



Geomagnetic Disturbances

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Commission
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June 15, 2012

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Geomagnetic Disturbances

- Coronal mass ejections from the sun send gusts of ionized particles into space
- Earth's magnetic field captures ionized particles causing varying magnetic fields on Earth's surface
- Changing fields induce voltage in the Earth (V/km) and cause DC electrical flows called Geomagnetically Induced Current (GIC) in the Bulk Power System

Geomagnetic Disturbances

- Threats to the BPS
 - Damage/destruction of equipment
 - Transformers
 - Generators
 - Breakers trying to operate
 - Capacitors
 - Increased VAR consumption
 - System voltage instability
 - Blackouts
 - Creation of harmonics
 - Incorrect operation of protection systems

Conflicting Results

- **Oakridge National Laboratory Study**
 - Predicts that well over 300 EHV transformers will be at-risk for failure or permanent damage
- **NERC Interim Report**
 - Most likely worst-case system impacts from a severe GMD event and corresponding GIC flow is voltage instability

Mitigation Steps

- **Hardware solutions**
 - **Series blocking capacitors**
 - **Neutral devices**
 - **Blocking capacitors**
 - **Reducing resistors**
 - **Increased GIC withstand capability**
- **Operations solutions**
 - **Reduced loading and load shedding**
 - **Increased reactive generation reserve**

GMD Staff Tech Conference

- Held April 30, 2012
- Panel I: Assessment of GMD Risks
 - DHS, researchers, NERC, industry
- Panel II: Moving Forward on GMD
 - NOAA, NRC, UK Dept. of Energy and Climate Change, researcher, NERC, industry
- Written comments accepted thru May 21

GMD Staff Tech Conference

- General agreement on:
 - Knowledge can be improved as urgent actions are taken
 - Standards are necessary to protect grid from GMDs
 - Grid collapse is unacceptable
 - GMD must be addressed regionally
 - Vulnerable & critical assets should be examined/protected

Potential Approaches to GMD

- Encourage voluntary action
- Industry development of standard(s)
- FERC order to develop reliability standard(s)
- Some combination

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- Thank you, and I look forward to discussing any questions.