry	10" 10" 12" 4"	Oil Gas Water Oil/Water	Hillhouse	
Houchin	10" 10" 12" 4"	Oil/Water Gas Lift Gas Water	Hogan	
Hogan	10" 10" 12" 4"	Oil/Water Gas Lift Gas Water		La Conchita
Gail	8" 8" 8"	Gas Oil Gas	Grace	
Grace	10" 12"	Gas Oil/Water		Carpinteria
Habitat	12"	Gas		Carpinteria
Gina	10" 8"	Oil/Water Gas		Mandalay
Gilda	12" 10" 8"	Oil/Water Gas Water		Mandalay

From	Pipeline		To	
Platform	I.D.	Type	Platform	Onshore Facility
Edith	8"	Gas	Eva *	
	6"	Oil	Ellen/Elly	
Eureka	12"	Oil/Water	Ellen/Elly	
	10"	Water (Inj)		
	8"	Gas		
Ellen/Elly	16"	Oil		San Pedro
Heritage	20"	Oil/Water	Harmony	
	12"	Gas		
Harmony	20"	Oil		Las Flores Canyon
	12"	Water		
	12"	Gas	Hondo	
Hondo	14"	Oil/Water	Harmony	
	12"	Gas		Las Flores Canyon
Hidalgo	18"	Oil/Water	Hermosa	
	10"	Gas		
Harvest	12"	Oil/Water	Hermosa	
	8"	Sour Gas		
Hermosa	24"	Oil/Water		Gaviota
	20"	Sour Gas		
Irene	20"	Oil/Water		Orcutt
	8"	Water		
	8"	Sour Gas		

(1) * Denotes state platform

(2) Pipelines from Platform "A" tie-in with pipelines from Platform "B" to onshore facility

Table 12.2. Pipeline Decommissioning Costs

Platform	Water Depth (ft)	Total Length of OCS Pipeline (mi)	Length of Pipeline to be removed (mi)	Total Pipeline Cost
A	188	2.3	0.0	$397,568
B	190	20.2	20.2	$3,138,559
C	192	1.6	0.0	$393,566
Edith	161	2.4	0.0	$247,296
Ellen	265	0.0	0.0	$0
Elly	257	6.4	4.5	$644,744
Eureka	700	5.3	0.0	$9,044,467
Gail	739	18.6	0.0	$4,174,981
Gilda	205	12.5	12.5	$2,067,471
Gina	95	0.6	0.6	$564,747
Grace	318	23.3	4.6	$3,071,068
Habitat	290	4.7	0.9	$697,656
Harmony	1,198	12.6	1.1	$5,514,710
Harvest	675	6.5	0.0	$2,708,438
Henry	173	7.5	0.0	$431,967
Heritage	1,075	14.2	0.0	$3,446,807
Hermosa	603	12.0	1.1	$3,596,598
Hidalgo	430	10.3	0.0	$2,953,508
Hillhouse	192	1.6	0.0	$456,372
Hogan	154	7.9	0.6	$750,152
Hondo	842	5.4	0.6	$3,069,862
Houchin	163	1.3	0.0	$228,358
Irene	242	4.6	4.6	$1,428,518
Average Cost per mile	-	-	-	$269,942
Total	-	181.6	51.3	$49,027,413

Table 12.3. Power Cable Removal Costs

Cable Origin	Cable Terminus	Water Depth (ft)	Length of cable to be removed (mi)	Total Cost
A	B	188	0.5	$168,611
B	C	190	0.5	$168,611
C	Shore	192	5.0	$888,856
Edith	Shore	161	7.0	$1,146,090
Ellen^	Elly	265	0.0	$0
Elly		257	0.0	$0
Eureka*	Ellen (qty. 2)	700	2.9	$348,520
Gail		739	0.0	$0
Gilda	Shore	205	7.0	$1,180,766
Gina	Shore	95	0.3	$228,081
Grace		318	0.0	$0
Habitat	P/F A	290	3.7	$716,817
Harmony*	Shore (qty. 2)	1,198	11.3	$1,021,164
Harvest		675	0.0	$0
Henry	Hillhouse	173	2.5	$537,380
Heritage	Harmony	1,075	7.4	$2,999,790
Heritage	Shore	1,075	19.8	$1,256,468
Hermosa		603	0.0	$0
Hildalgo		430	0.0	$0
Hillhouse	Shore	192	3.4	$663,911
Hogan	Shore	154	0.9	$345,992
Hondo*	Harmony (qty. 2)	842	9.0	$859,484
Houchin	Hogan	163	0.7	$320,644
Irene	Shore	242	2.8	$612,071
Average Cost per mile	-	-	-	$158,921
Total	-	-	84.7	$13,463,257

*Data represents combined length and cost of both cables

^ Connects to Elly by bridge, no sub-sea cable

Section 13: Materials Disposal

There are three primary methods of disposal for steel and other materials associated with dismantling a platform: refurbish and reuse, scrap and recycle, and dispose of in designated landfills. Opportunities for refurbishing and reusing facilities in the POCSR are very limited due to the age of the platforms, the current lack of additional oil and gas development in the POCSR, and inherent limitations associated with meeting the strict technical standards now required. Thus, it is assumed that the steel and other materials removed from platforms will be transported to shore for scrapping and recycling or disposal in landfills.

Due to the limited number of offshore decommissioning projects that have occurred in the POCSR, information on disposal costs is limited to that which was made available by Chevron for the 4-H Project. As noted Section 1, this project involved the decommissioning of four platforms having a combined weight of approximately 12,000 tons. The materials were transported by barge from the Santa Barbara Channel a distance of 100 miles to San Pedro, California. Chevron reported that the steel was sold as scrap for $330,000 and that it cost $1.3 million to process the steel, resulting in a net loss of $1.0 million or $333.00 per ton of steel. In addition, Chevron had to dispose of 3,000 tons of marine growth ($800,000), 1,000 tons of cement ($275,000), and 300 tons of drilling muds and cuttings ($275,000) which aggregates to approximately $1.4 million for disposal materials other than steel.

Based on a tour of local POCSR scrap facilities, Proserv has concluded that the two scrap yards operated by SA Recycling (Long Beach and Los Angeles) contained sufficient land area and equipment for disposal of the POCSR platforms. Other disposal locations considered were Asia, Oregon, and Mexico, but the costs would be significantly higher.

Cost Assumptions

This report assumes that platform structures will be transported by cargo barges from southern California to offloading facilities/scrap yards located in Long Beach and Los Angeles. It is assumed that other materials (nonferrous metals, cement, plastics, wood, etc.) will be transported to landfills in southern California for disposal. According to a disposal proposal by Schnitzer Steel Products Company (see Volume 2), platform disposal costs were estimated to be $384 per ton with a 15% contingency factor included in that value. The value of $384 was developed by Schnitzer Steel Products Company and includes site preparation, materials handling, materials offloading, materials demolition, and materials scrap processing costs for POCSR platforms. It was confirmed that although these estimates were produced assuming the scrapping facility was in the Pacific Northwest, these costs are considered current and applicable to any scrap facility in the Port of Los Angeles or Long Beach area. Table 13.1 shows platform disposal costs.

Conductor, power cable and pipeline disposal costs are estimated separately. Proserv has assumed the conductors, power cables and pipelines will be transported from the offloading site to disposal sites near Bakersfield, California. This assumption is consistent with previous decommissioning projects conducted in the POCSR including the Chevron 4-H Project and the Exxon Santa Ynez Unit power cable removal and repair projects that were conducted in 2003 and 2009. Transportation and disposal costs were calculated based on the assumption that one truck could carry 21.5 tons per load and the transportation cost would be $500 per load. In addition, there would be a dump disposal fee of $100 per ton. The information used to estimate costs was obtained from Standard Industries of Ventura, California.

Disposal costs for conductors, power cable and pipelines are presented in Tables 13.2, 13.3, 13.4. The disposal costs do not include any credits for the resale of any refurbished structures or equipment, or scrapping credit, nor do they include marine transportation costs from the decommissioning site to port because these costs were included in the platform structure removal costs described in Section 11 and detailed in Volume 2. Table 13.5 shows total material disposal costs.

Table 13.1. Platform Disposal Costs

Platform	Water Depth (ft)	Platform Weight* (Tons)	Disposal Costs Per Ton**	Total
A	188	3,457	$384	$1,327,488
B	190	3,457	$384	$1,327,488
C	192	3,457	$384	$1,327,488
Edith	161	8,038	$384	$3,086,592
Ellen	265	9,600	$384	$3,686,400
Elly	257	9,400	$384	$3,609,600
Eureka	700	29,000	$384	$11,136,000
Gail	739	29,993	$384	$11,517,312
Gilda	205	8,042	$384	$3,088,128
Gina	95	1,006	$384	$386,304
Grace	318	8,390	$384	$3,221,760
Habitat	290	7,564	$384	$2,904,576
Harmony	1,198	65,089	$384	$24,994,176
Harvest	675	29,040	$384	$11,151,360
Henry	173	2,832	$384	$1,087,488
Heritage	1,075	56,196	$384	$21,579,264
Hermosa	603	27,330	$384	$10,494,720
Hidalgo	430	21,050	$384	$8,083,200
Hillhouse	192	3,100	$384	$1,190,400
Hogan	154	3,672	$384	$1,410,048
Hondo	842	23,550	$384	$9,043,200
Houchin	163	4,227	$384	$1,623,168
Irene	242	7,100	$384	$2,726,400
Total	-	364,590	$384	$140,002,560

* Platform Weight is the estimated platform removal weight and includes the weights of the jacket, deck, piles and assumes that they are removed to a depth of 15ft below the mudline. Conductor disposal weights and costs are calculated separately.

** Includes a 15% Contingency Factor, does not include conductor disposal.

Table 13.2. Conductor Disposal Costs

Platform	Conductor Count	Conductor Length (ft)	Total Conductor Length (ft)	Conductor Weight (Tons)*	Total Cost **
A	55	268	14,740	2,948	$363,358
B	57	270	15,390	3,078	$379,381
C	43	272	11,696	2,339	$288,320
Edith	23	241	5,543	1,109	$136,641
Ellen	64	345	22,080	4,416	$544,298
Elly	0	0	0	0	$0
Eureka	60	780	46,800	9,360	$1,153,674
Gail	24	819	19,656	3,931	$484,543
Gilda	64	285	18,240	3,648	$449,637
Gina	12	175	2,100	420	$51,767
Grace	36	398	14,328	2,866	$353,202
Habitat	20	370	7,400	1,480	$182,419
Harmony	52	1,278	66,456	13,291	$1,638,218
Harvest	25	755	18,875	3,775	$465,291
Henry	24	253	6,072	1,214	$149,682
Heritage	49	1,155	56,595	11,319	$1,395,133
Hermosa	16	683	10,928	2,186	$269,388
Hidalgo	14	510	7,140	1,428	$176,009
Hillhouse	52	272	14,144	2,829	$348,666
Hogan	39	234	9,126	1,825	$224,967
Hondo	28	922	25,816	5,163	$636,394
Houchin	36	243	8,748	1,750	$215,648
Irene	24	322	7,728	1,546	$190,504
Total	817	10,850	409,601	81,921	$10,097,141

* Conductor weight includes weight of conductor, inner casing strings and annulus cement. All conductors are assumed to have an outside diameter of 24" and a weight of 400 lbs/ft.

**Costs are calculated based on a disposal rate of $500/truckload at 21.5 tons/truck plus a $100 per ton disposal fee.

Table 13.3 Power Cable Disposal Costs

Cable Origin	Cable Terminus	Length of OCS cable to be removed (mi)	Total Cost at $7000 per mile
A	B	0.5	$3,500
B	C	0.5	$3,500
C	Shore	3.0	$21,000
Edith	Shore	7	$49,000
Ellen	Elly	0.0	$0
Elly	-	0.0	$0
Eureka	Ellen (qty. 2)	2.9	$20,300
Gail	-	0.0	$0
Gilda	Shore	7.0	$49,000
Gina	Shore	0.3	$2,100
Grace	-	0.0	$0
Habitat	Platform A	3.7	$25,900
Harvest	-	0.0	$0
Henry	Hillhouse	2.5	$17,500
Hillhouse	Shore	3.4	$23,800
Hermosa	-	0.0	$0
Hildalgo	-	0.0	$0
Hogan	Shore	0.9	$6,300
Houchin	Hogan	0.7	$4,900
Hondo	Harmony (qty. 2)	9.0	$63,000
Harmony	Shore (qty. 2)	11.3	$79,100
Heritage	Harmony	7.4	$51,800
Heritage	Shore	13.9	$97,300
Irene	Shore	2.8	$19,600
Total	-	76.8	$537,600

Table 13.4 Pipeline Disposal Cost

Platform	Total Pipeline Length on OCS*	Length of Pipeline Removed from OCS (ft)**	Weight of Pipeline Removed (Tons) ***	Total Cost****
A	2.3	0	0	$ 0
B	20.2	106,746	3,469	$427,400
C	1.6	0	0	$0
Edith	2.4	0	0	$0
Ellen	0.0	0	0	$0
Elly	6.4	23,760	772	$95,200
Eureka	5.3	0	0	$0
Gail	18.6	0	0	$0
Gilda	12.5	65,856	2,140	$264,000
Gina	0.6	3,174	103	$12,800
Grace	23.3	24,288	789	$97,400
Habitat	4.7	4,500	146	$18,100
Harmony	12.6	6,000	195	$24,000
Harvest	6.5	0	0	$0
Henry	7.5	0	0	$0
Heritage	14.2	0	0	$0
Hermosa	12.0	6,000	195	$24,000
Hidalgo	10.3	0	0	$0
Hillhouse	1.6	0	0	$0
Hogan	7.9	3,200	104	$12,900
Hondo	5.4	3,000	98	$12,300
Houchin	1.3	0	0	$0
Irene	4.6	24,200	786	$97,100
Total	181.8	270,724	8,797	$1,085,200

*Total pipeline length is the cumulative length of all pipelines on the OCS.

** Length of pipeline to be removed is the cumulative length of pipeline to be removed on the OCS in water depths less than 200 feet.

***All pipelines are assumed to have an outside diameter of 12.75" and a wall thickness of 0.5" and weigh 65 lbs/ft.

****Costs are calculated based on a disposal rate of $500/truckload at 21.5 tons/truck plus a $100 per ton disposal fee.

Table 13.5. Materials Disposal Costs

Platform	Platform Disposal Costs	Conductor Disposal Costs****	Power Cable Disposal Costs	Pipeline Disposal Costs	Total Disposal Costs *****
A	$1,327,488	$363,358	$3,500	$0	$1,694,346
B	$1,327,488	$379,381	$3,500	$427,400	$2,137,769
C	$1,327,488	$288,320	$21,000	$0	$1,636,808
Edith	$3,086,592	$136,641	$49,000	$0	$3,272,233
Ellen	$3,686,400	$544,298	$0	$0	$4,230,698
Elly	$3,609,600	$0	$0	$95,200	$3,704,800
Eureka	$11,136,000	$1,153,674	$20,300	$0	$12,309,974
Gail	$11,517,312	$484,543	$0	$0	$12,001,855
Gilda	$3,088,128	$449,637	$49,000	$264,000	$3,850,765
Gina	$386,304	$51,767	$2,100	$12,800	$452,971
Grace	$3,221,760	$353,202	$0	$97,400	$3,672,362
Habitat	$2,904,576	$182,419	$25,900	$18,100	$3,130,995
Harmony	$24,994,176	$1,638,218	$79,100	$24,000	$26,735,494
Harvest	$11,151,360	$465,291	$0	$0	$11,616,651
Henry	$1,087,488	$149,682	$17,500	$0	$1,254,670
Heritage	$21,579,264	$1,395,133	$149,100	$0	$23,123,497
Hermosa	$10,494,720	$269,388	$0	$24,000	$10,788,108
Hidalgo	$8,083,200	$176,009	$0	$0	$8,259,209
Hillhouse	$1,190,400	$348,666	$23,800	$0	$1,562,866
Hogan	$1,410,048	$224,967	$6,300	$12,900	$1,654,215
Hondo	$9,043,200	$636,394	$63,000	$12,300	$9,754,894
Houchin	$1,623,168	$215,648	$4,900	$0	$1,843,716
Irene	$2,726,400	$190,504	$19,600	$97,100	$3,033,604
Total	$140,002,560	$10,097,141	$537,600	$1,085,200	$151,722,501

Section 14: Site Clearance

Site clearance operations are performed to ensure that OCS leases and the operational area surrounding platforms are free of obstructions that would interfere with other uses of the OCS, such as commercial trawling operations. Requirements for site clearance are found at 30 CFR 250.1700-1754.

Site clearance procedures for decommissioning a platform and associated pipelines and power cables in the POCSR will typically involve the following four step process: (1) pre-decommissioning survey, (2) post decommissioning survey, (3) Remotely Operated Vehicle (ROV)/diver target identification and recovery, and (4) test trawling. A survey vessel equipped with high-resolution side-scan sonar is used to conduct the pre- and post- decommissioning surveys. The pre-decommissioning survey documents the location and quantity of suspected debris targets. The survey is also used to map the location of pipelines, power cables, and sensitive environmental habitats (hard bottom areas and kelp beds) to ensure that the deployment and retrieval of anchors is done in a safe and environmentally sound manner. The post-decommissioning survey identifies debris lost during the project and documents any impacts from the operations such as anchor scars. An ROV and divers are deployed to further identify and remove any debris that could interfere with other uses of the area. Test trawling is conducted to verify that the area is free of any potential obstructions.

Cost Assumptions

Site clearance costs can vary significantly from project to project due to factors such as: water depth; the size of the area to be cleared and verified; the quantity, size, and type of debris; and weather conditions. The site clearance cost estimates presented below include costs for pre- and post-decommissioning side-scan-sonar surveys (SSS), ROV deployment, diving spreads, test trawl operations, and shell mound geotechnical and biological sampling. The costs do not include any expenses that would be incurred to remove shell mounds or mitigate impacts to commercial trawlers who may be precluded from trawling areas where shell mounds are located. The costs are based on information obtained from oil and gas companies and contractors that have conducted site clearance operations in the POCSR.

For platforms located in water depths up to 300 feet, Proserv assumed that an air/gas diving spread would be used. For platforms located in water depths exceeding 300 feet, Proserv assumed a saturation diving spread will be required. Proserv also assumed that the time required to conduct ROV and test trawl operations will increase from 7 days for platforms located in less than 300 feet of water to 14 days for platforms located in greater than 300 feet of water.

Site Clearance Costs

The estimated costs for site clearance and verification are $709,000 for platforms in less than 300 feet of water depth and $1,282,000 for platforms in greater than 300 feet of water. The cost calculations are shown in Table 14.1 below.

Table 14.1 Site Clearance Cost Calculations

Platform Water Depth (<300 feet)		Platform Water Depth (>300 feet)	
Pre-Decommissioning SSS 3 days x $12,000	$36,000	Pre-Decommissioning SSS 3 days x $12,000	$36,000
Mob/Demob	$12,000	Mob/Demob	$12,000
Data Analysis	$10,000	Data Analysis	$10,000
	$58,000		$58,000
Post-Decommissioning SSS 3 days x 12,000	$36,000	Post-Decommissioning SSS 3 days x 12,000	$36,000
Mob/Demob	$12,000	Mob/Demob	$12,000
Data Analysis	$10,000	Data Analysis	$10,000
	$58,000		$58,000
ROV Deployment 7 days x $14,000	$98,000	ROV Deployment 14 days x $14,000	$196,000
Diving Spread (air/gas diving) 10 days x $26,000	$260,000	Diving Spread (saturation diving) 10 days x $70,000	$700,000
Test Trawl Program 7 days x $5,000	$35,000	Test Trawl Program 14 days x $5,000	$70,000
Shell Mound Surveys Geotechnical & Biological	$200,000	Shell Mound Surveys Geotechnical & Biological	$200,000
Total Cost	$709,000	Total Cost	$1,282,000

Section 15: References and Acknowledgements

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- SA Recycling
- Schnitzer Steel Products Company
- Standard Industries
- Versabar
- Weatherford Decommissioning Services

Appendices Volume 1

Appendix 1: Maps of the Decommissioning Projects

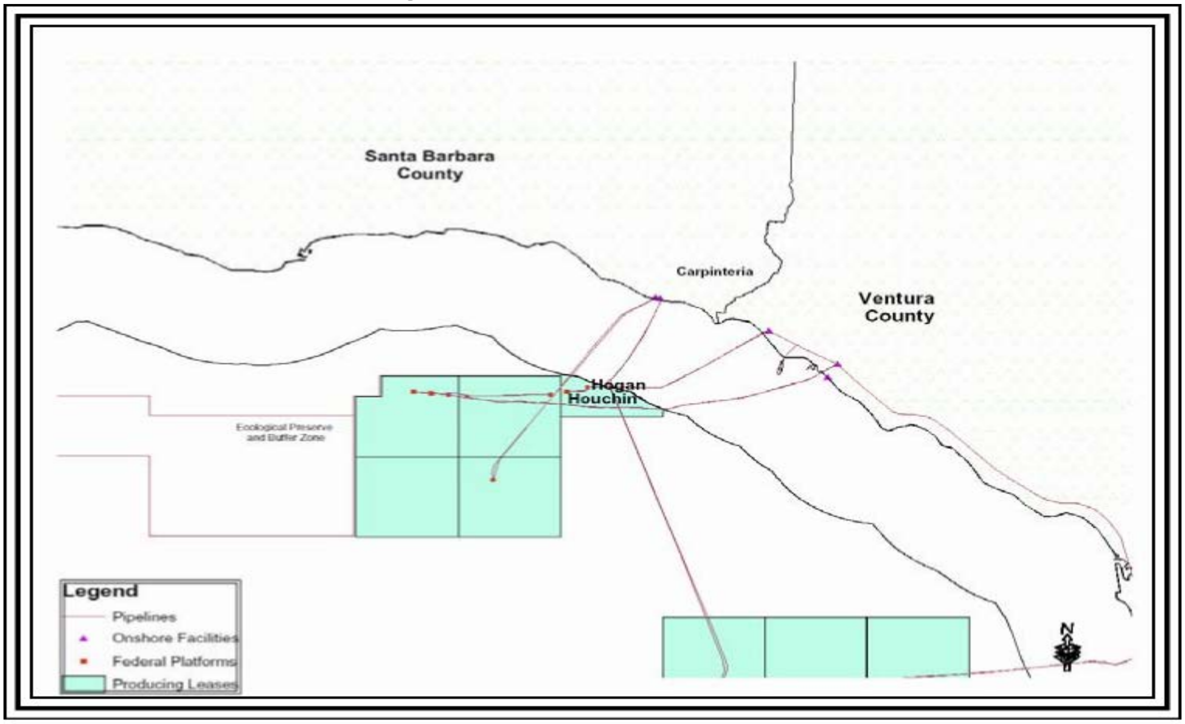

Figure A.1. Project I, Eastern Santa Barbara Channel

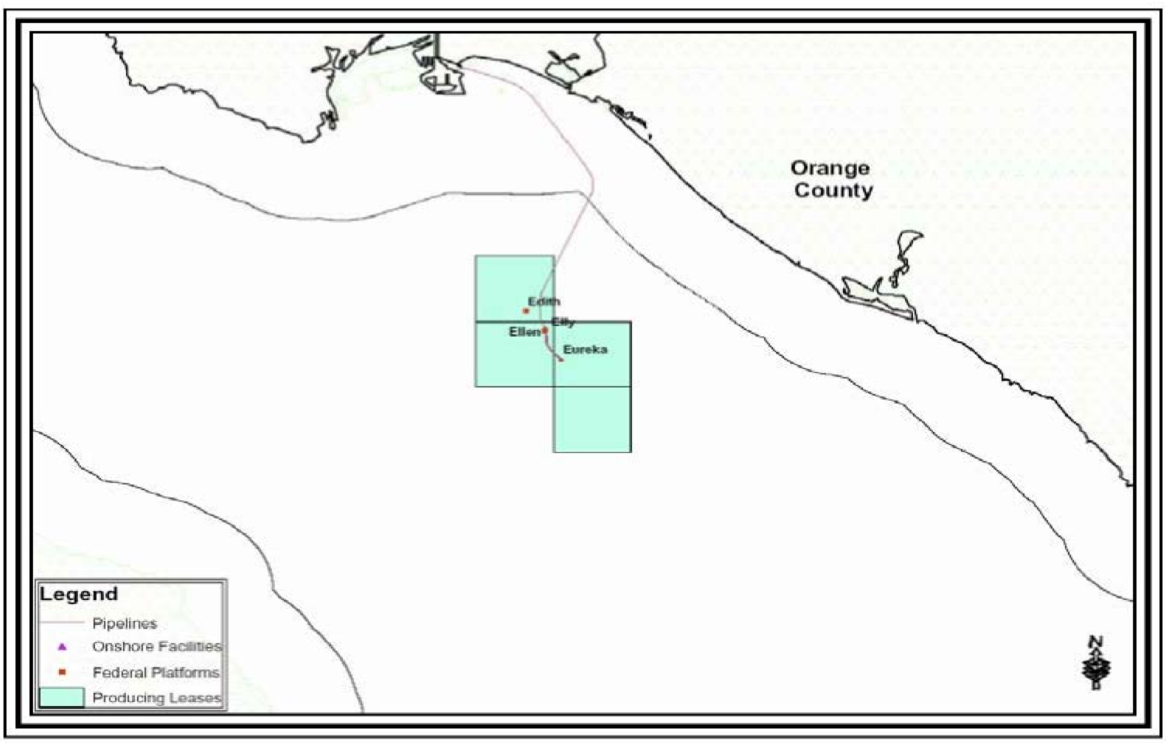

Figure A.2. Project II, South Coast

Figure A.3. Project III, Eastern Santa Barbara Channel

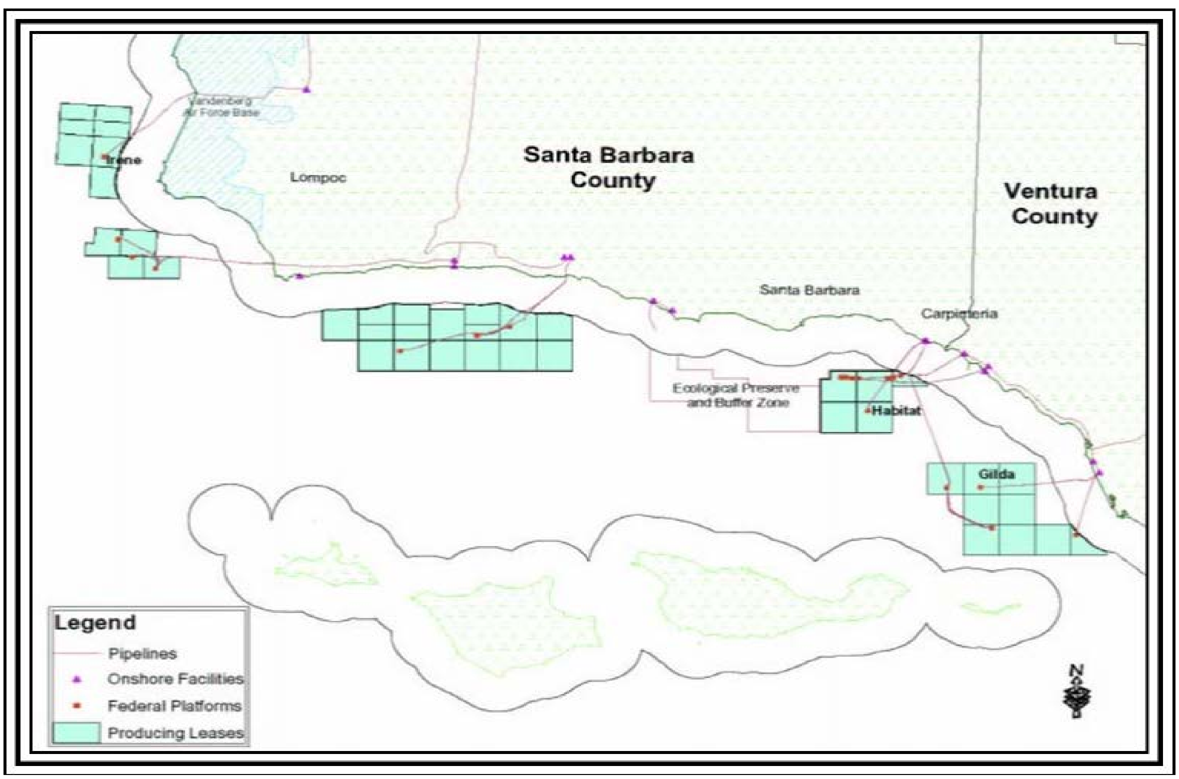

Figure A.4. Project IV, Santa Barbara Channel-Southern Santa Maria Basin

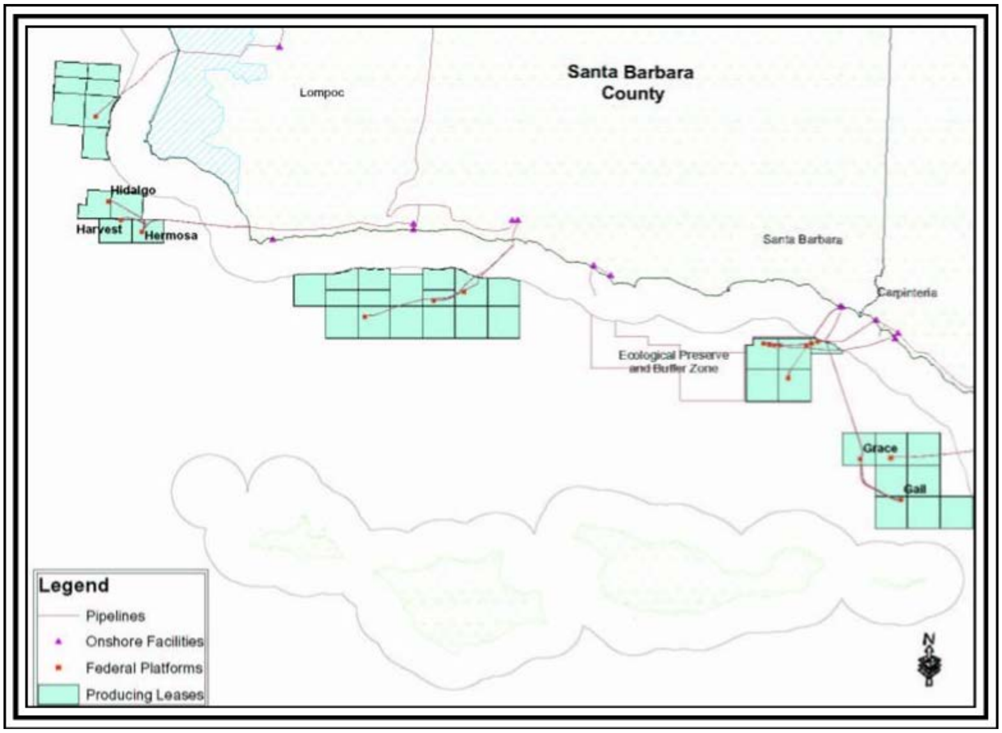

Figure A.5. Project V, Santa Barbara Channel-Santa Maria Basin

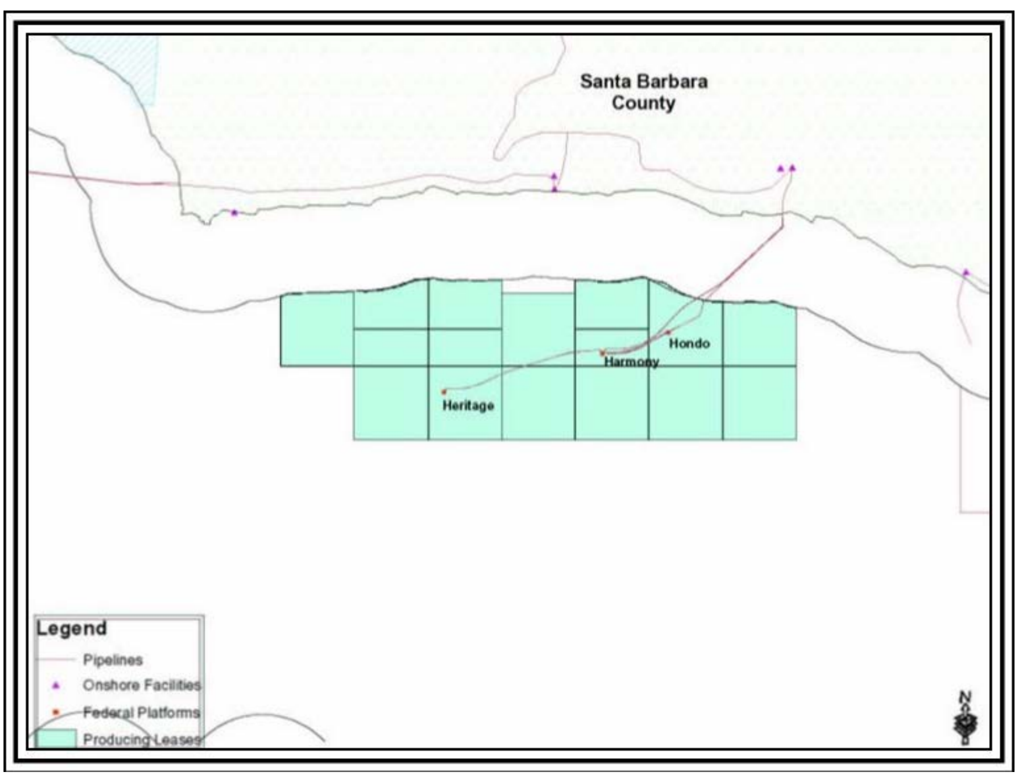

Figure A.6. Project VI, Western Santa Barbara Channel

Appendix 2: Total Cost by Decommissioning Category

Platform Name	Platform Removal	Conductor Removal	Site Clearance	Power Cable Removal	Platform Prep	Well Plugging & Abandonment	Pipeline Decommissioning	Weather Contingency	Misc. Work Provision	Permitting & Regulatory Compliance	Mobilization & Demobilization of Derrick Barge	Materials Disposal	Project Management, Engineering & Planning	Total
A	$3,847,788	$4,157,409	$709,000	$168,611	$957,710	$5,239,064	$397,568	$1,479,807	$2,219,711	$425,833	$3,060,000	$1,694,346	$1,238,172	$25,595,019
B	$3,847,787	$4,329,792	$709,000	$168,611	$957,710	$5,724,556	$3,138,559	$1,815,703	$2,723,555	$425,833	$3,060,000	$2,137,769	$1,510,081	$30,548,957
C	$3,917,124	$3,316,694	$709,000	$888,856	$957,710	$3,900,336	$393,566	$1,340,421	$2,010,632	$425,833	$3,060,000	$1,636,808	$1,126,663	$23,683,643
Edith	$9,371,983	$1,650,362	$709,000	$1,146,090	$1,163,564	$2,087,428	$247,296	$747,943	$2,243,830	$638,750	$4,590,000	$3,272,233	$1,310,058	$29,178,537
Ellen	$5,938,404	$5,910,614	$709,000	$0	$1,215,564	$7,095,344	$0	$980,305	$2,940,916	$638,750	$4,590,000	$4,230,698	$1,669,514	$35,919,110
Elly	$6,682,058	$0	$709,000	$0	$1,891,564	$0	$644,744	$426,438	$1,279,316	$638,750	$4,590,000	$3,704,800	$794,189	$21,360,859
Eureka	$30,425,645	$11,450,280	$1,282,000	$348,520	$2,628,383	$6,209,484	$9,044,467	$2,598,997	$7,796,994	$638,750	$4,590,000	$12,309,974	$4,911,102	$94,234,596
Gail	$34,281,481	$4,862,948	$1,282,000	$0	$3,264,383	$3,436,768	$4,174,981	$4,739,309	$7,108,965	$511,000	$9,072,000	$12,001,855	$4,104,205	$88,839,896
Gilda	$5,544,795	$5,063,282	$709,000	$1,180,766	$1,839,564	$7,880,044	$2,067,471	$2,295,460	$3,443,191	$851,667	$6,120,000	$3,850,765	$1,942,794	$42,788,799
Gina	$1,675,329	$739,207	$709,000	$228,081	$745,891	$1,510,000	$564,747	$567,132	$850,700	$425,833	$3,060,000	$452,971	$493,780	$12,022,672
Grace	$7,561,210	$3,811,997	$1,282,000	$0	$1,605,564	$4,314,044	$3,071,068	$2,004,969	$3,007,454	$511,000	$9,072,000	$3,672,362	$1,731,671	$41,645,339
Habitat	$5,640,962	$2,065,538	$709,000	$716,817	$1,709,564	$2,656,668	$697,656	$1,287,730	$1,931,596	$851,667	$6,120,000	$3,130,995	$1,135,696	$28,653,889
Harmony	$50,482,244	$15,845,720	$1,282,000	$1,021,164	$4,865,911	$7,068,992	$5,514,710	$8,095,779	$12,143,669	$851,667	$15,120,000	$26,735,494	$6,886,459	$155,913,807
Harvest	$33,076,224	$4,751,731	$1,282,000	$0	$3,900,383	$3,729,068	$2,708,438	$6,837,578	$6,837,578	$511,000	$9,072,000	$11,616,651	$3,955,828	$88,278,478
Henry	$3,351,684	$1,803,662	$709,000	$537,380	$1,269,710	$2,469,672	$431,967	$984,890	$1,477,335	$425,833	$3,060,000	$1,254,670	$845,846	$18,621,649
Heritage	$46,946,110	$13,578,128	$1,282,000	$4,256,258	$4,306,129	$10,241,356	$3,446,807	$7,889,419	$11,834,130	$851,667	$15,120,000	$23,123,497	$6,724,543	$149,600,043
Hermosa	$30,083,441	$2,840,279	$1,282,000	$0	$3,900,383	$2,540,036	$3,596,598	$6,099,099	$6,099,099	$511,000	$9,072,000	$10,788,108	$3,539,419	$80,351,462
Hidalgo	$24,621,842	$1,958,236	$1,282,000	$0	$3,302,492	$2,983,104	$2,953,508	$5,003,531	$5,003,531	$511,000	$9,072,000	$8,259,209	$2,968,095	$67,918,547
Hillhouse	$4,021,370	$3,984,545	$709,000	$663,911	$1,295,710	$4,779,384	$456,372	$1,517,365	$2,276,047	$425,833	$3,060,000	$1,562,866	$1,272,823	$26,025,227
Hogan	$8,086,753	$2,711,575	$709,000	$345,992	$957,710	$5,108,704	$750,152	$1,735,130	$2,602,697	$1,277,500	$7,020,000	$1,654,215	$1,493,591	$34,453,019
Hondo	$30,029,870	$6,340,742	$1,282,000	$859,484	$3,635,383	$5,145,272	$3,069,862	$4,628,929	$6,943,393	$851,667	$15,120,000	$9,754,894	$4,029,009	$91,690,506
Houchin	$7,845,027	$2,588,012	$709,000	$320,644	$957,710	$4,781,272	$228,358	$1,624,556	$2,436,833	$1,277,500	$7,020,000	$1,843,716	$1,394,402	$33,027,029
Irene	$5,996,669	$2,234,321	$709,000	$612,071	$1,605,564	$4,191,736	$1,428,518	$2,260,206	$2,260,206	$851,667	$6,120,000	$3,033,604	$1,342,230	$32,645,792
Total	$363,275,800	$105,995,074	$21,464,000	$13,463,257	$48,934,256	$103,092,332	$49,027,413	$66,960,696	$97,471,378	$15,330,000	$159,840,000	$151,722,501	$56,420,171	$1,252,996,877

Appendix 3: Platform Removal Weights (tons)*

Platform	Water Depth (feet)	Jacket	Piles	Conductors	Deck	Total Weight*
A	188	1,500	600	2,948	1,357	6,405
B	190	1,500	600	3,078	1,357	6,535
C	192	1,500	600	2,339	1,357	5,796
Edith	161	3,454	450	1,109	4,134	9,147
Ellen	265	3,200	1,100	4,416	5,300	14,016
Elly	255	3,300	1,400	0	4,700	9,400
Eureka	700	19,000	2,000	9,360	8,000	38,360
Gail	739	18,300	4,000	3,931	7,693	33,924
Gilda	205	3,220	1,030	3,648	3,792	11,690
Gina	95	434	125	420	447	1,426
Grace	318	3,090	1,500	2,866	3,800	11,256
Habitat	290	2,550	1,500	1,480	3,514	9,044
Harmony	1,198	42,900	12,350	13,291	9,839	78,380
Harvest	675	16,633	3,383	3,775	9,024	32,815
Henry	173	1,311	150	1,214	1,371	4,046
Heritage	1,075	32,420	13,950	11,319	9,826	67,515
Hermosa	603	17,000	2,500	2,186	7,830	29,516
Hidalgo	430	10,950	2,000	1,428	8,100	22,478
Hillhouse	190	1,500	400	2,829	1,200	5,929
Hogan	154	1,263	150	1,825	2,259	5,497
Hondo	842	12,200	2,900	5,163	8,450	28,713
Houchin	163	1,486	150	1,750	2,591	5,977
Irene	242	3,100	1,500	1,546	2,500	8,646

* Total Weight is the estimated platform removal weight and includes the weights of the jacket, deck, piles and conductors and assumes that they are removed to a depth of 15 feet below the mudline.

Appendix 4: Platform, Deck and Jacket Removal Details

Project I

Platform Name	Hogan	Houchin
Water Depth (feet)	154	163
Derrick Barge Capacity (tons)	500	500
Deck Weight (tons)	2,259	2,591
Deck Modules		
Max Weight Per module (tons)	350	430
Number of Modules	8	9
Jacket Weight (tons)	1,263	1,486
Jacket Sections		
Max Weight per Section (tons)	300	300
Number of Sections	5	5
Number of Piles	12	8

Project II

Platform Name	Edith	Elly	Ellen	Eureka
Water Depth (feet)	161	255	265	700
Derrick Barge Capacity (tons)	2000	2000	2000	2000
Deck Weight (tons)	4,134	4,700	5,300	8,000
Deck Modules				
Max Weight Per module (tons)	585	697	867	1,200
Number of Modules	12	10	12	10
Jacket Weight (tons)	3,454	3,300	3,200	19,000
Jacket Sections				
Max Weight per Section (tons)	1,200	1,100	1,600	1,000
Number of Sections	3	3	2	19
Number of Piles	12	12	8	24 skirt

Project III

Platform Name	Gina	A	B	C	Henry	Hillhouse
Water Depth (feet)	95	188	190	192	173	190
Derrick Barge Capacity (tons)	2,000	2,000	2,000	2,000	2,000	2,000
Deck Weight (tons)	447	1,357	1,357	1,357	1,371	1,200
Deck Modules						
Max Weight Per module (tons)	418	425	425	425	550	425
Number of Modules	2	4	4	4	4	4
Jacket Weight (tons)	434	1,500	1,500	1,500	1,311	1,500
Jacket Sections						
Max Weight per Section (tons)	434	1,500	1,500	1,500	1,311	1,500
Number of Sections	1	1	1	1	1	1
Number of Piles	6	12	12	12	8	8

Project IV

Platform Name	Gilda	Irene	Habitat
Water Depth (feet)	205	242	290
Derrick Barge Capacity (tons)	2,000	2,000	2,000
Deck Weight (tons)	3,792	2,500	3,514
Deck Modules			
Max Weight Per module (tons)	1,004	1,000	1,363
Number of Modules	6	5	6
Jacket Weight (tons)	3,220	3,100	2,550
Jacket Sections			
Max Weight per Section (tons)	1,100	1,600	1,300
Number of Sections	3	2	2
Number of Piles	12	8	8

Project V

Platform Name	Grace	Hidalgo	Hermosa	Harvest	Gail
Water Depth (feet)	318	430	603	675	739
Derrick Barge Capacity (tons)	4,400	4,400	4,400	4,400	4,400
Deck Weight (tons)	3,800	8,100	7,830	9,024	7,693
Deck Modules					
Max Weight Per module (tons)	1,000	1,378	1,269	1,698	1,894
Number of Modules	6	8	8	9	7
Jacket Weight (tons)	3,090	10,950	17,000	16,633	18,300
Jacket Sections					
Max Weight per Section (tons)	1,100	1,000	1,000	1,000	1,000
Number of Sections	3	11	17	17	19
Number of Piles	12 main 8 skirt	8 main 8 skirt	8 main 8 skirt	8 main 20 skirt	8 main 12 skirt

Project VI

Platform Name	Hondo	Heritage	Harmony
Water Depth (feet)	842	1075	1198
Derrick Barge Capacity (tons)	4,400	4,400	4,400
Deck Weight (tons)	8,450	9,826	9,839
Deck Modules			
Max Weight Per module (tons)	1,310	1,310	1,310
Number of Modules	13	13	13
Jacket Weight (tons)	12,200	32,420	42,900
Jacket Sections			
Max Weight per Section (tons)	1,000	1,000	1,000
Number of Sections	13	33	43
Number of Piles	8 main 12 skirt	8 main 26 skirt	8 main 20 skirt

Appendix 5: Deck and Jacket Specifications

Platform	Module Weights or Lift Weights (tons)	Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
A	Drill Deck Structure 425 Drilling Rig 237 Production Deck 325 Pipe Rack 370	12	12/40" to 80' BML	
B		12		
C		12		
Edith	Mod 1-471 Piperacks 246 Helipad 118 Quarters 438 Cap trusses 341 Flare 19	12	12/54" 200 to 280' BML	6 modules 2 cap trusses misc. other lifts
Ellen	E Deck 867 W Deck 816 C Deck 813 Sub St. 1-445 Sub St. 2-445	8	4/66" to 260' BML 4/48" to interior 230' BML	17 main lifts 12 modules

Platform	Module Weights or Lift Weights (tons)		Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
Elly	Cap Trusses	395	12	4-48" to 250' BML 2-42" interior to 220' BML 6-48" exterior to 220' BML	16 main lifts 10 modules
	SW deck				
	NW deck				
	E deck	697			
	Control Bld	260			
	C deck				
	Others				
	Prod. Skid	418			
Eureka	Modules up to 1,200 tons		8	Main 0 Skirt 24/60"	10 modules
Gail	East Deck	1,894	8	Main 8/60" Skirt 12/72"	7 main lifts
	West Deck	1,850			
	Driling Mod.	953			
	Comp. Mod.	869			
	Gen. SG Mod.	1,178			
	Flare	77			
	Crew Quarters	873			

Platform	Module Weights or Lift Weights (tons)		Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
Gilda	Drill Deck Equip.	1,004	12	12/48"	
	Drill Deck Steel	260		150 to 190' BML	
	Drill Rig	227			
	Prod. Deck Equip.	798			
	Prod. Deck Steel	305			
	Vert. added mass	1,192			
Gina	Deck	418	6	6/42"	
	Helideck	29		to 140' BML*	
	Others	---			
Grace			12	12/42" Main	
				8/48" Skirt	
Habitat	Skid Base	70	8		
	Derrick w/ sub.	562			
	Pump Package	1,363			
	Engine Package	639			
	Quarters	200			
	Reser. Mud/P Tank	680			

Platform	Module Weights or Lift Weights (tons)	Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
Harmony	WMSF 509 AU 1,025 EMSF 403 CU 804 AL Mod. 896 Quarters 957 CL 866 BU 1,310 BL 1,046 DU 800 DL 854 BX 242 Flare 127	8	Main 8/72" Skirt 20/84"	13 main lifts
Harvest	N Deck 1,698 Comp. 1,445 S Deck 1,425 Flare 50 G/SG 1,429 Quarters 921 C/U 931 Prod. 1,125 Total 9,024	8	Main 8/60" to 255' BML Skirt 20/72" to 235' BML	
Henry	Drilling Deck 465 Prod. Deck #1 356 Prod. Deck #2 550 (incl. some equip. but exclude rig & other equip.)	8	8/42" w/36" inserts to 170' BML	

Platform	Module Weights or Lift Weights (tons)	Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
Heritage	WMSF 509, AU Mod. 1,040 EMSF 403, Quarters 947 AL Mod. 886, CU/DU 804/800 CL Mod. 861, BU 1,310 BL 1,050, BX 237 DL 854, Flare 125	8	Main 8/72" Skirt 26/84"	13 main lifts
Hermosa	W/h Mod. 1,203 Prod. Mod. 1,269 Comp. Mod. 1,113 Util Mod. 1,150 Power Mod. 1,297 Pipe rack 320 Cap truss 777 Crew Quarters 700	8	Main 8/60" Skirt 12/72"	9 main lifts
Hidalgo	W/H Mod. 1,378 Prod. Mod 1,254 Comp. Mod 1,171 Util Mod. 955 Power Mod. 1,233 Pipe rack 266 Cap truss 1,071 Crew Quarters ----	8	Main 8/60" Skirt 8/72"	8 main lifts
Hillhouse		8		

Platform	Module Weights or Lift Weights (tons)	Number Jacket Legs	Number of Piles and Size	Number Lifts to Install Decks
Hogan	Drilling Deck & Equip. 302 Workover Rig 315 Deck Structure 997	12	12/36"	12 main lifts
Hondo		8	Main 8/48" & 42" inserts to 340' BML Skirt 12/54" & 48" to 250 BML	30 lifts
Houchin	Drlg. Deck Structure 432 Prod. Deck Structure 314 Drilling Rig 220 Pipecrack & Equip. 289 Other item of Equip.	8	8	9 main lifts
Irene	West Section 1,000 E Section 860 Cranes 0 Flare 25 Misc.	8	8/60"	

Appendix 6: Well Data

Platform	Water Depth	Average Well Depth	Well Count	Low # of Wells	Med Low # of Wells	Med High # of Wells	High # of Wells
A	188	2,500	52	45	5	1	1
B	190	2,500	57	49	6	1	1
C	192	2,500	38	33	3	1	1
Edith	161	4,500	18	12	4	1	1
Ellen	265	6,700	61	18	39	3	1
Elly	0	0	0	0	0	0	0
Eureka	700	6,500	50	6	38	5	1
Gail	739	8,400	24	0	19	2	3
Gilda	205	7,900	63	8	47	6	2
Gina	95	6,000	12	7	3	1	1
Grace	318	-	28	0	13	13	2
Habitat	290	12,000	20	1	16	2	1
Harmony	1,198	11,900	34	0	0	20	14
Harvest	675	10,000	19	0	0	14	5
Henry	173	2,500	23	20	1	1	1
Heritage	1,075	10,300	48	0	0	25	23
Hermosa	603	9,500	13	0	0	10	3
Hidalgo	430	10,700	14	0	0	8	6
Hillhouse	192	2,500	47	40	5	1	1
Hogan	154	5,400	39	13	18	4	4
Hondo	842	12,700	28	0	0	24	4
Houchin	163	5,100	36	12	16	4	4
Irene	242	9,800	24	0	2	20	2
TOTALS:	-	-	748	264	235	167	82

Appendix 7: Trends in Inflation and Recommendations on Updating Decommissioning Costs

For this study, Proserv was asked to compile information on inflationary trends related to offshore construction, and to make a recommendation on an appropriate index to apply to the decommissioning costs in the 5 year interval between decommissioning cost report updates. To make a determination of the appropriate inflation factor to use for POCSR decommissioning project cost estimates, we have evaluated construction trends internationally.

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 A.7, 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.

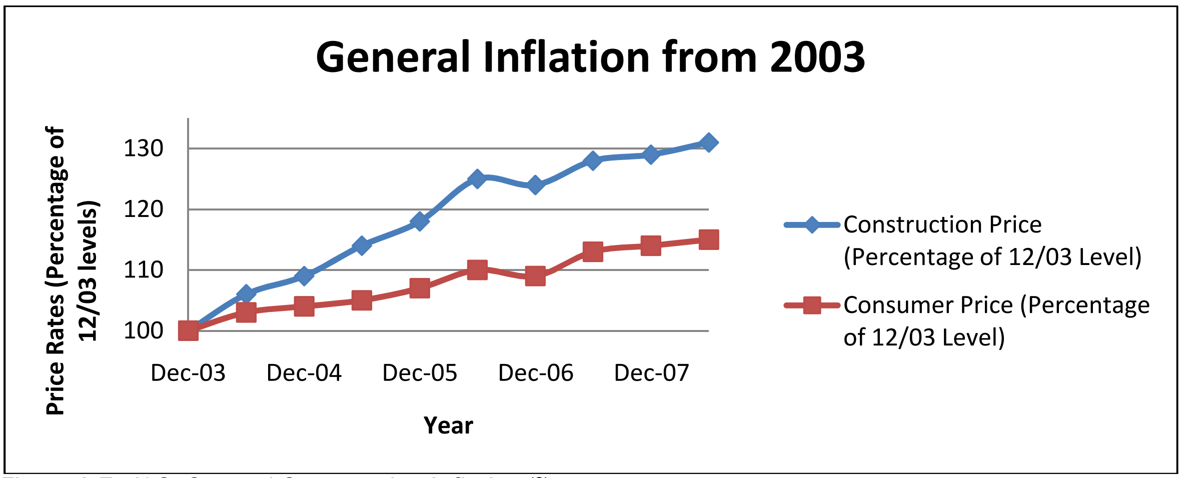

Figure A.7. U.S. General Construction Inflation [(2)]

Heavy construction has shown a greater increase in cost since 2003 primarily due to energy costs involved in operating heavy machinery. Figure A.8 shows a 41% increase in heavy construction costs, 26% higher than the CPI values, for an average annual rate of 8.97%.

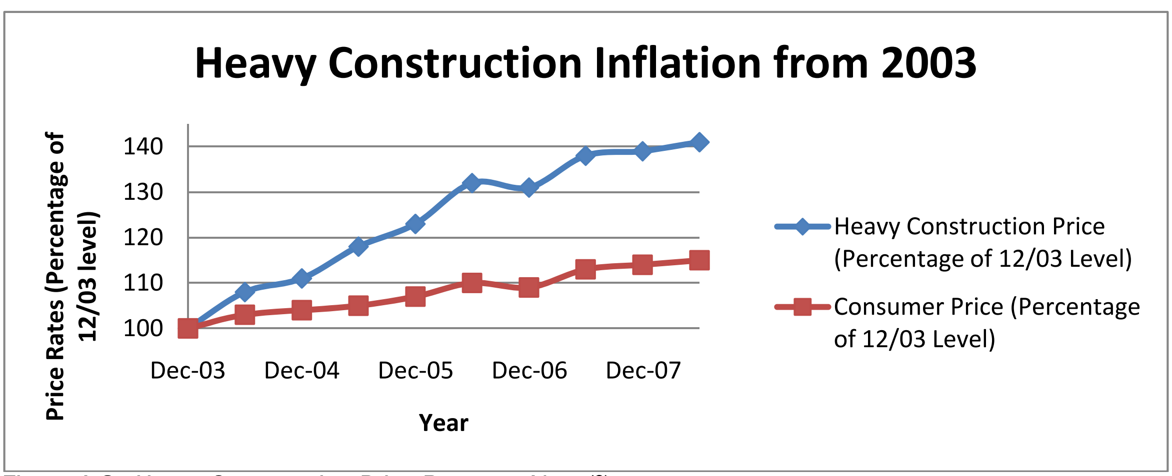

Figure A.8. Heavy Construction Price Rates vs. Year [(2)]

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 A.9.

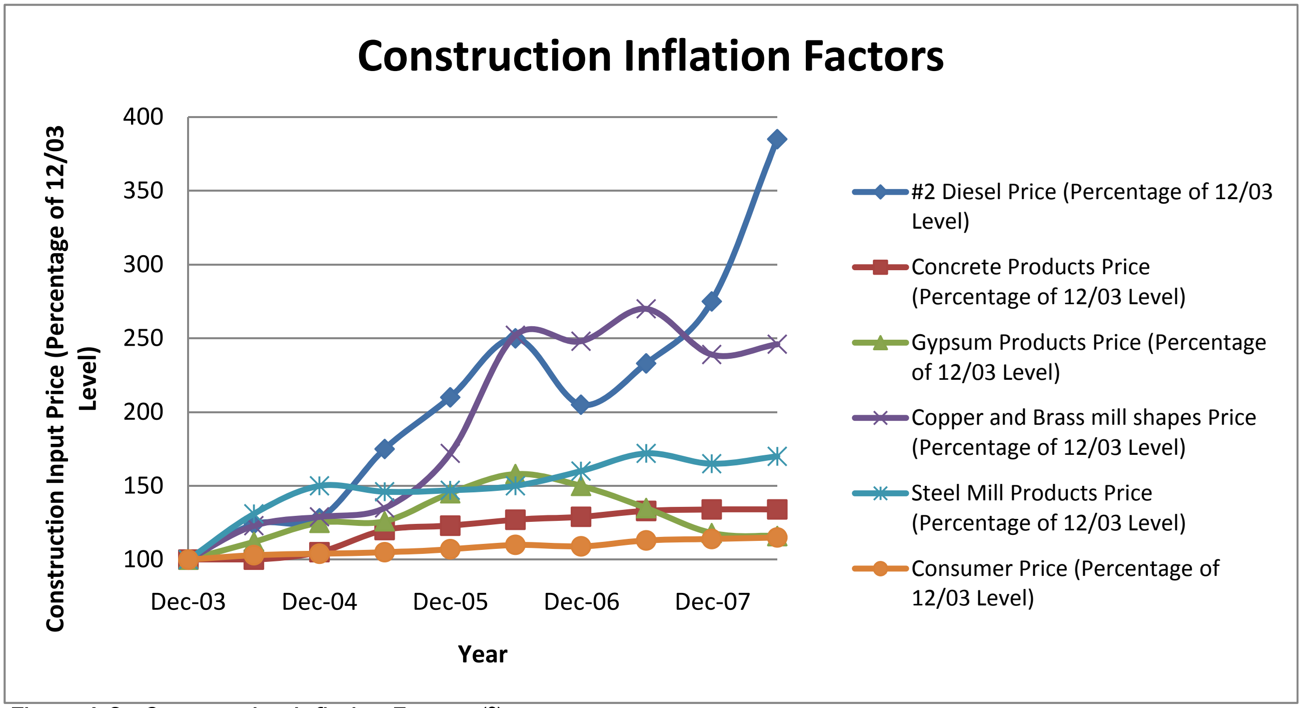

Figure A.9. Construction Inflation Factors (2)

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 POCSR decommissioning projects. Offshore vessel rates in Figure A.10 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 A.11. 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 A.9 above). (2) The general offshore vessel rate trend, excluding lift boats, has shown an annual average increase of 14.2% since 2003.

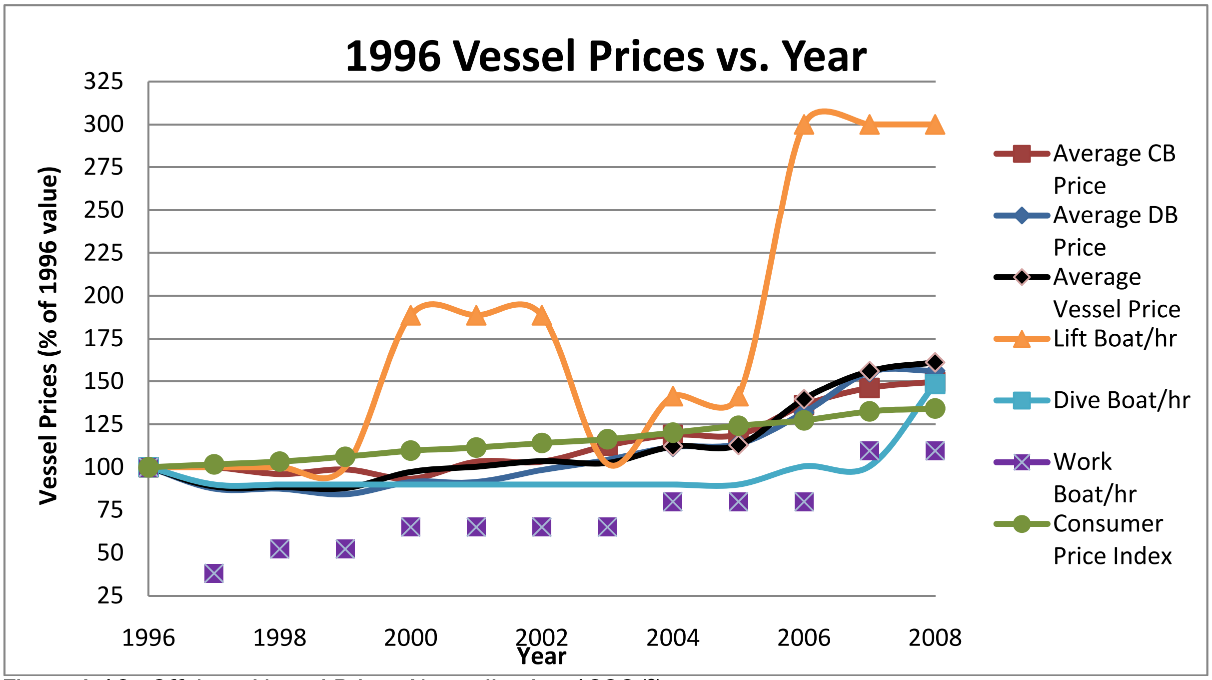

Figure A.10. Offshore Vessel Prices Normalized to 1996 (3)

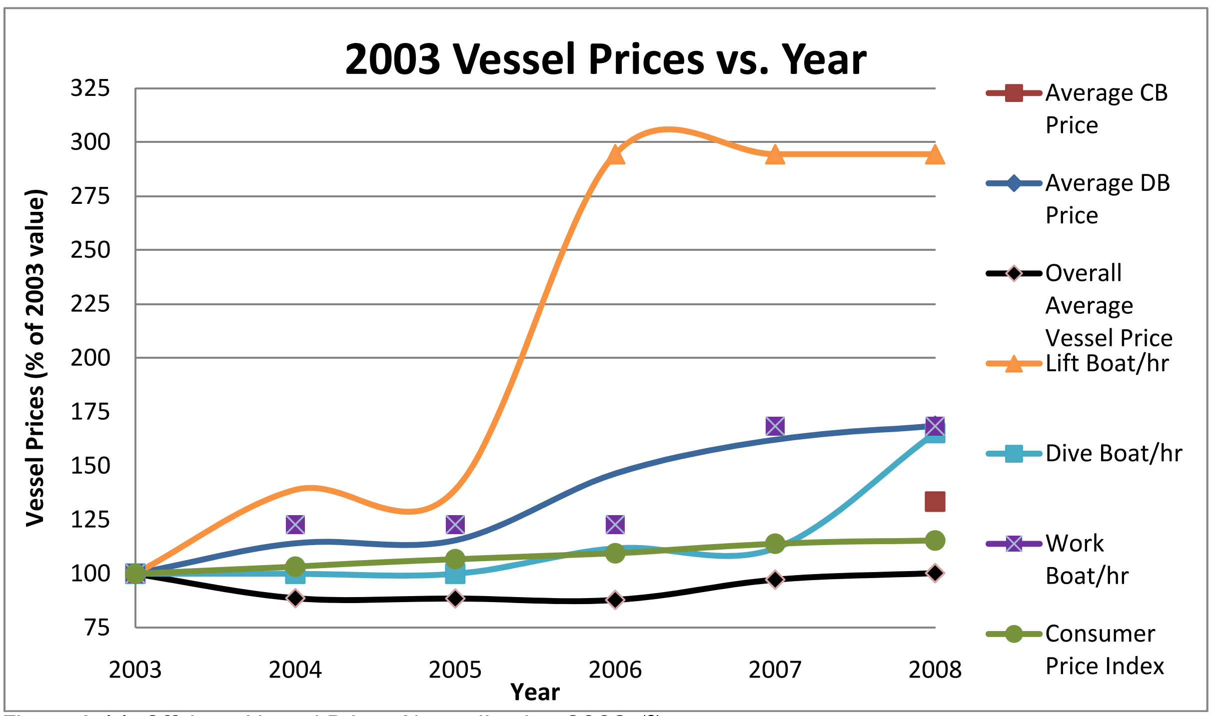

Figure A.11. Offshore Vessel Prices Normalized to 2003. (3)

Table A.1 shows the general construction rates for the U.S., Singapore, and India, as compiled by the U.S. Central Intelligence Agency (CIA).

Table A.1. Comparative General Construction Inflation Rates(2)

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%

Recommended Inflation Rate for the POCS 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% (Derrick Barge Average in Table A.2) for use in updating decommissioning costs in the five year interval between decommissioning report updates.

Table A.2. POCS Decommissioning Projects Cost Adjustment Factor

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	Average
Derrick Barge Yearly 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

Inflation References

1. www.cia.gov
2. http://www.agc.org/galleries/econ/AGC_CIA08_webFinal.pdf
3. Proserv Offshore's "PAES" Rates Database