HB Robinson / Shearon Harris
Reload Design and Safety Analysis Methodology Report

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Duke Energy Attendees

Julie Olivier (Manager, Nuclear Fleet Licensing)

Josh Duc (GO Regulatory Affairs)

John Caves (HNP Regulatory Affairs)

Scott Connelly (RNP Regulatory Affairs)

Bob Harvey (Manager, PWR Methods)

Kenny Epperson (PWR Methods)

Outline

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- Method Report Matrix
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- Regulatory Process
- DPC-NE-2005 Appendices for Robinson and Harris Nuclear Plants

Background

- Duke Energy performs the analyses of record for Oconee, McGuire, and Catawba, which includes reload physics design, core thermal hydraulic analysis, fuel mechanical analysis, and non-LOCA transient analysis
- The computer codes and methods used are approved by NRC and are largely independent of those used by its fuel vendors
- The analysis methods (computer codes and analysis approach) are similar at all nuclear stations (ONS/MNS/CNS)
- Following the merger of Duke Energy and Progress Energy (DEP), it is our intention to perform the reload licensing analysis for the (DEP) PWR plants (Robinson and Harris)
- To leverage the existing analysis experience, the analytic approach to be applied at RNP and HNP will be very similar to that used at ONS/MNS/CNS.

Background

- Cost Savings
  - Analysis costs are reduced
  - Reload design team objectives are aligned with company goals (better management of analysis margins)
- Flexibility to change fuel vendors
  - Makes competitive fuel bids more effective since fuel target peaking/operating limits can be pre-defined
- Flexibility to adapt to scheduling changes
  - Core redesigns at limited additional analysis costs
- Can provide timely and cost effective plant support for emergent issues

Methods Report Matrix

	MNS/CNS (Duke)	ONS (Duke)	Current RNP/HNP (AREVA)	Proposed RNP/HNP (Duke)
Physics Codes / Models	DPC-NE-1005 CASMO-4/SIMULATE-3	DPC-NE-1006 CASMO-4/SIMULATE-3	EMF 96-029 CASMO-3/PRISM	DPC-NE-1008 CASMO-5/SIMULATE-3
Physics Applications Power Distribution Monitoring	DPC-NE-2011	NFS-1001 DPC-NE-1002	ANF-88-054	DPC-NE-2011 revision
Physics Applications Reload Design	DPC-NF-2010	NFS-1001 DPC-NE-1002	EMF-96-029	DPC-NF-2010 revision
NSSS Codes / Models	DPC-NE-3000 RETRAN-02	DPC-NE-3000 RETRAN-3D	ANF-89-151 EMF-2310 ANF-RELAP S-RELAP5	DPC-NE-3008 RETRAN-3D
Subchannel T/H Methods	DPC-NE-3000 DPC-NE-2004 VIPRE-01	DPC-NE-3000 DPC-NE-2003 VIPRE-01	XN-75-21 XN-NF-82-21 XCOBRA-IIIC	DPC-NE-3008 DPC-NE-2005 (Appendix) VIPRE-01
SCD Methodology	DPC-NE-2005	DPC-NE-2005	EMF-92-081	DPC-NE-2005 revision
Transient Analysis	DPC-NE-3001 DPC-NE-3002 SIMULATE-3K (REA)	DPC-NE-3005 SIMULATE-3K (REA)	EMF-2310 (SRP Non-LOCA Ch 15) EMF 84-093 (SLB - Harris) XN-NF-78-44 (REA) XTRAN-PWR	DPC-NE-3009 SIMULATE-3K (REA)
Fuel Performance	DPC-NE-2008 (TACO-3) DPC-NE-2009 (PAD 4.0)	DPC-NE-2008 (TACO-3 and GDTACO)	EMF-92-116 (Mechanical Design) XN-NF-81-58 and ANF-81-58 RODEX2	TBD

Report Content / Approach

DPC-NE-1008

The report will consist of detailed comparisons of calculated key physics parameters with measurements obtained from several operating cycles of RNP and HNP and comparison against several critical experiments to quantify a pin uncertainty. These results are used to determine the acceptability of C5/S3 for calculation of physics parameters and to develop the 95/95 peaking uncertainty.

- Similar to DPC-NE-1005
- CASMO-4 replaced by CASMO-5
- No MOX applications or benchmark calculations
- Plans are to include benchmark calculations of cores containing IFBA/WABA fuel to address the option of alternate fuel products

Report Content / Approach

DPC-NE-2005 (revision presented later)

DPC-NF-2010 / DPC-NE-2011

DPC-NF-2010

The report describes the application of the reactor physics methods to determine reactivity and safety analysis inputs required to validate the Chapter 15 analyses.

- Minor changes / clarifications will be required

DPC-NE-2011

The report describes the methodology for determining the power dependent AFD limits and validation of the OP/ΔT and OT/ΔT setpoints

- Minor changes will be required and potential modification to Tech Spec monitoring

Report Content / Approach

DPC-NE-3008

The report will contain a description of the RETRAN and VIPRE base models used to perform the Chapter 15 non-LOCA safety analysis. Validation of the RETRAN models will be benchmarked to several Chapter 15 reference calculations (AOR) for RNP and HNP. Focus of benchmark is on the overall system response and sequence of events. The events being considered are:

UFSAR 15.1.2 – Increase in Feedwater Flow (HNP)

UFSAR 15.2.3 – Turbine Trip (HNP)

UFSAR 15.2.7 – Loss of Normal Feedwater (RNP)

UFSAR 15.2.8 – Feedwater Line Break (HNP)

UFSAR 15.3.2 – Complete Loss of Forced Coolant Flow (HNP)

UFSAR 15.3.3 – RCP Locked Rotor (RNP)

UFSAR 15.4.2 – Uncontrolled RCCA Bank Withdrawal (RNP)

Report Content / Approach

DPC-NE-3009

- This report will describe the methodology for simulating the UFSAR Chapter 15 transients and accidents for RNP and HNP
- The report will include details of the computer codes and models, methods for calculating safety analysis physics parameters and setpoints, and detailed modeling assumptions for all of the non-LOCA transients and accidents
- This methodology will be used to reanalyze the RNP and HNP UFSAR transients and accidents in order to establish an up-to-date design basis, and to support advanced fuel assembly and core reload designs

Schedule

Need:

- Support the Reload Licensing Analysis for HNP Cycle 22 and RNP Cycle 32
- Outage Dates/New Methods Implemented: H1EOC21 (4/18), R2EOC31 (9/18)
- Start of the Reload Analysis
  - HNP (December 2016)
  - RNP (Spring 2017)

Submittals:

DPC-NE-2005 (December 2014/January 2015)

DPC-NE-1008 (March/April 2015)

DPC-NE-3008 (April/May 2015)

DPC-NF-2010, DPC-NE-2011, DPC-NE-3009 (December 2015)

Regulatory Process

- LAR submittals
  - Methodology report
  - Tech Spec 5.6.5 and 6.9.1.6 changes
  - COLR/Tech Spec changes as required
- UFSAR changes
  - Implemented via 10 CFR 50.59 following methodology report approval with first in-house reload analysis
- Additional Work Scope
  - Turbine Trip analysis to support Tech Spec change to safety valve tolerances
  - Dose Analysis
  - Chapter 6 Analysis


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