St Lucie Unit 2
Changes Needed to Support Increased Steam Generator Tube Plugging

Agenda

Meeting Goals

Overview
- ZIRLO™ fuel rod cladding
- Reload safety analysis methodology changes
- Technical Specification changes

Details of Changes

Anticipated Submittals and Schedules

Summary

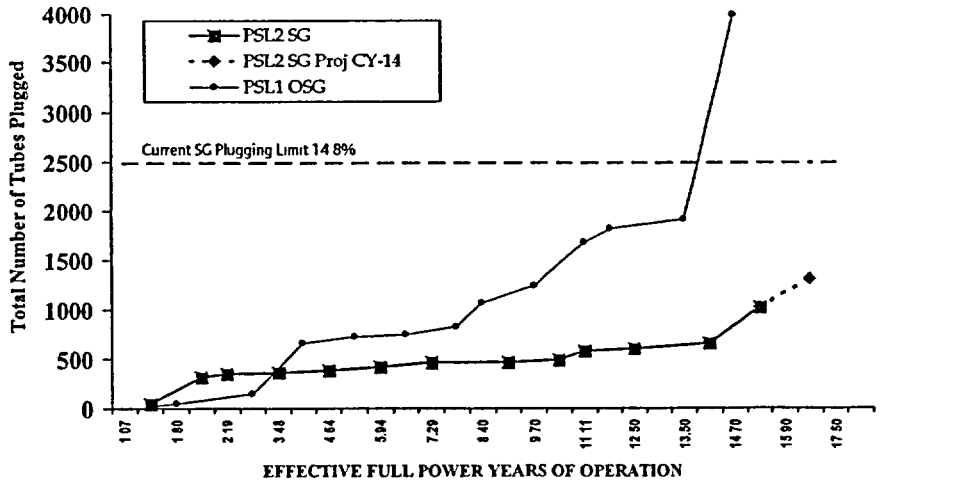
Meeting Goals

To present to the NRC staff the scope of the changes necessary to accommodate operation of St. Lucie Unit 2 with increased steam generator tube plugging (SGTP) up to 2520 tubes/SG (~30%) with approximately up to 600 tubes SGTP asymmetry (~7%)

To identify those areas that will require NRC staff review and approval

To identify the NRC review schedule needed to support St. Lucie Unit 2 Cycle 15 operation

Overview: St. Lucie Unit 2 Steam Generator Status



Overview: Strategy

Early action needed to avoid exigent analysis and NRC review

Changes needed to accommodate and minimize the impact of 30% SGTP

- Fuel design change to ZIRLO™ fuel rod cladding
- Reload methodology change to WCAP-9272-P-A
- Technical Specification changes

Overview: ZIRLO™

ZIRLO™ provides improved corrosion performance needed in the more adverse RCS thermal conditions due to increased SGTP

Extensive successful industry operating experience with ZIRLO™ clad fuel rods with over 2,650,000 fuel rods operated in 47 reactors and with burnups of up to 70,000 MWD/MTU (LTAs)

ZIRLO™ has been approved by the NRC for analysis with CENPD methods in CE-NSSS via CENPD-404-P-A

- NRC approval was subject to 5 conditions for use of ZIRLO™ which will be satisfied by FPL

Overview: Transition to WCAP-9272-P-A Methodology (Westinghouse)

WCAP-9272-P-A reload analysis methodology successfully used in reload analysis of over 540 reactor cores in the U. S. A.

Westinghouse Reload Safety Evaluation Methodology (WCAP-9272-P-A)

- Defines a bounding approach to the reload evaluation process
- Defines key safety parameters and their limiting direction
- Defines in general terms how safety analyses are done and effects of key safety parameters
- Results in a Reload Safety Analysis Checklist (RSAC) approach for reload analysis

St. Lucie Unit 2 transition to WCAP-9272-P-A requires all UFSAR Chapter 15 events to be re-analyzed or evaluated

All limiting events would also need to be re-analyzed to support 30% SGTP with associated RCS flow reduction and implementation of ZIRLO™

Overview: Transition to WCAP-9272-P-A Methodology (Westinghouse)

The Westinghouse and CE designs are similar and any minor dissimilarities (i.e., typically input parameters but occasionally a model change) can be accounted for and do not invalidate the reload methodology applicability or philosophy

Code, selection, use and applicability will be described, explained and justified

All code packages that are planned to be used have been previously licensed or will be re-licensed as necessary with the NRC

Selection of code packages does not invalidate the reload methodology applicability

Overview: Transition to WCAP-9272-P-A Methodology (Westinghouse)

Principle areas of licensing focus:

- changes to existing codes and models or new codes and models, and
- changes to existing methodology or new methodology

"New" means new with respect to the "intended application" (i.e., the code/model or method was previously licensed, but has been tailored/customized for the current application)

Certain items to be submitted to the NRC for review and approval. Since these items would have been previously licensed, the specific licensing application for St. Lucie Unit 2 should be straightforward

By identifying changes and areas that may need NRC review, the NRC staff will be able to more accurately gauge their resource needs to support the review

Overview: Technical Specification & COLR Changes

There are several Technical Specification and COLR changes:

- Related to 30% SGTP and associated RCS flow reduction
- Related to implementation of ZIRLO™
- Related to methodology changes
- Related to relocation of limits to COLR similar to TSTF-339, Rev. 2 and WCAP-14483-A

Details of Changes: ZIRLO™

ZIRLO™ approved by NRC for CENPD methods in CE-NSSS via CENPD-404-P-A

Five conditional requirements:

1. Corrosion limit (best estimate) will remain below 100 microns
   - The 100 micron limit will be added to the St. Lucie Unit 2 UFSAR and best estimate models will be used to confirm this limit is satisfied

2. All conditions in NRC SERs for CENPD methodologies, used for ZIRLO™ fuel analysis, will continue to be met except that ZIRLO™ cladding in addition to Zircaloy-4 cladding is approved
   - The NRC SER conditions for use of the CENPD methodologies used for the analysis of ZIRLO™ fuel will be satisfied

3. All CENPD methodologies will be used only within the range for which ZIRLO™ data was found to be acceptable in CEPD-404-P-A
   - The ZIRLO™ data ranges for the methodologies used will be verified

Details of Changes: ZIRLO™

4. Until data is available demonstrating performance of ZIRLO™ cladding in CE-NSSS, fuel duty will be limited with some provision for adequate margin to account for variations in core design (e.g., cycle length, plant operating conditions, etc.)
   - FDIm will be limited to the CE 16x16 design experience database, with only a limited number of fuel assemblies (8) allowed to reach 120% of this limit until data is available demonstrating performance of ZIRLO™ cladding in CENP designed plants

5. The approved burnup limit is 60 GWD/MTU
   - Burnup limit of 60 GWD/MTU for ZIRLO™ fuel will be added to the St. Lucie Unit 2 UFSAR

Details of Changes: Analytical Approach

A presentation of changes to existing codes and models or new codes and models will be provided first, followed by a presentation of changes to existing methodology or new methodology

The presentation looks at each functional discipline and the codes and models used

An assessment of each proposed code change is provided in the following table

Details of Changes: Analytical Approach - Codes and Models

Functional Discipline	Current Code Used	Proposed Code Used	Comments
Core Design	ALPHA/PHOENIX-P/ANC	Same	No change
Thermal-hydraulic Design	TORC	VIPRE/CETOP	Addendum submittal for incorporating ABB-NV & ABB-TV into VIPRE
Correlation	CE-1	ABB-NV	Upgrade correlation with ABB-NV which is NRC-accepted for referencing in applications for the St. Lucie Unit 2 fuel design
Fuel Rod Design	FATES-3B	Same	No change
Transient Analysis (non-LOCA)	CESEC/STRIKIN-II/ TORC/COAST	RETRAN/FACTRAN/ VIPRE-W/TWINKLE	Change is within the flexibility of the codes to model both Westinghouse and CE NSSS
Large Break LOCA	8SEM	99EM	Upgrade to 99EM which is NRC-accepted for referencing in applications for CE NSSS
Small Break LOCA	S1M	S2M	Upgrade to S2M which is NRC-accepted for referencing in applications for CE NSSS

Details of Changes: Analytical Approach - Codes and Models

VIPRE/ABB-NV

VIPRE is flexible with respect to modeling both Westinghouse PWRs and CE PWRs
- The main difference between modeling either Westinghouse or CE PWRs is the CHF correlation to be used in VIPRE for the corresponding fuel types

VIPRE originally licensed by the NRC with the W-3, WRB-1 and WRB-2 CHF correlations (later, WRB-2M was added to VIPRE and licensed with the NRC)

ABB-NV will be used for St. Lucie Unit 2 and ABB-TV is for 14x14 fuel with Turbo mixing vane grids

Both ABB-NV and ABB-TV correlations will be added to VIPRE and benchmarked to TORC results for its entire data base from topical report CENPD-387-P-A

Details of Changes: Analytical Approach - Codes and Models

VIPRE/ABB-NV (cont.)

Findings of a benchmark show that the two sub-channel analysis codes yield essentially the same results

The benchmark approach is the same used for the WRB-1 and WRB-2 qualifications with the VIPRE code

Details of Changes: Analytical Approach - Codes and Models

RETRAN/TWINKLE/FACTRAN are used for analysis of transient events

- The RETRAN code is used to perform analysis for most of the UFSAR transient events
- FACTRAN is used strictly in combination with either RETRAN or TWINKLE (RETRAN and TWINKLE provide certain time-dependent inputs required by the FACTRAN code)
- TWINKLE is limited to the analysis of uncontrolled CEA withdrawal from a subcritical or low power condition, and CEA ejection

The minor differences between Westinghouse and CE PWRs, and their corresponding fuel types, is well within the modeling capabilities of these codes

Details of Changes: Analytical Approach - Codes and Models

RETRAN/TWINKLE/FACTRAN (cont.)

Re-analysis of the limiting UFSAR Chapter 15 events are required for transition to Westinghouse WCAP-9272 Reload Methodology, 30% SGTP and reduced RCS flow

- TS changes will be submitted
- Use of these codes and models will be justified
- Results of transient analyses will be provided

The general approach using RETRAN can be extended to encompass application to the St. Lucie Unit 2 plant

- No code changes are necessary, but the St Lucie Unit 2 model would differ slightly compared to those models for Westinghouse PWRs
- The St. Lucie Unit 2 RETRAN thermal hydraulic model is comparable to that used for Westinghouse PWR analyses
- The St. Lucie Unit 2 specific control and protection system logic has been incorporated into the RETRAN model

Details of Changes: Analytical Approach - Codes and Models

RETRAN-02 (cont.)

The protection system simulation will include the St. Lucie Unit 2 variable high power, TM/LP and high pressurizer pressure reactor trips

Control systems will reflect St. Lucie Unit 2 design

The ECCS, including the SI system and safety injection tanks will reflect St. Lucie Unit 2 design

Details of Changes: Analytical Approach - Codes and Models

99EM and S2M

1999 Evaluation Model (99EM) for LBLOCA and Supplement 2 Model (S2M) Evaluation Model for SBLOCA are NRC- accepted for referencing in applications for CE designed PWRs

Analysis will use fuel performance data generated with the FATES-3B computer code

Since EMs for St. Lucie Unit 2 have already been accepted for use in licensing applications for CE-designed PWRs, UFSAR and licensing report will simply demonstrate acceptable ECCS performance

St. Lucie Unit 2 plant-specific studies will be performed for ZIRLO™ cladding

- ZIRLO™ cladding has been analyzed with 99 EM and S2M for two CE PWRs which showed that ECCS performance is not significantly impacted (small PCT benefit)

Details of Changes: Analytical Approach - Methods and Methodology

Analyses being performed support 30% SGTP, a reduced RCS flow, ZIRLO™ cladding, and transition to Westinghouse WCAP-9272 Reload Methodology

Even though some of these methodologies may have specific applications called out in the applicable Safety Evaluation Reports (SERs), the general approach, as documented in numerous topical reports, can be extended to encompass application to the St. Lucie Unit 2 plant

- Demonstration of applicability showing that safety and margins are maintained, will be documented in a licensing report that supports UFSAR changes

Details of Changes: Analytical Approach - Methods and Methodology

Methodology changes that will be incorporated into the St. Lucie Unit 2 analyses supporting Cycle 15 are:

- Relaxed Axial Offset Control (RAOC), analogous to the current Xe Swing methods to ensure safety analyses adequately address a range of power shapes
- Revised Thermal Design Procedure (RTDP), analogous to the current Extended Statistical Confirmation of Uncertainties (ESCU) methodology for statistical convolution of DNBR uncertainties
- Modeling of the current TM/LP trip function, analogous to the OTΔT and f(DI) trip functions normally employed in Westinghouse PWRs

Details of Changes: Analytical Approach - Methods and Methodology

Relaxed Axial Offset Control (RAOC)

Starting from a normal operating condition, the following accidents are simulated:

- Cooldown Transients
- Control Rod Malfunctions
- Boration/Dilution: Note that dilution accidents performed assuming manual rod control only, automatic control rod withdrawal and insertion is blocked in St. Lucie Unit 2

The methodology of RAOC, as described in the topical report, may refer to specific values applicable to Westinghouse-type PWRs, but the approach of handling axial offset (ASI) control, with appropriate numerical values used for St. Lucie Unit 2, can still be handled under RAOC

Details of Changes: Analytical Approach - Methods and Methodology

Relaxed Axial Offset Control (RAOC) (cont.)

UFSAR analyses will be updated and a licensing report will be prepared

- The NRC may only have to review minor differences of extending the methodology to the St Lucie Unit 2 application

Plant Monitoring and Surveillance

- Under RAOC Methodology (Part B of WCAP-10216-P-A, Revision 1A), $F_{xy}(z)$ surveillance has been replaced by $F_Q(z)$ surveillance
- W(z) function that represents the maximum likely increase in the equilibrium measured $F_Q(z)$ that might arise during power distribution transients will account for non-equilibrium operation
- This surveillance is applicable ONLY when fixed incore detectors are out of service

Details of Changes: Analytical Approach - Methods and Methodology

Revised Thermal Design Procedure (RTDP)

RTDP takes uncertainties in system parameters, peaking factors, fuel manufacturing, and engineering hot channel factors in a statistical combination with the uncertainty in a DNB correlation to obtain a DNB uncertainty factor

Correlation DNBR + DNB uncertainty factor = plant specific Design Limit DNBR (DL DNBR)

DL DNBR + generic margin = Safety Analysis Limit (SAL) DNBR which is used for the accident analysis (generic margin covers transition core effects, rod bow, etc.)

Since the uncertainties are all included in the uncertainty factor, the accident analysis is done with input parameters at their nominal or best estimate value

Details of Changes: Analytical Approach - Methods and Methodology

Thermal Margin/Low Pressure (TM/LP) Trip Function

DNB protection for the core is provided by TM/LP reactor trip function, which will be retained

TM/LP reactor trip function also ensures that vessel exit boiling is precluded to ensure that the ΔT (hot leg minus cold leg temperature) is proportional to power

Since use of the TM/LP reactor trip function is included in the current method, with slight modifications made to the methodology incorporating RAOC and RTDP, only those changes noted will require NRC review

UFSAR analyses will be updated and justified via the licensing report

- The NRC may only need to review minor differences of extending the methodology to the St Lucie Unit 2 application

Details of Changes: Analytical Approach - Methods and Methodology

Accident Analyses

Accident analyses will be briefly described as to the licensing impacts associated with 30% SGTP, reduced RCS flow analysis, ZIRLO™ cladding, and transition to the Westinghouse WCAP-9272 Reload Methodology

- A detailed screening process was performed which examined all of the current St. Lucie UFSAR Chapter 15 licensing basis analyses
- An assessment was performed to determine whether:
  - the WCAP-9272 reload methodology could be directly applied with little or no changes to the existing licensing basis analyses, or
  - the WCAP-9272 reload methodology does not address specific accidents and they need to be retained

Details of Changes: Analytical Approach - Methods and Methodology

Accident Analyses (cont.)

Analyses with essentially no licensing changes other then addressing the new initial conditions:

- CEA Drop Event
- Loss of Normal Feedwater
- Increased Main Steam Flow
- Feedwater Line Break Event
- CVCS Malfunction – Inadvertent Boron Dilution
- Inadvertent Opening of the Pressurizer Relief Valves
- Single Reactor Coolant Pump Shaft Seizure/Sheared Shaft
- Increase in Feedwater Flow/Decrease in Feedwater Temperature
- Loss of Condenser Vacuum/Loss of Electrical Load/Turbine Trip
- Decrease in Reactor Coolant Flow Rate/Complete Loss of RCS Flow
- Uncontrolled CEA Withdrawal from a Subcritical or Low Power Condition

Details of Changes: Analytical Approach - Methods and Methodology

Accident Analyses (cont.)

Analyses with minor licensing changes based on extension of methodology or code and models:

Methodology Differences:
- Uncontrolled CEA Withdrawal at Power: Credit TM/LP trip
- CEA Ejection: Separation of BOL/EOL HFP and HZP cases
- Asymmetric Steam Generator SLB Events: Not specifically analyzed for Westinghouse PWRs, bounded by other cases

Examine bounding case only on a reload basis:
- Steam System Piping Failures: Demonstrate Post-Trip Steamline Break w/ LOAC bounded by Post-Trip Steamline Break w/o LOAC

Details of Changes: Technical Specification & COLR Changes

Related to 30% SGTP and associated RCS flow reduction

TS 3.2.5 - RCS flow to be reduced to 335,000 gpm from 355,000 gpm

TS Figure 2.1-1 - TMSLL to change to reflect reduced flow conditions

TS Table 2.1-1 - Reference RCS to change to reflect 335,000 gpm

TS 3.1.1.4 - Revise MTC limit at HFP to < 0 pcm/°F

COLR Section 2.6 - A reduction in F_r may be needed

Details of Changes: Technical Specification & COLR Changes

Related to implementation of ZIRLO™

TS 5.3.1 - Change design features description to include ZIRLO™

TS 6.9.11.b - Add CENPD-404-P-A to COLR methodologies list

COLR Section 3.0 - Add CENPD-404-P-A to COLR methodologies list

Details of Changes: Technical Specification & COLR Changes

Related to methodology changes

TS 1.3.7, 4.2.1.3.c, 3.2.2,and 3.2.4 - Replace Fxy with Fq

TS 6.9.11.b - Add LOCA and WCAP-9272-P-A to COLR methodologies list

COLR Section 2.5 - Replace Fxy with Fq

COLR Figure 3.2-3 - Replace Fxy with Fq and Fr part power multiplier

COLR - Add a W(z) adjustment for Fq

COLR Section 2.6 - Add a part power multiplier to the Fr limit

COLR Figure 3.2-2 - Adjust to allow full power operation with excores only

COLR Section 3.0 - Add LOCA and WCAP-9272-P-A to COLR methodologies list

Details of Changes: Technical Specification & COLR Changes

Related to relocation of limits to COLR similar to TSTF-339, Rev. 2 and WCAP-14483-A

TS Figure 2.1-1 - TMSLL

TS Table 2.1-1, Item 4; Figures 2.2-1, 2.2-3 and 2.2-4 - TM/LP

TS 3.2-5, Table 3.2-2 - RCS pressure, temperature & flow rate

TS 6.9.1.11.a - Add limits moved to COLR

COLR - Add limits moved to COLR

Anticipated Submittals and Schedules

A VIPRE-W topical addendum for the addition of the ABB-NV and ABB-TV CHF correlations will be submitted

Licensing Report submittal will be prepared that references WCAP-9272-P-A:

- Describe the accident analyses in sufficient details to support the UFSAR revisions to Chapter 15, including identification and justification of any new methods or methodology or extensions of methods and methodology that have not been previously licensed, and
- Describe codes used in the analysis and specify new codes and models or extensions to codes and models that have not been previously licensed

Technical Specification and Bases changes and markups will be provided with summary discussion of justification for each change

Anticipated Submittals and Schedules

Schedule:

Activity	Anticipated Start/Submittal Date	Anticipated Finish/Approval Date
Meeting with NRC to Kick-off the Program	4/03	4/03
Addendum to VIPRE Topical * (WCAP-14565-P-A)	5/03	5/04
Acceptance Meeting for Addendum to VIPRE Topical (WCAP-14565-P-A)	6/03	6/03
Proposed Licensing Amendment for St. Lucie Unit 2 submittal	1/04	10/1/04
Acceptance Meeting for St. Lucie Unit 2 submittal	2/04	2/04

* Application of this topical will be referenced on the St. Lucie Unit 2 docket.

Summary

Scope of changes necessary to accommodate operation of St. Lucie Unit 2 with increased SGTP to ~30%, transition to ZIRLO™ cladding, and transition to WCAP-9272 approach requires only minor adjustment to extend to the unique trips and design features of St. Lucie Unit 2, identified and justified in the License Amendment Request

NRC staff review and approval can build upon the use of previously approved codes and models, focusing on the acceptability of any extensions beyond those that were previously approved

The expected content of the licensing documentation and proposed schedules have been provided to facilitate NRC planning:

- VIPRE-W topical addendum (5/03 - 5/04)
- License Amendment Request (1/04 - 10/04)