August 11 BGE Load Shed Event

Operating Committee

September 11

Kevin Hatch

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Key Takeaway Slide

- **Transmission import capability limited into Baltimore**
- **Limited but effective economic and emergency actions**
- **Approximately 20 MW of load shed to prevent potential cascade of 1,200 MW**
- **Local Transmission event does not trigger PAI**
- **Strong Coordination between PJM and Exelon throughout event**
- **Previous lessons learned applied** (Bi-annual Voltage Reduction Testing and Cascade situations)
- **Exelon Investigation on-going**

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Background

- RTO temperatures ranged from mid to upper 80s – peak RTO load of 143,562 MW. BGE zone 5238 MW
- Brandon Shores – 230kV Substation located close to Baltimore, MD
- Reports of tracking/arcing on insulators throughout entire station
- Studies identified cascading overloads requiring emergency procedures including pre-contingency load shed

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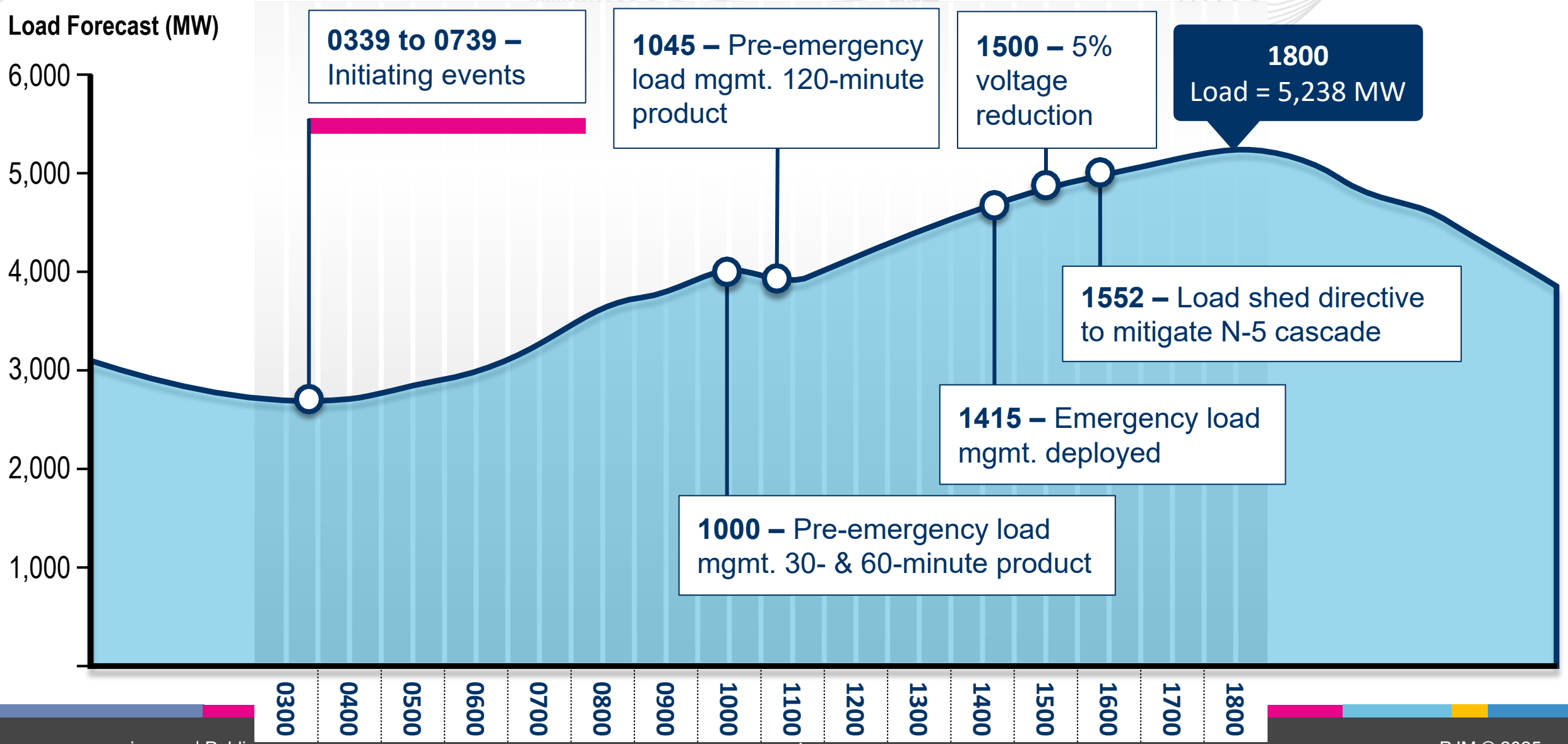
BGE Load Forecast – August 11, 2025



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Timeline – Facility Tripping

0300 | 0400 | 0500 | 0600 | 0700 | 0800

0339
Brandon Shores – Riverside 2345 230 kV line tripped.

0518
Brandon Shores – Waugh Chapel 2343
230 kV line came out of service and Brandon Shores 230 kV bus 3 tripped.

0556
Brandon Shores 230 kV Bus 4 & Brandon Shores – Wagner 2346
230 kV line came out of service.

0626
Brandon Shores – Riverside 2344 & Brandon Shores – Wagner 2347
230 kv lines operated

0739
- **Brandon Shores station service TX, Brandon Shores – Waugh Chapel 2342** 230 kv line came out of service . This resulted in the loss of entire Brandon Shores substation.

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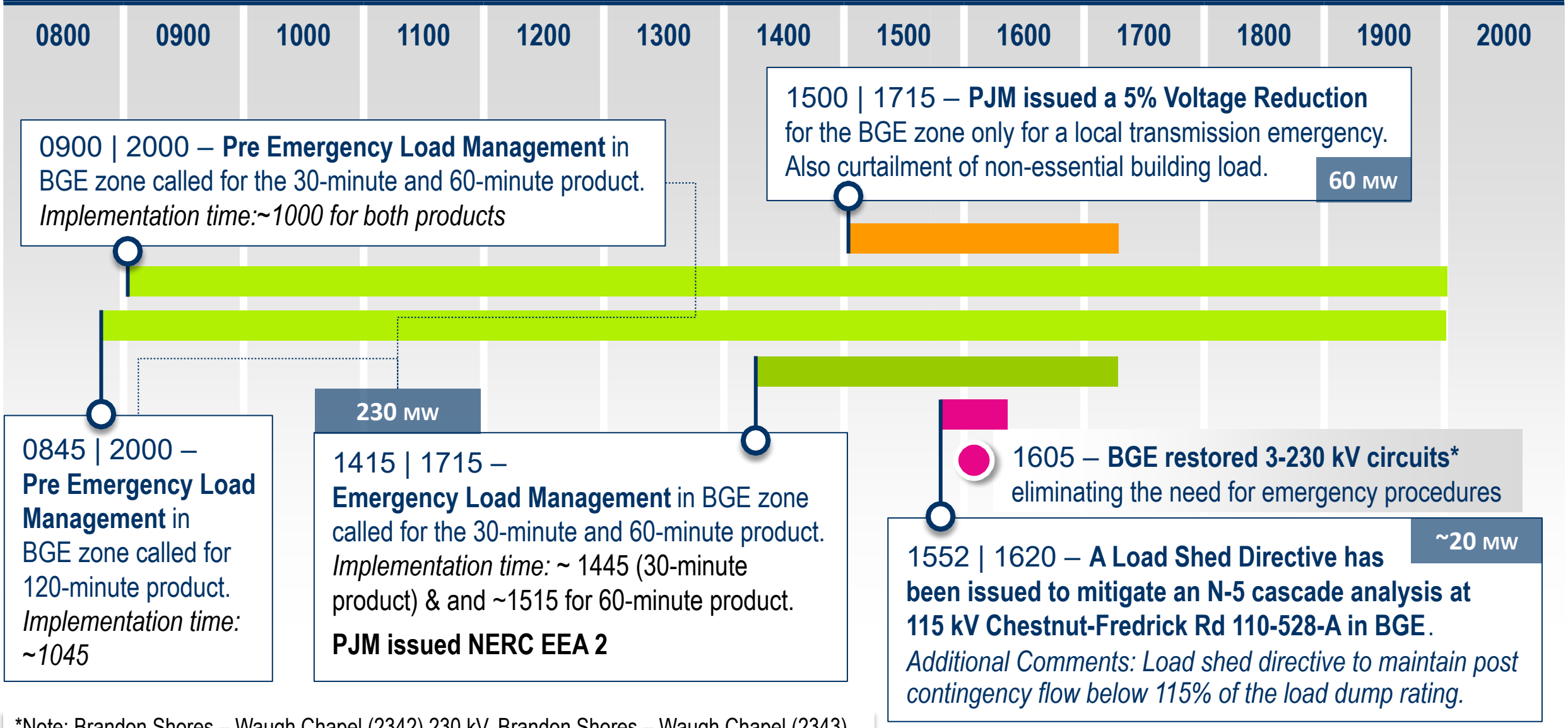
Timeline – Emergency Procedures



0900 | 2000 – **Pre Emergency Load Management** in BGE zone called for the 30-minute and 60-minute product.
Implementation time:~1000 for both products

1500 | 1715 – **PJM issued a 5% Voltage Reduction** for the BGE zone only for a local transmission emergency. Also curtailment of non-essential building load.

60 MW

0845 | 2000 – **Pre Emergency Load Management** in BGE zone called for 120-minute product.
Implementation time: ~1045

230 MW

1415 | 1715 – **Emergency Load Management** in BGE zone called for the 30-minute and 60-minute product.
Implementation time: ~ 1445 (30-minute product) & and ~1515 for 60-minute product.

PJM issued NERC EEA 2

1605 – **BGE restored 3-230 kV circuits*** eliminating the need for emergency procedures

~20 MW

1552 | 1620 – **A Load Shed Directive has been issued to mitigate an N-5 cascade analysis at 115 kV Chestnut-Fredrick Rd 110-528-A in BGE**.
Additional Comments: Load shed directive to maintain post contingency flow below 115% of the load dump rating.

*Note: Brandon Shores – Waugh Chapel (2342) 230 kV, Brandon Shores – Waugh Chapel (2343) 230 kV, Brandon Shores – Wagner (2346) 230 kV

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PJM Analysis/Actions During Event

- Peak studies indicated the need for Emergency Procedures with the potential of Load Shed for Cascade violations when exceeding BGE load of approx. 4900 MW
  - 4900 MW forecast at 15:00
  - 5200 MW peak forecast at 18:00
- Expected to be required to offload system by 250-300 MWs
- Load Management – approx. 230 MWs between PJM/BGE programs
- Generation capable of being online at peak provided approx. 20 MVA of relief
- Voltage Reduction Action – Expected 80 MW reduction of BGE System load based on previous Bi-annual Voltage Reduction testing (60 MW achieved)
- Commit long lead generation

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Cascade Analysis

- Approximately 20 MW of load shed to prevent potential cascade of 1,200 MW
- Relevant Procedures / Precedent:
  - NERC Standard PRC-023 R1.2 and R1.11
  - M13 5.4.1 Post-Contingency Load Dump Limit Exceedance Analysis (Cascade Analysis)
  - Lessons learned from 2011 Southwest blackout

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Communications and Coordination

Regular bi-hourly check-ins with PJM/BGE leadership

- Determine prioritization of work
- Communicate Emergency Plans
- Coordinate BGE Consumer Appeals and BGE Demand Response programs

System Operator Subcommittee Transmission (SOS-T) calls

Operation Emergency Response Team (OERT)

Member Relations coordination

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Next Steps

Exelon Investigation

PJM Event Review

PJM / Exelon / RF Coordination

Potential Lessons Learned & best practices

- Develop PJM Simulator training for August 11 event
- Potential modification to emergency procedure tool to indicate voltage reduction action not being a PAI for single zone

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Appendix

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NERC Standard PRC 23 R1.2 and R1.11

B. Requirements and Measures

R1. Each Transmission Owner, Generator Owner, and Distribution Provider shall use any one of the following criteria (Requirement R1, criteria 1 through 13) for any specific circuit terminal to prevent its phase protective relay settings from limiting transmission system loadability while maintaining reliable protection of the BES for all fault conditions. Each Transmission Owner, Generator Owner, and Distribution Provider shall evaluate relay loadability at 0.85 per unit voltage and a power factor angle of 30 degrees. *[Violation Risk Factor: High] [Time Horizon: Long Term Planning]*

2. Set transmission line relays so they do not operate at or below 115% of the highest seasonal 15-minute Facility Rating[1] of a circuit (expressed in amperes).

11. For transformer overload protection relays that do not comply with the loadability component of Requirement R1, criterion 10 set the relays according to one of the following:

- Set the relays to allow the transformer to be operated at an overload level of at least 150% of the maximum applicable nameplate rating, or 115% of the highest operator established emergency transformer rating, whichever is greater, for at least 15 minutesto provide time for the operator to take controlled action to relieve the overload.
- Install supervision for the relays using either a top oil or simulated winding hot spot temperature element set no less than 100° C for the top oil temperature or no lessthan 140° C for the winding hot spot temperature[3].

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M13 Cascade Analysis

5.4.1 Post-Contingency Load Dump Limit Exceedance Analysis (Cascade Analysis)

As indicated in section 5.4, a PCLLRW is issued after all other means of transmission constraint control have been exhausted or until sufficient generation is on-line to control the constraint within designated limits and timelines as identified in PJM Manual 03, Transmission Operations, Section 2 – Thermal Operating Guidelines. However, if post-contingency flows were to exceed the 15-minute Load Dump rating and the contingency were to occur, there is a concern that the facility may trip before actions could be implemented to reduce the flow within limits. To prepare for this potential N-2 (initial contingency plus the overloaded facility) and prevent a cascade, PJM will perform up to an N-5 analysis on facilities over 115% of their 15-minute Load Dump rating.

As indicated in PRC-023 R1.2 and R1.11, transmission line relays and transformer overload protection relays are set so they do not operate at or below 115% of the facility's highest emergency rating. For PJM facilities, the highest rating is the Load Dump rating. Therefore, PJM will perform the following cascade analysis for any facility that reaches or exceeds 115% of its Load Dump limit:

Note:
NOTE 1: In the event the post-contingency load dump exceedance was caused by the sudden loss of a generating resource or transmission element, the PJM dispatcher will immediately take action to mitigate the overload. The cascade analysis will be performed if it is determined there is not sufficient controlling actions to mitigate the initial overload below 115% of the load dump rating within 30-minutes of its identification.

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Cascade Analysis:

- If a facility approaches 115% of its Load Dump limit post-contingency, the PJM operator will study the loss of the contingency element and the overloaded facility.
  - If the study results indicate no additional facilities will be overloaded over 115% of their Load Dump limit, this is determined to be a localized event and no additional pre-contingency actions will be taken.
  - If the study results in an additional facility(s) over 115% of its Load Dump rating, the operator will continue the analysis to also simulate trip the additional facilities. This analysis will be performed tripping a maximum of 5 facilities. If the study indicates

    either a non-converged case (See NOTE 2) OR if the analysis continues to show facilities exceeding 115% of their Load Dump limits, this will be considered a potential cascade situation. The PJM operator will review the results with the Transmission Owner and direct pre-contingency Load Shed (see NOTE 3).

Note:
NOTE 2: If both PJM and the impacted TO(s) operators agree the non-convergence is the result of an unsupportable radial load pocket in the final state after taking out the initial contingency and overloaded elements (i.e. local voltage collapse), this will be considered a local event and pre-contingency load shed will NOT be instructed by PJM.

Note:
NOTE 3: Load Shed will be directed in the amount needed to maintain the post contingency flow below 115% of the Load Dump limit on the original contingency within 30-minutes of verification of the potential cascade situation.

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Contact

Presenter/SME:
Kevin Hatch

Kevin.Hatch@pjm.com

Member Hotline

(610) 666-8980

(866) 400-8980

custsvc@pjm.com

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