



TRANSMISSION BUSINESS

Transforming Today
for a Better Tomorrow

ABOUT BHEL

Since 1964, BHEL has been 'Making in India' as a leading Capital Goods sector company. Today, the company's businesses are in the areas of power and industry, offering comprehensive solutions, including products, systems and services to power generation (thermal, hydro, gas, nuclear and solar PV), transmission, transportation, defence, aerospace, oil & gas and other core sectors of the country, and also abroad. BHEL, incorporated as a Public Sector Undertaking of the Government of India with a shareholding of 63.17%, has established 16 manufacturing plants spread across India, producing capital goods for the customers in domestic as well as international markets. The

Company has steadily expanded its product portfolio through both partnerships with global OEMs as well as in-house product development. The in-house product development is backed by consistent investment of more than 2.5% of revenue on R&D and innovation. At BHEL, we firmly believe that serving our customers, protecting the environment, and contributing to society are intrinsically linked, and form the core of our corporate ethos. The Company has been supporting communities through programs like skill development; promoting health, hygiene & education; and running several programs on environmental protection & improvement.



765 kV Substation at Raichur, Karnataka, India

BHEL IN POWER TRANSMISSION

A Powerful Presence of Over Four Decades

BHEL is a well-established solution provider in the field of power transmission with a vast experience of more than four decades.

With its core competencies encompassing design, engineering, manufacturing, construction, testing, commissioning and servicing, BHEL offers a wide range of Transmission Products and Systems with contemporary technologies and conforming to International Quality Standards.

45+ Years of Experience	240+ Electrical Substations	6 major HVDC Projects	Supplied 7,50,000+ MVA Transformers/ Reactors
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Ultra High Voltage (UHV) Laboratory established at Corporate R&D, Hyderabad, India

CONCEPT TO COMMISSIONING AND BEYOND

BHEL provides cost-effective transmission solutions and services from concept to commissioning for EHV Substations, High Voltage DC (HVDC) Converter Stations and Power Quality & Stability Solutions - FACTS (Flexible AC Transmission Systems), backed by expert Power System Studies.

EHV Substation

BHEL has a rich EPC experience of execution of EHV & UHV class Electrical Substation/ Switchyard projects (both AIS & GIS type) ranging from 33 kV to 765 kV. With modern EPC infrastructure, expert manpower and in-house state-of-the-art facilities, BHEL has executed

400 kV Switchyard at 1x700 MW Bellary STPS in Karnataka, India



more than 240 substations in India & abroad for utilities and industries covering a vast array of applications with sites at varied and extreme geographical locations (deserts and high altitude areas) :

- Grid Substations
- Industrial Receiving Substations
- Switchyards for Power Generating Stations
- HVDC Converter Stations and associated Switchyard

HVDC Systems and Products

BHEL has vast expertise in HVDC domain and has executed major HVDC projects upto 800 kV in India.

BHEL has state-of-the-art manufacturing facilities for HVDC equipment and has supplied major products like Converter Transformers, Reactors, Thyristor Valves, Control Panels, Capacitor Banks, Instrument Transformers, Insulators, SCADA, etc. for these projects.



498 MVA, 400 kV Converter Transformer for Ballia-Bhiwadi HVDC Project

Major projects executed by BHEL are:

- 1500 MW, \pm 500 kV Rihand-Delhi HVDC Project
- 1500 MW, \pm 500 kV Chandrapur-Padghe HVDC Project
- 200 MW, + 200 kV National HVDC Project
- 2500 MW, \pm 500 kV Balia-Bhiwadi HVDC Project
- 6000 MW, \pm 800 kV North-East Agra UHVDC Project (World's first multi terminal HVDC System)
- 6000 MW, \pm 800 kV Raigarh-Pugalur UHVDC Project

Currently executing following two major HVDC Projects.

- 6000 MW, \pm 800 kV Khavda(KPS-II)-Nagpur UHVDC Project
- 6000 MW, \pm 800 kV Bhadla-Fatehpur UHVDC Project



Indoor DC Hall at NE Agra HVDC Terminal



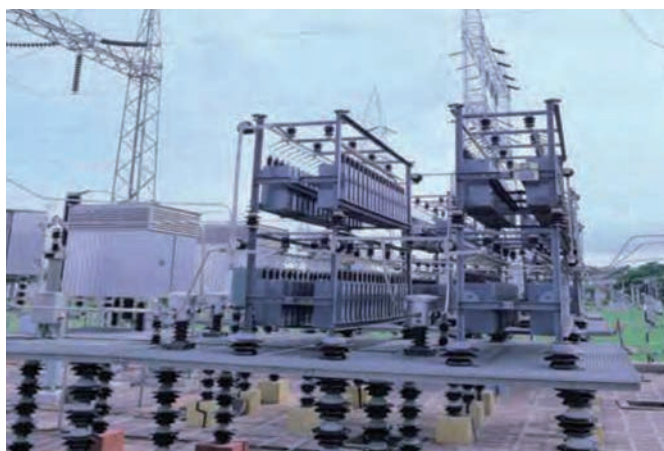
BHEL is the first and only Transformer Manufacturer in India having successfully Short Circuit tested Auto Transformers up to 500 MVA, 400 kV Class and Generator Transformer up to 333 MVA, 765 kV Class

Flexible AC Transmission System (FACTS) Solution

BHEL provides turnkey solutions for Reactive Power Management systems for both grid and industrial applications.

BHEL undertakes complete feasibility studies, system studies, system design and installation on turnkey basis. The major FACTS solutions offered by BHEL are:

- Fixed Series Compensation (FSC)
- IGBT based Static Compensators (STATCOM)
- Thyristor controlled Shunt Reactor (CSR)
- Phase Shifting Transformer (PST)
- Synchronous Condenser



India's first Fixed Series compensation scheme at Ballabhgarh (Haryana), India

INNOVATIONS & SOLUTIONS



India's first 400 kV Controlled Shunt Reactor at Itarsi Substation

Thyristor Controlled Shunt Reactor (CSR)

BHEL indigenously developed and commissioned India's first Controlled Shunt Reactor for application in 400 kV systems which offers all the advantages of a permanently connected Shunt Reactor while overcoming its disadvantages through Thyristor based control system to operate on continuous mode. With this, the required amount of reactive power (from zero to full capacity) can be controlled, based on grid requirements.

Gas Insulated Switchgear (GIS)

Over a period of time, GIS has gained popularity in Power Transmission considering its compactness, reliability, ease of maintenance and its growing applications in the areas with space limitations.

Under the Govt. of India's initiative of AatmaNirbhar Bharat (Self-reliant India), through in-house R&D efforts, BHEL has indigenously developed Gas Insulated Switchgear (GIS) for EHV range. BHEL offers prompt after-sale services through its expert engineers and assures ready availability of crucial spares for the GIS.



400 kV GIS for Chamera HEP

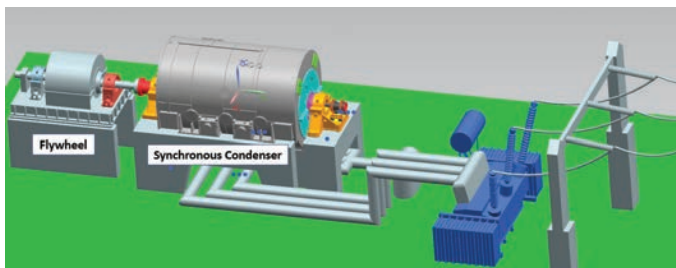
Digital Substation Solution

BHEL has successfully commissioned Digital Substation with India's first indigenously designed and developed 420 kV Fibre Optical Current Transformers (FOCTs) along with IEC 61850 compliant Intelligent Electronic Devices (IEDs) viz. Merging Unit (MU), Switchgear Control Unit (SCU) and Bay Control Unit (BCU) at HVDC substation at Bhiwadi (Rajasthan), India. BHEL is now fully geared up to offer complete digital substation solution.

Synchronous Condenser

Focusing on the contemporary needs of the Grid and considering the challenges being encountered with the changing mix of energy, integration of RE Power, Instability factor of the Grid and to deal with the Reactive compensation issues, BHEL has developed and geared up to offer Synchronous Condenser as a fruitful Grid solution under Make in India initiative which dynamically generates & absorbs reactive power and helps to maintain required voltage level, provides high short circuit strength to withstand fault level currents and high system inertia to resist variation in frequency.

With its in-house product base, BHEL may offer Synchronous condenser up to 300MVar rating.



Phase Shifting Transformer (PST)

An innovation of BHEL's in-house R&D, PST is a combination of Shunt & Series transformer units that control real power flow between the two networks by providing desirable phase shift between the systems. BHEL has designed, manufactured, installed and successfully commissioned India's first and the only 400 kV PST at Kothagudem TPS of TSGENCO (Telangana State Power Generation Corporation Limited).



India's first 400 kV Phase Shifting Transformer



400 kV Substation at Andal, West Bengal

MANUFACTURING CAPABILITIES AND OFFERINGS

BHEL has state-of-the-art manufacturing facilities and offers the following in-house manufactured products:

Power Transformers/ Reactors

- HVAC Power Transformers up to 1200 kV
- HVDC Converter Transformers up to 800 kV
- Series and Shunt Reactors up to 765 kV
- Dynamically Controlled Shunt Reactors up to 400 kV
- Phase Shifting Transformers for EHV & UHV applications
- Special Transformers including Dry type Transformers up to 15 MVA

Instrument Transformers

- Current Transformers up to 400 kV
- Fibre Optical Current Transformers up to 400 kV (FOCT)
- Electro-Magnetic Voltage Transformers up to 220 kV
- Capacitive Voltage Transformers up to 1200 kV

Control & Protection Equipment

- Control & Relay Panels
- Substation Automation System (SAS)
- SCADA
- Bay Control Unit (IEC61850 Compliant)
- Merging Unit (IEC61850-9-2-LE Compliant)
- Switchgear Control Unit (IEC61850 Compliant)

Switchgears

- Vacuum Circuit Breaker (3.3 kV to 33 kV)
- Gas Insulated Switchgear (GIS) for EHV range

Capacitors

- For HVDC and FACTS applications
- SVC as Shunt Capacitors, AC Filter Capacitors
- Series Capacitors in FSC/TCSC

Bushings

- Wall Bushings up to 245 kV
- Oil Cable Box Bushings up to 400 kV
- Bushings for higher creepage, cantilever load & altitude (145 kV- 420 kV)
- OIP Condenser Bushing - 52 kV to 525 kV for transformer application

Thyristor Equipment

- Thyristor Valves for HVDC transmission up to 800 kV



Thyristor Valves for Raigarh - Pugalur HVDC project



Country's first 1200 kV Auto Transformer at POWERGRID's National Test Station at Bina, Madhya Pradesh, India

Insulators

- Hollow Porcelain and Composite Insulators up to 765 kV
- Solid Core Insulators up to 400 kV
- Long Rod Composite Insulators up to 765 kV AC (210 kN) & \pm 800 kV DC (420 kN) application

Power System Studies

BHEL has a team of experts who have vast experience with utilities and manufacturers in India and abroad. BHEL undertakes Power System Studies, Feasibility Studies and Insulation Coordination Studies, etc. using the latest hardware and software tools for AC and DC systems.

A Trusted Partner

- Rich experience of more than four decades in Power Transmission & Distribution

- Proven performance in multiple profiles - EPC contractor, equipment supplier, consortium partner and service provider
- Dedicated infrastructure and experienced manpower for manufacturing and commissioning of transmission equipment
- An enterprise with a wide-spread manufacturing base, regional centres and offices across the country to respond with minimum turnaround time and to provide after-sales-services and spares on long term basis

Testing Facilities

BHEL has Ultra High Voltage Laboratory at par with international standards and is one of the largest screened testing facilities in the world for testing Transformers, Valves (Thyristor, IGBT) attached to its manufacturing plants.



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



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