DD-04-XX

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION

R. William Borchardt, Acting Director

In the Matter of	)	Docket Nos. 50-247 and 50-286
	)	
ENTERGY NUCLEAR OPERATION, INC.	)	License Nos. DPR-26 and DPR-64
	)	
	)	
(Indian Point Nuclear Generating,	)	(10 CFR 2.206)
Unit Nos. 2 and 3)	)	

PROPOSED DIRECTOR'S DECISION UNDER 10 CFR 2.206

I. Introduction

By letter dated September 8, 2003, as supplemented by letters dated September 22 and October 29, 2003, Mr. Alex Matthiessen of Riverkeeper, Inc., and Mr. David Lochbaum of the Union of Concerned Scientists (collectively, the Petitioners) filed a Petition pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 2.206. The Petitioners requested:

1. That the Nuclear Regulatory Commission (NRC) take immediate enforcement action against Entergy Nuclear Operations, Inc. (Entergy), the licensee for Indian Point Nuclear Generating, Unit Nos. 2 and 3 (IP2 and 3) in Buchanan, New York, by issuing an Order requiring Entergy to immediately shut down IP2 and 3 and maintain the reactors shutdown until the containment sumps are modified to resolve Generic Safety Issue 191 (GSI-191).

2. As an alternative, should the NRC deny the above request to require IP2 and 3 to shut down immediately, that the NRC issue an Order to prevent plant restart following each plant's next refueling outage until such time that the containment sumps are modified to resolve GSI-191. If this alternative is chosen, the Petitioners further requested a

requirement to be included within the Order for Entergy to (a) maintain all equipment needed for monitoring leakage of reactor coolant pressure boundary components within containment fully functional and immediately shut down the affected reactor upon any functional impairment to leakage monitoring equipment, and (b) refrain from any activity under 10 CFR 50.59, 10 CFR 50.90, Section VII.C of the NRC's Enforcement Policy, or Generic Letter 91-18, Revision 1, that increases or could increase the probability of a loss-of-coolant accident (LOCA).

The Petitioners stated that the basis for both of the requested enforcement actions in the Petition is a lack of reasonable assurance that the IP2 and 3 containment sumps will be able to perform their function during a LOCA. Their conclusions regarding the containment sumps are based on their analysis of publicly available reports that were prepared for the NRC by the Los Alamos National Laboratory (LANL). Specifically, LANL's findings are documented in the following reports:

1. NUREG/CR-6762, Volume I, "GSI-191 Technical Assessment: Parametric Evaluations for Pressurized Water Reactor [PWR] Recirculation Sump Performance" (hereafter referred to as the Parametric Study), dated August 2001.
2. NUREG/CR-6771, "The Impact of Debris Induced Loss of ECCS [Emergency Core Cooling System] Recirculation on PWR Core Damage Frequency," dated August 2001.
3. LANL Report LA-UR-02-7562, "The Impact of Recovery From Debris-Induced Loss of ECCS Recirculation on PWR Core Damage Frequency," dated February 2003.

These documents are cited in the Petition as the primary basis for the request to shut down IP2 and 3. The Petitioners further stated that the requested enforcement actions are appropriate based on precedents, including NRC actions taken at the Donald C. Cook and Davis-Besse Nuclear Power Plants in late 1997 and early 2002, respectively.

The Petitioners met with the Office of Nuclear Reactor Regulation's Petition Review Board (PRB) on September 24, 2003, to discuss the Petition and provide additional details in support of this request. This meeting was transcribed, and the transcript is publicly available as a supplement to the Petition.

In letters dated October 15, 2003, and January 20, 2004, Entergy provided information related to the Petition. This information was considered by the staff in its evaluation of the Petition.

By letter dated October 23, 2003, the NRC informed the Petitioners that their request for the NRC to issue an Order to immediately shut down IP2 and 3 was denied and that the issues in the Petition were referred to the Office of Nuclear Reactor Regulation for appropriate action.

II. Discussion

The potential for sump clogging in PWRs is an issue that is currently being evaluated by the NRC through the NRC's Generic Issue Program. The Petitioners used NRC-sponsored studies that were performed in support of the staff's review of GSI-191 to formulate the basis for their requested enforcement actions. Specifically, the Petitioners stated their belief that the requested enforcement actions are appropriate because:

1. There is insufficient assurance against containment sump failure and consequential impairment of the reactor core and containment cooling function; and
2. The public around Indian Point would be subjected to unnecessarily high risk until GSI-191 is resolved for IP2 and 3.

The Petitioners reached these conclusions by considering the Parametric Study and the associated risk study documented in NUREG/CR-6771. As noted above, the NRC denied the Petitioners' request for immediate shutdown of IP2 and 3. The NRC staff has evaluated the alternative actions requested by the Petitioners, and basis for the requested actions, as follows:

1. **Differences Between the Parametric Study and Actual Plants**: The Parametric Study does not raise sufficient concerns regarding plant-specific vulnerabilities of IP2 and 3 to warrant immediate action. The Parametric Study was a generic study that did not model individual plants in sufficient detail to provide information for drawing conclusions about the operability of a particular sump. The Parametric Study clearly states that the results are not adequate for that purpose. The Petitioners did not provide any detailed analysis or valid assessment to demonstrate the applicability of the generic study to support their assertion of its applicability to the actual IP2 and 3 sump design. Therefore, the staff continues to conclude that the Parametric Study is insufficient to support the conclusions the Petitioners have drawn regarding the operability of IP2 and 3 sumps.

The Parametric Study was specifically designed to answer two questions. First, is the ECCS sump clogging issue a plausible concern for domestic PWRs? Second, is there a need for additional regulatory action regarding PWR sumps? The Parametric Study answers these questions on a generic, not a plant-specific basis. It supports the conclusion that ECCS sump clogging is indeed an issue that merits additional study for PWRs. To demonstrate this, LANL conducted a study of 69 cases to determine if there were any typical plant features or characteristics (i.e., plant parameters) that would eliminate sump clogging as a plausible issue for PWRs. The study was conducted using a generic plant piping and containment configuration. Various plant parameters were then overlaid onto the generic plant. LANL used combinations of parameters that were reflective of actual licensed plants to determine a reasonable range of sump failure probabilities. Since each case was calculated using a combination of a generic plant piping and containment configuration, some generalized assumptions, and some actual plant characteristics, none of the parametric cases represent any of the 69 operating PWRs. Rather, the study can only be used to determine a range of overall possibilities that may exist. Further plant-specific study is needed to assess the sump reliability for individual plants. In any case, this study cannot be used to draw conclusions about the potential for sump clogging at specific plants, such as IP2 and 3.

To better understand the limited applicability of the Parametric Study, it is important to understand that debris generation and transport are strongly influenced by plant geometry. Factors such as pipe break orientation, locations of debris sources relative to the break, and locations of plant structures and gratings all have potentially significant impacts on both the amount of debris generated and the amount transported to the sump. For example, most plants use more than one type of insulation in their containment. In actual cases, some insulation types may only be used in certain locations throughout the containment. Different insulations create significantly different head loss characteristics (i.e., restrictions to flow) when entrained onto a sump screen. The Parametric Study lacked sufficient information to model actual debris types and source locations, so it was assumed that all insulation types were homogeneously mixed throughout the containment. This assumption, while adequate for the purposes of the study, distorts a predicted plant-specific response to different pipe break scenarios.

Because the Parametric Study was not intended to draw conclusions regarding specific plants, there are other limitations that make it inappropriate to apply the Parametric Study results to actual plants. For example, the information used in the study was not verified with nuclear power plant licensees for accuracy after the study was completed.

Entergy has stated that the ECCS recirculation flow rates are incorrect and are approximately double each plant's actual flow rate. Since the pressure drop (i.e., head loss) across a sump screen is directly proportional to the velocity squared, the calculated head losses in the Parametric Study for these two parametric cases could be higher by a factor of approximately four. Consequently, net positive suction head (NPSH) margins would be substantially better than reported in the study.

Another important limitation of the Parametric Study is that it does not model all unique plant-specific features. In the case of IP2 and 3, both units have two sumps in containment: an ECCS sump and a second containment sump that can also be used for recirculation. This second sump is located in a different part of the containment from the ECCS recirculation sump, utilizes the residual heat removal (RHR) pumps instead of the recirculation pumps, and is not put into operation during an accident unless initiated by operator action (i.e., will not collect debris on suction screens while the ECCS recirculation sump is operating). This backup system can be used for recirculation if the normal ECCS recirculation sump loses suction due to debris clogging of the sump screen. Thus, this backup system provides an additional level of redundancy and diversity at IP2 and 3. On page 15 of the Petition, the Petitioners indicate that the Indian Point extra sump has no impact on safety because the Parametric Study already analyzed this feature when it considered phased introduction of recirculation (i.e., half ECCS flow at a time). The Petitioners have misinterpreted the Parametric Study. The study considered utilizing half of the ECCS flow in a phased manner to model the use of one ECCS train at a time. The IP2 and 3 containment sump feature provides an additional sump not considered in the study. It is not another train of ECCS, but an entirely separate system.

The Parametric Study also used plant data that is at least 5-7 years old. Some plants have made significant changes during this time. As a result, the study modeled plant characteristics that do not necessarily reflect current plant configurations. For instance, Entergy and the former licensees have greatly reduced the amounts of calcium silicate (cal-sil) insulation in the containments of both Indian Point units (e.g., the new steam generators at IP2 are insulated with fiberglass). The result is that both plants now have minimal amounts of cal-sil. The parametric cases assumed by the Petitioners to represent IP2 and 3 had approximately 40 percent cal-sil. This assumption would overestimate head losses relative to IP2 and 3 because cal-sil debris has substantially higher head loss characteristics than fiberglass insulation. Additionally, Entergy has improved the design of IP2's ECCS recirculation pumps. This modification decreased the NPSH required by the pump, thus increasing the licensing basis NPSH margin from 0.97 feet of water (ft H_2O) to approximately 2.5 ft H_2O. This plant modification occurred after the data for the Parametric Study was obtained. These changes would lead to an estimate of the likelihood of ECCS sump failure for the parametric cases that are not representative of IP2 and 3.

NPSH margin for the recirculation mode of the ECCS system is dependent on several different factors including the flow rate, the height of the water level above the pump suction, the water temperature, and the containment pressure. For the purposes of licensing a nuclear plant, each licensee is required to conservatively calculate a minimum NPSH margin based on the worst case for each factor. This conservative calculation ensures that the ECCS pumps can handle the worst-case scenario. A licensing basis NPSH margin is calculated at large-break LOCA conditions assuming the maximum pump flow rate (i.e., runout flow), the maximum water temperature, the minimum water level in the sump, and assuming little or no containment pressure above atmospheric conditions. This method of calculating the licensing basis NPSH margin results in ECCS pumps that are designed with additional safety margin.

The Parametric Study used the licensing basis NPSH margin as the criterion for defining ECCS pump failure. This criterion assumes that loss of the licensing basis NPSH margin is equivalent to a complete failure of the ECCS pumps. While this criterion was appropriate for the purposes of the study, loss of the licensing basis NPSH margin does not necessarily mean that the ECCS pumps would fail, but may only degrade operation.

For all of the reasons cited above, the Parametric Study does not provide an adequate basis for drawing conclusions regarding the adequacy of sumps at actual operating plants, including IP2 and 3.

2. **Applicability of Cited Precedents**: The Petitioners cite prior regulatory actions at the Davis-Besse and Donald C. Cook Nuclear Power Plants as a basis for the requested immediate action. These actions are not applicable to IP2 and 3. The Donald C. Cook Nuclear Power Plant shut down voluntarily based on plant-specific information that called into question the adequacy of the sump design. Upon further evaluation, the

3. licensee's engineering staff concluded that the sump design was adequate, and no modifications to the sump were made. The Davis-Besse Nuclear Power Plant was shut down as a result of the reactor vessel head degradation issue. During this outage, the licensee identified unqualified coatings inside containment. The sump screen area was enlarged to resolve this issue. In both cases, the decisions were based on plant-specific evaluations. Given the nature of the Parametric Study, there is no plant-specific information at this time to support the conclusion that IP2 and 3 have a similar deficiency. As part of the resolution of GSI-191, all PWRs will be requested to perform an evaluation of the potential for debris clogging based on state-of-the-art, staff-approved methods using plant-specific information. Any deficiencies identified by these evaluations will have to be addressed by licensees in accordance with established regulatory requirements.

4. **Action Plan for Issue Resolution**: The staff believes that GSI-191 is an important issue, and it is currently being addressed through the NRC's Generic Issue Program. An action plan for resolution has been developed and is being followed. This action plan is publicly available through ADAMS (Accession No. ML032900950). All PWR licensees have been participating in the resolution process. Additionally, by implementing compensatory measures, such as those that were requested by NRC Bulletin 2003-01, "Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors" (e.g., alternate water sources or refilling the refueling water storage tank (RWST)), licensees have enhanced safety by improving guidance for successful operator recovery actions. Although many plants have taken steps to minimize the risks associated with this issue, an NRC-approved methodology for evaluating each plant's

sump performance is being developed to (1) ensure that each plant evaluates the potential for debris-clogging in a consistent manner based on state-of-the-art, staff-approved methods and plant-specific information; and (2) provide the NRC with the technical basis for ensuring that any proposed solution adequately addresses the issue. If the NRC's continued studies indicate that unsafe conditions exist at Indian Point or any other plant, immediate actions will be taken to ensure the continued health and safety of the public.

The Petitioners asserted that licensee actions to resolve the boiling-water reactor (BWR) strainer clogging issue in the 1990s showed further evidence that the Indian Point containment sump screens are likely undersized. All domestic BWRs replaced their suction strainers in response to NRC Bulletin 96-03, "Potential Plugging of Emergency Core Cooling Suction Strainers by Debris in Boiling-Water Reactors," dated May 6, 1996. This was done after performing a plant-specific analysis using an NRC-approved methodology. The current action plan for resolving GSI-191 is following a resolution path that is very similar to the BWR resolution, and includes (as noted above) the development of an NRC-approved methodology for evaluating each plant's susceptibility to sump clogging. Since BWRs and PWRs have significantly different designs, it cannot be assumed that because the BWRs all replaced their suction strainers, PWRs must also do so. BWRs and PWRs do not mitigate accidents in the same way. The mechanism driving debris transport to the ECCS strainers in the BWR suppression pool is very different from the debris transport mechanism in a PWR.

5. **GSI-191 Generic Risk Estimate**: Citing prior NRC reports, the Petitioners assert that these reports indicate that the containment sumps at Indian Point have a very high likelihood of failing during LOCA and that any argument to the contrary would be flawed. The NRC staff considers the risk estimates in LANL Report LA-UR-7562 to be more realistic estimates of the risk associated with the sump clogging issue. LANL Report LA-UR-02-7562, in effect, supercedes NUREG/CR-6771 since it provides updated risk estimates that utilize the latest information on pipe break frequencies and accounts for operator action, which were not originally considered in NUREG/CR-6771. Based on the LANL risk studies, the average plant core damage frequency (CDF) calculated for the GSI-191 containment sump issue is slightly less than 1E-5 per reactor year. This generic estimate indicates that, in combination with the actions taken in response to Bulletin 2003-01, it is safe for plants to continue to operate while they are performing the necessary plant-specific analyses. The estimate does justify further plant-specific analyses. If these analyses identify the potential for substantial safety enhancements, they will be promptly implemented.

Commercial nuclear power plants are designed and licensed with many layers of protection, a concept commonly referred to as defense-in-depth. The defense-in-depth approach ensures that plants have multiple layers of protection against the release of fission products to the surrounding environment, so that the failure of any one layer of protection will not result in fission product release. In general, defense-in-depth is created in the design of nuclear plants through the use of reliable systems and components. Despite the fact that systems are constructed reliably, nuclear power plants are designed to accommodate failures through redundancy (e.g., multiple trains), and the use of diverse methods to accomplish important safety functions. Finally, plants are designed with safety margin (i.e., designing the system or component for greater than the worst expected conditions) to provide for unforeseen events.

As noted above, the Petitioners request for immediate action (i.e., to order IP2 and 3 to immediately shut down until GSI-191 is resolved) was denied because there is currently no basis to conclude that IP2 and 3 are operating unsafely. The technical and regulatory basis provided by the Petitioners for their proposed alternative enforcement action is the same as for the request to immediately shut down IP2 and 3. Accordingly, the above discussion demonstrates that the basis provided by Petitioners for the requested actions does not support accelerating the resolution of GSI-191 for IP2 and 3 (i.e., require the licensee to resolve GSI-191 prior to starting up after each plant's next shutdown).

Consistent with our generic issue process, the NRC is currently conducting an investigation into the potential for sump clogging. As with any investigation, the NRC staff is gathering evidence to determine whether plants are susceptible to this problem or not. The evidence reviewed by the staff to date, including the Petition and the Parametric Study, does not support the actions requested by the Petitioners. However, it does not exclude the possibility that plants may have to make modifications or even shut down in the future in order to ensure compliance with the regulations. Once sufficient evidence is accumulated so that an appropriate determination can be made, the staff will take the appropriate regulatory action to address the issue.
The first step in being able to assess susceptibility to sump clogging, however, is the development of an engineering methodology for calculating the amount of debris

accumulation on the sump screens and the associated head loss across the debris bed. Without an approved methodology, it would be extremely difficult to determine with reasonable certainty whether a plant may be susceptible to the problem, and if modifications are made, would the modifications adequately address the issue. If plants make modifications in the future based on our resolution of the issue, these modifications should utilize an appropriate technical basis for determining the need for modifications. The schedule for resolving the issue is a risk-informed decision. Based on the risk estimates associated with GSI-191, the staff believes that the current schedule for resolution is appropriate.

III. Conclusion

As stated in the discussion above, the NRC staff has thoroughly reviewed the basis for the Petitioners' requested actions and denies the requested enforcement actions because the information provided in the Petition does not provide an adequate basis for immediate shutdown of the Indian Point Nuclear Generating Unit Nos. 2 and 3. On the basis of the same information, the staff also denies the Petitioners' proposed alternative course of action.

Consistent with the generic issue process, the NRC is currently conducting an investigation into the potential for sump clogging. As with any investigation, the staff is gathering evidence to determine whether specific plants are actually susceptible to this problem or not. The evidence reviewed by the staff to date, including the Petition and the Parametric Study, does not support the actions requested by the Petitioners. However, it does not exclude the possibility that plants may have to make modifications or even shut down in the future in order to ensure compliance with the regulations. Once sufficient evidence is accumulated so that an appropriate determination can be made, the staff will take the appropriate regulatory action to address the issue.

PROPOSED

As provided in 10 CFR 2.206(c), a copy of this Director's Decision will be filed with the Secretary of the Commission for the Commission to review. As provided for by this regulation, the decision will constitute the final action of the Commission 25 days after the date of the decision unless the Commission, on its own motion, institutes a review of the decision within that time.

Dated at Rockville, Maryland, this day of 2004.

FOR THE NUCLEAR REGULATORY COMMISSION

R. William Borchardt, Acting Director
Office of Nuclear Reactor Regulation

PROPOSED