



Experiences on Pre-Construction & Construction of Karachi Nuclear Power Plant Unit-2 & 3

By

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Plant	K-1*	C-1	C-2	C-3	C-4	K-2	K-3
Capacity (MWe)	137	325	330	340	340	1100	1100
Groundbreaking	1966	Dec 1992	Mar 2005	Aug 2010	Apr 2011	Nov 2013	Sep 2014
COD	1972	Sep 2000	May 2011	Dec 2016	Sep 2017	May 2021	Apr 2022

* KANUPP was permanently shutdown for decommissioning on August 01, 2021 after 50 years of safe operation



4 NPPs at Chashma

K-1, 1st NPP of Pakistan

Pre-Construction Activities of Karachi Nuclear Power Plant Unit-2 & 3

- Site Registration
- Construction License



Site Registration

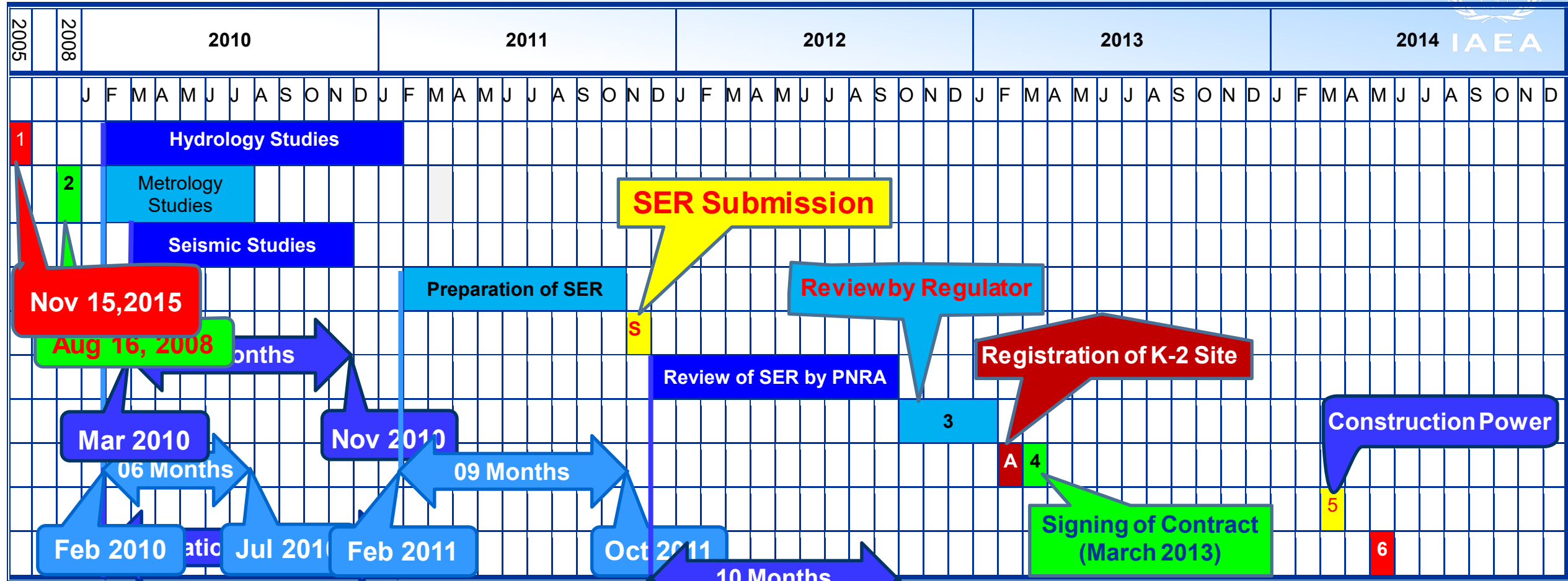
Application to the regulator, with the following documents:

- Site Evaluation Report (SER)**
- No Objection Certificates (NOC) from relevant departments of the federal, provincial and/or local governments**
- Quality Assurance Program.**

Pre-Construction Activities



2014 IAEA



1

Establishment of K-2 and K-3 Office (November 15, 2005)

2

Completion of Acquisition of 585 Acre land (August 16, 2008)

S

Submission of SER to Regulator (PNRA) (November 2011)

3

Incorporation of review comments

A

Registration of K-2 Site (February 28, 2013)

4

Signing of Contract

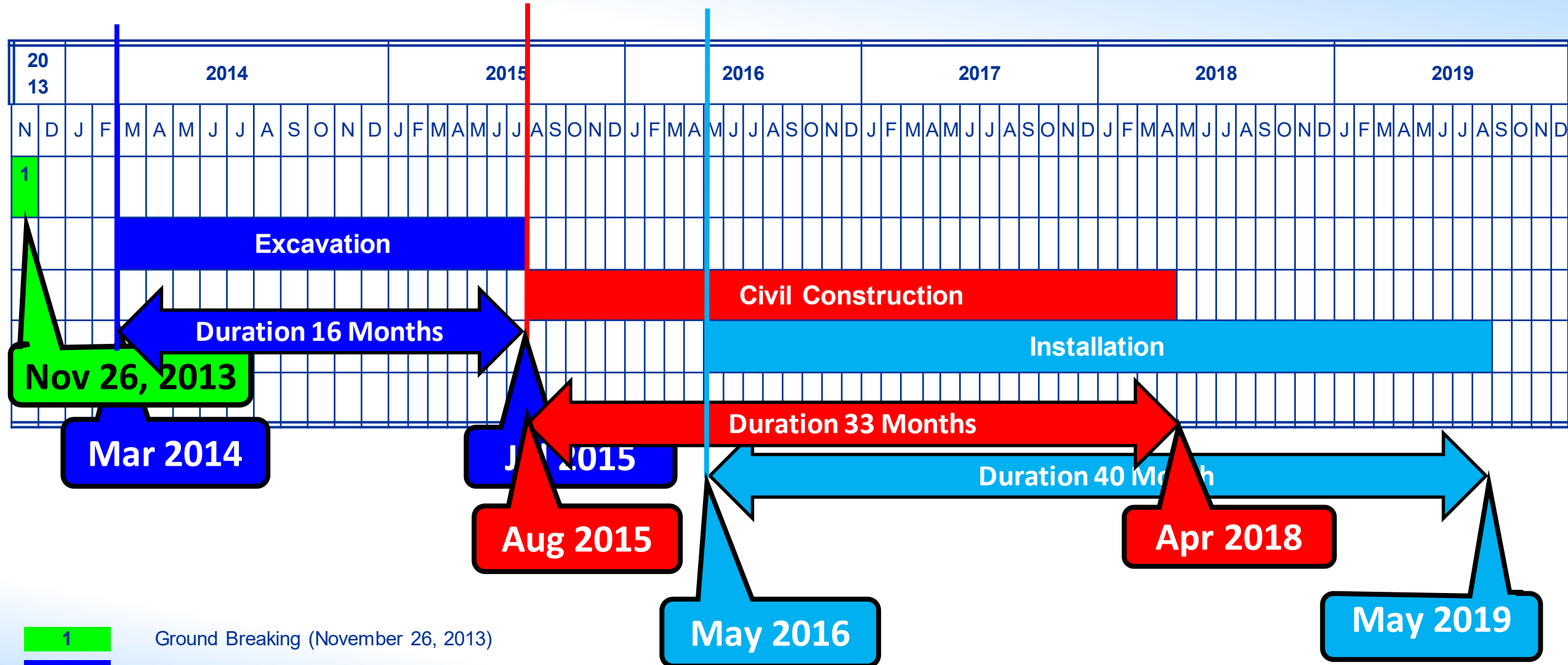
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Availability of Construction Power Supply (March 01, 2014)

6

Registration of K-3 Site (May, 2014)

Construction Schedule of K-2



- 1 Ground Breaking (November 26, 2013)
- 2 Excavation
- 3 Civil Construction
- 4 Installation

Activities During Construction



During Construction of K-2, there were two major activities

- 1. Permission for Commissioning**
- 2. Fuel Load Permit**

Permission for Commissioning

- 1. Commissioning Program**
- 2. Quality Assurance Program for Commissioning**

Commissioning Program Preparation

Preparation	Review by Regulator	No. Licensing Questions	Approval
Oct 2018– May 2019 (8 Months)	June 2019 – Aug 15 2019 (3 months)	149	Sep 17, 2019

Activities Performed During Construction



Activity	Docs in #	Man-hour (m-h)	Total m-h
Commissioning Test Procedure	628	40 m-h/procedure	25128
Commissioning Program	1	2112 m-h/Month (5 months)	10560
Commissioning Training Program	1	16 m-h/day (2 months)	704
Commissioning Personnel Training	Activity	8 m-h/day (35 months)	6160
System Operating Procedures	276	200 m-h/procedure	55200
Abnormal Operating Procedures	59	140 m-h/procedure	8200
Emergency Operating Procedures	49	120 m-h/procedure	5880
Alarm Response Procedures	164	164 m-h/procedure	22960
Administrative Procedures	95	120 m-h/procedure	11400
Operation Training Manual (374 Sys)	100 men	6 m-h/day (1 year)	147000
Emergency Preparedness & Planning	1	16 m-h/day (6 months)	1920
Surveillance Programs	164	320 m-h/program	11520

Fuel Load Permit



Following documents were submitted to PNRA for fuel load permit:

1. Final Safety Analysis Report (FSAR)
2. Probabilistic Safety Analysis Level One Plus Report (PSA Level 1 plus)
3. Commissioning Reports of Stage A
4. Technical Specifications
5. Radiation Protection Program
6. Emergency Preparedness Plans
7. Inspection Program
8. Fire Protection Program
9. Environmental Monitoring Program duly approved by our Environmental Protection Agency (EPA)
10. Radioactive Waste Management Program.
11. Pre-service Inspection (PSI) and In-service Inspection (ISI) Program.
12. Physical Protection Program.

Fuel Load Permit Contd.

13. Decommissioning Strategy.
14. Demonstration of the implementation of Emergency Preparedness Plans
15. EPP & Physical Protection Program, drills/exercises
16. Stage A tests & review of test reports

Additional documents

- Programs for maintenance, testing, surveillance and inspection of structures, systems and components important to safety
- Fire Protection Program

FSAR Preparation Schedule

Preparation	Review by Regulator	No. Licensing Questions	Approval
Mar 2018 – Apr 2019 (18 months)	Oct 2019 – Aug 2020 (11 months)	2366	Nov 20, 2020

Major Challenges Encountered During Project



(Challenge 1)

Development of Manpower for Operation & Maintenance

Operation Team Preparation

- Typically 6~7 years are required for training of O&M manpower.
- A mix of fresh and experienced manpower from Chashma and Karachi plants
- Preliminary training Manpower at CNPGS and KANUPP
- Participation in operation during commissioning
- Advanced training at Full Scale Training Simulator for operations.
- Advanced training at Full Scale Training Simulator for operations. Timely availability of FSTS helped in training of operations manpower
- Maintenance Training of experienced and fresh manpower at Vendors' facilities and Reference Plant





HR for each Plant Operations

Description	Qualification	#	Placement
Engineers for SS License	Elec., Mec., Chem. Nuclear	15	6 years before initial fuel loading
Engineers for SE License	Elec., Mech., Chem.	30	4 years before initial fuel loading
Local Control Rooms	Diploma (Elec., Mec., Chem. Electronics)	100	➤ 2-3 years before initial fuel loading

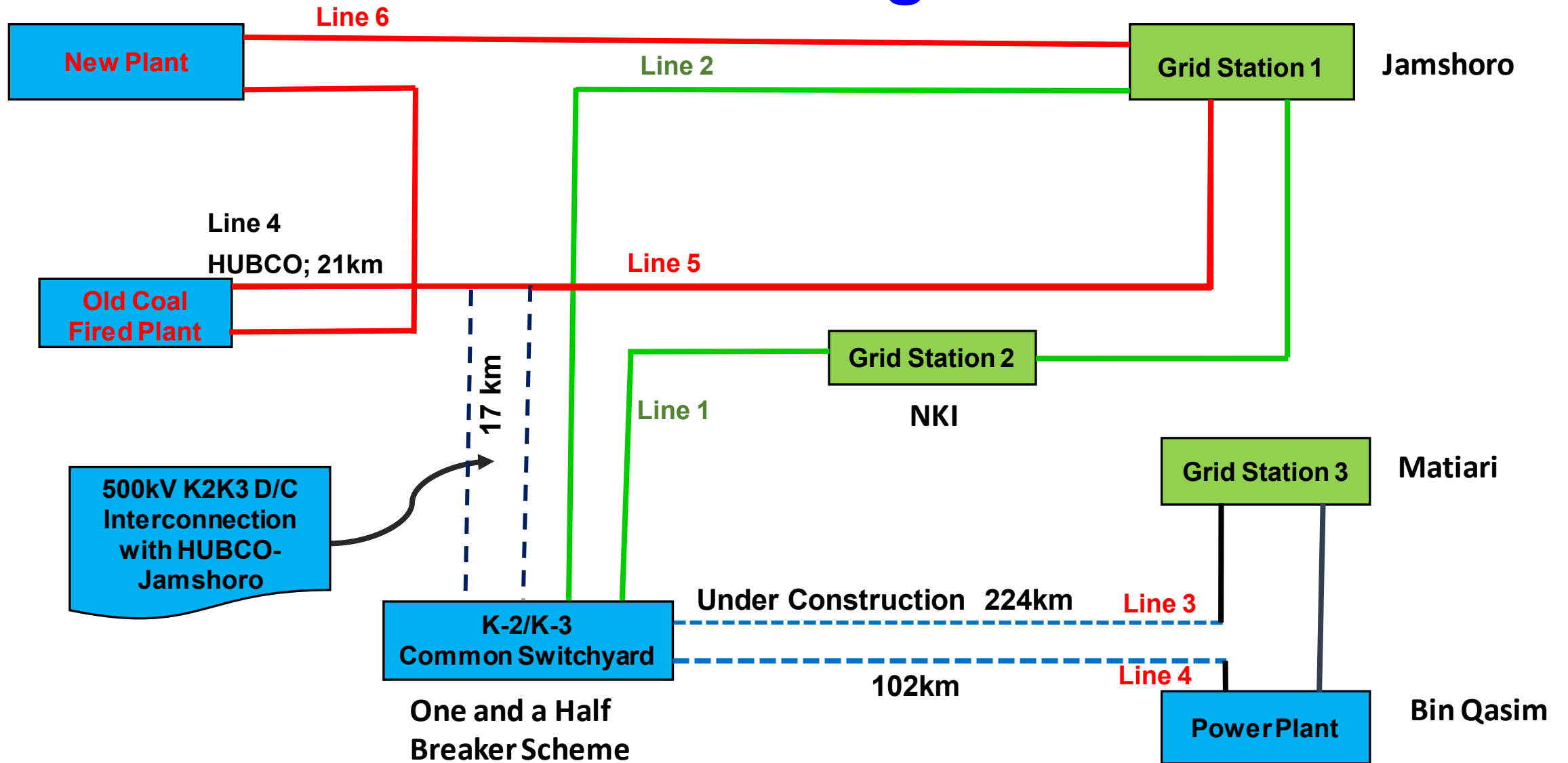
HR for Commissioning (Initial Fuel Loading Nov 28, 2020)

Core Team for Commissioning (Experience manpower to start the commissioning preparations)	Team Leader, Manager, Heads, Incharges (Placed 5.5 Years)
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HR (Engineers) for Commissioning (Cont.)

Description	Qualification	#	Placement
BOP Sections	(Elect, Mech, Chem, Electronics)	22	4 Y < IFL
NI Section	(Elect, Mech)	26	4 Y < IFL
CI Section	(Elect, Mech)	20	3 Y < IFL
Elect. Section	Electrical	20	4 Y < IFL
I&C Section	Electronics	24	3 Y < IFL
GTS	(Elect, Mech, Chem, Electronics)	15	3 Y < IFL (Experienced)
TSS	(Elect, Mech, Chem, Electronics)	32	3 Y < IFL

(Challenge 2) 500kV Interim Arrangement for K-3



Challenge 3

Heavy & Oversized Equipment and Fuel Transportation



**Generator Stator
(Heaviest eq. 520 tons)**



**Polar Crane (longest)
Length 45.272 m (145.53 feet), width
5.655 m and height 4.681 m**



**Steam Generator
Equipment Weight 365 tons**



**Fuel (Shifting from Ship to road
Trailer)**

Heavy & Oversized Equipment and Fuel Transportation



Challenge 4

Adoption of Operations Mindset from Commissioning Mindset



- Gradual pulling out of the project team and taking over of the production team
- Enough overlap
- Procedures of turnover available well before fuel loading
- Formation of team for each system & equipment takeover
- Identification and procurement of essential spares, tools and consumables

Challenge 5

Manning of Top Management at the Right Time



➤ Timely appointment of key positions of operating organization is vital to transfer the ownership.

➤ Operating Organization's Managers must be in place well before start of commissioning. Individual maintenance and operation engineers can still remain partially attached with the commissioning teams for the specific test associated with their systems.

➤ Experienced personnel for plant management positions

Challenge 6

Litigations



- Construction of K-2/K-3 challenged in courts
- Public awareness program for acceptance of nuclear power plant.
- Engaged litigant through on site visits as well as expert-to-expert liaison.
- Consensus were built by conducting general public meetings, Public and court hearings.

Challenge 7

Schedule Interfacing among Contractors

- Timely completion of owner's scope of work which requires planning/scheduling/construction in close coordination with all stakeholders majorly with the main schedule.
- For synchronization with main work schedule, the plans of owner scope of work were kept changing to avoid conflicts like availability of land, utilities, procurement, interface etc.
- As the design interface between those buildings and structures which were designed by main contractor but constructed by owner's subcontractor was not robust, there were a lot of re-scheduling of work.

Challenge 8

Miscellaneous



COVID 19 Measures

- Restriction on movement of owner & contractor personnel, materials & equipment.
- Measures to reduce the impact and losses to Project due to COVID-19:
 - Established quarantine facilities at site
 - Personnel entering the bio secure bubble had to undergo 15 days quarantine at site and multiple PCR tests to prevent contamination of site.
 - Retention of operations and commissioning teams on site in batches.
 - Plant areas were barricaded into zones: “Green Zone” - for bio-secured bubble and “Red Zone” for personnel residing at off-site residential facilities
 - Incentives were given to employees
 - In case of Positive case at site, quick isolation measures to prevent spread.

Others

- Feedback of Fuqing 5 & 6 NPPs
- Experience feedback of K-2 was used at K-3
- PREOSART conducted from March 02 to March 19, 2020.

Thank You