ONS Subsequent License Renewal
NRC Public Meeting
February 17, 2022

DUKE ENERGY®

Topic of Discussion

TRP 143.9 – Cycle Projections (RAI 4.3.1-1)

- Discuss the 80-year cycle estimates of Transients 5, 6, 19, 20A, 20B and 20C in UFSAR Table 5-2 to confirm that the cycle estimates are significantly lower than the design cycles of these transients. Note that the response to RAI 4.3.2-1 indicates that Transients 3 and 4 have a cycle estimate on the order of 1000 cycles.

TRP 143.9 – Cycle Projection (RAI 4.3.1-1)

Transient Cycle Count Tables

- ONS UFSAR Tables 5-2 (Transient Cycles for RCS Components Except Pressurizer Surge Line) and 5-23 (Operating Design Transient Cycles for Pressurizer Surge Line) define the allowable number of design cycles for each transient for the Reactor Coolant System (RCS).

Functional Design

- The transients and associated allowable cycles are meant to reflect a rational design basis for the ONS RCS piping and components and were established as a part of the functional design of the RCS. The basis for this design conservatively includes event cycles that the plant does not experience in actual operation. For example, the designer included transients and associated cycles for load follow operations which do not apply to Oconee as a baseload plant.

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Initial License Renewal

- For 60-years of operation, the set of functional design transient cycles were considered and several of the design transients were excluded from tracking based on their classification as historical events which are no longer performed during plant operation. Others were eliminated due to their large allowed number of design cycles that cannot be accumulated at a rate to exceed the established design values. Those transients that are tracked were projected to 60-years and were bounded by the established set of cycles.

Subsequent License Renewal

- The design has not changed, and the same approach was used for 80-years of operation. Each transient cycle that is tracked by the *Fatigue Monitoring Program* was projected to 80 years and remains bounded by the established set of cycles.

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Transients 3 & 4

- Transients 3 (Power Loading 8 to 100% Power) and 4 (Power Unloading 100 to 8% Power) contain a design transient cycle allowable of 18,000 cycles.
  - The large number of cycles for these two transients are associated with daily load following. The ONS Units have always been operated as base load plants. ONS does not currently perform and does not plan to perform load follow operations.
  - A conservative perspective for Transients 3 and 4 was provided in the response to RAI 4.3.2-1 only to indicate the conservative nature of these cycles estimated by the designer. The count for Transients 3 and 4 are not tracked by the *Fatigue Monitoring Program.*

Transients 5 & 6

- Transients 5 (10% Step Load Increase) and 6 (10% Step Load Decrease) contain a design transient cycle allowable of 8,000 cycles.
  - These transients are also associated with load follow operations, which ONS has not performed and does not plan to perform. Therefore, these transients are not tracked by the *Fatigue Monitoring Program*

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Transient 19

- Transient 19 (Feed and Bleed Operations) has a design transient cycle allowable of 4,000 cycles.
  - This transient is associated with changes in the RCS boron concentration to maintain proper reactivity balance. During operation, this is a flow transient, not a temperature transient.
  - This transient does not cause thermal fatigue of the RCS system and is not included in the RCS design basis. Therefore, tracking is not required due to the insignificant fatigue impact and large transient design allowable.

Transients 20A, 20B, & 20C

- Transient Cycles 20A (Makeup Cycling, Case 1), 20B (Pressurizer Spray Cycling), and 20C (Makeup Cycling, Case 2) have design transient allowable cycles of 30,000, 20,000, and 4,000,000 cycles, respectively.
  - These transients have no impact on thermal fatigue as the temperature of the system does not change during these transients. Therefore, these transients are not tracked by the *Fatigue Monitoring Program.*

TRP 143.9 – Cycle Projection (RAI 4.3.1-1)

- Conclusion
  - The design of the Reactor Coolant System (RCS) has not changed, and the same approach used for 60 years of operation was applied for 80 years of operation. Those transients that are tracked were projected to 80 years and were bounded by the established set of cycles.
  - The design transients that are not tracked will remain untracked for 80 years of operation based on the transients being historical (no longer performed), having a large number of allowed design cycles, and having a low impact on fatigue.
  - Transients 3, 4, 5, and 6 are all associated with load follow operations and have a large number of allowed design cycles which would not require tracking for ONS as a baseload plant. ONS has never been a load follow plant and Duke Energy has no plans to change ONS operations.
  - Transients 19, 20A, 20B, and 20C have no impact on fatigue because there are no temperature changes that occur during these transients. Therefore, tracking of these transients would not be required due to the combination of the large number of allowable design cycles and no impact on fatigue.

Topic of Discussion

TRP 143.9 – Cycle Projections (RAI 4.3.1-3)

- The response to RAI 4.3.1-3 indicates that the HPI nozzle and reactor vessel head components use reduced transient cycles, as reduced from the design cycles, for 80-year fatigue analyses. Describe the reduced cycles and basis of the reduced cycles (e.g., 80-year projected cycles) for these components.

TRP 143.9 – Cycle Projections (RAI 4.3.1-3)

RAI 4.3.1-3

- RAI 4.3.1-3, Request 1, asked to "Clarify whether the reduced transient cycles specified in Notes 2 and 7 of UFSAR Table 5-2 are also applied to SLRA Table 4.3.1-1 that describes the design cycles and cycle projections for subsequent license renewal fatigue monitoring."
- The response to RAI 4.3.1-3 (ML22007A11, Enclosure 1, Attachment 11) describes that the current ONS UFSAR Table 5-2, Notes 2 and 7, provide the basis for tracking the HPI and Reactor Vessel Head components that are designed to less than the 60-year design transients as of 2004. The response also states that ONS UFSAR Table 5-2, Notes 2 and 7, have been modified in UFSAR Change Number 2021-ONS-010 (effective 5/22/2021) to point to the *Fatigue Monitoring Program* tracking and managing of all components that are designed to less than the full number of design cycles.
- For clarity, the High Pressure Injection (HPI) and Reactor Vessel Head components that are designed to less than the full number of design cycles are the HPI stop valve-to-check valve welds and the Alloy 690 J-groove weld between the CRDM nozzle housings and the replacement closure heads.

TRP 143.9 – Cycle Projections (RAI 4.3.1-3)

HPI Components

- The HPI Nozzles were re-evaluated in 2006 and found to be acceptable for the full number of design cycles.
- The HPI stop valve-to-check valve welds were evaluated to the requirements of ASME Code, Section XI, Appendix L. The Appendix L interval of 10 years was evaluated as the allowable operating period. The ASME Code, Section XI, Appendix L inspections will be conducted by the Inservice Inspection (ASME Section XI, Inservice Inspection, Subsection IWB, IWC, and IWD (ONS SLRA, Appendix B2.1.1)) program.

CRDM J-groove welds

- The CRDM J-groove welds were qualified for 4,100 Unit Loading and Unloading (Transients 3 and 4) cycles each as described in the response to RAI 4.3.4-4. These transients are excluded from logging due to having a large allowable. Transients 3 and 4 are rare events for a base load plant and 4,100 events are much larger than the units experience during current operations.

TRP 143.9 – Cycle Projections (RAI 4.3.1-3)

Conclusion

- The HPI and Reactor Vessel Head components that are qualified to less than the full number of design cycles are the HPI stop valve-to-check valve welds and the CRDM J-groove welds between the CRDM nozzle housing and the replacement closure heads.
- The HPI stop valve-to-check valve welds are evaluated to the requirements of ASME Code, Section XI, Appendix L. The Appendix L requirements establish an acceptable cycle count for an allowable operating period of 10 years. Additionally, inspection of these welds are required and will be performed by the Inservice Inspection program. After the inspection, if no flaws are detected, the 10-year operating period is reset.
- The CRDM J-groove welds are qualified, in accordance with the functional design criteria, for 4,100 events each in Transients 3 and 4. These transients are associated with load follow operations and are not tracked by the *Fatigue Monitoring Program* since ONS is a base load plant.

Topics of Discussion

TRP 143.2 – Metal Fatigue of Non-Class 1 Components (RAI 4.3.3-2)

- The response to RAI 4.3.3-2 indicates that the stress analyses for the pressurizer sampling piping of Oconee Units 2 and 3 meet the acceptance criteria in paragraph 102.3.2(d) of the USAS B31.1 code. The paragraph allows that the difference between the allowable stress at the maximum temperature (S_h) and the sum of longitudinal stresses may be added to the $0.25S_h$ term of equation (1) of paragraph 102.3.2. Equation (1) calculates the allowable stress range S_A using the $0.25S_h$ term.

  However, the following references indicate that the applicant used paragraph 104.8.3.B of the B31.1 code (1977 Edition), which compares the S_A+S_h term with the total longitudinal stresses, rather than paragraph 102.3.2(d) that modifies the $0.25S_h$ term (References: Equations 8, 10 and 11 in the stress summary of Calculation No. OSC-2404, Revision 18, page 9 for ONS Unit 2 and Equations 8, 10 and 11 in the stress summary of Calculation No. OSC-2191, Revision 22, page 10 for ONS Unit 3). Please clarify why the applicant's response does not cite paragraph 104.8.3.B of the B31.1 code.

TRP 143.2 – Metal Fatigue of Non-Class 1 Components (RAI 4.3.3-2)

Code of Record (COR)

- The pressurizer sampling piping for Oconee Units 1, 2 and 3 are designed and analyzed to USAS B31.1.0 (1967). This version of the Power Piping code is the Code of Record for these lines.

Standard Stress Summary "Form"

- The calculations referred to by the NRC staff were reviewed during the audit of the ONS SLRA
- These ONS pressurizer sample line reanalysis calculations were completed in conjunction with initial license renewal. At that time, Duke Energy engineering used a standard stress summary "form" among the Duke plants. The form contains subheadings that do point to the equations and equation numbers that are derived from Duke Energy piping analysis specifications. These headings served as a convenient shorthand among the Duke pipe stress analysts, but do not dictate the design code specifics to be used.
- Within the ONS calculations for the pressurizer sampling piping are stress summary forms indicating that the applicable code is USAS B31.1.0 (1967). The equation numbers are used as an aid to the stress analyst but do not exist in the 1967 Code. However, the equations do represent, in simplified format, the methodology described in B31.1.0 1967 for performing piping stress analysis.

TRP 143.2 – Metal Fatigue of Non-Class 1 Components (RAI 4.3.3-2)

Confidence in the Equation

- The detailed analysis described in both USAS B31.1.0, §102.3.2(d) (1967) and ANSI B31.1, §102.3.2(d) (1977) are identical. In both descriptions, the primary and thermal expansion stresses are combined to utilize excess margin in the primary allowable stresses to offset extra thermal expansion stress. The methodologies between the two editions of the code did not change.

$$S_A = f\,(1.25\,S_c + 0.25\,S_h) \qquad (1)$$

- The 1977 edition added §104.8.3 *Additive Stress* to translate the narrative form of §102.3.2(d) *Additive Stresses* into a defined set of equations.
- Upon specific review of the Oconee pressurizer sampling piping analysis results, the 1977 Edition is not the source of the equations. The wording in B31.1.0 1967 Edition are the source of the methods used to generate the resultant stresses and stress ratios on the Stress Summary Form for these analysis.

TRP 143.2 – Metal Fatigue of Non-Class 1 Components (RAI 4.3.3-2)

Conclusion

- The response to RAI 4.3.3-2 is correct. The pressurizer sampling piping analysis for Oconee Units 1,2 and 3 strictly adheres to the guidance for stress analysis described within USAS B31.1.0, §102.3.2(d) (1967).

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