

# CASE STUDY

## Electrocution due to violation of Work Permit System

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### A. INTRODUCTION

A Fatal incident occurred at one of the Refinery on 14<sup>th</sup> November 2012 at around 12:35 PM. During the incident a contractor employee got electrocuted at field while working on 6.6KV HT motor of Sulphur Recovery Unit (SRU). The deceased person received burn injuries from electrocution after coming in contact with the 6.6KV power source and was immediately shifted to Refinery Hospital, where he was declared brought dead.

### B. THE INCIDENT

Main Combustion Chamber (MCC) air blowers-01/02/03 in SRU supplies air to the main burner to burn as much H<sub>2</sub>S as required to obtain 0.5 - 0.7 vol. % H<sub>2</sub>S at the outlet of the 3rd reactor stage.



**Fig1: Photograph showing MCC air blower-01/02/03**

On the date of incident at around 01:30 AM, SRU shift engineer observed that MCC air blower-03 was not developing the required flow. Immediately, MCC blower-02 was started & taken in line to meet the process requirement. However, field operator couldn't stop MCC blower-03 from field. SRU shift engineer referred this problem to sub-station electrical operator, who in turn switched 'OFF' the MCC blower-03 breaker from 6.6KV HT switchboard.

SRU shift engineer applied isolation for MCC blower-03 in electrical permit book kept in SRU control room. He then requested sub-station electrical operator to collect same from C/R & carry out necessary isolation from sub-station. Electrical operator didn't turn up to collect the isolation permit from SRU control room, and MCC blower-03 remained energized during night shift (6.6KV breaker 'OFF' but in 'Service' position).

In morning shift, new SRU shift engineer misinterpreted the isolation status of MCC blower-03 & issued Clearance certificate (Work permit) to electrical maintenance for attending motor 'field stop' problem. Meantime, electrical testing group verbally requested electrical maintenance to disconnect power cables of MCC blower-03 for Diagnostic testing job through external agency. Electrical maintenance disconnected the field power cables of MCC blower-03, so that testing jobs can also be started simultaneously. After that electrical maintenance attended field start/stop TNC switch, and it appears

that while doing so they accidentally 'Closed' the MCC blower-03 motor breaker from sub-station. With breaker closing, the power cable of MCC blower-03 got charged to 6.6 KV upto the motor terminal box.

Electrical testing along with contractor employees reached incident site at around 12:30 PM for diagnostic testing on MCC blower-03. Deceased person approached the MCC blower-03 to note down the name plate details, and got electrocuted after coming in contact with charged power cables.

### C. CRITICAL OBSERVATIONS

- Instructions regarding electrical isolation permit for MCC blower-03 & follow-up actions in morning shift were not clear in logbooks of SRU shift engineer & sub-station operators, on duty in Night shift.
- SRU shift engineer in Morning shift issued Work permit (clearance certificate) to electrical maintenance without actually confirming in writing that electrical isolation has been carried out by sub-station operator.

It may be noted that sub-station operator issue isolation certificate after ensuring breaker/switch is racked-out to 'isolated' position, and thereby ruling out any possibility of getting it 'ON' from field push-button or local panel.

- Reason for not isolating MCC blower-03 in night shift itself couldn't be established, as there were contradictory statements from SRU production & Sub-station electrical operators.
- As per the extant procedure, after clearance certificate is issued by production department certifying equipment is electrically isolated, it is not mandatory that maintenance group shall also check & verify equipment isolation status from sub-station.
- From the incident it was clear that when Electrical maintenance disconnected the power cables of MCC blower-03, the 6.6KV breaker at sub-station end was still in 'OFF' condition otherwise he would have been first to get electrical shock. It is only while attending the field TNC (Trip-Neutral-Close) switch that the breaker switched 'ON' from sub-station, and power cable got charged up to the motor terminal box. This possibly happened while E/M was tightening the control wirings & shorted the TNC 'close' contact, or while checking the freeness of TNC switch & moving it towards 'close' position.
- Work permit system was well defined in Refinery Safety manual.
- It was found that safety audit of complete electrical system was carried out every year, but there was no random checks/review to validate compliance to work permit system by higher level officers.
- MCC blower-03 6.6KV feeder from HT switchgear was tripped on earth fault protection.
- The incident site was found little cramped. It appeared that while noting down the name plate details of MCC blower-03, contractor employee stood on blower discharge pipe & took support of motor terminal box. In the process, he got electrocuted after touching the exposed power cable accidentally charged to 6.6KV voltage.



Motor name plate located adjacent to cable terminal box.

Motor cable terminal box - open at the time of Incident.

**Fig: MCC air blower -03 HT motor & cable terminal box.**

#### D. ROOT CAUSE ANALYSIS

1. Production shift engineer while issuing the clearance certificate to electrical maintenance misinterpreted the breaker status (Isolated/ OFF) of MCC blower-03 either due to unclear logbook instruction or miscommunication with sub-station operator.
2. Some of the maintenance activities related to incident were carried out without getting clearance certificate from production. Electrical maintenance disconnected the power cables of MCC blower-03, though clearance certificate was issued to attend 'field stop' problem only. Electrical testing also requested power disconnection job directly to electrical maintenance instead of getting clearance from production first.
3. There was no back-up system against inadvertent operation due to wrong communication, poor job knowledge or human errors. Maintenance group should also exercise their control over hazardous power source by system like lock out and tag out (LOTO) wherein production & maintenance group provide individual lock out device (e.g. Pad Lock) at power source after verifying the isolation status, and ensuring no energisation can be done without their permission. Tag out device provides information about the nature of the lock out, and warns operating personnel not to energize electrical equipment.

#### E. RECOMMENDATIONS

1. Strict adherence to standard operating procedures (SOPs) for work permit system to be ensured by working personnel of production & maintenance departments.
2. Before issuing clearance certificate (work permit), it must be ensured in writing that electrical isolation has been completed by isolating the breaker/ switches, and providing precautionary tags duly signed with date & time.
3. All shift activities & follow-up actions should be clearly recorded in Logbook.
4. Electrical audits should include verification of electrical permit system & its compliance w.r.t OISD-STD-I05 by higher level officials more frequently, to ensure there is no deviation in the electrical isolation/ energisation activities.
5. LOTO (lock out tag out) must be implemented wherein production & maintenance groups shall provide individual locking & tagging to ensure avoiding untoward incident & exercise control over the hazardous situations.



LOTO activity started after the incident

**Fig: MCC air blower-03 breaker in 6.6KV HT switchboard**