

Gas leakage from Corroded Gas Lift line in onshore installation

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A. BACKDROP

The Oil Exploration activity in Assam commenced in 1957 and Oil was struck in 1960 in Rudrasagar Field near Shibsagar, Upper Assam. One such field in this area was discovered in 1963 and put on production in 1968. At present, 162 wells are flowing Oil & Gas wells and 31 are operating effluent injection wells.

To facilitate Oil recovery, a vast network of Gas lift lines and well fluid lines is laid between the wells and respective installation(s). These gas lift as well as well fluid lines are laid through public land with proper ROW.

This year during an uneventful lazy afternoon an incident of fire occurred near the production installation in the above field. This fire incident occurred near a Dhaba which was located barely at a distance of 30-40 meters from the installation.

There was a leakage of gas from the gas lift line that eventually turned into fire and engulfed the Dhaba located very close to the line. A girl living in that Dhaba got burn injuries and was subsequently shifted to hospital where she succumbed to her injuries.

OISD team investigated the incident and the root cause of such a fatal accident.

B. THE INCIDENT

The Dhaba owner informed the central resident engineer about the gas leakage from pipeline near his Dhaba in the evening of the day before the accident. The leak being minor, it was decided by Company officials to attend the leakage next day morning. Resident Engineer in the night shift kept a close watch on the leakage point. Further, Dhaba owner was instructed to inform control room if leakage aggravated.

Repair of the pipeline by clamping was taken up on the next day. After completing the clamping job the pipeline was charged with gas at 1300 hrs. At 14:30 hrs. Pipeline ruptured from the point of repair resulting in fire. The fire engulfed the Dhaba. The girl in the Dhaba was caught in fire and suffered burn injuries. She was taken to hospital where she succumbed to her injuries subsequently. Meanwhile fire tender reached the site and extinguished the fire in few minutes.

Loss due to fire:

- Fatality of a girl child
- Gutting of Dhaba
- Few bicycles and hand driven trolley.

C. INVESTIGATION MODALITIES

The inquiry team visited the site of incident, production installation and Gas Compression Plant to review and assess the operational arrangements at these installations.

Team held discussions with the company officials responsible for operation of the installation and pipeline. The investigating team also interacted with few local people including the members from the affected family to have first-hand account of their version about the incident. Verification of events through documents and examining of various other related records was carried out. Pictures at the accident site were also taken.

D. SEQUENCE OF EVENTS

- Dhaba owner informed central resident engineer about the gas leakage from pipeline near his Dhaba.
- Resident engineer identified it as leakage from gas injection line. The leak was considered to be minor hence it was decided to plan the repair job next day in the morning. During the night shift a close watch was kept on the leakage point.
- The gas line was depressurized and permit issued during morning on the next day to carry out the repair job by clamping the leaky portion of the line.
- Repair job completed by 1230 hrs and pipeline charged with gas. No hydrocarbon leakage was observed at 1300 hrs.
- At 1430 hrs, gas started gushing out from the point where the pipeline was clamped which turned into a fire engulfing the Dhaba located 30-40 meters away from the installation.
- Fire tender was called from nearest fire station located at about 4-5 kilometres from the accident site. Fire tender reached the spot at 1435 hrs and fire fighting started. Meanwhile Installation manager instructed to stop all gas injection compressors at the field and also close down all gas injection supply lines.
- A girl child, daughter of the Dhaba owner, suffered burn injuries. She was initially shifted to local hospital and subsequently to hospital at nearby City where she succumbed to injury.

E. OBSERVATIONS

The team noted deficiencies in respect of engineering practices that were followed, absence of M&I concept, Procedural violations which contributed to the accident.

Engineering Related Gaps:

- Gas lift injection lines laying started in 1984. The pipeline under investigation was laid during that period only. No records about the exact date/year of the lines could be furnished to the audit team during investigation.
- Laying of pipelines has not been done as per established good engineering practices like maintaining minimum land cover for buried lines, minimum ground clearance for above ground lines, spacing between two lines etc. Lines are laid haphazardly. No standard guidelines have been followed for laying these lines.
- There is no system for preventive health checks for these pipelines. The pipelines have never been inspected since their installation.
- Pipelines route (ROW) cannot be identified. No patrolling along the ROW has been carried out since commissioning of the pipelines.
- Dwellings and other encroachments are observed in very close vicinity of the pipelines. The accident site i.e. the Dhaba is about 2 to 3 meter away from the pipeline.
- There is no written down policy/ procedure methodology to be adopted for repair of the pipelines. The decisions for repairs are taken by the respective field maintenance staff, based on their capability and experience.
- Mechanical integrity assessment of pipelines for pre and post repair jobs is not carried out. Repair jobs are carried out without any written recommendations.
- There is no provision of Emergency Shutdown Device (ESD) to timely isolate the facility in case of fire. Shutdown of compressors, closing of block valves etc was carried out manually during the incident.

Lack of clarity/coordination & procedural lapses:

- Severity of the leak and its likely consequences could have been assessed more thoroughly by the concerned officials on the day of reporting of the incident. It is pertinent to note here that incident assumes more significance in view of the concerns expressed by the Dhaba owner about likelihood of leak aggravation during the night hours. More so, since the installation is just 30 meters away and could have resulted in disaster had the fire/leaky gas engulfed the installation. It was a case of near miss incident. Hence the safest option would have been isolation and depressurization of the line at the time of reporting the incident
- Mention is being made of the procedure to handle such incidents as enumerated in the Emergency response Plan. The present incident falls under the category as mentioned under Case-II of this plan; where the scenario anticipated is crude spillage / Gas leakage which may lead to

fire /explosion. This written down plan could have helped in avoiding the accident. For example, as per plan in this scenario the action is to inform Fire station, Emergency Control room, Installation Manager, Mines Manager, Mines Safety Officer, Security, C&M etc. which was not followed.

- Assessment of physical condition of the pipeline prior to clamping was not carried out. The line had become paper thin at the leaky portion as can be seen from the photographs taken after the incident by the investigating team.
- Careful examination of the documents indicates that leak from the clamped portion still existed even after repairs and attempts were made to tighten the clamp while the line was in charged condition. The log book and daily diary of the RE clearly notes that the incident occurred while the repair jobs were still underway. This aspect was further corroborated by eye witness accounts.
- It may be pertinent to mention that the health of the line was poor so much so that the section of the line where clamp was provided was highly perforated and clamp repair of such line is never recommended.
- After the fire the leaky portion of the line was replaced with about six meters of new pipeline. It is not clear as to why only six meters of the pipeline was replaced. No mechanical integrity assessment of the pipeline post repairs was done. The welding joint after the repairs was not even radio graphed to check its efficacy. No hydro test of the line was done prior to recharging the line after replacement.
- There is no evidence of any attempt(s) made to extinguish the fire prior to arrival of the fire tender as first hand damage control. In view of close proximity of the accident site, fire water hoses from the existing fire water network of the station could have been laid and charged to extinguish the fire.
- Coordination for handling the incident needs to be improved. It is gathered that various activities like isolation of lines, stoppage of compressors, fire fighting etc were going on parallelly with no coordination between them. All the activities during the handling of the fire accident should have been coordinated under one person.
- There had been four incidents of leakages in gas injection line in this calendar year, which was reported as 'near miss' (as per incident classification of OISD, this incident would have been classified as minor or major). However, lessons from the near miss incidences are not learnt as the extant accident led to fatality and could have resulted in a disaster.
- At three locations of such incidents, repair job was carried out by welding and one by clamping. It seems that repair of pipeline job is a regular phenomenon, as the lines have become weak at several places.

Yet there has been absence of any written down policy regarding repair of pipelines; and repair jobs are taking place without any engineering considerations

- It has been observed that this 4" gas injection line does not have provision of automatic/ emergency shutdown system. Isolation of this line is done by a manual valve, which is at the far end of the installation and precious time can be lost in order to operate this valve during emergency. Since rupture of pipeline is so frequent in this location, automatic shut down system should be provided in such lines.

F. ROOT CAUSE OF THE INCIDENT

Poor Knowledge & deficient assessment of situation

Whether the condition of the pipeline was fit for repair through clamping or not was not ascertained. Even the maintenance personnel failed to check thru simple tests that are carried out like hammer test prior to taking up the repair job. In the absence of any written down repair/ maintenance policy/ procedure, it was left to the installation crew to decide by their experience the method of repair.

Violation of the Emergency Response Plan

This incident was not reported to Mines Manager, Mines Safety Officer etc. as per action required by Emergency Response Plan. The course of action for the repair of this pipeline may have been different with assessment of the situation by these officers had the incident reported earlier.

Deficient hazard management

Since the place of incident is encroached upon by outsiders, the hazard of leakage turning into fire should have been considered and necessary control measures should have been put in place. Seeing the vulnerability of the location, the repaired pipeline should have been tested with non hazardous medium before charging with gas.

Deficient policy of maintenance of pipeline

There have been incidents of pipeline leakages in the asset frequently. Health assessment of pipelines has not been carried out since installation of these lines.

G. RECOMMENDATIONS:

Immediate measures (Technical and Operational)

- The replaced portion of the line does not have sufficient land cover and the line is almost at the grade level. Considerable vehicular movement is still observed over this portion of the pipeline. As an immediate measure either the line in this section to be lowered to provide adequate land

cover of about 1.5 meters or a culvert to be built for vehicular movement for protecting the line against any possible damage in this section.

- The company must consider the extension of the fire water network of the installation outside the boundary limits to cover the residential area falling in close vicinity of the plant till this unauthorized encroachment is cleared / removed. Besides immediate steps must be taken for evacuation of unauthorized encroachments.
- A detailed fire plan with roles and responsibilities clearly defined for all types of incidents must be developed.
- A detailed operation and maintenance procedure for control system and safety interlocks for the entire pipeline system should be developed and followed. To handle such emergencies more effectively, it is recommended to examine the option of providing Emergency Shutdown Device (ESD) entailing shutdown of relevant equipment, closure of valves etc with an audio visual alarm in all the connected installations.
- Present health condition of all the pipelines to be assessed and critical areas requiring immediate attention should be identified with a suitable action plan. Further a programme of condition monitoring and maintenance should be developed and undertaken to ensure the integrity of these pipelines.
- A preventive maintenance manual for the entire pipeline network must be prepared & put into place immediately mentioning the periodicity (e.g. daily, weekly, monthly) of maintenance carried out and schedule adhered to. This should also include procedures for repair by clamping, removal and replacement of pipe / hot tapping and stopping etc. Roles and responsibilities for assessing the mechanical integrity for pre and post repairs should be clearly defined in this manual.
- Classification and reporting of the incidents should be strictly as per OISD laid down guidelines.
- Ground patrolling of the pipeline ROW should be started at regular intervals to observe surface conditions, leakage, construction activity, encroachments, soil washouts and any other factors affecting the safety and operation of the pipeline. All the encroachments along the ROW should be removed in a time bound manner.
- Public along the ROW till encroachment is removed should be made aware of the possible consequence of gas leaks on regular basis. This aspect should also be included and reviewed during regular internal audit(s).
- Long term measures
- The company must develop a long term plan to completely phase out these old lines in a time bound manner. While laying new lines (as and when these lines are due for replacement), guidelines provided in OISD

STD 226 should be duly followed. This standard provides minimum requirement for safety in design, construction, inspection, testing, commissioning, operation, maintenance, modifications, abandonment, corrosion protection, safety of these onshore natural gas cross country pipelines.

- Similarly for liquid hydrocarbon lines like well fluid lines, which are also laid along with these gas lift lines, the guidelines provided in OISD STD 141 should be followed as and when these lines are replaced.

Training & Education

- All the operating personnel should be educated to handle the emergencies as per laid down procedures. Regular mock drills should be conducted for various emergency scenarios and the records of these drills to be reviewed by Senior/top level officials on a regular basis.
- Regular training of personnel working in the terminal to handle such a situation must be organized including providing skill to maintenance crew. It has been seen that personnel in the installation do not have adequate awareness to fight such fire incidents.