

BHARAT HEAVY ELECTRICALS LIMITED AN INDUSTRIAL GIANT

Inspiring Innovation
Engineering Dreams

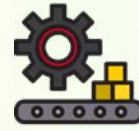


An Overview

Bharat Heavy Electricals Limited (BHEL) is India's premier state-owned public sector enterprise and flagship engineering and manufacturing company. Company's business spans across several core sectors of economy including transportation, defence, aerospace, oil & gas, power, transmission and renewables.



Making in India since
1964 and
supplying products
and services globally



16 manufacturing
facilities spread across
the country producing
equipment conforming to
international standards



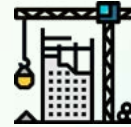
One of India's largest
employers in the
engineering space

30,000+ highly
skilled employees incl.

9,000 engineers



4 regional offices,
8 service centres and
15 regional marketing
centres



150+ ongoing
projects in different
parts of India & abroad



Ranks **one of the
highest in the capital
goods manufacturing
space in India**



References in
89 countries
in all six inhabited
continents





Consistent R&D spend of over **2.5%** of the annual revenue



82 technology collaborations undertaken with several global OEMs over the years



Shaping innovation capabilities & technology- with **dedicated R&D** centre in Hyderabad, 14 Centres of Excellence & 5 research centres



One of the few companies in the world having the **capability to design and manufacture equipment for entire range of power plants** – nuclear, hydro, thermal & gas, with proven capabilities to execute large size projects



State-of-the-art facilities specializing in engineering, manufacturing, testing, aftermarket services for equipment in the core infrastructure sectors - Power, Railways, Industrial Systems & Products, Defence & Aerospace



POWER



RENEWABLES



TRANSMISSION



RAIL TRANSPORTATION



OIL & GAS



DEFENCE & AEROSPACE



INDUSTRIAL SYSTEMS & PRODUCTS



WATER MANAGEMENT



e-MOBILITY



BATTERY ENERGY STORAGE SOLUTIONS





Coal Shed at 2x660 MW Maitree Supercritical Power Project in Bangladesh - EPC by BHEL

MAKING FOR THE WORLD

BHEL has been a reliable designer, manufacturer and supplier of world class power generation, transmission, transportation, defence, aerospace and industrial equipment for infrastructure sector to customers across the globe. Our international footprints span 89 countries across all the six inhabited continents. BHEL's in-house design team is well-versed with international design standards and our solutions are adaptable to the customer requirements. The company undertakes projects and contracts in all modes including EPC, Supply, Supply & Supervision, Consortium partner,

Contract Manufacturer, etc., as per customer requirement. Our spectrum of offerings includes one-stop solution for hydro, nuclear, solar, gas, thermal, railways, transmission as well as stand-alone products such as compressors, transformers, shunt-reactors, motors, pumps, heat exchangers, valves, oil-field equipment, after sales support etc.

Besides 195+ GW installed power capacity in India, we have so far supplied and installed 12 GW of power-plant equipment internationally and another 5 GW is under installation.

220/ 20 kV substation at Charikar, near Kabul, Afghanistan



POWER

The power generation segment comprises of nuclear, hydro, thermal, gas and renewable power plant businesses. BHEL has been in this segment for over five decades, having commissioned its first thermal-based set in 1969. The company has proven turnkey capabilities for executing power projects from concept to commissioning.

- BHEL offers a wide variety of efficient supercritical sets up to 1,000 MW rating, including 660/ 700/ 800 MW. We also offer lower rating thermal sets for utility and industrial applications.
- The company also offers state-of-the-art emission control equipment for thermal-based plants for lower carbon footprint and compliance with the world standard emission norms
- The company manufactures a wide range of products for nuclear power plants viz. steam generators, reactor headers and end shields, besides nuclear turbine-generator sets ranging from 220 MWe to 700 MWe ratings
- Customised hydro sets of Francis, Pelton and Kaplan types for different head-discharge combinations, are also engineered and manufactured by BHEL
- The company manufactures advanced-class large size gas turbines and matching generators. Additionally, the company supplies co-generation and combined cycle plants with higher plant efficiencies
- BHEL has proven expertise in plant performance improvement for BHEL and non-BHEL sets through renovation, modernization and uprating of a variety of power plant equipment including solution towards flexible operations

2x660 MW supercritical power plant commissioned by BHEL at Suratgarh, Rajasthan, India





Valve hall at Agra converter station, Uttar Pradesh, India for ± 800 kV, 6000 MW NE Agra HVDC Project

TRANSMISSION

BHEL is a leader in the field of power transmission in India with a wide range of transmission systems and products and having a proven track record across the globe.

- BHEL undertakes turnkey transmission projects from concept to commissioning on EPC basis which includes execution of EHV & UHV substations/ switchyards, both AIS and GIS types ranging from 33 kV to 765 kV, HVDC converter stations (up to ± 800 kV), and reactive power compensation schemes.
 - BHEL has executed a number of high voltage direct current (HVDC) projects in India, notably the world's first multi-terminal ± 800 kV, 6000 MW UHVDC Transmission link between North-Eastern part of India to Agra (Uttar Pradesh).
 - BHEL is the first Transformer Manufacturer in India having successfully Short Circuit tested up to 500 MVA, 400 kV Auto Transformers.
 - BHEL has indigenously developed and commissioned India's first 400 kV phase shifting transformer (PST).
- The major products manufactured and supplied by BHEL include:
- Power transformers up to 1200 kV
 - Converter transformers up to 800 kV, Thyristor valves and controls for HVDC application
 - Instrument transformers up to 1200 kV
 - Dry type transformers
 - Vacuum and Gas Insulated Switchgears
 - Control and relay panels, SCADA
 - Composite Insulators for upto 765 AC & 800 kV DC Application
 - FACTS – FSC, SVC, thyristor controlled shunt reactor (CSR) for dynamic reactive power management of long-range transmission lines.
 - Fibre Optic Current Transformer (FOCT)
 - Digital Substation Solution upto 400 kV

INDUSTRIAL SYSTEMS & PRODUCTS

BHEL supplies major equipment for a number of industries including Oil and Gas, Metallurgy and Mining, Petrochemicals, Chemicals, Automobiles, Steel, Aluminium, Cement, Fertiliser, Sugar, Paper, Textiles, etc.

Our vast range of products offered includes AC machines, alternators, centrifugal compressors, Oil Rigs, X-Mas Tree Valves, Transformers, Substations, Switchgear, Heat exchangers, pressure vessels, columns, fired heaters, locomotives, Downstream Oil and Gas packages (Sulphur Recovery Unit), Gas turbine

based co-generation and combined cycle power plants, steam turbine based captive power plants to suit the requirement of different industries, turbo-generators, complete range of steam generators (Circulating Fluidized Bed Combustion, Pulverised Fuel, Utility Boiler & heat recovery steam generator) for process industries capable of burning a wide variety of fuels, Electrostatic Precipitators and Fabric Filters.



Centrifugal compressor under assembly at BHEL works in Hyderabad, Andhra Pradesh, India



RAIL TRANSPORTATION

BHEL is a leading designer and manufacturer of Rail Transportation systems like semi high-speed trains, Electric Locomotives, Diesel Electric Shunting Locomotives and Electrical Multiple Units. BHEL also manufactures critical equipment like Traction Converters/ Inverters, Motors, Transformers, Bogies, Train Control Management System (TCMS).

- Supplied 800+ Locomotives for Railways and Industrial operation.
- Manufacturing capability of Electric Locomotives upto 9000 HP and Diesel

Electric Shunting Locomotives upto 3250 HP

- India's first fleet of fully air-conditioned AC EMU trains for the Mumbai sub-urban region equipped with BHEL- Electrics and control system
- Manufacturing 3-phase underslung equipment for a wide range of rolling stock including India's flagship project - Vande Bharat (semi high-speed) & Kolkata metro
- Exported state-of-the-art Traction equipment to South Asian, South-East Asian and African nations





DEFENCE AND AEROSPACE

- BHEL is a reliable supplier of equipment and services to Indian defence forces for almost three decades with dedicated engineering and manufacturing facilities
- Major products include super rapid gun mount (upgraded), strategic naval equipment, integrated platform management systems, thermos-pressed components, electrical machines, turret castings for T72 tanks, simulators, castings and forgings, etc.
- BHEL has been a reliable supplier to ISRO for solar panels and batteries for their satellites
- BHEL is one of the few firms worldwide with capability to design and manufacture heat exchangers for military aircraft and is supplying heat exchangers for Light Combat Aircraft (LCA) 'TEJAS'.
- Indian Space Research Organisation (ISRO) has partnered with BHEL for manufacturing of space-grade solar panels and satellite batteries. BHEL is rapidly expanding its offering in the aerospace segment.



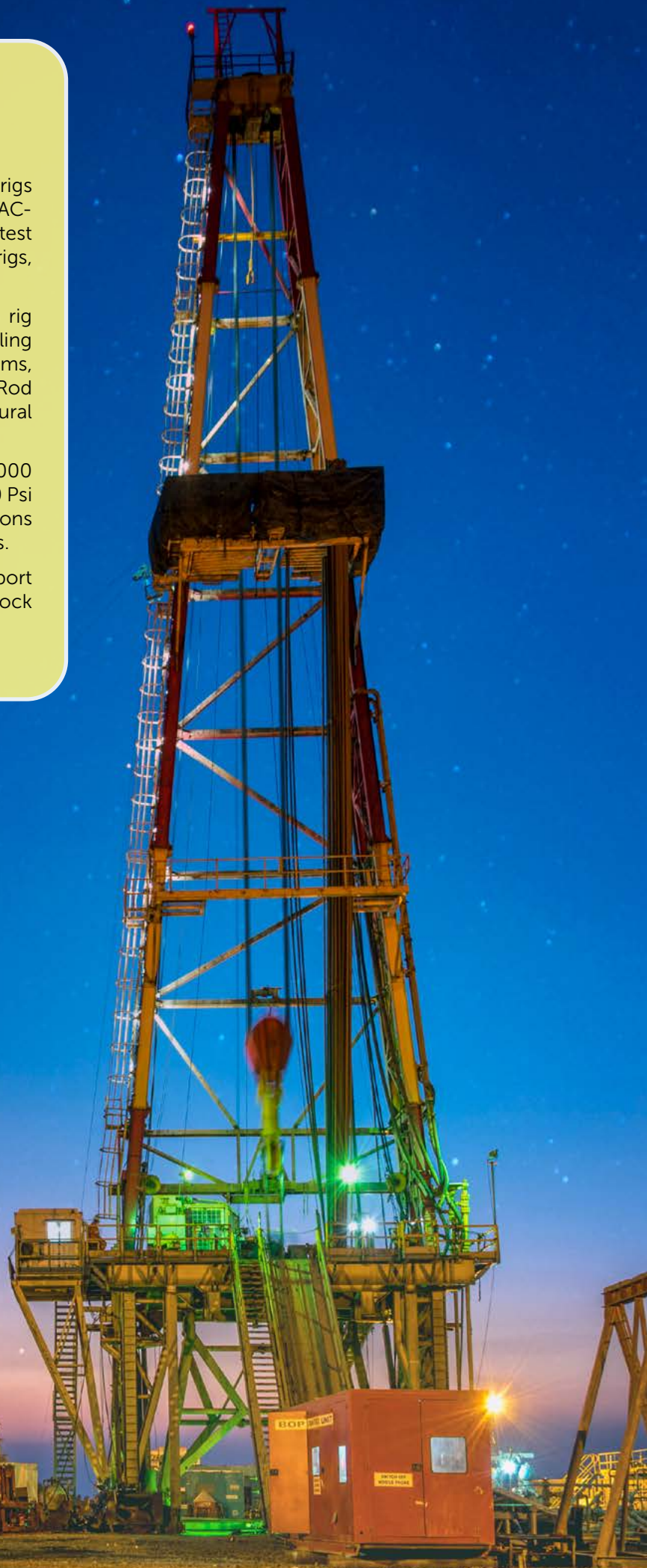
Heat Exchanger and pre-cooler for LCA Tejas - supersonic combat aircraft, indigenously designed and manufactured by BHEL

OIL & GAS

- BHEL supplies complete onshore drilling rigs capable of drilling up to 9,000 metres, with AC-SCR system or AC drives incorporating the latest state-of-the-art technology, and also mobile rigs, work-over rigs.
- BHEL also supplies onshore drilling rig equipment like draw works, rotary-table, travelling block, swivel, mast and substructure, mud systems, Artificial lift system (surface units of Sucker Rod Pumps) and rig electrics to leading oil and natural gas exploration companies of India.
- Wellheads and X-Mas tree valves up to 15000 Psi rating and Choke & Kill Manifold upto 10,000 Psi rating for onshore as well as offshore applications are also provided by BHEL to drilling companies.
- The company has also supplied casing support systems, mudline suspension systems and block valves for offshore application.



X-Mas tree Valve manufactured at BHEL's Tiruchirapalli unit in Tamil Nadu, India



BHEL-make EV-2000 land Oil Rig at ONGC Ankleshwar, Gujarat, India

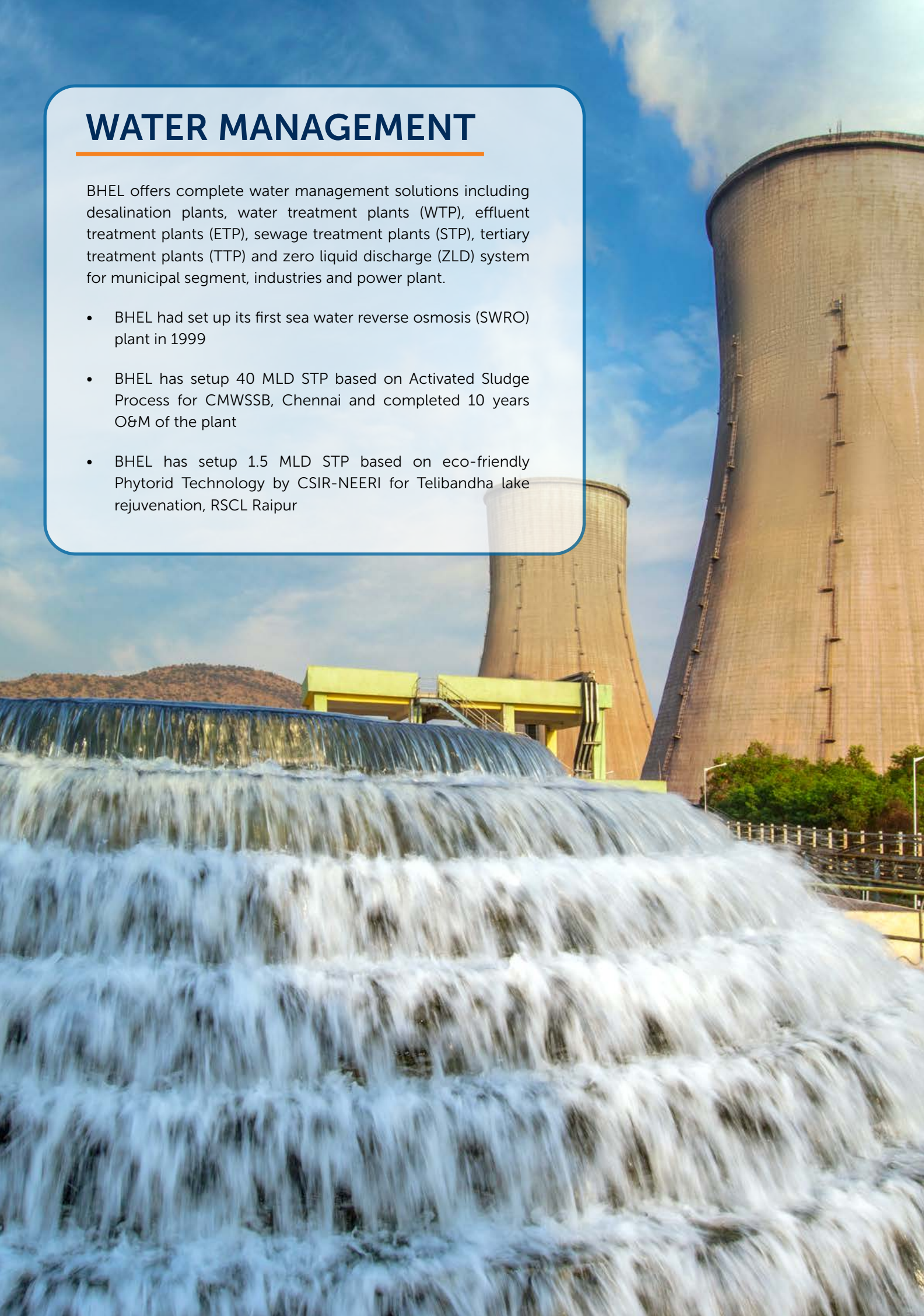
RENEWABLES

- BHEL is one of the few EPC players which manufactures almost all the major equipment of solar power plant viz. Solar Cells, Solar Modules, PCUs, HT Panels, SCADA, Power Transformers etc., with complete grid storage solutions
- BHEL has a dedicated industrial R&D Centre for developing high-efficiency silicon solar cells and process optimizations
- BHEL has emerged as the market leader in floating solar EPC segment in India by commissioning some of the country's largest floating solar power plants viz. NTPC Ramagundam 100 MW (Telangana), NTPC Simhadri 25 MW (Andhra Pradesh), NTPC Kayamkulam 22 MW (Kerala) etc.
- BHEL has a solar portfolio of more than 1200 MW, out of which more than 1100 MW capacity comprising of large scale utility Ground mounted, floating solar, Rooftop, Canal Top solar plants have already been commissioned

WATER MANAGEMENT

BHEL offers complete water management solutions including desalination plants, water treatment plants (WTP), effluent treatment plants (ETP), sewage treatment plants (STP), tertiary treatment plants (TTP) and zero liquid discharge (ZLD) system for municipal segment, industries and power plant.

- BHEL had set up its first sea water reverse osmosis (SWRO) plant in 1999
- BHEL has setup 40 MLD STP based on Activated Sludge Process for CMWSSB, Chennai and completed 10 years O&M of the plant
- BHEL has setup 1.5 MLD STP based on eco-friendly Phytotid Technology by CSIR-NEERI for Telibandha lake rejuvenation, RSCL Raipur

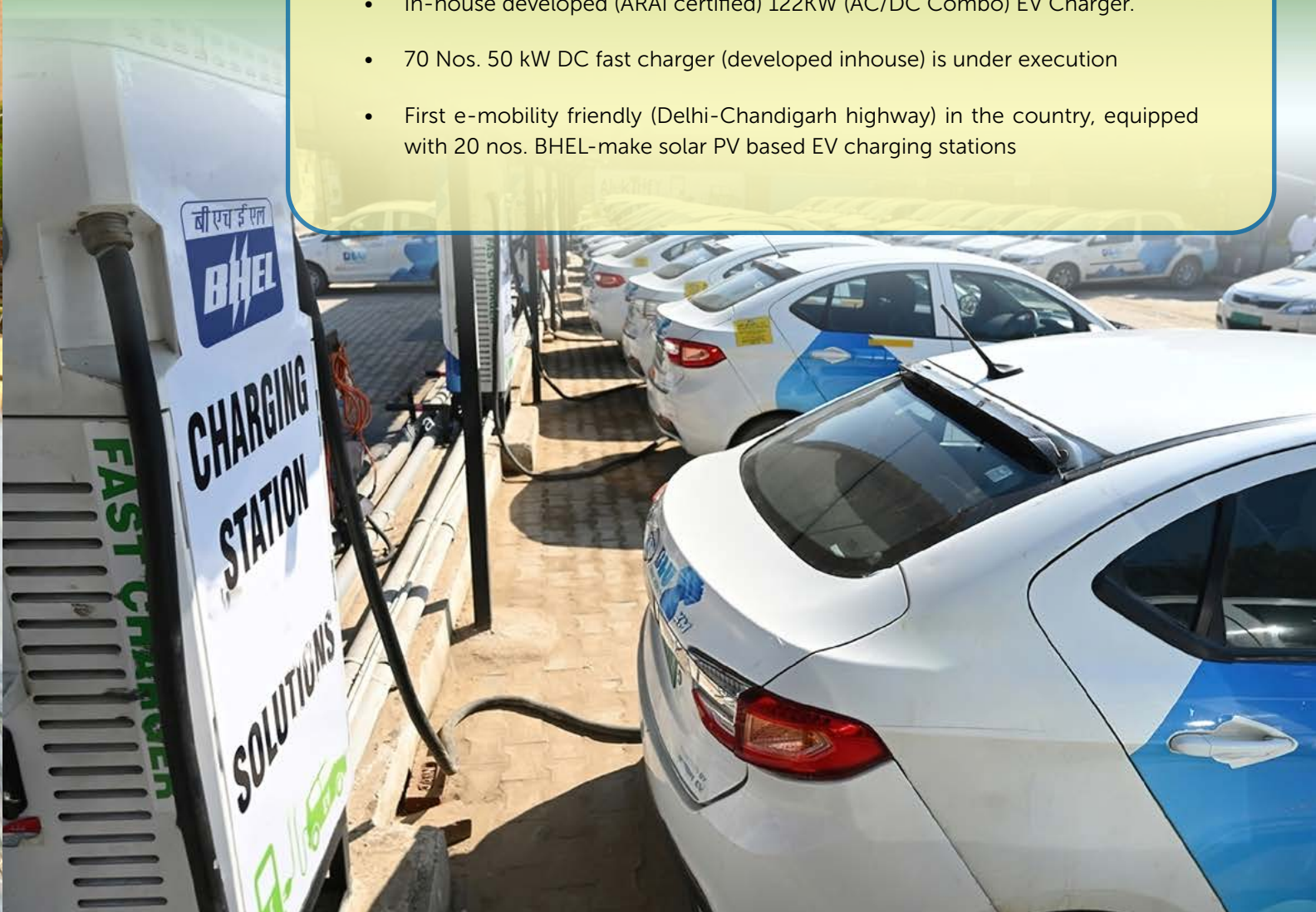




E-MOBILITY

BHEL is committed to the world's e-mobility mission in a significant way.

- End-to-end integrated EV Charging infrastructure solutions including solar based chargers for cities & Highways
- In-house developed (ARAI certified) 122KW (AC/DC Combo) EV Charger.
- 70 Nos. 50 kW DC fast charger (developed inhouse) is under execution
- First e-mobility friendly (Delhi-Chandigarh highway) in the country, equipped with 20 nos. BHEL-make solar PV based EV charging stations





BATTERY ENERGY STORAGE SOLUTIONS

- BHEL offers battery energy storage solutions to support the infirm power delivered by RE system and also standalone battery energy storage system connected with grid, with features like energy time shifting, power smoothing, frequency regulation, anti-islanding and VAR support
- Commissioned 1MWh battery energy storage system (BESS) with in-house developed PCS (power conditioning system) and EMS (energy management system) featuring three different types of battery chemistries-lithium ion battery, flow battery and advanced lead acid battery
- State-of-the-art facility for packaging and testing of Li-ion batteries for space applications. The company has assembled, tested and supplied batteries of 40 Ah - 180 Ah to ISRO for use in its satellites for more than two decades.



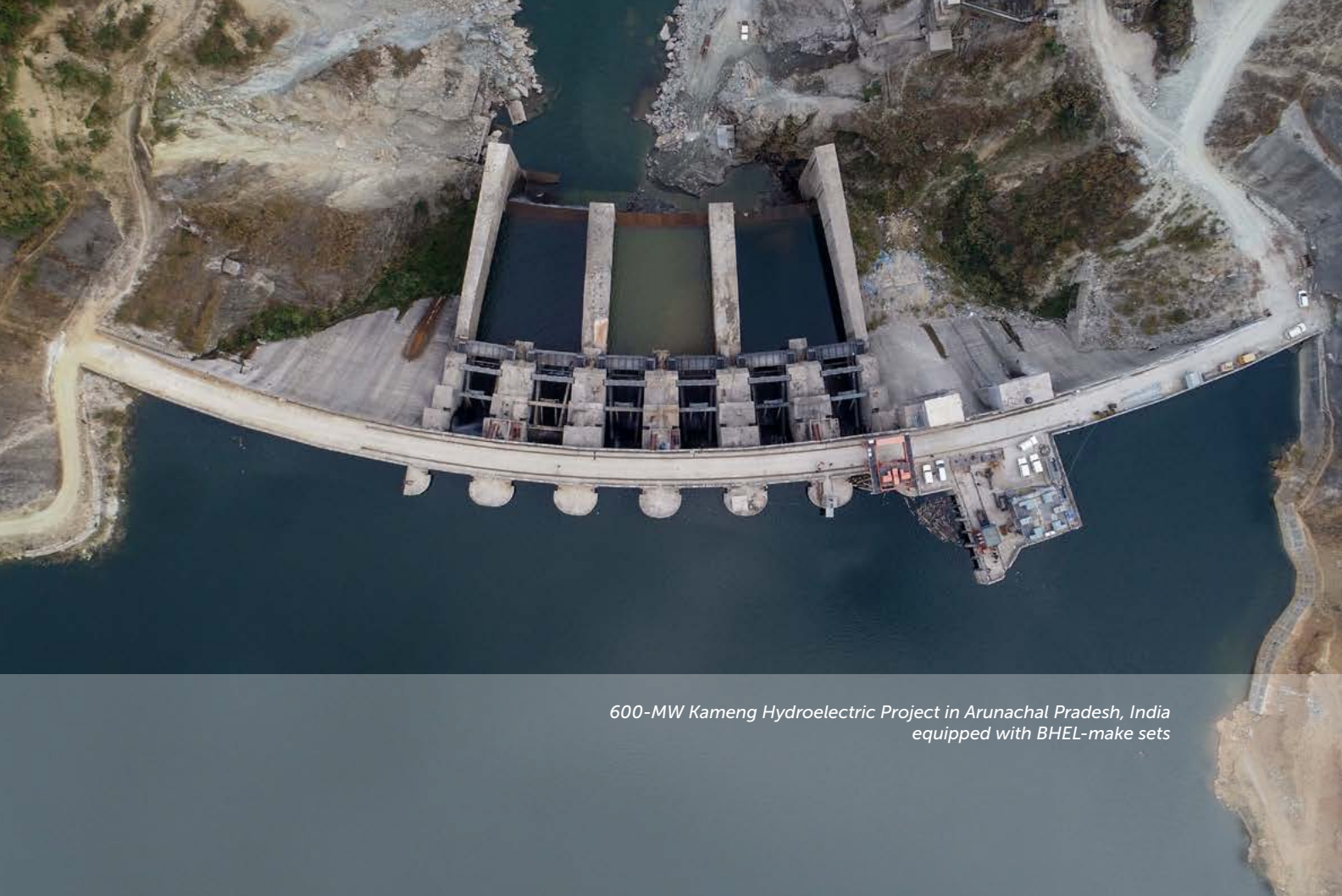
1 MW Battery Energy Storage System (BESS) developed and commissioned at BHEL's Corporate R&D division, Hyderabad, India

RESEARCH & DEVELOPMENT

- R&D expenditure (>2.5% of Turnover) – one of the highest in Indian engineering field
- Centres of Excellence for Intelligent Machines & Robotics, Machine Dynamics, Compressors & Pumps, Nanotechnology, UHV Engineering, Simulators, Computational Fluid Dynamics, Surface Engineering, Permanent Magnet Machines, Advanced Transmission Systems, Power Electronics and Control & Instrumentation
- Five specialized institutes viz. Ceramic Technological Institute, Amorphous Silicon Solar Cell Plant, Pollution Control Research Institute, Welding Research Institute and Centre for Electric Transportation for carrying out advanced R&D in various engineering disciplines and identified technological areas
- Filing patents/copyrights applications regularly – more than 4,800 filings
- Strong engineering and R&D base for in-house development of indigenous technologies
- Technology collaboration agreements with leading global manufacturing and engineering companies
- Focus on clean thermal technologies



UHV (Ultra High Voltage) Lab at BHEL's Bhopal unit, Madhya Pradesh, India



600-MW Kameng Hydroelectric Project in Arunachal Pradesh, India
equipped with BHEL-make sets

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