



Geomagnetic Disturbances

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Disclaimer

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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.**