

September 29, 2011

The Honorable Roscoe G. Bartlett
United States House of Representatives
Washington, D.C. 20515

Dear Congressman Bartlett:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of August 12, 2011, regarding concerns about the potential threat to U.S. nuclear reactors from an electromagnetic pulse (EMP) incident.

The NRC is aware of the potential significance of EMP to the nation's critical infrastructure and has reviewed the "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," issued in 2004. Beginning in the late 1970s, the NRC undertook a research program to study the effects of a high-altitude EMP on nuclear power plant safe-shutdown systems. From a series of reports, the last of which was completed in 2010, we concluded that reactors can achieve safe shutdown following a man-made EMP event or a solar or geomagnetically-induced current event.

Regarding the potential damage to the electric grid from an EMP event, the NRC does not have direct regulatory authority over electric transmission systems, except with regard to nuclear power plants. However, we do collaborate closely with the Federal Energy Regulatory Commission and the North American Electric Reliability Corporation on electric grid reliability and cyber security issues, including their EMP research and related activities.

The NRC is reviewing a petition for rulemaking that seeks a change in NRC regulations to require extended operation of nuclear power plant emergency power systems because of the possibility of a widespread and long-term loss of the electric power grid due to natural geomagnetic disturbances.

[Enclosed](#) for your information is the NRC's detailed response to the letter I received directly from Dr. William R. Graham and Dr. Peter Vincent Pry, which also was enclosed with your letter. This is a topic that has long been of interest to the NRC. I would be happy to discuss it further with you at any time. The NRC's Office of Congressional Affairs will contact your office to make arrangements for the NRC staff to receive the briefing offered in your letter.

Sincerely,

/RA/

Gregory B. Jaczko

[Enclosure](#): As stated

September 20, 2011

Dr. William R. Graham
EMPact America
P.O. Box 124
Elma, NY 14059

Dear Dr. Graham:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of August 4, 2011, about safeguarding nuclear reactors from natural and manmade disasters and in particular from electromagnetic pulse (EMP). Specifically, you requested that as the NRC reviews its regulations and programs aimed at protecting U.S. nuclear reactors that the NRC take into account geomagnetic storms and manmade EMPs.

The NRC is aware of the potential significance of EMP to the Nation's critical infrastructure and has reviewed the "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," issued in 2004. In the late 1970s, concerns with EMP-induced large currents and voltages in electrical systems led the NRC to undertake a research program to study the effects of EMP on nuclear power plant safe-shutdown systems. The NRC conducted this study and documented the results in NUREG/CR-3069, "Interaction of Electromagnetic Pulse with Commercial Nuclear Power Plant Systems," issued in February 1983. That report concluded that the safe-shutdown capability of nuclear power plants would, in general, survive the postulated manmade EMP event. In 2007, the NRC revisited this earlier study in light of the modernization of nuclear plants with digital systems, which potentially could be more susceptible to EMP. The new study, completed in 2009, also concluded that nuclear power plants can achieve safe shutdown following a manmade EMP event. In addition, a supplemental study, completed in 2010, which analyzed and compared the potential impacts on nuclear power plants from solar or geomagnetically-induced current events to those of the EMP events previously analyzed, led to the same conclusion.

The NRC is also aware of the potential damage to the electric grid that can occur from geomagnetically-induced currents resulting from a significant solar storm. In response to the strong geomagnetic storm on March 13, 1989, which caused major damage to electrical power equipment in Canada, Scandinavia, and the United States, the NRC issued Information Notice 90-42, "Failure of Electrical Power Equipment Due to Solar Magnetic Disturbances," dated June 19, 1990, to inform nuclear power plant licensees of the potential for damage to transmission systems and other components of the power grid from severe solar activity events.

The NRC does not have direct regulatory authority over the electric transmission systems, except with regard to nuclear power plants. The Federal Energy Regulatory Commission (FERC) has direct regulatory authority over these systems and the North American Electric Reliability Corporation (NERC) has the authority to develop and enforce reliability standards for these systems. The NRC collaborates closely with FERC and NERC on electric grid reliability and cyber security issues. The NRC has entered into separate Memorandum of Agreements with FERC and with NERC that commits each agency to share information, and coordinate on matters of mutual interest pertaining to the Nation's electric grid reliability and nuclear power plants.

In October 2010, the Oak Ridge National Laboratory (for FERC, in joint sponsorship with the U.S. Department of Energy and Department of Homeland Security) published a report assessing the vulnerability of the U.S. electric power grid to severe space weather. This report estimated that severe solar storms, occurring at a frequency of once every 100 years, could cause long-term (1–2 years) grid outages affecting about two-thirds of the nuclear power plants in the United States. The NRC staff has not yet evaluated these recent reports.

On March 15, 2011, the NRC docketed a petition for rulemaking (PRM-50-96) requesting that the NRC amend its regulations to ensure long-term cooling and makeup water for spent fuel pools at U.S. power reactors because of the possibility of a widespread and long-term loss of the electric power grid due to natural geomagnetic disturbances. The petition states that self-sufficiency is necessary since fuel resupply deliveries cannot be assured after a large induced current in the bulk power transmission system because of the disruption of petroleum and natural gas infrastructures caused by widespread and long-term loss of the electric power grid. The NRC is in the process of reviewing PRM-50-96. The petition and other documents related to the review of PRM-50-96 are available at <http://www.regulations.gov/> under Docket ID NRC-2011-0069.

The NRC staff is participating in and monitoring NERC's activities for protecting critical infrastructure from EMPs. Potential resolutions include hardening large power transformers from potentially damaging geomagnetic-induced currents and developing a strategy for obtaining spare parts. The staff is monitoring congressional activities on this issue, such as House Resolution 668 (the Secure High-Voltage Infrastructure for Electricity from Lethal Damage Act or SHIELD Act) to amend the Federal Power Act to protect the bulk-power system and electric infrastructure critical to the defense of the United States against natural and manmade EMP threats and vulnerabilities.

In summary, the NRC is considering all information available to date about the threats from a great geomagnetic storm and from a manmade EMP that could have potential adverse effects on the safe operation of nuclear power plants.

W. Graham

- 3 -

The NRC is committed to the safe and secure operation of all U.S. nuclear power plants, while at the same time promoting the effective and efficient regulation of NRC licensees. We will continue to work with all stakeholders to ensure that the concerns discussed in this letter are addressed properly.

Sincerely,

/RA by Martin J. Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Identical letter sent to:

Dr. William R. Graham
EMPact America
P.O. Box 124
Elma, NY 14059

Dr. Peter Vincent Pry
50185 Hays Beach Road
Scotland, MD 20687

September 20, 2011

Dr. Peter Vincent Pry
50185 Hays Beach Road
Scotland, MD 20687

Dear Dr. Pry:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to your letter of August 4, 2011, about safeguarding nuclear reactors from natural and manmade disasters and in particular from electromagnetic pulse (EMP). Specifically, you requested that as the NRC reviews its regulations and programs aimed at protecting U.S. nuclear reactors that the NRC take into account geomagnetic storms and manmade EMPs.

The NRC is aware of the potential significance of EMP to the Nation's critical infrastructure and has reviewed the "Report of the Commission to Assess the Threat to the United States from Electromagnetic Pulse (EMP) Attack," issued in 2004. In the late 1970s, concerns with EMP-induced large currents and voltages in electrical systems led the NRC to undertake a research program to study the effects of EMP on nuclear power plant safe-shutdown systems. The NRC conducted this study and documented the results in NUREG/CR-3069, "Interaction of Electromagnetic Pulse with Commercial Nuclear Power Plant Systems," issued in February 1983. That report concluded that the safe-shutdown capability of nuclear power plants would, in general, survive the postulated manmade EMP event. In 2007, the NRC revisited this earlier study in light of the modernization of nuclear plants with digital systems, which potentially could be more susceptible to EMP. The new study, completed in 2009, also concluded that nuclear power plants can achieve safe shutdown following a manmade EMP event. In addition, a supplemental study, completed in 2010, which analyzed and compared the potential impacts on nuclear power plants from solar or geomagnetically-induced current events to those of the EMP events previously analyzed, led to the same conclusion.

The NRC is also aware of the potential damage to the electric grid that can occur from geomagnetically-induced currents resulting from a significant solar storm. In response to the strong geomagnetic storm on March 13, 1989, which caused major damage to electrical power equipment in Canada, Scandinavia, and the United States, the NRC issued Information Notice 90-42, "Failure of Electrical Power Equipment Due to Solar Magnetic Disturbances," dated June 19, 1990, to inform nuclear power plant licensees of the potential for damage to transmission systems and other components of the power grid from severe solar activity events.

The NRC does not have direct regulatory authority over the electric transmission systems, except with regard to nuclear power plants. The Federal Energy Regulatory Commission (FERC) has direct regulatory authority over these systems and the North American Electric Reliability Corporation (NERC) has the authority to develop and enforce reliability standards for these systems. The NRC collaborates closely with FERC and NERC on electric grid reliability and cyber security issues. The NRC has entered into separate Memorandum of Agreements with FERC and with NERC that commits each agency to share information, and coordinate on matters of mutual interest pertaining to the Nation's electric grid reliability and nuclear power plants.

In October 2010, the Oak Ridge National Laboratory (for FERC, in joint sponsorship with the U.S. Department of Energy and Department of Homeland Security) published a report assessing the vulnerability of the U.S. electric power grid to severe space weather. This report estimated that severe solar storms, occurring at a frequency of once every 100 years, could cause long-term (1–2 years) grid outages affecting about two-thirds of the nuclear power plants in the United States. The NRC staff has not yet evaluated these recent reports.

On March 15, 2011, the NRC docketed a petition for rulemaking (PRM-50-96) requesting that the NRC amend its regulations to ensure long-term cooling and makeup water for spent fuel pools at U.S. power reactors because of the possibility of a widespread and long-term loss of the electric power grid due to natural geomagnetic disturbances. The petition states that self-sufficiency is necessary since fuel resupply deliveries cannot be assured after a large induced current in the bulk power transmission system because of the disruption of petroleum and natural gas infrastructures caused by widespread and long-term loss of the electric power grid. The NRC is in the process of reviewing PRM-50-96. The petition and other documents related to the review of PRM-50-96 are available at <http://www.regulations.gov/> under Docket ID NRC-2011-0069.

The NRC staff is participating in and monitoring NERC's activities for protecting critical infrastructure from EMPs. Potential resolutions include hardening large power transformers from potentially damaging geomagnetic-induced currents and developing a strategy for obtaining spare parts. The staff is monitoring congressional activities on this issue, such as House Resolution 668 (the Secure High-Voltage Infrastructure for Electricity from Lethal Damage Act or SHIELD Act) to amend the Federal Power Act to protect the bulk-power system and electric infrastructure critical to the defense of the United States against natural and manmade EMP threats and vulnerabilities.

In summary, the NRC is considering all information available to date about the threats from a great geomagnetic storm and from a manmade EMP that could have potential adverse effects on the safe operation of nuclear power plants.

P. Pry

- 3 -

The NRC is committed to the safe and secure operation of all U.S. nuclear power plants, while at the same time promoting the effective and efficient regulation of NRC licensees. We will continue to work with all stakeholders to ensure that the concerns discussed in this letter are addressed properly.

Sincerely,

/RA by Martin J. Virgilio for/

R. W. Borchardt
Executive Director
for Operations

Identical letter sent to:

Dr. William R. Graham
EMPact America
P.O. Box 124
Elma, NY 14059

Dr. Peter Vincent Pry
50185 Hays Beach Road
Scotland, MD 20687