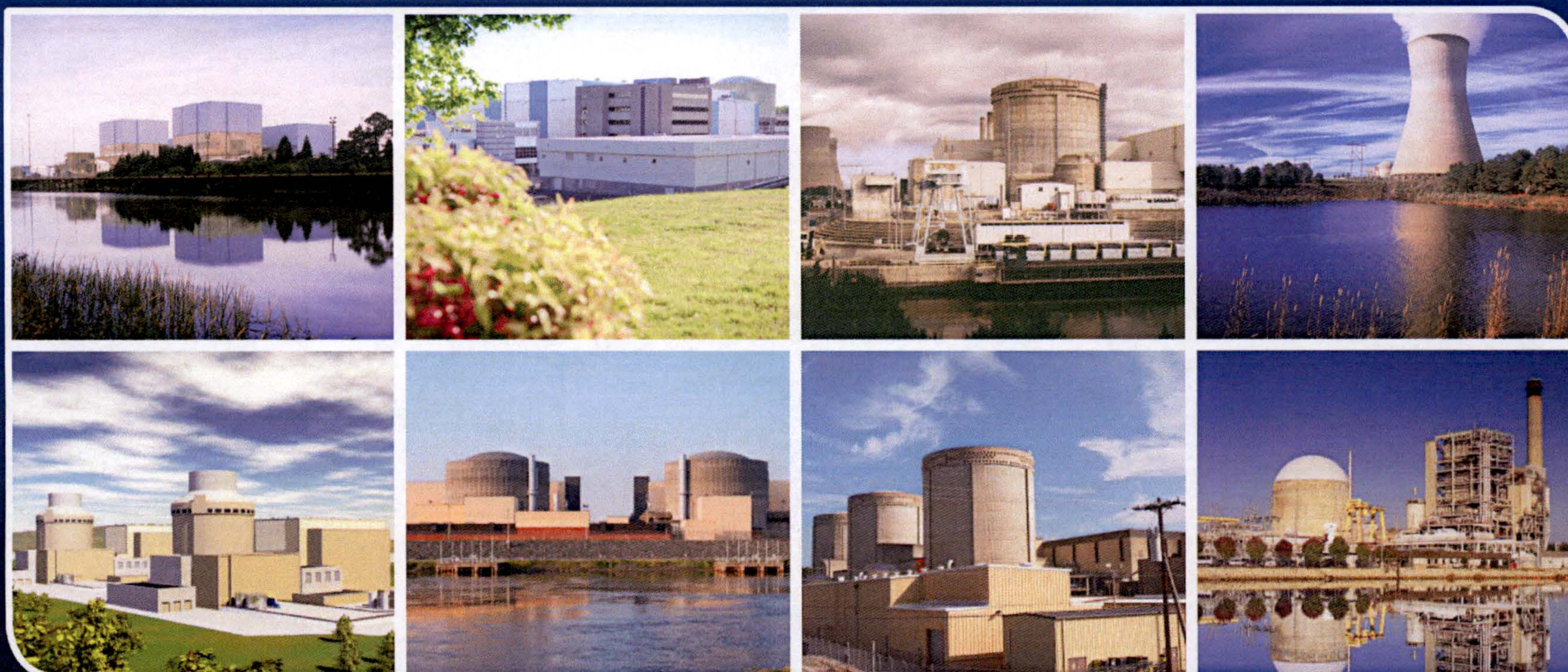
Enclosure 1

Introduction and Condensate Return
Non-Proprietary

(20 pages including cover page)



Levy COLA – ACRS Review

AP1000 Generic Issues

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Agenda
Levy COLA – AP1000 Issues Review

- Morning Session
  - Condensate Return

- Afternoon Session
  - Post Accident MCR Operator Dose
  - Hydrogen Venting inside Containment
  - Source Range Monitoring/Flux Doubling
  - MCR Heat Up

April 5th, 2016

Bob Kitchen – Duke Energy
Andy Pfister - Westinghouse

AP1000® PXS Condensate Return

Agenda
AP1000 Condensate Return Review

- Overview and update
  - Summary of design change
  - Why change is required
  - Licensing basis for Passive Residual Heat Removal
  - Update from previous ACRS meeting

Closed Session

- Review of supporting analyses –Design basis analyses
  - Safe shutdown and long term cooling analyses
  - Revised calculation models
  - PRHR heat transfer model and validation
- Plant recovery

QA Program Implementation and Technical Oversight

10CFR50 Appendix B Implementation

- COLA Development
  - Duke QA Program (ANSI N45.2) applies
  - Vendor QA programs approved and monitored by Duke
  - Change to DCD (Departure/Exemption)
    - Westinghouse develops change
    - Duke reviews and approves implementation of change
  - Licensing basis change implemented by departure and COLA revision

- COL Issuance
  - Duke QA Program (NQA-1)
  - Licensing basis change implemented by License Amendment

QA Oversight Activities

- NUPIC AP1000 Full Scope Audit of QA Program and Implementation Every 2 Years
- NUPIC AP1000 Limited Scope Audit Every 2 Years
  - Alternate with Full Scope Audit
- Semi-annual Performance Based Evaluation. Based on results of:
  - NUPIC Activities & Audits
  - Source Surveillances or Inspections
  - Procurement Receipt Activities, and
  - Supplier Problems Identified by Internal and External Sources
- Owner acceptance reviews performed for vendor initiated changes when implemented
- ISG-11 evaluations completed for Design Change Proposals

Lessons from Condensate Return

Areas for improvement in Duke oversight of Westinghouse

- The issue was not promptly entered into the Duke Corrective Action Program
- Initial reviews of Westinghouse technical products were not effectively structured or documented
- Initial Duke reviews did not challenge Westinghouse significance determination or need for extent of condition
- Duke did not effectively leverage NUPIC to examine Westinghouse response to Condensate Return and similar issues

Corrective Actions

- Procedures now require condition report for any change that exceeds ISG-11 criteria
- Engineering develops focused review plan of change and supporting documents
  - Review plans documented and approved
  - Reviews include significant interaction with Westinghouse SMEs
  - Supporting calculations and analyses are reviewed in detail
  - Final report written to document satisfactory completion of review
- Review of WEC corrective actions include extent of condition and Part 21 evaluation
- Manager, Vendor Quality is notified of emergent issue and corrective actions for incorporation in NUPIC – Westinghouse audit

Westinghouse Corrective Actions and Extent of Condition

- Root Causes
  - Insufficient design requirements flow down
  - Insufficient interface control between plant design and analysis
- Corrective Actions
  - Developed analysis design plans to document input sources, complete analysis scope, and identify key interfaces with other design elements
  - Developed/strengthened engineering interface control documentation to communicate requirements between analysis and design organizations
  - Extended safety analysis input database to cover Chapter 19E analyses
- Extent of Condition Findings
  - Prior to formal extent of condition, s analysis baseline update completed. Reconciled multiple input and assumption discrepancies:
    - Aligned SBLOCA and LBLOCA minimum backpressure multiplier
    - Aligned inputs between containment analysis and transient analysis
    - Generated more rigorous analysis basis for abnormal events
  - MCR Dose: failure to account for filter contribution, non-limiting SG blowdown assumption
  - Condensate Return: identified need for a benchmark analysis model

Westinghouse

Reason for the Design Change

- Previous analysis performed during design certification assumed a constant condensate return rate of 90%
- Investigations resulting from validation of this assumption determined the 90% return rate could not be met.
  - A result of as built design configurations that were different than testing used to establish the 90% return rate
- The safe shutdown temperature criteria in SECY-94-084 of 420°F in 36 hours could not be met with the calculated value of return rate without modifications.
- Without the design enhancements, ADS actuation would have been sooner following a non-LOCA event. Adequate core cooling would have been maintained

Summary Of Design Change

- The following plant changes have been incorporated to increase condensate return to the IRWST
  - Add downspouts to polar crane girder and internal stiffener to drain condensate directly to IRWST
    - Minimizes losses associated with re-attaching flow to containment wall and with flow over support plates
  - Optimize IRWST gutter design and location
    - Extended to collect above upper equipment hatch and personnel airlock
  - Changed routing of cables to hydrogen sensors
    - Reduces quantity of support plates (obstacles) attached to the containment dome
  - Would not have been met without design changes

GDC-34 Requirements

- A residual heat removal (RHR) system must be provided to remove residual heat from the reactor core so that specified acceptable fuel design limits (SAFDLs) and the design conditions of the reactor coolant pressure boundary are not exceeded
- Requires suitable redundancy of the components and features of the RHR system to ensure that the system safety functions can be accomplished, assuming loss of offsite or onsite power, coincident with a single failure.

SECY 94-084 states:

- 420°F is a safe, stable condition for passive plants.
- Other plant conditions constitute a safe, stable state as long as reactor subcriticality, decay heat removal and radioactive materials containment are properly maintained for the long term.
- Passive system capabilities can be demonstrated by appropriate evaluations during detailed design analyses, including
  - A safety analysis to demonstrate that the passive systems can bring the plant to a safe, stable condition and maintain this condition and
  - No transients will result in the specified acceptable fuel design limits and pressure boundary design limit being violated

Safe Shutdown
AP1000 - DCD Revision 19

- AP1000 DCD revision 19 has inconsistencies
  - Section 6.3.1.1 "Safety Design Basis" describes PRHR closed loop, "...capability to establish safe shutdown conditions, cooling the reactor coolant system to about 420°F in 36 hours."
  - DCD analysis that demonstrates 420°F in 36 hours is not a design basis analysis
- AP1000 DCD revision 19 supporting analyses demonstrate
  - Design meets GDC-34 requirements using Design Basis Analysis (Chapter 15) assumptions
  - Design achieves 420°F in 36 hours using conservative, non-bounding assumptions performance analysis
- Design description revised to establish clear separation of safety design basis from non-safety design features (Performance goal)

Design & Licensing Basis

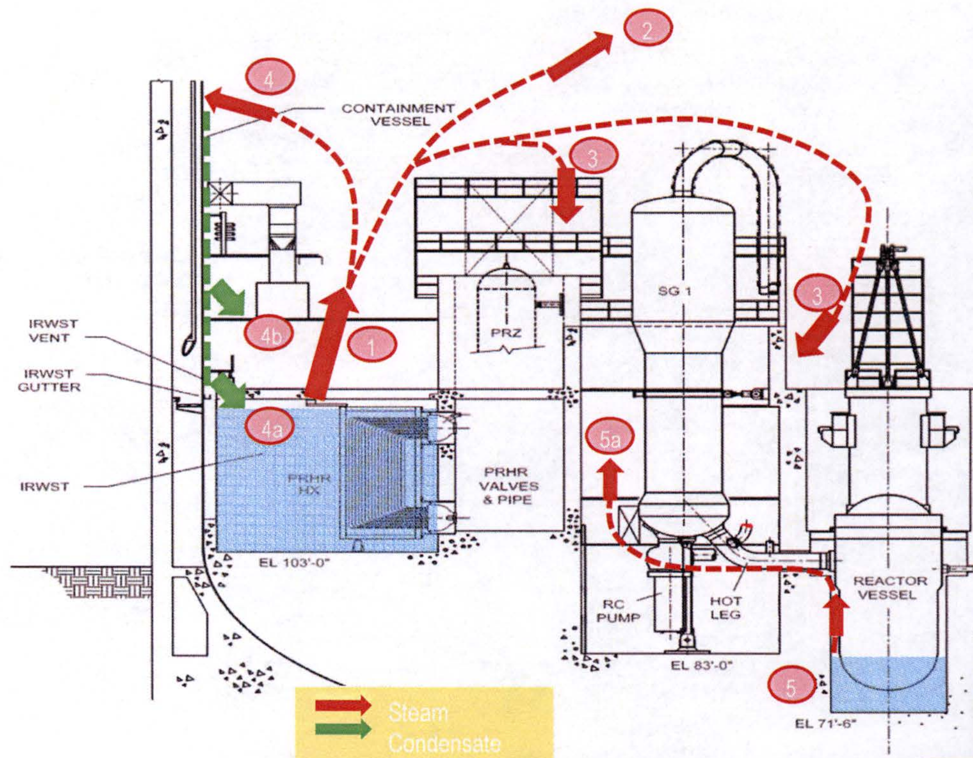
- PRHR safety design basis
  - Remove sufficient decay heat for at least 72 hours to maintain acceptable reactor coolant conditions following a non-LOCA event
- Non-safety design basis (License performance goal)
  - Establish reactor coolant temperature of 420°F in less than 36 hours
  - PRHR HX can maintain 420°F for greater than 14 days in closed loop operation

Summary of Licensing Basis Change

DCD Revision 19	Levy FSAR
1. For non-LOCA events, PRHR performance meets all Chapter 15 analysis requirements	1. FSAR Chapter 15 Design Basis Accident analysis extended to 72 hours
2. Safety design requirement that PRHR cooling can achieve safe shutdown in less than 36 hours.	2. No change in analysis method. FSAR clarifies that this is non-safety design requirement based on conservative, non-bounding analyses
3. PRHR cooling can maintain safe shutdown (SSD) indefinitely.	3. FSAR identifies that PRHR closed loop cooling can maintain SSD for greater than14 days based on conservative, non-bounding analysis

Where Does IRWST Steam Go?

1. Steam leaving IRWST
2. Pressurizes containment
   a. Lost from IRWST
3. Condenses on walls, floors, structures
   a. Lost from IRWST
4. Condenses on CV
   a. Most collected and returned to IRWST
   b. Some splashes / spills off
5. Losses from IRWST collect under RV, contact hot RV
   a. Steam rises up into cont.



Summary of Previous ACRS Interactions

- Overview of the Issue
  - Analysis approach
  - Empirical data used to determine losses
- Key Developments since Previous Meeting
  - Calculation Discrepancies identified in January 2015
    - Required analysis approach and calculations to be modified – WGOTHIC replaces PRHR Performance Calculation
    - RCA Performed
    - PIRT performed on use of LOFTRAN for long term duration

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