## 16.3 EVALUATION OF TIME-LIMITED AGING ANALYSES

As part of LRA, 10 CFR 54.21(c) requires that an evaluation of the TLAAs for the PEO be provided. In addition, 10 CFR 54.21(d) requires that a summary description of the TLAAs be included in the UFSAR. The following TLAAs have been identified and evaluated to meet these requirements.

### 16.3.1 CONTAINMENT TENDON PRESTRESS LOSS

There is a TLAA that provides acceptable Containment Tendon stress relaxation through the PEO. Tendon prestress losses are determined by measuring tendon lift-off force. Technical Specification Surveillance Requirement 3.6.1.2 and Technical Specification 5.5.6 establish the surveillance schedule for measuring lift-off forces as discussed in Section 5.5.2.2. The measurement is performed in accordance with a STP which provides the normalized lift-off forces required to be achieved during the surveillance test as a function of plant service after initial prestressing. These curves, which were originally projected to cover 40 years, were recalculated to project operation through the PEO.

This TLAA required reanalysis to project applicability through the PEO, and is therefore managed in accordance with 10 CFR 54.21(c)(1)(ii). This TLAA is also managed by an existing AMP (Table 16-1, Item 19) and is therefore also managed in accordance with 10 CFR 54.21(c)(1)(iii).

### 16.3.2 POISON SHEETS IN SPENT FUEL POOL

The criticality analysis for the Unit 1 SFP credits the existence of Carborundum (i.e., neutron absorbing) sheets located between spent fuel assemblies. These analysis assume the Carborundum material has a minimum concentration of Boron 10. This assumption accounts for the potential loss of boron carbide and is based on experiments showing that the Carborundum sheets experience a loss of boron carbide due to aging.

The Unit 1 SFP criticality analyses are therefore a TLAA as defined by 10 CFR 54.3.

This TLAA required reanalysis to project applicability through the PEO, and is therefore managed in accordance with 10 CFR 54.21(c)(1)(ii). This TLAA is also managed by an existing AMP (Table 16-1, Item 44) and is therefore also managed in accordance with 10 CFR 54.21(c)(1)(iii).

### 16.3.3 10 CFR 50.49 ENVIRONMENTAL QUALIFICATION PROGRAM

The TLAA aspect of EQ encompasses all long-lived equipment in the scope of the EQ Program, whether active or passive. Each EQ file for a group of long-lived components documents a TLAA. Environmentally-qualified equipment is replaced with qualified new or refurbished equipment prior to the end of its qualified life. Preventive maintenance is scheduled to initiate and execute these replacements. Qualified life re-evaluations are an ongoing activity and consider actual normal operating conditions as compared to design maximums (e.g., actual ambient temperatures are below the maximum design temperature that was used as the basis for the current qualified life). Qualified lives are adjusted up and down accordingly. Qualified life re-evaluations are performed under the current EQ Program and continue to be performed during the PEO.

The EQ TLAAs were revised to project applicability through the PEO, and are therefore managed in accordance with 10 CFR 54.21(c)(1)(ii). The EQ TLAAs are also managed by an existing AMP (Table 16-1, Item 246) and are therefore also managed in accordance with 10 CFR 54.21(c)(1)(iii).

### 16.3.4 REACTOR PRESSURE VESSEL TOUGHNESS REQUIREMENTS

There are four TLAAs that address loss of toughness due to irradiation embrittlement.

- Plant Heatup/Cooldown (Pressure/Temperature Limit) Curves (Tech Spec Figures 3.4.3-1 and 3.4.3-2).
- Low Temperature Overpressure Protection power-operated relief valve setpoints (Tech Spec Figure 3.4.12-1 is based on the pressure/temperature limits).
- Pressurized Thermal Shock requirements (10 CFR 50.61).
- The Reduction of Upper Shelf Energy (10 CFR Part 50, Appendix G).

These TLAAs use predictions of the cumulative damage to the RPV from irradiation embrittlement and were originally based on the 40-year expected service life of the plant. The TLAAs have been updated to consider the projected neutron fluence for the 20-year PEO.

These TLAAs are projected to the end of the PEO, and are therefore managed in accordance with 10 CFR 54.21(c)(1)(ii). These TLAAs are also managed by the CRVSP (Table 16-1, Item 75) such that the effects of aging due to irradiation embrittlement on the RPV are adequately managed through the PEO and are therefore also managed in accordance with 10 CFR 54.21(c)(1)(iii).

### 16.3.5 REACTOR VESSEL INTERNALS

There is one TLAA that is affected by fatigue.

- Core Support Plate and Core Support Barrel Lower Flange Weld

This TLAA uses predictions of the cumulative fatigue damage to the Core Support Plate and Core Support Barrel Lower Flange Weld. This TLAA considered the projected 20-year PEO. Results show that the fatigue cumulative usage factor is less than the ASME acceptance criterion of 1.00 for 60 years of operation when corrected for environmental effects.

Because this is a new analysis that remains valid through the PEO instead of the reevaluation of an existing analysis, the TLAA is classified as being managed in accordance with 10 CFR 54.21(c)(1)(i).

### 16.3.6 CONTAINMENT LINER FATIGUE

The ASME codes require that the containment liner material be prevented from experiencing significant distortion due to the thermal load and that the stresses be considered from a fatigue standpoint. The following fatigue loads were considered in the design of the liner plate:

- The annual outdoor temperature variation, assumed to be 40 cycles during the plants 40-year life;
- The interior temperature variations during the startup and shutdown of the RCS, assumed to be 500 cycles; and
- Thermal cycling due to a loss-of-coolant accident (LOCA), assumed to occur once during plant life.

The design of the liner plate and penetration sleeves included consideration of thermal stress and fatigue for which there was an assumed number and severity of thermal cycles. Since this assumption was partly based on a 40-year operating life, the fatigue analyses had to be reviewed to assure they remain valid during the PEO. The review of this TLAA determined it was valid to the end of the PEO. The TLAA is, therefore, being managed in accordance with 10 CFR 54.21(c)(1)(i).

### 16.3.7 MAIN STEAM PIPING FATIGUE

The Main Steam supply lines to the AFW pump turbines provide the system pressure boundary function and are subject to thermal loadings. According to the Section 10A discussion, 21,999 rapid full temperature cycles have been considered. However, even if the number of assumed cycles were limited to 7000 equivalent full temperature cycles, which is much more limiting, this piping would have to be cycled approximately once every 3 days over an extended plant life of 60 years. Under current plant operating practices, the system is operated only occasionally during plant heatups and cooldowns, during plant transients, and for periodic (monthly) testing. Plant heatups and cooldowns are limited to 500 each, and reactor trips are limited to 400 over plant life. Monthly testing over 60 years would contribute another 720 cycles. These actual and potential cycles combined equal slightly more than 2000 cycles for the AFW steam supply. It is, therefore, unlikely that the 7000 assumed cycles will be approached during the PEO. Thus, the existing analysis is considered to remain valid for the PEO, and there is reasonable assurance that the intended function will be maintained. This TLAA is, therefore, managed in accordance with 10 CFR 54.21(c)(1)(i).

### 16.3.8 NUCLEAR STEAM SUPPLY FATIGUE

Components in the Nuclear Steam Supply System (NSSS) are subject to a wide variety of varying mechanical and thermal loads that contribute to fatigue accumulation. The RCS components were designed in accordance with the ASME, Section III and the American National Standards Institute (ANSI) Standard B31.7. These codes require the design analysis for Class I components to address fatigue and establish limits such that initiation of fatigue cracks is precluded. Portions of Section 4.1 and the certified design specification identify the different design cyclic transients used in the fatigue analysis required by code for various major components of the RCS including the reactor vessel, RCS piping, steam generators, pressurizer, pressurizer auxiliary spray piping, and pressurizer surge line.

This TLAA use predictions of the cumulative damage due to low cycle fatigue and were originally based on the 40 year expected service life of the plant. This TLAA has been updated to consider the projected 20 year PEO and increase in fatigue damage due to environmental effects and is, therefore, managed in accordance with 10 CFR 54.21(c)(1)(ii).

This TLAA, being part of the FMP is also being managed through the PEO by an existing AMP (Table 16-1; Items 56, 77, 109, 203, and 205) and are therefore also managed in accordance with 10 CFR 54.21(c)(1)(iii).

### 16.3.9 CLASS 2 AND 3 PIPING COMPONENTS (OTHER THAN MAIN STEAM PIPING) FATIGUE

Systems that contain ANSI B31.7 Class II or III piping (other than main steam piping) have a stress limit based on 7000 cycles. These systems would have to be cycled approximately once every 3 days over an extended plant life of 60 years to reach 7000 cycles. Fatigue is not plausible for systems where the $\Delta T$ between system shutdown temperature and maximum operating temperature if the $\Delta T$ was small (equal to or less than 50°F). For systems where the $\Delta T$ is greater than 50°F, the number of thermal cycles for 60 years was conservatively estimated using plant operating history. Plant heatups and cooldowns are limited to 500 each, and reactor trips are limited to 400 over plant life. It is, therefore, unlikely that the 7000 cycles will be approached during the PEO. This TLAA is, therefore, being managed in accordance with 10 CFR 54.21(c)(1)(i).