

HV / CHP Fire Investigation Summary

Saturday 13th March 2021 20:32

Issue

- Fire in the SMC HV Switch Room (substation 350) which is connected to the SMC Combined Heat & Power (CHP).
- No persons injured or product damaged through this incident, though the potential for harm was clearly present.
- Significant damage caused to the HV switch room, panels and resistor blocks, which require extensive repairs.
- CHP unit offline, no onsite electricity generation through this unit (cost & environmental impacts).

Sequence of Events - Initial Investigation & CPA

- Saturday 13/03/21 @ 02:00: G59 Event Registered (power disturbance on the national grid), In response the CHPs switch off as a safety precaution.
- CBRE restarted the CHP in SMC (and Skin Mill only), the other CHPs were not restarted until Monday 15th March.
- 20:32: Fire alarm raised, fire crew attended SMC HV Switch Room & extinguished fire (SMC now without power).
- 21:30: **CPA Deployed**: CBRE with Quartzelec isolated the CHP power supply, ensuring the CHPs can't be restarted.
- Sunday 14/03/21: Focus on restoring power to SMC for production return on Monday, building confirmed safe:
 - Testing completed on the HV electrical system to provide power to the building (CHP remains isolated).
 - Full building and sub-system (fire, compressed air, etc.) checks complete and OK.
- Monday 15/03/21: Visual inspection completed on all other switch rooms for any warning signs or similar features known at this time - confirmed OK.
- Toolbox talk given by CBRE to engineers to ensure they are aware of CHP restart procedure.
- Centrica (CHP service provider) engaged to restart the remaining CHP engines (following G59 event, except SMC).

Sequence of Events - Further Investigation & Countermeasure

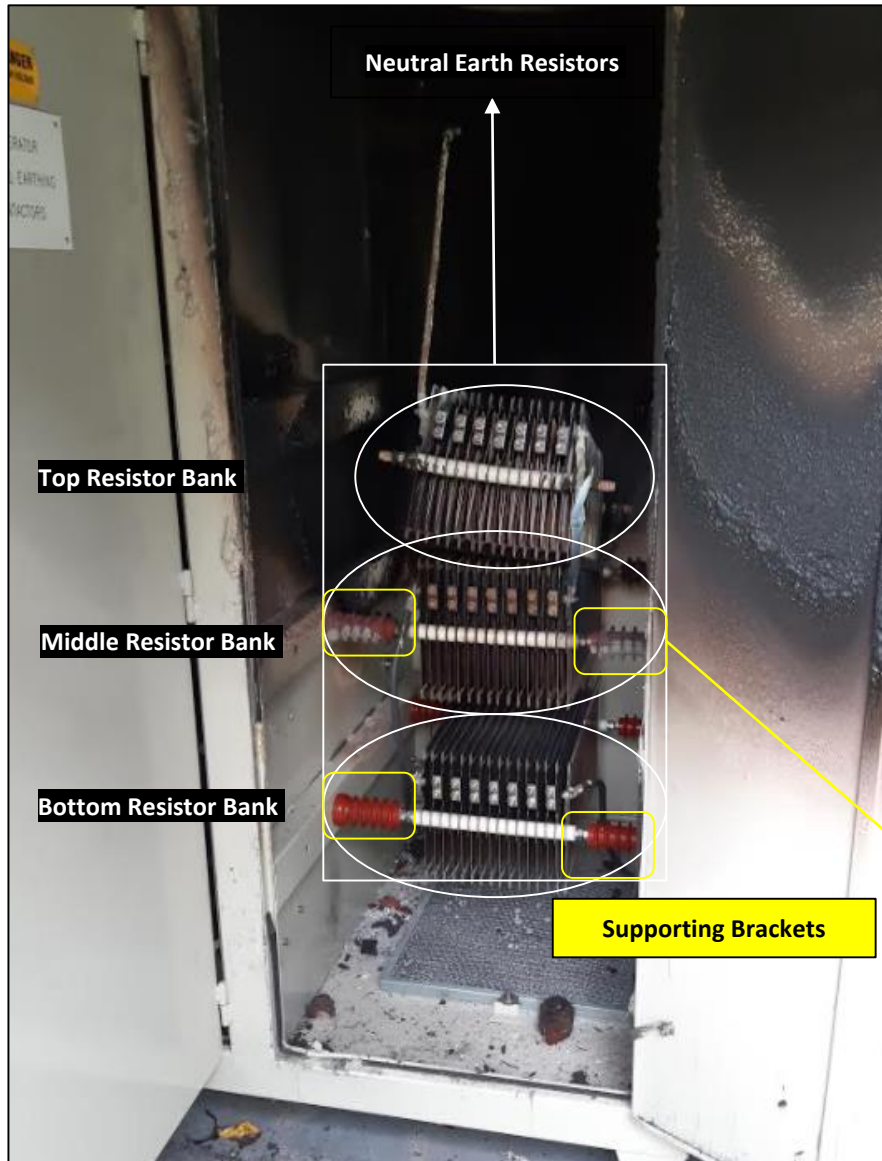
- Thursday 18/03/21: Full investigation started with HV Specialists (EA Technology) and Dennis Faldo (CBRE technical director and HV Specialist) to identify root cause and countermeasure, initial findings complete but investigation ongoing.
- Wednesday 24/03/21: Investigation report received by Airbus, including HV specialist findings, key findings:
 - Potential wiring diagram error
 - Excessive use of the HV circuit breaker
- Friday 26/03/21: CBRE obtained proposals from the HV specialist (EA Technology) for a further detailed technical assessment to establish that all protection was functioning correctly and identify the pre and post failure cause with recommendations for replacement components and suitability of all systems.
- A wide angle check for all features which potentially caused the issue completed - **No further risk**.
- Oil samples from the CHP transformers (Sub Station 350) taken to establish if there is damage to the transformers.

SMC HV / CHP Fire Location & Impacted Area



Location of CHP / HV Switch Panel and Substation 350 at Broughton Site

Investigation Findings

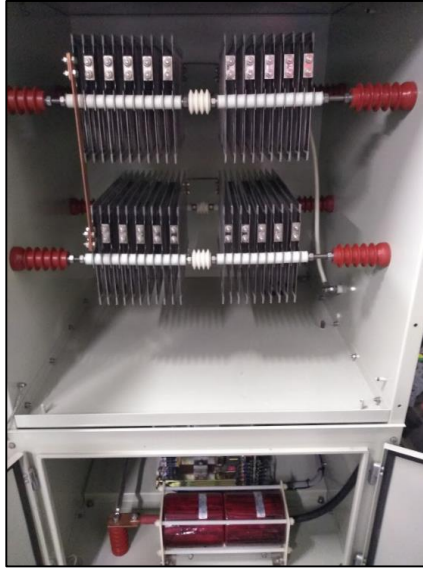


Investigation Findings:

- The fire originated in the HV Switch panel compartments that houses a specific component, **Neutral Earth Resistors (NERs)**
 - *The NERs generate a current to measure the CHP generated electricity and ensure the frequencies match before connecting to the national grid.*
 - The brackets of the top NER bank have failed & the top NER bank has fallen on the middle resistor bank.
 - There is a crack in the supporting brackets of the middle resistor bank > believed to have been caused by the incident.
 - Wide angle check complete on all other CHPs on site & we confirm this feature does **not** exist elsewhere.
 - The G59 event (very uncommon happening 2 or 3 times per year) occurred in the early hours on the same day of the fire and this powers down the CHPs.
 - CBRE restarted the CHPs in SMC and Skin Mill (as they are the only 2 which can be restarted locally), the others remained off until Centrica restarted them on Monday 15/03/21.
 - The protection relays had not been reset before the CHP had been restarted, however the unit would have been trying to synchronise with the grid (done through the NER) and would have failed due to the protection relays being active.
- An extremely excessive number of operations on the circuit breaker have been recorded supporting that the CHP repeatedly tried to connect.
 - This likely overloaded the NER resistor and created excessive heat which could have affected the isolator supports for the resistor.
 - Unable to withstand the heat the NER supporting bracket could have failed allowing the upper resistor to fall onto the middle resistor and cause an arc sufficient to initiate the fire.
 - Potential modes of failure:
 - a. Design error in restart protection systems
 - b. Process error in restart procedure



Wide Angle Checks



A380 NERs & Supporting Brackets - Defect Free



Zoomed in view of A380 CHP Supporting Bracket - Defect Free

Key Next Steps

- Appointment of EA Technology to carry out more detailed inspection and engineering assessment:
 - Detailed technical review of all information available to date.
 - Review relevant trip, alarm and operational status data.
 - Design review of the electrical system.
 - Design review of the protection system.
 - Establish adequacy of existing equipment and proposed changes to equipment / specification etc.
- Detailed review of CHP restart process with CBRE, amendments, training, validation.
- Review of Centrica appointment and 24/7 support moving forwards.
- Reinstatement of the unit is not a quick fix, current estimate is minimum 3 months (lead time confirmation and best commitments needed).