



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

April 6, 2015

Mr. Michael Mulligan  
P.O. Box 161  
Hinsdale, NH 03451

Dear Mr. Mulligan:

This letter responds to the petition you filed with Mr. Mark A. Satorius, Executive Director for Operations of the U.S. Nuclear Regulatory Commission (NRC) under Section 2.206 of Title 10 of the *Code of Federal Regulations* (10 CFR 2.206), "Request for Action under This Subpart," regarding equipment failures at Palisades Nuclear Plant (PNP). In your petition dated March 5, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14071A006), as supplemented on April 8, May 21, and September 3, 2014 (ADAMS Accession Nos. ML14143A212, ML14142A101, and ML14259A135, respectively), you requested immediate action to prevent PNP from restarting the reactor because a piece of primary coolant pump (PCP) impeller had broken free and become lodged between the reactor vessel (RV) and the flow skirt and because of flawed control rod drive mechanisms (CRDMs). You also requested numerous other licensee and NRC actions.

By e-mail dated March 19, 2014 (ADAMS Accession No. ML14083A680), the NRC staff acknowledged receiving your petition and stated that following the guidance of 10 CFR 2.206, it had referred your petition for action within a reasonable time. In the e-mail, the NRC also informed you that the agency was denying your request for immediate action to prevent PNP from restarting the reactor, based on the following factors:

- NRC staff performed an in-depth independent review of the licensee's analysis and concluded that the impeller piece did not pose a threat to safe operation of the reactor and RV.
- The licensee replaced all of the CRDM housings before plant startup.

By teleconference on April 8, 2014, and again on September 3, 2014, you addressed the Petition Review Board to clarify the bases for your petition. The transcripts of these meetings were treated as supplements to the petition and are available in ADAMS as previously noted in this letter.

In the agency's letter dated September 25, 2014 (ADAMS Accession No. ML14237A726), the NRC informed you that it was accepting your petition, in part, for review under 10 CFR 2.206 for the following specific issues and concerns from your March 5, 2014, petition as supplemented

by your e-mail dated May 21, 2014, and as supplemented by information you provided in teleconferences on April 8, 2014, and September 3, 2014:

- Request for PNP to open every PCP for inspection and clear up all flaws.
- Request for PNP to replace the PCPs with others designed for their intended duty.
- Request for an Office of the Inspector General (OIG) inspection on why different NRC regions have different analysis criteria for similar PCP events.
- Request for a \$10 million fine over these events.
- Request for PNP to return to yellow or red status and for the NRC to intensify its monitoring of PNP

After staff evaluation of your concerns, the NRC issued the proposed director's decision for comment to both you and the licensee on January 23, 2015 (ADAMS Accession Nos. ML14338A435 and ML14338A431). Your responses dated January 26, 29, and 30, 2015 (ADAMS Accession Nos. ML15035A217, ML15035A218, and ML15035A219, respectively), contained many comments, including your belief that the proposed director's decision did not explain certain accident scenarios and your belief that the NRC is inconsistent in the evaluation of PCP issues at various nuclear sites. The NRC evaluated your concerns, including comments received on the proposed director's decision. The final director's decision responds to your concerns that were accepted for review under the 10 CFR 2.206 process and the attachment to the final director's decision responds to your comments on the proposed director's decision. The NRC forwarded your request for an OIG inspection on why different NRC regions have different analysis criteria for similar PCP events to the OIG.

The NRC has found no basis for taking the requested enforcement-related actions against PNP; thus, the NRC denies your petition. The NRC determined that the licensee's actions to date are adequate and there is reasonable assurance that the operation of the PNP will not endanger the health and safety of the public. For the performance deficiencies and inspection findings that the NRC has identified at PNP, the agency will continue to monitor the progress of the licensee's completion of corrective actions through planned inspections consistent with the NRC's ongoing reactor oversight process.

The NRC will file a copy of the enclosed final director's decision (DD-15-03) with the Secretary of the Commission for the Commission's review in accordance with 10 CFR 2.206(c). As a provision of 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. The documents cited in the enclosed decision are available in ADAMS for inspection at the Commission's Public Document Room at One White Flint North, 11555 Rockville Pike (first floor), Rockville, Maryland, and from the ADAMS Public Library component on the NRC Web site at <http://www.nrc.gov/reading-rm.html> (the Public Electronic Reading Room).

I also have enclosed a copy of the "Notice of Issuance of Director's Decision under 10 CFR 2.206" that has been filed with the Office of the *Federal Register* for publication.

M. Mulligan

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I appreciate your efforts to bring this matter to the attention of the NRC. Please feel free to contact Jennivine Rankin by phone at 301-415-1530 or by e-mail at [Jennivine.Rankin@nrc.gov](mailto:Jennivine.Rankin@nrc.gov) to discuss any questions related to this petition.

Sincerely,



William M. Dean, Director  
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:

1. Final Director's Decision
2. *Federal Register* Notice

cc: Vice President, Operations  
Entergy Nuclear Operations, Inc.  
Palisades Nuclear Plant  
27780 Blue Star Memorial Highway  
Covert, MI 49043-9530

Listserv

**ENCLOSURE 1**

**Final Director's Decision**

**ADAMS Accession No. ML15054A365**

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

William M. Dean, Director

In the Matter of

Entergy Nuclear Operations, Inc. ) Docket No. 50-255  
License No. DPR-20  
Palisades Nuclear Plant )

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DIRECTOR'S DECISION UNDER 10 CFR 2.206

**I. Introduction**

By letter dated March 5, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14071A006), as supplemented on April 8, May 21, and September 3, 2014 (ADAMS Accession Nos. ML14143A212, ML14142A101, and ML14259A135, respectively), Mr. Michael Mulligan submitted a petition under Section 2.206 of Title 10 of the *Code of Federal Regulations* (10 CFR), "Requests for Action under This Subpart," to Mr. Mark A. Satorius, Executive Director for Operations, of the U.S. Nuclear Regulatory Commission (NRC). The petitioner requested the NRC and Entergy Nuclear Operations, Inc. (ENO, the licensee) to take actions for equipment failures at Palisades Nuclear Plant (PNP). As the basis for the request, the petitioner stated that PNP has had recent events and equipment failures, such as primary coolant pump (PCP) impeller pieces breaking off and lodging in the

reactor vessel (RV), leakage from the safety injection refueling water tank, and flaws in the control rod drive mechanisms.

By e-mail dated March 19, 2014 (ADAMS Accession No. ML14083A680), the NRC informed the petitioner it had denied his request for immediate action to prevent a PNP restart because a piece of PCP impeller was lodged between the RV and the flow skirt.

The petitioner addressed the Petition Review Board (PRB) by teleconference on April 8, 2014, and on September 3, 2014, to clarify the basis for the petition. The NRC treated the transcripts of these meetings as supplements to the petition; they are available in ADAMS as previously noted in this section.

On September 25, 2014, the NRC issued an acknowledgement letter (ADAMS Accession No. ML14237A726) to the petitioner accepting, in part, the petition for review. The letter informed the petitioner that five requests, listed in Section II below, met the criteria for review in accordance with Management Directive (MD) 8.11, "Review Process for 10 CFR 2.206 Petitions" (see [http://www.internal.nrc.gov/ADM/DAS/cag/Management\\_Directives/md8.11.pdf](http://www.internal.nrc.gov/ADM/DAS/cag/Management_Directives/md8.11.pdf)). The letter also stated that the petitioner's remaining requests did not meet the criteria for review, either because they were not requests for enforcement-related action or because they concerned resolved issues that had already been the subject of NRC staff review and evaluation. Enclosure 1 to the acknowledgement letter explains the staff's basis for why the NRC did not accept those requests into the 2.206 process.

On January 23, 2015 (ADAMS Accession Nos. ML14338A435 and ML14338A431) the NRC issued the proposed director's decision for comment to the petitioner and the licensee. The petitioner provided responses dated January 26, 29, and 30, 2015 (ADAMS Accession Nos. ML15035A217, ML15035A218, and ML15035A219, respectively). The NRC evaluation of these comments are provided as Attachment 1 to this final director's decision.

## II. Discussion

This section includes both the petitioner's requests for enforcement-related actions and the NRC's decisions.

### **Request 1: Request for PNP to open every PCP for inspection and clear up all flaws.**

NRC decision: As summarized in the PNP integrated inspection report dated May 7, 2014 (ADAMS Accession No. ML14127A543), the issue of broken impeller pieces has been the subject of continued regulatory oversight. The report details the chronology of significant PCP events at PNP dating back to 1983. In addition, the report indicates that PCP-B is the only pump in service with a refurbished impeller, which is more susceptible to fatigue-related failures than the remaining three pumps where the impellers have been replaced with newly manufactured impellers. The NRC recognizes that PCP-B continues to remain in service with potential impeller cracks; however, as stated in the inspection report dated May 7, 2014, the NRC did not identify any immediate safety concerns that would pose a danger to public health and safety or the environment. The NRC staff reached this conclusion by performing independent evaluations of the licensee's operability determination during the October 2011 vibration incident and during the 2014 refueling outage during which a lodged piece of impeller was found between the reactor vessel and flow skirt. During these evaluations, the NRC staff considered PNP's operating experience with broken impeller pieces and evaluated the impact the pieces have on the current transient and accident analyses as described in Chapter 14, "Safety Analysis" of the PNP final safety analysis report (FSAR) (ADAMS Accession No. ML14357A602). A summary of the NRC staff's previous evaluations is described below.

As stated in the NRC's acknowledgement letter dated September 25, 2014, the NRC staff reviewed in-depth the licensee's analysis of the interactions of PCP impeller pieces within the PCP. This review considered impeding flow, impacting other vanes, impeding pump coast-down, and causing pressure boundary damage. The PCPs have two design-basis safety functions: (1) the pumps provide reactor core cooling during coast-down in the event of a loss of electric power to all four PCPs, and (2) the pump casing is part of the primary coolant system (PCS) pressure boundary. To evaluate the impacts of the PCP pieces, NRC staff independently reviewed the licensee's operability evaluation during the October 2011 vibration incident and during the 2014 refueling outage. In the reviews, the NRC determined that the pump casing, impeller and, therefore, any impeller fragments, are constructed of ductile materials. Should impact occur between an impeller fragment and either the pump casing or the impeller, the result would be ductile deformation and not brittle fracture. Ductile deformation is not expected to cause the generation of a significant number of additional fragments or leakage through the pressure boundary as might occur in the case of brittle fracture. Based on the observed size of impeller fragments, clearances between the impeller and the pump case, the ductile nature of the materials involved, and the inertia of the impeller, jamming of the impeller by a fragment is considered highly unlikely. Impeller fragments may deform the impeller and/or the casing slightly, but would ultimately move out of the PCP. Consequently, there would be little effect on pump coast-down even if a piece broke off after a loss of electric power. In addition, the NRC staff examined a limiting scenario: a failed PCP impeller that reduces the effectiveness of coast-down flow provided by the flywheel. While this failure is believed to be highly unlikely, it is bounded by the analysis provided in Section 14.7.2, "Reactor Coolant Pump Rotor Seizure," of the PNP FSAR.

During the operability reviews in 2011 and 2014, the NRC staff also reviewed the impacts of PCP impeller pieces on the PCS pressure boundary. Loss of the pressure boundary because of potential impact was determined not to be a significant concern because of the pressure boundary thickness in comparison to the ductile piece dimensions and the small likelihood that significant impacts would occur. NRC staff also examined another limiting scenario: a failure of the impeller, which could cause a break in the pump and a leak of the reactor coolant system. This failure of the pressure boundary is believed to be highly unlikely and may not be credible; however, it is bounded by the analysis provided in Section 14.17.1, "Large Break LOCA [Loss-of-Coolant Accident]," of the PNP FSAR. NRC staff also examined the effects of PCP impeller pieces passing through the PCS cold leg, including potentially impacting a resistance temperature detector (RTD) and causing pressure boundary damage. NRC staff concluded that damage to the RTD resulting from an impeller piece contacting the RTD is not a significant safety concern. Dynamic flow analyses predicted that broken pieces from the pump would not contact the RTD. However, in the unlikely event that contact should occur, any interactions with RTD thermocouples would also be bounded by the large break LOCA analysis or Section 14.17.2, "Small Break LOCA," of the PNP FSAR. Based on these evaluations, the NRC staff concluded that any consequence of a PCP impeller failure on the safety functions of the PCP is bounded by the current design-basis safety analyses.

Besides evaluating impacts on the PCP, NRC staff also considered the potential impacts of a failed impeller on fuel. Impeller pieces are likely to remain stuck at the flow skirt or at the bottom of the RV, as evidenced by the discovery of previous pieces. This is because flow conditions were insufficient to elevate the pieces that reached the bottom of the RV and, therefore, those pieces would be expected to sit at the flow skirt or on the bottom of the RV. Because all of the instrumentation and control blades enter through the top of the reactor

vessel, no components are in the bottom of the RV for these larger impeller pieces to interact with and, therefore, they do not pose a safety risk. Although any piece that would become lodged at the flow skirt or the lower core support plate would cause a local flow disturbance, that disturbance would have long decayed away because of mixing and crossflow by the time the flow reaches the active fuel region of the core.

During evaluation of the licensee's operability determination regarding the wedged piece of impeller, NRC staff did recognize that very small pieces of the impeller could make it through the flow skirt and may interact with the fuel. However, interaction between small metal pieces and the fuel is possible in any reactor under any conditions. Although fuel failures do exist in the nuclear industry, these failures result from entirely different interactions with entirely different mechanisms. Fuel failures caused by small metal fragments, other than wires, have not been observed. Therefore, the likelihood of small impeller pieces causing fuel failure is very small. In addition, a clad failure caused by these small fragments would be similar to fretting-induced failures seen at operating reactors. If such a failure were to occur, it would be detectable through increased activity levels in the PCS. Radiation monitoring would detect this increase in PCS activity levels, and provide the licensee adequate time to take actions that minimize the impact of the fuel failure. If the failure progresses, the reactor would be shut down in accordance with the licensee's Technical Specification 3.4.16, "PCS Specific Activity" (ADAMS Accession No. ML052720263).

In the petitioner's supplement to the petition dated May 21, 2014, the petitioner postulated that impeller failure could result in erosion of the PCS piping. In considering this potential degradation mechanism, it is important to recognize that erosion is a mechanical wear process that generally occurs in two phase flows and results in loss of material from the pipe because of repeated impact of impinging particles. It is also important to recognize that a few

impacts from relatively large pieces of debris that may result in damage to piping are not erosion and has been addressed above. In the present case, the PCS flow is designed to be a single liquid phase (i.e., second phase particles such as those which could be generated by an impeller failure are not present). Past operating history indicates that flow through the PCS in the absence of contaminating particles, such as those which could be generated from an impeller, does not result in erosion. However, the velocity of the flow in the PCS is such that, in the presence of second-phase particles, the potential for erosion could exist. During evaluation of the 2011 vibration event, NRC staff evaluated this potential and concluded that the probability that erosion will occur as a result of impeller failure is extremely low because: (1) the number of particles generated in the appropriate size range to cause erosion would be very small, (2) those particles generated would quickly settle out of the flow stream in low velocity areas, and (3) the particles generated would have hardness values similar to the piping material in which the erosion is postulated resulting in minimal material removal per impact. In combination, these observations indicate that in the event of an impeller failure, few particles of the appropriate size would be generated, few impacts between the particles and the subject piping would occur, and minimal material removal would occur as a result of each impact. Based on the very limited potential for erosion that could exist because of an impeller failure, NRC staff concludes that PCP impeller pieces causing erosion of the PCS piping walls is not a significant safety concern. Furthermore, in the unlikely event that erosion should result in a failure of the PCS, the event would be bounded by the LOCA analyses identified above.

In conclusion, NRC staff recognizes that PCP-B remains in operation with a refurbished impeller that is more susceptible to fatigue-related failures. NRC staff has conducted independent analyses of potential scenarios where impeller pieces have broken off and concluded that any consequence would be within the design basis of PNP. NRC staff also

concludes that based on the considerations above, there is reasonable assurance that the operation of PNP will not endanger the health and safety of the public. Based on the analysis and the safety significance of potential impeller pieces, NRC concludes the petitioner's request to order PNP to open every PCP for inspection and clear up all flaws is unwarranted.

Therefore, the NRC denies the petitioner's request.

**Request 2: Request for PNP to replace the PCPs with others designed for their intended duty.**

NRC decision: On August 8, 2012, Region III documented a finding of very low safety significance and an associated non-cited violation for the failure of the licensee to operate the PCPs in accordance with their design operating criteria (ADAMS Accession No. ML12221A340). The licensee concluded that the causes of the failures are fatigue-related effects from the operation of the pumps in conditions beyond the maximum flow rates and below the minimum net positive suction head (NPSH) recommendations as described in the PNP FSAR and other design documentation. Cyclic pressure pulses and stresses are created under these reduced pressure conditions that act on the leading edges of the impellers, which can lead ultimately to vane cracking and the release of impeller fragments. The licensee noted, based on metallurgical examination of fragments, previous pump inspection findings, and the mechanism by which the cracks propagate, that weld-refurbished impellers were particularly susceptible to degrading to a point where a piece could be released. At normal operating temperature and pressure, there is adequate NPSH on all PCPs, such that these added stresses are not present. These conditions are present when operating only one or two PCPs during reduced temperatures and pressures (typically during startup and shut down activities). As a result, the licensee has instituted a monitoring plan, considered the preferred sequence for

starting/stopping PCPs during startups and shut downs, and has corrective actions to further explore procedure changes regarding operation of the PCPs and the resultant effect on other aspects of plant operation.

Currently, the licensee replaced three of the four PCP impellers with newly manufactured impellers. The licensee implemented compensatory actions to minimize operating the PCPs under low-head and high-flow conditions and established steps to consider sequencing the PCPs in a manner that prevents excessive fatigue. NRC staff notes that impellers repaired by welding may be, but not necessarily are, more prone to failure. NRC staff reviewed the licensee's implemented corrective actions to date and concludes they are appropriate in the interim while the licensee is working toward a long-term solution. NRC staff will continue the review of the licensee's corrective actions going forward to determine whether the licensee plans to eliminate the known susceptibility of impeller pieces breaking off and to correct the non-cited violation described in the August 8, 2012, inspection report. In addition, as detailed in its decision to Request 1 above, the staff concludes that there is no significant safety concern which would pose a danger to public health and safety, or the environment. Therefore, the NRC denies the petitioner's request to order PNP to replace the PCPs with others designed for their intended duty.

**Request 3: Request an Office of the Inspector General (OIG) inspection on why different NRC regions have different analysis criteria for similar PCP events.**

NRC decision: The petitioner's request has been forwarded on to the OIG.

NRC staff monitors similar instances of PCP failures through the Operating Experience Program administered by the Office of Nuclear Reactor Regulation, Division of Inspection and Regional Support, which collects, evaluates, and communicates operating experience, and

applies lessons learned. NRC staff notes there have been plants in other NRC regions where broken parts originated from the PCPs. For example, Salem Nuclear Generating Station, Unit 2 (Salem), recently encountered bolt failures because of stress corrosion cracking that resulted in bolt heads traveling to the lower core support plate. The issues experienced at PNP involved the PCP impellers, which is different than the bolting issues experienced at Salem; therefore, NRC staff analysis was specific to the phenomenon of PCP impeller pieces. Following the events of Salem, the NRC staff considered bolting issues at PNP and determined that PNP does not have a similar bolt configuration which would necessitate the application of similar analysis criteria.

**Request 4: Request a \$10 million fine over these events.**

NRC decision: Section 2.3.4, "Civil Penalty," of the NRC Enforcement Policy (ADAMS Accession No. ML13228A199) describes the NRC's policy of imposing graduated civil penalties taking into account the gravity of the violation as the primary consideration and the ability to pay as a secondary consideration. Civil penalties are considered for all severity level I, II, and III violations. The non-cited violation for the failure of the licensee to operate the PCPs in accordance with their design operating criteria documented in the PNP Integrated Inspection Report dated August 8, 2012, does not meet the threshold for civil penalties under the NRC's Enforcement Policy. In addition, the NRC staff reviewed the petition and did not find any information that would warrant issuance of additional violations related to PCPs. Therefore, the NRC denies the petitioner's request to impose a \$10 million fine on the licensee.

**Request 5: Request for PNP to return to yellow or red status and for the NRC to intensify its monitoring of PNP.**

NRC decision: The Reactor Oversight Process (ROP) action matrix reflects performance issues at the plant. More information regarding the ROP Action Matrix can be found at [http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/actionmatrix\\_summary.html](http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/actionmatrix_summary.html). The ROP integrates the NRC's inspection, assessment, and enforcement programs. The fundamental building blocks that form the framework for the regulatory oversight process are seven cornerstones of safety: initiating events, mitigating systems, barrier integrity, emergency preparedness, occupational radiation safety, public radiation safety, and security. These cornerstones have been grouped into three strategic areas: reactor safety, radiation safety, and safeguards. This framework is based on the principle that the agency's mission of assuring public health and safety is met when the agency has reasonable assurance that licensees are meeting the objectives of the seven cornerstones of safety. The reactor inspection program is an integral part, along with performance indicators (PIs), assessment, and enforcement, of the ROP. Acceptable performance in the cornerstones, as measured by the PIs and the risk-informed baseline inspection program, is indicative of overall licensee performance that provides for adequate protection of public health and safety.

The NRC determined the performance at PNP during the most recent quarter was within the Regulatory Response Column of the NRC's ROP action matrix due to a White finding in the Occupational Radiation Protection cornerstone and because all remaining inspection findings had very low (i.e., green) safety significance, and all PIs indicated that the licensee's performance was within the nominal, expected range (i.e., green). Added information regarding PNP's plant assessments and inspection findings can be found at [http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/PALI/pali\\_chart.html](http://www.nrc.gov/NRR/OVERSIGHT/ASSESS/PALI/pali_chart.html). NRC inspectors will continue to monitor the licensee's corrective actions to date and going forward to determine whether the licensee plans to eliminate the known susceptibility of impeller pieces breaking off.

Any other findings will be documented in future inspection reports and will contribute to the plant assessment under the ROP.

The NRC staff reviewed the inspection efforts to date, and does not find that more inspections beyond what has already been scheduled are necessary. As discussed in the NRC response to Request 1, NRC staff concludes that there is reasonable assurance that operating PNP will not endanger the health and safety of the public. For these reasons, the staff does not find that the PCP impeller issues necessitate moving PNP into a higher ROP Action Matrix Column requiring additional regulatory oversight. Therefore, the NRC denies the request to intensify monitoring at PNP.

### **III. Conclusion**

The NRC evaluated the petitioner's concerns, including comments received on the proposed director's decision. The NRC forwarded the petitioner's request for an OIG inspection on why different NRC regions have different analysis criteria for similar PCP events to the OIG. The NRC found no basis for taking the requested enforcement-related actions against PNP; thus, the NRC denies the petition. NRC staff did not find that the continued operation of PNP would adversely affect public health and safety. The NRC determined that the licensee's actions to date are adequate and there is reasonable assurance that the operation of the PNP will not endanger the health and safety of the public. For the performance deficiencies and inspection findings that the NRC has identified at PNP, the agency will continue to monitor the progress of the licensee's completion of corrective actions through planned inspections consistent with the NRC's ongoing reactor oversight process. Therefore, no further action is required for this petition.

Consistent with 10 CFR 2.206(c), the NRC staff will file a copy of this final director's decision with the Secretary of the Commission for the Commission to review. As provided for in 10 CFR 2.206(c)(1), the final director's decision will constitute the Commission's final action within 25 days of 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 6<sup>th</sup> day of April, 2015.

FOR THE U.S.NUCLEAR REGULATORY COMMISSION



Jennifer Uhle  
Jennifer Uhle, Deputy Director,  
Office of Nuclear Reactor Regulation.

COMMENTS RECEIVED FROM THE PETITIONER  
ON THE PROPOSED DIRECTOR'S DECISION  
DATED JANUARY 23, 2015

The U.S. Nuclear Regulatory Commission (NRC) sent a copy of the proposed director's decision to Mr. Michael Mulligan (the petitioner), for comment on January 23, 2015 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14338A435). The petitioner responded with comments on January 26, 29, and 30, 2015 (ADAMS Accession Nos. ML15035A217, ML15035A218, and ML15035A219, respectively). The NRC's response to the comments received is provided below:

Comment 1 (summarized)

The NRC did not explain a scenario where impeller blades are flung off of the shaft creating a vibration event. The petitioner postulates that the licensee may continue to run the pump and the vibration event damages all the primary coolant pump (PCP) seals and creates a loss of coolant accident. The petitioner cites a 1984 incident at Palisades Nuclear Plant (PNP) during which the bolts and guide pins that secure the impeller to the shaft had been severely damaged and three of the PCP seals had failed. Other details of this incident can be found in Information Notice No. 85-03 (Legacy ADAMS Accession No. 8501100655).

Response:

The NRC reviewed the information the petitioner supplied and requested more information from the licensee regarding the 1984 incident detailed in Information Notice No. 85-03. The NRC staff concludes the following:

- (1) Because of changes in the pump seal package design, a three-stage seal failure similar to the 1984 incident is not likely.
- (2) Because of changes in the instrumentation and plant procedures used to monitor PCP vibration, exceeding the design vibration limits established for the current pump seal package is not likely.

More information is provided below.

The NRC notes that the PCP seals at PNP have been changed to an improved seal design that can withstand the primary coolant system (PCS) operating pressure at each of the first three stages. Pump manufacturers developed more robust seals as operating experience was gained, harsh operating environments were better understood, and analysis technology improved. The seals on PCP A, C, and D were changed from the Byron-Jackson SU type shaft seal cartridges to the N-9000 design in September 1999. The PCP B seal was changed to the N-9000 seal design in February 2000. Therefore, a similar scenario where three stages of the PCP seals failed because of a similar vibration event as seen at PNP in 1984 is unlikely because of the upgraded, more robust seal packages.

During NRC staff review of Information Notice No. 85-03, the staff also compared the vibration levels during the 1984 incident with the vibration levels during the 2011 vibration event. The staff noted that the 1985 information notice indicated vibration levels reached the "danger" level of 10 mils using the vibration monitoring system in place in 1984. NRC staff also noted that during the 2011 vibration incident, the vibration levels on PCP P-50C increased slightly from

10.5 mils to 12 mils, remained steady for approximately 25 hours, and then increased to 22 mils for less than 3 seconds, before stabilizing at approximately 10 mils. The staff requested further information from the licensee to determine if the vibration seen during both events were comparable. During the same time as the seal package modifications, the instrumentation used to measure vibration was modified, which resulted in a change in the vibration reference levels. The vibration seen during the 1984 incident (approximately 10 mils) translates to a higher vibration seen by the instrumentation at PNP today, not because of greater vibration but because the vibration probes were relocated from the PCP motor frame to the pump seal area. With the current seal package and instrumentation location, the normal operating vibration seen at the plant ranges from 5–13 mils. The NRC staff confirmed with Flowserve, the PCP vendor, the normal operating vibration seen at the plant and the increased levels seen during the 2011 vibration event (22 mils) are bounded by the design of the current seal package. Twenty-two mils is below the Flowserve recommended shutdown limit of “amplitude exceeds 25 mils.” NRC staff also notes that the licensee has abnormal operating procedures that are followed during PCP vibration events. These procedures dictate actions the licensee must take, including shutdown of the reactor, in response to high vibration. Therefore, the vibration levels seen recently would not cause pump seal failure similar to the 1984 event detailed in Information Notice 85-03.

Lastly, as discussed in the final director's decision, the NRC staff reviewed the impacts of PCP impeller pieces on the PCS pressure boundary and the worst-case scenario where a failure of the impeller would cause a break in the pump and a leak of the PCS. As stated in the final director's decision, this is believed to be highly unlikely and may not be credible; however, it is

bounded by the analysis provided in Section 14.17.1, "Large Break LOCA," of the PNP final safety analysis report (FSAR).

Comment 2 (summarized)

The petitioner questions if there are PCP impeller quality requirements that would preclude cracks and broken impeller blades in the future.

Response:

Quality requirements for a component such as a PCP impeller are verified upon receipt by the licensee, when a receipt inspection is performed to ensure what the licensee ordered is what was received, and that the component is in the proper condition. Once installed, a post maintenance test is conducted to ensure the component is operating as it should. Once in operation, periodic surveillances, inspections, and preventive maintenance activities are conducted to monitor for component degradation as required by codes, standards, and regulations. There are several technical specification surveillances at PNP that can assist in monitoring PCP performance. These are surveillance requirement (SR) 3.3.1.1, which requires a channel check of the PCS instrumentation every 12 hours; SR 3.3.1.5 , which requires a channel functional test every 92 days; SR 3.3.1.8, which requires a channel calibration every 18 months; and SR 3.4.4.1, which requires verification of the operation of each PCS loop every 12 hours. Surveillance requirements 3.3.1.1, 3.3.1.5, and 3.3.1.8 are associated with the low PCS flow reactor trip signal and SR 3.4.4.1 is intended to verify adequate PCS loop operation.

In addition, 10 CFR 50.65, "Requirements for monitoring the effectiveness of maintenance at nuclear power plants," requires licensees to monitor structures, systems, and components

(SSC) in a manner sufficient to provide reasonable assurance that the SSC are capable of supporting their intended function. The PCS, including the PCPs, is scoped into the licensee's Maintenance Rule program, through which the licensee monitors the health and performance of the system and its components and implements preventive maintenance programs.

Despite receipt inspections, component testing, and monitoring, the NRC has considered the potential consequences of a PCP impeller degradation or failure. The NRC has previously documented the basis for the conclusion that impeller pieces did not represent a safety concern, particularly in PNP Integrated Inspection Reports dated August 8, 2012, and May 7, 2014 (ADAMS Accession Nos. ML12221A340 and ML14127A543, respectively). Decreased flow that would result from a sufficiently degraded PCP impeller is one of the reactor protection system trip inputs, which would automatically shut down the reactor if insufficient flow is provided for plant operation. The PCPs are designed with a flywheel to provide a certain amount of coastdown flow when the pump trips. As discussed in the final director's decision, the NRC staff examined a limiting scenario where a failed PCP impeller reduces the effectiveness of coast-down flow provided by the flywheel. The final director's decision states that this failure is believed to be highly unlikely; however, it is bounded by the analysis provided in Section 14.7.2, "Reactor Coolant Pump Rotor Seizure," of the PNP FSAR.

Comment 3 (summarized)

The petitioner had the following enforcement related concerns:

- The petitioner states that he considers the operating the PCPs below the net positive suction head recommendations contrary to plant licensing and the FSAR.

- As a result of this assessment, the petitioner questions why there have not been other violations issued to the licensee such as violations related to the licensee's corrective action program or Title 10 of the *Code of Federal Regulations* (10 CFR) 50.59, "Changes, Tests and Experiments."

Response:

The NRC agrees with the petitioner that the licensee operated the PCPs contrary to plant licensing and the FSAR. The NRC addressed this in the integrated inspection report dated August 8, 2012, and issued a non-cited violation of 10 CFR 50, Appendix B, Criterion III. The inspection report states the following:

A finding of very-low safety significance (Green) and associated NCV of 10 CFR 50 Appendix B, Criterion III, Design Control, was identified by the inspectors for the failure to operate the PCPs in accordance with their design operating criteria. Specifically the PCPs were operated under conditions that allowed degradation of the leading edges of the pump impellers to occur, which resulted in fragments being released into the PCS.

During evaluation of the 2011 vibration event, the NRC considered PNP specific design information and operating experience from other regional offices, and determined the non-cited violation for the failure of the licensee to operate the PCPs in accordance with their design operating criteria, as documented in the August 8, 2012, integrated inspection report to be most appropriate. As stated in the final director's decision, the licensee implemented corrective actions to evaluate changes regarding operation of the PCPs and the resultant impact on other aspects of plant operation. If the licensee determines under which operating conditions the

PCPs are deviating from their design operating criteria, and if any design changes are necessary to the plant, the NRC expects the licensee to comply with the requirements of 10 CFR 50.59 in the determination of whether a license amendment request is needed. The NRC will continue to monitor the progress of the licensee's completion of corrective actions through planned inspections consistent with the NRC's ongoing reactor oversight process.

Comment 4 (summarized)

The petitioner has issues with the transparency of the OIG and with the NRC staff documenting correspondence with the OIG.

Response:

The OIG operates with personnel, contracting, and budget authority independent from that of the NRC. Information, including ways to contact them can be found at <http://www.nrc.gov/insp-gen.html>. As stated in the final director's decision signed by Dr. Jennifer Uhle, Deputy Director of the Office of Nuclear Reactor Regulation, the petitioner's request for OIG inspection on why different NRC regional offices have different analysis criteria for similar PCP events has been forwarded to the OIG, as has this final director's decision.

Comment 5 (summarized)

The petitioner requests additional action from NRC staff, including the following:

- An independent regional materials inspector review of all safety reports associated with the PCP broken off blades and debris in the core.
- More comprehensive licensee event reports (LERs) and inspection reports when reporting on PCP problems.

Response:

As stated in the final director's decision, the NRC independently evaluated the license's operability determination during the October 2011 vibration event and during the 2014 refueling outage where a piece of impeller was found lodged between the reactor vessel and flow skirt. NRC staff supporting the independent evaluation and NRC staff selected as members of the PRB for this petition included staff with significant materials and materials inspection expertise from Region III and from the following technical groups with NRR: the Component Performance, Non-Destructive Examination, and Testing Branch within the Division of Engineering; and the Reactor Systems Branch and the Nuclear Performance and Code Review Branch within the Division of Safety Systems.

NUREG-1022, Revision 3, "Event Report Guidelines 10 CFR 50.72 and 50.73" (ADAMS Accession No. ML13032A220) offers guidance on the preparation of an LER. Inspection Manual Chapter 0612, "Power Reactor Inspection Reports" (ADAMS Accession No. ML12244A483) offers guidance on the preparation of inspection reports. NRC staff notes that the petitioner desires a more comprehensive LER and/or inspection report; however, those requests are outside the scope of the 10 CFR 2.206 process. Also, those requests do not have any bearing on the conclusions stated in the final director's decision.

The NRC staff has determined that the comments provided by the petitioner did not provide any relevant additional information and support for the petition that had not already been considered. Thus, the comments did not change the conclusion of the proposed director's decision, and the final director's decision denies the petitioner's request for enforcement action. The NRC appreciates the petitioner's comments and thanks the petitioner for raising the

concerns in the interest of protection of the health and safety of the public.

**ENCLOSURE 2**

**FEDERAL REGISTER NOTICE**

**ADAMS Accession No. ML15054A401**

**NUCLEAR REGULATORY COMMISSION**

**Docket No. 50-255; NRC-2015-XXXX]**

**Entergy Nuclear Operations, Inc.; Palisades Nuclear Plant**

**AGENCY:** Nuclear Regulatory Commission.

**ACTION:** Director's decision under 10 CFR 2.206; issuance.

**SUMMARY:** The U.S. Nuclear Regulatory Commission (NRC) has issued a final director's decision with regard to a petition dated March 5, 2014, as supplemented on April 8, May 21, and September 3, 2014, filed by Mr. Michael Mulligan (the petitioner), requesting that the NRC take action with regard to Entergy Nuclear Operations, Inc. (ENO or the licensee) at Palisades Nuclear Plant (PNP). The petitioner's requests and the final director's decision are included in the SUPPLEMENTARY INFORMATION section of this document.

**DATES:** [INSERT DATE OF PUBLICATION IN THE *FEDERAL REGISTER*].

**ADDRESSES:** Please refer to Docket ID NRC-20YY-XXXX when contacting the NRC about the availability of information regarding this document. You may obtain publicly-available information related to this document using any of the following methods:

- **Federal Rulemaking Web Site:** Go to <http://www.regulations.gov> and search for Docket ID NRC-20YY-XXXX. Address questions about NRC dockets to Carol Gallagher;

telephone: 301-415-3463; e-mail: [Carol.Gallagher@nrc.gov](mailto:Carol.Gallagher@nrc.gov). For technical questions, contact the individual listed in the FOR FURTHER INFORMATION CONTACT section of this document.

- **NRC's Agencywide Documents Access and Management System (ADAMS):**

You may obtain publicly-available documents online in the ADAMS Public Documents collection at <http://www.nrc.gov/reading-rm/adams.html>. To begin the search, select "ADAMS Public Documents" and then select "Begin Web-based ADAMS Search." For problems with ADAMS, please contact the NRC's Public Document Room (PDR) reference staff at 1-800-397-4209, 301-415-4737, or by e-mail to [pdr.resource@nrc.gov](mailto:pdr.resource@nrc.gov). The ADAMS accession number for each document referenced in this document (if that document is available in ADAMS) is provided the first time that a document is referenced.

- **NRC's PDR:** You may examine and purchase copies of public documents at the NRC's PDR, Room O1-F21, One White Flint North, 11555 Rockville Pike, Rockville, Maryland 20852.

**FOR FURTHER INFORMATION CONTACT:** Jennivine Rankin, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, Washington DC 20555-0001; telephone: 301-415-1530, e-mail: [Jennivine.Rankin@nrc.gov](mailto:Jennivine.Rankin@nrc.gov).

**SUPPLEMENTARY INFORMATION:**

Notice is hereby given that the Deputy Director, Nuclear Reactor Regulation, has issued a final director's decision (ADAMS Accession No. ML15054A365), on a petition filed by the petitioner on March 5, 2014 (ADAMS Accession No. ML14071A006), as supplemented on April 8, May 21, and September 3, 2014 (ADAMS Accession Nos. ML14143A212, ML14142A101,

and ML14259A135, respectively). The petitioner requested a number of actions be taken by the NRC and the licensee for equipment failures at PNP. As the basis for the request, the petitioner stated that there have been recent plant events and equipment failures at PNP, such as parts of the primary coolant pump (PCP) impeller breaking off and lodging in the reactor vessel (RV) and flaws in the control rod drive mechanisms (CRDMs). The petitioner requested immediate action to prevent the PNP from restarting due to a piece of PCP impeller that was lodged between the RV and the flow skirt and due to flawed CRDMs.

By email dated March 19, 2014 (ADAMS Accession No. ML14083A680), the NRC staff denied the petitioner's request for immediate action to prevent PNP from restarting, based on the following factors:

1. The NRC performed an in-depth independent review of the licensee's analysis and concluded that the impeller piece did not pose a threat to safe operation of the reactor and RV.
2. The licensee replaced all of the CRDM housings prior to plant startup.

By teleconference on April 8, 2014, and again on September 3, 2014, the petitioner addressed the Petition Review Board (PRB). The meetings provided the petitioner with an opportunity to provide additional information and to clarify issues cited in the petition. The transcripts of these meeting were treated as supplements to the petition and are available in ADAMS as previously noted.

In the agency's letter dated September 25, 2014 (ADAMS Accession No. ML14237A726), the NRC accepted the following specific issues of the petition for review under Section 2.206 of Title 10 of the *Code of Federal Regulations* (10 CFR):

1. Request for PNP to open every PCP for inspection and clear up all flaws.
2. Request for PNP to replace the PCPs with others designed for their intended duty.
3. Request an Office of the Inspector General (OIG) inspection on why different NRC regions have different analysis criteria for similar PCP events.
4. Request a \$10 million fine over these events.
5. Request for PNP to return to yellow or red status and for the NRC to intensify its monitoring of PNP.

The NRC sent a copy of the proposed director's decision to the petitioner and the licensee for comment on January 23, 2015 (ADAMS Accession Nos. ML14338A435 and ML14338A431). The petitioner and the licensee were asked to provide comments within 15 days on any part of the proposed director's decision that was considered to be erroneous or any issues in the petition that were not addressed. Comments were received from the petitioner and are addressed in an attachment to the final director's decision.

The Deputy Director of the Office of Nuclear Reactor Regulation denied the petitioner's requests for the following actions:

1. Request for PNP to open every PCP for inspection and clear up all flaws.

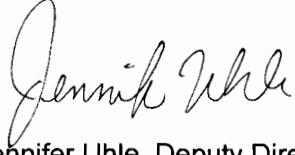
2. Request for PNP to replace the PCPs with others designed for their intended duty.
3. Request a \$10 million fine over these events.
4. Request for PNP to return to yellow or red status and for the NRC to intensify its monitoring of PNP.

The reasons for this decision are explained in the final director's decision DD-15-03 pursuant to 10 CFR 2.206 of the Commission's regulations. The petitioner's request for an OIG inspection on why different NRC regions have different analysis criteria for similar PCP events has been forwarded to the OIG. The NRC found no basis for taking the requested enforcement-related actions against PNP; thus, the NRC denies the petition. NRC staff did not find that the continued operation of PNP would adversely affect public health and safety. The NRC determined that the licensee's actions to date are adequate and there is reasonable assurance that the operation of the PNP will not endanger the health and safety of the public. For the performance deficiencies and inspection findings that the NRC has identified at PNP, the agency will continue to monitor the progress of the licensee's completion of corrective actions through planned inspections consistent with the NRC's ongoing reactor oversight process.

Consistent with 10 CFR 2.206(c), the NRC staff will file a copy of this final director's decision with the Secretary of the Commission for the Commission to review. As provided for in 10 CFR 2.206(c)(1), the final director's decision will constitute the Commission's final action within 25 days of the date of the decision unless the Commission, on its own motion, chooses to review the decision within that time.

Dated at Rockville, Maryland, this 6<sup>th</sup> day of April 2015.

For the Nuclear Regulatory Commission.



Jennifer Uhle  
Jennifer Uhle, Deputy Director,  
Office of Nuclear Reactor Regulation.

I appreciate your efforts to bring this matter to the attention of the NRC. Please feel free to contact Jennivine Rankin by phone at 301-415-1530 or by email at [Jennivine.Rankin@nrc.gov](mailto:Jennivine.Rankin@nrc.gov) to discuss any questions related to this petition.

Sincerely,

*/RA JUhlle for/*

William M. Dean, Director  
Office of Nuclear Reactor Regulation

Docket No. 50-255

Enclosures:

1. Final Director's Decision
2. *Federal Register* Notice

cc: Vice President, Operations  
Entergy Nuclear Operations, Inc.  
Palisades Nuclear Plant  
27780 Blue Star Memorial Highway  
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Listserv

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ADAMS Accession Nos.: Pkg: ML14071A005; Letter: ML15054A361; DD ML15054A365 \*concurred via email

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NAME	ABoland	MEvans	PJehle	WDean (JUhlle for)			
DATE	3/26/2015	3/25/2015	4/01/2015	4/06/2015			

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