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NUCLEAR POWER CORPORATION OF INDIA LIMITED
(A Government of India Enterprise)

Inside Tarapur 3&4

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Tarapur 3 & 4 - India's largest Nuclear Power Plant

About Tarapur 3 & 4

Tarapur Atomic Power Station Unit-3&4 (TAPS-3&4)is located on the West-coast of the Arabian sea at Tarapur, district Thane in the State of Maharastra. Some 130 km. north-west of Mumbai, it is well connected by road and rail. Mumbai - Ahmedabad National Highway (NH-8) is about 30 km. from Tarapur, and Boisar, the nearest railway station on Mumbai-Delhi railway line is about 12 kms from the site.

The two units have been set up in the vicinity of Tarapur Atomic Power Station Units 1 & 2 (TAPS-1&2), Inida's first nuclear power plant.

Tarapur Atomic Power Station comprises two units of 540 Mwe each, Pressurised Heavy Water Reactors (PHWRs). These units are totally indigenous. The construction on these units commenced with the first-pour-of-concrete on March 8, 2000, also called zero date in construction of nuclear power plants.

Overall Progress

Uni-4 achieved first criticality on March 6, 2005 i.e. within 5 years from the zero date, setting a new benchmark in construction of nuclear power projects. The unit was commissioned around 8 months ahead of schedule. It was synchronised with the grid on June 4, 2005 and commercial operation from September 12, 2005.

Unit-3 achieved first criticality on May 21, 2006 and was synchronised with the grid on June 15, 2006. It commenced commercial operation from August 18, 2006.

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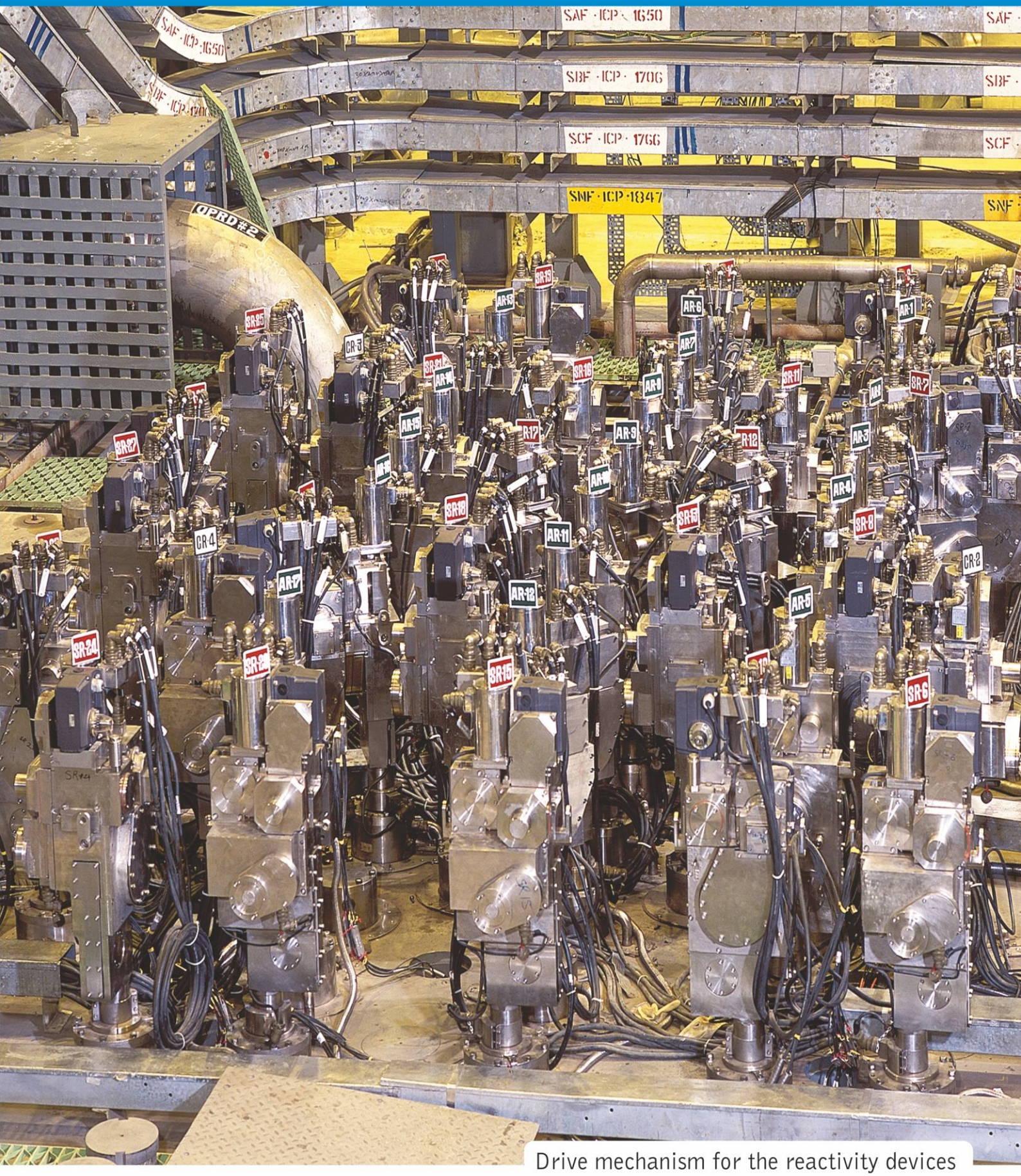
A Nuclear Power Plant involves large construction quantities

Major Quantities at a Glance

Item	Quantity	Item	Quantity
Concreting	600000 m^3	Piping	250 km
Reinforcement	150000 Te	Tubing	160 km
Structural Steel	56000 Te	Cabling	3000 km
Ventilation Ducting	47000 m^2	Wire Terminations	1 Million

Deployment of Major Plant and Machinery Resources for Safety Related Structures

Sr. No.	Equipment	Deployment at peak (nos)	Deployment Machine Months
1	Tower Cranes	10	552
2	Transit Mixer	12	672
3	Batching Plant	4	228
4	Ice Plant	5	282
5	Concrete Pump	8	438
6	Mobile Crane	8	444
7	Placer Boom	6	308
8	Air Compressor	8	444
9	Bar Shearing Machine	7	388
10	Bar Bending Machine	7	388
11	Weigh Bridge	2	114
12	Trailors	9	516
13	Welding Gensets	144	7896
14	Power Gensets	7	390
15	Dewatering Pumps	60	3390



Drive mechanism for the reactivity devices

Some Design Innovations

The conceptual design of 540-MWe reactor has evolved from its predecessor 220-Mwe PHWR design. Important changes in design, as compared to the 220-MWe-size units, are due to changes in reactor-physics. Besides, many additional design innovations in the 540-MWe PHWR have been introduced.

These include, for example:

- Use of two-tier reactivity devices, that control the reactor power
- Self-powered neutron detectors are used for in-core flux monitoring for regulation, protection and flux mapping.
- Introduction of liquid-zone control system for regulation of comparatively larger nuclear core than that of a 220-MWe unit.
- The primary heat transport (PHT) system of these reactors is split vertically into two separate, independent and identical loops with a provision of pressurizer for steady and enhanced safe-operation.
- A new design of fuelling-machine using rack-and-pinion
- Fuelling Machine air-lock was introduced for movement of Fuelling Machine from both reactors to a common place for ease in maintenance.
- Extensive use of computerised operator information system for control and operator information
- Gas insulated switchyard was introduced to minimize the adverse effect of saline environment
- All safety related buildings have seismically been qualified.

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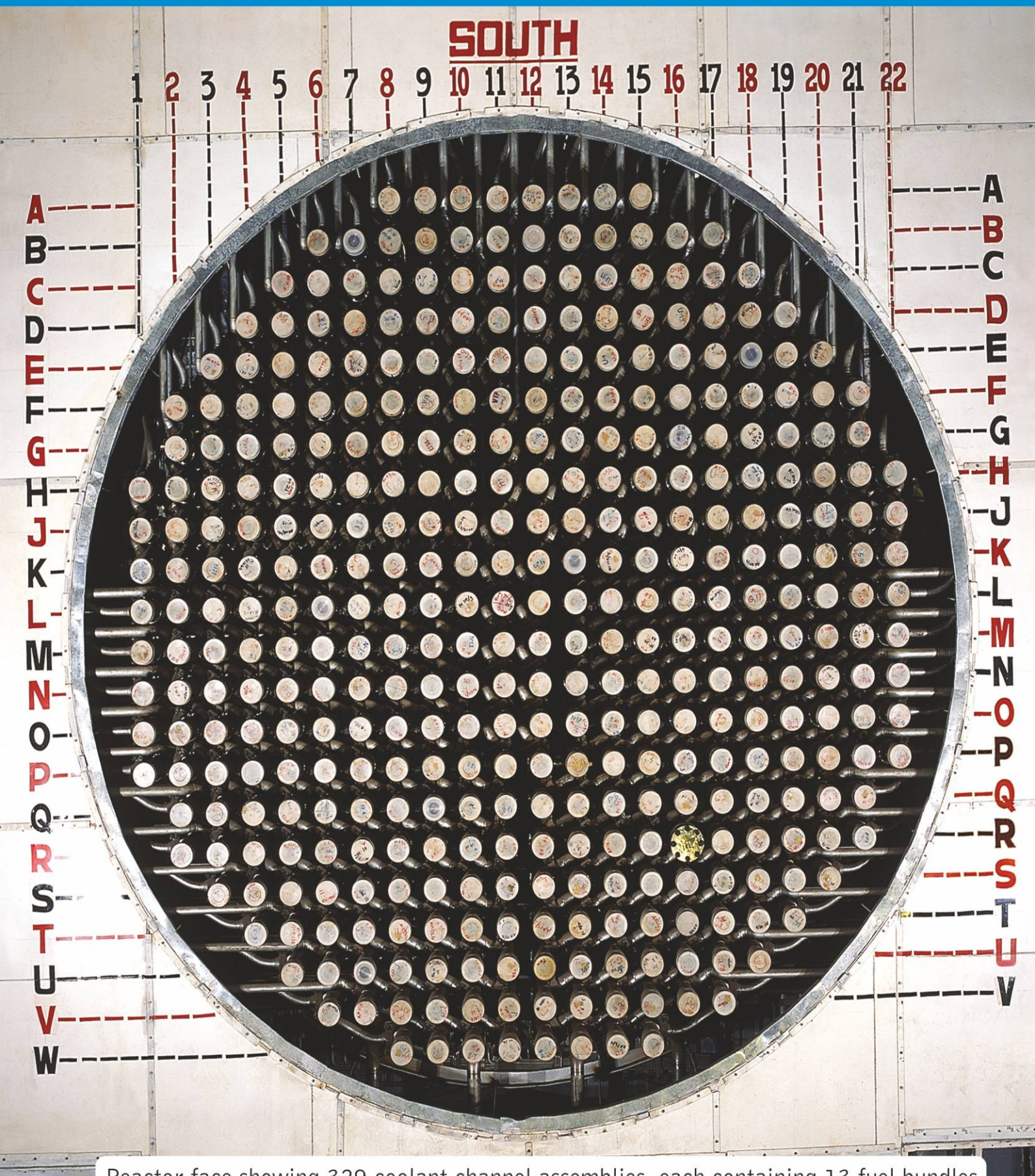
A view of Tarapur 3 & 4 as it was under construction in the year 2004

Some Special Achievements

Civil Works

- Two lifts of reactor containment-wall have been cast almost every month to speed up the construction.
- Inner containment dome concreting of both the units was completed in a record time of 22 days (TAPS-4) and 27 days (TAPS-3). Also the concreting of outer containment dome for both the units has been completed ahead of schedule.
- Pre-stressing of inner containment cables (706 Nos.) was completed successfully in 110 and 94-days in Unit-4 and Unit-3, respectively.
- Proof test and integrated leak rate test of the reactor building for both the units have been completed successfully.
- 21m high Turbo-Generator (TG) block-columns have been cast in just two lifts.
- 100m high ventilation stack has been completed in just two months using slip-form-shuttering method.
- Fresh water supply scheme of 12 million liter per day capacity was commissioned with a saving of Rs 90 million.



Reactor-face showing 329 coolant channel assemblies, each containing 13 fuel bundles

Some Special Achievements

Reactor Works

- 100 Te of 10 mm CS ball filling in the end-shield was completed in a week's time
- End-shield and Calandria welding was completed in a record time of 30 days and 22 days in Unit-4 and Unit-3, respectively breaking all the previous records.
- All liquid poison injection tubes were installed in minimum possible time for the reactivity devices installation and testing of drive-mechanism also completed in a record time.
- Installation of coolant channels was completed in a record time without any rejection of tubes.
- Wiring and tubing of fuelling-machine heads of both the Units completed in 20 days and the machine was commissioned in a record time of 3 months against planned 9 months.

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A fully Computerised Control Room

Calandria-Vault bottom showing Moderator Piping

Some Special Achievements

Nuclear & Conventional Piping and Mechanical Works

- All the four steam generators in both the reactor buildings were installed in only 2 months time using 15000 Tonne-Meter heavy-duty crawler crane. A record of lowering two steam generators in a single day was established in Unit-3.
- All Feeders in the Units-3 & 4 were installed in a record time of 5 months.
- 866000 inch-dia piping welding was completed in 36 months time.
- Primary heat transport (PHT) system hydro-test was completed in a single attempt.
- Hot-conditioning of the PHT system was completed in 71 hours and 54 hours in TAPP-4 and TAPP-3, respectively.
- Turbo-Generator of Unit-4 was taken on the turning-gear in 20 months from the start of the work.
- Condenser erection was completed ahead of schedule.

Modular construction has been used in gas insulated switchyard (GIS)

Some Special Achievements

Electrical and Control & Instrumentation

- 220 kV Gas Insulated Switchyard (GIS), Station Unit Transformers (SUT), 6.6 kV & 415 kV Switchgears were charged ahead of schedule.
- All the 4 diesel generator sets for each unit were synchronized with the grid (station load) considerably ahead of schedule to meet the requirement of emergency power supply to the plant.
- Erection of 400 kV Gas Insulated switchyard (GIS) was completed in only 5 months time using modular construction technique.
- All field instrumentation works have been completed ahead of schedule.
- All main control room panels have been installed and commissioned in both the units in a record time of 2 years.
- Hardware and software installations and their testing and commissioning were completed as per the plan for Computerized Operator Information system (COIS), Dual Processor Hot Standby Process control system (DPHS-PCS) and Programmable Digital Comparator System (PDCS-PCS), Reactor Regulating System (RRS), etc.

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Fueling machine head under commissioning

Some Special Achievements

Commissioning, Operation & Maintenance and Training

- All documentation work needed for commissioning was completed in time.
- Commissioning Group was fully set up just one year after the star of construction activities.
- Part task simulators for electrical system, reactor protection system, primary heat transport system and reactor regulating system were installed and commissioned to impart timely training to different batches of operators on the simulator. Subsequently, the full scope simulator was commissioned at NTC and validated with the plant data at various power levels of operations. The full scope simulator after validations and burn-in test was released for full fledged training of the engineers. All licensing engineers were trained on this simulator for achieving safe, reliable and error free operations of the plant systems and equipments.
- TAPS-3&4 construction personnel along with package contractor's work force has been participating satisfactorily for the last 4 years, in the site emergency exercise.
- A comprehensive training plan for construction work force has been introduced in TAPS-3&4. Extensive training and retraining were given to NPCIL and contractor's employees. On an average each individual (out of 10000 Nos. of contractor's peak work force at site) were trained/retrained four times in a year on safety and technical matters.
- The training systems and facilities at this station were adjudged by the Institute of Directors as the best and conferred with the Golden Peacock National Training Award for the year 2006.
- The Data Center at TAPS-3&4 has been listed for Best IT implementation for the year 2007 by the "PC QUEST" magazine.

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Reactor Building Pump Room

Some Special Achievements

Project Management

- 24x7 work-schedule followed
- All project works were broken down in 30,000 activities for close monitoring
- Special layout using project planner software was developed for six-monthly plan for timely monitoring of constraints and the same was launched on NPCIL intra-net
- Progress monitoring was done on daily basis using Local Area Network
- "Excellent" MOU rating achieved continuously for three years during the construction period
- Cent per cent yearly budget utilisation has been achieved
- An over-all saving of more than Rs 4 billion (Rs 400 crore) has been achieved

Improvement in Schedule of TAPP-3 over TAPP-4

Activity	TAPP - 4	TAPP - 3
Calandria Tube Installation	1 M 18 Days	1 M 12 Days
Coolant Channel Installation	4 M	3 M 21 Days
Feeder Erection to PHT Hydro Test	8 M 27 Days	4 M 14 Days
PHT Hydro to Hot-Conditioning	3 M 26 Days	2 M 3 Days
PHT Hot Conditioning	71 HRS	54 HRS

Improved Construction Methodology

- Construction-friendly Design
- Left-in-Shutters used in most of the Roof Slabs
- Slip-form Shuttering used in most of the Walls and Columns
- Self-Climbing Shutter used in Reactor Building Containment
- Computerized Batching plant
- Threaded Couplers used for joining reinforcement rods
- Pumping of Heavy Concrete
- Pumping of Lean Mix of Sand & Cement for Backfilling
- Auto Cad and 3-D Model Design
- Open Top Construction and Parallel Working
- Maximising Pre-Fabrication
- Modular Construction for Switch-Yard and Calandria Vault
- Early Installations of Building Cranes
- Mock-Up for Critical Jobs

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A view of Turbine-floor showing Turbo-Generator
which was brought to Turning-Gear much ahead of schedule

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