ATTACHMENT 5

NEI 12-16 Criticality Analysis Checklist

APPENDIX C: CRITICALITY ANALYSIS CHECKLIST

The criticality analysis checklist is completed by the applicant prior to submittal to the NRC. It provides a useful guide to the applicant to ensure that all the applicable subject areas are addressed in the application, or to provide justification/identification of alternative approaches.

The checklist also assists the NRC reviewer in identifying areas of the analysis that conform or do not conform to the guidance in NEI 12-16. Subsequently, the NRC review can then be more efficiently focused on those areas that deviate from NEI 12-16 and the justification for those deviations.

Subject	Included	Notes / Explanation
1.0 Introduction and Overview		
Purpose of submittal	YES	Section 1.0 of NEDC-33931P and Section 1.0 of LAR RS-21-064
Changes requested	YES	Section 1.0 of NEDC-33931P and Sections 2.1, 2.2, 2.3, and 2.4 of LAR RS-21-064
Summary of physical changes	YES	Section 1.0 of NEDC-33931P and Sections 2.1, 2.2, 2.3, and 2.4 of LAR RS-21-064
Summary of Tech Spec changes	YES	Sections 2.3, 2.4 and Attachment 2 of LAR RS-21-064
Summary of analytical scope	YES	Sections 1.0 and 3.0 of NEDC-33931P and Sections 2.1 and 2.2 of LAR RS-21-064
2.0 Acceptance Criteria and Regulatory Guidance		
Summary of requirements and guidance	YES	Section 2.0 of NEDC-33931P and Sections 2.1 and 2.2 of LAR RS-21-064
Requirements documents referenced	YES	Section 2.0 of NEDC-33931P and Sections 2.1 and 2.2 of LAR RS-21-064
Guidance documents referenced	YES	Section 2.0 of NEDC-33931P and Sections 2.1 and 2.2 of LAR RS-21-064
Acceptance criteria described	YES	Section 2.0 of NEDC-33931P and Sections 2.1 and 2.2 of LAR RS-21-064
3.0 Reactor and Fuel Design Description		
Describe reactor operating parameters	NO	Not applicable for the NEDC-33931P analysis. See Sections 3.7 and 5.5 of

		NEDC-33931P for depletion parameters and assumptions.
Describe all fuel in pool	YES	Section 4.0 of NEDC-33931P
Geometric dimensions (Nominal and Tolerances)	YES	Section 4.1 of NEDC-33931P
Schematic of guide tube patterns	NO	Not applicable for BWR fuel
Material compositions	YES	Section 4.0 of NEDC-33931P
Describe future fuel to be covered	YES	Section 4.0 of NEDC-33931P
Geometric dimensions (Nominal and Tolerances)	YES	Section 4.1 of NEDC-33931P
Schematic of guide tube patterns	NO	Not applicable for BWR fuel
Material compositions	YES	Section 4.0 of NEDC-33931P
Describe all fuel inserts	NO	There are no fuel inserts in analysis NEDC-33931P.
Geometric Dimensions (Nominal and Tolerances)		
Schematic (axial/cross-section)		
Material compositions		
Describe non-standard fuel	YES	Section 4.0 of NEDC-33931P
Geometric dimensions		
Describe non-fuel items in fuel cells	YES	Section 4.0 of NEDC-33931P
Nominal and tolerance dimensions	NO	Not applicable; analysis NEDC-33931P covers peak reactivity in every rack cell location
4.0 Spent Fuel Pool/Storage Rack Description		
New fuel vault & Storage rack description	YES	The new fuel vault analysis will be covered by the GESTAR II methodology and is not addressed in NEDC-33931P. See Section 2.2 of LAR RS-21-064 for details.
Nominal and tolerance dimensions		
Schematic (axial/cross-section)		
Material compositions		
Spent fuel pool, Storage rack description	YES	Section 5.1 of NEDC-33931P and Section 3.1 of LAR RS-21-064
Nominal and tolerance dimensions		
Schematic (axial/cross-section)		
Material compositions		
Other Reactivity Control Devices (Inserts)	YES	Sections 5.1-5.2 of NEDC-33931P and Section 3.1 of LAR RS-21-064
Nominal and tolerance dimensions		
Schematic (axial/cross-section)		
Material compositions		
5.0 Overview of the Method of Analysis		
New fuel rack analysis description	YES	The new fuel vault analysis will be covered by the GESTAR II methodology and is not addressed in NEDC-33931P. See Section 2.2 of LAR RS-21-064 for details.
Storage geometries		
Bounding assembly design(s)		
Integral absorber credit		
Accident analysis		
Spent fuel storage rack analysis description	YES	Sections 5.0, 3.5-3.7 of NEDC-33931P

Storage geometries	YES	Sections 5.1-5.2 of NEDC-33931P
Bounding assembly design(s)	YES	Section 5.3 of NEDC-33931P
Soluble boron credit	NO	Not applicable - No soluble boron credit in this BWR criticality analysis (NEDC-33931P)
Boron dilution analysis		
Burnup credit	NO	No burnup credit in BWR peak reactivity analysis NEDC-33931P – fuel is evaluated at peak reactivity
Decay/Cooling time credit	NO	No decay/cooling time credit in analysis NEDC-33931P.
Integral absorber credit	YES	Sections 5.1-5.2 of NEDC-33931P
Other credit	NO	No other credit in analysis NEDC-33931P.
Fixed neutron absorbers	YES	Boral panel (unit 1), insert (unit 2)
Aging management program	NO	Aging is not included in analysis NEDC-33931P; for Unit 2, no credit is taken for Boraflex. The potential for blistering on the Boral has been evaluated and the neutron absorber will continue to fulfill its function.
Accident analysis	YES	Section 5.5.3 of NEDC-33931P
Temperature increase	YES	Sections 5.4-5.5 of NEDC-33931P
Assembly drop	YES	Section 5.5.3 of NEDC-33931P
Single assembly misload	YES	Section 5.5.3 of NEDC-33931P
Multiple misload	NO	Uniform pool, no opportunity for multiple misload
Boron dilution	NO	Not applicable - No soluble boron credit in this BWR criticality analysis (NEDC-33931P)
Other	YES	Section 5.6 of NEDC-33931P
Fuel out of rack analysis	YES	Section 5.5 of NEDC-33931P considers worst case abnormal positioning of a fuel assembly outside the storage rack.
Handling		
Movement		
Inspection		
6.0 Computer Codes, Cross Sections and Validation Overview		
Code/Modules Used for Calculation of k_{eff}	YES	Section 3.0 of NEDC-33931P
Cross section library	YES	Section 3.1 of NEDC-33931P
Description of nuclides used	YES	Section 4.2 of NEDC-33931P
Convergence checks	YES	Section 3.3 of NEDC-33931P
Code/Module Used for Depletion Calculation	YES	Section 3.0 of NEDC-33931P
Cross section library	YES	Section 3.1 of NEDC-33931P
Description of nuclides used	YES	Section 4.2 of NEDC-33931P
Convergence checks	YES	Section 3.3 of NEDC-33931P

Validation of Code and Library	YES	Section 3.4, Appendix A of NEDC-33931P
Major Actinides and Structural Materials	YES	Section 3.4 of NEDC-33931P
Minor Actinides and Fission Products	YES	Section 3.4 of NEDC-33931P
Absorbers Credited	YES	Section 3.4 of NEDC-33931P
7.0 Criticality Safety Analysis of the New Fuel Rack		
Rack model	YES	The NFV rack CSA coverage for the new GNF3 fuel will be the GESTAR II analysis for GE designed low density NFV racks upon approval of this proposed license amendment. The LSCS NFV racks are GE designed low density racks with an interrack spacing of 12.25 inches, which is ≥ 10.5 inches (the criteria listed in GESTAR II) and thus the racks may be utilized to store new GNF fuel with in-rack SCCG k_{inf} ≤ 1.31. See Section 2.3 of LAR RS-21-064 for details.
Boundary conditions		
Source distribution		
Geometry restrictions		
Limiting fuel design		
Fuel density		
Burnable Poisons		
Fuel dimensions		
Axial blankets		
Limiting rack model		
Storage vault dimensions and materials		
Temperature		
Multiple regions/configurations		
Flooded		
Low density moderator		
Eccentric fuel placement		
Tolerances		
Fuel geometry		
Fuel pin pitch		
Fuel pellet OD		
Fuel clad OD		
Fuel content		
Enrichment		
Density		
Integral absorber		
Rack geometry		
Rack pitch		
Cell wall thickness		
Storage vault dimensions/materials		
Code uncertainty		
Biases		
Temperature		
Code bias		
Moderator Conditions		
Fully flooded and optimum density moderator		

8.0 Depletion Analysis for Spent Fuel		
Depletion Model Considerations	YES	Sections 3.0, 3.3, 3.4, 3.7, and 4.2 of NEDC-33931P
Time step verification		
Convergence verification		
Simplifications		
Non-uniform enrichments		
Post Depletion Nuclide Adjustment		
Cooling Time		
Depletion Parameters		
Burnable Absorbers		
Integral Absorbers		
Soluble Boron		
Fuel and Moderator Temperature		
Power		
Control rod insertion		
Atypical Cycle Operating History		
9.0 Criticality Safety Analysis of Spent Fuel Pool Storage Racks		
Rack model	YES	Section 5.2 of NEDC-33931P
Boundary conditions		
Source distribution		
Geometry restrictions		
Design Basis Fuel Description	YES	Section 5.3 of NEDC-33931P
Fuel density	YES	Section 4.1 of NEDC-33931P
Burnable Poisons	YES	Section 5.2 of NEDC-33931P
Fuel assembly inserts	NO	No fuel assembly inserts in analysis NEDC-33931P
Fuel dimensions	YES	Section 4.1 of NEDC-33931P
Axial blankets	NO	Section 3.7 of NEDC-33931P
Configurations considered	YES	Section 6.0 of NEDC-33931P
Borated	NO	Not applicable for this BWR analysis (NEDC-33931P)
Unborated	YES	BWR analysis NEDC-33931P considers unborated SFP.
Multiple rack designs	YES	Section 5.1 for rack descriptions and Section 6.0 for rack interfaces.
Alternate storage geometry	NO	Not applicable for analysis NEDC-33931P
Reactivity Control Devices	YES	Sections 5.1- 5.2
Fuel Assembly Inserts	NO	No fuel assembly inserts in analysis NEDC-33931P
Storage Cell Inserts	YES	Sections 5.1- 5.2 of NEDC-33931P
Storage Cell Blocking Devices	NO	No blocking devices in analysis NEDC-33931P
Axial burnup shapes	NO	Section 3.7 of NEDC-33931P

Uniform/Distributed	YES	Section 3.7 of NEDC-33931P
Nodalization	NO	Section 3.7 of NEDC-33931P
Blankets modeled	NO	Section 3.7 of NEDC-33931P
Tolerances/Uncertainties	YES	Sections 5.6 and 5.7 of NEDC-33931P
Fuel geometry		
Fuel rod pin pitch		
Fuel pellet OD		
Cladding OD		
Axial fuel position	NO	Section 3.7 of NEDC-33931P
Fuel content	YES	Section 5.6 of NEDC-33931P
Enrichment		
Density		
Assembly insert dimensions and materials	NO	No fuel assembly inserts in analysis NEDC-33931P
Rack geometry	YES	Section 5.6 of NEDC-33931P
Flux-trap size (width)	NO	Not applicable to non-flux-trap racks
Rack cell pitch	YES	Section 5.6 of NEDC-33931P
Rack wall thickness	YES	Section 5.6 of NEDC-33931P
Neutron Absorber Dimensions	YES	Section 5.6 of NEDC-33931P
Rack insert dimensions and materials	YES	Section 5.6 of NEDC-33931P
Code validation uncertainty	YES	Sections 3.4, 5.7, and Appendix A of NEDC-33931P
Criticality case uncertainty	YES	Section 5.7 of NEDC-33931P
Depletion Uncertainty	YES	Sections 3.4, 5.8 of NEDC-33931P
Burnup Uncertainty	NO	Not applicable for BWR peak reactivity analysis NEDC-33931P
Biases	YES	Section 5.0 of NEDC-33931P
Design Basis Fuel design	YES	Section 5.3 of NEDC-33931P
Code bias	YES	Sections 3.4, 5.5 of NEDC-33931P
Temperature	YES	Section 5.4 of NEDC-33931P
Eccentric fuel placement	YES	Sections 5.4-5.5 of NEDC-33931P
Incore thimble depletion effect	NO	Not applicable for analysis NEDC-33931P
NRC administrative margin	NO	Not applicable for analysis NEDC-33931P
Modeling simplifications	YES	Sections 3.7, 4.2 of NEDC-33931P
Identified and described		
10.0 Interface Analysis		
Interface configurations analyzed	YES	Sections 5.5, 6.0 of NEDC-33931P
Between dissimilar racks	YES	Section 6.0 of NEDC-33931P
Between storage configurations within a rack	YES	Section 5.5 of NEDC-33931P
Interface restrictions	NO	Section 6.0 of NEDC-33931P

11.0 Normal Conditions		
Fuel handling equipment	NO	Not in the scope and does not impact results of criticality analysis NEDC-33931P.
Administrative controls	YES	Section 2.4 and Attachment 2 of LAR RS-21-064
Fuel inspection equipment or processes	NO	Not in the scope and does not impact results of criticality analysis NEDC-33931P.
Fuel reconstitution	YES	Section 4.0 of NEDC-33931P
12.0 Accident Analysis		
Boron dilution	NO	Not applicable - No soluble boron credit in this BWR criticality analysis (NEDC-33931P)
Normal conditions		
Accident conditions		
Single assembly misload	YES	Section 5.5 of NEDC-33931P
Fuel assembly misplacement	YES	Section 5.5 of NEDC-33931P
Neutron Absorber Insert Misload	NO	Not applicable to this BWR analysis; no fuel assembly inserts in analysis NEDC-33931P.
Multiple fuel misloads	NO	Uniform pool, single storage configuration, no opportunity for multiple misloads
Dropped assembly	YES	Section 5.5 of NEDC-33931P
Temperature	YES	Section 5.4 of NEDC-33931P
Seismic event/other natural phenomena	YES	Section 5.5 of NEDC-33931P
13.0 Analysis Results and Conclusions		
Summary of results	YES	Section 7.0 of NEDC-33931P
Burnup curve(s)	NO	Not applicable for BWR peak reactivity analyses, including NEDC-33931P
Intermediate Decay time treatment	NO	Not applicable for BWR peak reactivity analyses, including NEDC-33931P
New administrative controls	YES	Section 2.4 and Attachment 2 of LAR RS-21-064
Technical Specification markups	YES	Sections 2.3, 2.4 and Attachment 2 of LAR RS-21-064
14.0 References	YES	**Section 8.0** of NEDC-33931P
Appendix A: Computer Code Validation:		**Appendix A** of NEDC-33931P
Code validation methodology and bases	YES	Appendix A of NEDC-33931P
New Fuel		
Depleted Fuel		
MOX		
HTC		
Convergence		

Trends Bias and uncertainty		
Range of applicability	YES	Described in Section 3.4 of NEDC-33931P
Analysis of Area of Applicability coverage	YES	Described in Section 3.4 of NEDC-33931P