

*Question #3: In priority order, what activities should the Federal Government undertake to enhance national capabilities to prepare for, recover from, adapt to or otherwise mitigate the effects of space weather events? Please include near-term and long-term objectives for each activity.*

*Submitted by Stephen Vollandt, InfraGard Electromagnetic Pulse Special Interest Group (EMP-SIG) Vice Chair.*

A culture of readiness must be established. Lessons and approaches can be learned from the readiness culture of the United States military, which is renowned for cycling large organizations through deployment and rebuilding cycles. Using this example, the Federal Government can approach the issue of readiness to prepare for, recover from, adapt to or otherwise mitigate the effects of space weather events in the same manner by which the military prepares and rebuilds a unit after return from a deployment. However, one key aspect must be inserted, and that is awareness of the need. This awareness is critical and allows for the placement of space weather readiness appropriately within the larger portfolio of opportunities, risk, and budgeting faced by any organization.

The geomagnetic disturbance risks posed by space weather are highly similar to those posed by man-made electromagnetic pulses (EMP). Particularly, High Altitude Electromagnetic Pulse (HEMP) weapons. Recently released documents from the Congressional EMP Commission bolster this fact:

- EMP Commission, Volume I, Assessing the Threat from EMP Attack – Executive Report, July 2017, publicly released April 2018 and available at: <http://www.dtic.mil/dtic/tr/fulltext/u2/1051492.pdf>; and
- EMP Commission, Volume II, Recommended E3 HEMP Heave Electric Field Waveform for the Critical Infrastructures, July 2017, publicly released April 2018 and available at: <http://www.dtic.mil/dtic/tr/fulltext/u2/1051494.pdf>

The InfraGard community preparedness guide, *Powering Through: From Fragile Infrastructures to Community Resilience* (hereafter *Powering Through*), states that both extreme space weather and EMP can create significant disruptions or permanent damage to critical infrastructure such as transformers, generator stations, SCADA/industrial controls, utility control centers, telecommunications including cell phones, radio emergency communications, emergency SATCOM communications, the internet, GPS, transportation systems, and water systems. *Powering Through* further describes how protection for EMP threats inherently protects against extreme solar weather. However, *Powering Through* describes how protection against the effects of solar weather only partly protects against EMP. EMP delivers three destructive electromagnetic pulses named E-1, E-2, and E-3. The E-3 pulse is similar to, and potentially more severe than, the Geomagnetic Disturbance caused by extreme solar weather.

While the cost of mitigating against E-3 is similar to that of protecting critical systems against the GMD created by space weather, if designed only for potential GMD, it will likely not protect against the E-3. Investing only in GMD protection and not E-3 protection would be a tragically poor investment decision.

The cascading effects of either a severe GMD or EMP both result in disruption or destruction of such a high proportion of critical infrastructure that economic activity and perhaps communications and transportation will not be sustainable for longer than local fuel supplies remain. It is important to note that a severe space weather or EMP event would meet the definition of an existential crisis, and create a catastrophic scenario, where the federal, state and local governments, as well as commercial and non-profit enterprises, would struggle to survive or provide minimal functionality.

*Powering Through* presents a Maturity Model that can be used to guide any organization through the steps needed to achieve readiness to prepare for, recover from, adapt to or otherwise mitigate the effects of space weather events. This Preparedness Maturity Model provides a sensible and reusable framework that organizations can use as a guide to evaluate preparedness efforts, identify gaps, and achieve readiness. It is helpful to first identify which maturity level your organization currently lies within, and then plan how to proceed to higher levels of maturity.

The five levels of the Maturity Model are:

- Level 1: Awareness Phase
- Level 2: Discovery Phase
- Level 3: Planning Phase
- Level 4: Implementation Phase
- Level 5: Mature State

Policy, which is the precursor for the effective portfolio management, is the fundamental functional area needed to achieve each of the five levels. Basic steps are described below:

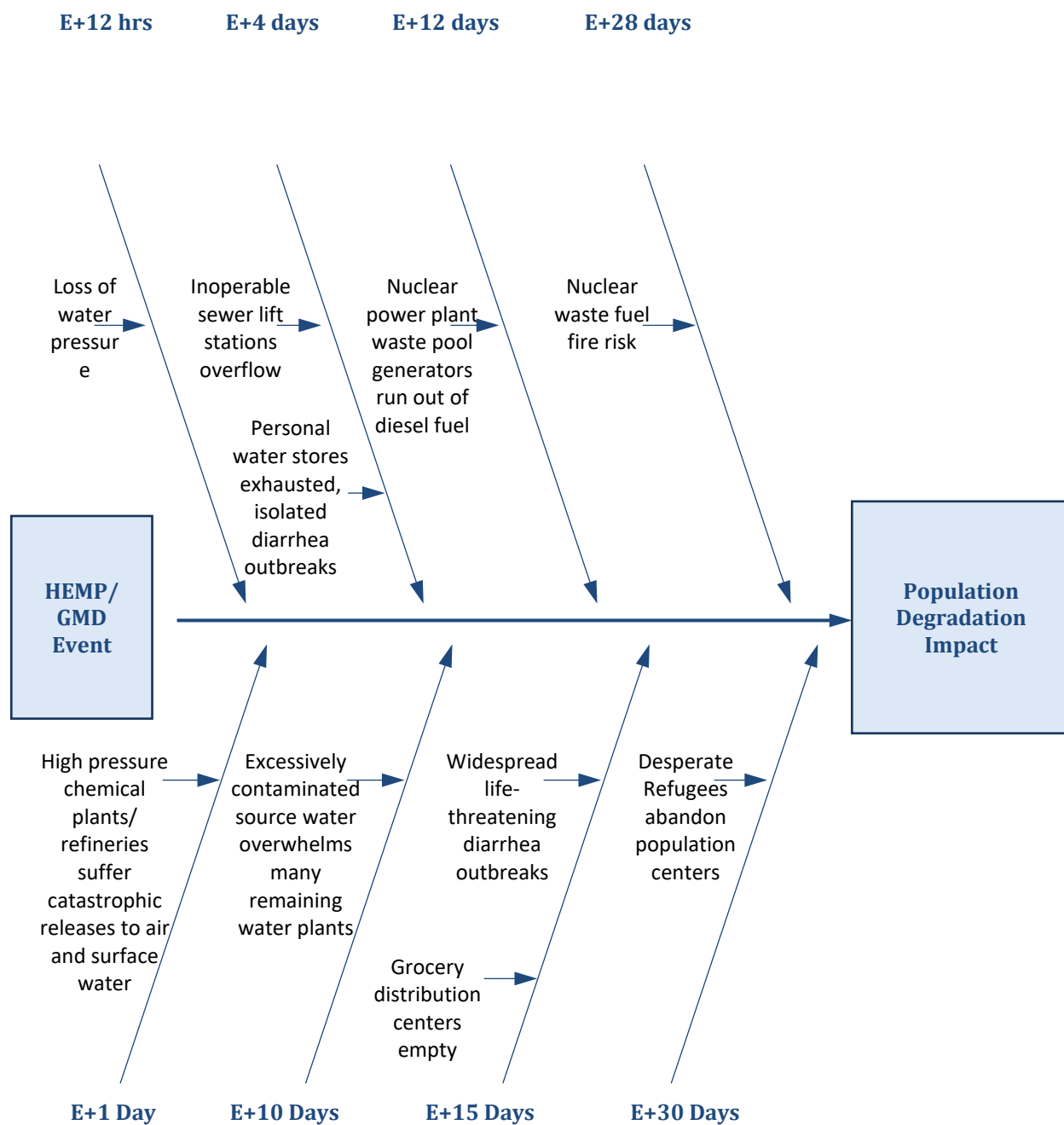
- Level 1: Awareness Phase
  - Key decision makers and stakeholders identified.
  - Plan in place to meet with key decision makers and stakeholders.
  - Meetings with key decision makers and stakeholders are scheduled or have been accomplished.
- Level 2: Discovery Phase
  - Existing policy assessed and compared to Preparedness Maturity Level 5.
- Level 3: Planning Phase

- Determine requirements and construct roadmaps, plans, associated schedules, resource allocations, and budgets to achieve the list of Preparedness Maturity Level 5 objectives.
- Level 4: Implementation Phase
  - Gain authority, initiate work, and accomplish plans to achieve the list of Preparedness Maturity Level 5 objectives.
- Level 5: Mature State
  - Policy is in place and the organization regularly conducts practice exercises and audits that demonstrate:
  - Private Sector:
    1. Contractual authority exists to rapidly invoke emergency contingency contracts that include provision of key services and supplies for all critical business operations sectors and their dependencies. Clear proxy and succession lines of authority are defined in writing and authorized by appropriate internal governance authorities. Governance mechanisms that facilitate immediate priority-based centralized sector control and recovery threshold-based release of control are regularly audited and improved.
    2. Event readiness preparations are authorized and continually improved.
    3. Mutual support agreements have been optimized and continually improved for Preparedness scenario.
    4. Critical services and supply providers routinely and successfully demonstrate improvements to their critical path survivability<sup>2</sup>, 5 and, ideally, for 400-day sustainment and recovery plans.<sup>3</sup>
    5. All existing and new critical employee participants have taken the oath to uphold and defend the U.S. Constitution against all enemies foreign and domestic.
  - Government:
    1. Elected leader's legal authority to rapidly declare post-event martial law that includes government control and mobilization of all sectors and their dependencies is regularly audited and improved as needed. Clear proxy and succession lines of authority defined and legally authorized. Governance mechanisms authorized to facilitate priority-based centralized sector control and recovery threshold-based release of control are regularly audited and improved.
    2. Event readiness preparations authorized and continually improved.
    3. Mutual support agreements have been optimized and continually improved for Preparedness scenario.

4. Critical Infrastructure providers routinely and successfully demonstrate improvements to their critical path survivability and, ideally, for 400-day sustainment and recovery plans.
5. All existing and new implementation participants have taken the oath to uphold and defend the U.S. Constitution against all enemies foreign and domestic.

It is helpful to be mindful of likely extreme consequences and basic corresponding dependencies as a planning aide when focusing policy towards reaching Level 5: Mature State. The following figure is provided to facilitate planning discussion and provide insight into critical path cross-dependency issues.

**NOTIONAL—For discussion purposes only**  
**HEMP/GMD Event worst-case early timeline**



**Figure 1: Grid Loss Worst-Case Early Timeline**

*Source:* Stephen Volandt, Auroros Inc.