तेल उद्योग सुरक्षा निदेशालय
Oil Industry Safety Directorate
ISO 9001:2015 certified

सुरक्षा संवाद
Suraksha Samwad

An opportunity to learn from mistakes....

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Addl. Director (E&P), OISD

Sh. Saurabh Kumar Arya joined OISD in 2017 as Addl. Director (Exploration & Production). He has acquired Bachelor of Technology in Chemical Engineering from HBTI, Kanpur (UP). He joined Oil & Natural Gas Corporation Limited in 1989 at BPB Platform, Offshore Mumbai where he was involved in well head activities, pre-commissioning & commissioning activities. In 1997, he was transferred to LPG/ CSU Plant, URAN where he was involved in phase wise development projects, annual shut down activities, modification jobs, product optimization & de-bottlenecking. He was also involved in commissioning of LPG plant at BGP Project of Petrobras in Brazil. He has 28 years' experience of project execution, pre- commissioning & commissioning activities. He has been continuously sharing knowledge/ lectures in various OISD workshops/ seminars.

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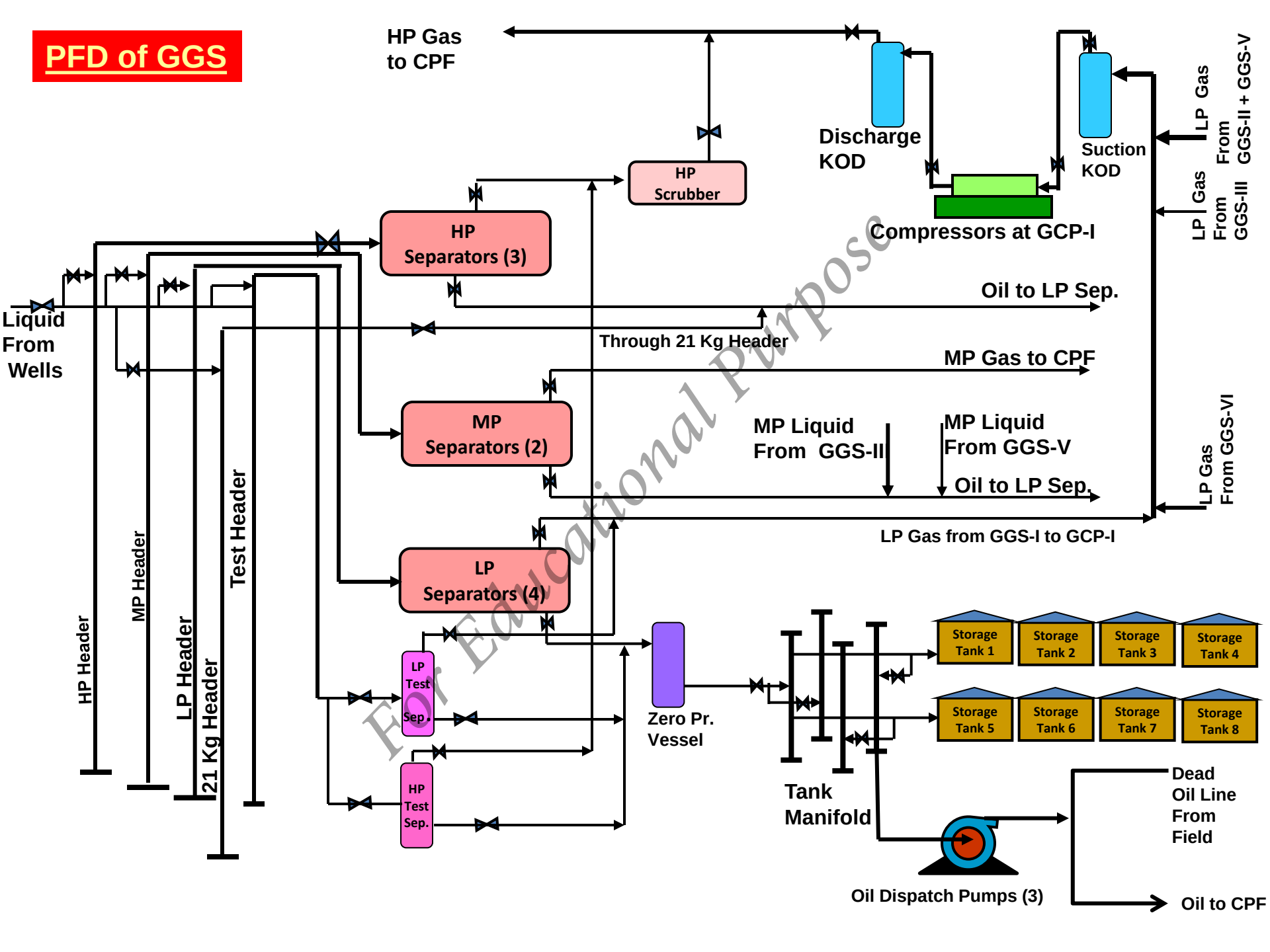
Storage Tank Fatal Fire Accident - A Case Study


PFD of GGS
HP Gas to CPF
Discharge KOD
Suction KOD
LP Gas From GGS-II + GGS-V
LP Gas From GGS-III
HP Scrubber
HP Separators (3)
Compressors at GCP-I
Oil to LP Sep.
Liquid From Wells
Through 21 Kg Header
MP Gas to CPF
MP Separators (2)
MP Liquid From GGS-II
MP Liquid From GGS-V
Oil to LP Sep.
LP Gas From GGS-VI
LP Gas from GGS-I to GCP-I
LP Separators (4)
HP Header
MP Header
LP Header
21 Kg Header
Test Header
LP Test Sep.
HP Test Sep.
Zero Pr. Vessel
Storage Tank 1
Storage Tank 2
Storage Tank 3
Storage Tank 4
Storage Tank 5
Storage Tank 6
Storage Tank 7
Storage Tank 8
Tank Manifold
Dead Oil Line From Field
Oil Dispatch Pumps (3)
Oil to CPF
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Brief Description

Sr.No	TANK NO.	Tank Content	TANK CAPACITY (M3)	Year (commissioned)	Dia (m)	Height/ Length (m)
1	Tank-1 (V)	Not in use	900 m3	1987	12.5 m	8 m
2	Tank-2 (V)	Emulsion	900 m3	1987	12.5 m	8 m
3	Tank-3 (V)	Emulsion	900 m3	1987	12.5 m	8 m
4	Tank-4 (V)	Emulsion	900 m3	1987	12.5 m	8 m
5	Tank-5 (V)	Emulsion	900 m3	1989	12.5 m	8 m
6	Tank-6 (V)	Emulsion	900 m3	1989	12.5 m	8 m
7	Tank-7 (V)	Emulsion	900 m3	1989	12.5 m	8 m
8	Tank-8 (V)	Emulsion	900 m3	1989	12.5 m	8 m
9	Testing tanks (H)	Emulsion	45 m3	1986	2.5 m	6.3 m
10	Testing tanks (H)	Emulsion	45 m3	1986	2.5 m	6.3 m
11	Testing tanks (H)	Emulsion	45 m3	1986	2.5 m	6.3 m

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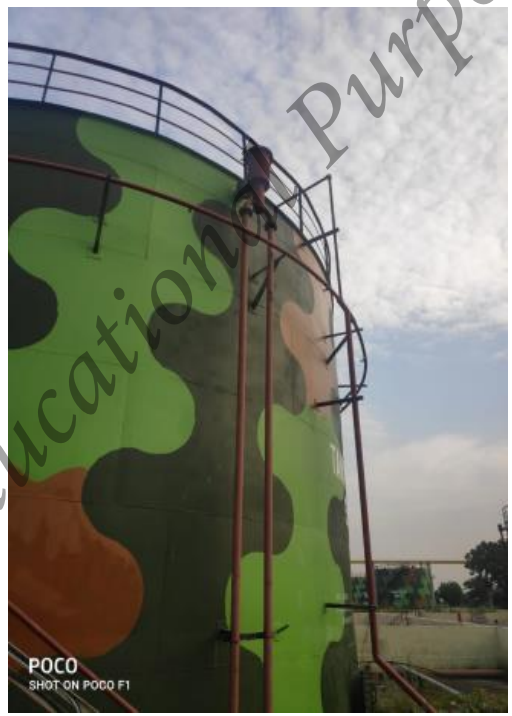
Brief Description

Additional Works Regarding Replacement of Foam Pourer Lines







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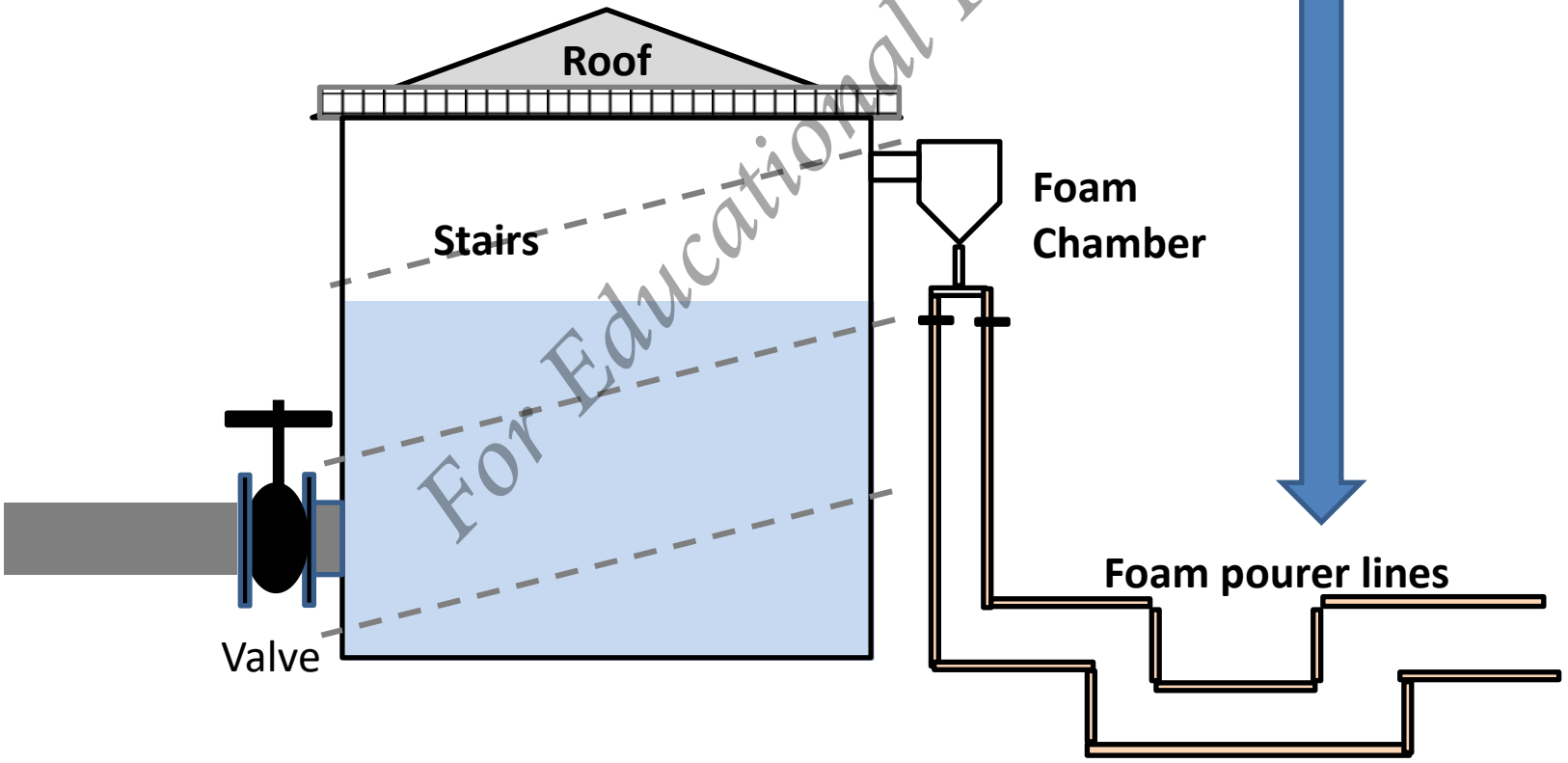
Photographs indicating the arrangement for the Foam Pourer with feed pipes

Job Description

Storage Tank T-03 status :

- ❑ Tank was offline – partly filled with water.
- ❑ M&I of the Tank was completed.
- ❑ Blind on valve had been removed. Valve kept closed.

Job entailed replacement of foam pourer lines



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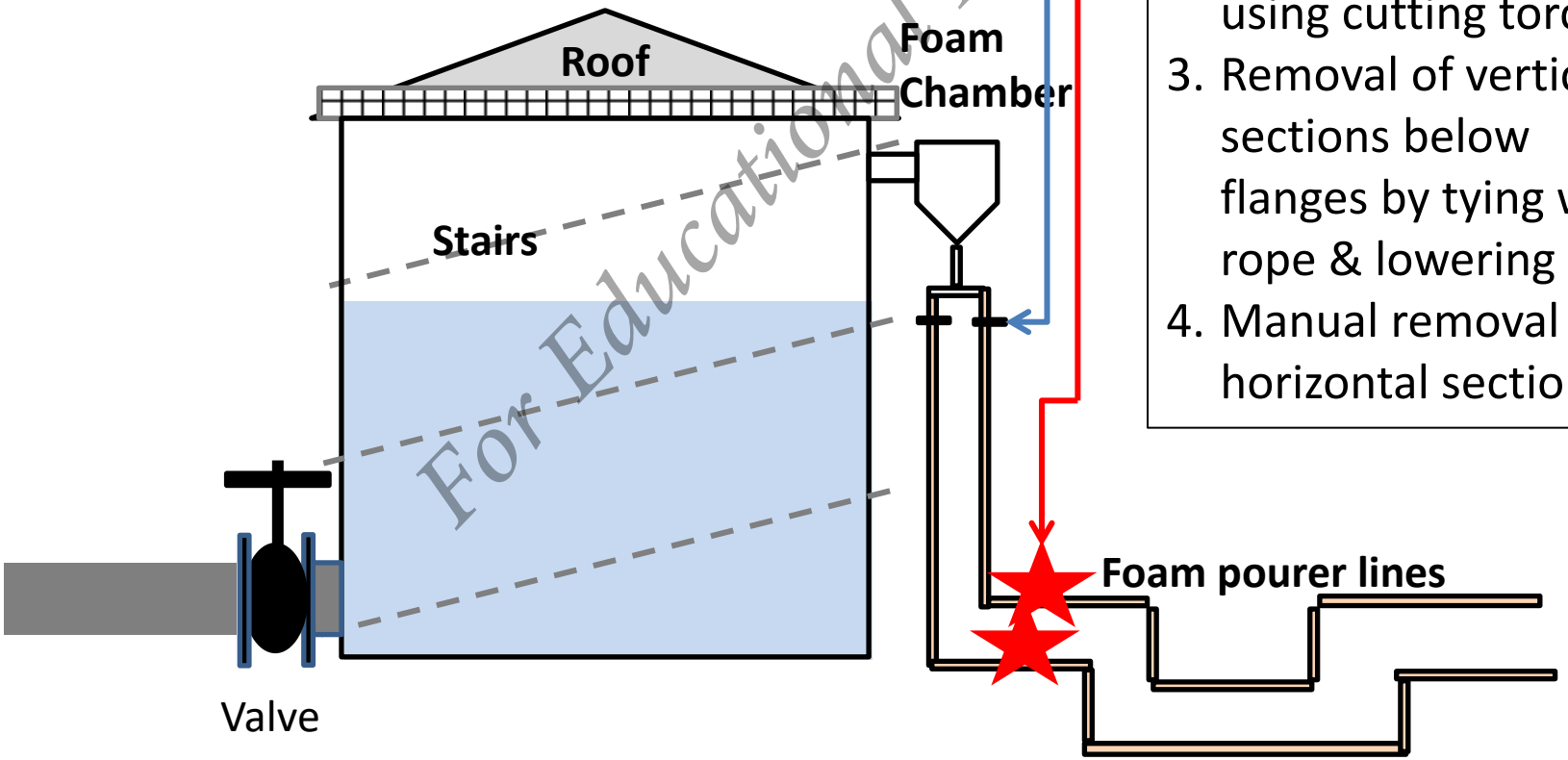
Method Adopted for the Job

- Job was not part of M&I activity
- Was taken up as a separate activity
- No hydrocarbon envisaged in line
- Out of 12, 10 other lines were similarly cut

Steps involved

1. Opening of flanges below foam chamber
2. Cutting the foam lines using cutting torches
3. Removal of vertical sections below flanges by tying with rope & lowering
4. Manual removal of horizontal section



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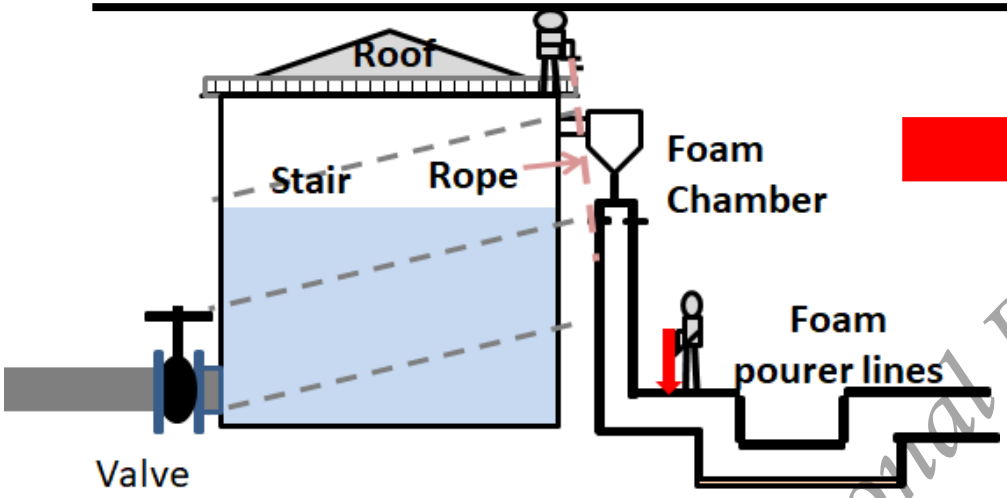
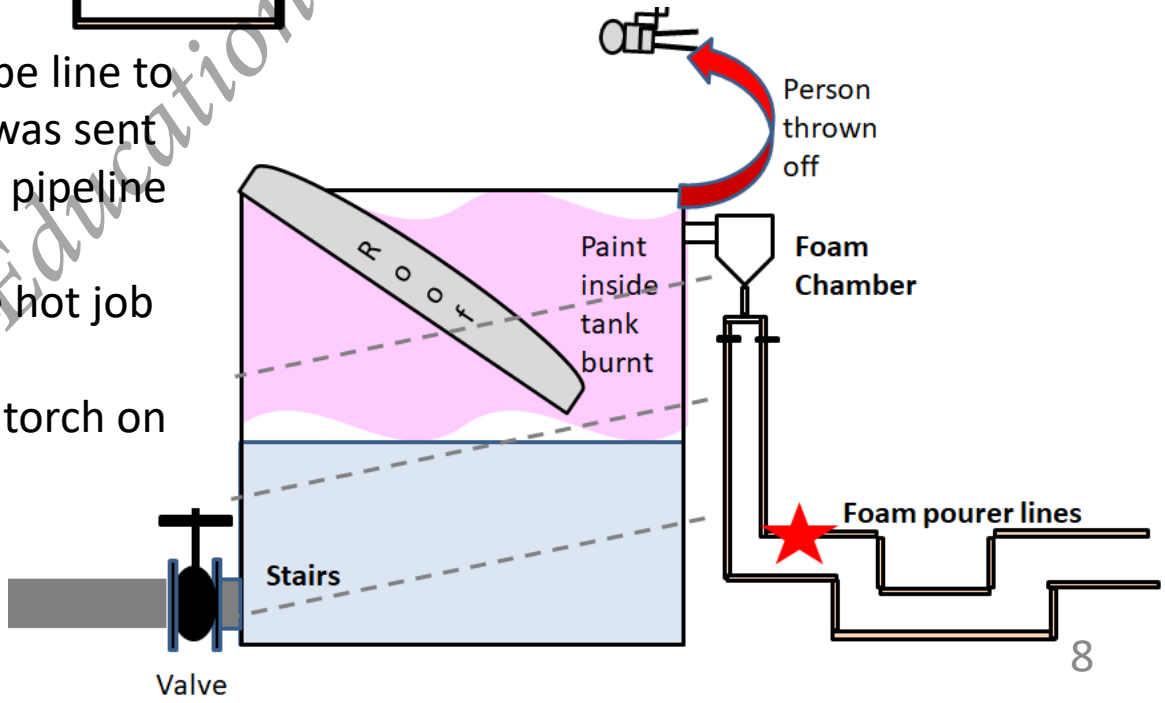
Sequence of Events



Fatal accident – Person on top of tank thrown off in burnt condition

- ✓ Rope was strung up on the pipe line to be cut to hold it. The helper was sent on top of the tank to hold the pipeline with the rope.
- ✓ Gas test was done around the hot job point (found Nil)
- ✓ Cut was made at point by gas torch on the line.
- ✓ Blast occurred inside tank after which there was fire.
- ✓ Helper fell from the roof and was found burnt



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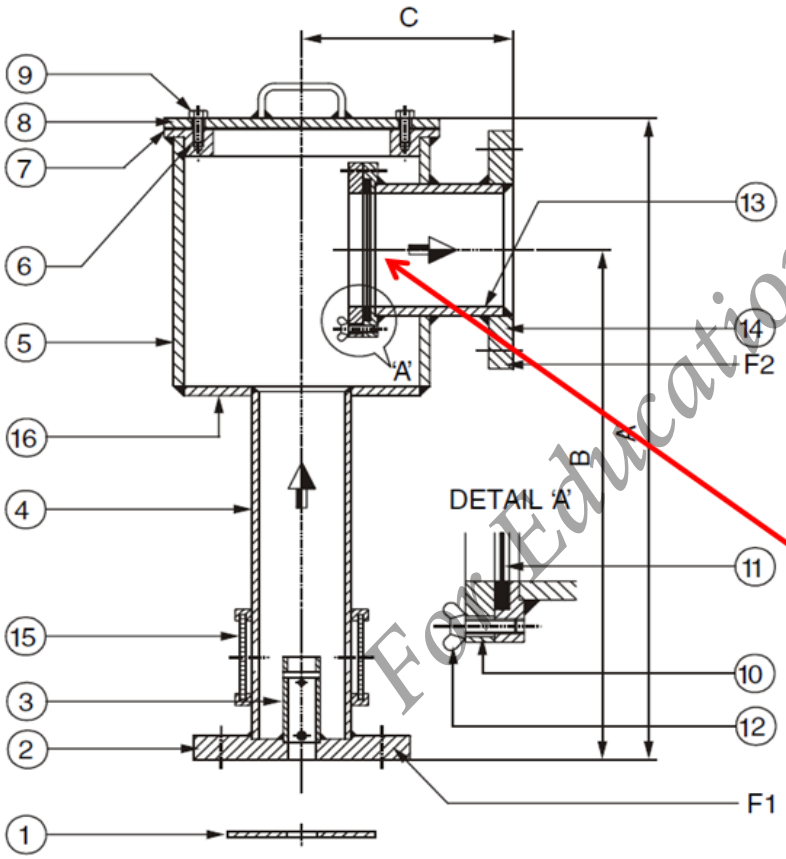
Probable Set of Events that led to Accident

The entire set of events has been based on the findings and premise that the Glass vapour seal in the Foam Chamber was not present.



ITEM NO.	DESCRIPTION	MATERIAL SPECIFICATION
1	ORIFICE PLATE	S.S. 304
2	INLET FLANGE	STEEL A105
3	AERATING PIPE	STEEL PIPE
4	FOAM MAKING CHAMBER	STEEL PIPE
5	FOAM CHAMBER	STEEL PIPE
6	CHAMBER FLANGE	STEEL
7	GASKET	NEOPRENE
8	INSPECTION HATCH	STEEL
9	BOLT	STEEL
10	VAPOUR SEAL RING & SEAT	STEEL
11	VAPOUR SEAL	GLASS
12	WING NUT & STUD	S.S. 304
13	DISCHARGE PIPE	STEEL PIPE
14	OUTLET FLANGE	STEEL
15	AIR STRAINER	S.S. 304
16	CHAMBER PLATE	STEEL

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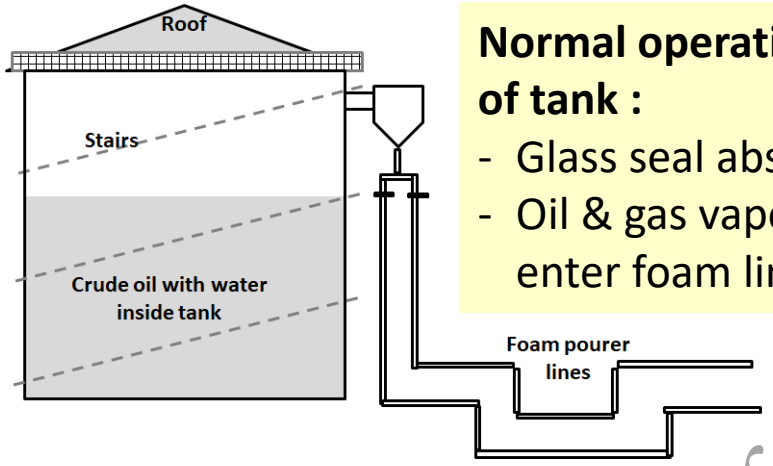
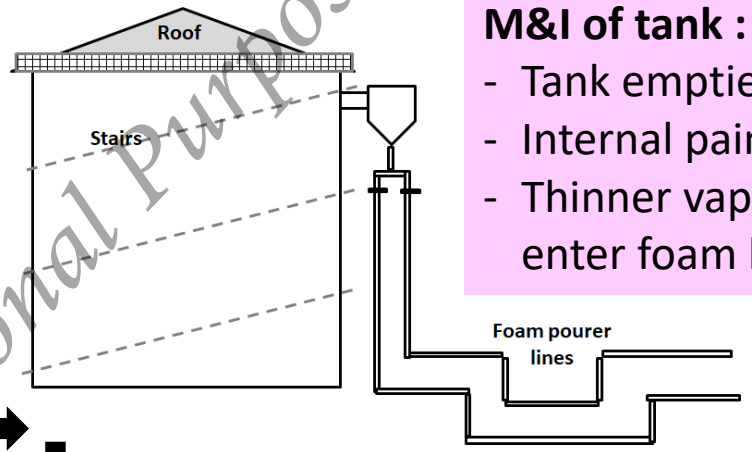
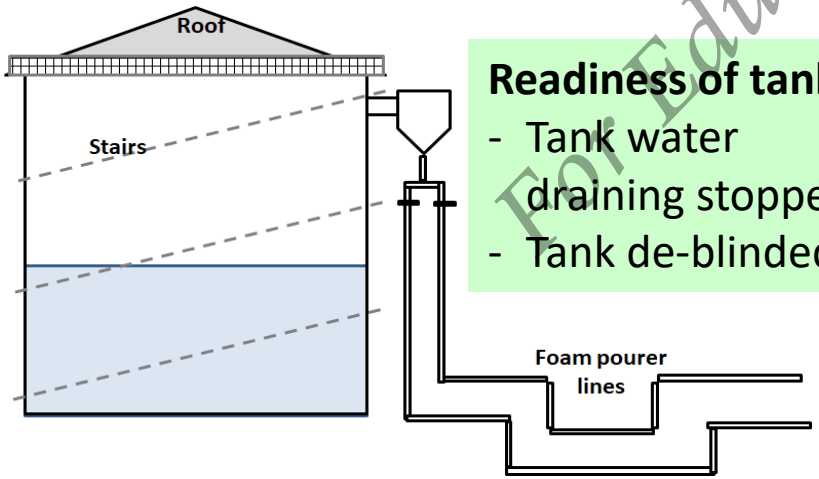
Probable Set of Events that Led to Accident



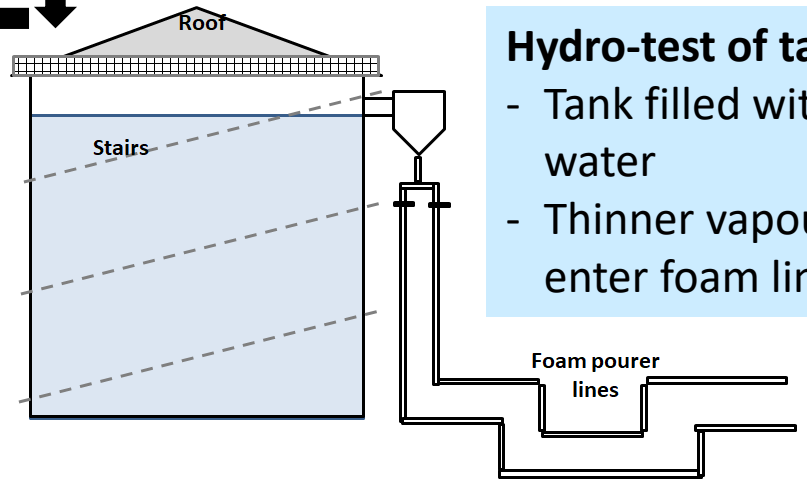
Normal operation of tank :
- Glass seal absent
- Oil & gas vapours enter foam lines



M&I of tank :
- Tank emptied
- Internal painting
- Thinner vapours enter foam lines



Readiness of tank :
- Tank water draining stopped
- Tank de-blinded



Hydro-test of tank :
- Tank filled with water
- Thinner vapours enter foam lines

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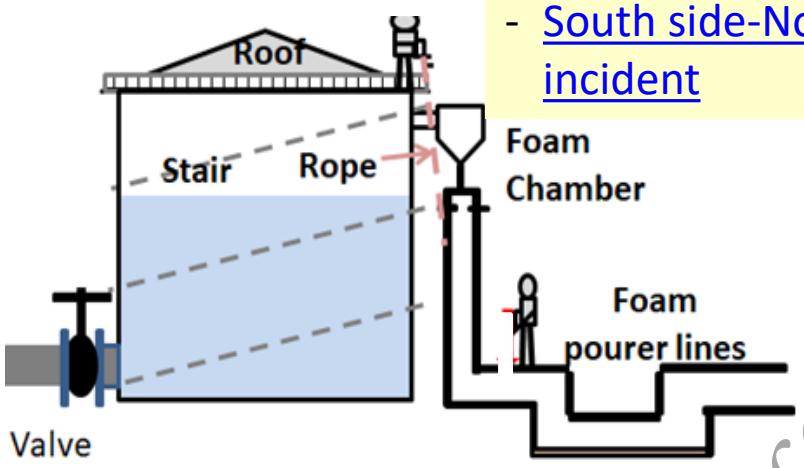
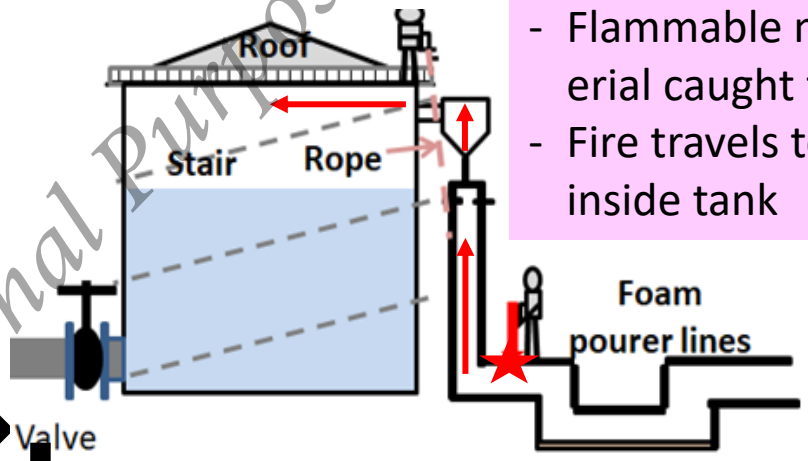
Probable Set of Events that Led to Accident

Job set up :
- Gas check zero
- South side-No incident

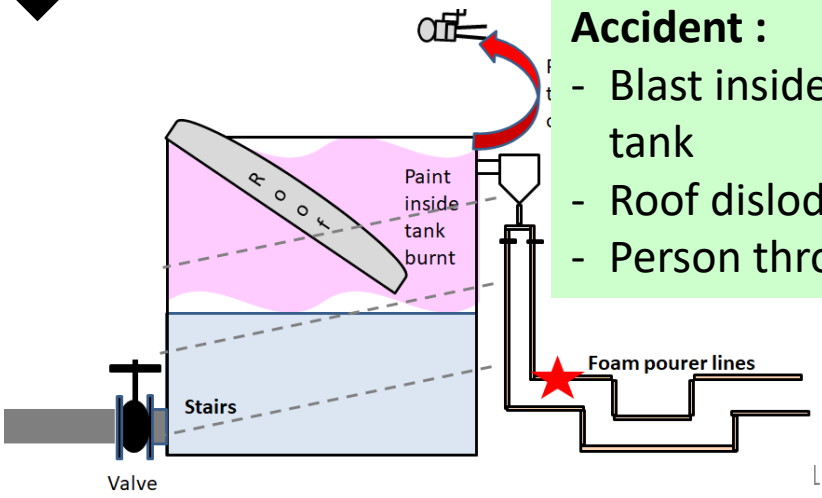


Gas torch cut :
- Flammable material caught fire
- Fire travels to inside tank



- As soon as cut was made, fire started smouldering inside pipe due to HC vapour and shot up through pipe like a fireball.
- Paint/ HC vapour/ oil inside the tank caught fire.
- Due to rapid heating, person on top got burnt.
- Tank burst at one seam and burnt person's body was thrown off.

Accident :
- Blast inside tank
- Roof dislodge
- Person thrown



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Major Lapses

1. Replacement of Foam pourer lines was being carried out without work order.
2. Job safety analysis on associated hazards & risks was not carried out prior to starting the job.
3. Hot job was taken up without positively isolating the tank. Blinding of the common foam pourer line downstream of the foam chamber was not done prior to the hot job.
4. Absence of Hydro-carbon in the tank was not ensured prior to taking up the job.
5. Foam pourer pipeline was not made hydrocarbon free either by flushing with water or purging with inert gas prior to the hot job.(No provision exist to drain accumulated foam water/ solution from the foam pourer lines)
6. All the requirements of the work permit system were not met prior to the job.
7. Defect report given by the fire section indicates missing vapour seal in the foam chamber. However, the same was not taken into consideration while replacing the foam pourer lines.

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Major Lapses

8. Inspection of fire fighting equipment & system was not carried out in line with clause 7.2.2 of OISD-STD-142 viz :
   a) Pressure testing of the foam chamber as and when tank is taken out of service for M&I.
   b) Pressure testing of normally dry piping during M&I of the tank or earlier in case visual inspection indicate questionable strength due to corrosion or mechanical damage.
9. Standard operating procedure (SOP) for replacement of foam pourer lines of the petroleum storage tanks and SOP to flush the foam pourer lines is not available.
10. Helper (DP) was sent on top of the tank to hold the pipeline with the rope. Arrangement of holding the pipeline with the rope by tying with some fixed support was not made.

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Root Cause Analysis & Recommendations

Root Causes

1. Absence of hydrocarbon in the tank and foam pourer lines was not ensured prior to taking up the hot job.
2. Flushing/ purging of foam pourer lines was not carried out.

Recommendations

1. The job should be carried out through valid work order. The contractor for executing a job/ work should be selected based on his expertise in the relevant field.
2. Qualification & competency level of contractor's supervisor and key personnel needs to be checked/ evaluated.
3. Job safety analysis should be carried out prior to all critical and non-routine job and the same should be linked with the work permit.
4. SOP needs to be developed & followed religiously for different operational and repair activities. These should be reviewed periodically and approved.
5. Hot job on any pipeline connected to the tank should be undertaken only after positive isolation of the tank and pipeline.

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Recommendations

6. Hot work on the pipeline should only be performed after the pipeline is made gas free and suitable testing is done to ensure such operation.
7. All the requirements of the work permit system should be complied prior to the job.
8. Inspection of firefighting equipment & systems should be carried out in line with OISD-STD-142.
9. All defects identified during M&I should be complied in a time bound manner.
10. Foam lines should have provision to drain accumulated foam water.
11. Systematic improvement actions should be taken including training to avoid number of errors attributed to the incident such as :

    - Analysing & identifying the potential hazards (Job safety Analysis)
    - Knowledge on work permit system
    - Inadequate supervision
    - Non-availability of SOP
    - Qualification & competency level of contractor's employees

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