Bureau of Safety and Environmental Enforcement

PANEL REPORT

BSEE PANEL REPORT 2024-01

Investigation of March 25, 2022, Hydraulic Workover Unit Failure Fatality

Lease OCS-G04909

Main Pass Block 64 Platform #19

Gulf of Mexico Region

New Orleans District

May 30, 2024

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EXECUTIVE SUMMARY

On March 25, 2022, an incident resulting in a single fatality occurred while SBS Energy Services (SBS) was rigging up a hydraulic workover unit (HWU) on a well at Sanare Energy Partner's (Sanare) Main Pass (MP) Block 64 Platform #19 single well caisson.

The MP 64 #19 well was installed in 1991 with a half-inch-thick, 20-inch diameter drive pipe (structural casing). The wellhead sits on top of the structural casing, and the structural casing is surrounded by a caisson trash cap. The trash cap keeps debris from falling into the annulus between the caisson and structural casing. After the incident, the Panel observed severe corrosion on the structural casing below the caisson trash cap.

Sanare contracted SBS to conduct tubing change operations at the MP 64 #19 facility. On March 20, the liftboat *Swordfish* arrived on location along with SBS crew to begin the operation. Welders installed pad eyes to the four corners of the small platform's top deck on March 21 to have guy line tie-off locations. A guy line is a tensioned cable, chain, rope, etc. attached from a free-standing structure to a firm location, such as a fixed platform to add stability to the structure. The SBS crew began to rig up the HWU on the well on March 22. The rig-up of the HWU continued to March 25.

The HWU consisted of the lower pipe ram, flow cross, double blind/shear rams, Anchor Spool system, annular preventer, work window, and assorted adaptor/spacer spools. The HWU was guyed off to the top deck of the platform from the ends of the Anchor Spool beams.

During the early morning of March 25, the SBS night crew used the crane to install the pipe jack onto the work window. The total weight of the HWU, which was being held up by the severely corroded structural casing and the crane, was now approximately 120,000 pounds. The crane remained rigged up to the pipe jack while work stopped to hold the morning safety meeting at approximately 0600 hours. At approximately 0830 hours, an SBS day crew member ("victim") disconnected the pipe jack from the crane. As the crane moved away, the HWU fell over into the water submerging the upper portion. The victim was wearing fall protection that was secured near the top of the HWU. He was still tied off when it fell, pulling him into the water. A diver recovered the victim from the water on March 26.

The Bureau of Safety and Environmental Enforcement (BSEE) convened a panel team (BSEE Panel) to investigate the incident that resulted in a fatality. The BSEE Panel identified probable and contributing causes of the incident. The BSEE Panel also identified recommendations to further promote safety, protect the environment, and conserve resources on the U.S. Outer Continental Shelf.

Probable Causes

- The 20-inch structural casing could not sustain the forces applied.
- Sanare did not ensure the structural integrity of the system upon which the HWU was placed.

Contributing Causes

- Sanare failed to consider all safety ramifications when choosing equipment for the operation.
- The master service agreement (MSA) between Sanare and SBS lacked details regarding the performance of duty expectations of both the operator and the contractor.

Contributing Factors

- High winds and sea conditions over time may have exacerbated the mechanical failure of the structural casing by causing stresses to the structural casing while supporting the HWU.
- The guy lines above the Anchor Spool were not completely installed at the time of the incident, so the Anchor Spool could not fully stabilize the HWU.

Recommendations

The BSEE Panel makes the following recommendations to industry as a result of its investigative findings detailed within this report to further promote safety and prevent a recurrence of the same or similar event, protect the environment, and conserve resources on the U.S. Outer Continental Shelf (OCS):

- Conduct a structural analysis that involves an assessment of the wellhead and the casing system's condition to ensure the HWU's weight can be supported.
- Ensure the workover equipment is suitable for the wellhead and casing system upon which the workover equipment is being placed.
- Be cautious when conducting workover campaigns at multiple facilities. Choosing equipment for the maximum size and rating needed for the campaign may result in equipment that is larger and heavier than necessary for smaller, lower-pressure wells.
- Ensure that MSAs and bridging documents accurately reflect the roles and responsibilities assumed by each party.

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) and (2).

The BSEE Region Director for the Gulf of Mexico (GOM) OCS convened a panel (BSEE Panel) by memorandum dated March 28, 2022, to investigate the incident that occurred at Main Pass (MP) Block 64 Well #19 on March 25, 2022. The BSEE Panel members were:

- Frank Musacchia – Accident Investigator, New Orleans District, GOM Region.
- James Holmes – Special Investigator, Safety and Incident Investigations Division, BSEE Headquarters.
- Stephen Harris[1] – Petroleum Engineer, Office of Incident Investigations, GOM Region.
- Su Ho – Civil Engineer, Office of Structural and Technical Support, GOM Region.

LEASE & PLATFORM

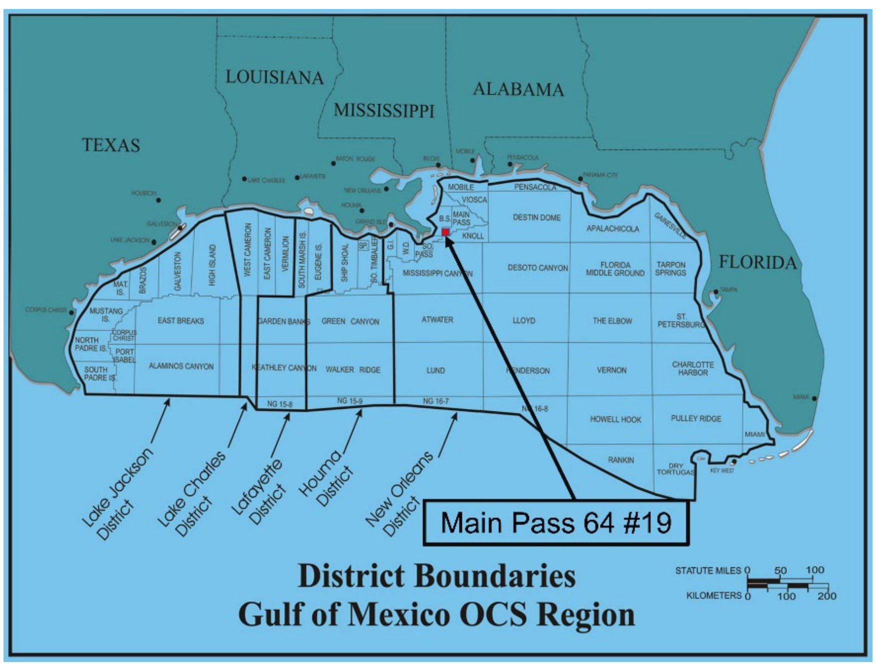

Figure 1: Main Pass 64 #19 Location

[1] Panel Chair

The incident occurred at MP 64 #19, OCS Lease G-04909, which consists of approximately 4,988 acres. The lease is approximately five miles from the coast of Louisiana (Figure 1). Sanare Energy Partners (Sanare) became the designated lessee in 2019 with 100% working interest.

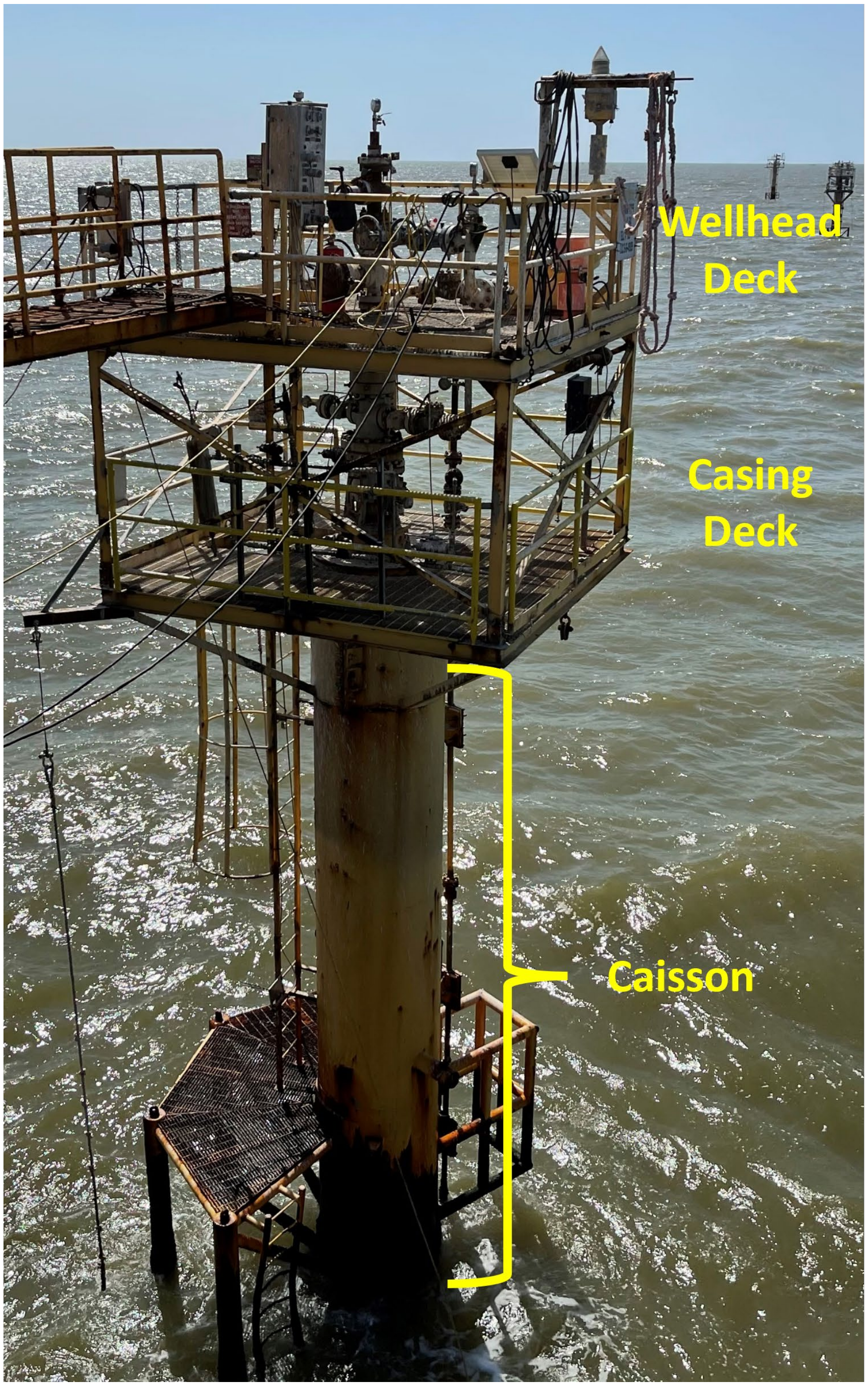

Figure 2: View of Main Pass 64 #19 Platform from L/B Swordfish Pre-Incident

MP 64 #19, shown in Figure 2, is a single well caisson structure with a water depth of 36 feet. Howell Petroleum Corporation installed the platform in 1991. The platform consisted of a wellhead deck and casing deck (Figure 2).

COMPANIES

Sanare was the designated operator of, and 100% owner of the working interest in, the MP 64 #19 platform at the time of the incident. As the designated operator, Sanare planned and implemented any operations on the structure.

SBS Energy Services (SBS) is a service company that specializes in hydraulic workover, snubbing, and coiled tubing operations. SBS was contracted by Sanare to conduct tubing change operations on the well using a hydraulic workover unit (HWU).

All Coast is a liftboat company that provided the liftboat (L/B) *Swordfish* for use during the operations at MP 64 #19.

Hardy Oilfield Services (HOS) provided a specialized guy system used to add stability to the HWU.

Fastorq is the company that was contracted to handle torquing the nuts on the HWU during its assembly (makeup).

BSEE INVESTIGATION

BACKGROUND

Sanare's "Change out Tubing Procedure" states, "[t]he primary objective of this procedure is to clean out the tubing of any paraffin or obstructions restricting access and/or flow downhole. Once the tubing is clear, pull redress, & rerun [gas lift valves] # 8 & 9, then the well will be acidized."

The SBS crew worked in two 12-hour shifts: day and night. The day crew worked from 0600 hours to 1800 hours, while the night crew worked from 1800 hours to 0600 hours.

TIMELINE OF EVENTS

March 20, 2022: the L/B *Swordfish* left the dock in transit to MP 64 #19, arriving that afternoon.

March 21, 2022: the L/B *Swordfish* was jacked up to working height and personnel boarded the liftboat along with welding equipment from M/V *Annette Adams*. Welders welded pad eyes to the four corners of the top deck of the platform for the Anchor Spool anchor points.

March 22, 2022: at approximately 1000 hours, Fastorq personnel started the production tree removal operations. At approximately 1500 hours, the day crew made up an adaptor riser spool along with a single pipe ram, flow cross, and double pipe ram to the wellhead (Figure 3). That morning, SBS personnel noticed that the locations on the platform I-beams where the pad eyes were welded needed to be reinforced due to metal loss from corrosion. The welders were called back out to add material to the corners of the platform's I-beams to strengthen the sites where pad eyes were welded. At approximately 1800 hours, a construction crew began installing scaffolding around the blowout preventer (BOP). The scaffolding work was shut down due to weather from approximately 2030 hours that day to 0030 hours the next morning.

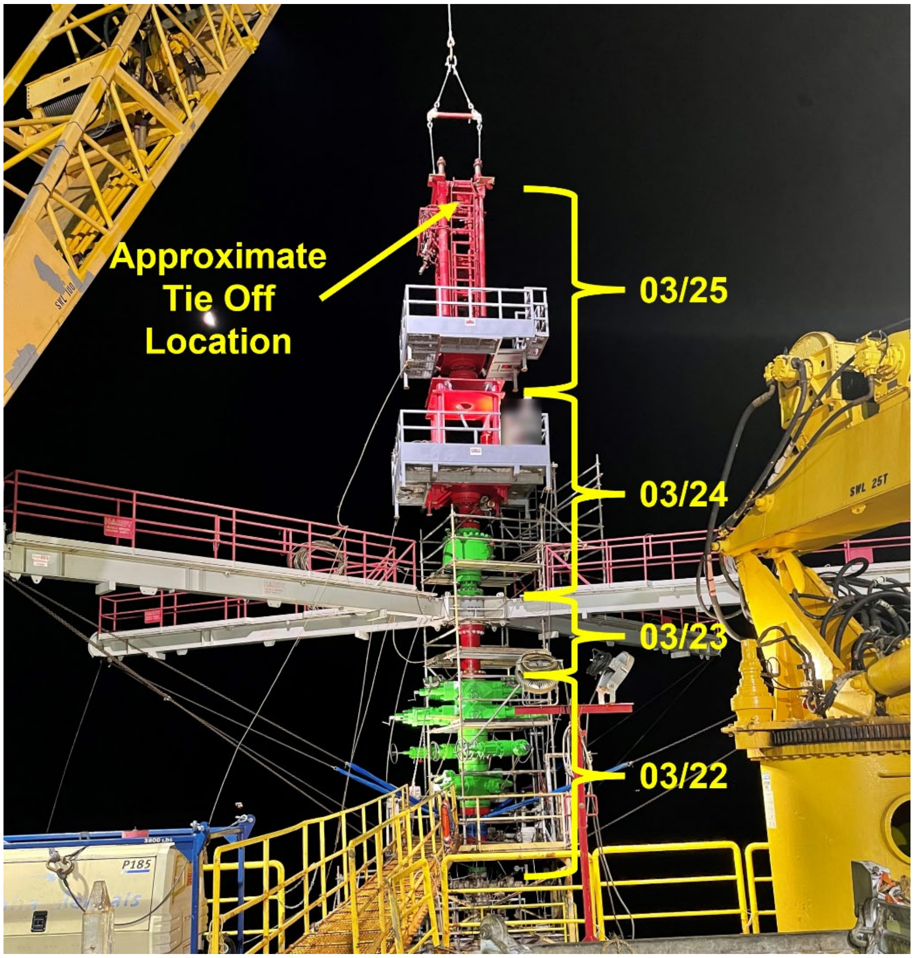

Figure 3: HWU Makeup Process by Day

March 23, 2022: the construction crew continued to build scaffolding around the BOP in the early morning. At approximately 0300 hours, the night crew mounted the Anchor Spool to a 4-foot riser spool which was then made up on the BOP. Fastorq personnel torqued bolts on the BOP and completed torquing at approximately 1000 hours. During that time, the welders arrived on location. After the Anchor Spool and riser were installed, the welders began to strengthen the corners where the pad eyes were installed, which took the rest of the day.

March 24, 2022: at approximately 0100 hours, the welders had completed strengthening corners and began to backload their equipment to a motor vessel. At approximately 0500 hours, installation of the first Anchor Spool beam began and was completed by the night crew before the morning safety/handover meeting. After the morning safety/handover meeting, the day crew finished installing the remaining three beams and secured the guy lines from the beams to the corner pad eyes by approximately 1200 hours. A guy line is a tensioned cable, chain, rope, etc. attached from a free-standing structure to a firm location, such as a fixed platform, to add stability to the structure.

The day crew continued to secure and level the HWU. At approximately 1730 hours, a safety/handover meeting was held for the night crew. The night crew installed the annular preventer and bell nipple onto the Anchor Spool. Subsequently, Fastorq personnel torqued the annular preventer flanges. At approximately 2230 hours, the night crew made up the work window and lower work basket, then installed them on the BOP stack. After installation, the night crew hammered the connection between the work window and annular preventer.

March 25, 2022: from approximately 0015 to 0030 hours, work ceased due to wind speeds in excess of 40 miles per hour (mph). Night crew personnel installed the upper work basket to the pipe jack on the liftboat deck at approximately 0430 hours. They then used the crane to make up the upper work basket and pipe jack to the work window, ending at approximately 0530 hours. After installation of the pipe jack, the crane, holding approximately 8,000 pounds, remained rigged up to the pipe jack.

At approximately 0600 hours, a safety/handover meeting for the day crew was held. After the meeting, the day crew installed guy lines from the work basket and the jack back to the anchor beams. At approximately 0830 hours, after installing the guy lines from the pipe jack to the anchor beams, the victim unshackled the crane rigging from the pipe jack. At this time, wind speeds were 13 to 21 mph. Within a few minutes, as the crane moved away from the HWU, the unit began to sway and fell into the water (Figure 4). The victim was wearing fall protection that was secured near the top of the HWU and was still tied off when it fell, pulling him down into the water.

Figure 4: HWU After Falling into the GOM

March 26, 2022: a diver recovered the victim from the water; he was found still tied off to the HWU.

EQUIPMENT

SBS was installing its hydraulic workover and snubbing signature 340k unit. The 340k denotes that the maximum pull capacity of the pipe jack is 340,000 pounds. The pressure ratings of BOP system components are identified as 5M, 10M, or 15M, and these ratings correspond to 5,000 psi, 10,000 psi, and 15,000 psi, respectively. The BOP system in use at the time of the incident consisted of an 11-inch 10M lower pipe ram, a flow cross, a double blind/shear ram, an 11-inch 5M annular preventer, and assorted adaptor/spacer spools (Figure 5). An adaptor spool was used to make up the 11-inch 10M lower pipe ram to the 7-1/16-inch 5M wellhead. The rig up of the HWU in this incident used a piece of equipment from HOS called the Anchor Spool. The Anchor Spool was located between the double blind/shear ram and the annular preventer. The total weight of the equipment on the wellhead, axial load, at the time of the incident was approximately 120,000 pounds.

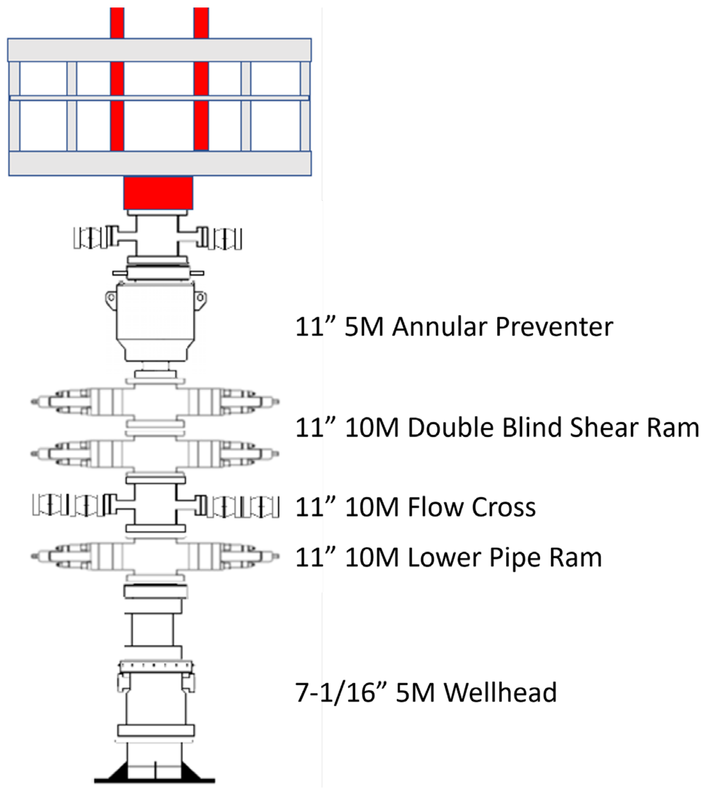

Figure 5: Annotated BOP Stack Diagram

The presentation given to Sanare and SBS by HSO states that the purpose of the Anchor Spool is to “solv[e] one of the Hydraulic Workover Unit’s most prevalent problems when rigging up on small facilities: [h]aving anchor points to safely stabilize the HWU.” To stabilize an HWU from horizontal forces such as wind which causes a bending load on the wellhead, an HWU is usually tied down to anchor points away from the wellhead with guy lines. On larger platforms, the guy lines attached to the HWU can be secured directly to the platform. On single well caisson platforms with a small footprint like MP 64 #19, however, metal beams have historically been welded to the caisson to provide anchor points away from the well. To obtain this effect, the Anchor Spool system uses a spool piece rigged up in the HWU stack to which beams are attached, as seen in Figure 6. Guy lines attached to the HWU above the Anchor Spool connect to the beams, and then the ends of those beams have guy lines fixed to the platform. The sole purpose of this system is to stabilize the HWU, not to support its weight.

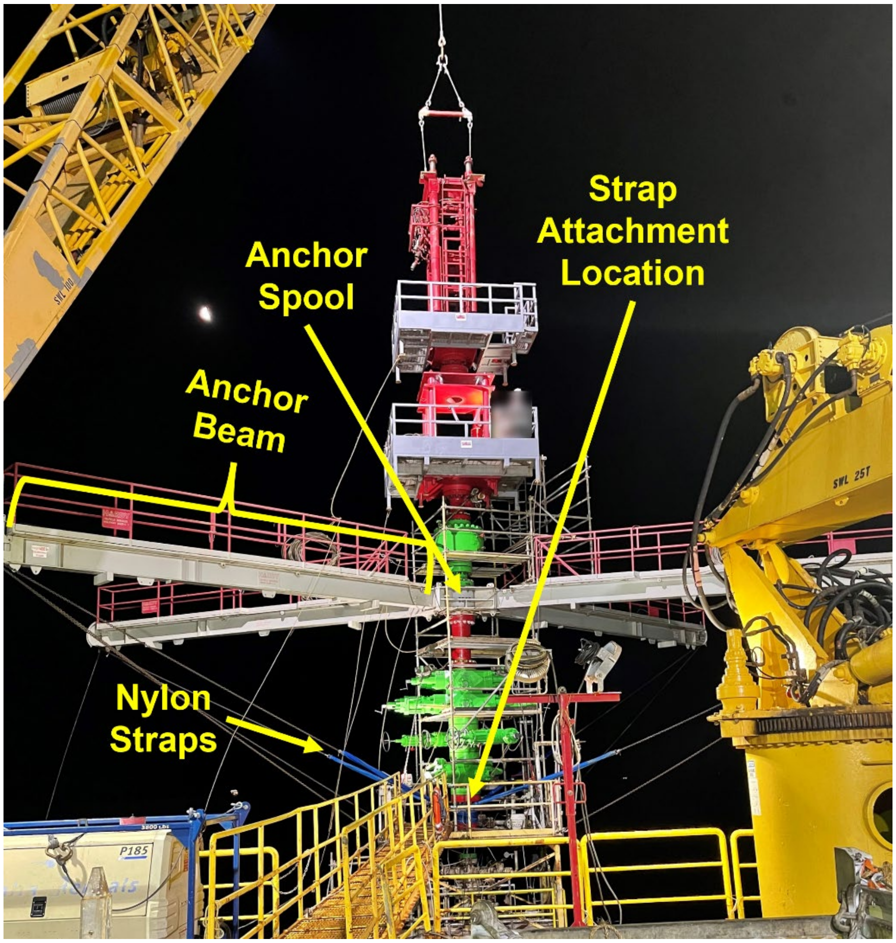

Figure 6: Annotated HWU Showing Nylon Strap Location

At MP 64 #19, the guy lines were connected to the four corners of the platform's top deck where pad eyes were installed, as described in the Timeline of Events section. The day crew supervisor stated in his interview that he noticed the HWU still had some sway even after they had installed most of the HWU. Though other personnel did not note anything of concern, the supervisor contacted HOS management to discuss what options he had to bolster the guy system. HOS management told the day crew supervisor that he could use the nylon straps provided in the equipment box to add additional anchor points, but the locations of those additional anchor points were not discussed. The supervisor decided that the additional guy lines would be attached to the spacer spool installed on the wellhead. This location did not provide additional security for the sway of the HWU since the nylon straps were attached to the HWU structure itself and not an independent structure such as the platform.

The Anchor Spool system weighed approximately 32,000 pounds and comprised roughly one quarter of the weight placed on the wellhead and structural casing.

WELL AND PLATFORM

Figure 7: Annotated Elements of the Wellhead and Platform (Right Photo Taken from the L/B Swordfish)

The MP 64 #19 platform structure was affixed to the 48-inch caisson seen in Figure 7. Within the 48-inch caisson is the 20-inch drive pipe (structural casing) with a half-inch thickness when originally installed. To prevent debris from entering the annulus between the 48-inch caisson and 20-inch structural casing, a trash cap was installed on top of the caisson. The structural casing rises a few inches above the top of the trash cap, with the rocket launcher sitting on top of the structural casing. The rocket launcher base plate was approximately 28-inch in diameter. The 10-3/4-inch casing can be seen in the window of the rocket launcher. Inside the 10-3/4-inch casing is the 7-5/8-inch casing and the tubing. The weight placed on the wellhead is held up by the structural casing. BSEE found no evidence that the rocket launcher was welded to the structural casing, which allowed the wellhead to move.

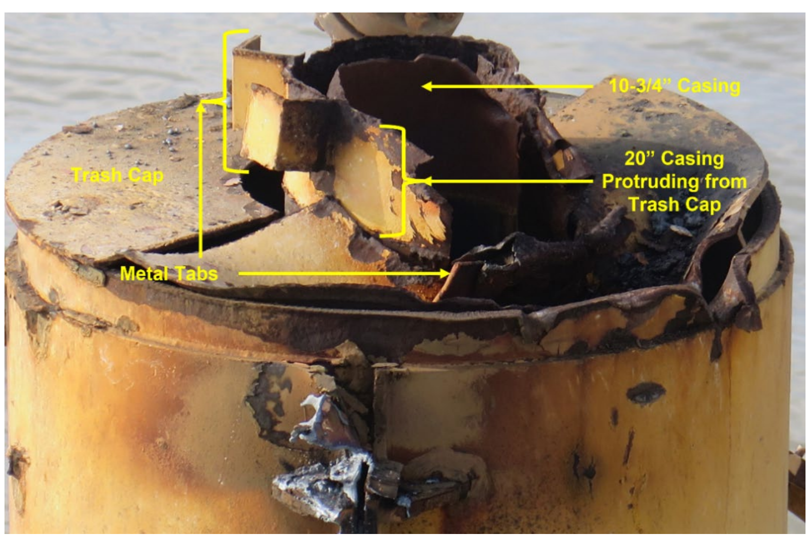

Figure 8: Annotated Casing After Site Clearance

There was no evidence that there were centralizers inside of the structural casing to keep the 10-3/4-inch casing appropriately centralized. Photographs show there were metal tabs attached to the structural casing where it protruded from the trash cap (Figure 8). However, those tabs were only welded to the structural casing, and BSEE did not observe evidence that the tabs were welded to the rocket launcher base plate (Figure 9).

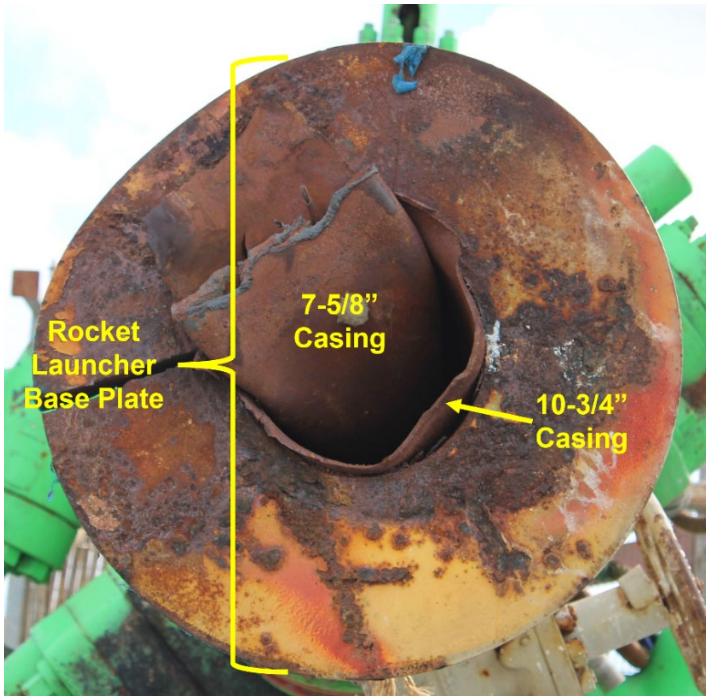

Figure 9: Bottom of Rocket Launcher Base Plate Post-Incident

Without mechanical centralizers, the 10-3/4-inch casing would have been free to move around in the structural casing. By extension, since the rocket launcher was not welded to the structural casing, the rocket launcher could move on the structural casing. This also means that while rigging up the HWU, the SBS crew needed to pay special attention that the rocket launcher was centralized on the structural casing. If the rocket launcher is not centralized on the structural casing, the ability of the structural casing to handle the load placed upon it can be compromised.

Figure 10: 10-3/4-inch Casing in Rocket Launcher from Top (Left) and Bottom (Right)

The rocket launcher sat on top of the structural casing but did not appear to have been welded to the metal tabs on the structural casing or the structural casing itself. Without the rocket launcher being mechanically fastened to the structural casing, the structural casing cannot provide substantial aid in counteracting the bending moment produced if the HWU leans. As such, much of the bending moment created at the rocket launcher-structural casing interface would not be taken by the structural casing, but rather by the 10-3/4-inch casing. This is because the rocket launcher base plate is surrounding the 10-3/4-inch casing. BSEE investigators observed severe corrosion on the 10-3/4-inch casing where it passed through the base plate of the rocket launcher (Figure 10).

Figure 11: Corroded 20-inch Structural Casing After Recovery (Left) and After Cleaning for Thickness Measurements (Right)

While inspecting the structural casing after recovery (Figure 11), BSEE investigators observed the degradation due to corrosion on the structural casing below the trash cap. The scaling and holes indicate a severe level of corrosion prior to the incident. When originally installed, the structural casing was one half-inch thick. The thickness of the recovered structural casing ranged from zero inches, where the holes are located, to just below one-half inch. Figure 12 shows the various measurements, in inches, of the structural casing's thickness taken in a grid by ultrasonic thickness (UT) measurement. Multiple areas in the upper portion of the structural casing contained holes or heavy thinning. Note 1, highlighted in red, shows the grids that have holes present. Highlighted in yellow are all the grids that had a thickness of less than one quarter inch, which is half of the original thickness of the structural casing. Some grids could not be measured due to the curvature of the material (Note 2) or no material being present (Note 3). Rows 14, 15, and 16 corresponds to the direction that the HWU fell toward.

	A	B	C	D	E	F	G	H	I	
1	LONGITUDINAL WELD SEAM									1
2	0.344	0.294	0.287	0.126	0.177	0.184	0.117	0.183	0.254	2
3	0.285	Note 1	0.248	Note 1	0.187	Note 1	0.251	0.140	0.176	3
4	0.154	Note 1	Note 1	Note 1	Note 1	Note 1	0.161	0.191	0.202	4
5	0.224	0.143	0.257	0.109	0.179	0.128	0.237	0.407	0.271	5
6	0.327	0.172	0.287	0.247	0.217	0.175	0.347	Note 2	Note 2	6
7	0.322	0.285	0.384	0.338	0.355	0.330	0.353	0.441	0.433	7
8	0.393	0.313	0.352	0.389	0.375	0.412	0.440	0.430	0.393	8
9	0.371	0.397	0.338	0.385	0.374	0.391	0.363	0.443	Note 2	9
10	0.491	0.390	0.374	0.397	0.355	0.401	0.389	0.370	0.387	10
11	0.221	0.224	0.366	0.300	0.341	0.353	0.322	0.266	0.384	11
12	0.332	0.374	0.351	0.200	0.380	Note 1	Note 1	0.326	Note 3	12
13	0.305	0.190 (Note 1)	0.318	0.281	0.188	0.290	Note 2	Note 3	Note 3	13
14	0.275	Note 1	Note 1	Note 1	Note 1	Note 1	Note 1	Note 3	Note 3	14
15	0.156 (Note 1)	0.233	Note 1	Note 1	Note 3	Note 3	Note 3	Note 3	Note 3	15
16	0.151	0.245	Note 1	0.173	Note 2	Note 2	Note 3	Note 3	Note 3	16
17	0.128	Note 2	Note 1	Note 1	0.177	0.243	Note 1	Note 2	Note 3	17
18	0.234	0.233	Note 2	Note 2	Note 2	Note 2	Note 2	0.223	0.183	18
19	Note 1	0.177	Note 1	0.271	0.256	0.233	Note 2	0.198	0.205	19
20	Note 2	0.198	Note 1	Note 1	Note 2	Note 2	Note 2	Note 2	Note 2	20
21	0.205	0.113	0.209	0.206	Note 1	Note 1	Note 2	Note 2	Note 2	21
	A	B	C	D	E	F	G	H	I	

Note 1: Hole present in grid square
Note 2: No measurement conducted in grid square
Note 3: No available marking area.

Figure 12: 20-inch Structural Casing Gridded Thickness Measurements in Inches

Approximately 120,000 pounds of equipment was placed on top of this severely degraded structural casing. Figure 13 shows where the structural casing buckled under the load. When the structural casing buckled, the 10-3/4-inch casing would have been the main element keeping the HWU from toppling. However, the 10-3/4-inch casing broke, and the 7-5/8-inch casing and the tubing inside bent when the HWU fell. The buckling occurred subsequent to the crane allowing the full HWU weight to transfer to the structural casing, which could no longer hold the HWU upright due to the unsteady foundation.

Figure 13: Buckled 20-inch Structural Casing After Recovery (Left) and After Cleaning for Thickness Measurements (Right)

OPERATION PLANNING

In BSEE interviews with Sanare management responsible for planning the operation, Sanare stated SBS was hired to complete the work, and thus to advise the proper way to complete the operation. When asked if any personnel from Sanare had conducted any analysis for suitability of the HWU being placed on the well, they responded that they did not know of any. Furthermore, BSEE inspectors did not find evidence that a wellhead integrity analysis or load analysis was conducted by either Sanare or SBS. Sanare personnel who planned the job had experience with conducting HWU operations on larger platforms where the HWU can be supported by the platform structure with the aid of support beams; however, these personnel stated that this was their first operation on a single well caisson.

The BSEE Panel reviewed the bridging agreement and master service agreement (MSA) between Sanare and SBS. A bridging agreement in general defines whose policies and safe work practices will be used. An MSA is an agreement between two parties that details the expectations of both parties during services rendered. Neither of these documents details an expectation from either Sanare or SBS to evaluate the ability of the well structure to handle the equipment load placed upon it.

Based on BSEE's review of emails and interviews, Sanare selected the equipment it used before any job-specific site survey was conducted. BSEE requested Sanare provide documentation to show how and why the equipment used was selected. Sanare only provided the bid from SBS and a statement that the day rate for SBS's equipment was less than the cost of a jack-up rig. No other response was provided.

SBS did conduct a site survey at the location; however, this survey only consisted of taking photographs of the location. SBS management stated that the survey they conducted was for equipment spacing and not to ensure the integrity of the wellhead. When asked to explain why it did not conduct any integrity checks or wellhead analysis, SBS stated that it just supplies the equipment and that Sanare is responsible for ensuring that the equipment can be used safely on its wellhead. SBS management stated they did ask Sanare if it had a recent Level I Survey, which Sanare did provide to SBS. However, a Level I Survey is a visual inspection of corrosion levels and would not have revealed issues concerning the integrity of the structural casing since the structural casing was mostly covered by the caisson trash cap.

After the site survey by SBS, an internal Sanare email stated SBS management communicated the "caissons looked fine, but we will need the Anchor Spool." Based on the interviews with Sanare management, they understood this to mean that SBS was making a statement on the suitability to conduct this operation with the equipment SBS had quoted. SBS management stated in an interview that decisions about what goes on top of Sanare's wells are made by Sanare and that SBS provides options. SBS management also conveyed to the BSEE Panel that they do not typically conduct an engineering survey on wells before rigging up, except on specific land jobs.

Visual observation below the trash cap prior to the operation would have shown the degraded state of the structural casing. This action, however, is not common during planning for this type of scenario and operation in the GOM. Many of the persons interviewed during the investigation indicated that the question of whether the wellhead could hold the equipment did not occur to them. Therefore, an operation such as removing a trash cap to observe the structural casing never arose. However, the presentation given to Sanare and SBS by HOS about the Anchor Spool states "[s]pecific calculations on flange sizes and integrity checks for corrosion etc. on the equipment below the Anchor Spool are required prior to each job."

In the Anchor Spool presentation, the word "support" was used multiple times to refer to the anchor beams as support beams. During the interview with the Sanare manager who wrote the procedure for the workover operation, BSEE asked if he understood the purpose of the Anchor Spool system, to which he responded, to provide "structural support for the rest of the hydraulic workover unit." Later in the interview, BSEE asked the manager what SBS would be looking for during their site surveys. He stated "basically, where they're [going to] tie on to the structure to provide support for the hydraulic workover unit." BSEE then asked the Sanare manager more specifically whether he was referring to axial load support or wind load support. He responded, "I think it's kind of yes to all the above" and followed up by stating, "I mean I'm not an expert on that, so I can't really say." Although the introduction in the presentation says the purpose of the equipment is to "hav[e] anchor points to safely stabilize the HWU," the use of the word "support" in the presentation can be interpreted to mean that the Anchor Spool does more than stabilize the HWU by providing support for the weight. This may have led to a misunderstanding by Sanare personnel planning the operation that the wellhead was not taking the full weight of the HWU equipment, especially since Sanare management had no experience rigging up on single well caissons, according to their interviews.

Other Considerations

The HWU consisted of an assortment of different sizes and rated components. The upper flange that the HWU connected to was a 7-inch 5M flange. However, a BOP system consisting of an 11-inch 10M single ram, a flow cross, a double ram, and associated adapter flanges was used. Since this workover operation was part of a workover campaign involving multiple wells, a larger BOP was used to accommodate the needs of other wells. Though having an oversized BOP is not uncommon, the weight difference, especially due to the pressure rating, can vary widely. The overrated and oversized BOP system weighed more than the BOP system that was required to be placed on this well.

Multiple times during the rig-up process, work was paused due to weather conditions. High wind speeds not only act on the HWU by causing side loading, but also create wave action that acts on the caisson, causing the caisson to move. Since the platform is attached to the caisson and the Anchor Spool is guyed to the platform, this movement is transferred to the HWU. These factors add bending loads to components responsible for keeping the HWU upright, such as the structural casing.

The "MMS Structural Permit Application for Caisson No. 19" states the maximum axial load on the caisson before causing further penetration into sediment is 98,000 pounds. This document shows the maximum axial load was calculated with a safety factor of two. The weight of the fully built HWU and tubing would have created an approximately 180,000-pound load before dynamic loading is considered. This shows that transferring the full load to the caisson could have also caused an unsafe situation.

CONCLUSIONS

The following conclusions were based upon the totality of the information provided to, and received by, the BSEE Panel during its investigation into the March 25, 2022, fatal incident.

PROBABLE CAUSES

BSEE defines probable causes as 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 existence of the cause and the degree of its contribution to the incident. The BSEE Panel identified the following as probable causes of the incident:

- The 20-inch structural casing could not sustain the forces applied.
    - The structural casing was severely corroded to the point of having many holes.
    - The rocket launcher was not attached to the structural casing and, therefore, did not aid in stability.
    - The structural casing buckled under the approximately 120,000-pound load within minutes after the crane was unlatched from the HWU.
- Sanare did not ensure the structural integrity of the system upon which the HWU was placed.
    - The personnel that selected the equipment did not have experience using an HWU on a single well caisson.
    - No examination of the structural casing below the caisson trash cap was conducted, leaving the poor condition of the structural casing unknown.
    - No consideration was given to axial and bending loads applied to the wellhead and structural casing system. The structural casing was the sole element supporting axial loads; however, because the structural casing was not welded to the rocket launcher, it did not play a significant role in the bending loads.

CONTRIBUTING CAUSES

BSEE defines contributing causes as 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 probable causes. The BSEE Panel identified the following as contributing causes of the incident:

- Sanare failed to consider all safety ramifications when choosing equipment for the operation.
    - BSEE found no evidence that Sanare considered the type of equipment and its loading effects on the well when it selected SBS as its contractor.

- The MSA lacked details regarding the performance of duty expectations of both the operator and the contractor.
    - Sanare believed that SBS ensured that the HWU could safely perform the operation without verifying that any analysis was conducted by SBS.
    - SBS did not verify that Sanare analyzed the safety of installing the HWU on the well.

CONTRIBUTING FACTORS

- High winds and sea conditions over time may have exacerbated the mechanical failure of the structural casing by causing stresses to the structural casing while supporting the HWU.
- The guy lines above the Anchor Spool were not completely installed at the time of the incident, so the Anchor Spool could not fully stabilize the HWU.

NOTE: These conclusions are based on the information available to the BSEE Panel at the time of writing. Sanare had not completed their investigation at the time BSEE's investigation concluded.

RECOMMENDATIONS

The BSEE Panel makes the following recommendations to industry following its investigative findings detailed within this report to further promote safety and prevent a recurrence of the same or similar event, protect the environment, and conserve resources on the U.S. Outer Continental Shelf (OCS):

- Conduct a structural analysis that involves an assessment of the wellhead and the casing system's condition to ensure the HWU's weight can be supported.
    - The structural casing should be analyzed as a structural element when supporting an HWU, as when a platform's structure is supporting an HWU.
    - Determine the structural capability of the casing system, including for potential loads and conditions of loading. Then select, install, and use the equipment capable of withstanding these loads and conditions.
- Ensure the workover equipment is suitable for the wellhead and casing system upon which the workover equipment is being placed.
    - Operators should determine whether a well's design is adequate to handle all potential loads and conditions of loading, such as axial and bending loads that could be encountered during an operation where equipment is put on top of a well.
    - When deciding the acceptable loading on a well, operators should consider the age of a well and how degradation from exposure, such as corrosion and fatigue, will decrease the well's structural integrity.

- Be cautious when conducting workover campaigns at multiple facilities. Choosing equipment for the maximum size and rating needed for the campaign may result in equipment that is larger and heavier than necessary for smaller, lower pressure wells.
    - Even if it is possible to install the equipment on the well, the larger equipment may be oversized for the smallest well.
- Ensure that MSAs and bridging documents accurately reflect the roles and responsibilities assumed by each party.