

## Explosion at OWS sump near Sour Water Stripper Unit

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### **1.0 INTRODUCTION**

An incident of explosion at OWS pit was reported resulting in fatality of a contract worker and injury to one company employee and four contract workers in a refinery.

### **2.0 INCIDENT**

On the day of the incident, hot work permit was issued for installing a vertical pump on the OWS pit. The LEL test was carried out by operations at 7.30 am on the same day and zero reading was recorded on the work permit. The maintenance crew lowered the pump inside the pit through pump opening with the help of hydra. The pump was installed on the support plate and stitch welding of the old and new plates was completed at three locations (Two in the East side and one on the South Side). The explosion and fire occurred when tack weld at the fourth location (west side) was attempted at around 11:15 am. Six workers present at the site were hit by the rubbles of pit cover and other structures present at the site. One worker was hit at back of his head and succumbed to injury. Five additional workers had injuries /fractures and were provided with medical support at Hospital.

### **3.0 SEQUENCE OF EVENTS**

OWS pit was taken for maintenance for removal of sludge as the pumps were frequently getting jammed during operation. The pumps were removed from the base during the cleaning operation. Subsequently the pit was cleaned.

During installation of the second pump, it was observed that the pump foundation bolts mounted on the support plate which is grouted to the pit top roof was damaged and was required to be cut and replaced.

Two additional plates (spacer & support plate with base bolts welded) were prefabricated which were required to be welded on the existing support plate for proper installation of the pump.

The sequence of events connected to this pit and pump are as below:

- a) OWS pit was emptied to ensure that liquid level is lowered to the minimum extent possible using one pump.
- b) Second day permit to carry out welding job for installation of second pump was issued but job could not be taken up as the welding group was engaged in some other activity.

- c) On day-3, pump support repair and the damaged bolts on the support plate were cut by grinding and an additional spacer plate was welded on the existing support plate mounted on the pit roof.
- d) On fourth day, hot work permit was issued at 9.00 hrs. and LEL test was carried out at 7:30 am holding the instrument in hand and extended downwards into the pit to the extent feasible.
- e) The shift in charge who inspected the location at 8:30 am prior to approving the permit reported minimum liquid level in the pit when viewed through the man hole.
- f) At around 9:45 am, maintenance crew arranged for a hydra to install the pump. Prior to installation, area operator inspected the pit from the pump opening and observed that the sump in the pit had very little liquid. Clearance was given for lowering the pump through the pump opening.
- g) The pump was installed on the support plate and the stitch welding of the old and new plates was completed at three locations (Two in the East side and one on the South Side). The explosion happened when tack weld at the fourth location (west side) was attempted at around 11:15 am.



**Explosion in OWS manhole- the pump foundation totally shattered**

#### **4.0 OBSERVATIONS/ FINDINGS**

- Even though Operation emptied the sump, complete emptying of the liquid from the sump could not be done. Some amount of liquid remained in the sump.

- The liquid content remaining inside the sump is more likely to be either sludge (H<sub>2</sub>S rich or oily) or oil. The ambient temperature was low at the time the gas test was done as it was early morning (7.30 AM). Subsequently, by 11:00 am, when the ambient temperature rose, vapors started emanating from the sludge. These vapors could either be H<sub>2</sub>S gas or hydrocarbon vapors. H<sub>2</sub>S is flammable at 4 % to 43%.
- The explosive mixture inside the pit could be formed with hydrocarbon vapors or H<sub>2</sub>S gas or the combination of these two. Since LEL level was zero at 7.30 AM as mentioned in work permit, it indicates presence of H<sub>2</sub>S gas inside the pit in range of flammable concentration.
- During initial tack welding spark from the welding torch could not have reached inside the pit and when tack welding was attempted on the other side the spark might have made contact with explosive mixture present inside the pit.
- No mention was made in the work permit for measuring toxic gas (H<sub>2</sub>S) concentration in the pit as additional safety precautions. It indicates that job safety analysis (JSA) for carrying out this job was not done.

## **5.0 ABNORMALITIES/ ROOT CAUSE OF INCIDENT**

- The concentration of Hydrocarbon vapors was less in the morning since the ambient temperature at 7.30 am was low.
- At 11.00 am atmospheric temperature increased; the concentration of HC / H<sub>2</sub>S vapors must have reached LEL level but at that time reading was not taken.
- SRU/SWS unit OWS pit will normally have presence of oil & H<sub>2</sub>S vapors. Since the material received in the pit had presence of H<sub>2</sub>S, the explosive mixture could be formed by H<sub>2</sub>S vapors which was not detected since the test was not carried out. The requirement of carrying out testing for the presence of toxic H<sub>2</sub>S prior to carrying out the hot job was not mentioned in the permit.
- Job safety analysis (JSA) for carrying out the job was not done otherwise it would have clearly indicated the presence of H<sub>2</sub>S.

## **6.0 RECOMMENDATIONS/ LEARNINGS FROM THE INCIDENT**

- The presence of explosive mixture must be measured just before the start of hot job such as welding, cutting etc.
- The measurement of H<sub>2</sub>S must also be taken besides hydrocarbon vapors wherever presence of H<sub>2</sub>S is expected.
- Work permit system needs to be strengthened and permit should be issued for specific job and not for multiple jobs.
- The reference of electrical isolation should be given on hot work permit to ensure electrical isolation of the equipment.
- Job safety analysis should be carried out before taking up any job.



**Explosion in OWS: The manhole cover blown up**