Power Uprate SER of Chinshan Plant

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Atomic Energy Council, Taiwan
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Outline

- Background
- Rules and Regulations of SPU
- Review Process
- SER & Major Findings
- Concluding Remarks

Background (1/2)

- **6 operating units have completed Measurement Uncertainty Recapture (MUR) in 10/9/2008**

	Chinshan	Kousheng	Maanshan
OLTP (**MWt**)	1775	2894	2775
%UPRATE	**1.7%** (1804)	**1.7%** (2943)	**1.69%** (2822)
DATE APPORVED	11/23/2007	5/1/2007	10/9/2008

Background (2/2)

- Taipower submitted first Stretched Power Uprate (SPU) application (1858 MWt, 4.66% OLTP) of Chinshan units 1&2 in 12/20/2010.
- Acceptance review was completed in 4/29/2011 and technical review period is scheduled to be 18 month starting from 4/29/2011.
- Safety review was completed in 11/15/2012. Currently Chinshan's CLTP is 1840 MWt.

Rules and Regulations of SPU (1/2)

- **According to Article 13 of Nuclear Reactor Facilities Regulation Act**
  - During the construction or the operation period of nuclear reactor facilities, neither of the design amendment nor equipment change, if involved in the significant safety items, shall be made without an application there for submitted to and approved by the competent authorities.
- **According to Article 8 of Enforcement Rules for the Implementation of Nuclear Reactor Facilities Regulation Act**
  - The extent of significant safety items provided under Article 13 of the Act is as follows:
    1. The amendment of the operating technical specification.
    2. …

    .

Rules and Regulations of SPU (2/2)

- **Technical review guidance of Stretched / Extended Power Uprate for BWR NPP.**

  (沸水式核能電廠中／大幅度功率提昇技術審查導則)

  - **Reference：**
    - **RS-001：Review Standard for Extended Power Uprates**
    - **NUREG-0800 Standard Review Plan**

Process of review (1/3)

- **A review task force team of experts(4) and AEC staff was established to conduct comprehensive technical review after acceptance review.(4/29/2011)**
  - issued 4 batches RAIs (total 179 RAIs)
  - TPC Submitted Reload Licensing Analysis Report , Mechanical Design Report for ATRIUM-10 Fuel Assemblies, Rod Withdrawal Error Analysis for ATRIUM™-10 Fuel for Chinshan Units 1 and 2 with ARTS and SPU
- **TPC suspended license renewal application.(5/4/2011)**
  - Exempt the review of SPU SAR 1.5 (the relation between SPU and license-renewal).

Process of review (2/3)

- **Held 5 review meetings with TPC (2011.7~2012.4)**
- **Held 2 special topic meetings**
  - Steam Dryer Vibration Monitoring (SDVM) Program(4/14/2011)
  - GL 96-06(4/23/2012)
- **TPC request 2 Steps Power Uprate (10/7/2011)**
  - 1st step : 2% OLTP uprate,
  - 2nd step :1% OLTP additive uprate
    - if SDVM is installed per EPRI BWRVIP-182A due to main steam line acoustic effect on steam dryer issue.
    - Minimum Alternating Stress Ratio

Process of review (3/3)

- **TPC Submitted SPU Assessment – JCO of Steam Dryer and Feedwater Sparger for Chinshan Unit 1&2(8/8/2012)**
  - Approved in 10/22/2012
- **1st step SPU SER approved in 11/15/2012**
  - have raised power to 103.66% OLTP
  - unit 1 in 11/23 /2012 ； unit 2 in 11/29 /2012

CS SPU SER & Major Findings (1/7)

- **The content of CS SPU SAR**

  (format refer to Hatch NPP SPU SAR)

  - Introduction
  - Reactor Core and Fuel Performance
  - Reactor Coolant System and Connected Systems
  - Engineered Safety Features
  - Instrumentation and Control
  - Electrical Power and Auxiliary Systems
  - Steam and Power Conversion Systems
  - Radwaste Systems and Radiation Sources
  - Reactor Safety Performance Evaluations
  - Other Evaluations

CS SPU SER & Major Findings (2/7)

- **The evaluation result of thermal limits, reactivity characteristics, stability are acceptable.**
  - Increase 4~6 fuel bundles
- **Reactor Coolant System and Connected Systems**
  - Peak pressure of RPV bottom increase 2 psia
    - ～1289 psia < 1390 psia (ASME allowable peak pressure)
  - Reactor Vessel Fracture Toughness

    [Beltline region (54 EFPY ,EOL = 60)]
    - Upper Shelf Energy (USE) > 50 ft-lb (10 CFR 50 Appendix G)
      - Material = 82 (U1)/100 (U2) ft-lb
      - Weldment = 109 (U1) /102 (U2) ft-lb Appendix G)
    - Adjusted Reference Temperature (ART)
      - 112℉ (U1)/ 94℉ (U2) < 200℉ (10 CFR 50 Appendix G)
- **MSIV Steam flow increase 4.4% < 13% MSIV design steam flow** (Original)

CS SPU SER & Major Findings (3/7)

- **Steam dryer**
  - U1 & U2 has indications
  - increased steam flow velocities induced vibration (FIV) loads increase (7%)
  - Services Information Letter (SIL) 644 [2] and BWRVIP-139-A
    - define a plant-specific inspection and monitoring plan
      - Baseline inspection before SPU
      - Each outage inspection after SPU
  - Chinshan Unit 1&2 steam dryer evaluation has demonstrated that the dryer will maintain structural integrity when operated at the Chinshan 1st step SPU conditions.

CS SPU SER & Major Findings (4/7)

- **CS Unit 1 feedwater spargers has liner indications near the flow holes**
  - The FIV stresses at SPU condition are substantially less than the 10,000 psi peak
  - JCO of the CS Unit 1 feedwater spargers
    - indications will self-arrest after a few cycles.
  - It is recommended that continue to be inspected at each outage
    - to assure that the extent of the exit hole cracking is acceptable for operation in the subsequent cycle.

CS SPU SER & Major Findings (5/7)

- **Complement main steam line break and feedwater line break analysis**
  - CS FSAR merely evaluate Recir. line break condition.
    - FSAR modification
  - Main steam line break govern Drywell temp.
    - review drywell coating performance

	Drywell peak pressure (psig)	Drywell peak temp. (°F)
Recir. Line break	31.5	278.8
main steam line break	30.9	311.5
feedwater line break	28.3	275.8

CS SPU SER & Major Findings (6/7)

- **CSCCW & TBCCW System thermal load increase < 2%**
  - CSCCW EX.thermal load increase 1.1 MBTU/hr to 65.3 MBTU/hr < 95.0 MBTU/hr design load.
  - TBCCW system has 7% original design thermal load margin SPU System thermal load increase < 2%
    - CSCCW：Combination Structure Closed Cooling Water
    - TBCCW ：Turbine Building Closed Cooling Water

CS SPU SER & Major Findings (7/7)

- **Main Condenser (MC)/Circulating Water System** (CWS)
- **SPU Normal operation outlet Temp. increase 0.3℃ (0.5℉)，peak temp. (summer)38.8℃ (101.8℉) < 42 ℃ (107.6℉) Limit temp.**
- **Main Condenser pressure increase 2%, peak pressure (summer) 74mm (2.9 in.) Hg abs 。**
- **Normal Chiller Water system thermal load will increase 2% OLTP after SPU.**

Concluding Remarks

- **No major changes or modification to equipment**
  - Feedwater heater drain control valve
- **2nd step uprate to1858 MWt**
  - TPC has to submit SDVM plan of stream dryer and reload Licensing Analysis Report of 1858 MWt.
- **TPC submitted uprate request for Kuosheng NPP in Nov. 2012**
  - 1st step :3.7% OLTP,
  - 2nd step :4.7% OLTP after SDVM installed per BWRVIP-182A

Thank You for Your Attention