

**REPORT ON FIRE INCIDENT IN SAP INSTRUMENT UPS PANEL ROOM ON  
29.11.2013 AT 22:20 HRS**

**Dated: 03/12/2013**

A committee comprising of following members was nominated by competent authority to investigate the incident of fire in UPS room of SAP on 29.11.2013 night:

- 1) Mr. C N Shah, JGM (Process),
- 2) Mr. J P Srivasatava, JGM (Utility)
- 3) Mr. R. K. Swain, Sr. Mgr (Elect.)

Committee immediately visited site in the morning of 30.11.2013 to get the first hand information and relevant details required for:

- To investigate the reasons for fire in UPS room of SAP on 29.11.2013 and
- To give recommendations / suggestions to avoid reoccurrence of such fire incident in future.

**Following Personnel of respective sections present at site during the fire incident were interviewed.**

**SAP Control Room operators**

- 1) Mr. Parminder Singh – Dy. Mgr (SAP- Process)
- 2) Mr. Shiv Kumar Singh Kuswaha – Asst. Mgr (SAP- Process)

**Instrumentation Dept.**

- 3) Mr. Karttika Chandra Nayak – Jr.Tech (Inst.) Gr-I.

**Electrical Dept.**

- 4) Mr. Satyajit Kar – Asst. Tech (Elect.) Gr-I.

**Fire & Safety**

- 5) Mr. Vinod Kumar Shukla – Senior Technician Gr. 10
- 6) Mr. Sanat Kumar Manna – Senior Fire Man Gr-II
- 7) Mr. S.N. Das – Fire Man Gr-I.

## **1.0 Plant condition before fire accident in UPS panel room.**

Both SAP were operating normal with SAP-I operating at sulphur firing of 31 t/h and SAP-II operating at sulphur firing of 27 t/h.

## **2.0 Sequence of events before and after fire accident**

In night shift on 29.11.2013 at 22.05 hrs, SAP Process control room Engineer observed annunciator alarm indicating UPS incoming power fail and it was immediately informed to Instrument technician.

Instrument technician visited the UPS room and diagnosed the alarm was due to incomer fail to UPS-2 and load was on battery bank. UPS-1 was running normal.

Instrument technician immediately informed to electrical technician to check power supply from MCC end for UPS-2.

Electrical technician checked power supply to UPS-2 at MCC end and found normal. In the meanwhile at 22:15 hrs, control room Engineers / operators observed sound like heavy hammering / sound from heavy object falling from surrounding area. It was assumed the hammering sound was due to leakage in LPS2 steam line but on checking at site steam line was found to be normal and other areas also no abnormality observed.

At approximately at 22:20 hrs, control room engineer observed black smoke from Marshalling cabinet room and immediately informed Fire & Safety department. He also informed T.G. Control room for possible emergency shutdown for both SAP1& 2.

Firemen arrived at 22:25 hrs and took stock of the situation. They observed control panel room and DCS room being rapidly occupied with black smoke and visibility getting zero. Control room to marshalling room door was locked and they made entry to UPS room by breaking back side door.

At 22:40 hrs UPS power was cut-off. Control room lighting also went off and the room was rapidly being filled with black smoke. Control room engineers/operators made exit through windows.

The burning battery banks initially tried to extinguish by CO<sub>2</sub> extinguisher and later DCP extinguisher were used to completely extinguish the fire and the entire process was completed in 2 hours.

### **3.0 Testimony statements**

#### **3.1 Testimony from Mr. Parminder Singh – Dy. Mgr (SAP- Process) & Mr. Shiv Kumar Singh Kuswaha – Asst. Mgr (SAP- Process)**

- 1) At 22:05 hrs Annunciator alarm indicated UPS incoming power fail and it was immediately informed to Instrument technician and then after about 10 minutes to electrical technician as the alarm was ringing at regular interval..
- 2) At 22:20 hrs hammering sound / some material falling sound was heard from and they immediately checked LPS2 header to check for any steam line leakages and other areas. No abnormality was found.
- 3) After 5 mins, black smoke was observed in instrument panel room and immediately informed Fire & Safety and TG control room to get prepared for emergency shutdown of SAP 1 & 2.
- 4) At 22:30 hrs took control shutdown of turbines and SAP.
- 5) At 22:45 hrs DCS power went off and also room was being filled with black smoke. Also control room light went off. All Engineers / operators made an escape through window due to zero visibility in the main door.

#### **3.2 Testimony from Mr. Karttika Chandra Nayak – Jr.Tech (Inst.) Gr-I.**

- 1) At 22:20 hrs received call from DCS operator indicating UPS incoming fail.
- 2) Immediately checked UPS panel and observed UPS-1 on normal power and UPS-2 came on battery bank load.
- 3) Informed to Electrical technician at 22:25 hrs to check power to UPS-2 at MCC end and went to toilet.

- 4) Heard series of explosion sounds at 22:30 hrs and immediately went towards DCS room. Within 4 to 5 minutes again heard explosion like sound.
- 5) After coming to control room, closed the door of DCS room to SAP control room to avoid smoke entry and broke the back side door of UPS room.
- 6) SAP Panel In-charge asked to stop power to DCS and informed to Electrical Technician accordingly.

### **3.3 Testimony from Mr. Satyajit Kar – Asst. Tech (Elect.) Gr-I.**

- 1) At 22:25 hrs received call from instrument technician indicating UPS incoming power fail to UPS-2. After some time, received call from DCS operator to check SAP UPS incoming power.
- 2) Immediately checked UPS-2 power at MCC end and it was found to be normal.
- 3) No explosive sound was heard in MCC room.
- 4) At 22.35 came down and seen black smoke in DCS control room.
- 5) At 22:40 HRS UPS-2 and by pass to UPS power was disconnected and UPS-1 power was left on. Same was informed to Dy. Mgr. (Electrical).

### **3.4 Testimony from Mr. Sanat Kumar Manna – Senior Fire Man Gr-II & Mr. S.N. Das – Fire Man Gr-I.**

- 1) At 22:25 Hrs received call from Mr. Gupta (SAP) to extinguish fire in SAP DCS room.
- 2) Immediately rushed to SAP control room with four member Fire team. Seen heavy black smoke in the DCS room. Also seen reddish fire below the battery bank stand.
- 3) Collected CO2 extinguishers and DCP extinguishers available in the plant.

- 4) Could not enter the UPS and DCS room as it was locked. Lock could not be broken. The glass of the back side door was broken for entry to extinguish fire.
- 5) The firemen entered in the UPS room were ready with BA set and fire extinguishers.
- 6) The burning battery banks initially tried to extinguish by CO<sub>2</sub> extinguisher. DCP extinguisher were required to use to completely extinguish the fire and the entire process was completed in 2 hours.

#### **4.0 Observations of committee at site**

The constituted committee visited the accident site on 30.11.2013 at 1030 hrs to identify the root cause of the fire and following are the committee observations.

- By visual inspection, the UPS-2 battery banks damaged completely and some partial damages to UPS-1 battery banks. Most of the batteries of UPS-2 were without case and more than half of the batteries of UPS-1 were without case.
- In the by-pass panel for UPS major fire marks in inside and outside were visible.
- No fire marks observed in UPS panels 1&2, but thermal degradation is observed inside the panel due to the close proximity with the fire. Display unit of both UPS-1 and 2 were burnt. Panel for Bypass of UPS was damaged from inside with fire.
- Both UPS room and DCS rooms were black filled with black smoke even after about 12 hours of fire even though temporary fans were operating for exhausting air.
- DCS panel top portion (exhaust fan) air filters burned.
- Lighting cables fixed on ceiling were hanging in burned condition.
- Both wall mounted split AC and 5 TR AC unit were burnt.
- Fire and safety people contained the fire using CO<sub>2</sub> extinguishers and DCP fire extinguishers.
- There was no damage to the marshalling unit cables. Only panels were black due to smoke particles.
- The aluminium frame partition between Battery room and DCS room was burnt.
- The glasses of the SAP control room were cracked due to fire and may be mini explosion. The partition glass between DCS room and Instrument

panel room has developed some cracks probably may be due to high temperature and pressure built by smoke (or) by impact of plastic shrapnel's during the series of explosion of batteries.

- It is informed by instrument engineer that as per UPS supplier, maintenance free batteries shall be replaced after 3 years of service. Battery bank of UPS-1 was replaced in April, 2013. Battery bank of UPS – 2 was in line since commissioning of UPS in 2007. As per the catalogue of battery supplier, design life of battery is 10 years.
- The battery bank was placed very close to the wall and heat dissipation may be poor.

## **5.0 Possible reasons for explosion / fire of lead acid batteries**

- ### **5.1 Excessive charging electrolyzes** some of the water emitting hydrogen and oxygen. This process is known as "gassing". Wet cells have one way vents to release any gas produced.

If the accumulated hydrogen and oxygen within either a VRLA or wet cell is ignited, an explosion results. The force can burst the plastic casing or blow the top off the battery, spraying acid and casing shrapnel. An explosion in one cell may ignite the combustible gas mixture in remaining cells.

- ### **5.2 lead-acid battery can explode when it is undergoing a heavy discharge** because it is producing Hydrogen gas, H<sub>2</sub>(g), at this time. The gas is given off from the Sulfuric Acid (H<sub>2</sub>SO<sub>4</sub>) as it reacts with the lead plates in the battery. If there is a source of ignition nearby, a spark from "jumping" a dead battery is plenty to do it. You can imagine the mess it could make as the battery can literally 'come apart' throwing acid, lead and pieces of the battery case 15 to 20 feet in all directions.

### **5.3 Improper setup**

If the battery is set inadequately in its base, or if the cables are improperly attached to the terminals, sparks may occur which ignite the gases emitted by the battery.

### **5.4 Sparks**

Sparks due to short circuit etc. near the exhaust vents through which the

harmful buildup gases escape the battery can ignite them, causing the battery to explode.

- 5.5 Many lead acid explosions are believed to occur when electrolytes are below the plates in the battery and thus, allowing space for hydrogen/oxygen to accumulate. When the battery is engaged, it may create a spark that ignites the accumulated gases and causes the battery to explode.
- 5.6 It was observed that there was complete damage of electrical components in bypass panel to UPS i.e. SCVS (Servo control voltage stabilizer) panel due to fire that may be due to loose connection of wires inside the panel. Spark would have generated during the operation.

No physical cable damages was observed in incoming power cables from MCC to UPS panels. Hence fire due to electrical short circuit in power cable to UPS may not be a possibility.

## 6.0 Conclusion

The UPS – 2 was on battery load. Hence the battery bank of UPS-2 was on discharging mode. The generation of hydrogen from batteries can be due to discharging operation of UPS-2 batteries and possible spark from any source as mentioned above or spark due to electrical start / stop of split AC or over heating in any of the more than 6 year old batteries of UPS – 2 may would have led to fire in one of the over heated battery and than series of battery bursts.

## 7.0 Recommendations by committee

- 1) The UPS panels and its battery bank shall be kept in separate room to avoid any damage to panels in event of battery fire/explosion. Keep batteries in a well ventilated area away from sparks or open flames. Prevent open flames, sparks or electric arcs in charging areas. Battery room shall have explosion proof fittings. Separate Battery room and UPS room may be considered for all other plants i.e. PAP, DAP, Energy center, boiler , Utility plants etc.
- 2) Battery shall be replaced after completion of its life as recommended by UPS OEM / battery supplier.

- 3) Smoke detectors shall be provided with a Alarm and indication at fire & safety control room for prompt action.
- 4) Separate Annunciator alarm window shall be provided for power fail indication for UPS-1 & 2 and by-pass to UPS.
- 5) Additional alternate doors shall be provided to DCS control room.
- 6) Periodic readings shall be recorded of all UPS panels and control panels.
- 7) Positive pressure shall be maintained in DCS room and SAP control room to avoid ingress of outside atmosphere. This may also be considered for all other plants i.e. PAP, DAP, Energy center, boiler , Utility plants etc.
- 8) The door between DCS marshalling cabinet room and SAP control room shall not be locked.
- 9) The glass provided in the partition of SAP control room shall be shatter proof.
- 10) Schedule of regular checking of the tightness of interconnecting cables of the battery bank
- 11) Proper record of periodic battery checking for battery voltage, charging current, loose connections of terminals etc to be maintained.

  
3/12/13

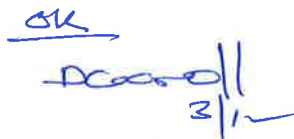
R. K. Swain  
Sr. Mgr (Elect.)

  
3/12/2013

J P Srivasatava  
JGM (Utility)

  
3/12/13

C N Shah,  
JGM (Process),

  
3/12