NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Gannon Storm

NERC Observations and After-Action Review

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Space Weather Roundtable
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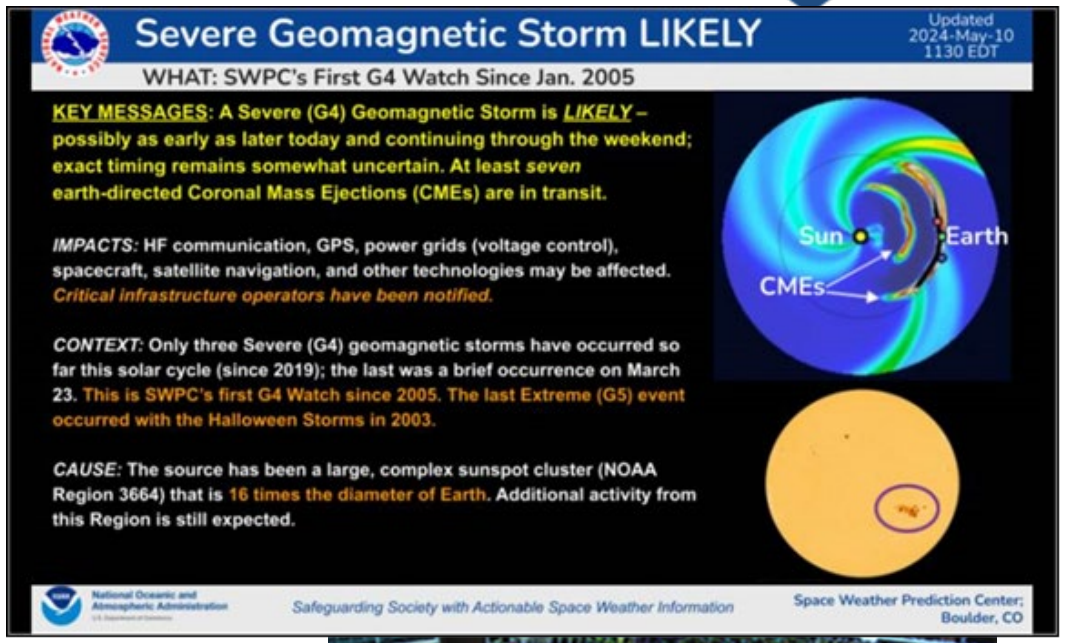
The Grid Performed Well During the Gannon Storm

- Gannon Storm: the strongest geomagnetic disturbance (GMD) in past two decades occurred in May 2024
- Bulk Power System (BPS) remained stable and served all connected load throughout the 3-day event
- A complete review is in progress using NERC's data collection programs and stakeholder inputs to understand:
  - GIC impacts on the BPS
  - GMD Vulnerability Assessment model accuracy
  - Operating mitigations effectiveness
- After-action review supports continued development for GMD tools and operating procedures
- Results of the review will be available in 2025

NERC's social media post for GMD Data

Early Notification Enabled Operators To Posture the Grid

- Reliability Coordinators (RC) received warning from the U.S. Space Weather Prediction Center (SPWC) six hours prior to onset
- Grid operators implemented GMD Operating Procedures as required by mandatory reliability standards
- Actions taken by system operators:
  - Implementing conservative operating protocols
  - Scheduling additional generation
  - Cancellation of some transmission maintenance
  - Increased monitoring of system geomagnetically-induced currents (GICs) and system performance
- **Early notification helped operators implement more extensive mitigations**



Reliability Was Closely Monitored During the Gannon Storm

- System voltages and frequency on the interconnected transmission system were largely unaffected
- United States Northeast, Mid-Atlantic, and Western Canada observed localized impacts to power system equipment
- Reports of GMD-related effects on the BPS:
  - Operator alarms for high GIC and temperatures at power transformers
  - Unexpected transmission line and voltage support equipment disconnects (tripping)
  - Activation of GIC blocking devices
  - High levels of harmonic currents on the system
  - Voltage oscillations at some inverter-based resources

GIC Blocking Device Connected to Large Power Transformer

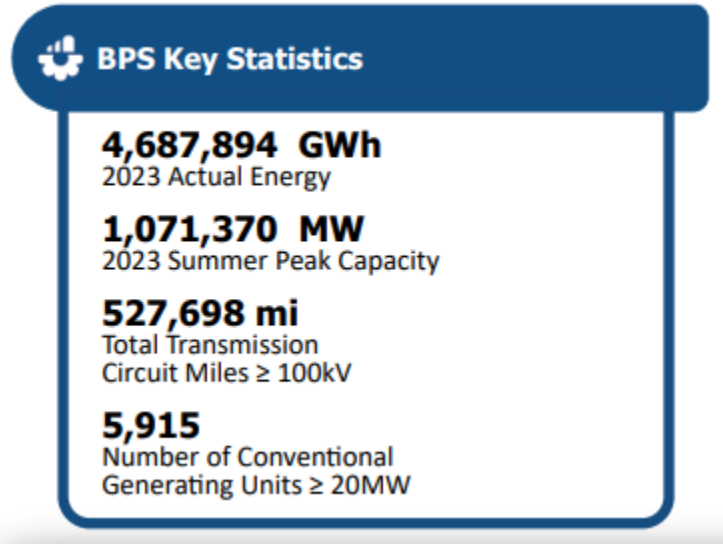
Gannon Storm Is Being Reviewed Using NERC's Data Programs

Analysis of NERC data sources is progressing

U.S. grid equipment owners are required to report in NERC's data systems. Data is finalized after each calendar year.

- GMD Data: over 390 geomagnetically-induced current (GIC) monitors reporting
- Transmission: Outage information on major equipment (transformers, lines)
- Generators: Outage and performance information on generating equipment

NERC's preliminary review agrees with initial reporting of isolated impacts to generators and transmission equipment.



NERC Data Sources include GMD Data System, Transmission Availability Data System (TADS), and Generator Availability Data System (GADS).

GMD Data System is available to the public. Access to GADS, TADS and MIDAS are restricted.

Information is available at:
NERC/Performance Analysis

Grid Planners and Operators Shared Gannon Storm Experience

Workshop takeaways:

- Excellent opportunity for GIC model validations
  - Validation studies have been conducted by EPRI, electric industry, and others in the space weather community
  - Lack of magnetometer coverage poses a challenge in some regions
- Isolated instances of GIC interference with voltage support equipment were observed and must be analyzed to prevent future occurrences. **Voltage issues are the key risk with GMD events.**
- Operators desire more GIC data-sharing during events to improve awareness of system conditions

The October 2024 Workshop Materials are available here: October 2024 GMD Workshop

Key themes are consistent with the findings of the *Space Weather Advisory Group's User Needs Survey*

Reducing Risk from Severe Space Weather

- NERC and our partners in the Electric Reliability Organization reduce risks to the Bulk Power System from severe GMD events through three main efforts:
  - State of the art Reliability Standards | TPL-007-4 and EOP-010-1
  - Partnerships for leading-edge research and tool development
  - Data collection program to improve knowledge and understanding

- We look forward to sharing results of the Gannon Storm after-action review broadly in 2025

Questions and Answers