国家核安全局
National Nuclear Safety Administration

Overview of AP1000 Commissioning Inspection in P.R. China

National Nuclear Safety Administration

Sept. 2017

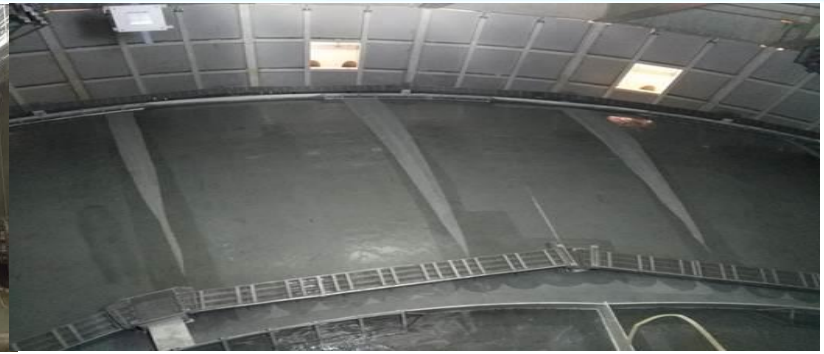
MULTINATIONAL DESIGN EVALUATION PROGRAMME

contents

1. Status of AP1000 Projects

Sanmen Unit 1

- NI CI&BOP of unit 1 have been finished construction and total 564 rooms and areas have been turnover .
- HFT finished on June 30, 2017, and now 399 commissioning tests (Stage A) finished.
- All the 113 systems and 194 package have turnover to operation, and Unit 1 finished NI building cleaning. Plan to initial fuel load.



Sanmen Unit 2

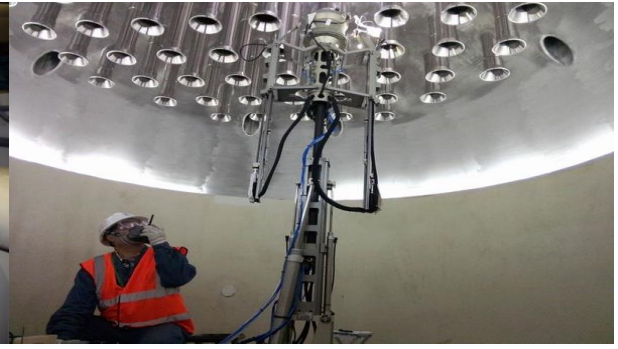
- CV water film coverage ratio test completed on April 28, 2017.
- CV SIT/ILRT completed on May 31, 2017.
- CHT completed on September 2, 2017.
- 230 of 239 package turnover to commissioning and 178 of them has been tested.

Haiyang Unit 1

- NI/CI/BOP of unit 1 have been finished construction and total 292 rooms have been turnover.
- HFT finished on July 12, 2017, and now 328 commissioning tests (Stage A) finished.
- 168 TOTO packages have turnover to operation, Finished NI building cleaning. Ready for initial fuel load.

Haiyang Unit 2

- SGs hydro test was completed and satisfied on 22 Dec. 2016.
- Containment SIT/ILRT completed and satisfied on July 21, 2017.
- System turnover packages are turned over in 94.1%, where 29 TOPs are finalized TOTO to temporarily turnover to production.
- A1stage testing is in progress, component tests are finished in 60% and system preoperational testing 13%.

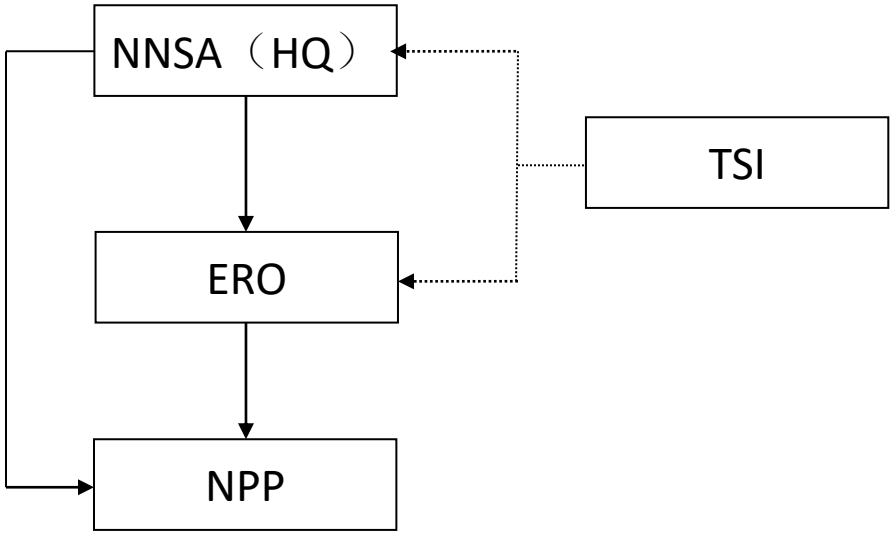


2. Inspection of AP1000 Commissioning

2.1 Commissioning Inspection Preparation

- NNSA approved Commissioning Program of Sanmen and Haiyang Unit 1&2, including revised edition.
- NNSA issued Commissioning Inspection Program of AP1000 for Sanmen and Haiyang Unit 1&2 in Jan. 2016.
- NNSA and ERO draw up commissioning test inspection procedures.

Organization



-National Nuclear Safety Administration (NNSA HQ)
-East China Regional Office of NNSA (ERO)
-Technical Support Institute (TSI)
-AP1000 Expert Group
---------technical support ———————— inspecting

2.2 Commissioning Inspection Items

Stage A

- Cold Functional Testing (A1)
- Hot Functional Testing (A2)

Stage B

- FL &HFT before criticality(B1)
- Initial criticality(B2)
- Low power testing(B3)

Stage C

- Low power plateau(C1)
- 25%FP plateau(C2)
- 50%FP plateau (C3)
- 75%FP plateau (C4)
- 90%FP plateau (C5)
- 100%FP plateau(C6)

FPOT/F3POT	
Passive Core Cooling System Hot Functional Test Procedure (PXS-T1P-504)	A2
Thermal Stratification Cycling and Striping (PZR Surge & Spray Line) (GW-T1P-508)	A2
Reactor Vessel Internals Vibration Testing (RXS-T1P-502)	***A2***
Passive Core Cooling Automatic Depressurization System Precore Hot Functional Test Procedure (PXS-T1P-505)	A2
SG Natural Circulation Testing (RCS-T1P-606)	B3
PRHR Natural Circulation Testing (PXS-T1P-602)	***C6***
Rod Cluster Assembly Out of Bank Measurements (GW-T1P-620)	C3
Load Follow Demonstration (GW-T1P-634)	C6
Significant Tests	
RCS Cold Hydrostatic Test Procedure(RCS-T1P-503)	A1
Containment System Integrated Leakage Rate Test - Type A(CNS-T1P-501)	A1/A2
RCP Cold And Hot Precore Hot Functional Test Procedure(RCS-T1P-506)	A2
Initial Fuel Loading (GW-T1P-601)	B1
Rod Drop Time Measurement(PLS-T1P-604)	B1
Initial Criticality and Low Power Physics Tests (LPPT) (GW-T1P-611)	B2/B3
Plant Trip From 100 Percent Power (GW-T1P-636)	C6
100% Load Rejection startup test(GW-T1P-633)	C6

2.3 Commissioning Inspection Activity

- NNSA finished two control point inspection , including:
  - Reactor Coolant System Cold hydrostatic test of Sanmen and Haiyang Unit 1
  - Initial fuel Loading of Sanmen and Haiyang Unit 1
- NNSA finished 47 commissioning tests (Stage A) witness.

3. Challenges of AP1000 Commissioning Inspection

-a. Design Change

-b. Acceptance Criteria

-c. Prerequisites in Procedure

-d. Equipment Deficiencies treatment

Design Change

✓ Up to 17 August 2017, Sanmen Unit 1 had issued 3100 DCPs, 377 DCPs of which impact FSAR . At the same time, Sanmen Unit 1 issued 31937 effective E&DCRs during the construction. Every E&DCR or DCP needs test impact evaluation. Some DCP or E&DCR were issued after the commissioning tests which are great challenge to test quality and schedule. For example, DCIS. Of Unit 1 had performed 12 times software updates from the PLS software BL7.4/7.5 to the latest BL7.11 ICP 11, and with 4 DDB rebuilds. After the software update, tests need to be evaluated for any re-test because of the new software.

	Before HFT	During HFT	After HFT
DCP	2997	102	1
EDCR	28228	2565	144

Acceptance Criteria

- Some tests do not have acceptance criteria． 48 tests in 12 procedures of AP1000 have no acceptance criteria defined.
- The test data will be collected onsite and sent to WEC, WEC offshore will analyzed the data and feedback whether test result can meet acceptance criteria.
- Some acceptance criteria were revised after test.

Prerequisites in Procedure

- One commissioning procedure consists of several tests , with numerous prerequisites. All the prerequisites are be assembled in one section. It is difficult to recognize which prerequisites belong to the specific test.

Equipment Deficiencies treatment

There were several equipment significant deficiencies occurred in testing . Below are the major issues during commissioning:

- CA31 neutron block boron silicon leakage
- ADS4 pipe vibration issue
- ADS1-3 Valve issue
- refueling machine and fuel handling machine issues

Thank You!