

INTERNAL PEER REVIEW (IPR) OF PAKISTAN RESEARCH REACTOR-1 (PARR-1)

Said Kashif Shah
Pakistan Atomic Energy Commission

Presentation Layout

- **Pakistan Atomic Energy Commission (PAEC)**
- **Description of Pakistan Research Reactor-1 (PARR-1)**
- **Internal Peer Review (IPR) of PARR-1**

PAKISTAN ATOMIC ENERGY COMMISSION

Establishment: 1956, Atomic energy Research Council

Reorganization: 1964, Atomic Energy Commission

- Nuclear Energy
- R&D
- Agriculture & Biotechnology
- Cancer Hospitals
- HRD

NUCLEAR POWER PLANTS

KARACHI NUCLEAR POWER PLANTS (KANUPP)

Location: Karachi
Type: CANDU (CANada Deuterium and Uranium)
Power: 137 MWe
Commercial Operation: 1972

Under Construction K2 & K3
Expected date of Operation 2021
Power: 1100 MWe each

CHASHMA NUCLEAR POWER PLANTS (CHASHNUPP)

No of Units 4
Location: CHASHMA (Mianwali)
Type: PWR (Pressured Water Reactor)
Power: 2*325, 2*340 MWe

FUTURE PLANS 8800 MWe by the year 2030

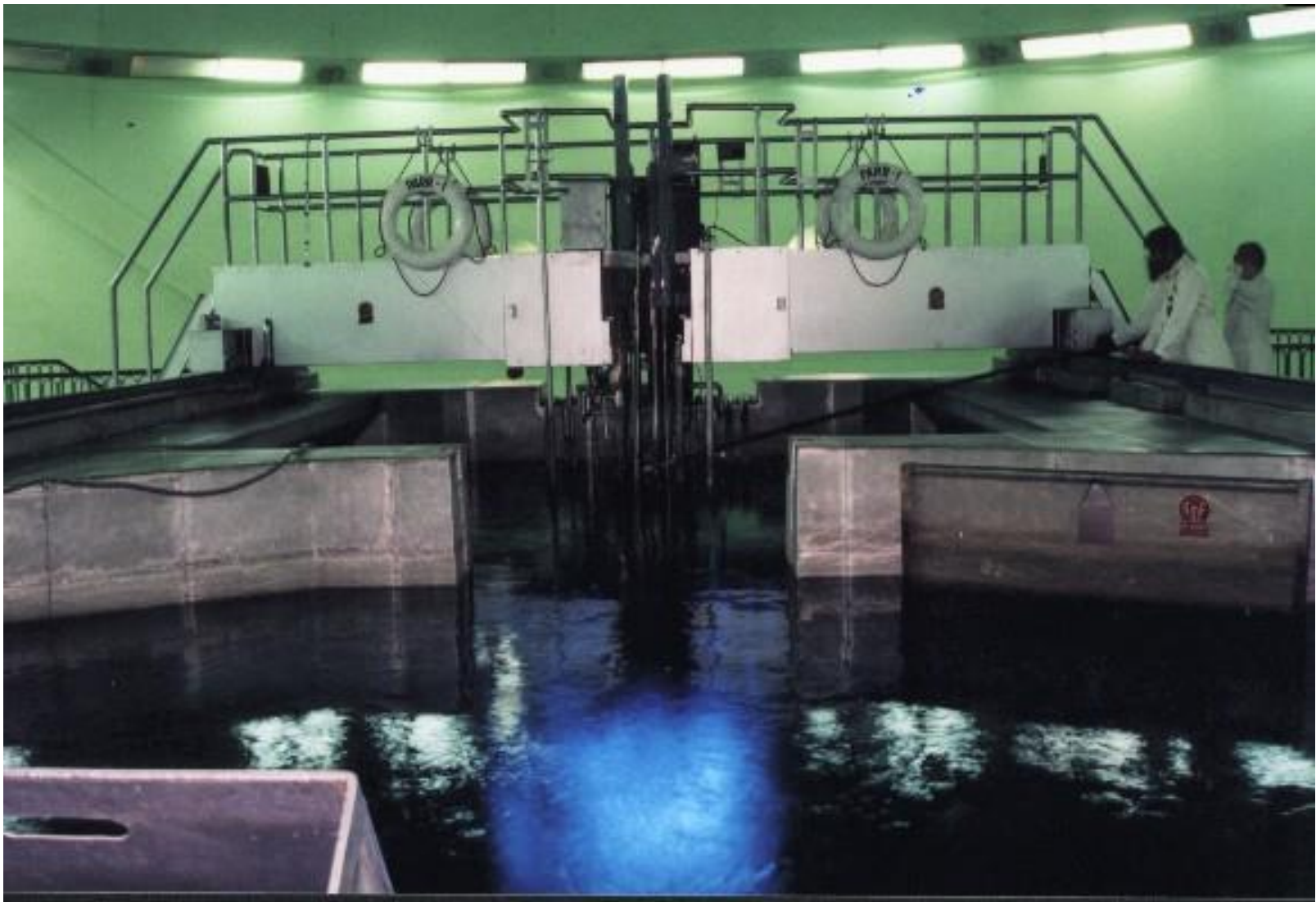
RESEARCH REACTORS

Pakistan Research Reactor-1 (PARR-1)

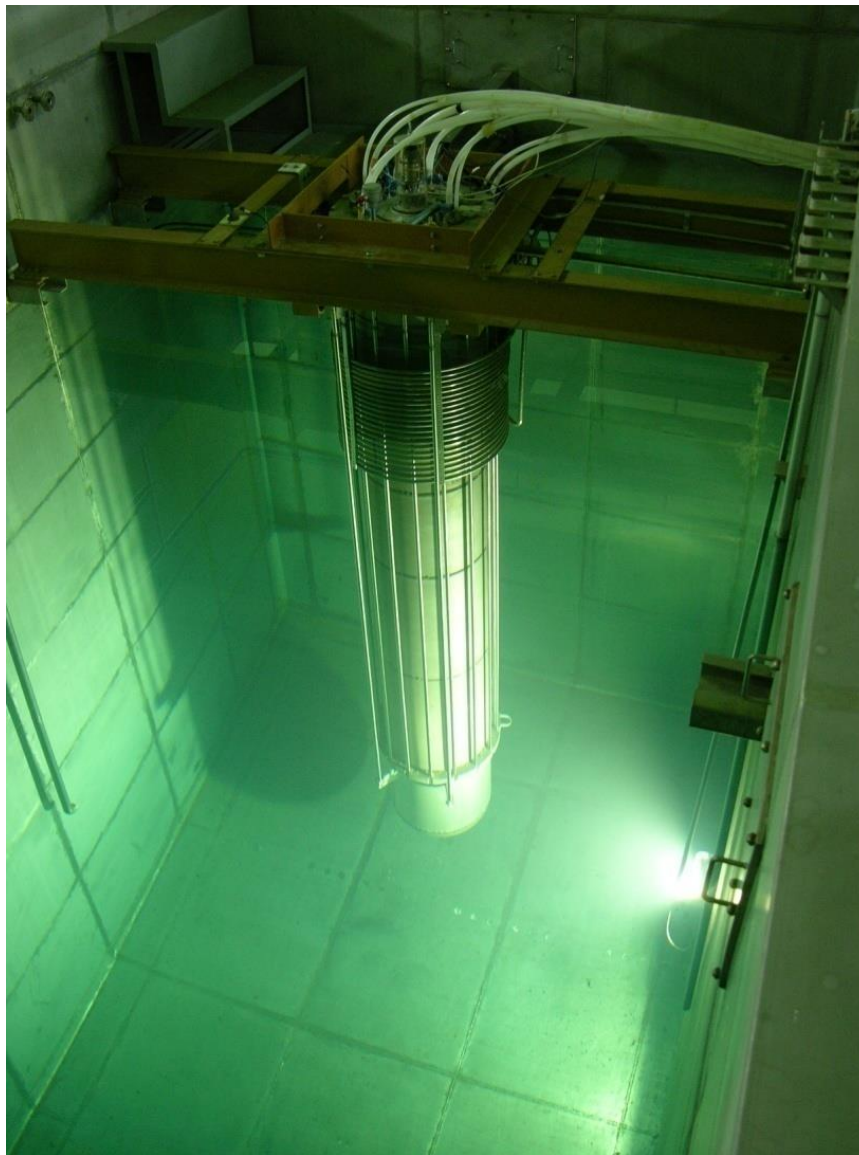
Location:	PINSTECH, Nilore, Islamabad
Type:	Pool Type
Power:	5 MW (initial) 10 MW (Redesigned by PAEC)
First Criticality:	1965
Purpose:	Research, Isotope Production , Training of Manpower

Pakistan Research Reactor-2 (PARR-2)

Location:	PINSTECH, Nilore, Islamabad
Type:	Tank in Pool type
Power:	30 KW (initial)
First Criticality:	1989
Purpose:	Research, Isotope Production , Training of Manpower



PARR-1 IN OPERATION



Pakistan Research Reactor-2 (PARR-2)

IAEA Workshop on safety reassessment of research reactors in the light of the lessons learned from the Fukushima Daiichi accident

Pakistan Institute of Nuclear Science and Technology (PINSTECH)

The goals for establishing PINSTECH can be broadly described as:

- **Undertaking research in various nuclear fields**
- **Providing guidance and leadership in the technological development for the application of nuclear energy**
- **Providing radioisotopes to meet the need of nuclear medical centers, industry research institutes**
- **Developing human resources for working as professionals in nuclear fields**



A VIEW OF PARR-1 and PINSTECH

12/06/2017

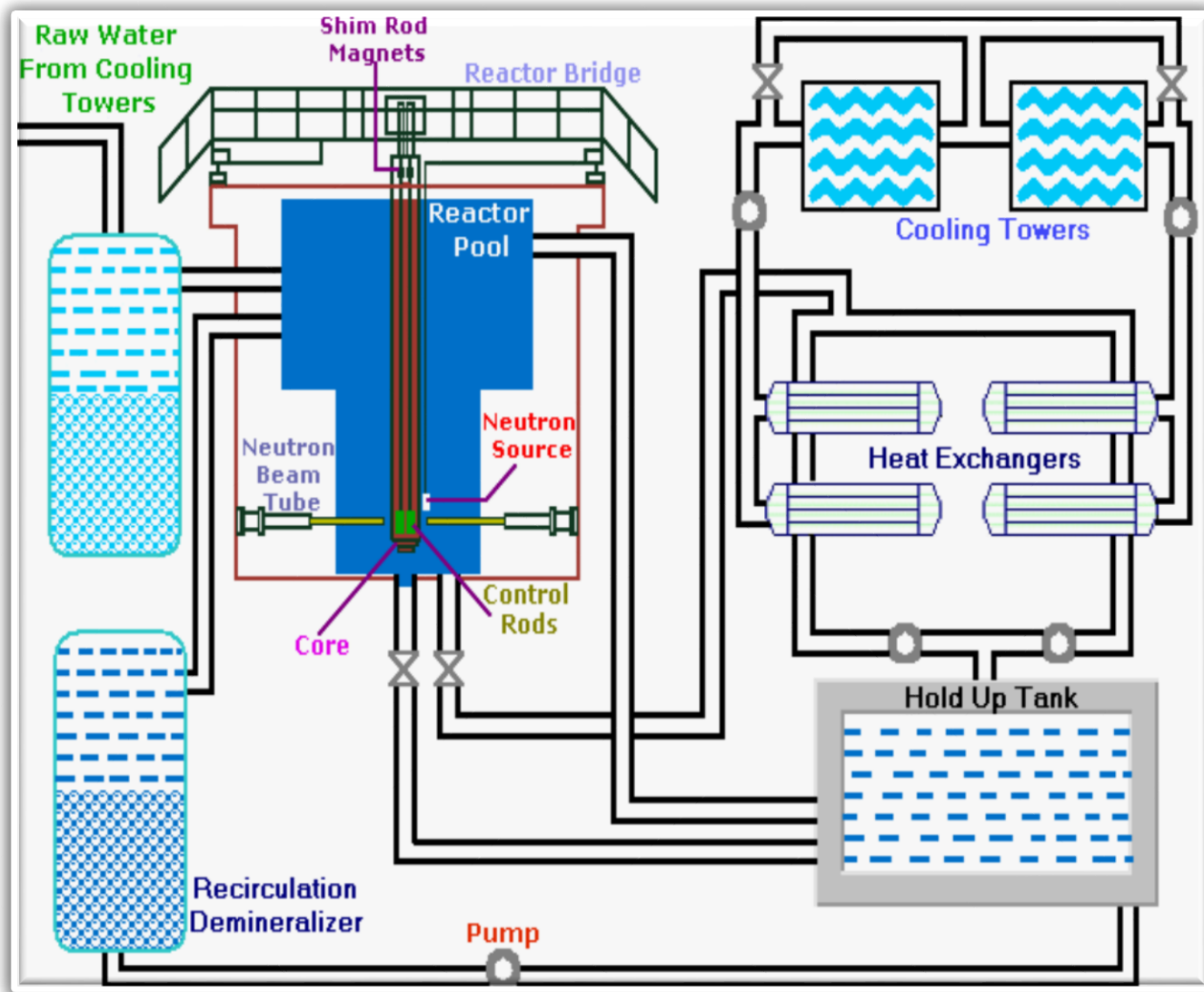
IAEA Workshop on safety reassessment of research reactors in the light of the lessons learned from the Fukushima Daiichi accident

Main Specifications of PARR-1

Type	Swimming Pool
Nominal core power (MW)	10
Lattice pitch (mm)	81.0×77.11
Fuel material and enrichment	U ₃ Si ₂ -Al (19.99 % by wt)
Cladding material	Aluminum
Coolant/Moderator	Light water (H ₂ O)
Coolant flow rate (m ³ /hr)	950
Reflector	Light water and Graphite
Fuel element description	Straight plate MTR type fuel element
U ²³⁵ contents per fuel plate (g)	12.61
Control rods	Oval shaped 5 rods
Composition of control rods	80% Ag, 15% In, 5% Cd
Operational Modes	Manual and Automatic
Neutron Flux:	
Max. Flux (th) (n/cm ² -s)	~9.0×10 ¹³
Max. Flux (fast) (n/cm ² -s)	~2.6×10 ¹⁴

Milestones of PARR-1

Contract signed	05 March 1962
Contract Parties	IAEA, Pakistan and USA
Construction started	May 1963
Construction Completed	1965
Initial Criticality with HEU fuel	21 Dec 1965
First Full Power Operation at 5 MW	09 June 1966
Renovation of Instrumentation and Control	1986
Dismantling of Last HEU Core	Nov 1990
First Criticality with LEU fuel	31 Oct 1991
First High Power Operation at 9 MW with LEU fuel	07 May 1992
First Full Power Operation at 10 MW with LEU fuel	27 Feb 1998
First Irradiation of Fuel Plates for ⁹⁹ Mo Production	16 July 2010



Schematic Diagram of PARR-1

REVIEW CRITERIA

Following documents were reviewed

- Safety Analysis Report (SAR)
- Policies and Plans
- Procedures and Practices.

Against

- IAEA Safety Standards
- National regulations
- International best practices

OBJECTIVE OF INTERNAL PEER REVIEW

- Operational safety review
- Safety assessment of PARR-1
- Preparation for the proposed INSARR Mission

SCOPE OF INTERNAL PEER REVIEW (IPR)

- Safety Analysis (SAN)
- Safety Analysis Report (SAR)
- Siting and Protection against External Events (SPE)
- Modifications (MOD)
- Utilization and Experiments (UEM)
- Operational Limits and Conditions (OLC)
- Conduct of Operations (COP)
- Operating Organization and Reactor Management (OOR)
- Management System (MSY)
- Safety Culture (SCU)
- Radiation Protection Program (RPP)
- Safety Committees (SCO)
- Emergency Planning (EMP)
- Radioactive Waste Management (RWM)
- Training and Qualification (TRQ)
- Regulatory Supervision (REG)
- Maintenance and Periodic Testing (MPT)
- Decommissioning (DEC)

METHODOLOGY

- IPR Team formation
- Area coordinators from PARR-1

Actions by the reviewers

- Review of technical documents
- Observation of on-going activities including reactor related Structures, Systems and Components (SSC's).
- Interviews/ discussions with workers at the job sites.
- Visit of relevant areas/ offices/ workshops/ labs/ warehouses etc.
- Interview/ discussion with relevant Managers/ Heads/ Area Coordinators.
- Discussion among the team members at the end of the day.

METHODOLOGY

Facility Walk Downs

- Cooling Tower
- HVAC Room
- Reactor Hall
- Analytical Lab RW-5,
- Spent Fuel Storage Bay
- EMG Lab
- Pump House
- Emergency Diesel Generator Area
- Solid Waste Storage Area
- Solid Waste Conditioning/
Compaction Hall
- SSDL Lab
- Radio Chemistry Lab

ISSUES AND RECOMMENDATIONS

SAFETY ANALYSIS

- Additional safety barriers for prevention of accident
- Planning of mitigation actions for any accident situation
- Analysis of possible consequences of incidents and accidents

Recommendations

Following should be considered in Safety Analysis chapter of SAR:

- Comprehensive list of Postulated Initiating Events including human errors, specialized internal events and external events (including fire events)
- Methods of identification and selection of initiating events. Methods of analysis for each postulated initiating event including qualitative and quantitative information.
- Complete spectrum of accident (DBA/BDBA) initiating events considered in the analysis, and justification for the rejection of particular initiating events.
- The criteria and safety principles regarding single failure criterion and common cause failure.

ISSUES AND RECOMMENDATIONS

SAFETY ANALYSIS REPORT

- Revision of SAR as per current IAEA Safety Guide IAEA SSG-20 (2012) “safty assessment for research reactors and preparation of SAR” and National Regulation PNRA PAK/923 (2012) “regulation on the safety of nuclear research reactors operation”.
- PARR-1 has revised the SAR, submitted to corporate office.

ISSUES AND RECOMMENDATIONS

SITING AND PROTECTION AGAINST EXTERNAL EVENTS (SPE)

Site shall be investigated with regard to all the characteristics that could affect safety in natural and human induced events. The hazards associated with external events (and combinations of events) that are to be considered in the design of the reactor.

Recommendations

- Assessment of the hazard for Structures, Systems and Components (SSCs) due to maximum recorded earthquake ground induced motion
- Analyses of internal events (internal fires or explosions, internal flooding and exothermic chemical reactions) and external events (explosions, aircraft crashes, fires, toxic spills and effects from adjacent facilities)

Thank you!