ASSESSMENT OF DEEP WATER PIPELINE REPAIR IN THE GULF OF MEXICO

SEMI-ANNUAL PROGRESS REPORT

February 4, 1999

Prepared By:

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I. INTRODUCTION

The report contained herein presents the semi-annual progress of the Assessment of Deep Water Pipeline Repair in the Gulf of Mexico project as awarded to Project Consulting Services, Inc. (PCS) by U.S. Department of the Interior Minerals Management Service (MMS) on July 1, 1998. The project scope includes the practical assessment of currently available technology in deep water pipeline repair considering historic system performance, technological strong points, and technological weak points. The final deliverable of the project is a report that provides recommendations to push the current technology and to fill the gaps in existing technology. The final report shall also include any incidental design and operational issues relating to deep water pipelines as discovered during the course of the project.

This progress report presents the following information:

- Methodology adopted by PCS to fulfill our final objectives
- Historical background relating to deep water pipeline repair
- Overview of the information gathered by PCS to date
- Projection of future PCS activities for the upcoming year

This progress report is intended to convey preliminary project information that will allow the MMS to understand the work completed to date, the work in progress, and the emphasis for upcoming tasks. Several exhibits in the form of tables are included in their preliminary form and provide a large quantity of information gathered from all facets of the industry. PCS intends to further develop these exhibits during the course of the project so that they or the information they contain can be included in the final report in the most effective format.

II. METHODOLOGY

The initial focus for the project was making contact with the industry leaders in deep water pipeline repair technology. From July 1998 – December 1998, the primary direction was introducing the project to suppliers, service companies, and operators who have interests in the deep water Gulf of Mexico. These companies were generally receptive to these inquiries and were eager to share and exchange information. The initial success of our investigation resulted in invitations to meet with key individuals that have been involved in deepwater pipeline repair from its inception in the early 1970's. We accepted every opportunity to meet with these industry pioneers both in the New Orleans and the Houston areas. These meetings produced leads, both domestically and abroad, to the individuals who are currently focused on deep water pipeline repair. During the course of our research, there were several entities that were reluctant to share information for proprietary reasons, however efforts are being made to determine a general overview of their objectives as it relates to deep water pipeline repair.

Additional sources of information being pursued include the Internet, OTC proceedings, and topic specific conferences. These sources have yielded information on the current industry status

of deep water pipeline repair as well as several leads on currently available technology. There are still plans to attend several conferences that focus on deep water pipeline repair.

Creation of a data base is in progress which will facilitate the tracking and recording of each contact or publication that is researched during the course of the project. This data base is being designed to be a working document for use during the research effort as well as a reporting tool that will be incorporated into the final report upon project completion. A sample of the data base contents is contained in Appendix A. Since this is a working document, it is anticipated that the database format will evolve as more information becomes available, therefore the final format may differ significantly.

III. HISTORY OF DEEP WATER REPAIR TECHNOLOGY

For the last twenty years oil and gas producers in the Gulf of Mexico have pressed aggressively into deep waters in the Gulf of Mexico, and in the last several years the pace of drilling and development in deep water has accelerated. The oil and gas industry has developed new approaches and new technology to meet the challenges of deep water work. The industry is continually introducing new technology including many new designs for offshore production platforms, new marine construction equipment, and techniques for installing pipelines and risers in deep water.

Deep water has been defined as water depths beyond the reach of deep diving, which is generally below 1,200 feet. In these depths all work must be accomplished remotely and without direct intervention by a diver. Therefore, all repair work must be accomplished using a combination of specialized equipment, tools, and procedures. All work on the seafloor must be performed by remotely operated vehicles (ROVs). Alternative repair methods include pipeline recovery to the surface, the subsea installation of repair clamps and the removal and replacement of damaged sections of pipe on the sea floor. Pipeline recovery to the surface can present as much difficulty as seafloor repair scenarios because remote intervention is still required for tasks such as pipe cutting and pipe manipulation. Repair clamps are generally viewed as temporary fixes that may require deration of the pipeline until permanent repairs can be completed.

Almost thirty years ago, pipeline operators were just beginning to realize the difficulties associated with deep water pipeline repair. Our initial research has yielded a preliminary history of deep water repair programs referenced back to 1973. A preliminary summary is included in Appendix B for reference. The information contained within the summary is from one source, therefore follow up is in progress to verify the accuracy of the data.

IV. OVERVIEW OF INFORMATION GATHERED TO DATE

The discussions held with the contacts made from July 1998 to December 1998 were primarily focused on acquiring information about the current readiness of the industry to provide equipment and services for a pipeline repair in the deep water regions of the Gulf of Mexico. The ensuing discussions led to topics dealing with not only Gulf of Mexico readiness but also

worldwide readiness in general. Deep water repair technology had established a history in the North Sea and Mediterranean out of necessity many years before there was a need in the Gulf of Mexico. It is not suprising that there are currently only two complete system in existence capable of repairing deep water pipelines, and these systems reside in the North Sea and the Mediterranean areas.

During an interview with BP Exploration, Inc. (BP), Project Engineer Mr. Jim Riley, stated that BP has an interest in the current state of readiness of deep water pipeline repair capabilities in the deep water Gulf of Mexico. One hypothetical scenario considered by BP was a large damaged pipeline section below diver depths resulting in a total pipeline shut-in. The time required to repair the pipeline to its original operating conditions was estimated at eight (8) months. This included time to mobilize equipment from Europe, procure the mechanical connectors, fabricate repair spools, and develop the tools required to cut, clean, and prepare the pipeline for the repair.

The scenario described above poses a large financial risk to any deep water pipeline operator. The costs associated with repairing the damaged pipe includes not only the costs of the repair itself. They also include the deferred revenue associated with an extended duration shut-in. The repair equipment required for such a task is limited to large dynamically positioned vessels with large work-class ROVs. The mobilization and operation of a large vessel to perform such a repair can be costly. Despite the risk involved with operating a deep water pipeline, operators have pressed forward with projects extending well beyond diver depths in the Gulf of Mexico.

It has been inferred that operators proceed under the assumption that risk of deep water pipeline damage is mitigated by virtue of being in deep water. This assumption may have merit. Assuming a pipeline is stable on-bottom and has been properly designed, installed, and operated, there is little that can affect the integrity of a pipeline in deep water other than a direct impact from a heavy object. Damage potentials that exist in shallow waters including vessel anchors, commercial fishing, and the effects of tropical storms are virtually eliminated. For example, almost all construction vessels operating in deep water are equipped with dynamic positioning (DP) systems that allow the vessels to maintain station without the need for anchors.

Though risk of pipeline damage may be mitigated in deep water, there is a general interest among pipeline operators to develop contingency plans in case the need for deep water pipeline repair arises. Outlined below is an overview of the various processes, entities, and issues associated with the repair of a deep water pipeline:

Deep Water Pipeline Repair Process

The process of repairing a pipeline in deep water breaks down into several functional topics:

1) Survey and Identification of Damage
2) Selection of Marine Support Equipment
3) Removal of Damaged Pipe
4) Pipe Preparation
5) Installation of Hardware
6) Testing and Commissioning.

The types of companies that provide these services and equipment are touched upon in the following discussions:

Pipe Lay Contractors

As expected, all of the deepwater pipe lay contractors in the Gulf of Mexico are interested in pipeline repair as a logical extension of their current capabilities. PCS is in regular contact with these companies and has discussed deepwater repair scenarios with them on several projects over the last few years. We plan to stay abreast of their capabilities during the course of this project.

ROV and Support Services Contractors

ROVs are used in all phases of deepwater pipeline repairs. All of the proposed methods, equipment, and procedures which have been proposed for deepwater pipeline repair, without exception, employ ROVs. The ROVs which can perform the multiple functions proposed are "work-class" ROVs. These ROVs represent a set of ROVs of a certain size, power, and depth capability. PCS has contacted all of the companies which currently operate work-class ROVs in the Gulf of Mexico, including:

1) Oceaneering International, Inc.
2) Sonsub, Inc.
3) SubSea International, Inc.
4) Stolt Comex Seaway Inc.
5) Canyon Offshore, Inc.
6) Global Industries, Ltd.
7) Cal Dive International
8) Racal

These eight (8) companies all claim they have the capability to provide ROV services in support of deepwater pipeline repair, limited only by the availability of their ROVs at the time. Many of these companies also offer one or more ROV support vessels, some of them dynamically-positioned. Most of the ROV operating companies have been involved in deepwater offshore

construction of production platforms and pipelines, and they offer operational experience and specific engineering services in support of deepwater pipeline work.

Existing Deep Water Pipeline Repair Equipment

While many types of equipment, tools, and procedures exist in the Gulf of Mexico for deepwater pipeline repairs, there is no single, complete system in the Gulf of Mexico at this time. As mentioned above, there are two complete deepwater repair systems in the oil and gas industry worldwide today. A set of pipeline handling frames and associated equipment are built by Statoil. The control systems and ROV interfaces for this equipment are engineered and manufactured by SubSea International. Recent reports indicate that this system is in storage in Stavanger, Norway. The second system is owned by Saipem and operated by its ROV operating subsidiary Sonsub. This system is located either in Italy or Norway. In both cases, these are large systems which can only be transported by sea. However, their operational and control systems can be transferred directly to systems which could be built and made available in the Gulf of Mexico.

Connectors and Related Equipment

There are at least five major manufacturers of pipeline connectors and related equipment which are actively marketing their equipment for deepwater pipeline repairs. These companies include:

1) Cameron
2) Oil States/Hydrotech
3) FMC
4) Big Inch Marine Systems
5) ABB Vetco

PCS has interviewed these five companies, four of them in person. In addition, there are other manufacturers that offer products for deepwater pipeline repairs, such as Morgrip and Drilquip.

V. PROJECTION OF FUTURE PROJECT ACTIVITIES

We estimate that Phase I of the project is 53% complete bringing total project completion to approximately 38%. This is based on the updated project schedule that can be found in Appendix C. The research performed to date has revealed a wealth of information sources yet to be explored including companies developing new technology both domestically and overseas and custodians of existing technology located exclusively overseas. The remainder of Phase I is to be spent meeting with and establishing new leads, visiting the developing and existing technology, and following up with previous contacts as required. Current efforts include scheduling interviews with Shell Deep Water Development Systems, Inc. (Houston), Stolt Comex Seaway, Inc. (New Orleans), LTS (Houston), Shell International Exploration & Production (Netherlands), SNAM/Saipem/Sonsub (Houston and Milan), and Statoil (Stavanger).

Phase II tasks, which consist primarily of data evaluation, are slowly being implemented over the next several months. We anticipate Phase II to officially begin in May 1999. Phase II activities include dedicating more resources towards the development and maintenance of the database and to the sorting of information for detailed analysis. We plan to use the results from the completed analysis as a basis for the final report which is scheduled for completion in December 1999. We are anticipating follow up research extending throughout the project duration due to scheduling of events such as technology conferences and availability of key contacts within the industry.

VI. CONCLUSION

The industry response has been positive to our inquiries to the current state of technology in the deep water Gulf of Mexico. Most of the companies we have interviewed, including service companies, equipment manufacturers, and pipeline operators, either expressed an interest in developing deep water pipeline repair technology or currently have some technology available. We do note that many components exist, or the technology to commercially manufacture the components exist, however there is no single entity that can offer a complete repair system beyond diver depths in the Gulf of Mexico. The components of such a system, in general, are job specific, meaning that tooling and equipment developed for one pipeline repair may not applicable to another. Deep water repair is a costly proposition for pipeline operators to consider, however the risk of damage is prompting the deep water operators to initiate further development of the technology.

APPENDIX A

SAMPLE DATA BASE

Minerals M.. ..ement Service
Assessment of Deepwater Pipeline Repair Capabilities
DATABASE

Company Name	Company Type (S=Supplier) (O=Operator) (C=Contractor) (E=Engineering/ Consulting Firm) (M=Misc.)	Company Product or Service	First Interview Date	Street Address	P.O. Box	City	State	ZIP	Country	Company Telephone	Company Fax	Contact	Title	Beeper	Contact e-mail
ABB				1515 Poydras Street Suite 1360		New Orleans	LA	70112	USA	504-527-6824 or 504-522-1522	504-523-7507	Brian Taylor	Sr. Sales Rep	504-552-1585	
Allseas Services USA, Inc.				333 N. Sam Houston Pkwy E.		Houston	TX	77060	USA	281-999-3330	281-999-6363	G.P.(Peter) Olden	Project Mgr		po@allseas.com
Alexander's Gas & Oil Connections	M	Information	6/24/98	Internet Website: http://www.gasandoil.com	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	maris@xs4all.nl
Allseas Services USA, Inc.				333 N. Sam Houston Pkwy E. Suite 1275		Houston	TX	77060	USA	713-999-3300	713-999-6363	Roy H. Sijthoff	U.S. Rep		
BAUGH Consulting Engineers, Inc				14626 Oak Bend		Houston	TX	77079	USA	713-497-7312	713-497-7312	Benton F. Baugh, Ph.D., P.E.			
Big Inch Marine Systems	S	Pipeline End Connectors	8/19/98	Northwoods Industrial Park West 12235 FM 529		Houston	TX	77041	USA	713-849-1165	713-466-1283	Rex Mars	VP Sales		
BP Exploration	O	Oil and Gas Production	12/8/98	BP Exploration Inc.	P.O. Box 4587	Houston	TX	77210-4587	USA	281-560-3051	281-597-4287	James W. Riley II	Project Engineer		
" " "	" " "	" " "	" " "	BP Plaza 200 WestLake Park Boulevard		Houston	TX	77079	USA	same	same	same	same		
CAL DIVE INTERNATIONAL	S			13430 Northwest Freeway Suite	N/A	Houston	TX	77040	USA	713-690-1818	713-690-2204	Randall Drewry	VP Bids & Proposals	Res713-370-8218	N/A
" " "	S	Construction Diving	Attempted 10/7/98	" " "	" " "	" " "	" " "	" " "	" " "	" " "	" " "	John Sokol	N/A	N/A	N/A
CAMERON	S	Pipeline End Connectors	12/8/98	13013 Northwest Freeway (77040)	P.O. Box 1212	Houston	TX	77251-1212	USA	713-939-2483	713-393-2980	Tom R. Schmitz, P.E.	Sr. Product Design Specialist Marine Engineering		
CAMERON	S	Pipeline End Connectors	12/8/98	13013 Northwest Freeway (77040)	P.O. Box 1212	Houston	TX	77251-1212	USA	713-939-2058	713-939-2611	Jerry Skweres, P.E.	Mgr Project		skweresj@camerondiv.com
CAMERON	S	Pipeline End Connectors	12/8/98	13013 Northwest Freeway (77040)	P.O. Box 1212	Houston	TX	77251-1212	USA	713-939-2483	713-939-2980	Albert Sheppard, Jr. Product Manager			
Cayon Offshore				5212 Brittmoore Road		Houston	TX	77041	USA	713-856-6010	713-856-6020	Bill Tink	VP Sales &Marketing		btink@canyonrov.com
Ceanic Corporation				1902 Diver Drive		New Iberia	LA	70560	USA	318-369-9040	318-364-7403	Denny Swartz	Sales & Special Project		web site www.ceanic.com
Canyon Offshore Inc.				10801 Hammerly Boulevard Suite		Houston	TX	77043	USA	318-461-6772	713-461-6737	Cliff Chamblee	VP Sales & Operations	713-961-6074	
Coflexip Stena Offshore				7660 Woodway Suite 390		Houston	TX	77063	USA	713-789-8540	713-789-7367	Henry Kolanski	Sales Mgr Flexible Pipe Systems		Henry_Kolanski@CSO-Houston. Ccmail.compuserve. Com
Conoco Inc.				Dubai, 2064 600 North Dairy Ashford	P.O. 2197	Houston	TX	77252	USA	713-293-1208	713-293-5529	William S. (Bill) Tillinghast, P.E.	Senior Staff Engineer		
Cooper Oil Tool					P.O. Box 1212	Houston	TX	77251-1212	USA	713-939-2959	713-939-2423	?Duplicate Albert Sheppard, Jr. Product Manager	Manger		
Cooper Oil Tool					P.O. Box 1212	Houston	TX	77251-1212	USA	713-939-2754	713-939-2115	?Duplicate Tom R. Schmitz, P.E.			
Costain Engineering & Construction				Land & Marine House Port Causeway		Bromborough	Wirral	L62 4TG	Merseyside	051-645-8000	051-645-4005	Ron J. Furlong	Contracts Director		
DeepStar	M	Deep Water Technology Research Organization	9/1/98	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Paul R. Hays	DeepStar Project Manager, Texaco	N/A	N/A
Exxon					P.O. Box 446	Houston	TX	77210-44	USA	713-656-4348	713-656-4329	Sanjay Sinha	Saipem Pipelines Engineer		sanjay.sinha@exxon sprin
Exxon					P.O. Box6170	New Orleans	LA	70161-17	USA	504-561-3499		Tim Arthur	Senior Staff Engineer		
Halliburton	S, C	Oilfield Equipment and Services	N/A	8432 South 135 W	N/A	Alvarado	TX	76009-97	USA	817-783-5811	817-783-5812	David J. Leidel, Ph.D.	Principal Engineer Explosive Products Center		
Kongberg Offshore FMC Corporation Wellhead Equipment Div.				1777 Gears Road Box 3091		Houston	TX	77253	USA	281-591-4223	281-591-4030	John A. Fitzgeral	Sr. Sales Rep		internet john_fitzgerald@f
FMC Corporation Wellhead Equipment Division				1777 Gears Road Box 3091		Houston	TX	77253	USA	281-591-4223	281-591-4107	Shiva P. Singeetham	Sr. Development Engineer		
?DuplicateGrayloc Products				1515 Poydras Street Suite 1360					USA						

2/4/99

WORK IN PROGRESS

PRELIMINARY

APPENDIX B

HISTORY OF DEEP WATER PIPELINE REPAIR SYSTEMS

HISTORY OF DEEPWATER PIPELINE REPAIR SYSTEMS (PRELIMINARY)

Item	Date	Sponsor	Depth	Scope of Work	Type/Participants/Status/Comments
1	73-76	Exxon	4,000'	Repair 36" pipe	JIP/16. Report 76-77. Conceptual only, predated work
2	74-77	Shell	3,000'	Repair 36" pipe	JIP/6. Report 77. Conceptual only.Submersible catamaran carrying all tools, repair devices, spoolpieces, etc.
3	77	Statoil	1,500'	Repair 36" pipe.	Several concepts commissioned. Hydrotech design/d/built subsea frame for installing mechanical connectors using 1 Atm. Suit.
4	81-83	Gulf Oil	8,000'	Size not defined	JIP/4-6. Preliminary design completed; fabrication drawings not funded. System based on use of ROVs, mechanical connectors,existing equipment
5	84-86	SNAM	2,000'	20" spoolpiece	Part funding by THERMIE. Hardware constructed. Modules and frames used to perform separate functions, I.e. cutting, concrete removal, etc. Connections used cold-forging system.
6	88-90	Hydrotech/ Sonsub	2,000'	Repair 20" pipe	Joint Venture, attempted JIP, dissolved for lack of interest. System based on ROVs, mechanical connectors, subsea equipment.
7	92-99	Sonsub/ Saipem/ Snamprogetti	3-10,000'	Repair 26" pipe	Part funding by THERMIE. ROVs perform all functions --cutting,concrete removal, etc. X-Loc connectors used. Tested at 1,200'. Tested in Norway 97-98.
8	94-99	Statoil/ NorskHydro	2,000'	Repair 24" pipe	Funded by Troll Oil Pipelines, Haltenpipe. Successful field test. ROV operated, uses mechanical connectors,. 16" pipe repair capability.
9	95-99	Major	not defined	Repair clamps for	Hydrotech clamps, ROV installed. Tested remotely operated mechanical connectors.
10	92-99	Texaco	All pipelay depths	All pipe diams.	JIP/18+. Proprietary. Concept is retrieve pipe to surface and weld on ends, lower to seafloor and install jumper. Studying pollution control. No equipment constructed.
11	96-99	SNAM/Saip	3,300'	Repair 20"/26" pi	Connectors,cold forging, spoolpiece sched for testing 97. Cutting,cleaning, frames scheduled for testing 98.

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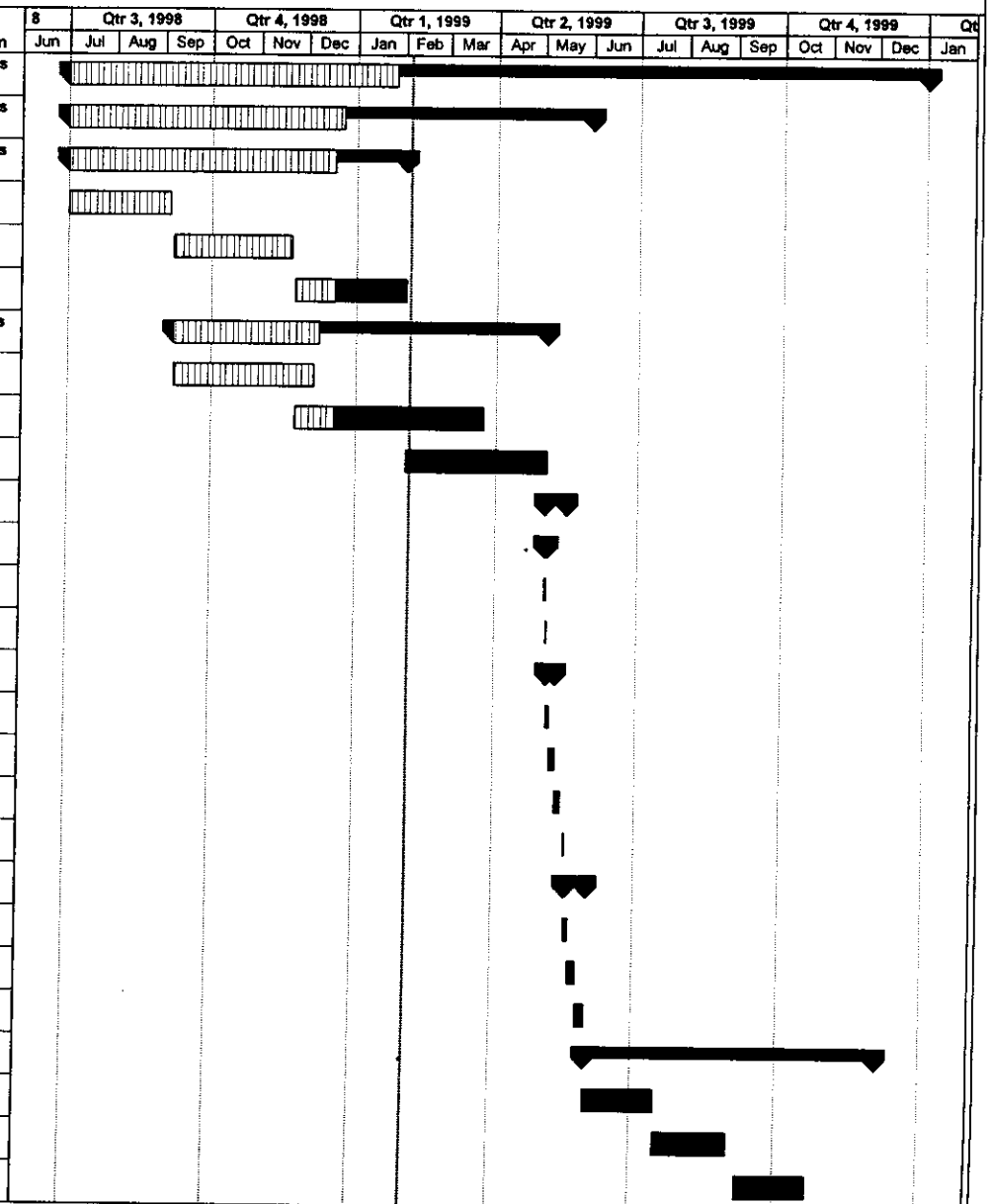
APPENDIX C

PROJECT SCHEDULE

Minerals Management Service
Assessment of Deepwater Pipeline Repair in the Gulf of Mexico

ID	Task Name	Start	Finish	% Complete	Duration
1	**ASSESSMENT OF DEEP WATER PIPELINE REPAIR IN THE GULF OF MEXICO**	**Wed 7/1/98**	**Sat 1/1/00**	**38%**	**393 days**
2	**PHASE I**	**Wed 7/1/98**	**Mon 5/31/99**	**53%**	**239 days**
3	**Vendor / Contractor Sourcing**	**Wed 7/1/98**	**Mon 2/1/99**	**79%**	**154 days**
4	Construction Contractor	Wed 7/1/98	Fri 9/4/98	100%	48 days
5	Vendors	Mon 9/7/98	Fri 11/20/98	100%	55 days
6	R.O.V. Contractors	Mon 11/23/98	Mon 2/1/99	38%	51 days
7	**Vendor / Contractor In-House Evaluation Meetings**	**Mon 9/7/98**	**Mon 5/3/99**	**39%**	**171 days**
8	Construction Contractor	Mon 9/7/98	Fri 12/4/98	100%	65 days
9	Vendors	Mon 11/23/98	Tue 3/23/99	22%	87 days
10	R.O.V. Contractors	Tue 2/2/99	Mon 5/3/99	0%	65 days
11	**Vendor / Contractor Visits**	**Mon 5/3/99**	**Sun 5/16/99**	**0%**	**10 days**
12	**Local Contractor Visits**	**Mon 5/3/99**	**Tue 5/4/99**	**0%**	**2 days**
13	Local Visit No. 1	Mon 5/3/99	Mon 5/3/99	0%	1 day
14	Local Visit No. 2	Tue 5/4/99	Tue 5/4/99	0%	1 day
15	**Domestic Vendor / Contractor Visits**	**Wed 5/5/99**	**Mon 5/10/99**	**0%**	**4 days**
16	Domestic Visit No. 1	Wed 5/5/99	Thu 5/6/99	0%	2 days
17	Domestic Visit No. 2	Fri 5/7/99	Mon 5/10/99	0%	2 days
18	**Foriegn Contractor Visit**	Tue 5/11/99	Sun 5/16/99	0%	4 days
19	**PROGRESS MEETING**	Mon 5/17/99	Mon 5/17/99	0%	1 day
20	**Conference / Exhibition / Workshops**	**Tue 5/18/99**	**Mon 5/31/99**	**0%**	**10 days**
21	Local Conference	Tue 5/18/99	Thu 5/20/99	0%	3 days
22	Domestic Conference	Fri 5/21/99	Tue 5/25/99	0%	3 days
23	Foreign Conference	Wed 5/26/99	Mon 5/31/99	0%	4 days
24	**PHASE II**	**Tue 6/1/99**	**Fri 12/3/99**	**0%**	**134 days**
25	Follow Up Research	Tue 6/1/99	Thu 7/15/99	0%	33 days
26	Construction Contractors Data Evaluation	Fri 7/16/99	Tue 8/31/99	0%	33 days
27	Vendors Data Evaluation	Tue 9/7/99	Thu 10/21/99	0%	33 days



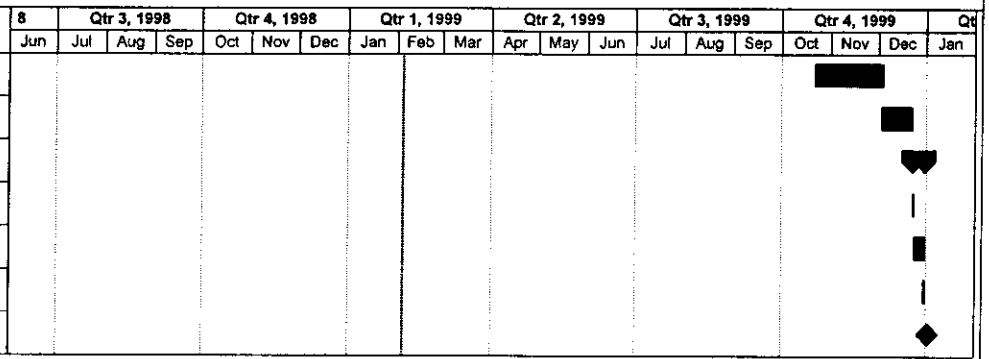
Project: Assessment of Deep Water Pipeline Repair in the Gulf of Mexico
Date: February 04, 1999

Task
Progress
Milestone
Summary
Rolled Up Task
Progress
Rolled Up Milestone
Rolled Up Progress
External Tasks
Project Summary
Split
Rolled Up Split

PCS Job No. 98120

Minerals Management Service
Assessment of Deepwater Pipeline Repair in the Gulf of Mexico

ID	Task Name	Start	Finish	% Complete	Duration
28	R.O.V. Contractors Data Evaluation	Fri 10/22/99	Fri 12/3/99	0%	31 days
29	Draft Final Report Preparation	Fri 12/3/99	Wed 12/22/99	0%	14 days
30	**PRE-PUBLISH MEETING**	**Thu 12/23/99**	**Thu 12/30/99**	**0%**	**6 days**
31	Meeting	Thu 12/23/99	Thu 12/23/99	0%	1 day
32	Report Revisions	Fri 12/24/99	Thu 12/30/99	0%	5 days
33	Final Report Submittal	Thu 12/30/99	Thu 12/30/99	0%	1 day
34	**Project Completion**	Sat 1/1/00	Sat 1/1/00	0%	0 days



Project: Assessment of Deep Water Pipeline Repair in the Gulf of Mexico
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Task
Progress
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Rolled Up Task
Progress
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