NRC NEWS

U.S. NUCLEAR REGULATORY COMMISSION

Office of Public Affairs Telephone: 301/415-8200

Washington, D.C. 20555-0001 E-mail: opa@nrc.gov

Web Site: http://www.nrc.gov

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(Slide 1) **The NRC and Grid Stability**

Remarks by Jeffrey S. Merrifield, Commissioner
U. S. Nuclear Regulatory Commission

at the

ANS Executive Conference on
Grid Reliability, Stability and Off-Site Power
Denver, Colorado
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THE EVENT -

(Slide 2) On August 14, 2003, I was the Acting Chairman on what I thought was going to be just another routine day at the NRC. I had a series of scheduled meetings that day, including a briefing on grid reliability, where the staff discussed the trends in loss of offsite power events at nuclear power plants. The staff informed me that the number of these events was decreasing, which was encouraging. They also mentioned, however, that the duration of individual events was tending to be longer.

Around 4:00 p.m. that afternoon, Bill Travers, the EDO at that time, came into my office and informed me that the staff was assembling in our Operations Center in response to the automatic shutdown of several nuclear plants in the Northeast and Midwest. At that time, we did not know whether it was caused by multiple operational events or, perhaps by a coordinated act of terrorism.

(Slide 3) As information continued to pour in the rest of the afternoon and into the evening hours, we came to learn that nine nuclear power plants in the U.S., as well as 11 in Canada, and a host of coal-fired power plants had been disconnected from the grid because of electrical instabilities, resulting in the blackout of major portions of the Northeast and Midwest in the U.S. and parts of Canada. **(Slide 4)** In fact, virtually every power plant east of the Mississippi experienced voltage swings of variable amplitude, though plants further from the Northeast corridor saw only minor voltage perturbations.

(Slide 5) By the next morning, after a long night at the Ops Center, we were only beginning to understand the magnitude of the blackout. I participated in several conference calls, including calls with the White House Situation Room, to discuss the causes of the event with the staff of the National Security Council as well as various Cabinet members.

Of course, as soon as the safety of the reactors was assured, the next question was how quickly could they restart to restore electrical power to the millions of people who still were without power. We received a number of calls by Friday afternoon (August 15), including some from the White House, asking when the plants would be back on line. We also had a series of phone calls with our counterparts on the Canadian Nuclear Safety Commission.

As you all know, after a nuclear power plant shuts down, it cannot just be restarted at the flip of a switch. Components in several systems must be realigned, those systems must be walked down to confirm their readiness, and the reactor operators must go through a checklist before pulling control rods to restart the nuclear reaction. It typically takes between eight and 24 hours for a reactor to restart after it trips offline. In addition, after a station blackout event, the transmission line operators must also ensure the grid is ready before the plant can close its generator output breaker and resume supplying power to the grid. There are a number of steps required to restore electrical power once the grid has gone down. That being said, most of the nuclear power plants were restarted within a few days and the grid returned to normal.

So, what caused the event? We would eventually find that poor maintenance of transmission lines including tree trimming, lack of sensor and relay repair or replacement, poor maintenance of control room alarms, poor communications between load dispatchers and power plant operators, and a lack of understanding of transmission system interdependencies were all major contributors to the domino effect that resulted in plant after plant tripping off line because of the collapse of the electrical grid.

This event was truly a wake-up call for the North American transmission system operators as well as electricity generating companies.

(Slide 6) WHY DOES NRC CARE ABOUT GRID STABILITY?

Nuclear power reactors must be cooled continuously, even when shut down. The numerous pumps and valves in the reactor cooling systems therefore must have access to electrical power at all times, even if the normal power supply from the grid is degraded or completely lost.

As a regulator, we want to minimize the time a nuclear power plant is subjected to a complete loss of offsite power, otherwise known as Station Blackout. Even though plants are designed with emergency diesel generators to supply power to pumps and valves that keep the reactor cool when normal power is lost, we do not like to challenge those diesel generators any more than is absolutely necessary.

The NRC was concerned about grid reliability long before the 2003 blackout event. On August 12, 1999, while the Callaway plant (in Missouri) was offline in a maintenance outage, the plant saw the offsite power supply voltage fall below minimum requirements for a 12-hour period. The voltage drop they observed was caused by peak levels of electrical loading and the transport of large amounts of power on the grid adjacent to Callaway. The licensee noted that the deregulated wholesale power market contributed to conditions where higher grid power flows were likely to occur in the area near Callaway. Alliant Energy had to spend ten's of millions of dollars to install new transformers with automatic tap changers to keep voltage above minimum requirements, and capacitor banks to improve the reactive power (volt-amps reactive, or VARs) factor in the Callaway switchyard.

As a result of deregulation, many electric utilities were split into electric generating companies and transmission and distribution companies. Thus, nuclear power plants now must rely on outside entities to maintain the switchyard voltage within acceptable limits. Over time, some transmission companies have become less sensitive to the potential impacts that grid voltage can have on nuclear plant operations.

A big part of our risk-informed regulatory strategy depends on plants having access to reliable offsite power. We assume that there will be very few times when a plant will be subjected to a total loss of offsite power, and when such condition exists it will be for a relatively short period of time (hours or days rather than weeks). Our strategy of allowing more on-line maintenance to be performed on certain important safety equipment such as the emergency diesel generators makes sense as long as the risk of a plant trip remains very low during the period of time that equipment is out of service. This philosophy relies on the fact that a total loss of offsite power is a rare occurrence that will be corrected in a short period of time.

(Slide 7) WHAT DID WE DO ABOUT THE BLACKOUT?

Our mission is to ensure that our nation's nuclear power plants are operated in a manner that protects the public health and safety, and promotes the common defense and security. We initially focused our attention on the nine U.S. nuclear units that automatically shut down as designed, in response to the voltage swings on the grid. Subsequently, we concluded that all of these plants responded well to the event, and their emergency diesel generators automatically started and powered the safety equipment to ensure the reactors continued to be adequately cooled after offsite power was lost.

President Bush initiated a bilateral task force with Canada to look into the causes of the blackout and develop recommendations to avoid a recurrence. Then-Chairman Nils Diaz was the NRC representative appointed to the task force.

Several key issues related to nuclear plants were examined by the task force. These issues included:

- Did grid operators understand the potential impact of voltage and frequency instability on nuclear power plants?

- Did nuclear power plant operators have the necessary protocols and equipment to communicate with the grid operators to facilitate taking action to minimize the impacts of grid instability on nuclear plants?

- Are there practices used in the nuclear power industry that could be useful to non-nuclear power producers?

The discussion of these issues significantly raised awareness of the specialized impacts on nuclear plants and led to a number of initiatives in both the industry and the government to address those concerns.

(Slide 8) As a result of our task force participation and independent reviews and assessments, the NRC has taken several actions to improve plant readiness to react to unstable grid conditions. These actions include:

- Development of special procedures otherwise known as Temporary Instructions [TIs] for our resident inspectors to review the readiness of U.S. nuclear plants for the summer peak cooling season. The resident inspectors have used these procedures each spring for the last three years to ensure all nuclear plants are prepared for potential grid problems.

- Established protocols for equipment operability assessments and maintenance rule assessments.

- Issued a Generic Letter 2006-02, "Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power," which asked licensees to provide information on:

1. communication protocols between nuclear plants and grid operators;
2. grid analysis tools used to confirm adequate offsite power;
3. offsite power restoration procedures; and
4. station blackout analysis on loss-of-offsite-power frequency.

The NRC is in the process of assessing the information provided by our licensees to develop a further understanding of grid issues and to determine if further NRC action is necessary.

(Slide 9) We have not only been interacting with the licensee community. As a result of discussions I had with former Chairman Pat Wood and current Chairman Joe Kelliher, the Commission held two meetings with the Federal Energy Regulatory Commission (FERC). The first was a closed meeting held on May 19, 2005, and the second was a public meeting held on April 24, 2006, to discuss the relationship between grid reliability and nuclear plant safety. As a result of these meetings, the Commission agreed to provide FERC with data collected on the frequency and duration of offsite power events, human reliability research and other information that may help FERC better understand nuclear plant sensitivity to grid conditions. I have every confidence that any action FERC takes in response to this information will help to alleviate negative impacts on nuclear power plants in unstable grid conditions.

(Slide 10) WHAT HAS THE INDUSTRY BEEN DOING DURING THIS TIME FRAME?

In addition to the many efforts underway at the government level, the industry, to its credit, has been proactive in addressing grid stability issues. According to the data from the Edison Electric Institute, by 2008 the industry plans to almost double its investment in transmission-related activities using 2000 as a baseline. This financial commitment demonstrates a recognition on the part of industry that sub par transmission equipment can have a significant impact on grid stability.

(Slide 11) In addition, the industry has initiated a number of activities to address grid reliability.

- In December 2004, the Institute for Nuclear Power Operations (INPO) issued an addendum to their Significant Operating Experience Report (SOER)-99-1 addressing offsite power concerns in response to the northeast blackout. SOER-99-1 highlights the fact that grid reliability concerns have been an outstanding issue for some time. SOER-99-1 was first issued in December 1999 following grid events in South Africa and the U.S. The addendum expanded the original recommendations and clarified others.

- The North American Electric Reliability Council (NERC) and the Nuclear Energy Institute (NEI) have conducted a number of activities to both improve communication and establish working protocols between nuclear stations and grid operators. These actions help ensure reliable offsite power and reduce risk to the grid from maintenance activities. Again, this is not the first time NERC and NEI have sponsored workshops on grid reliability. In 2001, NERC and NEI conducted workshops on grid reliability, but the event of 2003 as well as other events highlighted the need to have additional, more focused workshops.

(Slide 12) WHERE DO WE GO FROM HERE?

Although we have done considerable work to date, there is much we must continue to focus on:

- we must concentrate on nuclear power plant safety as our primary focus;

- we must ensure that communication protocols between grid operators and nuclear plant operators are in place to assess the impacts of grid disturbances on nuclear units in real time;

- we must continue our partnerships with FERC and NERC to ensure nuclear plants are in compliance with our regulations and that grid operators adhere to FERC/NERC guidelines;

- we must continue to identify best practices between the transmission organizations and the nuclear plant operators to assist in further improvements in our electrical system; and

- we will continue to encourage nuclear plant operators and grid operators to openly discuss the issue of grid operators requesting nuclear units to down power multiple times in a short period of time due to the "largest single contingency" constraint.

Aside from the issues discussed above, there are special considerations for new reactors. Two of those issues that are of particular concern include:

- Should new units be designed to withstand a 100% load reject without shutting down?

- What is the impact of bringing LARGE baseload generators (>1,200 MW) onto the grid?

Hopefully, the new communications infrastructure that has been in place since the blackout will help find the answers to these challenging questions. We are committed to pursuing answers to these and other outstanding questions and to maintaining our strong oversight of nuclear power plants.