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Presentation on:

DOSE REDUCTION PROCESS AND TECHNIQUES AT CHASHMA NPP-1

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1. Mission Statement

"To generate electricity in a demonstrably safe, reliable and cost effective manner over the long term for the benefit of our society and stake holders as well as to consolidate the basis for development of the nuclear power industry in Pakistan"

2. Plant Specific Information

- Owner: Pakistan Atomic Energy Commission (PAEC)
- Regulatory Regime of Pakistan Nuclear Regulatory Authority (PNRA)
- Supplier: CZEC/China
- Designer: SNERDI/China
- Rated Thermal Power: 998.6 MWth
- Gross Electrical Output: 325 MWe
- 02 loop PWR light water reactor
- Fuel Assemblies:121, Enriched Uranium Level: 3.4%.

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- Construction started in 1992
- Project Completion in 2000.
- 5 Radiation Zones of RCA based on dose rate.
- 1st Criticality (3rd May 2000)
- Commercial Operation since 15th Sep. 2000.
- 12 Refueling Outages till date
- 239 days continuous operation in cycle-8

3. Regulatory Dose Limits

Organ or Tissue	Dose Quantity	Dose Limits (mSv/y)	
		Radiation Workers	Public
Whole body	Effective dose	20	1
Lens of the eye	Equivalent dose	20	15
Extremities or Skin	Equivalent dose	500	50

4. Plant Radiological Design

- Shielding Design for Occupational exposure is 50 mSv/y (old standard)
- RCA divided into 05 Radiation Zones based on dose rate
- Administrative control to access rooms of zone – III and higher

Zone-I	Zone-II	Zone-III	Zone-IV	Zone-V
μSv/hr				
<10	<25	<150	<1000	>1000

5. Administrative Control limits

- Compliance with latest Standard (Regulatory limit 20 mSv/y)
- Plant Administrative Limits (below 20 mSv/y)

Organ or Tissue	Dose Quantity	Station (mSv/y)	Unit (mSv/y)
Whole body	Effective dose	15	3.75
Lens of the eye	Equivalent dose	112	56
Extremities	Equivalent dose	375	187

6. The ALARA Principle

- Management has strong commitment towards ALARA
- ALARA Committee has been established which provides oversight to radiological control. Committee meets twice a year
- Emphasis on adherence to RP procedure and safety instructions
- Outage Collective dose targets

7. Dose Reduction in Normal Process

Design Provisions and Features

- Purification system in downstream of Let-down HX
- Cation/Anion/Mixed bed resin column
- Filter in SCV at up/down stream of mixed bed.
- Gas stripping function
  - ✓ Radioactive Noble gases are removed during normal operation
  - ✓ Pressurizer & VCT
  - ✓ SGW for treatment

8. Dose Reduction in Outages

A. Oxidation Process

- A dose reduction technique.
- The process involves removal of the magnetite layer of corrosion products formed during power operation.
- Hydrogen peroxide (H_2O_2) is injected in the primary system. The corrosion products get detached from the system.
- The contaminants are removed through ion exchange column (mixed bed) and filter in SCV.

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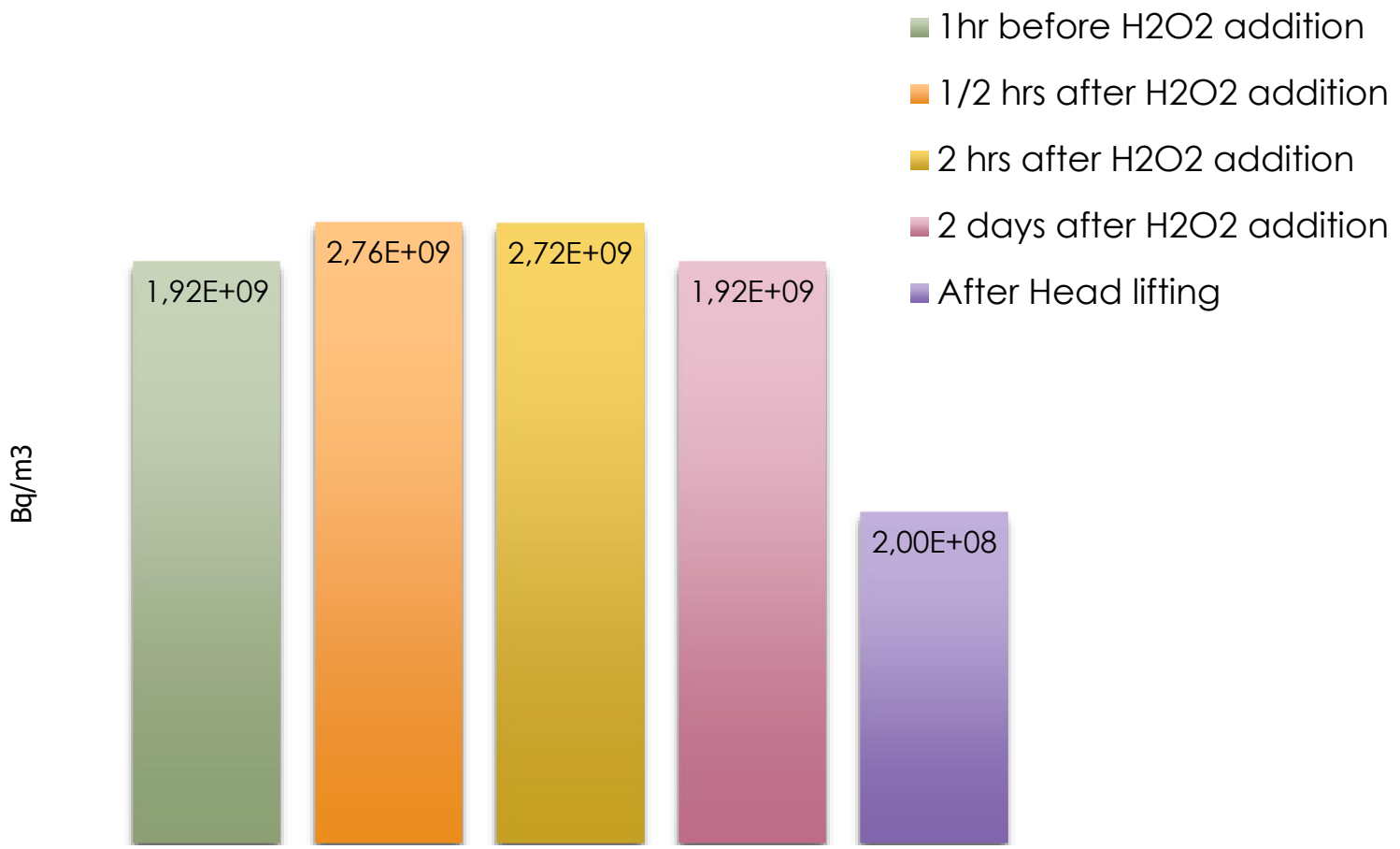
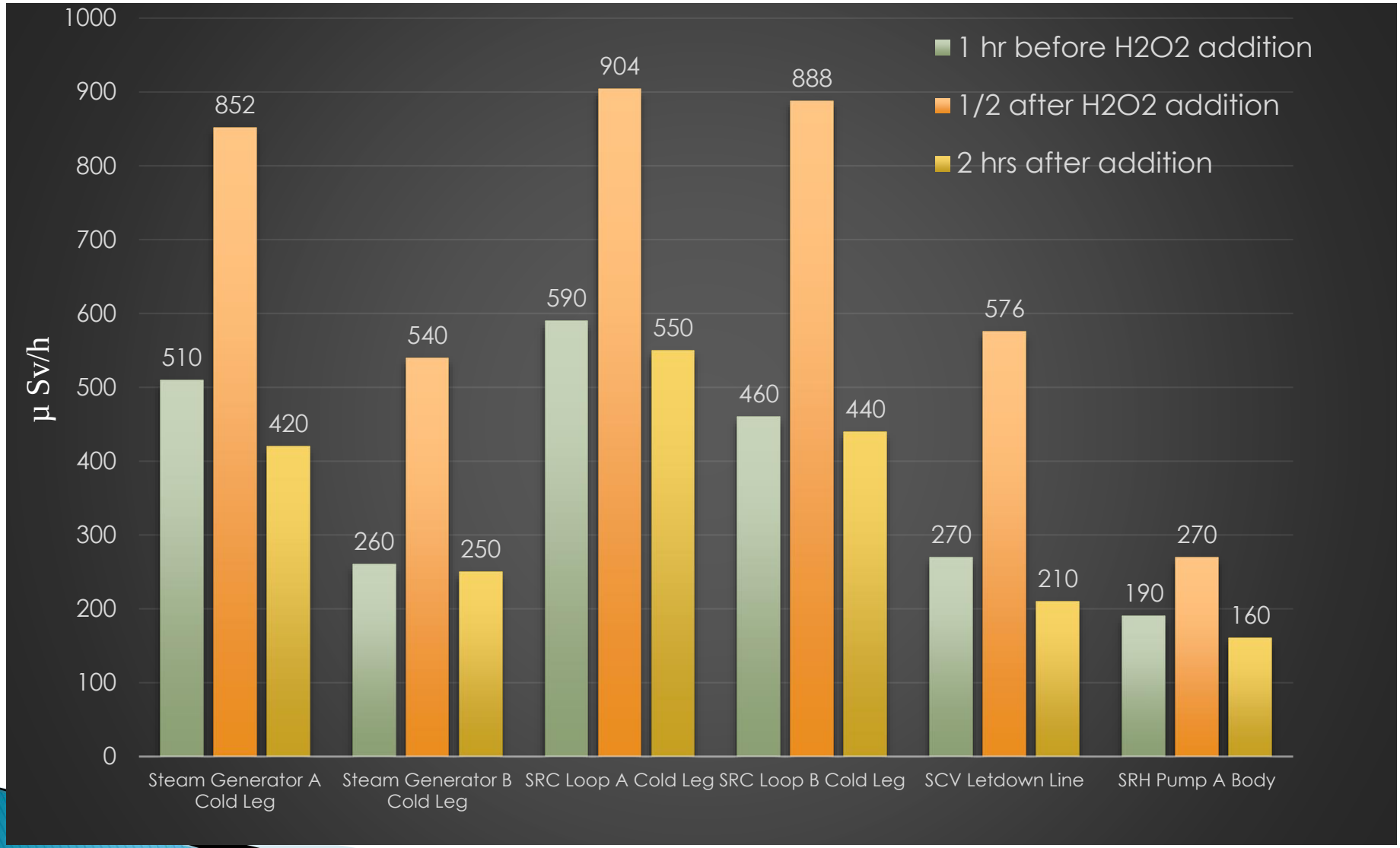
- RPV Head is opened when radionuclide concentration in SRC meets a certain criteria:
  - ✓ Total γ $< 4E+9$ Bq/m^3 and/or
  - ✓ Co-58 $< 2E+8$ Bq/m^3
  - Co-60 $< 2E+8$ Bq/m^3
  - I-131 $< 5E+7$ Bq/m^3
  - Xe-133 $< 1E+8$ Bq/m^3

B. Coolant Activity during oxidation Process



C. Dose Rate Trends at Selected Points



9. Dose Reduction in RCP Maintenance

Chemical Decontamination of RCP

A. AP-CITROX , a proven De-Cont. method is applied.

Following were salient features of the process.

- work piece is kept at 90-95 °C in AP Solution
- work piece is kept at 90-95 °C in CITROX Solution
- work piece is made passive by use of H_2O_2 at 60 °C in an acidic medium

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B. Total Activity Leached out from RCP;

- Total 158 GBq (~4 Ci) removed.
- Nuclide leached out were mainly Mn-54, Cr-51, Co-58, Co-60, Zr-95, Nb-95, Sb-124, Mo-99, Fe-59 & Sn-113.
- Dose rates at the surface of RCP for different selected points were < 1mSv/hr (except hot spot).

C. Dose Reduction Factor (DRF)

	RCP-B	RCP-A
DRF range	11~50	2.5~58
Ave. DRF	27	24

E. RCP Overhauling Steps






10. Dose Reduction in SG Inspections

Nozzle Dam Cover Modification

A. Installation & removal of Man-Way Cover and Nozzle Dam Cover on SG is performed in alternate outage .

B. Before modification of ND Cover

- ND Cover was too Heavy
- Two workers needed for installation / removal
- Two minutes needed inside SGs (50 mSv/hr) for installation and removal
- 13 man-mSv is collective dose for this job

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C. After modification

- Light weight ND Cover fabricated
- 01 worker needed for installation / removal
- 01 minute needed inside SGs (50msv/hr) for installation and vice versa
- 07 man-mSv collective dose

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SG Man-Way Cover Installation / Removal

- Installation & removal of Man-Way Cover of SGs is performed manually in C-1 in each outage.
- The collective dose received during this job is ~ 18man-mSv
- State of the art Pneumatic-hydraulic Pump for installation & removal of Man-Way Cover has been arranged .
- Maintainers training underway at mock up.
- Estimated collective dose reduction in is expected to be 12man-mSv (70%).

THANKS!