

# ***NRC Response to Fukushima Dai-ichi Accident***

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# ***Fukushima Dai-ichi pre-accident***





# FUKUSHIMA SEQUENCE OF EVENTS



*Protecting People and the Environment*

# ***NRC Response***

**Executive, Reactor Safety, Protective Measures, Safeguards, Public Affairs, and Liaison Teams**





# Hydrogen Explosions



# Site Team



- Stationed in U.S. Embassy in Tokyo
- Meet regularly with Japanese officials
- Support U.S. Ambassador
- Provide technical guidance as requested



# Initial NRC Actions

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NEW REACTORS  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, DC 20555-0001

March 18, 2011

NRC INFORMATION NOTICE 2011-05: TOHOKU-TAIHEIYU-OKI EARTHQUAKE  
EFFECTS ON JAPANESE NUCLEAR POWER  
PLANTS

**ADDRESSEES**

All holders of or applicants for operating licenses for nuclear power reactors under the provision of Title 10 of the Code of Federal Regulations (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," except those who have permanently ceased operations and have certified that fuel has been permanently removed from the reactor vessel.

All holders of or applicants for a standard design certification, standard design approval, manufacturing license, limited work authorization, early site permits or combined license issued under 10 CFR Part 52, "Licenses, Certifications and Approvals for Nuclear Power Plants."

**PURPOSE**

The U.S. Nuclear Regulatory Commission (NRC) is issuing this information notice (IN) to inform addressees of effects of the Tohoku-Taiheiyou-Oki Earthquake on nuclear power plants in Japan. The NRC expects that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. Suggestions contained in this IN are not NRC requirements, therefore, no specific action or written response is required.

**DESCRIPTION OF CIRCUMSTANCES**

The following summary of events is provided based on the best information available at this time. The situation in Japan regarding recovery efforts for the Fukushima Daiichi Nuclear Power Station continues to evolve on an hourly basis.

On March 11, 2011, the Tohoku-Taiheiyou-Oki Earthquake occurred near the east coast of Honshu, Japan. This magnitude 9.0 earthquake and the subsequent tsunami caused significant damage to at least four of the six units of the Fukushima Daiichi nuclear power station as the result of a sustained loss of both the offsite and on-site power systems. Efforts to restore power to emergency equipment have been hampered or impeded by damage to the surrounding areas due to the tsunami and earthquake.

ML110760432

IN 2011-05

TI 2515/183

**NRC INSPECTION MANUAL** IRB  
TEMPORARY INSTRUCTION 2515/183  
FOLLOWUP TO THE FUKUSHIMA DAIICHI NUCLEAR STATION  
FUEL DAMAGE EVENT

CORNERSTONE: INITIATING EVENTS AND MITIGATING SYSTEMS

**APPLICABILITY:** This Temporary Instruction (TI) applies to all holders of operating licenses for nuclear power reactors, except plants which have permanently ceased operations.

**2515/183-01 OBJECTIVES**

The objective of this TI is to independently assess the adequacy of actions taken by licensees in response to the Fukushima Daiichi nuclear station fuel damage event. The inspection results from this TI will be used to evaluate the industry's readiness for a similar event and to aid in determining whether additional regulatory actions by the U.S. Nuclear Regulatory Commission are warranted. Therefore, the intent of this TI is to be a high-level look at the industry's preparedness for events that may exceed the design basis for a plant. If necessary, a more specific followup inspection will be performed at a later date.

**2515/183-02 BACKGROUND**

On March 11, 2011, the Tohoku-Taiheiyou-Oki Earthquake occurred near the east coast of Honshu, Japan. This magnitude 9.0 earthquake and the subsequent tsunami caused significant damage to at least four of the six units of the Fukushima Daiichi nuclear power station as the result of a sustained loss of both the offsite and on-site power systems. Efforts to restore power to emergency equipment have been hampered or impeded by damage to the surrounding areas due to the tsunami and earthquake. The following background information is current as of March 18, 2011.

Units 1 through 3, which had been operating at the time of the earthquake, scrambled automatically, inserting their neutron absorbing control rods to ensure immediate shutdown of the fission process. Following the loss of electric power to normal and emergency core cooling systems and the subsequent failure of back-up decay heat removal systems, water injection into the cores of all three reactors was compromised, and reactor water levels could not be maintained. Tokyo Electric Power Company (TEPCO), the operator of the plant, resorted to injecting sea water and boric acid into the reactor vessels of these three units, in an effort to cool the fuel and ensure the reactors remained shutdown. However, the fuel in the reactor cores became partially uncovered. Hydrogen gas built up in Units 1 and 3 as a result of exposed, overheated fuel reacting with water. Following gas venting from the primary containment to relieve

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**NRC INSPECTION MANUAL** IRB  
TEMPORARY INSTRUCTION 2515/184  
AVAILABILITY AND READINESS INSPECTION OF  
SEVERE ACCIDENT MANAGEMENT GUIDELINES (SAMGs)

CORNERSTONE: MITIGATING SYSTEMS

**APPLICABILITY:** This Temporary Instruction (TI) applies to all holders of operating licenses for nuclear power reactors, except plants which have permanently ceased operations.

**2515/184-01 OBJECTIVES**

The objectives of this TI are to:

- Determine that the severe accident management guidelines (SAMGs) are available and how they are being maintained.
- Determine the nature and extent of licensee implementation of SAMG training and exercises.

**2515/184-02 BACKGROUND**

On March 30, 2011, the Executive Director for Operations chartered a task force to conduct a near-term evaluation of the need for agency actions following the events in Japan. During the task force's deliberations, the importance of severe accident management guidelines (SAMGs) has been highlighted. The SAMGs were implemented as a voluntary industry initiative in the 1990s and are not part of the agency's routine Reactor Oversight Program. In order to evaluate the current status of SAMGs onsite and determine the need for any further recommendations, the task force is requesting the enclosed information regarding SAMGs at operating power reactors be gathered, assessed, and summarized.

**2515/184-03 INSPECTION REQUIREMENTS AND GUIDANCE**

03.01 Assess the availability and readiness of the licensee's ability to access and implement the SAMGs at their facility. Answer the following questions by filling out the attached datasheet.

- When were the SAMGs last updated? Are controlled copies of the SAMG located in the technical support center (TSC) (Y/N), emergency operations facility (EOF) (Y/N), control room (Y/N)? For licensees that use one common EOF for multiple reactor sites, one review of the EOF will serve for all applicable sites.

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TI 2515/184

OMB Control No.: 3150-0012

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, DC 20555-0001

May 11, 2011

NRC BULLETIN 2011-01: MITIGATING STRATEGIES

**ADDRESSEES**

All holders of operating licenses for nuclear power reactors, except those who have permanently ceased operation and have certified that fuel has been removed from the reactor vessel.

**PURPOSE**

The U.S. Nuclear Regulatory Commission (NRC) is issuing this bulletin to achieve the following objectives:

- To require that addressees provide a comprehensive verification of their compliance with the regulatory requirements of Title 10 of the Code of Federal Regulations (10 CFR) Section 50.54(h)(2).
- To notify addressees about the NRC staff's need for information associated with licensee mitigating strategies under 10 CFR 50.54(h)(2) in light of the recent events at Japan's Fukushima Daiichi facility in order to determine if 1) additional assessment of program implementation is needed, 2) the current inspection program should be enhanced, or 3) further regulatory action is warranted, and
- To require that addressees provide a written response to the NRC in accordance with 10 CFR 50.54(f).

**BACKGROUND**

Following the terrorist events of September 11, 2001, the readiness of NRC-regulated facilities to manage challenges to core cooling, containment and spent fuel pool cooling (SFP) following large explosions or fires was enhanced through a series of orders and imposition of license conditions. These requirements were formalized in the rulemaking of March 27, 2009, resulting in 10 CFR 50.54(h)(2).

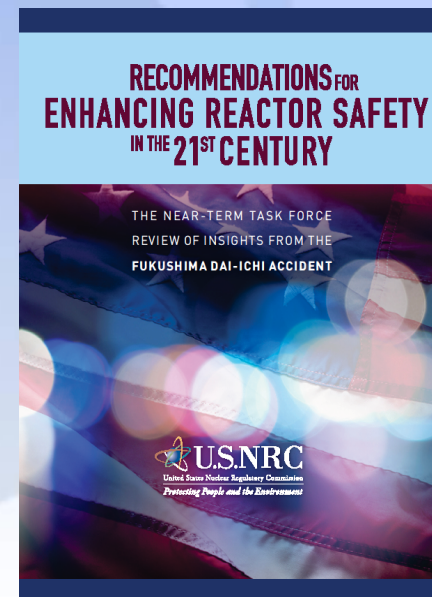
The NRC conducted a comprehensive inspection of the implementation of the mitigating strategies developed by licensees in 2008. Subsequently the NRC incorporated this inspectable area into the baseline reactor oversight process on a sample basis as part of the terminal fire protection inspection.

ML111250360

BL 2011-01

# ***NRC Lessons Learned Review***

- Commission directed a methodical and systematic review of the safety of U.S. facilities in light of events in Japan
- Near-Term Task Force review complete  
([www.nrc.gov](http://www.nrc.gov))





# ***Categorization of NTTF Recommendations***

- **Subsequent to the NTTF Report, recommendations were categorized into three tiers:**
  - **Tier 1 - To be implemented without unnecessary delay**
  - **Tier 2 - Could not be initiated in the near term due to resource or critical skill set limitations**
  - **Tier 3 - Require further staff study to support a regulatory action**

# ***Tier 1 Recommendations***

**2.1 – Reevaluations of Seismic and Flooding Hazards**

**2.3 – Facility Walkdowns Related to Seismic and Flooding Hazards**

**4.1 – Rulemaking Regarding Station Blackout Events**

**4.2 – Order Related to Mitigating Strategies for Beyond Design Basis Events**

**5.1 – Order Related to Reliable Hardened Vents for Mark I and II Containments**

**7.1 – Order Related to Spent Fuel Pool Instrumentation**

**8.0 – Rulemaking on Integration of Emergency Operating Procedures, Severe Accident Management Guidelines, and Extensive Damage Mitigation Guidelines**

**9.3 – Enhanced Emergency Preparedness Staffing and Communications**



# ***Other Recommendations for NRC Action***

- **Tier 2 Recommendations**
  - Spent fuel pool makeup capability
  - Other emergency preparedness regulatory actions
- **Tier 3 Recommendations**

# ***Tier 1 Implementation***

- **Implementation Goals:**
  - Issue Orders and 50.54(f) letters by the March 11<sup>th</sup> anniversary date of the Japan events
  - Focus early implementation on Recommendations with highest safety benefit (Recommendations 2.3 and 4.2)
  - Prepare for evaluation of licensee responses and NRC inspections



# BACKGROUND SLIDES

# ***Recommendation 2.1***

- **Seismic and Flooding Reevaluation:**
  - **Justification for 50.54(f) Letter:**
    - Fukushima demonstrated the importance of selecting an appropriate design basis for external hazards and the significant consequences of not adequately protecting against those hazards
  - **Request:**
    - Licensee's will be requested to reevaluate the seismic, flooding, and other external hazards at their site using present day methods and guidance. The results will determine whether additional regulatory actions are necessary (e.g., ordering plant modifications)
  - **Timeline:**
    - Implementation guidance within 180 days following issuance of 50.54(f) letter
    - Site responses will be prioritized, however, all responses will be expected by:
      - Seismic – 3 years
      - Flooding – 2 years
      - Other External Hazards – 2 years

## ***Recommendation 2.3***

- **Seismic and Flooding Walkdowns:**
  - **Justification for 50.54(f) Letter:**
    - Fukushima demonstrated the importance of protecting against external hazards
  - **Request:**
    - Licensee's will be requested to develop a methodology and acceptance criteria to perform walkdowns. They will then implement the walkdowns. We would expect any performance deficiencies identified would be addressed by the site's corrective action program. The walkdowns will incorporate an integrated approach, including procedures, training, and staffing; along with the underlying strategy to address the hazard
  - **Timeline:**
    - Licensees will be asked to propose a methodology within 90 days, and then submit the walkdown results within 180 days of the NRC's endorsement of that methodology



## ***Recommendation 4.2***

- **Mitigating Strategies for Beyond Design Basis Events:**
  - **Basis for Order:**
    - Uncertainties for events greater than previously considered
    - Need for additional defense-in-depth measures
  - **Requirement:**
    - Develop, implement, and maintain strategies and equipment to mitigate the effects of beyond design basis challenges to core, containment, and spent fuel pool cooling functions
  - **Timeline:**
    - Implementation guidance within 90 days following issuance of Order
    - Full implementation within 2 years from the issuance of guidance

# ***Recommendation 5.1***

- **Reliable Hardened BWR Vents:**
  - **Basis for Order:**
    - Smaller relative containment volume of BWR Mark I and Mark II containment designs, and limited time to potential containment failure following a severe accident
  - **Requirement:**
    - Enhanced reliability during prolonged station blackout (SBO) conditions
  - **Timeline:**
    - If implementation guidance is required, it will be available 90 days following issuance of Order
    - Full implementation within 3 years from the issuance of guidance
  - **Additional Issue:**
    - Preamble to Orders will identify filters as an issue under consideration

# ***Recommendation 7.1***

- **Reliable Spent Fuel Pool Instrumentation:**
  - **Basis for Order:**
    - Uncertainties evident during events in Japan highlighted need for enhanced spent fuel pool (SFP) instrumentation to support protection from off-site radiation releases and prioritization of mitigations and recovery actions
  - **Requirement:**
    - For beyond design basis events
    - Instrumentation must support maintaining SFP inventory for safety functions
    - Instrumentation must support adequate prioritization of event mitigation or recovery
  - **Timeline:**
    - If implementation guidance is required, it will be available 90 days following issuance of Order
    - Full implementation within 2 years from the issuance of guidance



## ***Recommendation 9.3***

- **Enhanced EP Staffing and Communications:**
  - **Justification for 50.54(f) Letter:**
    - Fukushima highlights the need to enhance existing EP programs to address prolonged station blackout (SBO) and multiunit events
  - **Request:**
    - Request information about communications equipment power during multiunit emergency events with prolonged SBOs (>72 hours)
    - Request information about staffing necessary for response to multiunit events with a prolonged SBO
  - **Timeline:**
    - Written responses expected within 90 days

# ***Recommendations 4.1 and 8***

- **Station Blackout Rulemaking:**
  - **Path Forward:**
    - SRM-SECY-11-0124 directed the staff to “initiate the rulemaking as an advance notice of proposed rulemaking (ANPR) rather than a proposed rule”
    - Staff has formed a working group and is working to issue an ANPR expeditiously
  - **Timeline:**
    - Commission directed that SBO rulemaking be completed within 24-30 months
- **Emergency Procedures Integration Rulemaking:**
  - **Path Forward:**
    - Staff will initiate an ANPR and hold a public meeting during comment period
    - Results of ANPR will be incorporated into a regulatory basis and proposed rulemaking activities
  - **Timeline:**
    - Rulemaking will follow the timeline contained in SECY-11-0137