



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

SEPTEMBER 26, 2023

**LASALLE COUNTY STATION, UNITS 1 AND 2 – AUTHORIZATION AND SAFETY
EVALUATION FOR ALTERNATIVE REQUEST NO. I4R-14 (EPID L-2023-LLR-0025)**

LICENSEE INFORMATION

Recipient's Name and Address: Mr. David P. Rhoades
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4300 Winfield Road
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Licensee: Constellation Energy Generation, LLC

Plant Name and Units: LaSalle County Station, Units 1 and 2

Docket Nos.: 50-373 and 50-374

APPLICATION INFORMATION

Submittal Date: May 3, 2023

Submittal Agencywide Documents Access and Management System (ADAMS) Accession No.: ML23123A219

Alternative Provision: The applicant requested an alternative under Title 10 of the *Code of Federal Regulations* (10 CFR), paragraph 50.55a(z)(1) "Acceptable level of quality and safety."

Applicable Code Edition and Addenda: American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), section XI, subsection IWL, 2007 Edition with 2008 Addenda.

ISI Requirement: ASME Code, section XI, "Rules for Inservice Inspection of Nuclear Power Plant Components," subsection IWL, IWL-2421(b) inspection dates and examination requirements for sites with multiple plants and table IWL-2500-1, "Examination Category L-B, Unbonded Post-Tensioning System," Item Nos. L2.10, L2.20, L2.30, L2.40 and L2.50.

Applicable Containment Inservice Inspection (CISI) and Interval Start/End Dates: Third 10-year CISI interval; October 1, 2017, to September 30, 2027.

Brief Description of the Proposed Alternative: The May 3, 2023, submittal summarized the proposed tendon surveillance schedule (including the most recent surveillances from 2003) in a table on page 4 of 7. The proposed alternative from the ASME Code inspection dates and

examination requirements in IWL-2421(b) and related items in table IWL-2500-1, Examination Category L-B for the post-tensioning system are as follows.

1. For Item No. L2.10, the proposed alternative is to extend the interval for LaSalle County Station (LaSalle), Units 1 and 2, tendon force and elongation measurement from 10 years for each unit (i.e., 5 years alternating between the two units) to 20 years for each unit (i.e., 10 years alternating between the two units).
2. For Item No. L2.20, the proposed alternative is to eliminate the requirement for one sample tendon of each type (from tendon sample for L2.10) to be de-tensioned, and single wire removal, examination, and testing.
3. For Item No. L2.30, the proposed alternative is to extend the interval for the detailed visual examination of tendon anchorage hardware and surrounding concrete, and free water documentation from 5 years to 10 years for each of the two units.
4. For Item Nos. L2.40 and L2.50, the proposed alternatives are: (i) to extend the interval for the sampling and testing of corrosion protection medium (CPM) and free water from 5 years to 10 years for each of the two units, and (ii) to limit initial CPM laboratory tests required per Table IWL-2525-1 to that for determining absorbed water content; and perform the remaining corrosive ions and reserve alkalinity tests only on those samples that have a water content above the acceptance limit, and are collected at an anchorage where free water and / or corrosion is found or if specified by the subsection IWL Responsible Engineer (RE).

The submittal requested the proposed alternative for the remainder of the current third CISI interval for LaSalle, Units 1 and 2, and continue until the end of the current renewed license expiring April 17, 2042, for LaSalle, Unit 1, and December 16, 2043, for LaSalle, Unit 2.

For additional details on the licensee's request, refer to the documents located at the ADAMS Accession No(s). identified above.

STAFF EVALUATION

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed the information provided in the proposed alternative request and noted that the licensee will continue to conduct the general visual examinations and detailed visual examination of suspect areas on a 5-year frequency on each unit as required by table IWL-2500-1 (L-A) "Examination Category L-A, Concrete." Any indications identified during these examinations are precursors that may lead to additional examinations in accordance with table IWL-2500-1 (L-B) "Examination Category L-B, Unbonded Post-Tensioning System," as determined by the RE. As required by IWL-2510, this would include examination of the concrete surfaces and tendon end anchorage areas (end caps, bearing plates, area concrete) on a 5-year frequency to identify evidence of damage, deformation, water intrusion, corrosion, cracking, or CPM, leakage. Tendon end caps are required to be removed for this examination if there is evidence of tendon end cap deformation or damage.

The NRC staff also reviewed the plant-specific operating experience information, and summary results of LaSalle, Units 1 and 2, examinations provided in the enclosure to the request. These examinations and tests were conducted, during 10 inspections for LaSalle, Unit 1, and 9 inspections for LaSalle, Unit 2, over almost a 40-year period (1980-2019) for each of the

requirements of section XI, subsection IWL, table IWL-2500-1 (L-B), Item Nos. L2.10, L2.20, L2.30, L2.40, and L2.50. The NRC staff's evaluation of each code examination item number is provided below.

Item No. L2.10, Tendon Force Trends and Forecasts

Section 4.1 of the enclosure to the request states that the measured tendon forces and trend forecasts demonstrate that the mean prestressing forces in the containment will remain above the specified minimum required value (MRV) limits. Section 4.1.6 summarizes the results of past tendon surveillances, the most recent being in 2019 on LaSalle, Unit 2, and notes that the projected (forecast) forces in the hoop and vertical tendons based on regression analysis of measured forces as well as 95 percent lower confidence limit trend remain above the minimum required mean force at 100 years, which is beyond the expiration of the current 60-year renewed operating license.

The NRC staff reviewed the lift-off force data in figures 1, 3, 5 and 7 of the enclosure to the request, and verified that the projected forces remain above the MRV (i.e., 575 kilo-pound (kip) and 600 kip, respectively, for the hoop and vertical tendons) beyond the deferred next inspection and through the end of the current 60-year operating license for both units. Based on the statistical analyses of past surveillance results, and the ample margin between the measured force trend (forecast) values and the MRV, the staff finds it acceptable to extend the interval of the post-tensioning system examinations and tests (ASME Code, section XI, table IWL-2500-1(L-B), Item No. L2.10), from 5 years alternating to 10 years alternating between LaSalle, Units 1 and 2, for the third 10-year CISI interval. Accordingly, the next tendon force measurement will be conducted in 2028 (+/- 1 year) on LaSalle, Unit 1.

Item No. L2.20, Wire Examination and Test Results

Section 4.3 of the enclosure to the request states that during each surveillance sample test wires (one wire from one tendon in each tendon group from each unit) were extracted, examined for corrosion, and tested for ultimate tensile strength and elongation at failure.

The NRC staff reviewed the results of the tests, as summarized in tabular form in section 4.3.1 of the enclosure to the request and noted that all the tensile tests were above the minimum specified value of 240 kips per square inch (ksi) with exception of one (237 ksi), with an overall mean value of 252 ksi for LaSalle, Unit 1, and 250 ksi for LaSalle, Unit 2. The NRC staff also noted that all the elongation tests were at or above the minimum of four (4) percent elongation with exception of two (3.4 and 3.9 percent), with an overall mean value of 4.8 percent for LaSalle, Unit 1, and 4.5 percent for LaSalle, Unit 2. In addition, while there were variations, the data did not show any apparent trend of increasing or decreasing wire strength or elongation over time. The NRC staff also noted that, where corrosion was observed from visual examination of extracted wires, they were all found to be at the lowest severity level, that is, Level 1 (bright metal with no oxidation) or Level A (bright, uniform in color). Since the examination and testing of extracted sample wires has shown no significant degradation of condition, strength, or elongation over a time period of approximately 40 years, and has not identified any significant ongoing active corrosion since the 2003 operating experience discussed in the next section, the NRC staff finds it acceptable to waive the requirement for sample wire removal and testing (ASME Code, section XI, table IWL-2500-1 (L-B), Item No. L2.20), for the third 10-year CISI interval. Accordingly, the next tendon wire removal, examination, and testing, will be conducted in 2028 (+/- 1 year) on LaSalle, Unit 1.

Item No. L2.30, Anchorage Hardware and Surrounding Concrete Inspection

Section 4.2 of the enclosure to the request summarizes the results of end anchorage examinations performed periodically through the LaSalle, Unit 1, 40th year and Unit 2, 35th year surveillances. During each of the surveillances end anchorage areas were visually examined for evidence of corrosion, presence of free water, broken wires or missing button heads, damage to or distortion of load bearing components, and cracks in concrete, adjacent to bearing plates. The NRC staff reviewed the results of these examinations summarized in subsections 4.2.1 through 4.2.5, and replacement of corroded vertical tendons in 2003 and 2004 in subsection 4.2.6, of the enclosure to the request.

The NRC staff noted the following from review of tendon anchorage area examination results:

- During the 2003 surveillance (LaSalle, Unit 1 25th year and LaSalle, Unit 2 20th year), a number of subgroup A vertical tendons (seven in LaSalle, Unit 1 and two in LaSalle, Unit 2) were found to have broken wires (ranging from three to 53 out of 90 wires in a tendon) which were significantly corroded near the upper ends. A root cause evaluation concluded the broken wires to have resulted from corrosion due to water intrusion at the upper end access well floor plates through faulty gaskets in conjunction with insufficient CPM coverage on the wires. The root cause was eliminated by corrective actions consisting of 2003/2004 replacement of designated tendons (10 in LaSalle, Unit 1 and two in LaSalle, Unit 2), replacement of access well floor plate gaskets (with ongoing periodic replacement as deemed necessary), replacing lower anchorage end cap gaskets (or tightening subgroup B tendon end cap hold down bolts) where CPM leaks were observed, and refilling vertical tendons with CPM. Examination results since 2004 indicate that corrective actions appear to be effective thus far.
- Corrosion documented during surveillances conducted since 2003 through 2019 on both units identified no corrosion greater than severity Level 2 (reddish-brown metal with no pitting) or Level B (partial loss of color), based on which the licensee concluded that observed corrosion in the prestressing system end anchorage hardware is not progressing or adversely impacting containment structural integrity.
- Only 3 wires were found protruding or missing button heads during subsequent examinations performed to date after completion of tendon replacement in 2004; this represents a miniscule fraction of the total number of 18,900 button heads examined and there is no indication that the rate of wire damage is increasing over time.
- Only minor amounts of free water have been found in anchorage areas, pH has been alkaline, and no corrosion has been associated with such water that has been found.
- No distorted or damaged anchor heads, bushings, shims or bearing plates have been found.
- No concrete cracks exceeding 0.01 inches in width were found adjacent to the tendon bearing plates.
- The end anchorage visual examination trends since 2003/2004 show that the condition of the post-tensioning system anchorage hardware and adjacent concrete is stable and is not experiencing any significant ongoing degradation.

The NRC staff reviewed the information related to the anchorage hardware examinations and noted that no active or significant corrosion or damage has been identified in the approximately 15 years between tendon replacement in 2003/2004 and the most recent inspection in 2019. In addition, an insignificant number of broken wires (three out of 18,900 examined) have been found and no significant concrete cracks or degradation has been identified. Free water quantities identified during these inspections has also been insignificant. Further, considering the 2003 operating experience of broken wires due to corrosion in several vertical tendons and corrective actions taken, the inspection results since then to-date do not appear to indicate the presence of active degradation mechanisms that will cause significant degradation if the inspection interval is extended. Therefore, the NRC staff finds it acceptable to extend the interval of the anchorage hardware examinations (ASME Code, section XI, table IWL-2500-1(L-B), Item No. L2.30), from 5 years to 10 years for the third 10-year CISI interval for each of LaSalle, Unit 1, and LaSalle, Unit 2. Accordingly, the next tendon anchorage hardware and adjacent concrete examination will be conducted in 2028 (+/- 1 year) on both LaSalle units.

Item Nos. L2.40 and L2.50, CPM and Free Water Testing

Section 4.4 of the enclosure to the request notes that CPM was collected at the ends of the sample tendons during each of the surveillances and tested for chlorides, nitrates, sulfides, absorbed water content, and since 1997 the reserve alkalinity (expressed as neutralization or base number).

The NRC staff reviewed the summary information and plant-specific data from 2003 through 2019 provided in subsections 4.4.2.1 through 4.4.2.3 of the enclosure to the request and noted that for corrosive ions and water content, every test was well below the acceptance criteria stated in subsection 4.4.2. The one exception was related to reserve alkalinity where the 2007 test results were considered to be erroneous (test results are a clear outlier from rest of the tests) and in 2013-14, three of the 70-sample base numbers are slightly below the 17.5 lower acceptance limit. Nevertheless, the overall data does not appear to indicate an age-related degradation of CPM reserve alkalinity. Further, the base numbers from the most recent 2019 testing are well above the lower acceptance limit. Also, from the staff evaluation for Item No. L2.30, only minor amounts of free water have been found in anchorage areas, measured pH has been alkaline, and no corrosion has been associated with such water that has been found.

Based on the adequate test results, and no indication that the results will degrade over time, the NRC staff finds it acceptable to extend the interval of the CPM test for absorbed water, and free water tests (ASME Code, section XI, table IWL-2500-1(L-B), Item Nos. L2.40 and L2.50), from 5 years to 10 years for each of the two LaSalle units for the third 10-year CISI interval. In addition, based on past examination results from 2003 to date, the CPM appears to be retaining its corrosion protection function, and the NRC staff finds it is acceptable to waive the requirement to perform the tests of CPM for corrosive ions and reserve alkalinity (base number) for the third CISI interval for LaSalle, Units 1 and 2, because these tests may not be necessary unless evidence of active corrosion is found from visual examinations of anchorage hardware/wires, or the quantity of absorbed water in the CPM is above the acceptance limit; in which case the samples are collected at an anchorage where free/absorbed water and / or corrosion is found or if specified by the subsection IWL RE. No such conditions exist as of the last inspection. Accordingly, the next CPM and free water examination and testing will be conducted in 2028 (+/- 1 year) on both LaSalle units.

Summary

Based on the above evaluation, the NRC staff determines that the licensee has demonstrated adequate performance of the unbonded post-tensioning system by presenting adequate plant-specific post-tensioning system inspection results, operating experience and corrective actions, and technical evaluations demonstrating applied tendon prestress level will remain acceptable beyond the deferred next inspection. Therefore, the NRC staff finds that the use of proposed alternative I4R-14 for LaSalle, Units 1 and 2, for the third 10-year IWL CISI interval, (October 1, 2017, through September 30, 2027), provides an acceptable level of quality and safety.

The NRC staff finds it reasonable to authorize a one-time extension of the interval between post-tensioning system examinations based on its above review of the plant-specific inspection results, operating experience, and corrective actions taken, including the most recent (2019) inspection results from the current CISI interval provided in the licensee's request. Additionally, such case-by-case one-time basis deferral is consistent with all the six precedents cited in the licensee's request. However, considering past precedents and plant-specific operating experience, the NRC staff does not find it reasonable to authorize the extended inspection interval for future CISI intervals through the end of the current renewed license without reviewing updated plant-specific post-tensioning system examination results from future inspection interval(s), OR without use of alternative requirements developed through the consensus codes and standards process (e.g., ASME Code Case N-926).

CONCLUSION

The NRC staff has determined that the proposed alternative in the licensee's request referenced above would provide an acceptable level of quality and safety.

The NRC staff concludes that the licensee has adequately addressed the regulatory requirements set forth in 10 CFR 50.55a(z)(1).

The NRC staff authorizes the use of proposed alternative I4R-14 at LaSalle, Units 1 and 2, for only the third CISI interval (October 1, 2017, through September 30, 2027).

All other ASME Code, section XI, requirements for which an alternative was not specifically requested and authorized remain applicable, including third-party review by the Authorized Nuclear Inservice Inspector.

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Date: September 26, 2023

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**LASALLE COUNTY STATION, UNITS 1 AND 2 – AUTHORIZATION AND SAFETY
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DATED SEPTEMBER 26, 2023**

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