NMC
Committed to Nuclear Excellence

Prairie Island Nuclear Generating Plant
Operated by Nuclear Management Company, LLC

AUG 3 1 2005

L-PI-05-073
10 CFR 50.54(f)

U S Nuclear Regulatory Commission
ATTN: Document Control Desk
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Prairie Island Nuclear Generating Plant Units 1 and 2
Dockets 50-282 and 50-306
License Nos. DPR-42 and DPR-60

Nuclear Management Company Response to Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors," for the Prairie Island Nuclear Generating Plant

By letter dated September 13, 2004, the Nuclear Regulatory Commission (NRC) issued Generic Letter (GL) 2004-02. By letter dated March 7, 2005, Nuclear Management Company, LLC (NMC) provided the required 90-day response.

In GL 2004-02, the NRC required that specific information be provided by September 1, 2005. NMC is providing the September 1, 2005, response to GL 2004-02. Enclosure 1 contains the NMC response for the Prairie Island Nuclear Generating Plant Units 1 and 2.

Summary of Commitments

This letter contains four new commitments and no revisions to existing commitments.

1. NMC will evaluate and modify as appropriate the Prairie Island Unit 1 and Unit 2 Emergency Core Cooling (ECCS) systems to support long-term decay heat removal and resolve the issues identified in GL 2004-02 by December 31, 2007.
2. NMC will complete verification of downstream components for long-term wear by December 31, 2005. This response will be amended if the conclusions from the downstream effects analyses or the final design deviate significantly from the information provided in this response.
3. NMC will submit a license amendment request to change the Technical Specification Surveillance Requirement 3.5.2.8 to reflect the new design by December 31, 2005.

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4. NMC will perform measurements to estimate the amount of latent dirt and dust inside containment every other refueling outage in the respective Prairie Island Nuclear Generating Plant Units 1 and 2. Measurements were completed during the last Unit 1 and Unit 2 outages (Cycle 23, for each unit). The next measurements for each unit will be performed during their respective Cycle 25 refueling outages. Assuming the results indicate that the housekeeping practices provide an adequate level of cleanliness, NMC may choose to relax this frequency.

I declare under penalty of perjury that the foregoing is true and correct. Executed on

AUG 3 1 2005

Thomas J. Palmisano
Site Vice President, Prairie Island Nuclear Generating Plant
Nuclear Management Company, LLC

Enclosure(1)

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC

ENCLOSURE 1
RESPONSE TO GENERIC LETTER 2004-02
PRAIRIE ISLAND NUCLEAR GENERATING PLANT

Plant Description

PINGP 1&2 are Westinghouse two loop pressurized water reactors. The containment arrangement is similar for both units. The Emergency Core Cooling Systems (ECCS) is comprised of the Safety Injection (SI) and the Residual Heat Removal (RHR) systems. Following a loss of coolant accident (LOCA), the SI and RHR pumps initially draw suction from the Refueling Water Storage Tank (RWST). The transfer to recirculation of the containment sump liquid is initiated after the liquid in the RWST reaches a set level prescribed in the Emergency Operating Procedures. Recirculation of the liquid in the containment sump is only required following a LOCA. Containment Spray is not addressed in this evaluation as the Containment Spray System is not used during post-LOCA recirculation operation.

SI System

The primary purpose of the SI System is to automatically deliver borated water to the Reactor Coolant System (RCS) in the event of a loss of coolant accident. This protection is afforded for all RCS pipe break sizes including a double ended pipe break.

The SI System consists of two redundant high head pumps. If, during recirculation operation, RCS pressure is above the RHR Pump discharge pressure, the RHR Pump(s) are aligned to provide suction to the SI Pump(s) for high head recirculation.

The SI Pumps discharge into both cold legs. Throttle valves are provided in the lines to balance the flow rates between the two injection lines to the RCS cold legs to ensure that adequate flow is provided to the intact cold leg should the other cold leg be ruptured.

Design flow rate for the SI Pumps is 700 gpm (gallons per minute) each
Runout flow rate for the SI Pumps is 835 gpm each

RHR System

The RHR Pumps serve dual functions. The normal function of the RHR Pumps is to remove residual heat during reactor shutdown. During normal power operation the RHR pumps are aligned to perform the low head safety injection function. During post accident mitigation, the RHR Pumps are used to inject borated water to the Reactor Coolant System through nozzles in the Reactor Vessel (upper plenum injection). The RHR Pumps are also used to recirculate liquid from the containment sump and pump to the reactor vessel or to the suction of the high head SI Pumps.

The RHR System consists of two redundant low head pumps. During the injection phase of post-accident mitigation, the RHR Pumps draw suction from the RWST. Should RCS pressure be above the RHR Pump discharge pressure, the pumps would initially be discharging through the minimum flow bypass line during the injection phase, then to the suction of the SI Pumps ("piggy-back" mode) during the recirculation phase of post-accident mitigation.

Design flow rate of the RHR Pumps is 2000 gpm each
Runout flow rate of the RHR Pumps is 2600 gpm each
Maximum flow rate during recirculation is approximately 2085 gpm each (based on system hydraulics)

Containment Sump B is located in the basement elevation of containment to provide a water collection source for the suction of the RHR Pumps. During recirculation, both RHR Pumps can draw suction from Sump B. During a LOCA, Sump B will fill and a liquid level will be established on the basement floor. The height of the liquid level is a function of the size of the RCS break. That is, for the large break LOCA, a higher water level will be established due to injection of the SI Accumulators and voiding in the RCS. For a small break LOCA (depending on the RCS break size), the Accumulators may be isolated prior to injection and the RCS may remain full resulting in less liquid accumulation on the containment basement floor. However, for a small break LOCA, the RHR Pump flow and associated net positive suction head (NPSH) requirements would be much less.

To provide bounding results, the analyses described below assume the minimum liquid water level in containment associated with a small break LOCA coupled with the runout flow rate for the RHR pumps more indicative of a large break LOCA. As discussed above, based on the system hydraulics, the maximum RHR pump flow rate is considerably less than runout flow rate.

Nuclear Regulatory Commission (NRC) Requested Information

2. ***Addressees are requested to provide the following information no later than September 1, 2005:***

(a) *Confirmation that the ECCS and CSS recirculation functions under debris loading conditions are or will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. This submittal should address the configuration of the plant that will exist once all modifications required for regulatory compliance have been made and this licensing basis has been updated to reflect the results of the analysis described above.*

NMC Response

(a) PINGP 1&2 ECCS recirculation functions will be in compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of the subject generic letter under debris loading conditions before December 31, 2007. As discussed above, the Containment Spray system is not operated during post LOCA recirculation. Response 2.(b), below, describes the actions that will be taken to provide this compliance. All additional information provided in this response relates to the plant configurations following completion of the described actions.

Based on the analyses, NMC has decided to replace the current screens with new strainers[1]. Performance Contracting, Inc. (PCI) has been selected as the strainer vendor. Sargent and Lundy (S&L) and Westinghouse have performed the Generic Safety Issue 191 (GSI-191) analyses, to date.

Activities to support bringing all aspects of the station into full compliance with the issues of Generic Safety Issue 191 (GSI-191) include:

- Containment walkdowns to quantify potential debris sources (completed)
- Debris generation and transport analyses (completed)
- Calculation of required and available NPSH (NPSH head loss through new strainer is pending)
- Defining screen requirements (completed)
- Screen structural analyses (pending)
- Procedures to address sump screen blockage (completed)
- Chemical effects analysis (in progress)
- Downstream effects analyses (in progress)
- Upstream effects evaluation (pending)

[1] The terms "strainer" and "screen" are used interchangeably in this submittal. The term "screen" is used by Technical Specifications and the term "strainer" is used by PCI (the vendor), but both refer to the same component.

This response is based on the current available information. This response will be amended if the conclusions from the yet to be completed downstream effects analyses or the final design deviate significantly from the information provided in this response.

The PINGP 1&2 licensing basis will be updated to reflect the results of the analyses and modifications performed to demonstrate compliance with the regulatory requirements. This update will be performed in accordance with 10 CFR 50.71.

NRC Requested Information

(b) A general description of and implementation schedule for all corrective actions, including any plant modifications, that you identified while responding to this generic letter. Efforts to implement the identified actions should be initiated no later than the first refueling outage starting after April 1, 2006. All actions should be completed by December 31, 2007. Provide justification for not implementing the identified actions during the first refueling outage starting after April 1, 2006. If all corrective actions will not be completed by December 31, 2007, describe how the regulatory requirements discussed in the Applicable Regulatory Requirements section will be met until the corrective actions are completed.

NMC Response

(b) A description of the implementation schedule for each of the activities listed in response to NRC Request 2(a) above are provided below.

Containment walkdowns to quantify potential debris sources

Detailed containment walkdowns to inventory potential debris sources were completed during the Fall 2004 (Unit 1) and Spring 2005 (Unit 2) refueling outages. The walkdowns included sampling for latent debris sources.

Debris generation and transport analyses

The debris generation and transport analyses were competed earlier this year. The results from these analyses are discussed below.

Calculation of required and available NPSH

Calculation of required NPSH and available NPSH with a clean screen was determined previously. Determination of preliminary head loss through the planned replacement strainer has been performed as part of the bid process. Final determination of the final head loss through the replacement strainer will be completed as part of the final design. Final design is scheduled to support installation of the replacement strainers in Unit 1 during the Spring 2006 refueling outage and Unit 2 during the Fall 2006 refueling outage.

Defining strainer requirements

The strainer requirements have been fully defined in a bid specification and a contract has been awarded based on a proposal to meet the bid specification. Pertinent information from the bid specification is provided in response to specific information requests below.

Strainer structural analyses

The structural analyses of the replacement strainer will be completed as part of the design. Final design is scheduled to support installation of the replacement strainers in Unit 1 during the Spring 2006 refueling outage and Unit 2 during the Fall 2006 refueling outage.

Procedures to address sump blockage

Emergency Contingency Action procedure for containment sump blockage was issued for each unit earlier in 2005. The procedures are not dependent upon sump screen design, and the change to the replacement screens is intended to be transparent to the Operator.

Chemical effects

The evaluations and testing for chemical effects is in progress. Final results are expected to be based on strainer vendor testing.

Downstream effects

The downstream effects analyses for both the fuel and mechanical components (pumps, valves, etc.) are in progress and are scheduled for completion by the end of October 2005. Any modifications related to downstream effects will be identified as described in sections 2.(d)(v) and (vi).

Upstream effects

The evaluations for potential choke points have been completed. An evaluation of the upstream effects of debris on the strainers is an integral part of the strainer design process. Scale testing of the conceptual design with a debris mix and loading that bounds the PINGP 1&2 debris transport analyses will be performed by the vendor selected to design and fabricate the replacement screens. It is expected that final acceptance of the replacement screens will be based on the demonstrated test performance.

Corrective Actions

Based on the results from debris generation and transport analyses identified and described below, modifications to the existing debris screens will be implemented to meet the Applicable Regulatory Requirements discussed in the generic letter. Modifications consist of new sump strainers with a surface area of approximately 800 square feet with 0.095 -inch diameter perforations (current proposed design). The new strainers will occupy the space around the existing sump as well as an area adjacent to the sump (Figures 1 and 2 show the current proposed strainer configuration for Unit 1 containment). The plant modifications for installation of the replacement strainers will be implemented during the Spring 2006 refueling outage for Unit 1 and Fall 2006 refueling outage for Unit 2.

NMC will complete all corrective actions necessary to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of the subject generic letter before December 31, 2007.

The PINGP 1&2 licensing basis will be updated to reflect the results of the analyses and modifications performed to demonstrate compliance with the regulatory requirements. This update will be performed in accordance with 10 CFR 50.71.

Figure 1
Proposed Strainer Configuration

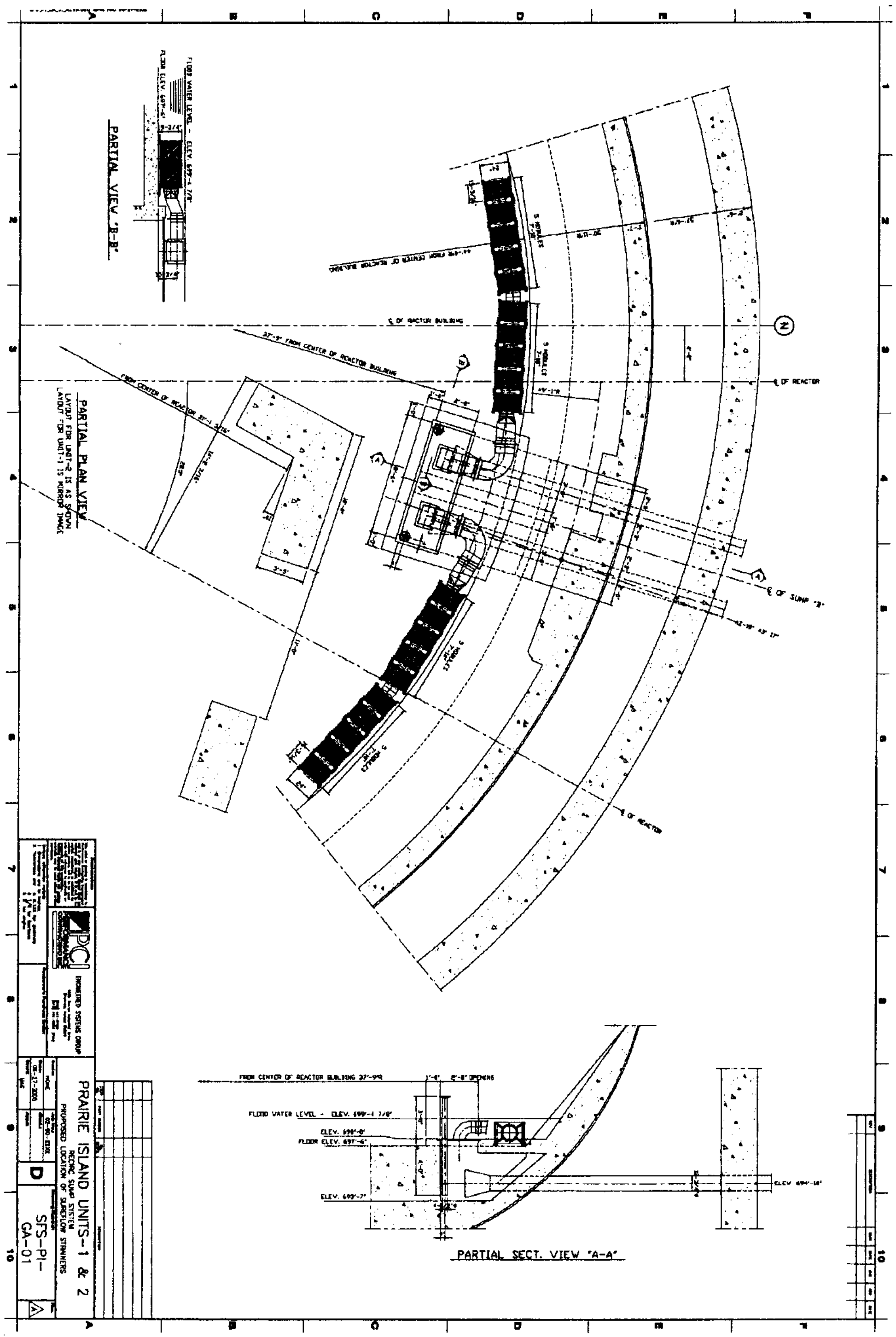
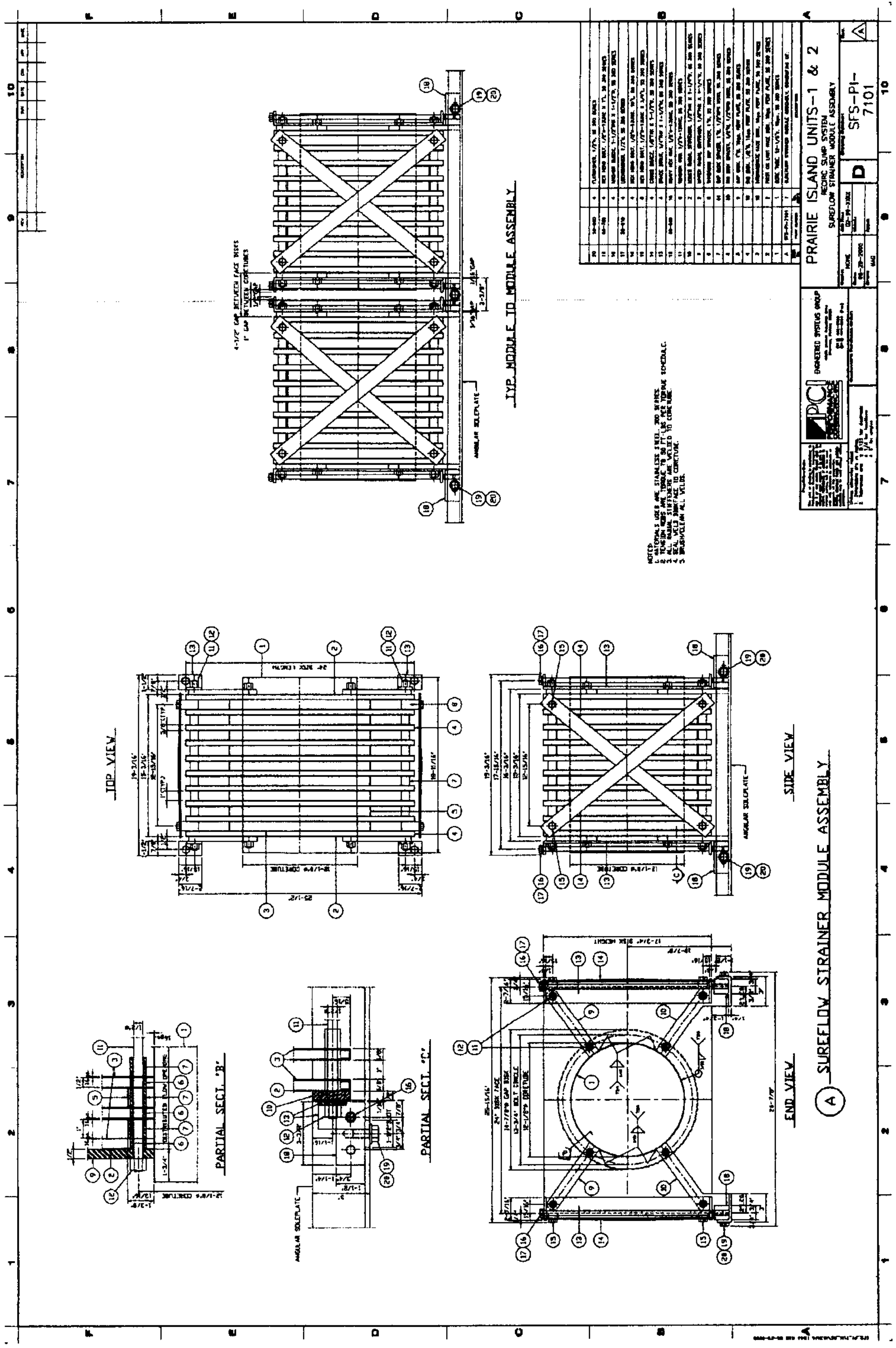


Figure 2
Proposed Strainer Configuration



NRC Requested Information

(c) *A description of the methodology that was used to perform the analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage and operation with debris-laden fluids. The submittal may reference a guidance document (e.g., Regulatory Guide 1.82, Rev. 3, industry guidance) or other methodology previously submitted to the NRC. (The submittal may also reference the response to Item 1 of the Requested Information described above. The documents to be submitted or referenced should include the results of any supporting containment walkdown surveillance performed to identify potential debris sources and other pertinent containment characteristics.)*

NMC Response

(c) The analysis of the susceptibility of the ECCS recirculation functions to the adverse effects of post-accident debris blockage was performed using methodology in the Nuclear Energy Institute (NEI) Guidance Document NEI 04-07, as modified by the NRC's safety evaluation for NEI 04-07. Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI 02-01, Revision 1.

PINGP 1&2 have two loop Reactor Coolant Systems. Each loop consists of the reactor coolant pump (RCP), steam generator (SG) and associated piping located within concrete vaults. The two loops in each unit are nearly identical with the exception that loop B includes the pressurizer (PRZ) and the associated surge line piping. The inside of the larger vault (RCS loop B) measures approximately 50 feet x 15 feet x 50 feet. A concrete slab with large access openings (3 feet high across the width) separates each vault from the basement elevation and the containment sump. The large access opening allow free drainage of liquid from the postulated break locations inside the vault to the containment basement elevation.

Containment Walkdowns

The containment walkdowns were performed in accordance with the guidance in NEI 02-01, Rev. 1 as modified by the NRC safety evaluation. All results are documented. The walkdowns and documentation searches included identification of insulation types, coatings (qualified and unqualified), miscellaneous debris sources and sampling for latent debris (dirt and dust).

The walkdowns identified qualified coatings surface areas within zones of influence (ZOI) and all unqualified coatings inside of containment. The walkdowns of unqualified coatings included sample measurements of the coating thickness.

The walkdowns specifically looked for tape, tags, labels, tie-wraps, and general cleanliness. All items identified were documented during the walkdowns and are conservatively assumed to be 100% transported to the sump screens.

The sampling for latent dust and lint was made by wiping down representative surfaces of known area with pre-weighed decontamination wipes (masolin cloth). The increase in weight of the wipes was recorded together with the location and surface area covered. This is described in more detail later.

Debris Generation

The debris generation analyses were performed in accordance with the guidance in NEI 04-07 and the associated NRC safety evaluation. Sargent & Lundy performed these analyses. As discussed below, the generation analyses considered several cases to identify the limiting debris loadings at the sump screen. The following summarizes the steps used in the debris generation analyses.

Unit Overview

The debris generation calculation addresses both units. A review of the physical plant layout was performed to ascertain any differences between the units that might affect this calculation. The review concluded that both units have similar containment layouts and only differ in the equipment layout within the SG/PRZ vaults. In Unit 1, the SG is in the middle, with the PRZ and the RCP located on either side of the SG. In Unit 2, the RCP is in the middle with the SG and the PRZ located on either side of the RCP. The difference in this equipment layout also results in somewhat different piping layout in these two vaults. The equipment and piping layout in the other two vaults (Loop A) is nearly identical.

The insulation for most lines and equipment is nearly identical in both units. The majority of insulation is mirror reflective metallic insulation (RMI) except for the Unit 1 SGs, which are insulated with Transco RMI. All metallic insulation used inside of containment is stainless steel. There is some fibrous blanket insulation installed on the Main Steam (MS) and Feedwater (FW) piping restraints located outside of the vaults. The fibrous blanket insulation is located outside of the zones of influence for all loss of coolant accident (LOCA) break locations. PINGP 1&2 only use sump recirculation for LOCA mitigation. The inside volumes of several of the MS and FW restraints contain calcium silicate (Cal-Sil) insulation. The Cal-Sil is an internal part of the restraint with steel cover plates to completely retain the insulation; thus, the Cal-Sil would not be a potential debris source.

Break Selection

Identifying the break locations is the first step in determining LOCA generated debris. The "limiting" break is identified as the break that results in the type, quantity and mix of debris generation that is determined to result in the maximum debris transport potential and the maximum head loss across the sump screen. Break sizes for pipe lines 2" and smaller were not considered. The following Figures 3 and 4 show the postulated break locations. The description following the figures describes the break locations.

Figure 3
Unit 1 Break Locations

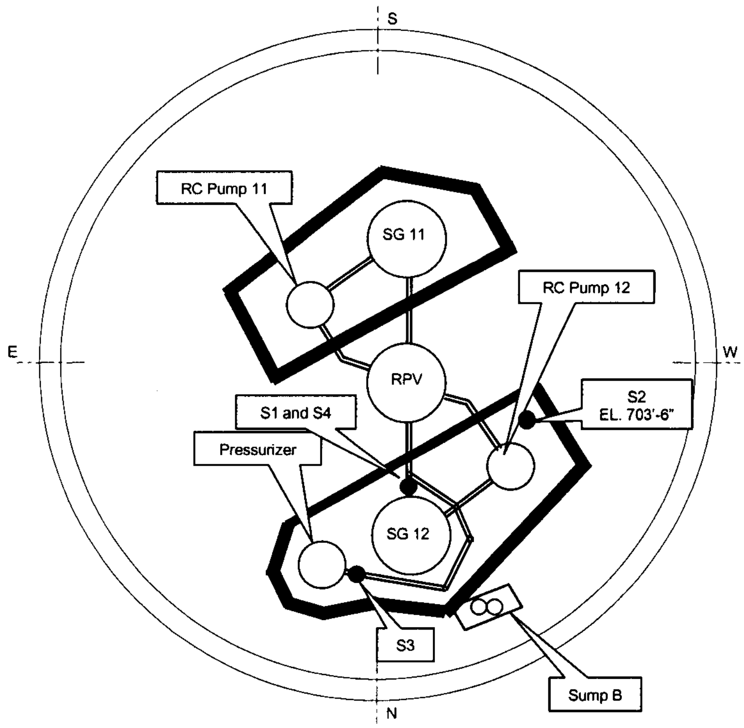
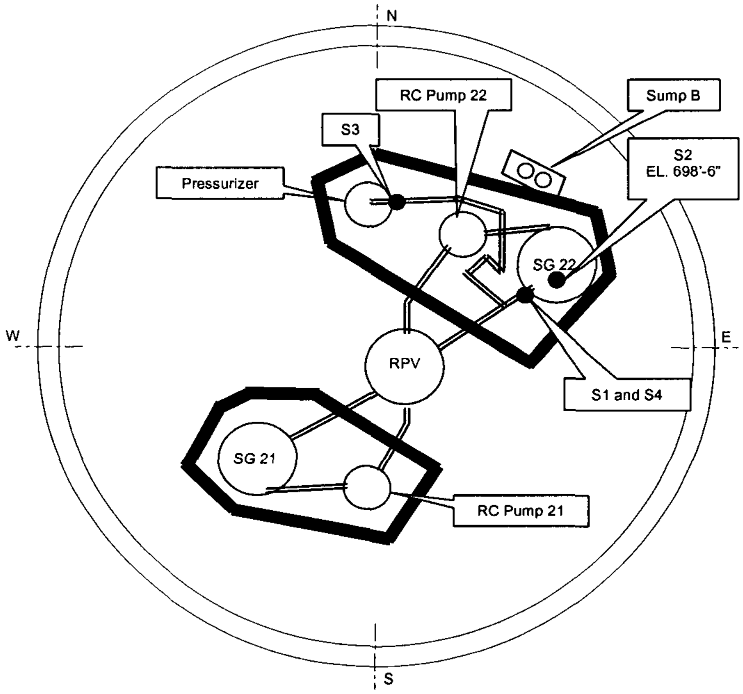


Figure 4
Unit 2 Break Locations



The calculation selected vault B in each unit as the representative vault for the debris generation since vault B contains more insulated pipe and equipment (SG, RCP, and PRZ) and is closer to the containment sump. Breaks were selected as follows:

Break S1 & S4 at the hot leg at the inlet to Unit 1 SG. This break is the limiting break from a debris standpoint because it affects the largest quantity of reflective mirror insulation on piping and the major equipment in the vault and the largest quantity of qualified coatings in the zone of influence.

Break S1 & S4 at the hot leg at the inlet to Unit 2 SG. This break is the limiting break from a debris standpoint because it affects the largest quantity of reflective mirror insulation on piping and the major equipment in the vault and the largest quantity of qualified coatings in the zone of influence.

Break S2 at the Unit 1 12-inch SI Accumulator Injection line. This break is the largest break at the basement elevation with close proximity to the sump. This break results in easier transport of debris to the containment sump.

Break S2 at the Unit 2 8-inch Train B RHR suction line. This break is the largest break at the basement elevation with close proximity to the sump. This will result in easier transport of debris to the containment sump.

Break S3 at the Unit 1 pressurizer surge line near the connection to the pressurizer. The break was chosen as another large break within the vault that would affect the pressurizer insulation and most piping and equipment insulation.

Break S3 at the Unit 2 pressurizer surge line near the connection to the pressurizer. The break was chosen as another large break within the vault that would affect the pressurizer insulation and most piping and equipment insulation.

Debris Generation

Based on the postulated break locations, the quantities of debris generated were determined using the guidance in NEI 04-07 and the associated NRC safety evaluation. Table 1 summarizes the debris quantities by break location from the debris generation analyses. The methodology used to determine these debris quantities is described in more detail below for each debris type.

Table 1
Summary of LOCA Generated Debris

Debris Type	Units	Break S1	Break S2	Break S3	Break S4
INSULATION					
Unit 1					
Transco RMI Foil	[ft^2]	1207.89	0	0	797.21
Transco RMI Large Debris	[ft^2]	1207.89	0	0	1618.57
Mirror RMI (standard bands)	[ft^2]	17,449.49	6394.50	22,025.61	15,030.91
Mirror RMI Large Debris (standard bands)	[ft^2]	5644.24	0	0	3225.66
Unit 2					
Mirror RMI (standard bands)	[ft^2]	33,358.15	2934.35	22,711.30	20,779.0
Mirror RMI Large Debris (standard bands)	[ft^2]	21,121.32	0	800.15	8542.15
Misc. Fiber (use for both units)	[ft^3]	0.014	0.014	0.014	0.014
COATINGS					
Unit 1					
Carboline - Carbozinc 11	[ft^3]	0.71	0.141	0.204	0.228
Carboline - Phenoline 305 Primer	[ft^3]	0.08	0.083	0.022	0.025
Carboline - Phenoline 305 Finish	[ft^3]	1.496	0.366	0.429	0.481
Carboline 195	[ft^3]	0.392	0.417	0.113	0.126
Unit 1 Qualified Coatings Total	[ft^3]	2.678	1.007	0.768	0.86
Unit 2					
Carboline - Carbozinc 11	[ft^3]	0.71	0.141	0.204	0.228
Carboline - Phenoline 305 Primer	[ft^3]	0.08	0.083	0.022	0.025
Carboline - Phenoline 305 Finish	[ft^3]	1.496	0.366	0.429	0.481
Carboline 195	[ft^3]	0.392	0.417	0.113	0.126
Unit 2 Qualified Coatings Total	[ft^3]	2.678	1.007	0.768	0.86
UNQUALIFIED COATINGS (Both Units)	[ft^3]	1.98	1.98	1.98	1.98
LATENT DEBRIS					
Unit 1	[lbm]	104.4	104.4	104.4	104.4
Unit 2	[lbm]	115.9	115.9	115.9	115.9

Debris Type	Units	Break S1	Break S2	Break S3	Break S4
FOREIGN MATERIALS [(1)]					
Fiber cloth on insulation cable	[ft^2]	23.76	23.76	23.76	23.76
Labels (plastic) (75% area) – qualified labels only included if in ZOI	[ft^2]	9.29	8.67	9.29	9.29
Light bulbs – only included if in ZOI	[ft^2]	32.46	2.44	32.46	32.46
Stickers (75% area)	[ft^2]	15.71	15.71	15.71	15.71
Signs (plastic) (75% area)	[ft^2]	0.67	0.67	0.67	0.67
Tags (plastic & paper) (75% area)	[ft^2]	20.56	20.56	20.56	20.56
Tape (75% area)	[ft^2]	52.87	52.87	52.87	52.87
Tie Wraps	[ft^2]	14.64	14.64	14.64	14.64
Vent Fan Expansion Bellows	[ft^2]	4.71	4.71	4.71	4.71
Miscellaneous Materials	[ft^2]	3.26	3.26	3.26	3.26
TOTAL FOREIGN MATERIALS	[ft^2]	**177.93**	**147.28**	**177.93**	**177.93**

(1) Foreign Materials are from Unit 1; which bound those identified in Unit 2

Insulation

The zones ZOI for the reflective mirror, Transco RMI, and fibrous blanket insulation installed in Unit 1 and Unit 2 containment were obtained from NRC safety evaluation Table 3-2. As previously discussed, Cal-Sil was not considered as it is completely contained in the steel restraints. This calculation assumed that mirror insulation on large equipment subject to the destructive pressure of the postulated pipe break would be damaged on the surface(s) directly exposed to the jet pressure. Insulation on the back surface of the equipment will also be damaged, however, it will become large debris. The calculation tabulated the quantity of the small destroyed debris and large debris.

Coatings

In accordance with NRC safety evaluation section 3.4.2.1 a ZOI of 10D (ten pipe diameters) was used to determine the quantities of qualified coatings that fail.

All unqualified coating were assumed to fail regardless of location.

Foreign Material

The quantity of type of foreign material inside containment was based on the walkdown data performed for Unit 1 and Unit 2 containment. The foreign material identified included self-adhesive labels, stickers, tape, placards, tags, etc. The foreign material conservatively includes all materials inside of containment (i.e., those within a ZOI, submergence area, containment spray area and non-spray areas). Furthermore, to provide a bounding assumption, all foreign material was assumed to transport to the sump.

Latent Debris

The quantity of latent debris (dirt and dust) was determined by representative sampling. The vertical and horizontal surface areas inside of containment were determined assuming that 100% of the surface area is susceptible to debris accumulation (except for surfaces oriented downward). The representative mass per unit area on the horizontal and vertical surfaces was determined using repeated swiping with a masolin cloth. Several representative surfaces were sampled (containment shell, concrete walls, vertical surfaces on components, floors, piping, cable trays, Polar Crane girder, structural steel, etc.). The sample locations were selected based on visual observations to provide conservatively high estimates of total dirt and dust. Furthermore, the samples were taken near the end of the respective unit refueling outage, but prior to clean-up, to ensure that the values measured were much higher than actually would be expected in an event. Subsequent walkdowns following clean-up, but prior to containment close-out showed that containment is maintained in a much cleaner state during operation than at the point the sampling was conducted. These techniques ensure that the quantities of dirt and dust predicted by the sampling are very conservative.

Debris Transport

The transport of the debris from the break location to the sump screen is evaluated using the methods outlined in section 3.6 of NEI 04-07 with the modifications recommended in the NRC safety evaluation. The means of transport considered are blowdown, washdown, pool fill and recirculation for all types of debris.

Fibrous debris was characterized into four debris size categories based on the interpretation of the test data. The NEI small fines category was subdivided into fines (8%) and small pieces (25%) and the NEI large category was subdivided into large debris (32%) and intact debris (35%). The fines and small pieces were considered to transport to the screen, the large debris does not transport in bulk, but erodes and transports as fines and the intact debris does not transport.

All particulate and coating (qualified and unqualified) debris was modeled as fines and 100% transports to the screen.

The RMI size distribution is based on the categorization provided in the NRC safety evaluation (Appendix II). For Mirror the values used are 1.6% fines and 98.4 % large debris. For Transco the values used are 75% fines and 25% large debris.

Transportation from the break location to the screen is evaluated through the use of decision trees and considers the effect of dislocation, hold up on the floor or other structures, deposition in an active or inactive pool, lifts over curbs, and erosion.

Miscellaneous debris (tape, labels, etc.) is not included in the debris load, but is considered in the screen design as a sacrificial area. As discussed above, it is conservatively assumed that all of the miscellaneous debris is transported to the sump screen.

Calculation of Available NPSH

RHR pump available NPSH from the containment sump is determined based on static head from the water elevation to the pump and the frictional losses between the sump and the pump. No credit is taken for containment over-pressure. Frictional losses are determined based on a pump flow rate of 2600 gpm. Minimum available NPSH to the RHR pumps is determined to be 27.8 feet. Pump required NPSH at 2600 gpm is 14 feet. As discussed above, based on system hydraulics the maximum RHR pump flow is 2085 gpm. At the lower flow rate the available NPSH would be higher and the required NPSH would be lower, providing additional margin.

Screen Head Loss

The purchase specification developed for the replacement strainers dictates that the maximum allowable head loss across the sump screen is 10 feet, based on the NPSH margin available (13.8 feet). Although the entire NPSH margin is available for the allowable head loss, a portion of the NPSH margin is conservatively retained.

Preliminary results (from PCI strainer vendor) indicate a head loss of approximately 5 feet at 5200 gpm at a liquid temperature of 65°F. 5200 gpm is assuming both RHR pumps are operating at runout flow rate of 2600 gpm each. As discussed above, based on system hydraulics, maximum RHR pump flow rate is 2085 gpm each. The final strainer head loss analysis will be performed by the strainer vendor and will be documented as part of the design change information. Thus, considerable margin is retained to address items such as chemical effects.

Downstream Effects

Flow Clearance

This evaluation, using the overall guidance provided in NEI 04-07 and NRC safety evaluation, identified the flow clearances for components in the ECCS recirculation flow path. The evaluation is based on the sump screen hole size of 1/8" diameter. This screen hole size is larger and thus bounds the downstream effects of the proposed new strainer. The evaluation concluded the nuclear fuel, RHR and SI pumps require a more detailed flow blockage/wear evaluation. This is described in more detail in Section 2.d(v) of this document.

Long Term Effects on ECCS

This evaluation considered the inputs from the Flow Clearance evaluation mentioned above and analyzed the downstream effects in accordance with the methodology provided in WCAP-16406-P. The results are summarized in Section 2.d(vi) of this document.

Effects on Reactor Vessel Internals and Fuel

This analysis of the effects on the fuel is being performed by Westinghouse. The analysis is based on the guidance provided in WCAP-16406-P. The results are summarized in Section 2.d(vi) of this document.

<u>Chemical Effects</u>

An evaluation of the applicability of the Chemical Test Plan to PINGP 1&2 specific post-LOCA conditions was performed. The Integrated Chemical Effects Test Plan provides a list of materials to be tested, as well as their volume ratios. It also provides a list of chemical parameters for the testing. An inventory of the test materials has been developed in this evaluation for the PINGP 1&2 containments. Potential head loss due to chemical effects will be factored into the design for the new strainer based on yet to be performed sump strainer supplier testing.

NRC Requested Information

(d) The submittal should include, at a minimum, the following information:
(i) The minimum available NPSH margin for the ECCS and CSS pumps with an unblocked sump screen.

NMC Response

(d)(i) The only pumps that take suction from the sump are the RHR pumps. As previously discussed, the containment spray pumps are not operated in the recirculation mode. The minimum available NPSH margin for the RHR pumps at switchover to sump recirculation, not including the clean screen head loss, is 13.8 feet assuming that the pump is operating at runout flow rate of 2600 gpm. As discussed above, system hydraulics limit the maximum pump flow rate to 2085 gpm. At 2085 gpm, the required NPSH would be less and the minimum available NPSH margin would be increased. The clean screen head loss is small (<0.1 feet based on experience). However, the exact values will only be known when the design is finalized.

NRC Requested Information

(d)(ii) The submerged area of the sump screen at this time and the percent of submergence of the sump screen (i.e., partial or full) at the time of the switchover to sump recirculation.

NMC Response

(d)(ii) The preliminary design for the new strainers provides approximately 800 square feet of surface area. Based on the design specification and the proposed design, the strainers will be fully submerged with the minimum water level in containment; i.e., 100% of the strainer will be submerged for both large and small break LOCAs at the time of the switchover to sump recirculation. As discussed above, minimum water level is determined based on a small break LOCA scenario. For a large break LOCA, the water level would be higher.

NRC Requested Information

(d)(iii) The maximum head loss postulated from debris accumulation on the submerged sump screen, and a description of the primary constituents of the debris bed that result in this head loss. In addition to debris generated by jet forces from the pipe rupture, debris created by the resulting containment environment (thermal and chemical) and CSS washdown should be considered in the analyses. Examples of this type of debris are disbonded coatings in the form of chips and particulates and chemical precipitants caused by chemical reactions in the pool.

NMC Response

(d)(iii) The maximum postulated head loss from debris accumulation on the submerged sump strainer is specified to be 10 feet of water or less. This is the value specified in the purchase specification. As discussed above, the preliminary evaluations by the new strainer vendor are on the order of 5 feet at 5200 gpm. The primary constituents of the debris bed at the sump strainer predicted from the analyses for the limiting case are shown in Table 2, below. As also shown in Table 2 the values provided to the strainer vendor are selected to bound the values in the analyses. For example, 170 lbm of latent particulate debris is provided to the strainer vendor. These margins are included (and clearly identified in plant documentation) for conservatism.

Table 2
Debris at Sump

Debris Type	Units	Debris at Sump	Debris assumed at Sump in Replacement Strainer Specification
INSULATION			
Unit 1			
Transco RMI Foil	[ft^2]	680.0	900
Transco RMI Large Debris	[ft^2]	0	
Mirror RMI (standard bands)	[ft^2]	209.4	300
Mirror RMI Large Debris (standard bands)	[ft^2]	0	
Unit 2			
Mirror RMI (standard bands)	[ft^2]	400.3	450
Mirror RMI Large Debris (standard bands)	[ft^2]	0	
COATINGS			
Unit 1			
Carboline - Carbozinc 11	[ft^3]	0.7	1.0
Carboline - Phenoline 305 Primer	[ft^3]	0.1	0.15
Carboline - Phenoline 305 Finish	[ft^3]	1.5	2.0
Carboline 195	[ft^3]	0.4	0.5
Unit 2			
Carboline - Carbozinc 11	[ft^3]	0.7	1.0
Carboline - Phenoline 305 Primer	[ft^3]	0.1	0.15
Carboline - Phenoline 305 Finish	[ft^3]	1.5	2.0
Carboline 195	[ft^3]	0.4	0.5
UNQUALIFIED COATINGS (Both Units)	[ft^3]	1.98	2.5
Fibers			
Misc. Fiber	(ft^3]	< 0.1	0.1
Latent Fibers	[lbm]	15.66	30
Fiber Cloth on Cable Insulation	[ft^2]	23.76	30
Vent Fan Expansion Bellows	[ft^2]	4.71	6
Particulate			
Light Bulbs	[ft^2]	32.46	40
Latent Particulate	[lbm]	100	170

Sump screen design includes sacrificial area to accommodate miscellaneous debris sources.

The above debris does not include debris resulting from chemical effects. PINGP 1&2 use NaOH as the buffer. A comparison of the Electric Power Research Institute/NRC chemical test plan and the PINGP 1&2 plant specific parameters has been performed. This comparison shows that, with the exception of carbon steel, sump pH, and the sump temperature profile, the chemical test parameters bound the PINGP 1&2 values. Although the PINGP 1&2 ratio for carbon steel is not bounded by the test ratio, the carbon steel is not submerged and is only subject to spray. Since the time duration of containment spray is short by comparison to the overall duration of the test, the excess amount of carbon steel is not significant. Actual predicted sump pH is less than that used during the testing program. Predicted limiting sump liquid temperature profile is greater than that used during the testing program. Sump strainer suppliers are currently developing plans and schedule to quantify the additional head loss associated with Chemical Debris. NMC plans to evaluate the adequacy of the strainer design and will incorporate chemical effects once the test results to quantify chemical debris effect on head loss have been published. At the same time, an additional evaluation will be performed to determine the impact of the sump pH and the increased temperature profile on the head loss due to chemical effects.

As discussed above, margins in assumed debris quantity, assumptions for flow rate through the screens, and NPSH available have been reserved in the current design that is expected to be more than sufficient to address the chemical precipitant head loss. For example, the current NPSH available margin with a clean screen is on the order of 13.5 feet. The strainer vendor predicts a head loss of approximately 5 feet with both RHR pumps operating at runout condition (5200 gpm). This leaves almost 200% margin not accounting for any system flow reductions later in the event.

NRC Requested Information

(d)(iv) The basis for concluding that the water inventory required to ensure adequate ECCS or CSS recirculation would not be held up or diverted by debris blockage at choke-points in containment recirculation sump return flowpaths.

NMC Response

(d)(iv) In general, the containment floor plans are clear of major obstructions that could prevent flow from reaching the containment sump screens. The configuration of the containment basement elevation is conducive to directing flow to the containment sump. The entire basement elevation of the containment building serves as the ECCS sump for collection of water introduced to the containment following a LOCA. The basement floor elevation is essentially an open area except for the primary reactor shield wall, the walls and supports for the loop compartments (vaults), and the refueling cavity. The flow paths from the upper levels of containment to the lower levels are relatively free: i.e., open stairways and/or floor grating. The vaults contain the RCPs and SGs. These vaults have large openings that allow all liquid to spill to the containment basement elevation. The volume of sumps and other holdup volumes not connected to the recirculation sump have been included in the minimum water level calculation. The Refueling Pool drains through a 4-inch pipe and valve to Sump A. The valve is locked open during normal operation. The pool drain has a trash grate that would not be prone to blockage. The containment closeout procedures include specific verifications that the refueling pool drain is not blocked. Therefore, a credible path to the containment pool exists and there is no hold up of inventory in the Refueling Pool. Further, there are no drainage paths that bypass the ECCS suction screen.

NRC Requested Information

(d)(v) The basis for concluding that inadequate core or containment cooling would not result due to debris blockage at flow restrictions in the ECCS and CSS flowpaths downstream of the sump screen, (e.g., a HPSI throttle valve, pump bearings and seals, fuel assembly inlet debris screen, or containment spray nozzles). The discussion should consider the adequacy of the sump screen's mesh spacing and state the basis for concluding that adverse gaps or breaches are not present on the screen surface.

NMC Response

(d)(v) The flow paths downstream of the containment sump were analyzed to determine the potential for blockage due to debris passing through the sump screen. The methodology was based on WCAP-16406-P.

These evaluations were done for all components in the recirculation flow paths including, but not limited to, throttle valves, flow orifices, pumps, heat exchangers, valves and fuel assemblies. The methodology employed in this evaluation is based upon input obtained from a review of the recirculation flow path shown on Piping and Instrument Drawings and plant procedures. The following steps were used to perform this analysis:

- Determine the maximum characteristic dimension of the debris based on clearance through the sump screen with consideration of deformable particles.
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings, technical manuals, etc.) for the components to obtain flow clearance dimensions.
- Determine blockage potential through a comparison of the flow clearance through the component with the flow clearance through the sump screen.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Consistent with WCAP-16406-P, the analyses allowed for debris larger than the strainer openings to account for deformable particles. Preliminary indications are that there are no significant concerns with these effects.

PINGP 1&2 do not have any cyclone separators (an identified vulnerability where installed). The RHR pumps are of relatively robust single stage design without intervening hydrostatic bearings. System piping is free from small orifices; for example, the high head injection line orifices are 0.875 inches diameter. The RHR heat exchanger tubing has an internal diameter of 0.652 inches. Valves that are capable of being remotely throttled for flow control are relatively large fail-open butterfly valves (8") in the RHR system and normally open gate valves (6") in the SI system. All of these openings are much greater than the proposed replacement strainer hole size of 0.095 inches.

Unless a LOCA is very small, SI pump operation will not be necessary while on sump recirculation. For a small LOCA, the SI pump would be operated during recirculation, until the RCS is cooled down and depressurized to allow RHR pump injection. Maximum time frame for SI pump operation during recirculation is less than twelve hours.

The analyses have identified select components that warrant further evaluation. As discussed in (d)(vi) below, the long-term downstream evaluations are in progress. The resolution and corrective actions for the above components will be performed with the long term evaluations.

The new strainer design will ensure that gaps at mating surfaces within the strainer assembly and between the strainer and the supporting surface do not have gaps in excess of the strainer hole size of .095".

NRC Requested Information

(d)(vi) Verification that close-tolerance subcomponents in pumps, valves and other ECCS and CSS components are not susceptible to plugging or excessive wear due to extended post-accident operation with debris-laden fluids.

NMC Response

(d)(vi) Verification of debris blockage of downstream components is described in (d)(v). Verification of downstream components for long-term wear is in progress and is scheduled to be completed by the end of 2005. Preliminary results are as follows:

ECCS System Evaluation

For the long term wear evaluations, the quantity and type of debris is derived from the Debris Transport and Head Loss calculations and the sump screen Procurement Specification. The "Analysis of Available NPSH to the RHR Pumps from the Containment Sump" is used to determine the amount of fluid in which the debris will be mixed. Preliminary calculations have been performed for heat exchangers, orifices, and valves based on a conservative values for C_{co} of 0.0007 and decay coefficient of 0.02 for the methodology in WCAP-16406-P. The preliminary results indicate that these components will not be adversely affected. Based on the short operating time period for the SI system components the SI pumps are not expected to be adversely affected. Additional analysis work is ongoing for the RHR pumps.

Fuels and Reactor Vessel Evaluation

For the long term evaluations of the fuel assemblies and the reactor vessel flow passages, the quantity and types of debris is derived from the Debris Transport and Head Loss calculations. Preliminary calculations have been performed using the methodology in WCAP-16406-P. Evaluation of the effects of the debris on the fuel and reactor vessel flow passages indicates that the ability to maintain long term core cooling will not be adversely affected. This is based on the relatively low concentration of fibrous debris and the large available flow passages.

NRC Requested Information

(d)(vii) Verification that the strength of the trash racks is adequate to protect the debris screens from missiles and other large debris. The submittal should also provide verification that the trash racks and sump screens are capable of withstanding the loads imposed by expanding jets, missiles, the accumulation of debris, and pressure differentials caused by post-LOCA blockage under predicted flow conditions.

NMC Response

(d)(vii) The sumps are located outside the missile barriers and any zones of influence of high energy line breaks. Therefore, the screens are not subject to loads from missiles or expanding jets during a loss of coolant accident. Therefore, trash racks are not required. The new strainers will be designed for the effects of weight, thermal, differential pressure, and seismic loading. The new strainers will be designed to withstand the loads imposed by the accumulation of debris and pressure differentials under bounding flow conditions (5200 gpm) as specified in the design requirements.

NRC Requested Information

(d)(viii)If an active approach (e.g., backflushing, powered screens) is selected in lieu of or in addition to a passive approach to mitigate the effects of the debris blockage, describe the approach and associated analyses.

NMC Response

(d)(viii) The strainers selected for PINGP 1&2 are of a passive design. No active mechanisms are being implemented to mitigate the effects of debris blockage. Therefore, this specific request is not applicable.

NRC Requested Information

(e) A general description of and planned schedule for any changes to the plant licensing bases resulting from any analysis or plant modifications made to ensure compliance with the regulatory requirements listed in the Applicable Regulatory Requirements section of this generic letter. Any licensing actions or exemption requests needed to support changes to the plant licensing basis should be included.

NMC Response

(e) The proposed corrective actions will require a change to the plant licensing bases to ensure compliance with the regulatory requirements identified in the Applicable Regulatory Requirements section of this generic letter. Technical Specification surveillance requirement (SR) 3.5.2.8 requires inspection of each ECCS train trash rack and screen every 24 months. As discussed above, the replacement strainer does not include a trash rack. Therefore, SR 3.5.2.8 will need to be changed to reflect the new design.

NRC Requested Information

(f) A description of the existing or planned programmatic controls that will ensure that potential sources of debris introduced into containment (e.g., insulations, signs, coatings, and foreign materials) will be assessed for potential adverse effects on the ECCS and CSS recirculation functions. Addressees may reference their responses to GL 98-04, "Potential for Degradation of the Emergency Core Cooling System and the Containment Spray System after Loss-of-Coolant Accident Because of Construction and Protective Coating Deficiencies and Foreign Material in Containment," to the extent that their responses address these specific foreign material control issues.

NMC Response

(f) NMC realizes that control of potential debris sources inside of containment is very important and that debris sources that are introduced to containment need to be identified and assessed. Potential debris sources can be generally categorized into the following general areas: insulation, coatings (both qualified and unqualified), miscellaneous sources (labels, tags, tape, etc.), and dirt/dust. NMC currently implements the following controls for these potential sources of debris.

Insulation used inside of containment is identified on site drawings. Walkdowns performed in support of the resolution of GL 2004-02 confirmed the accuracy of these drawings. As discussed previously, PINGP 1&2 use almost entirely reflective metallic insulation inside of containment (few exceptions on Main Steam and Feed Water piping restraints). The plant specification for insulation requires that all insulation used inside of containment in the future be reflective metallic. The modification process requires that materials introduced to containment be will be assessed for potential adverse effects on the ECCS recirculation function.

The majority of the coatings inside of containment were procured, applied and are maintained as qualified protective coatings. This includes all coatings on the containment steel shell, concrete, structural steel and components. As described in the response to NRC Generic Letter 98-04, dated November 11, 1998,

> "NSP [now NMC] periodically conducts condition assessments of Service Level 1 coatings inside containment. Coating condition assessments are conducted as part of the plant surveillance program during each refueling outage. As small localized areas of degraded coatings are identified, those areas are evaluated and scheduled for repair or replacement, as necessary. The periodic condition assessment, and the resulting repair/replacement activities, assure that the amount of Service Level 1 coatings that may be susceptible to detachment from the substrate during a LOCA event is minimized."

The debris generation calculation discussed above, includes margin for potential detachment or failure of limited quantities of qualified coatings (greater than the localized areas observed during inspections). NMC recognizes that discussion is ongoing between the NRC and the industry regarding the requirements for inspections of qualified coatings and that these requirements may be changing in the future. NMC will evaluate any changes to these requirements and make changes to the periodic inspection programs, as necessary.

Unqualified coatings have been identified by location, surface area and thickness. The majority of unqualified coatings inside of containment are component Original Equipment Manufacturer coatings. Modifications inside of containment are controlled through the modification process. As part of the modification process, materials that are introduced to containment are identified and evaluated to determine if they could affect sump performance or lead to equipment degradation. The identification of materials includes any coating applications that are required either by the equipment manufacturer or applied on site. Specifically, new or replacement equipment are evaluated for the potential of unqualified coatings. Any new unqualified coatings are evaluated, and if determined to be acceptable, are included in the log of unqualified coatings.

Walkdowns in support of resolution of GL 2004-02 identified and quantified miscellaneous potential sources of debris (tags, labels, identification tape, etc.) inside of containment. The modification process requires that materials introduced to containment be identified and evaluated for potential impact to the sump and equipment as part of the design process. Administrative procedures control the types of tags and labels that can be used inside of containment.

During recent outages, efforts have been taken to reduce the quantities of these miscellaneous debris sources inside of containment.

During operation above Mode 5, containment is treated as a foreign material exclusion (FME) area. Site procedures require that all items entering containment are logged. Use of the log provides assurance that materials entering containment are removed and do not become a potential debris source. Materials inside of containment are assessed for potential adverse effects on the ECCS recirculation function.

At the end of an outage, a formal containment closeout surveillance procedure is performed. The closeout is performed to ensure that materials that could reduce safeguards systems operation/performance (including containment sump and ECCS systems) are removed from containment or adequately secured. Items not removed require a documented engineering evaluation to provide the basis for concluding that the item remaining in containment is acceptable. As part of containment closeout (per Technical Specification Surveillance Requirement SR 3.5.2.8) each ECCS train containment sump and sump screens are inspected for damage or debris. Also, the refueling pool drain (potential choke point location) is verified not to be obstructed and that there are no potential debris sources in the pool area that could obstruct the drain in the event of a loss of coolant accident.

As discussed above, as part of the containment walkdowns used to identify potential debris sources, measurements were taken to conservatively estimate the amount of latent dirt and dust inside of containment. These measurements were taken at a point during the respective refueling outage where the level of dirt and dust would be much higher than during normal power operation. Subsequent to the measurements being taken but prior to unit startup, extensive cleaning was performed. These cleaning activities are consistent with normal housekeeping practices and associated administrative requirements. To provide an additional level of conservatism, the actual dirt and dust quantities assumed in the analysis are much greater than the values determined from the measurements. In order to ensure that the analysis remains bounding, NMC will perform measurements to estimate the amount of latent dirt and dust inside containment every other refueling outage in the respective Prairie Island Nuclear Generating Plant Units 1 and 2. Measurements were completed during the last Unit 1 and Unit 2 outages (Cycle 23, for each unit). The next measurements for each unit will be performed during their respective Cycle 25 refueling outages. Assuming the results indicate that the housekeeping practices provide an adequate level of cleanliness, NMC may choose to relax this frequency.