

24Th SYMPOSIUM RESILIENT SUPPLY CHAIN FOR PAKISTAN

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THE PAKISTAN ACADEMY OF ENGINEERING

OVERVIEW OF SUPPLY CHAIN FOR NUCLEAR POWER PLANTS

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SCHEME OF PRESENTATION

- NUCLEAR POWER PROGRAM OF PAKISTAN
- GOALS / TARGETS OF NUCLEAR POWER PLANTS
- OBJECTIVES OF SUPPLY CHAIN FOR NPPs
- MAJOR COMPONENTS OF SUPPLY CHAIN
- SAFE OPERATION OF KANUPP WITHOUT VENDOR SUPPORT

NUCLEAR POWER PROGRAM OF PAKISTAN

- SIX NUCLEAR POWER PLANTS IN OPERATION (TOTAL GENERATION 3530MWe)
- ONE NUCLEAR POWER PLANT IN DECOMMISSIONING
- OTHERS IN PLANNING PHASES

FIRST NUCLEAR POWER PLANT – KANUPP

- 137 MWe
- COMMISSIONED IN AUG 1971
- PERMANENTLY SHUTDOWN FOR DECOMMISSIONING AFTER 50YEARS OF OPERATION



NUCLEAR POWER PROGRAM OF PAKISTAN

300 MWe NPPs AT CHASHMA

		C O D	TARIFF
•	C-1	325MWe SEPT 2000	6.6076
•	C-2	325MWe MAY 2011	10.9123
•	C-3	340MWe DEC 2016	15.4134
•	C-4	340MWe SEPT 2017	15.3394



NUCLEAR POWER PROGRAM OF PAKISTAN

1100MWe NPPs AT KARACHI

			C O D	TARIFF
•	K-2	1100 MWe	MAY 2021	12.2461
•	K-3	1100 MWe	APR 2022	NOT YET FINAL

FUTURE PROGRAM

- GOP ENERGY MIX 8800 MWe NUCLEAR BY YEAR 2030
- 1100MWe AT CHASHMA SITE
(CONTRACT FINALIZATION PHASE)
- ADDITIONAL SITES IN PLANNING
- DEVELOPMENT OF INDIGENOUS NPP (UNDER CONSIDERATION)



GOALS / TARGETS OF NUCLEAR POWER PLANTS

- SAFE AND SUSTAINABLE OPERATION OF NPPs
- AVAILABILITY TARGET OF > 90%
- BASE LOAD OPERATION
- NORMALLY 14 MONTHS OPERATION CYCLE FOLLOWED BY 6-8 WEEKS RE-FUELLING OUTAGE (RFO)
- MULTIPLE LEVEL PERFORMANCE MONITORING / ASSESSMENT
 - PLANT LEVEL (NPP)
 - CORPORATE LEVEL (PAEC)
 - NATIONAL REGULATORY BODY (PNRA)
 - INTERNATIONAL REVIEWS (IAEA, WANO)
- PERFORMANCE INDICATORS (PIs)
 - SAFETY PIs
 - OPERATION / RELIABILITY PIs
- THE PERFORMANCE OF NPPs AROUND THE WORLD IS MONITORED / REVIEWED AND REPORTED ON INTERNATIONALLY AGREED PIs (NEI, IAEA, WANO ETC)

OBJECTIVES OF SUPPLY CHAIN FOR NPPs

- ASSESSING THE CURRENT NATIONAL SUPPLY CHAIN AND CAPABILITIES OF PAEC FOR ENHANCING SAFETY, RELIABILITY AND SUSTAINABILITY OF NUCLEAR POWER PROGRAM
 - COMBAT THE RESTRICTIONS DUE TO EMBARGOES AND INTERNATIONAL SANCTIONS
 - MINIMIZE DEPENDENCE ON VENDOR COUNTRY / SUPPLIERS
 - LIFE TIME SUPPORT
 - DESIGN LIFE EXTENSION 60 YEARS → 80/100 YEARS
 - AGEING MANAGEMENT
 - OBSOLESCENCE
 - INDIGENOUS DESIGN / ENGINEERING SUPPORT FACILITIES / SERVICES DEVELOPMENT
- WITH THE SUPPLY CHAIN PROGRAM FOR NUCLEAR POWER PLANTS, PAEC IS ON THE PATHWAY OF SELF RELIANCE AND TECHNOLOGICAL ENHANCEMENT LEADING TO INDIGENOUS NUCLEAR POWER PROGRAM IN PAKISTAN

MAJOR COMPONENTS OF SUPPLY CHAIN

1) HUMAN RESOURCES DEVELOPMENT

- MS/PhD PROGRAM
- PAKISTAN INSTITUTE OF ENGINEERING AND APPLIED SCIENCES (PIEAS)
- OPERATION / MAINTENCE TRAINING CENTERS
 - KINPOE AT KARACHI
 - CHASHCENT AT CHASHMA
- O/M TRAINING FOR DIPLOMA HOLDERS
- PAKISTAN WELDING INSTITUTE (PWI)
- NATIONAL CENTER FOR NON-DESTRUCTIVE TESTING (NCNDT)
- MANAGEMENT TRAINING PROGRAMS
- SKILL DEVELOPMENT PRGORAMS
- CYBER SECURITY PROGRAMS

2) NUCLEAR FUEL SUPPLY / SUPPORT

- LIFE TIME SUPPORT BY VENDOR
- FOR KANUPP NUCLEAR FUEL WAS INDIGENOUSLY DEVELOPED
- SAFE STORGE OF SPENT NUCLEAR FUEL
- NUCLEAR WASTE MANAGEMENT FACILITIES

- PAEC IS MAKING NUCLEAR FUEL FOR ITS RESEARCH REACTORS AND HAS THE CAPABILITY TO FABRICATE NUCLEAR FUEL FOR THE NUCLEAR POWER PLANTS

MAJOR COMPONENTS OF SUPPLY CHAIN

3) DESIGN AND ENGINEERING SUPPORT FACILITIES

- PROCESS AND EQUIPMENT DESIGN CENTERS
 - SAFETY UPGRADES / IMPROVEMENTS
 - DESIGN LIFE EXTENSION
 - LESSONS LEARNT
 - OPERATING EXPERIENCE FEED BACK (OEF)
- EQUIPMENT MANUFACTURING WORKSHOPS FOR SAFETY CLASS EQUIPMENT AND SPARE PARTS
- I & C AND ELECTRICAL SYSTEMS / EQUIPMENT
- EQUIPMENT QUALIFICATION AND TESTING FACILITIES
- MOCK-Ups FOR MAINTENANCE TRAINING
- FULL SCALE PLANT SIMULATORS FOR OPERATOR TRAINING / LICENSING
- SPECIALIZED WELDING TECHNOLOGY
- NDT / NDE FACILITIES

- PAEC DESIGN AND ENGINEERING FACILITIES ARE ISO, ASME AND IEEE CERTIFIED FOR CONVENTIONAL AND NUCLEAR SAFETY CLASS EQUIPMENT MANUFACTURING.

4) FINANCIAL SUPPORT

- O/M BUDGET
- DEVELOPMENT PROJECTS FOR AGEING MANAGEMENT AND PLANT LIFE ENHANCEMENT
- DECOMMISSIONING FUND REQUIREMENT AT THE END OF DESIGN LIFE AND BEYOND
- DECOMMISSIONING AFTER 60-80YEARS AND FOR NEXT 30-40YEARS.

SAFE OPERATION OF KANUPP WITHOUT VENDOR SUPPORT

- COMMERCIAL OPERATION OF KANUPP IN 1972
- VENDOR COUNTRY EMBARGO IN 1976
- TOTAL CUT-OFF OF
 - NUCLEAR FUEL SUPPLY
 - HEAVY WATER SUPPLY
 - SPARE PARTS SUPPLY
 - FUEL MANAGEMENT SUPPORT

- PAEC ACCEPTED THE CHALLENGE TO CONTINUE PLANT OPERATION WITHOUT VENDOR SUPPORT

- INDIGENOUS DEVELOPMENT FOR KANUPP OPERATION
 - LOCALLY DEVELOPED NUCLEAR FUEL
 - HEAVY WATER PRODUCTION
 - LOCAL DEVELOPMENT OF SPARE PARTS AND REPLACEMENT EQUIPMENT
 - TESTING AND QUALIFICATION OF NUCLEAR FUEL AND SAFETY CLASS EQUIPMENT
 - MANPOWER TRAINING PROGRAM (O/M)
 - CC&I FACILITIES
 - NDT / NDE AND ISI

- LOCAL NUCLEAR FUEL FABRICATION ALONGWITH UP-GRADATION AND REFURNISHMENTS LEAD TO SAFE OPERATION OF KANUPP FOR 50YEARS (1971 – 2021)

- WITH PAEC'S INVOLVEMENT IN NPP SINCE EARLY 70's, IT HAS DEVELOPED SUBSTENTIAL EXPERTISE IN MAJOR INFRASTRUCTURE SUPPORT.
- LOCAL INDUSTRIAL SUPPORT AND FEW OTHER AREAS NEED TO BE FURTHER DEVELOPED.

THANK YOU