13 February 2024

Unit C4 incident – Technical findings and learnings

CS Energy has released its report on the technical contributing factors to the Callide Unit C4 incident. The report summarises our understanding of what happened on Unit C4, based on the work we have done with a range of experts, including Aurecon and Dr Sean Brady.

What happened and why?

On 25 May 2021 an incident occurred on Unit C4 at Callide Power Station that caused extensive damage to the unit and had a significant impact on the transmission network. The power station was safely evacuated and no one was injured.

Our analysis has found that the Unit C4 incident was the result of the simultaneous failure of key electrical equipment and system back-ups in a series of complex events that could not have been anticipated.

What triggered the incident?

On the day of the incident, a new battery charger for the Unit C4 direct current (DC) system had been commissioned and was being connected to Unit C4. During the connection process, there was a collapse of voltage in the Unit C4 DC system. The new Unit C4 Battery Charger was required to maintain the voltage in the Unit C4 DC system but failed to do so.

What happened when the DC voltage collapsed?

As the voltage in the DC system dropped, it caused the Unit C4 alternating current (AC) system to “trip” (turn off). The loss of AC supply to Unit C4 prevented the recovery of the DC supply to Unit C4.

What impact did this have on Unit C4?

The loss of both the Unit C4 DC supply and Unit C4 AC supply meant that critical systems required for the safe operation of the turbine generator were unavailable. The loss of DC supply meant Unit C4 also lost its ability to disconnect from the grid and shut down safely.

The turbine tripped and was no longer being driven by steam, but was still connected to the grid. It went from generating electricity, to consuming electricity – a process called ‘motoring’. This resulted in the turbine generator continuing to spin. This, in combination with the loss of critical systems, such as lubrication oil pumps, directly led to the destruction of the turbine generator.

What caused this to happen and what has been done to fix it?

1. Interlocking design prevented battery being connected during switching operation

Callide C Power Station’s original design features an interlocking system so two batteries cannot be connected into the same system. This prevents a battery being connected during switching and limits the reliability of the critical DC supply system to that of the AC supply system.

How we have addressed this: We have modified the design of Callide C so that during switching a battery is always connected to provide necessary redundancy for critical protection circuits.

2. The activation of arc flap protection tripped the AC supply

The loss of DC supply incorrectly triggered arc flap protection, which resulted in the loss of AC supply. This resulted in the loss of turbine oil pumps and prevented the battery charger recovering the DC voltage.

How we have addressed this: The arc flap protection logic has been modified so it will not trip in response to short-term deviations in DC supply (such as that which occurred during the C4 event).

3. Automatic Changeover Switch was not operated

The Unit C4 Automatic Changeover Switch (ACS) is designed to automatically change over DC supply to the standby Station DC system. The ACS did not operate automatically as it was damaged during a dual unit trip event in January 2021.

Following the January event, CS Energy undertook an engineering investigation and worked with the Australian Energy Marker Operator (AEMO) to return the units to full capacity. The actions identified during the investigation into the dual unit trip included a modification to the ACS control circuitry. At the time of the Unit C4 incident the modification was not yet ready for implementation, but was within the planned timeframe for the modification.

On the day of the incident, the ACS was available for manual operation, but it was not manually operated. Systems to understand the incident were unavailable in the control room and switching personnel exited the switch room as part of the site evacuation to manage personal safety.

How we have addressed this: The ACS has been modified in two ways:

- The preferred position has changed from the Unit Main Switchboard to Station Main Switchboard. This ensures that protection systems are supplied from different batteries, reducing the impact of a single failure.
- The control circuitry of the ACS has been modified to increase reliability.

4. Failure of the battery charger to maintain voltage.

The battery charger failed to instantly maintain the DC voltage within the required operating range.

How we have addressed this: We are replacing the C4 Battery Charger with a unit that has more redundancy, delivering increased reliability, prior to return to service.

Other safety improvements

We are increasing the redundancy in Callide C's DC supply by adding another battery/charger system. This involves installing an additional switchboard, battery and battery charger. This modification will be completed prior to the return to service of C4.

More broadly, other actions we have taken to improve safety and process safety at CS Energy include:

- We engaged Advisian to assess the condition of plant and equipment at Kogan Creek, Callide C and Callide B power stations and review the effectiveness of CS Energy's Asset Management Systems. Based on their assessments we have incorporated actions into our asset plans.

- We have invested in additional resources and engineering capability. This includes more operators, a dedicated process safety team, and a new Principal Engineer Team with a focus on engineering standards and assurance.

- We have made improvements to a number of our systems, including our incident classification and reporting system and our maintenance backlog system, with better oversight and management reporting.

View an animation of the Unit C4 incident.

Media enquiries

CS Energy Media Line	07 3854 7399