NRC INSPECTION MANUAL

TEMPORARY INSTRUCTION 2515/158

FUNCTIONAL REVIEW OF LOW MARGIN/RISK SIGNIFICANT COMPONENTS AND HUMAN ACTIONS

CORNERSTONES: INITIATING EVENTS, MITIGATING SYSTEMS, AND BARRIER INTEGRITY

APPLICABILITY: Each Regional Office will identify one candidate site for this TI. The candidate site should be selected based on a consideration of the following factors:

- Recent adverse performance trend as indicated by inspection findings, cross-cutting issues, or performance indicators. However, the site selected preferably should not have been subject to significant inspection activities in the engineering and design area within the last year. For the purposes of this TI, examples of significant inspection activities include IP 95003 and oversight under Inspection Manual Chapter 0350.

- Site attributes such as design and licensing basis consistency with established NRC regulatory positions, quality and scope of design basis information, unique plant safety features, and recent licensing basis changes that could reduce safety analysis margins (e.g. power uprates) should also be considered when selecting a site for this TI.

2515/158-01 OBJECTIVE

The objective of this TI is to perform four, focused engineering inspections at candidate power reactor sites. At each of the four reactor sites, inspectors will utilize this TI to assess the adequacy of the facility's design and the design implementation for selected risk-significant components and operator actions. The results of these four pilot inspections will be assessed to decide whether changes should be made to the Reactor Oversight Process to improve the effectiveness of NRC inspections in the design/engineering area.

2515/158-02 BACKGROUND

Recent staff reviews of Reactor Oversight Process data indicate that inspections conducted using inspection procedure 71111.21, "Safety System Design and Performance Capability," can be enhanced to better identify and assess risk significant issues. In some instances, the inspections had identified numerous design/engineering issues, but the issues were classified as either minor or of very low safety significance by the Significance Determination Process (SDP), and, as a result, detailed extent of condition reviews of the identified issues were not conducted by the licensee or the NRC, consistent with the ROP. In order to improve the effectiveness of NRC design/engineering inspections, this TI will focus on risk significant, low margin components and human actions. The results of these pilot inspections will be reviewed collectively to assess whether permanent changes are warranted to the ROP inspection and assessment processes.

The inspection method used for this TI differs from the current safety system design and performance capability inspection module in the following areas:

- Inspection activities will not be limited to one or two systems, but instead, will be focused on risk-significant, low margin components and operator actions.
- Significant effort will be spent assessing relevant industry operating experience associated with the samples selected for inspection.
- The inspection sample will not be limited to mitigating system components and may include components that could be contributors to initiating events.
- If performance deficiencies are identified, extent-of-condition reviews will be performed of identified issues.
- A more detailed inspection report will be written that will include an integrated assessment of performance weaknesses.
- Overall, the inspection is more resource intensive and will require about 700 hours of direct inspection.

These changes are intended to focus inspection efforts on design and engineering areas which are likely to have high safety significance and that are potentially most susceptible to design errors.

Further background information on this TI can be found in SECY-04-0071, dated April 29, 2004 (ML040970328).

2515/158-03 INSPECTION REQUIREMENTS

03.01 Inspection Schedule. The TI will be performed with a dedicated inspection team over the course of five weeks. The inspection schedule will normally include one week of in-office preparation, one week of on-site preparation, two weeks of on-site inspection, and one week of in-office inspection. The inspection time line is expected to include the following:

Pre-Inspection Site Visit	Team leader and Senior Reactor Analyst meet with licensee to identify risk significant components and operator actions. The pre-inspection site visit should be conducted at least two weeks before the first on-site week.
Week 1	In-office week to allow team preparation. Licensee should compile documentation requested during pre-inspection site visit.
Week 2	On-site preparation/inspection week with entire team to identify low margin areas for additional inspection focus.
Week 3	On-site detailed design engineering review of high safety significant, low margin areas. Inspection activities also include operations, maintenance, testing, and material condition reviews. Depending on location and accessibility of site design basis information, portions of this review may be conducted at the licensee's corporate engineering offices.
Week 4	In-office preparation/inspection activities.
Week 5	On-site inspection follow-up (including extent-of-condition reviews) for identified issues.
Week 6	Documentation of inspection results. To be done in accordance with Appendix E.
Exit Meeting	To be scheduled following completion of on-site activities to allow sufficient time to evaluate inspection findings.

03.02 Team Staffing And Administration. The design review portion of the inspection should be performed by inspectors with extensive nuclear plant design experience, preferably comparable to the experience gained through previous employment with an architect engineering firm. It is important also that the inspectors performing the design review have a good understanding of integrated plant operations, maintenance, testing, and quality assurance so that they are able to relate their findings to the other functional areas being inspected. Therefore, the inspection team will generally consist of a team leader, two or three contractors with expertise in power plant design, and a combination of two or three Regional and NRR inspectors. Consideration should be given to appointing one of the NRC inspectors as an assistant team leader and including a dedicated technical assistant (NRC intern) on the team. Because the team will conduct a multi-disciplinary engineering review, team members should be selected with expertise in mechanical and electrical design, operations, and maintenance. Additional regional inspectors may also be assigned to the team during the pilots for training and developmental purposes.

The team leader will develop and distribute to the team a detailed inspection plan which should contain team member assignments, additional technical guidance, and logistical information. The team leader will complete the pre-inspection checklist (Attachment A) prior to the team's first full week on site.

The effectiveness of this TI will be greatly enhanced if the various inspection team members are able to benefit from each other's inspection efforts. Accordingly, daily team meetings allow the team members to share their findings. Experience indicates that significant findings originate from team meeting discussions that allow related inspection findings in different functional areas to be pieced together. Through the synergism of team meetings, seemingly unrelated observations in one functional area may lead key inspectors responsible for other functional areas to examine specific issues leading to a broader understanding of problem areas.

03.03 Sample Selection TI sample selection will be based on a risk-informed approach to identify the most risk significant components and operator actions at the facility. As a minimum, the team leader and a Senior Reactor Analyst (SRA) should visit the selected site during the preparation phase to facilitate sample selection. The goal of this meeting is to identify an initial inspection sample that will be subject to an available margin review during the first on-site inspection week. Inspection samples should be identified at the major component (e.g. pump, motor operated valve, etc.) or procedural step level to assist in inspection planning. Included within the sample selected should be passive components such as sump screens, strainers, piping, cables, etc., whose failure could impact system functionality. To the extent practical, the sample should include a diverse range of equipment and human actions.

The team leader and the SRA should develop an approach for identifying the most critical components and operator actions at the selected facility. Although the methods used to identify the most risk-significant components and operator actions will be dependent on the type and quality of the licensee's risk assessment tools, the following criteria should be considered:

- Risk Reduction Worth (RRW): The RRW is the factor by which the plant's core damage frequency decreases if the component or operator action is assumed to be successful. Components or operator actions with a RRW value of 1.005 or greater should be considered for inclusion in the inspection sample. A lower threshold may be used if desired.

- Risk Achievement Worth (RAW): The RAW is the factor by which the plant's core damage frequency increases if the component or operator action of interest is assumed to fail. Components and actions with a RAW value of 2 or greater should be considered for inclusion within the inspection sample. A lower threshold may be used if desired.

- Subjective risk rankings based on engineering or expert panel judgement such as those performed to identify risk significant structures, systems, and components for the licensee's Maintenance Rule program. These subjective risk rankings typically are performed to establish the risk significance of equipment that may not be fully modeled in the licensee's probabilistic risk assessment.

- Other risk criteria established by the team leader and SRA (e.g. operating experience, engineering judgment, etc.). Consideration should be given to inclusion of risk-significant initiating events and plant structures within the initial sample selection population.

The goal of this initial component and operator action effort is to identify approximately ten risk significant operator actions and fifty risk-significant components that will then be screened to identify low margin areas. Attachment B, "Inspection Sample Selection Flowchart," provides a flowchart for the sample selection process.

In coordination with the NRR Inspection Program Branch staff, select a sampling of approximately five operating experience items (such as NRC generic communications, licensee event reports, or violations) related to risk-significant initiating events.

03.04 Identification of Low Margin Areas. The team will spend the first week onsite reviewing the identified risk-significant component and operator action samples to identify low margin areas. Margin is typically defined as the difference between the actual (or predicted) and required performance of a system, component, operator action. Low margin can be a function of the original design, caused by design modifications, or can be due to degraded material conditions. In identifying specific inspection areas for the margin review, the team should broadly assess component and operator attributes necessary to meet the probabilistic risk assessment functional success criteria. For example, if the sample selection review identifies a specific pump failure to start or run as risk-significant, margin review activities should consider all conditions that could reasonably cause loss of pump flow (e.g. clogged suction strainer, loss of motive power, inadequate net positive suction head, valve misalignment or failure, etc.). The following activities should be performed to identify low margin areas:

- Design and engineering specialists should review detailed calculations associated with the identified risk-significant components to identify areas of low margin. In this case, the inspector should identify calculations showing little margin between predicted results and calculation and/or regulatory acceptance criteria.

- Operations and maintenance inspectors should perform facility walkdowns and maintenance history review to assess the material condition of risk-significant components. Additionally, operator workarounds and maintenance rule data should be reviewed to identify degraded conditions.

- Corrective action program review. Operations and maintenance inspectors should perform a review of corrective action program documents associated with the selected components and human actions.

- Operations inspectors should review procedures and operator task analysis validation studies to identify critical operator actions with little margin between the time required and the time available to complete an action.

The margin review should include evaluation of the impact of recent plant modifications or licensing basis changes on available margin. In particular, licensing changes that can reduce safety analysis margins, such as extended power uprates, should be considered.

The margin review should be used to reduce the initial risk-significant sample population down to approximately twenty components and five operator actions.

In coordination with the NRR Inspection Program Branch staff, select a sampling of approximately fifteen operating experience items (such as NRC generic communications, licensee event reports, or violations) related to the risk-significant, low margin components and operator actions selected for the plant site.

03.05 Detailed Component And Operator Action Engineering Review Requirements. For those components and operator actions identified as being risk significant with low available margin, the team should review the following attributes for each inspection sample:

a. Detailed Design Review

The purpose of the design inspection is to verify that the system(s) will function as required. In the process of reviewing the design, inspectors should verify the appropriateness of design assumptions, boundary conditions, and models. Independent calculations by the inspectors may be required to verify appropriateness of the licensee's analysis methods. The interfaces between safety related and non-safety related systems should also be reviewed.

In reviewing the functional adequacy of the selected system(s), the inspectors should determine whether the design basis is met by the installed and tested configuration. The inspectors should understand not only the original purpose of the design but the manner and conditions under which the system will actually be required to function during transients and accidents. For example, if UFSAR information was used as inputs for design or procedures, these inputs should be verified to be consistent with the design bases.

Attachment C, "Design Review Inspection Attributes," and Attachment D, "Design Review Questions," provide general guidelines for performance of the detailed design review of risk-significant low margin components and operator actions.

b. Procedures and Operations Review

Walk-through the system operating procedures and the system P&IDs with the operators. Verify that the procedures can be performed using the main control panel and the alternate shutdown panel and that components and equipment are accessible for normal and emergency operation. If any special equipment is required to perform these procedures, determine if the equipment is available and in good working order. Verify that the knowledge level of the operators is adequate concerning equipment location and operation.

c. Material Condition and Equipment Reliability Review

1. Review any outstanding maintenance work requests on the component and any deficiencies that could affect the ability of the component to perform its function(s).

2. Review any outstanding design issues, including temporary modifications, operator workarounds, and items that are tracked by the operations or engineering departments.

3. Perform a walkdown inspection of the component. Identify any discrepancies between the existing alignment of the system equipment and the correct alignment. Inspect for visible signs of deficient conditions such as corrosion, missing fasteners, cracks, degraded insulation, etc.. Use the following examples to identify items to review during the walkdown.

   (a). Valves are correctly positioned and do not exhibit leakage that would impact the function(s) of any given valve.

   (b). Electrical power is available as required.

   (c). Major system components are correctly labeled, lubricated, cooled, ventilated, etc.

   (d). Hangers and supports are correctly installed and functional.

   (e). Essential support systems are operational.

   (f). Ancillary equipment or debris does not interfere with system performance.

   (g). Valves are locked as required by the licensee's locked valve program.

4. Technical Evaluations/Corrective Action Program Review

   For each low margin, risk-significant component within the sample selection, the inspectors should review all associated corrective action documents generated within the last four years. Review the adequacy of any licensee technical evaluation (corrective action program evaluations, engineering evaluations, operability determinations etc..) associated with the component, and verify if operability is justified. Verify that the licensee considered other degraded conditions and their impact on compensatory measures for the condition being evaluated. Verify that the licensee performed sufficient evaluation to identify and correct the cause(s) of the identified equipment problem. Refer to the FSAR and other design basis documents during the review.

   If operability is justified, no further review is required. If the operability evaluation involves compensatory measures, determine if the measures are in place, will work as intended, and are appropriately controlled. If operability is not justified determine impact on any Technical Specification LCOs. Refer to NRC Generic Letter 91-18, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions," Revision 1, October 8, 1997, for additional information.

5. Maintenance Effectiveness Review

(a). Review the component history files for the selected components for the past four years; however, a longer interval may be necessary. While reviewing the maintenance history, look for recurring equipment problems and attempt to determine if any trends exist.

(b). Review maintenance procedures for technical adequacy. Determine if the component is being adequately maintained to ensure its operability under all accident conditions.

(c). Review applicable vendor manuals, generic communications (i.e., Bulletins, Information Notices, Generic Letters, and special studies) and verify that the licensee has integrated and implemented the applicable items into the maintenance program.

d. Review of Operator Actions

For each risk-significant, low margin operator action selected for detailed review, the inspectors should consider the following:

- the specific operator actions required;
- the potentially harsh or inhospitable environmental conditions expected;
- a general discussion of the ingress/egress paths taken by the operators to accomplish functions;
- the procedural guidance for required actions;
- the specific operator training necessary to carry out actions, including any operator qualifications required to carry out actions;
- any additional support personnel and/or equipment required by the operator to carry out actions;
- a description of information required by the control room staff to determine whether such operator action is required, including qualified instrumentation used to diagnose the situation and to verify that the required action has successfully been taken;
- the ability to recover from credible errors in performance of manual actions, and the expected time required to make such a recovery;
- consideration of the risk significance of the proposed operator actions; and
- the time available to complete an action based on safety analyses and the methods used by the license to verify and validate that the required actions can be completed within the available time. This review area should include

a field walkdown to validate the licensee's timing assumptions. Particular attention should be given to actions that must be accomplished outside the control by auxiliary equipment operators.

03.06 Surveillance Testing, Modifications, And Operating Experience Review. The inspection team shall also perform a sampling review of surveillance tests, permanent plant modifications, and operating experience. Selected samples should be closely associated with the inspection sample selected for the detailed design review to effectively utilize team knowledge derived from performance of the detailed design review.

a. Surveillance Testing Review

Review four Technical Specification surveillance requirements associated with risk-significant, low-margin components within the scope of this inspection. Preferably, the surveillance requirement samples should be selected that test the maximum number of risk-significant components. The focus of this review should be on the adequacy of the testing to demonstrate system operability, as opposed to the adequacy of the programmatic aspects of the testing.

1. Verify by witnessing surveillance tests and/or reviewing the test data, that SSCs selected meet the Technical Specifications, Updated Final Safety Analysis Report (UFSAR), and licensee procedure requirements, and demonstrate that the SSCs are capable of performing their intended safety functions (under conditions as close as practical to accident conditions or as required by Technical Specifications) and their operational readiness.

2. Significant surveillance test attributes for consideration include the following:

(a). Preconditioning.

(b). Effect of testing on the plant has been adequately addressed by control room and/or engineering personnel.

(c). Acceptance criteria is clear and demonstrates operational readiness and is consistent with the supporting design calculations and other licensing documents.

(d). Test equipment range and accuracy are consistent with the application and has current calibration. Verify the plant equipment calibration is correct, accurate, properly documented and the calibration frequency is in accordance with TS, UFSAR, licensee procedures and commitments.

(e). Test is performed in sequence and in accordance with written procedure.

(f). Jumpers installed or leads lifted during testing are properly controlled.

(g). Test data is complete, verified and meets procedure requirements.

(h). Test frequency was adequate to demonstrate operability (meets Technical Specification requirements), and reliability.

(i). Test equipment is removed after testing.

(j). After completion of testing, equipment is returned to the positions/status required for the SSCs to perform its safety function.

(k). For IST activities, testing methods, acceptance criteria, and required corrective actions are in accordance with the applicable version of the ASME Code, Section XI. Review reference values or changes to reference values for consistency with the design bases.

(l). Unavailability of the tested equipment is appropriately considered in the licensee's performance indicator data.

(m). For test results that do not meet the acceptance criteria, results of engineering evaluations, root cause analyses, and bases for returning to operable status are acceptable.

(n). For selected safety related instrumentation and control surveillance tests (i.e. RPS, NIs, etc.) verify that reference setting data has been accurately incorporated into the test procedure.

b. Permanent Plant Modification Review

Review at least two permanent plant modifications associated with risk-significant, low margin components within the scope of this inspection.

1. Design Review

(a). Review the design adequacy of the modification by performing the activities identified in Attachment C, "Design Review Inspection Attributes," and Attachment D, "Design Review Questions."

(b). Verify that the licensee has considered the conditions under which the licensee may make changes to the facility or procedures or conduct tests or experiments without prior NRC approval. Verify that the licensee has appropriately concluded that the change, test or experiment can be accomplished without obtaining a license amendment. For the changes, tests, or experiments that the licensee determined that evaluations were not required, verify that the licensee's conclusions were correct and consistent with 10 CFR 50.59.

2. Implementation Review

Verify that modification preparation, staging, and implementation does not impair the following:

- In-plant emergency/abnormal operating procedure actions

- Key safety functions

- Operator response to loss of key safety functions

3. Testing Review.

   Verify that post-modification testing will establish operability by:

   - Verifying that unintended system interactions will not occur.

   - Verifying SSC performance characteristics, which could have been affected by the modification, meet the design bases.

   - Validating the appropriateness of modification design assumptions.

   - Demonstrating that the modification test acceptance criteria have been met.

c. Operating Experience Review

   For the operating experience items selected for review, the team should assess how the licensee evaluated and dispositioned each item. Focus should be on ensuring that the conditions discussed in the operating experience are either not applicable, or have been adequately addressed by the licensee to ensure operability of the component. To the extent practical, the inspectors should acquire objective evidence that the operating experience item has been resolved, beyond a written licensee evaluation. For example, if the operating experience item required a procedure change, the inspector should verify the procedure was changed. If the operating experience required modification of a component, the inspector should verify the modification was completed.

03.07 <u>Extent-of-condition Review</u>. The inspectors should perform an extent of condition review on any findings identified during this inspection that resulted in inoperable equipment or safety systems. The extent of condition review should be focused on other like risk significant components or systems and should be detailed enough to frame the overall safety significance of the problem. The objective of this review is to permit better characterization of identified findings and support an integrated assessment of performance weaknesses. If sufficient time is not available to complete this review during this inspection, the licensee may be asked to perform the review, or additional inspection follow-up should be conducted.

2515/158-04 GUIDANCE

Not Used

2515/158-05 REPORTING REQUIREMENTS

The results of this TI shall be documented in accordance with the requirements of Inspection Manual Chapter 0612, “Power Reactor Inspection Reports.” However, the report outline should follow the format prescribed in Attachment E, “Sample Report Outline.”

2515/158-06 COMPLETION SCHEDULE

The inspection requirements of this TI are to be completed by January 31, 2005.

2515/158-07 EXPIRATION

This temporary instruction will remain in effect until March 1, 2005.

2515/158-08 CONTACT

Please address general questions regarding this temporary instruction to J. Jacobson at (301) 415-2977.

2515/158-09 STATISTICAL DATA REPORTING

All direct inspection effort expended in connection with this TI is to be charged to TI 2515/158, “Functional Review of Low Margin/Risk Significant Components And Human Actions.”

For the purposes of tracking the completion of the baseline inspection program, the direct inspection hours for this TI may be credited with performance of the following baseline inspection modules (to the extent that the TI inspection requirements were completed):

71111.02 Evaluation of Changes, Tests, or Experiments
Credit for completion of 71111.02 biennial inspection requirements may be assigned for each 10 CFR 50.59 licensee evaluation and changes, tests, or experiments screening reviewed during performance of this TI.

71111.15 Operability Evaluations
Credit each evaluation reviewed during the Section 03.04 component design review with four hours per review

71111.17 Permanent Plant Modifications (Biennial Review Only)
2 inspection samples/15 hours

71111.22 Surveillance Testing
4 inspection samples/24 hours

71111.21 Safety System Design and Performance Capability Inspection Complete

2515/158-10 ORIGINATING ORGANIZATION INFORMATION

10.01 Organizational Responsibility. This TI was initiated by NRR/DIPM/IIPB.

10.02 Resource Estimate. The direct inspection effort to be expended in connection with this TI is estimated to be 700 hours based on three weeks of inspection with a team of six inspectors.

10.03 Training. No special training is planned for the conduct of this temporary instruction.

REFERENCES

1. IP 71111.04, “Equipment Alignment,” January 17, 2002
2. IP 71111.15, “Operability Evaluations,” January 17, 2002
3. IP 71111.17, “Permanent Plant Modifications,” January 17, 2002
4. IP 71111.21, “Safety System Design and Performance Capability,” July 10, 2003
5. IP 71111.22, “Surveillance Testing,” January 17, 2002
6. IP 71152, “Identification and Resolution of Problems,” September 8, 2003
7. IP 93801, “Safety System Functional Inspection (SSFI),” July 15, 1996
8. Information Notice 97-078, “Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times,” October 23, 1997

ATTACHMENTS

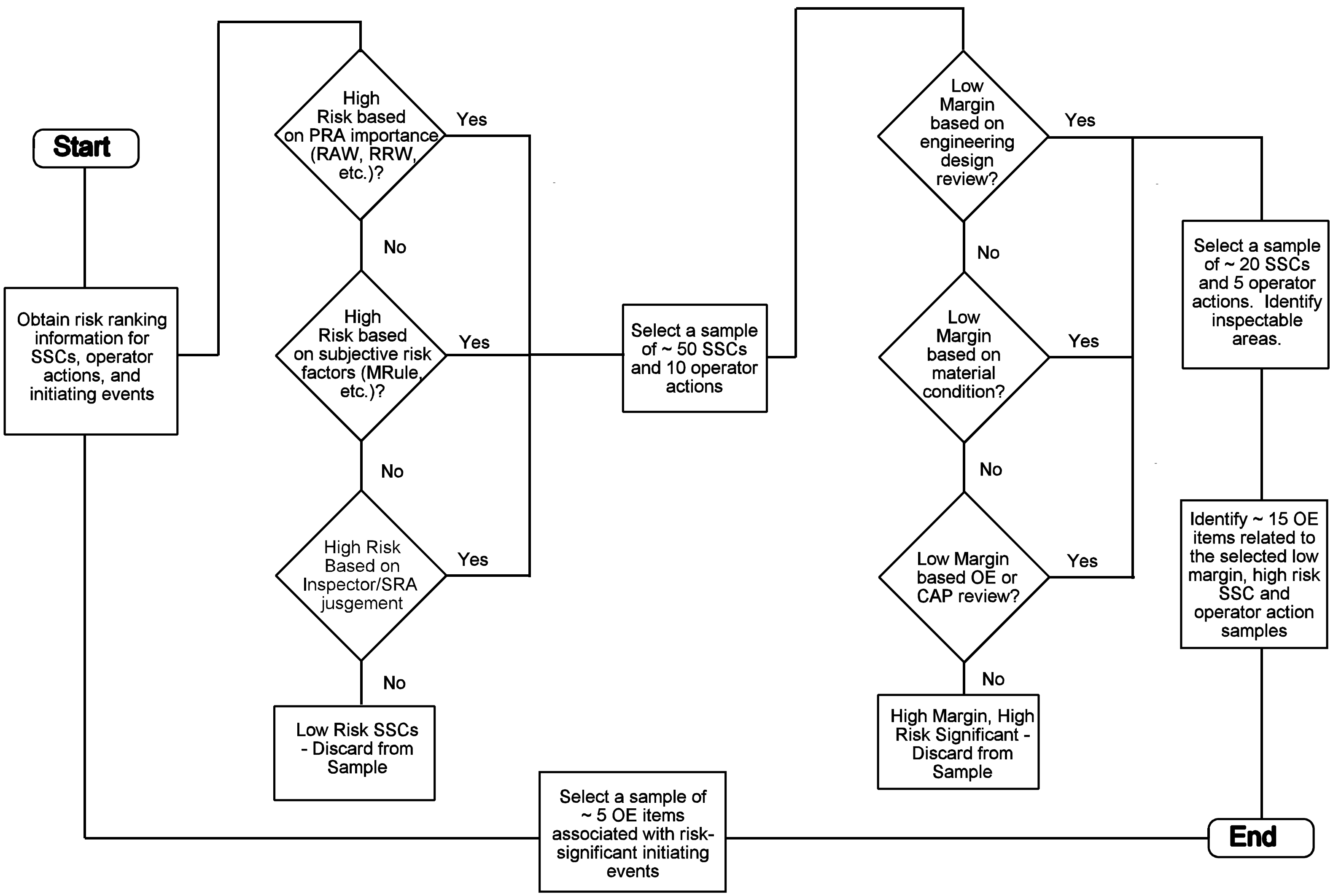
ATTACHMENT A - PRE-INSPECTION CHECKLIST
ATTACHMENT B - INSPECTION SAMPLE SELECTION FLOWCHART
ATTACHMENT C - DESIGN REVIEW INSPECTION ATTRIBUTES
ATTACHMENT D - DESIGN REVIEW QUESTIONS
ATTACHMENT E - INSPECTION REPORT OUTLINE

END

ATTACHMENT - A
PRE-INSPECTION CHECKLIST

Pre-Inspection Checklist		
Item	Scheduled	Completed
Site Selected T-60		
Site Notified T-45		
Inspection Dates Finalized T-38		
Contractors Locked In T-30		
Team Members Finalized T-30		
Team Leader Visit Scheduled T-30		
Team Leader Pre-Inspection Visit T-21		
Team Space Allocated T-14		
Inspection Finding Tracking Methods Agreed Upon With Licensee T-14		
Hotel Accommodations Made T-14		
Inspection Plan Issued T-14		
Risk Significant Samples Identified T-14		
Full Team Preparation In Office T-7		
Entrance Meeting T=0		
Low Margin Samples Identified T+4		

T=0 is the first on-site day for the whole team.



ATTACHMENT B
INSPECTION SAMPLE SELECTION FLOWCHART

ATTACHMENT C

DESIGN REVIEW INSPECTION ATTRIBUTES

The table below, “System Needs,” is a listing of attributes that are needed for a system to perform its required function. During inspection preparation, identify which attributes are to be inspected. Perform the inspection activities associated with the selected attributes.

System Needs	
Attributes	**Inspection Activity**
Process Medium • water • air • electrical signal	Verify that process medium will be available and unimpeded during accident/event conditions. • Example: For an auxiliary feedwater system, verify that the alternate water source will be available under accident conditions.
Energy Source • electricity • steam • fuel + air • air	Verify energy sources, including those used for control functions, will be available and adequate during accident/event conditions • Example: For a diesel driven auxiliary feedwater pump, verify that diesel fuel is sufficient for the duration of the accident. • Example: For an air-operated pressurizer PORV, verify that either sufficient reservoir air will exist or instrument air will be available to support feed and bleed operation. • Example: For a standby DC battery, verify adequacy of battery capacity.
Controls • initiation actions • control actions • shutdown actions	Verify control system will be functional and provide desired control during accident/event conditions. • Example: For refueling water storage tank level instrumentation providing signal for suction swap-over to containment sump, verify that the setpoint established to ensure sufficient water inventory and prevent loss of required net positive suction head is acceptable.
Operator Actions • initiation • monitoring • control • shutdown	Verify operating procedures (normal, abnormal, or emergency) are consistent with operator actions for accident/event conditions. • Example: If accident analyses assume containment fan coolers are running in slow speed, verify that procedures include checking of this requirement. • Example: If accident analyses assume that containment spray will be manually initiated within a certain time, verify that procedures ensure manual initiation within assumed time and that testing performed to validate the procedures was consistent with design basis assumptions. Verify instrumentation and alarms are available to operators for making necessary decisions. • Example: For swap-over from injection to recirculation, verify that alarms and level instrumentation provide operators with sufficient information to perform the task.
Heat Removal • cooling water • ventilation	Verify that heat will be adequately removed from system • Example: For an emergency diesel generator, verify heat removal through service water will be sufficient for extended operation.

Verify that the system condition and tested capability is consistent with the design bases and is appropriate. The table below, “System Condition and Capability,” is a listing of applicable attributes that could be inspected. Perform the inspection activities associated with the selected attributes.

System Condition and Capability	
Attributes	**Inspection Activity**
Installed Configuration • elevations • flowpath components	Verify, by walkdown or other means, that system installed configuration will support system function under accident/event conditions • Example: Verify level or pressure instrumentation installation is consistent with instrument setpoint calculations. Verify that component configurations have been maintained to be consistent with design assumptions.
Operation	Verify that operation and system alignments are consistent with design and licensing basis assumptions • Example: For a containment spray system, verify emergency operating procedure changes have not impacted design assumptions and requirements. • Example: For a service water system, verify flow balancing will ensure adequate heat transfer to support accident mitigation.
Design • calculations • procedures	Verify that design bases and design assumptions have been appropriately translated into design calculations and procedures.
Testing • flowrate • pressure • temperature • voltage • current	Verify that acceptance criteria for tested parameters are supported by calculations or other engineering documents to ensure that design and licensing bases are met. • Example: Verify that flowrate acceptance criteria is correlated to the flowrate required under accident conditions with associated head losses, taking setpoint tolerances and instrument inaccuracies into account. Verify that individual tests and/or analyses validate integrated system operation under accident/event conditions. • Example: Verify that EDG sequencer testing properly simulates accident conditions and the equipment response is in accordance with design requirements.
Component Degradation	Verify that potential degradation is monitored or prevented. • Example: For ice condensers, verify that inspection activities ensure air channels have been maintained consistent with design assumptions. Verify that component replacement is consistent with inservice/equipment qualification life. Verify that the numbers of cycles are appropriately tracked for operating cycle sensitive components.

System Condition and Capability	
Attributes	**Inspection Activity**
Materials and Equipment/ Environmental Qualification • Temperature • Humidity • Radiation • Pressure • Voltage • Vibration • Seismic	Verify that equipment qualification is suitable for the environment expected under all conditions. Verify materials/components are compatible with physical interfaces. Verify material component properties serve functional requirements under accident/event conditions. Verify Code and safety classification of SSCs is consistent with design bases. Verify replacement schedule consistent with inservice/equipment qualification life. • Example: Verify equipment is qualified for room temperatures under accident conditions.
Equipment Protection • fire • flood • missile • high energy line break • HVAC • freezing	Verify equipment is adequately protected. • Example: Verify freeze protection adequate for CST level instrumentation. • Example: Verify that conditions and modifications identified by the licensee's high energy line break analysis have been implemented.
Component Inputs/Outputs	Verify that component inputs and outputs are suitable for application and will be acceptable under accident/event conditions. • Example: Verify that valve fails in the safe configuration. • Example: Verify that required inputs to components, such as coolant flow, electrical voltage, and control air necessary for proper component operation are provided.
Operating Experience	Verify that applicable insights from operating experience have been applied to the selected components. • Example: Verify that component functioned appropriately when challenged during transients.

ATTACHMENT D
DESIGN REVIEW QUESTIONS

During the design review, inspectors should consider the following questions:

Valves

1. Are the permissive interlocks appropriate?

2. Will the valve function at the pressures that will exist during transient/accident conditions?

3. Will the control and indication power supply be adequate for system function?

4. Is the control logic consistent with the system functional requirements?

6. What manual actions are required to back up and/or correct a degraded function?

Pumps

7. Is the pump capable of supplying required flow at required pressures under transient/accident conditions?

8. Is adequate net positive suction head (NPSH) available under all operating conditions?

9. Is the permissive interlock and control logic appropriate for the system function?

10. Is the pump control adequately designed for automatic operation?

11. When manual control is required, do the operating procedures appropriately describe necessary operator actions?

12. What manual actions are required to back up and/or correct a degraded function?

13. Has the motive power required for the pump during transient/accident conditions been correctly estimated and included in the normal and emergency power supplies?

14. Do vendor data and specifications support sustained operations at low flow rates?

15. Is the design and quality of bearing and seal cooling systems acceptable?

Instrumentation

16. Are the required plant parameters used as inputs to the initiation and control system?

17. If operator intervention is required in certain scenarios, have appropriate alarms and indications been provided?

18. Are the range, accuracy, and setpoint of instrumentation adequate?

19. Are the specified surveillance and calibrations of such instrumentation acceptable?

Circuit Breakers and Fuses

20. Is the breaker control logic adequate to fulfill the functional requirements?

21. Is the short circuit rating in accordance with the short circuit duty?

22. Are the breakers and fuses properly rated for the load current capability?

23. Are breakers and fuses properly rated for DC operation?

Cables

24. Are cables rated to handle full load at the environments temperature expected?

25. Are cables properly rated for short circuit capability?

26. Are cables properly rated for voltage requirements for the loads?

Electrical Loads

27. Have electrical loads been analyzed to function properly under the expected lowest and highest voltage conditions?

28. Have loads been analyzed for their inrush and full load currents?

29. Have loads been analyzed for their electrical protection requirements?

As-built System

30. Are service water flow capacities sufficient with the minimum number of pumps available under accident conditions?

31. Have modified equipment components falling under the scope of 10 CFR 50.49 been thoroughly evaluated for environmental equipment qualifications considerations such as temperature, radiation, and humidity?

32. Are the modifications to the system consistent with the original design and licensing bases?

ATTACHMENT E
INSPECTION REPORT OUTLINE

The documentation requirements for this TI exceed the standard for routine inspection activities. Although inspection findings shall be documented in accordance with Inspection Manual Chapter 0612, “Power Reactor Inspection Reports,” additional information, as described below, should also be provided in the TI report documentation. This additional information will assist the staff in evaluating the effectiveness of design inspection activities.

Cover Letter

- In addition to the format specific in IMC 0612, the cover letter may include discussion of the integrated assessment of inspection issues identified during the inspection.

Cover Page

Summary of Findings

- In addition to a summary of each finding identified during the inspection, an integrated assessment should be provided to highlight potential programmatic issues that may have contributed to the inspection findings. The integrated assessment should be performed following completion of the onsite inspection. The intent of this assessment is to identify common themes among the identified findings rather than performance of a programmatic review of the licensee’s design/engineering programs.

Table of Contents (optional)

Report Details:

4. OTHER ACTIVITIES [OA]

4OA5 Other Activities

.1 Inspection Sample Selection

[Describe the methodology used to identify risk-significant, low margin, inspection samples]

.2 Component and Operator Action Design Review

[For each risk-significant, low margin component or operator action within the inspection scope, provide documentation for each attribute reviewed.]

.2.1 EXAMPLE-123, "Example Component"

[Identify the component function and basis for selection]

.2.1.1 Detailed Design Review

[Each report section should be documented in a format similar to the format shown for this section]

a. Inspection Scope

[Describe the scope of the design review, including the design attributes that were verified]

b. Findings

[Describe the results of the inspection activities. The level of detail provided in this section exceeds the normal documentation requirements of IMC 0612. The inspector should document the results of all review activities and include discussion of all identified issues (including minor violations or performance issues)]

.2.1.2 Procedures and Operation Review

.2.1.3 Material Condition and Equipment Reliability Review

.2.1.4 Review of Operator Actions

.....

.2.1.5 Example Operator Action

.....

.3 Surveillance Testing, Modifications, and Operating Experience Review

[Describe each surveillance test, permanent plant modification, and operating experience item reviewed in the following sections.]

.3.1 Surveillance Testing Review

a. Inspection Scope

b. Findings

.3.2 Permanent Plant Modification Review

.3.3 Operating Experience Review

.4 Extent-of-Condition Review

a. Inspection Scope

b. Findings

4OA6 Meetings

END