



UNITED STATES
NUCLEAR REGULATORY COMMISSION
OFFICE OF INSPECTION AND ENFORCEMENT
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INSPECTION AND ENFORCEMENT MANUAL

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INSPECTION PROCEDURE 64100

POSTFIRE SAFE SHUTDOWN, EMERGENCY LIGHTING AND OIL COLLECTION CAPABILITY AT OPERATING AND NEAR-TERM OPERATING REACTOR FACILITIES

PROGRAM APPLICABILITY: 2513, 2514, 2515 (BASIC), 2525

64100-01 INSPECTION OBJECTIVES

To obtain sufficient information to determine whether a reactor facility is capable of achieving postfire safe shutdown (per 10 CFR 50, Appendix R) and to determine whether the postfire safe shutdown physical configuration and procedures are sufficiently well documented to permit the licensee to maintain the established capabilities over the plant's operating life. This validated configuration is periodically reverified through the use of Inspection Procedure 64150 "Triennial Postfire Safe Shutdown Capability Reverification."

64100-02 INSPECTION REQUIREMENTS

Since postfire safe shutdown requirements depend on the date of issue of a reactor plant's full-power operating license (see Sections 03.01 a and b below) and since these requirements are very consistent between plants licensed before January 1, 1979, the inspection requirements provided in this section and Appendix A to this procedure are written for pre-79 reactor plants. When this procedure is used to assess the capabilities of a post-79 reactor plant, these requirements should be modified in accordance with that plant's specific licensing requirements. See items 12, 13, and 14 of Section A of Appendix A to this inspection procedure for detailed information on documents which represent approval of plant configurations.

The following requirements refer to sections of Appendix R to 10 CFR 50.

02.01 Section III.G.2, Redundant Train Safe Shutdown Capability

- a. Functional Requirements. Verify the following:
 1. The reactivity control function shall be capable of achieving and maintaining cold shutdown reactivity conditions.
 2. The reactor coolant makeup function shall be capable of maintaining the level within the level indication of the pressurizer (or solid plant) for PWRs. For BWR's, the NRC has approved

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partial short-term core recovery using the automatic depressurization system (ADS) and low-pressure coolant injection system (LPCIS). Note that this option eliminates the need for the hot shutdown maintenance capability of Section III.G.1.a. of Appendix R.

3. The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.
 4. The process monitoring function shall be capable of providing direct readings of the process variables necessary to perform and control the functions in Items a.1., a.2., and a.3. above. Note: Source range neutron indication is not necessarily required for any reactor plant. An alternative method of direct reactivity measurement can be provided. See Interpretation 1 of Enclosure 1 to reference 04.11.
 5. The supporting functions shall be capable of providing the process cooling, lubrication, and other services necessary to permit the operation of the equipment used for safe shutdown functions.
- b. Verify that plant fire areas are sufficiently bounded to withstand the hazards associated with the area and, as necessary, to protect important equipment within the area from a fire outside the area.* Also verify, on a sample basis, that plant fire areas which contain components from both redundant trains of safe shutdown equipment meet one of the following:
1. requirements of Section III.G.2 of Appendix R
 2. an alternative or dedicated shutdown capability meeting the requirements of III.G.3 and III.L of Appendix R as described in the safety evaluation report (SER) issued by NRR or licensee documents referenced therein**
 3. requirements of approved exemption requests
- c. Verify that cables (safety-related and non-safety-related) and equipment in selected fire areas have been identified and analyzed by the licensee to show that they would not prevent safe shutdown operation because of hot shorts, open circuits, or shorts to ground. Verify circuit breaker coordination and fuse protection has been analyzed and provided, as necessary.
- d. Verify, on a sample basis, that the installation of necessary fire detectors and automatic fire suppression systems required by Section III.G.2 of Appendix R has been accomplished. In addition, review licensee evaluations which verify that the installed automatic suppression systems would adequately suppress fires associated with the hazards of each area.

* Refer to Interpretation 4 and Section 3.1 of the Questions and Answers of Generic Letter (GL) 86-10 (reference 04.11).

**See Section 02.02 below for inspection requirements if alternative or dedicated postfire safe shutdown capability is provided.

- e. Verify, on a sample basis, that redundant trains of systems required for hot shutdown located in the same fire area are not subject to damage from fire suppression activities or from the rupture or inadvertent operation of fire suppression systems.* Determine each of the following:
 - 1. whether a fire in a single location could, indirectly, through the production of smoke, heat, or hot gases, cause activation of potentially damaging fire suppression for all redundant trains
 - 2. whether a fire in a single location (or inadvertent actuation or rupture of a fire suppression system) could, through local fire suppression activity, indirectly cause damage to all redundant trains (e.g., sprinkler caused flooding of other than the locally affected train)
 - 3. whether, in response to a fire in a single location, the utilization of manually controlled fire suppression systems could cause damage to all redundant trains
- f. Verify that systems necessary to achieve and maintain cold shutdown from either the control room or other control station(s) can be repaired within 72 hours.

02.02 Sections III.G.3 and III.L, Alternative and Dedicated Shutdown

- a. Review the systems and equipment used to meet the alternative or dedicated shutdown requirements. Verify that they meet the following functional requirements:
 - 1. The reactivity control function shall be capable of achieving, monitoring, and maintaining cold shutdown reactivity conditions.
 - 2. The reactor coolant makeup function shall be capable of maintaining the reactor coolant level above the top of the core for BWRs or be within the level indication in the pressurizer (or solid plant) for PWRs.
 - 3. The reactor heat removal function shall be capable of achieving and maintaining decay heat removal.
 - 4. The process monitoring functions shall provide direct reading of the process variables necessary to control the functions in Items a.1., a.2., and a.3., above.**
 - 5. The supporting functions shall be capable of providing the process cooling, lubrication, etc., necessary to permit the operation of the equipment used for safe shutdown functions.
- b. Verify that alternative or dedicated shutdown capability is in conformance with applicable NRR SERs and their supplements, or other applicable licensing documents.

* See references 04.08 and 04.09.

**See reference 04.04.

- c. Examine alternative or dedicated shutdown equipment. Verify that it is independent of the fire area, room or zone under consideration and that electrical isolation is provided as described in the applicable NRR SERs, and their supplements or other applicable licensing documents.
- d. Review the licensee's surveillance program for testing the reliable operation of alternative or dedicated shutdown equipment. Establish that a controlled postfire safe shutdown has been shown to be achievable from outside of the control room. Furthermore, verify that the transfer of control from the control room to the alternative location for equipment required for safe shutdown is demonstrated. Verify that this transfer ensures that operation of this equipment is not affected by fire-induced spurious operation. Also, verify that upon transfer of control from the control room to the alternative location, required circuits are protected by separate fusing and power supplies.
- e. Verify that the licensee's training program for licensed and non-licensed personnel has been expanded to include alternative or dedicated safe shutdown capability.
- f. Verify that personnel required to achieve and maintain the plant in hot shutdown following a fire using the alternative shutdown system can be provided from normal onsite staff, exclusive of the fire brigade.
- g. Verify that adequate procedures for use of the alternative shutdown system exist. Verify that the operators can reasonably be expected to perform the procedures within applicable shutdown time requirements. Ensure that adequate communications are available for the personnel performing alternative or dedicated safe shutdown. The licensee can be requested to demonstrate the adequacy of the alternative shutdown procedures by "walking through" the procedural steps.
- h. Verify, on a sample basis, that installation of necessary fire detectors and automatic fire suppression systems required by Section III.G.3 of Appendix R is as described in NRR SERs and their supplements or other applicable licensing documents. In addition, verify that the installation of automatic suppression systems would adequately suppress fires associated with the hazards of the areas.
- i. Verify that the licensee has dedicated repair procedures, equipment and materials to accomplish repairs of damaged components required for cold shutdown, that these components can be made operable, and that cold shutdown can be achieved within 72 hours.

02.03 Section III.J., Emergency Lighting

- a. Verify that the plant emergency lighting capabilities meet the following requirements of Section III.J. of Appendix R.

1. Required Areas for Emergency Lighting

- (a) control room (unless specifically excluded as a requirement through exemption or deviation)

- (b) other critical area(s) and access routes which require illumination to allow manual safe shutdown equipment operation or the monitoring of safe shutdown indications
- 2. If the emergency lights are powered from a central battery or batteries, then the distribution system must contain protective devices such that a fire in one area will not cause a loss of emergency lighting in any unaffected area needed for safe shutdown operations.
- 3. Review the manufacturer's information to verify that battery power supplies are rated with at least an 8-hour capacity.
- b. In addition to the regulatory requirements of III.J, the following areas should be reviewed:
 - 1. Tour the plant and inspect the emergency lights installed in areas required for postfire shutdown and in the access routes to those areas. By requesting the licensee to perform an emergency lighting test for selected plant areas, verify the following:
 - (a) the lamps are properly aimed
 - (b) the batteries are being properly maintained including:
 - charge rate indication (lamp or meter)
 - specific gravity indication is within specification
 - (c) sufficient illumination is provided to permit access for the monitoring of safe shutdown indications and/or the proper operation of safe shutdown equipment
 - 2. Review the preventive maintenance surveillance procedure used for periodic checks of the emergency lights and verify that the maintenance frequencies and procedures are as specified by the manufacturer.

02.04 Section III.0, Oil Collection Systems for Reactor Coolant Pumps

- a. Review the drawings and calculations for the oil collection system to verify that all potential leakage points in the reactor coolant pump oil system have been contained and the drain line(s) have been sized to accommodate the maximum leak rate.
- b. Verify that the oil collection system components have been designed so that there is reasonable assurance that they would withstand the safe shutdown earthquake (see Section III.0 of Appendix R) or that the RCP lube oil system and associated appurtenances are seismically designed to withstand the safe shutdown earthquake and that the licensee has submitted and NRR has approved an exemption for a non-seismically designed oil collection system. See GL 86-10 (reference 04.11), Enclosure 2, Question 6.1.

can be safely shutdown, although permanent postfire safe shutdown procedures and physical barriers are not in place.

4. Conceptual Review. It is NRC policy that regions are to inspect reactor plants, using IP 64100 as a guide, where postfire safe shutdown implementation problems are believed to exist. Another reason for inspecting a reactor plant "in process", may be a request by the licensee for a review of its design or implementation decisions. In both cases, costly design or implementation errors and associated delays in achieving permanent postfire safe shutdown capability may be avoided.
5. Full Reinspection. Subsequent to an initial validation inspection or a revisit under IP 64100, the region may determine that a licensee has essentially failed to provide the capability to conduct a controlled, successful postfire safe shutdown. Such failed inspections will be followed by a full reinspection when the licensee has conducted the necessary postinspection re-analyses, design, procurement, and implementation activities. Power operation before the full reinspection would be conducted with appropriate interim compensatory measures in effect.
6. Periodic Reverification. A reactor plant's or station's mechanical and electrical configuration and operating procedures are to be periodically reviewed to verify that the licensee has maintained established post-fire safe shutdown capabilities. This periodic reverification is conducted under Inspection Procedure 64150.

d. Inspection Team Structure

1. A minimum inspection team consists of the following members:
 - (a) Team Leader - leads discussion with licensee at entrance and exit interview. Should be a regionally based inspector. Also participates in inspection effort.
 - (b) Mechanical Safe Shutdown Specialist - identifies and examines equipment and cabling necessary to achieve postfire safe shutdown.*
 - (c) Electrical Safe Shutdown Specialist - identifies and examines cabling and circuitry necessary to achieve postfire safe shutdown and identifies associated circuits of concern, the adequacy of these circuits' electrical separation, isolation, and protective features, and circuit breaker coordination and fuse protection.*
 - (d) Fire Protection Specialist - inspects fire protection of the safe shutdown systems, equipment, and circuits.*

*Regions may use inspectors who have the necessary expertise, request assistance from NRR, or use available IE contractors who have the necessary expertise.

2. Inspection experience to date has shown the effectiveness of adding one team member to review the licensee's alternative safe shutdown systems and procedures.

e. Inspection Plan Preparation and Onsite Inspection Activities

1. This is a technically complex inspection. Because there are many variations in the technical details by which a facility can meet safe shutdown criteria, a site-specific inspection plan must be prepared. See Appendix A for detailed direction on the preparation of inspection plans.
2. Certain documents approved and issued during the spring of 1986 have a direct effect on inspection plan preparation and onsite inspection activities: SECY-85-306; SECY-85-306B; and a March 7, 1986 memorandum from Samuel J. Chilk, Secretary to the Commission, to Victor Stello, Jr., Acting EDO. SECY 85-306 directed the issuance of GL 86-10. These documents were discussed in detail with regional postfire safe shutdown inspectors during a May 7, 1986 meeting called by the Director, Division of Inspection Programs, IE. Minutes at that meeting are contained in an August 11, 1986 memorandum from Leon E. Whitney, Lead Contact for Fire Protection, DI, IE to Regional Division Directors. This minutes memorandum provides answers to questions raised by inspectors during the May 7, 1986 meeting.

Selected inspection related matters arising from GL 86-10 are discussed below. However, all the documents listed above should be read and understood by all inspectors and/or contractors assigned to postfire safe shutdown inspection teams.

- (a) To minimize confusion associated with license conditions (see Sections 03.01a and b above) GL 86-10 states that each licensee should place its fire protection program and major commitments (including Fire Hazard Analysis and technical specification requirements) in its FSAR. The fire protection program would then be subject to changes under 10 CFR 50.59 without prior NRC approval (as long as the licensee established that the changes would not adversely affect the ability to achieve and maintain postfire safe shutdown).
- (b) The six "Interpretations of Appendix R," and the "Appendix R Questions and Answers" of GL 86-10 provide guidance as to acceptable methods of satisfying Commission regulatory requirements. Other methods proposed by licensees for complying with Commission regulations also may be satisfactory, and inspectors will consider them on their own merits. The guidance of "Interpretations of Appendix R" and "Appendix R Questions and Answers" differs from prior guidance (including GL 83-33). It is intended that GL 86-10 take precedence. Questions on this matter should be addressed to the NRC project manager for the facility to be inspected.

- b. Emergency operating procedures for achieving postfire cold shutdown.
- c. Fire pre-plans for critical areas, if developed.
- d. Results of any tests conducted to verify the capabilities and operability of postfire safe shutdown equipment.
- e. Results of qualification and/or acceptance tests for special features provided for postfire safe shutdown.

END

Appendix A

APPENDIX A

INSPECTION PLAN PREPARATION

- A. Pre Audit Materials. The region should request that the licensee provide the following information to the inspection team at least 2 weeks before the inspection to permit the inspection team to properly prepare for this comprehensive and complex inspection:
1. Piping and instrumentation (flow) diagrams for hot shutdown and cold shutdown systems, alternative or dedicated shutdown systems, and the reactor coolant pump oil collection system.
 2. Plant layout and equipment location drawings which identify the physical plant locations of hot shutdown and cold shutdown equipment.
 3. Color-coded, marked-up electrical raceway drawings which identify the cable routing of power, control and indication circuits for those plant systems necessary to achieve and maintain hot shutdown.
 4. Single line ac and dc electrical power and control cable distribution diagrams.
 5. Plant layout drawings which identify fire area boundaries and fire protection equipment locations.
 6. Marked-up plant layout drawings which identify the locations of emergency lighting units.
 7. Associated circuit analyses.
 8. Drawings which depict the physical and seismic design of reactor coolant pump oil collection system.
 9. Plant operating procedures which describe normal hot and cold shutdown from inside the control room, emergency hot and cold shutdown from emergency control stations outside and independent of the control room, and shutdown operations which utilize alternative or dedicated shutdown capability and, if applicable, natural circulation.
 10. Fire damage control and repair procedures for cold shutdown systems.
 11. Analyses and evaluations of the adequacy of automatic suppression systems.
 12. All Branch Technical Position (BTP) ASB 9.5-1 Appendix A SER's.
 13. All approved exemption requests and related SERs plus supporting documentation developed by the licensee.

- (c) Determine whether enough qualified personnel, exclusive of the fire brigade, would be available on shift to perform the necessary shutdown operations.
 - (d) Determine whether communications capability is adequate to conduct the procedure in a controlled manner.
 - (e) Determine whether the licensees training program includes periodic training in the use of postfire safe shutdown procedures and operations.
 - (f) Determine, through interviews with a sample of plant operators, whether their knowledge of alternative or dedicated postfire safe shutdown procedures is adequate.
- 7. The inspector should note that Section III.L.5. of Appendix R requires that alternative or dedicated cold shutdown equipment shall not be damaged by fire or the fire damage shall be limited so that cold shutdown can be achieved within 72 hours.
 - 8. The inspector should note that Section III.G.3.b. of Appendix R requires that alternative or dedicated safe shutdown capability is required "where redundant trains of systems required for hot shutdown...may be subject to damage from fire suppression activities or from the rupture or inadvertent operation of fire suppression systems."
 - 9. The inspector should note that Section III.L.3. of Appendix R requires that alternative shutdown capability "shall accommodate postfire conditions where offsite power is available and where offsite power is not available for 72 hours." To simplify post-fire shutdown procedures, some licensees may purposely open the offsite supply breaker(s), thereby placing the plant electrical and mechanical system in a known configuration. Other licensees may possess procedures which utilize offsite power, if available. At these facilities, credit taken for the failed position of some equipment and breakers on loss of offsite power may not be appropriate when offsite power is not lost.
- F. Cold Shutdown Equipment Selection. From the information developed in Section B.2 above, select specific cold shutdown equipment, instrumentation, and cabling for review. Selection of one or two components in each functional area should be an adequate sample size. These items, in addition to the equipment required for hot shutdown, are those necessary to achieve cold shutdown. For example, for a PWR:
- 1. reactor coolant system pressure reduction - auxiliary spray line valve controls
 - 2. decay heat removal - RHR pump
 - 3. support systems - onsite power

G. Inspection of Selected Cold Shutdown Equipment Repair Capability

1. The inspector should note that Section III.G.1.b. of Appendix R requires that fire damage to cold shutdown equipment be capable of repair within 72 hours.
2. The licensee's analyses and/or submittals should clearly identify which cold shutdown equipment could be damaged in a postulated fire in each fire area.
3. For postulated fires in selected fire areas, assess the accuracy of the licensee's listing of cold shutdown equipment damage.
4. Material required for cold shutdown equipment repair should be demonstrated to be available onsite.
5. The cold shutdown equipment repair procedures should be clearly achievable within the 72-hour limitation of Section F.1 above.

END

