

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF SAFETY AND ENVIRONMENTAL ENFORCEMENT
GULF OF MEXICO REGION

ACCIDENT INVESTIGATION REPORT

For Public Release

1. OCCURRED

DATE: 08-NOV-2017 TIME: 0120 HOURS

2. OPERATOR: Shell Offshore Inc.

REPRESENTATIVE:
TELEPHONE:

CONTRACTOR:
REPRESENTATIVE:
TELEPHONE:

- STRUCTURAL DAMAGE
- CRANE
- OTHER LIFTING
- DAMAGED/DISABLED SAFETY SYS.
- INCIDENT >\$25K **Fire Damage**
- H2S/15MIN./20PPM
- REQUIRED MUSTER
- SHUTDOWN FROM GAS RELEASE
- OTHER **Platform Evacuation**

3. OPERATOR/CONTRACTOR REPRESENTATIVE/SUPERVISOR ON SITE AT TIME OF INCIDENT: 8. OPERATION:

4. LEASE: G11445

AREA: GB LATITUDE:
BLOCK: 128 LONGITUDE:

5. PLATFORM: A-Enchilada
RIG NAME:

- PRODUCTION
- DRILLING
- WORKOVER
- COMPLETION
- HELICOPTER
- MOTOR VESSEL
- PIPELINE SEGMENT NO.
- OTHER

6. ACTIVITY: EXPLORATION(POE)
 DEVELOPMENT/PRODUCTION (DOCD/POD)

7. TYPE:

- HISTORIC INJURY
- REQUIRED EVACUATION 2
- LTA (1-3 days) 1
- LTA (>3 days) 1
- RW/JT (1-3 days)
- RW/JT (>3 days)
- Other Injury

- FATALITY
- POLLUTION
- FIRE
- EXPLOSION

- LWC
- HISTORIC BLOWOUT
 - UNDERGROUND
 - SURFACE
 - DEVERTER
 - SURFACE EQUIPMENT FAILURE OR PROCEDURES

COLLISION HISTORIC >\$25K <=\$25K

9. CAUSE:

- EQUIPMENT FAILURE
- HUMAN ERROR
- EXTERNAL DAMAGE
- SLIP/TRIP/FALL
- WEATHER RELATED
- LEAK
- UPSET H2O TREATING
- OVERBOARD DRILLING FLUID
- OTHER _____

- 10. WATER DEPTH: 705 FT.
- 11. DISTANCE FROM SHORE: 102 MI.
- 12. WIND DIRECTION:
SPEED: M.P.H.
- 13. CURRENT DIRECTION:
SPEED: M.P.H.
- 14. SEA STATE: FT.
- 15. PICTURES TAKEN:
- 16. STATEMENT TAKEN:

17. INVESTIGATION FINDINGS:

On November 8, 2017 at approximately 1:18 a.m., an explosion occurred in the vicinity of the 30-inch sales gas pipeline pig launcher (PL) on the Garden Banks (GB) Block 128 "A" (Enchilada) platform, owned and operated by Shell Offshore, Inc. (SOI). At the time of the explosion, two operators were preparing to launch a pig through the 30-inch sales gas pipeline. One operator (OP-1) sustained a concussion, back injuries, and second degree burn injuries. The other operator (OP-2) suffered minor injuries. Both operators were evacuated to Galveston, TX for medical treatment. Following the explosion, a fire ensued, causing the evacuation of the platform. SOI reported no pollution associated with the incident.

The Exclusive Right-of-Use (EROU) agreement between the 30-inch sales gas pipeline operator (Enbridge) and SOI described the responsibilities incumbent upon Enbridge and SOI. Enbridge facilities included the 30-inch sales gas PL, the 30-inch departing sales gas pipeline and riser, and interconnecting piping (ICP), cables, instrumentation, controls, drains and valves associated with the operation of the 30-inch sales gas pipeline. SOI was responsible for "routine operations," including general site upkeep of Enbridge facilities; operating, maintaining and performing minor repairs to Enbridge facilities; conducting routine inspections of Enbridge facilities; launching and receiving pipeline pigs at the direction of Enbridge; and notifying Enbridge of any major repairs or maintenance identified while conducting routine operations.

The night shift during which the incident occurred began at 6:00 p.m. on November 7, 2017. OP-1 and OP-2 were the only operators on shift at the time of the incident, and no other work crews were performing work other than two support services personnel, who remained in the Main Deck Quarters Buildings. SOI normally has three operators on duty during the night shift at Enchilada, but the third operator departed Enchilada early to attend training onshore. During the evening meeting, the Operations Supervisor stated that he discussed, among other things, the task of loading the PL. During the first portion of the shift, the operators conducted routine checks, which included loading the 30-inch pig onto the carrier.

At approximately midnight, OP-1 went to the PL to begin loading the pig. Since they were the only personnel performing operations work during this shift, they did not flag off the area around the PL. OP-1 proceeded to isolate the pressure safety low on the PL (tag number PSL-9132). OP-1 then attempted to operate the pigging valve (tag number HCV-9131) and the "kicker" valve (tag number SDV-9133), and they did not operate, indicating successful isolation of PSL-9132. OP-1 did not place PSL-9132 back into service at this time, in accordance with SOI's approved operating procedure.

OP-1 then proceeded to verify the status of the following valves, indicated by tag numbers and position: SDV-9132 - opened, SDV-9133 - closed, and HCV-9131 - closed. OP-1 stated that he also secured the air supply for pneumatic relays for SDV-9133 and HCV-9131 by closing the manual ball valves on the 1/2 -inch air control lines. In addition, OP-1 stated that he verified the following valves were closed: the 2-inch primary and secondary bypass valves, the 2-inch flare valve, the 3/4-inch trap drain valves, and the 1/2-inch vent valve. OP-1 did not lockout/tagout (LO/TO) any of these valves.

At 12:02 a.m. on November 8, 2017, OP-1 opened the 2-inch flare valve in order to bleed the PL. OP-1 closed the valve at 12:13 a.m., with zero pounds per square inch (psi) indicated on the PL pressure gauge. Upon opening the 1/2-inch vent valve and the 3/4-inch trap drain valves, OP-1 discovered that gas was coming out of the drain, indicating that the PL was not properly isolated from the sales gas. OP-1 closed the valves, stopped work, and notified OP-2 to assist. After OP-2 arrived, OP-1 proceeded

to the control room to perform unrelated tasks, while OP-2 remained in the area to continue the procedure.

In an attempt to achieve positive isolation, OP-2 cycled HCV-9131 open and closed. At 12:23 a.m., OP-2 opened the 2-inch flare line to bleed the PL, but was unable to achieve positive isolation. After two subsequent attempts, OP-2 was able to obtain a positive seal on HCV-9131 at 1:00 a.m., and closed the 2-inch flare valve. OP-2 notified OP-1 that he was ready to open the PL closure door. OP-1 was in the control room, and began monitoring the gas detector (tag number ASH-RX-E1-1). OP-2 proceeded to open the PL closure door and notified OP-1 that the pig was ready to be loaded. OP-1 proceeded to the job site and assisted OP-2 with loading the pig into the PL.

Once the pig was loaded into the PL, OP-1 operated the side ratchet to tighten the PL closure door and OP-2 operated the top ratchet which was supposed to secure the clamp around the edge of the PL closure. After actuating the top ratchet, OP-2 stated that he inserted the pressure warning lock (bleed pin). Neither OP-1 nor OP-2 stated that they conducted a visual inspection to ensure the clamp ring was properly secured. OP-1 then proceeded to the 2-inch flare valve, and OP-2 proceeded to the 2-inch globe valve. At 1:17 a.m., OP-2 introduced pressure into the PL by slightly opening the 2-inch globe valve, and OP-1 noted the increasing pressure on the PL pressure gauge.

After noting approximately 300 psi on the PL pressure gauge, OP-1 began closing the 2-inch flare valve. Shortly thereafter, both operators heard a "snap" coming from the direction of the PL closure. The "snap" sound was followed immediately by an explosion, which occurred at 1:18 a.m. The PL closure door was propelled off of the facility, in addition to other items, including a junction box and a section of handrail. Following the explosion, a fire began on the east side of the PL and propagated back to the PL closure, as indicated in video documentation.

Both operators stated that they were blown to the deck after the explosion. They also stated that they observed a "fireball" overhead after the explosion. Both operators managed to make their way over to the Auxiliary Control Center (Aux MCC) as a muster point. Once in the Aux MCC, OP-2 contacted the operator shore base and advised them that the "trap door blew off," and to "shut everyone else in." OP-2 then attempted to communicate with the Operations Supervisor on the radios and Gaitronics system, with no response. Eventually, OP-1 was able to talk to the Operations Supervisor, who told them to make their way over to the life boat, located at the southeast corner of the platform. All 46 personnel safely evacuated the platform and proceeded to a nearby platform.

After evacuation, the flame continued, and was continuously fed by natural gas from the pipeline. Initially, the flame protruded from the PL closure in a "J" shape, extending horizontally approximately 25 feet and vertically approximately 105 feet. No video or photo documentation was available from the time of the incident until 6:00 p.m. on November 8, 2017. At 6:00 p.m., photo documentation shows a three- to five-foot flame protruding from the PL closure. The flame gradually reduced in height, and monitoring vessels reported no visible sign of any flames at 4:00 a.m. on November 9, 2017. During this time period, the pipeline pressure (measured downstream of the 30-inch departing pipeline flow safety valve) reduced from 1025 psi at the time of the incident to 585 psi.

On the afternoon of November 9, 2017, a third-party fire safety team boarded the platform to verify associated valve positions and to ensure that the associated valves were closed. The boarding team reported that the following valves were found in the open position: the 2-inch primary and secondary bypass valves (manual ball valves), the 2-inch globe valve, the 3/4-inch isolation valves, the 30-inch departing valve (HCV-9134), the 2-inch flare valve, and the 2-inch flare shutdown valves (locked

open). The 2-inch globe valve and the 2-inch flare valve are throttling valves, and were found to be partially opened.

These valve positions were consistent with the procedural steps completed at the time of the incident. The boarding team closed all of these valves except HCV-9134; the boarding team stated that they were unable to achieve a completely closed position. Another boarding team closed HCV-9134 on November 10, 2017. On November 11, 2017, SOI confirmed that the platform was sufficiently isolated from the affected gas export pipeline. The BSEE investigation team conducted its initial site visit on November 13, 2017.

The third-party fire safety team who were the first persons to board the platform following the incident also reported that one of the actuated valves was found open, which was not consistent with the procedural steps completed at the time of the incident. This valve, commonly referred to as the "kicker" valve, was tagged as SDV-9133 on the platform Mechanical Flowsheet, but physically tagged as HCV-9133. It was a 12-inch ball valve with a double-acting pneumatic actuator, meaning that the actuator could only function by porting air to either the "opened" or "closed" side of the actuator. According to the SOI approved operating procedure, this valve should have been closed throughout the procedure.

This valve contained two independent position indicators. The first indicator, mounted on top of the actuator, was integral to the actuator. It consisted of a football-shaped position indicator that moved as the actuator moved (parallel to flow direction indicates open, and perpendicular to flow direction indicates closed). The second indicator was an electronic/visual indicator, which not only provided an electronic signal to the safety system logic, but also provided a visual indication of the valve position. However, the fire destroyed the visual element of this indicator, and it was unreadable at the time of the BSEE investigation team site visit.

The alarm history showed that the status of SDV-9133 was "CLOSED" at 1:21 a.m. on November 8, 2017. (NOTE: SDV-9133 is designated for "Operator Use Only" and is not subject to the valve closure times specified by 30 CFR 250.855.) Also, SOI personnel stated that the integral indicator was installed in such a way that it indicated in the opposite direction of the actual valve position. According to SOI, the fire safety team used a keyway for their initial determination instead of using the actual indicator, resulting in the valve being in the opposite position as that determined by the fire safety team. The BSEE investigation team contacted the fire safety team leader, but he declined to be interviewed.

Following the initial report that the "kicker" valve was found in the open position, and that the valve position was determined to be a potential cause of the incident, the BSEE investigation team attempted to determine the different possibilities as to how air pressure was able to actuate the valve from the closed position. From photographs and schematics, the BSEE investigation team located a small ball valve at the end of a segment of tubing attached to one end of the actuator. The ball valve handle indicated that the valve was approximately 30 degrees open. The investigation team was unable to determine the purpose of this valve, other than that it provided a potential air path from the actuator to atmosphere. In an attempt to obtain further information, the BSEE investigation team planned to take more detailed photographs of the tubing associated with the "kicker" valve. However, SOI had disposed of the tubing before the team had the opportunity to document it.

The SOI investigation team provided an analysis of the gas release using several flow and dispersion software models, comparing gas flow through a partly open 2-inch globe valve versus a fully open 12-inch ball valve. The team concluded that the evidence is consistent with gas flowing through a partly open 2-inch globe valve. Using the same

assumptions (effective area through the 2-inch globe valve and calculated mass flow rate exiting the PL), the BSEE investigation team achieved similar results for flame length calculations using American Petroleum Institute (API) Standard 521, Annex C.

The BSEE investigation team also performed flame length calculations through a 12-inch ball valve using vendor test data for valve coefficients. The data provides experimentally-generated valve flow coefficient values versus valve closure angles. The actual test curves range from 10 degrees to 75 degrees, with 0 degrees denoting a fully opened valve. In order to provide sufficient mass flow to produce the flame length observed during the incident, the valve flow coefficient would place it at some point between 75 degrees of closure and full closure.

At the time of the incident, the two night operators were performing the task of "KAH-9310 - Sales Gas 30" Pig Loading." The written operating procedure (OP) was approved by both rotating PICs, and stated the required "Man-hours by craft" at three operators for 45 minutes. Both operators stated that they usually use three personnel, but that the job can be performed with only two operators.

The OP was given a Risk Assessment Matrix (RAM) Rating of "B5," derived from SOI's Permit to Work Matrix. The "B" indicates the likelihood of consequences ("Heard of in Industry"), and the "5" indicates the severity of consequences (highest severity). The "B5" RAM Rating placed this task into the "moderate risk" category, which required the following documentation:

- Permit to Work or Approved Operating Procedure (Include isolation requirements in OP);
- Job Safety Analysis (JSA);
- LO/TO method: Certificate (unless included in the OP).

The OP stated that the only required permits and plans were "Step Sign off Required" and "Drip Tricky Tasks." "Step Sign off Required" indicates that each step is supposed to be signed or initialed by the person who performs that step immediately after the completion of the step, along with the time that the step was completed. "Drip Tricky Task" is simply an advisory that there is the possibility of encountering liquid seepage at some point during the task.

Each step contains a detailed description of the step and "Key Points" describing elements of safety, quality, and critical points. Both operators involved in the task stated that they were using the OP during the task. Neither the BSEE investigation team nor SOI personnel were able to recover the OP used during the task.

The OP provided to the BSEE investigation team included the isolation requirements and the LO/TO requirements. However, there was no indication in the OP that a JSA was required per SOI's Permit to Work (PtW) Matrix. SOI's explanation was that this task was considered to be "routine," and therefore did not require a JSA. The PtW Matrix contains individual activities identified as "exempt," meaning that they do not require any PtW documentation. Pig Loading and Launching is not listed as an exempt activity; in fact, Pig Loading and Launching is specifically identified in the Integrated Job Planning Matrix, with the documentation requirements as listed above.

The BSEE investigation team inquired about maintenance performed on the PL and/or its associated valves and components. Witnesses stated that about one year prior, maintenance was performed on the HCV-9131 valve due to excessive leaking. Contract personnel discovered that the valve would not consistently seal. The valve was neither replaced nor repaired; instead, the procedure was amended in order to ensure that the valve eventually created a seal prior to opening the PL closure door.

The new procedure called for a ten-minute wait period after bleeding the PL barrel

pressure to make sure the valve was holding pressure. If the valve would not hold pressure, then the new procedure stated to "equalize the trap and reactuate HCV-9131 and repeat bleed down." The procedure further stated to repeat this process until a positive isolation was established. SOI has a Management of Change (MOC) process structured to identify, review, and approve changes before they are implemented. The BSEE investigation team received no indication that the MOC process was followed prior to this procedural change being implemented.

The BSEE investigation team reviewed the provided SOI procedure for "KAH-9130 Sales Gas 30-inch Pig Loading," noting the following discrepancies when compared to the actual sequence of events.

1. With the stated objective being to safely load a 30-inch gas pig without risk to personnel or asset, the SOI procedure specifies a total of three (3) operators for the work. In this instance, two operators completed the work. Witness statements indicated that there is usually a third operator working during this shift; however, the third operator ended the hitch early to attend training.
2. SOI categorized this work as "B5" according to its Risk Assessment Matrix (RAM); the "B" indicated a low probability of occurrence (2 out of 5), and the "5" indicated the highest possible severity rating (5 out of 5). Overall, the RAM specified a category of "Moderate" risk. The RAM also specified that this work required an Approved OP, JSA, and LO/TO method. However, the OP provided to the BSEE investigation team did not specify "JSA" or "LO/TO" as a required permit/plan, even though the OP listed multiple instances where valves were supposed to be LO/TO. The work crew did not document a JSA for the work in this instance.
3. Step 4 in the OP stated to "Verify SDV-9132 is opened. Apply LO/TO tag to HLR." The BSEE investigation team received no indication that a LO tag was applied to the SDV-9132 HLR. One of the operators stated that they "just knew it was open."
4. Step 5 in the OP stated to "Verify SDV-9133 is closed. ...apply LO/TO tag to HLR." The BSEE investigation team saw no indication that a LO tag was applied to the SDV-9133 HLR. Also, the SOI procedure deviates from the Enbridge procedure in that the Enbridge procedure requires the air supply to be disconnected, not simply interrupted.
5. Step 6 in the OP stated to "Verify SDV-9131 is closed. ...apply LO/TO tag." The BSEE investigation team saw no indication that a LO tag was applied to SDV-9131, although the team discovered a LO device resting on the valve actuator during its site visit. Also, the SOI procedure deviates from the Enbridge procedure in that the Enbridge procedure requires the air supply to be disconnected, not simply interrupted.
6. Step 7 in the OP stated to verify primary and secondary 2-inch bypass valves...are closed, and to apply LO/TO tags to both valves. The BSEE investigation team saw no indication that any LO tags were applied to either of these valves.
7. Step 8 in the OP stated to "Verify 2" flare valve is closed. Apply LO/TO tag." The BSEE investigation team saw no indication that a LO tag was applied to this valve.
8. Step 9 in the OP stated to "Verify ¾" ball valves are closed. Apply LO/TO tag between valves." The BSEE investigation team saw no indication that a LO tag was applied between these valves.
9. Step 10 in the OP stated to "Verify ½" needle valve on top of launcher is closed. Apply LO/TO tag to valve." The BSEE investigation team saw no indication that a LO tag was applied to this valve.

10. Step 14 of the OP stated the following: "Close 2-inch flare valve. Allow pig trap to sit for 10 minutes. If there is any pressure build up, equalize the trap and re-actuate HCV-9131 and repeat bleed down (Step 12). Repeat 10 minute sit test. Repeat above steps until a positive isolation is established." It further stated the following key point: "If pressure build up persists on multiple sealing surfaces, use Cameron Maintenance Procedure to grease valve." Witnesses stated that this step was implemented approximately one year prior to the incident due to the lack of HCV-9131 to maintain positive isolation. Also witnesses stated that they did not recall using the Cameron Maintenance Procedure.

11. Step 26 of the OP was where the operators were supposed to "close & secure receiver door." The OP listed a process safety advisory, which stated, "When closing the door, use the [side] gear ratchet and do not over tighten. LOOSEN [SIDE] RATCHET WHEN CLAMP IS TIGHTENED." Also, the original equipment manufacturer (OEM) operation instruction listed the following: "Where installed, disengage the [side] ratchet binder from the closure door. WARNING: Make sure door, clamp rings, and pressure-warning lock are fully closed and secured and the [side] ratchet binder is unhooked from the closure door before attempting to pressurize vessel." The operator who closed the door stated that he fully tightened the side ratchet, but did not loosen or disengage the side ratchet binder from the closure door.

The OEM for the PL closure door specified the following closing procedures:

"1. Inspect, clean, and lubricate the O-ring, O-ring groove, the door sealing surfaces, and the pressure-warning lock.

WARNING: Replace damaged O-rings. A damaged O-ring can create a hazardous environment from leaking fluids and result in personal injury and/or property damage.

2. Push the door over the O-ring sealing surface until the door is completely closed, showing no gap between the door and hub faces. Where installed, use the [side] ratchet binder to completely close door.

3. Set the clamp-ring [top] ratchet binder to close and ratchet the handle until the clamp rings are pulled together and completely engage the closure door.

4. Install the pressure-warning lock. Make sure the pressure-warning screw is not cross threaded into the hub. Should the pressure-warning screw not start into the threaded opening, the [top] ratchet may require minor adjustment by opening or closing slightly to align the screw. Install the pressure-warning lock screw hand tight only.

5. Where installed, disengage the [side] ratchet binder from the closure door.

WARNING: Make sure door, clamp rings, and pressure-warning lock are fully closed and secured and the [side] ratchet binder is unhooked from the closure door before attempting to pressurize vessel. Spraying line fluids or sudden door opening may result in personal injury and/or property damage.

6. The vessel can now be pressurized to line pressure and placed on-stream."

SOI and Enbridge had a third party (DNV-GL) perform mechanical failure mode testing and root cause testing of the PL barrel, the PL closure door, the clamp rings, and other items associated with the PL assembly. After performing laser-scan imaging of all items, DNV-GL was able to reconstruct the PL assembly via 3D modeling. The following highlights the findings:

- The scanned images showed four distinct damage marks (witness marks) on the PL

closure door that coincided with distinct witness marks on the clamp rings. When all the witness marks were aligned, one of the clamp rings showed a deviation of approximately two inches from the ideal "closed" position of the PL closure.

- The ideal clevis pin to clevis pin centerline (CP-CP) distance (clamp ring closed, with lugs aligned) was 24.89 inches. The CP-CP distance with the witness marks aligned was 26.76 inches.
- The top ratchet binder holding the clamp rings together, including the eyelets, experienced plastic elongation of approximately 7/12 inches before failure.
- The side ratchet binder was discovered to be nearly fully tightened, resulting in a ratchet length (eye center to eye center) of 10.4 inches. According to the original vessel drawings, this distance should be 11.1 inches.
- The tolerance between the inside of the clamp ring and the outer lips of the PL barrel and closure door was 1/64 inch.

DNV-GL concluded in their final report that the immediate cause of the incident was "incomplete closure of the clamp rings," which resulted in a "reduced engagement" between one of the clamp ring channels and the door and barrel flanges. Their conclusion was based on the locations of the witness marks, the measured lengths of subject and exemplar ratchet binders, and component reconstruction.

18. LIST THE PROBABLE CAUSE(S) OF ACCIDENT:

Equipment Failure - The explosion occurred after the top ratchet binder holding the clamp rings failed, resulting in the subsequent opening of the clamp rings. The fire occurred after the explosion when the expelled flammable gas mixture encountered an ignition source. The ignition source was likely a spark created either as a result of metal-to-metal contact or from an electrical arc due to damaged electrical wiring.

Failure to Follow Procedures - Regarding the task of closing the PL closure door, the first procedural failure involved the side ratchet binder. The side ratchet binder was initially tightened, and was not loosened once the clamp was thought to be secured. The failure to loosen the side ratchet binder contradicted both the warning in the OEM procedure and a "Key Point" in the SOI job procedure.

Also, the pressure-warning lock was not installed through both clamp ring lugs, confirming improper alignment of the clamp rings. The improperly aligned clamp ring exerted a tensile force in excess of the ultimate strength of the top ratchet binder, resulting in the failure of the binder and the explosive opening of the PL closure door.

19. LIST THE CONTRIBUTING CAUSE(S) OF ACCIDENT:

Inadequate Hazard Analysis - SOI's PtW Matrix specified that a JSA was required for this task, yet the OP did not indicate the requirement for a JSA. The explanation that the task was "routine" does agree with 30 CFR 250.1911 (b) (4), which states that the person in charge of the job may decide that a JSA is not required for particular jobs conducted on a recurring basis. However, 30 CFR 250.1911 (b) states that a JSA must be conducted for activities identified in your SEMS program. The BSEE investigation team concluded that the OP contained in their Integrated Job Planning Matrix met the criteria for conducting a JSA. The BSEE investigation team received no indication that a JSA was performed prior to commencing work in this instance.

Improper MOC - When SOI changed their procedure after problems were reported with the

pigging valve (HCV-9131), the BSEE investigation team concluded that there should have been a corresponding MOC executed, since the OP was changed instead of an in-kind replacement or repair of the valve.

Inadequate Supervision (Control of Work) - The BSEE investigation team concluded that the excessive number of procedural discrepancies indicated a lack of sufficient supervisory control over the work performed in this instance. Also, both rotating PICs approved the job procedure, eliminating SOI-mandated risk assessment controls by not requiring a JSA to be conducted.

20. LIST THE ADDITIONAL INFORMATION:

Failure to Follow LO/TO policy - The failure to lock out the 12-inch "kicker" valve may have resulted in the valve opening at some point following the explosion. The BSEE investigation team concluded that while the flame length calculations support the possibility of gas flow through the 2-inch globe valve, the team could not rule out the possibility of gas flow through the 12-inch "kicker" valve, which should have been closed throughout the incident. While this action would not have resulted in the occurrence of the incident, it would have increased the severity of the fire by allowing a greater mass flow rate of gas through the PL opening.

21. PROPERTY DAMAGED:

NATURE OF DAMAGE:

- 30-inch sales gas pig launcher
- Piping and valves associated with the pig launcher
- Numerous other items in the vicinity of the explosion (NW corner of the Subcellar Deck
- Buildings, piping, electrical wiring, structure

The explosion caused several items to be expelled overboard and other items to be damaged. The fire caused heat damage to the items along the path of the flame.

ESTIMATED AMOUNT (TOTAL): \$44,000,000

22. RECOMMENDATIONS TO PREVENT RECCURANCE NARRATIVE:

1. The GOMR Office of Safety Management should consider issuing a Safety Alert/Bulletin emphasizing the importance of adhering to established procedures, including LO/TO.
2. The GOMR Office of Safety Management should consider performing a SEMS program evaluation of the GB-128 "A" facility in the areas of Hazard Analysis, Operating Procedures, Safe Work Practices, and Mechanical Integrity.

23. POSSIBLE OCS VIOLATIONS RELATED TO ACCIDENT: YES

24. SPECIFY VIOLATIONS DIRECTLY OR INDIRECTLY CONTRIBUTING. NARRATIVE:

1. G-110 (S) - SOI failed to protect health, safety and the environment by not performing operations in a safe and workmanlike manner to protect employees.
2. L-126 (S) - SOI failed to ensure that the pipelines and associated valves, flanges, and fittings were designed, installed, operated, and maintained to provide safe and pollution-free operations.

25. DATE OF ONSITE INVESTIGATION:

13-NOV-2017

28. ACCIDENT CLASSIFICATION:

26. INVESTIGATION TEAM MEMBERS:

**Harold Griffin / Karen Bearb / Wade
Guillotte / Stephen Harris / Steven
Pelous**

29. ACCIDENT INVESTIGATION
PANEL FORMED:

OCS REPORT: **NO**

27. OPERATOR REPORT ON FILE:

30. DISTRICT SUPERVISOR:

Elliott S. Smith

APPROVED

DATE: **21-SEP-2018**