

## Vogtle PEmails

---

**From:** Hoellman, Jordan  
**Sent:** Thursday, March 01, 2018 12:00 PM  
**To:** Vogtle PEmails  
**Subject:** Public Presentation for 3/8 Technical Exchange on Crediting China First of a Kind Testing at Vogtle Units 3 and 4  
**Attachments:** FPOT NRC Tech Exchange Presentation Mar 8 2018 - Public Slides (Final).pdf

Attached is the presentation for the open portion of the 3/8/2018 technical exchange meeting for crediting China first of a kind testing. These slides do not contain SUNSI and may be released to the public.

**Hearing Identifier:** Vogtle\_COL\_Docs\_Public  
**Email Number:** 230

**Mail Envelope Properties** (SN6PR09MB2608BC42D1A1A004DA4EBACDD5C60)

**Subject:** Public Presentation for 3/8 Technical Exchange on Crediting China First of a Kind Testing at Vogtle Units 3 and 4  
**Sent Date:** 3/1/2018 11:59:58 AM  
**Received Date:** 3/1/2018 12:00:08 PM  
**From:** Hoellman, Jordan

**Created By:** Jordan.Hoellman2@nrc.gov

**Recipients:**  
"Vogtle PEmails" <Vogtle.PEmails@nrc.gov>  
Tracking Status: None

**Post Office:** SN6PR09MB2608.namprd09.prod.outlook.com

Files	Size	Date & Time
MESSAGE	220	3/1/2018 12:00:08 PM
FPOT NRC Tech Exchange Presentation Mar 8 2018 - Public Slides (Final).pdf		
852563		

**Options**  
**Priority:** Standard  
**Return Notification:** No  
**Reply Requested:** No  
**Sensitivity:** Normal  
**Expiration Date:**  
**Recipients Received:**

# VOGTLE

## UNITS 3&4



## Crediting First of a Kind Testing from China AP1000 Units



NUCLEAR DEVELOPMENT

# Agenda

- Background
- Quality Assurance Program Assessment
- China Test Assessments and Applicability to Vogtle 3&4
  - In-containment Refueling Water Storage Tank Heatup Test
  - Reactor Vessel Internal Vibration Testing
  - Core Makeup Tank Test Heated Recirculation Tests
  - Automatic Depressurization System Blowdown Test
- Path Forward

## Background

- The VEGP 3&4 Combined Licenses (COLs) currently require First Plant Only Tests (FPOTs) and First Three Plant Only Tests (F3POTs) be performed on both Unit 3 and Unit 4
- If Licensee would like to credit a test performed at a previous plant (unit), a LAR is required.
- SNC would like to credit testing completed on the China AP1000 units
- During certification of AP1000, the purpose of first plant only testing was provided in Section 14.2.5:
  - Special tests to further establish a unique phenomenological performance parameter of the AP1000 design features beyond testing performed for Design Certification of the AP600 and that will not change from plant to plant, are performed for the first plant only. Because of the standardization of the AP1000 design, **these special tests (designated as first plant only tests) are not required on follow plants.**

## Background

- The SNC intent is to submit LARs covering China FPOT/F3POT applicability
- The LAR scope will be split by:
  - Pre-operational tests
  - Start-up tests
- The LAR scope being split allows for submittal of the first LAR while the remaining FPOT tests are being completed and/or vetted
- This presentation will cover the pre-operational testing scope for the first LAR
  - In-containment Refueling Water Storage Tank (IRWST) Heatup Test
  - Reactor Vessel Internal Vibration Testing (or Comprehensive Vibration Assessment Program, CVAP)
  - Core Makeup Test Heated Recirculation Tests (F3POT)
  - Automatic Depressurization System Blowdown Test (F3POT)

## LAR Scope

- LAR(s) will be submitted to delete the COL conditions requiring First Plant Only and First 3 Plant Only Tests for Vogtle 3&4
- The LAR technical evaluation will demonstrate
  - Adequacy of China QA program governing FPOT/F3POT
  - Acceptability of China FPOT/F3POT results
  - Applicability of China FPOT/F3POT results to Vogtle 3&4

# COL Requirements for Pre-Operational FPOT

## (2) Pre-operational Testing

- (a) SNC shall perform the design-specific pre-operational tests identified below:
  - 1. In-Containment Refueling Water Storage Tank (IRWST) Heatup Test (first plant test as identified in AP1000 Design Control Document (DCD), Rev. 19, Section 14.2.9.1.3 Item (h));
  - 2. Pressurizer Surge Line Stratification Evaluation (first plant test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.7 Item (d)) as revised by Amendment No. 83;
  - 3. Reactor Vessel Internals Vibration Testing (first plant test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.9);
  - 4. Core Makeup Tank Heated Recirculation Tests (first three plants test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.3 Items (k) and (w)); and
  - 5. Automatic Depressurization System Blowdown Test (first three plants test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.3 Item (s)).



# Proposed COL Changes

## (2) Pre-operational Testing

(a) SNC shall perform the design-specific pre-operational tests identified below:

- ~~1. In-Containment Refueling Water Storage Tank (IRWST) Heatup Test (first plant test as identified in AP1000 Design Control Document (DCD), Rev. 19, Section 14.2.9.1.3 Item (h));~~
- ~~2. 1. Pressurizer Surge Line Stratification Evaluation (first plant test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.7 Item (d)) as revised by Amendment No. 83;~~
- ~~3. Reactor Vessel Internals Vibration Testing (first plant test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.9);~~
- ~~4. Core Makeup Tank Heated Recirculation Tests (first three plants test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.3 Items (k) and (w)); and~~
- ~~5. Automatic Depressurization System Blowdown Test (first three plants test as identified in AP1000 DCD, Rev. 19, Section 14.2.9.1.3 Item (e));~~

- b) SNC shall review and evaluate the results of the applicable tests identified in Section 2.D.(2)(a) of this license and confirm that these test results are within the range of acceptable values predicted or otherwise confirm that the tested systems perform their specified functions in accordance with AP1000 DCD Rev. 19, Section 14.2.9,
- c) SNC shall notify the Director of NRO, or the Director's designee, in writing, upon successful completion of the applicable design-specific pre-operational tests identified in Section 2.D.(2)(a) of this license; and
- d) SNC shall notify the Director of NRO, or the Director's designee, in writing, upon the successful completion of all the ITAAC included in Appendix C to this license.

Corresponding changes would be proposed to UFSAR

## LARs Impacting FPOT LAR Submittal

Licensing Changes Impacting FPOT LAR-17-033 (155), Submitted Oct. 2017 NRC Approved LAR-16-011 (100) Aug. 2017 LAR 125, Feb. 2018 Submittal	<b>Pre-Operational Tests</b>
	IRWST Heatup
	Pressurizer Surge Line Stratification Evaluation
	Reactor Vessel Internals Vibration
	CMT Heated Recirculation (F3POT)
LAR-17-041 (84), Submitted Nov. 2017	ADS Blowdown (F3POT)
	<b>Startup Tests</b>
	Natural Circulation
	RCCA Out of Bank
	Load Follow Demo

## Proposed Path Forward

- Perform assessment of China Quality Assurance Program (complete)
- Assess Sanmen test execution for pre-op tests (complete)
- Evaluate Sanmen/Haiyang pre-op FPOT results (complete)
- Evaluate Sanmen/Haiyang pre-op F3POT results (still need last F3POT reports from recently completed Sanmen 2 tests)
- Demonstrate applicability (LAR)
- Revise FPOT/F3POT License Conditions (LAR)



Southern  
Nuclear

# Quality Assurance Program Assessment

## Overview

- Comparison of Chinese Regulation to 10 CFR 50 Appendix B
- Assessment of implementation
  - Review of completed tests
  - Observations for future tests
  - Westinghouse/Customer interface during testing

## Comparison of Chinese Regulation to 10 CFR 50 Appendix B

- Industry Subject Matter Expert compared requirements from China HAF 003-1991, “Safety Regulations for Quality Assurance of Nuclear Power Plants” to 10 CFR 50 Appendix B
- Concluded that requirements of HAF 003 are comparable to, and encompass, the requirements of Appendix B

## Review of Completed Tests

- Test specifications (including acceptance criteria) are developed and approved by the design authority (Westinghouse)
- SNC completed a review of the completed test procedures at Sanmen/Haiyang for QA adherence
  - The review resulted in no impacts to the test results
- SNC will continue to monitor future tests

# Applicability of China Tests to Vogtle 3&4



# IRWST Heatup Licensing Commitments

## UFSAR 14.2.5

### IRWST Heatup Test (14.2.9.1.3 item (h))

During preoperational testing of the passive core cooling system, a natural circulation test of the passive residual heat removal (PRHR) heat exchanger is conducted (item f). For the first plant only, thermocouples are placed in the IRWST to observe the thermal profile developed during the heatup of the IRWST water during PRHR heat exchanger operation. This test will be useful in confirming the results of the AP600 Design Certification Program PRHR tests with regards to IRWST mixing, and is useful in quantifying the conservatism in the Chapter 15 transient analyses.

Due to the standardization of the AP1000, the heatup and thermal stratification characteristics of the IRWST will not vary from plant to plant. **The PRHR heat exchanger design, and the size and configuration of the IRWST are standardized, such that the heatup characteristics will not significantly change from plant to plant.**

Therefore, since the phenomenon to be tested (i.e., heatup and mixing characteristics of the IRWST) will not vary significantly from plant to plant due to standardization, a first plant only test of the IRWST heatup characteristics is justified.

## IRWST Heatup Licensing Commitments (post LAR)

- Proposed acceptance criteria for IRWST heat up test described in LAR-17-033 for UFSAR Section 14.2.9.1.3, item h):

The heatup characteristics of the in-containment refueling water storage tank water are verified by measuring the vertical water temperature gradient that occurs in the in-containment refueling water storage tank water at the passive residual heat removal heat exchanger tube bundle and at several distances from the tube bundle, during testing in Items f) [\[PRHR natural circulation preoperational test—required for all plants\]](#) and g) [\[PRHR forced flow test—required for all plants\]](#), above. **Note that this verification is required only for the first plant.** The acceptance criterion demonstrates that the average IRWST heatup is consistent with the PRHR heat transfer modeling in the Chapter 15 analysis. These results (in conjunction with Items f) and g)) are evaluated to demonstrate that the overall PRHR heat transfer performance, i.e., heat removal from the RCS, is conservative with respect to the analysis documented in Chapter 15.

# CVAP Licensing Commitments

- The CVAP test program is described in UFSAR Subsection 3.9.2.4
  - The AP1000 reactor internals testing is part of a comprehensive vibration assessment program performed in accordance with Regulatory Guide 1.20
  - This testing obtains data to verify the structural integrity of the AP1000 reactor internals with regard to flow-induced vibrations, as part of an internals vibration assessment program.
  - This program also includes visual examination of the reactor internals after testing is completed, and analysis of the test data.
- The program is directed toward confirming the long-term, steady-state vibration response of the reactor internals for operating conditions.
- LAR-125 to be submitted and will revise CVAP description from DCD Rev. 19 and align to CVAP completed in China

## CVAP Licensing Commitments

- During certification, NRC approved CVAP Topical Reports, containing methodology to measure, analyze, and inspect the reactor vessel internals for vibration, which are Incorporated by Reference (IBR) Documents, WCAP-15949 and WCAP-16687
- However, CVAP methodology in IBR WCAP-15949 and WCAP-16687 needs to be revised:
  - Finalized reactor vessel internals (RVI) design is not incorporated
- WCAP-17983 and WCAP-17984 were created to update CVAP measurement, analysis, and inspection information
  - Methodology continues to comply with Reg. Guide 1.20
  - Incorporates the revised RVI design
  - Incorporates acoustical loads from the canned RCPs
  - Adds data collection points for RCS cooldown and pump speed reduction as part of test conditions during tested shutdown conditions
  - WCAP-15949 and WCAP-16687 will be removed from UFSAR Table 1.6-1, retained as historical references in UFSAR Chapter 3
- WEC LAR-125 will propose replacing WCAP-15949 and WCAP-16687 with WCAP-17983 and WCAP-17984

LAR-125 proposed changes will align Vogtle CVAP with China CVAP

# CMT Recirculation Licensing Commitments

## (UFSAR 14.2.5) Core Makeup Tank Heated Recirculation Tests (14.2.9.1.3 Items (k) and (w))

“During preoperational testing of the passive core cooling system, a test is performed for each plant to verify the CMT inlet piping resistances. In addition, cold draining tests of the CMTs are conducted that verify the discharge piping resistance and proper drain rate of the CMTs for each plant. **For the first three plants**, two additional CMT tests are conducted during hot functional testing of the RCS. These tests are a natural circulation heatup of the CMTs followed by a test to verify the ability of the CMTs to transition from a recirculation mode to a draindown mode while at elevated temperature and pressure.

Operation of the CMTs in their natural circulation mode is conducted on the first three plants only for the following reasons:

- Natural circulation of the CMTs will not vary from plant to plant, provided that the other verifications discussed above are performed as specified.
- Natural circulation testing of the CMTs was extensively tested as part of the Design Certification Tests.
- Performance of this test results in significant thermal transients on Class 1 components including the CMTs and the direct vessel injection nozzles.”

## CMT Recirculation Licensing Commitments

### UFSAR 14.2.9.1.3 Passive Core Cooling System Testing, Item (k):

*“[Proper operation of the core makeup tanks to perform their reactor water makeup and boration function is verified by initiating recirculation flow through the tanks during hot functional testing with the reactor coolant system at  $\geq 530^{\circ}\text{F}$ . This testing is initiated by simulating a safety signal which opens the tank discharge isolation valves, and stops reactor coolant pumps after the appropriate time delay. The proper tank recirculation flow after the pumps have coasted down is verified. Based on the cold leg temperature, CMT discharge temperature, and temperature CMT flow instrumentation, the net mass injection rate into the reactor is verified” **Note that this verification is required only for the first three plants.]\****



# CMT Recirculation Licensing Commitments

## (UFSAR 14.2.5) Core Makeup Tank Heated Recirculation Tests (14.2.9.1.3 Items (k) and (w))

“During preoperational testing of the passive core cooling system, a test is performed for each plant to verify the CMT inlet piping resistances. In addition, cold draining tests of the CMTs are conducted that verify the discharge piping resistance and proper drain rate of the CMTs for each plant. **For the first three plants**, two additional CMT tests are conducted during hot functional testing of the RCS. These tests are a natural circulation heatup of the CMTs followed by a test to verify the ability of the CMTs to transition from a recirculation mode to a draindown mode while at elevated temperature and pressure.

Operation of the CMTs in their natural circulation mode is conducted on the first three plants only for the following reasons:

- Natural circulation of the CMTs will not vary from plant to plant, provided that the other verifications discussed above are performed as specified.
- Natural circulation testing of the CMTs was extensively tested as part of the Design Certification Tests.
- Performance of this test results in significant thermal transients on Class 1 components including the CMTs and the direct vessel injection nozzles.”

# CMT Recirculation Licensing Commitments

## UFSAR 14.2.9.1.3 Passive Core Cooling System Testing, Item (w):

*"[In conjunction with the verification of the core makeup tanks to perform their reactor water makeup function and boration function described in item k) above, the proper operation of the core makeup tanks to transition from their recirculation mode of operation to their draindown mode of operation after heatup will be verified. This testing will also verify the proper operation of the core makeup tank level instrumentation to operate during draining of the heated tank fluid. The in-containment refueling water storage tank initial level is reduced to at least 3 feet below the spillway level as a prerequisite condition for this testing in order to provide sufficient ullage to accept the mass discharged from the reactor coolant system via the automatic depressurization stage 1.*

*The recirculation operation in Item k) above, should be continued until the core makeup tank fluid has been heated to  $\geq 350^{\circ}\text{F}$ . The core makeup tank isolation valves are then closed, the reactor coolant pumps are started, and the reactor coolant system is reheated up to hot functional testing conditions. This testing is initiated by shutting off the reactor coolant pumps, opening the core makeup tank isolation valves, and by opening one of the automatic depressurization stage 1 flow paths to the in-containment refueling water storage tank. This will initiate a large loss of mass from the reactor coolant system, depressurization of the reactor coolant system to the bulk fluid saturation pressure, and additional recirculation through the core makeup tank. Core makeup tank draindown initiates in response to the continued depressurization and mass loss from the reactor coolant system. The automatic depressurization stage 1 flow path is closed after the core makeup tank level has decreased below the level at which stage 4 actuation occurs. **Note that this verification is required only for the first three plants.]\*\*"***



## ADS Blowdown Test Licensing Commitments

### (UFSAR 14.2.5) ADS Blowdown Test (14.2.9.1.3 Item (s))

“During preoperational testing of the passive core cooling system, the resistance of the automatic depressurization system Stage 1, 2, 3 flow path(s) is verified. For the first three plants only, an automatic depressurization blowdown test is performed to verify proper operation of the ADS valves, and demonstrate the proper operation of the ADS spargers to limit the hydrodynamic loads in containment to less than design limits. This test is performed on only the first three plants for the following reasons:

- The operation of the ADS, and the resultant hydrodynamic loads will not vary significantly from plant to plant.
- Full scale automatic depressurization testing was performed in the AP600 Design Certification Program. Testing was conducted to conservatively bound ADS flow rates and resultant hydrodynamic loads that will be experienced by the plant during ADS operation.
- Performance of this test results in significant thermal transients on Class 1 components including the primary components. It also results in hydrodynamic loads in containment including the IRWST.”

# ADS Blowdown Test Licensing Commitments

## UFSAR 14.2.9.1.3 Passive Core Cooling System Testing, Item (s):

*“[During hot functional testing of the reactor coolant system, proper operation of automatic depressurization is verified by blowing down the reactor coolant system. This testing verifies proper operation of the stage 1, 2, and 3 components including the ability of the spargers to limit loads imposed on the in-containment refueling water storage tank by the blowdown. Proper operation of the stage 1, 2 and 3 valves is demonstrated during blowdown conditions. **Note that this verification is required only for the first three plants.]\*\***”*

## Applicability of China Tests to Vogtle 3&4

- First Plant Only Tests performed at SM1/HY1 were successful
- Test results from China have been reviewed for applicability to Vogtle 3&4
- Applicability of the tests is shown through
  - ITAAC
  - Design Control
  - Construction tolerances

Testing at China Sites establishes the unique phenomenological performance parameters of the AP1000 design features

## Licensing Path Forward

- LAR(s) will be submitted to revise the COL conditions requiring First Plant Only and First 3 Plant Only Tests for Vogtle 3&4
- The LAR technical evaluation will demonstrate
  - Adequacy of China QA program governing FPOT/F3POT
  - Acceptability of China FPOT/F3POT results
  - Applicability of China FPOT/F3POT results to Vogtle 3&4