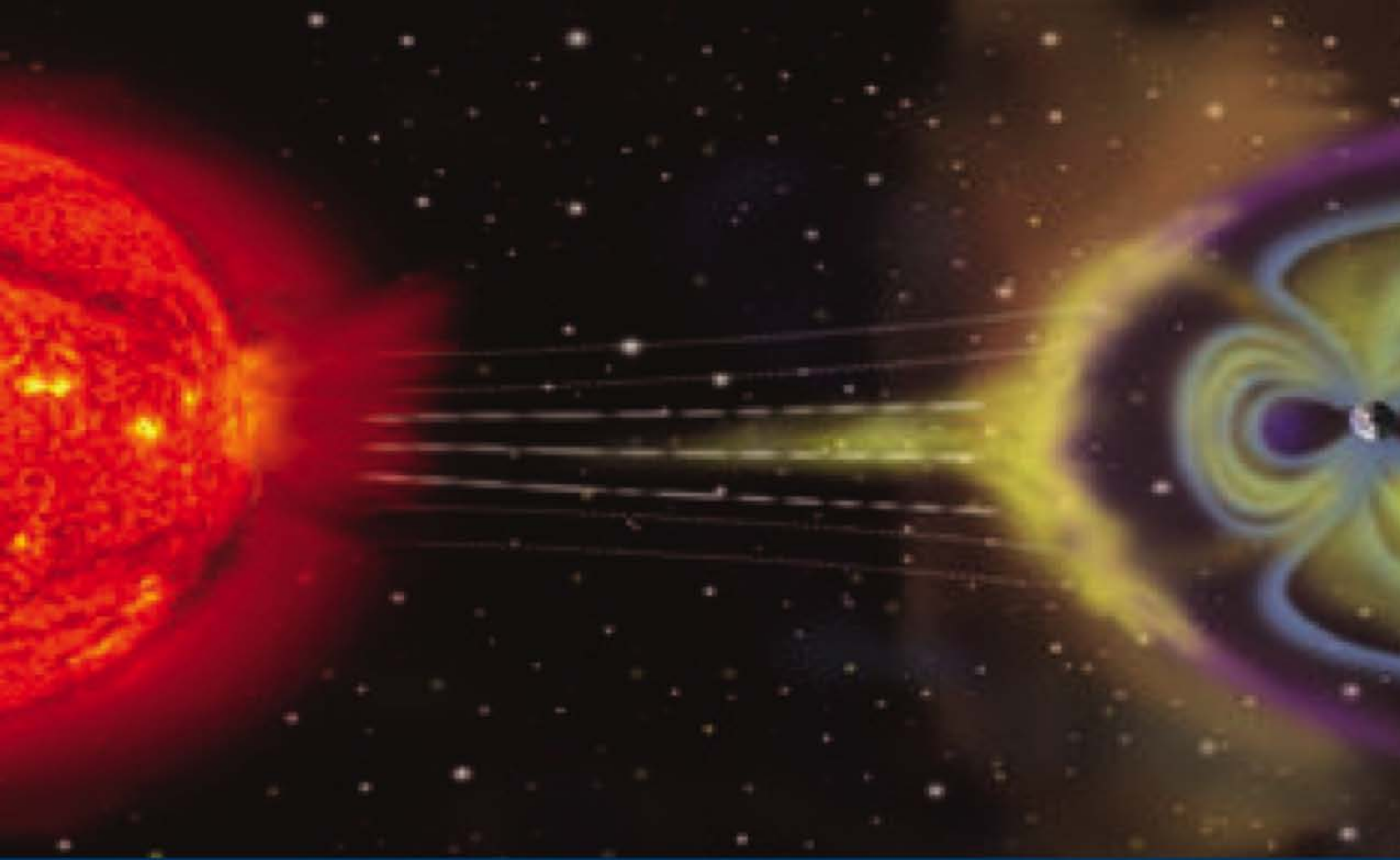

Managing Critical Disasters in the Transatlantic Domain – The Case of a Geomagnetic Storm

Workshop Summary

February 23-24, 2010
Boulder, CO

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FOREWORD

The Federal Emergency Management Agency (FEMA) is pleased to have had the opportunity to partner with the European Union, European Commission, Swedish government, U.S. National Weather Service (NWS), and the U.S. National Oceanic and Atmospheric Agency (NOAA) to discuss readiness for a widespread, catastrophic disaster—a geomagnetic storm. Unlike natural hazards that we have faced in the past, disasters caused by abnormal solar activity could pose a worldwide threat and disrupt energy supplies, air transport, telecommunications, and other critical infrastructure.

Addressing such a large-scale disaster in purely national terms is not sufficient and requires international collaboration. During the first day of the two-day workshop, senior leaders from the U.S. and their European counterparts learned about space weather events and the types of warnings and alerts available to detect a geomagnetic storm. The group also compared and contrasted current plans, policies, and procedures to prepare for and respond to a large-scale emergency. The workshop provided an opportunity to strengthen partnerships and improve lines of communication between the United States and Europe to ensure maximum and efficient protection against the risk of a widespread, geomagnetic storm.

Natural disasters caused by solar activity do not recognize borders or international boundaries. It is in the United States' best interest to couple national efforts with strong international cooperation in order to restore full capacity of our critical infrastructure after a disaster and ultimately keep Americans and people around the world safe. This workshop exemplified the importance of transatlantic cooperation in emergency preparedness and management. We are pleased, in close collaboration with our Swedish partners, to submit the following report, which we hope will serve as a tool to encourage further discussion on the topic.

W. Craig Fugate,

Administrator of the Federal Emergency Management Agency
Department of Homeland Security

I am very pleased to have co-organized this workshop together with the Federal Emergency Management Agency (FEMA). This is an important step in further solidifying the long-standing relationship between Sweden and the United States in the area of emergency management and homeland security. It is also an important vehicle to ensure that we create and sustain critical networks across the Atlantic within the societal security domain.

We can no longer afford to draw a sharp line between national, European, and global security. If we are going to succeed in our endeavor to protect our citizens, our shared values, and critical interdependent societal functions against the broad spectrum of potential emergencies, disasters, and crises, we need to cooperate across national borders and across continents. The discussions during the workshop identified several opportunities for closer cooperation leading to better *shared* capacity to prevent, mitigate, respond, and recover from a broad range of contingencies. Several concrete action items are included in this report. I look forward to follow-up on the recommendations in this after-action report with my partners in the U.S., the European Union, and Sweden.

I want to acknowledge the leadership and commitment of Administrator Fugate, who suggested we pursue this activity in the first place. It was a true transatlantic effort in planning and preparations. The result was a high-yield dramatic experience for all of us. Thank you to my Swedish and European partners for contributing to this effort. Finally, thank you to the U.S. National Oceanic and Atmospheric Administration (NOAA) for being such graceful hosts. It is now up to all of us together that this important event leads to concrete measures that enhance the common capacity to deal with catastrophic disasters in the transatlantic domain.

Helena Lindberg
Director-General of the Swedish Civil Contingencies Agency (MSB)

EXECUTIVE SUMMARY

The United States (U.S.) Federal Emergency Management Agency (FEMA), the Swedish Civil Contingencies Agency (MSB), and the U.S. National Oceanic and Atmospheric Administration (NOAA) planned and hosted *The Workshop on Managing Critical Disasters in the Transatlantic Domain – The Case of a Geomagnetic Storm* in Boulder, Colorado, on February 23-24, 2010.

The overarching goals of the Geomagnetic Storm Workshop were to allow senior government officials and representatives of both public and private entities from the U.S., Sweden, and the European Union (EU) to compare and contrast the current plans, policies, and procedures used to prepare for and respond to a widespread disaster in the U.S. and EU. The workshop also provided a means to discuss communications between the U.S. and EU in the event of a catastrophic disaster with Transatlantic implications.

For this workshop, NOAA introduced a scenario of a geomagnetic storm, which could impact multiple nations simultaneously. The impact of the geomagnetic storm was discussed during both the detection and response phases.

The workshop identified several issues in the international domain that need additional exploration and development. These include:

- Increasing the distribution and utility of space weather alerts and warnings
- Opening international pathways between operations centers to routinely exchange threat and common operating picture information
- Integrating experts and researchers into the emergency management sector
- Working collaboratively on improving protection and resiliency of critical infrastructure
- Developing plans for managing and prioritizing scarce critical resources in the international domain
- Enhancing space weather education and communication for societal stakeholders
- Creating a mechanism to share lessons learned from national and international disaster/crisis management exercise programs

While these areas were identified within the context of a space weather event, all workshop participants agreed that improvements would also benefit all-hazards prevention, preparedness, response, and recovery efforts.

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EXERCISE OVERVIEW

Exercise Name

A Workshop on Managing Critical Disasters in the Transatlantic Domain – The Case of a Geomagnetic Storm

Exercise Dates

February 23, 2010 – February 24, 2010

Location

The David Skaggs Research Center, National Oceanic and Atmospheric Administration
325 Broadway
Boulder, CO 80305

Sponsors

- Department of Homeland Security (DHS)/FEMA/National Exercise Division (NED), International Affairs Division and National Integration Center
- National Oceanic and Atmospheric Administration (NOAA)
- Swedish Civil Contingencies Agency (MSB)

Program

National Exercise Program, Senior Officials Exercise Program

Scenario Type

Space Weather – Geomagnetic Storm

Participating Organizations

European Partners

- European Commission, Environment Directorate-General, Unit for Prevention and Preparedness
- European Union Delegation to the U.S. in Science, Technology and Education
- Institute for the Protection and Security of the Citizen, Joint Research Centre, European Commission
- Svenska Kraftnät, (Swedish National Grid)
- Swedish Civil Contingencies Agency (MSB)
- Embassy of Sweden
- Swedish National Electrical Safety Board
- Swedish Post and Telecom Agency (PTS)
- International Space Environment Service (ISES)

United States Partners

- Department of Energy
- Department of Homeland Security (DHS)
    - National Protection and Programs Directorate (NPPD)
        - Office of Infrastructure Protection, Partnership Outreach Division Office of Cybersecurity and Communications, National Communications System
    - Federal Emergency Management Agency (FEMA)
        - External Affairs Office, International Affairs Division
        - Operations
        - National Preparedness and Protection
            - National Integration Center (NIC)
            - National Exercise Division (NED)
        - Region VIII
- National Oceanic and Atmospheric Administration (NOAA)
    - National Weather Service (NWS)/National Centers for Environmental Prediction
    - Space Weather Prediction Center
- North American Electric Reliability Corporation (NERC)
- Federal Energy Regulatory Commission (FERC)

Number of Participants

- Players: 29
- Speakers and Observers: 11

EXERCISE DESIGN SUMMARY

Workshop Goals and Objectives

The goals of the Geomagnetic Storm Workshop were to allow senior government officials and representatives of public-private entities from the U.S., Sweden, and the EU to compare and contrast the current plans, policies, and procedures used to prepare for and respond to a widespread disaster in the U.S. and EU and to discuss communications between the U.S. and EU in the event of a catastrophic disaster.

The FEMA, MSB, and NOAA planning effort identified the following specific objectives for the senior participants in the Geomagnetic Storm Workshop:

- Emphasize supporting transatlantic ties at leadership levels in preparing for and responding to a widespread disaster.
- Improve U.S.-EU systems for communicating during a response to a disaster.

Space Weather and Its Impacts

Space weather describes the conditions in space that affect earth and its technological systems. Space weather is a consequence of the behavior of the sun, the nature of earth's magnetic (geo-magnetic) field and atmosphere, and our location in the solar system. The active elements of space weather are proton particles, electromagnetic energy, and solar wind that effects earth's magnetic field, rather than the more commonly known weather contributors of water, temperature, and air. Hurricanes and tsunamis are dangerous, and forecasting their arrival is a vital part of dealing with severe weather. Similarly, space weather forecasters monitor the sun to assist users in avoiding or mitigating severe space weather. These are storms that originate from the sun and occur in space near earth or in the earth's atmosphere.

Most of the disruptions caused by space weather storms involve technology. Susceptible technology is quickly growing in use. Satellites, for example, carry weather information, military surveillance, TV and other communications signals, credit card and pager transmissions, navigation data, and cell phone usage. With the rising use of technologies, vulnerability to space weather events has increased dramatically.

The sun is the overwhelming source of space weather on earth. The basic energy source for the sun is nuclear fusion, which uses the high temperatures and densities within its center to fuse hydrogen, producing energy and creating helium. Activitives on the sun are turbulent. Sunspots, dark areas on the solar surface, contain strong magnetic fields that are constantly shifting. A moderate-sized sunspot is about as large as the earth. Sunspots form and dissipate over periods of days or weeks. Groups of sunspots, especially those with complex magnetic field configurations, are often the sites of solar flares.

Solar flares are intense, short-lived releases of energy. They are seen as bright areas on the sun in optical wavelengths and as bursts of noise in radio wavelengths; they can last from minutes to hours. Flares are our solar system's largest explosive events. The primary energy source for flares appears to be the tearing and reconnection of strong magnetic fields. They radiate throughout the electromagnetic spectrum, from gamma rays to x-rays, through visible light out to kilometer-long radio waves.

Coronal Mass Ejections (CMEs) are slower but potentially more harmful solar occurrences than flares. The outer solar atmosphere, the corona, is structured by strong magnetic fields. Where these fields are closed, often above sunspot groups, the confined solar atmosphere can suddenly and violently release bubbles or tongues of gas and magnetic fields known as CMEs. A large CME can contain a billion tons of matter that can be accelerated to several million miles per hour in a spectacular explosion. Solar material streaks out through the interplanetary medium, impacting any planet or spacecraft in its path. CMEs are sometimes associated with flares, but usually occur independently.

Earth-directed CMEs pose a grave threat to earth's technological infrastructure. If a CME impacts earth causing a geomagnetic storm, the rapidly changing geomagnetic field caused by the CME can induce powerful electrical currents that disrupt and disable transformers, capacitors, and other critical equipment leading to the collapse of power grids. On March 13, 1989, in Montreal, Quebec, 6 million people were without commercial electric power for 9 hours as a result of a geomagnetic storm. Some areas in the northeastern U.S. and in Sweden also lost power. Geomagnetic storms also disrupt navigation and Global Positioning Systems (GPS) and threatens satellite operations.

The list of consequences grows in proportion to our dependence on burgeoning technological systems. The subtleties of the interactions between the sun and the earth, and between solar particles and delicate instruments, have become factors that affect our well being.

Workshop Scenario Overview

The workshop scenario was divded into two modules:

- Module 1: Detection – Solar Flare and Radiation Storm
- Module 2: Response – Geomagnetic Storm

In Module 1, an extremely large and magnetically complex sunspot cluster emerged on the sun on February 19-20, 2010. Several major solar flares erupted from this sunspot group on February 20-23, 2010.

On February 24, 2010, the strongest of these series of flares erupted, a powerful R5 on the NOAA Space Weather Scales. Satellite measurements indicate that this was the largest solar flare observed in the space era. An intense solar radiation storm accompanied this flare, beginning just minutes after the flare erupted. Widespread communication problems began in association with the flare, including disruption of high frequency (HF) communications and GPS serivces. A powerful and fast CME was also observed soon after the flare. Radiation storm levels soon crossed the extreme S5 level. Numerous satellite anomalies were experienced by many satellite agencies, and disruptions were reported in many industry sectors including banking, telecommunications, and aviation.

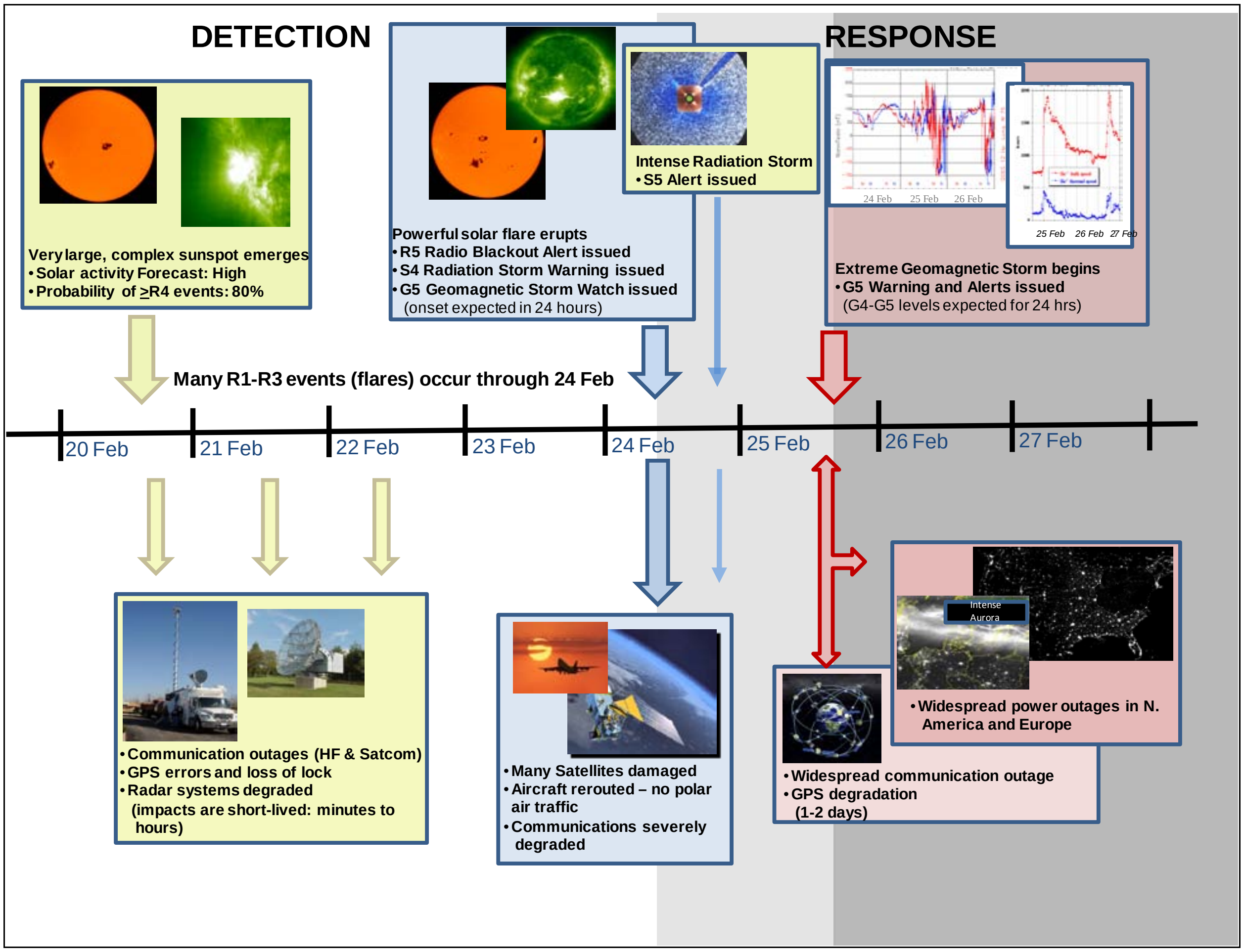
In Module 2, an intense geomagnetic storm began on February 25, 2010, during a particularly cold weather outbreak in the Northeastern U.S. and Northern Europe. Significant electric power grid problems occurred, and a massive power fluctuation affected the transmission grid. Within one hour, cascading power outages were reported throughout the eastern and mid-Atlantic U.S. and eastern Canada.

Power stations reported numerous generator step-up transformers and transmission transformers out of commission, with projected replacements and repairs taking weeks and even months. This raised immediate concern of a critical infrastructure collapse with loss of water distribution, sewage disposal, hospital care, phone service, and fuel resupply. Satellite outages were reported, and cell phones experienced significant service disruptions.

Significant problems were also reported in Northern Europe. Power outages were reported in large areas of southern Sweden, Scotland, Northern England, and the upper tip of Northern Europe. The power outage's effects on international air transport and financial markets were widespread.

The extreme geomagnetic storm lasted for 24 hours, ending late on February 26. Full recovery of the U.S. power grid is expected to take six months. Many populated areas are expected to be without power for weeks or months.

This diagram depicts the events discussed in Module 1 & 2 of the workshop scenario



WORKSHOP OUTCOMES

Opportunities Identified

Actionable Space Weather Alerts and Warnings

The International Space Environment Service (ISES) and the NOAA Space Weather Prediction Center (SWPC) issue alerts, warnings, and watches on space weather to their subscribers. However, some participating organizations expressed concern about the clarity and utility of these alerts and warnings.

Workshop participants highlighted the need for space weather forecasters to clearly understand the needs of their customers and to provide warnings with practical value for them. Specifically, several public-private and private sector organizations involved in the workshop asked that space weather alerts be "actionable"—that is, to provide sufficient clarity of the threat so that organizations could understand how the danger is relevant to their operations. NOAA representatives explained that the NOAA Space Weather Scales (www.swpc.noaa.gov/NOAAscales/NOAAscales.pdf) provide warning scales along with expected impacts on technological equipment. However, NOAA representatives acknowledged that customer needs are constantly changing, and that increased communication and coordination between space weather forecasters and their subscribers would help forecasters continuously improve their products.

Customer education has already proved helpful to space weather-affected industry. In one instance, the Global Navigation Satellite System (GNSS) recently updated and improved its signals and systems based on the recognition of space weather threats to satellite operations. A counter-example is in the United States, the Long Range Navigation (LORAN) System has been recently de-commissioned. Adjustments to curtail space weather information and its effects to subscribers with de-commisioned technology are also needed for system efficiency.

Actionable Space Weather Alerts and Warnings Recommendation

- It is recommended that communication between space weather forecasters and their customers be improved by developing a common terminology. The SWPC, along with affected sector-related agencies, such as FEMA, DHS/Office of Infrastructure Protection (IP), MSB Global Monitoring & Analysis Section, and the European Commission's Joint Research Centre and other relevant stakeholders, should collaborate to develop a common terminology as well as to educate customers on space weather phenomena and consequences. This approach could be broadened to apply to other natural hazards as well.

Increasing Information Exchange Between Operations Centers

Workshop participants identified an information-sharing opportunity during the discussions. Participants recognized that U.S. and EU operations and coordination centers, such as the U.S. National Operations Center (NOC), the FEMA National Response Coordination Center (NRCC), the MSB's Operations Center, the Swedish Prime Minister's Crisis Management Coordination Secretariat, and the EU Monitoring and Information Centre (MIC) do not routinely share space weather or any other warnings and alerts that could improve situational awareness and understanding.

Increasing Information Exchange Between Operations Centers Recommendations

- It is recommended that each of these and other centers ensure that they currently subscribe to U.S. SWPC and ISES notifications. These space weather notifications provide an opportunity for government agencies and private sector entities to take appropriate, preventive measures and allow them to inform their constituents, customers, and the general public of potential or actual concerns as necessary.

- It is recommended that U.S. and European operations centers share not only space weather information with each other, but also other all-hazards products. Examples of these products include the FEMA Daily Situation Report (SITREP) and the EU MIC Daily Report. In fact, FEMA and EU participants exchanged contact information at the workshop to start sharing the FEMA SITREP and EU Daily Report immediately.

- It is recommended that appropriate government agencies in the U.S. and EU, such as FEMA and the MSB, establish a working group to formalize processes and procedures for information sharing between operation centers, including but not limited to holding regular video and audio conferences, and participating in leadership conference calls.

Integration of Experts and Researchers in the Emergency Management Sector

The participants noted that expert knowledge is of the essence for emergency managers before, during, and after disastrous events. This is especially true in novel events, or during infrequent contingencies. It is also important that experts are aware of how the emergency management sector functions and that a mutual understanding exists regarding the critical importance of providing timely information and advice.

Integration of Experts and Researchers in the Emergency Management Sector Recommendation

- It is recommended that appropriate U.S. and European agencies exchange best practices and examples on how experts and researchers can be integrated into the emergency management sector and how to best provide and receive advice during disasters.

Critical Infrastructure Protection and Resiliency

Workshop participants highlighted the need to assess the vulnerability of technological systems that could be impacted by space weather conditions. They raised concerns that, in many cases, both the private and public sectors do not fully understand the level of interconnectivity between various infrastructures and therefore do not grasp the extent of the space weather threat.

If industry leaders understand the impacts of geomagnetic storms on the electrical generation and transmission system and technological equipment, they can develop plans and procedures to make systems more resilient. For example, grid operators can implement plans to power down or shut down vulnerable systems before they are damaged or destroyed. Developers of new technologies, such as nanotechnology, can take into account the severe consequences that space weather can cause. In addition, researchers and developers for new power grids and flight control systems should proceed in interdisciplinary fashion so that new systems include hardening and resiliency capacities rather than requiring retrofit solutions later.

Participants frequently mentioned the importance of protecting critical infrastructure and key resources (CIKR) from space weather hazards. Both the U.S. and the EU have developed strategies for protecting critical infrastructure, particularly energy and transportation systems, from terrorist attacks and natural hazards. In some cases, it has been found that electromagnetic pulse (EMP)-protected transformers also have a higher degree of protection against the CME phenomena.

<u>Critical Infrastructue Protection and Resiliency Recommendations</u>

- It is recommended that key U.S. and European CIKR agencies and stakeholders formalize transatlantic collaboration and communication, through working groups and conferences, on protecting CIKR from, and mitigating the potential impacts of, hazardous space weather. A recent example of a U.S. and EU activity close to this issue area was the Commercial Satellite Critical Infrastructure Protection Workshop hosted by the EU JRC in Ispra, Italy, on March 2-3, 2010.

- It is recommended that appropriate U.S. and European agencies exchange risk and threat analysis methods and results for improving prevention capabilities in an all-hazards context. One promising initial step was the first EU-U.S. Expert Meeting on Critical Infrastructure Protection that took place on March 4-5, 2010, in Madrid, Spain.

- It is recommended that government agencies tasked with coordinating the protection of CIKR encourage vulnerable sectors, such as energy, transportation, and telecommunications, to review and update their contingency, continuity, and consequence management plans to reflect an all-hazards approach.

Prioritization of Scarce Critical Resources in the International Domain

During the workshop, participants discussed the prioritization and allocation of scarce critical resources in the aftermath of a severe geomagnetic storm. For example, a geomagnetic storm can destroy large electrical transformers which are expensive and time-consuming to replace. Because of the cost, most electric companies do not keep spare transformers on-hand. Even if an electric company is able to locate spare transformers, transportation and installation would take at least three weeks. New orders for replacement equipment can take up to 18 months or even longer to fulfill. If Sweden, Great Britain, and the United States all suffered transformer damage from a geomagnetic storm, it would be difficult for equipment providers to prioritize which countries should receive replacement parts.

Participants discussed not only the scarcity of equipment, but also the scarcity of technical experts needed to solve major electrical system problems. Individuals with electrical grid expertise have become centralized in a small number of global firms. During a space weather crisis in which electrical grids are compromised in a number of countries, these experts could become over extended in their efforts to restore the system. Additionally, if a crisis strikes, it is reasonable to expect that utility workers will ensure the safety and security of their families before they focus on utility operations.

Population centers have limited food and commodity inventories on hand. Hospital supply systems, for instance, operate on a just-in-time replenishment cycle. Generators are seldom installed and are often intended to be used for a very short period. Major electrical outages would wreck havoc with the supply chain management system for these and other citicial supplies. Replenishing these supplies requires operable telecommunications systems, data processing capability, and the fuel to transport shipments.

<u>Prioritization of Scarce Critical Resources in the International Domain Recommendations</u>

- It is recommended that by working together, government and private sector equipment providers should develop and review prioritization policies and procedures. More analysis may be needed to identify what can become scarce critical resources after a consequential disaster in the transatlantic domain. This will enhance the ability of officials to make timely decisions during an emergency.

- It is recommeded that both government and industry leaders develop plans to assist utility employees' families. This would allow the employees to focus on restoring critical societal functions, such as the electrical system, rather than being overly concerned about the safety and security of their loved ones.

- It is recommended that local and national leaders have processes in place to prioritize key resources to ensure distribution to recipients with the greatest needs.

Enhancing Education and Public Messaging on Space Weather Incidents

Workshop participants discussed developing space weather education for government leaders. However, one participant reminded the group that in both the U.S. and EU, leaders and their staffs change frequently through the electoral process. Therefore, the participants suggested the development of educational mechanisms that leaders and staffers can access when they arrive in office.

Workshop participants agreed that the public also requires education on space weather, with particular focus on the education of children, a method that has often shown promising results. Effective communication and messaging to the public during and post-incident is equally important. The participants identified several opportunities for emergency managers and local and national leaders to enhance public communication during a geomagnetic storm.

<u>Enhancing Education and Public Messaging on Space Weather Incidents Recommendations</u>

- It is recommended that agencies utilize government education programs such as Ready.gov, the U.S. Citizen Corps, the Swedish www.Skyddsnatet.se as well as equivalent European programs, and other community preparedness initiatives to inform the public and other societal stakeholders about the potential impacts of space weather, and provide tips on how to prepare for, protect against, respond to, and recover from the effects by developing family and community disaster plans with an emphasis on preparedness. This can also involve providing resources such as web site links and contact information to the public, so that they may conduct further research on their own, if desired. It is recommended that information released to the public focuses on mitigating the effects of geomagnetic storms, rather than on what causes these storms.

- It is recommended that a centralized government point of contact for media and public inquiries be in place for space weather-related issues. This point of contact can encourage and facilitate communication with the private sector on space weather issues, contingency plans, and recovery procedures. Social media, such as Facebook and Twitter, should be employed along with videos and podcasts on Government web sites to educate the public on space weather and its impacts.

Sharing Lessons Learned from National and International Exercise Programs

Throughout the workshop, participants repeatedly returned to the need to capture and share space weather information between transatlantic partners. Workshop participants referenced significant geomagnetic events from the past and the actions taken by the relevant authorities related to them. With the globalization of society, workshop participants noted that future events will become multinational issues. Awareness and preparedness is therefore vital to effective response.

By definition, high-impact, low-frequency events like solar storms do not occur with sufficient regularity to instill experience-based awareness. Therefore, stakeholders must promote awareness through sharing experiences and lessons learned from national and international disaster/crisis management exercise programs.

Sharing Lessons Learned from National and International Exercise Programs Recommendations

- It is recommended that stakeholders build a process for sharing the knowledge of subject matter experts (SMEs) during space weather-related exercise planning and conduct.

- It is recommended that an electronic information-sharing tool similar to the DHS Lessons Learned Information Sharing web site (www.llis.gov) be developed as a cost-effective solution for information sharing on national and international disaster/crisis management exercise programs. The U.S., Sweden, EU, and other partner nations around the world could contribute materials approved for international distribution. This would allow international partners to share experiences, lessons learned, best practices, and information related to all-hazards incidents (including space weather events) in an efficient and timely manner.

CONCLUSIONS AND NEXT STEPS

The *Workshop on Managing Critical Disasters in the Transatlantic Domain – The Case of a Geomagnetic Storm* strengthened transatlantic emergency management ties and increased awareness among both U.S. and EU stakeholders of the dangers posed by severe space weather.

Workshop participants accomplished the workshop objectives and identified several specific opportunities for stakeholders to increase preparedness and enhance transatlantic ties and communication. While these areas were identified within the context of a space weather event, workshop participants agreed that there were improvements to be made across all-hazards planning.

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ANNEX A – PARTICIPANTS

Primary Attendants:

Europe

- Helena Lindberg, Director-General, Swedish Civil Contingencies Agency (MSB), Sweden
- Mikael Odenberg, President and CEO, Svenska Kraftnät, (Sweden National Grid), Sweden
- Magnus Olofsson, Director-General, Swedish National Electrical Safety Board, Sweden
- Katarina Kämpe, Deputy Director-General, Swedish Post and Telecom Agency (PTS), Sweden
- Stephan Lechner, Director, Institute for the Protection and Security of the Citizen, European Commission (EC) Joint Research Centre
- Ian Clark, Head of Unit for Prevention and Preparedness, EC Environment Directorate-General (DG)
- Astrid-Christina Koch, Science Counselor, European Union Delegation to the U.S. in Science, Technology and Education

United States

- W. Craig Fugate, Administrator, FEMA
- William Carwile, Associate Administrator, Response & Recovery, FEMA
- Timothy Manning, Deputy Administrator, Protection and National Preparedness, FEMA
- Thomas Bogdan, Director, Space Weather Prediction Center, NOAA
- Brent Colburn, Director, External Affairs Office, FEMA
- Michael Assante, Vice President and Chief Security Officer, NERC
- James Caverly, Director, Office of Infrastructure Protection, Partnership Outreach Division
- Anthony Lucas, Energy Infrastructure Coordinator, Infrastructure Security & Energy Restoration, U.S. Department of Energy
- Jerry L. Taylor, Senior Engineer, Office of Electric Reliability, FERC

Secondary Attendants:

Europe

- Bo Krantz, Senior Vice President and CAO, Svenska Kraftnät (Swedish National Grid), Sweden
- Jonny Nilsson, Head of Robust Communications, Swedish Post and Telecom Agency (PTS), Sweden
- Henrik Olsson, Swedish National Electrical Safety Board, Sweden
- Sanna Zandén Kjellén, Strategic Adviser on EU affairs to the Head of Department for Coordination and Operations, Swedish Civil Contingencies Agency (MSB), Sweden

United States

- Ralph Anderson, Senior Regional Entity Compliance Auditor, NERC
- Lyric Clark, International Relations Specialist, International Affairs, FEMA
- Mike Coen, Counselor to the Administrator, FEMA
- Tim Deal, Federal Preparedness Coordinator, FEMA Region VIII
- Rhonda Dunfee, Control Systems Security, Department of Energy
- Douglas Gore, Acting Regional Administrator, FEMA Region VIII
- Stacie Greff, Director, External Affairs, FEMA Region VIII
- Dan Griffiths, Response Division Director, FEMA Region VIII
- Mark Lauby, Director of Reliability Assessments, NERC
- Al Mongeon, Homeland Security Activities Coordinator, NWS
- William Murtagh, Program Coordinator and Space Weather Forecaster, Space Weather Prediction Center, NOAA

Moderators:

- MG (Ret) Steve Saunders, National Integration Center, FEMA
- Michael Mohr, Homeland Security Liaison, Embassy of Sweden

Speakers and Observers:

Europe

- Gianmarco Baldini, Scientific Officer, Institute for the Protection and Security of the Citizen, Joint Research Centre, European Commission

- Henrik Lundstedt, Deputy Director, International Space Environment Service (ISES), Sweden
- Rolf Olsson, Head of Exercises Section, Swedish Civil Contingencies Agency (MSB), Sweden

<u>United States</u>

- Joseph Kunches, Space Scientist, NOAA
- Jim Madon, Director, National Communications System, Department of Homeland Security
- Tom Peltzer, Space Weather Prediction Center, NOAA
- Dianne Suess, Executive Officer, Space Weather Prediction Center, NOAA
- Louis Uccellini, Director, NWS/National Centers for Environmental Prediction
- Norm Winterowd, MERS Chief, FEMA Region VIII

Exercise Planners and Support Staff

<u>Europe</u>

- Jesper Grönvall, Homeland Security Advisor, Embassy of Sweden
- Arya Honarmand, Executive Officer, Exercise Section, Swedish Civil Contingencies Agency (MSB), Sweden
- Cecilia Fogelberg, Executive Officer, Exercise Section, Swedish Civil Contingencies Agency (MSB), Sweden
- Jan Lundberg, Executive Officer, Swedish Civil Contingencies Agency (MSB), Sweden

<u>United States</u>

- Rebecca Bean, National Exercise Division, FEMA
- David Short, Exercise Support Team
- Kathleen Ellis, Exercise Support Team
- Beth-Ann Gillier, Exercsie Support Team

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ANNEX B – ACRONYMS

CIKR	Critical Infrastructure and Key Resources
CME	Coronal Mass Ejection
DHS	U.S. Department of Homeland Security
EC	European Commission
EPCIP	European Programme for Critical Infrastructure Protection
EU	European Union
FEMA	U.S. Federal Emergency Management Agency
FERC	Federal Energy Regulatory Commission
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HF	High Frequency
HILF	High-impact, low-frequency
IP	Office of Infrastructure Protection
ISES	International Space Environment Service
MIC	Monitoring and Information Centre
MSB	Swedish Civil Contingencies Agency
NERC	North American Electric Reliability Corporation
NIPP	National Infrastructure Protection Plan
NOAA	National Oceanic and Atmospheric Administration
NOC	National Operations Center
NRF	National Response Framework
NRCC	National Response Coordination Center
NWS	National Weather Service
PTS	Swedish Post and Telecom Agency
SITREP	Situation Report
SME	Subject Matter Expert
SWPC	Space Weather Prediction Center
U.S.	United States

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ANNEX C – REFERENCES

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National Response Framework (NRF) Resource Center
http://www.fema.gov/emergency/nrf/index.htm

Service Assessment: Intense Space Weather Storms October 19 – November 07, 2003
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International Space Environment Service
http://www.ises-spaceweather.org/

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Environment Fact Sheet: Civil Protection: Together We Are Stronger
http://ec.europa.eu/environment/civil/pdfdocs/2007_factsheet.pdf

Global Disaster Alert and Coordination System
http://www.gdacs.org/about/GDACS_JRC.pdf

Joint Research Centre: European Commission
http://ec.europa.eu/dgs/jrc/index.cfm?id=1370
http://ec.europa.eu/dgs/jrc/downloads/jrc_passport_en.pdf

LiveMon: Real Time Monitoring and Visualization of Disaster Events
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