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: **28-JUL-2012** TIME: **0600** HOURS

2. OPERATOR: **Stone Energy Corporation**
   REPRESENTATIVE:
   TELEPHONE:
   CONTRACTOR:
   REPRESENTATIVE:
   TELEPHONE:

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

4. LEASE: **00089**
   AREA: **EC** LATITUDE:
   BLOCK: **64** LONGITUDE:

5. PLATFORM: **A**
   RIG NAME:

6. ACTIVITY:
   - [ ] EXPLORATION(POE)
   - [X] DEVELOPMENT/PRODUCTION (DOCD/POD)

7. TYPE:
   - [ ] HISTORIC INJURY
     - [ ] REQUIRED EVACUATION
     - [ ] LTA (1-3 days)
     - [ ] LTA (>3 days
     - [ ] RW/JT (1-3 days)
     - [ ] RW/JT (>3 days)
     - [ ] Other Injury
   - [ ] FATALITY
   - [ ] POLLUTION
   - [X] FIRE
   - [ ] EXPLOSION
   - LWC
     - [ ] HISTORIC BLOWOUT
     - [ ] UNDERGROUND
     - [ ] SURFACE
     - [ ] DEVERTER
     - [ ] SURFACE EQUIPMENT FAILURE OR PROCEDURES
   - COLLISION [ ] HISTORIC [ ] >$25K [ ] <=$25K
   - [ ] STRUCTURAL DAMAGE
   - [ ] CRANE
   - [ ] OTHER LIFTING DEVICE
   - [ ] DAMAGED/DISABLED SAFETY SYS.
   - [X] INCIDENT >$25K **Booster Gas Compressor**
   - [ ] H2S/15MIN./20PPM **Damage**
   - [ ]
   - [ ] REQUIRED MUSTER
   - [ ] SHUTDOWN FROM GAS RELEASE
   - [ ] OTHER

6. OPERATION:
   - [X] PRODUCTION
   - [ ] DRILLING
   - [ ] WORKOVER
   - [ ] COMPLETION
   - [ ] HELICOPTER
   - [ ] MOTOR VESSEL
   - [ ] PIPELINE SEGMENT NO.
   - [ ] OTHER

8. CAUSE:
   - [X] EQUIPMENT FAILURE
   - [ ] HUMAN ERROR
   - [ ] EXTERNAL DAMAGE
   - [ ] SLIP/TRIP/FALL
   - [ ] WEATHER RELATED
   - [ ] LEAK
   - [ ] UPSET H2O TREATING
   - [ ] OVERBOARD DRILLING FLUID
   - [ ] OTHER

9. WATER DEPTH: **50** FT.

10. DISTANCE FROM SHORE: **21** MI.

11. WIND DIRECTION: **NW**
    SPEED: **3** M.P.H.

12. CURRENT DIRECTION:
    SPEED: **3** M.P.H.

13. SEA STATE: FT.

17. INVESTIGATION FINDINGS:

On the morning of July 28, 2012, at approximately 0400 hours the production crew at EC-46-A platform was awakened by the SCADA system alarm. The SCADA system indicated that the emergency shutdown device (ESD) had been activated at EC-64-A (unmanned satellite platform) for unknown reasons. Believing that there was no cause for alarm, the lead operator decided to wait until later (approximately 0600 hours) to call for the field boat to transport production operators over to EC-64-A to assess the cause of the ESD activation. While en route to EC-46-A, the boat crew contacted the operators and informed them of smoke emanating from EC-64-A platform. The field boat picked up two operators and traveled approximately 20 minutes to EC-64-A. Upon arrival, the field boat utilized its fire monitors to extinguish the fire in the rental booster gas compressor skid. Subsequent to extinguishing the major flames, the operators boarded the platform and utilized hand held fire extinguishers to extinguish the remaining incipient fires. The fire damage was confined to the compressor (i.e. Worthington "SUPERCUB") skid and there was no report of any pollution associated with this incident.

On July 28, 2012, BSEE conducted an initial onsite investigation and learned that operators performed an inspection of the compressor the day preceding the incident and did not report any unusual anomalies with respect to the compressor's performance. The BSEE investigation team's assessment of the compressor unit revealed that the number 2 cylinder separated from the distance piece and there were loose bolts (i.e. studs) on the number 4 cylinder gas inlet flange, both being a release point of high pressure natural gas into the atmosphere. The compressor's crankcase tie down stud on left side of compressor frame between number 1 and number 3 cylinders was found broken. The compressor crankcase lube oil filter housing which is made of malleable metal was destroyed in the fire. Thus, allowing in excess of 50 gallons of lube oil in the crankcase to leak into the compressor skid and fuel the fire. The investigation team also learned that a 250 gallon polypropylene (poly) tank was used as a lube oil "day tank" and mounted inside the compressor skid approximately 12 feet from the number 2 cylinder. The day tank contained approximately 225 gallons of oil and was destroyed in the fire. Its flammable contents also leaked into the compressor skid and fueled the fire. Furthermore, the compressor unit's engine was equipped with turbo chargers located in close proximity to the number 2 cylinder. Turbo chargers operate at extremely high temperatures capable of igniting natural gas vapors.

The BSEE investigation team also learned of several other significant factors that either directly or indirectly contributed to the catastrophic failure of the studs that secure the number 2 cylinder to the distance piece. Operators responsible for daily inspections of the compressor unit at EC-64-A stated that this unit had an excessive vibration issue (capable of breaking double XX heavy nipples) that was ultimately resolved when extensive repairs were performed on the compressor unit during an overhaul in June, 2010. BSEE requested and reviewed compressor maintenance service reports from the June, 2010 overhaul up to the date of the incident. BSEE's review of these reports revealed that the level of detail with respect to the type of work documented during PM inspections by the mechanics was inconsistent. The reports provided no evidence that critical studs manipulated during the overhaul were "periodically rechecked for tightness" in accordance with chapter 7 of the "SUPERCUB" Compressor Installation, Operating and Maintenance manual. The reports reviewed also revealed that, although mechanics performed necessary "call out" type work between June, 2010 and August, 2011, the frequency of routine PM inspections was inconsistent with the third party company's plan for conducting PM type inspections on their compressor units. At some point between June 10, 2012, and July 2, 2012, the compressor developed a notable oil leak between the number 2 cylinder and the distance piece. On July 2, 2012, two third party mechanics arrived at EC-64-A to perform preventive maintenance (PM) on the compressor unit. As part of the maintenance work performed; the mechanics documented "pulling doors on distance pieces and checking bolts". An interview with the mechanics that performed the PM revealed that they utilized a "breaker bar and socket with a 4 foot cheater pipe" rather than adhering to the manufacturer's recommendation to utilize a torque wrench for tightening the bolts that secure the number 2 cylinder to the distance. This

method of checking the tightness of the bolts was referred to as the "field check" technique by the third party compressor company, but yet the purpose for tightening the bolts was to minimize the leak between the number 2 cylinder and the distance piece. It was reported that the third party mechanics informed the lessee's field operator representative (in an undocumented conversation) that the number 2 cylinder would have to be sent to a machine shop in order to properly address the leak. The investigation also revealed that although the lessee was contractually obligated to provide transportation for third party mechanics to access the rental compressor at EC-64-A, they did not provide much oversight of the work performed by the mechanics. Furthermore, the third party compressor company utilized subcontract mechanics on their behalf to perform maintenance on the rental compressor unit at EC-64-A.

As a result of the platform being unmanned at the time of the incident, the BSEE investigation team is uncertain of the exact sequence of events that transpired on the early morning of July 28th, but as a result of interviews with personnel experienced with similar compressor incidents and the extensive review of the compressor components involved in the incident; the following chain of events are believed to have occurred:

1. The studs that secured the number 2 cylinder to the distance piece failed catastrophically (Vibration became extremely violent) which caused the number 2 cylinder to shift resulting in a change in the number 2 piston rod clearance inside the cylinder, thus allowing the piston rod to damage (scar) the rod packing and then strike the crank end of the cylinder wall. The compressor crankcase vibration switch activated.
2. As the number 2 cylinder separated approximately ½ inch from the distance piece, gas escaped into the atmosphere as a result of damage to the rod packing.
3. Natural gas was ignited by one, a combination of, or all of the following factors: a) The extremely hot turbo charger. b) A significant influx of gas into the engine air breather. c) Metal to metal contact in the area of the number 2 cylinder when the unit made its final revolutions during the shutdown process.
4. The flash fire ignited used lube oil and possibly oil saturated absorbent pads in the compressor skid.
5. The fire spread to the nearby poly tank which melted and leaked lube oil into the compressor skid causing the fire to spread throughout the skid.
6. The fire melted the malleable compressor crankcase lube oil filter housing causing lube oil to leak into the compressor skid and spread the fire.

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

A catastrophic failure of the studs that secured the number 2 cylinder to the distance piece of the rental booster gas compressor initiated a sequence of events, as described in the Investigative Findings, which ignited and fueled the fire.

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

1. Possibility that prior history of vibration caused damage to studs that catastrophically failed.
2. Possibility of repetitive tightening of the studs that catastrophically failed as a result of re-using the same studs time after time caused the studs to stretch and become fatigued.
3. Possibility of the studs being over tightened during the process of utilizing a "breaker bar and socket with a 4 foot cheater pipe" in an attempt to stop the oil leak that developed between the number 2 cylinder and the distance piece.

4. The failure to follow chapter 7 of the "SUPERCUB" compressor operating and maintenance manual, may have led to the catastrophic failure of the studs that secured the number 2 cylinder to the distance piece.
5. The lessee failed to provide oversight of critical work being performed on the rental compressor onboard their platform.
6. The lessee failed to recognize the hazards involved with mounting a 250 gallon poly lube oil day tank inside the compressor skid. As a result, the possibility of the violent vibration associated with the number 2 cylinder caused the poly tank to develop a leak which led to the fire being exacerbated.

20. LIST THE ADDITIONAL INFORMATION:

The twelve studs that failed on the number 2 cylinder were sent to an independent lab for examination and testing. The examiner's results revealed that nine of the twelve studs showed some amount of fatigue, the most being 40 percent and the least being 10 percent with the remaining percentage being affected by shear. The visual examination of the number 1 stud revealed this stud was affected by corrosion and the type of fracture appeared to be the result of 100 percent fatigue whereas the type of fracture associated with studs 2, 6 & 9 were the result of 100 percent shear with the remaining studs affected by a combination of fatigue and shear. Three other studs were also affected by corrosion.

Although the BSEE investigation team was unable to determine whether the studs that failed were the original studs from when the unit was first assembled, it was noted in the independent lab report that "there were two different looking bolts (i.e. studs) used on this compressor." The lab report also stipulates "Both types of bolts were tested for tensile properties and the results were very similar and within ASTM specifications for B7 bolts." It is important to note that the data analyzed did not consider the effects of utilizing a breaker bar and four foot cheater pipe to tighten the studs.

21. PROPERTY DAMAGED:

Compressor components

NATURE OF DAMAGE:

Fire damage

ESTIMATED AMOUNT (TOTAL): **$600,000**

22. RECOMMENDATIONS TO PREVENT RECURRANCE NARRATIVE:

Lake Charles district recommends OSM issue a safety alert in order to heighten industry's awareness of the significant findings associated with this investigation and provide recommendations to preclude or avert a reoccurrence of this nature as follows:
1. Review OEM specifications in order to determine proper tightening requirements of compressor fasteners (i.e. studs, bolts, ect.) during installation and maintenance.
2. Review OEM specifications in order to determine the recommended frequency and instances for checking the proper tightness of fasteners associated with compressors.

3. Evaluate the condition of fasteners that are being considered for re-use.
4. Survey offshore facilities to identify sites that utilize plastic tanks containing flammable liquids and evaluate the location on the facility in which such tanks are being utilized. It is recommended that plastic tanks stored in close proximity to high vibration areas, high heat sources, compressor packages, etc. be relocated to an area more suitable for such containers.

23. POSSIBLE OCS VIOLATIONS RELATED TO ACCIDENT: **NO**

24. SPECIFY VIOLATIONS DIRECTLY OR INDIRECTLY CONTRIBUTING. NARRATIVE:

25. DATE OF ONSITE INVESTIGATION:

28-JUL-2012

26. ONSITE TEAM MEMBERS:

Scott Mouton / Darron Miller / Mitch Klump / Carl Matte / Guy Bertrand /

29. ACCIDENT INVESTIGATION PANEL FORMED: **NO**

OCS REPORT:

30. DISTRICT SUPERVISOR:

Williamson, Larry

APPROVED DATE: **14-NOV-2012**

FIRE/EXPLOSION ATTACHMENT

1. SOURCE OF IGNITION: **Turbo charger, engine intake, and or metal to metal contact**

2. TYPE OF FUEL:
- [X] GAS
- [ ] OIL
- [ ] DIESEL
- [ ] CONDENSATE
- [ ] HYDRAULIC
- [X] OTHER **lube oil**

3. FUEL SOURCE: **Release of gas from booster gas compressor unit.**

4. WERE PRECAUTIONS OR ACTIONS TAKEN TO ISOLATE KNOWN SOURCES OF IGNITION PRIOR TO THE ACCIDENT ? **NO**

5. TYPE OF FIREFIGHTING EQUIPMENT UTILIZED:
- [X] HANDHELD
- [X] WHEELED UNIT
- [ ] FIXED CHEMICAL
- [ ] FIXED WATER
- [ ] NONE
- [X] OTHER **Boat firewater monitor**

INJURY/FATALITY/WITNESS ATTACHMENT

[X] OPERATOR REPRESENTATIVE
[ ] CONTRACTOR REPRESENTATIVE
[ ] OTHER _____

[ ] INJURY
[ ] FATALITY
[X] WITNESS

NAME:

HOME ADDRESS:

CITY: STATE:

WORK PHONE: TOTAL OFFSHORE EXPERIENCE: YEARS

EMPLOYED BY:

BUSINESS ADDRESS:

CITY: STATE:

ZIP CODE:

[X] OPERATOR REPRESENTATIVE
[ ] CONTRACTOR REPRESENTATIVE
[ ] OTHER _____

[ ] INJURY
[ ] FATALITY
[X] WITNESS

NAME:

HOME ADDRESS:

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