Dominion Resources Services, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060

Dominion

September 1, 2005

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

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DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2
RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Dominion Energy Kewaunee, Inc. (DEK) is providing the response for Kewaunee Power Station in Attachment 1. Dominion Nuclear Connecticut, Inc. (DNC) is providing the response for Millstone Power Station Units 2 and 3 in Attachments 2 and 3, respectively. Virginia Electric and Power Company (Dominion) is providing the response for North Anna Power Station Units 1 and 2 in Attachment 4 and for Surry Power Station Units 1 and 2 in Attachment 5.

A116

Should you have any questions regarding the responses provided, please contact Mr. Paul R. Willoughby at (804) 273-3572.

Very truly yours,

David A. Christian
Senior Vice President - Nuclear Operations and
Chief Nuclear Officer

Attachments (6)

Commitments in this letter are provided in Attachment 6.

cc: U.S. Nuclear Regulatory Commission
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COMMONWEALTH OF VIRGINIA)
)
COUNTY OF HENRICO)

The foregoing document was acknowledged before me, in and for the County and Commonwealth aforesaid, today by David A. Christian, who is Senior Vice President – Nuclear Operations and Chief Nuclear Officer, of Dominion Energy Kewaunee, Inc., Dominion Nuclear Connecticut, Inc. and Virginia Electric and Power Company. He has affirmed before me that he is duly authorized to execute and file the foregoing document in behalf of those companies, and that the statements in the document are true to the best of his knowledge and belief.

Acknowledged before me this 1st day of September, 2005.

My Commission Expires: August 31, 2008.

Margaret B. Bennett
Notary Public

(SEAL)

ATTACHMENT 1

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

**DOMINION ENERGY KEWAUNEE, INC.
KEWAUNEE POWER STATION**

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

KEWAUNEE POWER STATION

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Dominion Energy Kewaunee, Inc. (DEK) is providing the response for Kewaunee Power Station (KPS) below.

Current System Description

The residual heat removal (RHR) pumps take suction from the containment sump. The sump inventory consists of spilled reactor coolant, injected water from the safety injection (SI) system accumulators and the refueling water storage tank (RWST), and internal containment spray (ICS) drainage.

The SI pumps take suction from the RHR pumps for small break sizes where the reactor coolant system pressure remains in excess of the shutoff head of the residual heat removal pumps at the end of the injection phase.

With two ECCS trains available, a RHR pump is manually aligned to take suction from the containment sump when the RWST reaches 37% level. The second train is manually aligned for recirculation standby when the RWST reaches 4% level. If only one train of ECCS is available, the train is manually aligned for recirculation when the RWST reaches 10% level.

Operation of the ICS system in the recirculation mode is not credited in the KPS safety analyses.

NRC Requested Information

2(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.**

DEK Response

2(a) Upon completion of activities described in this attachment related to modifications to the containment sump, the KPS ECCS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02).

Upon completion of modifications to the containment sump as a result of the analysis required by GL 04-02, the operation and general configuration of the KPS containment recirculation sump will remain similar to the current design. The existing sump screens will be replaced with a new strainer with increased surface area and with a lower height to be fully submerged at the start of recirculation. The sump strainer will remain a passive component.

Containment walkdowns have been completed to quantify potential debris sources in containment, verify flow paths and choke points and gather data for the conceptual design of a replacement strainer. The debris generation calculation, downstream effects evaluations for blockage, and the debris transport and head loss calculation have been drafted and are in review. The chemical effects evaluation and the downstream effects evaluation for long-term wear and fuel blockage evaluations are in progress.

No licensing basis changes requiring NRC approval are anticipated for KPS.

This response is based on information currently available and will be amended if the final design deviates significantly from the information provided.

NRC Requested Information

2(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.

DEK Response

2(b) Based on the results of debris generation, transport and head loss analyses, a modification to the containment recirculation sump is required to meet the applicable regulatory requirements section in the Generic Letter. The following is a general description of the modification:

- The two conical-shaped sump screens over the common sump will be replaced with a passive sump strainer sized to accommodate the KPS post-accident debris load.
- The surface area of the new strainer is anticipated to be approximately 600 square feet (without thin bed effect (TBE)) to 1600 square feet (with TBE).
- The sump strainer perforation size is anticipated to be less than 1/8 inch diameter.
- The new strainer is anticipated to be fully submerged at the start of recirculation.
- Sacrificial surface area will be provided to account for miscellaneous debris sources such as tape, tie-wraps, paper and plastic equipment labels, etc.
- Head loss margin will be maintained for post-accident chemical effects and future changes in debris loading.

The sump strainer modification may also include modifying the perforated bottom float support plates for the sump level indicator switches. The support plates have perforations that provide a water entry point into the sump. If the final strainer design has perforations smaller than the support plate perforations, the plates will be modified.

No modifications have been identified as a result of downstream evaluations performed to date.

In addition to the sump strainer modification, maintenance activities to be performed include:

- Replacement of pipe insulation on the service water lines to the control rod drive mechanism shroud cooling coils. The fiberglass insulation on this piping is exposed to containment spray and the insulation and stainless steel lagging is in a degraded condition. The insulation will be replaced with like materials to improve its material condition.

- Repair of the pipe insulation stainless steel lagging on the steam generator blowdown piping in the reactor containment basement. The affected piping is submerged post-accident. The stainless steel lagging will be replaced or repaired to improve its material condition.

Implementation Schedule

The sump strainer modifications and maintenance activities are planned to be completed during the fall 2006 refueling outage.

NRC Requested Information

2(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.)

DEK Response

2(c) The analysis of the susceptibility of the ECCS recirculation functions to the adverse effects of post-accident debris blockage was performed using the methodology in Nuclear Energy Institute (NEI) Guidance Document NEI 04-07, Revision 0, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, as modified by the NRC Safety Evaluation Report for NEI 04-07, Revision 0.

Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI Guidance Document NEI 02-01, dated September 2002.

Downstream effects evaluations for blockage are being performed using the guidance in WCAP-16406-P, dated June 2005.

The results of the analyses will be documented in plant-specific evaluations. The following is a list of the evaluations and their current status:

- Debris Generation Calculation – in final review
- Debris Transport and Head Loss Calculation – in final review
- Downstream Effects Evaluation – Flow Clearances – in final review
- Downstream Effects - Evaluation for Wear – in progress
- Downstream Effects – Fuel Evaluation – in progress

- Chemical Effects and Margin Evaluation – in progress

The results of containment walkdowns to identify and document post-loss of coolant accident (LOCA) debris sources are documented in the KPS corrective action program.

An identified exception to the approved NEI methodology and NRC SER is that break selection was not performed at regular intervals (such as 5 ft discussed in the SER) along the RCS piping. Rather, the method used for break selection ensures that the limiting break has been selected due to both the amount and mix of insulation, coatings and foreign materials postulated to be removed as debris. All smaller lines are bounded by the selected breaks.

NRC Requested Information

2(d)(i) Minimum NPSH margin for ECCS and CSS pumps with unblocked sump screen.

DEK Response

2(d)(i) The minimum available net positive suction head (NPSH) margin for the RHR pumps at switchover to sump recirculation, not including clean strainer head loss, is greater than 16.0 feet. Clean strainer head loss is anticipated to be small (less than one foot) and will be determined upon final design approval.

The KPS ICS pumps are not credited for taking suction from the recirculation sump.

NRC Requested Information

2(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.

DEK Response

2(d)(ii) The replacement strainer will have a submerged area of greater than 600 ft^2 for either a large or small break LOCA at switchover to recirculation. The replacement strainer will be 100% submerged upon switchover to recirculation.

<u>NRC Requested Information</u>

2(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.**

<u>DEK Response</u>

2(d)(iii) The maximum postulated head loss from debris accumulation on the submerged sump strainer is specified to be 10.0 feet of water or less.

The primary constituents of the debris bed at the sump screen are: reflective metal insulation, fibrous insulation, calcium silicate, qualified and unqualified coatings, latent debris and miscellaneous materials such as labels and tags.

The above debris does not include debris resulting from chemical precipitants. KPS uses sodium hydroxide (NaOH) for post-accident recirculation pH control. A comparison of the ICET chemical test for Test #1 and the KPS plant-specific parameters was performed. The comparison showed that, with the exception of carbon steel, concrete surface area, sump pH, and the sump temperature profile, the ICET chemical test parameters bound the KPS values. Evaluations are in progress to address the parameters not bounded by the ICET results.

Sump strainer suppliers are currently developing plans and schedules to quantify the additional head loss associated with chemical precipitants. KPS has reserved head loss margin in the sump strainer design and will reevaluate the available margin once test results to quantify head loss from chemical precipitants are known.

NRC Requested Information

2(d)(iv) **Basis for concluding 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 flow paths.**

DEK Response

2(d)(iv) Recirculation flow paths and potential holdup areas have been evaluated. The reactor cavity, Sump C, will fill post-accident. This holdup volume was accounted for in the minimum water level calculation. Additionally, a small volume of water will be contained in the refueling pool cavity. This volume will reduce the post-accident submergence level by 0.2 inches and will not adversely impact the minimum specified recirculation sump water level used in KPS calculations.

No transport paths have been identified as a flow blockage or diversion concern.

NRC Requested Information

2(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.**

DEK Response

2(d)(v) Evaluation of the flow paths downstream of the containment sump to determine the potential for blockage due to debris passing through the sump strainer is in progress. The acceptance criteria were determined based on WCAP-16406-P evaluation methodology.

The scope of the evaluation includes the components in the recirculation flow paths such as throttle valves, flow orifices, pumps, heat exchangers, and valves. The methodology employed in this evaluation is based upon input obtained from a review of the recirculation flow path shown on piping and instrument diagram drawings and plant procedures. The steps used in obtaining the flow clearance are as follows:

- Determine the maximum characteristic dimension of the debris (clearance through the sump strainer).
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings and/or manuals) 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 strainer.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Components with a flow clearance less than or equal to the strainer perforation size will require further evaluation. Those components are the SI pump and RHR pump wear rings.

The components in the recirculation path were also reviewed to identify components with clearances greater than 110% of the sump strainer perforation size and less than 200% of the sump strainer perforation. No components were identified within this range.

Long term downstream evaluations, including the fuels evaluation, are in progress. The fuel vendor is currently performing evaluations for blockage through the reactor vessel internals as well as for blockage of the reactor fuel. Any necessary corrective actions for the above components will be performed following the long-term evaluations as part of the resolution of GSI-191.

The new strainer design will ensure that gaps at mating surfaces within the strainer assembly and between the strainer and the supporting surface are not in excess of the strainer perforation size. Similarly, the design will ensure that drainage paths to the sump that bypass the sump strainer will not have gaps in excess of the strainer perforation size.

NRC Requested Information

2(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.**

DEK Response

2(d)(vi) Clearances in downstream components are described above in response to item 2(d)(v). Evaluation of downstream components for adverse effects due to long-term wear is in progress. The methodology used is presented in WCAP-16406-P. Where excessive wear is found using this methodology, a refined approach using alternate methods may be used.

Preliminary calculations have been performed for KPS heat exchangers, orifices, and valves in the recirculation system. The preliminary results are as follows:

- Acceptable wear is shown for the RHR heat exchangers, SI and RHR system orifices, and RHR system throttle valves.
- Relief valves in the SI and RHR systems that could be subjected to debris were found acceptable because they will not lift during post-LOCA recirculation.
- Instrumentation required during post-LOCA recirculation was identified and the corresponding root valves were evaluated for clearance. All clearances were found to be greater than the screen opening size.
- Evaluations of instrumentation for debris settling in the instrument lines are in progress. No results are available at this time.
- Evaluations for pumps, SI system throttle valves, and piston (lift) check valves are in progress. No results are available at this time.

NRC Requested Information

2(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.

DEK Response

2(d)(vii) The containment recirculation sump is located outside the missile barriers and any high-energy line break zones of influence. Therefore, the strainer is not subject to loads from missiles or expanding jets during a loss of coolant accident. Trash racks are not required to protect the strainer from missiles and other large debris. The strainers will be designed to withstand the loads imposed by the accumulation of debris and pressure differentials under predicted flow conditions as specified in the design requirements, as well as seismically generated loads.

NRC Requested Information

2(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.**

Dominion Response

2(d)(viii) The replacement recirculation sump strainer selected for KPS will be a passive design.

NRC Requested Information

2(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.

DEK Response

2(e) No licensing changes requiring NRC approval to ensure compliance with the regulatory requirements of GL 04-02 are anticipated as a result of corrective actions made for KPS. Should changes requiring NRC approval become necessary, the NRC will be advised in a timely manner.

Changes to the existing ECCS sump screen will be evaluated under 10CFR50.59. Appropriate changes to KPS licensing basis documents will be completed as determined by the evaluation.

NRC Requested Information

2(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.

DEK Response

2(f) The following is a description of programmatic controls KPS utilizes to prevent introduction of debris into containment.

Routine Containment Inspections

A containment inspection is performed prior to criticality at the end of each refueling outage or applicable maintenance outage using approved procedures. The procedures provide instruction for identifying and removing items that could pose a debris concern and provide instruction for ensuring specific components are properly secured. A similar procedure is used for conducting containment inspections during power operations.

Insulation Activities

Insulation installation and removal at KPS is controlled by a general maintenance procedure and station engineering specifications. The engineering specifications provide requirements for installation of new and existing insulation. The insulation general maintenance procedure, which provides general guidance for removal and reinstallation of insulation, will be enhanced to ensure insulation activities in containment maintain the post-accident temperature profiles and minimize post-LOCA debris.

Coatings Applications

KPS has a program for the procurement, application and maintenance of Service Level I protective coatings used inside containment. The program is described in a letter addressed to the US NRC, dated November 12, 1998, in response to Generic Letter 98-04. The program is implemented by station procedures and an engineering specification. The procedures provide personnel responsibilities for maintaining the program, personnel qualification requirements, coating application instructions and monitoring the performance of applied coatings. A coatings log is maintained which indicates the amount and location of unqualified coatings in containment.

Foreign Material Exclusion

KPS has a foreign material exclusion (FME) program that is implemented by station procedures to prevent the intrusion of foreign materials into plant components and systems during maintenance activities. The program uses a graded approach to foreign material exclusion. FME Level 1 requires the highest level of foreign material control and is for those areas where a closeout inspection may not detect foreign material. FME Level 2 requirements are specified for areas where foreign material could be readily retrieved and can be detected by a closeout inspection. The FME program helps assure foreign material is not introduced into containment or the emergency recirculation system during maintenance activities.

Equipment Labeling

KPS has implemented station procedures for controlling equipment labeling. The procedures address equipment labeling in containment to prevent the introduction of post-LOCA debris by means of inappropriate labels.

Latent Debris

Latent debris in containment (for example, dirt and dust) was sampled and quantified during the fall 2004 refueling outage. The quantity of latent debris in the KPS containment is minimal. The containment building is routinely pressure washed for contamination control, which also minimizes the presence of latent debris. A station procedure will be developed to routinely sample the containment to quantify the latent debris to ensure the quantity of debris is managed. This new procedure will be issued prior to the next refueling outage.

Plant Modifications

To assist in the prevention of introducing post-LOCA debris by means of new plant modifications, the design change stakeholder interface list for KPS was revised. The revisions include a designated individual to monitor modifications for their potential impact on the containment post-LOCA debris inventory and recirculation drainage paths. The design change process form that identifies design considerations will be enhanced to assist in identifying modifications that could impact the recirculation system.

ATTACHMENT 2

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 2

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

MILLSTONE POWER STATION UNIT 2

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Dominion Nuclear Connecticut, Inc. (DNC) is providing the response for Millstone Power Station Unit 2 (MPS2) below.

Current System Description

The MPS2 ECCS design includes low pressure safety injection (LPSI) pumps, high pressure safety injection (HPSI) pumps, and containment spray (CS) pumps that work together to reduce containment temperature and pressure and remove core decay heat following an accident. Additionally, MPS2 has four safety related containment air recirculation coolers which provide containment atmosphere cooling using a closed cooling water system following a loss of coolant accident (LOCA).

Following a design basis LOCA, reactor coolant system (RCS) pressure will drop resulting in a safety injection actuation signal (SIAS) and containment pressure will rise resulting in a containment spray actuation (CSAS) signal. Upon receipt of the SIAS, the LPSI pumps and the HPSI pumps start to inject water into the RCS from the refueling water storage tank (RWST). Upon receipt of the CSAS signal, the CS pumps start drawing water from the RWST and spraying that water into containment via spray headers to lower containment temperature and pressure.

When the RWST reaches its low level point, the transfer to the recirculation mode is automatically initiated with a sump recirculation actuation signal (SRAS). The LPSI pumps automatically stop on SRAS, the sump suction valves open so that HPSI and CS pumps take suction from the containment sump, and CS water is cooled by one heat exchanger on each train to remove heat from containment during recirculation.

In the long term, if the RCS is not refilled, simultaneous hot and cold leg injection is initiated for boron precipitation control. Lineups for this include restarting one LPSI pump to provide either hot leg or cold leg injection.

NRC Requested Information

2(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.

DNC Response

2(a) Upon completion of activities described in this attachment related to modifications to the containment sump, the MPS2 ECCS and CSS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02).

Upon completion of modifications to the containment sump as a result of the analysis required by GL 04-02, the operation and general configuration of the MPS2 containment recirculation sump will remain similar to the current design. The existing sump screen will be replaced with a new sump strainer with increased surface area. At the start of recirculation the new strainer will be fully submerged. The sump strainer will remain a passive component. In addition, selected insulation is planned to be replaced with an insulation of a different type with fewer adverse effects.

Containment walkdowns have been completed to quantify potential debris sources in containment, verify flow paths and choke points and gather data for conceptual design of a replacement strainer. The debris generation calculation, downstream effects evaluations for blockage, and the procurement specifications have been drafted and are in review. The debris transport and head loss calculation, chemical effects evaluation and the downstream effects evaluation for long-term wear are in progress.

No licensing basis changes requiring NRC approval are anticipated for MPS2.

This submittal presents preliminary design information based on ongoing design and analysis work. This response to GL 04-02 is based on the currently available information and will be amended if the final design deviates significantly from the information provided.

2(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

<u>DNC Response</u>

2(b) Containment walkdowns identified potential debris sources within containment. Walkdowns also have quantified latent debris in containment and estimated the amount of foreign material that could become debris such as stickers, labels, and tags. From these walkdowns, debris generation calculations have been prepared. A summary of debris types generated in the worst case LOCA is included in section 2d(iii) of this response. Transport and head loss calculations are in progress. Head loss testing may be conducted to determine the actual head loss for the postulated debris load on the replacement strainer.

Based on preliminary results from debris generation and transport analyses, replacement of the existing debris screens will be required to meet the applicable regulatory requirements discussed in GL 04-02. The replacement sump strainer will be a passive strainer of an advanced design with a complex configuration to ensure a relatively high surface to volume ratio as well as the ability to maintain the necessary net positive suction head (NPSH) margin for the ECCS pumps. Based on preliminary information, the new sump strainer will have a surface area of approximately 7900 square feet with 0.0625 (1/16)-inch diameter perforations. The preliminary strainer surface area noted above assumes all generated debris transports to the sump. A reduced strainer surface area may be included in the final design once transport calculations are performed and head loss testing, if conducted, is complete.

NRC and industry testing has found that calcium silicate insulation can contribute significantly to high head loss across a strainer and can result in the formation of chemical precipitants which could cause further head loss. Therefore, DNC is considering replacement of calcium silicate insulation which could contribute to LOCA-generated debris with an insulation of a different type that has fewer adverse effects. Additional modifications of the replacement strainer may be required based on the results of the ongoing analysis of debris laden fluid on downstream blockage and wear potential. Implementation of necessary plant modifications is planned to be performed during the fall 2006 outage.

Changes will be made to specifications, the coatings program, design control procedures, containment inspection procedures, and housekeeping procedures to control potential debris sources so that the governing debris generation and transport analyses remain valid. A detailed description of these changes is included in section 2(f) of this response.

Head loss testing of specific plant debris loads and specific strainer designs will be conducted as necessary to determine final head loss and required strainer area.

Dominion is participating in industry testing regarding coatings zone of influence (ZOI) and head loss testing of chemical precipitants.

Uncertainties regarding head loss due to chemical precipitants and results from downstream effects evaluation could impact the final size of the strainer and the final size of the perforations. The surface area of the strainer will have sufficient margin to account for any existing uncertainties as well as margin for future debris uncertainties at the time that the final surface area is to decided.

The above described activities are planned for completion no later than December 31, 2007. Physical plant modifications inside containment (strainer and insulation replacement) are planned for the fall 2006 refueling outage. Completion of debris generation, transport and head loss analyses is planned to be complete by March 2006 in order to support implementation of physical modifications. Licensing basis changes and implementation of programmatic controls are planned to be completed as necessary prior to implementation of plant changes and in all cases no later than the end of December 2007.

NRC Requested Information

2(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.)**

DNC Response

2(c) The analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage was performed using methodology in the NEI Guidance Document NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, as modified by the SER for NEI 04-07. Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI 02-01.

MPS 2 is a two loop pressurized water reactor. Each loop room houses one steam generator and two reactor coolant pumps. Additionally, the east steam generator cavity is adjacent to the pressurizer. The outer walls of the D-ring extend from a lower elevation of - 3' 6" to El. 63' 0".

The majority of the insulation inside the MPS2 containment is RMI, Nukon, flexible elastomeric, mineral fiber, encapsulated mineral wool and calcium silicate.

Break Selection

Break selection was performed using guidance in Regulatory Guide 1.82, Rev. 3 and NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004. Breaks were selected to maximize the amount of debris generated and to generate the mix of insulation that is expected to provide the worst sump screen head loss. Candidate breaks were selected on the largest piping (RCS piping) near the steam generators due to the amount of insulation debris generated. Breaks in feedwater and/or main steam system piping are not considered as they will not require the ECCS and/or CSS to operate in recirculation mode. In accordance with NEI 04-07, small-bore piping (2" nominal diameter and less) is not considered as the impact will be bounded by the larger breaks. Because of the large zones of influence (ZOI) of the dominant insulation material in MPS2 containment, it is unnecessary to analyze breaks at any prescribed interval along the RCS piping in order to find the worst break. Virtually any of the breaks in the RCS piping will remove most of the insulation within the loop room walls.

Insulation

Individual insulation zones of influence (ZOIs) are used to determine the total generated debris. The ZOI for the RMI, Nukon, Transco encapsulated mineral wool, Cal-Sil, mineral fiber and fiberglass installed in containment were obtained from NRC SER Table 3-2. Where no guidance is provided for a particular insulation, conservative ZOIs are used.

Coatings

All qualified coating debris is quantified using the ZOI radius of 10.0D, as specified by the NRC SER. All concrete and structural steel coatings within the ZOI are determined based on dimensioned plant drawings. For the purpose of determining impacted coating volumes, all coated surfaces within the ZOI are assumed to have the maximum of the possible thickness values specified by both current and historical specifications. In accordance with NEI 04-07 and the NRC SER, all unqualified coatings are considered to fail regardless of their location within containment. Similarly, all qualified coatings that have been identified as being degraded are considered to fail regardless of their location within containment.

Dominion is considering using a ZOI radius of 4.0D for coatings based on industry testing that is currently scheduled to be performed in the Fall of 2005.

Foreign Material

Foreign material (e.g. tags, tape, stickers, etc.) was identified and surface area was estimated. An appropriate strainer area will be added to account for the strainer area that would be blocked by the foreign material dislodged during and post LOCA conditions.

Latent Debris

A latent debris walkdown was performed in accordance with the NEI/SER guidelines in Section 3.5. Vertical surfaces were sampled per the NRC SER guidance similar to horizontal surfaces. Debris characterization was completed per the NEI/SER guidance.

Debris Transport Methodology

The transport of the debris from the break location to the sump strainer is evaluated using the methods outlined in NEI 04-07 with the enhancements recommended in the NRC SER. The means of transport considered are blowdown, washdown, pool fill and recirculation for all types of debris. The recirculation transport analysis was performed by Sargent & Lundy using computational fluid dynamics (CFD) models developed using the computer program FLUENT. The CFD models were created by RWDI, Inc. Outputs of the CFD analysis include global (entire containment) and local (near sump pit) velocity contours, turbulent kinetic energy (TKE) contours, path lines and flow distributions for various scenarios.

Strainer Head Loss

The final strainer head loss analysis will be performed by the strainer vendor and will be documented as part of the final design. The debris head loss will be based on test results that bound the MPS2 plant-specific debris mix. The strainer size will be conservative for the post-LOCA velocity and water level. The total head loss across the sump strainer will be equal to the sum of the fiber/particulate debris bed head loss, the RMI debris bed head loss and the clean strainer head loss.

Downstream Effects

For downstream effects, see paragraphs 2(d)(v) and 2(d)(vi).

Exceptions to Methodology

The only identified exception to the approved NEI methodology and NRC SER is that break selection was not performed at regular intervals (such as 5 ft discussed in the SER) along the RCS piping. Rather, the method used for break selection in combination with the large ZOI for the fiberglass insulation ensures that the limiting break has been selected due to both the amount and mix of insulation postulated to be removed as debris. All smaller lines (such as pressurizer surge line and safety injection lines) are bounded by breaks in the RCS piping near the steam generators due to the size of piping and the amount of insulation involved.

<u>NRC Requested Information</u>

2(d)(i) Minimum NPSH margin for ECCS and CSS pumps with unblocked sump screen.

<u>DNC Response</u>

2(d)(i) The minimum available NPSH margin for the ECCS pumps in the recirculation mode at switchover to sump recirculation, not including the clean screen head loss, is 0.84 feet. The limiting pumps are the high-pressure safety injection (HPSI) pumps. The LPSI pumps are automatically tripped off upon initiation of recirculation, but one may be started several hours later for boron precipitation control. Conservative NPSH analyses have concluded that the LPSI pump NPSH margin is not limiting during boron precipitation control. The NPSH margin for the CS pumps in the recirculation mode at switchover to sump recirculation is not limiting. The clean screen head loss has not been determined but will be small (<0.1 feet based on experience). The actual value for clean screen head loss will be determined in the final design.

NRC Requested Information

2(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.

DNC Response

2(d)(ii) The replacement strainers will have a submerged area of approximately 7900 square feet for either a large or small break LOCA at switchover to recirculation. The replacement strainers will be 100% submerged upon switchover to recirculation.

NRC Requested Information

2(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.**

DNC Response

2(d)(iii) The maximum postulated head loss from debris accumulation on the submerged sump screen is specified to be 0.6 feet of water or less. The primary constituents of the debris bed at the sump screen are expected to include reflective metal insulation, Nukon fiber insulation, fiberglass insulation, mineral fiber, encapsulated mineral wool, calcium silicate, qualified and unqualified coatings, latent debris, and miscellaneous debris such as stickers and tags.

The above debris does not include debris resulting from chemical precipitants. DNC uses TSP as the buffer for MPS2. A comparison of the ICET chemical test summary for Test #2 and #3 and the MPS2 plant specific parameters is in progress. The comparison for test #2 shows that with the exception of concrete (surface), sump pH, sump temperature, and spray duration, the ICET chemical test parameters bound the MPS2 values. Evaluations are in progress to address the remaining parameters not bounded by the ICET results.

Sump strainer suppliers are currently developing plans and schedules to quantify the additional head loss associated with chemical precipitants. DNC plans to evaluate the adequacy of the strainer design and will include margin for head loss due to chemical precipitants once the test results to quantify that head loss are known.

NRC Requested Information

2(d)(iv) **Basis for concluding 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 flow paths.**

DNC Response

2(d)(iv) Water hold-up in containment has been evaluated and documented in a plant calculation. Walkdowns conducted per NEI 02-01 identified no additional choke points, hold-up areas, or water diversion paths not accounted for in the calculation.

Additionally, an inspection for non-LOCA generated material that could potentially obstruct recirculation water is conducted as part of the containment cleanliness inspection program prior to restart after each refueling outage. The controlling procedure will specifically address the need to assure that the containment is free of all items that could be washed to the sump strainer or could block an open flow path.

NRC Requested Information

2(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.**

DNC Response

2(d)(v) Evaluation of the flow paths downstream of the containment sump to determine the potential for blockage due to debris passing through the sump strainer is in progress. The assumed sump strainer opening size is 1/16" for this analysis. The actual strainer opening size in the replacement strainer will be decided as a part of the final design based on this analysis. The acceptance criteria were based on WCAP-16406-P evaluation methodology.

The scope of the evaluation includes the components in the recirculation flow paths such as throttle valves, flow orifices, spray nozzles, pumps, heat exchangers, and valves. The methodology employed in these evaluations is based upon input obtained from a review of the recirculation flow path shown on piping and instrument diagram drawings and plant procedures. The steps used in obtaining the flow clearance are as follows:

- Determine the maximum characteristic dimension of the debris (clearance through the sump strainer).
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings and/or manuals) 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 strainer.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Several components have flow clearances that require further evaluation due to their blockage potential. These components are ECCS pumps (wear ring clearances) including LPSI, HPSI, and CS pumps, SI throttle valves, and nuclear fuel.

Long term downstream evaluations, including the fuels evaluation, are in progress. The fuel vendor is currently performing evaluations for blockage through the reactor vessel internals as well as for blockage of the reactor fuel. Any necessary corrective actions for the above components will be performed following the long-term evaluations as part of the resolution of GSI-191.

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 perforation size. Similarly the design will ensure that any drainage paths to the sump that by pass the sump screen will also have a maximum debris size bypass equivalent to the strainer perforation size.

NRC Requested Information

2(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.**

DNC Response

2(d)(vi) Verification that close tolerance subcomponents are not susceptible to plugging or wear due to extended post-accident operation is in progress. Preliminary information related to debris blockage of downstream components is described in 2(d)(v). Verification of downstream components for long-term wear is in progress. Any corrective actions that are shown to be necessary as a result of these evaluations are planned to be completed prior to December 31, 2007.

The long-term downstream effects evaluation is in progress using the methodology and acceptance criteria presented in WCAP-16406-P. Where excessive wear is found using this methodology, a refined approach using alternate methods may be used.

For the long-term wear evaluations, the quantity and type of debris will be derived from the debris transport and head loss calculations and the procurement specification. The containment flood level after the RWST is empty is used as a basis for determining the amount of fluid in which the debris will be mixed.

Wear evaluation of flow orifices, heat exchangers, and ECCS pumps are in progress.

Throttle valves used for flow balancing in the injection lines are the most susceptible valves to wear. Based on the wear analysis results, additional valves may be evaluated. The long-term wear evaluation is in progress.

Instrumentation required during the post-LOCA recirculation has been identified and the corresponding root valves are being evaluated for clearance and wear. Evaluations of instrumentation for debris settling in the instrument lines are in process.

NRC Requested Information

2(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.

DNC Response

2(d)(vii) The preliminary design for the replacement sump strainer does not include trash racks. The ECCS sump is located outside the missile barriers and any high-energy line break zones of influence. However, preliminary analysis indicates the strainer is subject to loads from expanding jets or pipe whip from nearby high-energy lines. The replacement strainer will be designed to withstand these loads without collapse or structural damage. In addition, the strainer will be designed to withstand loads imposed by the accumulation of debris, pressure differentials under predicted flow conditions as specified in the design requirements, and seismically generated loads.

NRC Requested Information

2(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.**

DNC Response

2(d)(viii) The strainers selected for MPS2 are of a passive design.

NRC Requested Information

2(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.**

DNC Response

2(e) No licensing changes requiring NRC approval to ensure compliance with the regulatory requirements of GL 04-02 are anticipated as a result of corrective actions made for MPS2. Should changes requiring NRC approval become necessary, the NRC will be advised in a timely manner.

Changes to the existing ECCS sump screen will be evaluated under 10CFR50.59. Appropriate changes to the MPS2 licensing basis will be completed as determined by the evaluation.

NRC Requested Information

2(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.

DNC Response

2(f) Programmatic controls for containment debris sources will be put into existing procedures to ensure that the potential containment debris load is adequately controlled to maintain ECCS pump NPSH margin.

Piping and Equipment Insulation

Insulation in containment will be controlled using the thermal insulation specification and the design control process.

All proposed insulation changes in containment will be reviewed against the existing insulation for impact on the strainer head loss and ECCS pump NPSH margins.

Any additions and deletions of insulation in containment will be reviewed for impact on strainer head loss.

The design review process will be updated to require that any potential debris source to be put into containment (such as fibrous or particulate material other than insulation) is reviewed for its location and potential impact on ECCS sump strainer head loss.

Latent Debris

Due to the large fibrous debris load in the MPS2 containment, latent debris is a relatively small contributor to strainer head loss. A thorough latent debris inventory was completed and a conservative bounding number was chosen for the debris calculations. It is expected that further latent debris inventories will not be required and that latent debris will be adequately controlled through housekeeping and containment cleanup. As necessary, latent debris will be sampled and quantified using a calculation of containment surface area developed for this purpose. This activity will be specifically linked to GSI-191 and compliance with 10 CFR 50.46.

Changes have been made to the plant housekeeping procedure to explicitly describe containment housekeeping expectations for work sites and the general containment area. These procedure steps will be specifically linked to resolution of GSI-191 and compliance with 10 CFR 50.46. Training has been provided to plant staff and supplemental staff to emphasize the need for and awareness of the importance of maintaining a clean containment.

Coatings

Coating application and repair in containment are controlled by an existing coatings program and service level 1 specification. This program and specification will be reviewed for needed changes to ensure that:

- Service Level 1 coatings are periodically inspected and maintained.
- Unqualified coatings are tracked and minimized in containment to ensure that the total quantity of unqualified coatings does not exceed the quantity analyzed in the debris analysis.
- On a going-forward basis types and thicknesses of allowed coatings are bounded by the assumptions made in the debris analysis.

Foreign Material Control

Containment housekeeping, containment closeout, and foreign material control procedures will be updated as necessary to describe the connection of foreign material to ECCS sump performance. This procedural direction will strengthen current guidance to include required reviews for any material to be left in containment that has not been previously evaluated.

Flow Paths and Choke Points

Changes to the design control procedures will be made to require review of any changes that could affect flow paths of recirculation water in containment or post-LOCA water level in containment. These changes will be required to be evaluated for impact on MPS2 compliance with 10 CFR 50.46.

ATTACHMENT 3

NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

DOMINION NUCLEAR CONNECTICUT, INC.
MILLSTONE POWER STATION UNIT 3

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

MILLSTONE POWER STATION UNIT 3

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Dominion Nuclear Connecticut, Inc. (DNC) is providing the response for Millstone Power Station Unit 3 (MPS3) below.

Current System Description

The MPS3 ECCS design includes several sets of pumps that reduce containment temperature and pressure and remove core heat following an accident. Following a design basis loss of coolant accident (LOCA), reactor coolant system (RCS) pressure will drop resulting in a safety injection signal (SIS) and containment pressure will rise resulting in a containment depressurization actuation (CDA) signal. Upon receipt of the SIS, the charging pumps, intermediate high head safety injection (SI) pumps and low head safety injection (RHS) pumps are started to inject water into the RCS from the refueling water storage tank (RWST). Upon receipt of the CDA signal, the quench spray system (QSS) pumps also start drawing water from the RWST and spraying that water into containment via spray headers to lower containment temperature and pressure. The recirculation spray system (RSS) pumps start (after a time delay of approximately 660 seconds) and draw water from the containment emergency sump and spray that water into containment via spray headers to assist in lowering containment temperature and pressure. When the RWST reaches its low-low level point, (approximately half full), the transfer to the recirculation mode is initiated. The RHS pumps automatically stop on the RWST low-low level signal and the SI and charging pumps are manually realigned to take suction from the discharge of one of the two RSS pumps on each train to continue core heat removal. These pumps remain aligned to the spray headers and excess pump flow not used by the ECCS pumps is directed to the spray headers. The other RSS pump on each train continues to discharge to its spray header to continue lowering containment temperature and pressure. The QSS pumps continue to take suction from the RWST and discharge to spray headers until they stop automatically on a RWST level signal indicating that the RWST is empty. Recirculated containment water is provided to each RSS pump through a dedicated inlet line from the containment emergency sump. Each RSS pump discharges to a dedicated RSS heat exchanger that is cooled by service water from Long Island Sound.

NRC Requested Information

2(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.

DNC Response

2(a) Upon completion of activities described in this attachment related to modifications to the containment sump, the MPS3 ECCS and CSS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02).

Upon completion of modifications to the containment sump as a result of the analysis required by GL 04-02, the general configuration of the MPS3 containment recirculation sump will remain similar to the current design. The existing sump screen will be replaced with a new sump strainer with increased surface area. At the start of recirculation the new strainer will be fully submerged. The sump strainer will remain a passive component. In addition, selected insulation is planned to be replaced with an insulation of a different type with fewer adverse effects.

Containment walkdowns have been completed to quantify potential debris sources in containment, verify flow paths and choke points and gather data for conceptual design of a replacement strainer. The debris generation calculation, downstream effects evaluations for blockage, and the procurement specifications have been drafted and are in review. The debris transport and head loss calculation, chemical effects evaluation and the downstream effects evaluation for long-term wear are in progress.

DNC will submit a license amendment request for MPS3 to change the actuation method and the start time of the RSS pumps. As part of its analysis related to resolution of the GSI-191, DNC has determined that additional water is required as a prerequisite for the start of the MPS3 RSS pumps during LOCAs. The additional water is necessary to assure flashing does not occur in the suction piping and that there is adequate net positive suction head (NPSH) available for the RSS pumps in the recirculation mode. In order to obtain this additional water it is necessary to delay the initiation of RSS pump start until the RWST reaches its low-low level. Waiting for the transfer of the additional water from the RWST to the containment sump would result in providing sufficient margin for RSS pump suction piping flashing and NPSH under the debris loading conditions required to be postulated for the analysis specified by GL 04-02.

Following implementation of this proposed license amendment, the only change to the previously described ECCS operation following a LOCA is for the RSS pump start to be delayed to the RWST low-low level signal (same signal which causes the RHS pumps to stop). Thus, on receipt of a CDA signal, containment spray will only be provided by the QSS pumps drawing water from the RWST until the RSS pumps start on the RWST low-low level signal. A comprehensive description of this change and the resulting analyses will be forwarded with the license amendment request.

This submittal presents preliminary design information based on ongoing design and analysis work. This response to GL 04-02 is based on the currently available information and will be amended if the final design deviates significantly from the information provided.

<u>NRC Requested Information</u>

2(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.

<u>DNC Response</u>

2(b) Containment walkdowns identified potential debris sources within containment. Walkdowns are planned to quantify latent debris in containment and estimate the amount of foreign material that could become debris such as stickers, labels, and tags. From these walkdowns, debris generation calculations have been prepared. A summary of debris types generated in the worst case LOCA is included in section 2d(iii) of this response. Transport and head loss calculations are in progress. Head loss testing may be conducted to determine the actual head loss for the postulated debris load on the replacement strainer.

Based on preliminary results from debris generation and transport analyses, replacement of the existing debris screens will be required to meet the applicable regulatory requirements discussed in GL 04-02. The replacement sump strainer will be a passive strainer of an advanced design with a complex configuration to ensure a relatively high surface to volume ratio as well as the ability to maintain the necessary net positive suction head (NPSH) margin for the ECCS pumps. The new sump strainer will have a surface area of about 6840 square feet with 0.0625 (1/16)-inch diameter perforations based on preliminary design information. The new strainers will occupy approximately the same area occupied by the current sump screen. The preliminary strainer surface area noted above assumes all generated debris transports to the sump. A reduced strainer surface area may be included in the final design once transport calculations are performed and head loss testing is complete.

NRC and industry testing has found that micro porous insulation can contribute significantly to high head loss across a strainer and can result in the formation of chemical precipitants which could cause further head loss. Therefore DNC is considering replacement of microtherm insulation which could contribute to LOCA-generated debris with an insulation of a different type and which has fewer adverse effects. Additional modifications may be required based on the results of the ongoing analysis of blockage and wear potential of debris laden fluid downstream of the replacement strainer. Implementation of necessary plant modifications is planned for the spring 2007 outage and in any case no later than December 31, 2007.

Analysis of downstream effects and chemical effects is in progress. Head loss testing results for chemical effects will be factored into the final strainer design as necessary.

Changes will be made to specifications, the coatings program, design control procedures, containment inspection procedures, and housekeeping procedures to control potential debris sources so that the governing debris generation and transport analyses remain valid. A more detailed description of these changes is included in section 2(f) of this response.

Head loss testing of specific plant debris loads and specific strainer designs will be conducted as necessary to determine final head loss and required strainer area.

Participation in industry testing regarding coatings zone of influence (ZOI) and head loss testing of chemical precipitants is also planned for DNC.

Uncertainties regarding head loss due to chemical precipitants and results from downstream effects evaluation could impact the final size of the strainer and the final size of the perforations. The surface area of the strainer will have sufficient margin to account for any existing uncertainties as well as margin for future debris uncertainties at the time that the final surface area is decided.

The above described activities are planned for completion no later than December 31, 2007. Physical plant modifications inside containment (strainer and insulation replacement) are planned for the spring 2007 refueling outage. Completion of debris generation, transport and head loss analyses is planned for March 2006 in order to support implementation of physical modifications. Licensing basis changes and implementation of programmatic controls are planned to be complete as necessary prior to implementation of plant changes and in all cases no later than the end of December 2007.

DNC plans to make one plant change that requires a license amendment for MPS3. DNC is proposing to change the method of starting the recirculation spray pumps after a CDA signal. Currently, the RSS pumps are started using delay timers that are initiated by the CDA signal. The RSS pumps have a 660-second delay. DNC plans to start the RSS pumps on a RWST low-low level signal after the CDA signal to ensure that the containment water level provides sufficient strainer submergence for the debris analysis. The RSS actuation signal is currently specified in technical specification surveillance requirement 4.6.2.2.c.

NRC Requested Information

2(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.)**

DNC Response

2(c) The analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage was performed using methodology in the NEI Guidance Document NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, as modified by the SER for NEI 04-07. Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI 02-01.

MPS3 is a four loop (designated as loops 1, 2, 3 & 4) pressurized water reactor (PWR). Each loop consists of one steam generator (SG), one reactor coolant pump (RCP) and the associated reactor coolant system (RCS) piping, and is located within its own compartment. The four loops are nearly identical. Major differences include the pressure (PZR) surge line in Loop 2 and the residual heat removal pump suction lines in Loops 1 and 4.

Break Selection

Break selection was performed using guidance in Regulatory Guide 1.82, Rev. 3 and NEI 04-07. Breaks were selected to maximize the amount of debris generated and to generate the mix of insulation that is expected to provide the worst sump screen head loss. Candidate breaks were selected on the largest piping (RCS piping) near the steam generators due to the amount of insulation and coatings debris generated. Breaks in feedwater and main steam system piping are not considered as they will not require sump recirculation. In accordance with NEI 04-07, small-bore piping (2" nominal diameter and less) is not considered as its impact will be bounded by the larger breaks. Because of the large zones of influence

(ZOI) of the dominant insulation material in the MPS3 containment, it is unnecessary to analyze breaks at any prescribed interval along the RCS piping in order to find the worst break. Virtually any of the breaks in the RCS piping will remove most of the insulation within the loop room walls.

Insulation

Individual insulation ZOIs are used to determine the total generated debris. Where no guidance is provided for a particular insulation destruction pressure, conservative ZOIs are used.

Coatings

All qualified coating debris is quantified using the ZOI radius of 10.0D. All concrete and structural steel coatings within the ZOI are determined based on dimensioned plant drawings. For the purpose of determining impacted coating volumes, all coated surfaces within the ZOI are assumed to have the maximum of the possible thickness values specified by both current and historical specifications. In accordance with NEI 04-07 and the SER, all unqualified coatings are considered to fail regardless of their location within containment. Similarly, all qualified coatings that have been identified as being degraded are considered to fail regardless of their location within containment.

Dominion is considering using the ZOI radius of 4.0D for coatings should it be justified based on industry testing that is currently scheduled to be performed in the fall of 2005.

Foreign Material

Foreign material (e.g. tags, tape, stickers, etc.) was not quantified in the walkdown report and no data is currently available regarding the foreign material. Therefore, an appropriate strainer area will be added to account for the strainer area that would be blocked by the foreign material dislodged during and post LOCA conditions.

Latent Debris

No detailed latent debris data is available for the MPS3 containment. As a conservative input for the debris generation calculations, it is assumed that there is 200 lb_m of latent debris in the MPS3 containment. Due to the significant amount of fibrous insulation in the MPS3 containment, the overall contribution of latent debris to the total debris loading is small.

Latent debris quantities are planned to be determined in the upcoming fall 2005 refueling outage per the NEI/SER guidance.

Debris Transport

The transport of the debris from the break location to the sump strainer is evaluated using the methods outlined in NEI 04-07 with the enhancements recommended in the NRC SER. The means of transport considered are blowdown, washdown, pool fill and recirculation for all types of debris. The recirculation transport analysis was performed by Sargent & Lundy using computational fluid dynamics (CFD) models developed using the computer program FLUENT. The CFD models were created by RWDI, Inc. Outputs of the CFD analysis include global (entire containment) and local (near sump pit) velocity contours, turbulent kinetic energy (TKE) contours, path lines and flow distributions for various scenarios.

Strainer Head Loss

The final strainer head loss analysis will be performed by the strainer vendor and will be documented as part of the final design. The debris head loss will be based on test results that bound the MPS3 plant-specific debris mix. The strainer size will be conservative for the post-LOCA velocity and water level. The total head loss across the sump strainer will be equal to the sum of the fiber/particulate debris bed head loss, the RMI debris bed head loss and the clean strainer head loss.

Downstream Effects

For downstream effects, see paragraphs 2(d)(v) and 2(d)(vi) of this attachment.

Exceptions to Methodology

The only identified exception to the approved NEI methodology and NRC SER is that break selection was not performed at regular intervals (such as 5 ft discussed in the SER) along the RCS piping. Rather, the method used for break selection in combination with the large ZOI for the fiberglass insulation ensures that the limiting break has been selected due to both the amount and mix of insulation postulated to be removed as debris. All smaller lines (such as pressurizer surge line and safety injection lines) are bounded by breaks in the RCS piping near the steam generators due to the size of piping and the amount of and mix of debris involved.

NRC Requested Information

2(d)(i) **Minimum NPSH margin for ECCS and CSS pumps with unblocked sump screen.**

DNC Response

2(d)(i) After implementation of the license amendment described in section 2(e), the minimum available margin for the ECCS pumps in the recirculation mode at switchover to sump recirculation, not including the clean screen head loss, will be 7.3 feet. The only pumps which take suction from the sump are the RSS pumps. This limiting margin is the margin to suction line flashing for these pumps. The NPSH margin is less limiting. The clean screen head loss has not been determined but will be small (<0.1 feet based on experience). The actual value for clean screen head loss will be determined in the final design.

NRC Requested Information

2(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.

DNC Response

2(d)(ii) The replacement strainers will have a submerged strainer area of approximately 6840 ft2 for either a large or small break LOCA at switchover to recirculation. The replacement strainers will be 100% submerged upon switchover to recirculation.

NRC Requested Information

2(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.**

DNC Response

2(d)(iii) The maximum postulated head loss from debris accumulation on the submerged sump screen is specified to be 7.3 feet of water or less. The primary constituents of the debris bed at the sump screen are expected to include fiberglass insulation, qualified and unqualified coatings, latent debris, and miscellaneous debris such as stickers and tags.

The above debris does not include debris resulting from chemical precipitants. DNC uses TSP as the buffer for MPS3. A comparison of the ICET chemical test summary for Test #2 and the MPS3 plant specific parameters has been performed. The comparison shows that with the exception of concrete surface, the ICET chemical test parameters bound the MPS3 values. The bounded test parameters at MPS3 include: sump pH, sump water temperature profile, and spray flow to area ratio and duration. Evaluations are in progress to address the remaining parameter not bounded by the ICET results.

Sump strainer suppliers are currently developing plans and schedules to quantify the additional head loss associated with chemical precipitants. DNC plans to evaluate the adequacy of the strainer design and will include margin for head loss due to chemical precipitants once the test results to quantify that head loss are known.

NRC Requested Information

2(d)(iv) Basis for concluding 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 flow paths.

DNC Response

2(d)(iv) Water hold-up in containment has been evaluated and documented in a plant calculation. Walkdowns conducted per NEI 02-01 identified no additional choke points, hold-up areas, or water diversion paths not accounted for in the calculation.

Additionally, an inspection for non-LOCA generated material that could potentially obstruct recirculation water is conducted as part the containment cleanliness inspection program prior to restart after each refueling outage. The controlling procedure will specifically address the need to assure that the containment is free of all items that could be washed to the sump strainer or could block an open flow path.

NRC Requested Information

2(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.**

DNC Response

2(d)(v) Evaluation of the flow paths downstream of the containment sump to determine the potential for blockage due to debris passing through the sump strainer is in progress. The assumed sump strainer opening size is 1/16" for this analysis. The actual strainer opening size in the replacement strainer will be decided as a part of the final design based on this analysis. The acceptance criteria were based on WCAP-16406-P.

The scope of the evaluation includes the components in the recirculation flow paths such as throttle valves, flow orifices, spray nozzles, pumps, heat exchangers, and valves. The methodology employed in this evaluation is based upon input obtained from a review of the recirculation flow path shown on piping and instrument diagram drawings and plant procedures. The steps used in obtaining the flow clearance are as follows:

- Determine the maximum characteristic dimension of the debris (clearance through the sump strainer).
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings and/or manuals) 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 strainer.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Several components have flow clearances that require further evaluation due to their blockage potential. These components are ECCS pumps (wear ring clearances), safety injection throttle valves, and nuclear fuel.

Long-term downstream evaluations, including the fuels evaluation, are in progress. The fuel vendor is currently performing evaluations for blockage through the reactor vessel internals as well as for blockage of the reactor fuel. Any necessary corrective actions for the above components will be performed following the long-term evaluations as part of the resolution of GSI-191.

The new strainer design will ensure that gaps at mating surfaces within the strainer assembly and between the strainer and the supporting surface are not in excess of the strainer perforation size.

NRC Requested Information

2(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.

DNC Response

2(d)(vi) Verification that close tolerance subcomponents are not susceptible to plugging or wear due to extended post-accident operation is in progress. Preliminary information related to debris blockage of downstream components is described in 2(d)(v). Verification of downstream components for long-term wear is in progress. Any corrective actions that are shown to be necessary as a result of these evaluations are planned to be completed prior to December 31, 2007.

The long-term downstream effects evaluation is in progress using the methodology and acceptance criteria presented in WCAP-16406-P. Where excessive wear is found using this methodology, a refined approach using alternate methods may be used.

For the long-term wear evaluations, the quantity and type of debris will be derived from the debris transport and head loss calculations and the procurement specification. The containment flood level after the RWST is empty is used as a basis for determining the amount of fluid in which the debris will be mixed.

Wear evaluation of flow orifices, heat exchangers, and ECCS pumps are in progress.

Throttle valves used for flow balancing in the injection lines are the most susceptible valves to wear. Based on the wear analysis results, additional valves may be evaluated. The long-term wear evaluation is in progress.

Instrumentation required during the post-LOCA recirculation has been identified and the corresponding root valves are being evaluated for clearance and wear. Evaluations of instrumentation for debris settling in the instrument lines are in process.

NRC Requested Information

2(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.

DNC Response

2(d)(vii) The preliminary design for the replacement sump strainer does not include trash racks. The ECCS sump is located outside the missile barriers and any high-energy line break zones of influence. The strainer will be designed to withstand the loads imposed by the accumulation of debris, pressure differentials under predicted flow conditions as specified in the design requirements, and seismically generated loads.

NRC Requested Information

2(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.

DNC Response

2(d)(viii) The strainers selected for MPS3 are of a passive design.

NRC Requested Information

2(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.

DNC Response

2(e) As described in the response to Item 2(b), DNC plans to submit one license amendment request for MPS3 in September 2005. DNC proposes to change the method of starting the RSS pumps from timer delays to RWST level. This change requires a revised containment analysis and modifications to the alternate source term (AST) LOCA analysis which is currently under review by the NRC. Implementation is anticipated upon restart of the unit after the spring 2007 refueling outage.

DNC has performed a revised containment analysis using the LOCTIC computer code to perform the following UFSAR calculations: LOCA peak pressure and temperature; long-term containment depressurization for verification of containment leakage assumptions in the dose consequences, and verification of ECCS and CS pipe stress limits. LOCTIC is the code used in the current analysis of record. The AST LOCA analysis for MPS3 assumes containment leakage at the TS value for the first hour and one-half the design leakage beyond one hour. The change in RSS initiation results in changes to the AST analysis to confirm dose limits are met.

NRC Requested Information

2(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.

DNC Response

2(f) Programmatic controls for containment debris sources will be put into existing procedures to ensure that the potential containment debris load is adequately controlled to maintain ECCS pump NPSH margin.

Piping and Equipment Insulation

Insulation in containment is controlled on plant drawings and/or by specification. Any changes to piping or equipment insulation are reviewed using the thermal insulation specification and the design control process.

All proposed insulation changes in containment will be reviewed for impact on the postulated post-LOCA debris load on the strainer and the resulting head loss.

Any additions and deletions of insulation in containment will be reviewed for impact on the strainer head loss.

The design review process will be updated to require that any potential debris source to be put into containment (such as fibrous or particulate material other than insulation) is reviewed for its location and potential impact on ECCS sump strainer head loss.

Latent Debris

Due to the large fibrous debris load in the MPS3 containment, latent debris is a relatively small contributor to strainer head loss. A thorough latent debris inventory is planned for the refueling outage in the fall of 2005 to confirm that the actual amount of latent debris in containment is well below the amount assumed in debris calculations. A conservative bounding number for latent debris quantity was chosen for the debris calculations. It is expected that further latent debris inventories will not be required and that latent debris will be adequately controlled through housekeeping and containment cleanup. As necessary, latent debris will be sampled and quantified using a calculation of containment surface area developed for this purpose. This activity will be specifically linked to GSI-191 and compliance with 10CFR50.46.

Changes have been made to the plant housekeeping procedure to explicitly describe containment housekeeping expectations for work sites and the general containment area. These procedure steps will be specifically linked to resolution of GSI-191 and compliance with 10CFR 50.46. Outage training has been provided to plant staff and supplemental staff during refueling outages to emphasize the need for and awareness of the importance of maintaining a clean containment.

Coatings

Coating application and repair in containment are controlled by an existing coatings program and service level 1 specification. This program and specification will be reviewed for needed changes to ensure that:

- Service Level 1 coatings are periodically inspected and maintained.
- Unqualified coatings are tracked and minimized in containment to ensure that the total quantity of unqualified coatings does not exceed the quantity analyzed in the debris analysis.
- On a going-forward basis types and thicknesses of allowed coatings are bounded by the assumptions made in the debris analysis.

Foreign Material Control

Containment housekeeping, containment closeout, and foreign material control procedures will be updated as necessary to describe the connection of foreign material to ECCS sump performance. This procedural direction will strengthen current guidance to include required reviews for any material to be left in containment that has not been previously evaluated.

Flow Paths and Choke Points

Changes to the design control procedures will be made to require review of any changes that could affect flow paths of recirculation water in containment or post-LOCA water level in containment. These changes will be evaluated for impact on MPS3 compliance with 10 CFR 50.46.

ATTACHMENT 4

NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

**VIRGINIA ELECTRIC AND POWER COMPANY
NORTH ANNA POWER STATION UNITS 1 AND 2**

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

NORTH ANNA POWER STATION UNITS 1 AND 2

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Virginia Electric and Power Company (Dominion) is providing the response for North Anna Power Station Units 1 and 2 (NAPS) below.

Current System Description

The NAPS ECCS and containment heat removal systems include several pumps that reduce containment temperature and pressure and remove core heat following an accident. Following a design basis loss of coolant accident (LOCA), reactor coolant system (RCS) pressure will drop, resulting in a safety injection (SI) signal, and containment pressure will rise, resulting in a containment depressurization actuation (CDA) signal. The SI and recirculation spray (RS) systems use the containment sump water following a LOCA.

The SI signal starts the high head safety injection (HHSI) and low head safety injection (LHSI) pumps, which inject water from the refueling water storage tank (RWST) into the RCS cold legs. Each NAPS unit has three HHSI pumps, two of which start on an SI signal, and two LHSI pumps. When the RWST water level reaches the low-low setpoint, the SI system swaps automatically from injection to recirculation mode. The HHSI pumps swap suction from the RWST to the LHSI pump discharge. The LHSI pumps swap suction from the RWST to the containment sump and deliver flow to both the RCS cold legs and the suction of the HHSI pumps. Later in recirculation mode operation, SI flow is directed to the hot legs to preclude exceeding boron solubility limits. The SI system does not have heat exchangers between the containment sump and the RCS. The SI system depends on the RS system to cool the containment sump water sufficiently to provide adequate NPSH margin for the LHSI pumps operating in the recirculation mode.

The RS system is the long-term containment heat removal system. The RS system assists in depressurizing the containment to subatmospheric conditions consistent with the assumptions for containment leakage in the dose consequences analyses. The RS system consists of four pumps that start on delay timers after a CDA signal, take suction directly from the containment sump, discharge to a dedicated heat exchanger that is cooled by the service water system, and spray the sump water into the containment via dedicated spray headers. The two inside RS pumps (located inside the containment sump) are started after a 400-second delay from the CDA signal. The two outside RS pumps (located outside containment) are started after a 210-second delay from the CDA signal. Two casing cooling pumps and the common casing cooling tank are designed to increase net positive suction head available to the outside RS pumps by injecting cold water into the suction of the spray pumps. Each casing cooling pump supplies one outside spray pump with cold borated water from the casing cooling tank. The casing cooling pumps are considered part of the outside RS subsystems.

The NAPS design includes two quench spray (QS) pumps that are started by the CDA signal. The QS pumps draw water from the RWST and deliver flow to spray headers to lower the containment pressure and temperature before the RS pumps start. The QS pumps are operated until the RWST is empty.

NRC Requested Information

2(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.**

Dominion Response

2(a) Upon completion of activities described in this attachment related to modifications to the containment sump, the NAPS ECCS and CSS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02).

Upon completion of modifications to the containment sump as a result of the analysis required by GL 04-02, the general configuration of the NAPS containment recirculation sumps will remain similar to the current design. The existing sump screens will be replaced with new sump strainers with increased surface area. Dominion plans to use a passive strainer design for NAPS. However, Dominion has been investigating the feasibility of an active design.

Containment walkdowns have been completed to quantify potential debris sources in containment, verify flow paths and choke points and gather data for conceptual design of a replacement strainer. The debris generation calculation, downstream effects evaluations for blockage, and the procurement specifications have been drafted and are in review. The debris transport and head loss calculation, chemical effects evaluation and the downstream effects evaluation for long-term wear are in progress.

Section 2(b) describes the two plant changes associated with the license amendment requests that will be required to meet regulatory requirements. Dominion will submit these license amendment requests for NAPS as described below in 2(e).

As discussed in the phone conversation with the NRC staff on August 2, 2005, changes requiring revised containment and dose consequences analyses are necessary in order for the new strainers to have adequate margin for resolution of the GSI-191 issue at NAPS. This submittal presents preliminary information based on ongoing design and analysis work. This response to GL 04-02 is based on the currently available information and will be supplemented once final design information becomes available.

NRC Requested Information

2(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.

Dominion Response

2(b) Containment walkdowns have identified potential debris sources within containment, have quantified latent debris in containment, and have estimated the amount of foreign material that could become debris such as stickers, labels, and tags. Preliminary debris generation calculations have been prepared. These preliminary analyses indicate that modifications to the existing containment sump will be required to meet the applicable regulatory requirements discussed in GL 04-02. At this time, Dominion has not finalized a strainer design for NAPS because debris analyses and testing are not complete. Since the strainer design is currently in progress, the exact values of certain parameters, including the surface area and footprint, have not been determined. However, the perforation size will be at most 0.125 inch diameter based on the current design, but may be reduced as the new strainer design is finalized. Dominion plans to install the replacement sump strainer in accordance with the GL 04-02 implementation schedule of December 31, 2007. Modifications to the NAPS1 sump are planned to be completed during the fall 2007 refueling outage. Modifications to the NAPS2 sump are planned to be completed during the spring 2007 refueling outage.

Dominion plans to make two plant changes that require license amendments at NAPS. First, the method of starting the RS pumps using delay timers after a CDA signal will be changed. The inside RS pumps have a 400-second delay and the outside RS pumps have a 210-second delay. Dominion plans to start the RS pumps on a low RWST level signal after the CDA signal to ensure that the containment water level provides sufficient strainer submergence for the debris analysis. The RWST level actuation setpoint is still being determined by analysis. Second, Dominion plans to gain net positive suction head (NPSH) margin for the RS and

LHSI pumps by increasing the containment air partial pressure operating limits in TS Figure 3.6.4-1. Both changes require revised containment and dose consequences analyses. Dominion plans to implement the changes in the strainer installation outage, provided the license amendment requests are approved in accordance with the schedule in Item 2(e).

Changes will be made to specifications, the coatings program, design control procedures, containment inspection procedures, and housekeeping procedures to control potential debris sources so that the governing debris generation and transport analyses remain valid. A detailed description of these changes is included in Section 2(f) of this response.

NRC Requested Information

2(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.)

Dominion Response

2(c) The analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage was performed using the methodology in the NEI Guidance Document NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, as modified by the SER for NEI 04-07. Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI 02-01. The application of the methodology to NAPS and any exceptions to the NEI methodology are described below.

NAPS NSSS systems are Westinghouse three loop pressurized water reactors (PWRs). The system consists of one reactor vessel (RX), three steam generators (S/Gs), three reactor coolant pumps (RCPs), one pressurizer (PZR) and the reactor coolant system (RCS) piping. The NSSS system is located inside various compartments consisting of three S/G cavities (or loop rooms), one RX cavity, and individual cubicles for the pressurizer, pressurizer relief tank (PRT), regenerative heat exchangers, and excess letdown heat exchanger. Each S/G cavity houses one steam generator and one RCP along with the loop piping and stop valves.

Debris Generation Methodology

A comparison of the plant general arrangement drawings indicates that NAPS Units 1 and 2 have similar equipment layouts. The floor elevations are identical, and the geometry indicates that the equipment arrangement is similar for each unit, even though the North – South orientation of the loops is different.

The majority of the insulation inside the NAPS containments is RMI, calcium silicate (steel jacketed or encapsulated), TempMat, Thermal Wrap, and foam glass. Differences in insulation between the two units have been identified in walkdowns and the debris generation calculation uses the more conservative input.

Break Selection

Break selection was performed using guidance in Regulatory Guide 1.82, Rev. 3 and NEI 04-07. Breaks were selected to maximize the amount of debris generated and to generate the mix of insulation that is expected to provide the worst sump screen head loss. Candidate breaks were selected on the largest piping (RCS piping) near the steam generators due to the amount of insulation debris generated. Breaks in feedwater and/or main steam system piping are not considered as they will not require the ECCS and/or CSS to operate in recirculation mode. In accordance with NEI 04-07, small-bore piping (2" nominal diameter and less) is not considered, as the impact will be bounded by the larger breaks.

Insulation

Individual insulation zones of influence (ZOIs) are used to determine the total generated debris. The ZOI for the RMI, Cal-Sil, Temp-Mat, and fiberglass installed in containment were obtained from NRC SER Table 3-2. Where no guidance is provided for a particular insulation, conservative ZOIs are used.

Coatings

Qualified coating debris is quantified using a ZOI radius of 10.0D, as specified by the NRC SER. Concrete and structural steel coatings within the ZOI are determined based on dimensioned plant drawings. For the purpose of determining impacted coating volumes, all coated surfaces within the ZOI are assumed to have the maximum of the possible thickness values specified by both current and historical specifications. In accordance with NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, and the SER, all unqualified coatings are considered to fail regardless of their location within containment. Similarly, qualified coatings that have been identified as being degraded are considered to fail regardless of their location within containment. Dominion is considering using the ZOI radius of 4.0D for coatings based on industry testing that is currently scheduled to be performed in the fall of 2005.

Foreign Material

Foreign material (e.g., tags, tape, stickers, etc.) was identified, but not quantified in the NEI 02-01 walkdown reports. An appropriate strainer area will be added to account for the strainer area that would be blocked by the foreign material dislodged during and post-LOCA conditions.

Latent Debris

No detailed latent debris data is available for the NAPS containment. Based on the similarities with Surry's containment, the latent debris data collected during the SPS2 spring 2005 outage has been used in preliminary analyses. Latent debris walkdowns will be performed in accordance with the NEI/SER guidelines during the upcoming refueling outages, as required.

Fire Wrap Material

No fire wrap materials are located within the ZOI of the breaks analyzed. Fire wrap materials are located in the annulus areas of the containment. The fire wrap material without a jacket is considered to fail as a result of the containment spray.

Debris Transport Methodology

The transport of the debris from the break location to the sump strainer will be evaluated using the methods outlined in NEI 04-07 with the enhancements recommended in the NRC SER. The means of transport considered will include blowdown, washdown, pool fill and recirculation for all types of debris. The recirculation transport analysis will be performed by Sargent & Lundy using computational fluid dynamics (CFD) models developed using the computer program FLUENT. The CFD models will be created by RWDI, Inc. Outputs of the CFD analysis will include global (entire containment) and local (near sump pit) velocity contours, turbulent kinetic energy (TKE) contours, path lines and flow distributions for various scenarios.

Strainer Head Loss

The final strainer head loss analysis will be performed by the strainer vendor and will be documented as part of the final design. The debris head loss will be based on test results that bound the NAPS plant-specific debris mix. The strainer size will be conservative for the post-LOCA velocity and water level. The total head loss across the sump strainer will be equal to the sum of the fiber/particulate debris bed head loss, the RMI debris bed head loss and the clean strainer head loss.

Downstream Effects Methodology

For downstream effects, see Items 2(d)(v) and 2(d)(vi) in this attachment.

Exceptions to NEI 04-07 and NRC SER

The only identified exception to the approved NEI methodology and NRC SER is that break selection was not performed at regular intervals (such as 5 ft discussed in the SER) along the RCS piping. Rather, the method used for break selection in combination with the large ZOI for the fiberglass insulation ensures that the limiting break has been selected due to both the amount and mix of insulation postulated to be removed as debris. All smaller lines (such as the residual heat removal and safety injection lines) are bounded by breaks in the RCS piping near the steam generators due to the size of piping and the amount of and mix of debris involved.

NRC Requested Information

2(d)(i) Minimum NPSH margin for ECCS and CSS pumps with unblocked sump screen.

Dominion Response

2(d)(i) The minimum available NPSH margin with unblocked sump screen has not been finalized. As described in Items 2(b) and 2(e), Dominion is planning to perform revised containment analyses, including a transient calculation of NPSH available for the LHSI and RS pumps. Dominion will report the minimum NPSH margin in the plant-specific LAR described in Item 2(e).

NRC Requested Information

2(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.

Dominion Response

2(d)(ii) Dominion has not finalized the replacement sump screen surface area, so the submerged surface area cannot be reported at this time. Dominion is investigating plant design changes for either full or partial submergence. As described in Items 2(b) and 2(e), Dominion is planning to delay starting the RS pumps to credit a higher water level for wetted screen surface area. Preliminary analysis indicates a strainer height of 2 ft would support full submergence when the RS pumps start. Because the long-term containment water level is greater than 4 ft (at the time the LHSI pumps take suction from the sump), Dominion is investigating strainers that are partially submerged when the RS pumps start, but quickly become fully submerged when the LHSI pumps swap over to sump recirculation.

<u>NRC Requested Information</u>

2(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.**

<u>Dominion Response</u>

2(d)(iii) The maximum postulated head loss from debris accumulation on the submerged screen has not been finalized. As described in Items 2(b) and 2(e), Dominion is planning to perform revised containment analyses, including a transient calculation of NPSH available for the LHSI and RS pumps. The minimum NPSH margin from the revised analyses will be an input to determine the strainer size and acceptable debris head loss.

The primary constituents of the debris bed at the sump screen without credit for the CFD analysis in progress are Transco reflective metal insulation (RMI), RMI jacketing, calcium silicate, thermal wrap (fiberglass), TempMat, ThermoLag, fiberglass insulation, marinite board, cerafiber, silicone foam, qualified and unqualified coatings, and latent debris.

The above debris does not include debris resulting from chemical effects. Dominion uses NaOH as the buffer for NAPS. A comparison of the ICET chemical test summary for Test #1 and the NAPS plant specific parameters has been performed. The comparison shows that with the exception of inorganic zinc primer coating, carbon steel, concrete surface, sump pH, sump water temperature profile, and spray flow to area ratio and duration, the ICET chemical test parameters bound the NAPS values. Evaluations are in progress to address the remaining parameters not bounded by the ICET results.

Sump strainer suppliers are currently developing plans and schedules to quantify the additional head loss associated with chemical precipitants. Dominion plans to evaluate the adequacy of the strainer design and will include margin for head loss due to chemical precipitants once the test results to quantify that head loss are known.

NRC Requested Information

2(d)(iv) **Basis for concluding 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 flow paths.**

Dominion Response

2(d)(iv) The "choke points" were evaluated as part of the NAPS GSI-191 walkdowns. No choke points or flow diversions were identified. Dominion is planning to perform additional verification walkdowns for NAPS, as needed, during upcoming refueling outages.

Additionally, an inspection for non-LOCA generated material that could potentially obstruct recirculation water is conducted as part of the containment cleanliness inspection program prior to restart after each refueling outage. The controlling procedure specifically addresses the need to assure that the containment is free of all items that could be washed to the sump strainer or could block an open flow path.

NRC Requested Information

2(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.

Dominion Response

2(d)(v) Evaluation of the flow paths downstream of the containment sump to determine the potential for blockage due to debris passing through the sump strainer is in progress. The acceptance criteria were based on WCAP-16406-P evaluation methodology.

The scope of the evaluation includes the components in the recirculation flow paths such as throttle valves, flow orifices, spray nozzles, pumps, heat exchangers, and valves. The methodology employed in this evaluation is based upon input obtained from a review of the recirculation flow path shown on piping and instrument diagram drawings and plant procedures. The steps used in obtaining the flow clearance are as follows:

- Determine the maximum characteristic dimension of the debris (clearance through the sump strainer).
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings and/or manuals) 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 strainer.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Based on the flow clearance evaluation, the following components require further review and investigation:

- IRS, ORS, LHSI, and HHSI/Charging Pumps
- Unit Specific Root Isolation Valves, Globe Valves
- RS Cooler Orifice and ORS Pump Seal Head Tank
- Unit Specific Relief Valves
- Unit Specific Flow Instrumentation

The long-term downstream evaluations, including the fuels evaluations, are in progress. The fuel vendors are currently performing evaluations for blockage through the reactor vessel internals as well as for blockage of the reactor fuel. Any necessary corrective actions for the above components will be performed following the long-term evaluations as part of the resolution of GSI-191.

The new strainers will be designed for the effects of weight, thermal, differential pressure, and seismic loading. The need to design the new strainers for jet impingement and missile loads from pipe breaks has not been confirmed. This will be addressed during the fall 2005 (NAPS2) and spring 2006 (NAPS1) refueling outage walkdowns.

The new strainer design will ensure that gaps at mating surfaces within the strainer assembly and between the strainer and the supporting surface are not in excess of the strainer perforation size. Similarly, the design will ensure that drainage paths to the sump that bypass the sump strainer will not have gaps in excess of the strainer perforation size.

<u>NRC Requested Information</u>

2(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.**

<u>Dominion Response</u>

2(d)(vi) Verification of debris blockage of downstream components is described in 2(d)(v) above. Verification of downstream components for long-term effects is in progress, and the final results will be completed as noted in Section 2(a) above.

The long-term downstream effects evaluation is in progress using the methodology and acceptance criteria presented in WCAP-16406-P. Where excessive wear is found using this methodology, a refined approach using alternate methods may be utilized.

For the long-term wear evaluations, the quantity and type of debris will be derived from the debris transport and head loss calculations and the procurement specification. The containment flood level after the RWST is empty is used as a basis for determining the amount of fluid in which the debris will be mixed. The status of component evaluations are as follows:

- Evaluations of flow orifices and elements in the SI and RS systems are in progress. No results are available.
- Throttle valves used for flow balancing in the SI system are the most susceptible valves to wear. Based on the wear analysis results, additional valves may be evaluated. The long-term wear evaluation is in progress and no results are currently available.
- Instrumentation required during the post-LOCA recirculation has been identified and the corresponding root valves are being evaluated for clearance. Evaluations of instrumentation for debris settling in the instrument lines are in process. No results are currently available.
- Wear evaluations of the SI, RS, and charging pumps are in progress. No results are currently available.
- Evaluations for RS heat exchangers are in progress. No results are currently available.

NRC Requested Information

2(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.**

Dominion Response

2(d)(vii) The containment recirculation sumps are located outside the missile barriers and any high energy line break zones of influence. Therefore, the strainer is not subject to loads from missiles or expanding jets during a loss of coolant accident. Trash racks are not required to protect the strainer from missiles and other large debris. The strainers will be designed to withstand the loads imposed by the accumulation of debris and pressure differentials under predicted flow conditions as specified in the design requirements, as well as seismically generated loads.

<u>NRC Requested Information</u>

2(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.

<u>Dominion Response</u>

2(d)(viii) Dominion plans to use a passive strainer design for NAPS. However, Dominion has been investigating the feasibility of an active design.

NRC Requested Information

2(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.

Dominion Response

2(e) As described in the response to Item 2(b), Dominion plans to make two plant changes that require license amendments. Dominion plans to change the method of starting the RS pumps from timer delays to RWST level. Dominion also plans to increase the containment air partial pressure operating limits in TS Figure 3.6.4-1. These changes require a revised containment analysis and modifications to the NRC-approved alternate source term (AST) LOCA analysis.

Dominion plans to submit a revised containment analysis using the GOTHIC computer code to perform the following UFSAR calculations: LOCA and steam line break peak pressure and temperature; long-term containment depressurization for verification of containment leakage assumptions in the dose consequences; and NPSH available for the LHSI and RS pumps. The GOTHIC methodology will replace entirely the Stone & Webster LOCTIC methodology that is currently used in NAPS UFSAR Chapter 6. Consequently, the GOTHIC method of analysis represents a "departure from a method of evaluation described in the FSAR" as defined in 10 CFR 50.59(a)(1) and requires a license amendment in accordance with 10 CFR 50.59(c)(2)(viii). Dominion will submit the GOTHIC containment analysis methodology with plant-specific analyses that support the proposed changes to TS Figure 3.6.4-1 and the RS pump start method in February 2006.

The AST LOCA analysis for NAPS assumes containment leakage at the TS value for 1 hour. From hours 1-4 after the accident initiation, containment leakage is assumed to correspond to a containment pressure of 0.5 psig. At the end of hour 4, the containment pressure is assumed to be subatmospheric and remain subatmospheric thereafter (no containment leakage). The planned changes to delay the RS pumps and modify TS Figure 3.6.4-1 require a relaxation of the currently approved containment leakage assumptions for NAPS. As a result, Dominion will submit a revised AST LOCA analysis for NRC review in February 2006.

To meet the GL 2004-02 compliance date of December 31, 2007, North Anna will request that the LARs described above be approved by February 1, 2007. This approval date will allow implementation of the change to the RS pump start and TS Figure 3.6.4-1 during the spring 2007 refueling outage on North Anna Unit 2.

NRC Requested Information

2(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.

Dominion Response

2(f) Dominion intends to ensure that potential quantities of post-accident debris are maintained within the bounds of the analyses and design bases that support ECCS and CSS recirculation functions.

Programmatic controls for containment debris sources will be put into existing procedures or new procedures will be developed, as required, to ensure that the potential containment debris load is adequately controlled to maintain ECCS pump NPSH margin. These controls will address piping and equipment insulation, housekeeping, coatings, foreign materials, and in-containment modifications for effects on recirculation function.

Piping and Equipment Insulation

Existing programs and procedures control insulation in containment.

The governing standard dealing with approved types of pipe and HVAC insulation will be revised, as necessary, to address the need to account for changes to the existing insulation or the addition of new insulation in containment and the appropriate method of tracking various insulation types, e.g., weight, surface area, volume, etc.

Existing procedures will be revised or new procedures established to ensure changes to insulation, not undertaken in conjunction with a design change package or other change process, are controlled so that they are pre-approved and tracked.

Appropriate revisions will be made to the Engineering Design Control Program to accommodate changes to the existing requirements for banned and controlled in-containment materials.

Latent Debris

Thorough latent debris inventory walkdowns are planned during the North Anna 2 Fall 2005 RO and North Anna 1 Spring 2006 RO to validate the input used in containment debris calculations. As necessary, latent debris will be sampled and quantified using a calculation of containment surface area developed for this purpose. This activity will be specifically linked to GSI-191 and compliance with 10CFR50.46.

Containment cleaning and foreign material controls are further described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Coatings

Coatings in containment are controlled by an existing coatings program and service level 1 specification.

A materials standard has been revised to reference GSI-191 and to emphasize that only qualified protective coatings are to be used on procured equipment in containment unless an unqualified coating is approved.

Other applicable engineering standards will be revised, as required, to include provisions for maintaining inventories of unqualified protective coatings and pipe and HVAC insulation as controlled in containment materials so as to preserve any necessary design basis margins.

Current inventories of unqualified coatings and insulation have been determined and documented. Maximum allowable amounts of unqualified coatings and insulation must be established based on GSI-191 concerns and any modifications made to the existing capability or performance of the containment sump screens.

Appropriate revisions will be made to the Engineering Control Program to accommodate changes to the existing requirements for banned and controlled materials in containment.

Foreign Material Control

Containment housekeeping, containment closeout, and foreign material control procedures will be updated, as required, to describe the connection of foreign material to ECCS sump performance. This procedural direction will strengthen current guidance as described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Flow Paths and Choke Points

Changes to the design control procedures will be made to require review of any changes which could affect flowpaths of recirculation water in containment or post-LOCA water level in containment. Verification of existing drainage pathways is described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Appropriate revisions will be made to the Engineering Control Program to accommodate changes to the existing requirements for banned and controlled materials in containment.

ATTACHMENT 5

NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

**VIRGINIA ELECTRIC AND POWER COMPANY
SURRY POWER STATION UNITS 1 AND 2**

RESPONSE TO NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

SURRY POWER STATION UNITS 1 AND 2

In a letter dated September 13, 2004, the NRC issued Generic Letter 2004-02, "Potential Impact of Debris Blockage on Emergency Recirculation During Design Basis Accidents at Pressurized-Water Reactors." The generic letter identified a potential susceptibility of recirculation flow paths and sump screens to debris blockage. The generic letter requested that addressees perform an evaluation of the emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions in light of the information provided in the letter and, if appropriate, take additional actions to ensure system function. Additionally, addressees were requested to submit the information specified in the letter to the NRC.

In accordance with 10 CFR 50.54(f), Virginia Electric and Power Company (Dominion) is providing the response for Surry Power Station Units 1 and 2 (SPS) below.

Current System Description

The SPS ECCS and containment heat removal system includes several pumps that reduce containment temperature and pressure and remove core heat following an accident. Following a design basis loss of coolant accident (LOCA), reactor coolant system (RCS) pressure will drop, resulting in a safety injection (SI) signal, and containment pressure will rise, resulting in a consequence limiting safeguards (CLS) high high containment pressure signal. The SI and recirculation spray (RS) systems use the containment sump water following a LOCA.

The SI signal starts the high head safety injection (HHSI) and low head safety injection (LHSI) pumps, which inject water from the refueling water storage tank (RWST) into the RCS cold legs. Each SPS unit has three HHSI pumps and two LHSI pumps. When the RWST water level reaches the low-low setpoint, the SI system swaps automatically from injection to recirculation mode. The HHSI pumps swap suction from the RWST to the LHSI pump discharge. The LHSI pumps swap suction from the RWST to the containment sump and deliver flow to both the RCS cold legs and the suction of the HHSI pumps. Later in recirculation mode operation, SI flow is directed to the hot legs to preclude exceeding boron solubility limits. The SI system does not have heat exchangers between the containment sump and the RCS. The SI system depends on the RS system to cool the containment sump water sufficiently to provide adequate NPSH margin for the LHSI pumps operating in recirculation mode.

The RS system is the long-term containment heat removal system. The RS system assists in depressurizing the containment to subatmospheric conditions consistent with the assumptions for containment leakage in the dose consequences analyses. The RS system consists of four pumps that start on delay timers after a CLS signal, take suction directly from the containment sump, discharge to a dedicated heat exchanger that is cooled by the service water system, and spray the sump water into the containment via dedicated spray headers. The two inside RS pumps (located inside the containment sump) are started after a 120-second delay from the CLS signal. The two outside RS pumps (located outside containment) are started after a 300-second delay from the CLS signal.

The SPS design includes two containment spray (CS) pumps that are started by the CLS signal. The CS pumps draw water from the RWST and deliver flow to spray headers to lower the containment pressure and temperature before the RS pumps start. The CS pumps are operated until the RWST is empty.

NRC Requested Information

2(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.**

Dominion Response

2(a) Upon completion of activities described in this attachment related to modifications to the containment sump, the SPS ECCS and CSS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02).

Upon completion of modifications to the containment sump as a result of the analysis required by GL 04-02, the general configuration of the SPS containment recirculation sumps will remain similar to the current design. The existing sump screens will be replaced with new sump strainers with increased surface area. Dominion plans to use a passive strainer design for SPS. However, Dominion has been investigating the feasibility of an active design.

Containment walkdowns have been completed to quantify potential debris sources in containment, verify flow paths and choke points and gather data for conceptual design of a replacement strainer. The debris generation calculation, downstream effects evaluations for blockage, and the procurement specifications have been drafted and are in review. The debris transport and head loss calculation, chemical effects evaluation and the downstream effects evaluation for long-term wear are in progress.

Section 2(b) describes the two plant changes associated with the license amendment requests that will be required to meet regulatory requirements. Dominion will submit these license amendment requests for SPS as described below in 2(e).

As discussed in the phone conversation with the NRC staff on August 2, 2005, changes requiring revised containment and dose consequences analyses are necessary in order for the new strainers to have adequate margin for resolution of the GSI-191 issue at SPS. This submittal presents preliminary information based on ongoing design and analysis work. This response to GL 04-02 is based on the currently available information and will be supplemented once final design information becomes available.

NRC Requested Information

2(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.

Dominion Response

2(b) Containment walkdowns have identified potential debris sources within containment, have quantified latent debris in containment, and have estimated the amount of foreign material that could become debris, such as stickers, labels, and tags. Preliminary debris generation calculations have been prepared. These preliminary analyses indicate that modifications to the existing containment sump will be required to meet the applicable regulatory requirements discussed in GL 04-02. At this time, Dominion has not finalized a strainer design for SPS because debris analyses and testing are not complete. Since the strainer design is currently in progress, the exact values of certain parameters, including the surface area and footprint, have not been determined. However, the perforation size will be at most 0.1875-inch diameter based on the current design, but may be reduced as the new strainer design is finalized. Extensive engineering activities, complicated changes to the SPS containment analyses required for resolution of the GSI-191 issue considering the SPS containment subatmospheric design, and vendor delivery of replacement screens will be required to achieve the schedule date provided. Dominion plans to install the replacement sump strainers in accordance with the GL 04-02 implementation schedule of December 31, 2007. Modifications to the SPS1 sump are planned to be completed during the fall 2007 refueling outage. Modifications to the SPS2 sump are planned to be completed by December 31, 2007.

Dominion plans to make two plant changes that require license amendments at SPS. First, the method of starting the RS pumps using delay timers after a CLS signal will be changed. The inside RS pumps have a 120-second delay and the outside RS pumps have a 300-second delay. Dominion plans to start the RS pumps on a low RWST level signal after the CLS signal to ensure that the containment water level provides sufficient strainer submergence for the debris analysis. The RWST level actuation setpoint is still being determined by analysis. Second, Dominion plans to gain net positive suction head (NPSH) margin for the RS and LHSI pumps by increasing the containment air partial pressure operating limits in TS Figure 3.8-1. Both changes require revised containment and dose consequences analyses. Dominion plans to implement the changes in the strainer installation outage, provided the license amendment requests are approved in accordance with the schedule in Item 2(e).

Changes will be made to specifications, the coatings program, design control procedures, containment inspection procedures, and housekeeping procedures to control potential debris sources so that the governing debris generation and transport analyses remain valid. A detailed description of these changes is included in section 2(f) of this response.

NRC Requested Information

2(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.)

Dominion Response

2(c) The analysis of the susceptibility of the ECCS and CSS recirculation functions to the adverse effects of post-accident debris blockage was performed using the methodology in the NEI Guidance Document NEI 04-07, "Pressurized Water Reactor Sump Performance Evaluation Methodology," dated December 16, 2004, as modified by the SER for NEI 04-07. Containment walkdowns to support the analysis of debris blockage were performed using the guidelines provided in NEI 02-01. The application of the methodology to SPS and any exceptions to the NEI methodology are described below.

SPS NSSS systems are Westinghouse three loop pressurized water reactors (PWRs). The system consists of one reactor vessel (RX), three steam generators (S/Gs), three reactor coolant pumps (RCPs), one pressurizer (PZR) and the reactor coolant system (RCS) piping. The NSSS system is located inside various compartments consisting of three S/G cavities (or loop rooms), one RX cavity, and individual cubicles for the pressurizer, pressurizer relief tank (PRT), regenerative heat exchangers, and excess letdown heat exchanger. Each S/G cavity houses one steam generator and one RCP along with the loop piping and stop valves.

Debris Generation Methodology

A comparison of the plant general arrangement drawings indicates that SPS Units 1 and 2 have similar equipment layouts. The floor elevations are identical, and the geometry indicates that the equipment arrangement is similar for each unit, even though the North – South orientation of the loops is different.

The majority of the insulation inside the SPS containments is reflective metal insulation (RMI), calcium silicate (steel jacketed or encapsulated), TempMat, Thermal Wrap, and foam glass. Differences in insulation between the two units have been identified in walkdowns and the debris generation calculation uses the more conservative input.

Break Selection

Break selection was performed using guidance in Regulatory Guide 1.82, Rev. 3 and NEI 04-07. Breaks were selected to maximize the amount of debris generated and to generate the mix of insulation that is expected to provide the worst sump screen head loss. Candidate breaks were selected on the largest piping (RCS piping) near the steam generators due to the amount of insulation debris generated. Breaks in feedwater and/or main steam system piping are not considered as they will not require the ECCS and/or CSS to operate in recirculation mode. In accordance with NEI 04-07, small-bore piping (2" nominal diameter and less) is not considered, as the impact will be bounded by the larger breaks.

Insulation

Individual insulation zones of influence (ZOIs) are used to determine the total generated debris. The ZOI for the RMI, Cal-Sil, Temp-Mat, and fiberglass installed in containment were obtained from NRC SER Table 3-2. Where no guidance is provided for a particular insulation, conservative ZOIs are used.

Coatings

All qualified coating debris is quantified using a ZOI radius of 10.0D, as specified by the SER. Concrete and structural steel coatings within the ZOI are determined based on dimensioned plant drawings. For the purpose of determining impacted coating volumes, all coated surfaces within the ZOI are assumed to have the maximum of the possible thickness values specified by both current and historical specifications. In accordance with NEI 04-07 and the SER, all unqualified coatings are considered to fail regardless of their location within containment. Similarly, qualified coatings that have been identified as being degraded are considered to fail regardless of their location within containment.

Dominion is considering using the ZOI radius of 4.0D for coatings based on industry testing that is currently scheduled to be performed in the fall of 2005.

Foreign Material

Foreign material (e.g., tags, tape, stickers, etc.) was identified, but not quantified in the NEI 02-01 walkdown reports. An appropriate strainer area will be added to account for the strainer area that would be blocked by the foreign material dislodged during and post LOCA conditions.

Latent Debris

The latent debris data collected during the SPS2 spring 2005 outage has been used in preliminary analyses. Latent debris walkdowns will be performed in accordance with the NEI/SER guidelines during the upcoming refueling outages, as required.

Fire Wrap Material

No fire wrap materials are located within the ZOI of the breaks analyzed. Fire wrap materials are located in the annulus areas of the containment. The fire wrap material without a jacket is considered to fail as a result of the containment spray.

Debris Transport Methodology

The transport of the debris from the break location to the sump strainer will be evaluated using the methods outlined in NEI 04-07 with the enhancements recommended in the NRC SER. The means of transport considered will include blowdown, washdown, pool fill and recirculation for all types of debris. The recirculation transport analysis will be performed by Sargent & Lundy using computational fluid dynamics (CFD) models developed using the computer program FLUENT. The CFD models will be created by RWDI, Inc. Outputs of the CFD analysis will include global (entire containment) and local (near sump pit) velocity contours, turbulent kinetic energy (TKE) contours, path lines and flow distributions for various scenarios.

Strainer Head Loss

The final strainer head loss analysis will be performed by the strainer vendor and will be documented as part of the final design. The debris head loss will be based on test results that bound the SPS plant-specific debris mix. The strainer size will be conservative for the post-LOCA velocity and water level. The total head loss across the sump strainer will be equal to the sum of the fiber/particulate debris bed head loss, the RMI debris bed head loss and the clean strainer head loss.

Downstream Effects Methodology

For downstream effects, see Items 2(d)(v) and 2(d)(vi) in this attachment.

Exceptions to NEI 04-07 and NRC SER

The only identified exception to the approved NEI methodology and NRC SER is that break selection was not performed at regular intervals (such as 5 ft discussed in the SER) along the RCS piping. Rather, the method used for break selection in combination with the large ZOI for the fiberglass insulation ensures that the limiting break has been selected due to both the amount and mix of insulation postulated to be removed as debris. All smaller lines (such as the residual heat removal and safety injection lines) are bounded by breaks in the RCS piping near the steam generators due to the size of piping and the amount of and mix of debris involved.

NRC Requested Information

2(d)(i) Minimum NPSH margin for ECCS and CSS pumps with unblocked sump screen.

Dominion Response

2(d)(i) The minimum available NPSH margin with unblocked sump screen has not been finalized. As described in Items 2(b) and 2(e), Dominion is planning to perform revised containment analyses, including a transient calculation of NPSH available for the LHSI and RS pumps. Dominion will report the minimum NPSH margin in the plant-specific LAR described in Item 2(e).

<u>NRC Requested Information</u>

2(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.

<u>Dominion Response</u>

2(d)(ii) Dominion has not finalized the replacement sump screen surface area, so the submerged surface area cannot be reported at this time. Dominion is investigating plant design changes for either full or partial submergence. As described in Items 2(b) and 2(e), Dominion is planning to delay starting the RS pumps to credit a higher water level for wetted screen surface area. Preliminary analysis indicates a strainer height of 2 ft would support full submergence when the RS pumps start. Because the long-term containment water level is greater than 4 ft (at the time the LHSI pumps take suction from the sump), Dominion is investigating strainers that are partially submerged when the RS pumps start, but quickly become fully submerged when the LHSI pumps swap over to sump recirculation.

NRC Requested Information

2(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.**

Dominion Response

2(d)(iii) The maximum postulated head loss from debris accumulation on the submerged screen has not been finalized. As described in Items 2(b) and 2(e), Dominion is planning to perform revised containment analyses, including a transient calculation of NPSH available for the LHSI and RS pumps. The minimum NPSH margin from the revised analyses will be an input to determine the strainer size and acceptable debris head loss.

The primary constituents of the debris bed at the sump screen without credit for the CFD analysis in progress are: asbestos, calcium silicate, Cal-Sil/asbestos, fiberglass, Paroc, Transco RMI foil, TempMat, Transco Thermal-Wrap fiber, metal insulation jacketing, cloth insulation jacketing, silicone foam firestop, Cerafiber, Marinite, qualified and unqualified coatings, latent debris and miscellaneous debris such as stickers and tags.

The above debris does not include debris resulting from chemical effects. Dominion uses NaOH as the buffer for SPS. A comparison of the ICET chemical test summary for Test #1 and the SPS plant specific parameters has been performed. The comparison shows that with the exception of inorganic zinc primer coating, concrete surface, sump pH, and spray duration, the ICET chemical test parameters bound the SPS values. Evaluations are in progress to address the remaining parameters not bounded by the ICET results.

Sump strainer suppliers are currently developing plans and schedules to quantify the additional head loss associated with chemical precipitants. Dominion plans to evaluate the adequacy of the strainer design and will include margin for head loss due to chemical precipitants once the test results to quantify that head loss are known.

NRC Requested Information

2(d)(iv) **Basis for concluding 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 flow paths.**

Dominion Response

2(d)(iv) The "choke points" were evaluated as part of the SPS GSI-191 walkdowns as well as the SPS2 latent debris walkdown. No choke points or flow diversions were identified. Dominion may choose to perform additional verification walkdowns for SPS1, as needed, during the spring 2006 refueling outage.

Additionally, an inspection for non-LOCA generated material that could potentially obstruct recirculation water is conducted as part of the containment cleanliness inspection program prior to restart after each refueling outage. The controlling procedure will specifically address the need to assure that the containment is free of all items that could be washed to the sump strainer or could block an open flow path.

NRC Requested Information

2(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.**

Dominion Response

2(d)(v) Evaluation of the flow paths downstream of the containment sump to determine the potential for blockage due to debris passing through the sump strainer is in progress. The acceptance criteria were based on WCAP-16406-P evaluation methodology.

The scope of the evaluation includes the components in the recirculation flow paths such as throttle valves, flow orifices, spray nozzles, pumps, heat exchangers, and valves. The methodology employed in this evaluation is based upon input obtained from a review of the recirculation flow path shown on piping and instrument diagram drawings and plant procedures. The steps used in obtaining the flow clearance are as follows:

- Determine the maximum characteristic dimension of the debris (clearance through the sump strainer).
- Identify the recirculation flow paths.
- Identify the components in the recirculation flow paths.
- Review the vendor documents (drawings and/or manuals) 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 strainer.
- Identify the components that require a detailed evaluation and investigation of the effects of debris on their capability to function.

Based on the flow clearance evaluation, the following components require further review and investigation:

- IRS, ORS, LHSI, and HHSI/Charging Pumps
- Unit Specific Root Isolation Valves, Globe Valves
- Unit Specific Relief Valves
- Unit Specific Flow Instrumentation

The long-term downstream evaluations, including the fuels evaluations, are in progress. The fuel vendor is currently performing evaluations for blockage through the reactor vessel internals as well as for blockage of the reactor fuel. Any necessary corrective actions for the above components will be performed following the long-term evaluations as part of the resolution of GSI-191.

The new strainers will be designed for the effects of weight, thermal, differential pressure, and seismic loading. For SPS2, the new strainers are not subjected to jet impingement or missile loads from pipe breaks since they are located outside the missile barriers. For SPS1, the need to design for jet impingement and missile loads has not been confirmed. This will be addressed during the spring 2006 refueling outage walkdowns.

The new strainer design will ensure that gaps at mating surfaces within the strainer assembly and between the strainer and the supporting surface are not in excess of the strainer perforation size. Similarly, the design will ensure that drainage paths to the sump that bypass the sump strainer will not have gaps in excess of the strainer perforation size.

NRC Requested Information

2(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.**

Dominion Response

2(d)(vi) Verification of debris blockage of downstream components is described in 2(d)(v) above. Verification of downstream components for long-term effects is in progress, and the final results will be completed as noted in Section 2(a) above.

The long-term downstream effects evaluation is in progress using the methodology and acceptance criteria presented in WCAP-16406-P. Where excessive wear is found using this methodology, a refined approach using alternate methods may be utilized.

For the long-term wear evaluations, the quantity and type of debris will be derived from the debris transport and head loss calculations and the procurement specification. The containment flood level after the RWST is empty is used as a basis for determining the amount of fluid in which the debris will be mixed. The status of component evaluations are as follows:

- Evaluations for flow orifices and elements in the SI and RS systems are in progress. No results are available.
- Throttle valves used for flow balancing in the SI system are the most susceptible valves to wear. Based on the wear analysis results, additional valves may be evaluated. The long-term wear evaluation is in progress and no results are currently available.
- Instrumentation required during the post-LOCA recirculation has been identified and the corresponding root valves are being evaluated for clearance. Evaluations of instrumentation for debris settling in the instrument lines are in process. No results are currently available.
- Wear evaluations of the SI, RS, and charging pumps are in progress. No results are currently available.
- Evaluations for the RS heat exchangers are in progress. No results are currently available.

<u>Requested Information</u>

2(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.**

<u>Dominion Response</u>

2(d)(vii) The sumps are located outside the missile barriers and any high energy line break zones of influence. Therefore, the strainers are not subject to loads from missiles or expanding jets during a loss of coolant accident. Trash racks are not required to protect the strainers from postulated jets and missiles due to the strainer location inside containment. The strainers will be designed to withstand the loads imposed by the accumulation of debris and pressure differentials under predicted flow conditions as specified in the design requirements, as well as seismically generated loads.

NRC Requested Information

2(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.

Dominion Response

2(d)(viii) Dominion plans to use a passive strainer design for SPS. However, Dominion has been investigating the feasibility of an active design.

NRC Requested Information

2(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.**

Dominion Response

2(e) As described in the response to Item 2(b), Dominion plans to make two plant changes that require license amendments at SPS. Dominion plans to change the method of starting the RS pumps from timer delays to RWST level. Dominion also plans to increase the containment air partial pressure operating limits in TS Figure 3.8-1. These changes require a revised containment analysis and modifications to the NRC-approved alternate source term (AST) loss of coolant accident (LOCA) analysis.

Dominion plans to submit a revised containment analysis using the GOTHIC computer code to perform the following UFSAR calculations: LOCA and steam line break peak pressure and temperature; long-term containment depressurization for verification of containment leakage assumptions in the dose consequences; and NPSH available for the LHSI and RS pumps. The GOTHIC methodology will replace entirely the Stone & Webster LOCTIC methodology that is currently used in SPS UFSAR Chapters 5 and 6. Consequently, the GOTHIC method of analysis represents a "departure from a method of evaluation described in the FSAR" as defined in 10 CFR 50.59(a)(1) and requires a license amendment in accordance with 10 CFR 50.59(c)(2)(viii). Dominion will submit the GOTHIC containment analysis methodology with plant-specific analyses that support the proposed changes to TS Figure 3.8-1 and the RS pump start method in December 2005.

The AST LOCA analysis for SPS assumes containment leakage at the TS value for 1 hour. From hours 1-4 after the accident initiation, containment leakage is assumed to correspond to a containment pressure of 0.5 psig. At the end of hour 4, the containment pressure is assumed to be subatmospheric and remain subatmospheric thereafter (no containment leakage). The planned changes to delay the RS pumps and to modify TS Figure 3.8-1 require a relaxation of the currently approved containment leakage assumptions for SPS. As a result, Dominion will submit a revised AST LOCA analysis for NRC review in December 2005.

To meet the GL 2004-02 compliance date of December 31, 2007, Dominion will request that the license amendment requests described above be approved by September 1, 2006. This approval date will allow implementation of the change to the RS pump start and TS Figure 3.8-1 during the fall 2006 refueling outage at SPS2.

<u>NRC Requested Information</u>

2(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.**

<u>Dominion Response</u>

2(f) Dominion intends to ensure that potential quantities of post-accident debris are maintained within the bounds of the analyses and design bases that support ECCS and CSS recirculation functions.

Programmatic controls for containment debris sources will be put into existing procedures or new procedures will be developed, as required, to ensure that the potential containment debris load is adequately controlled to maintain ECCS pump NPSH margin. These controls will address piping and equipment insulation, housekeeping, coatings, foreign materials, and in-containment modifications for effects on recirculation function.

<u>Piping and Equipment Insulation</u>

Existing programs and procedures control insulation in containment.

The governing standard dealing with approved types of pipe and HVAC insulation will be revised, as necessary, to address the need to account for changes to the existing insulation or the addition of new insulation in containment and the appropriate method of tracking various insulation types, e.g., weight, surface area, volume, etc.

Existing procedures will be revised or new procedures established to ensure changes to insulation, not undertaken in conjunction with a design change package or other change process, are controlled so that they are pre-approved and tracked.

Appropriate revisions will be made to the Engineering Design Control Program to accommodate changes to the existing requirements for banned and controlled in-containment materials.

Latent Debris

A thorough latent debris inventory was performed during the SPS2 spring refueling outage with a similar walkdown planned for the SPS1 spring 2006 refueling outage to validate the input used in containment debris calculations. As necessary, latent debris will be sampled and quantified using a calculation of containment surface area developed for this purpose. This activity will be specifically linked to GSI-191 and compliance with 10CFR50.46.

Containment cleaning and foreign material controls are further described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Coatings

Coatings in containment are controlled by an existing coatings program and service level 1 specification.

A material standard has been revised to reference GSI-191 and to emphasize that only qualified protective coatings are to be used on procured equipment in containment unless an unqualified coating is approved.

Other applicable engineering standards will be revised, as required, to include provisions for maintaining inventories of unqualified protective coatings and pipe and HVAC insulation as controlled in containment materials so as to preserve any necessary design basis margins.

Current inventories of unqualified coatings and insulation have been determined and documented. Maximum allowable amounts of unqualified coatings and insulation must be established based on GSI-191 concerns and any modifications made to the existing capability or performance of the containment sump screens.

Appropriate revisions will be made to the Engineering Control Program to accommodate changes to the existing requirements for banned and controlled materials in containment.

Foreign Material Control

Containment housekeeping, containment closeout, and foreign material control procedures will be updated, as required, to describe the connection of foreign material to ECCS sump performance. This procedural direction will strengthen current guidance as described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Flow Paths and Choke Points

Changes to the design control procedures will be made to require review of any changes that could affect flow paths of recirculation water in containment or post-LOCA water level in containment. Verification of existing drainage pathways is described in the Dominion response to NRC Bulletin 2003-01 (Serial No. 03-368).

Appropriate revisions will be made to the Engineering Control Program to accommodate changes to the existing requirements for banned and controlled materials in containment.

Serial No. 05-212
Docket Nos. 50-305
50-336/423
50-338/339
50-280/281

ATTACHMENT 6

NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS

COMMITMENTS

DOMINION ENERGY KEWAUNEE, INC.
DOMINION NUCLEAR CONNECTICUT, INC.
VIRGINIA ELECTRIC AND POWER COMPANY
KEWAUNEE POWER STATION
MILLSTONE POWER STATION UNITS 2 AND 3
NORTH ANNA POWER STATION UNITS 1 AND 2
SURRY POWER STATION UNITS 1 AND 2

NRC GENERIC LETTER 2004-02: POTENTIAL IMPACT OF DEBRIS BLOCKAGE ON EMERGENCY RECIRCULATION DURING DESIGN BASIS ACCIDENTS AT PRESSURIZED-WATER REACTORS COMMITMENTS

Alphanumeric numbers in bold (e.g., **[2(a)]**, **[2(d)(iii)]**) following each commitment denotes the section of the response where the commitment is located. Wording in (brackets) denotes wording added for clarity of the commitment.

Dominion Energy Kewaunee, Inc. (DEK), Dominion Nuclear Connecticut, Inc. (DNC), and Virginia Electric & Power Company (Dominion) have identified four commitments for all its sites as a result of the evaluations performed to date in response to Generic Letter 2004-02. These commitments are as follows:

1. Upon completion of activities described in this attachment related to modifications to the containment sump, the ECCS recirculation functions under post-accident debris loading conditions will be in compliance with the regulatory requirements listed in Generic Letter 2004-02 (GL 04-02). **[2(a)]**
2. Dominion (DEK, DNC) plans to evaluate the adequacy of the strainer design and will include margin for head loss due to chemical precipitants once the test results to quantify that head loss are known. **[2(d)(iii)]**
3. Any corrective actions that are shown to be necessary (for components affected by downstream effects) as a result of these evaluations (long-term wear) are planned to be completed prior to December 31, 2007. **[2(d)(vi)]**
4. Programmatic controls for containment debris sources will be put into existing procedures as necessary to ensure the potential containment debris load is adequately controlled to maintain ECCS pump NPSH margin. **[2(f)]**

In addition, the following additional commitments have been identified for the sites/units indicated:

Millstone Unit 3

5. DNC will submit a license amendment request for MPS3 to change the actuation method and the start time of the RSS pumps. **[2(a)]**

North Anna Power Station

6. Dominion will report the minimum NPSH margin in the NAPS plant-specific LAR described in Item 2(e). **[2(d)(i)]**
7. Dominion will submit the GOTHIC containment analysis methodology with plant-specific analyses that support the proposed changes to TS Figure 3.6.4-1 and the RS pump start method in February 2006. **[2(e)]**

8. The planned changes to delay the RS pumps and modify TS Figure 3.6.4-1 require a relaxation of the currently approved containment leakage assumptions for NAPS. Dominion will submit a revised AST LOCA analysis for NAPS for NRC review in February 2006. **[2(e)]**

Surry Power Station

9. Dominion will report the minimum NPSH margin in the SPS plant-specific LAR described in Item 2(e). **[2(d)(i)]**
10. Dominion will submit the GOTHIC containment analysis methodology with plant-specific analyses that support the proposed changes to TS Figure 3.8-1 and the RS pump start method in December 2005. **[2(e)]**
11. The planned changes to delay the RS pumps and to modify TS Figure 3.8-1 require a relaxation of the currently approved containment leakage assumptions for SPS. As a result, Dominion will submit a revised AST LOCA analysis for SPS for NRC review in December 2005. **[2(e)]**