Análisis de las medidas de prevención ante el riesgo natural de "tormenta solar" en el plano internacional: Fundamentos para una nueva estrategia de intervención española

Miguel Ángel Rodríguez Arias

Jornadas Técnicas sobre el Clima Espacial
Escuela Nacional de Protección Civil, Madrid.
23-24 febrero 2011.

Índice de la presentación.

I. Una evolución paralela: Los estudios sobre el alcance del multi-escenario “tormenta solar” y sus implicaciones como base de las suvesivas medidas (“Reasonable worst-case scenario”).

II. Síntesis de la estructura actual de la respuesta.

III. Avance de conclusiones para un nueva estrategia española por armar ante los riesgos naturales del clima espacial.

El evento de Quebec: la auténtica llamada de atención.

1. Antecedente inmediato Evento Quebec, auténtica “llamada de atención” (el evento Carrington 1859, o el evento de 1921 quedaban muy atrás...)

Enfoque EEUU/Canadá:

- Informe “Québec Disturbance”, 1989, North American Electric Reliability Corporation (NERC)
- Posterior Informe: “Final report on August 14 2003 Blackout in the United states and Canada - Causes and Recommendations”,
- Y del informe del Northwest Power Coordinating Council (NPCC)

Document C-15 "Procedures for Solar Magnetic Disturbances Which Affect Electric Power Systems“.

-Reciente Informe Nerc: “Executive briefing on Electro magnetic pulse and geomagnetic storm events” de 24 de agosto de 2009

- Febrero de 2010, the North American Electric Reliability Corporation (“NERC”) and the U.S. Department of Energy (“DOE”) published their report entitled “High-Impact, Low-Frequency Event Risk to the North American Bulk Power System” (“HILF report”).

2. Distintos workshops, encuentros, incluido el de la OTAN: “NATO Advanced Science Institute on Space Storms and Space Weather Hazards” en Junio de 2000.

El inicio de la actual estrategia de intervención americana en 2006: La Orden Presidencial Ejecutiva 13407- Public Alert and Warning System

3. En el plano legislativo y de las medidas Orden Presidencial Ejecutiva 14407 de 26 de junio de 2006—>FEMA

- Section 1. *Policy.* It is the policy of the United States to have an effective,

reliable, integrated, flexible, and comprehensive system to alert and warn the American people in situations of war, terrorist attack, natural disaster, or other hazards to public safety and well-being (public alert and warning system), taking appropriate account of the functions, capabilities, and needs of the private sector and of all levels of government in our Federal system, and to ensure that under all conditions the President can communicate with the American people.

- Sec. 4. *Reports on Implementation.* Not later than 90 days after the date of this order, the Secretary of Homeland Security shall submit to the President, through the Assistant to the President for Homeland Security and Counterterrorism, a plan for the implementation of this order, and shall thereafter submit reports from time to time, and not less often than once each year, on such implementation, together with any recommendations the Secretary finds appropriate.

Informe Kappenman

-John Kappenman preparará para FEMA bajo la Orden Presidencial Ejecutiva 13407 el informe “ *Vulnerability of the Electric Power Grid for Severe Geomagnetic Storms* “ que es el que dará lugar al posterior informe 2008 US National Academy of Sciences Report on “Severe Space Weather Events—Understanding Societal and Economic Impacts Workshop Report Committee on the Societal and Economic Impacts of Severe Space Weather Events” (del que es coautor) y que es el que saltará a los medios, pero Kappenman irá más allá.

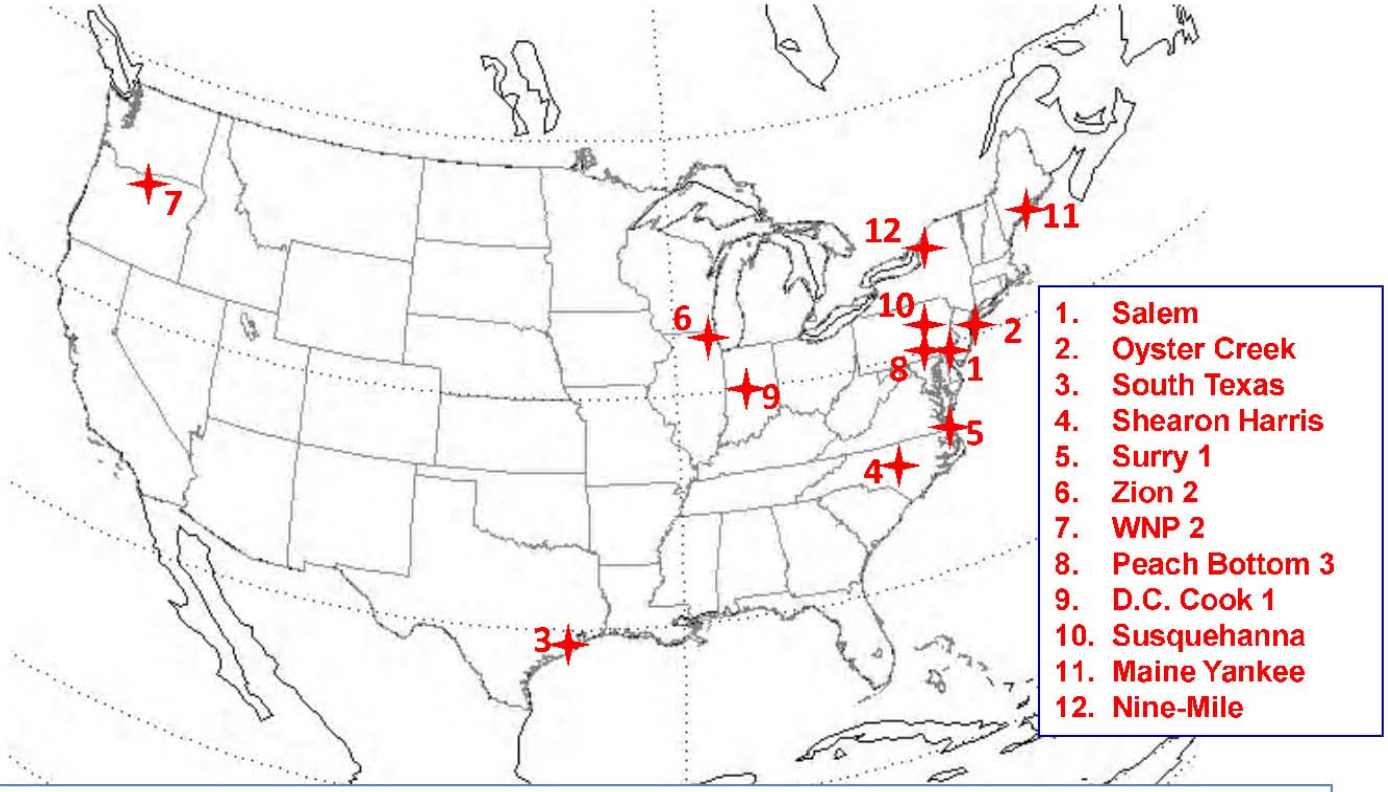
- Parcialmente recogido en el Informe Metatech “Geomagnetic Storms and Their Impacts on the U.S. Power Grid” (197 páginas)

- Se prevé como escenario de referencia “Reasonable worst case scenario” en el que se plantea como escenario un severo (corrige al alza) o bien un escenario extremo. Prevé un escenario entorno a 4-10 veces Québec (Pág. 14). Si bien llega a señalar que Quebec fue solo una X tamaño medio y que se han llegado a detectar llamaradas X22.Tampoco el tamaño tiene que ser lo determinante: “Reasonable worst case scenario” Británico.

En el informe Metatech se documentan hasta 12 incidentes en centrales nucleares americanas tras la tormenta geomagnética de Quebec: destaca Salem y Chicago, esta última especialmente seria, los responsables de la central no llegaron a saber que pasó. También se deja constancia de la afectación de una central térmica.

Nuclear Plant GSU Transformer Incidents

Within 25 months after the March 1989 Storm



Latent Impacts of March 1989 Storm – Delayed Failures of Large Transformers at Nuclear Plants suspected across US

“Sólo” se habla de transformadores no de refrigeración, ni de afectación de sistemas electrónicos por la onda similar a EMP.

¿Cuántos incidentes produciría algo similar entre las 196 centrales nucleares del continente europeo? ¿y una tormenta con una intensidad x4 o x10?.

El enfoque de cooperación en materia de infraestructuras críticas europeas

en ningún sitio como este queda de manifiesto, si adoptamos medidas como las propuestas en EEUU con nuestras 8 centrales pero Francia no lo hace con sus 56 o Reino Unido no lo hace con sus 16...

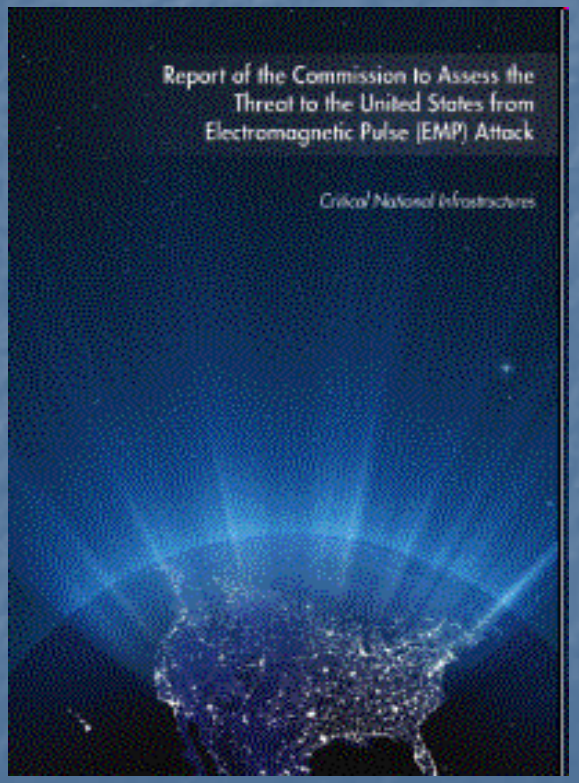
Figure 2-33. Damaged transformer at the Salem Nuclear Plant.

- **“On April 3, 1994 a moderate intensity storm occurred. During this storm a GSU transformer at Zion Nuclear plant (on the outskirts of Chicago) failed catastrophically.**
- **The failure was so severe that the transformer tank, containing thousands of gallons of oil, ruptured and started a major fire in the yard at the plant, which eventually involved control circuits and other sensitive systems. The fire also spread into the generator hydrogen cooled isobus inside the plant.**
- In many postmortem analyses of transformer failures, it is very difficult to assess the failure cause, given unknowns about the unique design variations and unique operational exposure of each transformer. In particular, static electrification was a failure mode of tansformers of this vintage, and would be unrelated to GIC exposure. Considering the unknowns and multiple plausible failure causes, very few definitive failure diagnoses can be expected. The operator of the plant facility has resisted the association of this failure with the geomagnetic storm event, however they had not been undertaking any effort to monitor for GIC in the transformer or at any other locations in their regional transmission network. Observations of GIC were made at utilities elsewhere north, south, east and west relative to their location. **The space weather conditions that spawned the April 3, 1994 storm were associated with long-duration and recurrent solar activity sources. Therefore, storm conditions occurred from early April to mid-April. Over that same period of time, the local utility also experienced major GSU transformer failures at the Braidwood nuclear plant (April 5, 1994) and at the Powerton coal plant (April 15, 1994).** Again, the operator has resisted the association of these failures with GIC, even thoughthe timing of these events would appear to be extraordinarily coincidental.”

Las distintas Comisiones del Congreso EEUU se pronuncian sobre los riesgos de un efecto EMP malicioso/ o una geomagnetic disturbance por eventos naturales

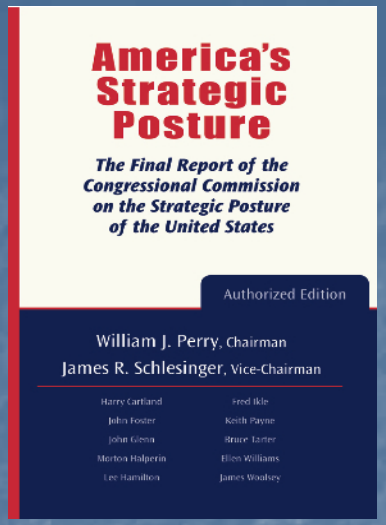
Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack Critical National Infrastructures

de 2008. (Y otra versión previa de 2004 donde Ya contemplaba el riesgo de tormenta solar)



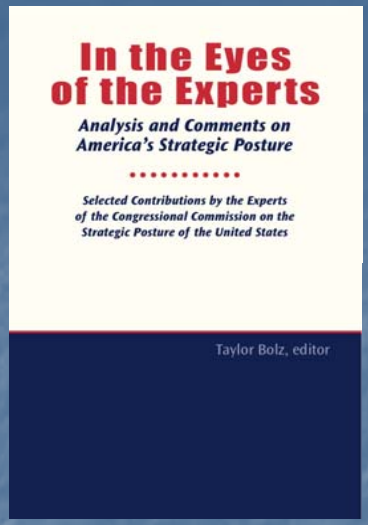
Un vistazo a su índice completo es suficiente

- **Table of Contents**



America's Strategic Posture
The Final Report of the Congressional Commission on the Strategic Posture of the United States

In the Eyes of the Experts
Analysis and Comments on America's Strategic Posture



"The [EMP] Commission reported that the ubiquitous dependency of society on the electrical power system, coupled with the EMP's particular damage mechanisms, creates the possibility of long-term, catastrophic consequences for national security.

- **The Commission stated, "Should significant parts of the electrical power infrastructure be lost for any substantial period of time … many people may ultimately die for lack of the basic elements necessary to sustain life in dense urban and suburban communities … [and] the Federal Government does not today have sufficiently robust capabilities for reliably assessing and managing EMP threats."**
- However, the consensus of the EMP commission in 2008 was that the United States need not remain vulnerable to catastrophic consequences of an EMP attack, and that the nation's vulnerability can be reasonably reduced by coordinated and focused effort between the private and public sectors. The Committee stated that thecost for improved security in the next three to five years would be modest, especially when compared with the costs associated with the war on terror and the value of the national infrastructures threatened.

Subcommittee on Emerging Threats, Cybersecurity and Science and Technology“

En Julio de 2009 un Subcomité del Congreso “Hearing was held on Geomagnetic Storms, EMP and Related Threats to the National Electric Grid. The hearing took place in the U.S. House of Representatives Committee on Homeland Security: the Subcommittee on Emerging Threats, Cybersecurity and Science and Technology“

From the Chairwoman’s opening statement:
“The electric grid is fundamental to our lives and our country’s existence. Without electricity, banks shut down. Food goes bad. Sewage and water plants don’t function. Medicines expire. Chaos ensues and crime explodes. We simply cannot afford to lose broad sections of the grid for days, weeks, months, or years…The potentially devastating effects of an EMP to the grid are well documented.

Vídeo de la sesión
http://www.empcouncil.org/English/Resources/ResouceInside.asp?itemId=10324

Abierta convergencia de comprensión británica/alemana en torno al tipo de fenómeno y a las consecuencias en cascada/dominó

Reino Unido:

-Creación del Scientific Advisory Group for Emergencies (SAGE) o Grupo de Asesoramiento Científico para Emergencias (asesoramiento antes, durante y después, reciente artículo de la Universidad de Cambridge

http://www.csap.cam.ac.uk/news/article-science-emergencies/

- Incluido un Código de conducta del SAGE: "*Principles of Scientific Advice to Government* "

- Web recogida en la web oficial del Gobierno Británico incluyendo el reciente artículo publicado en marzo de 2011 por su asesor Jefe y el de Obama en el New York Times "Celestial Storm Warnings"

-Sir John Beddington, es su Presidente.

-"I raised the issue with the Cabinet Office Civil Contingencies Secretariat, arguing that it needs to be higher up the agenda," he told The Times. That is happening. I've advised that this is a serious concern. We're moving in the next two years into the peak of the solar cycle."There is an analogy here with volcanic ash," he went on. "It's a natural event which has a certain frequency. With 20-20 hindsight, we should have recognized the chance of disruption from volcanic ash, given the frequency of eruptions in Iceland, and we didn't. We need to learn from that experience," he added. "This was a natural event that wasn't expected, which as it transpired caused major problems. Space weather could be significantly more problematic, so we need to be prepared."

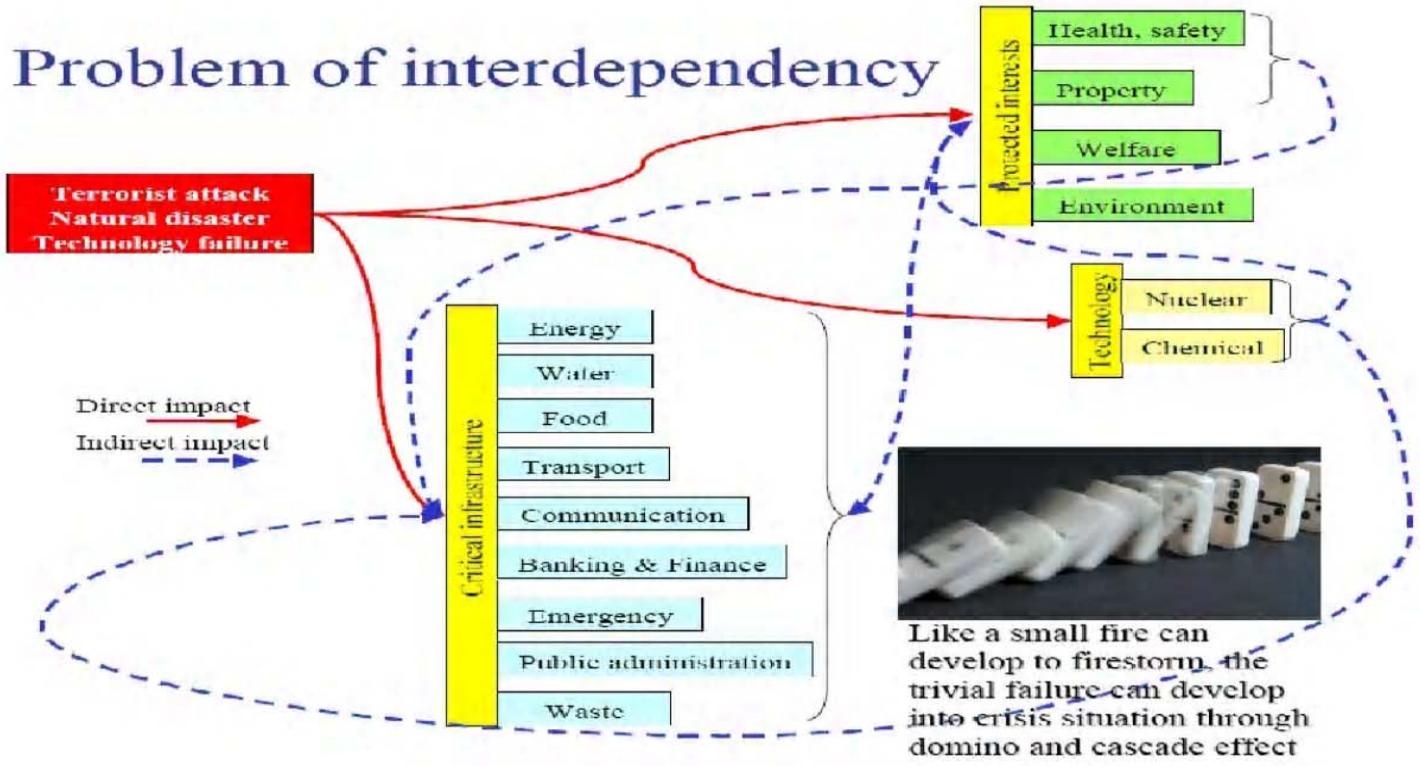
- “HC 499 - **Scientific advice and evidence in emergencies**. Memorandum submitted by the Government Office for Science and the Cabinet Office (SAGE 00)” Informe PDF de 275 páginas que recoge documentos y comparecencias del propio Beddington y distintos miembros del SAGE ante una Comisión del Parlamento Británico sobre los riesgos del clima espacial y otros 3 escenarios más destacados. Plantean 4 worst case scenario en torno a 4 distintos tipos de riesgos que priorizan.

-Las “yellow pages” de Beddington.

- El reasonable worst case scenario de clima espacial no tiene que llegar a ser un “Evento Carrington”: una severe storm de las que se llega a sostener que ha habido en torno a 30 en los últimos 150 años. Paradigmáticamente una tipo 1921 ya sería paradigmática; o una rápida sucesión siempre dependiendo de adicionales circunstancias.

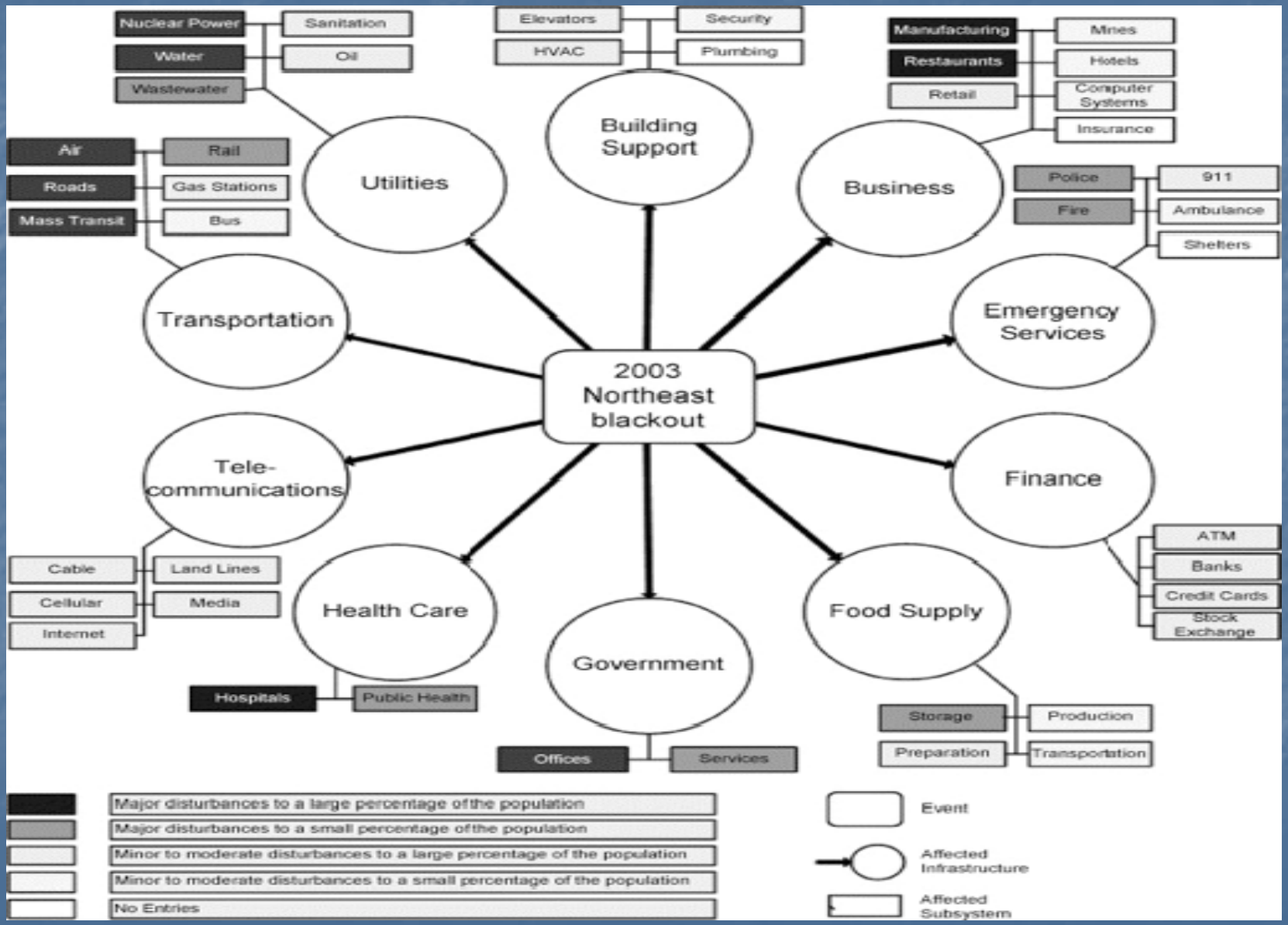
- **El enfoque alemán** partirá igualmente de un enfoque multiescenario con sendos informes de los efectos de un repentino corte del suministro eléctrico perdurable, sea por evento natural o por ataque terrorista.Informe SIMKRIT del Instituto para la Tecnología de la Universidad de Karlsruhe

(SIMKRIT, Simulation Kritischer Infrastrukturen für das krisenmanagement). Idéntico incapie de la interdependencia de la industria nuclear y química del resto de factores, y los derechos y seguridad de las personas.



entnommen: Benes,CITIPLAN, 2007

Paralelismo con el enfoque americano: multiescenario o escenario en cascada



- Versión resumida (Kurzfassung) del informe de Protección Civil Alemana (Bundesamt für Bevölkerungsschutz und Katastrophenhilfe ‚BBK) "**Krisenmanagement bei einer großflächigen Unterbrechung der Stromversorgung am Beispiel Baden-Württemberg**"

3 ópticas temporales de colapso desde las que lo analizan todo:

-Interrupción generalizada del suministro y afectación de infraestructuras 8 horas

-Interrupción generalizada del suministro y afectación de infraestructuras 8-24 horas.

-Interrupción generalizada del suministro y afectación de infraestructuras por un periodo de tiempo indetermiando superior a las 24 horas.

- Se va analizando distintos sectores. Se prevé el fallo de bombeo de agua potable a los hogares entre las 8 y las 24, la afectación de la operatividad de los servicios de emergencia desde el principio, de los servicios médicos (2- "Auswirkungen auf das Gesundheitswesen", pág. 15) en especial en esto último se detalla desde el fallo de la maquinaria de pronóstico a la de tratamiento (centros de diálisis), de refrigeración (rotura de la cadena de frío de las vacunas), situación de los enfermos internados en psiquiátricos… a refinerías y transporte ("4.Auswirkungen von Stromausfällen auf die Treibstoffversorgung", con cuestiones como la imposibilidad de valerse de grandes depósitos sino se cuenta con bombas de emergencia con suministro independiente para bombear el combustible);

- Respecto de la cuestión de las aguas residuales para un escenario de más de 24 horas se prevé expresamente la inundación de algunas calles y pasos subterráneos en centros urbanos por acción del desbordamiento de las aguas fecales ("Überflutung tief gelegener Straßen und Unterführungen), taponamiento general de las canalizaciones y riesgo sanitario de propagación de enfermedades (pág. 19).

Se reconoce la caída inmediata ("sofortiger") del funcionamiento de las estaciones de móvil no aseguradas ya en el escenario A, así como de routers, modems… (pág 23). Y en especial el tiempo adicional de al menos 4 o 5 días más que costaría reestablecer todo ello aún si a las 24 horas se reestableciese el suministro eléctrico.

- Consideraciones en torno a los planes de alarma y movilización de Protección Civil de Alemania en caso de corte duradero de suministro eléctrico

V-B-2 Alarmierung der Einsatzkräfte ohne Strom

Ziel der Planungshilfe/Maßnahmenliste:

- Sicherstellung der Alarmierung von Einsatzkräften in der nichtpolizeilichen Gefahrenabwehr
- Planung und Vorbereitung von alternativen Alarmierungswegen

1. Alarmierungspläne

	Maßnahme	*Erläuterung*	☑
1.1	Prüfung, ob die Alarmierung der Einsatzkräfte auch bei einem Stromausfall gesichert ist	Sollte dies nicht gewährleistet sein, Umsetzung der folgenden und ggf. weiterer aufgrund der örtlichen Gegebenheiten notwendiger Maßnahmen.	☐
1.2	Alarm- und Einsatzpläne auch in Papierform	Möglicherweise funktionieren die PCs und die Alarmgeber in der Feuerwehreinsatzzentrale nicht (hier auf jeden Fall außer Batteriepufferung auch Fremdeinspeisung vorsehen).	☐

2. Alternative Alarmierungswege

	Maßnahme	*Erläuterung*	☑
2.1	Vorrat an analogen Telefonen anlegen	Alarmierung ist über analoge Telefone in der Regel möglich, wenn der Angerufene auch ein analoges Telefon hat.	☐
2.2	Einsatz von Lautsprecherwagen, Handsirenen und Megaphonen planen	Alternativen zur Alarmierung über stromabhängige Sirenen oder Funkmeldeempfänger.	☐
2.3	Prüfen, ob Alarmierung der jeweiligen Einsatzkräfte im Schnellballsystem/ Selbstalarmierung sinnvoll ist	Ggf. Melder benennen, falls alarmiert werden muss und die Kommunikationsnetze bereits ausgefallen sind.	☐
2.4	Abholen der Einsatzkräfte an ihren Wohnungen oder Arbeitstellen einplanen	Der Öffentliche Personen-Nahverkehr und der Straßenverkehr sind durch den Stromausfall stark eingeschränkt, so dass die individuelle Mobilität erheblich vermindert ist.	☐
2.5	Prüfen, ob die Festlegung einer Selbstalarmierung für die Einsatzkräfte sinnvoll ist	Ggf. festlegen, dass sich ab einem 30-minütigen Stromausfall, die Einsatzkräfte unaufgefordert z. B. zum Feuerwehrhaus begeben.	☐

- Paralelo proyecto alemán GRASB, en su segundo año de realización, "Forschungsprojekt GRASB zur Sicherung der Versorgung der Bevölkerung mit Strom "

  http://www.bbk.bund.de/cln_007/nn_398006/DE/03__Aktuelles/01__Meldungen/Nachrichten/2010/01101300__Forsch__projekt__GRASB.html

  Y aquí se puede descargar un completo PDF con toda la info, explicando la participación de actores privados, etc.
  http://www.bbk.bund.de/cln_012/nn_398006/SharedDocs/Publikationen/Broschueren__Flyer/Flyer__GRASB,templateId=raw,property=publicationFile.pdf/Flyer_GRASB.pdf

- Enfoque militar/de seguridad nacional por parte de la Luftwaffe alemana (Ejército del aire) de las posibles amenazas derivadas del Clima Espacial, y la necesidad de adoptar medidas logísticas específicas que garanticen la capacidad de comunicación del ejército.

  http://www.luftwaffe.de/portal/a/luftwaffe/kcxml/04_Sj9SPykssy0xPLMnMz0vM0Y_QjzKLNzKId_dxB8lB2F7O-pFw0aCUVH1vfV-P_NxU_QD9gtyIckdHRUUAl64xJQ!!/delta/base64xml/L2dJQSEvUUt3QS80SVVFLzZfMjBfR0xH?yw_contentURL=%2F01DB060000000001%2FW28EKHNN126INFODE%2Fcontent.jsp

El análisis alemán de la situación de los internos hospitalizados pone de manifiesto la cuestión paralela de los presos en los centros penitenciarios (Orden público fugas masivas/responsabilidad legal del Estado por su confinamiento con alimentos y adecuados cuidados, ¿cómo?)
- Tomar en consideración adaptación situación masificada de partida, necesidad de revisión de medidas de seguridad, protocolos, suministros, mecanismos de comunicación y petición de refuerzos.

- Instituciones Penitenciarias - Noticias
  Viernes, 14 de Agosto de 2009.

  CSI·F denuncia que la prisión de Fontcalent estuvo ayer cinco horas sin suministro eléctrico

  El sindicato CSI·F ha denunciado que el Centro Penitenciario de Fontcalent (Alicante) sufrió ayer el apagón de todos sus sistemas eléctricos así como la caída de las líneas telefónicas, lo que provocó un fallo de seguridad que podía haber ocasionado graves incidencias. La Central Sindical Independiente y de Funcionarios (CSI·F) responsabiliza a la Dirección del centro penitenciario de falta de previsión ya que no tomó ninguna clase de medidas preventivas para impedir un agujero en la seguridad del centro que puso en peligro a los funcionarios. Durante más de cinco horas, y no por primera vez esta semana, en la cárcel de Alicante no funcionaban las puertas automáticas, cámaras de seguridad, teléfonos ni cualquier tipo de mecanismo eléctrico. Esto supone que había acceso desde el patio central de la cárcel hasta la calle a través de unas puertas que se pueden abrir manualmente al no haber suministro eléctrico. El sindicato CSI·F lamenta que la dirección del centro no tomara ninguna medida adicional de seguridad el mismo día en el que se había previsto el traslado del presunto asesino de otro recluso, hecho ocurrido el pasado domingo 9 de agosto. El sindicato afirma que gracias al esfuerzo de los funcionarios, se han evitado situaciones graves en Fontcalent como los ocurridos recientemente.

  http://www.csi-csif.es/comunitatvalenciana/Article6956.html

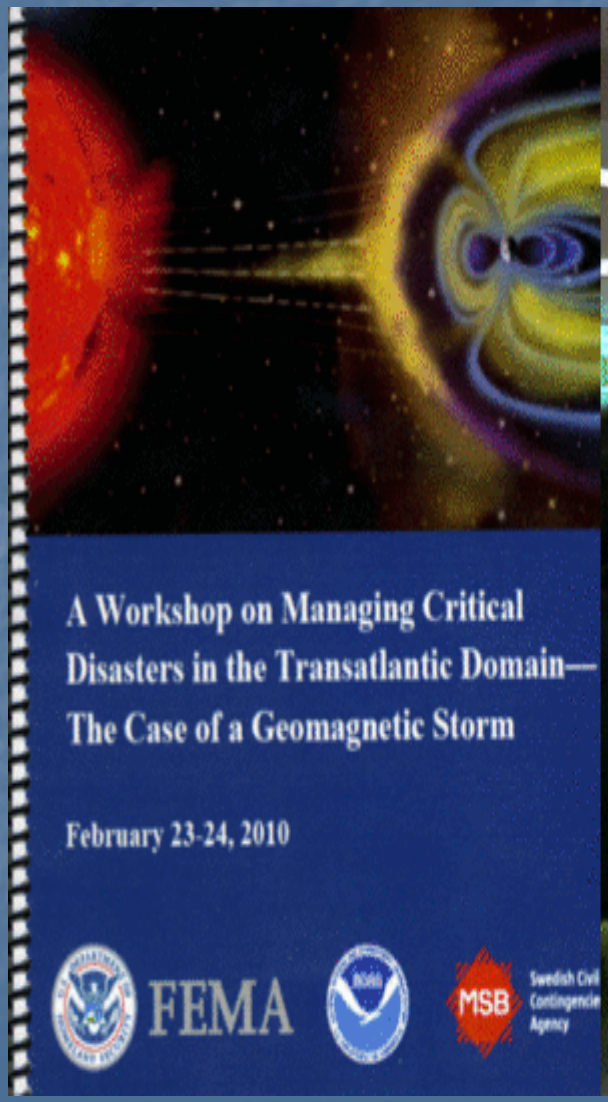

EIS
SUMMIT
SUMMARY
REPORT
ELECTRIC INFRASTRUCTURE
SECURITY SUMMIT
SEPTEMBER 20, 2010
WESTMINSTER HALL, PARLIAMENT,
UNITED KINGDOM

Aparece un nuevo actor orientado a la cooperación internaconal con las “Naciones amigas”: Londres

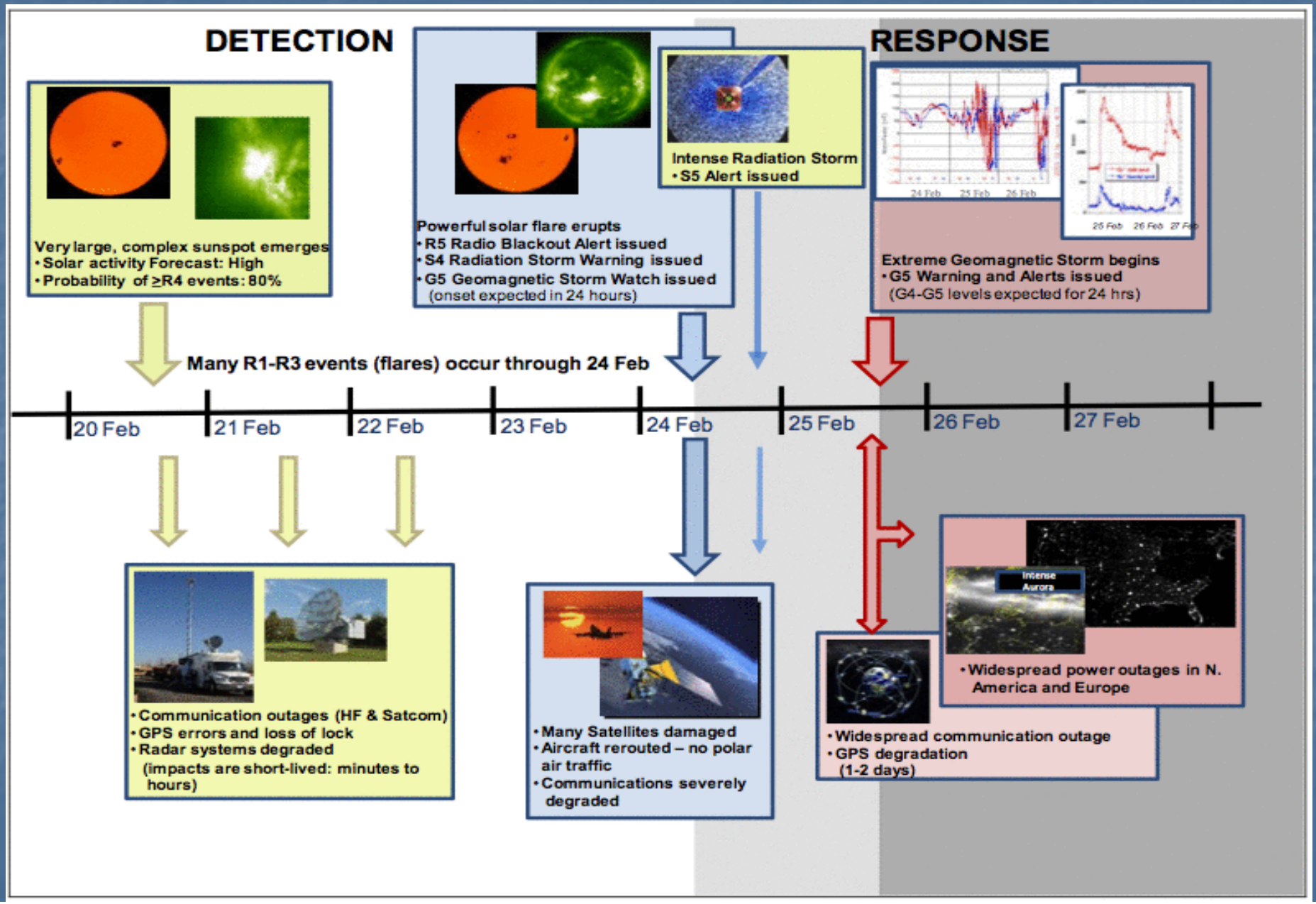
- Pdf “supervivencia naciones” Parlamento Británico
- El EIS Council (Electric Infrastructure Security Council) no es estatal, pero está formado por congresistas, autoridades, etc, y se abre participación, expresamente a agentes estatales.
- Vía informal, agilizadora, de cooperación internacional?
- http://www.empcoalition.org/images/upload/media/EISS%20Brochure_3.pdf

“Reasonable worst case scenario” al que dirigir las medidas

La tormenta solar G4 que ya sucedió: El simulacro de cooperación atlántica NOAA-FEMA-Red centros regionales ESIS- Comisión Europea y la Dirección General de Protección Civil de Suiza.



Así se prevé el escenario multicatástrófico “tormenta solar” con vasta afectación de EEUU-Canadá y Europa.



Varias de las contundentes conclusiones y recomendaciones a los Estados tras el simulacro son desatendidas, en particular:

- 1- “space weather education for government leaders.However, one participant reminded the group that in both the U.S. and EU, leaders and theirstaffs change frequently through the electoral process. Therefore, the participants suggested thedevelopment of educational mechanisms that leaders and staffers can access when they arrive in office”. Pág. 15

- **2-Enhancing Education and Public Messaging on Space Weather Incidents Recommendations (Pág. 15-16)**

  -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.

  -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.

  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.

- Paradójicamente mientras los Estados permanecen al margen de esta recomendación respecto el clima espacial, incluso Reino Unido, hace apenas 3 meses, el 21 de diciembre de 2010, acaba de ser aprobado un nuevo documento marco europeo respecto la previsión y gestión de emergencias por los Estados miembro en la UE: **"Staff Working Paper on Risk Assessment and Mapping Guidelines for Disaster Management"**:
- "(...) Draft risk assessments should be widely consulted with stakeholders [u]and interested parties, including central and regional levels of government and specialised departments. (...)[u]Moreover, extensive public information on the process and outcomes of risk assessments will be necessary to lead to a better understanding of the risks and to enable all stakeholders and the general public to become more engaged in emergency planning, preparedness and response. (...)
- The following actions should accompany national risk assessments:

  - Publication of potential risk scenarios to inform the population about the government's preparatory measures for emergencies and to provide advice on how the general public could be better prepared;

  - Information to stakeholders and the general public on the particular risks they face, through for instance the dissemination of **hazard maps**;

  - Cooperation with the private sector where their risk assessments complement the efforts of public authorities.

  http://ec.europa.eu/echo/civil_protection/civil/pdfdocs/prevention/COMM_PDF_SEC_2010_1626_F_staff_working_document_en.pdf

- En esto insistirían, adicionalmente, los asesores científicos de Obama y del Ministro David Cameron (Holdren-Beddington) en el ya comentado artículo en el New York Times de hace un par de semanas:

  "Some of these measures can bear fruit quickly, while others will pay off over the longer-term. **What is key now is to identify, test, and begin to deploy the best array of protective measures practicable, in parallel with reaching out to the public with information explaining the risks and the remedies. There is commitment on both sides of the Atlantic to doing exactly that."**

- http://www.nytimes.com/2011/03/11/opinion/11iht-edholdren11.html

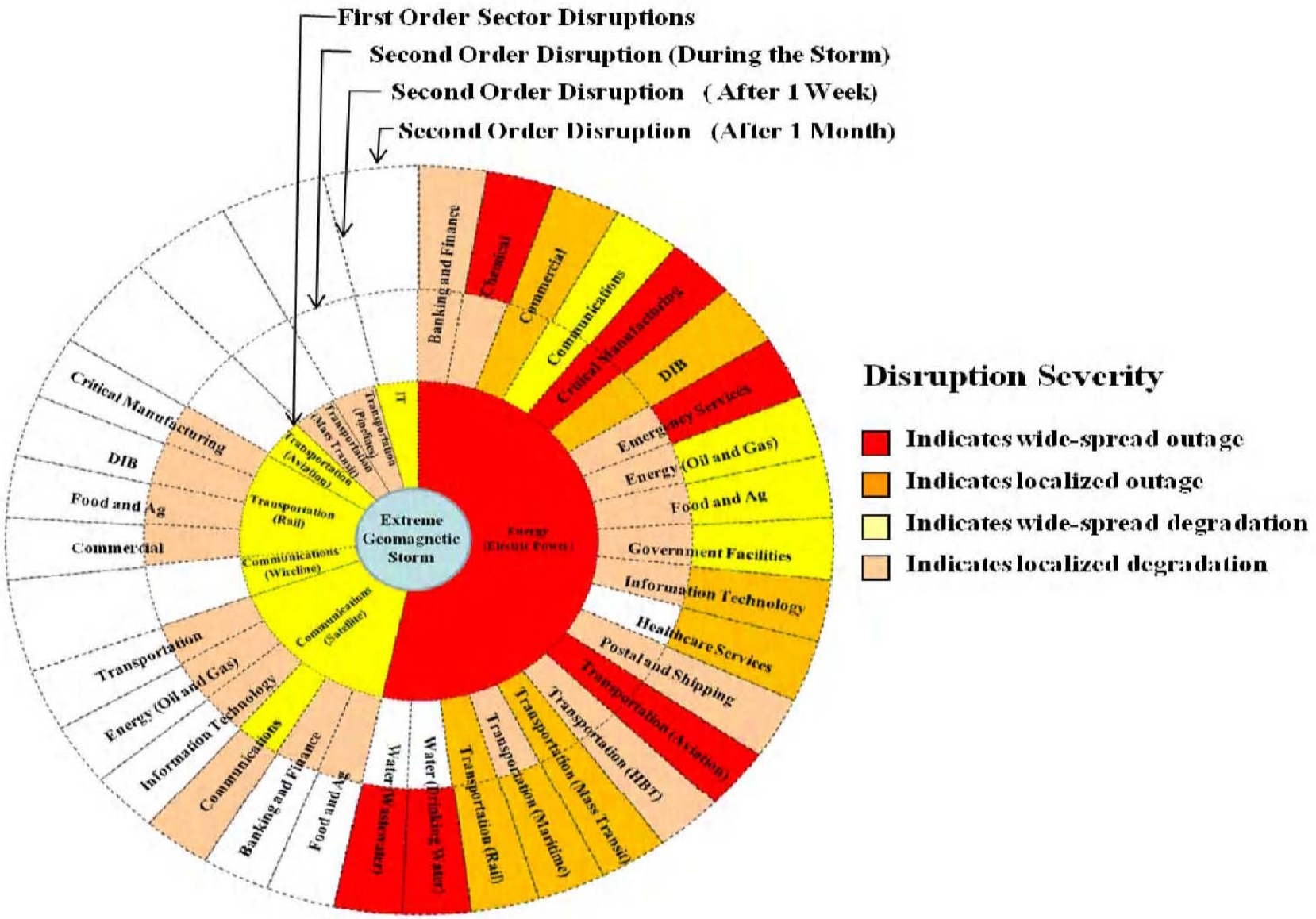
Cooperación internacional y otros actores económicos

- Informe de Zurich.
- **Solar Storms: Protecting Your Operations Against the Sun's 'Dark Side'**
- A.V. Riswadkar and Buddy Dobbins Zurich Services Corporation
- Risk Engineering
- 4/08/2010
- Programa internacional. Viviendo con una estrella
- Informe monográfico de la aseguradora Lloyds de enero de 2011: las tormentas solares como uno de los 3 grandes riesgos emergentes para este año.
- Informe OCDE I “Future Global Risks”
- Informe OCDE II “Geomagnetic Storm”

- Informe OCDE II “Geomagnetic Storm” abunda en el carácter multiescenario:

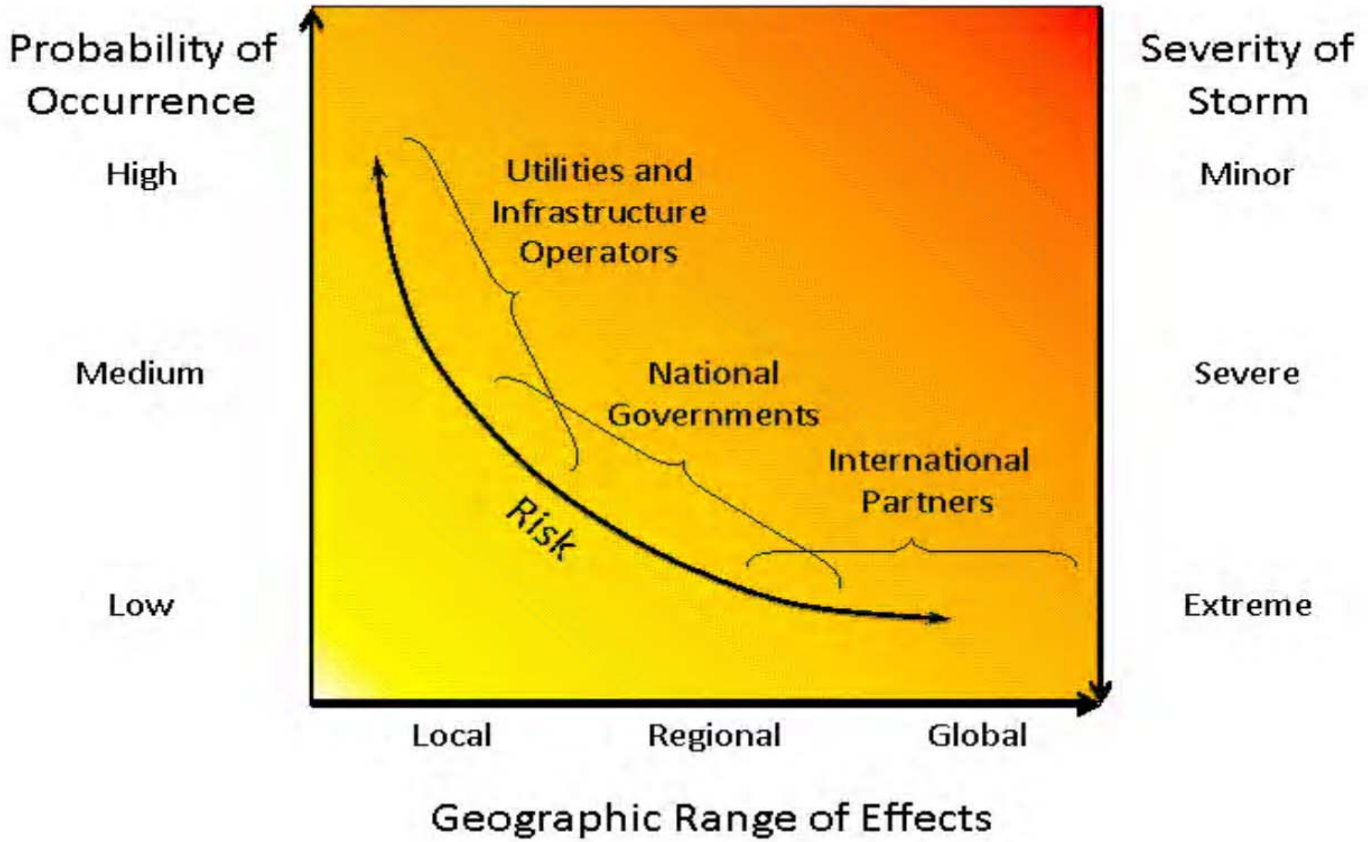
  “The loss of electricity could cause mass transit and passenger rail systems to fail and traffic signals to stop working, both situations where accidents could ensue. The loss of refrigeration could affect those who rely on medications that must be kept cold. Water shortages due to the failure of electrical pumps to convey the water or power the purification plants could also lead to acute exposure to toxicants or disease. Firefighters would not have access to water to put out fires and hospitals would not have access to water to take care of at-risk patients. In each case, however, other circumstances beyond a geomagnetic event are necessary to lead to injury, illness, or death. Pág. 24.

Figure 7. First and Second Order Critical Infrastructure Disruptions



Source: original to this document

Figure 3. Responsibilities for Geomagnetic Storm Risk Management Based on Relative Probability and Geographic Range of the Estimated Effects



Source: original to this document

En los últimos 150 años hemos tenido 9 tormentas magnéticas superiores a la de 1989 (quebec). Informe OCDE.

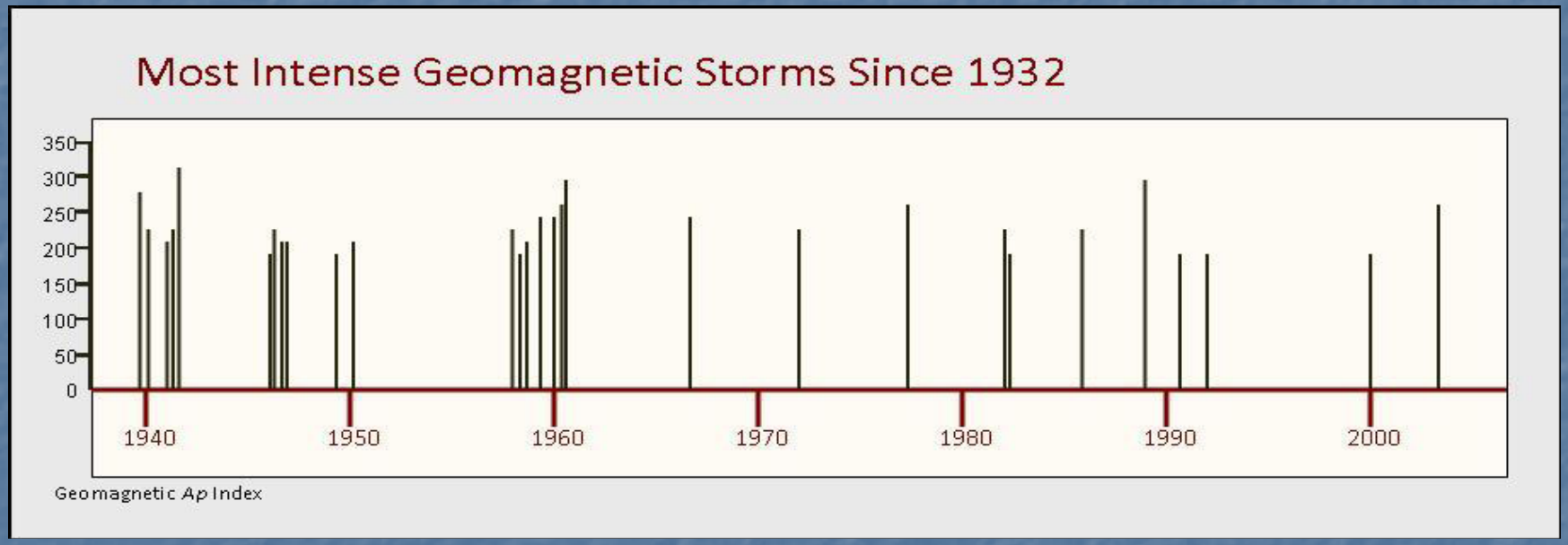


Table 2. Estimated Frequencies for Geomagnetic Storms of Different Magnitudes

Strength of the Storm (nanoTesla)	Frequency
> 100	4.6 per year
> 200	9.4 per 10 years
> 400	9.73 per 100 years
> 800	2.86 per 1,000 years
> 1,600	7.41 per 1,000,000

Source: Love and Gannon (2009)

Primera ley americana aprobada en primera instancia en la Cámara Baja

- Text of HR 5026 as approved by the House and excerpts of the floor debate from the Congressional Record. GRID RELIABILITY AND INFRASTRUCTURE DEFENSE ACT – (House of Representatives - June 09, 2010)

Crea Comité

-Da 12 meses a actores públicos proteger

-Da 12 meses a operadores privados para cumplir con determinadas obligaciones en materia de recambios

Puede obligar con ordenes ejecutivas tras 12 meses

- SEC. 2. AMENDMENT TO THE FEDERAL POWER ACT.
  (a) Critical Electric Infrastructure Security.--Part II of the Federal Power Act (16 U.S.C. 824 et seq.) is amended by adding after section 215 the following new section:
  ``SEC. 215A. CRITICAL ELECTRIC INFRASTRUCTURE SECURITY.

  ``(4) GEOMAGNETIC STORMS.--Not later than 1 year after the date of enactment of this section, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, issue an order directing the Electric Reliability Organization to submit to the Commission for approval under section 215, not later than 1 year after the issuance of such order, reliability standards adequate to protect the bulk-power system from any reasonably foreseeable geomagnetic storm event. The Commission's order shall specify the nature and magnitude of the reasonably foreseeable events against which such standards must protect. Such standards shall appropriately balance the risks to the bulk-power system associated with such events, including any regional variation in such risks, and the costs of mitigating such risks.

- ``(5) LARGE TRANSFORMER AVAILABILITY.--Not later than 1 year after the date of enactment of this section, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, issue an order directing the Electric Reliability Organization to submit to the Commission for approval under section 215, not later than 1 year after the issuance of such order, reliability standards addressing availability of large transformers. Such standards shall require entities that own or operate large transformers to ensure, individually or jointly, adequate availability of large transformers to promptly restore the reliable operation of the bulk-power system in the event that any such transformer is destroyed or disabled as a result of a reasonably foreseeable physical or other attack or geomagnetic storm event. The Commission's order shall specify the nature and magnitude of the reasonably foreseeable attacks or events that shall provide the basis for such standards. Such standards shall--

- (2) COMMISSION AUTHORITY.--If the Commission identifies a defense critical electric infrastructure vulnerability that the Commission, in consultation with owners and operators of any facility or facilities designated by the President pursuant to paragraph (1), determines has not adequately been addressed through measures undertaken by owners or operators of defense critical electric infrastructure, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, promulgate a rule or issue an order requiring implementation, by any owner or operator of defense critical electric infrastructure, of measures to protect the defense critical electric infrastructure against such vulnerability. The Commission shall exempt from any such rule or order any specific defense critical electric infrastructure that the Commission determines already has been adequately protected against the identified vulnerability. The Commission shall make any such determination in consultation with the owner or operator of the facility designated by the President pursuant to paragraph (1) that relies upon such defense critical electric infrastructure.

- Comparativa de modificaciones operadas:
- http://bartlett.house.gov/News/DocumentPrint.aspx?DocumentID=202311

Senador Bartlett : Bill Amended to Delete Threat to Electric Grid During Federal Government Alert of Solar Storm

Congressman Roscoe Bartlett said, "It is unfortunate that while one part of the federal government was warning us of possible solar electromagnetic pulse (EMP) damage to our electric grid, a key Senate Committee approved a bill to ignore this threat. It's particularly ironic since the Senate amended a bill, H.R. 5026, approved unanimously by the House that would specifically protect the grid against solar EMP and other physical threats."

- (…)
- http://bartlett.house.gov/News/DocumentSingle.aspx?DocumentID=202311
- Aquí su discurso integro durante su aprobación inicial en el Congreso Junio.
- http://www.youtube.com/user/RepRoscoeBartlett#p/a/u/0/gOuJLzO82DQ

Segunda ley americana presentada para su tramitación el 11 de febrero de 2011

Secure High-voltage Infrastructure for Electricity from Lethal Damage Act' or the

`SHIELD Act'

`(c) Measures To Address Grid Security Vulnerabilities-

`(1) COMMISSION AUTHORITY- If the Commission, in consultation with appropriate Federal agencies, identifies a grid security vulnerability that the Commission determines has not adequately been addressed through a reliability standard developed and approved under section 215, the Commission shall, after notice and opportunity for comment and after consultation with the Secretary, other appropriate Federal agencies, and appropriate governmental authorities in Canada and Mexico, promulgate a rule or issue an order requiring implementation, by any owner, operator, or user of the bulk-power system in the United States, of measures to protect the bulk-power system against such vulnerability. Any such rule or order shall include a protection plan, including automated hardware-based solutions. Before promulgating a rule or issuing an order under this paragraph, the Commission shall, to the extent practicable in light of the urgency of the need for action to address the grid security vulnerability, request and consider recommendations from the Electric Reliability Organization regarding such rule or order. The Commission may establish an appropriate deadline for the submission of such recommendations.

`(2) RESCISSION- The Commission shall approve a reliability standard developed under section 215 that addresses a grid security vulnerability that is the subject of a rule or order under paragraph (1), unless the Commission determines that such reliability standard does not adequately protect against such vulnerability or otherwise does not satisfy the requirements of section 215. Upon such approval, the Commission shall rescind the rule promulgated or order issued under paragraph (1) addressing such vulnerability, effective upon the effective date of the newly approved reliability standard.

`(3) GEOMAGNETIC STORMS AND ELECTROMAGNETIC PULSE- Not later than 6 months after the date of enactment of this section, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, issue an order directing the Electric Reliability Organization to submit to the Commission for approval under section 215, not later than 6 months after the issuance of such order, reliability standards adequate to protect the bulk-power system from any reasonably foreseeable geomagnetic storm or electromagnetic pulse event. The Commission's order shall specify the nature and magnitude of the reasonably foreseeable events against which such standards must protect. Such standards shall appropriately balance the risks to the bulk-power system associated with such events, including any regional variation in such risks, and the costs of mitigating such risks. If the Commission determines that the reliability standards submitted by the Electric Reliability Organization pursuant to this paragraph are inadequate, the Commission shall promulgate a rule or issue an order adequate to protect the bulk-power system from geomagnetic storms or electromagnetic pulse as required under paragraph (1).

`(4) LARGE TRANSFORMER AVAILABILITY- Not later than 1 year after the date of enactment of this section, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, issue an order directing the Electric Reliability Organization to submit to the Commission for approval under section 215, not later than 1 year after the issuance of such order, reliability standards addressing availability of large transformers. Such standards shall require entities that own or operate large transformers to ensure, individually or jointly, adequate availability of large transformers to promptly restore the reliable operation of the bulk-power system in the event that any such transformer is destroyed or disabled as a result of a geomagnetic storm event or electromagnetic pulse event. The Commission's order shall specify the nature and magnitude of the reasonably foreseeable events that shall provide the basis for such standards. Such standards shall--

`(A) provide entities subject to the standards with the option of meeting such standards individually or jointly; and

`(B) appropriately balance the risks associated with a reasonably foreseeable event, including any regional variation in such risks, and the costs of ensuring adequate availability of spare transformers.

(...)

`(2) COMMISSION AUTHORITY- If the Commission identifies a defense critical electric infrastructure vulnerability that the Commission, in consultation with owners and operators of any facility or facilities designated by the President pursuant to paragraph (1), determines has not adequately been addressed through measures undertaken by owners or operators of defense critical electric infrastructure, the Commission shall, after notice and an opportunity for comment and after consultation with the Secretary and other appropriate Federal agencies, promulgate a rule or issue an order requiring implementation, by any owner or operator of defense critical electric infrastructure, of measures to protect the defense critical electric infrastructure against such vulnerability. The Commission shall exempt from any such rule or order any specific defense critical electric infrastructure that the Commission determines already has been adequately protected against the identified vulnerability. The Commission shall make any such determination in consultation with the owner or operator of the facility designated by the President pursuant to paragraph (1) that relies upon such defense critical electric infrastructure.

`(3) COST RECOVERY- An owner or operator of defense critical electric infrastructure shall be required to take measures under paragraph (2) only to the extent that the owners or operators of a facility or facilities designated by the President pursuant to paragraph (1) that rely upon such infrastructure agree to bear the full incremental costs of compliance with a rule promulgated or order issued under paragraph (2).

- **Solar pulses' threats to power grid prompt legislation**
  (...)
- The bill makes the ominous case that "contemporary U.S. society is not structured, nor does it have the means, to provide for the needs of nearly 300 million Americans without electricity."
  The legislation, which also addresses the threat of such a pulse event set off by terrorists, would require large-transformer operators to have available replacements "to promptly restore the reliable operation of the bulk-power system."
  Beyond the loss of power, grid failure could have another sobering consequence: the release of deadly radiation. Thomas Popik and his colleagues at the New Hampshire-based Foundation for Resilient Societies say if the country's 104 nuclear power plants lost connection to the power grid, cooling pools in which spent fuel rods are stored could boil over, exposing the hot, zirconium-clad rods and sparking fires that would release radiation.
  Nuclear power plants are required to have back-up alternatives, such as diesel generators, and to be able to operate their safety systems off the grid for at least 30 days.
  That's not long enough, Popik says. He and the foundation filed a petition with the Nuclear Regulatory Commission earlier this month proposing regulations that would require backup safety procedures so spent fuels could operate unattended until grid power was restored.
  A report last October from the Oak Ridge National Laboratory in Tennessee suggested excess heat from surging currents caused by solar flares could damage high-voltage transformers and bring down the grid east of the Mississippi and in the Pacific Northwest. Replacing the transformers could take up to two years.
  "If large transformers were to become damaged, the major cities would become uninhabitable and the United States would not be able to support its current population," Popik said last week.
  (...)

  http://www.independentmail.com/news/2011/feb/26/solar-pulses-threats-power-grid-prompt-legislation/

El sistema Europeo derivado de la Directiva- La ley española 16 marzo 2011

- Directiva 2008/114, del Consejo, de 8 de diciembre, sobre la identificación y designación de Infraestructuras Críticas Europeas y la evaluación de la necesidad de mejorar su protección (en adelante, Directiva 2008/114/CE)

- **Proyecto de Ley por la que se establecen medidas para la protección de las infraestructuras críticas.** 16 de marzo de 2011.Aprobada.

II. Síntesis de la estructura del enfoque y medidas ante el riesgo natural “tormenta solar”, según lo ya expuesto.

- Escaso grado de atención priorización de esta cuestión por parte de numerosos países desarrollados.
- Incluso cuando se presta atención todo ello se suele priorizar el monitorizaje con una paradójica falta de desarrollo de qué y cómo hacer a partir de la detección (paradójico Canadá).
- Ausencia de un enfoque multidisciplinar que aborde a los distintos sectores implicados (excepción el nuevo Consejo Científico Asesor británico específico en caso de emergencia y el que acaba de crear-reformar, a modo de asesoramiento presidencial, el Presidente Obama Orden Presidencial Ejecutiva.
- Irrumpe en escena la paralela consideración de efectos EMP maliciosos fruto de guerra o ataque terrorista.

III. Avance de conclusiones para un nueva estrategia española por armar ante los riesgos naturales del clima espacial.

1. Estructura nacional integrada. Multidisciplinar. Pero integrar/coordinar también agentes privados/Estatales (autonómicos)/cooperación internacional (nueva ley-Directiva Europea obliga a operadores críticos)-Actual Centro de Infraestructuras Críticas de la nueva ley española.

2. Triple objetivo:

- Permanente monitorizaje clima espacial (red ISES+nuevo sistema Warning Europeo)
- Coordinación e impulso de la implementación medias prevención (Similar a la Comisión de la Defense Act de EEUU, con tales funciones)

a) Centrales Nucleares, Plantas Químicas.

b) Hospitales (atención a la refrigeración de vacunas, rotura de la cadena de frío). Pacientes internos (Informe Protección Civil Alemania)

c) Prisiones

d) Comunicación y operatividad servicios de emergencia/bomberos y orden público/seguridad nacional

e) bombas de emergencia para bombeo de combustible

f) Alcantarillado (previsión Protección Civil Alemana colapso de alcantarillados y, expresamente para Protección Civil de Alemania, salida de aguas fecales a superficie en las primeras 24 horas, corte de algunas calles bajas y pasos a nivel, inicio de riesgo de epidemias)

f) Fallo casi inmediato (“sofortiges” de comunicaciones

g) Fallo dentro de las primeras 8 horas, generalizado, de los sistemas de agua corriente a domicilio

f) Comisión EMP de los EEUU: sector financiero, datos fiscales

g) Comisión EMP de los EEUU: fallo de los vehículos de transporte.

- Coordinación medidas de alerta temprana inmediata a al conjunto de operadores críticos privados, autoridades locales y autonómicas, ejército y fuerzas de seguridad

3. Información y educación clara y efectiva a la población civil en los riesgos derivados del clima espacial y las buenas prácticas individuales, familiares, comunitarias (página web oficial, etc). Información temprana a la ciudadanía (suscripción de correo electrónico, aviso por sms telefónico como en Japón, teléfono de atención, uso de redes sociales siguiendo recomendaciones de Boulder, etc)

4. Impulso de mecanismos oficiales o “extraoficiales”, ambos, de Cooperación internacional UE-EEUU/EIS Council/ONU/Viviendo con una Estrella. Muy en particular impulsar la implementación, con urgencia, de medidas de cooperación en el marco de las medidas previstas por la Directiva Europea de Infraestructuras críticas en materia Nuclear.

5. Creación de un organismo específico científico y multidisciplinar de asesoramiento a las autoridades. Paralela función de información y formación.


EIS
SUMMIT
SUMMARY
REPORT
ELECTRIC INFRASTRUCTURE
SECURITY SUMMIT
SEPTEMBER 20, 2010
WESTMINSTER HALL, PARLIAMENT,
UNITED KINGDOM

- **A James Cameron film? No, just Va. preparing for solar storms**
  (...)
  The National Oceanic and Atmospheric Administration is providing background for a webinar on March 17 and a workshop in Richmond on March 28 about ejections of the solar corona. The training will be part of this year's Virginia Emergency Response Team Exercises, an annual mandate from the General Assembly for the state to examine responses to a widespread power outage. It's one of about 30 training events each year.
  (...)
  http://hamptonroads.com/2011/02/james-cameron-film-no-just-va-preparing-solar-storms

- Pág 88,

  However, the flare that was suspected of triggering the March 13, 1989 superstorm was only in the mid range of the X class, and not close to the most energetic events observed.What is more relevant is the location of the eruption on the solar disk and the resulting CMEs probable connection to the Earth. **In particular, the large X22+ flare event of April 2, 2001, while ~30 times larger than the March 89 flare, was located at the far west limb of the Sun, and the resulting CME ejecta was not Earth-directed and only provided a small glancing blow upon arrival at the Earth.**

Lubchenko

- AA
- Washington.

El Partido Republicano de los EEUU tiene un Comité de Estudio que

está analizando

esta amenaza dentro de las amenazas contra la
seguridad nacional ¿el PP o el PSOE tienen algún grupo de trabajo sobre esto?.
http://rsc.jordan.house.gov/UploadedFiles/NSGW_030211_Update.pdf

- IES Londres
- ¿Quiénes?
- -karltonn
- Seul
- Senadores... ONG, pero medidas internacionales,
- 1er Londres
- 2º Washington Abril

- Londres
- -Japon Korea, Francia, Alemania
- Zurich

- Síntesis de recomendaciones
- Simulacro atlántico de tormenta solar: Comisión E-NOAA: dar info + formación a la población, se llega utilizar usar redes sociales para acercarse al público (facebook + twiter). En ello volverán a incidir el asesor científico de Barack Obama y el del Gobierno británico.

Anexo Documental al Informe

- 1-Informe de la Academia de Ciencias Americanas para la NASA.
- **Severe Space Weather Events--Understanding Societal and Economic Impacts:**
- **A Workshop Report**
- http://books.nap.edu/catalog.php?record_id=12507

- 2- Informe aseguradora LLOYD`s (uno de los tres mayores riesgos emergentes para 2011, incluido un inquietante capítulo sobre riesgos de radiación "on the ground")
- 3-Informe aseguradora Zurich
- 4-Informe OCDE I(Informe "Future Global Shocks")
- 5-Informe OCDE II (Informe monográfico "Geomagnetic Storm)
- 6-Ley americana I
- 7-Ley americana II (centrales nucleares)
- 19-Black out final report (Apagón de Canadá de 1989)
- 8- Informe EMP/GMD (Natural Geomagnetic Disturbance)
- 9- Informe del Banco Federal de Atlanta sobre las repercusiones económicas (efectos psicológicos)
- 10- Foro empresas tormenta solar.
- 11-Informe Protección Civil Alemania
- 12-Trabajos de la Luftwaffe Alemana
- 13-Trabajos del Parlamento Europeo (preguntas I, II, y III)
- 14-Nuevo sistema de warning a ciudadanos
- 14- Informe simulacro 2010 tormenta solar Comisión Europea, más Suiza-NOAA.
- 15-Comisión parlamentaria Reino Unido.
- 16-Informe Comisión Europea sobre el riesgo de radicación
- 17-Investigaciones de la Universidad de Stanford (efecto rayos UV
- 18-Investigaciones de la Universidad de Calsruhe.
- 19-Directiva Europea Infraestructuras Críticas
- 20-Informe UE Infraestructuras Críticas.
- 20-Ley Española Infraestructuras Críticas
- Protección Civil California
- 22-Managing Critical Disasters in the Transatlantic Domain - The Case of Geomagnetic Storm. Workshop Summary /FEMA/MSB

Debilidades del enfoque.

- En general la propia OCDE en su análisis se muestra crítica con la ausencia de estructuras coordiandas de gestión del riesgo de tormenta geomagnética en el plano nacional, salvo EEUU
- (pág. 41)
- El enfoque se ve adicionalmente debilitado al centrarse más en “space weather monitoring and prediction services”, más que un enfoque completo e integrado de análisis/gestión de riesgos.
- rather than full-scope risk analysis or management. ¿Qué se hará si se detecta?

Nuevamente los EEUU serán la excepción, con las dos leyes, la segunda especialmente mirada para la protección de las 106 Centrales Nucleares americanas. (Informe OCDE, Idem).

- En Particular es la OCDE la que destaca la ausencia de tales estructuras coordinadas de gestión del riesgo de tormenta solar en el seno de la UE:

- - “space weather education for government leaders.However, one participant reminded the group that in both the U.S. and EU, leaders and theirstaffs change frequently through the electoral process. Therefore, the participants suggested thedevelopment of educational mechanisms that leaders and staffers can access when they arrive in office”. Pág. 15
- **-Enhancing Education and Public Messaging on Space Weather Incidents Recommendations (Pág.**

  -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.

  -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.

  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.

- *Electric Infrastructure Council (EIS) Summit - 11 April 2011 - Washington DC (Rep Franks)*
- The first Electric Infrastructure Security (EIS) Summit took place in London on September 20, 2010, in the U.K. Parliament, Westminster Hall. As the first world summit on infrastructure security, EISS London founded a new international security framework designed to foster information sharing, discussion, coordination and cooperation in assessing and protecting national infrastructures against physical threats such as EMP and Severe Geomagnetic Storms.
- The second EIS Summit will take place in the Capitol Building, Washington D.C. on April 11, 2011. To apply for registration for EISS Washington D.C.

- New NASA study: There is limited time to
- upgrade national electric grids to avoid solar
- flare-induced, global scale burn out.5
- Based on new research (NASA and U.S. National Academy of Sciences),
- about once per century periodic solar activity reaches the extreme levels
- that last occurred about 150 years ago, bathing the earth in a field of high
- energy particles. This causes a severe geomagnetic storm, that would burn
- out electric grids, control systems and other electronics all over the planet.
- Modern societies depend on electronics and the national power grid
- for food, water, communication, transportation, medical care, security,
- environmental quality, entertainment, waste management, economic activity
- and shelter. Just as we once, belatedly, began building fire hydrants, smoke
- detectors, emergency sprinklers and fire extinguishers into our homes and
- businesses, today it is basic prudence to protect this new infrastructure.
- In previous centuries, unprotected wood infrastructures meant severe risk to
- homes and cities. In the 21st century unprotected, interconnected electrical
- infrastructures represent catastrophic risk to cities and nations.