



UNITED STATES
NUCLEAR REGULATORY COMMISSION
REGION IV
1600 EAST LAMAR BOULEVARD
ARLINGTON, TEXAS 76011-4511

July 6, 2020

EA-20-054

Ms. Maria L. Lecal
Executive Vice President
Chief Nuclear Officer
Arizona Public Service Company
P.O. Box 52034, MS 7602
Phoenix, AZ 85072-2034

SUBJECT: PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, 3 AND
INDEPENDENT SPENT FUEL STORAGE INSTALLATION (ISFSI) – ISFSI
INSPECTION REPORT 05000528/2020010, 05000529/2020010,
05000530/2020010, AND 07200044/2020001

Dear Ms. Lecal:

This letter refers to the inspection conducted on March 1 - 5, 2020, at your Palo Verde Nuclear Generating Station facility. The enclosed report presents the results of this inspection. The purpose of the inspection was related to the facility's dry cask storage activities associated with your Independent Spent Fuel Storage Installation. The U.S. Nuclear Regulatory Commission (NRC) inspectors discussed the preliminary inspection findings with Mr. Todd Horton, Vice President of Site Operations, of your staff at the conclusion of the on-site portion of the inspection. A final exit briefing was conducted telephonically with Mr. Horton on May 27, 2020.

The inspection examined activities conducted under your license as they relate to safety and compliance with the Commission's rules and regulations and with the conditions of your license. Within these areas, the inspection consisted of selected examination of procedures and representative records, observations of site meetings, performance of independent radiation measurements, and interviews with personnel. Specifically, the inspection reviewed compliance with the requirements specified in the NAC International, Certificate of Compliance No. 1031 and the associated technical specifications, the NAC MAGNASTOR Final Safety Analysis Report, and Title 10 of the *Code of Federal Regulations* (10 CFR) Parts 20, 50, and 72.

Based on the results of this inspection, two apparent violations were identified and are being considered for escalated enforcement action in accordance with the NRC Enforcement Policy. The current Enforcement Policy is included on the NRC's Web site at <http://www.nrc.gov/about-nrc/regulatory/enforcement/enforce-pol.html>. The apparent violations involved: (1) the failure to perform a written evaluation for a change to the NAC MAGNASTOR dry cask storage system and obtain a license amendment for a change in methodology for performing tip-over calculations; and (2) the failure to adequately analyze the consequences of a hypothetical MAGNASTOR CC5 spent fuel cask tip-over accident on the Independent Spent Fuel Storage Installation pad. The circumstances surrounding these apparent violations, the significance of the issues, and the need for lasting and effective corrective action were discussed with members of your staff during the inspection exit meeting on May 27, 2020.

Before the NRC makes its enforcement decision, we are providing you an opportunity to: (1) respond in writing to the apparent violations addressed in this inspection report within 30 days of the date of this letter, (2) request a predecisional enforcement conference, or (3) request alternative dispute resolution. If a predecisional enforcement conference is held, it will be open for public observation and the NRC may issue a press release to announce the time and date of the conference. If you decide to participate in a predecisional enforcement conference or pursue alternative dispute resolution, please contact Mr. Greg Warnick, Chief, Reactor Inspection Branch, at 817-200-1249 within 10 days of the date of this letter. A predecisional enforcement conference should be held within 30 days and an alternative dispute resolution session within 45 days of the date of this letter.

If you choose to provide a written response, it should be clearly marked as a "Response to Apparent Violations in NRC ISFSI Inspection Report 05000528/2020010, 05000529/2020010, 05000530/2020010, and 07200044/2020001; EA-20-054" and should include for each apparent violation: (1) the reason for the apparent violation or, if contested, the basis for disputing the apparent violation; (2) the corrective steps that have been taken and the results achieved; (3) the corrective steps that will be taken; and (4) the date when full compliance will be achieved. Your response may reference or include previously docketed correspondence, if the correspondence adequately addresses the required response. Additionally, your response should be sent to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with a copy to the Regional Administrator, U.S. Nuclear Regulatory Commission, Region IV, 1600 East Lamar Blvd., Arlington, Texas 76011-4511, within 30 days of the date of this letter. If an adequate response is not received within the time specified or an extension of time has not been granted by the NRC, the NRC will proceed with its enforcement decision or schedule a predecisional enforcement conference.

If you choose to request a predecisional enforcement conference, the conference will afford you the opportunity to provide your perspective on these matters and any other information that you believe the NRC should take into consideration before making an enforcement decision. The decision to hold a predecisional enforcement conference does not mean that the NRC has determined that a violation has occurred or that enforcement action will be taken. This conference would be conducted to obtain information to assist the NRC in making an enforcement decision.

The topics discussed during the conference may include information to determine whether violations occurred, information to determine the significance of the violations, information related to the identification of the violations, and information related to any corrective actions taken or planned. In presenting your corrective actions, you should be aware that the promptness and comprehensiveness of your actions will be considered in assessing any civil penalty for the apparent violations.

In lieu of a predecisional enforcement conference, you may request alternative dispute resolution with the NRC in an attempt to resolve this issue. Alternative dispute resolution is a general term encompassing various techniques for resolving conflicts using a neutral third party. The technique that the NRC has decided to employ is mediation. Mediation is a voluntary, informal process in which a trained neutral mediator works with parties to help them reach resolution. If the parties agree to use alternative dispute resolution, they select a mutually agreeable neutral mediator who has no stake in the outcome and no power to make decisions. Mediation gives parties an opportunity to discuss issues, clear up misunderstandings, be creative, find areas of agreement, and reach a final resolution of the issues.

Additional information concerning the NRC's alternative dispute resolution program can be obtained at <http://www.nrc.gov/about-nrc/regulatory/enforcement/adr.html>, as well as NRC brochure NUREG/BR-0317, "Enforcement Alternative Dispute Resolution Program," Revision 2 (Agencywide Documents Access and Management System (ADAMS) Accession ML18122A101). The Institute on Conflict Resolution at Cornell University has agreed to facilitate the NRC's program as a neutral third party. Please contact the Institute on Conflict Resolution at 877-733-9415 within 10 days of the date of this letter if you are interested in pursuing resolution of this issue through alternative dispute resolution.

The number and characterization of apparent violations described in the enclosed inspection report may change as a result of further NRC review. You will be advised by separate correspondence of the results of our deliberations on this matter.

In addition, the NRC inspectors documented one violation of very low safety significance (Green) and one Severity Level IV violation in this report. Both findings involved a violation of NRC requirements. The NRC is treating these violations as non-cited violations consistent with Section 2.3.2.a of the Enforcement Policy.

If you contest the non-cited violations or significance of the violations, you should provide a response within 30 days of the date of this inspection report, with the basis for your denial, to the U.S. Nuclear Regulatory Commission, ATTN: Document Control Desk, Washington, DC 20555-0001, with copies to: (1) the Regional Administrator, Region IV; (2) the Director, Office of Enforcement, U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001; and (3) the NRC resident inspector at the Palo Verde Nuclear Generating Station.

In accordance with 10 CFR 2.390 of the NRC's "Agency Rules of Practice and Procedure," a copy of this letter, its enclosure, and your response, if you choose to provide one, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's ADAMS, accessible from the NRC Web site at <http://www.nrc.gov/reading-rm/adams.html>. To the extent possible, your response should not include any personal privacy or proprietary information so that it can be made available to the public without redaction.

If you have any questions concerning this matter, please contact Mr. Greg Warnick of my staff at 817-200-1249.

Sincerely,

Mary C. Muessle, Director
Division of Nuclear Materials Safety

Docket Nos.: 05000528, 05000529,
05000530, and 72-00044
License Nos.: NPF-41, NPF-51, NPF-74

Enclosure: Inspection Report

U.S. NUCLEAR REGULATORY COMMISSION

REGION IV

Docket Nos.: 05000528; 05000529; 05000530; 07200044

License Nos.: NPF-41, NPF-51, NPF-74

Report No.: 05000528/2020010; 05000529/2020010; 05000530/2020010;
and 07200044/2020001

Enterprise Identifier: I-2019-005-069; I-2019-001-0137

Licensee: Arizona Public Service Company

Facility: Palo Verde Nuclear Generating Station Units 1, 2, 3 and
Independent Spent Fuel Storage Installation (ISFSI)

Location: 5951 South Wintersburg Road
Tonopah, AZ 85072-2034

Inspection Dates: March 1 – 5, 2020

Inspectors: Lee E. Brookhart, Senior ISFSI Inspector
Reactor Inspection Branch
Division of Nuclear Materials Safety, Region IV

Eric J. Simpson, CHP, Health Physicist
Reactor Inspection Branch
Division of Nuclear Materials Safety, Region IV

W. Chris Smith, Reactor/ISFSI Inspector
Reactor Inspection Branch
Division of Nuclear Materials Safety, Region IV

Approved By: Mary C. Muessle, Director
Division of Nuclear Materials Safety, Region IV

Enclosure

EXECUTIVE SUMMARY

NRC Inspection Report 05000528/2020010, 05000529/2020010, 05000530/2020010, and 07200044/2020001

The U.S. Nuclear Regulatory Commission (NRC) conducted an inspection of the licensee's programs and activities for safe handling and storage of spent fuel at the Palo Verde Nuclear Generating Station's (PVNGS) Independent Spent Fuel Storage Installation (ISFSI) on March 1 - 5, 2020. Under 10 CFR 72.210 and 10 CFR 72.212, PVNGS elected to adopt and utilize a different storage system to store spent fuel casks at its ISFSI.

In March 2019, the NRC began ISFSI inspections to observe PVNGS's dry run demonstrations to utilize the NAC MAGNASTOR storage system. Specifically, the March 2019 inspection observed welding and non-destructive testing demonstrations performed by the licensee (ADAMS Accession No. ML19122A295). In August and September 2019, the NRC continued the inspection by observing additional dry run demonstrations and performed a program review to evaluate the licensee's implementation of the use of the MAGNASTOR system into the site's existing 10 CFR Part 50 and Part 72 programs (ADAMS Accession No. ML19310G838). During that inspection, the NRC concluded that the licensee lacked numerous calculations or evaluations and the programs review under Inspection Procedure (IP) 60856 could not be completed.

This inspection covered the remaining dry run demonstrations required by the technical specifications, finished the licensee's 10 CFR 72.212 programs review, and included observations of the first canister loading operation of the NAC MAGNASTOR storage system at PVNGS. The inspection continued with in-office review of information from March through May 2020.

The inspectors identified two apparent violations that are being considered for escalated enforcement action in accordance with the NRC Enforcement Policy. Additionally, the inspectors identified one violation of very low safety significance (Green) and one Severity Level IV violation. The Green violation (Reactor Oversight Process) and the Severity Level IV violation are being treated as non-cited violations (NCVs) consistent with Section 2.3.2.a of the Enforcement Policy.

Pre-operational Testing of an Independent Spent Fuel Storage Installation, IP 60854

The licensee successfully completed all the pre-operational testing activities listed in the NAC MAGNASTOR License's Technical Specification 5.8. The licensee fully demonstrated that the procedures, programs, and training related to those dry cask storage operations had been successfully integrated into its site operations. The inspectors did not identify any issues of concern requiring documentation related to the licensee's pre-operational testing activities conducted under IP 60854. (Section 1.2.a)

Operation of an Independent Spent Fuel Storage Installation, IP 60855

The first canister loading inspection included 24-hour coverage to observe the loading operations for the critical tasks associated with the licensee's MAGNASTOR loading. The inspectors observed operations which included fuel loading, heavy lifts to place the lid on the

canister, welding and nondestructive testing of the canister lid-to-shell weld, hydrostatic pressure testing, and vacuum drying operations. (Section 2.2.a)

The inspectors identified a Severity Level IV, NCV of 10 CFR 72.146(a), for the licensee's failure to ensure applicable regulatory requirements and design basis criteria were correctly translated into procedures. Specifically, the licensee failed to ensure that the hydrostatic procedure steps followed the NAC MAGNASTOR Operating Manual directions to keep the canister vented to prevent possible over-pressurization of the canister. The inspectors identified the procedural discrepancies prior to the performance of the hydrostatic testing operations. Additionally, subsequent steps in the procedure would have restored adequate pressure relief provisions, such that, over-pressurization of canister would have been unlikely. (Section 2.2.b)

Review of 10 CFR 72.212(b) Evaluations, IP 60856

The inspectors completed a review of the licensee's 10 CFR 72.212 report for the inclusion of the NAC MAGNASTOR storage system into the site's existing 10 CFR Part 72 and Part 50 programs. The inspectors reviewed structural evaluations, seismic stability evaluations, and tornado missile analysis. (Section 3.2.a)

The inspectors identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of design for the seismic interaction between the MAGNASTOR dry cask storage system's ventilated concrete cask, the safety-related fuel handling building ventilation, and the spent fuel pool structures. As a result, the licensee performed a new evaluation that demonstrated the ventilated concrete cask would not affect safety-related structures, systems, or components within the fuel handling building. (Section 3.2.b)

Review of 10 CFR 72.48 Evaluations, IP 60857

The inspectors performed a review of the licensee's procedures, equipment, and process changes that had been performed through the site's 10 CFR 72.48 program to implement the NAC MAGNASTOR system at the licensee's facility. (Section 4.2.a)

The inspectors identified two apparent violations related to the licensee's MAGNASTOR tip-over analysis. The NRC identified the licensee's evaluation departed from a method described in the MAGNASTOR Final Safety Analysis Report to another method that was not approved by the NRC for the intended application and the licensee failed to obtain a license amendment prior to implementing the proposed change in accordance with 10 CFR 72.48(c)(2)(viii). Additionally, the licensee failed to establish adequate design control measures to ensure regulatory requirements and the design basis were correctly translated into the site's tip-over evaluation in accordance with 10 CFR 72.146(a). (Section 4.2.b)

REPORT DETAILS

Summary of Plant Status

Palo Verde Nuclear Generating Station (PVNGS) initiated dry cask storage operations in 2003 utilizing the NAC, Universal Multi-Purpose Canister system (UMS), approved under Certificate of Compliance (CoC) 72-1015. The UMS casks stored at PVNGS's Independent Spent Fuel Storage Installation (ISFSI) are maintained in accordance with License Amendment 5, and NAC UMS Final Safety Analysis Report (FSAR), Revision 11. At the time of the on-site inspection, PVNGS's ISFSI pad contained 152 NAC UMS ventilated concrete casks (VCCs), each containing the steel Transportable Storage Container (TSC) with a capacity for 24 pressurized water reactor spent fuel assemblies. The licensee selected to switch storage designs and utilize the NAC MAGNASTOR Storage System under CoC 72-1031, Amendment 7, and FSAR Revision 10. The MAGNASTOR TSC has the capacity to store 37 pressurized water reactor spent fuel assemblies in each VCC. The inspection reviewed the remaining dry run demonstrations for use of the MAGNASTOR system, completed the licensee's programs review, and evaluated the licensee's first loading operations of the MAGNASTOR system.

1 Pre-operational Testing of an ISFSI (IP 60854)

1.1 Inspection Scope

The inspectors reviewed by direct observation and independent evaluation that the licensee has developed, evaluated, implemented, and demonstrated pre-operational testing activities to safely load spent fuel into the NAC MAGNASTOR dry cask storage system and transfer the loaded spent fuel canister to the site's ISFSI. The inspections verified the licensee fulfilled all appropriate testing acceptance criteria and implemented all required changes to the appropriate plant programs and procedures to support ISFSI operations.

1.2 Observations and Findings

a. Dry Run Activities

On March 1 - 2, 2020, the inspectors observed and evaluated the licensee's pre-operational testing and training exercises. These activities are required to be performed by a general licensee prior to use of the system to load spent fuel assemblies. The NAC MAGNASTOR CoC 72-1031, Appendix A, Technical Specification (TS) 5.8 contained a list of loading, closure, handling, unloading, and transfer operational dry runs that are required to be performed by the general licensee prior to the first loading of a cask. The licensee had completed many of the required pre-operational activities in 2019. The inspectors observed PVNGS perform the following demonstrations to meet TS 5.8, which completed all remaining pre-operational testing activities before the licensee could load MAGNASTOR casks:

- Loading a dummy fuel assembly into the TSC, including independent verification (TS 5.8.c)
- Selection and verification of fuel assemblies to ensure conformance with appropriate loading configuration requirements (TS 5.8.d)
- Installation of the TSC closure lid (TS 5.8.e)

1.3 Conclusions

The licensee successfully completed all the pre-operational testing activities listed in the NAC MAGNASTOR License's TS 5.8. The licensee fully demonstrated that the procedures, programs, and training related to those dry cask storage operations had been successfully integrated into its site operations. The inspectors did not identify any issues of concern requiring documentation related to the licensee's pre-operational testing activities conducted under IP 60854.

2 Operation of an Independent Spent Fuel Storage Installation (IP 60855)

2.1 Inspection Scope

The inspection included 24-hour coverage of the loading operations for the critical tasks associated with the licensee's first MAGNASTOR loading. The inspectors reviewed selected procedures and records to verify the dry cask storage operations were performed in compliance with the NAC CoC 72-1031, the associated TSs, and the NAC MAGNASTOR FSAR.

2.2 Observations and Findings

a. Loading Activities

The inspectors evaluated the licensee's MAGNASTOR cask loading operations from March 2 - 5, 2020. Specifically, the inspectors observed the following activities associated with the first MAGNASTOR loading operations at PVNGS:

- Loading of spent fuel under water into the canister
- Remote placement of the lid onto the canister once loaded with spent fuel
- Lowering of water around the canister to support canister processing operations
- Welding and non-destructive examinations of the lid to the shell welds
- Bulk water removal from canister
- Vacuum drying operations of the canister

The inspectors performed a walkdown of the spent fuel floor in Unit 3 and the rail car with the concrete overpack on the bottom floor in the spent fuel building.

The inspectors evaluated documents and records associated with the first loading operations that included:

- Spent fuel selection for the first canister in the loading campaign (MAGNASTOR cask No.1)
- Selected radiological surveys of the dry cask operations
- Selected dry cask storage condition reports (CRs)
- Dry cask loading procedures, welding procedures, and non-destructive examination procedures

b. Canister Isolation

The inspectors identified a Severity Level IV, non-cited violation of 10 CFR 72.146(a), for the licensee's failure to ensure applicable regulatory requirements and design basis criteria were correctly translated into procedures.

On March 3, 2020, the inspectors were observing PVNGS's loading operations associated with the first MAGNASTOR canister loading activities. During the pump down activities to remove water from the Cask Loading Pit to allow welding and processing operations of the canister, the inspectors identified that PVNGS Procedure 780P-9ZZ04, "MAGNASTOR Cask Loading Operations," Revision 0, for setup of hydrostatic testing per Steps 6.4.5 and 6.4.6, directed personnel to install and torque the drain and vent port fittings onto both the vent and drain ports simultaneously. Installing a closed fitting onto both possible vent paths (vent and drain ports) isolates the TSC with both fuel and water and creates a possibility that a canister could over-pressurize as the decaying fuel heats the water when no pressure-relief provision had been installed.

Vendor Document No 30032-P-01, "MAGNASTOR System Operating Manual for PVNGS," Revision 3, Steps 4.2.5.4 "Fuel Loading Operations," steps 31 and 37.g. direct actions to install vent lines to the vent port to prevent pressurization when the TSC is loaded with fuel and water. Additionally, a review of the NAC MAGNASTOR FSAR found no discussion of isolating the canister during operations or any analysis that evaluated the buildup of pressure due to heating of water by spent fuel while the canister is isolated.

10 CFR 72.146(a) "Design Control," states, in part, that the licensee shall establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license or CoC application for those structures, systems, and components (SSCs) to which the section applies, are correctly translated into specifications, drawings, procedures, and instructions.

Contrary to the above, on February 14, 2020, the licensee approved a procedure that failed to establish measures to ensure that applicable regulatory requirements and the design basis, as specified in the license or CoC application for those structures, systems, and components (SSCs) to which the section applies were correctly translated into procedures. Specifically, the licensee failed to ensure procedure steps followed NAC MAGNASTOR Operating Manual directions to install vent lines to the vent port to prevent pressurization of the TSC.

The Reactor Oversight Process does not specifically consider violations of 10 CFR Part 72 in its assessment of licensee performance. Therefore, it is necessary to address this violation using traditional enforcement. This violation was dispositioned per the traditional enforcement process using Section 2.3 of the NRC's Enforcement Policy.

The licensee's failure to ensure that applicable regulatory requirements and design basis were correctly translated into procedures, as required by 10 CFR 72.146(a), was determined to be a Severity Level IV violation of NRC requirements. The inspectors determined that the finding was of low safety significance since the NRC identified the issue prior to the licensee's performance of hydrostatic operations and since the

estimated time-frame the canister would have been in the condition due to the inadequate procedure was short. Specifically, subsequent steps in the procedure would have restored adequate pressure relief provisions, such that, over-pressurization of canister would have been unlikely.

Consistent with the guidance in the NRC Enforcement Manual, Part I, Section 1.2.6.D, if a violation does not fit an example in the Enforcement Policy violation examples, it should be assigned a severity level: (1) commensurate with its safety significance; and (2) informed by similar violations addressed in the violation examples. The violation was evaluated as Severity Level IV because it is similar to Enforcement Policy Section 6.5.d.1.

The licensee entered the issue into the Corrective Action Program (CAP) as CR 20-02846. The licensee restored compliance by revising the procedure to ensure the TSC is never isolated without a relief path. Because the licensee entered the finding into the CAP, the safety significance of the issue was low, and the issue was not repetitive or willful, this Severity Level IV violation was treated as a non-cited violation (NCV), consistent with Section 2.3.2.a of the Enforcement Policy (NCV 07200044/2020-001-01, Failure to have design basis correctly translated into procedures).

2.3 Conclusions

The first canister loading inspection included 24-hour coverage to observe the loading operations for the critical tasks associated with the licensee's MAGNASTOR loading. The inspectors observed operations which included fuel loading, heavy lifts to place the lid on the canister, welding and nondestructive testing of the canister lid-to-shell weld, hydrostatic pressure testing, and vacuum drying operations.

The inspectors identified a Severity Level IV, non-cited violation of 10 CFR 72.146(a), for the licensee's failure to ensure applicable regulatory requirements and design basis criteria were correctly translated into procedures. Specifically, the licensee failed to ensure that the hydrostatic procedure steps followed the NAC MAGNASTOR Operating Manual directions to keep the canister vented to prevent possible over-pressurization of the canister. The inspectors identified the procedural discrepancies prior to the performance of the hydrostatic testing operations. Additionally, subsequent steps in the procedure would have restored adequate pressure relief provisions, such that, over-pressurization of canister would have been unlikely.

3 **Review of 10 CFR 72.212(b) Evaluations (IP 60856)**

3.1 Inspection Scope

The licensee's 10 CFR 72.212 programs review was originally conducted from August 13-16, 2019 and was documented in NRC Inspection Report 05000528/2019003, 05000529/2019003, 05000530/2019003, and 07200044/2019002 (ADAMS Accession No. ML19310G838). The licensee's programs for heavy loads, emergency planning, fire protection, quality assurance, radiation protection, site conditions, and record retention were reviewed against the requirements in the MAGNASTOR design basis and NRC regulations. At the conclusion of the inspection, a

number of evaluations were identified to have not been performed that were required by 10 CFR 72.212(b). The inspectors reviewed the outstanding documents to ensure the MAGNASTOR storage systems were enveloped by the site's conditions and met all design basis requirements to be used at PVNGS.

3.2 Observations and Findings

a. 10 CFR 72.212 Report Review

During the inspection period, the inspectors completed the licensee's 10 CFR 72.212 review to evaluate the licensee's program implementation of the MAGNASTOR spent fuel dry cask storage system into the site's existing 10 CFR Part 50 and Part 72 programs.

Specifically, the inspectors evaluated the following:

- The licensee's structural and seismic calculations for MAGNASTOR storage operations which included stability of the VCC in the fuel handling building
- Review of the licensee's completed 10 CFR 72.212 report for the MAGNASTOR system
- Site-specific tornado missile evaluation

b. Seismic Evaluation of VCC in the PVNGS Fuel Handling Building

The inspectors identified a Green NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of design for the seismic interaction between the MAGNASTOR dry cask storage system's VCC and the safety-related fuel handling building ventilation and the spent fuel pool structures.

The VCC is a non-seismic Category I component, and during a seismic event, it could interact or adversely affect the adjacent safety-related seismic Category I fuel building heating, ventilation, and air-conditioning (HVAC) equipment or the adjacent seismic Category I cask loading pit. Specifically, because the VCC is not restrained on the railcar, it is possible that it could tip over, uplift, rock, or slide off the railcar and impact nearby safety-related equipment. Subsequent to the August 2019 inspection, the licensee determined that there was no seismic analysis for the VCC in the stack-up configuration and that calculation A0-CC-ZD-0009, "Dry Cask Storage Project Accident Evaluations," was not revised for the new MAGNASTOR VCC design. These types of analyses are referred to as seismic II/I and are intended to demonstrate that non-safety related or non-seismic Category I systems, equipment, or structures will not collapse or otherwise affect adjacent seismic Category I SSCs.

On November 15, 2019, the licensee revised calculation A0-CC-ZD-0009, however, the inspectors determined that there was no specific analysis of the VCC. Instead, the calculation stated, in part, that it used engineering judgement to conclude that the sliding distance of the VCC is on the "same order of magnitude as those of the Saflift Analysis, which was evaluated to slide a maximum of 2.15 inches."

The inspectors reviewed the "Saflift Analysis" referenced above and found it was contained in calculation 13-CN383A-A00082-0, "DRY CASK STORAGE PROJECT-

SAFLIFT STORAGE STAND SLIDING AND UPLIFT ANALYSIS,” Revision 0, dated December 9, 2002. Calculation 13-CN383A-A00082-0 was created to determine the possible sliding and uplift (tipping) that may occur to the spare crane hoists and hooks, which are also stored near the railcar in the fuel handling building.

The inspectors questioned the assumptions of crane hoist calculation 13-CN383A-A00082-0 and how they applied to cask calculation A0-CC-ZD-0009. On February 27, 2020, calculation A0-CC-ZD-0009 was reperformed using the actual geometry of the VCC. In this revision of the analysis it was determined the VCC could slide up to 11 inches. However, the inspectors found the February 27, 2020, revision to the calculation had errors. Specifically, the railcar was assumed to be a rigid body, yet the railcar’s platform rests on a spring suspension system, and the analysis failed to include any rocking motion or amplification of the VCC that would be caused by the springs.

As a result of the inspectors’ questions, the licensee revised calculation A0-CC-ZD-0009 on March 12, 2020, using the computer program LS-DYNA. The revision included an accurate model of the railcar suspension behavior including rocking. This revision of the analysis demonstrated the VCC would not affect safety-related SSCs within the fuel handling building. The inspectors did not identify any issues with the revised calculation.

Title 10 CFR Part 50, Appendix B, Criterion III “Design Control,” requires, in part, that measures shall be established to assure that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions. The licensee performed calculation A0-CC-ZD-0009, in part, to comply with those regulatory requirements.

Contrary to the above, from August 30, 2019, to March 12, 2020, the licensee failed to verify the design basis was correctly translated into specifications, drawings, procedures, and instructions. Specifically, the licensee failed to ensure that Calculation A0-CC-ZD-0009 for the VCC on the railcar was seismically qualified within the fuel handling building.

The licensee’s failure to perform an adequate seismic analysis of the VCC within the fuel handling building was a performance deficiency. The inspectors determined the performance deficiency was more than minor because it was associated with the Design Control attribute of the Mitigating Systems cornerstone and adversely affected the cornerstone objective to ensure the availability, reliability, and capability of systems that respond to initiating events to prevent undesirable consequences. Additionally, the finding was determined to be more than minor because it involved a complete revision to a seismic calculation that required the use of a new method.

The inspectors assessed the significance of the finding using Appendix A, “The Significance Determination Process (SDP) for Findings At-Power.” The inspectors determined the significance of the finding was Green, or very low safety significance, because it was a deficiency affecting the design or qualification of a mitigating SSC that maintained its operability. No cross-cutting aspect was assigned to this finding because the inspectors determined the finding did not reflect present licensee performance. The licensee entered the issue into the CAP as CR 19-12132, CR 20-02996, and CR 20-02420. The licensee restored compliance by revising the analysis to ensure the

MAGNASTOR cask would not affect adjacent safety-related SSCs during a seismic event. Because the licensee entered the finding into the CAP, the safety significance of the issue was low, and the issue was not repetitive or willful, this violation was treated as an NCV, consistent with Section 2.3.2.a of the Enforcement Policy (NCV 0500530/2020-010-01, Failure to ensure VCC was seismically qualified within the fuel handling building).

3.3 Conclusions

The inspectors completed a review of the licensee 10 CFR 72.212 report for the inclusion of the NAC MAGNASTOR storage system into the site's existing Part 72 and Part 50 programs. The inspectors reviewed structural evaluations, seismic stability evaluations, and tornado missile analysis.

The inspectors identified a Green finding and associated NCV of 10 CFR Part 50, Appendix B, Criterion III, "Design Control," for the licensee's failure to verify the adequacy of design for the seismic interaction between the MAGNASTOR dry cask storage system's VCC and the safety-related fuel handling building ventilation and the spent fuel pool structures. As a result, the licensee conducted an adequate evaluation that demonstrated the VCC would not affect safety-related SSCs within the fuel handling building.

4 **Review of 10 CFR 72.48 Evaluations (IP 60857)**

4.1 Inspection Scope

The licensee's 10 CFR 72.48 screenings and evaluations performed to incorporate the use of the MAGNASTOR dry cask storage system at PVNGS ISFSI were reviewed to determine compliance with regulatory requirements.

4.2 Observations and Findings

a. 10 CFR 72.48 Reviews

The inspectors reviewed several 10 CFR 72.48 screenings performed by the licensee for the implementation of the MAGNASTOR Cask at the site. The inspectors evaluated the following:

- The process by which the licensee evaluates 10 CFR 72.48 screenings and evaluations performed by the CoC holder
- The 10 CFR 72.48 screening associated with the PVNGS's site-specific ISFSI pad characteristics and non-mechanistic tip-over calculation
- The 10 CFR 72.48 screening associated with PVNGS's site-specific tornado missile impacts

b. Apparent Violations (Non-mechanistic Cask Tip-over Analysis)

The inspectors identified two apparent violations related to the licensee's analysis of the MAGNASTOR Cask Tip-over analysis. The licensee made a change from the NAC UMS dry cask storage system to a new design, known as the NAC MAGNASTOR dry cask storage system. The MAGNASTOR FSAR Section 3.7.3.7, "Concrete Cask Tip-Over," states, in part, that the concrete cask tip-over analyses are performed using LS DYNA. LS-DYNA is an explicit finite element program used for the nonlinear dynamic analysis of structures in three dimensions. FSAR Section 3.10.4.4, "Concrete Cask Finite Element Model for Tip-Over Evaluation," states, in part, that two half-symmetry finite element models of the concrete cask, concrete pad, and soil subgrade are constructed of solid brick elements using the LS-DYNA program for the cask tip-over evaluation.

The licensee prepared a 10 CFR 72.48 screen, "72.48 S-20-001," Revision 0, to verify the previously-constructed ISFSI concrete pads, (which were designed and fabricated to be compatible with multiple different dry fuel storage systems) would not adversely affect MAGNASTOR design functions. There were several differences between the MAGNASTOR and the NAC UMS designs that had to be reconciled. Specific differences for the ISFSI pad included: concrete thickness, concrete density, concrete compressive strength, soil thickness, soil density, and soil modulus of elasticity. In addition to these changes, the MAGNASTOR concrete cask overpack design was changed from a "standard" concrete cask model 1, called a CC1, to a CC5 at PVNGS. There were several differences between the CC1 and CC5 concrete cask overpack design, including: cask height, cask steel liner thickness, cask lid thickness, the addition of 3-inch steel bars in ventilation inlets, and rebar spacing.

In the 10 CFR 72.48 screen S-20-001, the licensee stated, in part, that two calculations (EDC 2019-00077, "Dry Cask Storage Project Accident Conditions," Revision 2; and NAC memorandum ED20190048, "Justification of Current MAGNASTOR VCC Tip-Over Evaluations for Palo Verde Spent Fuel Storage Project," Revision 2) were developed to demonstrate that the intended design functions of the ISFSI storage pads would be accomplished under the required conditions for the NAC MAGNASTOR dry cask storage system. The S-20-001 screen also stated that *"the calculations use the methodology and equations described in the MAGNASTOR FSAR. It is therefore concluded that these evaluations do not replace or adversely revise an evaluation or method of evaluation described in the Cask UFSAR."*

The inspectors noted that Sections 3.7.3.7 and 3.10.4.4 of the MAGNASTOR FSAR, stated that LS-DYNA (a software modeling program) was the method of evaluation for cask tip-over accidents. The inspectors noted that NAC memorandum ED20190048 (above) did not utilize LS-DYNA to evaluate the effects of a CC5 MAGNASTOR canister tip-over accident on PVNGS's ISFSI pad.

Instead of using LS-DYNA, the licensee used linear scaling (ratios) to account for changes to the concrete thickness, concrete density, concrete compressive strength, soil thickness, soil density, and soil modulus of elasticity. The licensee's usage of the scaling method within memorandum ED20190048, resulted in the licensee's determination that the angular velocity of the two casks were the same. As a result, the licensee concluded the CC5 tip-over results were the same as for a CC1 tip-over.

The inspectors independently assessed the two cask designs and determined that angular momentums were not the same. The inspectors determined that the licensee's usage of a scaling method resulted in the errant determination that each cask had a uniform density cylinder. Despite the CC1 and CC5 cannisters having differences (e.g., cask height, cask center of gravity, cask steel liner thickness, cask lid thickness, the addition of 3-inch steel bars in ventilation inlets to CC5, and rebar spacing) the licensee failed to analyze the CC5 cask with LS-DYNA as described in the FSAR.

The inspectors determined that the linear scaling method utilized in memorandum ED20190048 was non-conservative and that it was not the FSAR-described method (LS-DYNA). As a result, as specified in 10 CFR 72.48 and as discussed in the NRC endorsed guidance, Nuclear Energy Institute 96-07 Appendix B, "Guidelines for 10 CFR 72.48 Implementation," the inspectors determined that PVNGS required prior NRC review and approval prior to implementing the cask modification. Specifically, PVNGS changed from a method described in the FSAR (LS-DYNA) to another method (linear scaling) that was not approved by the NRC for the intended use at the PVNGS ISFSI. This resulted in a departure from the FSAR's described method of evaluation for establishing the design bases for a tip-over accident.

Apparent Violation #1 – 10 CFR 72.48

Title 10 CFR 72.48(c)(2)(viii) requires, in part, that a general licensee request that the certificate holder obtain a CoC amendment pursuant to 10 CFR 72.244, prior to implementing a proposed change that would result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses.

Contrary to the above, from February 2 - 28, 2020, the licensee did not request that the certificate holder obtain a CoC amendment prior to implementing a proposed change that would result in a departure from a method of evaluation described in the FSAR (as updated) used in establishing the design bases or in the safety analyses. Specifically, the licensee did not evaluate a change to the cask design using the finite element code LS-DYNA, which is the FSAR described method of evaluation for the cask tip-over design.

The licensee's failure to request that the certificate holder obtain a CoC amendment for a change that resulted in a departure from a method of evaluation described in the FSAR was identified as an apparent violation of 10 CFR 72.48(c)(2)(viii) (AV 07200044/2020-001-02, Failure to obtain license amendment for tip-over analysis).

In response to this issue, the licensee entered the issue into the CAP as CR 20-07210. To restore compliance, the licensee performed a new tip-over analysis of the CC5 cask on the PVNGS's ISFSI pad using LS-DYNA, the FSAR-described method of evaluation. The limiting parameter in the tip-over analysis was the acceleration (g values) imparted to the fuel basket during a tip-over event. The results of the PVNGS specific LS-DYNA analysis demonstrated that the fuel basket accelerations would be 25.8 g and would remain below the FSAR limitation of 26.4 g. However, the licensee's previous attempts to utilize a non-approved method using linear scaling was shown to be non-conservative since the fuel basket acceleration was estimated to be 24.0 g.

Apparent Violation #2 - 10 CFR 72.146(a)

Title 10 CFR 72.146(a), "Design control," requires, in part, that applicable regulatory requirements and the design basis are correctly translated into specifications, drawings, procedures, and instructions.

Contrary to the above, from August 2019 to February 27, 2020, the licensee failed to establish adequate design control measures to ensure that applicable regulatory requirements and the design basis were correctly translated into specifications, drawings, procedures, and instructions. Specifically, the licensee failed to adequately analyze the consequences of a design basis MAGNASTOR CC5 spent fuel cask tip-over accident on the PVNGS ISFSI pad. The CC5 cask tip-over analysis used linear scaling methods and failed to demonstrate the dry cask storage system would meet design basis acceleration limits because it underestimated the actual accelerations that would have occurred. For CC5 casks used at PVNGS's ISFSI, the fuel basket accelerations as predicted using the linear scaling method were 24.0 g, but when performed using the LS-DYNA method predicted fuel basket accelerations of 25.8 g.

The licensee's failure to establish adequate design control measures was identified as an apparent violation of 10 CFR 72.146(a) (AV 07200044/2020-001-03, Failure to establish adequate design control measures for tip-over analysis).

The inspectors ultimately determined that the CC5 cask tip-over accelerations were bounded by the FSAR limits, and there were no potential consequences for these violations. However, the Reactor Oversight Process does not specifically consider the regulatory process impact in its assessment of licensee performance. Therefore, it was necessary to address these violations which impeded the NRC's ability to regulate using traditional enforcement. In accordance with NRC Enforcement Manual, Part II, Section 2.1.3.D.5.b, these related violations met consideration for escalated enforcement. The licensee departed from an approved method of evaluation which required NRC approval, the licensee failed to obtain that approval, the consequences of the change was of very low safety significance, and it was determined that the NRC would not have approved the use of the non-conservative linear scaling methodology that the licensee originally utilized to evaluate cask tip-over accident.

4.3 Conclusions

The inspectors performed a review of the licensee's procedures, equipment, and process changes that had been performed through the site's 10 CFR 72.48 program to implement the NAC MAGNASTOR system at the licensee's facility.

The inspectors identified two apparent violations related to the licensee's MAGNASTOR tip-over analysis. The inspectors identified the licensee's evaluation departed from a method described in the MAGNASTOR FSAR to another method that was not approved by the NRC for the intended application and did not obtain a license amendment prior to implementing the proposed change in accordance with 10 CFR 72.48(c)(2)(viii). Additionally, the licensee failed to establish adequate design control measures to ensure regulatory requirements and the design basis were correctly translated into the site's tip-over evaluation in accordance with 10 CFR 72.146(a).

5 Exit Meeting Summary

On May 27, 2020, the NRC inspectors presented the final inspection results to Mr. Todd Horton, Vice President of Site Operations, and other members of the licensee's staff. The licensee acknowledged the issues presented.

SUPPLEMENTAL INSPECTION INFORMATION

PARTIAL LIST OF PERSONS CONTACTED

Licensee Personnel

M. Diane, Regulatory Affairs
D. Elkinton, Regulatory Affairs
B. Hansen, Director, Nuclear Fuels
M. Kura, Regulatory Affairs
L. McIntyre, Nuclear Fuels Engineer
K. McVay, Nuclear Fuels Engineer
T. Weber, Director, Regulatory Affairs

INSPECTION PROCEDURES USED

IP 60854 Pre-operational Testing of an ISFSI
IP 60855 Operation of an ISFSI
IP 60856 Review of 10 CFR 72.212 Evaluations
IP 60857 Review of 10 CFR 72.48 Evaluations

LIST OF ITEMS OPENED, CLOSED, AND DISCUSSED

Opened

07200044/2020-001-02	AV	Failure to obtain license amendment for tip-over analysis
07200044/2020-001-03	AV	Failure to establish adequate design control measures for tip-over analysis

Opened and Closed

07200044/2020-001-01	NCV	Failure to have design basis correctly translated into procedures
05000530/2020-010-01	NCV	Failure to ensure VCC was seismically qualified within the fuel handling building

LIST OF ACRONYMS USED

ADAMS	Agencywide Documents Access and Management System
CC	Concrete Cask
CR	Condition Report
CAP	Corrective Action Program
CFR	<i>Code of Federal Regulations</i>
CHP	Certified Health Physicist
CoC	Certificate of Compliance
EDC	Engineering Document Change
FSAR	Final Safety Analysis Report
IP	Inspection Procedure
ISFSI	Independent Spent Fuel Storage Installation
NCV	Non-Cited Violation
NEI	Nuclear Energy Institute
NRC	U.S. Nuclear Regulatory Commission
PVNGS	Palo Verde Nuclear Generating Station
SSC	Structures, Systems, and Components
TS	Technical Specification
TSC	Transportable Storage Canister
UFSAR	Updated Final Safety Analysis Report
UMS	Universal Multi-Purpose Canister System
VCC	Ventilated Concrete Cask

PALO VERDE NUCLEAR GENERATING STATION, UNITS 1, 2, 3 AND INDEPENDENT
 SPENT FUEL STORAGE INSTALLATION (ISFSI) – ISFSI INSPECTION REPORT
 05000528/2020010, 05000529/2020010, 05000530/2020010, AND 07200044/2020001;
 DATED – JULY 6, 2020

DISTRIBUTION:

SMorris, ORA	LWilkins, OCA
AVegel, ORA	AMoreno, RIV/OCA
MMuessle, DNMS	SLingam, NRR
LHowell, DNMS	BMaier, RSLO
GWarnick, DNMS	AAgrawal, IPAT
LBrookhart, DNMS	JDixon, DRP
ESimpson, DNMS	PVossmar, DRP
WCSmith, DNMS	ELantz, DRP
MHay DRP	CPeabody, DRP
JKozal, DRP	RBywater, DRP
RLantz, DRS	DYou, DRP
GMiller, DRS	YDubay, DRP
DCylkowski, ORA	PJayroe, IPAT
EBurket, RIV/ETS	BCorrell, IPAT
MKotzales, NMSS	MHerrera, DRMA
MDavis, NMSS	R4Enforcement
WAllen, CA	R4DNMS_RxIB

cc:
 Mory Diane, Sr. Consultant
 Regulatory Affairs
Mohamed.Mory.Diane@aps.com

Electronic Distribution to Palo Verde Nuclear Generating Station

ADAMS ACCESSION NUMBER: ML20168A355

SUNSI Review By: LEB		ADAMS: <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No	<input type="checkbox"/> Sensitive <input checked="" type="checkbox"/> Non-Sensitive	<input type="checkbox"/> Non-Publicly Available <input checked="" type="checkbox"/> Publicly Available	Keyword NRC-002
OFFICE	RxIB	RxIB	RxIB	C/RxIB	
NAME	LEBrookhart	EJSimpson	WCSmith	GGWarnick	
SIGNATURE	/RA/	EJS	/RA/	/RA/	
DATE	6/18/2020	6/18/2020	6/18/2020	7/1/2020	
OFFICE	ORC	SES/ACES	TL/ACES	D/DNMS	
NAME	DMCylkowski	JGKramer	JRGroom	MCMuessle	
SIGNATURE	/RA/	/RA/ E	/RA/	/RA/	
DATE	6/18/2020	6/18/2020	6/18/2020	7/6/2020	

OFFICIAL RECORD COPY