

NRC INSPECTION MANUAL

IRIB

INSPECTION PROCEDURE 71111 ATTACHMENT 06

FLOOD PROTECTION MEASURES

INSPECTABLE AREA: Flood Protection Measures

CORNERSTONES: Initiating Events
Mitigating Systems

EFFECTIVE DATE: January 1, 2016

INSPECTION BASES: Flooding due to internal causes has been shown to be a significant contributor to risk at some facilities. Flooding has the potential to make multiple trains of equipment and support equipment inoperable. Flooding may also affect operator mitigation and recovery actions.

LEVEL OF EFFORT: Annually, perform 2 samples for internal flooding. The **internal flood area** selected **as part of the sample** could consist of one or multiple rooms depending upon plant layout.

If applicable, for sites with a history of cable degradation or failures due to submergence, perform an additional sample annually consisting of risk-significant cables located in areas susceptible to water accumulation for extended periods of time.

71111.06-01 INSPECTION OBJECTIVE

01.01 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.

02.01 Document Review and Inspection Area Selection.

- a. Review the final safety analysis report (FSAR) and seek input from Senior Reactor Analysts regarding site-specific flood risk analysis documents (e.g., licensee internal events PRA, and external SDP notebooks, as applicable) to identify those areas that are most likely to be affected by internal flooding, including water intake facilities. Review licensee documentation that shows the design basis flood levels for areas containing safety-related equipment. Review problem reports and corrective actions for past flooding events.
- b. Based on licensee's flooding risk studies, select plant areas containing risk significant structures, systems, and components (SSCs) which are susceptible to flooding.
- c. Review 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).
- d. Select cable routing areas susceptible to submergence during flooding conditions, or where cables may be exposed to moisture from condensation and wetting, that contain multiple train or multiple risk-significant cables of a type susceptible to failure or degradation due to water submergence or moisture-induced damage. The inspection sample should be informed by the types of cables deployed at the site and their susceptibility to failure or degradation due to wetting, submergence, or moisture-induced damage as well as the effectiveness of the licensee's programs for dewatering, monitoring, and/or performance testing of inaccessible or underground cables.

02.02 Inspection Activities.

- a. Walkdown the selected area(s) or room(s). By observation/design reviews, including reviews of preventive maintenance (PM) activities, consider the following attributes. Give priority to those attributes which are risk significant for the site specific installation:
 1. Sealing of equipment below the design basis internal flood elevation, such as electrical conduits.
 2. Sealing of equipment floor plugs, holes or penetrations in floors and walls between flood areas.
 3. Adequacy of watertight doors between flood areas.
 4. Common drain system and sumps, including floor drain piping and check valves where credited for isolation of flood areas within plant buildings.
 5. Verify that the drain system has adequate protection (screens/covers) to prevent debris from disabling the drain system or components in the drain system.

6. Operable sump pumps, level alarm and control circuits including maintenance and calibrations of flood protection equipment.
7. Sources of potential internal 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.
8. Condition and availability of temporary or removable flood barriers (i.e., gaskets).
9. Verify critical equipment such as equipment necessary to perform Emergency Operating Procedure (EOP) actions, is not below the maximum room water level calculated for flooding events as described in EOPs (as applicable).
10. **Flood barrier impairment tracking and compensatory measures.**
 - b. For those areas where operator actions are credited, verify that the procedures such as abnormal or emergency procedures for coping with flooding can reasonably be used to achieve the desired actions, including whether the flooding event could limit or preclude the required operator actions.
 - c. **At sites with a history of underground cable failures or degradation due to condensation, wetting, submergence, or moisture-induced damage, perform an additional annual sample to assess 1-2 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 within the scope of the Maintenance Rule.**

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, boroscopes/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 shall 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.

1. **When feasible, verify by direct observation that the cables are not submerged in water. For dry areas, assess 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 required to determine the extent of environmental degradation or impact on plant safety.

2. **When feasible**, verify by direct observation that cables and/or splices appear intact. Observe the condition of cable support structures. Verify the integrity of cables with degraded or missing support structures.
3. If applicable, verify proper dewatering device (sump pump) operation and verify level alarm circuits are set appropriately to ensure that the cables will not be submerged. If dewatering devices are not installed, determine whether drainage is provided and is functioning for the **cable routing areas** selected. If neither **dewatering devices nor drainage have been installed**, verify that the **operational environment of the cables is consistent with the manufacturer's design specifications and qualification criteria**.
4. Inspections only need to be detailed enough to determine the condition of the cables located within the **cable routing areas**. If **issues** are identified, or questions arise during the course of 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**.
5. (For those plants within the period of extended operation). If significant moisture is identified, verify that 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.

02.03 Problem Identification and Resolution.

Flooding has the potential to cause common mode failure of equipment in multiple areas. Verify that the licensee has entered **any issues** identified during the inspection in the licensee's corrective action program. Verify that the licensee is identifying issues at an appropriate threshold and entering them in the corrective action program. Verify that **issues** included in the licensee's corrective action program are properly addressed for resolution. See Inspection Procedure 71152, "Identification and Resolution of Problems," for additional guidance.

71111.06-03 INSPECTION GUIDANCE

<u>Cornerstone</u>	<u>Inspection Objective</u>	<u>Risk Priority</u>	<u>Example</u>
Initiating Events	Identify internal flooding which could cause initiating events	Potentials for common-cause failures Barriers between flood areas	Adequate maintenance of expansion joints on high volume/low pressure systems Firewater sprinkler maintenance

<u>Cornerstone</u>	<u>Inspection Objective</u>	<u>Risk Priority</u>	<u>Example</u>
	<p>Identify postulated submergence source and duration for selected cable routing area(s)</p>	<p>Unanalyzed sources of internal flooding</p> <p>Areas below the flood plane</p> <p>Cables whose failure due to moisture-induced damage could disable risk-significant equipment within the scope of the Maintenance Rule</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>

<u>Cornerstone</u>	<u>Inspection Objective</u>	<u>Risk Priority</u>	<u>Example</u>
Mitigating Systems	<p>Identify internal 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>

71111.06-04 RESOURCE ESTIMATE

The annual resource expenditure for this inspection procedure is estimated to be 17 to 23 hours to review internal flood protection features based on inspector’s discretion at a site regardless of the number of units at that site.

71111.06-05 COMPLETION STATUS

Inspection of the minimum sample size will constitute completion of this procedure in the Reactor Program System (RPS). That annual minimum sample size will consist of 2 internal flooding samples, and 1 cable routing area sample (if applicable) per section 02.02 of this procedure.

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

Inspection Procedure 71152, "Identification and Resolution of Problems."

Regulatory Guide 1.102, "Flood Protection for Nuclear Power Plants."

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

Information Notice (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.

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.

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

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

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

END

ATTACHMENT 1
Revision History For 71111.06

Commitment Tracking Number	Issue Date	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution 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	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	ML063470279

Commitment Tracking Number	Issue Date	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution Accession Number (Pre-decisional, Non-public information)
N/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	ML073520328
N/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	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	ML090700224
N/A	ML11244A012 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	ML11297A116
N/A	ML15140A133 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	ML15141A040 71111.06-1768 ML15141A060 71111.06-1863 ML15141A072

Issue Date: 11/25/15
Effective Date: 01/01/16

Att 1-2

71111.06