National Space Weather Strategy Comments of Foundation for Resilient Societies
Submitted to Office of Science and Technology Policy on May 29, 2015

General Comments

1. The National Space Weather Strategy is arguably one of the most consequential planning efforts that the U.S. Government has ever undertaken. Nonetheless, public comments are limited to only 500 words. There should be a second round of comments without word limits and in an open and transparent process that allows all comments to be viewed publicly, consistent with other federal public participation processes.
2. The National Space Weather Strategy emphasizes forecasting of space weather and is less focused on mitigation of impacts on critical infrastructure.

Modification at Line 153

"To be effective, the benchmarks must be developed in a timely manner using transparent methodology *and publicly available data* with a clear statement of assumptions and uncertainties."
Rationale: Government policies should not rely on data concealed from public scrutiny.

Modification at Line 172

Extreme space weather events are ~~low frequency,~~ potentially high-impact events that will require a coordinated national response and recovery effort. (Strike "low frequency.")
Rationale: A 12% chance of a severe solar storm per decade (according to NASA scientists) is not a low frequency event.

Modification at Line 212

Asset owners and operators should have plans and capabilities to enable them to "operate through" space weather hazards, including use of automatically-activated protective equipment and backup power supplies.
Rationale: Advance planning and mitigation should allow infrastructure operators to provide uninterrupted services.

Insertion at Line 270

Collect data for modeling of space weather impacts: Data to model space weather impacts relies on preexisting collection systems that were designed for scientific research but not specifically designed to support space weather modeling. The U.S. Government will conduct a review of space weather data sources, identify gaps, and propose additional collection systems. The principal data collection systems for space weather will be controlled and managed by government agencies, similar to other meteorological and geological data. Government data may be supplemented by data collected by private infrastructure owners, provided that all data collected on naturally-occurring phenomena shall be made public and available for independent scientific research.
Rationale: The current system of magnetometer observatories does not provide enough stations to accurately model space weather effects across North America. The existing program to collect ground model data was not designed to model space weather effects. There is no

government system to collect geoelectric field measurements during solar storms. Geoelectric fields can be calculated using Geomagnetically Induced Current (GIC) readings during solar storms, but these readings have been held as proprietary data by infrastructure owners. Moreover, proprietary data such as transformer winding resistance and conductor resistance are required to back out geoelectric field data from GIC data; specific collectors for geoelectric fields would be more accurate and could provide public data. Just as wind speed readings during hurricanes and seismic readings during earthquakes are public and accessible for independent scientific research, space weather impact data should be freely available to public researchers.

Insertion at Line 238

Develop decision support data for critical assets impacted by space weather: While some assets impacted by space weather are owned by the government, the vast majority of assets are owned by private industry. Government decision-makers need data on the locations and attributes of critical assets that are most vulnerable to space weather impacts; this requires ongoing and updated studies. This decision support data can be used to target pre-event mitigation measures and manage post-event repair and replacement.
Rationale: The scope of impact of space weather is largely unknown because no inventory of critical assets has been taken and no ongoing vulnerability studies are being conducted. For example, while the U.S. Energy Information Administration collects and publishes a database of electricity generation plants and their top-level design characteristics such as capacity, transmission voltage, and fuel source, there is no parallel database for critical high voltage transformers. Without knowing the locations and basic design characteristics of hard-to-replace equipment, government decision-makers will be hard-pressed in a crisis to assist in repair and replacement efforts. Moreover, without ongoing vulnerability studies, government decision-makers will be unable to target cost-effective mitigation steps. Examples of other critical assets impacted by space weather include electric generators, electrically-driven gas pipeline compressors, satellites, and long-haul telecommunication systems. Critical locations may include sites that are modeled to experience high geoelectric fields and/or harmonic distortion in electric power during space weather events that may overheat and damage equipment. Effective repair and replacement of critical equipment after space weather events will require close government and industry coordination during conditions that may include long-term grid outage. Information about hard-to-replace equipment and spare stockpile characteristics should be designed for non-electronic storage/retrieval and communicated in advance of space weather events.

Insertion at Line 270

Develop analytic tools and frameworks for space weather impacts and mitigations: Space weather can have large economic and social consequences while costs of mitigation measures may be a small percent of potential losses. Rigorous and data-supported analytic tools and frameworks are essential for good policy decisions. Where possible, event probabilities should be used as an explicit part of decision-making.

Rationale: Prior analysis of space weather impacts and mitigations has focused on technical vulnerabilities and mitigation methods. Examination of potential economic losses and costs of mitigation has been missing or poorly documented and supported. A National Space Weather Strategy could benefit from standard decision tools such as statistical correlation of observations and impacts, cost-benefit analysis, probabilistic risk assessment, and project costing for mitigation steps.

Insertion at Line 332

Improve forecasting system reliability and resiliency: The current space weather forecasting and dissemination system has single points of failure. Due to the importance of these systems, backup systems and procedures should be established.
Rationale: Examples of single points of failure in the forecasting system include single satellite sensors, supercomputer data processing at a single location, and bottlenecked communications in Boulder, Colorado.