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# PNGRB KNOWLEDGE SHARING WORKSHOP 2023

## CASE STUDY ON SR LINE LEAK IN CDU-III UNIT OF VR

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# INTRODUCTION

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- Visakh refinery configuration comprises of three Crude Distillation Units (CDU - I/II/III) with total name plate capacity of 8.33 MMTPA, downstream secondary processing units & treating facilities and associated utilities.

- CDU-III was commissioned in the year 1999-2000 with 3 MMTPA capacity and revamped to 3.4 MMTPA in 2012.

- The unit broadly consists of following sections:
  - Crude preheat train & desalter
  - Atmospheric section
  - Naphtha stabilizer section
  - Vacuum section.

# BRIEF OF THE INCIDENT

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- On 25.05.2021, CDU-III unit was in operation with a feed rate of 450 m3/hr. (Design: LS 590 m3/hr.; HS 620 m3/hr.) with a crude mix of 61.5% Arab Light + 31.5% AXL + 3.3% Murban + 1.5% Slop.

- At around 15:06 hrs., a fire was noticed in the pipe rack above the pump bay and on a part of adjacent south Technological Structure containing Reflux drums / condensers / Air Fin Coolers at different decks.

- Immediately emergency shutdown of the unit was taken and Emergency Response & Disaster Management Plan (ERDMP) of refinery was activated for Level-II emergency.

- Fire was extinguished at 16:10 hrs. (All clear given at 16:15 hrs.)

- There was no injury to any of the operating or contract personnel.

# POST INCIDENT FINDINGS

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- During flushing of Vac Column bottom circuits, leakage of Flushing oil observed from one of the 6” elbow on SR (Short Residue) pump discharge line, upstream of the Pre-Heat Exchangers.

- Upon Insulation removal a hole of about 3” dia size found on the inner arc of 6” elbow.

- Mechanical failure of the elbow caused spillage of SR on grade level and deck 1 of TS

- Spilled SR caught fire due to auto ignition (SR temp 350 deg. C and auto ignition temp 280 deg. C).

**6” SR Line ruptured hole in elbow – seen after insulation removal**

# POST INCIDENT FINDINGS

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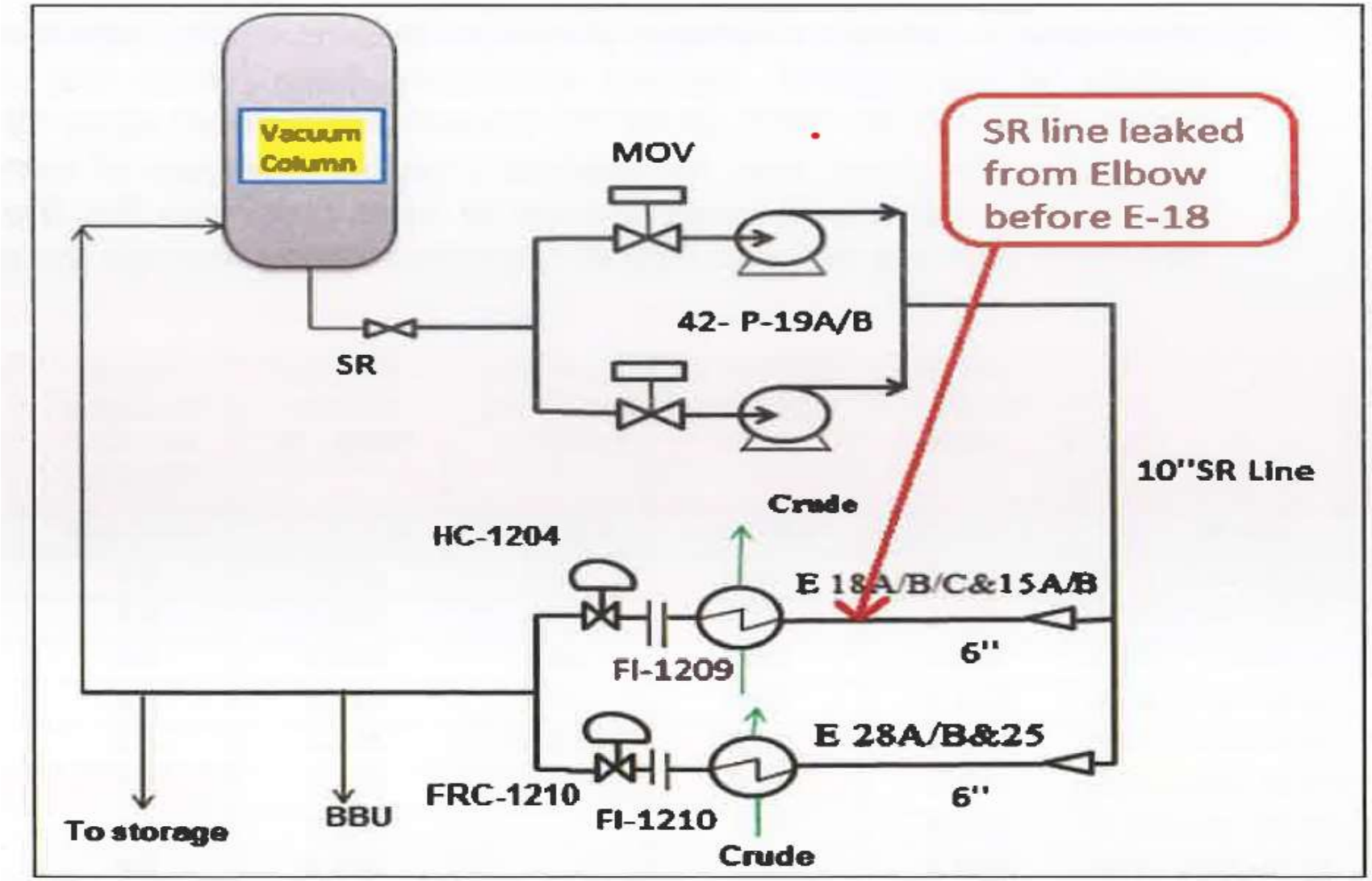


SR CIRCUIT SCHEMATIC

# POST INCIDENT FINDINGS

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- Metallurgy of the failed elbow as per Positive Material Identification (PMI) was found to be Carbon Steel (CS) instead of Alloy steel (P5 metallurgy-design spec).

- 100% PMI was carried out for the entire SR circuit during the previous unit T&I (2016). Two adjacent elbows on the SR pump discharge line were identified as CS instead of P5 metallurgy

- Localized corrosion of CS metallurgy resulted in thinning and failure of the subject elbow.

- Reason of localized corrosion is attributed to combined effect of high temp sulfidic corrosion and naphthenic acid corrosion.

# IMMEDIATE CAUSE OF INCIDENT

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- SR leak from the failed CS elbow and subsequent auto ignition.
- The material of construction of the failed elbow (CS metallurgy) does not meet the intended design specification of P5 metallurgy required for high temp and high corrosive service (SR).
- The rupture opening of the CS elbow occurred due to severe thinning caused by localized corrosion.

# ROOT CAUSE *(WHAT WENT WRONG)*

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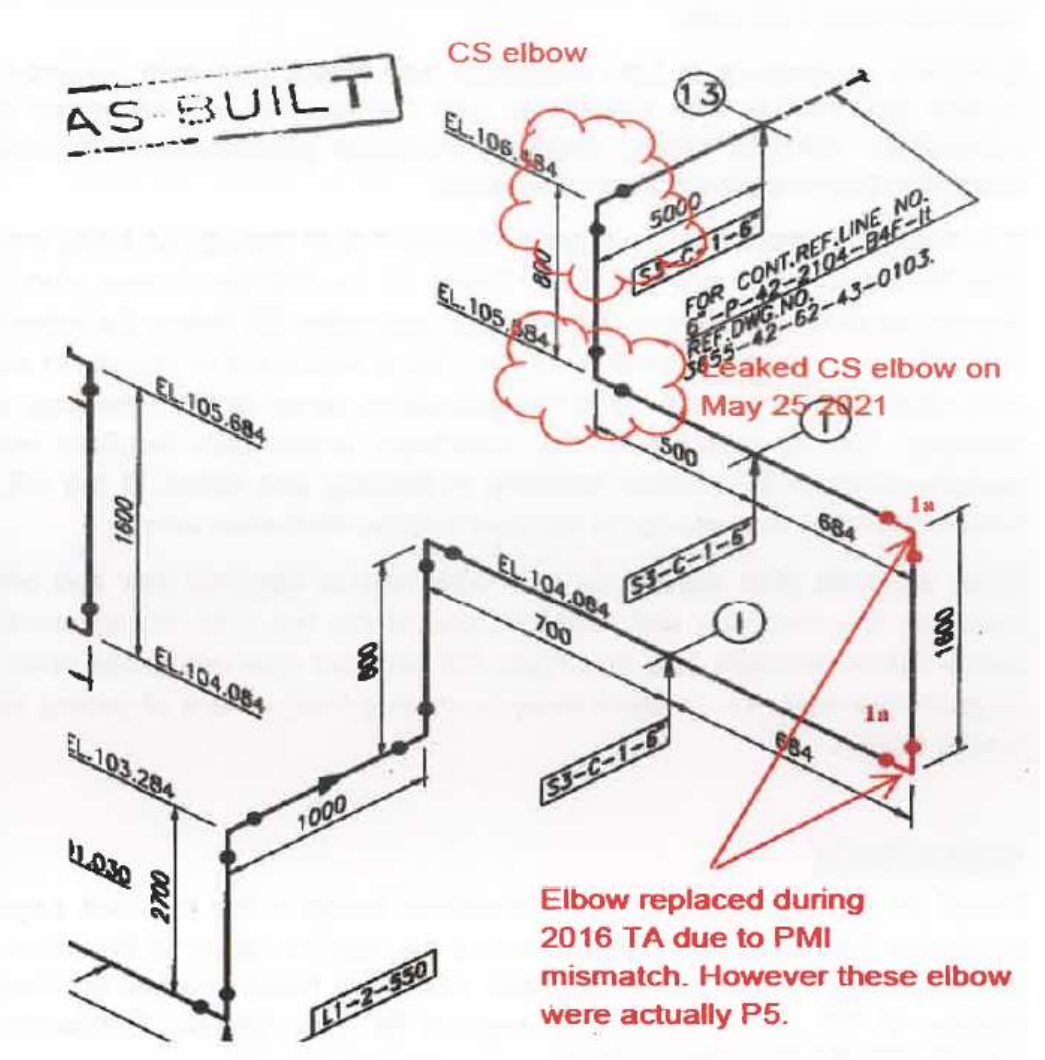
- The said two CS elbows were installed by mistake during Projects execution in 1999.
- During 2016, two separate isometrics were used by PMI and UTG agencies. Subject two elbows were identified as CS and marked on the PMI isometric.
  - A different set of two adjacent elbows were inadvertently marked while transferring from the PMI isometric to UTG isometric and attached with Inspection recommendation.
  - Wrong marking resulted in replacement of two P5 metallurgy elbows instead of identified CS elbows. One of these CS elbows failed leading to the subject incident.



# ACTIONABLE LEARNING

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- Revised Inspection SOP is put in place to ensure usage of correct metallurgy at fabrication stage and during repairs.
    - Implemented Four stage PMI checks: 1) At Vendor site by HPCL TPI; 2) At Warehouse; 3) At Fit-up stage and 4) Before Hydro test.
    - PMI and UTG related Inspection recommendations are issued with separate isometrics.
    - Joint certification by Inspection and Executing department is established to ensure correct metallurgy usage at original fabrication/replacement stage.
- Integrity operating windows (IOW) for critical circuits are developed and implemented in line with API RP 584.

# Thank You