OCS Report
MMS 91-0066

Investigation of the Exxon Company U.S.A. Pipeline Leak Eugene Island Block 314 May 6, 1990

Gulf of Mexico
Off the Louisiana Coast

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U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Region

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Don Howard
John Guidry
William Hauser
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U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office

New Orleans
November 1991

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Investigation and Report

Authority

The following investigative panel of Minerals Management Service (MMS) personnel were given the assignment to investigate and to prepare a public report on the pipeline leak that occurred on or about May 6, 1990, at Eugene Island Block 314 off the Louisiana Coast:

Don Howard	John Guidry
William Hauser	Jack Leezy

The panel members were named by memorandum dated May 15, 1990, pursuant to Section 208 (subsections 22d, e, and f) of the Outer Continental Shelf (OCS) Lands Act, as amended (1978).

Procedures

The MMS accident investigation panel members conferred by teleconference in late May 1990 and determined what initial information was needed from Exxon Company U.S.A. (Exxon) and Texaco Pipeline Inc. (Texaco). Upon obtaining this information, the panel, excluding Mr. Hauser, met at the MMS Gulf of Mexico OCS Regional Office in New Orleans, Louisiana, on August 23, 1990. Each member reviewed the collected data. The panel chairman, Mr. Don Howard, considered all the facts and data presented and determined that additional information was needed from Texaco. The information was received on September 13, 1990. The panel met in New Orleans on November 20 and November 21, 1990, and reviewed all the information obtained.

Introduction

Background

Texaco is the pipeline right-of-way (ROW) holder of the main 20-inch pipeline of the Eugene Island Pipeline System (EIPS), which originates at South Marsh Island Block 128 and terminates at Caillou Island, Louisiana. This pipeline makes up the main body of EIPS. Pipeline spurs to this 20-inch pipeline have been laid by other operators; these spurs and the main line make up the entire EIPS. Texaco is the operator of this pipeline, MMS Royalty Measurement Pipeline System 29.5, which gathers liquid hydrocarbon produced from Federal oil and gas leases in the Vermilion, South Marsh Island, and Eugene Island Areas. The product comes onshore at Caillou Island, Louisiana, where it changes from the 20-inch EIPS pipeline to the Texaco 16-inch pipeline, then continues to Texaco's 1617 Coteau Road gathering facility located at Houma, Louisiana. Offshore Lease Automatic Custody Transfer (LACT) unit points for royalty and sales purposes are established at the Federal oil and gas lease injection points. The onshore metering facility provides overages/underages for the entire EIPS. These are allocated back to the individual leases based on the LACT unit readings at the various offshore injection points.

The leak involved an 8 ⅝-inch spool piece, connecting an 8 ⅝-inch Exxon pipeline to the EIPS 20-inch pipeline. The pipeline Segment No. 4030 extends 5,000 feet from Exxon's Platform B to a subsea tie-in (SSTI) on the EIPS 20-inch pipeline, all located in Eugene Island Block 314, Lease OCS-G 2111. (See Attachment 1.) Pipeline Segment No. 4030 was

approved August 18, 1976, under 30 CFR 256 regulations. Operational regulation of Segment No. 4030 and the entire EIPS is in accordance with Department of Transportation Regulation 49 CFR 195 — Transportation of Hazardous Liquids by Pipeline. Segment No. 4030 had been placed out of service by Exxon in 1988 by closing their block valve near the SSTI.

Description of Incident

On May 6, 1990, several companies began calling in oil-spill sightings within the Eugene Island Block 314 area. Texaco was notified of an oil spill in the general area of their 20-inch EIPS. Consequently, Texaco began making flights over the area and testing their 20-inch pipeline. These tests were inconclusive. Texaco Offshore Producing Division initiated the deployment of a Clean Gulf Associates Fast Response Unit (FRU) to the spill site to begin cleanup operations on the morning of May 7, 1990. Texaco decided to shut down the EIPS until the source was identified.

On May 7, 1990, the entire EIPS was shut in by 5 a.m. Divers and surveying equipment were dispatched to the oil-spill site to help determine and eliminate the source of the spill. Approximately 15-20 bbl of spilled product were recovered by the FRU before operations were halted by adverse sea conditions. Three additional FRU's were dispatched.

On May 8, 1990, no corrective or skimming operations were performed because of adverse sea conditions. Four FRU's stood by on location.

On May 9, 1990, divers located and determined that the source of the spill was a broken 1-inch valve on a section of an 8 ⅝-inch pipeline belonging to Exxon U.S.A. and tying into the EIPS.

On May 10, 1990, divers removed the section of pipeline containing the broken valve and blind-flanged the ends of the pipe remaining on the seafloor.

On May 11, 1990, the EIPS was tested and returned to service.

Oil-Spill Observation Reports

On May 6, 1990, Texaco sighted and reported a spill moving through Eugene Island 313 Field. Texaco estimated the slick to be 5 miles long by 2 miles wide with an approximate volume of 900 bbl. Light brown to rainbow colors were observed. The weather reported was northerly winds at 20 mph, 2- to 3-foot seas, and a southerly current moving the slick south. Exxon also reported a spill sighting from Eugene Island Block 314 Platform B. Both companies began shutting in platforms and contacting neighboring platforms that deliver production to the EIPS to begin shutting in operations.

On May 7, 1990, a Texaco-activated Clean Gulf Associates FRU arrived at the spill site. Texaco reported the center of the slick at 7 a.m. to be 28.15° latitude and 91.41° longitude; the source of the slick was still unknown. The slick was estimated to be 17 miles long by 8 miles wide. The color was still light brown to rainbow in the most concentrated area, which was 5 miles by 2 miles in size. Winds were reported at 20 mph from the north.

On May 8, 1990, the slick consisted of mostly windrows of a silvery sheen over a 10-mile by 30-mile area. The high seas (4-6 ft) and wind were dissipating the slick.

On May 9, 1990, Exxon reported a spill sighting at 3 p.m.; measuring ⅛ mile long and 20 yards wide, the slick was moving south-southeast. Texaco informed Exxon that the spill was coming from an out-of-service pipeline belonging to Exxon. That morning, Texaco had also reported two small slicks consisting of a light sheen in the area. Later field flights reported that the slick had completely dissipated. Reported winds were 20 mph from the north.

On May 10, 1990, Exxon reported a spill sighting from Eugene Island Block 315; the estimated spill size was ¼ mile long by 10 yards wide and rainbow in color. The slick was moving toward the south. Winds were blowing 10-15 mph, seas were 3-5 feet.

Analysis of System Receipts and Deliveries and Leak Detection

The EIPS had a procedure to monitor continuously the difference in input and output volumes of oil in the pipeline at its terminal in Houma, Louisiana. When the difference between input and output volumes exceeded the normal variance by 300 bbl per hour, several checks of the system were to be made to determine the cause of the difference. However, this method of leak detection was not functional at the time of the pipeline spill because of problems with communications and the computer systems. The pipeline leak was discovered through the observation of an oil slick on the morning of May 6, 1990, and was later confirmed by divers on May 9, 1990.

Failure Analysis

The underwater video and photographs of the 1-inch pipe threadolet and the 1-inch valve indicate that a lateral, external force pulled or pushed the 1-inch valve from the threadolet, stripping its threads. The 1-inch valve appeared to have been initially positioned vertically. It was found on the seafloor near the location of the threadolet. Inspection of the damaged valve and threadolet showed no corrosion on the surfaces that had made a metal-to-metal seal; this lack of corrosion indicated that the valve had been removed recently. Further, the valve piping had been bent approximately 15 degrees before the threads stripped, allowing the pipe to separate from the threadolet.

Leak Rate Determination

Texaco's office in Houma, Louisiana, gathers daily information from meter readings for both the offshore and onshore portions of the EIPS. System overages and underages are compared in order to determine any abnormality in sales and/or leaks in the system.

Pressure charts at each of the offshore and onshore injection points are monitored daily for any drop in pressure, which also may indicate a leak.

On the morning of May 6, 1990, a sighting of the oil spill was made while it was passing through the field in the vicinity of Eugene Island Block 313 Platform A. Using a volumetric reference chart for oil spills and the area of the slick, Texaco estimated a loss of 900 barrels (bbl) of oil. Subsequent to the repair of the leak, an "over/short" 6-month summary of the system production indicated the possible loss of up to 13,600 bbl because of the leak.

Possible Oil-Spill Volume

The analysis of the overages/underages of the total EIPS at the Houma, Louisiana, metering facility, supported by analytical leak rates, indicates that a spill of 13,600 bbl was possible during the time period from 1 a.m. on May 6 through 5 a.m. on May 7, 1990.

Panel Investigation and Findings

Investigated Aspects The MMS panel members independently investigated the following aspects of this incident:

- System measurement balance data were supplied by Texaco from their over/under monthly reports on the EIPS for the period January through November 1990. Additional data for this period were made available from the MMS Production Verification Unit.

- Oil-spill reports to the U.S. Coast Guard and the MMS during the period of May 6, 1990, through May 11, 1990, for the affected leak area

- Pressure-flow calculations of the pipeline leak

- Onshore inspection of the damaged 1-inch valve and retrieved pieces of trawl netting

- Photographic evidence (video and print) of the affected section of the pipeline in its subsea location

- The surface spill path, using U.S. Coast Guard sighting data and local meteorological data of the prevailing weather conditions during the time of the leak

System Measurement Balance

The latest pipeline receipts for EIPS indicate that deliveries at the terminal were short approximately 13,600 bbl of oil for May 1990. Review of receipts for EIPS before and after the pipeline spill (12 months in 1989, January through April 1990, and June through November 1990) shows that the pipeline system had shortages as great as 8,950 bbl (0.23% of receipts) and overages up to 2,500 bbl (0.10%). For 1989, EIPS showed a shortage of 25,400 bbl (0.08%), and through November 1990 a shortage of 5,733 bbl of oil (0.02%). These imbalances may be caused by such factors as

1. meter factors on the 36 connected platforms,
2. meter prover tolerances, or
3. meter readings not taken precisely at 7 a.m. on the first of each month.

If the following overage/shortage figures for EIPS are considered, it is impossible on the basis of pipeline receipts to determine the exact volume of oil that leaked from the pipeline.

Eugene Island Pipeline System Receipts for 1990

Month	Receipts	Over/Short	%Over/Short
Jan.	2,674,093	2,210	0.08
Feb.	2,485,572	1,744	0.07
Mar.	2,595,572	(1,349)	-0.05
Apr.	2,886,639	1,320	0.05
May	2,551,719	(13,600)	-0.53
June	3,154,535	3,758	0.12
July	3,504,418	5,302	0.15
Aug.	3,496,292	(1,158)	-0.03
Sept.	3,358,483	(817)	-0.02
Oct.	3,855,820	6,168	0.16
Nov.	4,041,761	(8,951)	-0.22
Dec.	0	0	0
Year-to-Date Totals	*34,604,904*	*(5,373)*	*-0.02*

Oil-Spill Reports

Almost all available oil-spill research and models relate to surface spills and not subsurface spills, such as this one. In the case of subsurface spills, not all of the oil may reach the surface. The *first* spill volume was estimated from the observed slick (2 miles by 5 miles in area) to be approximately 900 bbl. This calculation was made by Texaco using an API chart.

Analytical Pipeline Leak Model

The complexity of the EIPS, with 36 input tie-ins, made it necessary to estimate the pipeline pressure at the leak point. From upstream injection pump pressures, corrected for friction and hydrostatic head pressure, the estimated pressure at the pipeline leak location was 574 pounds per square inch. Flow calculations were made to estimate the minimum time required for a volume of 13,600 bbl to flow through the opening, which was assumed to be a 1-inch diameter hole or 0.00545 square feet. This time was estimated to be 12.88 hours, assuming no friction loss at the

opening. The amount of time from when the spill was first observed until the pipeline was shut in was 22 hours.

Consideration of Factors Affecting the Surface Appearance and the Observation of Leaked Oil

Once a spill occurs and a surface slick is formed, there are a number of physical, chemical, and biological processes that can alter the original mixture of the oil components.

The two major processes that affect the spilled oil volume are evaporation and dispersion. Studies have shown that up to two-thirds of the original oil volume may be lost because of evaporation and dispersion in a period of a few hours to a day.

In addition to the two major factors affecting the surface appearance of an oil slick, other factors must be considered in estimating a volume of oil spilled. These include slick thickness, oil-water interfacial tension, sea state, the amount of particulate matter in the water column, and the number of days from the beginning of the spill to the time the slick size is estimated. All these factors can be considered in estimating the volume of oil spilled for a given-size oil slick. However, this estimate would be only for the oil that appeared on the surface of the water. There is evidence, as shown in studies of the *Ixtoc* oil spill, that not all subsurface-released oil will appear on the water surface. Oil plumes were shown to remain in the water column for periods of time. Furthermore, it was shown that subsurface plumes do not necessarily move in the same direction as surface plumes.

Cause of Leak

On May 9, 1990, a diver found the source of the leak. A 1-inch valve had been torn out of a threadolet. The valve's pipe threads had been torn, indicating the valve had been forcibly removed. It was found on the seafloor near the threadolet. The 1-inch valve had been located on a spool piece of 8 ⅝-inch pipe between Texaco's block valve and Exxon's block valve. Texaco's block valve was open and Exxon's block valve was closed. (See Attachment 2.) When the valve was removed, oil backflowed from the EIPS 20-inch pipeline through the open Texaco valve to the spool piece and out of the threadolet.

The diver reported that the subsea tie-in (SSTI) assembly was not buried below the mud line and that there were pieces of a trawling net in the area, which he recovered along with the 1-inch valve. (See Attachment 3.) The repair crew believes that the damage was caused by a trawling net that hooked the 1-inch valve and stripped it from the threadolet.

Conclusions

The damage to the pipeline occurred sometime during the night of May 5, 1990.

Because of the absence of anchor scars near the SSTI assembly, the panel concluded that the protruding 1-inch valve was snagged by a trawl net and pulled from the threadolet.

The most probable volume of oil spilled was 4,569 barrels. This figure was obtained by taking a 5-month average of the sum of the overage/shortage receipts from the EIPS during the months of March through July 1990. This 5-month average included two months of uninterrupted EIPS receipts before and after the pipeline leak.

The SSTI assembly did not have the required minimum coverage and was not protected by a structure to prevent damage from commercial fishing operations at the time of the spill incident.

The proper way to place a pipeline segment out of service is to close all valves servicing that segment at a subsea tie-in. In this instance both the Exxon and Texaco valves should have been closed.

The Texaco valve had not been requested to be closed by either Texaco or Exxon when Exxon placed its segment out of service in 1988.

Recommendations

Texaco should develop and implement a reliable volumetric leak detection system in order to detect possible pipeline leaks. The leak detection system should be continuous and monitored at frequent intervals.

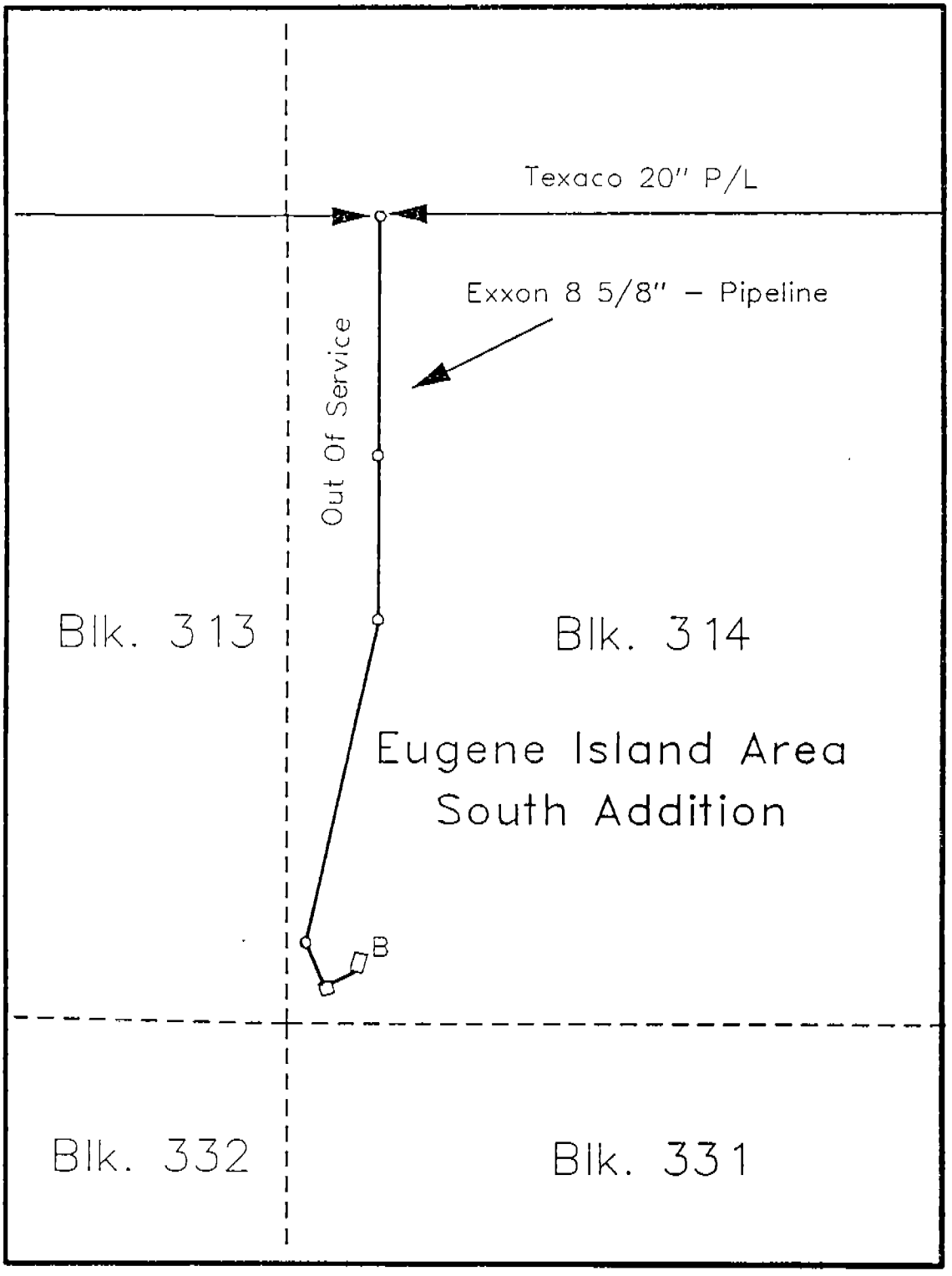
Subsea pipeline tie-ins should be buried in accordance with Department of Transportation Regulations or, in lieu of burial, cages, domes, or sandbags should be placed to protect tie-ins from damage.

Pipeline operators should develop a procedure to ensure that an out-of-service pipeline is adequately isolated from an operating pipeline system by closing all valves to prevent oil backflow in the event that an out-of-service pipeline is damaged.

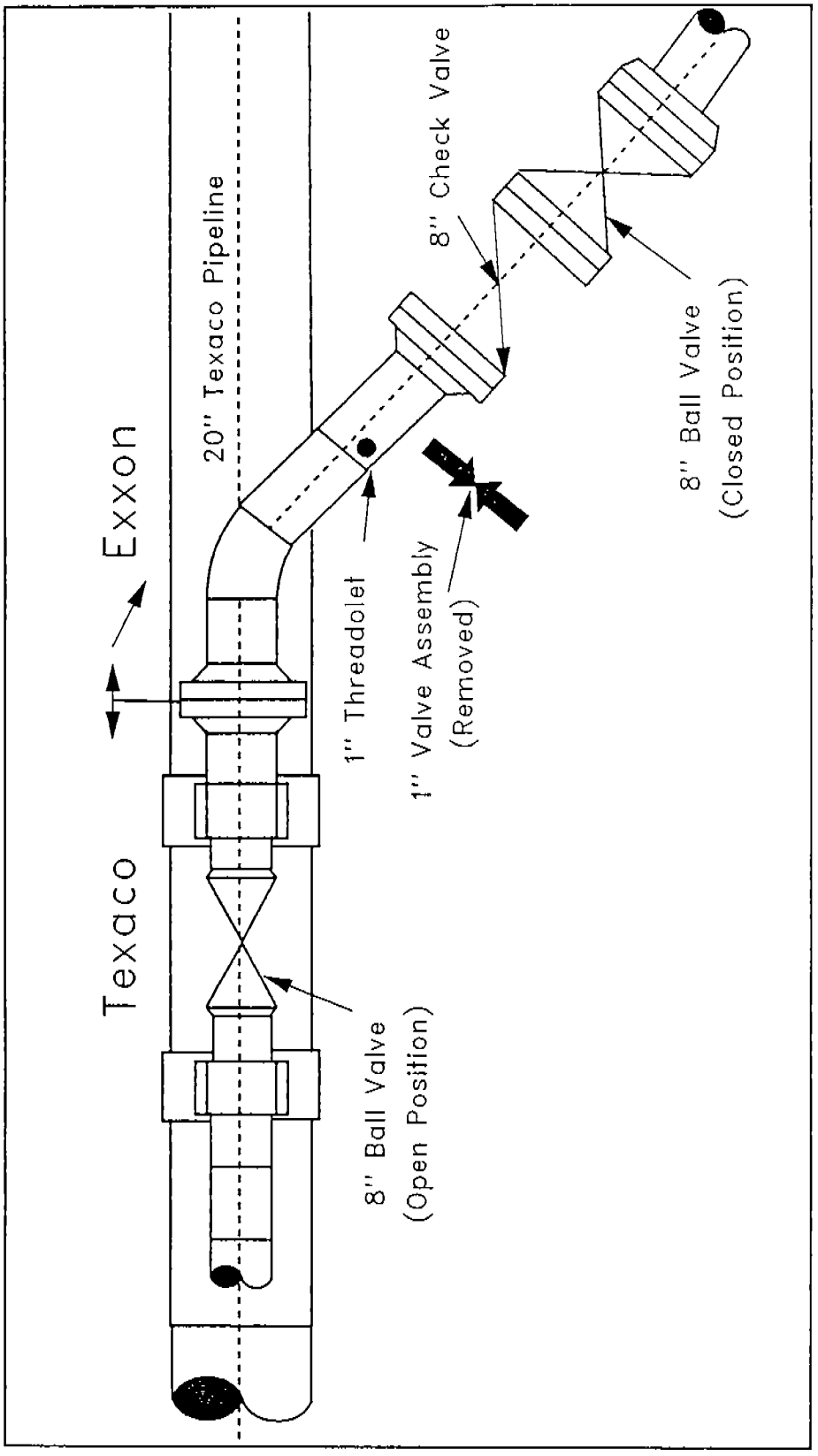
Marine maps need to be updated as to the location of pipelines, with pipeline tie-ins given highest priority.

Pipeline operators should orient subsea tie-in assembly bleed-off valves whereby if coverage is lost the valve would not pose a hazard to commercial fishing operations.

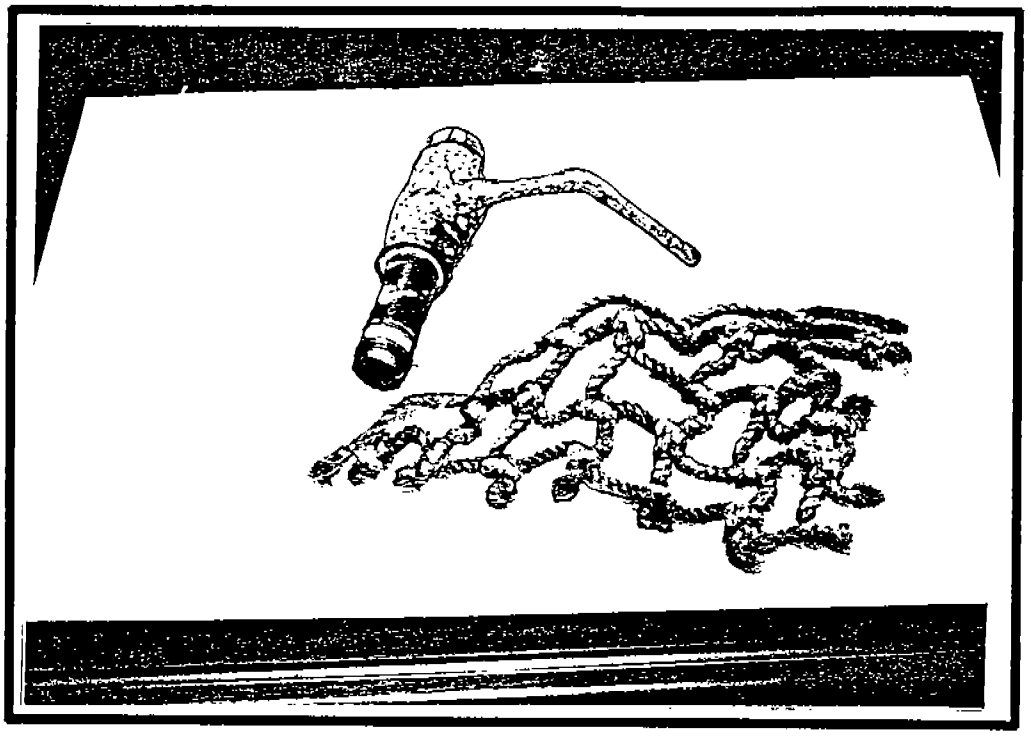
The MMS should modify current regulations to require improved protection of subsea appurtenances and periodic inspection of all subsea appurtenances to ensure adequate protection from damage.



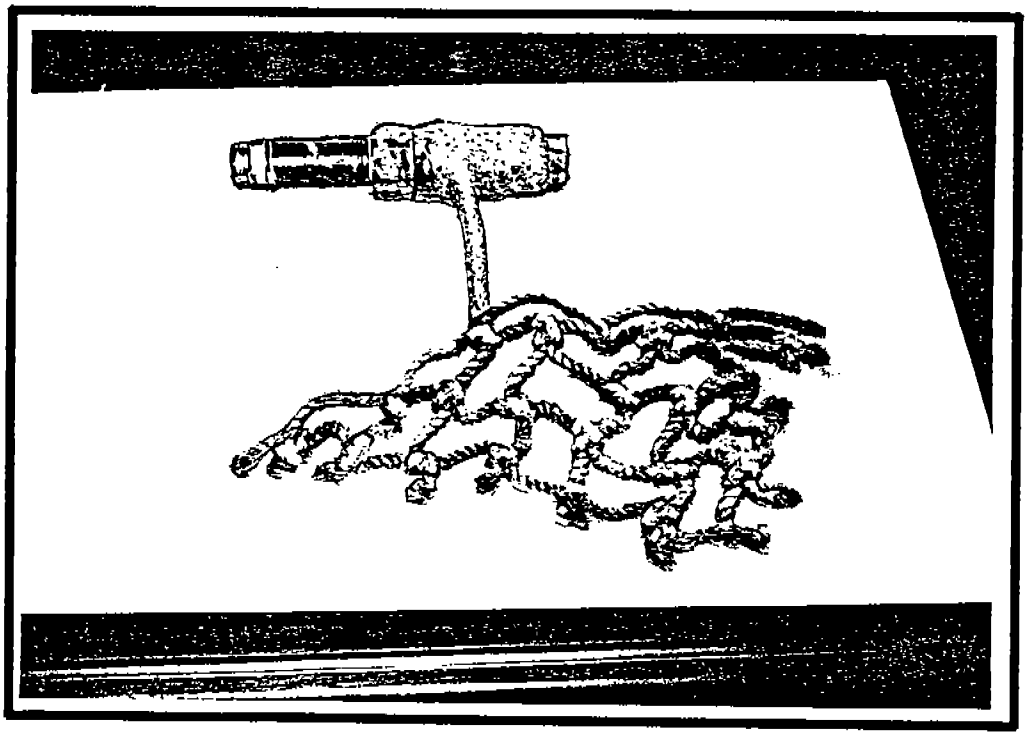
Eugene Island Area South Addition.



Subsea Tie-in at Time of Incident (Plan View).



One-inch Valve Assembly.



Piece of Trawl Net.