

UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
WASHINGTON D.C. 20555

July 20, 1993

NRC INFORMATION NOTICE 93-53: EFFECT OF HURRICANE ANDREW ON TURKEY POINT
NUCLEAR GENERATING STATION AND LESSONS LEARNED

Addressees

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice to alert addressees to the lessons learned from the joint NRC/industry team review of the effect of Hurricane Andrew on Turkey Point Nuclear Generating Station. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice are not NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances

Turkey Point, situated on the shores of Biscayne Bay about 40 kilometers (25 miles) south of Miami, Florida, is the site for four electric generation units. Units 1 and 2 are fossil fuel fired and Units 3 and 4 are pressurized light water moderated nuclear units that are owned and operated by the Florida Power and Light Company. The area experiences tropical storms about once every 2 years and hurricane-force winds once every 7 years.

On August 24, 1992, Category 4 (on a scale of 1 to 5, where 5 is the most severe) Hurricane Andrew hit south Florida and caused extensive onsite and offsite damage at Turkey Point. An NRC/industry team was organized to review the damage that the hurricane caused the nuclear units and the utility actions to prepare for the storm and recover from it, and to compile lessons that might benefit other nuclear reactor facilities. Results of the team review are presented in the report, "Effect of Hurricane Andrew on the Turkey Point Nuclear Generating Station from August 20-30, 1992," issued in March 1993. This report was distributed to all power reactor licensees by the Institute of Nuclear Power Operations on June 10, 1993.

Discussion

Hurricane Andrew is historic because this is the first time that a hurricane significantly affected a commercial nuclear power plant. The eye of the

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storm, with sustained winds of up to 233 kilometers per hour (km/h) [145 miles per hour (mph)] and gusts of 282 km/h (175 mph), passed over the Turkey Point site and caused extensive onsite and offsite damage.

The onsite damage included loss of all offsite power for more than 5 days, complete loss of communication systems, closing of the access road, and damage to the fire protection and security systems and warehouse facilities. However, despite the intensity of the hurricane and the age of the plant, onsite damage was limited to fire protection, security, and several non-safety-related systems and structures. There was no damage to the safety-related systems except for minor water intrusion and some damage to insulation and paint, and there was no radioactive release to the environment. The units remained in a stable condition and functioned as designed.

Lessons Reinforced and Lessons Learned

The joint team report describes circumstances that existed at the Turkey Point site during and immediately following the hurricane and identifies several lessons reinforced and learned from the effect of Hurricane Andrew on the nuclear units. The issues and lessons are summarized below:

(1) Adequacy of Timing of Plant Shutdown in Anticipation of a Hurricane

Turkey Point procedures for timing of a plant shutdown in anticipation of a hurricane require that the plant be in at least Mode 4 (i.e., hot shutdown) 2 hours before the onset of hurricane-force winds at the site. Estimating 8 hours to complete an orderly shutdown, the licensee began a plant shutdown approximately 12 hours before the predicted landfall of the hurricane. As a result, both units were in Mode 4 when Hurricane Andrew struck. However, the licensee commitments in response to the station blackout rule only require the licensee to commence shutdown at least 2 hours before the onset of hurricane-force winds. Therefore, starting a plant shutdown strictly in accordance with the licensee commitments could have resulted in the plant being in the midst of a dual-unit shutdown when offsite power was lost. Additionally, at Turkey Point (and at other commercial reactors susceptible to hurricane damage), important equipment (e.g., auxiliary feedwater) is located outside and likely would not be accessible during a hurricane.

(2) Adequacy of Licensee Offsite Communications for Natural Disasters

Although diverse and redundant communications equipment existed at Turkey Point, offsite communications were lost during the storm because of a common vulnerability to wind damage. Normal telephone service failed because the storm blew down the lines near the station. The dedicated commercial telephone lines servicing the control room, technical support center, and emergency operations facility, used to give initial notification and status to the State in an emergency, also

failed. The Federal Telecommunications System (FTS)-2000 lines used for the Emergency Notification System failed, cutting off normal communications with the NRC Operations Center. The cellular telephone systems also did not function because the storm damaged the onsite antennas and the offsite repeating stations. Except for one hand-held radio on the company FM radio system, the plant radio systems did not function during and immediately following the storm. Overall, all offsite communications were lost for about 4 hours during the storm, and reliable communications were not restored for about 24 hours following the storm. A temporary satellite communications system provided by the NRC aided recovery efforts considerably and would have been more beneficial if it had been on site before the storm.

(3) Adequacy of Compensatory Measures for Equipment or Facilities Not Designed for a Hurricane

A number of important systems, structures, or facilities for security, emergency response, effluent monitoring and disposal, and low-level waste storage were not designed for hurricane-force winds and were or could have been severely damaged during the storm. In anticipation that equipment or facilities could become inoperable, compensatory measures were taken or were available before or after the storm. For example, after the storm, security officers were placed on roving patrols to compensate for the loss of the physical integrity of the protected area. Portable air-sampling and dosimetry equipment was available at the site to compensate for the air-sampling stations that were lost. Before the storm, radioactive materials, including dry active waste, were secured in Sealand containers, and a high-integrity container was used for solidified resins. Thus, radioactive waste was adequately protected from the elements to prevent its spread during the storm. The emergency plan considered these circumstances and contained contingency measures. However, because of damage to the plant stack and associated ductwork and monitoring equipment, a major radiological release path could not have been monitored if it had been necessary to do so.

(4) Early Preparations for Hurricane

Turkey Point benefited greatly from prior hurricane experience of the plant staff and extensive planning done in preparing and implementing the Emergency Plan Implementing Procedure (EPIP), "Natural Emergencies." The EPIP was also significantly expanded as a result of the insights gained in part from the individual plant examination (IPE) for Turkey Point. These additional procedures, which dealt with preparation for a Category 5 hurricane, contributed significantly to the licensee preparations. A copy of the Turkey Point EPIP is provided in Appendix R of the joint team report. Using the control room simulator to train operators immediately before the storm enabled the operators to be more alert to any likely plant transients.

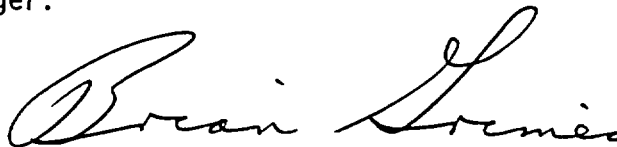
After the hurricane, the licensee had to take numerous extraordinary actions to establish a support services infrastructure (e.g., housing, food, water, and transportation) that would allow the staff to report to the plant each day. Such requirements could be more extreme following other external events (e.g., severe earthquake) for which there was no warning to permit advance preparations, including the evacuation of families of plant personnel. The assistance provided by personnel at the St. Lucie plant in meeting the immediate and longer term needs at Turkey Point, such as personnel, spare parts, and supplies, was very helpful to the recovery.

(5) Impact of Nonsafety Equipment on Important Equipment

During the storm, failed nonsafety-grade equipment damaged certain important equipment. For example, the high water tank collapsed onto the fire water system, rendering the fire protection system inoperable. In addition, the storm threatened safety-related equipment (e.g., potential collapse of the damaged Unit 1 chimney onto the diesel generator building).

Unlike some other natural disasters, onset of a hurricane is predictable and, as a result, lends itself to adequate early preparations for minimizing its effect on a facility. The Turkey Point experience indicates that existing plant procedures and other additional measures contemplated in response to hurricanes may not be fully responsive to the challenges posed by a storm of the magnitude of hurricane Andrew. On the basis of the experience with Hurricane Andrew at Turkey Point, the NRC staff is considering the need for additional regulatory actions.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact the technical contact listed below or the appropriate Office of Nuclear Reactor Regulation project manager.



Brian K. Grimes, Director
Division of Operating Reactor Support
Office of Nuclear Reactor Regulation

Technical contact: F. Hebdon, NRR
(301) 504-2024

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List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED
 NRC INFORMATION NOTICES

| Information Notice No. | Subject | Date of Issuance | Issued to |
|------------------------|----------------------------------------------------------------------------------------------------------------------------|------------------|---------------------------------------------------------------------------------|
| 93-52 | Draft NUREG-1477, "Voltage-Based Interim Plugging Criteria for Steam Generator Tubes" | 07/14/93 | All holders of OLs or CPs for pressurized water reactor (PWRs). |
| 93-51 | Repetitive Overspeed Tripping of Turbine-Driven Auxiliary Feed-water Pumps | 07/09/93 | All holders of OLs or CPs for nuclear power reactors. |
| 93-50 | Extended Storage of Sealed Sources | 07/08/93 | All licensees authorized to possess sealed sources. |
| 93-49 | Improper Integration of Software into Operating Practices | 07/08/93 | All holders of OLs or CPs for nuclear power reactors. |
| 93-48 | Failure of Turbine-Driven Main Feedwater Pump to Trip Because of Contaminated Oil | 7/6/93 | All holders of OLs or CPs for nuclear power reactors. |
| 92-06, Supp. 1 | Reliability of ATWS Mitigation Systems and Other NRC-Required Equipment not Controlled by Plant Technical Specification | 07/01/93 | All holders of OLs or CPs for nuclear power reactors. |
| 93-47 | Unrecognized Loss of Control Room Annunciators | 06/18/93 | All holders of OLs or CPs for nuclear power reactors. |
| 93-46 | Potential Problem with Westinghouse Rod Control System and Inadvertent Withdrawal of A Single Rod Control Cluster Assembly | 6/10/93 | All holders of OLs or CPs for Westinghouse (W)-designed nuclear power reactors. |
| 93-45 | Degradation of Shutdown Cooling System Performance | 06/16/93 | All holders of OLs or CPs for nuclear power reactors. |

OL = Operating License
 CP = Construction Permit

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Unlike some other natural disasters, onset of a hurricane is predictable and, as a result, lends itself to adequate early preparations for minimizing its effect on a facility. Experience with Hurricane Andrew provides an opportunity for reviewing existing plant procedures and implementing additional considerations to minimize potential damage to plants due to a hurricane. On the basis of NUREG-1474, the staff is determining the need for regulatory actions to address the effect of hurricanes on any facilities.

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