FNP Program: NiCrFe Component Assessment Program	Document Type: Plant-Specific Program Attribute Comparison
Version: 1	

FNP NiCrFe Component Assessment Program Attribute Comparison

FNP Program	NiCrFe Component Assessment Program; LRA Section B.5.8
Precedent Program	**Catawba / McGuire** Alloy 600 Review, LRA Appendix B3.1* and B.3.20.1
Precedent Program SER Reference	**Catawba / McGuire** SER, NUREG-1772, ML030850251; Sections 3.1.2.2.2 and 3.0.3.10.2

* - Note: The Catawba / McGuire LRA description of the Alloy 600 Review is not presented in a typical 10 attribute format. As such, this document pulls pertinent information from the Catawba / McGuire LRA and associated license renewal documentation as applicable to address each attribute.

1. OBJECTIVE

This document supports application for renewal of the FNP Units 1 and 2 operating licenses.

This document compares the FNP NiCrFe Component Assessment Program's pertinent attributes against a previously submitted program credited by another applicant. The objective is to identify areas where similar program attributes have been previously accepted by the NRC staff in an SER.

Comparisons of plant specific programs, which are those that are different from any of the programs evaluated in NUREG-1801, require comparisons of pertinent program attributes. These will typically include the first six attributes only:

- Program Scope
- Preventive Actions
- Parameters Inspected or Monitored
- Detection of Aging Effects
- Acceptance Criteria
- Monitoring and Trending

The corrective action, confirmatory process, and administrative controls attributes are considered to be plant-specific attributes common to all aging management programs. Therefore, no comparison is made for these three attributes.

The operating experience attribute is plant-specific and cannot be directly compared to another applicant. Therefore, no comparison is made for this attribute.

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2. PROGRAM ATTRIBUTE COMPARISON:

2.1 Program Scope

2.1.1. FNP LRA

"The FNP program scope includes nickel base alloy reactor coolant pressure boundary components with known or potential susceptibility to PWSCC, excluding steam generator tubes, which are specifically addressed by the Steam Generator Program, and Reactor Internals which are addressed by the Reactor Vessel Internals Program."

2.1.2. Precedent LRA (Catawba / McGuire) (LRA Appendix B.3.1)

"The purpose of the Alloy 600 Aging Management Review is to ensure that nickel-based alloy locations are adequately inspected by the Inservice Inspection Plan (Appendix B.3.20) or other existing programs such as the Control Rod Drive Mechanism and Other Vessel Head Penetration Program (Appendix B.3.9), the Reactor Vessel Internals Inspection (Appendix B.3.27), and the Steam Generator Integrity Program (Appendix B.3.31)."

2.1.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.1.2.2.2)

"The objective of the applicant's Alloy 600 Aging Management Review (A600 AMR) is to provide general oversight and management of primary water stress corrosion cracking (PWSCC) in nickel-based alloy (Alloy 600) components within the scope of license renewal, and to ensure that nickel-based alloy locations are adequately inspected by the ISI Plan (Section B.3.20 of LRA Appendix B) or other existing programs, such as the Control Rod Drive Mechanism and Other Vessel Head Penetration Program (Section B.3.9 of LRA Appendix B), the Reactor Vessel Internals Inspection Program (Section B.3.27 of LRA Appendix B), and the Steam Generator Integrity Program (Section B.3.31 of LRA Appendix B)."

2.1.4. Discussion

The FNP NiCrFe Alloy Component Assessment Program scope is more limited than the scope specified by Duke for the Catawba / McGuire Alloy 600 Review. The FNP program is limited to pressure boundary components (and associated thermal sleeves), with the exclusion of steam generator tubes. In addition to reactor coolant pressure boundary components, the Duke program includes reactor internals and all steam generator components as well.

Of particular note in the Catawba / McGuire SER was program coverage for the pressurizer surge and spray nozzle thermal sleeves. Duke originally did not include the thermal sleeves within the scope of license renewal, only later to add

these components. Duke also committed to provide the NRC staff the results of the susceptibility assessment for these components.

The FNP Pressurizer surge and spray nozzle thermal sleeves are constructed from austenitic stainless steel, not NiCrFe alloy. Pressure boundary welds attaching the thermal sleeves to the nozzle are constructed from NiCrFe Alloy and are included within the FNP NiCrFe Alloy Component Assessment Program.

It should also be noted that the FNP program does not focus on RPV head penetration degradation. The FNP LRA indicates that the FNP RPV heads will be replaced prior to entering the period of extended operation. These new RPV heads will utilize penetrations fabricated from improved materials of construction. The replacement design utilizes thermally treated Alloy 690.

The FNP program scope is bounded by the scope of components included within the Catawba / McGuire Alloy 600 Review.

2.2 Preventive Actions

2.2.1. FNP LRA

"The NiCrFe Component Assessment Program does not contain any direct preventive or mitigating attributes. However, the Water Chemistry Control Program provides prevention attributes. Material replacement is also an available option to prevent or mitigate the potential for PWSCC."

2.2.2. Precedent LRA (Catawba / McGuire) (LRA Appendix B.3.1)

The Catawba / McGuire LRA does not specifically address preventive actions associated with the Alloy 600 Review. However, a review of the Catawba / McGuire LRA did not identify any preventive attributes associated with this activity.

2.2.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.1.2.2.2)

The Catawba / McGuire SER section evaluating the Alloy 600 Review does not discuss any preventive actions associated with this program. No preventive action requirements would be expected for this program.

2.2.4. Discussion

No preventive actions are addressed by the FNP NiCrFe Component Assessment Program, nor the Catawba / McGuire Alloy 600 Review. No issues regarding preventive actions for the Alloy 600 Review were identified in the Catawba / McGuire SER.

No preventive actions are expected for this type of program. As such, no important comparison can be made regarding this attribute.

2.3 Parameters Inspected or Monitored

2.3.1. FNP LRA

"The FNP program will not directly inspect or monitor cracking within NiCrFe alloy components. The program assessment will utilize the most current industry susceptibility models to develop a set of plant specific inspection requirements to address potential PWSCC in FNP NiCrFe components."

2.3.2. Precedent LRA (Catawba / McGuire) (LRA Appendix B.3.1)

"The Alloy 600 Aging Management Review will identify Alloy 600/690, 82/182 and 52/152 locations. A ranking of susceptibility to PWSCC will be performed for the nickel-based alloy locations. A review will be performed to ensure that nickel-based alloy locations are adequately inspected by the Inservice Inspection Plan (Appendix B.3.20) or other existing programs such as the Control Rod Drive Mechanism and Other Vessel Head Penetration Program (Appendix B.3.9), the Reactor Vessel Internals Inspection (Appendix B.3.27), and the Steam Generator Integrity Program (Appendix B.3.31)."

2.3.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.1.2.2.2)

"The applicant stated that the A600 AMR will identify Alloy 600/690, 82/182, and 52/152 locations. A ranking of susceptibility to primary water stress corrosion cracking (PWSCC) will be performed for the nickel-based alloy locations. The applicant indicated that it will perform a review to ensure that nickel-based alloy locations are adequately inspected by the ISI Plan or other existing programs, such as the Control Rod Drive Mechanism and Other Vessel Head Penetration Program, the Reactor Vessel Internals Inspection Program, or the Steam Generator Integrity Program."

And,

"By letter dated January 28, 2002, the staff requested, in RAI B.3.1-1, that the applicant confirm the following aspects of the A600 AMR:

1. ***The A600 AMR is simply a susceptibility ranking review calculation that will be used to determine whether inspection techniques proposed in aging management programs for managing aging effects in Alloy 600 components of the reactor coolant pressure boundary components (including reactor vessel internal components) should be enhanced or augmented;*** *and*

2. The program attributes are normally provided in the application for programs that are listed in the LRA as aging management programs. Since the A600 AMR is simply a review program, the program attributes for the review are not necessary.

In its response dated April 15, 2002, the applicant stated that the staff's description of the A600 AMR is correct. ***The purpose of the A600 AMR is simply to ensure that nickel-based alloy locations are adequately inspected by either the ISI Plan or other existing programs****, such as the Control Rod Drive Mechanism and Other Vessel Head Penetration Program, the Reactor Vessel Internals Inspection Program, and/or Steam Generator Surveillance Program. These aging management programs are described in detail in Sections B.3.20, B.3.9, B.3.27, and B.3.31 of LRA Appendix B, respectively, and evaluated in Sections 3.0.3.9.1, 3.1.3.2.2.1, 3.1.4.2.2.1, and 3.1.5.2.2.1 of this SER, respectively."*

2.3.4. Discussion

No parameters are directly monitored or inspected by the FNP NiCrFe Component Assessment Program nor the Catawba / McGuire Alloy 600 Review. Both programs are assessment programs used to determine augmented inspection requirements for Nickel Alloy components. The ISI Program is used to perform any resultant augmented inspections.

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2.4 Detection of Aging Effects

2.4.1. FNP LRA

"This assessment program will not directly detect or size PWSCC cracks within NiCrFe components. However, the program will be used to recommend augmented inspection locations, schedules and techniques based upon the capability of detecting tight PWSCC type cracks prior to any loss of component intended function. Inspection methods may include visual, surface, or volumetric methods."

2.4.2. Precedent LRA (Catawba / McGuire) (LRA Appendix B.3.1))

"Inspection method and frequency of inspection for the Alloy 600/690, 82/182, and 52/152 locations for the period of extended operation will be adjusted as needed based on the results of this review. In addition, supplemental inspections for the period of extended operation will be developed as needed."

2.4.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.1.2.2.2)

"The inspection method and frequency of inspection for the Alloy 600/690, 82/182, and 52/152 locations for the period of extended operation will be adjusted as needed, based on the results of this review. In addition, the applicant will develop supplemental inspection scopes for the period of extended operation as necessary."

2.4.4. Discussion

Both the FNP NiCrFe Alloy Component Assessment Program and the Catawba / McGuire Alloy 600 Review will utilize industry based models and plant-specific operating experience to set augmented inspection requirements, inspection methods, and inspection frequencies. The NRC staff concluded that this approach is acceptable in the Catawba / McGuire SER.

2.5 Monitoring and Trending

2.5.1. FNP LRA

"The cracking susceptibility assessment, subsequent identification of enhanced inspection requirements, and any initial inspections will be performed for both Units 1 and 2 prior to entering the period of extended operation. Updates to the susceptibility assessment and inspection plans will be based upon new or improved industry data, susceptibility models, and operating experience. The frequency of subsequent inspections, and the inspection methodologies utilized, will be based on the results of any initial inspections.

Program inspections will be integrated with FNP ISI Program inspections and results will be tracked within the FNP ISI Plan."

2.5.2. Precedent LRA (Catawba / McGuire) (LRA Section B.3.1)

"For McGuire, this review will be completed following issuance of renewed operating licenses for McGuire Nuclear Station and by June 12, 2021 (the end of the initial license of McGuire Unit 1). For Catawba, this review will be completed following issuance of renewed operating licenses for Catawba Nuclear Station and by December 6, 2024 (the end of the initial license of Catawba Unit 1). The results of this review will be incorporated into the unit specific inservice inspection (ISI) plans for the ISI intervals during the period of extended operation."

2.5.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.1.2.2.2)

"For McGuire, the applicant stated that this review will be completed following issuance of the renewed operating licenses for the McGuire Nuclear Station, and by June 12, 2021, which corresponds to the end of the initial 40-year license period for McGuire 1. For Catawba, the applicant stated this review will be completed following issuance of the renewed operating licenses for the Catawba Nuclear Station, and by December 6, 2024, which corresponds to the end of the initial 40-year license period for Catawba 1. The applicant indicated that the results of these reviews will be incorporated into the unit-specific ISI plans for the ISI intervals during the period of extended operation."

2.5.4. Discussion

The FNP program and the Catawba / McGuire Program both indicate that the PWSCC susceptibility review will be performed prior to the expiration of the current unit operating licenses. Additionally, augmented inspection requirements will be incorporated into the unit's ISI Plan for the period of extended operation. The NRC staff approved this approach in the Catawba / McGuire SER.

2.6 Acceptance Criteria

2.6.1. FNP LRA

"Acceptance criteria for any flaws identified will be based upon ASME Section XI requirements or other acceptable fracture mechanics methods. If the flaw is to remain in service, the acceptance evaluation will consider component stresses, updated crack growth rate models, and material toughness."

2.6.2. Precedent LRA (Catawba / McGuire) (LRA Section B.3.20.1

"Flaws detected during examination are evaluated by comparing the examination results to the acceptance standards established in ASME Section XI, IWB-3500 and IWC-3500. Unacceptable indications require detailed analyses, repair, or replacement."

2.6.3. Precedent SER Reference (Catawba / McGuire) (SER Section 3.0.3.10.2)

"[Acceptance Criteria] The applicant stated that flaws detected during examination are evaluated by comparing the examination results to the acceptance standards established in ASME Code, Section XI. Unacceptable indications require detailed analyses, repair, or replacement. The ASME Code, Section XI, acceptance standards ensure that all Service Conditions (A-D) are protected by maintaining the safety margin of the component throughout the service life of the component. When evaluating an operating component for an indication that exceeds the allowable acceptance standards established in IWB-3500 and IWC-3500, Section XI requires the use of the original safety margins for all operating conditions (i.e., normal, upset, emergency, and faulted conditions). The safety margins vary for specific cases (e.g., component, geometry, etc.) but are always consistent or conservative with respect to the original design margins. The staff accepts the flaw evaluation methodology of the Code as the industry standard and, therefore, the staff finds the management of aging effects based on the Code criteria to be acceptable."

2.6.4. Discussion

Program acceptance criteria were not specified for the Catawba / McGuire Alloy 600 Review since this program was not specifically evaluated against the 10 attributes of an effective AMP by Duke. The FNP NiCrFe Component Assessment Program is conservatively evaluated against the 10 attributes in the FNP LRA. Acceptance criteria wording in the FNP LRA is consistent with acceptance criteria specified by the FNP ISI Program and ASME Section XI. As such, this attribute is compared against the Catawba / McGuire ISI Plan acceptance criteria.

FNP and Catawba / McGuire both rely on ASME Section XI standards as the principle criteria for continued component service. As such, there is a direct correlation between the FNP and Catawba / McGuire Programs.

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3. ATTRIBUTE COMPARISON SUMMARY

The NRC Staff found the Catawba / McGuire Alloy 600 Review approach to be acceptable. This position was confirmed in a Feb. 14, 2003 letter from the ACRS to the Commission regarding Catawba / McGuire license renewal:

> *"With regard to reactor vessel penetration nozzle cracking and head wastage issues, Duke has committed to incorporate the future industry resolution of these issues into the VHP Nozzle Program and the Alloy 600 Management Review Program. This provides reasonable assurance that the effects of aging associated with the VHP Nozzle Program and the Alloy 600 Review Program will be adequately managed so that the intended function(s) will be maintained in a manner that is consistent with the current licensing basis throughout the period of extended operation."*

These conclusions are applicable to the FNP NiCrFe Alloy Component Assessment Program with the following clarifications:

- The FNP Program is limited to RCPB components excluding steam generator tubes, which are specifically addressed by the Steam Generator Program, and Reactor Internals which are addressed by the Reactor Vessel Internals Program. The Catawba / McGuire Program is credited for a larger scope of components.

- The FNP LRA indicates that the FNP RPV heads will be replaced prior to entering the period of extended operation. These new RPV heads will utilize improved materials of construction (thermally treated Alloy 690). As such, the FNP program is not focused on RPV head penetration degradation as the leading location for PWSCC.