



Implementation of Ageing management Programme in Indian NPPs: Regulatory Perspective

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Topics

- Status of nuclear power programme in India
- AERB
- Renewal of Authorisation
- Periodic Safety Review
- PSR of Indian NPPs
- Ageing Management Programme
- Findings with respect to Ageing
- Conclusion



Status of Nuclear Power Programme in India

NPPs in operation

			Year of commissioning
TAPS 1&2	2X160 MWe	BWR	1969
RAPS-1	150 MWe	PHWR	1972
RAPS-2	200 MWe	PHWR	1980
MAPS-1&2	2X220 MWe	PHWR	1983 & 1985
NAPS-1&2	2X220 MWe	PHWR	1989 & 1991
KAPS-1&2	2X220 MWe	PHWR	1992&1994
KGS-1&2	2X220 MWe	PHWR	2000&1999
RAPS-3&4	2X220 MWe	PHWR	2000&1999
TAPP-3&4	540 MWe	PHWR	2005
KGS-3	220 MWe	PHWR	2007



Status of Nuclear Power Programme in India

NPPs Under Construction

KGS-3	220 MWe	PHWR
RAPS-5&6	2X220 MWe	PHWR
Kalpakkam	500 MWe	FBR
Kudankulam	2X1000 MWe	VVER



Atomic Energy Regulatory Board

- AERB was established in 1983
- Regulatory framework for safety of all activities related to atomic energy program & use of ionising radiation in India, under Sections 16, 17 and 23 of Atomic Energy Act, 1962
- Mission of AERB is to ensure that the use of ionizing radiation and nuclear energy in India does not cause undue risk to the health and environment





Renewal of Authorisation

- Authorisation for operation: Instrument of regulation of NPPs
- Authorisation with limited term
- Renewal of authorisation towards end of current authorisation
- Formal system for initial and periodic renewal of authorisation
- System of renewal since 1993
- Application for Renewal of Authorisation (ARA)
- Requirement of Periodic Safety Reviews for Renewal of Authorisation, from 2001.



Periodic Safety Review: Requirements

- AERB Code on Regulation of Nuclear and Radiation Facilities
- AERB guide on 'Consenting process for Nuclear Power Plants and Research Reactors' – AERB/SG/G-1.
- AERB guide for Renewal of Authorisation for Operation of NPPs' – AERB/SG-O-12
- PSR – once in 10 years
- First PSR for a reactor of new design – 5 years after initial authorisation



Periodic Safety Review

- Review of Ageing Management an important aspect
- Review objectives
 - NPP ageing is being effectively managed and safety margins are adequate
 - Ageing management program is in place for future operation



PSR of Indian NPPs

- PSRs carried out for
 - NAPS (2003)
 - KAPS (2004)
 - MAPS (2005)
 - RAPS-2 (in progress)

- Comprehensive Safety Review for Long term operation of TAPS 1&2 (2000 – 2005)
- Comprehensive Safety Review of RAPS-2 during EMCCR (1997)



Ageing Management Programme

- Ageing Management Programme: One of the Generic action items of PSR
- Ageing Management Programmes drawn up as per AERB guide on Life Management of Nuclear Power Plants (AERB/NPP/SG/O-14)
 - Identification of SSCs important to safety (classification based on AERB guide AERB/SG/D-1)
 - Categorization
 - Replaceable/repairable
 - Replaceable with re-engineering
 - Non-replaceable
 - Identification of degradation mechanism
 - Monitoring
 - Mitigation
- Expert Group on Ageing Management, at AERB

Ageing Management Programme

Tabular Format for Ageing Management Report
Table 1 - Design Input

Structures, Systems and Components (SSC)	Safety Classification	Material of Construction	Environment	Degradation Mechanism	Element of Ageing Management Program which addresses it and reference document

Table-2 Addressing Ageing Management

Structures, Systems and Components (SSC)	Extent of AMP accomplished vis-à-vis envisaged	Results of Ageing Management Program	Reference document	Conclusion and further action planned



PSR: Findings with respect to ageing

- Plants have complied with the established programmes for maintenance, in-service inspection, chemistry control, etc, since beginning
- No concerns of any life limiting ageing degradation of non-replaceable SSCs.
 - Reactor Vessels, containment at TAPS
 - Calandria, end shields, calandria vaults, RCB structures at PHWRs



PSR: Findings with respect to ageing

- The main ageing related concerns
 - Coolant Channels
 - Feeder pipes of Primary Heat Transport System
 - Steam Generators at MAPS
 - Obsolescence Issues



Ageing management of coolant channels

- Pressure Tube material – Zircaloy-2
 - originally used in reactors up to KAPS – 1.
 - Hydrogen pick up
 - Shifting of garter spring spacers
 - Extensive inspections, repositioning of garter springs
 - Replacement after 10 to 12 Full Power Years
 - Presently phased out from all operating units



Ageing management of coolant channels

- Zr – 2.5% Nb Pressure Tubes:
 - Lead reactor KAPS – 2 completed 10 FPY
 - Present concern: Creep
 - Issues of Axial / Diametric creep
 - Inspections, material surveillance, modeling



Ageing management of PHT feeders

- Concern regarding thinning of elbows on outlet side feeders
- Higher rate of thinning than expected
- Flow Assisted Erosion - Corrosion
- Problem was more pronounced in RAPS-2, MAPS, NAPS
- Coverage and scope of In-service Inspection of feeders enhanced
 - More number of feeders monitored
 - Inspection of straighter portion also in addition to elbows
- En-masse replacement done for RAPS-2, MAPS-1, NAPS-1&2, KAPS-1
 - SA – 333 Grade – 6 with higher chromium
 - Elbows of higher schedule (160) for increased margins



Steam Generators at MAPS

- Hairpin heat exchangers with Monel-400 tubes
- Tube leaks encountered in the late nineties
- Degradation mechanism: Under deposit pitting corrosion
- Deposits with significant amount of Cu, near tube sheets
- No evidence of the problem in RAPS units
- Problem peculiar to coastal unit employing sea water cooling
- SGs of MAPS units replaced
- Continuous blow down implemented



Obsolescence Issues

- In older units
- Mainly on Electrical and Instrumentation
- Addressed through replacements & upgradations
- Typical cases
 - DGs & MGs of Emergency Power Supplies
 - Switch gear
 - Controllers
 - Indicating Alarm Meters
 - Solenoid Valves
- Issues associated with replacements
 - Engineering / Specification
 - Vendor identification
 - Qualification



Conclusion

Implementation of systematic programme for ageing management of SSCs is a requirement for the NPPs in India. Review of adequacy of the ageing management programme and its adequacy are important aspects in the PSR. Implementation of ageing management programme has been helpful in systematically addressing the ageing concerns of SSCs important to safety at the NPPs. The endeavor at AERB is to ensure that the safety margins of the plant remain at acceptable levels, through effective ageing management.



Thank You!