CASE STUDY

OISD/CS/2024-25/E&P/08 Dt.:04.09.2024

INTRODUCTION

Title: Fire in a Battery Room
Location: Offshore wellhead platform.
Loss/ Outcome: Fire damage to battery room and nearby areas

BRIEF OF INCIDENT:

A fire broke out in the battery room of an offshore wellhead platform of an organization. Smoke was noticed by crew members on a nearby manned platform almost 10 hours after the fire had started. The power supply to the wellhead platform from the FPSO, where well fluids from wells of the platform were processed and which supplied power to the well platform, was cut off and all the wells of the wellhead platform were closed. The fire, triggered by a thermal runaway reaction in the Nickel-Cadmium (Ni-Cad) batteries, resulted in the burning out of 352 batteries. It also caused significant fire damage to the electrical infrastructure and inflicted heat-related damage to the adjacent shelter room.

OBSERVATIONS/ SHORTCOMINGS

1. The battery room contained four banks of Nickel Cadmium batteries. In November 2022, three of these battery banks of a particular make were supplied, installed, and commissioned by an Original Equipment Manufacturer (OEM). These batteries have since been observed to exhibit overheating and high current withdrawal, indicating potential quality or installation issues that may be leading to a thermal runaway reaction.
2. There was a significant delay in deploying the engineers from OEM to investigate the initial heating reports. The organization seemed overly reliant on the OEM to resolve the issue, rather than taking proactive steps or exploring alternative solutions.
3. Despite battery heating issues being reported, the organization failed to implement regular battery room monitoring. No record of monitoring was not available for the last month till the fire incident. Despite intimation from the organization to the OEM about the potential for battery fires and the need for isolation, neither action was taken.
4. The signal alarm due to the presence of smoke in the battery room was transmitted to the SCADA system on FPSO at midnight on the date of the incident. However, the alarms were in an inhibited state and the SCADA system for the Well Head platforms was not being monitored at night. Furthermore, the night data was not reviewed in the morning.

5. There were significant deficiencies in maintaining, documenting, and managing safety-critical equipment. All the three H_2 detectors were faulty. No Bypass was taken to mitigate the risks associated with the non-functional equipment. No authorization from the appropriate management level was obtained to continue operations. There was no record of the calibration of gas detectors positioned near the air intake duct outside of the battery room.
6. A review of the ventilation room's preventive maintenance (PM) records showed insufficient maintenance activities due to the absence of a checklist. Although parameters like insulation resistance, winding resistance, and current drawn were recorded, the ventilation system's efficacy was not evaluated.
7. It was also observed that no internal audit was conducted to assess the hazards and risks of the wellhead platform.
8. Emergency response plan was available at the FPSO. However, the scenario of electrical fire or fire in the battery room was not included in the emergency response platform.

CONCLUSION / ROOT CAUSE

1. The fire incident was due to the continuous overheating and overcharging of the Ni-Cadmium battery banks supplied by OEM which led to a thermal runaway condition within the battery banks.
2. Organization's over-reliance on OEM for resolving battery issues without seeking alternative solutions or taking independent actions led to significant delays in addressing critical battery problems.
3. The absence of continuous battery room monitoring when batteries were heating allowed critical parameters like voltage and temperature to escalate without detection. SCADA system for well-head platforms was not monitored at night, and alarms were in an inhibited state. There was no action for about 11 hours.

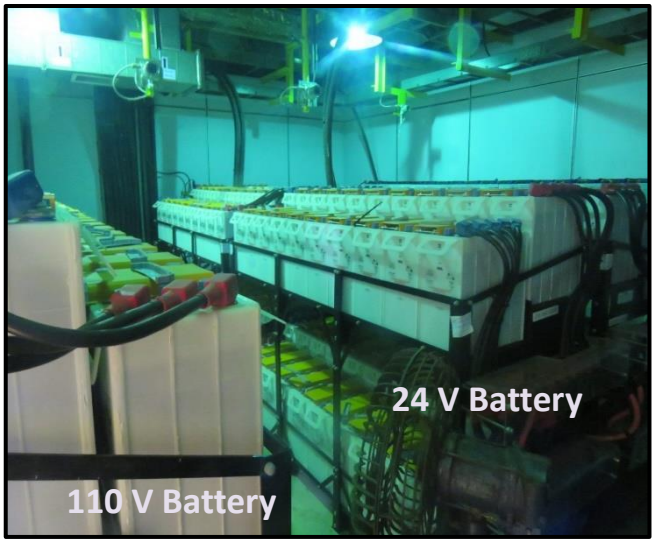
RECOMMENDATIONS

1. **Preventing Runaway reaction in Nickel-Cadmium batteries:**
   a) Battery temperatures should be maintained within optimal ranges as specified by the OEM. [Refer clause 6.2.1.3 of IEEE Std 1635-2012/ASHRAE Guideline 21-2012].
   b) Battery management system (BMS) should be used to control the amount of charge and output of battery systems. BMS are meant to shut down or control the battery before thermal run-away may occur. [Refer to clause 52.3.2 of NFPA-1].
   c) A system to disconnect batteries in case of ventilation failure should be ensured. [Refer to clause 10.3.4.3.7.2 of API 7F-2018]
2. **Competency building:**
   a) The organization should establish a rapid response protocol to address for equipment failures, including battery heating issues, with defined action timelines. This protocol should incorporate contingency plans for independent action when external support is unavailable. To mitigate delays in response to battery heating issues organization should broaden its service provider network beyond the original equipment manufacturer (OEM) by exploring alternative service options.
   b) A training program should be developed and imparted to maintenance crew members to equip maintenance crew members with the knowledge and skills necessary for effective

troubleshooting and maintenance of the battery and charger systems. Basic electrical safety training should be imparted to service officers at the installation as per the requirement of training course 201 and 202 of OISD-STD-176.

3. **Quality assurance during procurement:** A stricter quality assurance procedure should be enforced during battery procurement and installation. The past performance and safety of batteries from different suppliers under identical conditions may be evaluated before procurement.
4. **Battery Banks Monitoring, Preventive Maintenance and Isolation Protocols:**
   a) A detailed preventive maintenance checklist as per OEM guidelines should be developed and followed. It shall be ensured that checklists cover all critical parameters.
   b) The manufacturer guidelines for maintenance, particularly regarding cell voltage levels and procedures for handling cells with voltages below specified thresholds should be strictly followed for troubleshooting as per OEM.
   c) Regular monitoring should be implemented for battery parameters, including temperature, voltage, and current, to detect anomalies early and prevent potential failures. Additionally, clear protocols for isolating batteries should be established if abnormal conditions are detected, ensuring that the risk of overheating or thermal runaway is minimized.
   d) The SCADA systems for Well Head platforms should be actively monitored at all times (both day and night times). The alarm management protocols shall be reviewed and revised to prevent alarms from being inhibited.
5. **Gas and Heat Detection:** All existing faulty hydrogen detectors should be replaced/rectified with reliable ones in the battery room. Calibration of gas detectors and H_2 detectors should be executed without exception as per OEM guidelines/company policy. A bypass should be undertaken with proper level of authorization in accordance with company policy when safety-critical equipment is non-operational or malfunctioning or non-available.
6. **Ventilation System:** The efficacy of ventilation systems in battery rooms should be regularly assessed. The alarm or safety interlock that gets activated upon loss of ventilation should be explored for transmitting signals to the manned station.
7. **Fire Suppression System:** A fire assessment study should be conducted to determine the necessity of a firefighting system in the battery room. [Refer to clause N 52.3.2.7 of NFPA-1, 2018]
8. **Emergency Response Plan:** The scenario for fire in the battery room should be included in the emergency response plan for Well Head platforms. Regular emergency response training drills shall be conducted for personnel to effectively respond to fire and other emergencies on Well Head platforms.
9. **Internal Audit of well-head platforms:** The organization should establish a comprehensive internal audit program for well head platforms to regularly assess the safety and operational integrity of critical systems, including the battery rooms.

PHOTOGRAPHS OF INCIDENT



Photograph of battery room of a similar well head platform

Photograph of burned battery room at the well platform post fire incident

Photograph of shelter room of a similar well head platform

Photograph of shelter room at the well platform post fire incident

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This Case study is based on the Investigation report submitted by committee and published for information purpose only. This information should be evaluated to determine if it is applicable in your operations, to avoid recurrence of such incidents.