Chemeca2026
Innovate. Integrate. Impact.
28 – 30 September 2026
Melbourne, Australia

Hazards Australasia 2026

Chemeca 2026 and Hazards Australasia
28 – 30 September, Melbourne, Australia

Critical Minerals: Lessons from Major Incidents in a Changing Energy Economy

Andrew Shepherd and William Sydes

Major Hazards Facilities, Specialist and Regulatory Services, QLD

Andrew.Shepherd@oir.qld.gov.au

ABSTRACT

In Australia, the term *critical minerals* is defined by federal and state governments as metallic and non-metallic elements that are both essential to modern technologies, the economy, national security, and subject to a heightened risk of supply disruption. Australia's current critical minerals list comprises 31 materials used across batteries, renewable energy systems, aerospace, defence, and advanced electronics. Export earnings for 2024–2025 is estimated at approximately AUD 7.6 billion, with lithium, nickel, and rare earth elements representing the highest-value commodities. The latest project pipeline identifies around 130 critical mineral studies and developments underway.

Whilst the expansion of Australia's critical minerals sector is both capital-intensive and fast-tracked, it also introduces a range of chemical and engineering challenges. Many of these facilities present hazards more commonly associated with chemical processing plants than with traditional mining operations, and therefore require robust, fit-for-purpose safety management systems.

This paper reviews several recently reported process-safety incidents at critical mineral facilities (both domestic and international), which are increasing in frequency. The intent of this work is therefore to support the safe development of future critical mineral projects.

The key conclusions drawn from this review are: energy-release events remain the leading cause of catastrophic failures and commissioning/maintenance phases present disproportionately higher risk.

Several recurring systemic weaknesses were identified across the incident records prior to the incidents occurring, notably: acid loss-of-containment, gas-accumulation events, hydrogen build-up and pressure excursions.

Therefore, there is a need for critical mineral projects to have robust safety assessment, safety management systems and emergency response frameworks. This will ensure that the risks during projects can be adequately managed, as well as promoting safe handover and continuity to the operate phase practitioners.

In addition, critical mineral projects may have safety implications on the broader supply chain because of the introduction of additional hazard classes. This includes the transport and storage of large quantities of hazardous materials and Schedule 15 chemicals.

Taken collectively, a few recommendations emerge from the research presented here. Rapid scaling of critical mineral production, particularly in newly established or emerging processing hubs, elevates risk when process maturity and safeguard development lag expansion.

These findings also underscore the need for legislation that adequately addresses the major risks inherent in critical mineral operations, supported by robust licensing, regulatory oversight, and assurance systems tailored to the sector.

KEY WORDS

Critical minerals, major incidents, lessons learned.

BIOGRAPHY

Andrew has been involved in the resources and energy industry for 30 years in various technical and leadership roles. He is a fellow of Engineers Australia and has a PhD in chemical engineering from Heriot Watt University, UK

CONFERENCE PROGRAM

Please indicate which conference program your abstract relates to:

x☐ Hazards Australasia

☐ Chemeca