ATTACHMENT 71111.21

INSPECTABLE AREA: Component Design Bases Inspection

INSPECTION BASES: This inspection of component design bases verifies that plant components are maintained within their design basis. Additionally, this inspection provides monitoring of the capability of the selected components and operator actions to perform their design bases functions. As plants age, modifications may alter or disable important design features making the design bases difficult to determine or obsolete. The plant risk assessment model assumes the capability of safety systems and components to perform their intended safety function successfully. This inspectable area verifies aspects of the Initiating Events, Mitigating Systems and Barrier Integrity cornerstones for which there are no indicators to measure performance.

LEVEL OF EFFORT: Review 15-25 risk significant samples in the following categories: components and operating experience.

71111.21-01 INSPECTION OBJECTIVE

To gain reasonable assurance that risk significant structures, systems, and components (SSCs) can adequately perform their design basis function. This includes reasonable assurance that the risk significant component can fulfill their design basis function during or after licensee's activities (e.g., maintenance, surveillance) which can affect component's availability, reliability and capability. Additionally, this includes that reasonable assurance that risk significant issues resulting from the generic communications have been adequately addressed.

71111.21-02 INSPECTION REQUIREMENTS AND GUIDANCE

02.01 Sample Selection. Using the guidance provided in paragraphs 02.01.a through 02.01.c, select the required number of components and operating experience for inspection as follows: 11 to 16 components; one to three components associated with containment-related SSCs which are considered for LERF implications (see Table 4.1 of IMC 0609 Appendix H for selection); and three to six components associated with issues identified through one of the operating experience feedback process identified in paragraph 02.02.d. Licensees typically maintain a list of most risk significant systems from which most of the core damage frequency is attributed. Additionally, the inspection team should solicit input from the resident inspectors for possible components for inspection.

Component selection can be performed through the following approaches:

- System Approach: Select components in the most risk significant systems for inspection. Risk-significant components in most risk significant systems are considered for inspection in the system approach. See paragraph 02.01.a for more guidance on using the system based approach.

- Risk-Significance/Low Margin Approach: Select components which are risk-significant. Use of low margin, (either design, maintenance or operating margins), for selection as a component for inspection is optional. See paragraph 02.01.b for more guidance on using risk and low margin approach.

- Event Scenario-Based Approach: See paragraph 02.01.c for more guidance on using the event scenario-based approach.

The team leader shall obtain from senior reactor analyst (SRA) in the regional office a list of potential components for inspection. Additionally, the team leader should obtain from the licensee a listing of potential components for inspections, sorted by risk. The team leader should make an initial selection of components for inspection based on component risk, operating experience information and whether the component was inspected during the previous CDBI inspections. The number of components initially selected for inspection should be greater than the number of samples needed to satisfactorily complete the CDBI inspection procedure. This will allow the flexibility of other team members to refine the initial component selection while still satisfying the inspection sample criteria. Component selection can be performed during the bagman trip (pre-inspection site visit) but should be finalized during the end of the in-office preparation week. SRA participation in the bagman trip is highly encouraged to assist the team leader with the sample selection.

a. System Approach. Identify the most risk significant systems and select components in the risk significant systems based on their risk. Factors discussed in paragraphs 02.01.b and 02.01.c.4, as applicable, should be used in developing the selection. Also, consider identified deficiencies in the licensee's corrective action program, corrective maintenance, and operating experience as factors for determining whether a component should be selected. Many facilities maintain a list of most risk significant systems.

b. Risk-Significance/Low Margin Approach. Use the following as a guide when selecting components using risk significant and low margin approach:

   Although the methods used to identify the 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:

   1. 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.

2. 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 1.3 or greater should be considered for inclusion within the inspection sample. A lower threshold may be used if desired.

3. Subjective risk rankings based on engineering or expert panel judgment 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.

4. The use of dominant accident sequences in PRAs to select components may be appropriate for SSCs that are more significant to LERF than CDF; external events (e.g., fire, seismic, flood) than internal events (e.g., LOCAs); or risk during shutdown than during normal operation.

Other risk criteria established by the team leader (e.g., operating experience, engineering judgment, etc.). 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 margin review should evaluate the impact of plant modifications or licensing basis changes on available margin. Consider licensing changes that can reduce safety analysis margins, such as extended power uprates. Contact the NRR licensing project manager to obtain this information.

The following attributes should be considered in evaluating component margin.

Analytical (design) margin is the margin in the design calculations related to the performance of the component. For example, the analytical margin for a pump includes flow and head required for the pump to perform its function compared to the calculated capacity of the equipment. For valves required to change position, valve thrust margin and stroke time margin should be considered. For an emergency diesel generator or battery, the capacity margin should be considered. These design margin values can be extracted from the licensee's design analyses. The margin between the design performance of components and actual performance can be extracted from test results. Evaluate test alignments for components to verify that acceptance criteria are appropriate for accident conditions that may differ from the test condition.

Operations margin refers to components required to be operated during high risk and/or time critical operations. During a station blackout, the plant may take credit for rapid operator actions to manually control equipment. The operation of equipment may be dependent on operator actions within specific time limits. For example, operators may be required to realign the charging pumps within a specific time to prevent a reactor coolant pump seal LOCA in a PWR if cooling water is lost. In these cases, operators would have little time to recover if the component did not respond as expected.

Maintenance margin refers to the physical condition and reliability of the components being reviewed. The plant PRA may not reflect the actual reliability of the installed components. Review of system health reports, condition reports, operating experience, and discussions with plant personnel can identify components with a history of failures. For example, an isolation valve with a history of significant leakage could reduce the margin in a fluid system. Unreliable HVAC components could affect critical equipment in the area. Review maintenance rule history and obtain input from the Resident Inspectors.

Complexity margin is a subjective evaluation of the complexity of the design associated with the component being considered. A more complex design may be more vulnerable to failures, and is more likely to include a design error that could result in a potential common mode failure. For example, an incorrect setpoint in the controls for a component could be applied to both trains of redundant equipment, resulting in both trains being vulnerable to failure.

c. Event Scenario-Based Approach.

1. Review the licensee's most current PRA model, the NRC's SPAR model and the Risk-Informed Site-Specific SDP Notebook select components associated with accident sequences. These accident sequences can be segmented into the following broad categories – the initiating event frequency, and the mitigation equipment/functions, which include operator actions for using or recovering the mitigation equipment. Each of these categories should be inspected.

2. For the initiating event (IE) category review the mechanisms that have caused the IE at this and other facilities. For some IEs there will be a large number of previous events. In that case take a sampling emphasizing the site-specific ones and the most current that would be applicable to the reactor type. Include in the inspection any alarms and indications that could alert operators and take shutdown actions prior to the initiating event happening. Although performance deficiencies of this type may screen out as Green (very low risk significance) under the ROP, identification and rectification of these errors/deficiencies are a benefit to the public and reduce public risk.

3. For the mitigating equipment (ME) category translate the basic events of the dominant cutsets of the PRA model into specific components. Begin with the component importance measure, for example Birnbaum, to gauge its risk worth. This numerical result is the increase in risk for the component being out of service for one year.

4. Consideration should also be given to the following factors:

   (a) What is a reasonable exposure time?

   (b) Is this a standby or normally operating component?

   (c) How well does the normal operating condition mirror the accident conditions

   (d) What level of confidence does the periodic testing give in terms of accident performance?

   (e) The potential failure mechanism involved

   (f) Do Technical Specifications govern how long the component can be out of service

   (g) Is recovery from the component's failure reasonable?

5. Example Scenarios

   (a) Example #1 – A safety related instrument inverter with a Birnbaum value of 2E-4 is normally in service and carries loads equal to or less than those for accident conditions. Recovery from inverter failure is not reasonable. It is routinely monitored by aux operators every 8 hours and its failure is fully known by the operators in the Main Control Room via multiple alarms and equipment failures but, does not cause a reactor trip. Technical Specifications does require plant shutdown within 6 hours upon loss of the inverter. Just using the Birnbaum, this would be a "high" risk component for inclusion in the inspection sample. However, realistically the component can only be out of service less than a day before the plant is shutdown. Now the risk significance is 2E-4 * 1/365 days = 5.5E-7 (Green). Given a reasonable exposure time and that the normal operating conditions are essentially performing a constant test of the inverter; it should be classified as "low" risk.

   (b) Example #2 – A non-Technical Specification Auxiliary Feed Water Pump with a Birnbaum of 2E-4 is maintained by the licensee in a standby condition with no routine monitoring by aux operators. It is energized (bump tested) every quarter and flow tested to a head curve every 18 months. This component clearly should be included in the inspection sample. A simple breaker or discharge valve mis-alignment/failure could realistically have a 90 day exposure time or a risk significance of 2E-4 * 90/365 days = 5E-5 (Yellow). This would be a fail to start in the PRA. A bearing mis-assembly may only show up during a flow test as a fail to run with a risk significance of 2E-4 (Red).

The attributes for emphasis during the component inspection should be biased, depending upon the answers to these questions. Recognize that for standby components the fail-to-run is far more serious than the fail-to-start because recovery from failed-to-run is more difficult to accomplish by the nature of the failure (i.e., correction to a bearing mis-assembly would require component disassembly which would take much longer time than a correction of a simple breaker or valve misalignment). Additionally, fail-to-run has a longer exposure time since it takes longer to reveal itself because surveillances performed to verify ability of SSCs to perform over an extended period is performed less frequently. Therefore, the inspection for the FTR mechanism should take precedence. Also, inspection of the pump's suction valve would take precedence over the discharge valve. A failure of the suction valve, whether through a mechanical or electrical failure or because the valve is mispositioned, may cause un-recoverable pump failure in a matter of minutes whereas failure of the discharge valve may cause pump failure in matter of hours. Once the component is selected, two other facets should be included in the inspection. The first items to inspect are those mechanisms that could result in a common cause failure. The second item to inspect is confirmation that the machinery history/reliability is reasonably consistent with the PRA basic event failure probability.

02.02 Inspection Requirements and Guidance

a. Design Review: Verify that components will function as required and support the proper operation of associated systems. Verify the appropriateness of design assumptions, boundary conditions, and models. Independent calculations by inspectors may be required to verify appropriateness of the licensee's analysis methods.

Determine whether the design basis is met by the installed and tested configuration. Review the original purpose of the design and the manner/conditions under which the system will be required to function during transients and accidents. If UFSAR information was used as inputs for design or procedures, these inputs should be verified to be consistent with the design bases. Review interfaces between safety related and non-safety related components.

Focus on those attributes that are not fully demonstrated by testing, have not received recent in-depth NRC review, or are critical for the component function. Appendix 1, "Component Review Attributes," lists attributes needed for a component to perform its required function and potential inspection activities. The listing should be modified as appropriate based on the selected components. Appendix 2 lists component design review considerations.

1. Review outstanding design issues, including open/deferred or canceled engineering action items, temporary modifications, operator workarounds, and items that are tracked by the operations or engineering departments. For the

preceding three years, identify any instances of when and why these systems were operated out of their normal configuration by interviewing appropriate Operations and Engineering Department personnel.

2. Verify that design bases, licensing bases, and performance capability of components have not been degraded through modifications. Review the design adequacy of the modification by performing the activities identified in Section 02.02.a and IP 71111.17, "Evaluation of Changes, Tests, or Experiments and Permanent Plant Modifications."

3. Verify that the licensee has considered the conditions under which they 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. Refer to IP 71111.17 for more information.

4. Determine whether post-modification testing establishes operability by verifying:

   (a) Unintended system interactions will not occur

   (b) SSC performance characteristics, which could have been affected by the modification, meet the design bases

   (c) Appropriateness of modification design assumptions

   (d) Modification test acceptance criteria have been met.

5. Verify that operator actions can be accomplished as assumed in the licensee's design basis or as assumed in the licensee's PRA analysis. The intent of this inspection requirement is to support verification of engineering inputs and assumptions. Resource permitting, the team may verify other aspects of operating procedures such as whether any special equipment is required to perform these procedures and if the equipment is available and in good working order. Additionally, the team may choose to verify that the knowledge level of the operators is adequate concerning equipment location and operation.

   Some aspect to consider when verifying whether the key operator actions can be performed within the constraints of the design analyses include:

   (a) Specific operator actions required

   (b) Potentially harsh or inhospitable environmental conditions expected

   (c) General discussion of the ingress/egress paths taken by the operators to accomplish functions

(d) Procedural guidance for required actions

(e) Specific operator training necessary to carry out actions, including any operator qualifications required to carry out actions

(f) Any additional support personnel and/or equipment required by the operator to carry out actions

(g) 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

(h) Ability to recover from credible errors in performance of manual actions, and the expected time required to make such a recovery

(i) Consideration of the risk significance of the proposed operator actions

(j) 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 time dependent actions that must be accomplished outside the control room by auxiliary equipment operators

(k) Observe demonstrations or training in the simulator that validate operator actions for a given event or accident condition

b. Review of Maintenance Areas: Obtain a brief description of each of the licensee's corrective maintenance performed on the components selected for inspection. Description of the corrective maintenance work performed should be sufficient to allow understanding of the type of work performed for each of the components in the systems. Additionally, inspectors should try to determine through review of these corrective work maintenance activities whether licensee's preventive maintenance or other programs such as aging management are being reasonably effective in preventing component failures. Discussions with plant engineering or operations department may be necessary to understand the reasons for the corrective maintenance activities.

1. Review outstanding repetitive maintenance work requests and deficiencies that could affect the ability of the components to perform their functions.

2. Ensure that the licensee has procedures for establishing, implementing, and maintaining preventive maintenance (PM) requirements associated with safety related equipment.

3. Ensure that PM activities are performed as scheduled. When not performed as scheduled, ensure that management controls are followed to defer and/or

4. reschedule the PM. Any equipment failure should be evaluated to determine if the PM program could be changed to prevent future failures.

5. Verify that the licensee was in compliance with these procedures for components that have exceeded vendor recommended life times.

6. Use the licensee's list of safety-related components that must meet 10 CFR Part 50, Appendix B requirements to identify safety-related components and sub-components. From this list, conduct an audit to verify comparable components are included in a periodic PM program.

7. Review past equipment failures of the audited components for root causes attributable to components or sub-components being left in a system beyond their intended service life.

8. For those components that are beyond vendor-recommended life, use licensee procedures governing PM practices for safety-related components to verify that the licensee has:

   (a) a PM program that includes these components

   (b) a PM program is adequate and robust and incorporates accepted industry practices (e.g., R.G. 1.33)

   (c) conducted an appropriate assessment for age-related issues for components installed beyond vendor-recommended life through periodic testing or an engineering evaluation that has accounted for environmental effects (elevated temperatures, humidity, harsh environments).

   Some equipment, such as batteries, cables, and other electrical components, have calculations that estimate expected service life. If elevated temperatures and other hazardous conditions, such as submergence, or unusual operational demands (i.e., abnormal or asymmetric loading), have not been properly accounted for, then estimated service life can be reduced and result in situations where the components may fail earlier than predicted.

8. Ensure the selected SSCs that are subject (operating in the post-40-year licensing period) to aging management review pursuant to 10 CFR Part 54 are being managed for aging (e.g., loss of material, cracking, reduction of heat transfer) in accordance with appropriate aging management programs. Indications of aging should be evaluated to determine if changes to the aging management program are required in order to ensure degradation is identified prior to loss of intended function.

9. Perform a walkdown inspection to identify equipment alignment discrepancies. Inspect for deficient conditions such as corrosion, missing fasteners, cracks, and degraded insulation. See Appendix 3. Obtain records of inspection for those

areas which are not normally accessible (e.g., some areas where system piping is routed may not normally be accessible; however, licensee may have performed periodic inspections in the past and have recorded their inspection results. Review photographs or videos which may have been taken during these types of inspections, if available.

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 section 7.3 of Part 9900 Technical Guidance, "Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety (ML073531346)," for additional information. NRC's Regulatory Issue Summary 2005-20. Revision 1 (ML073440103) contains the most recent revision of Part 9900 Technical Guidance on operability determinations.

c. Review of Problem Identification and Resolution Area. Verify that the licensee is identifying engineering design issues and problems and entering them in their corrective action program.

1. Obtain a brief description of all corrective action documents written against the components selected for inspection. Have the licensee sort by system, component, significance (use licensee's significance determination assigned to the corrective action document) and followed by adequate description of the deficiency identified in order to determine whether a copy of the full corrective action document is desired for additional review by the team.

2. Review selected corrective action documents for the last three years, including those resulting from events and degraded/deficient conditions. Review reports of Augmented Inspection Teams or Special Inspections to evaluate adequacy of licensee corrective actions. Review adequacy of licensee technical evaluation (corrective action program evaluations, engineering evaluations, operability determinations). Determine if operability is justified and problems are properly identified and corrected. Verify that the licensee considered other degraded conditions and their impact on compensatory measures for the condition being evaluated.

3. Sample the effectiveness of corrective actions taken by the licensee to issues identified during previous CDBIs

4. Inspection report should list all corrective action reports reviewed. Additionally, the inspection report should contain those corrective action documents which were written to resolve issues identified by the current CDBI inspection team in the section of the inspection report attachment commonly titled "List of Documents Reviewed."

d. Review of Operating Experience Issues. Review operating experience issues related to the selected components as well as generic or common cause issues that are not

related to the components. Some of the operating experience selected should cover initiating events and barrier integrity cornerstones. Assess how the licensee evaluated and dispositioned each item. The focus should be on ensuring that the conditions discussed in the operating experience either are not applicable, or have been adequately addressed by the licensee to ensure operability of the component. To the extent practical, 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, verify that the procedure was changed. If the operating experience required modification of a component, verify that the modification was completed.

Information Notice 2008-02, "Findings Identified During Component Design Bases Inspections," provides findings from previous CDBIs. This is a good source to determine whether licensees are addressing generic issues that may apply to their site. Additional sources for obtaining operating experience information include the following:

1. Historical operating experience associated with CDBI (http://nrr10.nrc.gov/rorp/ip71111-21.html)

2. Any operating experience smart sample associated with the CDBI inspection procedure (http://nrr10.nrc.gov/forum/ic/7111121.html)

Components inspected in previous CDBIs may be re-inspected. This may include attributes not previously inspected, or where attribute conditions change (such as by modifications to hardware or manner of operation, and performance history).

02.03 Inspection Schedule.

a. Preparation for the on-site visit/sample selection week (a.k.a. "bagman trip") should include:

   1. Review the most recent CDBI inspection report

   2. Become familiar with most risk significant event scenarios and components at the plant

   3. Become familiar with the most (top ten) risk significant safety systems at the plant

   4. Become familiar with the plant electrical distribution design

   5. Develop an initial set of components to be considered for inspection from the list obtained from the senior reactor analyst (SRA)

b. Week 1. On-site preparation/sample selection (commonly referred to as the "bagman trip")

1. Unless a suitable alternative is approved by regional management, team leader shall make a site visit/bagman trip. During this trip, the team leader should validate the components initially selected for inspection before the site visit. The team leader should ensure that the components proposed for inspection by the regional SRA are reflective of current plant risk and should be inspected based on discussion with plant personnel, past inspection results and current industry operating experience information. Accompaniment of regional SRA during the on-site preparation week is encouraged to support vetting of components for inspection since this process may involve discussions with plant risk engineering department management and staff.

2. The team leader shall identify and obtain plant procedures, drawings, modification packages, calculations, analysis and other background information associated with components selected for inspection so that the team members can understand the risk significance of the component during the first in-office week.

3. The team leader should depart the site with a greater number of components than the number required to satisfy inspection requirements. This will allow vetting of possible components for inspection by other team members during the first in-office preparation week.

c. Week 2. In-office preparation/finalizing samples for inspection. The inspection team should finalize the components selected for inspection during this time period. Minor adjustments to components selected for inspection during the bagman trip are acceptable. Team leader shall encourage team synergy by maximizing opportunities for team member interactions during the in-office preparation week. With the exception of team travel days (Monday and Friday), the team leader should conduct daily team meetings during the in-office preparation week. Additionally, team leader shall ensure adequate and timely access to information being provided by the licensees is made available to team members, including NRC contractors. This will allow NRC to adequately review licensee design information and develop questions relevant to component design before the first on-site inspection week.

d. Week 3. On-site inspection of selected samples.

e. Week 4. In-office inspection activities. The team leader should maintain contact with team members working in their home offices, by conducting periodic team meetings.

f. Week 5. On-site inspection of selected samples.

g. Week 6. On-site inspection of selected samples (final week of inspection).

h. Week 7. Documentation of inspection results.

Regions may revise the above schedule as long as the below resource estimate and the contractor Statement of Work are not exceeded. The team leader requires additional time to prepare for the inspection and to integrate the report input.

Team leader should request sufficient working spaces to allow for conduct of team meetings and to allow inspectors to conduct interviews with plant personnel without disrupting other inspection team members.

71111.21-03 DOCUMENTATION

Section 02.01, Sample Selection, states that component attributes should not be re-inspected in subsequent CDBIs unless certain conditions apply. CDBI reports should identify component inspection scope in sufficient detail to implement this requirement. This includes (1) component description/number (e.g., Essential 4.16kV Switchgear EH12) and (2) attributes inspected (e.g., maximum available fault current).

71111.21-04 RESOURCE ESTIMATE

The inspection procedure is estimated to take 408 hours NRC effort (plus or minus 15%). This is based on a multi-disciplinary team comprised of team leader and two to three regional inspectors (operations/maintenance and engineering). In addition, the team includes two contractor design specialists in the mechanical and electrical/instrumentation and control disciplines. All CDBIs should be performed on a triennial cycle.

71111.21-05 COMPLETION STATUS

Inspection of the minimum sample size will constitute completion of this procedure in the RPS. The minimum sample size consists of 15 risk significant samples regarding engineering support of systems and components regardless of the number of units at the site.

71111.21-06 REFERENCES

IP 71111.04, “Equipment Alignment”

IP 71111.15, “Operability Evaluations”

IP 71111.17, “Evaluation of Changes, Tests, or Experiments and Permanent Plant Modifications”

IP 71111.22, “Surveillance Testing”

IP 71152, “Identification and Resolution of Problems”

IP 93801, “Safety System Functional Inspection (SSFI)”

Information Notice 97-078, “Crediting of Operator Actions in Place of Automatic Actions and Modifications of Operator Actions, Including Response Times”

Information Notice 2008-02, “Findings Identified During Component Design Bases Inspections”

SECY-04-0071, “Proposed Program to Improve the Effectiveness of the Nuclear Regulatory Commission Inspections of Design Issues,” dated April 29, 2004 (ML040970328)

SECY-05-0118, “Results of the Pilot Program to Improve the Effectiveness of Nuclear Regulatory Commission Inspections of Engineering and Design Issues,” dated July 1, 2005 (ML051390465)

Generic Aging Lessons Learned (GALL) Report, NUREG-1801 Final Report, Revision 2 (ML103490041)

END

Appendix 1, Component Review Attributes

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 pump, verify that the alternate wate source will be available under accident conditions. • Example: For emergency core cooling system piping, verify that the piping is kept free of voids as required by design bases or Technical Specifications.
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 air reservoir 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 component controls 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 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.

Attributes	**Inspection Activity**
Operator Actions • initiation • monitoring • control • shutdown	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 major components • Example: For an emergency diesel generator, verify heat removal through service water will be sufficient for extended operation.
Installed Configuration • elevations • flowpath components	Verify, by walkdown or other means, that components' installed configuration will support its design basis 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 component operation and alignments are consistent with design and licensing basis assumptions • Example: For containment spray system components, verify emergency operating procedure changes have not impacted design assumptions and requirements. • Example: For service water system components, verify flow balancing will ensure adequate heat transfer to support accident mitigation
Design • calculations • procedures • plant modifications	Verify that design bases and design assumptions have been appropriately translated into design calculations and procedures. Also, verify that performance capability of selected components have not been degraded through modifications.

Attributes	**Inspection Activity**
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 criterion 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 component 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. Verify that the activities established in the aging management programs to identify, address, and/or prevent aging effects (such as loss of material, loss of preload, or cracking) are being performed. Consult with the regional license renewal point of contact for support if needed.

Attributes	**Inspection Activity**
Equipment/ Environmental Qualification • Temperature • Humidity • Radiation • Pressure • Voltage	Verify that equipment qualification is suitable for the environment expected under all conditions. 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 to protect selected highly risk-significant components.
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.

Appendix 2, Component Design Review Considerations

Valves

1. Are the permissive interlocks appropriate?

2. Will the valve function at the pressures and differential 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?

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

Pumps

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

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

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

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

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

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

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

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

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

Instrumentation

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

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

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

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

Circuit Breakers and Fuses

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

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

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

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

Cables

1. Are cables rated to handle full load at the environmental temperature expected?

2. Are cables properly rated for short circuit capability?

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

Electrical Loads

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

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

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

As-built System

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

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

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

Appendix 3, Component Walkdown Considerations

1. Is the installed component consistent with the piping and instrument diagram?

2. Will equipment and instrumentation elevations support the design function?

3. Has adequate sloping of piping and instrument tubing been provided?

4. Are required equipment protection barriers (such as walls) and systems (such as freeze protection) in place and intact?

5. Does the location of the equipment make it susceptible to flooding, fire, high energy line breaks, or other environmental concerns?

6. Has adequate physical separation/electrical isolation been provided?

7. Are there any non-seismic structures or components surrounding the components which require evaluation for impact upon the selected component?

8. Does the location of equipment facilitate manual operator action, if required?

9. Are baseplates, hangers, supports and struts installed properly?

10. Are there indications of degradations of equipment?

11. Are the motor-operated valve operators and check valves (particularly lift check valves) installed in the orientation required by the manufacturer?

Appendix 4, Sources of Information.

Information	Suggested Sources
Design Bases	Updated Final Safety Analysis Report (UFSAR) Design Basis Documentation System Descriptions Design Calculations Design Analyses Piping & Instrumentation Drawings Significant Design Drawings Significant Surveillance Procedures Pre-operational Test Documents Vendor Manuals
Licensing Bases	NRC Regulations Plant Technical Specifications UFSAR NRC Safety Evaluation Reports Generic Aging Lessons Learned (GALL) Report, NUREG-1801 Final Report, Revision 2 (ML103490041)
Applicable Accidents/Events	UFSAR Individual Plant Examination PRA analyses Emergency Operating Procedures (EOPs)
System Changes	System Modification Packages (including post modification test documents) 10 CFR 50.59 Safety Evaluations Temporary Modifications Work Requests Setpoint Changes EOP Changes
Industry Experience	Licensee Event Reports Bulletins Generic Letters Information Notices
PRA Information	Individual Plant Examinations (IPE) or Updated PRA model results Risk-informed inspection notebooks Risk importance rankings for SSCs Dominant accident sequences Important operator actions Individual Plant Examinations for External Events

Attachment 1
Revision History for IP 71111.21

Commitment Tracking Number	Accession Number Issue Date Change Notice	Description of Change	Description of Training Required and Completion Date	Comment and Feedback Resolution Accession Number
N/A	06/22/06	Revision history reviewed for last four years	No	N/A
None	06/22/06	IP 71111.21 has been revised to clarify the margin review step of sample selection and also, the inspection resources.	No	ML061660110
None	01/31/08 CN 08-005	Revised to (1) provide flexibility in selection of samples in categories of components, operator actions, and operating experience; (2) generally preclude re-inspection of items previously inspected by SSDPCs and CDBIs.; and (3) perform CDBIs on a triennial cycle.	No	N/A
None	08/19/08 CN 08-024	Guidance on re-inspecting samples inspected in previous CDBIs. Reference to Information Notice on CDBI findings.	No	NA
N/A	12/06/10 CN 10-025	Incorporated numerous changes to improve the IP resulting from the ROP Design Engineering Inspection Working Group (DEIWG) (ML091380189)	No	ML103080992
N/A	ML12045A441 08/14/12 CN 12-017	Incorporated changes to reflect verification of inspection commitments of SSCs during the period of extended operation (i.e., post-40-year operating period.)	No	ML12200A059