

Engineering New India

Engineering Consultants for NPCIL's *First Indigenous*
2x700 MWe PHWR at Kakrapar, Gujarat



KAPP - Kakrapar Atomic Power Plant Unit 3&4, located at Kakrapar, near Surat in Gujarat

THE SCOPE

The Kakrapar Atomic Power Plant located at Kakrapar, near Surat in is the first indigenously designed and built Pressurised Heavy Water Reactor (PHWR) unit of 700MWe capacity. Tata Consulting Engineers (TCE) worked very closely with NPCIL on the project and provided consulting engineering services for:

1. Detailed engineering including preparation of P&ID's, Specifications, Datasheets, Piping layouts, HVAC layouts, Earthing and Lighting Diagrams, Tray Layouts, Elementary and Wiring Diagrams and Instrument Specification Sheets
2. Development of an integrated 3D model which included entire reactor system along with safety systems, utilities and secondary cycle.
3. Complete engineering and 3D modelling of BoTIP (Balance of Turbine Island Package) for this Nuclear reactor.
4. Development of first Mobile Fuel Transfer Machine for 700 MWe PHWR.

This was the first time such an integrated 3D engineering was performed for an indigenous Nuclear Power Plant. TCE is proud to be associated with the Design Engineering of the unit.

THE CHALLENGES

TCE took up the challenge of Detailed Engineering and 3D Modelling of KAPP-3&4 (Kakrapar Atomic Power Project), the first 2 X 700 MWe PHWR type nuclear power plant for NPCIL. **It was for the first time in the Indian nuclear industry that the 3D Model of the entire plant was developed concurrently during engineering of the plant.** The significant challenges faced were:

1. The 700MWe nuclear reactor was to be an upgrade of the existing 540 MWe reactor (which also designed by TCE in 2001).
2. The plant layout, building locations and structures were completely different as compared to the earlier plants.
3. 3D Modelling was at a nascent stage, and this was the first time that the technology was being used for a nuclear power plant in India.

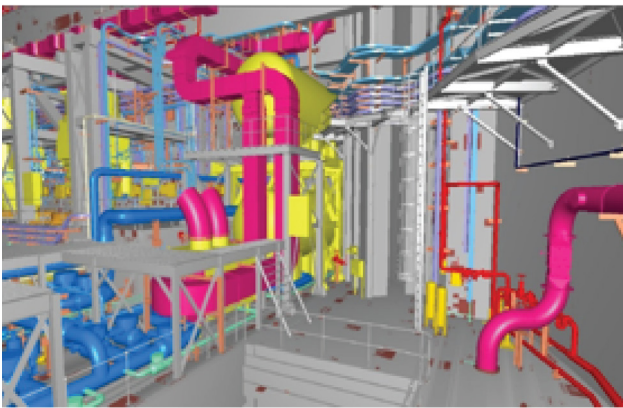
TCE was elated with the challenge and took up the 3D Modelling and Detailed Design Engineering. It technically involved engineering the plant from scratch as the new plant was an upgrade of an existing plant for which 3D Modelling had not been performed when it was engineered many years earlier.

THE 3D DETAILED ENGINEERING

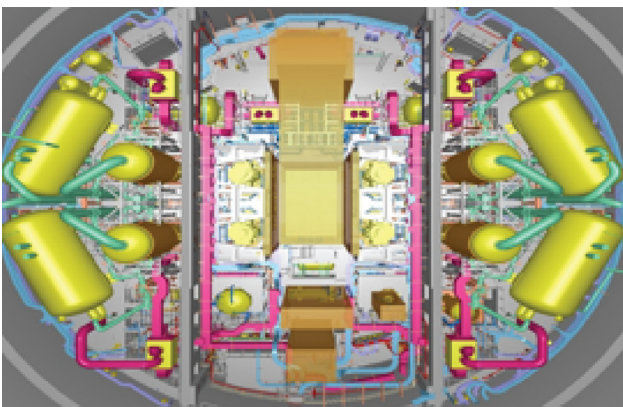
The work started with the preparation of Process and Instrumentation Diagrams (P&ID)'s, Specifications, Datasheets, Piping layouts, HVAC Layouts, Earthing Diagrams, Lighting Diagrams and Cable Tray Layouts, Elementary Drawings, Wiring Diagrams, Instrument Specification Sheets etc.

The complete engineering information was then transformed into a 3D model. As 3D technology was new to NPCIL, TCE worked with NPCIL on the concepts of integrated 3D engineering which helped extract information to build an intelligent 3D model.

As a first step, development of 3D model involved preparation of 400+ Intelligent P&ID's; completing this step helped NPCIL prepare a preliminary estimate of material requirement.

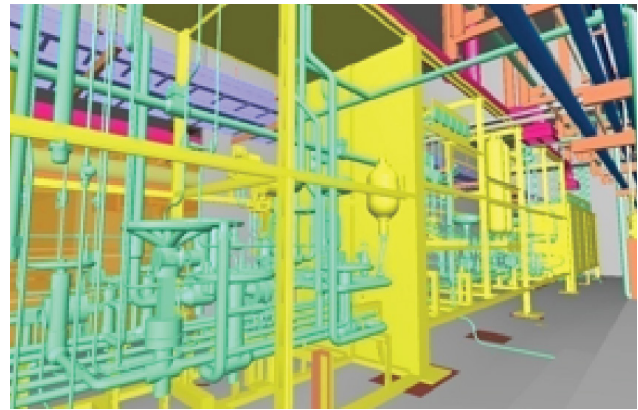


Reactor Building Pump Floor



Top View of the Reactor Building

As the next step, 3D Modelling was done of the Concrete and Steel Structures, Embedded Parts, Platforms, Equipment, Piping, Cable Trays, HVAC, etc. Construction deliverables like Equipment Layouts, Piping Isometric, Piping Layouts, HVAC Layouts, Cable Trays Layouts, Support drawings and MTO's were extracted from the 3D Model.



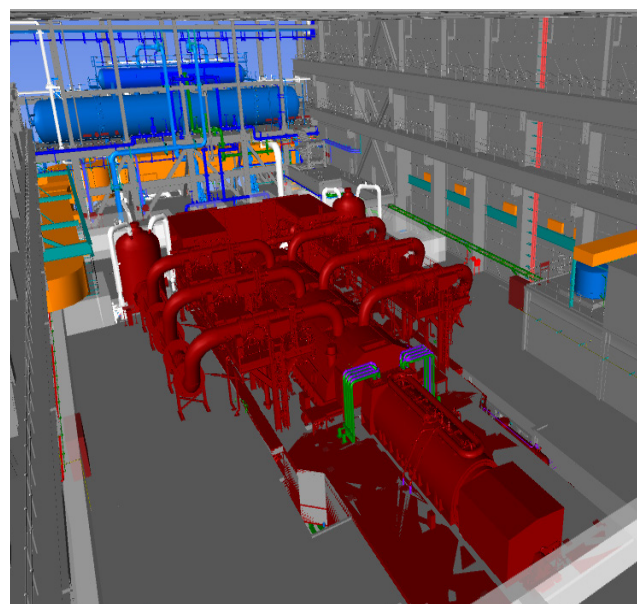
Panel Tubing

BALANCE OF TURBINE ISLAND PACKAGE

TCE also provided engineering and procurement assistance services for Balance of turbine Island package (BOTIP).

TCE completed the design and engineering including Design Basis Reports, Concept Notes, Piping Designs, Optimisation Studies, Process Engineering, Development and Finalisation of Control and Logic requirements, and Construction Drawings for Piping, Civil, Electrical, HVAC, and C&I engineering.

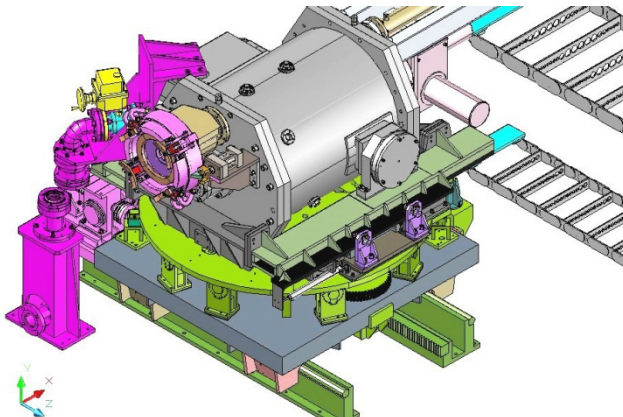
TCE also provided 3D Modelling and Engineering of the complete Turbine Building including all Systems inside the Turbine Building in an Integrated Engineering Environment. All deliverables were generated for erection purpose from the Integrated Engineering Environment.



3D model view of Turbine Floor

THE MOBILE FUEL TRANSFER MACHINE

TCE also developed the Conceptual Design and complete detailed engineering of a new concept of *On Power Mobile Fuel Transfer Machine* located inside the Fuel Transfer Room. It involved developing and designing a remotely operated machine for storage of New Fuel bundles, loading of new fuel bundles into Fuelling Machine Head, receiving Spent Fuel bundles from Fuelling Machine Head and Storage of the Spent Fuel bundles.

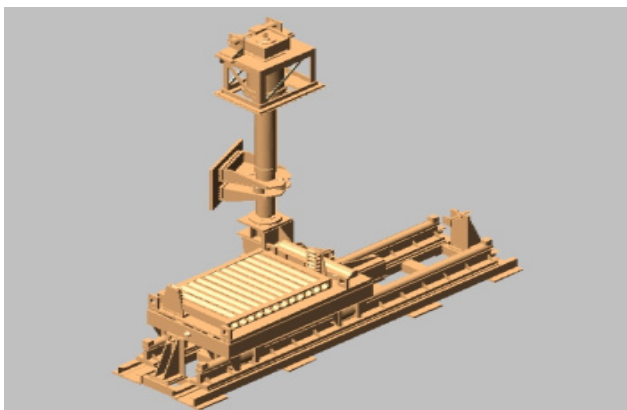


Mobile Fuel Transfer Machine

OTHER IMPORTANT COMPONENTS

TRAY LOADING MACHINE (TLM)

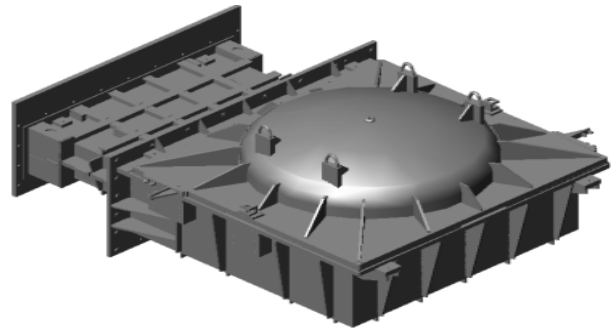
The TLM was provided in the water-filled Tray Loading Bay for loading of the Spent Fuel Bundles in the Spent Fuel Storage Tray.



Tray Loading Machine

PORTABLE SEALING GATE (PSG)

A Portable Sealing Gate was provided to seal the rectangular opening in the wall between the Tray Loading Bay and Spent Fuel Storage Bay (SFSB).



Portable Sealing Gate

SUMMARY

TCE is proud to proclaim that they are carrying forward the torch lit by beloved JRD Tata with Homi J. Bhabha in making available Atomic Power for civilian purposes in India. Since the inception of Nuclear Power in India, there are now 22 Nuclear Power Plants in operation generating 6255 MWe power and 7 are under construction and projected to generate another 4824 MWe energy. TCE has partnered with NPCIL on 85% of these plants and has been associated with the Department of Atomic Energy since 1968.

TCE is a pioneer in Nuclear Power Plant Engineering in India and has been the Consulting Engineering partners for NPCIL right from the initial 220 MWe plants to the 500 MWe ones and now the 700 MWe plants. TCE is presently engineering the Gorakhpur Units 1 & 2 which form the basis for the ten reactors planned in a fleet mode as announced by the Government of India in 2017.

TCE is very happy and proud to share that India's first 700 MW indigenous nuclear plant - KAPP Unit 3 at Kakrapar achieved criticality on 22nd July 2020 demonstrating India's progress towards long term energy security.