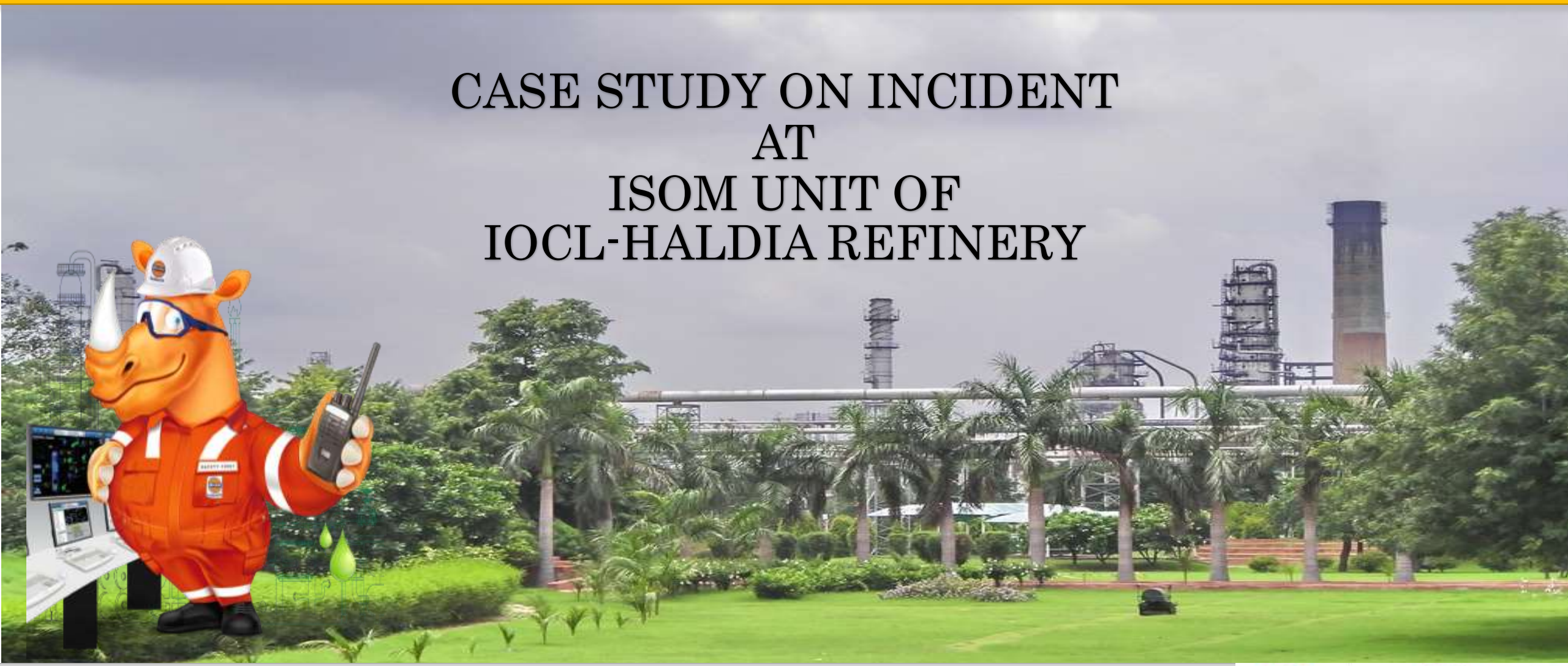
Knowledge Sharing Workshop on Petroleum Refineries
by PNGRB & HPCL

CASE STUDY ON INCIDENT AT ISOM UNIT OF IOCL-HALDIA REFINERY



Visakhapatnam, 27th February 2023

IndianOil

2023 STRENGTHENING THE GREEN RESOLVE

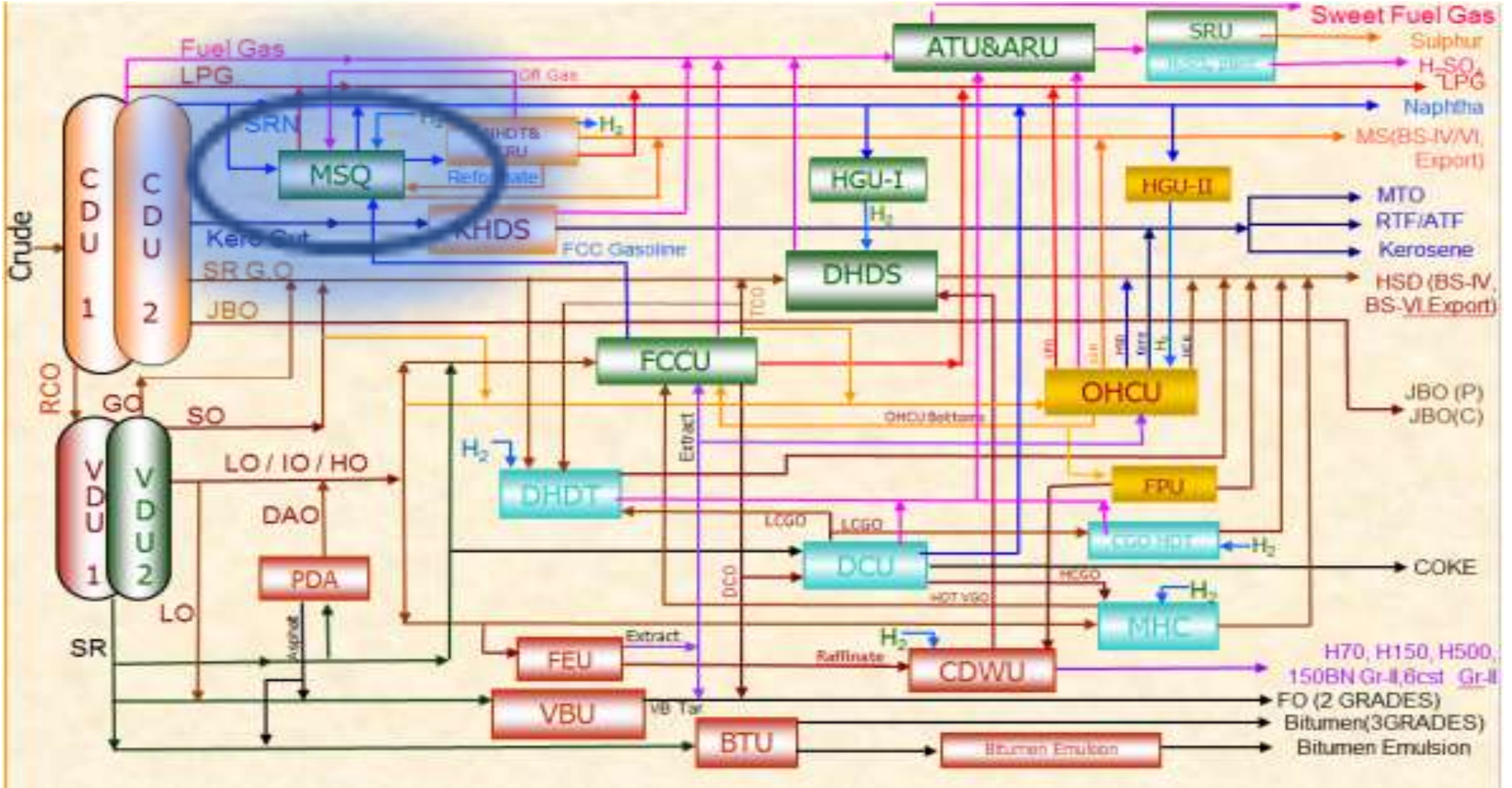
The Incident

- MSQ Block comprising of VDU,NHT,ISOM and Prime G units were under M&I shutdown.

Unit	Shut down duration
NHT	24 days (13th Dec – 5th Jan 2022)
ISOM	24 days (13th Dec – 5th Jan 2022)
Prime-G	52 days (1st Dec – 21th Jan 2022)
VDU-2	4 days (13th Dec – 16th Dec 2021)

- On 21.12.2021, While blinding of the flanges of the Stabilizer column reboiler (86-E-01) of ISOM unit, for hydrotesting of the liquid inlet line of the reboiler, Naptha along with Water came out .
- At 14.50 hrs, there was an explosion followed by Fire.
- Fire was put out /died down within a time period of 6 minutes.
- Fatality of 5 workers and 39 injuries resulted.

Block Flow Diagram of Haldia Refinery-IOCL



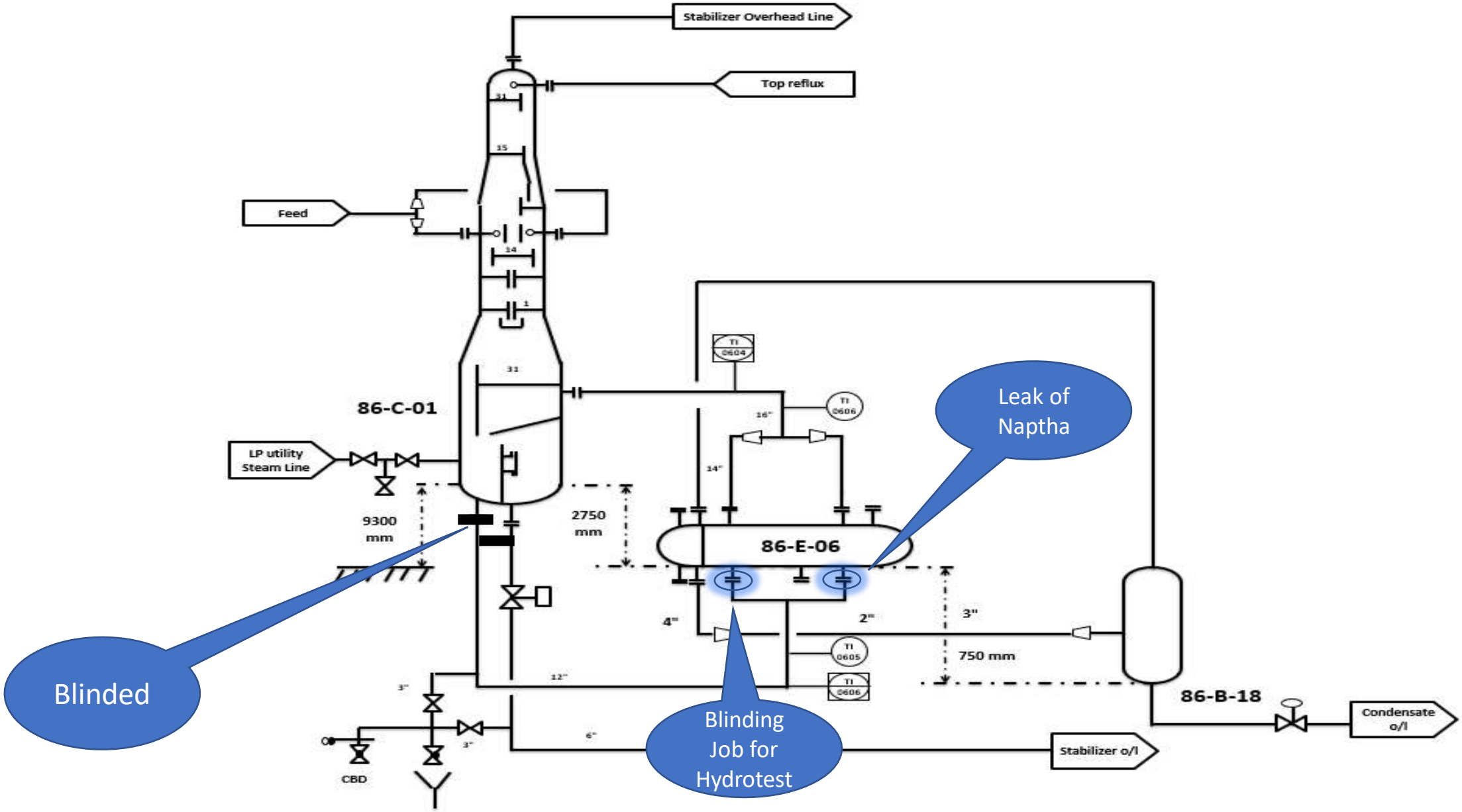
THE UNIT – ISOMERIZATION UNIT(U-86)

- The objective of the Light Naphtha Isomerization is to produce Isomerate with a minimum octane required of 87.0 in order to meet the Gasoline Pool octane constraint.
- The isomerization feedstock corresponds to the blend of the light reformate from reformate splitter column (Unit 85) and the Light Hydrotreated Naphtha product (Unit 85).
- The Unit capacity is based on 122,000 TPA with an on-stream factor of 8000 h/yr. The Unit turndown rate is 50% of the design capacity while making on-specification products.
- Isomerization is the conversion of low octane straight chain compounds to their higher octane branched isomers employing an activated chloride catalyst in the presence of once through hydrogen (also dried).
- The isomerization reactor temperatures are kept low in the range 120-160° at lower temperatures to minmize hydrocracking to achieve maximum yields.

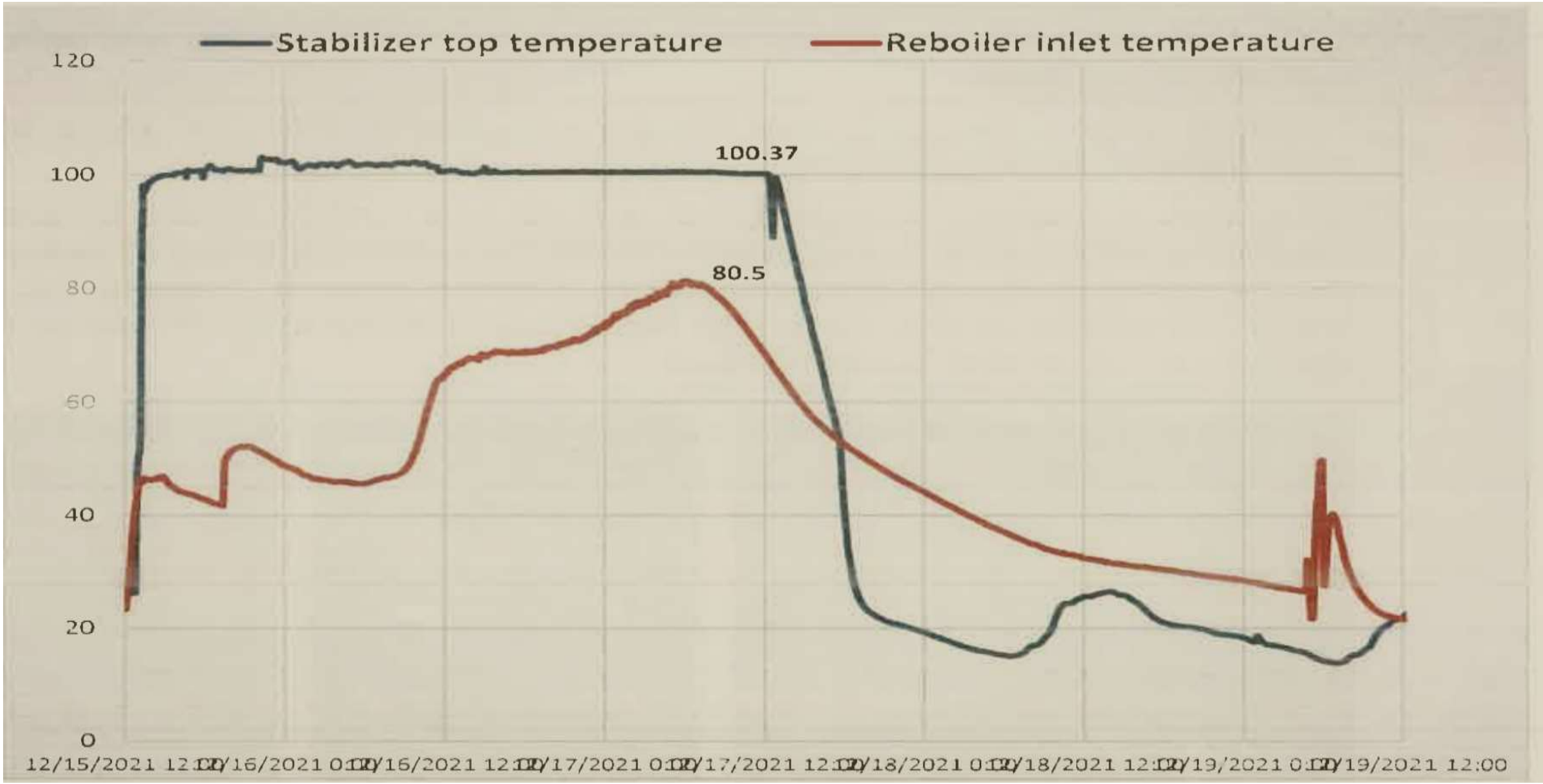
CHRONOLOGY OF EVENTS

- MSQU (U-86, ISOM) was under Maintenance & Inspection (M&I) shutdown and feed out was done on 13.12.2021, 00:30 hrs.
- As part of shutting down of the unit, 86 C-01 (ISOM Stabilizer) was to be handed over for M&I and 86-C-01 bottom line to 86-E-06 (Stabilizer reboiler) was to be handed over for hydro testing as per inspection recommendation.
- Accordingly, 86-C-01 (Stabilizer Column) empty out by draining and depressurization, followed by N2 pressurization, water flushing, and steaming was done.
- After that, blinding of the column was started on 18.12.2021 and was completed on 19.12.2021.
- Again, final steaming was started on 20.12.2021 followed by hot water flushing
- Blinding of 86-C-01 bottom liquid outlet line at column was done on 20.12.2021 at around 15:00 hrs.
- Blinding activity of 86-E-06 (Stabilizer reboiler) both liquid inlet nozzles as preparation for hydrotest were started on 21.12.2021.
- During the flange opening activity for blinding of 86-E-06 inlet flanges, naphtha started coming out of the flanges.
- At 14.50 hrs, there was an explosion followed by fire leading to fatality of 3 contract workers and injury of 41 persons [from FIR].

SCHEMATIC DIAGRAM OF THE STABILISER & REBOILER



CHRONOLOGY OF EVENTS



PROBABLE CAUSES LEADING TO THE INCIDENT

- The column bottom has a partition and two outlets (from each partition). One outlet goes to the 86-B-06(Chloride Guard) and the other partition outlet goes to the thermo symphonic Reboiler (86-E-06, Stabilizer reboiler).
- While flushing, the hold up on the rundown side gets flushed through the rundown line to 86-B-06 (Chloride Guard) , the hydrocarbon hold up in the reboiler circuit has to be drained to the CBD-CL/OWS thereby ensuring freeing of hydrocarbons in the reboiler circuit also.
- As per the feedback from the operating group, the 3” drain of the reboiler circuit along with the drain in liquid outlet line to 86-B-06 (Chloride Guard) was kept open in OWS instead of CBD-CL during final flushing. The same was crosschecked for completion of flushing by collecting drain sample which was water free of naphtha. Thereby it was concluded that flushing is complete.
- Also, during the site visit of the committee on 22.12.2021 morning at 10.30 hrs the drain valves were found in open condition.
- While checking on 24.12.2021 for Naphtha hold up in the reboiler circuit by adding water from the reboiler outlet line, it was observed that the reboiler circuit was still filled with light naphtha.
- This could be possible if the draining was not complete in the reboiler circuit which could have happened due to the plugging/choking of the 3” drain (or) due to valve gate fallen.
- Spillage of hold up Naphtha from the reboiler inlet flange during flange opening for blinding and simultaneous hot job in the immediate vicinity led to the explosion followed by fire.

GAPS AND LAPSES

1. Inadequate SOP for handing over procedure of 86-C-01 (Stabilizer column) and 86-E-06 (Stabilizer reboiler).
2. Job specific permits were not used for hydrotesting and blinding.
3. While permits were issued in SAP, Clearances were not issued in SAP.
4. CBD-CL was planned for maintenance and for taking into service before start of shutdown of the unit. However, it was not taken inline before start of shutdown.
5. Extensive Scaffolding in the already congested unit leading to obstruction in escape route.
6. Improper permit conditions applied while issue of permit (Expected residual hazards- No /JSA not required/Non-Sparking Tools-NA/IFR suits- No)
7. Non availability of Gas detectors due to outage of DCS on account of UPS maintenance. No mitigation measures put into place for disabling Hydrocarbon Gas detectors like placement of Standalone Gas detectors.
8. At the time of incident, no operating personnel were present in the unit (U-86, Isom unit in MSQ block), especially near hot job area (86-B-13, Chloride Guard of LPG) and reboiler inlet flange (86-E-06, Stabilizer reboiler).
9. Work area/Unit wise portfolio for Field Operators not assigned.
10. Key HSE personnel engaged with Disaster management drill and have to do extensive coordination with external agencies like NDRF, District Administration, State police, etc.

RECOMMENDATIONS

1. Dechoking of drain line and revisioning / replacement of suspected 1st drain valve of the reboiler circuit of 86-C-01(Stabilizer column) / 86-E06(Stabilizer reboiler).
2. The existing drain lines from column and reboiler are joined after first block valves and is routed to CBD-CL /OWS as a common header through a separate valve in CBD-CL/OWS. This needs to be separated for ensuring individual circuit draining, accordingly modifications shall be done.
3. Review of SOP for handover of 86-C-01(Stabilizer column) and 86-E-06 (Stabilizer reboiler). in view of the adequacy of flushing and making it hydrocarbon free.
4. Job and Equipment specific permits shall be issued.
5. Use of IFR suit shall be mandatory for all the persons entering Battery area including all the contract workers.
6. Alternate arrangements/mitigation measures shall be adopted before impairment of any Safety systems as per the requirements of Fire protection Impairment Permit procedures.
7. Ensure availability of Closed Blowdown Drum (CBD) for draining of hydrocarbons during normal operation and shutdown periods.
8. Erection of Scaffoldings should be done such that unrestricted free movement and escape route is available for operation, maintenance and contract workers.
9. Field Operators work area/unit wise portfolio shall be assigned.
10. The present CCTV is facing the unit periphery and not towards the equipments/ working area. The locations of CCTV placement shall be reviewed and placed to cover maximum working area of the plant. During shutdown period, the panel operator to monitor the CCTVs and alert all concerned in case of any deviation/observation.
11. Avoid Conducting any major exercise like Disaster drills during M&I shutdown of the Refinery as it requires deployment of the key persons including Fire and Safety Team handling shutdown jobs.These key personnel gets engaged with Disaster management drill and have to do extensive coordination with external agencies like NDRF, District Administration, State police, etc.

PHOTOGRAPHS FROM INCIDENT SITE- Reboiler inlet flange

PHOTOGRAPHS FROM INCIDENT SITE- Reboiler inlet flange

PHOTOGRAPHS FROM INCIDENT SITE- Reboiler inlet and outlet flanges at column

THANK YOU

I could have saved a life that day,
But I chose to look the other way.
It wasn't that I didn't care,
I had the time, and I was there.

But I didn't want to seem a fool,
Or argue over a safety rule.
I knew he'd done the job before,
If I called it wrong, he might get sore.
The chances didn't seem that bad,
I've done the same, he knew I had.

So I shook my head and walked on by,
He knew the risks as well as I.
He took the chance, I closed an eye,
And with that act, I let him die.

I could have saved a life that day,
But I chose to look the other way.
Now every time I see his wife,
I'll know I should have saved his life.

That guilt is something I must bear,
But it isn't something you need to share,
If you see a risk that others take,
That puts their health or life at stake.
The question asked, or thing you say,
Could help them live another day.

If you see a risk and walk away,
Then I hope you never have to say,
I could have saved a life that day,
But I chose to look the other way

By Don Marell

P&ID OF STABILISER & REBOILER CIRCUIT