A safer, better CS Energy

July 2024

PURPOSE

As a major provider of energy services to Queensland, CS Energy's number one value is safety.

This response plan outlines how we are applying learnings from the Callide Unit C4 (Unit C4) incident and the Callide Unit C3 (Unit C3) partial cooling tower collapse to bolster the safety, reliability, and resilience of our operations.

This response plan should be read in conjunction with CS Energy's technical report into the Unit C4 incident and the Brady Heywood Report, as well as the investigation report into the partial collapse of the Unit C3 cooling tower.

This plan may evolve as we continue to consult with our people and industry experts.

BACKGROUND

Unit C4 incident

On 25 May 2021, an incident occurred on Unit C4, which resulted in an explosion and substantial damage to the unit, forcing it offline. Shortly afterwards, Callide's three other operating units tripped and went offline. Multiple power stations and high voltage transmission lines in Central Queensland also tripped, leading to a significant reduction of load and temporary separation between Queensland and the rest of the National Electricity Market (NEM).

The training, competency, and professionalism of our people on the day ensured the site was fully evacuated and nobody was injured.

Incidents such as that which occurred at Unit C4 are typically the result of multiple complex technical and organisational factors. In June 2021, Brady Heywood was engaged to lead an external investigation into the incident.

In February 2024, CS Energy published its own report into the technical factors that contributed to the incident and the actions we have taken to protect against a similar event occurring in the future.

Early drafts of three key sections of the Brady Heywood Report were published in June 2024. The Brady Heywood Report was published on 17 July 2024.

Unit C3 partial cooling tower collapse

On 31 October 2022, a structural failure occurred on a section of the Unit C3 cooling tower. Nobody was injured and the unit was immediately taken offline as a precaution.

The condition of the Unit C3 cooling tower was assessed and an investigation into the incident was undertaken. While the Unit C4 cooling tower was not damaged in the incident, its condition was assessed because it was of the same design and age.

It was determined that the safest and best option for returning the Callide C units to service was for both cooling towers to be demolished and rebuilt.

The new Unit C3 cooling tower was commissioned in March 2024 and Unit C3 was returned to service on 1 April.

Construction of the new Unit C4 cooling tower is underway to enable the return service of the Unit C4.

WHY DID THE C4 INCIDENT OCCUR?

Both CS Energy's technical report and the Brady Heywood Report are consistent in the technical factors that led to the Unit C4 incident.

Four key factors were identified:

- **Switching the Unit C4 online without battery redundancy.** Interlocking design prevented the battery being connected during switching operation while online.
- **The Unit C4 battery charger** failed to maintain voltage in the DC system.
- **The loss of AC and DC supply.** Activation of arc flap protection tripped the AC supply.
- **Automatic changeover switch (ACS)** was damaged from a previous event and was not able to operate in automatic mode and recover the voltage in the Unit C4 DC system.

CS Energy has taken action to address these technical factors at all its sites. This includes:

- **220V DC main switchboard key interlock modifications**: Modifying key interlocking circuits to enable batteries to be paralleled, but not battery chargers. This ensures one battery is always connected.
- **Battery charger replacement**: New battery chargers have multiple rectifier circuits, rather than single, that include N+3 redundancy and allows online replacement of faulty components.
- **6.6kV Unit and Station switchboards arc flap protection modification**: Arc flap protection logic has been modified with electric current conditioning to ensure the arc flap protection will be resilient to short term deviations in DC supply.
- **ACS – the normal switch position and reliability modifications**: The normal position has been changed from the Unit Main Switchboard to Station Main Switchboard and the control circuitry for the switch has been modified. This ensures different protections systems are supplied by different batteries – increasing redundancy.
- **Increased redundancy:** Converted the three-battery system into four-battery system.

OTHER LEARNINGS FROM THE BRADY HEYWOOD REPORT

The Brady Heywood Report observed that effective process safety practices were a key organisational factor that could have reduced the likelihood of the Unit C4 incident.

Process safety is about understanding and managing the operational plant hazards that could lead to a catastrophic failure.

There are two key parts to the findings on process safety.

1. Direct factors: Process safety controls relating to technical contributing factors

The Brady Heywood Report finds safety controls specific to the four technical contributing factors were inadequate. These controls include:

- management of change and plant modification processes.
- assessment of process safety risk.
- understanding of risks and controls.
- formal risk analysis documentation around decisions.

2. Wider factors: Process safety culture maturity within the organisation

The Brady Heywood Report concluded that the failure of Unit C4 would have been unlikely had any one of the four technical contributing factors been mitigated. It did however acknowledge that it is highly unlikely that CS Energy could have anticipated that a DC system voltage collapse could result in the arc flap protection operating and lead to the loss of the AC supply to Unit C4.

The report did identify that at an organisation-wide level there was not sufficient understanding of our overarching process safety risks.

The report notes there were a variety of influences on this, including:

- under resourcing, and a change of focus in the process safety program that resulted in a process to create bowties for each site (which visually map out hazards and controls) not being completed.
- a variety of competing initiatives, along with significant turnover of key roles, impacting the focus on process safety.
- not a strong enough focus on process safety performance; and learning from incidents was not well communicated or implemented and addressed symptoms rather than root causes.
- a range of external influences impacting on CS Energy.

WHY DID THE C3 COOLING TOWER INCIDENT OCCUR?

The investigation report into this incident concluded that the root cause of the partial collapse of the Unit C3 cooling tower was unfavourable water chemistry. The cooling towers were being operated with elevated chlorine and high pH levels in the cooling tower water. High chlorine levels were implemented to eliminate the risk of legionella and safeguard human health. This led to the accelerated degradation of the timber components of the cooling towers and loss of strength in the structure.

The investigation report also identified other factors that contributed to the partial collapse, including defects from original construction of the cooling towers, with the chemical erosion caused by the chlorine and pH levels making the defects in the timber prematurely significant. While previous inspections and repairs had been undertaken and a planned refurbishment was about to commence, there were also difficulties in accessing the cooling tower structure in order to inspect and carry out maintenance and repairs.

In designing and constructing the new cooling towers, we have taken onboard the lessons from the cooling tower incident. The new cooling towers use factory-made fibreglass composite material, manufactured and constructed with quality control processes in place. We have also designed access points into the cooling tower structure to aide thorough inspections.

OUR RESPONSE PLAN

These incidents serve as a valuable learning experience for CS Energy. There are lessons not just for our business, but for the broader power generation industry.

The information we have gathered through our own investigations and in working alongside experts such as Aurecon, Brady Heywood and Worley, has given us the insight needed to develop a comprehensive multi-year plan to bolster the safety, reliability, and resilience of our operations.

Importantly, since these incidents we have taken action to progressively improve safety for our people and plant, at Callide and our other assets across the State.

We are committed to learning from the events of 2021 and 2022 and acknowledge there is more to learn and act on going forward across the organisation.

Our goal is to continue to evolve our safety culture to become a High Reliability Organisation. In simple terms, it means becoming an organisation that avoids serious safety events, despite operating in a hazardous environment.

It is about understanding and having awareness of our risks, including that:

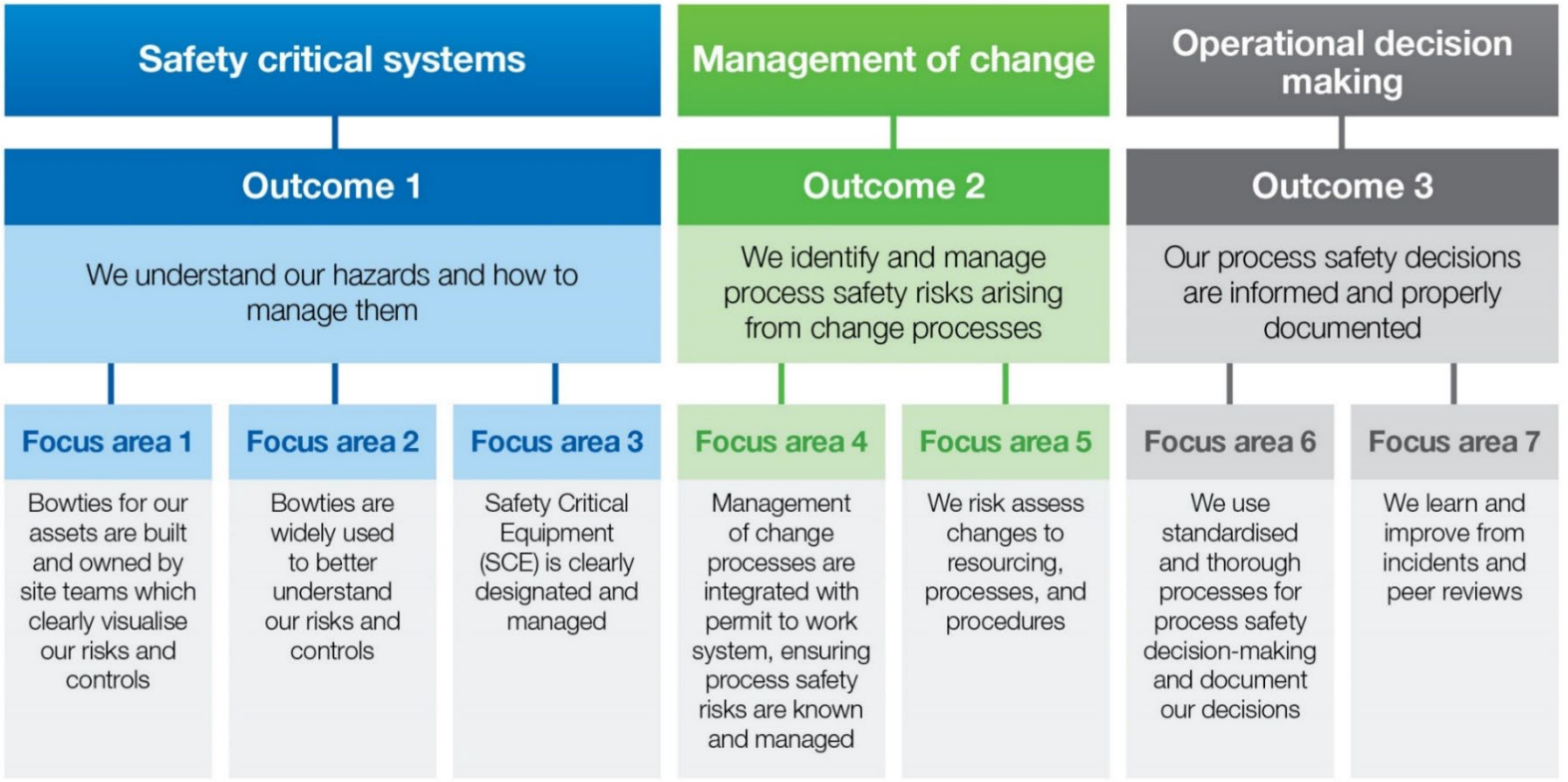
- our safety systems, processes and controls work to mitigate risk to an acceptable level; and
- there is a low tolerance to the risk of failure.

It is a complex and ambitious target to meet. To help get us there, an Independent Advisory Group comprising external experts in safety risk, process safety and organisational design has been established. This group will guide and support us in developing and implementing a plan that clearly outlines milestones for transforming CS Energy into a High Reliability Organisation. The group reports directly to the Chief Executive Officer, with direct access to the Board.

This response plan underpins our overarching goal to becoming a High Reliability Organisation. It prioritises investment in systems, plant, and capabilities that will ensure our people are set up for success in managing our technical and organisational risks. Implementation of the plan will require a clear and sustained focus from our Board and our leadership teams.

In addition to regularly reviewing our response plan, we will report annually on our progress against it in our annual report and on our website.

We will improve the safety and reliability of our business by focusing on:



Knowledge and systems Integration

We capture, organise and store knowledge so that it is accessible and helps our employees make informed decisions. Our systems facilitate the seamless exchange and sharing of knowledge and information.

Governance and assurance

We monitor and check work and prioritise improvement opportunities to be safer. We test the robustness of our systems, procedures, and controls against good industry practice. We are accountable.

People and culture

We use our systems and processes to identify potential failures before they occur. We foster a culture of learning from mistakes and encourage people at all levels to speak up, share knowledge and contribute to decision making processes.

ACTIONS COMPLETED

Technical factors of Unit C4 incident	
Interlocking design prevented the battery being connected during switching operation	✓ The key interlocking circuits have been modified to enable batteries to be paralleled, but not battery chargers. This will ensure that during switching operations a battery can always be connected to provide necessary redundancy for critical protection circuits. This modification has been applied to Unit C3, Unit C4 and Station 220V Main Switchboard.
The activation of arc flap protection tripped the AC supply	✓ The arc flap protection logic has been modified with electrical current conditioning so it will only trip if the arc flap switch operates in association with a high electrical current. This will ensure the arc flap protection will be resilient to short term deviations in DC supply. This modification has been applied to Unit C3, Unit C4 and Station 220V Main Switchboard.
Automatic changeover switch was damaged and unable to operate in automatic mode	✓ The ACS has been modified in two ways: – The normal position has been changed from the Unit Main Switchboard to Station Main Switchboard. This will ensure that 'X' and 'Y' protection systems are supplied from different batteries, reducing the impact of a single failure. – The control circuitry of the ACS has been modified to ensure reliability. This modification has been applied to Unit C3, Unit C4 and Station 220V Main Switchboard.
Failure of the battery charger to maintain voltage	✓ The Unit C4 220V battery charger installed at the time of the incident includes a single rectifier circuit and as such any reliability issues may cause the unit to cease operating completely. ✓ The Unit C3, Unit C4 and Station chargers have been replaced with units with multiple rectifier circuits that include N+3 redundancy and enable online replacement of faulty components. ✓ N+3 redundancy means that the three rectifier modules can fail without preventing the charger from providing rated load.
Focus areas	
Safety critical systems	✓ Outcomes from a recent Worley asset management review have been embedded into our forward capital program and asset management plans. ✓ In partnership with expert consultants (Worley) and operational leaders from CS Energy we have re-invigorated our process safety improvement program. This has included establishing a dedicated process safety support team for each site. ✓ Developed new process safety metrics to drive improved performance. ✓ Subset of bowties completed and acquired "good practice" set of power station bowties. ✓ Co-creating with our people a standard for bowtie risk assessment that will allow them to be integrated into daily work.
Management of Change	✓ Centralised how we view open technical modifications, which provides a more holistic view of what modifications are open and which are the priority to close out. ✓ Moved from paper-based to electronic system to manage technical modifications.
Operational decision making	✓ Changed our operational risk assessment process to strengthen the controls around modifications. ✓ Reviewed operational risk assessment process and strengthened this process based on learnings to date. ✓ Established regular incident review and action review processes to capture learnings and respond to root causes. ✓ Defined safety critical equipment and embedded in maintenance management system.

Underpinning investment	
Knowledge and systems integration	✓ Redrafted the Enterprise Scorecard to include process safety measures. ✓ Changed shift changeover process to improve knowledge transfer and daily operational risk awareness. ✓ Delivered the Callide C and Callide B control system simulator projects to improve operator competence and response to emergency scenarios. ✓ Improved drawing management so that we can better understand the correct configuration of plant and fault find.
Governance and assurance	✓ Between Nov 2021 and Feb 2024, completed six independent reviews of process safety risk areas. ✓ Operational risk assessments integrated into our risk management system, improving governance and visibility. ✓ Incident and Hazard Module added to our risk system, improving visibility and monitoring of actions. ✓ Undertaken third party review of risk and compliance function including: – Review by the Institute of Internal Auditors. – Ashurst Risk Advisors maturity assessment and recommendations for capability uplift in risk and compliance. – Board risk management workshop to address the Board's risk appetite. – Worley review of process safety risk management framework. ✓ As a result of these reviews, we have: – Restructured the Risk, Compliance and Assurance function, by separating Assurance and renaming it Internal Audit. Under this new focused Internal Audit function, we have created (and are recruiting for) a new Head of Internal Audit role to lead this uplift. – Six additional new roles have been created in Risk and Compliance to improve capability and capacity. – Refreshed the Internal Audit strategy and planning process, building more assurance into the high-risk areas of the business. This includes adding independent verification processes for audit, risk, obligation and incident actions committed to by management. ✓ Independent Advisory Group established to support process safety and action plans to become a High Reliability Organisation.
People and culture	✓ Changes to the Board and Management team, along with the creation of an Independent Advisory Group and the appointment of two specialist advisors to the Board. ✓ Since May 2021, onboarded 65 new roles at Callide (including 23 Operators, 6 technical, 11 trades) and 15 new technical support/engineering roles. ✓ As part of a program to uplift leadership capability, rolled out training on how to deliver effective performance reviews and measure accountability against performance standards. ✓ Organisational Change Management Function created and change model adopted. ✓ Leadership restructure to support the creation of the Transformation Office to spearhead the implementation of this plan. ✓ Refreshed and rolled out leadership and employee development programs including our safety culture program CODE (Culture, Ownership, Drive, Energy).

ACTIONS PLANNED AND UNDER WAY

Safety critical systems: We understand our hazards and how to manage them.			
Focus areas	**Actions under way**	**What is this action about**	**When**
Bowties for our assets are built and owned by site teams that clearly visualise our risks and controls.	• Build library of bowties and Hazard and Operability Studies (HAZOPs) in a format that makes them easy to use. • Build tranches of bowties prioritised on risk. These will be built as new assets are delivered and regularly reviewed for our existing assets. • Roll out training on how to create and use a bowtie. • Integrate into risk management plans at our sites, including for new assets.	• Brady Heywood Report found the process safety program introduced in 2018 changed focus and a bowtie project was not completed, resulting in a lack of understanding of critical risks. • Bowties are effective tools for visualising risk and understanding controls. They are compiled using cross-functional teams of site teams and external facilitators. • We commit to building bowties with our people and use their expertise and experience. We will share our co-authored bowties and embed them into our work activities.	Tranche 1 Now - June 2025
Bowties are widely used to better understand our risks and controls.	• Incorporate bowties into risk reviews, audits and incident learning reviews. • Create library of bow-tie safety shares. • Leaders communicate the changed approach to bowties.	• Brady Heywood Report identifies the need to develop risk competency. This does not stop at creation of bowties and must translate into using the knowledge from bowties and HAZOPS into risk management.	Tranche 1 June 25 onwards
Safety critical equipment is clearly designated and managed.	• Better define our safety critical equipment based on the output from our bowties. • Ensure any change or work on safety critical equipment is properly risk assessed and documented.	• Brady Heywood Report identifies the need to develop risk competency. Bowties and HAZOPS will ensure we precisely define our safety critical equipment and controls and uplift our process safety risk management.	Tranche 1 Now - June 25
	• Ensure all safety critical equipment is labelled in the electronic work permit system, so everyone has visibility.		June 25 onwards
Management of Change: When changing our plant, equipment, or our process safety resourcing, we identify and manage process safety risks.			
Focus areas	**Actions under way**	**What is this action about**	**When**
Management of change processes are integrated with permit to work system, ensuring process safety risks are known and managed.	• CS Energy is currently upgrading our paper-based permit to work system to an electronic system. When this rolls out, we will integrate management of change processes into the new system. • The current procedure to return plant to service has been changed. There are now additional checks in the commissioning process when there has been a modification or change.	• Management of change is a term used in industrial workplaces that describes the systematic approach to managing the physical, operational, procedural, and people aspects of any change. It recognises that even a temporary change adds an element of risk. • Brady Heywood Report identified that management of change processes were sometimes not used.	End 2025 Mid 2025

	• Create definitions and communicate on what is a complex, simple or temporary change to assist risk assessment, workflow and procurement.	• Creating a linkage of management of change processes into the permit to work process will provide a further check point before work commences that any required management of change and risk assessments have occurred and are documented. • Brady Heywood Report found the procurement of the Unit C4 battery charger was characterised as a like-for-like replacement and therefore its installation did not adequately consider all risks. Adding procurement checkpoints will ensure our specification and scopes are risk assessed and that testing for duty scenarios is done before use.	
	• Build in procurement check points to confirm documented risk assessment processes within management of change.		End 2024
We risk assess changes to resourcing, processes and procedures.	• Develop and implement a process for risk assessing the changes to the way we work that might arise as a result of a plant upgrade or modification or changes to resourcing.	• Brady Heywood Report found that the subsequent change to a process or workflow resulting from a physical change to plant was not known, risk assessed or documented. This included documenting decisions to not undertake work. • We need to document risk assessments including those for doing the work as well as not doing the work.	Mid 2025
Operational decision making: Our process safety decisions are informed and documented.			
Focus areas	**Actions under way**	**What is this action about**	**When**
We use standardised and thorough processes for process safety decision-making and document our decisions.	• Review switching processes to include risk assessment update on the day of switching inclusive of plant status change on the day of the switching.	• Brady Heywood Report found instances where there was no evidence of documenting risk assessments. We need to document our risk assessments and these need to leverage the risk competency we develop with bowtie and HAZOP creation. This has specific application within switching procedures.	End 2024
	• Using our suite of bowties and HAZOPs to assist in documented risk assessment.		End 2024
	• Develop and make available to everyone a Process Safety dashboard that makes risks and issues visible.		End 2024
We learn and improve from incidents and peer reviews.	• Update process for reviewing all process safety incidents and demonstrate how learning is captured and used.	• Brady Heywood Report found that not all process safety incidences or near misses became learning opportunities. This is another necessary step to building risk competence, looking for weak signals and becoming a reliable organisation that builds a culture around learning.	End 2024
	• Create standardised learning summaries that can be shared with all teams.		End 2024
	• Create a risk-based system for seeking peer review of safety critical decisions and process safety residual risk.		Mid 2025

We will underpin these actions by investing in:

	Actions under way	What is this action about	When
Knowledge and systems integration	• Establish our Transformation Office to better prioritise, integrate and ensure our strategy to execution processes deliver the transformation.	• Brady Heywood Report found that there was data, information, or knowledge in the business that was not used to support risk assessment or decision making.	Oct 2024
	• Implement controls and training so all users of our risk and audit system understand how to effectively manage risk and close out corrective actions.		March 2025
	• Invest in upgrading CS Energy's digital infrastructure, how data is governed and used, and how systems integrate.		Ongoing
Governance and assurance	• As part of re-defining the Internal Audit function we are recruiting a new Head of Internal Audit leader who will have a direct reporting line to an Executive, and regular interaction with the CEO and Board and Audit Committee Chair outside Committee meetings. • In addition, we are recruiting additional in-house specialists while continuing to work with external experts. Once onboarded, the team will maintain clarity of roles across the three lines of defence (operational management, risk compliance, and internal audit) to provide assurance at every level.	• The Brady Heywood Report found audits surfaced issues around process safety and management of change, but these did not result in corrective actions to address the root cause. These actions will help ensure that when audits raise weak signals or governance issues that action to address these are implemented and measured.	End of 2024
	• Internal Audit will have a focus on uplifting the capability across the business including implementing a new process that will require management to take action to address the root cause of issues and eliminate repeat audit findings. • This will include management sign off on risk mitigation actions and priorities, and independent verification reports to the Board.		End of 2024
	• To achieve cultural change, roll out a risk and resilience education and training plan, focusing on education, sharing learnings and testing risk control effectiveness.		Throughout FY25
	• Enhance the Enterprise Risk Management system to improve data governance and reporting capability, in line with the risk management framework uplift.		March 2025
People and culture	• With the support of the Independent Advisory Group, Worley and the Jonah Group, establish a Board endorsed multi-year roadmap to transform to a High Reliability Organisation.	• The Brady Heywood Report indicates organisational factors that could have been identified and mitigated. Being highly reliable in a hazardous industry requires adoption of new attributes and behaviours to shift culture.	November 2024
	• As part of becoming a High Reliability Organisation, implement the plan to create a culture of learning where there is a free flow of bad news, problem identification is encouraged and used to facilitate a change where there is greater risk awareness and interrogation of what could go wrong.		Multi-year program end 2027

Glossary

Abbreviation	Term
AC	Alternating current.
ACS	Automatic Changeover Switch.
Bowties	A diagram which visually maps out hazards and controls.
DC	Direct current.
HAZOP	Hazard and Operability Studies.
HRO	High Reliability Organisation. An organisation that avoids serious safety events, despite operating in a hazardous environment.
IAG	Independent Advisory Group. Panel of experts appointed to assist CS Energy with our goal to become a High Reliability Organisation.
MOC	Management of change.
NEM	National Electricity Market.
Permit to work (PTW)	The Permit to Work (PTW) system works to provide all workers safe access to plant and equipment, by managing access and minimising the level of risk via isolating plant and controlling associated hazards.
Process safety	Process safety is about understanding and managing the operational plant hazards that could lead to a catastrophic failure.

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