2012 AEC-NRC Bilateral Technical Meeting

Overview of Recent Regulatory Activities in Taiwan

Department of Nuclear Regulation
Atomic Energy Council, Taiwan

May 19, 2012

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- Operating Nuclear Power Plants Performance Record
- Recent Nuclear Regulatory Activities
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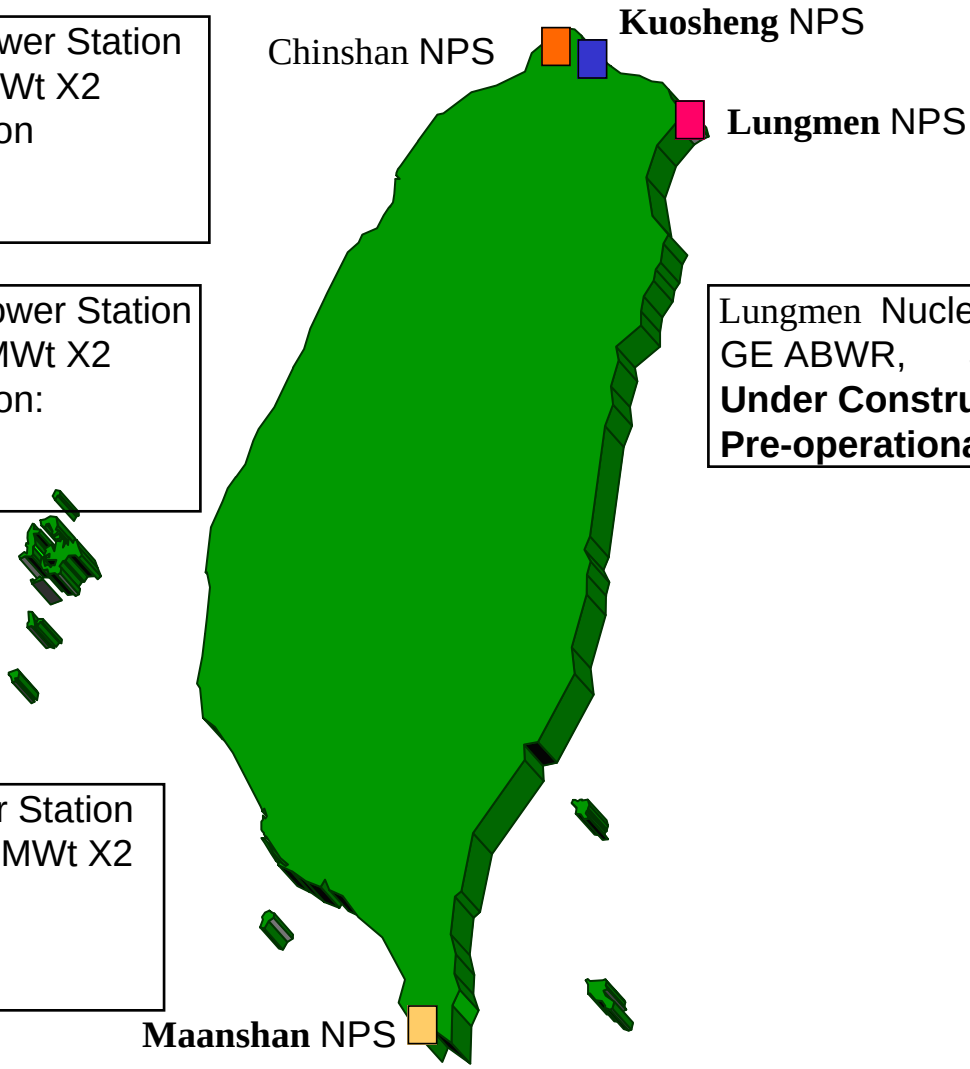
Operating Nuclear Power Plants Performance Record

Operating Nuclear Power Plants Performance Record

Chinshan Nuclear Power Station
GE BWR 4, 1775MWt X2
Commercial Operation
#1: Dec. 1978
#2: July 1979

Kuosheng Nuclear Power Station
GE BWR 6, 2894MWt X2
Commercial Operation:
#1: Dec. 1981
#2: Mar. 1983

Maanshan Nuclear Power Station
W PWR, 3 loop, 2775MWt X2
Commercial Operation
#1: July 1984
#2: May 1985



Lungmen Nuclear Power Station
GE ABWR, 3926MWt X2
Under Construction and Pre-operational Testing

Locations and Major Features of NPPs in Taiwan

Operating Nuclear Power Plants Performance Record

Real-Time Nuclear Power Plant Operational Status

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Plant & Units	Chinshan		Kuosheng		Maanshan	
	Unit 1	Unit 2	Unit 1	Unit 2	Unit 1	Unit 2
Reactor Status	Operating	Operating	Reactor Shutdown	Operating	Operating	Operating
Reactor Power (%)	100	100		100	100	100
Generator Output (MWe)	628	637		1001	975	955

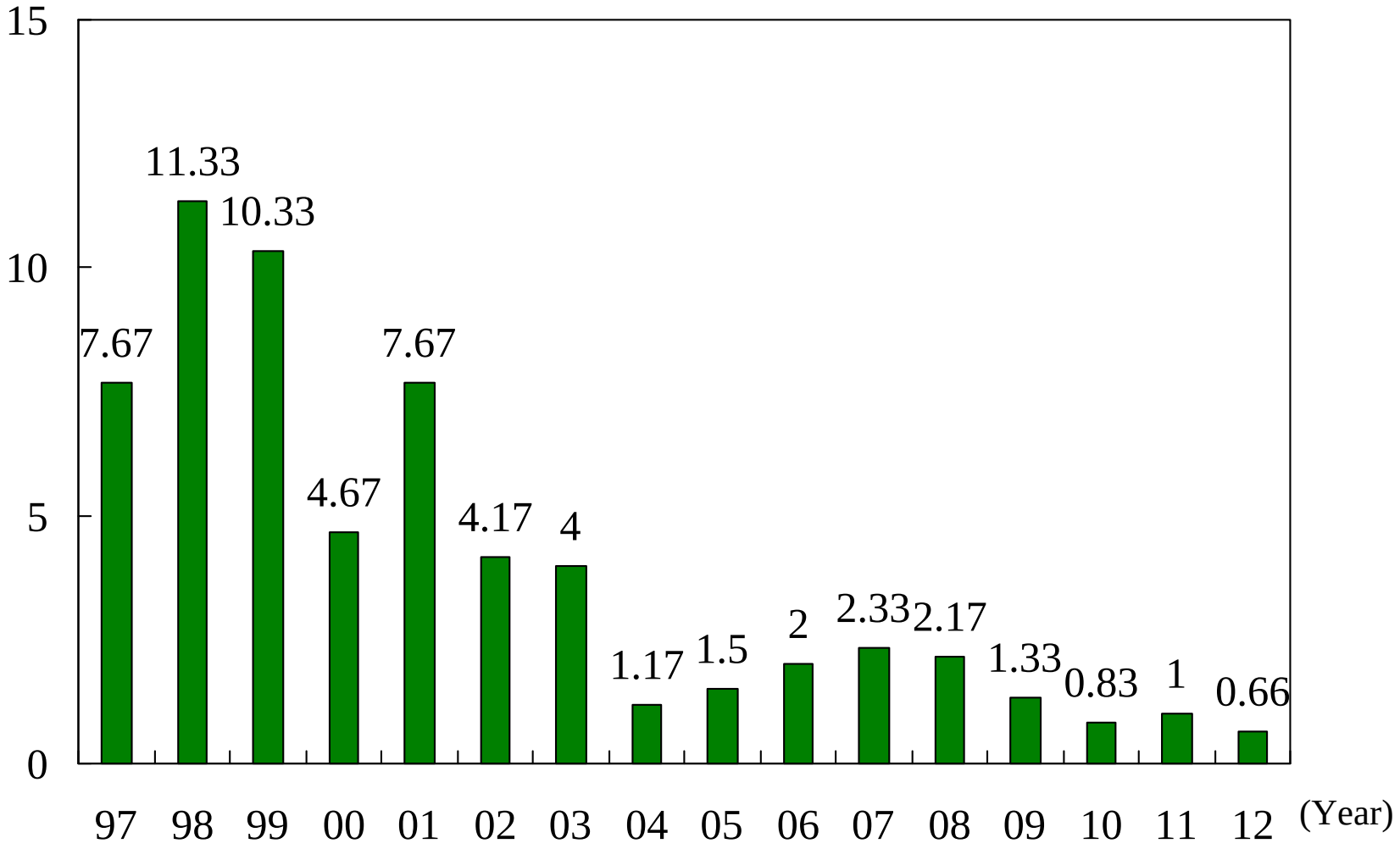
Reactor Status Display :
[Green] : Operating, [White] : Refueling Outage, shutdown, [Gray] : Computer Maintenance, Computer down, Communication Fault, and Connected to Simulator for drill.

Reactor Power and Generator Output Display :
[Green] : Reactor Power within 100%, [White] : Reactor Power between 101%~102%, [Yellow] : Reactor Power above 102%

Display is changing automatically every 5 seconds; decimals will round off for the numbers.

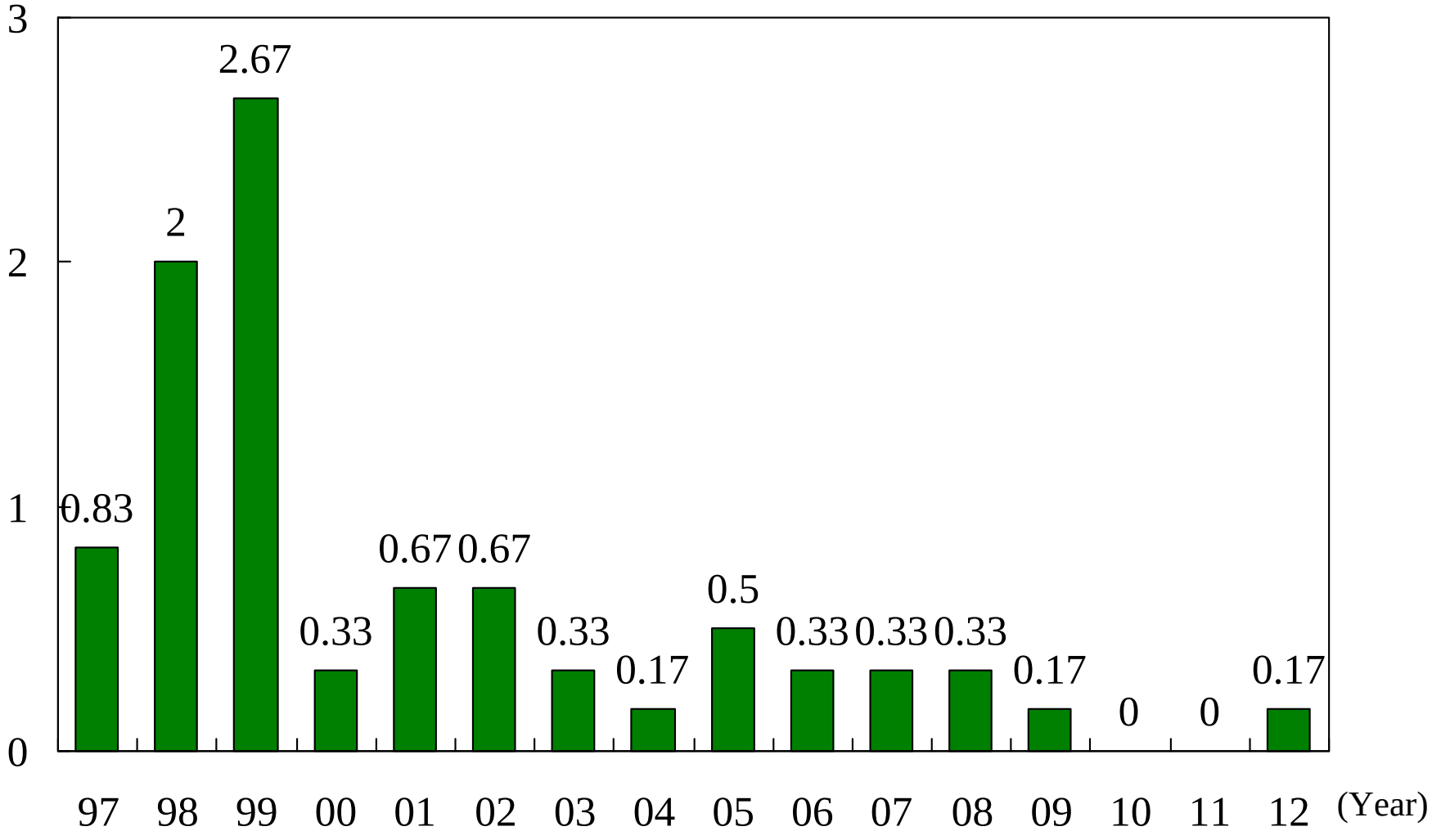
http://gamma.aec.gov.tw/spds/plantdata_e.asp

Operating Nuclear Power Plants Performance Record



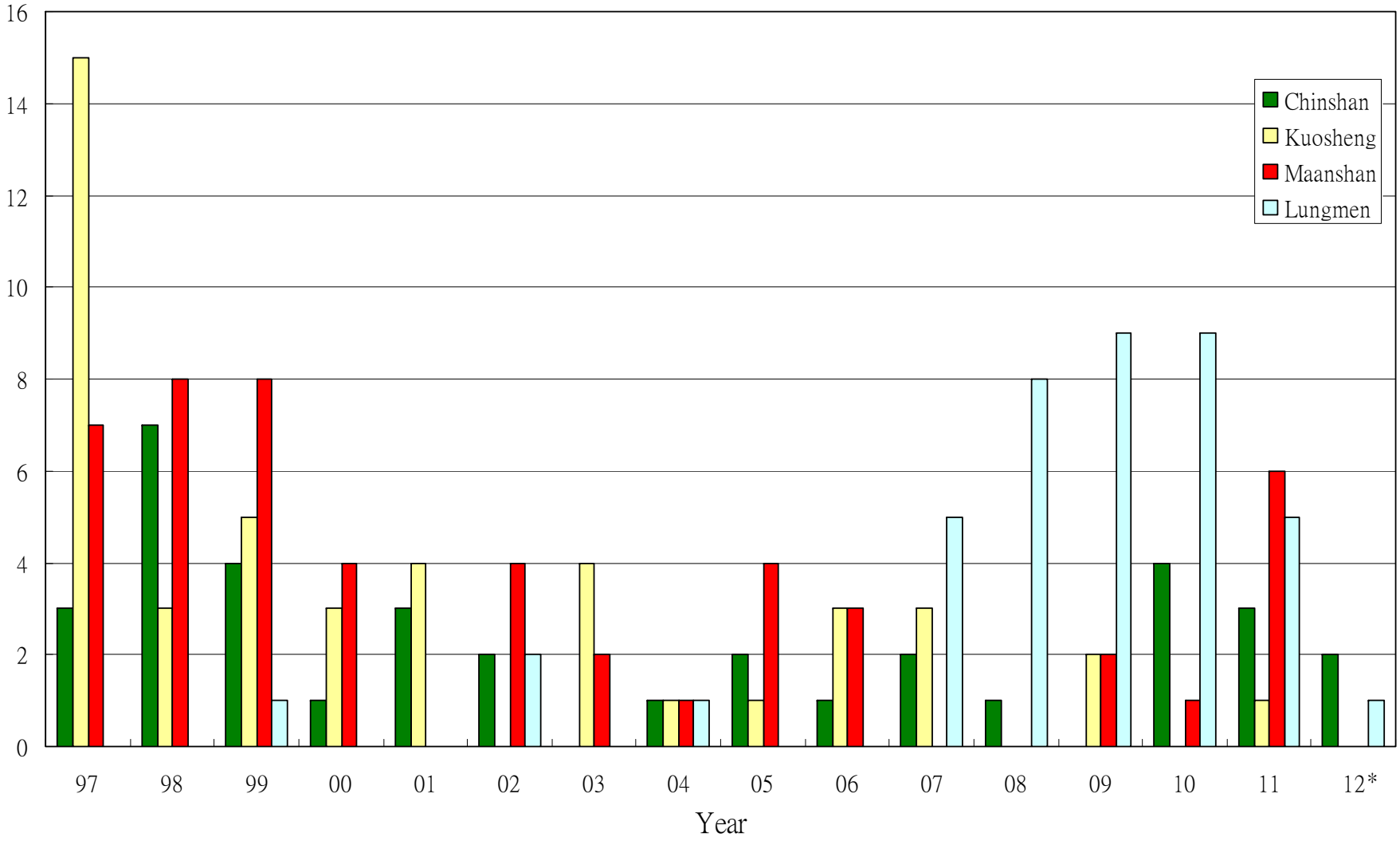
Average Number of RERs per Unit

Operating Nuclear Power Plants Performance Record



Average Number of Scram per Unit

Number of Violations for each plant



Number of Violation for Each Plant（* : Data up to the end of May 2012）

Recent Nuclear Regulatory Activities

- Stretch Power Uprate Review of Chinshan NPP
- Transient Analysis Methodology Licensing Applications
- Seismic Upgrade from 0.3g to 0.4g for Chinshan NPP
- Underground Water and Buried Piping Monitoring
- Safety Re-evaluation and Enhancement Plan for Seismic Resistance
- Risk-Informed Application Review
- Domestic Fire Protection Standard for NPPs
- RPV Support Skirt Anchor Bolt Fracture of Kuosheng Unit 1
- Violations in Design Changes and Implementations of Lungmen Project
- RBSW AV Problems at Lungmen NPP

Stretch Power Uprate Review of Chinshan NPP (1/2)

- TPC submitted Chinshan's Stretch Power Uprate (SPU) application in Dec. 2010.
- Chinshan's OLTP is 1,775MWt and CLTP is 1,804MWt (101.66% OLTP) due to Measurement Uncertainty Recapture (MUR) Power Uprate on 2009.2.24 and 2008.7.9 for unit 1 and unit 2 respectively.
- 2 Step Power Uprate
  - Raise to 1,840MWt (103.66% OLTP) in Oct. 2012 for Unit 1 and Jan. 2013 for Unit 2 after restart from refueling outage.
  - Raise to 1,858MWt (104.66% OLTP) after steam dryer vibration monitoring (SDVM) is installed. (Schedule to be determined by TPC)
- Constant Rx. Pressure Power Uprate (CPPU)
- No major changes or modification to equipment.

Stretch Power Uprate Review of Chinshan NPP (2/2)

- Safety Review Process and Major Tasks Summary
  - A review task force team of experts and AEC staff was established
  - Review guidance: NRC RS 001 “review standard for EPU” and previously approved SPU application
  - Held 5 review meetings with TPC
  - Issued 179 RAIs
  - After latest review meeting in May 2012, there are 10 RAIs needed to be clarified by TPC, mainly related to steam dryer and feedwater nozzle continuing operation safety analysis
- TPC will submit related reports for SPU for review, i.e. reload safety analysis, design changes report, FSAR and Tech. Spec. amendment request, etc.
- SERs are being prepared.
- According to the schedule, it’s expected to make decision on application in mid-October 2012.

Transient Analysis Methodology Licensing Applications

- Transient Analysis has mainly been performed for TPC by the fuel vendors.
- In order to develop TPC's own safety analysis capability, TPC submits a series of topical reports of TITRAM (TPC/INER Transient Analysis Methods) for licensing review.
- Totally 40 reports, 28 have been approved (2006-2012), and 6 are expected to be approved in June 2012.
- Part of these reports have been implemented in the MUR applications. Some are prepared for supporting the SPU projects.

Seismic Upgrade from 0.3g to 0.4g for Chinshan NPP

- Soon after Fukushima accident, the Government requested TPC to implement the Seismic Upgrade from 0.3g to 0.4g for Chinshan NPP
- TPC submitted the implementation plan to AEC in Oct. 2011
- NRC USI-A-46 methodology is used by TPC to assess the seismic adequacy of equipment
- In TPC's schedule, the assessment will be completed in June 2014 and start to implement site work
- The completion date of this project estimate Dec. 2017

Underground Water and Buried Piping Monitoring

- TPC was requested to implement a groundwater protection program due to many foreign incidents of tritium leaks
- Buried pipes of potential leakage were identified firstly
- Site-specific conceptual models of groundwater transport and buried pipes monitoring management will be established for three NPPs
- Chinshan and Kuosheng site conceptual models has been submitted in May 2012 and currently are under review

Safety Re-evaluation and Enhancement Plan for Seismic Resistance (1/2)

- Background
  - Hengchun Earthquake (M_L=7.0) induced two major shocks to Maanshan NPP on Dec. 26, 2006
  - New active fault identified
    - Sanchiao Fault (fault length 34 km or longer) of Northern Taiwan near Chinshan and Kuosheng NPPs
    - Hengchun Fault (fault length 16 km or longer) of Southern Taiwan near Manshan NPP
  - Experience from KK and Hamaoka NPPs in Japan
  - Experience from Fukushima Daiichi NPP in Japan

Safety Re-evaluation and Enhancement Plan for Seismic Resistance (2/2)

- Scope of Plan
  - Geologic survey on land and marine region (~ June 2012)
    - To get geologic characteristics of active faults
    - Sanchiao Fault may have longer length (> 40km) extended to the sea of Northern Taiwan based on the preliminary marine survey
  - Seismic hazard re-analysis (~ Dec. 2012)
    - Design base earthquake re-evaluation
    - Site effect analysis of NPP would be included as well.
  - Re-evaluation of seismic resistance margin (~ Dec. 2013 or earlier)
  - Reinforcement of seismic resistance on SSCs.

Risk-Informed Application Review (RI-ISI) (1/5)

- Scope of RI-ISI
  - Only for class-1 and class-2 piping

    -Class-1 piping on B-J and B-F welds

    -Class-2 piping on C-F-1 and C-F-2 welds
  - NOT include

    -augmented inspection from FAC (all the piping segments classified as category A and B in TPC's Long-term FAC Program will be regarded as suspected piping)

    -PWSCC welds

    ∗RPV/PZR welds subject to AMP-139 inspection

    ∗after Weld Overlay, return to ISI or RI-ISI program

Risk-Informed Application Review (RI-ISI) (2/5)

- Status of RI-ISI
  - A pilot study just for RHR system of Kuosheng NPP (2004)
  - RI-ISI review guidance developed by INER (2005)
  - RI-ISI programs are prepared by TPC
  - Tentative schedule for RI-ISI program submittal
    - Kuosheng: 2012 (EOC-22)
    - Chinshan: 2011 (EOC-25)
    - Maanshan: 2015 (EOC-22)

Risk-Informed Application Review (Status of OLM) (3/5)

- TPC Self-management guideline and self-assessment reports for on-line maintenance have been reviewed and approved in 2010
- AEC has conducted routine or special inspection to monitor and check maintenance effectiveness of NPPs

Risk-Informed Application Review (PRA Update) (4/5)

- Update PRA models for three NPPs
  - Adopt the newer generic data for initiating events, components and CCF factors
  - Compile specific data to the end of 2009
  - CCF factors used the MGL model
- Update the fire PRA modeling by the methodology of NUREG/CR-6850 for Chinshan NPP (BWR-4 plant)

Risk-Informed Application Review (ILRT Interval Extension) (5/5)

- Maanshan MS1 ILRT 10-year interval due before Dec. 2011, not well-prepared for the test because of internal miscommunication
- Apply to be postponed to the next refueling outage in May 2012 -- 5 months extension proposed
- The review refer to
  - Submittals of Farley NPP
  - Internal and external events PRA models of Maanshan NPP
  - The methodology of EPRI TR-1018423, Risk Impact Assessment of Extended Integrated Leak Rate Testing Intervals
  - NEI 94-01, Industry Guideline for implementing Performance-Based Option of 10CFR Part 50, Appendix J
- Acceptable criteria: population dose rate, LERF, CCFP (conditional containment failure probability) , RG 1.174 risk measures △LERF

Domestic Fire Protection Standard for NPPs (1/3)

- The current fire protection programs in Taiwan's Nuclear Power Plants are in accordance with GDC 3, RG 1.120, NFPA Standards...
- However, National Fire Agency of Taiwan has also a general fire standard, which shall be applied to the nuclear power plants, too.
- NPPs have difficulty to meet regulations applied to other industries.

Domestic Fire Protection Standard for NPPs (2/3)

- According to AEC inspection findings:
  - NPPs still have many noncompliances with current licensing basis, mainly in Appendix R
  - Certain features cannot even fully satisfy regulations from National Fire Agency of Taiwan
- Due to these facts, AEC is developing a new regulation designated to NPPs, that is, fire regulation effective only within power block of NPPs.

Domestic Fire Protection Standard for NPPs (3/3)

- The new regulation refers to NFPA-805, other relevant NFPA Standards, RG 1.189, and 10CFR50.48(c).
- The draft version has been completed in the end of 2011.
- Now, AEC is waiting for the Legislative Yuan to approve the law modifications to authorize the lawmaking of Domestic Fire Protection Standard for NPPs.

RPV Support Skirt Anchor Bolt Fracture of Kuosheng Unit 1(1/2)

- AEC requested TPC to perform KS-1 additional UT on all 120 RPV support skirt anchor bolts due to an anchor bolt fracture found at KS-2 during refueling outage last year
- One broken, two almost broken, and four bolts with crack indications were found in the KS-1 UT results performed in this March
- When KS-1 reactor switched to shutdown mode, one seismometer 0SG-XE-105 measured max. 0.29g acceleration in vertical direction

RPV Support Skirt Anchor Bolt Fracture of Kuosheng Unit 1(2/2)

- This event attracts large amount of public and media attention and concerns
- AEC established a task force to investigate, from the aspects of civil structure, metal material, seismic, geological, and environment
- Only after the root cause of bolt fracture being confirmed and making sure no common cause exists, KS-1 may restart with AEC's permission
- The technical details of this event will be presented by TPC later

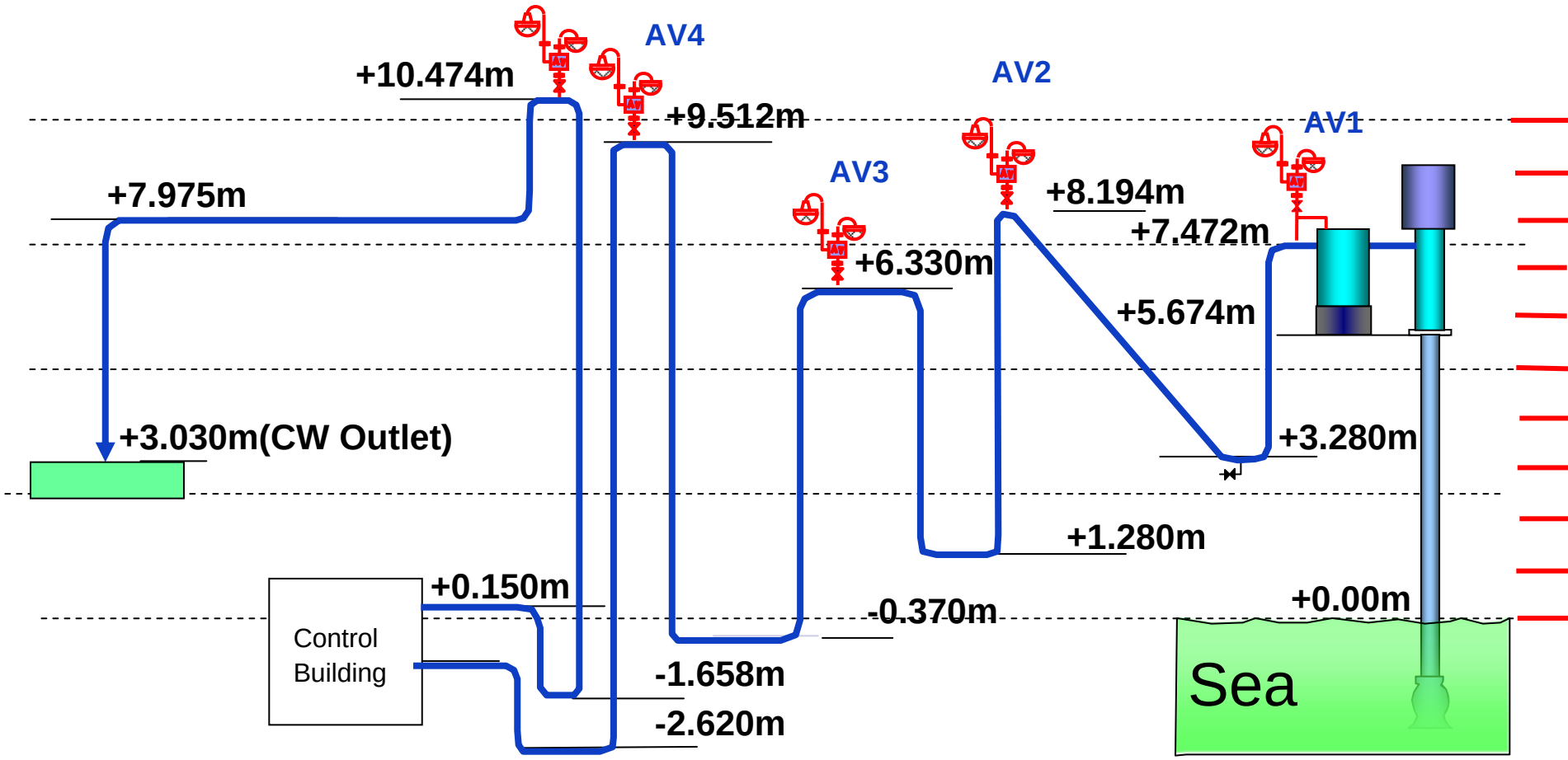
Violations in Design Changes and Implementations of Lungmen Project

- AEC inspectors found that TPC performed safety related design changes and implementations by themselves, not through the cognizant design and engineering organizations, during the period from Dec. 2009 to the end of 2010
- AEC has issues 3 notices of violation in 2008 for the same reason
- AEC has once agreed with a temporary measures for TPC's design changes in 2009. However, when GEH returned to the site (Mar. 2010) and E&C/URS was designated in charge of BOP design changes (Nov. 2009), the temporary measures has been repealed in Nov. 2009
- AEC issued a Level 2 Violation and a NT$15M (~US$500K) penalty to TPC

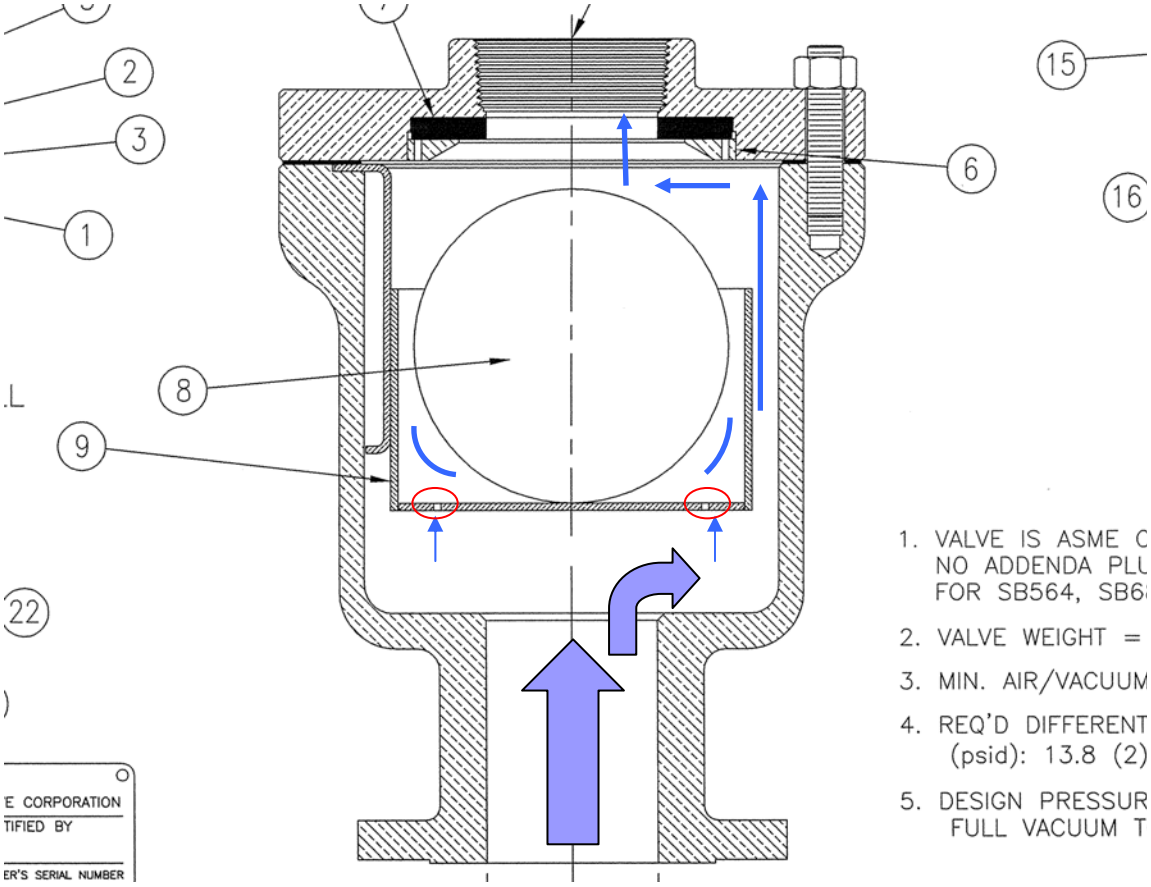
RBSW AV Problems at Lungmen NPP

- Lungmen RBSW system uses automatic air & vacuum relief valves (AVs) to vent air in the seawater piping when the system starts
- Recently some AVs failure to function have been found. The ball inside AV fails to close after the air has been vented, and sea water flow out through the valve
- Since Sept. 2011, three major flooding events have happened at RBSW pump room, piping trench and valve rooms, respectively
- Two violations have been issued by AEC for the RBSW AV problems

RBSW Waterway Elevation and AV Locations



Lungmen RBSW air & vacuum relief valve



Concluding Remarks

- The overall safety performance of nuclear power plants in Taiwan is continuously maintained at a high level of standards
- The goal of the reactor regulation is not only to assure the safety of the NPPs in order to protect the public health and environment but also to maintain the stable/reliable operation.
- Continue our effort to be more effective, efficient, consistent, open and transparent in regulatory activities

Thank You for Your Attention