

Trip of New England Solar Farm Transformers 1 and 2 on 5 October 2022

March 2023

Reviewable Operating Incident
Report under the National
Electricity Rules





Important notice

Purpose

AEMO has prepared this report in accordance with clause 4.8.15(c) of the National Electricity Rules, using information available as at the date of publication, unless otherwise specified.

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Contact

If you have any questions or comments in relation to this report, please contact AEMO at system.incident@aemo.com.au.

The NEM operates on Australian Eastern Standard Time (AEST). All times in this report are in AEST.



Abbreviations

Abbreviation	Term
AEMC	Australian Energy Market Commission
AEMO	Australian Energy Market Operator
AEST	Australian Eastern Standard Time
CT	current transformer
DNSP	Distribution Network Service Provider
ITC	inspection test checklist
kV	kilovolt/s
NEM	National Electricity Market
NER	National Electricity Rules
NESF	New England Solar Farm
REF	restricted earth fault
TNSP	Transmission Network Service Provider

Incident review

This reviewable operating incident¹ report is prepared in accordance with clause 4.8.15(c) of the National Electricity Rules (NER). It has been prepared using information provided by Transgrid², Essential Energy³ and NESF Pty Ltd as Trustee for New England Solar Project Trust⁴, and from AEMO systems.

Table 1 Summary of event

Details	
Reviewable operating incident type	<ul style="list-style-type: none"> Non-credible contingency event impacting critical transmission elements.
Incident details	This report relates to a reviewable operating incident ⁵ that occurred on 5 October 2022 in New South Wales. The incident involved the trip of the New England Solar Farm (NESF) 330/33 kilovolt (kV) transformer 1 and transformer 2 which disconnected the 330 kV B busbar at Uralla substation.
Incident classification	Other causes – human error. During installation and commissioning of the current transformers (CTs) on the NESF 330/33 kV transformer 1 and 2, X-set restricted earth fault (REF) CT polarities were inverted. A subsequent network disturbance resulted in tripping of both NESF transformers for an event where they were expected to remain connected.
Generation impact	Nil
Customer load impact	Nil
Related incidents	On 4 September 2022, a reviewable incident occurred at the Uralla and NESF 330 kV substations. The root cause for this previous incident was also identified as human error – insufficient isolations on the NESF protection panel. For full details please see AEMO’s published report ⁶ .
Pre-incident conditions	Prior to the event, NESF was out of service and isolated via 33 kV circuit breakers SF_INC1A, SF_INC1B, SF_INC2A and SF_INC2B.
Incident key events	<ol style="list-style-type: none"> At 1548 hrs on 05 October 2022, the Armidale to Walcha South 66 kV line tripped. Simultaneously, Uralla 330 kV circuit breakers 5012, 5022, 5412 and 5422 opened. This tripped both NESF 330/33 kV transformers 1 and 2 and disconnected the 330 kV B busbar at Uralla. Figure 1 shows the configuration following the event. At 1410 hrs on 18 October 2022, the NESF 330/33 kV transformers 1 and 2 were returned to service.
Incident cause	<p>Post-incident investigations by Transgrid and Essential Energy have confirmed:</p> <ul style="list-style-type: none"> A scissor lift being operated by a third party made contact with the Armidale to Walcha South 66 kV line, causing this line to trip⁷. The investigation into the root cause of the scissor lift contacting the 66 kV line is ongoing and outside the scope of this incident report. Simultaneously, NESF 330/33 kV transformers 1 and 2 unexpectedly tripped. It was later identified that the REF protection relays operated incorrectly for an out-of-zone fault, causing the NESF transformers to trip. <p>Further investigations by NESF concluded that:</p> <ul style="list-style-type: none"> During the fault, the NESF 330/33 kV transformers 1 and 2 HV neutral CTs measured 25 A primary current, which caused the set X HV REF protection to operate and trip NESF 330/33 kV transformer 1 and 2. The cause of the trip was identified as human error. The X-set REF CT polarities were inverted on both transformers during the installation and commissioning process of the NESF 330/33 kV

¹ Reviewable operating incidents are defined by NER clause 4.8.15(a) and the Australian Energy Market Commission (AEMC) Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

² Transgrid is the Transmission Network Service Provider (TNSP) for New South Wales.

³ Essential Energy is a Distribution Network Service Provider (DNSP) in New South Wales.

⁴ NESF Pty Ltd as Trustee for New England Solar Project Trust is the registered participant for New England Solar Farm (NESF).

⁵ See NER clause 4.8.15(a)(1)(i), as the event relates to a non-credible contingency event; and the AEMC Reliability Panel Guidelines for Identifying Reviewable Operating Incidents.

⁶ The published reviewable incident report is at https://www.aemo.com.au/-/media/files/electricity/nem/market_notices_and_events/power_system_incident_reports/2022/trip-of-uralla-330-kv-b-bus-and-330-kv-cb-5012-on-4-september-2022.pdf?la=en.

⁷ The Armidale to Walcha 66 kV line is owned by Essential Energy.

Details	
	<p>transformers 1 and 2. This led to a network disturbance, causing NESF transformers to trip when they were expected to remain connected.</p> <p>During the investigation, it was also identified that NESF 330/33 kV transformer 1 and 2 330 kV neutral CT secondary terminals were incorrectly wired to 800/1 CT turns ratio rather than 500/1.</p>
Power system response (facilities and services)	There were no other material impacts on the broader power system, load, or generation.
Rectification	Following the incident on 5 October 2022, NESF has confirmed that the NESF 330/33 kV transformers 1 and 2 polarity of the X-set HV REF CT polarity has been rectified. In addition, NESF 330/33 kV transformer 1 and 2 330 kV neutral CT ratios have been corrected to 500/1. The secondary connection changes have been verified as correct through on-site testing.
Power system security	The power system remained in a secure operating state throughout this incident and the Frequency Operating Standard ⁵ was met for this incident.
Reclassification	<p>AEMO assessed whether to reclassify this incident as a credible contingency event⁸.</p> <p>The cause of this non-credible contingency event was not known prior to the equipment’s return to service and AEMO was not satisfied that this non-credible contingency was unlikely to reoccur. Therefore, AEMO correctly reclassified this event as credible at 1737 hrs on 18 October 2022. As the root cause of the incident had been identified and rectified, AEMO considered this incident was unlikely to re-occur and correctly removed the reclassification of this incident as a credible contingency at 1600 hrs on 21 March 2023.</p>
Market information	<ul style="list-style-type: none"> • AEMO issued Market Notice 102079 at 1657 hrs on 5 October 2022, advising that the NESF as well as NESF 330/33 kV transformers 1 and 2 had tripped. AEMO had not instructed any load shedding and was not advised of any disconnection of the bulk electrical load. • AEMO issued Market Notice 102365 at 1738 hrs on 18 October 2022, advising that this incident had been reclassified from 1737 hrs until further notice. The cause of the incident was unknown and AEMO was not satisfied that the non-credible contingency event was unlikely to re-occur. • AEMO issued Market Notice 106862 at 1600 hrs on 21 March 2023, advising that AEMO considered this event unlikely to re-occur and that the reclassification of this incident as a credible contingency has been removed.
Conclusions	<p>AEMO has concluded that:</p> <ol style="list-style-type: none"> 1. On 5 October 2022, the Armidale to Walcha South 66 kV line tripped after a scissor lift contacted the circuit. At the same time, the NESF 330/33 kV transformers 1 and 2 tripped, which disconnected Uralla 330 kV busbar B, due to the unexpected operation of the NESF transformer REF protection. 2. AEMO correctly identified the need to reclassify this incident as a credible contingency until the cause of the incident had been identified and rectified. Subsequently, NESF confirmed that the NESF X-set REF CT polarity inversions had been corrected. As the root cause of the incident had been identified and rectified, AEMO considered this incident was unlikely to re-occur and removed the reclassification of this incident as a credible contingency at 1600 hrs on 21 March 2023. 3. The power system remained in a secure operating state throughout this incident. 4. The root cause of the incident has been identified as human error – during the installation and commissioning process, NESF 330/33 kV transformers 1 and 2 X-set REF CT polarities were inverted. Subsequently, the NESF transformers tripped in this event for a network disturbance where they were expected to remain connected. 5. NESF has confirmed that, for future projects and wherever REF protection is affected by an equipment replacement/installation, a specific inspection test checklist (ITC) will be used. This ITC will incorporate primary injection testing to verify CT ratios, polarities, and protection stability.
Recommendations	AEMO plans to share the findings from this event with the Power System Security Working Group by Q3 2023.

⁸ AEMO is required to assess whether or not to reclassify a non-credible contingency event as a credible contingency event – NER 4.2.3A(c) – and to report how the reclassification criteria were applied – NER 4.8.15(ca).

Figure 1 Post-incident diagram

