

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: 18-JUL-2021 TIME: 0930 HOURS

2. OPERATOR: Exxon Mobil Corporation

REPRESENTATIVE:

TELEPHONE:

CONTRACTOR:

REPRESENTATIVE:

TELEPHONE:

- STRUCTURAL DAMAGE
- CRANE
- OTHER LIFTING
- DAMAGED/DISABLED SAFETY SYS.
- INCIDENT >\$25K #4 mooring line failure
- H2S/15MIN./20PPM
- REQUIRED MUSTER
- SHUTDOWN FROM GAS RELEASE
- OTHER

3. OPERATOR/CONTRACTOR REPRESENTATIVE/SUPERVISOR 8. OPERATION:

ON SITE AT TIME OF INCIDENT:

4. LEASE: G10380

AREA: AC LATITUDE:

BLOCK: 25 LONGITUDE:

5. PLATFORM: A-Hoover Spar

RIG NAME:

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

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

9. CAUSE:

7. TYPE:

INJURIES:

HISTORIC INJURY

OPERATOR CONTRACTOR

REQUIRED EVACUATION

LTA (1-3 days)

LTA (>3 days)

RW/JT (1-3 days)

RW/JT (>3 days)

FATALITY

Other Injury

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

POLLUTION

FIRE

EXPLOSION

LWC  HISTORIC BLOWOUT

UNDERGROUND

SURFACE

DEVERTER

SURFACE EQUIPMENT FAILURE OR PROCEDURES

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

10. WATER DEPTH: 4825 FT.

11. DISTANCE FROM SHORE: 137 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:

On July 18, 2021, Exxon Mobil Corporation (ExxonMobil) reported an incident on the Diana Hoover Spar (Facility) located at Alaminos Canyon (AC) block 25. The incident involved the loss of 1 of the 12 mooring lines due to a mooring line chain link failure. The incident occurred while conducting normal production operations. The estimated cost of repair is between 10 and 15 million US dollars. The United States Coast Guard (USCG) and the Bureau of Safety and Environmental Enforcement (BSEE) each performed an independent investigation of the incident.

According to ExxonMobil's report, while conducting normal production operations on the Spar Facility, the Operators heard a loud rumble noise and felt the Facility shake slightly. The Operators surveyed the Facility and discovered the number four mooring line parted. On July 27, 2021 a remotely operated vehicle (ROV) surveyed the 11 remaining mooring lines and reported no anomalies identified during the survey.

According to documentation supplied by ExxonMobil, a Facility Model (performed in 2010) contained updated information on moorings, risers and Metocean Criteria following Hurricanes Ivan, Katrina, and Rita in the Gulf of Mexico consistent with API RP 2MET. The model analysis also investigated multi-line failure scenarios which include mooring system performance (offsets and tensions) analysis for one and two lines failed, in various return period storms. Based on the 2010 Facility Model, the Lessee determined the Facility was stable with the remaining eleven mooring lines and within safety standards to continue production operations.

ExxonMobil recovered the broken link from the chain on the seafloor and sent the chain link to Stress Engineering Services, Inc. (SES) for evaluation. The 160 mm size, R4 material grade chain link had been in service approximately 20 years prior to failure. The failed chain link exhibited two fractures: one at a crown and one at the flash weld. SES performed several tests on the chain link, including visual examination, wet fluorescent magnetic particle testing, dimensional measurements, fractography, metallography, hardness testing, and other material characterization tests.

SES investigation report found that both the crown fracture and the weld fracture were associated with hydrogen embrittlement. Each fracture had evidence of surface pitting at the fracture origin and adjacent intergranular fracture features. Both fractures also exhibited brittle final fractures and low ductility overall.

According to SES investigation report, the Material Characterization Tests found that the chain link properties did not satisfy ABS requirement for Grade R4 mooring chain, nor any other grade of mooring chain. Tensile ductility and impact toughness were both found to be low. The prior austenite grain size was large, particularly around the flash weld, and the link hardness was high, particularly in the crown. The poor link properties are most likely the result of improper heat treatment during manufacturing, which resulted in low inherent toughness and increased susceptibility to hydrogen embrittlement.

According to the SES report, based on a review of the fracture origins and deformation in the link following fracture, the most likely sequence of events was that the crown fractured first, which subsequently led to the weld fracture. The location of the crown fracture origin at the extrados of the crown and the transverse orientation of fracture propagation indicated that tensile stresses dominated crack growth. According to the SES report there was no evidence that stress from out-of-plane bending or twisting contributed to the fractures. There was also no evidence of a weld repair associated with either fracture. Other than the two fractures, SES test results detected no additional cracks in the chain link.

ExxonMobil conducted visual inspection and hardness testing on all accessible links from the AC25 SPAR deck to the waterline on the remaining 11 top chains which

accounted for approximately 20 links per line. The resulting test results indicated zero out of tolerance readings according to ABS Grade 4 requirements. Hardness testing is an indicator of the required properties making the chain susceptible to hydrogen embrittlement and brittle fracture. Additionally, chain locker #4 entry was performed, and hardness testing was conducted on the links adjacent to the failed link (up to 15 links away from failure) and each tested link exhibited high hardness.

ExxonMobil anticipates the replacement of the mooring line chains to take approximately six to nine months due to the lead time required to manufacture the replacement chains.

USCG is completing their independent review of the incident. BSEE Office of Structural and Technical Support is aware of the incident and the investigation findings.

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

The mooring chain link fractures initiated from hydrogen embrittlement. The material properties of the link were not satisfactory for Grade R4 mooring chain, nor any other grade of mooring chain recognized by ABS. The high hardness of the link made it susceptible to hydrogen embrittlement and was likely the result of improper heat treatment.

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

None

20. LIST THE ADDITIONAL INFORMATION:

21. PROPERTY DAMAGED:

NATURE OF DAMAGE:

Mooring line chain

The chain susceptible to hydrogen embrittlement and brittle fracture.

ESTIMATED AMOUNT (TOTAL): \$10,000,000

22. RECOMMENDATIONS TO PREVENT RECURRANCE NARRATIVE: None

23. POSSIBLE OCS VIOLATIONS RELATED TO ACCIDENT: NO

24. SPECIFY VIOLATIONS DIRECTLY OR INDIRECTLY CONTRIBUTING. NARRATIVE: None

25. DATE OF ONSITE INVESTIGATION:

28. ACCIDENT CLASSIFICATION:

29. ACCIDENT INVESTIGATION

26. INVESTIGATION TEAM MEMBERS: Edward Keown /

PANEL FORMED: NO

OCS REPORT:

27. OPERATOR REPORT ON FILE:

30. DISTRICT SUPERVISOR:

Stephen Martinez

APPROVED DATE: 03-JAN-2022