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U. S. Nuclear Regulatory Commission
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Donald C. Cook Nuclear Plant Units 1 and 2
RESPONSE TO NUCLEAR REGULATORY COMMISSION
BULLETIN 2003-01 REGARDING DEBRIS BLOCKAGE OF
RECIRCULATION SUMP

Reference: Nuclear Regulatory Commission Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors," dated June 9, 2003

The Nuclear Regulatory Commission (NRC) issued the referenced bulletin to inform pressurized water reactor (PWR) licensees of 1) the results of NRC-sponsored research identifying the potential susceptibility of PWR recirculation sump screens to debris blockage in the event of a high-energy line break requiring recirculation operation of the emergency core cooling system (ECCS) or containment spray system (CTS), and 2) the potential for additional adverse effects due to debris blockage of flowpaths necessary for ECCS and CTS recirculation and containment drainage.

The NRC requested that licensees provide a response within 60 days of the date of the bulletin containing the information requested in either Option 1 or Option 2 as stated in the bulletin. Indiana Michigan Power Company (I&M) is responding to Option 2 which is restated below:

"Option 2: Describe any interim compensatory measures that have been implemented or that will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming ECCS and CSS recirculation functions until an evaluation to determine compliance is complete. If any of the interim compensatory measures listed in the Discussion section will not

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> be implemented, provide a justification. Additionally, for any planned interim measures that will not be in place prior to your response to this bulletin, submit an implementation schedule and provide the basis for concluding that their implementation is not practical until a later date."

The attachment to this letter provides I&M's response to Option 2. This letter contains no new commitments.

Should you have any questions, please contact Mr. Brian A. McIntyre, Manager of Regulatory Affairs, at (269) 697-5806.

Sincerely,

A. C. Bakken III
Senior Vice President, Nuclear Operations

JW/dmb

Attachment

c: Director, Office of Nuclear Reactor Regulation
J. L. Caldwell, NRC Region III
K. D. Curry, Ft. Wayne AEP, w/o attachments
J. T. King, MPSC, w/o attachments
MDEQ – WHMD/HWRPS, w/o attachments
NRC Resident Inspector
M. A. Shuaibi, NRC Washington DC

AFFIRMATION

I, A. Christopher Bakken III, being duly sworn, state that I am Senior Vice President, Nuclear Operations of American Electric Power Service Corporation and Vice President of Indiana Michigan Power Company (I&M), that I am authorized to sign and file this response with the Nuclear Regulatory Commission on behalf of I&M, and that the statements made and the matters set forth herein pertaining to I&M are true and correct to the best of my knowledge, information, and belief.

American Electric Power Service Corporation

A. C. Bakken III
Senior Vice President, Nuclear Operations

SWORN TO AND SUBSCRIBED BEFORE ME

THIS 7th DAY OF August, 2003

Julie E. Newmiller
Notary Public

My Commission Expires 8-22-04

JULIE E. NEWMILLER
Notary Public, Berrien County, MI
My Commission Expires Aug 22, 2004

ATTACHMENT TO AEP:NRC:3054-12

RESPONSE TO NRC BULLETIN 2003-01.

This attachment provides Indiana Michigan Power Company's (I&M) response to Option 2 in the Requested Information section of Nuclear Regulatory Commission (NRC) Bulletin 2003-01. This response discusses: 1) plant specific measures not identified in the bulletin that have been implemented at Donald C. Cook Nuclear Plant (CNP), 2) compensatory measures identified in the bulletin that have been implemented, and 3) interim compensatory measures identified in the bulletin that have not been implemented and the justification for not implementing them.

1) Plant Specific Measures that are Not Identified in the Bulletin

This section provides a description of plant specific measures implemented at CNP to address potential debris blockage of recirculation sump screens. These measures are not identified in the list of possible interim compensatory measures provided in the Discussion section of the bulletin. Rather than providing operational actions to compensate for recirculation sump screen blockage, these measures are directed at assessing the magnitude of potential blockage, evaluating the effect of such blockage on safety systems, and controlling potential debris sources so as to minimize blockage. I&M considers that these measures provide a high degree of assurance that debris blockage of the recirculation sump screens that prevents the emergency core cooling system (ECCS) and containment spray system (CTS) from performing their required safety functions would not occur at CNP.

Control of Fibrous Insulation

Concerns over fibrous material in containment were identified during the 1997-2000 dual unit outage. To address these concerns, I&M revised the CNP design specification for thermal insulation. The revised CNP specification prohibits the use of fibrous insulating material (e.g. Temp-Mat, Fiberglass) inside containment in locations that are within credible zones of influence (ZOIs) for loss of coolant accident (LOCA) and high energy line break (HELB) locations. (The ZOI is the region surrounding a postulated pipe rupture that is subjected to destructive jet forces from the blow down of high energy fluid.) The revised CNP specification also requires that all non-metallic pipe insulation (which includes fibrous insulation) inside the containment building be encapsulated, i.e., enclosed or covered in such a way as to prevent the generation and transportation of debris under post accident conditions. A significant amount of fibrous insulation was removed from the Unit 1 and Unit 2 containments and replaced with non-fibrous insulation during the 1997-2000 dual unit outage to comply with the revised CNP specification.

Containment Recirculation Sump Protection Program

I&M established a Containment Recirculation Sump Protection Program as a result of concerns identified during the 1997-2000 dual unit outage regarding potential debris in containment. The objective of this program is to preserve the design and licensing basis of the recirculation sump by evaluating and controlling materials within containment that could potentially restrict flow through the sump screen during post-accident operations. The program establishes overall standards for containment conditions relative to sump performance, defines the division of responsibility for achieving the standards, and defines the relationship among the various CNP specifications and procedures necessary for program implementation.

The Containment Recirculation Sump Protection Program procedure characterizes potential debris types, defines standards for the presence of each type in containment, and provides qualitative assessment of their relative impact on sump operation during post-accident recirculation. The potential debris types characterized in the program include metal components (conduit, electrical boxes, piping and valves), fibrous materials (fibrous insulation, fire stops in cable trays and conduit), metallic insulation, calcium silicate insulation, coatings, tape, labels, plastic tie wraps, marinite board, tygon tubing, Styrofoam, sealants, and general debris/loose dirt. The Containment Recirculation Sump Protection Program procedure also identifies the working level specifications and procedures that implement specific program requirements.

Safety Related Coatings Program

During the 1997-2000 dual unit outage, containment coatings identified to be in poor condition were identified, repaired and/or removed. I&M also established a Safety Related Coatings Program during the 1997-2000 dual unit outage. The program assures that safety-related coatings are procured, applied and maintained in accordance with applicable requirements. The condition of the containment coatings is assessed each refueling outage to ensure timely identification and detection of potential problems in the coating systems and to permit coating work to proceed accordingly. The condition assessment is performed by a Level II or Level III coatings inspector qualified in accordance with ANSI N45.2.6, "Qualifications of Inspection, Examination, and Testing Personnel for the Construction Phase of Nuclear Power Plants." Coating defects are documented in the CNP corrective action program. Degraded coatings (blistering, peeling flaking, etc.) are typically removed and the exposed surfaces are scheduled for recoating as appropriate.

Containment Debris Generation and Transport Study

In 1997, I&M had a study conducted to evaluate the Unit 1 recirculation sump performance during post-accident conditions. This study was based on methodologies adapted from efforts to resolve ECCS pump suction strainer blockage issues at Boiling Water Reactors (BWR). These methodologies and the associated assumptions were modified to better reflect Pressurized Water Reactor (PWR) and CNP-specific conditions.

The results of the study indicated that, given the configuration and general material condition inside the Unit 1 containment, the recirculation sump would perform its design function following a LOCA requiring operation of the ECCS or CTS in the recirculation mode. The study's quantitative results indicated that the head loss across the sump screen would be acceptable, i.e., adequate net positive suction head would be available for the ECCS and CTS pumps under representative conditions. These conditions consisted of complete destruction of the insulation in one quadrant of lower containment, with 25 percent of the debris transported to the sump screen, forming a uniform bed across the entire screen. The debris transport factor of 25 percent accounted for debris sedimentation onto the containment floor or other structures in the containments. The bounding quadrant was that which would produce the largest debris quantity transported to the sump. Although the study was performed using inputs applicable to Unit 1, the results of the study are considered representative of Unit 2 based on the similarity of the Unit 1 and Unit 2 containment designs, insulation materials, and material condition inside the containments.

Although the BWR methodology had been modified to better reflect PWR and CNP-specific factors, the model represented an early application of the BWR methodology to a PWR configuration. Given the early nature of this application, and that inputs to the analysis were changing due to the removal of debris sources from the containments during the 1997-2000 dual unit outages and planned modifications to ensure adequate containment recirculation sump inventory, the debris generation and transport calculation was not incorporated into the CNP design basis. However, the model did provide a basic analysis of debris generation and transport based on the best available information, and provided reasonable assurance that debris blockage would not prevent the recirculation sump for performing its safety function following a LOCA.

Effect of Small Debris Downstream of the Sump Screens

As described below, I&M has assessed the potential effect of small debris that could pass through the recirculation sump screens on the three downstream components of primary concern; ECCS and CTS pump bearings, ECCS high pressure throttle valves, and CTS spray nozzles.

- I&M determined that the ECCS pump bearings would not be affected since they are not hydrostatic bearings, i.e. they do not come in contact with the pumped fluid. The CTS pumps contain a hydrostatic wear ring that is in contact with the pumped fluid. However, I&M's assessment determined that the pumps would remain capable of performing their design function if small debris blocked the holes in the wear ring.
- During the 1997-2000 dual unit outage, the ECCS high pressure throttle valves were replaced, and pressure reducing orifices were installed to prevent or minimize the impact of cavitation. The orifices were sized such that the throttle valve position would be sufficiently open to preclude clogging by small debris.
- The design of the CTS spray nozzles is such that they are not subjected to clogging by particles less than approximately 1/4 inch.

2) Compensatory Measures Identified in the Bulletin that Have Been Implemented

This section provides a description of the compensatory measures identified in the bulletin that have been implemented at CNP. The headings in this section correspond to compensatory measures listed in the Discussion section of the bulletin.

Operator Training on Indications of and Responses to Sump Clogging

A significant consequence of sump clogging would be cavitation of ECCS and CTS pumps using the sump as the suction source. As part of initial licensing training, classroom training is provided for generic issues associated with indications of pump cavitation such as symptoms, effects, and methods of prevention. This training includes starting the pump, monitoring the pump parameters and stopping the pump if cavitation is detected. Review of the CNP procedure for loss of emergency coolant recirculation is included in the licensed operator requalification program that is performed on a two year cycle.

More Aggressive Containment Cleaning and Increased Foreign Material Controls

During the 1997-2000 dual unit outage, I&M performed extensive cleaning of the Unit 1 and Unit 2 containments and ice condensers. Walk-downs of both containments were performed to identify debris sources, with particular focus on potential debris sources located within the ZOIs for HELBs. As a result of these walk-downs, a significant quantity of potential debris-producing material was removed from the containments. This material included corrosion products, tape, filters, granular charcoal, and other foreign material. These actions were characterized as "extensive" in an associated NRC Inspection Report, 50 315/97017(DRP); 50 316/97017(DRP), dated April 9, 1998. Additional walk-downs of the containment buildings were performed during subsequent system readiness reviews. During these walk-downs, other potential debris sources were identified and removed, e.g., labels and tags which could melt or otherwise become loose debris under accident conditions. In addition, a significant amount of debris was recovered from the ice condensers when the ice beds were melted. Rigorous foreign material controls were implemented for the re-load of the ice beds and any subsequent ice condenser maintenance.

The containments are inspected for loose debris by a team of at least two Operations Department personnel prior to establishing containment integrity following refueling outages. This inspection is required by Technical Specification (TS) 4.5.2.c.1. Standard Westinghouse TSs do not contain an equivalent requirement. The procedure governing these inspections requires inspecting for loose debris (e.g., rags, paper, trash, tape, peeling paint or paint chips, tools, loose or peeling caulk, clothing, tarps, plastic coverings, hoses, fasteners, unencapsulated fire seal damming and forming material, un-encapsulated fibrous material, polystyrene foam) in accessible areas of the containment. The procedure also requires inspection of the recirculation sump inlet screen for damage, and inspection of both the recirculation sump and the containment sump (which is connected to the recirculation sump) for debris. The inspection of the recirculation sump for debris by Operations Department personnel is in addition to an independent inspection of the recirculation sump for debris by Maintenance Department personnel, to satisfy the 18 month surveillance requirements of TS 4.5.2.d.2. The procedure for inspection by Maintenance Department personnel includes entry into the sump cavity and inspection of the inside of the residual heat removal system suction piping from the sump to the first isolation valve. If a containment entry is made after establishing containment integrity, CNP procedures require an inspection of the areas affected by the entry to verify that no loose debris (rags, trash, clothing, etc.) is present in the containment which could be transported to the recirculation sump and cause restriction of the pump suctions during LOCA conditions. This inspection is required by TS 4.5.2.c.2. Standard Westinghouse TSs do not contain an equivalent requirement.

I&M has enhanced the CNP foreign material exclusion (FME) program to provide specific instructions for work inside containment and specific instructions for work inside the ice condenser. The program requires that both the containment and the ice condenser be treated as systems with respect to FME control. All material taken into containment or debris generated during the course of work must be utilized and/or brought out of containment. The ice condenser is treated as a high risk FME area, requiring additional controls.

The walk-downs and programs completed during 1997-2000 outages to address potential debris sources described above, and to address fibrous insulation and coating concerns described in Section 1, were similar to those endorsed by the current industry guidance contained in Nuclear Energy Institute document NEI 02-01, "Condition Assessment Guidelines: Debris Sources Inside PWR Containments," Revision 1, dated September 2002. During the May-June, 2003 Unit 2 refueling outage, I&M again conducted walk-downs of the Unit 2 containment consistent with the guidance contained in NEI 02-01. These walk-downs confirmed the effectiveness of the programs implemented during the 1997-2000 outage to control fibrous insulation, improve the conditions of coatings, and remove potential debris sources. Since these programs were applied to both units, the recent Unit 2 walk-downs provide reasonable assurance that conditions in Unit 1 containment are similar to those observed in Unit 2. Walk-downs consistent with the guidance contained in NEI 02-01 are planned for the Fall 2003 Unit 1 refueling outage.

Ensuring Containment Drainage Paths are Unblocked

The CNP containment is a Westinghouse ice condenser design. The design includes a lower compartment that contains the reactor coolant system (RCS) and associated equipment and piping, an ice condenser, and an upper compartment. The lower compartment also includes an annulus which contains ancillary equipment (piping, valves, accumulators, heat exchangers, etc.). The upper and lower compartments are separated by a structural barrier called the divider barrier. The divider barrier includes the walls of the ice condenser compartment, the compartments enclosing the upper portion of the steam generators and pressurizer, the control rod drive missile blocks and reactor cavity vertical bulkhead, and portions of the refueling canal walls and the operating deck. In the event of a HELB in the lower compartment, door panels located below the operating deck open due to the pressure rise in the lower compartment. This allows air and steam to flow from the lower compartment into the ice condenser. The resulting pressure increase within the ice condenser causes the intermediate deck doors and the door panels at the top of the ice condenser to open, allowing the air to flow out of the ice condenser into the upper compartment. The ice condenser condenses the steam as it enters the ice compartment, limiting the peak pressure in the containment. Condensation of steam within the ice condenser results in a continual flow of steam from the lower compartment to the condensing surface of the ice, reducing the time that the lower compartment is at an elevated pressure and reducing the overall containment pressure. Twenty-one twelve inch diameter drains in the floor of the ice condenser provide a means of draining condensed steam and melted ice. Flapper valves located on each drain, normally closed to prevent hot air infiltration, open to allow drainage to the lower compartment floor. In addition to the water from the HELB, ECCS injection water, and ice melt water, recirculation inventory is added to the containment from CTS ring headers in the upper and lower compartments, including the annulus.

The containment drainage system is designed to ensure that the water entering the containment from the HELB, ECCS injection flow, CTS flow and ice condenser ice melt flow back to the lower compartment floor and to the containment recirculation sump. The containment recirculation sump entrance is located in the lower compartment, inside the crane wall. The significant flow paths within the containment to allow water to return to the containment recirculation sump include:

- CTS flow and ice condenser moisture carryover from the upper compartment to the lower compartment through the refueling cavity drains (two 12 inch drains and one 10 inch drain).
- CTS flow from the upper compartment to the lower compartment through drains located in a ventilation well and a stairwell in the upper compartment which each contain one of the two Containment Air Recirculation/Hydrogen Skimmer Fans.
- CTS flow from the annulus area of the lower compartment to the area inside the crane wall via two large (four foot high by ten foot wide) curbed openings in the crane wall and then through a series of five, ten inch diameter openings (two for one four foot by ten foot opening, and three for the other four foot by ten foot opening) in the flood-up overflow walls. The two curbed openings in the crane wall are protected by coarse grating to catch large debris. The five ten inch openings are protected by deflector plates to prevent large debris from blocking the openings, should the gratings fail.
- CTS flow from the reactor cavity area (in the event of a break in the cavity area) to the lower compartment via a spillover.
- Condensed steam and ice melt flow from the twenty one, 12 inch diameter, ice condenser floor drains to the lower compartment. In the unlikely event that an ice condenser floor drain became blocked, water can flow freely to drains located in other ice condenser bays.

Specific inspections of these drainage paths are conducted as follows:

- The refueling cavity drains from the upper to lower compartment are inspected in accordance with TS 4.6.5.8 prior to increasing the RCS temperature above 200 degrees Fahrenheit. The inspection verifies that the associated blind flanges (installed to allow flooding of the refueling cavity) are removed and that the drain lines are free of debris.
- The ventilation well and stairwell drains from the upper compartment to the lower compartment are inspected prior to increasing the RCS temperature above 200 degrees Fahrenheit and verified to not have plugs installed.
- The openings in the crane wall to allow flow from the annulus area to inside the crane wall are inspected prior to increasing the RCS temperature above 200 degrees Fahrenheit and verified to have the grating securely installed and free of potentially clogging material.
- The spillover path from the reactor cavity to the lower compartment is not specifically inspected since it is not susceptible to debris blockage.
- The ice condenser floor drains are verified to be operable every 18 months in accordance with the surveillance requirements of TS 4.6.5.7.

Ensuring Sump Screens are Free of Adverse Gaps and Breaches

The recirculation sump entrance is located inside the crane wall, with the crane wall extending part way down into the sump, dividing it into two portions. In an accident, water from the lower volume of containment would enter the portion of the sump inside the crane wall through inlet screens located at the sump entrance. The water would flow down and under the crane wall, and enter the suction pipe for the RHR pumps and the CTS pumps. As described below, all openings to the recirculation sump have features designed to prevent debris greater than approximately 1/4 inch from entering the sump.

The recirculation sump inlet screen design is such that there are no gaps or spaces, other than the coarse grating and fine screen openings. The screen assembly consists of individual screen panels which are bolted to structural steel, which is bolted to the concrete sump opening. The individual screen panels consist of a composite arrangement where the fine screen is sandwiched between the two coarse grating sections and welded to form a single panel. The horizontal and vertical bars of the coarse gratings are aligned to act as a flow straightener and mitigate vortex formation by equalizing local velocity differences. The fine screen wire mesh has 3/16 inch square openings, which prevents debris greater than approximately 1/4 inch from entering the recirculation sump.

The recirculation sump is connected to the containment sump by an eight inch diameter cross connect pipe. A 3/16 inch mesh framed screen assembly is installed on the cross-connect pipe. Similar to the fine screen on the sump inlet, this screen prevents debris larger than approximately 1/4 inch from entering the recirculation sump. The containment sump is also equipped with a coarse grating and fine screen at its entrance.

The recirculation sump is a vented chamber. Air is vented from the portion of the sump located inside the crane wall through five 3/4 inch diameter holes in the sump roof slab. The five vent holes are covered with framed debris screens. Similar to the fine screen on the sump inlet, this screen prevents debris larger than approximately 1/4 inch from entering the recirculation sump. Air is vented from the portion of the sump located outside the crane wall through a six inch diameter vent pipe that penetrates the crane wall and is open to the lower volume of containment, inside the crane wall. The open end of the vent pipe is well above the maximum expected post-accident water level in containment. The sump vent is covered with a circular plate having holes that are approximately 1/4 inch in diameter.

The inspection of the recirculation sump for debris by Maintenance Department personnel to satisfy the 18 month surveillance requirements of TS 4.5.2.d.2. includes verification that the sump components (gratings, screens) show no evidence of structural distress or corrosion. The inspection includes verification that that the wire mesh screen does not contain rips, tears, openings, or gaps that would allow debris greater than approximately 1/4 inch to pass through or around the screen. The screen in the eight inch diameter cross-connect pipe from the containment sump and the screen in the stand pipe are also inspected to verify there are no rips, tears, openings or gaps that are big enough to allow passage of debris larger than approximately 1/4 inch.

Venting of the sump ensures that the maximum differential pressure across the screens/grating is limited to the hydrostatic pressure difference corresponding to difference in water level upstream and downstream of the sump screens. The structural capacity of the screens has been evaluated. The evaluation determined that the structural capacity of the screens/grating, including the vertical supports and anchor bolts, exceeds that needed to withstand hydrostatic pressure differential at the maximum flood-up conditions.

3) Interim Compensatory Measures Identified in the Bulletin that Have Not Been Implemented and Justification for Not Implementing Them

This section identifies the two potential interim compensatory measures identified in the bulletin that I&M considers unnecessary for CNP. I&M considers these measures to be unnecessary based on 1) the measures taken to control debris and fibrous insulation, the inspections for containment cleanliness and screen integrity, the screen structural analysis, and the results of the debris generation and transport study described in Sections 1 and 2 above, and 2) the specific justifications for each potential measure described below. The headings in this section correspond to compensatory measures listed in the Discussion section of the bulletin.

Procedural Modifications, if Appropriate, that Would Delay the Switchover to Containment Sump Recirculation (e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CTS intermittently)

During the 1997-2000 dual unit outage, three plant modifications were performed that provide additional sump inventory and/or delay the switchover to containment sump recirculation. These modifications may also preclude the need for a recirculation phase during a small break LOCA. The modifications consisted of:

- Creating openings in the flood-up overflow wall separating the pipe annulus region from the RCS loop compartment to allow water to flow freely between these areas and provide more inventory to the sump,
- Changing the engineered safety features actuation initiating signal and time delay to start the containment air recirculation/hydrogen skimmer fans earlier in the accident to delay CTS actuation and increase the ice melt rate, and
- Increasing the refueling water storage tank (RWST) volume useable in an accident.

In addition, modifications to improve the accuracy of level measurements in the RWST and the containment recirculation sump were implemented to add margin and reduce the cognitive burden on the operators during switchover from the injection phase to the recirculation phase. The CNP procedure for transferring to cold leg recirculation was changed during the 1997-2000 dual unit outage to include a requirement to check that the minimum necessary water level exists in the recirculation sump prior to initiating the transfer.

The CNP emergency procedures are based on generic procedures provided by the Westinghouse Owners Group (WOG). Accordingly, I&M considered the WOG recommendations in determining if procedural modifications to delay switchover to sump recirculation should be implemented at CNP. Based on the WOG recommendations and the measures described in Sections 1 and 2 above, I&M determined that the procedural modifications were not appropriate. The WOG recommendations are summarized below.

For a large LOCA that requires ECCS injection flow and CTS spray, pre-emptive operator actions to stop pumps or throttle flow solely for the purpose of delaying switchover to sump recirculation are not recommended by the WOG until the impact of the changes are evaluated on a generic basis for the following reasons:

- Operator actions to stop ECCS or CTS pumps or throttle flow may result in conditions that are either outside of the design basis safety analyses assumptions or violate the design basis safety analyses assumptions (single failure). This would result in the potential for creating conditions that would make the optimal recovery more challenging (e.g., stopping containment spray impacts containment fission product removal, recirculation sump pH and equipment environment qualification design basis requirements).

- The WOG Emergency Response Guidelines (ERG) are symptom-based procedures that provide for the monitoring of plant parameters and prescribe actions based on the response of those parameters. To avoid the risk of taking an incorrect action for an actual event, the WOG ERGs do not prescribe contingency actions until symptoms that warrant those contingency actions are identified.
- These actions would be inconsistent with the current operator response using the WOG ERGs that has been established through extensive operator training. The expected operator response is based on the optimal set of actions considering both design basis accidents and accidents outside the design basis. The WOG ERG operator response is not limited to a specific accident progression in order to provide optimal guidance for a wide range of possible accidents.
- To be effective in delaying the switchover to sump recirculation, operator actions to stop ECCS or CTS pumps must be taken in the first few minutes of an accident. This introduces a significant opportunity for operator errors based on other actions that may be required during this time frame. Any new operator actions to stop ECCS or CTS pumps, when modeled in a probabilistic risk assessment, are likely to result in increased risk due to operator error.

Guidance to delay depletion of the RWST is contained in the WOG procedure for loss of emergency coolant recirculation. This procedure provides actions to reduce the outflow from the RWST to preserve the RWST inventory once it has been determined that a loss of sump recirculation capability exists. Although a loss of sump recirculation capability would be outside the plant design and licensing basis, the procedure provides actions for delaying RWST inventory depletion, while ensuring adequate core cooling flow and containment heat removal as necessary.

For a small to medium LOCA, guidance to delay depletion of the RWST before switchover to sump recirculation exists in the WOG procedure for post LOCA cool down and depressurization. This procedure provides actions to cool down and depressurize the RCS to reduce the break flow, thereby reducing the injection flow necessary to maintain RCS subcooling and inventory. The operating ECCS pumps would be sequentially stopped to reduce injection flow, based on pre-established criteria that maintain core cooling, resulting in less outflow from the RWST. For smaller LOCAs, it would be possible to cool down and depressurize the RCS to cold shutdown conditions before the RWST is drained to the switchover level. Therefore cold leg recirculation would not be required, and sump blockage would not be an issue.

Ensuring that Alternative Water Sources are Available to Refill the RWST or to Otherwise Provide Inventory to Inject Into the Reactor Core and Spray Into the Containment Atmosphere

RWST refill and use of alternate makeup sources for the RCS during design bases accidents is not assumed in the safety analyses and plant design bases, and would introduce the potential for containment flooding and the loss of instrumentation and equipment inside containment. Guidance in the WOG procedure for loss of emergency coolant recirculation addresses RWST refill once it has been determined that loss of ECCS recirculation capability exists.