Managing the impact of DPV Tripping

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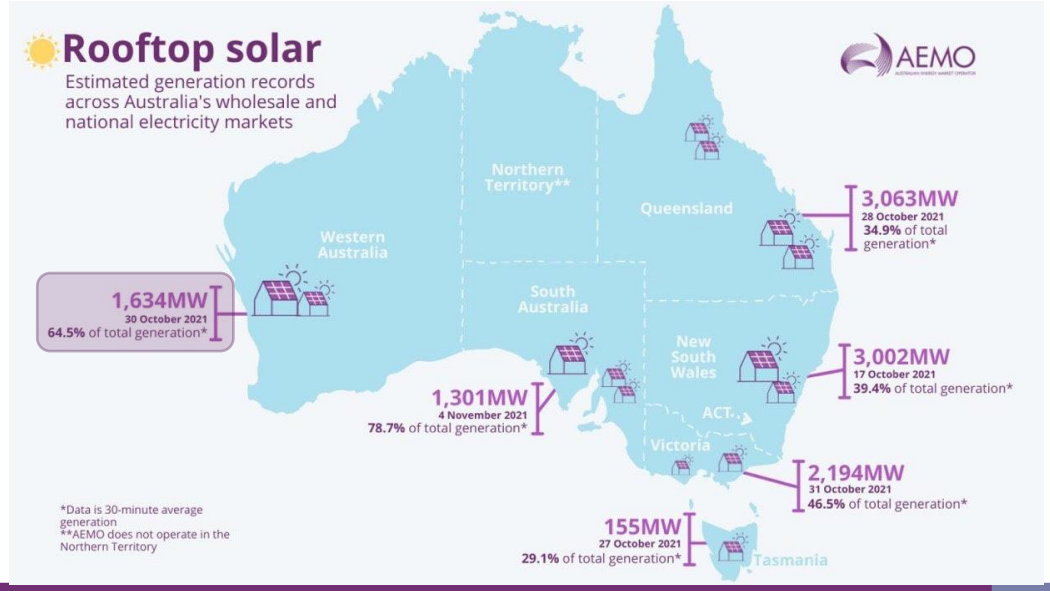
Background

- It has been identified that a proportion of DPV inverters disconnect or reduce output in response to voltage and/or frequency disturbances on the power system.
- AEMO and Western Power have been working to develop a means to estimate the magnitude of DPV disconnection, which happens simultaneously with some loss of load, and understand the impact on the system.
- The loss of DPV, particularly with a utility scale generator, increases the size of the generation contingency.
- To manage system security, AEMO ensures sufficient primary frequency response to prevent Under Frequency Load Shedding as a result of a single credible contingency.
- While the analysis that underpins these outcomes has progressed significantly, there is ongoing refinement as better information becomes available and the outcomes may change over time.

Voltage disturbances are caused by network faults, and vary in impact depending on the type of fault.

Frequency disturbances are caused by generation contingencies, which may include the loss of DPV.



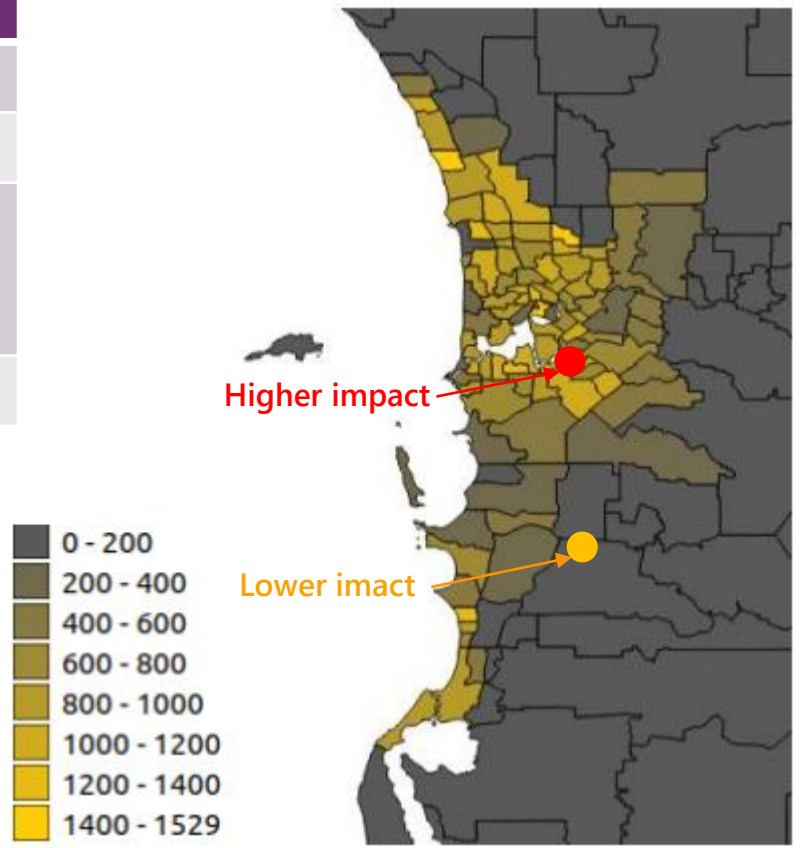
SWIS Generation Contingency

Generation can be suddenly lost in the SWIS in different ways, as given below:

Type	Terminology	Cause (as an example)
Type 1	GEN	Boiler Tube leak
Type 2	DPV	Transmission fault
Type 3	Special Schemes	MARNET - A fault along the line between Northern and Three Springs Terminals and subsequent loss of connected generators and load
Type 4	DPV+GEN	Transmission faults at generator terminals

The severity of DPV tripping is dependant on the type of fault, time of fault and location of fault.

e.g. a fault within the metropolitan area in the middle of a clear weather day will result in greater DPV loss.



Installed DPV by postcode (kVA/km2)

Managing Frequency Stability

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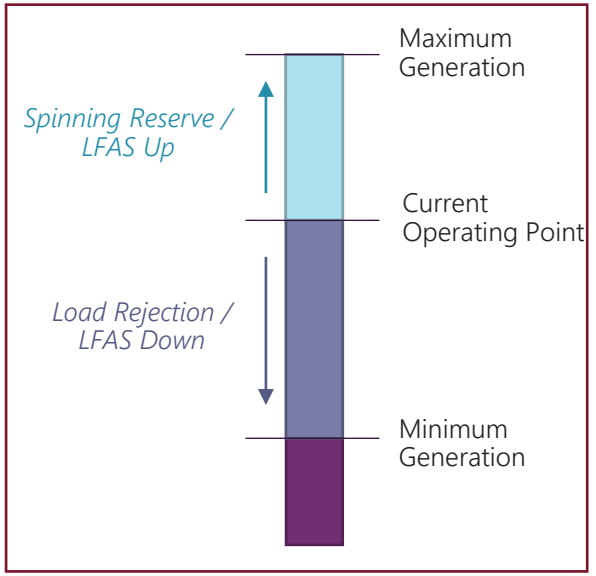
Factors Affecting Frequency Response

Factor	Better Response	Worse Response
System load	Higher load	Lower load
System inertia	Higher inertia	Lower inertia
Contingency size	Smaller contingency	Larger contingency
Spinning Reserve quantity	Higher SRAS quantity	Lower SRAS quantity
Spinning Reserve speed of response	Fast SRAS response	Slow SRAS response

- Table above shows five main factors determining frequency response.
- WEM Rules (Clause 3.10.2) considers the Spinning Reserve quantity relative to the contingency size. This will change post implementation of the new ESS Framework.
- This empirical relationship may not sufficiently mitigate the contingency risk in some situations, for an evolving SWIS with high penetrations of renewable energy and DER.
- Further complicating this is the WEM Rules requirement to include LFAS in the quantity of Spinning Reserve, which makes available SRAS a highly dynamic quantity (as LFAS is always being consumed) .



Frequency Stability Results – 5th Sep. 2021

- Study Date: 05/09/2021 (prior to study results being available)
- Study Period: 09:00 – 16:00 (7 hours)
- Fault Types: 3ph, 2ph, 1ph
- Contingency Type: DPV+GEN (155 MW)

Analysis to confirm: If this contingency occurred, would UFLS result?

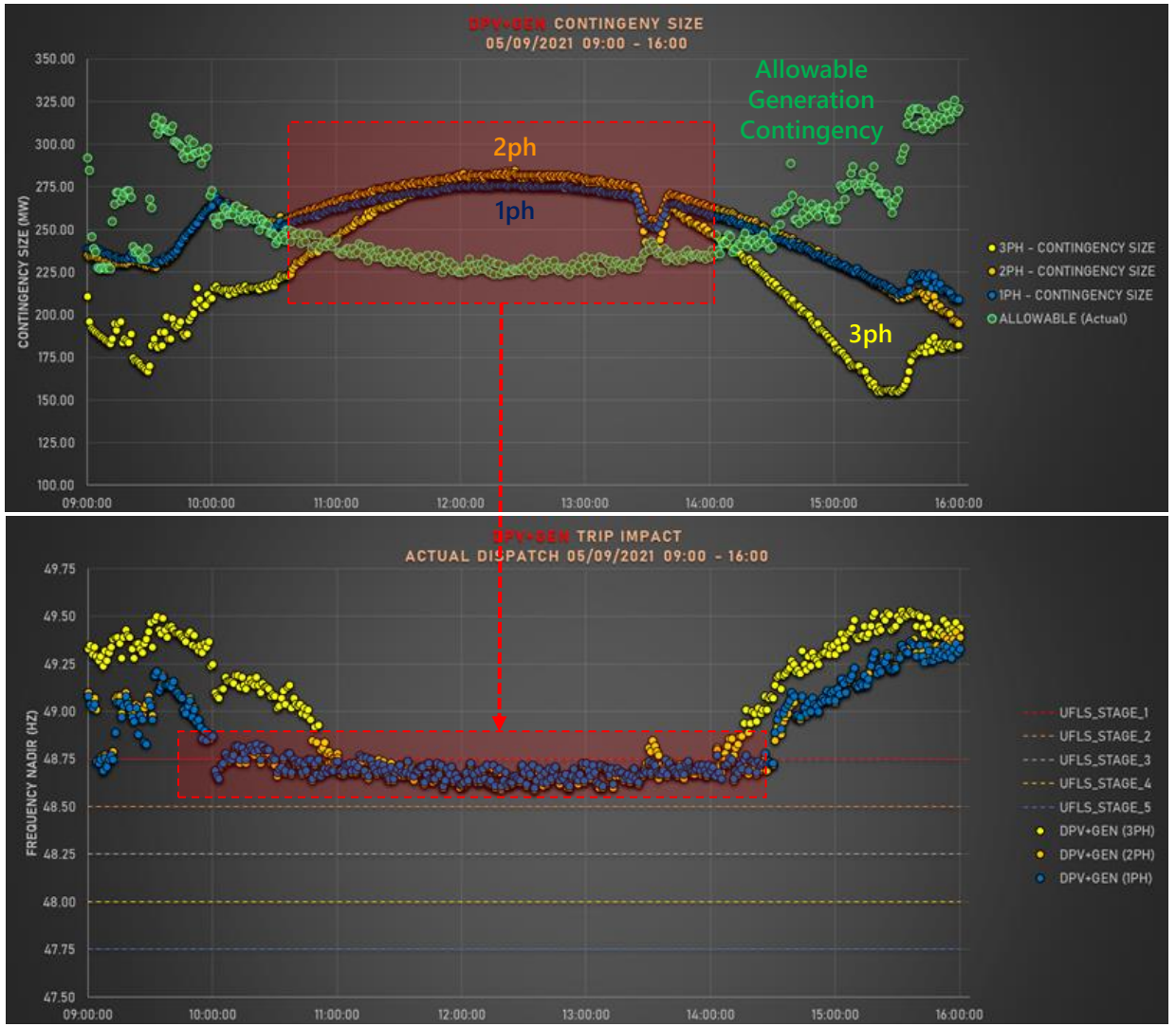
Outcome: there was a period of about 3 hours, that if a specific event occurred, UFLS may have resulted.

(Allowable Generation Contingency = no UFLS predicted)

Feasible Remedial Actions:

- Provisioning higher Spinning Reserve and/or
- Reducing the largest contingency size (DPV or GEN).

GEN @ 155 MW



Frequency Stability Results – Interim Remedial Actions

- The results given below show that a combination of both of the proposed remedial actions could be taken to maintain system security following a transmission fault resulting in the loss of DPV+GEN during low load period.
- This was also a practical manageable option in real time.
- Further analysis is being done to investigate the options of providing greater contingency response and less constraining of the largest unit.

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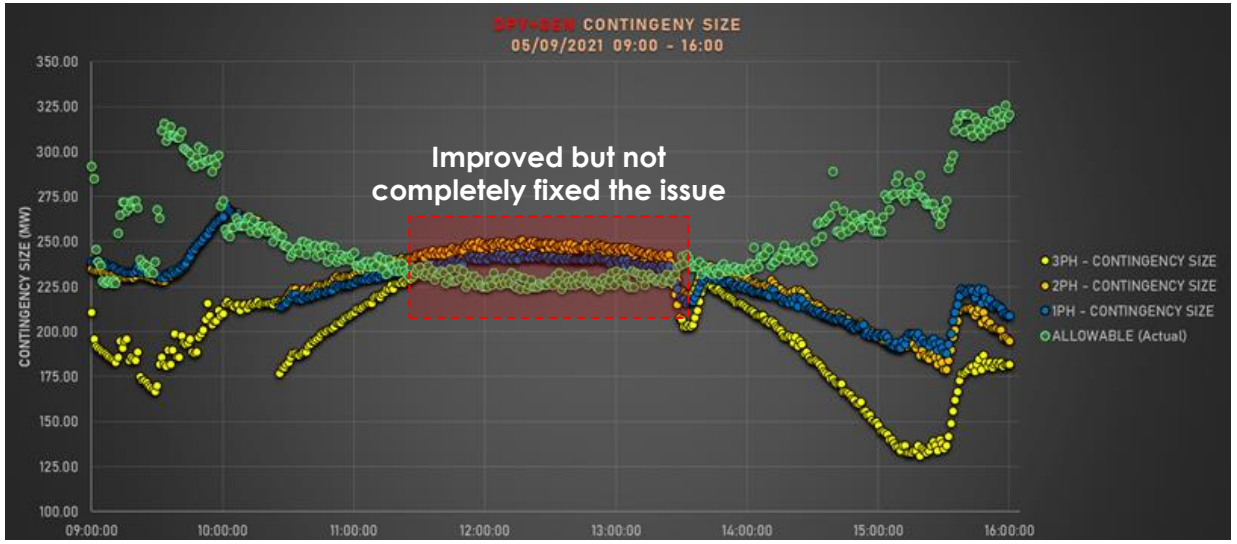
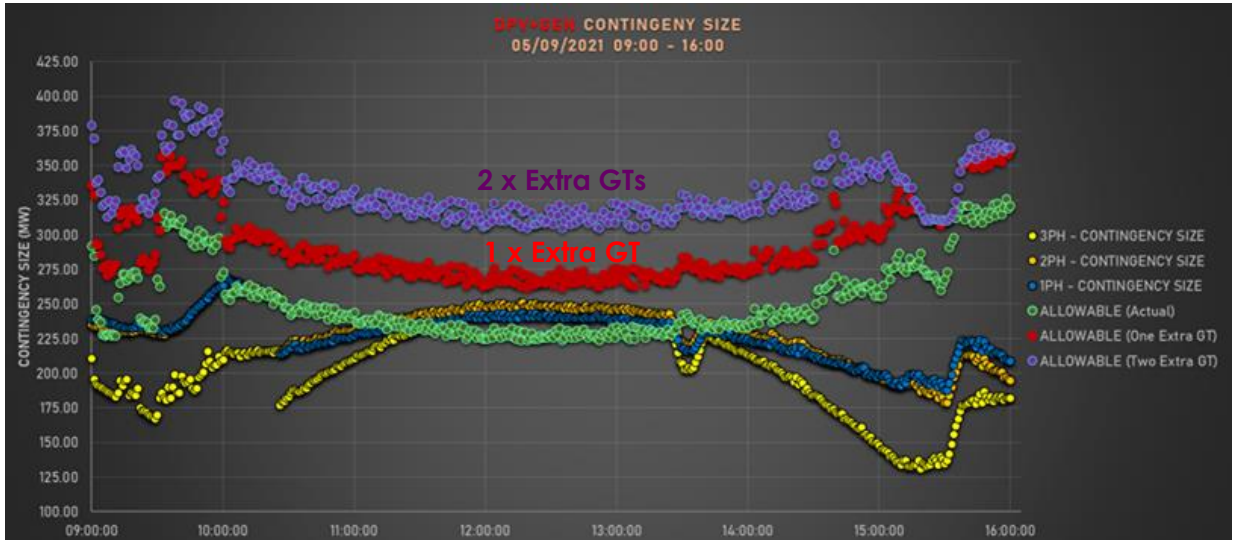
WEM dispatch advisory

Dispatch Advisory ID:	208453
Withdrawal Date and Time:	**20-Nov-2021 12:15:30**
Issued Date and Time:	20-Nov-2021 11:06:17
Operating State:	Normal
Start Date:	20-Nov-2021

Remedial Action 1: Constrain largest unit GEN @ 120 MW



Remedial Action 2: Provision more SRAS Extra Synergy GTs



Conclusion & Future Works

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Actions taken to date

- AEMO must dispatch generation to ensure adequate Spinning Reserve is available to maintain system security taking into account the largest contingency size. This may be within merit or out of merit if additional generators are required.
- If necessary, it may be necessary to constrain down the largest generator to manage the contingency size taking into account extra Spinning Reserves that AEMO can reasonably enable.
- AEMO may cancel or recall the outages on certain parts of the network, which are electrically close to the largest generation unit, to reduce the risk of inadvertent faults that may occur resulting in losing the largest unit in the system, and consequentially DPV.
- Enhanced inverter standards, some components of which were introduced in July 2021 and the new version of AS4777 to be enforced from 18 December 2021, are expected to ensure that the amount of DPV tripping does not increase going forward.
- AEMO's *Renewable Energy Integration – SWIS Update* contains recommendations for additional actions required to support the response capability.

Conclusions and Next Steps

- AEMO is working with Western Power to improve estimates of the amount of load and DPV that may trip during a voltage disturbance and considering exactly what contingencies should be considered credible for this purpose.
- AEMO is currently taking action when these contingencies may occur to mitigate the risk to the system.
- AEMO is considering the operational actions available under the WEM Rules to mitigate this risk to ensure system security during low load and other operating conditions. As the analysis and findings evolve the approach may change over time.
- AEMO is working with Western Power and Synergy to operationalise EWPA's policy to manage DPV under emergency conditions.

For more information

please visit www.aemo.com.au

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