

# NRC INSPECTION MANUAL

IRIB

## INSPECTION PROCEDURE 71111 ATTACHMENT 06

### FLOOD PROTECTION MEASURES

Effective Date: January 1, 2023

PROGRAM APPLICABILITY: IMC 2515 A

CORNERSTONES: Initiating Events  
Mitigating Systems

INSPECTION BASES: See Inspection Manual Chapter (IMC) 0308, Attachment 2

#### SAMPLE REQUIREMENTS:

Sample Requirements		Minimum Baseline Completion Sample Requirements		Budgeted Range	
Sample Type	Section(s)	Frequency	Sample Size	Samples	Hours
Flooding	03.01	Annual	1 per site	1 to 3 per site	6 to 18 per site

#### 71111.06-01 INSPECTION OBJECTIVE

This inspection will focus on verifying that the licensee's flooding mitigation plans and equipment are consistent with the licensee's design requirements and the risk analysis assumptions.

#### 71111.06-02 GENERAL GUIDANCE

Inspectors should review: 1) the final safety analysis report (FSAR) and seek input from Senior Reactor Analysts regarding site-specific flood risk analysis documents (e.g., licensee events probabilistic risk assessment (PRA), and external significance determination process (SDP) notebooks, as applicable) to identify those areas that are most likely to be affected by internal and external flooding, including water intake facilities. Individual plant examinations (IPE) may contain additional information. Consider seasonal susceptibilities to floods caused by hurricanes, heavy rains, and flash floods. 2) licensee documentation that shows the design basis flood levels for areas containing safety-related equipment. 3) condition reports and corrective actions for past flooding events. Consider weather-related information gathered during plant status reviews or from external news sources. Based on licensee's flooding risk studies, inspectors should select plant areas containing risk-significant structures, systems, and components (SSCs) which are susceptible to flooding. As a minimum, one flooding sample associated with internal flooding should be performed. Based on a site-specific risk analysis and weather-related events, an additional flooding sample associated with external flooding may be

**performed.** Generic communications which contain additional background information on flood protection measures are found in the References section of this Inspection Procedure.

The following table provides general inspection guidance for sample selection.

<u>Cornerstone</u>	<u>Inspection Objective</u>	<u>Risk Priority</u>	<u>Examples</u>
Initiating Events	<p>Identify flooding which could cause initiating events</p> <p>Identify postulated submergence source and duration for selected cable routing area(s)</p>	<p>Potentials for common-cause failures</p> <p>Barriers between flood areas</p> <p>Unanalyzed sources of flooding</p> <p>Areas below the flood plain</p> <p>Cables whose failure due to moisture-induced damage could disable risk-significant equipment within the scope of the Maintenance Rule</p>	<p>Adequate maintenance of expansion joints on high volume/low pressure systems</p> <p>Firewater sprinkler maintenance</p> <p>Unusual testing configurations for large volume water systems</p> <p>Cable rating and qualification is consistent with postulated submergence conditions</p> <p>Cables susceptible to submergence are de-energized during postulated submergence conditions</p>
Mitigating Systems	<p>Identify flooding events which could cause loss of safe-shutdown equipment</p> <p>Identify cable routing areas susceptible to submergence during flooding conditions (or where cables may be exposed to moisture from condensation and wetting)</p>	<p>Locations containing high volume/low pressure systems, such as firewater, service water and component cooling water, especially in areas containing flexible piping expansion joints.</p> <p>Locations containing cables whose failure due to moisture-induced damage could disable risk-significant equipment within the scope of the Maintenance Rule</p>	<p>Water-tight doors, sump pumps, and alarms</p> <p>Adequate sealing of safe-shutdown electrical equipment below the flood line</p> <p>Check valves in open drain systems common to different flood areas</p> <p>Cable rating and qualification is consistent with postulated submergence conditions</p> <p>Cables susceptible to submergence are de-energized during postulated submergence conditions</p>

For each sample, routine review of problem identification and resolution activities should be conducted using IP 71152, "Problem Identification and Resolution."

## 71111.06-03 INSPECTION REQUIREMENTS

### 03.01 Flooding.

**Verify that flooding sources are analyzed, designated flooding barriers **and equipment** are functional and appropriate to protect critical mitigating systems and equipment, and operator coping actions can reasonably be completed. Walkdown a selected area(s) or room(s) susceptible to flooding.**

#### Specific Guidance

Inspectors should conduct observation/design reviews, including reviews of preventive maintenance (PM) activities, and consider the following attributes, giving priority to those attributes which are risk significant for the site-specific installation:

#### 1. Flood Seals and Barriers

- Sealing of equipment below the design basis flood elevation, such as electrical conduits. **Consider if the service life of seals is consistent with the manufacturer's recommendations or that a documented engineering evaluation provides justification for service life beyond the manufacturer's recommendations.**
- Sealing of equipment floor plugs, holes or penetrations in floors and walls between flood areas. **Consider if procedures or programs to monitor for degraded conditions have been implemented.**
- Adequacy of watertight doors between flood areas. **Consider alignment of "dog ears," adequacy of seals, and wear or impact damage on critical parts of the doors.**
- Condition and availability of temporary or removable flood barriers (i.e., gaskets, **sandbags, or sand baskets**).
- Flood barrier impairment tracking and compensatory measures.
- **Protection of access to the ultimate heat sink for safe shutdown from storm surge debris impact (external flooding).**

#### 2. Drainage Systems and Sumps

- Common drain system and sumps, including floor drain piping and check valves where credited for isolation of flood areas within plant buildings.
- Drain system has adequate protection (screens/covers) to prevent debris from disabling the drain system or components in the drain system.
- Operable sump pumps, level alarm and control circuits including maintenance and calibrations of flood protection equipment.

- Anti-siphon features, such as check valves and vacuum breaks, used to prevent external flooding ingress.
- Perimeter drain systems that minimize the egress of water to safety-related plant areas are functional (external flooding).

### 3. Operator Actions

- For those areas where operator actions are credited, inspectors should consider if such procedures can reasonably be used to achieve the desired actions, including whether the flooding event could limit or preclude the required operator actions.
- Critical equipment, such as equipment necessary to perform Abnormal Operating Procedure (AOP) or Emergency Operating Procedure (EOP) actions, is not below the maximum room water level calculated for flooding events as described in AOPs or EOPs (as applicable).
- Water levels and associated effects (e.g., waves, run-up, or debris) will not impair support functions or the performance of necessary actions.
- Procedures or activities include a discussion on warning time and notification that a flood is imminent (external flooding).
- Procedures or activities can be executed as specified and within the required timeframe (e.g., closure of water-tight doors achievable in the available timeframe).
- Presence of other factors (e.g., equipment availability and staffing) will not prevent implementation of required actions.
- Proposed actions will not result in consequences that adversely affect other required safety or security functions (e.g., impairing required cooling functions).
- Procedures include a discussion on how long the site could be flooded and appropriate considerations for the duration of the flood (e.g., availability of required consumables) (external flooding).
- Consider observing flood mitigation drills and tabletops when possible.

### 4. Other Considerations

- Sources of potential flooding that are not analyzed or not adequately maintained, for example failure of flexible piping expansion joints, failure of fire protection system sprinklers, roof leaks, rest room backups, and failure of service water lines. For external flooding, are processes in place for incorporating or assimilating information from external sources (e.g., the National Oceanic and Atmospheric Administration or Army Corp of Engineers).
- Inaccessible power cables (e.g., those found in underground bunkers/manholes, cable trenches, cable troughs, above ground and underground duct banks, underground vaults, etc.) are adequately protected from environmental

conditions and being monitored (through inspection and/or testing) in accordance with licensee programs. Cable support structures are consistent with the design and any licensee commitments. Additional guidance on inaccessible power cables can be found in Attachment 1.

#### 71111.06-04 REFERENCES

10 CFR 50.65, "Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"

Circular 78-06, "Potential Common Mode Flooding of ECCS Equipment Rooms at BWR Facilities," May 31, 1978

Generic Letter 2007-01, "Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients"

IMC 0308, Attachment 2, "Technical Basis for Inspection Program"

IMC 2515, Appendix A, "Risk-Informed Baseline Inspection Program"

IMC 2515, Appendix D, "Plant Status"

IN 02-12, "Submerged Safety Related Electrical Cables"

IN 03-08, "Potential Flooding Through Unsealed Concrete Floor Cracks"

IN 05-11, "Internal Flooding/Spray-Down of Safety-Related Equipment Due to Unsealed Equipment Hatch Floor Plugs and/or Blocked Floor Drains," May 6, 2005

IN 05-30, "Safe Shutdown Potentially Challenged by Unanalyzed Internal Flooding Events and Inadequate Design," November 07, 2005

IN 07-01, "Recent Operating Experience Concerning Hydrostatic Barriers"

IN 10-26, "Submerged Electrical Cables"

IN 16-11, "Potential for Material Handling Events to Cause Internal Flooding"

IN 83-44, "Potential Damage to Redundant Safety Equipment as a Result of Backflow Through the Equipment and Floor Drain System," July 1, 1983

IN 83-44s1, "Potential Damage to Redundant Safety Equipment as a Result of Backflow Through the Equipment and Floor Drain System," August 30, 1990

IN 87-49, "Deficiencies in Outside Containment Flooding Protection," October 9, 1987

IN 88-60, "Inadequate Design and Installation of Watertight Penetration Seals," August 11, 1988

IN 92-69, "Water Leakage from Yard Area Through Conduits into Buildings," September 22, 1992

IN 94-27, "Facility Operating Concerns Resulting from Local Area Flooding," March 31, 1994

IN 98-31, "Fire Protection System Design Deficiencies and Common-Mode Flooding of  
Emergency Core Cooling System Rooms at Washington Nuclear Project Unit 2,"  
August 18, 1998

IP 71152, "Problem Identification and Resolution"

END

## Attachment 1: Inaccessible Power Cables

Inaccessible power cable routing areas or locations (e.g., underground bunkers/manholes, cable trenches, cable troughs, above ground and underground duct banks, underground vaults, cable entry points into buildings below ground level, etc.) that contain cables whose failure could disable risk-significant equipment or multiple trains within the scope of the Maintenance Rule should be inspected when made reasonably accessible. Cable failures or degradation can occur due to condensation, wetting, submergence, or moisture-induced damage.

NOTE: Inspection efforts should not create undue burden on the licensee. The intent is to coordinate access to the applicable areas (cable trenches, cable troughs, underground duct banks, underground vaults, etc.) in advance in order to minimize the impact on licensees. For those plants within the period of extended operation, bunkers/manholes within the scope of license renewal are also subject to inspections as part of the licensee's aging management program for inaccessible power cables. Whenever possible, inspection activities should be arranged such that NRC inspectors accompany plant personnel on the licensee's periodic inspections. If necessary, borescopes / cameras can be used to inspect cable routing areas in lieu of direct physical access. If sump pumps have been installed, verification that the sump pumps are functioning (e.g., level indication or alarm) is an acceptable alternative to direct observation if the affected areas are not periodically opened for direct inspection (provided that power is available to these systems during the postulated flooding events). However, these areas should be made a priority for inspection when availability exists. Additional guidance on reviews/tours of normally inaccessible areas is provided in Inspection Manual Chapter 2515, Appendix D, "Plant Status."

- a. When feasible, consider direct observation that the cables are not submerged in water. For dry areas, consider current state for evidence (water marks on wall, debris in cable trays, etc.) which may indicate previous submergence. If the cables are submerged, or there is evidence of previous submergence, further evaluation in consultation with Regional or NRR subject matter experts may be considered to determine the extent of environmental degradation or impact on plant safety.
- b. When feasible, consider by direct observation that cables and/or splices appear intact. Consider observation of the condition of cable support structures. Consider the integrity of cables with degraded or missing support structures.
- c. If applicable, consider proper dewatering device (sump pump) operation and level alarm circuits are set appropriately to ensure that the cables will not be submerged. If dewatering devices are not installed, consider whether drainage is provided and is functioning for the cable routing areas selected. If neither dewatering devices nor drainage have been installed, consider if the operational environment of the cables is consistent with the manufacturer's design specifications and qualification criteria.
- d. Inspections may only consider the condition of the cables located within the cable routing areas. If issues are identified, or questions arise during the inspection, inspectors should contact the Regional or NRR technical specialists for guidance and/or assistance in the determination of the acceptability or unacceptability of any issues.
- e. (For those plants within the period of extended operation). If moisture is identified, consider if the licensee takes action to keep the cables dry and assess cable degradation in accordance with the licensee's aging management program for inaccessible power cables.

- f. Consider the licensee's inspection, testing and monitoring programs to detect the degradation of inaccessible or underground power cables that support emergency diesel generators, offsite power, emergency service water, service water, component cooling water and other systems that are within the scope of 10 CFR 50.65 (the Maintenance Rule).



Attachment 2: Revision History for IP 71111.06

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
N/A	04/03/00 CN-00-003	71111.06 has been issued to provide the minimum inspection oversight for determining the safety performance of operating nuclear power reactors.	N/A	N/A
N/A	01/17/02 CN-02-001	71111.06 has been issued to provide the minimum inspection oversight for determining the safety performance of operating nuclear power reactors.	N/A	N/A
N/A	<a href="#">ML063470601</a> 01/25/07 CN-07-003	IP 71111.06 has been revised to address feedback form 71111.06-889 to update procedure based on inspection and operating experience. Also, the Level of Effort and Inspection Basis sections were changed to give the flexibility to select either internal or external samples based on inspectors' discretion.	N/A	<a href="#">ML063470279</a>
N/A	<a href="#">ML072960248</a> 01/31/08 CN-08-005	IP 71111.06 has been revised to address the 2007 ROP realignment, shifting external flooding review to IP 71111.01, and to correct typographic errors.	N/A	<a href="#">ML073520328</a>
N/A	<a href="#">ML082120529</a> 08/19/08 CN 08-024	IP 71111.06 has been revised to clearly state that an inspection sample is one area. This addresses feedback form 71111.06-1267.	N/A	N/A
N/A	<a href="#">ML083170651</a> 06/25/09 CN-09-016	IP 71111.06 has been revised to address feedback form 71111.06-1294. A revision has also been made to the inspection requirements associated with underground cables. This inspection was changed from an optional sample to a mandatory sample as a result of information gathered from GL 2007-01.	N/A	<a href="#">ML090700224</a>

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment Resolution and Closed Feedback Form Accession Number (Pre-Decisional, Non-Public Information)
N/A	<a href="#">ML11244A012</a> 10/28/11 CN-11-025	IP 71111.06 has been revised to include guidance on age-related degradation and license renewal aging management programs.	N/A	<a href="#">ML11297A116</a>
N/A	<a href="#">ML15140A133</a> 11/25/15 CN-15-027	IP 71111.06 has been revised to address feedback forms 71111.06-1768 and 71111.06-1863 and expand on guidance related to inspection of cable routing areas susceptible to flooding or where cables may be exposed to moisture from condensation or wetting.	N/A	<a href="#">ML15141A040</a> 71111.06-1768 <a href="#">ML15141A060</a> 71111.06-1863 <a href="#">ML15141A072</a>
N/A	ML19291A958 10/21/20 CN 20-053	Major revision. Relocated optional requirements to the guidance section to better align with IMC 2515, Section 8.04, sample completion requirements. Added AP1000 sample requirements. Five year periodic review. Reformatted to conform to IMC 0040.	None	ML19316B052 (2019)  ML20233A518 (2020)
N/A	ML21075A363 07/09/21 CN 21-023	Revisions include: 1) Address Feedback Form 71111.06-2434. Required cable degradation sample deleted. Oversight of cable degradation may be performed if desired as part of an Internal Flooding sample. 2) Clarified requirements vs guidance per OIG-16-A-12 (ML16097A515). 3) Formatting reflects current IMC 0040 (ML19352E640) requirements.	None	ML21092A029  ML21075A362 71111.06-2434
N/A	ML22066B334 08/01/22 CN 22-015	Samples revised per NRR direction using Enclosure 2 (ML19070A040) of SECY-19-0067 (ML19070A050) as guidance.	None	N/A Issued as final.