Welding Undermatching of the Eastern Gas Pipeline in NSW – Terms of Reference for an Engineering Technical Risk Assessment

Background

The NSW Department of Climate Change, Energy, the Environment and Water (NSW DCCEEW or 'the Department') has requested independent advice from the Office of NSW Chief Scientist & Engineer (OCSE) on the risk of pipeline failure due to weld undermatching[1], particularly of the Easten Gas Pipeline (EGP) in NSW.

Several pipeline failures in other countries over the past decade have been attributed to a combination of weld undermatching and ground movement. As some operating pipelines in Australia (including the EGP) have similar external operating environments and material specifications to those that have failed elsewhere, these incidents raise the possibility of similar failures occurring in Australia under similar circumstances.

Divergent opinions on the risk posed to Australian pipelines from weld undermatching in specific contexts have emerged from various assessments and reviews.

Scope

The independent advice (the Review) aims to evaluate the scientific and technical literature and professional opinions of subject matter experts on the risk of a full-bore rupture of the EGP from weld undermatching on the section of this pipeline that traverses the Illawarra Escarpment. In particular, the Review will focus on weld undermatching on high strength steels and the physical environment characteristics of potential areas which can cause stress on the pipeline, such as the Illawarra Escarpment. The Review will inform the Department's position on whether the issue poses an unacceptable risk.

Key questions for this desktop review include:

Design, construction and welding procedures

- What range of grades of high strength pipe does the weld undermatching risk apply to?

[1] The term "weld undermatching" in pipeline engineering refers to a condition where the yield strength or tensile strength of the weld metal is lower than that of the base pipe material. This mismatch can affect the structural integrity and performance of the pipeline, especially under high stress conditions (such as can be created from ground movement caused by a landslip or subsidence).

- What grades of pipe (e.g. X70) and welding consumables are specified along different EGP segments in NSW?
- Was weld metal strength qualification verified against base metal properties (tensile and yield strength)?
- Were any sections constructed using materials with known variability in mechanical properties (e.g. imported pipe, legacy stock, or mixed mill batches)?
- How do design assumptions align with standard requirements (e.g. AS/NZS 2885.2 and ISO 3183) on weld matching? Have studies been undertaken on the appropriateness of these standards by any jurisdiction?
- What welding standard was in place in Australia at the time of construction?
- What welding procedures were approved, and were any deviations recorded during construction?
- Were mechanised welding systems used, and if so, how was weld quality consistency verified?
- Were field girth welds subjected to post-weld heat treatment (PWHT) or not?
- Are there records of rework, repair welds, or sections that required abnormal welding parameters?

Operational and Environmental Factors

- Where are the key locations of environmental concern?
- Have there been any recorded strain events (ground movement, subsidence, landslips, or thermal expansion) along the EGP corridor that could amplify undermatching risk?
- How does operational pressure and temperature cycling influence the likelihood of weld overstrain?
- Are there known locations with high bending stresses (e.g. river crossings, horizontal directional drilling sections) that overlap with girth welds?
- Are there sections with hydrogen exposure or blending trials that could influence weld toughness or embrittlement risk?

Integrity Management and Monitoring

- Has undermatching risk been included in the pipeline's integrity management plan and risk register?
- What is the frequency and scope of inline inspections and how sensitive are tools to girth weld anomalies?

- Have any inline inspection or dig-up results identified anomalous strain, deformation, or weld failures?
- Have there been any dig-ups or direct inspections of the girth welds along the section of the EGP where there are known areas that could cause external stress on the EGP (such as along the Illawarra Escarpment). If so, what were the results?
- How has residual stress or strain data been used in previous risk assessments? How is it being used in ongoing assessments?
- What mitigation measures (e.g. strain-based design criteria, weld repair protocols, surveillance frequency) are in place?

In addition to above, the Review will also look at benchmarking and lessons learned from other jurisdictions. For example:

- Have there been similar investigations into undermatching risks in comparable pipelines in Australia?
- How do welding procedures and material controls on the EGP compare to other Australian or international pipelines (e.g. in the US, EU or China)?
- Are there current or historical incidents globally that inform best practice for managing undermatching in X70 or similar steels?

The Review will:

- Conduct a literature review of existing relevant data and papers.
- Analyse and summarise position statements from Australian and international research and industry experts on weld undermatching and associated considerations.
- Engage technical experts to provide independent advice regarding weld undermatching and possible risks.
- Carry out targeted stakeholder consultations to test, validate, and reanalyse preliminary findings from the literature review and expert advice.

Out of Scope

The Review is not intended to be a compliance assessment. The advice will not include policy recommendations or implementation planning.

Process

Final report will be delivered in mid-2026 and will be published on OCSE website.

OCSE will deliver this work within internal staff resources, costs associated with engaging external technical experts will be recovered from the Department.