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

June 7, 2013

C. Jordan Weaver, Ph.D.
Natural Resources Defense Council, Inc.
1152 15th Street NW, Suite 300
Washington, DC 20005

Dear Dr. Weaver:

On behalf of the U.S. Nuclear Regulatory Commission (NRC), I am responding to the petition submitted by the Natural Resources Defense Council, Inc. (NRDC), under Title 10 of the *Code of Federal Regulations* (10 CFR) 2.206, "Requests for Action under This Subpart," requesting enforcement action against Entergy Nuclear Operations, Inc., the licensee for Indian Point Nuclear Generating, Unit No. 2 (hereinafter referred to as Indian Point 2). In your petition dated April 16, 2012 (available as Agencywide Documents Access and Management System (ADAMS) Accession No. ML12108A052), you requested that the NRC order the licensee to remove the passive autocatalytic recombiners (PARs) from the Indian Point containment because the PAR system could have unintended ignitions in the event of a severe accident, which in turn could cause a hydrogen detonation.

As the basis for your request, you provided the following, in part, in support of your petition:

- Indian Point is located close to the Ramapo seismic zone. The facility was constructed to withstand a magnitude 6.0 earthquake, but the site may be susceptible to a magnitude 7.0 earthquake. A major earthquake could result in a severe reactor accident that exceeds the design basis.

- The PAR systems are simple devices consisting of catalyst surfaces where spontaneous catalytic reactions occur in the presence of hydrogen. PARs do not need external power or operator action to function. Consequently, control room operators cannot deactivate them or remove them from service.

- It is reasonable to assume that one or two hydrogen recombiners could remove hydrogen produced during a design-basis accident. Hydrogen generation during a design-basis accident is estimated at 0.001 to 0.05 kilograms (kg)/second and the hydrogen removal capacity per PAR unit is several grams per second of H_2.

- You cited reports of hydrogen generation of 0.1 to 10 kg per second during a severe reactor accident. Pressurized-water reactors would need 30 to 60 hydrogen recombiners in containment to mitigate these levels of hydrogen production.

- You cited data from experiments in which PARs malfunctioned by having unintended ignitions when elevated hydrogen concentrations (8 to 10 percent and higher) were present.

- You cited a number of studies that describe the risks and difficulties of using igniters for hydrogen control in containment. Your petition links the risks of igniters with PARs.

- PARs could be overwhelmed by the production of hydrogen in a severe reactor accident, and a detonation could occur.

- The Indian Point containment design pressure is 47 pounds per square inch gauge (psig), and a probabilistic risk-assessment study predicts containment failure at approximately 126 psig. You cited studies of 75 percent and 100 percent core metal-water reaction with peak containment pressures approaching the failure limits.

- You linked local elevated concentrations of hydrogen gas, unintended ignitions by PARs, and predicted detonations.

On June 14, 2012, you, along with Mr. Mark Leyse, addressed the Petition Review Board (PRB). You provided additional clarification that your concerns focus on severe reactor accidents and not on the NRC's design-basis accident. In addition, you modified your petition by requesting that the PARs be replaced with electrically powered thermal hydrogen recombiners. The transcript of that meeting is publicly available as ADAMS Accession No. ML12300A412.

On June 22, 2012, the PRB met to consider your petition based on the criteria in NRC Management Directive (MD) 8.11, "Review Process for 10 CFR 2.206 Petitions," (ADAMS Accession No. ML041770328). The PRB initially recommended rejecting your petition.

On July 30, 2012, the NRC informed you that the PRB's initial recommendation was to reject the petition on these bases: (1) the NRC staff has previously reviewed and resolved the issues raised in the petition, and (2) the petitioner identified deficiencies within NRC regulations.

On September 12, 2012, you, along with Mr. Leyse, addressed the PRB a second time. You objected to the PRB's initial recommendation because the PRB did not address the petition's research regarding PARs malfunctioning by having ignitions during testing under elevated hydrogen concentration. You noted that the PRB did not cite any document indicating that the NRC had reviewed and evaluated this scenario. You also cited a July 2011 International Atomic Energy Agency report indicating that the PAR ignition problem has not been resolved. The transcript of that meeting is publicly available as ADAMS Accession No. ML12300A428.

On October 10, 2012, the PRB met internally to make its final recommendation. Based on the additional information provided in your second presentation, the PRB reconsidered its initial recommendation and accepted your petition for review under 10 CFR 2.206. By letter dated November 16, 2012 (ADAMS Accession No. ML12305A411), you were informed that the PRB accepted your petition for review.

Following staff evaluation of your concerns, the PRB decided to deny your petition and the proposed Director's Decision was sent to you and the licensee for comment on March 29, 2013 (ADAMS Accession No. ML13050A543). The NRC did not receive any comments on the proposed Director's Decision.

The issues in this final Director's Decision involve your concerns that PARs could have unintended ignitions on their catalytic surfaces in the event of a severe reactor accident, which in turn could result in a hydrogen detonation. Your petition has been denied because the NRC does not agree that the presence of PARs represent a sufficient risk to warrant their removal by order. Multiple ignition sources besides PARs would be present inside containment to initiate combustion at lower flammability limits, which would be expected to keep hydrogen concentrations below detonable levels. Furthermore, the NRC staff believes that the presence of PARs could prove beneficial in the event of an extended station blackout.

Finally, the NRC staff notes that on October 14, 2011 (ADAMS Accession No. ML11301A094), the NRDC submitted a petition for rulemaking pursuant to 10 CFR 2.802, "Petition for Rulemaking," to amend 10 CFR 50.54, "Combustible Gas Control for Nuclear Power Reactors." The staff is tracking this request as Petition for Rulemaking (PRM)-50-103. The staff has referred your petition of April 16, 2012, to PRM-50-103 so that your concerns regarding the presence of PARs after a severe reactor accident will be considered under future rulemaking.

The NRC will file a copy of the enclosed Director's Decision (DD-13-01) 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 located 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 have also enclosed a copy of the *Federal Register* notice entitled, "Notice of Issuance of the Director's Decision under 10 CFR 2.206," which the agency has filed with the Office of the Federal Register for publication.

Letter from Eric Leeds to Dr. C. Jordan Weaver dated June 7, 2013.

SUBJECT: 2.206-PASSIVE AUTOCATALYTIC RECOMBINER SYSTEM AT INDIAN POINT

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Please feel free to contact Douglas Pickett by telephone at 301-415-1364 or by e-mail to Douglas.Pickett@nrc.gov to discuss any questions you may have concerning this petition.

Sincerely,

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

Docket No. 50-247

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

cc: Vice President, Operations
Entergy Nuclear Operations, Inc.
Indian Point Energy Center
450 Broadway, GSB
P.O. Box 249
Buchanan, NY 10511-0249

Listserv

ENCLOSURE 1

Final Director's Decision

ADAMS Accession No. ML13128A436

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

Jennifer L. Uhle, Deputy Director

In the Matter of	)	Docket No. 50-247
	)	
ENTERGY NUCLEAR OPERATIONS, INC.	)	
	)	License No. DPR-26
ENTERGY NUCLEAR INDIAN POINT 2, LLC	)	
	)	
Indian Point Nuclear Generating Unit No. 2	)	
	)	

DIRECTOR'S DECISION UNDER 10 CFR 2.206

I. INTRODUCTION

By electronic transmission dated April 16, 2012 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML12108A052), Dr. C. Jordan Weaver of the Natural Resources Defense Council, Inc. (NRDC), the Petitioner, submitted a petition under Title 10 of the *Code of Federal Regulations* (10 CFR) 2.206, "Requests for Action under This Subpart," to Mr. R. W. Borchardt, Executive Director for Operations, U.S. Nuclear Regulatory Commission (NRC or Commission). The Petitioner requested that the NRC take enforcement action by ordering Entergy Nuclear Operations, Inc. (Entergy), the licensee for Indian Point Nuclear Generating Unit No. 2 (Indian Point 2), to remove the passive autocatalytic recombiners (PARs) from the Indian Point 2 containment. The Petitioner subsequently supplemented the petition by requesting that the PARs be replaced with electrically powered thermal hydrogen recombiners.

Actions Requested

In the petition dated April 16, 2012, the Petitioner requested that the NRC order the licensee for Indian Point 2 to remove the PARs from the Indian Point 2 containment because the PAR system could have unintended ignitions in the event of a severe reactor accident, which, in turn, could cause a hydrogen detonation (i.e., a combustion wave traveling at a supersonic speed, relative to the unburned gas). The Petitioner stated that experimental data demonstrates that Indian Point 2's two PAR units could have at least one unintended ignition on their catalytic surfaces after a severe reactor accident.

As the basis for the request, the Petitioner stated, in part:

- The PAR systems are simple devices consisting of catalyst surfaces where spontaneous catalytic reactions occur in the presence of hydrogen and oxygen to form water vapor. PARs are passive systems and do not need external power supplies or operator action to function. As a consequence, control-room operators cannot deactivate them or remove them from service.
- The PARs at Indian Point 2 are capable of controlling hydrogen generated from the NRC's design-basis accident as described in the Indian Point 2 updated final safety analysis report. The focus of the petition is on the behavior of PARs following a severe reactor accident.
- Following a severe reactor accident, hydrogen generation rates could overwhelm the PARs at Indian Point 2. As a result, the containment atmosphere could have elevated concentrations of hydrogen gas approaching eight to 10 percent or greater.
- The petition refers to data from tests, including work sponsored by the NRC at the Sandia National Laboratory Surtsey test facility, in which PARs were observed to have

unintended ignitions in environments containing elevated levels of hydrogen gas (i.e., eight to 10 percent). According to the Petitioner, ignitions could lead to detonations.

- The NRC has not published any documentation indicating that the issue of PAR ignitions have been studied and resolved.
- Removal of the PARs at Indian Point 2 will lead to a safer post-accident condition because a potential source of ignition would be removed. Furthermore, if the PARs are replaced by electrically powered hydrogen thermal recombiners, control-room operators would have the option of deactivating them because electrically powered hydrogen thermal recombiners can also have unintended ignitions.

Representatives of the Petitioner made a presentation before the NRC's Petition Review Board (PRB) on June 14, 2012, to clarify the bases for the petition. The Petitioner acknowledged that the PARs at Indian Point 2 could adequately control hydrogen generated from the NRC's design-basis accident. The Petitioner focused on severe reactor accidents in which significant quantities of hydrogen gas can be generated very quickly. The Petitioner stated that test results demonstrate that PARs can have ignitions in environments containing high concentrations of combustible gases that could lead to a detonation. During the presentation, the Petitioner supplemented the petition by requesting that the licensee replace the PARs with electrically powered thermal hydrogen recombiners because control room operators would have the option of deactivating electrically powered recombiners during a severe reactor accident. The transcript of this meeting (ADAMS Accession No. ML12300A412) has been added as a supplement to the petition.

By electronic transmission dated July 30, 2012 (ADAMS Accession No. ML122550089), the PRB informed the Petitioner that its initial recommendation was to reject the petition from the 10 CFR 2.206 review process based on the finding that (1) the petitioner raises issues that have already been the subject of NRC staff review and evaluation either at that facility, at other

similar facilities, or on a generic basis for which a resolution has been achieved, the issues have been resolved, and the resolution is applicable to the facility in question, and (2) the request addresses deficiencies within existing NRC rules.

Representatives of the Petitioner made a second presentation before the PRB on September 12, 2012. The Petitioner objected to the PRB's initial recommendation because the PRB did not address the petition's research regarding PARs malfunctioning by having ignitions in environments containing elevated hydrogen concentration. The Petitioner questioned whether detonations would be acceptable to the NRC following a severe reactor accident and noted that the PRB did not cite any document indicating that the NRC had reviewed and resolved this possibility. The Petitioner also cited a 2011 International Atomic Energy Agency report indicating that the PAR ignition problem has not been resolved. In the concluding remarks, the Petitioner stressed that the petition was not about whether a large dry containment could withstand a detonation, but rather that PARs can initiate ignitions following a severe reactor accident that could lead to a detonation. The transcript of this meeting (ADAMS Accession No. ML12300A428) has been added as a supplement to the petition.

By letter dated November 16, 2012 (ADAMS Accession No. ML12305A436), the Petitioner was informed that, based on the additional information provided in the second presentation before the PRB, the PRB reconsidered its initial recommendation and accepted the petition for review under 10 CFR 2.206. Furthermore, the Petitioner was informed that, while evaluating the petition, the NRC staff would take into consideration long-term actions taken or planned by the NRC's task force responding to the events of March 2011 at the Fukushima Dai-ichi nuclear power plant in Japan.

All documents cited in this Director's Decision are available for inspection at the NRC's Public Document Room (PDR), located at One White Flint North, Room O1-F21, 11555 Rockville Pike (first floor), Rockville, Maryland. Publicly available documents created or

received at the NRC are accessible electronically through ADAMS in the NRC Library at *http://www.nrc.gov/reading-rm/adams.html*. Persons who do not have access to ADAMS or who encounter problems in accessing the documents located in ADAMS should contact the NRC's PDR reference staff by telephone at 1-800-397-4209 or 301-415-4737, or by sending an e-mail to *PDR.Resource@nrc.gov*.

II. DISCUSSION

Indian Point 2 is a pressurized-water reactor characterized as having a large dry containment. The containment building is a reinforced concrete axisymmetric right vertical cylindrical structure with a hemispherical dome lined with a steel plate on the inside. Two PARs are located on the operating deck outside the missile shield wall at the 29-meter (95-foot) elevation. This location is away from the reactor coolant piping and possible impingement from high-energy line breaks. There are five safety-related fan coolers that cool and mix the post-accident containment atmosphere. Two seismic class 1 hydrogen and oxygen analyzers are available to monitor hydrogen and oxygen concentrations and provide the sampling capability required by NUREG-0737, "Clarification of TMI Action Plan Requirements," Item II.B.3.

In the NRC's design-basis accident, the amount of hydrogen gas generated is limited to the amount produced by an oxidation reaction of five percent of the cladding metal with steam over a two-minute period. The Petitioner does not question the ability of the PARs to adequately control hydrogen following the NRC's design-basis accident. The Petitioner states that hydrogen generation during a design-basis accident is estimated at 0.001 to 0.05 kilograms per second and the hydrogen-removal capacity per PAR unit is several grams per second of hydrogen. Therefore, the PARs would be sufficient to keep hydrogen concentrations below four volume percent so that there would not be any reasonable expectation of deflagrations (i.e.,

combustion waves traveling at a subsonic speed, relative to the unburned gas) within containment.

Following a severe reactor accident, the zirconium-alloy fuel cladding used in U.S. light-water reactors begins reacting with steam at a significant rate, producing zirconium oxide, hydrogen gas, and heat. The mass of zirconium present in a typical commercial light-water reactor core is sufficient to produce hundreds of kilograms (kg) of hydrogen. The Petitioner cites reports of hydrogen generation of 0.1 to 10 kg per second during a severe reactor accident. The Petitioner further states that pressurized-water reactors, similar to Indian Point 2, would need 30 to 60 hydrogen recombiners in containment to mitigate these levels of hydrogen production. As a matter of reference, it has been estimated that the 1979 accident at Three Mile Island produced 400 kg of hydrogen.

PARs are characterized as simple devices without moving parts that do not need power supplies to operate. They consist of multiple cartridges with catalytic surfaces that are exposed to the containment atmosphere. When exposed to free hydrogen, a catalytic reaction combines the hydrogen and available oxygen to form water vapor. While PARs do not require a power supply to operate, they also cannot be stopped or deactivated by control-room operators. For this reason, the Petitioner requests the NRC to order the removal of PARs from the Indian Point 2 containment and replace them with electrically powered thermal hydrogen recombiners that can be started or deactivated by control-room operators.

The Petitioner states that PARs would be overwhelmed by the production of hydrogen following a severe reactor accident resulting in elevated concentrations of hydrogen, which would lead to combustion. Combustion, in turn, could lead to a detonation. The NRC has acknowledged that electrically powered hydrogen recombiners would be overwhelmed by the production of hydrogen following a severe reactor accident, and the agency does not question the Petitioner's assertion that PARs would be similarly overwhelmed.

The Petitioner also cites the results of tests in which PARs had unintended ignitions in environments containing elevated concentrations of hydrogen. The Petitioner made numerous references to the NRC-sponsored tests conducted by Sandia National Laboratory at the Surtsey test vessel in 1998. The results of this work were published in NUREG/CR-6580, "Performance Testing of Passive Autocatalytic Recombiners." The Surtsey tests, which were conducted to evaluate and understand the behavior of PARs under varying conditions, documented that PARs can have ignitions. As a result of ignitions, the PARs would effectively become igniters. The petition cites a number of studies describing the risks and difficulties of modeling igniters for hydrogen control.

In summary, the Petitioner believes that after a severe reactor accident, the PARs at Indian Point 2 would be overwhelmed by the production of hydrogen, combustible levels of hydrogen would be created, the PARs would have unintended ignitions, and the ignitions could be followed by a detonation. While the petition does not focus on whether the Indian Point 2 containment could withstand a detonation, this is clearly inferred as the ultimate safety consideration. The Petitioner believes that ordering the removal of the PARs and replacing them with electrically powered thermal hydrogen recombiners would result in a safer configuration because control room operators would be able to deactivate conventional recombiners, if necessary. In support of the petition, the Petitioner cites a number of research papers that have been published and testing that has taken place since 2003 (when the NRC revised 10 CFR 50.44, "Combustible Gas Control for Nuclear Power Reactors," resulting in the current staff position on hydrogen control).

In its evaluation of the NRDC petition, the NRC staff notes that when hydrogen concentration reaches the lower flammability limit of five volume percent at room temperature and 1 atmosphere of pressure, it can be ignited (i.e., burned by deflagration) and will generate a slowly rising pressure spike (on the order of several seconds long). For hydrogen

concentrations greater than 10 volume percent, experimental results have shown that flame acceleration could occur and reach sonic velocity. If the hydrogen concentration exceeds 19 volume percent in a confined volume or becomes stratified, it will detonate rather than burn. As a matter of reference, the 1979 accident at Three Mile Island, which included a hydrogen deflagration and a resultant pressure spike of 28 pounds per square inch, was attributed to a hydrogen concentration of eight and a half volume percent (NUREG/CR-2569, "Response of the Zion and Indian Point Containment Buildings to Severe Accident Pressures").

The discussion in the remainder of this section conveys the NRC staff's belief that (1) a detonation caused by hydrogen combustion during a degraded core accident at Indian Point 2 is considered unlikely, and (2) there are benefits for keeping the PARs and, therefore, they should not be removed from the Indian Point 2 containment. The benefits include the following:

(1) Hydrogen deflagrations are the most likely mode of combustion in degraded core accidents. The likelihood and nature of deflagrations inside containment are influenced by gas-mixture composition and availability of ignition sources. Because of the small amount of energy needed to ignite combustible mixtures, there are numerous potential ignition sources, such as sparks from electrical equipment, electrostatic discharges, hot jets and gases, hot surfaces (including PARs), core melt particles, etc. Most of these sources tend to occur randomly and for a short duration. What makes PARs beneficial compared to these selected ignition sources is that they continually remove hydrogen from the atmosphere before hydrogen concentrations reach the lower flammability limit. If the unit exceeds its recombination range, resulting in locally high surface temperatures, the PAR will act as a reliable igniter, thereby initiating combustion at "lean" hydrogen concentrations resulting in "milder" deflagrations.

(2) Indian Point 2's large dry containment exhibits extremely favorable design characteristics: (1) it has a large free volume that would dilute any releases from the

reactor coolant system, (2) hydrogen generation will tend to be in the lower containment region, promoting gas mixing, and (3) it has high containment-pressure capacity. During a degraded core accident, the containment could withstand the consequences of a global deflagration without loss of function.

(3) In SECY-00-0198, "Status Report on Study of Risk-Informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.44 (Combustible Gas Control)," the NRC staff concluded that combustible gases are not a significant challenge to containment integrity for approximately 24 hours after the onset of core damage for large dry containments. However, hydrogen concentration could increase over a long period of time (on the order of days). SECY-00-0198 recommended that licensees have severe-accident management strategies for control of combustible gases because they might challenge the containment integrity in the long term (over more than 24 hours). Indian Point 2 has Severe Accident Management Guidelines (SAMGs) that provide options to control-room operators for managing long-term accumulation of combustible gases. Entry into the SAMGs will only occur after it has been determined that the Emergency Operating Procedures are no longer effective in controlling a severe reactor accident. Options within the SAMGs include (1) preventing undue hydrogen accumulation by intentionally igniting hydrogen when concentrations are still relatively low and deflagration-induced pressures would be relatively benign, and (2) preventing hydrogen from igniting by keeping the containment steam inert. The Indian Point 2 SAMGs, combined with the hydrogen and oxygen analyzers, are designed to control the long-term threat to containment integrity from a combustion event late in a core-meltdown accident sequence. It should be noted that while, at present, the development of the SAMGs is an industry initiative that is neither required nor reviewed by the NRC, a rulemaking has

been initiated in response to the Fukushima Dai-ichi accident to require better integration of emergency response procedures, including SAMGs.

(4) The staff believes that the presence of PARs at Indian Point 2 would make it safer and would outweigh the benefits of replacing them. In the event of an extended station-blackout condition, similar to what occurred at Fukushima, the PARs would be an effective means of controlling long-term accumulation of hydrogen gas. If the PARs were removed and replaced by electrically powered hydrogen thermal recombiners, as recommended by the Petitioner, this means of controlling hydrogen gas accumulation during station-blackout conditions would not be available.

III. CONCLUSION

The Petitioner sought enforcement action to improve public and plant worker safety at Indian Point 2. The Petitioner requested that the NRC order the licensee for Indian Point 2 to remove the PARs from the Indian Point 2 containment and replace them with electrically powered thermal hydrogen recombiners. The Petitioner believes that the PAR system could have unintended ignitions on their catalytic surfaces in the event of a severe reactor accident, which in turn could cause a hydrogen detonation.

The NRC staff has reviewed the NRDC petition and does not agree that the presence of PARs represents a sufficient risk to warrant their removal by order. Following a severe reactor accident, multiple ignition sources, besides PARs, would be present in containment to initiate combustion at lower flammability limits, which would be expected to keep hydrogen concentrations below detonable levels. Furthermore, the NRC staff believes that the presence of PARs could prove beneficial in the event of an extended station blackout. Therefore, the petitioner's request to order the removal of PARs at Indian Point 2 is denied.

The NRC sent the proposed Director's Decision to both the Petitioner and the licensee by letters dated March 29, 2013 (ADAMS Accession No. ML13050A543). The Petitioner and

the licensee were asked to provide comments within 30 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 not received from either the Petitioner or the licensee.

As provided in 10 CFR 2.206(c), the NRC will file a copy of this Director's Decision 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 7th day of June 2013.

FOR THE NUCLEAR REGULATORY COMMISSION.

Jennifer L. Uhle, Deputy Director,
Reactor Safety Programs,
Officer of Nuclear Reactor Regulation.

ENCLOSURE 2

Federal Register Notice

ADAMS Accession No. ML13128A457

[7590-01-P]

U.S. NUCLEAR REGULATORY COMMISSION

DOCKET NO. 50-247

LICENSE NO. DPR-26

ENTERGY NUCLEAR OPERATIONS, INC.

ENTERGY NUCLEAR INDIAN POINT UNIT 2, LLC

NOTICE OF ISSUANCE OF THE DIRECTOR'S DECISION UNDER 10 CFR 2.206

Notice is hereby given that the Deputy Director, Reactor Safety Programs, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission (NRC or Commission) has issued a Director's Decision on a petition filed by the Natural Resources Defense Council, Inc., (hereafter referred to as "the Petitioner"). The petition, dated April 16, 2012 (available as Agencywide Documents Access and Management System (ADAMS) Accession No. ML12108A052), concerns the operation of Indian Point Nuclear Generating Unit No. 2 (Indian Point 2), owned by Entergy Nuclear Indian Point 2, LLC, and operated by Entergy Nuclear Operations, Inc.

The Petitioner requested that the NRC order the licensee for Indian Point 2 to remove the passive autocatalytic recombiners (PARs) from the containment building and replace them with electrically powered thermal hydrogen recombiners because the PAR system could have unintended ignitions in the event of a severe reactor accident, which in turn could cause a hydrogen detonation. The Petitioner stated that experimental data demonstrates that Indian

Point 2's two PAR units could have at least one unintended ignition on their catalytic surfaces following a severe reactor accident.

As the basis for the request, the Petitioner stated, in part, that:

- The PAR systems are simple devices consisting of catalyst surfaces where spontaneous catalytic reactions occur in the presence of hydrogen and oxygen to form water vapor. PARs are passive systems and do not need external power supplies or operator action to function. As a consequence, control room operators cannot deactivate them or remove them from service.
- The PARs at Indian Point 2 are capable of controlling hydrogen generated from the NRC's design-basis accident as described in the Indian Point 2 updated final safety analysis report. The focus of the petition regards the behavior of PARs following a severe reactor accident.
- Following a severe reactor accident, hydrogen generation rates could overwhelm the PARs at Indian Point 2. As a result, the containment atmosphere could have elevated concentrations of hydrogen gas approaching eight to 10 percent or greater.
- The petition cites data from tests, including work sponsored by the NRC at the Sandia National Laboratory's Surtsey test facility, where PARs were observed to have unintended ignitions in environments containing elevated levels of hydrogen gas (i.e., eight to 10 percent). According to the Petitioner, ignitions could lead to detonations.
- The NRC has not published any documentation indicating that the issue of PAR ignitions has been studied and resolved.
- Removal of the PARs at Indian Point 2 will lead to a safer post-accident condition because a potential source of ignition would be removed. Furthermore, if the PARs are replaced by electrically powered hydrogen thermal recombiners, control-room operators

would have the option of deactivating them because electrically powered hydrogen thermal recombiners can also have unintended ignitions.

The NRC sent a copy of the proposed Director's Decision to the Petitioner and the licensee for comment on March 29, 2013. The Petitioner and the licensee were asked to provide comments within 30 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 not received from either the Petitioner or the licensee.

The Deputy Director of the Office of Nuclear Reactor Regulation denied the Petitioner's request to order the removal of the two PAR units from the Indian Point 2 containment building and replace them with electrically powered thermal hydrogen recombiners. The NRC staff has reviewed the petition and does not agree that the presence of PARs represents a sufficient risk to warrant their removal by order. Following a severe reactor accident, multiple ignition sources, besides PARs, would be present in containment to initiate combustion at lower flammability limits, which would be expected to keep hydrogen concentrations below detonable levels. Furthermore, the NRC staff believes that the presence of PARs could prove beneficial in the event of an extended station blackout.

The Director's Decision (DD-13-01) under Title 10 of the *Code of Federal Regulations* (10 CFR) 2.206, "Requests for Action under This Subpart," explains the reasons for this decision. The complete text is available in ADAMS under Accession No. ML13128A436 for inspection at the Commission's Public Document Room located at One White Flint North, Public File Area 01 F21, 11555 Rockville Pike (first floor), Rockville, Maryland, and online in the NRC library at http://www.nrc.gov/reading-rm.html.

The NRC will file a copy of the Director's Decision with the Secretary of the Commission for the Commission's review in accordance with 10 CFR 2.206. As a provision of this regulation, the Director's 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 Director's Decision in that time.

Dated at Rockville, Maryland, this 7 day of June 2013.

FOR THE NUCLEAR REGULATORY COMMISSION.

Jennifer L. Uhle, Deputy Director,
Reactor Safety Programs,
Office of Nuclear Reactor Regulation.

Please feel free to contact Douglas Pickett by telephone at 301-415-1364 or by e-mail to Douglas.Pickett@nrc.gov to discuss any questions that you may have concerning this petition.

Sincerely,

/RA by JUhle for/

Eric J. Leeds, Director
Office of Nuclear Reactor Regulation

Docket No. 50-247

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

cc: Vice President, Operations
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Buchanan, NY 10511-0249

Listserv

DISTRIBUTION: G20120253
See next page

ADAMS Accession Nos.
ML13128A379 (Package)
ML13128A397 (Transmittal Letter)
ML13128A436 (Final Director's Decision)
ML12108A052 (Incoming petition)
ML13128A457 (*Federal Register* Notice)
*via email

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