Bureau of Safety and Environmental Enforcement

PANEL REPORT

BSEE PANEL REPORT 2023-003

Investigation of January 24, 2021, Seadrill West Neptune Drillship Fatality

Lease OCS-G24102

Mississippi Canyon Area Block 727

Gulf of Mexico Region

New Orleans District

July 24, 2023

Figure 1 - Incident scene

BSEE's National Investigation Program is administered by its Safety and Incident Investigations Division in Sterling, VA. Panel investigations, an integral tool for safety improvement, are chaired by division and regional staff, and conducted in coordination with region and district staff.

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ABBREVIATIONS AND ACRONYMS

ALMS – Asset Liability Management System

BSEE – Bureau of Safety and Environmental Enforcement

CFR – Code of Federal Regulations

GOM – Gulf of Mexico

GOMR – Gulf of Mexico Region

HSE – Health, Safety and Environmental

JSA – Job Safety Analysis

LGI – Lifting Gear Inspection

MC – Mississippi Canyon

MSL – Marine Section Lead

NDT – Non-Destructive Testing

OCS – Outer Continental Shelf

OCSLA – Outer Continental Shelf Lands Act

OIM – Offshore Installation Manager

PIC – Person in Charge

PTW – Permit to Work

TSL – Technical Section Lead

SEMS – Safety and Environmental Management System

SWA – Stop Work Authority

SWP – Safe Work Practice

TBRA – Task Based Risk Assessment

U.S.C. – United States Code

USCG – United States Coast Guard

UWA – Ultimate Work Authority

DEFINITIONS

Probable Causes are those actions, events, or conditions that:

a) Would have prevented the incident event from occurring, if corrected;
b) Contributed significantly to the incident; and
c) Have the most compelling supporting evidence as to both the existence of the cause and the degree of its contribution to the incident.

Contributing Causes are those actions, events, or conditions that;

a) May have prevented the incident event from occurring, if corrected;
b) Contributed somewhat to the incident; and
c) Have less compelling evidence than the probable causes.

Contributing Factors are those actions, events, or conditions that would not have prevented the incident from occurring but contributed significantly to the occurrence and/or severity of the incident.

Day Shift is the shift worked from *0600* to *1800*

Night Shift is the shift worked from *1800 t*o *0600*

EXECUTIVE SUMMARY

On January 24, 2021, an Inspector employed by Allrig, Inc. (Allrig) working onboard Seadrill US Gulf, LLC (Seadrill) West Neptune drillship located at Mississippi Canyon (MC)- Block 727 was pinned when five steel plates fell on him while conducting a Loose Lifting Gear inspection (LGI). Kosmos Energy Gulf of Mexico Operations, LLC (Kosmos Energy) had contracted with Seadrill and is the designated operator on record. The Allrig Inspector's (hereinafter referred to as "victim") injuries were fatal.

Weeks prior to the incident, Kosmos Energy ordered five 4-foot-by-8-foot steel plates (three – 3/8 inches thick and two – 1 inch thick) weighing approximately 4000 pounds collectively. These materials were delivered by boat for use as doubler plates for well flowback equipment onboard West Neptune. For the purpose of this report, "doubler plates" are steel plates used in between the deck of the drillship and well test equipment. Using a crane, the Seadrill crews initially stored the plates in a basket but later moved them out of the basket and laid them flat on dunnage in the riser storage area. Seadrill then moved the plates again to clear the area for storing riser piping. Seadrill's rig crew moved the steel plates with a crane to a location on the starboard side towards the aft of the drillship, outside of the riser storage area. Seadrill secured the plates using a two-inch, Long-Wide Handle Ratchet Buckle synthetic web tiedown strap with wire hooks (hereafter referred to as the "ratchet strap") rated at a working load limit (WLL) of 3,333 pounds. The ratchet strap secured the plates up against two stanchion beams in a horizontal upright position facing the aft of the drillship, resting on their eight-foot-long edges. The Seadrill rig crew hooked the ratchet end of the strap above the plates to the stanchion beam and hooked the other end below the plates to the stanchion beam. Once the rig crew secured the plates, they released the crane and left the two cable slings used for rigging (double wrapped and choked on each end of the plates) attached to the plates. The cable sling closest to the starboard side of the drillship was trapped between the stanchion beam and plates.

On January 21, 2021, two Allrig personnel (victim and assistant) contracted by Seadrill arrived on location to start their twenty-eight day hitch. Prior to the start of the hitch, the assistant initially scheduled to work with the victim became ill on his time off and another assistant was assigned to take his place. For reasons unknown, the assistant documented on the West Neptune arrival log that it was not his first time visiting the ship, even though it was. During their hitch, they were to conduct a loose lifting gear inspection and Non-Destructive Testing (NDT).

On January 24, 2021, an announcement was made during a morning meeting for crews working onboard to place their loose lifting gear on the deck in a designated area near the drilling welding workshop so it could be inspected by the victim and the assistant. The victim and assistant used a color code during their inspection. They inspected loose lifting gear previously painted blue during the last inspection. If the gear passed inspection, they painted over the blue with purple and stenciled the associated metal tags. At approximately 1300 hrs. (after lunch),

the victim noticed two cable slings attached to the steel plates, and he tried to remove them for inspection. The victim was able to remove one of the cable slings off one side of the plates without assistance but needed help to remove the other, which was trapped between the stanchion beam and plates. At approximately 1330 hrs., the victim called out for the assistant and instructed him to loosen the ratchet strap (which was holding the plates in place but was not part of their cable sling inspection) while the victim attempted to keep the plates from falling over by leaning his shoulder against the top of the plates. As the assistant loosened the ratchet strap, the wire hook came free of the stanchion beam and the plates fell on the victim's lower back pinning him up against a metal post across from the stanchion beams. The assistant yelled for help while he tried to lift the plates but was unable to free the victim. Numerous personnel arrived at different intervals but were unsuccessful lifting the plates by hand. The onboard medic arrived at the incident location and found the victim non-responsive.

The BSEE GOMR Director convened a Panel to investigate the cause(s) of the fatality. The Panel, comprising BSEE and USCG professionals, identified the following probable causes, contributing causes, and contributing factors that may have contributed to the totality of the incident:

Probable Causes

- Allrig personnel failed to recognize a pinch point and securely block / stabilize the weight of the plates prior to releasing the tie down, as recommended by the ratchet strap manufacturer.
- The Allrig assistant was not authorized to work onboard the drillship without a mentor, and the other Seadrill SSE policies that would have raised awareness of his SSE status were not followed.
- Allrig personnel went outside of the intended job scope by loosening the ratchet strap to remove the cable sling from the steel plates for inspection.

Contributing Causes

- Seadrill personnel failed to orientate the plates so that the cable slings used to lift them could be removed from the plates after placement up against the stanchion was complete, as stated in the Seadrill Lifting Operations Directive Guidelines.
- Seadrill stored the plates in a position that reduced their stability when the ratchet strap was removed and made them more likely to tip over. The position may also have made this instability less apparent to personnel.

Contributing Factors

- Seadrill directives do not clearly address storage of heavy materials.
- Service Provider Competency checklist was not completed by Seadrill to ensure Allrig

personnel had adequate training.

- The loose lifting gear inspection was considered by many personnel on the drillship to be low risk because the lifting gear was not attached to loads when inspections were conducted. They also regarded the victim as very experienced and capable at his job. As a result, the hazard analysis and supervision of the job may not have been prioritized.
- There was no consensus among the Seadrill personnel on who was the direct supervisor of the Allrig personnel at the time of the incident. The MSL would normally have been the supervisor of their lifting gear inspections, but he was working the night shift at the time of the incident.
- Seadrill and Allrig personnel did not conduct a written Task Based Risk Assessment (i.e., a JSA), which would have included a step-by-step procedure for the job. It was acceptable under Seadrill's policies not to use the written TBRA due to the job involving only two people and being (perceived as) low risk. However, the process of writing a TBRA would have highlighted and documented the limited scope of the job, which could have discouraged the Allrig personnel from exceeding that scope by inspecting cable slings outside of the designated area.

The BSEE Panel makes the following recommendations in an effort to further promote safety, protect the environment, and conserve resources on the U.S. Outer Continental Shelf (OCS). The following listing contains some of the key recommendations identified as a result of the investigative findings detailed within this report:

- Operators and contractors should ensure all hazards are identified and communicated to personnel in a timely and meaningful way and that findings receive appropriate consideration and corrective actions.
- Operators and contractors should abide by their respective SEMS bridging documents.
- Supervisory personnel should be knowledgeable of their responsibilities and take an active role in supervision, task planning, hazard analysis, and ensuring the job scope is followed, especially for the work of short-term contractors.
- Supervisory roles and responsibilities over contract personnel should be clearly defined and communicated. Policies for reassigning these responsibilities when the primary supervisor will not be available should be implemented and enforced.
- Training, guidance, and SWPs (Safe Work Practices) in the directives should be consistent and clear to reduce the risk of a misunderstanding.
- Communication of hazards should be sufficient to prevent personnel from inadvertent hazard exposure.
- Before deviating from the initial job scope, stop work, re-assess, and update hazard analyses and work permits to maintain effectiveness within the dynamic working environment.

- Policies and procedures for safely securing and moving heavy objects that could tip over should be continually developed and revised.
  - Personnel should be trained on awareness of hazardous sources of stored potential energy (not only from objects dropped from height), and such hazards should be addressed in JSAs, hazard hunts, and dropped object inspections.
  - Policies should address best practices for storage of heavy objects for later use. Safe primary and secondary storage locations should be identified in advance and communicated to the personnel involved in the handling of these objects.

INTRODUCTION

AUTHORITY

Pursuant to 43 U.S.C. § 1348(d)(2) (Outer Continental Shelf [OCS] Lands Act, as amended) and 30 CFR part 250 (Department of the Interior regulations), the Bureau of Safety and Environmental Enforcement (BSEE) is required to investigate and prepare a public report of this incident. BSEE has authority pursuant to 43 U.S.C. § 1348(f) to summon witnesses and require the production of documents while conducting an investigation pursuant to 43 U.S.C. § 1348(d)(1)-(2).

BSEE's Gulf of Mexico (GOM) OCS Region, New Orleans District Office was notified of the incident on January 24, 2021. By memorandum dated January 26, 2021, the investigation Panel was formed and initiated its investigation of the operational incident. The Panel included:

- Andrew Gros – Chairman, Senior Incident Investigation Coordinator, Office of Incident Investigations, GOM OCS Region.
- William Harper, PE – Petroleum Engineer, Office of Safety Management, GOM OCS Region.
- Darron Miller – Special Investigator, Safety and Incident Investigations Division, Headquarters.
- Nakia Banks – Lieutenant, Marine Investigator, USCG Sector New Orleans.

BACKGROUND

At the time of the incident, the victim was assigned to perform tasks associated with drilling and marine operations within the Mississippi Canyon (MC) Block 727 lease area, OCS-G 24102 ("the lease") onboard Seadrill's West Neptune drillship. Other activities aboard West Neptune at the time of the incident included completion operations on the SS#003 well, as well as various crane operations and tasks, assigned and initiated during the day shift.

Lease

The MC 727 lease covers approximately 5,000 acres on the OCS, within the GOM, off the Louisiana coast (*see Figure 1)*. Kosmos Energy acquired the lease through assignment after a merger of Deep Gulf Energy II, LLC and Deep Gulf Energy III, LLC in 2018. Kosmos Energy, as a lessee and designated operator, was responsible for ensuring all operations performed on the lease were conducted in compliance with all applicable regulations. See, e.g., 30 CFR 250.146.

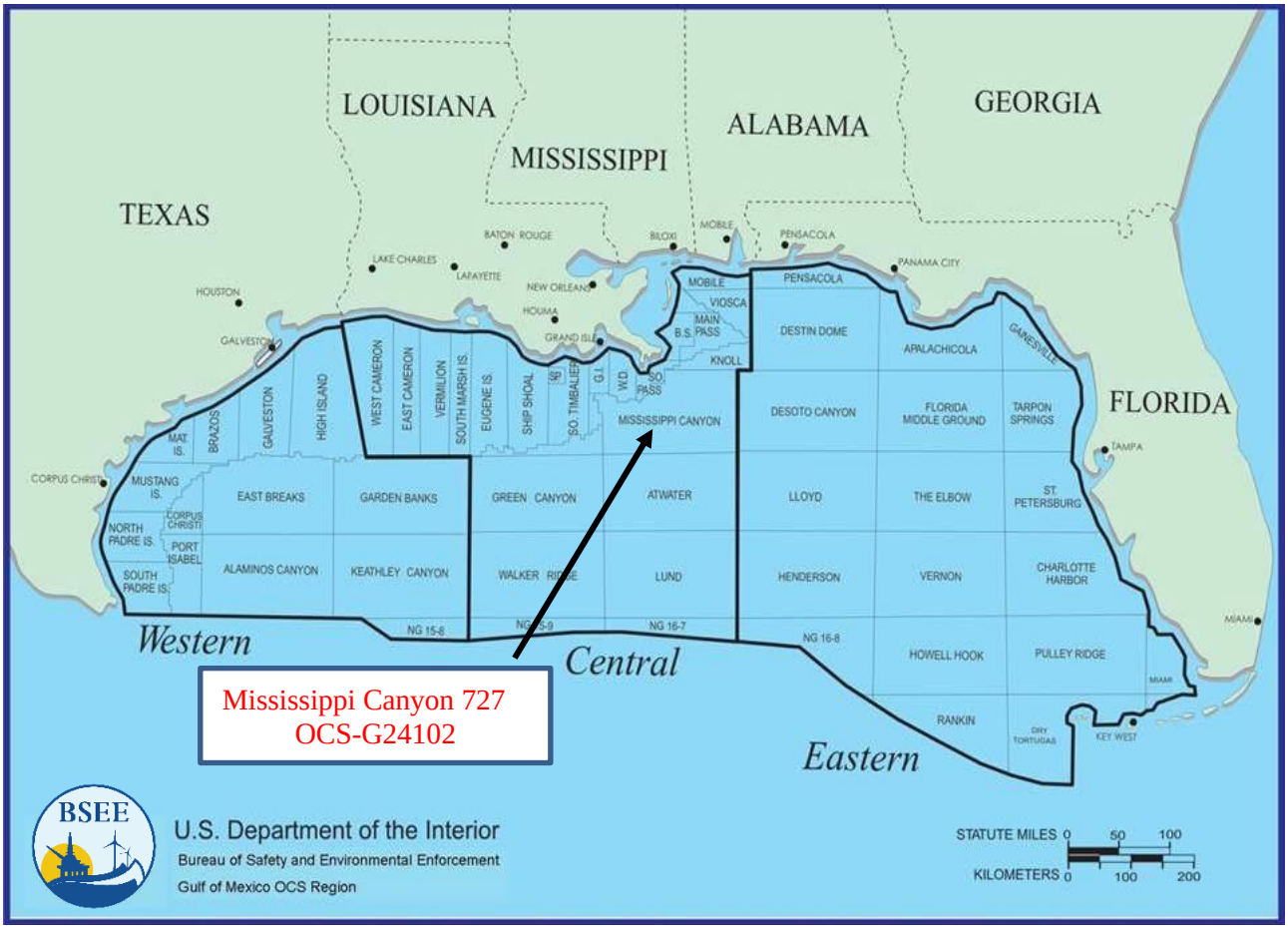

Figure 2-MC 727 "West Neptune Drillship" location

Drillship

Seadrill's West Neptune is a 6th generation ultra-deepwater drillship owned and operated by Seadrill US Gulf, LLC. The ship is 748 feet long and 137.8 feet wide with a maximum drilling depth of 37,500 feet. (*see Figure 3*). It was built in 2014 by Samsung Heavy Industries and can accommodate 200 persons. The water depth at the drillship location is approximately 4912 feet, and the distance from shore is approximately 54 miles.

Figure 3- Photograph of West Neptune Drillship

Companies

Kosmos Energy, the lessee and operator of record, used contractors to perform its drilling operations. Seadrill is the owner/operator of West Neptune and contracted Allrig to perform Loose Lifting Gear Inspections (LGI) and Non-Destructive Testing (NDT). A total of 178 personnel were present on the facility at the time of the incident, including 12 Kosmos Energy personnel, 76 Seadrill personnel, and 90 contract personnel (from 18 different contracted service provider companies).

The primary contracted service providers involved with relevant onsite operations were:

- Seadrill for drilling operations.
- Allrig for inspection services.

Reporting Structure

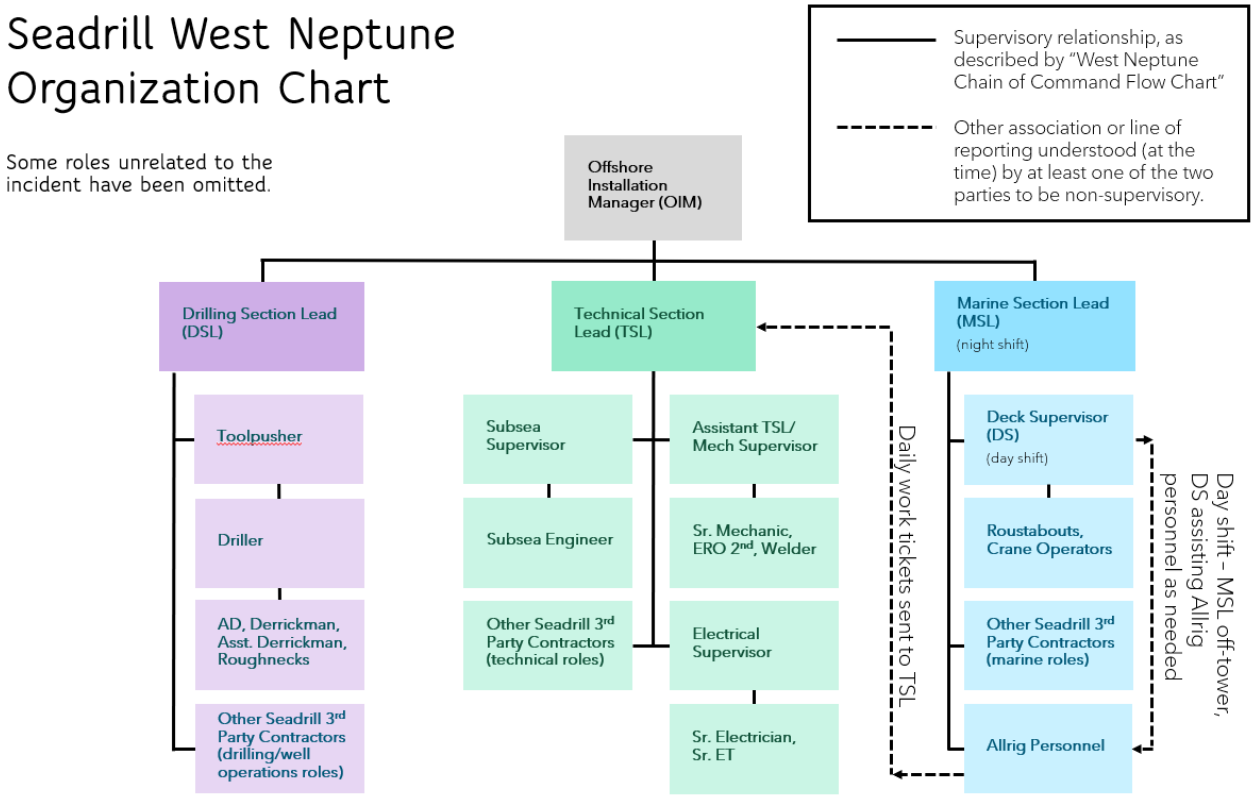

Figure 4- Representation of Seadrill's West Neptune Reporting Structure and Lines of Authority at the Time of Incident

Drillship Operations

Seadrill conducted Drilling/Marine operations on a 24-hour basis using two primary 12-hour shifts, with shifts scheduled from *0600 - 1800* (day shift) and *1800 - 0600* (night shift). Seadrill inspection and maintenance operations were typically conducted during the day shift, on a 12-hour basis, starting at *0600*.

The victim and assistant were to report to the Technical Section Leader (TSL), who was working the day shift, when needed for NDT work and to the Marine Section Lead (MSL), who was working the night shift, for loose lifting gear inspections. The Deck Supervisor who was working the day shift was also assigned to assist the victim and assistant as needed during the loose lifting gear inspection.

The Steel Plates

Kosmos Energy ordered five – 4 feet x 8 feet (two – 1 inch thick and three – 3/8 inches thick) steel plates to use as doubler plates to stage replacement well test equipment. Seadrill had well test equipment staged from its previous job, but Kosmos Energy wanted to use equipment from a different company. Seadrill had removed the well test equipment from the previous supplier but had not received the replacement equipment.

The five steel plates were initially on a supply boat and were transferred in a basket that was loaded onto the West Neptune. Later, Seadrill removed the steel plates from the basket and laid them flat with dunnage underneath on the deck to free up the basket for other uses. Seadrill again moved the steel plates and rested them in an upright position on their long edges on dunnage (two pieces of wood), then secured the plates to stanchion beams using a ratchet strap. Seadrill normally would have used the storage rack onboard West Neptune to store the steel plates, but it was full and unable to fit the steel plates purchased by Kosmos Energy. (Figure 5)

Figure 5 – Steel storage rack onboard West Neptune

Pictures provided by Seadrill showed the stanchion beams were ¼ inch out of square to the deck, leaning towards the aft of the ship, which put the plates at an estimated 0.60 degree angle while ratchet strapped in position. (Figure 12)

Figure 6 - Ratchet Strap that held the steel plates up against the stanchion beams

TIMELINE OF EVENTS

The Panel developed the following Timeline from a combination of documentation and witness accounts obtained throughout the course of its investigation of the January 24, 2021 incident:

December 15, 2020

Kosmos ordered five – 4 feet X 8 feet (two – 1 inch thick and three – 3/8 inches thick) sheets of steel plates to use as doubler plates to stage well test equipment. Seadrill had removed well test equipment staged on West Neptune from its previous job but had not received the replacement equipment.

December 15, 2020 thru January 23, 2021

The five steel plates were initially loaded in a basket on West Neptune when removed from the supply boat. Later, Seadrill removed the plates from the basket and laid them flat, with dunnage underneath, on the deck to free up the basket for other uses. Seadrill again moved the plates to their final resting place, where they rested horizontally in the upright position on dunnage (two pieces of wood), secured to stanchion beams by a ratchet strap. The cable slings used to move the plates with the crane were left still attached on each end. The storage racks for the plates onboard West Neptune were full and were unable to fit the plates purchased by Kosmos Energy.

January 21, 2021

The victim and assistant arrived at 1300 hrs. onboard West Neptune to conduct LGI and NDT. NDT would be conducted as requested by the Seadrill Subsea Supervisor.

a. The assistant that was previously scheduled to work with the victim could not show up for work onboard West Neptune because of illness.
b. The assistant's replacement was on days off from working on West Capricorn and was assigned to fill in to assist the victim on West Neptune.
c. It was not the victim's first time on West Neptune, but it was the replacement assistant's first visit to the ship. Despite this, the replacement assistant selected "No" on the orientation form for "First time visited."
d. The victim and assistant discussed work scope with the TSL and Subsea Supervisor. The plan for the next day was to start the LGI and any NDT requested by the Subsea Supervisor.

January 22, 2021

The victim and assistant started the LGI inspection as previously noted on the Daily Site Report.

January 24, 2021

The LGI inspection was announced in the morning meeting and departments were told to stage their cable slings in the pipe rack area to be inspected. The victim inspected, color coded, and stenciled all cable slings in the pipe rack area. The victim noticed the cable slings still attached on the steel plates secured against the stanchion beams outside of the pipe rack area. The victim removed the first cable sling from the steel plates, but he could not remove the second cable sling from the plates because it was pinched between the beams. The victim asked the assistant to loosen the ratchet strap holding up the plates while he physically tried to hold the plates upright. When the assistant loosened the ratchet strap, the ratchet strap hook came off the beam to which it had been attached, and the plates fell on the victim, trapping him between the plates and a 4 inch x 4 inch square metal post.

At the time of the incident, the following Seadrill personnel were in the following locations:

a. The Deck Supervisor was in the Nav Bldg.
b. The Assistant Technical Section Lead was in the Nav Bldg.
c. The Technical Section Lead was in his office.
d. The Marine Section Lead was working nights and was in his room.
e. The Offshore Installation Manager had just finished in the Galley and was headed to the Nav Deck.

BSEE INVESTIGATION

The Seadrill West Neptune was in an elevated COVID-19 status when the incident was reported to the BSEE New Orleans District After Hours engineer on January 24, 2021. This meant BSEE personnel responding had to be tested and quarantined according to BSEE's internal COVID policies. The BSEE had Houma District inspectors, trained to conduct incident investigations, who had already been tested and quarantined, were ready, and conducted the onsite investigation on January 25, 2021. BSEE personnel also ordered Kosmos Energy and its contractors to identify, preserve, and secure items within the incident area and retain all documents related to the incident. Throughout the investigation, the Panel conducted several interviews and requested that Kosmos, Seadrill, and Allrig representatives provide documents and photos. The Panel reviewed hundreds of documents, including records of the Contractor training, maintenance, and inspections, and Operator / Contractor Policies.

The Panel focused its requests for documentation on accomplishing the following investigative goals and objectives:

- Understanding the operational chain of events leading up to the incident, the incident, and the response to the incident.
- Identifying the activities of Kosmos Energy and its contractors relative to the operational incident and its surrounding events.
- Comparing the actions of each relevant contractor involved to the standard of safety and performance established and agreed upon by both Kosmos Energy and each contractor performing operations on its behalf and as documented in their Safety and Environmental Management Systems (SEMS) plans and bridging documents.
- Reviewing bridged SWPs and training records correlative to the work being performed and relative to the operational incident and its surrounding events.

The following represents the key focus areas and relevant findings identified during the investigation:

Incident Scene

The incident scene was located at the starboard/aft side near the riser deck area. The following images were selected by the Panel to provide a general overview of the incident scene:

Figure 7 – Dunnage used to support plates on edge and approximate top and bottom connection points of ratchet strap wire hooks.

Figure 8- Area where the plates were stored

Figure 9 - Position of steel plates against vertical steel post

The following is an analysis by the investigation Panel of the forces acting on the plates immediately after the ratchet strap was loosened, but before the victim was pinned by the plates.

1. Calculate the total weight of the five steel plates.

The total weight of the plates must be calculated to determine the forces acting on the plates. The five steel plates were stacked vertically on their long edge. Three plates were 3/8 inches thick and two plates were 1 inch thick. The density of carbon steel is 490 lb/cubic foot[1]. The combined weight of the five 4-feet-by-8-feet steel plates is the sum of the product of the length, width, thickness, and density of each plate.

	3/8" thick plate	**1" thick plate**
Length (long edge) (feet)	8	8
Width (short edge) (feet)	4	4
Thickness (feet)	0.03125	0.08333
Single plate volume (cubic feet)	1.0	2.7
Steel density (lbs/cubic feet)[1]	490	490
Single plate weight (lbs)	490	1307
Quantity	3	2
Total Weight (lbs)	1470	2613
m_{plates} = total mass of all five plates (lbs)	**4083 lbs**	

Figure 10 - Total weight of steel plates calculation

[1]Engineering ToolBox, (2004). *Metals and Alloys - Densities*. [online] Available at: https://www.engineeringtoolbox.com/metal-alloys-densities-d_50.html Accessed 27 May 2021.

For the purposes of the following calculations, the five plates will be assumed to act as a single mass with the following dimensions:

	Five plates
Length (feet)	8
Width (height) (feet)	4
Thickness (base) (feet)	0.260
Mass (lbs)	4083
Center of gravity location:	
Vertical (feet)	2
Horizontal (feet)	0.130

Figure 11 - Plates single mass dimensions

2. **Calculate the angle of the plates relative to the deck before the ratchet strap was loosened**

   The following calculations will show the forces acting on the plates over a range of possible tilt angles. This will in turn demonstrate the very narrow conditions under which the plates would have remained stable and upright, and how quickly the force required to hold the plates upright could have overwhelmed the victim once the plates began to fall.

   According to the Seadrill incident investigation report, the stanchion that the plates were secured to was not perpendicular to the deck. This means that when the plates were secured in place by a ratchet strap (and immediately before the ratchet strap was loosened), they were slightly tilted to the aft of the drillship (towards the victim).

Figure 12 - Out of square measurement

The photos above from the Seadrill report show a 2 foot square positioned flush against the deck. Because the stanchion is slightly tilted, the square does not lie flush against the stanchion. The gap between the stanchion and the square is 1/4 inches. This is shown in the diagram below (not to scale).

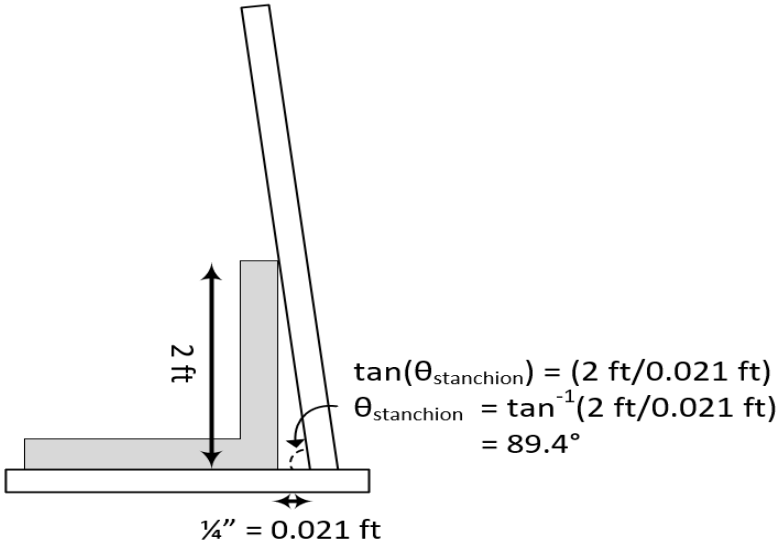

Figure 13 – Illustration of steel plates angle calculation based on out of square measurement.

If the stanchion had been perpendicular to the deck, this angle would have been 90 degrees. According to the calculations, the stanchion is tilted by an angle of 90 – 89.4 = **0.60 degrees towards the aft of the drillship**. This means that even when the plates were attached to the stanchion with the ratchet strap, they were tilted towards the victim by an angle of no less than 0.60 degrees relative to the surface of the deck. Although this angle is small, it will be shown in later calculations that even a small angle can have a significant effect.

The angle calculated above is relative to the deck of the drillship. However, the actual tilt angle of the plates may have been larger due to the effects of wind and wave action on the pitch of the drillship. The following calculations will show the forces acting on the plates due to gravity. The tilt angles used below are relative to the force of gravity rather than the angle of the plates relative to the deck of the drillship (i.e., they include any tilt angle attributable to the pitch of the drillship).

3. Calculate the force acting on the plates to tip them over.

The following calculations will show the conditions when the plates would have been stable and would not have tipped over, and when they would have become unstable and would have begun to fall. Because the plates immediately began to fall towards the victim after the ratchet strap was loosened, the Panel concluded the plates were in an unstable condition.

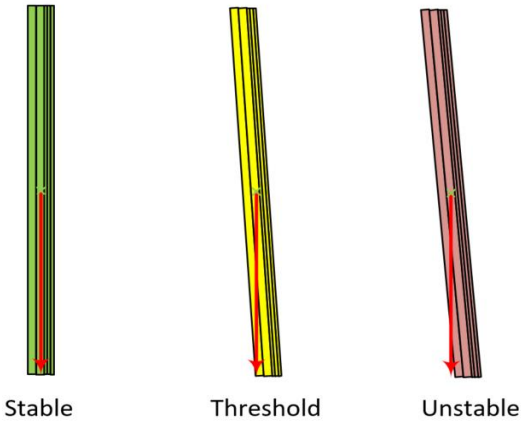

Figure 14 - Illustration of steel plates stable and unstable positions

After the ratchet strap was loosened, the plates would only remain upright and stable if their center of gravity was above and within the footprint of the base of the plates. If the center of gravity was directly above the bottom edge of the base of the plates (as shown in the middle stack of plates in the drawing above), any further tilting would cause the plates to become unstable and fall over. This threshold tilt angle is calculated below:

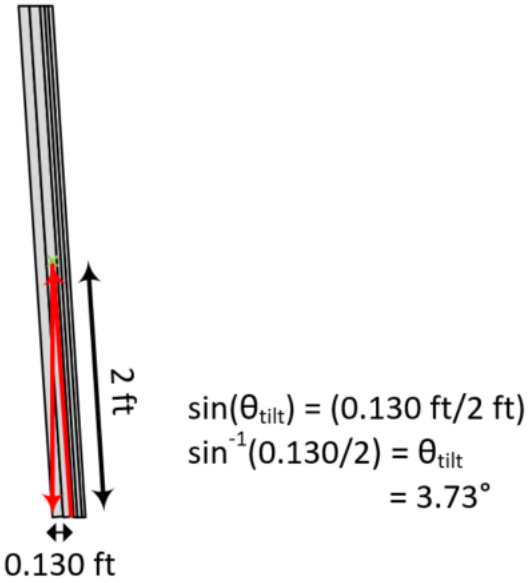

Figure 15- Illustration of weight calculations based on angles of the plates

If the steel plates were tilted by more than 3.73° when the ratchet strap was loosened, gravity would act on the plates causing them to tilt further and fall towards the victim. As the tilt angle (θ_{tilt}) increases further, the force pushing the plates over (F_{fall}) would increase, and the victim would have to apply more force to prevent the plates from tilting further. The victim used his body to counteract this force by pushing horizontally against the plates in the opposite direction. However, he was not able to apply sufficient force to prevent the plates from falling.

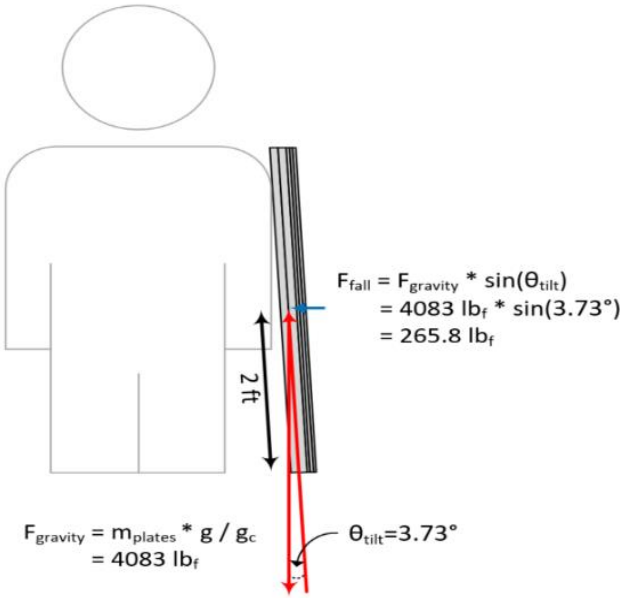

Figure 16 - Illustration of the victim's body position to plates with angle and weight calculations. The amount of force required to keep the plates upright shortly after the plates become unstable is shown on the right.

4. **Calculate the mechanical advantage created by pushing the plates above their center of gravity.**

   The force pushing the steel plates over (F_{fall}), calculated in the previous section, is applied at the center of gravity, which is located 2 feet above the bottom edge of the steel plates. However, the victim applied force (F_{IP}) to the steel plates with his shoulder, which was above the center of gravity. We will assume that he applied force horizontally to the top edge of the steel plate. Applying force above the center of gravity of the plates creates a second-class lever, resulting in a mechanical advantage and the effect of a greater force applied to the center of gravity (F_{lever}). This reduced the amount of force that the victim would have had to apply to hold the steel plates upright, but this was not enough to prevent the plates from falling.

   The following diagram uses a different angle (10°) from the previous calculations to show how the forces increased significantly with only a small increase in tilt angle.

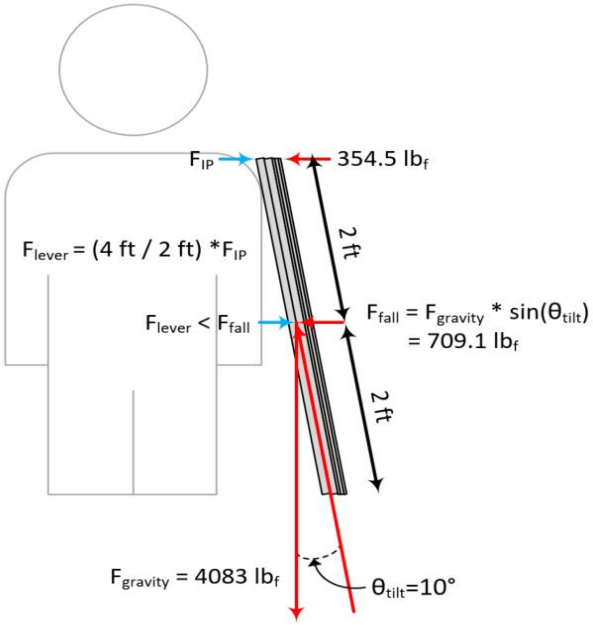

Figure 17 - Illustration of the victim's body position to steel plates with angle and weight calculation as the angle of the steel plates decreased

As shown in the diagram above, due to the mechanical advantage, applying force to the top of the plate has the same effect as applying double the force to the center of the plate. Therefore, only half as much force is required to counteract the force pushing the plates over (F_{fall}). The relationships between tilt angle and these forces is shown in the table below. However, even with this mechanical advantage, the victim could not apply sufficient force to stop the plates from falling.

Tilt angle (θ_{tilt}, degrees)	3.73	4	5	6	8	10
Force pushing plates over at center of gravity (F_{fall}, lb_f)	265.8	284.8	355.9	426.8	568.3	709.1
Force required at the top of the plates to prevent them from falling (F_{IP}, lb_f)	132.9	142.4	177.9	213.4	284.1	354.5

Figure 18 - Relationships between tilt angle and forces

It should be noted that the tilt angle is relative to the force of gravity – this includes both the tilting of the steel plates relative to the deck (which was at minimum equal to the tilt angle of the stanchion that was calculated previously, 0.60 degrees) as well as the pitch angle of the drillship. Since such a small angle is sufficient to destabilize the steel plates, the motion of the ship may have been a significant factor, even if the wind and wave actions were minimal.

5. **The Panel identified four conclusions from the above calculations:**
    - Although the tilt angle of the plates at the time of the incident is not known, it is notable that the minimum tilt that would destabilize the plates was very small and **may not have been noticeable by the personnel.** As shown in the above calculations, the plates would have become unstable when tilted by only 3.73°. This small angle would have moved the center of gravity of the plates by only 0.130 feet (1 9/16 inches), and the top edge of the plates by only 0.260 feet (3 1/8 inches).

    - Because the stanchion that the plates were attached to was tilted towards the victim by 0.60°, the range of potential angles where the plates would remain stable was very narrow, **which increased the likelihood that they would become unstable and fall.**

    - Although it is not known how much force the victim applied (or was capable of applying) to the plates, it is clear from these calculations that as the plates began to fall, the force of gravity pushing the plates over would have quickly exceeded any amount of force that the victim could have applied. **When the plates were tilted by only 6 degrees, 213.4 lbf of force applied to the top of the plates would have been required to prevent them from falling further.** Therefore, it is likely that he would have been unable to stop the plates from falling once they became unstable.

    - Following from the above conclusions, although there may have been safer ways to remove the cable slings from the plates for inspection, **the way that these plates had been stored and secured at the West Neptune introduced hazards that may not have been immediately apparent to the personnel.**

SAFETY AND ENVIRONMENTAL MANAGEMENT SYSTEM

The Code of Federal Regulations (CFR) requires each OCS operator to develop, implement, and maintain a Safety and Environmental Management System (SEMS) Program (30 CFR 250.1900).

Seadrill and Kosmos signed a bridging document that detailed which SEMS responsibilities would be handled by each party, or jointly. The following management system elements were covered in this agreement and are relevant to the incident. Unless otherwise noted, these responsibilities were exclusively assigned to Seadrill.

Job Safety Analysis (JSA) and Ultimate Work Authority (UWA)

Under the bridging document, Seadrill managed the JSA procedure, form, and tracking. Seadrill was also responsible for rig-specific HSE Case/hazard analysis. The Ultimate Work Authority was the Seadrill OIM.

A written Task Based Risk Assessment (TBRA, which is Seadrill's form for JSAs) was not conducted for the work involved with this incident, but an oral five-point check risk assessment was conducted by Allrig personnel before work started. A TBRA would have required the victim, assistant, and their immediate supervisor to create a written step-by-step procedure, a written assessment of risks involved with the job, and a description of any mitigations that should have been used to address these risks. It would have been reviewed and signed by both the immediate supervisor of the Allrig personnel and the Ultimate Work Authority (OIM). Implicit in all TBRAs is the recognition that the personnel must stay within the job scope and procedure specified on the TBRA, and if the job is later found to present new hazards or require activities that were not covered in the TBRA, the TBRA must be revised and re-approved before work can continue.

There are no specific Seadrill polices that would have required a TBRA for this job, and the interviewed personnel agreed that performing the oral five-point check was appropriate for two-person jobs that were considered to be low risk. However, considering the consequences, the job as executed posed risks that were not accounted for or were underestimated when it was being planned and authorized.

The OIM stated in his interview that the Allrig personnel's job scope did not include removing in-use cable slings, such as the ones attached to the steel plates. He believed that they should have known this through word-of-mouth, but he was unsure if it was explicitly stated in any written Seadrill procedure. Had a TBRA been conducted, it could have provided an opportunity for this instruction to be communicated to the Allrig personnel and documented on the TBRA.

Stop Work Authority (SWA)

Seadrill and Kosmos were jointly responsible for communicating Stop Work Authority. Seadrill provided procedures, administration, and communication of SWA to personnel onboard. Per both Seadrill policy and the Code of Federal Regulation (30 CFR 250.1930), all personnel have the authority to stop work they deem to be unsafe. Under the regulation, invocation of SWA effectively suspends the authorization for the work underway, and approval from the UWA is required to resume work.

Under both the Code of Federal Regulations and Seadrill policy, SWA should be used when the work cannot be completed without creating an imminent risk or danger. Under Seadrill policy, SWA can also be used to stop work that is exceeding the scope of the prior risk assessment and approved procedure and is therefore introducing unknown risks. Personnel stated in interviews that SWA was not used prior to the incident because the personnel did not reasonably foresee the risk involved with loosening the ratchet strap to remove the cable sling from the steel plates for inspection.

Dropped Object Management and Energy Isolation (Lockout/Tagout)

Seadrill was responsible for the dropped object management program and procedure for drillship operations (subsea architecture excluded) as well as for energy isolation policies.

Although these policies were in effect at the time of the incident, they were not intended or understood to cover the hazards associated with heavy objects resting on the deck that have the potential to tip over, such as the steel plates. These hazards are not typically included in dropped object prevention programs, although some energy isolation programs would consider the plates to be a form of hazardous potential energy. The Seadrill West Neptune personnel who were interviewed for this investigation did not indicate that the plates presented a potential energy hazard that would have been addressed under these policies.

Operating Procedures, Safe Work Practices

Because Allrig personnel's work scope was not part of drilling operations, it fell under Seadrill's policies for operating procedures and safe work practices. This included Seadrill's General Safety Rules, covering HSE work rules and safe work practices. The storage of the plates and the management of cable slings and lifting gear was the responsibility of Seadrill's marine department, under the leadership of the Marine Section Lead (MSL). Seadrill's polices define the job-specific responsibilities of the MSL as including "[m]anaging the marine department," ensuring "clear daily operational guidelines are provided to all direct reports," and providing "visible leadership by spending time in the field and monitoring daily operations."

Personnel interviews revealed that there was no consensus regarding which person held the responsibility for supervising the Allrig personnel, and that the Allrig personnel effectively had no direct supervisor at the time of the incident.

- At the time of the incident, the **MSL** was working the night shift and was not able to directly supervise their work or perform the responsibilities mentioned above. In his interview, the MSL stated that the Technical Section Lead (TSL) was responsible for supervising the Allrig personnel.

- The **TSL** said it was the MSL's responsibility to supervise the Allrig personnel. He stated that the Bosun or OIM would have been in charge during the day and would have communicated with the MSL. However, on the day that the Allrig personnel boarded the West Neptune (1/21/21), they discussed their work scope for the hitch with the TSL and subsea supervisor. The TSL had been signing off on the Allrig personnel's time and work tickets, which the victim had been emailing to him at the end of their shifts. The TSL stated that the Deck Supervisor would have been overseeing the Allrig personnel for their cable sling inspections. If the Allrig personnel had been performing non-destructive testing, the TSL would have been their supervisor. Although the Allrig Daily Site Reports stated that "any NDT required by sub-sea" was part of their work scope, no NDT work had been conducted during that hitch at the time of the incident.

- The **OIM** said that he had personally told the MSL that the loose lifting gear inspection was the MSLs responsibility and to delegate to the deck supervisor.

- The **Deck Supervisor** stated that he had no supervisory responsibilities over contractors, although he understood that he was to assist the Allrig personnel if they needed his help during their lifting gear inspection.

- The **Allrig assistant** stated that his supervisor was the TSL, at least for non-destructive testing activities, but that he generally relied on the victim to communicate with the Seadrill employees.

Lifting Operations

Seadrill was responsible for the procedures and safe work practices for lifting operations. The Seadrill Lifting Operations directive (DIR-37-0085) states that "[a]fter use, the slingers should stow slings in a tidy manner on a suitable rack off the floor." Because the cable slings were left on the plates when they were secured in place on the deck, they were being used for a purpose unrelated to lifting operations that some of the personnel may not have been aware of. Allrig personnel were not advised of this use by Seadrill personnel and did not account for it while planning their job. Additionally, per Seadrill's lifting operations directive, removing slings from loads should only be performed by appropriately trained personnel on lifting teams, e.g., riggers. Neither of the Allrig personnel was trained as a rigger.

Short Service Employee Program

Seadrill was responsible for the administration and procedures of their Short Service Employee (SSE) program. This applied to their employees and contractors.

The Seadrill Short Service Employee policy (DIR-37-0016) was not followed. It was the Allrig assistant's first time aboard the West Neptune, despite the fact that he indicated otherwise on the arrival form. Had he been identified as an SSE, the following would have been required by the policy:

- Assignment of a suitable mentor by the section leader (e.g., the MSL) and OIM. The mentor would accompany the SSE during their shifts.
- The mentor and SSE would complete an initial Short Service Employee checklist prior to the first hitch/shift.
- The mentor and SSE would complete end of hitch evaluations, which would be approved and signed by the OIM.
- The SSE would complete at least two 28-day hitches.
- The OIM and section leader would sign off on the SSE evaluation as complete at the end of the evaluation period if they deemed that the SSE had completed the goals of the program.
- The SSE would wear a green hard hat to identify them as such to other personnel.

The OIM stated in his interview that had the assistant identified himself as an SSE, his mentor most likely would have been the victim, which would not have changed the conditions or supervision of the job. However, the green hard hat and the recognition of his SSE status by the other personnel on the drillship could have encouraged additional scrutiny and oversight, and the OIM, section leader, and mentor (the victim) would reasonably be expected to have had more involvement in assessing his understanding of Seadrill policies.

Although many roles were involved with the SSE procedure, the OIM and rig manager were assigned the responsibility for implementation of the SSE program. However, the rig manager is not normally onboard the drillship and was not onboard at the time of the incident.

HSE Orientation

Seadrill and Kosmos were jointly responsible for providing the drillship HSE orientation to personnel. The orientation covered many of the previously mentioned Seadrill policies. HSE meetings and communication of safe work practices to personnel were also Seadrill's responsibility.

The Allrig personnel received their orientation on January 21, 2021. Although no evidence was found indicating that the orientation of the Allrig personnel failed to meet Seadrill's

requirements, there may have been opportunities for Seadrill and/or Kosmos personnel to communicate or emphasize any of the previously mentioned practices, policies, or instructions to the Allrig personnel during their orientation, and to verify that they were understood. The onboarding victim and assistant initialed the arrival log acknowledging they had attended the Induction Video and agreed to follow the policies and procedures described.

Skills Review and Training for Scope of Work

Seadrill was responsible for verifying that their personnel and contractors (service providers) were properly trained for their scope of work, though the service providers were responsible for providing personnel who are trained and competent for the tasks they are required to perform. Allrig provided documentation for the training and qualifications of their two employees which demonstrated that they were adequately trained and certified in their scope of work. However, for Seadrill's service providers (including Allrig) to perform their jobs safely, they also needed to be knowledgeable of Seadrill's work policies, including those described above.

Seadrill provided records showing that the victim had completed training modules in Seadrill's policies, including Dropped Object Awareness, Manual Handling, Risk Assessments, and Permit to Work. Training records were also provided for the other relevant personnel on the West Neptune. However, Seadrill provided no records showing that the Allrig assistant had completed any Seadrill training modules.

Selection and Verification of Seadrill's Subcontractors

Seadrill was responsible for verifying that Allrig met the requirements for Seadrill's SEMS program and was also required to verify that its contractors met or exceeded the Kosmos HSE requirements.

Under Seadrill's polices (Management of Service Providers, DIR-37-0163, version 3), the OIM was responsible for review and approval of the Service Provider Competency Checklist (FRM-37-0088) before service providers commence activities onboard. This form includes questions regarding the contractor's training in the job they will be performing, if they have the risk assessment tools for their job (e.g. JSA or TBRA), and whether they are familiar with Seadrill's policies, e.g., pre-job safety meetings, risk assessments, and the permit to work system. This form also addresses whether the contractor will be assigned a mentor, and who their mentor will be.

The OIM onboard Seadrill West Vela signed the checklist completed by the victim on June 13, 2020 for an unrelated job (crane inspections), but it was not completed by the OIM onboard West Neptune. Additionally, this checklist was not completed for the Allrig assistant.

Although it is unclear whether lack of awareness or training in Seadrill's work policies directly contributed to the incident, there were deficiencies in the processes for verifying the training of the Allrig personnel. Had the Service Provider Competency Checklist been completed for the two Allrig personnel, the training deficiencies could have been discovered. Remedial training could have been conducted and the team could have been assigned a Seadrill employee as a mentor to supervise their job.

Conclusions

The following conclusions were based upon the totality of the information provided to and reviewed by the Panel during its investigation into the January 24, 2021, fatal incident.

Probable Causes

- Allrig personnel failed to recognize a pinch point and securely block / stabilize the weight of the plates prior to releasing the tie down, as recommended by the ratchet strap manufacturer.
- The Allrig assistant was not authorized to work onboard the drillship without a mentor, and the other Seadrill SSE policies that would have raised awareness of his SSE status were not followed.
- Allrig personnel went outside of the intended job scope by loosening the ratchet strap to remove the cable sling from the steel plates for inspection.

Contributing Causes

- Seadrill personnel failed to orientate the plates so that the cable slings used to lift them could be removed from the plates after placement up against the stanchion was complete, as stated in the Seadrill Lifting Operations Directive Guidelines.
- Seadrill stored the plates in a position that reduced their stability when the ratchet strap was removed and made them more likely to tip over. The position may also have made this instability less apparent to personnel.

Contributing Factors

- Seadrill directives do not clearly address storage of heavy materials.
- Service Provider Competency checklist was not completed by Seadrill to ensure Allrig personnel had adequate training.

- The loose lifting gear inspection was considered by many personnel on the drillship to be low risk because the lifting gear was not attached to loads when inspections were conducted. They also regarded the victim as very experienced and capable at his job. As a result, the hazard analysis and supervision of the job may not have been prioritized.
- There was no consensus among the Seadrill personnel on who was the direct supervisor of the Allrig personnel at the time of the incident. The MSL would normally have been the supervisor of their lifting gear inspections, but he was working the night shift at the time of the incident.
- Seadrill and Allrig personnel did not conduct a written Task Based Risk Assessment (i.e., a JSA), which would have included a step-by-step procedure for the job. It was acceptable under Seadrill's policies not to use the written TBRA due to the job involving only two people and being (perceived as) low risk. However, the process of writing a TBRA would have highlighted and documented the limited scope of the job, which could have discouraged the Allrig personnel from exceeding that scope by inspecting cable slings outside of the designated area.

Recommendations

The results of the Panel investigation yielded a number of recommendations aimed at improving safety performance and preventing a recurrence or similar event sequence. The Panel recommends companies operating on the U.S. Outer Continental Shelf consider the following to further promote and protect the health and safety of personnel, the environment, and OCS resources:

- Operators should ensure all hazards are identified and communicated to personnel in a timely and meaningful way and that findings receive appropriate consideration and corrective actions.
- Operators and contractors should abide by their respective SEMS bridging documents.
- Supervisory personnel should be knowledgeable of their responsibilities and take an active role in supervision, task planning, hazard analysis, and ensuring the job scope is followed, especially for the work of short-term contractors.
- Supervisory roles and responsibilities over contract personnel should be clearly defined and communicated. Policies for reassigning these responsibilities when the primary supervisor will not be available should be implemented and enforced.

- Training, guidance, and SWPs in the directives should be consistent and clear to reduce the risk of a misunderstanding.
- Communication of hazards should be sufficient to prevent personnel from inadvertent hazard exposure.
- Before deviating from the initial job scope, stop work, re-assess, and update hazard analyses and work permits to maintain effectiveness within the dynamic working environment.
- Policies and procedures for safely securing and moving heavy objects that could tip over should be continually developed and revised.
    - Personnel should be trained on awareness of hazardous sources of stored potential energy (not only from objects dropped from height), and such hazards should be addressed in JSAs, hazard hunts, and dropped object inspections.
    - Policies should address best practices for storage of heavy objects for later use. Safe primary and secondary storage locations should be identified in advance and communicated to the personnel involved in the handling of these objects.