ICE CONDENSER SYSTEM INSPECTIONS

A. PURPOSE

The purpose of this document is to provide guidance to inspectors for inspecting the Ice Condenser (IC) system.

B. BACKGROUND

The IC system is safety significant and problems can be subtle and difficult to evaluate via the Significance Determination Process. The system not only provides containment pressure suppression but provides a significant contribution to containment recirculation sump inventory, especially for small break scenarios.

During the late 1990's, a number of problems were identified regarding maintenance and surveillance of IC systems at the five facilities with IC containments. These included inadequate surveillance techniques, poor basket weighing and servicing practices, damaged ice baskets, damaged doors, missing hardware such as basket screws and intermediate deck bolting, stuck/blocked doors, foreign material, unsecured upper deck tape, excessive flow passage blockage, and floor upheaval. Extensive inspections were performed at all five facilities resulting in significant improvements in maintenance and surveillance practices. This document captures knowledge gained from those inspections, which may be applied when the IC is selected to be inspected as part of the Reactor Oversight Process.

The Ice Condenser Utility Group (ICUG) developed a new standard Technical Specification (TS) for ice mass determination. The ICUG topical submittal including NRC safety evaluation (Topical Report ICUG-001, Application of the Active Ice Mass Management Concept to the Ice Condenser Ice Mass Technical Specification, dated October 2003, ADAMS Accession No. ML033110091) provides valuable background information regarding ice mass considerations. However, the inspector should thoroughly review all applicable site specific TSs and TS bases information prior to the inspection.

C. DISCUSSION

A number of TS surveillances are required at each IC facility. One or more of these could be chosen for review under Procedure 71111.22, Surveillance Testing. In addition, observations for other IC problems such as foreign material, unsecured tape, and missing bolting could be performed during the containment walkdown required under Procedure 71111.20, Refueling and Outage Activities, Section 02.06. The inspector may consider review of IC problem history, discuss IC system health with the System Engineer or equivalent including the IC schedule to determine how and when to perform the inspection.

Caution: The inspector should be fully aware of the special precautions regarding IC entries for general personnel safety, use of special clothing, appropriate portable lights, and radiation controls.

1. Ice Weighing Guidance

   A significant IC surveillance is the weighing of ice baskets to confirm sufficient ice exists as defined by the TS to perform the design function. This surveillance is often performed during an outage but may be approved for performance at power. If this surveillance is chosen, the opportunity would be provided for observations of several of the areas where problems have been experienced with ICs. The observations may require multiple entries and in both the upper and lower regions of the IC. Additional specific guidance is as follows:

   Ice Basket Weighing: In order to assess the accuracy of licensees' ice mass determination, the inspector should observe a sample of (10-20) baskets being weighed from various rows by at least two different crews and note down both as-found and as-left weighing. Note: The ice basket as-left/as-found weight should always meet the minimum acceptable weight specified in TS. The as-found weight provides important information regarding IC performance such as sublimation rates, past performance, localized problems, and the need for additional weighing and replenishment. In selecting samples for observation, the inspector should consider historical weight and sublimation performance as well as localized sublimation drivers such as air handling unit performance and locations of warm air infiltration. The licensee's weighing practices should be in accordance with written procedures and provide accurate consistent weights. The IC workers (often contractors) should receive adequate training and licensee oversight. If stuck baskets are identified, select at least two for observation of freeing activities. The licensee personnel should have taken all precautions to prevent damaging baskets in the process of freeing frozen baskets. Damage can be caused by twisting or jacking. Note where jacking is being performed so that later inspections in the lower region can be observed for damage. Note weights of baskets observed for later confirmation during record reviews. Generally confirm adequate controls over vendor personnel.

   If online weighing is approved and observed, the inspector should be aware of special restrictions such as the number of bays obstructed during the activity, the number of intermediate deck doors rendered inoperable, contingency plans in the unlikely event of an accident, transportability of material brought into the IC, and restrictions on aluminum for at power operations.

Ice Basket Evacuation: This is normally accomplished by either mechanical vibration or thermal drilling. With mechanical vibration, evaluate the post evacuation inspection process to identify any damage created by the mechanical vibrators. This may include internal basket video inspections. The inspector may also consider independent sample inspections verifying lack of damage to serviced baskets. For thermal drilling evacuation, review the licensee's measures for excess water removal from vulnerable areas such as the bay wear slabs and substructure and observe for any water leakage outside the baskets. If temperature is in the high range, this process can also lead to freezing and subsequent basket damage during attempts to free the baskets. The temperature range of the thermal drilling process is usually conducted between 400 and 600 degrees F.

Weight Data Review: The inspector should check whether previously recorded weights were properly incorporated into the data. Generally confirm that data is consistent with field observations regarding highest sublimation areas. Evaluate disposition of baskets unable to be weighed, e.g., frozen baskets. Confirm final as-left weight meets the TS minimum requirements and any maximum weight design criteria. Expected sublimation rates for each basket should be incorporated into the analysis. Sublimation is evident by coning or narrowing of the ice column particularly at the bottom of the basket. Some sublimation is expected and does not result in the ice bed being inoperable. Review the licensee calculation for sublimation rates to confirm it is in the expected ranges and within calculation assumptions.

Additional observations can also be performed during ice weighing inspections as follows:

Flow passage blockage: Observe flow passages for any excessive blockage (TS requirement). Observations early in the outage prior to defrosting will give a picture of IC performance during the cycle. In addition, this inspection performed later in the outage can serve to confirm removal of ice bags, if used.

Evidence of abnormal lower ice floor (wear slab) upheaval: Observe for concrete spauling around substructure, wear slab to lower turning vane clearance, and inlet door binding.

Evidence of excessive ice buildup: Observe for icing which could have blocked intermediate or inlet doors.

Ice basket visual inspections: Observe a sample of accessible locations for missing screws. The licensee should have an evaluation of how many screws can be missing and the basket may still be considered operable.

Licensee Foreign Material Exclusion (FME) control process: Verify FME controls have been established. Some debris is possible and may have occurred in the past, however, current FME practices should be rigorous. Pay particular attention to materials brought into the IC such as rope, tape, plastic bags, etc. Observation

of the ice melt tank and filters can provide information regarding the adequacy of FME practices. A program for inspection, documentation, and removal or evaluation of acceptability of any debris left in the IC should be established.

Flow passage cleaning: If cleaning is performed during other observations, verify adequate lighting is used and inspections are performed from both lower and intermediate deck areas. Acceptance criteria should be supported by approved vendor guidance and assure sufficient margins for the ensuing operating cycle. Passage cleaning tools can also be a source of damage to baskets. Inspections should be concentrated in areas known to have the most blockage.

2. Door Inspection Guidance

The inspector should thoroughly review the surveillance criteria and basis for these inspections. Specific criteria will be established for inlet doors, intermediate deck doors, and top deck doors (blankets). The lower inlet door's surveillance is particularly sensitive to test technique. Therefore, the inspector should observe this technique and assure accuracy and consistency. For example, licensees may take multiple measurements and have preestablished consistent gauge locations. Also observe for door damage and damage to bumper bags and/or springs. Note that these doors have to open with relatively low differential pressure and yet have enough closing force to prevent inadvertent opening during normal operations which can cause localized sublimation or condensation ice formation. In addition, these doors are expected to open relatively consistently to prevent uneven melting (more vulnerable for small break scenarios). Intermediate deck doors are vulnerable to binding and condensation ice buildup causing excessive opening forces. Upper blankets and associated tape can be improperly attached and these are subject to damage. Damaged blankets are subject to moisture saturation. Note that a few inoperable doors may not make the IC inoperable but the licensee should have a thorough evaluation of the problem and the effect on operability. When reviewing licensees' routine surveillance testing, the inspector should question the testing methodology to demonstrate compliance with TS. A recent inspection at DC Cook IC door testing revealed that the licensee failed to verify several critical parameters such a s the TS required opening angle, and the applied force moment-arm length and the closing/ opening torque requirements did not properly consider the frictional torque requirements. See the following inspection report for more details:
http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/REPORTS/cook_2001020.pdf

3. Containment Walkdown Guidance

As a minimum, the inspector should observe for loose debris, clogging of IC drains, loose screws and other hardware, loose insulation, unsecured upper deck tape, and damaged hardware such as upper deck blankets and doors. Alternately, the inspector can observe for damaged baskets from the bottom of the baskets during the debris/drain inspection, confirm baskets are pinned, observe for missing bolting on the intermediate deck, confirm removal of lower door jams, and verify the intermediate bypass vent assembly is properly secured (note that some area of the

vent assembly is required to be open for small break LOCA steam flow). Note: The inspector should determine when access to the lower IC area will be restricted to assure the inspection opportunity is not missed.

END