



Ground Effects Topical Group

SWWT plenary session

Magnus Wik - NeuroSpace

About GETG

- Spokesperson: Magnus Wik (NeuroSpace)
- The Ground Effects Topical Group (GETG):
 - Modelling the occurrence of geomagnetic variations and geoelectric fields during space weather events.
 - Modelling GIC in electric power systems (discrete grounding).
 - Modelling GIC in buried pipeline networks (continuous grounding).
 - Measurements of geomagnetic variations, geoelectric fields and GIC.
 - Development of forecast techniques of geomagnetic storms and GIC based on neural networks and physical models.
 - Risks and hazards from an insurance and social perspective.
 - Analysis and classification of extreme events.
 - Public outreach.

Projects & Collaborations

- IRF (Swedish Institute of Space Physics) and MSB (the Swedish civil contingency agency) continue the collaboration “Solar storms and space weather”. The goal is to develop improved warnings and forecasts based on solar data.
- NeuroSpace is also collaborating with IRF to establish a new service/website “Swedish Space Weather Center” as part of ISES.
- PRIVAD (Program for Risk and Vulnerability Analysis Development) framework program: Report “Geomagnetic disturbances and their impact on power systems” by Industrial Electrical Engineering and Automation, Lund University. Sponsored by Swedish MSB.
- IRF continue the collaboration with SVK (Swedish National Grid). The purpose is to deliver early warnings of solar storms and possible effects on power systems.
- GIC study, by FMI, for power company Statnett (Norway) (completed)
- National Grid UK: Real time data services and advice by BGS. Development work planned on UK grid model with real-time data.

Projects & Collaborations

- BGS has started electric field measurements at three sites in UK (Eskdalemuir, Lerwick and Hartland). They will e.g. provide reference to the modelled electric field.
- GIC research, at National Resources Canada (NRCan), includes a strong collaboration with the GIC team of the "North China Electric Power University (NCEPU)" in Beijing, China. Collaboration with the Manitoba Hydro company ("GIC Simulator" software).
- Solar Shield, level-2 (30-60 min) forecasts have also been implemented/included into EURISGIC forecast service for dB/dt.

EU/FP7 project:



- **Main objectives:**

The first European prototype forecast tool, based on in-situ solar wind observations and on magnetosphere-ionosphere simulations, to produce real-time GIC warnings for the European high-voltage power grid.

European-wide risk map giving the statistical probability of large GIC values.

Estimate the largest possible GIC flowing anywhere in the European high-voltage power grid based on archived data.

- **Achievements:**

Statistics of the geoelectric field and GIC in Europe (1996-2008).

Nowcasting and forecasting (GIC, dB/dt) (MHD simulations and NN empirical model)

Scenarios of extreme GIC events (ongoing)

New measurements of GIC.

Digitisation of old recordings:

- UK geomagnetic (including the Carrington storm)

- Hungarian geoelectric recordings (since 1957)

EU/FP7 project: EURISGIC

- Details about the EURISGIC project and main results (as well as future projects) will be presented at the GETG splinter session, Friday, 22nd, 13:30-15:00
- Demonstration of the EURISGIC project at the fair.
- Several presentations related to GETG and EU/FP7 project EURISGIC:
 - Solar Conditions for Large Ground Geomagnetic dB/dt Events (Wintoft et al)
 - Extreme Value Statistics applied to Geoelectric Activity in Europe (Wesztergom et al)
 - Interactive Web Application for Visualization of Geomagnetically Induced Currents (Katkalov et al)
 - The EURISGIC Forecast Service (Wintoft et al)
 - GIC Recordings at the North-West of Russia for EURISGIC Project: Data and Modeling (Sakharov et al)
 - Russian Geomagnetic Recordings in the 19th Century compared to Modern Observations (Myllys et al)
 - Assessment of Extreme Geomagnetically Induced Currents in the Norwegian Power Grid (Myllys et al)
 - Carrington as a Benchmark: Comparisons of the September 1859 Storm using Newly Digitised Data for London (Humphries et al)
 - Space-Weather Impact on the Power Grid - An International Perspective (Krausmann et al)
 - Solar Activity and Transformer Failures in Greece (3): New Results on non Linear Regression Analysis (Zois)
 - Verifying GIC Nowcast Models with Geo-Electric Field Measurements (Kelly et al)
 - Forecast Evaluation as Applied to Geomagnetic Activity Categories (E. Clarke, A. Thomson)
 - The Polar Cap (PC) Index and Power Grid Disturbances (P. Stauning)

Meetings

- The workshop “Space weather and power grid” was held in Ispra, Italy, 29-30 October 2013. (JRC together with the Swedish Civil Contingencies Agency (MSB) and NOAA).
- XIIth Scientific Assembly (“Living on a Magnetic Planet”) in Merida, Yucatan, Mexico, August 26-31, 2013.
- The joint meeting “Space Weather: the importance of observations” by the Royal Astronomical Society and the Royal Meteorological Society was held at Imperial College London, on 13th November 2013.
- 8th International Workshop of the electricity managers and specialists power grid complex of Russia, CIS and Baltic countries, April 8 – 13, 2013, Moscow, Russia: The first time the topic was included in the official training course of Chief Engineers and Technical Directors of power grids from former USSR.
- M.O.R.E. 27 Seminar: Ground effects of solar storms, 16-17 Jul 2013, Berlin (The Geneva Association: international think tank of the insurance industry).
- Consortium members have also given several presentations at different occasions and other smaller meetings (also outside of the space weather community).

Discussion and Conclusions

- We would like more non-scientists, e.g. from civil contingency agencies, power engineers and insurance companies, to join the GETG.
- A possible follow-up of EURISGIC, focusing on technological effects of GIC on power grids, has already been considered for Horizon 2020.
- It has been discussed that many power operators are interested in nowcasted and forecasted geoelectric fields, in US and Europe. This data can then be used by individual operators for e.g. GIC calculations.
- Discussions are ongoing about the continuation of some parts of EURISGIC into services and applications. Funding needed.
- At present there are, at least, geoelectric field measurements at British Geological Survey (UK) and Geodetic and Geophysical Institute (Hungary). Is it possible with a collaboration on electric field measurements, and maybe a network of stations in Europe?
- There is much effort in developing new transformer types, immune to GIC, and analyzing GIC impact by new power system simulators (PSS/E, Power World).

Discussion and Conclusions

- It should also be noted, that the main influence of geomagnetic disturbances on mobile and fixed telecommunication is through the electric power supply. In case of an outage, the backup power supply may last only for a few hours!
- GPS signals are also used in power companies for accurate timing. Precision timing is required for monitoring and control of electrical power networks, and equipment, and e.g. to aid diagnostics and troubleshooting.
- Governments, authorities and industries have begun to establish action plans and collaboration how to handle the threat from GIC.
- GETG (and Geomagnetic/GIC community) to support the ESA geomagnetic Expert Service Centre (led by University of Tromsø) as part of SSA.
- GIC has serious effect on power systems also at mid- and low-latitude regions, as shown e.g. from transformer damage in south Africa in 2003 and 2004.
- Scientific and technical studies motivated by EURISGIC:
 - Improved forecasting (simulations and empirical methods)
 - More accurate assessments of extreme events
 - Worst case GIC scenarios (equipment and operation)

Discussion and Conclusions

- Perhaps, a generally accepted GIC-WCS can have a big impact on how to determine reliability standards for system protection, new equipment, system operation routines and real-time monitoring and (SW) forecasting.
- the North American Reliability Corporation (NERC) holds a voltage collapse caused by reactive power shortage associated with GIC as the most important consequence (compared to power shortage due to transformer damage).
- But it is important to point out that GIC may affect system operation also during less severe conditions as well as by accumulated effects from several events.
- Also, if many transformers still were to be damaged, the US Department of Homeland Security (DHS), initiated a project (RecX) to develop an EHV recovery transformer allowing for easier transportation and more rapid installation, enabling faster recovery in the event of an emergency.
- In Europe, we can perhaps expect that new reliability standards would be issued by ENTSO-E (European Network of Transmission System Operators for Electricity). Currently, however, most of the related work are associated with JRC/EU.

Thank You!

Join GETG?
Comments, feedback or suggestions?

e-mail: magnus@neurospace.se

Website: <http://www.spaceweather.eu/swwt/gic>



See you at the fair!

GETG/EURISGIC splinter, Friday, 13:30-15:00