



**Investigation of Flash Explosion and Injuries
South Timbalier Block 151, Production Platform
OCS 00463
June 15, 2002**

Gulf of Mexico
Off the Louisiana Coast



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

**Investigation of Flash Explosion and Injuries
South Timbalier Block 151, Production Platform
OCS 00463
June 15, 2002**

Gulf of Mexico
Off the Louisiana Coast

Jack Williams
Fred Mosely
Douglas Savin

Contents

Investigation and Report

- Authority, 1
- Procedures, 3

Introduction

- Background, 5
- Brief Description, Flash Explosion. Production Platform, OCS 00463, 5

Findings

- Preliminary Activities – Preparation of the Operation, 7
- Chronology – Events Prior to the Flash Explosion, 8
- Chronology – Events During and After the Flash Explosion, Injuries, Aid, and Evacuation, 14
- Summary of Inspection of Site of Flash Explosion, 16
- Investigation of Incident – Explosive Mixture, Ignition, 17
 - Source of explosive mixture, 17
 - Source of ignition, 18
- Injuries, Emergency Response, and Rescue, 19

Conclusions

- The Accident, 21
- Flash Explosion, 21
- Injuries, 23

Recommendations

- Safety Alert, 26

Appendix

- Attachment 1 Location of Lease OCS 00463, South Timbalier Block 151.
- Attachment 2 Diagram, OCS 00463 Production Platform, Position of Crew.
- Attachment 3 Diagram, OCS 00463 Upper Low Pressure Separator and Lower Low Pressure Separator and Position of Crew at Time of Flash Explosion.
- Attachment 4 Lower Low Pressure Separator.
- Attachment 5 Lower Low Pressure Separator, Manway Hatch, Position of Crew.
- Attachment 6 Guard Rail Opposite Manway Hatch, Lower Low Pressure Separator, after Explosion.
- Attachment 7 Sprung Handrail Fencing and Debris from Explosion.

Investigation and Report

Authority

On 15 June 2002, a contract crew from Production Management Industries, L.L.C. (hereinafter referred to as “PMI” or the “Contractor”) was conducting maintenance and repair operations on the South Timbalier Block 151, OCS 00463, production platform (hereinafter referred to as the “Platform”) on behalf of the operator, ChevronTexaco, Inc. (hereinafter referred to as the “Operator”). The objective of the operation was to clean several production vessels, including two stacked low-pressure separators.

At approximately 0045 hrs, at the request of Operator personnel and with the consent of the Contractor foreman, a Contractor crew member assigned to the crew cleaning the lower low-pressure separator suited up to retrieve a sample of the sand, scale, and sludge from within the vessel. After entering the vessel, he proceeded into the rear part of the vessel, which had not as yet been subjected to cleaning operations. As he bent down to collect a sample from the bottom of the separator, a flash fire and blast ignited, traveling out of the manway of the tank with explosive force. The crew member within the vessel was slightly burned and injured, but was able to escape out of the manway. When the ignited blast exited the manway, it burned or otherwise injured three other crew members, including one who was blown off of the platform, falling 50-70 feet into the water. All of the injured workers were subsequently rescued and evacuated for medical treatment.

Pursuant to Section 208, Subsection 22 (d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act, as amended in 1978, and the Department of the Interior Regulations 30 CFR 250, the Minerals Management Service (MMS) is required to investigate and prepare a public report of

this accident. By memorandum dated 10 August 2002, the following personnel were named to the investigative panel:

Jack Williams, Chairman – New Orleans Louisiana

Fred Mosely – Houma, Louisiana

Douglas Savin – Houma, Louisiana

Procedures

On 16 June 2002, representatives of MMS visited the site of the flash explosion to review events, inspect the layout of the platform, and photograph the site. On 22 October 2002, members of the Contractor crew involved in the clean-out operation met with Houma District and Office of Safety Management personnel to review the events of the incident. On 16 December 2002, personnel from the MMS panel investigating the incident conducted additional interviews with crew members of the Contractor who were present and witnessed the incident. On 22 January 2003, members of the Panel interviewed additional personnel present on the Platform during the incident, to gather additional information and review the course of events. On 14 April 2003, members of the Panel attended a symposium conducted by the Operator in which the root causes of the incident were discussed.

In addition to the interviews, other information was gathered at various times from a variety of sources. This information included the following reports and statements:

- Notes, written statements and tapes of interviews of Contractor foremen, work crew members, the project manager, and the safety representative;
- Contractor's accident investigation report;
- Contractor's Confined Space Entry policy;
- Contractor's Supervisor's Report of Employee Injury;
- Operator's Schematic of the Platform;
- Operator's Schematic of stacked low-pressure separators;
- Contractor's pre-job hazard assessment;
- Contractor's Confined Space Entry Form for entry prior to flash explosion;
- Contractor's Gas Detector calibration and verification;

- Contractor's training records;
- Pictures of site of flash explosion;
- Operator's accident investigation report.

Introduction

Background

Lease OCS 00463 covers approximately 5,000 acres and is located in South Timbalier Block 151, Gulf of Mexico, offshore Louisiana. *(For lease location, see Attachment 1.)* The lease was issued to Gulf Oil Corporation in 1955 and was subsequently unitized with other leases in 1959. In 1985, record title interest was acquired by Chevron U.S.A. Inc., which assumed the status of Operator. Subsequently, that company was merged into ChevronTexaco, Inc., which assumed the role of Operator in 2001. The lease is 100-percent owned by the Operator.

Brief Description, Flash Explosion, Production Platform, OCS 00463

On 15 June 2002, a Contractor crew from PMI was conducting maintenance and repair operations on the Platform on behalf of the Operator. The objective of the operation was to clean several production vessels, including a high-pressure separator, the floatation cell, the wet-oil tank, and two stacked low-pressure separators, upper and lower.

The operation began on 12 June 2002 and continued on a 24-hour, two-shift basis, throughout 13-15 June 2002. On the evening of 14 June 2002, crew change was completed at approximately 1800 hrs, and after safety meetings held by the Operator and Contractor personnel, cleaning of the upper low-pressure separator and lower low-pressure separator vessels was initiated.

At approximately 2100 hrs, the PMI project manager retired, as he had reached the Contractor's limit of 17 consecutive work hours. The crew cleaning the lower low-pressure separator was preparing to make an additional entry after previously cleaning the front of the vessel through the manway. At the request of Operator personnel, a Contractor crew member assigned to the lower

low-pressure separator donned his protective suit and equipment and prepared to retrieve a sample of the sand and scale from the rear of the vessel.

After entering through the manway, he proceeded into the rear portion of the vessel, which had not as yet been subjected to cleaning operations. As he bent down to collect a sample from the approximately one-inch- to one-foot-thick sand, scale, and sludge in the bottom of the vessel, a flash fire ignited, traveled across the top of the interior of the vessel and exited the manway with explosive characteristics. The crew member within the vessel was slightly burned and injured but was able to escape out of the manway. When the flash explosion exited the manway, it burned or otherwise injured three other crew members, including one who was blown overboard, falling 50-70 feet into the Gulf of Mexico.

Findings

Preliminary Activities – Preparation of the Operation

Early in 2002, a “turnaround” of the Platform was planned and scheduled by the Operator. The turnaround included a general shut-in of production so that various maintenance and repair activities and upgrading of the facilities could take place.

As part of the turnaround operation, the Operator contracted PMI to clean, repair, and restore the Platform’s pressure vessels to specifications. These included the floatation cell, the high-pressure separator, the wet-oil tank, and two stacked low-pressure separators, upper and lower. PMI had been contracted periodically to maintain the vessels on the Platform for a number of years, and thus had kept extensive records of the history of work on these particular vessels. For this particular job, the project manager for the Contractor was the primary contact point for the Operator. As such, after an initial job description from the Operator, he discussed the particular needs of the operation, designed the job, reviewed the safety and timing of the operation, and scheduled the work with concurrence of the Operator. The Operator provided the logistical support and transportation.

On 8 June 2002, the work crews for the Contractor were mobilized to participate in an annual safety refresher course conducted by the Contractor. This was followed on 11 June 2002, by a “super safety session” discussion, conducted by the Operator, of all turnaround operations, and the expectations by the Operator for an incident-free operation. This session was attended by all contractors and personnel involved in the turnaround.

On the vessel-cleaning part of the turnaround, the Operator relied on the expertise of the Contactor to ensure that proper operational and safety procedures conformed to the Operator's safety requirements. According to testimony, the Operator personnel actually on site during the job were not necessarily involved with, nor had expertise in, the specific cleaning or production operations related to these vessels.

PMI mobilized approximately 26 employees for their part of the Platform turnaround, including one health/safety manager, one project manager, and six foremen, each with a three-man crew. Prior to mobilizing the crew, the health/safety manager ensured all personnel training records were current and met all of the Operator's requirements for each job.

Chronology – Events Prior to the Flash Explosion

7 June 2002 – The Contractor rigging crew unloaded the equipment necessary for the cleaning operation onto the Platform.

11 June 2002 – After the “super safety session” conducted by the Operator for all contract crews involved in the turnaround, Contractor crews were transported to the living quarters on South Timbalier Block 130 Platform.

12 June 2002 – Operations commenced on the Platform by transporting the day shift from South Timbalier Block 130 to the Platform. The Operator specified the work to continue on a 24-hour a day basis and, as such, the Contactor provided two full work shifts that included three foremen on each shift. The day shift attended a pre-work safety meeting conducted for all contractors by the Operator and additional meetings specific to the task at hand conducted by the project manager. They set up the equipment needed to begin the cleaning operations on the floatation cell, the wet-

oil tank, and the high-pressure separators. Isolation of the vessels to be cleaned was performed by double block and bleed and skilleting.

The night crew relieved the day crew at 1800 hrs. After a safety operations meeting conducted by the Operator, and another meeting specific to the job at hand conducted by Contractor personnel, the shift work preparation continued by writing the Job Safety Analysis (JSA) for each individual task. The shift then continued operations begun by the day shift, including pumping out the floatation cell and transferring the fluid in the wet-oil tank to the dry-oil tank.

13 June 2002 – 0600 hrs – The crew change was initiated with the day crew relieving the night shift. They first attended the Operator-conducted safety meeting, followed by the project manager's meeting that outlined the work scope for the shift. The crews then wrote JSA's. Isolation of the wet-oil tank was completed and, after ventilation and gas testing, a confined space entry into the wet-oil tank was made to initiate removal of the debris. Gas detection testing of the floatation cell indicated the presence of an unacceptable level of hydrocarbons, which prevented initiation of confined space entry into that vessel. Therefore, ventilation and flushing continued until an acceptable gas test reading was obtained.

After the crew change at 1800 hours and the completion of the usual safety meetings, scope discussion, and the writing of the JSA's, cleaning of the wet-oil tank continued and cleaning of the floatation cell was initiated. Additionally, the high-pressure separator was isolated, ventilated, and tested for gas in preparation of cleaning operations. After removal of the fluids, entry into the high-pressure separator was initiated and the vessel was cleaned of all sand and debris, which were transferred to the cuttings boxes. Upon completion of the cleaning of the high-pressure separator, that vessel was prepared to be returned to service.

14 June 2002 – 0600 hrs – The day shift came on duty, conducted the Operator and Contractor safety meetings, job scope discussion, and the writing of the JSA's. According to testimony, two engineering personnel from the Operator discussed the need to speed up the work to return to production as soon as possible. Instructions were given to the Contractor project manager to complete cleaning of the upper low-pressure separator and lower low-pressure separator by about 0800 hours on 15 June 2002 or forgo that particular operation. The stated reason for this request was to complete the work concurrently with completion of the other contractor's activities so as to return the Platform to production as early as possible. Confined space entry work continued in the wet-oil tank and cleaning of the floatation cell was completed. The high-pressure separator hatches were secured.

1930 hrs – The night shift completed the crew change. Operator personnel conducted a meeting with the supervisors for several different tasks including the Contractor's operation. After the shift meeting, the Contractor foremen conducted their own JSA meetings. The crew went through the standard hazards and held a walk-through with the project manager and Operator's production personnel, checking the position of the valves, whether they were blocked and bled, etc., including a discussion of the condition of the piping connected to the vessels. The inlet valve for the lower low-pressure separator was reported to be double blocked and bled. However, subsequent investigation could not determine the actual position and condition of the bleed valve.

On each shift, the Contractor crews were organized into three groups of three men, each supervised by a foreman reporting to the project manager. Contractor personnel on the nightshift included the project manager; three foremen, including the foreman for the upper low-pressure separator and his three crew members; the foreman for the lower low-pressure separator and his crew, which included the worker assigned for confined space entry; and the foreman for the wet-

oil tank and his crew. The wet-oil tank crew included one new temporary employee working for the summer. By Contractor policy, a new or inexperienced employee was assigned a mentor until he was deemed fully qualified. All foremen and crew members were trained with both formal schooling and experience. *(See attachment 2 for diagram of platform vessel location.)*

2000 hrs – The lower low-pressure separator crew set up and began draining the vessel and opening the manway hatch. The foreman for the lower low-pressure separator then filled in and signed his entry permit slips, allowing personnel to initiate confined space entry.

Approximately 2100 hrs – The project manager reached the limit of continuous workhours under the work rules of the Contractor. These work rules required him to go off duty and rest. He reviewed the ongoing work being conducted on the three vessels and assigned the foreman for the wet-oil tank the additional responsibility of acting as overall contact point to coordinate the work on all of the vessels if any necessity should arise. According to testimony, in the event of an uncertainty as to procedure, he was instructed to wake the project manager for guidance.

2130 hrs – The lower low-pressure separator crew drained the fluid off the separator and removed that vessel's manway hatch. The foreman for the lower low-pressure separator then took a measurement through the manway by using a gas detector, which returned a negative reading. *(See attachment 3 for schematic of positioning of upper low-pressure separator and lower low-pressure separator.)* The foreman then reached into the vessel and checked the vessel's contents nearest the hatch with the gas detector, which again returned a negative reading. It should be noted that breaking the plane of the hatch technically constituted a confined space entry, for which the foreman was not equipped properly. A crew member then suited up with protective clothing and made a confined space entry to begin washing the tank. The crewman

used a suction hose to clean out the inlet side of the tank adjacent to the manway hatch, getting primarily water. Thereafter, he attempted to wash out the sand, eventually clogging up the pump just prior to a break for the mid-shift meal. For this operation on the lower low-pressure separator, the crew did not follow published Contractor and Operator safety requirements that called for opening the second hatch accessing the vessel and ventilating for a period of time, and continuously ventilating during any entry. They also only tested for hydrocarbon presence near the hatch of the open manway and did not follow company policy when the plane of the hatch was broken by the supervisor checking with the gas detector.

The upper low-pressure separator cleaning crew began preparing the separator for confined space entry by beginning the removal of the manway hatch bolts. Simultaneously, the crew cleaning the wet-oil tank was preparing to initiate a confined space entry.

2300 hrs – The Contractor crews broke for midshift meal. According to testimony, during the break Operator personnel requested that the Contractor arrange for the retrieval of a sample of the sand and debris from the lower low-pressure separator. This request was passed to the foreman for that operation.

15 June 2002 – 0030 hrs – The crews resumed activities, with the wet-oil tank crew continuing to prepare for further confined space entry. The crew on the upper low-pressure separator continued to break the bolts, preparing to ventilate the tank and initiate cleaning operations. At the direction of the foreman for the lower low-pressure separator, a crew member prepared for a confined space entry to continue cleaning the vessel and to retrieve the previously requested sample. After testing the area of the manway hatch with a gas detector, the foreman again reached into the vessel through the hatch and tested for the presence of hydrocarbons, with negative results. It is unclear whether he used the gas detector in the upper part of the vessel.

The crew member carrying out the confined space entry was equipped with all required equipment, including suit, breathing air, boots, gloves etc. He had with him a plastic sample jar and an approved explosion-proof flashlight. He proceeded behind the weir, about two-thirds to three-quarters of the way to the back, and bent to take a sample. This area of the vessel had not yet been disturbed by washing, and the sand, scale, and debris were between one-inch to one-foot thick in the bottom of the tank, with a thin covering or film of oil and water.

At this moment, the crew working on the upper low-pressure separator encountered difficulties in fully opening the manway hatch because of a frozen swing arm mechanism. The foreman for the upper low-pressure separator came down the ladder to speak with the foreman for the lower low-pressure separator about the problem, standing in front of the manway hatch of the lower low-pressure separator. The foreman for the lower low-pressure separator had watched the confined space entry progress of his crewman to retrieve the sample, until he could no longer see the crewman through the manway. He then stooped to adjust the nozzle of a soap sprayer that he had begun using to clean the outside of the vessel of some residual oil. Simultaneously, the summer worker assigned to the crew cleaning the wet-oil tank was passing the lower low-pressure separator, having been sent to retrieve additional protective gear. He stopped beside the foreman for the upper low-pressure separator and inquired what was being sprayed on the lower low-pressure separator and why. (*See Attachments 2 and 3 for position of crew members. See Attachment 4-5, picture of stacked lower low-pressure separator and manway hatch, and position of crew.*) The weather was hot and humid with occasional heat lightning observed in clouds on the horizon. On another platform connected by a bridge, a welding crew from another company was conducting welding operations.

Chronology – Events During and After the Flash Explosion, Injuries, Aid and Evacuation

15 June, 0045 hrs. – The crewman inside the lower low-pressure separator moved toward the back of the vessel, faced the right-hand wall, and bent down to fill his sample jar. A flash explosion, described as a fireball, suddenly proceeded across the upper part of the vessel and out of the manway hatch. Some accounts indicate the fireball was accompanied by a rushing or rumbling that reverberated in the pipes.

The fireball passed over the crouching crewman inside the separator, who felt the heat before hearing anything. He rapidly exited the vessel, diving over the weir and out the manway. In the process, he hurt his shoulder and received second-degree burns on his forearm, neck, and left ear.

As the fireball exited the manway, the blast passed over the crouching foreman for the lower low-pressure separator, who was adjusting the soap nozzle. He heard a rumble, followed by a concussion and blast that knocked him down and left a ringing sensation in one ear and redness of the skin on one hand. The foreman stood up, turned, and saw one man down on the platform. Meanwhile, the exiting blast directly impacted the two employees observing the operation while standing in front of the manway hatch. The foreman for the upper low-pressure separator was propelled by the blast back against the guardrail fence. The fireball burned off most of his trousers and the impact of his body against the guardrail/cyclone fence, or flying debris, produced numerous bruises and a puncture on his right leg from an unknown source. Approximately 40 percent of his body had first- or second-degree burns, with about 15 percent of his body receiving second-degree burns, primarily near his midriff.

The same blast also directly impacted the summer employee who was standing next to the upper low-pressure separator foreman, about six feet from the open manway hatch of the lower low-

pressure separator. The summer employee was blown backward into the guardrail. (*See Attachment 6 for picture of guardrail after explosion.*) The guardrail in this area of the platform consists of a regulation-height pipe frame with cyclone fencing attached to the frame with plastic ties and/or cyclone material fasteners spaced about every four feet located around the rail and through the fencing. The bottom of the cyclone fencing in a 6- to 8-foot-long guardrail panel next to the one that was impacted was held in place by a single plastic wire tie. It is unknown how the guardrail fence panel impacted by the summer employee and foreman was secured to the frame. The guardrail frame the summer employee impacted was bent outward, and the cyclone fencing was sprung and deformed outward, leaving a significant gap at the bottom. Pieces of clothing were later discovered on the bottom of the fencing material (*see Attachment 7*).

The impact of the blast then caused the summer employee to be thrown off of the platform into the water from a height of 50-70 feet, after first striking the guardrail. He sustained burns over 50-percent of his body from the fireball, the burns being mostly second degree with some first degree. He also sustained a broken rib and an injury to one of his legs.

The summer employee remained conscious after hitting the water but was entangled in something, possibly an air hose. In heavy seas he was able to disentangle himself and swim around the platform to the +10 landing from which a ladder was hung to within about six feet of the sea. By timing the waves, he was able to grasp the lower rung of the ladder and pull himself onto the plus-ten landing just as another crew member arrived to lend assistance.

On the main platform deck, the other members of the Contractor work crews administered to the injured. Two crew members had witnessed the summer employee being blown into the water. One ran to the rail and could see the summer employee swimming. As another crew member activated the man-overboard alarm, he ran down the stairs toward the +10 to see if he could help

but did not access either a lifering or lifejackets from the storage bins to take with him.

According to testimony, on the deck of the Platform there was considerable uncertainty about how many crew members were overboard because three hard hats were in the water. In the general confusion, no life rings were thrown to the man overboard.

After the summer employee pulled himself to safety, and was subsequently evacuated by stretcher up the stairs from the plus-ten deck, the injured crew members were all collected on the bridge of the Platform and emergency helicopter evacuation was called. The weather conditions were deteriorating and medivac helicopters were not immediately available. Therefore, after an elapse of about two hours, an Operator field helicopter landed and took the two worst injured, the summer employee and the foreman for the upper low-pressure separator, to a hospital onshore. Shortly thereafter, a medivac craft took the other two crew members, and a staff member who had been injured jumping out of bed at the sound of the alarm, to the same onshore hospital.

Summary of Inspection of Site of Flash Explosion

The site of the incident was inspected by personnel from the Contractor, the Operator, and MMS immediately after the incident. The Contractor and Operator also engaged several consultant experts to review technical data and examine equipment.

The gas detector used to check the lower low-pressure separator was recovered and sent to a lab for functional testing. No ventilation equipment was located near the lower low-pressure separator manway hatch, and the other entry point was unopened. A double block on the inlet line to the separator was noted, though the bleed valve, which some testimony indicated was not properly open and which may have been removed or replaced after the incident, may not have been operational. No skillets were found on the vent line, and the primary check valve was broken. However, the redundant check valve and PSV were operational. The consultants for the

Contractor and Operator found no evidence of burns or flame markings within the inlet or vent piping.

The guardrail in the path of the flash explosion, opposite the open manway hatch of the lower low-pressure separator in this area of the Platform, was bent outward and the cyclone fencing was sprung loose at the bottom and deformed outward, leaving a significant gap at the bottom. The cyclone fencing material was imbedded with debris, work materials, cloth, cardboard boxes, etc. that were apparently blown into the fence by the force of the explosion (*see Attachment 7*).

Investigation of Incident – Explosive Mixture, Ignition

Source of explosive mixture

The flash explosion in the lower low-pressure separator required the presence of an explosive mixture and a source of ignition. The explosive mixture in the separator originated from one of three possible sources: (1) gas transported from an outside source, into the vessel through existing piping connections, mixed with oxygen from the open manway; (2) a flammable gas from some unknown source such as a non-hydrocarbon based mixture of soap spray; (3) gas generated from within the vessel mixed with oxygen from the open manway, including the possibility that the gas may have been present from the beginning of the cleaning operation,

Testimony by some crew members on site during the flash explosion mentioned the existence of a rushing sound possibly similar to gas flow, which resonated within the piping attached to the separator vessel immediately prior to the explosion. However, according to documents there were no flame markings or evidence of explosive burns within any of the attached piping nor was there any other evidence that would indicate back-flow in the external lines.

No evidence was found to support the possible creation of a flammable by-product not associated with hydrocarbons within the separator, such as a soap spray mist from the spray cleaner being used to clean the outside of the vessel.

Flammable hydrocarbon gas flashes off hydrocarbon liquids when the pressure is reduced. Some residual liquids covered the sand and debris in the bottom of the separator. It is also common for significant hydrocarbon gas that has already flashed to be trapped within pores of sand and debris, and held in place even at atmospheric pressure. Such gas will usually be released slowly with time, or be more rapidly released when the sediments are disturbed.

The GASTECH model “Genesis” gas detection meter was sent to SOLA Communications, Inc., for evaluation and readings test after the incident. The report from SOLA found the meter to have corrosion on the inter connection board and reported the LEL sensor was reading “low” on initial test, “possibly due to very low batteries.” SOLA reported that after the batteries were changed, the meter read “to near normal.” The report also noted that the meter was last calibrated by Contractor on 10 June 2002. The charge on the meter’s batteries at the time of its use in the separator could not be determined. It is unknown if the top part of the separator was checked with the gas detector.

Source of Ignition

Ignition source for the flash explosion was investigated extensively by the Contractor, Operator, and MMS. The possible sources of ignition from within the separator were considered, including the equipment carried into the vessel by the crewman (flashlight, plastic sample jar, self contained breathing apparatus equipment, and clothing). A finding as to the likely ignition source within the separator for the flash explosion could not be reached. All of the types of equipment carried into the vessel were of approved design and no other articles that could have caused the ignition

were within the vessel. The crewman inside the vessel reported the flash explosion traveled from the rear of the separator toward the front, passing along the top of the vessel. However, this information did not aid the identification of an internal source of ignition, as no readily apparent sources of ignition existed in the rear of the vessel away from the crewman.

The possible sources of ignition from outside the vessel were also considered, including static atmospheric electricity, lightning, a mechanical spark from tools in the immediate vicinity of the open manway hatch, and induced current from welding activities on another, bridge-connected platform. To ignite the flash explosion, such a source would have to produce a spark within the flammable oxygen/fuel mixture. The soap-spraying activity outside the open manway was an unusual activity. However, no proof can be assembled that the equipment used, or the activity, produced any spark. Likewise, the other activities in the area and/or the atmospheric conditions do not readily help identify a source of ignition. The Platform was cathodic protected and the only hot-work in the area was being conducted a considerable distance away on another bridge-connected platform. Though the atmospheric conditions were somewhat charged, no lightning strikes were observed in the vicinity of the Platform.

Injuries, Emergency Response, and Rescue

The injuries to crew members in the vicinity of the flash explosion all were directly related to the fire and blast wave, or human reaction to the flash explosion. Because the main fire/blast passed over their heads, the injuries to the crewman within the vessel and the foreman for the lower low-pressure separator consisted of minor first- and second-degree burns and partial temporary ringing in the ears.

The injuries to the foreman for the upper low-pressure separator and the summer worker were associated with either the fire or blast-induced concussion and contact with other objects or

equipment in the area. The foreman was burned by the direct flash explosion and was physically injured by either flying debris or by being thrown against the guardrail by the pressure wave. The summer worker, in addition to sustaining injuries associated with the fire (burns) and the effects of the pressure blast, possibly sustained other injuries as a result of the fall into the Gulf of Mexico.

The immediate response to the accident by the crew was somewhat chaotic, as most of the first-responders had been close enough to the flash explosion to be affected. From testimony, other crew members observed that a man was overboard and they subsequently sounded the alarm. However, in the confusion, no floatation devices were thrown to the overboard person and the only aid offered was by another crew member who arrived at the +10 deck without rescue equipment.

Conclusions

The Accident

The incident on the Platform included two events: (1) the flash explosion itself and (2) the resulting injuries.

Flash Explosion

Cause of flash explosion

The flash fire and blast was caused by a flammable mixture explosively igniting within the vessel. The flammable mixture was present in the vessel because of the following:

1. The failure to initially vent the vessel according to policy and the failure to follow confined space entry procedures;
2. The failure to vent the vessel continuously during entry;
3. The failure to test the entire vessel properly for the presence of the flammable mixture prior to initiating confined space entry activities, which allowed the existence of the explosive conditions to be undetected.

Probable cause of flash explosion – source of flammable mixture

1. The probable source of the flammable mixture was from within the separator.

After examination of the alternative sources of origin for the mixture, the likelihood of the fuel source being from outside of the separator was probably low. The blocking and bleeding of the external lines was probably sufficient to contain any leakage or gas backflow into the separator despite the lack of best practices and some deficiencies in the techniques and application of skilleting and bleeding. As no other

evidence was found to support the possibility of a flow of gas into the separator, the “rushing” sound mentioned in some testimony is best interpreted as being a resonance from the flash explosion itself and probably unrelated to gas flow.

No evidence was found to indicate the potential of an unknown or outside agent such as soap spray to create a flammable mixture within the vessel.

2. The source of the flammable mixture within the vessel was probably gas released when the residual debris and sludge within the vessel were disturbed, combined with gas flashed off of residual liquids.

It is likely that gas trapped in the separator sludge would have been slowly released during the break for mid-shift meal, a period that also allowed oxygen to further filter into the tank. The release of the trapped gas was likely accelerated when the sediments were disturbed during sample gathering.

Possible cause of flash explosion

1. It is possible that the presence of a manager would have corrected the flawed onsite procedures that were initiated without oversight, thus possibly preventing the flash explosion.

The project manager who usually reviewed procedures and performance was off duty because of work rules. Had another project manager been on site and been in charge of the night shift, it might have created a desirable “double check” of procedures actually being followed, possibly preventing the policy violations.

2. It is possible the meter used to detect the presence of gas in the vessel either returned a false low reading due to low batteries, or failed to detect a significant level of LELs because of an improper utilization. In such case, it is possible that the vessel always contained significant levels of hydrocarbon gas because of the failure to ventilate, even at the time of the first confined space entry.

Injuries

Cause of injuries

1. The injuries resulting from the flash explosion were caused by the presence of personnel either within the vessel itself or immediately outside of it within the effective radius of the blast.
2. The personnel assigned to work on the vessel were injured as they performed operations without first ensuring a safe condition as specified by confined space entry regulations and/or Contractor and Operator policy.

Four separate violations of the Contractor policy involving confined space entry were noted in the period leading to the flash explosion, including requirements for initial and continuous ventilation, proper employment of gas detection in the entire area to be entered, donning proper protective gear and signing permits prior to breaking the plane of the hatch even to insert a gas detector.

The failure to properly ventilate the vessel and test the entire vessel for hydrocarbons prior to the entry to retrieve the sample directly led to the injuries sustained by the members of the cleaning crew. The foreman for the low pressure separator and the

crewman inside of the vessel both avoided more serious injury by the happenstance of being crouched below the direct blast path of the flash explosion.

3. The personnel not assigned to the lower low pressure separator were injured in the normal performance of their duties because of their proximity to the manway hatch from which the blast exited.

The foreman for the upper low pressure separator was burned by the direct force of the flash explosion and most likely suffered punctures from being thrown into equipment or barriers or possibly from being hit by flying debris.

The crew member who was blown into the water was propelled by the blast into the fence, springing the fencing material outward and breaking any plastic ties holding the fencing to the rail frame. This most likely allowed him to fall through the gap created at the bottom of the fencing possibly adding additional injuries to the burns from the direct blast and other injuries sustained from bodily impact with barriers or debris.

Possible cause of increased injury severity

1. Even without proper venting, the failure to open both vents of the vessel prior to initiating operations within it possibly contributed to the injuries by channeling the blast out of a single exit, thus increasing the force of the flash explosion. The presence of a second exit point for the blast would possibly have reduced the severity of the force that was directed into the workers outside the tank.

-
2. The failure of the guard barrier to prevent a crew member from being blown overboard allowed him to fall approximately 50-70 feet into the water, possibly contributing to the severity of his injuries.

Recommendations

Safety Alert

It is recommended the MMS issue a Safety Alert to read as follows:

A work crew initiated a confined space entry into a low-pressure separator to sample undisturbed sand and sludge behind the weir. While the sample was being retrieved, a flash explosion ignited in the vessel, exiting the open hatch. The explosion injured four workers, one of whom was blown off the platform. An MMS investigation produced panel Report MMS 2003-046, available at

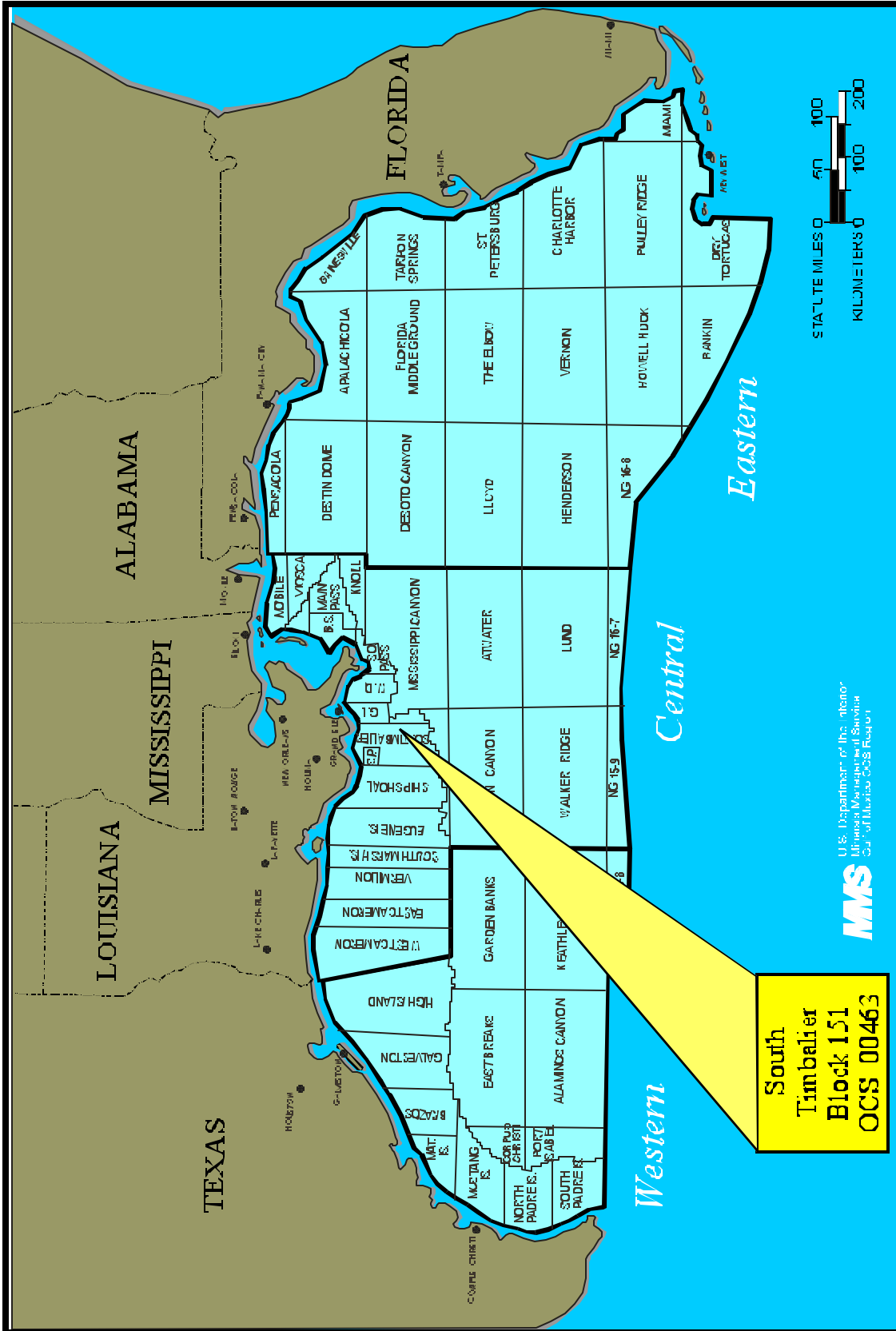
www.gomr.mms.gov/homepg/offshore/safety/acc_repo/accindex.html

The explosion was caused by the failure to open both hatches, ventilate, and continuously ventilate the vessel during entry, despite extensive pre-job procedural reviews. In addition, a gas detector was not deployed throughout the entire area of entry. These procedural failures occurred in part because of no managerial double-check of the actual operation. The injuries were caused by the explosion's impact on personnel inside the vessel and immediately outside the open hatch. One man struck the guardrail cyclone fence material, springing it loose from its frame, before falling into the water. No flotation aids were thrown to him.

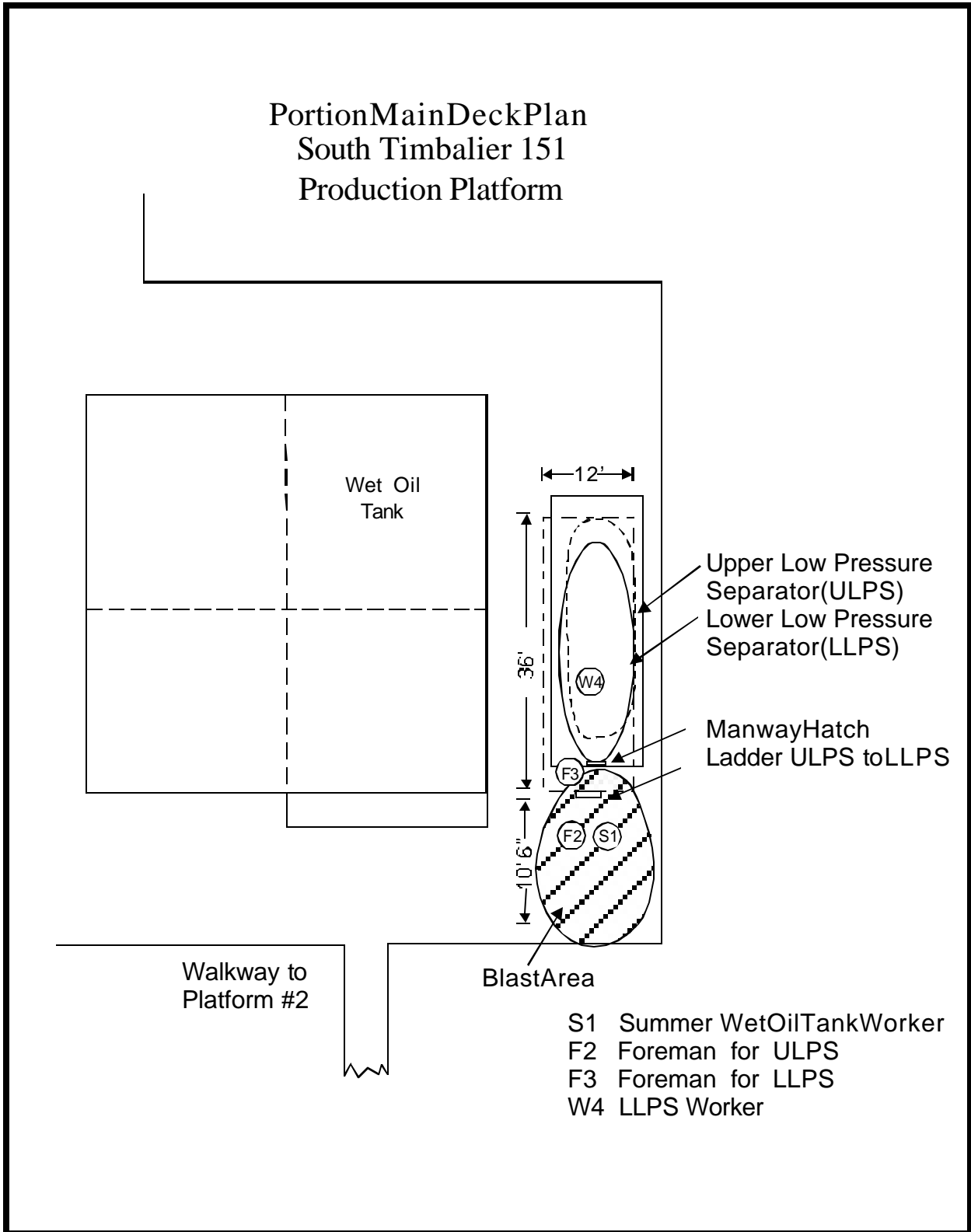
The MMS recommends to Operators the following actions:

- The operators should emphasize proper confined space entry procedure in the pre-job safety meetings and have a second party confirm the procedures are being followed;
- Personnel not involved in a particular confined space entry should be made aware of the potential danger areas immediately outside any open hatchway of a vessel;
- Work crews should be reminded in safety meetings of the location of emergency flotation devices and the need to access them first in a man-overboard situation;

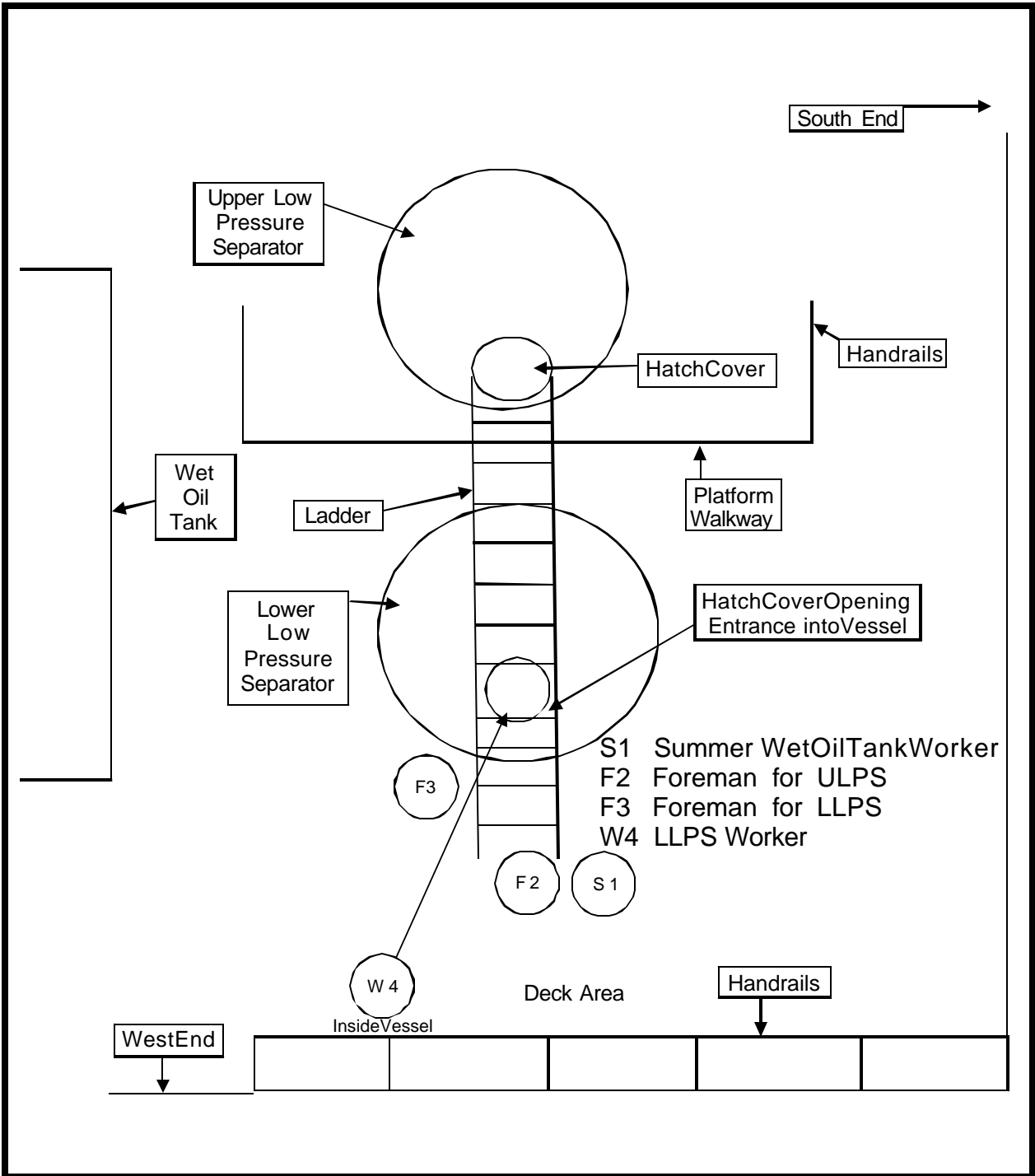
- Operators should review guard barrier ability to contain standard impacts, especially in the vicinity of major production equipment, vessels, and work areas.



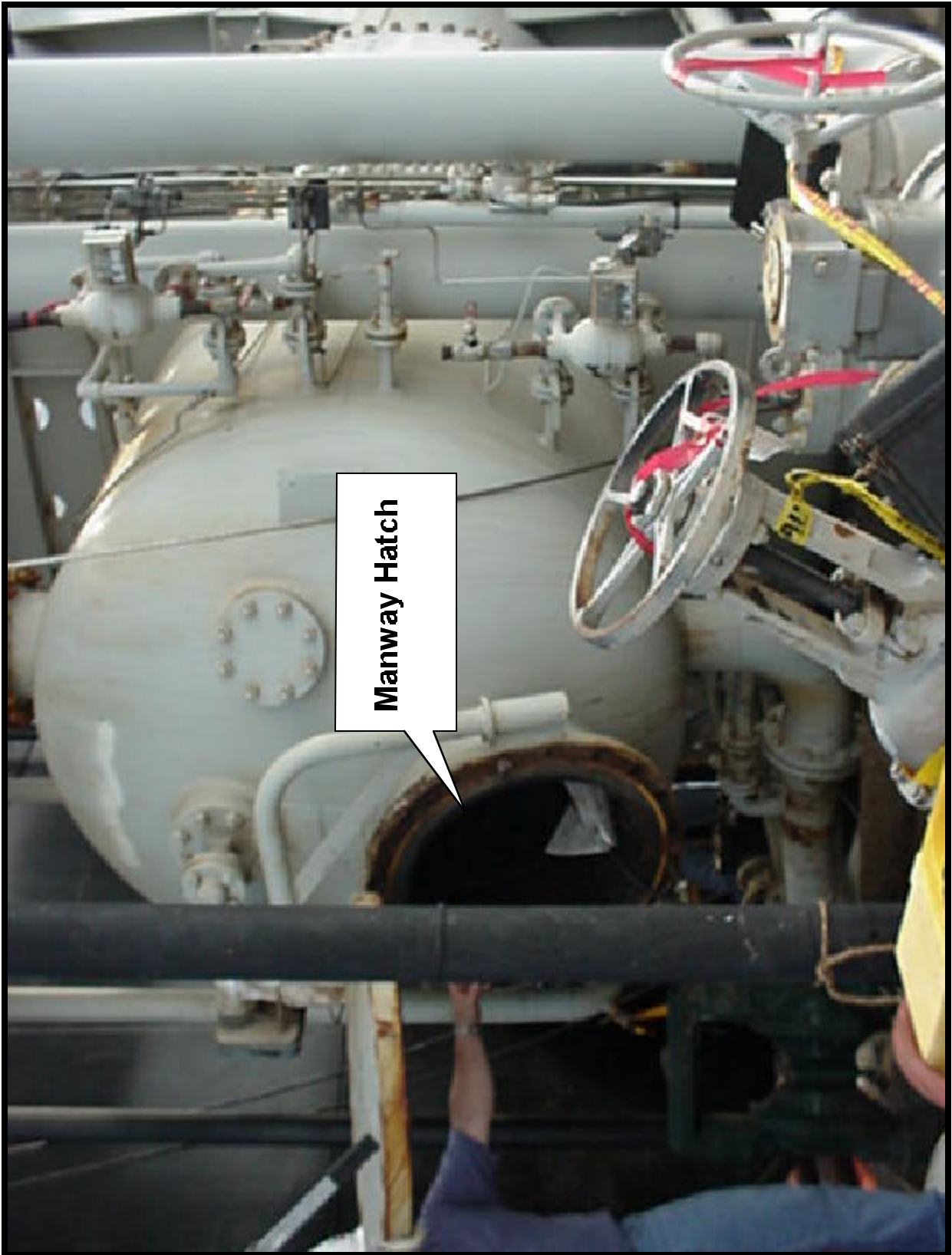
Location of Lease OCS 00463, South Timbalier Block 151



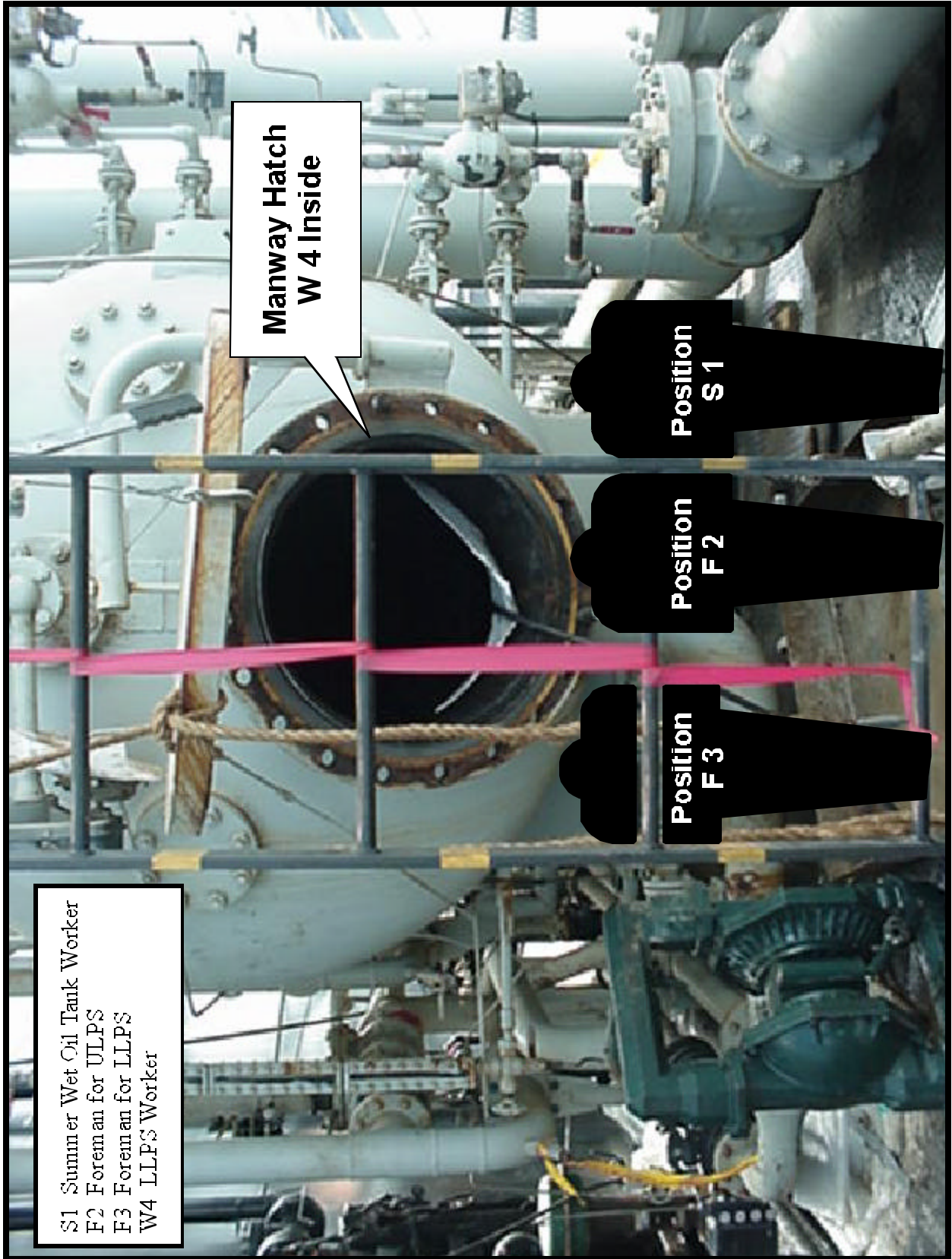
Diagram, OCS 00463 Production Platform, Position of Crew



Diagram, ULPS and LLPS and Position of Crew at the Time of Flash Explosion



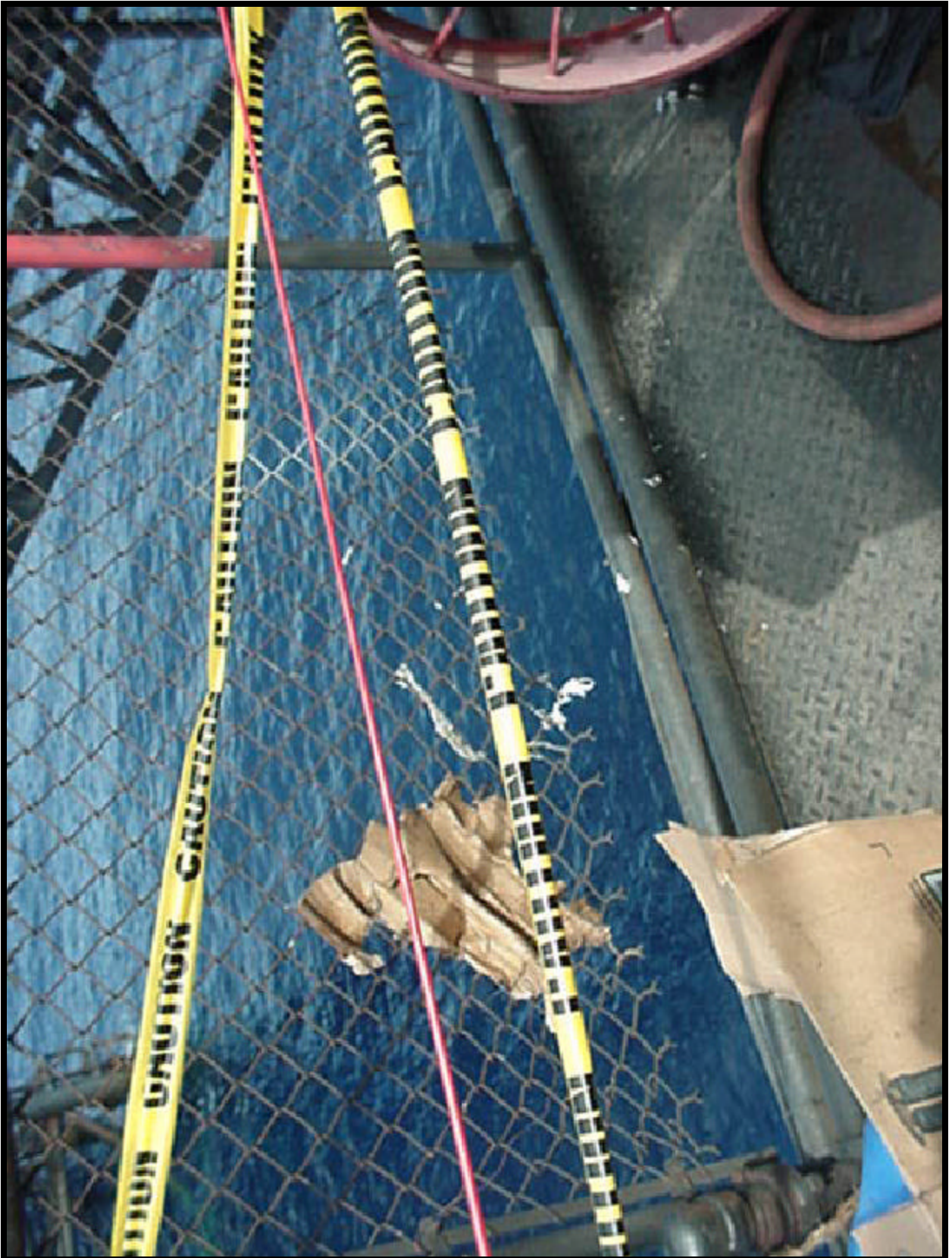
Lower Low Pressure Separator



Lower Low Pressure Separator, Manway Hatch, Position of Crew



Guard Rail Opposite Manway Hatch, LLPS, after Explosion
S1 Summer Wet Oil Tank Worker



Sprung Handrail Fencing and Debris from Explosion