I. OVERVIEW / SIGNATURES

Facility: Waterford 3 Steam Electric Station

Document Reviewed: **Change/Rev.:** N/A
Cycle 14 Reload Analysis Report (RAR) [Westinghouse Letter NF-WFTD-05-1, reference 3]; Waterford Unit 3 Cycle 14 Lead Test Assemblies [Westinghouse Letter NF-WTFD-05-14, reference 10]; and UFSAR changes for Cycle 14 [ER-W3-2004-0116-003, reference 15] described herein.

System Designator(s)/Description: N/A

Description of Proposed Change:

Material Evaluated:

The engineering reports document the evaluation of the design and performance of the Waterford 3 Cycle 14 reload core [RAR reference 3] and the four Next Generation Fuel (NGF) Lead Test Assemblies (LTA's) [reference 10] contained therein. There are 100 new assemblies to be loaded for Cycle 14. All but 4 of the new assemblies are of the same mechanical design as the assemblies loaded for Cycle 13. There are 4 NGF LTA's being loaded into the core and a detailed description is included later in this description and in the referenced report. The core reload was evaluated against the extended power uprate (EPU) plant conditions and reference safety Analyses of Record (AOR's). It is dependent on successful implementation of ER-W3-2001-1149-000 [reference 9]. The COLSS/CPC set points and COLR will be addressed in a separate 50.59 evaluation.

The purpose of the Cycle 14 RAR is to document the analyses and assessments performed to demonstrate the acceptable operation of the Cycle 14 core design. The major considerations of the evaluation of the design and performance of the Cycle 14 core were the Cycle 14 specific reload core characteristics and the EPU Groundrules [reference 2] and the EPU safety analyses.

The purpose of the NGF LTA report is to document that use of the 4 NGF LTA's remains within regulatory and design criteria. The NGF LTA report provides the evaluations, testing and analyses that constitute the bases of the regulatory and design criteria.

Material Exempted:

The fuel rod cladding material for the 4 NGF LTA's required an NRC exemption since the clad material was not explicitly addressed by using the Baker-Just equations for metal-water reactions as specified in 10CFR50.46 Appendix K since the Baker-Just equations presumes the use of specific alloys of Zircaloy clad fuel.

Cycle 14 Non-Fuel Related Changes

The facility changes required for EPU were already evaluated in ER-W3-2001-1149-000 [reference 9] and the reload will compare the Cycle 14 core design to the EPU AOR's and EPU Groundrules [reference 2]. The EPU ER determined new bounding analyses for fuel performance, ECCS performance and non-LOCA transients.

The In-Core Instrumentation (ICI) thimble plate will be raised 2.9 inches and the Quickloc flanges will be lengthened 2.7 inches to mitigate thimble tube growth. The change in the position of the ICI's has been incorporated into the vendor's neutronics model and will be addressed in the set point analysis [page 2-2 of reference 3].

Cycle 14 Nuclear Design Changes

The Waterford 3 Cycle 14 core will contain 117 irradiated assemblies (24 batch U and 92 batch W, 1 batch T in the core center returning to the core after being discharged in refuel 12), 96 new fresh batch X assemblies and 4 NGF LTA's. The number of new assemblies has increased from 92 to 100 new assemblies to control power peaking and support energy needs of the EPU core. The 33 batch T and 68 batch U assemblies currently present in the Cycle 13 core will be discharged from the core. The initial U-235 enrichments of the lead test assemblies range from 4.35 to 4.00 weight percent. The initial U-235 enrichments of the remaining 96 batch X assemblies range from 4.48 to 4.13 weight percent. There was a small difference in enrichments in order to match the reactivity of the NGF LTA's with other batch X assemblies. The batch X enrichments are similar to the 4.20 to 4.55 weight percent used for the Cycle 13 batch W assemblies.

Integral burnable poison rods containing erbia were first introduced into Waterford 3 cores in Cycle 9 (batch R). Reload batch X will consist of seven sub-batches with six different erbia loadings. The loading of erbia will range from no erbia rods in sub-batch X0 and the NGF LTA's to 100 erbia rods in sub-batch X5. The erbia loading is 2.1 weight percent erbia. The total number of erbia rods (7328) in fresh fuel assemblies has increased over the 6176 erbia rods in Cycle 13 to hold down peaking in the core. Except for the NGF LTA's, the fuel mechanical key design parameters for batch X fuel assemblies will be the same as those for the Cycle 13 batch W fuel assemblies. The NGF LTA's will have a higher fuel pellet stack density, a smaller fuel pellet O.D., a smaller fuel rod cladding I.D., a smaller cladding O.D. and a correspondingly higher water-to-fuel ratio. These differences have been accounted for in the core design analysis.

The reactor core will be loaded with quarter-core rotational symmetry in a low neutron leakage configuration in which "twice-burned" batch U assemblies will be loaded on the core periphery, and fresh batch X assemblies will be mixed with "once-burned" batch W assemblies in the core interior. This strategy is similar to that used in Cycle 13 when the batch T assemblies were loaded on the edge of the core, and fresh batch W fuel assemblies were mixed with batch U assemblies in the interior. This type of loading tends to maximize fuel efficiency of the core and minimize neutron fluence to the reactor vessel. The peripheral assembly relative integrated powers will be somewhat higher than those in Cycle 13, but because of EPU, the excore detector signals in Cycle 14 will be significantly larger than in Cycle 13. The change in excore neutron flux is addressed in EPU ER-W3-2001-1149-007 [reference 5].

In order to mitigate thimble tube growth, the In-Core Instrumentation (ICI) thimble plate will be raised 2.9 inches and the Quickloc flanges will be lengthened 2.7 inches. The change in the position of the ICI's has been incorporated into the core design neutronics model and will be explicitly addressed during the set point analysis.

The Cycle 14 core was designed on a nominal best estimate cycle energy of 510.3 EFPD for a Cycle 13 energy of 503 EFPD. Evaluations have been completed to demonstrate the applicability of the reload analysis for Cycle 13 energies between 488 and 518 EFPD, and for the corresponding Cycle 14 bounding cycle end point energies from 544.4 EFPD down to 528.9 EFPD.

Predicted critical boron concentrations, moderator temperature coefficients and minimum scram reactivity worths are similar to those calculated for Cycle 13. The cycle maximum axial power peaking factors are expected to be very similar, but the radial and planar peaking factors will be significantly lower in Cycle 14 due to the greater number of fresh fuel assemblies. The maximum assembly exposure at the end-of-cycle will be higher than that calculated for the previous cycle, but remains within the design and regulatory limits.

Cycle 14 Fuel Mechanical Design Changes

There are no major mechanical design changes for the standard Batch X fuel and grid cages. The upper end fitting was changed slightly to reduce the overall height of the assembly by 0.20 inches and increase the margin for potential assembly growth before the assembly hold-down springs reached a solid height (i.e., the springs became fully compressed.) The offset bend along the bottom edge of the Guardian grid was modified to improve the welding fit up with the lower end fitting to reduce rework and does not alter its performance. Several documentation only changes were also made to the design.

Cycle 14 Lead Test Assemblies

The Next Generation Fuel assemblies [reference 10] will be installed to gather performance data on this enhanced fuel assembly design. An assessment by the fuel vendor has shown that the operation of the LTA's will be within the bounds of the existing safety analysis for all Anticipated Operational Occurrences and Postulated Accidents. All fuel assembly and fuel rod acceptance criteria for the LTA's have been shown to be met. The thermal-hydraulic analysis for Cycle-14 showed that the LTA's will not be the limiting assemblies. The use of the LTA's required a Technical Specification change, the results of this 50.59 are dependent on issuance of that change, see item 5 section II.A.5. The Licensing Plan for these LTA's included the submittal to the NRC of a Cladding Exemption Report for the use of Optimized ZIRLO (OPTIN) cladding. The NRC has granted an exemption to 10CFR50.46 Appendix K for the NGF LTA's [reference 6].

The Next Generation Fuel lead assemblies are a new design of the CE 16x16 fuel assembly developed to improve fuel reliability to resolve grid to rod fretting for the entire length of the assembly and to increase thermal performance of the bundle. The new design incorporates improved materials for both the fuel rod cladding and the skeleton of the assembly. The new design includes a reduced fuel rod diameter, mixing vanes, a pair of additional grids for increased coolant flow mixing, and several other changes related to manufacture of the new assembly design.

Summary of Major Reload Topics

The Cycle 14 RAR [reference 3] documents the analyses and assessments performed to demonstrate the acceptability of the Cycle 14 core design. This report was reviewed by Entergy personnel as required by NOECP-702, Waterford 3 Reload Process. Below are brief summaries of the purpose and results for the major areas of evaluation. Cited references are located at the end of this evaluation.

The assessments performed consist of comparing the Cycle 14 core design against multiple checklists that indicate that the AOR's remain bounding. The two checklists used are the Physics Assessment Checklist (PAC) and the Comprehensive Checklists (CCL). The PAC assessment confirms that the physics parameters used in the AOR's are applicable to Cycle 14. The CCL assessment confirms that the non-physics parameters for the Cycle 14 plant configuration and operating parameters are bounded by those assumed for the AOR's. If the Cycle 14 parameters were not bounded, an exception was generated and resolved.

Physics Assessment (PAC)

The purpose of the physics assessment is to confirm that the physics parameters used in the AOR's are applicable to Cycle 14. The primary elements that impact the physics assessment are the Cycle 14 specific core design characteristics. These were explicitly incorporated into the neutronics models and files used to perform the physics assessment. For Cycle 14, this methodology included the application of the No Clad Lift–Off and erbia burnable absorber methodologies.

All analyses and assessments were performed using NRC approved methodologies (in accordance with Technical Specification 6.9.1.11.1.) Neutronic parameters important to safety were generated using NRC approved codes and methods. Physics parameters used in the assessment of safety analyses were generated consistent with the Technical Specification LCO's. There are no reload-driven Technical Specification changes that are required for Cycle 14.

There were four parameters that did not meet the PAC assessment.

1) The single CEA withdrawal parameters were not met. Sufficient margin to accommodate the single CEA withdrawal within deadband event will be reserved as part of the Cycle 14 set point process.

2) The refueling boron concentration was not met. The required refueling boron concentration will be reduced by crediting insertion of the N-2 CEA configuration. This is listed as an external requirement of Table 6-9 [reference 3].

3) The core octant power asymmetry was not met. The impact of the cycle-maximum octant power asymmetry will be addressed during the set point process.

4) The maximum pin burnup at MOC was not met. The COLR limit on linear heat rate must be reduced to12.9 kW/ft for the entire cycle because of the presence of high exposure batch U assemblies that exceed 50,000 MWD/T at BOC. (These assemblies have Inconel top-grids that Waterford 3 wants on the core periphery to resolve top grid fretting fuel failures).

Entergy assessments for the standard CE 16x16 batch X fuel assemblies and the NGF LTA's confirmed batch X compliance to fuel storage criticality bases [references 12 and 13].

Revised COLSS and CPC set points will be determined in the set point analysis under a separate 50.59 and will be implemented per station procedures prior to the startup of Cycle 14. Also, the requirements of Table 6-9, PAC Assessment External Requirements, [reference 3] will be adequately addressed for Cycle 14. The types of actions required to address Table 6-9 are limitations on the length of the outage to less than 163 days, implementing the COLR, maintaining the refueling boron concentration for shutdown margin requirements and timing of actions concerning boron dilution. The actual close-out of these requirements is a letter transmitted to the vendor indicating how the requirements are met and they are listed as item 4 in section II.A.5 of this 50.59 evaluation.

Fuel Performance Analysis

The purpose of the fuel performance analysis is to demonstrate acceptable fuel performance (e.g. rod internal pressure, power-to-melt, axial densification factor, etc.) for the Cycle 14 design and operating conditions. The reload process evaluates the applicability of the Fuel Performance AOR to Cycle 14. If determined to be applicable, the AOR results are valid for use by Mechanical Design, Non-LOCA Safety Analysis, ECCS Performance and Digital Set Points Analysis.

The AOR and related assessments for EPU and the lead test assemblies were determined to be applicable to Cycle 14. Based upon the evaluations and analyses, all fuel assembly and fuel rod criteria have been shown to be met. The four CE 16x16 NGF LTA's containing Optimized ZIRLO™ clad fuel rods have been determined to be acceptable for Waterford Unit 3 Cycle 14, and subsequent operation to a lead rod burnup of 60,000 MWD/MTU and a plant rated power level of 3716 MWt. Even though the use of the CE 16x16 NGF LTA's do not result in any unreviewed safety questions and a Waterford 3 exemption from 10CFR50.46 App. K for the NGF LTA's cladding material, a Technical Specification change is required due to wording in the Waterford 3 Technical Specifications [reference 16]. The required Technical Specification change is listed as item 5 in section II.A.5 of this 50.59 evaluation.

Thermal Hydraulic Analysis

The purpose of the Thermal Hydraulic (TH) analysis was to demonstrate that the thermal hydraulic performance of the Cycle 14 core remained bounded by the Thermal Hydraulic AOR's. Steady state DNBR analyses for Cycle 14 at the rated core power of 3716 MWth were performed using the TORC computer code, the CE-1 Critical Heat Flux (CHF) correlation, simplified TORC modeling methods and the CETOP code. The ABB-TV critical heat flux correlation for the NGF LTA's was not credited for performance of the NGF LTA's,

The Modified Statistical Combination of Uncertainties (MSCU) methodology was applied to the Waterford 3 specific TH parameters and other uncertainty factors at the 95/95 confidence/probability level to verify that the Specified Acceptable Fuel Design Limit (SAFDL) of 1.26 on the CE-1 Critical Heat Flux (CHF) correlation minimum DNBR remains applicable for Cycle 14. The effects of rod bow on DNBR margin are incorporated into the safety and set point analysis. NRC approved methods were used for the analysis and it was determined that the TH performance of the Cycle 14 core is bounded by the AOR's.

Non-LOCA Safety Analysis

The purpose of the non-LOCA safety analyses is to demonstrate that for the Cycle 14 design and operating conditions, that the consequences of various postulated Design Basis Events (DBE's) are acceptable. The reload process evaluates the applicability of the AOR's for the various DBE's to Cycle 14. The evaluation documents the key analysis inputs from the safety analysis ground rules, the bounding physics analysis, the bounding fuel performance analysis and the bounding thermal hydraulic analysis needed to validate the bounding non-LOCA analyses. The DBE's are categorized into three groups: Moderate Frequency, Infrequent and Limiting Fault events. The DBE's were evaluated with respect to four criteria: offsite dose, reactor coolant system pressure, fuel performance (DNBR and fuel centerline melt SAFDL's), and loss of shutdown margin. All Chapter 15 FSAR events were reviewed to assure that they meet their respective criteria for Cycle 14.

The use of the lead test assemblies and issues with the AOR (CR-WF3-2005-0495) required that a cycle specific assessment of the CEA ejection analysis be performed [reference 7]. The assessment demonstrated that the results of the AOR bounded the Cycle 14 specific analysis. The results presented in the EPU AOR remained bounding with fuel failure less than 15% as was used for the radiological dose analysis.

The COLSS and CPC set points required to ensure the criteria will be addressed in a separate 50.59.

Emergency Core Cooling System (ECCS) Performance Analysis

An ECCS performance evaluation was performed for Cycle 14 to demonstrate conformance to the ECCS Acceptance Criteria for Light Water Nuclear Power Reactors. The ECCS performance analysis is comprised of the Large Break Loss of Coolant Accident (LBLOCA), Small Break Loss of Coolant Accident (SBLOCA) and post-LOCA Long Term Cooling (LTC) analyses.

The Cycle 14 ECCS performance evaluation demonstrated that the results of the EPU analyses for LBLOCA, SBLOCA and LTC apply to Cycle 14. The results from the limiting break are bounded by the AOR and conform to the ECCS acceptance criteria (Peak Cladding Temperature ≤ 2200 °F, Maximum Cladding Oxidation ≤ 17%, Maximum Core-Wide Cladding Oxidation ≤ 1% and maintaining a coolable geometry and long term cooling). The results will be applicable for the Peak Linear Heat Generation Rate (PLHGR) reported in the COLR and the EPU licensed core power level.

Check the applicable review(s): (Only the sections indicated must be included in the Review.)

☐	**EDITORIAL CHANGE of a Licensing Basis Document**	**Section I**
☐	**SCREENING**	**Sections I and II required**
☒	**50.59 EVALUATION EXEMPTION**	**Sections I, II, and III required**
☒	**50.59 EVALUATION (#: 05-012)**	**Sections I, II, and IV required**

Preparer: E. G. Wiegert/ Edward G. Wiegert /EOI-W3/Nuclear Engineering/ 4-15-05
Name (print) / Signature / Company / Department / Date

Reviewer: D. E. Barr/ /EOI-ECH/NEAD PWR Fuels/ 4/19/05
Name (print) / Signature / Company / Department / Date

OSRC: Richard J. Mooney 4/22/05
Chairman's Name (print) / Signature / Date
[Required only for Programmatic Exclusion Screenings and 50.59 Evaluations.]

II. SCREENINGS

A. Licensing Basis Document Review

1. Does the proposed activity impact the facility or a procedure as described in any of the following Licensing Basis Documents?

Operating License	YES	NO	CHANGE # and/or SECTIONS IMPACTED
Operating License	☐	☒	N/A
TS	☐	☒	N/A
NRC Orders	☐	☒	N/A
If "YES", obtain NRC approval prior to implementing the change by initiating an LBD change in accordance with NMM ENS-LI-113. (See Section 5.2[13] for exceptions.)			

LBDs controlled under 50.59	YES	NO	CHANGE # (if applicable) and/or SECTIONS IMPACTED
FSAR	☒	☐	Chapter 4 – detailed list in the basis section
TS Bases	☐	☒	N/A – TSCR has been submitted for change in TS 5.3.1
Technical Requirements Manual	☐	☒	N/A
Core Operating Limits Report	☐	☒	N/A - Will be changed under separate 50.59
NRC Safety Evaluation Report and supplements for the initial FSAR[1]	☐	☒	N/A
NRC Safety Evaluations for amendments to the Operating License[1]	☐	☒	N/A
If "YES", perform an Exemption Review per Section III OR perform a 50.59 Evaluation per Section IV OR obtain NRC approval prior to implementing the change. If obtaining NRC approval, document the LBD change in Section II.A.5; no further 50.59 review is required. However, the change cannot be implemented until approved by the NRC. AND initiate an LBD change in accordance with NMM ENS-LI-113.			

LBDs controlled under other regulations	YES	NO	CHANGE # (if applicable) and/or SECTIONS IMPACTED
Quality Assurance Program Manual[2]	☐	☒	N/A
Emergency Plan[2, 3]	☐	☒	N/A
Fire Protection Program[3, 4] (includes the Fire Hazards Analysis)	☐	☒	N/A
Offsite Dose Calculations Manual[3, 4]	☐	☒	N/A
If "YES", evaluate any changes in accordance with the appropriate regulation AND initiate an LBD change in accordance with NMM ENS-LI-113. No further 50.59 review is required.			

[1] If "YES," see Section 5.2[5]. No LBD change is required.
[2] If "YES," notify the responsible department and ensure a 50.54 Evaluation is performed. Attach the 50.54 Review.
[3] Changes to the Emergency Plan, Fire Protection Program, and Offsite Dose Calculation Manual must be approved by the OSRC in accordance with NMM OM-119.
[4] If "YES," evaluate the change in accordance with the requirements of the facility's Operating License Condition or under 50.59, as appropriate.

2. **Does the proposed activity involve a test or experiment not described in the FSAR?** ☒ Yes ☐ No

If "yes," perform a 50.59 Evaluation per Section IV OR obtain NRC approval prior to implementing the change AND initiate an LBD change in accordance with NMM LI-113. If obtaining NRC approval, document the change in Section II.A.5; no further 50.59 review is required. However, the change cannot be implemented until approved by the NRC.

3. **Basis**

Explain why the proposed activity does or does not impact the Operating License/Technical Specifications and/or the FSAR and why the proposed activity does or does not involve a new test or experiment not previously described in the FSAR. Discuss other LBDs if impacted. Adequate basis must be provided within the Screening such that a third-party reviewer can reach the same conclusions. Simply stating that the change does not affect TS or the FSAR is not an acceptable basis.

Operating License (Operating License, Technical Specifications, NRC Orders)

The Cycle 14 RAR and NGF LTA Report describe and address the design, accident analyses and performance of the Cycle 14 core and the fuel assemblies that constitute the Cycle 14 core. A review of the proposed EPU Waterford 3 Operating License determined that the information in the license is not impacted by the Cycle 14 RAR. The Cycle 14 core design and analyses results meet the EPU Technical Specification requirements. Safety Limits, Limiting Safety Settings and Limiting Conditions of Operation governing the operation of the EPU design core are bounding for the Cycle 14 core.

Even though the use of the CE 16x16 NGF LTA's does not result in any unreviewed safety questions and Waterford 3 has an exemption from 10CFR50.46 App. K for the NGF LTA's cladding material, a Technical Specification change is required due to wording in the Waterford 3 Technical Specifications [reference 16]. The required Technical Specification change is listed as item 5 in section II.A.5 of this 50.59 evaluation.

NRC Confirmatory Orders and Immediate Orders were reviewed and it was determined that these documents do not address core reload details or other specific information addressed in the Cycle 14 RAR.

LBDs Controlled Under 50.59 (FSAR, TS Bases, TRM, COLR, NRC SERs)

Revisions to the Waterford 3 Updated FSAR (UFSAR) will be required as a result of Cycle 14 changes. Primarily, these changes include revisions to the description of the Cycle 14 core with the new assemblies, new core physics parameter values, and changes to the fuel design description. In addition, some editorial changes will be made. The following table lists the sections, tables, and figures to be changed.

Section/Table/Figure	*Description*
Page 4-i	Table of Contents
Page 4-iv	List of Tables
Page 4-ix	List of Figures
4.3A	Fuel Cycle 13
4.3A.1	General Description
4.3A.2.1.1	Fuel Design
4.3A.2.3	Thermal Design
4.3A.2.5	Shoulder Gap Adequacy
4.3A.3.1.1	Fuel Management
4.3A.3.1.2	Power Distribution
4.3A.3.1.3	Maximum Fuel Rod Burnup
4.3A.4.1	DNBR Analysis
4.3A.4.2	Effects of Fuel Bowing on DNBR Margin
Table 4.3A-1	Cycle 13 Core Loading
Table 4.3A-2	Nominal Physics Characteristics

Section/Table/Figure	*Description*
Table 4.3A-3	Limiting Values of Reactivity Worths and Allowances for Hot Full Power Steam Line Break
Table 4.3A-4	Reactivity Worth of CEA Regulating Groups at Hot Full Power
Table 4.3A-5	Cycle 13 Thermal Hydraulic Parameters at Full Power
Figure 4.3A-2	Waterford-3 Fuel Management Scheme
Figure 4.3A-3	Waterford-3 Cycle 13 Assembly Average Burnups
Figure 4.3A-8	Waterford-3 Cycle 13 Assembly Relative Power Density, BOC, HFP, Equilibrium Xenon, ARO
Figure 4.3A-9	Waterford-3 Cycle 13 Assembly Relative Power Density, MOC, HFP, Equilibrium Xenon, ARO
Figure 4.3A-10	Waterford-3 Cycle 13 Assembly Relative Power Density, EOC, HFP, Equilibrium Xenon, ARO

No TS Bases changes or TRM changes were identified to be necessary due to the Cycle 14 reload activities.

The Cycle 14 COLR will provide the specific reload related operational limits for the Cycle 14 core. Technical Specification 6.9.1.11 requires that the COLR be revised for each core reload. The COLR is not addressed under this 50.59.

The results of the Cycle 14 reload analyses as described in the RAR are consistent with the requirements in NRC SERs for Waterford 3. Changes to COLSS/CPC set points, which are not covered by this 50.59, will ensure that the core is operated such that the analyses requirements are met.

LBDs Controlled Under Other Regulations

Reload analyses inputs and results are not addressed in the QAPM, E-Plan, Fire Protection Program and the ODCM. Based on this, no changes to these documents are required to support the Cycle 14 RAR.

TEST OR EXPERIMENT

The cycle 14 core reload will be implemented in accordance with station procedures and Technical Specifications. Therefore, the Cycle 14 reload does not constitute a test or experiment.

The incorporation of four NGF LTA's into Cycle 14 does constitute a test or experiment and is addressed in Part IV of this 50.59.

INDEPENDENT SPENT FUEL STORAGE INSTALLATION

Waterford 3 does not have an Independent Spent Fuel Storage Facility.

4. References

Discuss the methodology for performing LBD searches. State the location of relevant licensing document information and explain the scope of the review such as electronic search criteria used (e.g., key words) or the general extent of manual searches per Section 5.5.1[5](d) of LI-101. **NOTE: Ensure that manual searches are performed using controlled copies of the documents. If you have any questions, contact your site Licensing department.**

LBDs/Documents reviewed via keyword search:	Keywords:
LBDS_50_59 (Group)	Reload (47 hits), safety analysis (221 hits), safety analyses (80 hits), nuclear fuel (25 hits), region T (6 hits), region U (1 hit), region W (0 hits), batch (56 hits), batches (56 hits), active core (8 hits), core height (7 hits), Cycle 13 (9 hits), lead test assemblies (0 hits), moderator temperature coefficient (0 hits), mtc (32 hits)

LBDs/Documents reviewed manually:

Performed a manual review of UFSAR Chapters 4, 6, 7, 9 and 15; Technical Specifications; the Operating License; Technical Requirements Manual; and EPU documentation

5. Is the validity of this Review dependent on any other change? ☒ **Yes** ☐ **No**

If "YES", list the required changes/submittals. The changes covered by this 50.59 Review cannot be implemented without approval of the other identified changes (e.g., license amendment request). Establish an appropriate notification mechanism to ensure this action is completed.

This 50.59 is dependent on:

1. Approval of implementation of Extended Power Uprate [ER-W3-2001-1149-000]. (Approval of License Amendment Request received April 15, 2005)
2. Implementation of the Cycle 14 Core Operating Limits Report (COLR) (Closure of Licensing commitment A22710 for Cycle 14)
3. Installation of the Cycle 14 Core Operating Limits Supervisory System (COLSS) and Core Protection Calculator (CPC) addressable constant changes. (Closure of Licensing commitment A26614)
4. Contingencies listed in Tables 6-10 and 7-3 of the Cycle 14 RAR [reference 3]. (Closure of this item on mode 5 restraint list)
5. Approval of License Amendment Request NPF-38-258 change to TS 5.3.1. (Closure of Licensing commitment A22697)

B. ENVIRONMENTAL SCREENING

If any of the following questions is answered "yes," an Environmental Review must be performed in accordance with NMM Procedure ENS-EV-115, "Environmental Evaluations," and attached to this 50.59 Review. Consider both routine and non-routine (emergency) discharges when answering these questions.

Will the proposed Change being evaluated:

	Yes	No	
1.	☐	☒	Involve a land disturbance of previously disturbed land areas in excess of one acre (i.e., grading activities, construction of buildings, excavations, reforestation, creation or removal of ponds)?
2.	☐	☒	Involve a land disturbance of undisturbed land areas (i.e., grading activities, construction, excavations, reforestation, creating, or removing ponds)?
3.	☐	☒	Involve dredging activities in a lake, river, pond, or stream?
4.	☐	☒	Increase the amount of thermal heat being discharged to the river or lake?
5.	☐	☒	Increase the concentration or quantity of chemicals being discharged to the river, lake, or air?
6.	☐	☒	Discharge any chemicals new or different from that previously discharged?
7.	☐	☒	Change the design or operation of the intake or discharge structures?
8.	☐	☒	Modify the design or operation of the cooling tower that will change water or air flow characteristics?
9.	☐	☒	Modify the design or operation of the plant that will change the path of an existing water discharge or that will result in a new water discharge?
10.	☐	☒	Modify existing stationary fuel burning equipment (i.e., diesel fuel oil, butane, gasoline, propane, and kerosene)?[1]
11.	☐	☒	Involve the installation of stationary fuel burning equipment or use of portable fuel burning equipment (i.e., diesel fuel oil, butane, gasoline, propane, and kerosene)?[1]
12.	☐	☒	Involve the installation or use of equipment that will result in a new or additional air emission discharge?
13.	☐	☒	Involve the installation or modification of a stationary or mobile tank?
14.	☐	☒	Involve the use or storage of oils or chemicals that could be directly released into the environment?
15.	☐	☒	Involve burial or placement of any solid wastes in the site area that may affect runoff, surface water, or groundwater?

[1] See NMM Procedure ENS-EV-117, "Air Emissions Management Program," for guidance in answering this question.

C. SECURITY PLAN SCREENING

If any of the following questions is answered "yes," a Security Plan Review must be performed by the Security Department to determine actual impact to the Plan and the need for a change to the Plan.

Could the proposed activity being evaluated:

	Yes	No	
1.	☐	☒	Add, delete, modify, or otherwise affect Security department responsibilities (e.g., including fire brigade, fire watch, and confined space rescue operations)?
2.	☐	☒	Result in a breach to any security barrier(s) (e.g., HVAC ductwork, fences, doors, walls, ceilings, floors, penetrations, and ballistic barriers)?
3.	☐	☒	Cause materials or equipment to be placed or installed within the Security Isolation Zone?
4.	☐	☒	Affect (block, move, or alter) security lighting by adding or deleting lights, structures, buildings, or temporary facilities?
5.	☐	☒	Modify or otherwise affect the intrusion detection systems (e.g., E-fields, microwave, fiber optics)?
6.	☐	☒	Modify or otherwise affect the operation or field of view of the security cameras?
7.	☐	☒	Modify or otherwise affect (block, move, or alter) installed access control equipment, intrusion detection equipment, or other security equipment?
8.	☐	☒	Modify or otherwise affect primary or secondary power supplies to access control equipment, intrusion detection equipment, other security equipment, or to the Central Alarm Station or the Secondary Alarm Station?
9.	☐	☒	Modify or otherwise affect the facility's security-related signage or land vehicle barriers, including access roadways?
10.	☐	☒	Modify or otherwise affect the facility's telephone or security radio systems?

Documentation for accepting any "yes" statement for these reviews will be attached to this 50.59 Review or referenced below.

III. 50.59 EVALUATION EXEMPTION

Enter this section only if a "yes" box was checked in Section II.A.1.

A. Check the applicable boxes below. If any of the boxes are checked, clearly document the basis in Section III.B, below. If none of the boxes are appropriate, perform a 50.59 Evaluation in accordance with Section IV. Provide supporting documentation or references as appropriate.

☐ The proposed activity meets all of the following criteria regarding design function per Section 5.5[1](a):

The proposed activity does not adversely affect the design function of an SSC as described in the FSAR; **AND**

The proposed activity does not adversely affect a method of performing or controlling a design function of an SSC as described in the FSAR; **AND**

The proposed activity does not adversely affect a method of evaluation that demonstrates intended design function(s) of an SSC described in the FSAR will be accomplished.

☐ An approved, valid 50.59 Review(s) covering associated aspects of the proposed activity already exists per Section 5.5[1](b). Reference 50.59 Evaluation # _____ (if applicable) or attach documentation. Verify the previous 50.59 Review remains valid.

☒ The NRC has approved the proposed activity or portions thereof per Section 5.5[1](c). Reference: NRC Letter from N. Kalyanam to J.E. Venable, "Waterford Steam Electric Station, Unit No. 3 (Waterford 3), Exemption from the Requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.46 and 10 CFR Part 50, Appendix K (TAC No. MC2999)" dated July 28, 2004. [reference 6]

B. Basis

Provide a clear, concise basis for determining the proposed activity may be exempted such that a third-party reviewer can reach the same conclusions.

The referenced letter provided an exemption for the "Optimized ZIRLO" cladding material. The exemption is for the use of the cladding material in four lead test assemblies for lead rod average burnup of up to 60,000 MWD/MTU. The exemption was required since the cladding material used in the NGF LTA's was not specified by statute in 10CFR50.46 Appendix K [references 6 & 8].

IV. 50.59 EVALUATION

License Amendment Determination

Does the proposed Change being evaluated represent a change to a method of evaluation ONLY? If "Yes," Questions 1 – 7 are not applicable; answer only Question 8. If "No," answer all questions below. ☐ Yes ☒ No

Does the proposed Change:

1. Result in more than a minimal increase in the frequency of occurrence of an accident previously evaluated in the FSAR? ☐ Yes ☒ No

   BASIS: (references cited are at the end of the evaluation)

   The Cycle 14 core design is similar to the Cycle 13 core design except for additional bundles to limit peaking, four NGF LTA's and operating at a higher power for EPU [reference 9]. The 96 batch X Cycle 14 assemblies and the four NGF LTA's are compatible with the existing fuel handling and storage equipment. All batch X assemblies and the four NGF LTA's are capable of withstanding the expected handling loads (FSAR Sections 4.2.1.1 and 4.2.3.1.5). The 0.20 inch change in assembly height is within the capability of the fuel handling system and is within the tolerances of the applicable plant procedures. Since no changes to the interlocks, mechanical stops or administrative controls at the plant are required to accommodate the Cycle 14 fuel, the probability of a fuel handling accident (FSAR Section 15.7.3.4) will not be increased.

   The probability of erroneous loading of fuel pellets or fuel pins of different enrichment in a fuel assembly or erroneous placement or orientation of fuel assemblies in the core (FSAR Section 15.4.3.1) due to the design change features in batch X assemblies has not increased. Extensive quality controls are used to ensure that fuel components are built correctly. Final core verification (serial number, core location and orientation check of each fuel assembly) will be performed after the Cycle 14 core is loaded to ensure that the core configuration is consistent with the design documentation. Post-refueling startup testing will be performed to verify design predictions with observed core behavior.

   Based on the discussion above, the frequency of occurrence of an accident previously evaluated in the FSAR will not be increased due to the installation and operation of the Cycle 14 core.

2. Result in more than a minimal increase in the likelihood of occurrence of a malfunction of a structure, system, or component important to safety previously evaluated in the FSAR? ☐ Yes ☒ No

   BASIS: (references cited are at the end of the evaluation)

   The batch X fuel assemblies are acceptable for use in Waterford 3 Cycle 14. The nuclear design with batch X fuel was accomplished using NRC approved analysis methodologies under approved quality assurance programs. The performance of the batch X assemblies is not expected to be significantly different from previous batches. There is acceptable mechanical design margin for the Cycle 14 core containing batch X fuel assemblies and other resident fuel batches. All assemblies, except the batch T center assembly, in the Cycle 14 core will employ the Inconel top spacer grids to improve fuel grid to rod fretting performance. The probability of fuel failure due to mechanical flow induced vibration and fretting (FSAR Sections 4.2.1.2.1.g, 4.2.3.1.1, 4.2.3.1.3, 4.2.3.2.1 and 4.2.3.2.4) with the new Inconel spacer grids is reduced. All the fuel assemblies will meet the required design and functional requirements. Adequate shoulder gap is predicted for all of the batches in the Cycle 14 core. There are no fuel mechanical issues that would require Cycle 14 water chemistry to be operated outside the established industry guidelines. Evaluations of the lead test assemblies demonstrate that they satisfy all design criteria [reference 10].

   The loading of the Cycle 14 fuel assemblies in the core and subsequent operation will not require any physical changes to plant equipment or systems. The batch X fuel assemblies are similar in design to the batch W assemblies (Cycle 13 reload) and no impact on the performance or reliability of any plant systems will result from their use.

   The AOR and related assessments for EPU and the lead test assemblies were determined to be applicable to Cycle 14. Based upon the evaluations and analyses, all fuel assembly and fuel rod criteria have been

shown to be met. The four NGF LTA's containing Optimized ZIRLO™ clad fuel rods have been determined to be acceptable for Waterford Unit 3 Cycle 14, and subsequent operation to a lead rod burnup of 60,000 MWD/MTU and a plant rated power level of 3716 MWt.

The Cycle 14 fuel and core designs will not degrade the performance of any safety system assumed to function in the safety analyses, nor will these changes decrease the reliability of safety systems. Relative to Cycle 13, the predicted critical boron concentrations, moderator temperature coefficients, and the minimum scram reactivity worths are similar. Calculated maximum axial power peaking factors are similar to those in Cycle 13, and the radial and planar peaking factors are significantly lower.

The Cycle 14 reload design does not involve a change in seismic requirements, separation criteria, environmental qualification, or single failure criteria for any plant system, structure, or component. Equipment redundancy and independence will not be affected, and no protection features will be modified. Additional loads will not be imposed on any safety or support system.

The Cycle 14 core reload design with the lead test assemblies and batch X fuel will not degrade the performance of any safety system assumed to function in the safety analyses, nor will these changes decrease the reliability of safety systems or require that any systems be operated outside their design limits. The dimensions and placement of the guide tubes, with the exception of 0.20 inch change in length, in the batch X fuel assemblies remain the same as batch W fuel assemblies ensuring no compatibility issues with CEA's. The lead test assemblies maintain the same guide tube envelope ensuring no compatibility issues with CEA's.

Based on the discussion above, there is no characteristic of the Cycle 14 core that would increase the probability of a malfunction of equipment important to safety. Therefore, the likelihood of an occurrence of a malfunction of an SSC important to safety is not increased.

3. Result in more than a minimal increase in the consequences of an accident previously evaluated in the FSAR? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

As a result of the Cycle 14 core reload, there will be no new pathways to the environment created for radioactive material release. The equipment designed to either mitigate the radiological consequences of an accident, or control the release of radioactive material will not be affected.

The increase in thermal power and the increase in energy content of the core were addressed as part of EPU and are included in the EPU AOR's. All LOCA and non-LOCA transients have been evaluated for Cycle 14 [reference 3] and the results were found acceptable. The evaluations included the NGF LTA's in non-limiting core locations. All events were found to be bounded by the EPU AOR's. The set points, when established by the set point analysis, will ensure the conclusions of the Cycle 14 RAR and necessary margin requirements are met. These set points (COLSS, CPCs, and COLR updates) will be covered by a separate 50.59 and will be installed prior to Cycle 14 operation.

The CEA ejection was re-evaluated for the NGF LTA's and it was demonstrated that the results of the AOR bounded the Cycle 14 specific analysis. The results presented in the EPU AOR remained bounding with fuel failure less than 15% as was used for the radiological dose analysis.

The four LTA's will use Optimized ZIRLO cladding, and an exemption from the NRC for the use of this material [reference 6] has been obtained.

Entergy assessments for the standard CE 16x16 fuel assemblies and the LTA's confirmed Batch X compliance to the fuel storage criticality bases [references 12 & 13].

The functions of equipment designed to either mitigate the radiological consequences of an accident, or control the release of radioactive material, will not be affected. The maximum assembly exposure at the end–of–cycle will be higher than that in Cycle 13, but the predicted maximum fuel pin exposure will be less than the 60,000 MWd/T limit.

The batch X fuel assemblies have the same envelope, materials, dimensions and structural cage as those previously used at Waterford 3. Adequate shoulder gap is predicted for all of the batches of fuel used in the Cycle 14 core. The chemical and metallurgical performance of the batch X fuel is expected to be

unchanged from the batch W fuel. As such, no change will occur in the radiological release rate/duration, no new release mechanisms are postulated, and no impact will occur to any radiation release barriers.

The characteristics of the NGF LTA's and batch X fuel will not significantly affect the consequences of a fuel handling accident as currently presented in UFSAR Section 15.7.3.4. The design of the batch X assemblies is the same as for batch W relative to connection of a handling tool to the assemblies. The weight of the batch X assemblies is essentially the same as the batch W assemblies. The assumption of the number of fuel pins that are postulated to fail during the design basis fuel handling accident is still the same and the release inventory assumed in the analysis of the accident is still valid. Therefore, consequences of a design basis fuel handling accident will not increase.

Based on the above, the consequences of accidents previously evaluated in the FSAR will not be increased due to installation and operation of the Cycle 14 core.

4. Result in more than a minimal increase in the consequences of a malfunction of a structure, system, or component important to safety previously evaluated in the FSAR? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

The Cycle 14 fuel management and design changes require no equipment modifications. The design differences between Region X fuel and Region W fuel are relatively minor and do not impact any SSC important to safety. Important equipment will function in the same manner with the Cycle 14 reload core as with the previous core. The function and duty of the equipment important to safety is not altered. No changes in the assumptions concerning equipment availability or failure modes have been made.

The NGF LTA's were evaluated to the same criteria as the remainder of the batch X fuel and met all design criteria except for the cladding material. An exemption has been obtained for the cladding material.

Thus, the consequences of a malfunction of equipment important to safety are not increased by the changes associated with the Cycle 14 reload.

5. Create a possibility for an accident of a different type than any previously evaluated in the FSAR? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

Installation and operation of the Cycle 14 core does not introduce an accident initiator or potential single failure not already considered in the Updated FSAR. The fuel assemblies comprising the Cycle 14 core (including the new batch X fuel and NGF LTA's) meet all required design and functional requirements. The nuclear design of batch X fuel was accomplished using NRC-approved analysis methodologies under approved quality assurance programs. The performance of the batch X assemblies is not expected to be significantly different than previous fuel batches. The Cycle 14 reload core will not result in changes to the radiological release rate/duration, will not create new release mechanisms, and will not impact radiation release barriers. There are no new system interactions or connections resulting from the Cycle 14 core reload nor is it necessary to modify the design, function, or operation of any equipment or to install new equipment.

There were no changes in the failure modes of equipment important to safety as a result of the design and analyses associated with the Cycle 14 reload. No initiators of any of the accidents already postulated are impacted by the Cycle 14 reload. Therefore, operation of Waterford 3 with the Cycle 14 core will not cause an accident of a different type than any previously evaluated in the FSAR.

6. Create a possibility for a malfunction of a structure, system, or component important to safety with a different result than any previously evaluated in the FSAR? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

As stated previously, the Cycle 14 fuel management and design changes require no equipment modifications. The design differences between batch X fuel and batch W fuel are minor and do not impact any SSC important to safety. Important equipment will function in the same manner with the Cycle 14 reload core as with the previous core. There are no new modes of failure associated with any of the changes identified previously in this evaluation for Cycle 14. The continued use of the Inconel top grid

utilized on the batch U and batch W assemblies remaining in the core meets all design and functional requirements and has not shown evidence of problems during Cycle 13. No changes due to the Cycle 14 reload analysis will significantly alter the way in which Waterford 3 operates. The set points, when established by the set point analysis, will ensure the conclusions of the Cycle 14 RAR and necessary margin requirements are met. These set points (COLSS, CPCs, and COLR updates) will be covered by a separate 50.59 and will be installed prior to Cycle 14 operation.

The NGF LTA's were evaluated to the same criteria as the remainder of the batch X fuel and met all design criteria except for the cladding material. An exemption has been obtained for the cladding material.

Based on the above, the possibility of a malfunction of equipment important to safety having a different result than any previously evaluated will not be created due to the fuel management, reload fuel assembly design changes, or other reload-related changes necessary to operate Cycle 14.

7. Result in a design basis limit for a fission product barrier as described in the FSAR being exceeded or altered? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

The Cycle 14 core (including the new batch X fuel assemblies and NGF LTA's) meet all required design and functional requirements. The design of the Cycle 14 reload was accomplished using NRC-approved analysis methodologies under approved quality assurance programs. The reload design process has considered all required postulated events and found them to be bounded by the AOR's. The set points, when established by the set point analysis, will ensure the conclusions of the Cycle 14 RAR and necessary margin requirements are met. These set points (COLSS, CPCs, and COLR updates) will be covered by a separate 50.59 and will be installed prior to Cycle 14 operation. In addition, since the nuclear characteristics of the Cycle 14 fuel are bounded by the assumptions used in the applicable criticality analyses, the results of these analyses are also bounding for Cycle 14.

The change to the Waterford 3 Technical Specifications that is required as a result of using the NGF LTA's has been identified and submitted. The results of this 50.59 are dependent of the issuance of the Technical Specification Change listed in section II.A.5.

Since the key characteristics of the Cycle 14 fuel are bounded by the assumptions used in the applicable criticality analyses [references 12 & 13], the results of these analyses are also bounding for Cycle 14.

Based on a review of the reload analysis results, the Updated FSAR, and the Bases of the Waterford 3 Technical Specifications, no design basis limit for a fission product barrier will be exceeded for Cycle 14.

8. Result in a departure from a method of evaluation described in the FSAR used in establishing the design bases or in the safety analyses? ☐ Yes ☒ No

BASIS: (references cited are at the end of the evaluation)

In accordance with Technical Specification 6.9.1.11.1, the Cycle 14 core was designed and evaluated using NRC-approved analysis methodology under an approved quality assurance program. For Cycle 14, the methodologies used were consistent with the EPU submittal and included the application of the No Clad Lift–Off and erbia burnable absorber methodologies. No new methodologies were required to verify that the EPU AOR's are applicable to Cycle 14 or to perform the necessary cycle-specific CEA Ejection analysis. In addition, the COLSS and CPC set points required for Cycle 14 operation will be determined using the same approved methods. These set points will be covered under a separate 50.59.

Therefore, there has been no deviation from the methods of evaluation described in the FSAR and Technical Specification 6.9.1.11.1.

If any of the above questions is checked "YES", obtain NRC approval prior to implementing the change by initiating a change to the Operating License in accordance with NMM Procedure ENS-LI-113.

References

1. Entergy Letter W3C1-2004-0013, "Waterford-3 Cycle 14 3716 Power Uprate Groundrules,", J.B. Holman to J.M. Betancourt, December 16, 2004.
2. Calculation ECS03-001, Rev. B, "Waterford-3 3716 MWt Power Uprate Groundrules."
3. Westinghouse Letter NF-WTFD-05-1, "Waterford-3, Cycle 14 Final Reload Analysis Report (RAR)," J.M. Betancourt to J.B. Holman, January 24, 2005.
4. Westinghouse Letter NF-WTFD-04-28, "Recommended FSAR Updates for Waterford-3 Cycle 14," J.M. Betancourt to D.E. Barr, December 16, 2004.
5. ER-W3-2001-1149-007, "3716MWt Extended Power Uprate Evaluation of FSAR Chapter 7 (Instrumentation and Controls) and related Design and Licensing Basis Changes."
6. NRC Letter from N. Kalyanam to J.E. Venable, "Waterford 3 Steam Electric Station, Unit No. 3 (Waterford 3), Exemption from the requirements of Title 10 of the Code of Federal Regulations (10 CFR) 50.46 and 10 CFR Part 50, Appendix K (TAC No. MC2999)," dated July 28, 2004.
7. Westinghouse calculation, CN-TAS-03-8, Rev. 4, "Control Element Assembly Ejection for the Waterford-3 3716 MWt Power Uprate."
8. Entergy Letter W3F1-2004-0069, "Call with NRC Regarding Approved 10 CFR 50.46 Exemption Allowing the Use of Optimized ZIRLO," D. Miller to File, August 4, 2004.
9. ER-W3-2001-1149-000, "Extended Power Uprate."
10. Westinghouse Letter NF-WTFD-05-14, "Design Report for CE 16 x 16 NGF, Waterford 3, Region X, LTAs," J.M. Betancourt to D.E. Barr, March 14, 2005.
11. ER-W3-2004-0137-000, "Reactor Vessel Internals Zicaloy ICI Thimble Growth."
12. Entergy Letter CEO-2005/00030, "Waterford-3 Reload Batch-X Compliance to Fuel Storage Criticality Bases," S.L. Rowe to M.R. McKinney, February 14, 2005.
13. Calculation NEAD-SR-05/007, Rev. 0, "WSES-3 Cycle-14 Criticality Review for Next Generation Lead Fuel Assemblies."
14. Westinghouse Report WF-FMDE-DR02, Rev. 1, "WSES-3 Batch U Fuel Assembly Technical Evaluation," February 8, 2002.
15. ER-W3-2004-0116-003, "Cycle 14 Reload Analysis Report 50.59."
16. License Amendment Request NPF-38-258.