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BHEL PROFILE

Indian Engineering.
Global Enterprise.

ENGINEERING SUSTAINABLE SOLUTIONS

BHEL An Overview

Established in 1964, Bharat Heavy Electricals Limited (BHEL) is the largest engineering and manufacturing enterprise in India in the energy and infrastructure sector with the capability to manufacture the entire range of power plant equipment.

BHEL caters to the core sectors like Power Generation, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas, Water, Defence & Aerospace, and e-Mobility & Energy Storage Solutions, and has references in 83 countries across the globe. BHEL's mammoth size of operations is evident from its widespread network of 16 Manufacturing Units, 2 Repair Units, 4 Regional Offices, 8 Service Centres, 1 Subsidiary, 3 Overseas Offices, 3 Joint Ventures, 15 Regional Marketing Centres and more than 150 project sites across India and abroad.

Through its strategic partnerships with global technology leaders, BHEL has been acquiring technologies for the past five decades, which are adopted and indigenised at its in-house Corporate R&D Division and Research and Product Development (RPD) centres at manufacturing units that work together to evolve optimal solutions to suit customer-specific needs. While all the manufacturing units and other entities of the company have been accredited to Quality Management Systems (ISO9001), major manufacturing units have also been accredited to Environmental Management Systems (ISO 14001) and Occupational Health & Safety Management Systems (OHSAS 18001).

Power

The power generation segment comprises thermal, gas, hydro and nuclear power plant businesses. BHEL has been in this business for almost five decades, having commissioned its first coal-based set in 1969. The company has proven turnkey capabilities for executing power projects from concept to commissioning. BHEL offers a wide variety of coal-based sets of up to 1,000 MW rating, including 660/700/800 MW rating sets based on supercritical technology and sub-critical sets of up to 600 MW unit rating. The company also offers state-of-the-art emission control equipment for coal-based plants for lower carbon footprint and compliance with the revised emission norms notified by the Government of India. BHEL sets are customised for Indian conditions and fully comply with the technical standards notified by the Central Electricity Authority (CEA).

Additionally, the company supplies co-generation and combined cycle plants with higher plant efficiencies. BHEL also manufactures Circulating Fluidized Bed Combustion (CFBC) boilers that efficiently utilise the low calorific lignite available in India and has commissioned power projects based on CFBC technology up to 250 MW rating.

The company manufactures a wide range of products for nuclear reactors viz. steam generators, reactor headers & end shields, besides nuclear turbine-generator sets ranging from 220 MWe to 700 MWe ratings. Customised hydro sets from 5 MW to 300 MW 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.

BHEL has proven expertise in plant performance improvement through renovation, modernisation and uprating of a variety of power plant equipment.

Transmission

BHEL is a leader in the field of power transmission in India with a wide range of transmission systems and products and 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.

The company has executed a number of High Voltage Direct Current (HVDC) projects in India, notably the world's largest ±800 kV, 6000 MW Ultra High-Voltage Multi-terminal DC transmission link between North Eastern part of India and Agra (Uttar Pradesh). BHEL is also currently executing +800 kV, 6000 MW, Raigarh-Pugalur HVDC project, which is another milestone project in HVDC segment.

The products manufactured by BHEL include power transformers up to 1200 kV, HVDC converter transformers up to 800 kV, current transformers up to 400 kV, capacitive voltage transformers up to 1200 kV, dry type transformers, shunt reactors up to 765 kV, power capacitors, vacuum and SF6 switchgears, gas insulated switchgear up to 400 kV, control and relay panels, SCADA, IEC 61850 based Substation Automation System, thyristor valves and controls for HVDC application, ceramic and composite insulators, FACTs devices (FSC, SVC, Thyristor Controlled Shunt Reactor (CSR)) for dynamic reactive power management of long transmission lines.

BHEL has indigenously developed India's first 400 kV Phase Shifting Transformer (PST) and commissioned it at Kothagudem power plant in Telangana. The PST contributes towards improving the transmission efficiency and also averts grid collapse in case of system instability.

Industry

BHEL supplies major equipment for a number of industries including oil and gas exploration, metallurgy and mining, pipelines, petrochemicals, chemicals, automobiles, steel, aluminium, refinery, cement, fertilizer, sugar, paper, textiles, etc. The range of products offered includes AC machines, alternators, centrifugal compressors, heat exchangers, pressure vessels, columns, fired heaters, cryogenic air separation plants, gas turbine based co-generation and combined cycle power plants, steam turbine based captive and co-generation power plants to suit requirement of different industries, turbo-generators, complete range of steam generators for process industries capable of burning a wide variety of fuels, diesel engine based power plants, electrostatic precipitators, fabric filters, etc.

Transportation

BHEL is a leading supplier of electrical propulsion systems and traction equipment for all types of rolling stock to Indian Railways, which operates one of the world's largest railway networks. India's first fully air-conditioned AC EMU is equipped with BHEL-supplied IGBT based propulsion equipment. The company also manufactures complete electric locomotives (up to 6000 HP) & EMU coaches for Indian Railways. BHEL manufactures diesel electric locomotives (up to 3000 HP) catering to the shunting requirements of various industries and power utilities.

BHEL has also diversified into the area of track maintenance machines and coach manufacturing for Metros & Indian Railways.

Oil & Gas

BHEL supplies complete onshore drilling rigs capable of drilling up to 9,000 M, with AC-SCR system or AC drives incorporating the latest state-of-the-art technology, mobile rigs, work-over rigs and sub-sea wellheads. BHEL also supplies onshore drilling rig equipment like draw works, rotary-table, travelling block, swivel, mast and substructure, mud systems and rig electrics to leading oil and natural gas exploration companies of India.

Wellheads and X-Mas tree valves up to 10,000 Psi rating 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.

Renewables

With a current portfolio of more than 465 MW in the field of photovoltaics, BHEL has generated expertise in critical parts of the silicon value chain, viz., processing of silicon wafer to cell, processing of cell to PV module and in design, supply, installation, commissioning and O&M of grid interactive utility, rooftop solar, canal top and floating solar PV power plants. Thus, offering turnkey solutions for solar PV plants. BHEL has a dedicated R&D group in the area of semiconductor materials, nano and thin film devices. ISRO has partnered with BHEL for space-grade solar panels and satellite batteries.

Water Business

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 power plants, industries and municipal applications. The company set up its first Sea Water Reverse Osmosis (SWRO) plant in 1999.

Defence and Aerospace

BHEL has emerged as a reliable supplier of equipment and services to Indian defence forces for more than two decades with dedicated engineering and manufacturing facilities. Major products include super rapid gun mount, strategic naval equipment, integrated platform management systems, thermo-pressed components, 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 'TEJAS'. BHEL is rapidly expanding its offering in the aerospace segment.

e-Mobility & Energy Storage Solutions

BHEL is committed to nation's e-Mobility mission in a significant way. BHEL had manufactured and supplied more than 300 Battery Powered Road Vehicles in the past. Presently it is geared up to provide end-to-end integrated e-mobility solutions for cities. BHEL is focusing on a diversified portfolio consisting of traction motors and controls, Lithium ion battery packs and charging infrastructure.

BHEL has a state-of-the-art facility for packaging and testing of Li-ion batteries for space applications. The company has assembled, tested and supplied more than 70 batteries of 45 Ah – 180 Ah to ISRO for use in its satellites during the last 15 years.

BHEL is also capable of delivering complete grid storage solutions with in-house developed Power Conditioning System and SCADA.

International Business

BHEL has established itself as a global player with footprints in 82 countries across the globe. Starting its journey with the first export order for Malaysia in the early seventies, the company has been expanding its references year by year. These references encompass complete power projects on EPC basis (thermal, hydro, gas), substation & rehabilitation projects, along with a wide gamut of products including turbines, generators, boilers, DG sets, control equipment, transformers, capacitors, bushings, insulators, switchgears, solar modules, motors, wellheads, castings, valves, locomotives, etc. The company has also been providing after-sales support to its overseas customers in the form of spares and services. The cumulative installed capacity of power plants overseas with BHEL-supplied equipment stands at close to 11 GW.

AFRICA
Algeria
Benin
Comoros
D.R. Congo
Egypt
Eswatini
Ethiopia
Ghana
Kenya
Libya
Malawi
Mauritius
Mozambique
Nigeria
Rwanda
Senegal
South Africa
Sudan
Tanzania
Togo
Uganda
Zambia
Zimbabwe

ASIA
Afghanistan
Azerbaijan
Bangladesh
Bhutan
China
Hong Kong
Indonesia
Iran
Iraq
Japan
Jordan
Kazakhstan
Kuwait
Laos
Malaysia
Myanmar
Nepal
Oman
Philippines
Saudi Arabia
Singapore
South Korea
Sri Lanka
Syria
Taiwan
Tajikistan
Thailand
U.A.E.
Vietnam
Yemen

EUROPE
Belarus
Belgium
Bulgaria
Cyprus
Estonia
Finland
France
Georgia
Germany
Greece
Ireland
Italy
Malta
Poland
Romania
Russia
Sweden
Switzerland
Turkey
Ukraine
U.K.

NORTH AMERICA
Canada
United States of America

OCEANIA
Australia
New Caledonia
New Zealand
Samoa

SOUTH AMERICA
Chile
Suriname
Trinidad & Tobago

■ **Countries with BHEL presence**

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Bharat Heavy Electricals Limited
www.bhel.com
Corporate Identity Number: L74899DL1964GOI004281

CC/500/01/2019


POWER


INDUSTRY

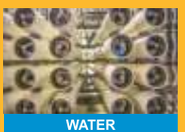

RENEWABLES


DEFENCE & AEROSPACE


TRANSMISSION


TRANSPORTATION


OIL & GAS


WATER

Powering Progress...Brightening Lives. Touching Every Indian Home

ELECTRICAL MACHINES [MOTORS]

ELECTRICAL MACHINES

Product	Application
AC Machines for Safe Area Application (Voltage: AC 3 Ph, 415 V to 13800 V, Frequency: 50 / 60 Hz, Enclosure: SPDP / CACW / TEFC / TETV CACA / Duct ventilated) 2 to 30 poles	
• Squirrel Cage Induction Motors (150 kW to 22000 kW) For industries (cement, paper, sugar, rubber, Steel, irrigation, Thermal Power Projects, Mines,Refineries etc.	Fans / compressors / pumps / crusher / mills / conveyors
• Slip Ring Induction Motors (150 kW to 10000 kW) For Industries (cement, rubber), Irrigation, Mines etc.	Fans / crusher / mills / blowers / banbury mixture / conveyors
• Synchronous Motors (1000 kW to 25000 kW) For Industries (paper, steel, Refinery, Irrigation etc.)	Fans / compressors / pump
• Variable Speed Motors Squirrel cage induction motors (150 kW to 22000 kW) Synchronous motors (1000 kW to 25000 kW) For industries and power plant	Fans / kiln ID Fan.

2800 kW, 6.6 kV, 4 P Vertical Sq. Cage Induction Motor for NPCIL

6000 kW, 11 kV, 6 P, 60 Hz Slip Ring Induction Motor for City Cement, UAE

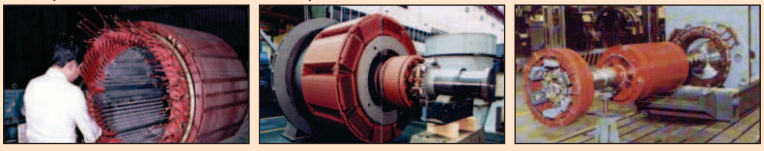
2150 kW, 6.6 kV, 4 P Constant Torque Motor for Essar Construction India Ltd.

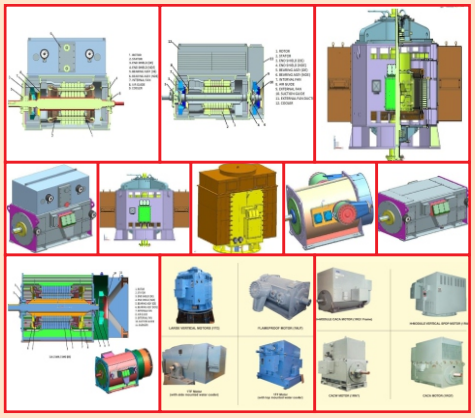
AC Machines for Hazardous Area Application (Fixed speed or with VFD)

Fans / compressors / pumps

(Voltage:AC 3 Ph, 415 V to 13800 V, Frequency : 50 / 60 Hz, Enclosure: SPDP / TETV/CACW/TEFC/ CACA/Duct ventilated),
For Industries (chemical, fertilizer, gas & Petroleum, refinery, pumping station etc.)

- Flame-Proof Squirrel Cage Induction Motors (Ex 'd')
  (150 kW to 1500 kW)





ELECTRICAL MACHINES

Product	Application
• Non-sparking Squirrel Cage Induction Motors (Ex 'n') (150kW to 4000kW) (higher rating on request) • Increased Safety Squirrel Cage Induction Motors (Ex 'e') (150kW to 4000kW) (higher rating on request) • Pressurized Squirrel Cage induction Motors (Ex 'p') (150 kW to 22000 kW) • Pressurized Synchronous Motors (Ex 'p') (1000 kW to 25000 kW)	**Industrial Application/ Oil Refinery/ For Circulation Water Pumps in Thermal Power Plant**
Mill Duty Motors (150 kW to 5000 kW with base speed > 150 rpm) For steel mills	Fans
Industrial Alternators (3000 kVA to 25000 kVA) For Industries (sugar / cement / steel / paper / chemicals), Captive power plants	Steam turbine / Gas turbine / Diesel engine
Induction Generators (300 kVA to 6000 kVA) For Mini / Micro HEP	Hydro turbine
Wind Generators (300 kVA to 3000 kVA) For wind farm	Wind turbine

275 kW, 6.6 kV, 2 P Increased safely H-Compact Motor for KSB Pumps Ltd.

Large Size Wound Rotor Alternator (17.5 Mw, 11 Kv.4p For Khanna Paper)

Slow Speed Pressurised Sy. Motor (1.2 MW, 6.6 KV, 18P For IOCL, Mathura)

MAJOR DEVELOPMENTS

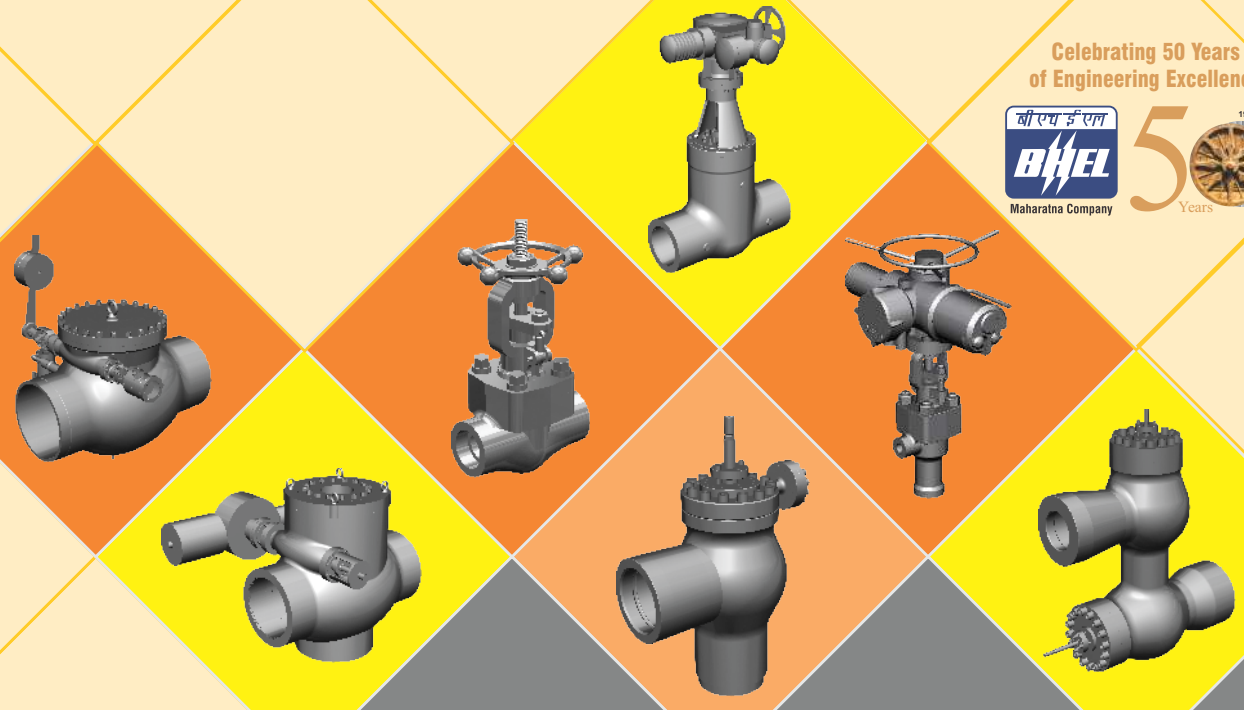
- Largest Rated 22 Pole, 5200 kW, 11 kV Vertical Sq. Cage Induction Motor for 5 x 800 MW Ultra Mega Power Plant of Coastal Gujrat Power Ltd., Mundra
- Largest Rated 18 Pole, 3400 kW, 11 kV Vertical Sq. Cage Induction Motor for Circulating Water Pump application for LANCO Anapara Project
- Largest Rated 16 Pole, 3350 kW, 11 kV Vertical Sq. Cage Induction Motor for Circulating Water Pump application for NTPC, Simhadri.
- Largest Rated 6000 kW, 11 kV 6 Pole, 60 Hz Slip Ring Induction Motor for Mill application for export to City Cement, UAE
- Largest Rated 5500 kW, 6.6 kV, 4 Pole, CACA Pressurized Sq. Case Induction Motor for operation in Zone-II Hazardous Area with gas group-IIA, IIB, IIC and temp. class T3 for BPCL for Kochi Project.
- Largest Rated 2150 kW, 6.6 kV, 4 Pole, Sq. cage Induction Motor delivering constant torque in the speed range of 160 RPM for Slurry Pump application for ESSAR Construction India Ltd
- Largest Rated 4150 kW,2 x 4 kV, 10 Pole, VFD Synchronous Motor for ID Fan application for TNEB, North Chennai
- Largest Rated 17500 kW, 11 kV, 4 Pole, Brushless Alternator for Khanna Paper Mills, Amritsar.
- 3000 KW, 420 V, Pole Brushless Alternator for Captive Power Generation
- Largest Rated 13 MW/11 kV/4p, CACA, pressurized, Synchronous Motors for centrifugal compressors for operation in zone-II, Hazardous Area for gas well in Oman.
- Smallest 150 kW 415 JV 12 Pole, flame proof motor for raw reciprocating compressor and exported to Laksel, Singapore.
- Largest constant motor newly rated 1150 kW 6.6kV 4 pole VFD Driven KILN, duty motor.

VALVES

Celebrating 50 Years
of Engineering Excellence

बीएचईएल
BHEL
Maharatna Company

1964 - 2014
50 Years



VALVES PRODUCT RANGE

VALVES PRODUCT RANGE

Corporate Profile

Bharat Heavy Electricals Limited (BHEL) is India's largest engineering and manufacturing company of its kind engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, systems and services for the core sectors of the economy. BHEL manufactures over 180 products under 30 major product groups that cater to the needs of the power, transmission, industry, transportation, renewable energy, oil and gas, telecommunications, non-conventional energy sectors and defence. BHEL has 17 manufacturing units, 2 repair units, 4 regional offices, 8 service centres, 8 overseas offices, 15 regional centres, 7 joint ventures, and infrastructure to execute more than 150 project sites across India and abroad. BHEL's products, services and projects have been exported to over 76 countries worldwide in all six inhabited continents of the world.

BHEL has turnkey 'concept-to-commissioning' capability for executing power projects, with proven, operational project installations of over 1,24,000 MW for utility, captive power and industrial applications.

BHEL Tiruchirappalli

BHEL Tiruchirappalli Complex comprises the High Pressure Boiler Plant, the Seamless Steel Plant, the Welding Research Institute located at Tiruchirappalli, the Power Plant Piping Unit at Thirumayam, the Piping Centre at Chennai, and the Industrial Valves Plant at Goindwal (Punjab).

Valves

BHEL Tiruchirappalli manufactures valves to the highest international standards for a wide range of critical applications in the power, industry and oil & gas sectors.

BHEL's Industrial Valves Plant (IVP) at Goindwal manufactures Gate Valves, Globe Valves, Swing-check Valves of various materials from carbon steel to stainless steel with special features like motorized or geared operation, limit switch and indicator arrangement, lock or chain-wheel, etc.

Widest range of valves

BHEL's product range includes Gate, Globe and Non-return Valves, Angle drain & Blow down Valves, Safety Valves and Safety Relief Valves, Electrical Relief Valves, Quick Closing Non-return Valves, Cold Re-heat Line Non-return Valves, Forged Steel Valves, HP-LP Bypass Systems, Soot Blowers, Wall De-slaggers, Water Level Gauges and Oil-field Equipment such as Well-heads, X-mas Trees, Block Valves, Mud-line Suspension Systems and Choking Manifold.

Meeting world standards

BHEL valves conform to international codes such as ASME, API, ANSI, DIN and IBR. BHEL High Pressure Cast Steel Valves and Quick Closing Non-return Valves are manufactured with technology from TOA Valve Company (Japan), Forged Steel Valves, Safety Valves, Safety Relief Valves, Electrical Relief Valves and Y-type Valves with technology from Dresser Industries Inc., (USA), Oil-field equipment with technology from Kvaerner National (USA), HP-LP Bypass Systems with technology from Sulzer Thermtec (Switzerland) and Soot Blowers with technology from Copes-Vulcan (USA).

Sophisticated manufacturing and testing facilities

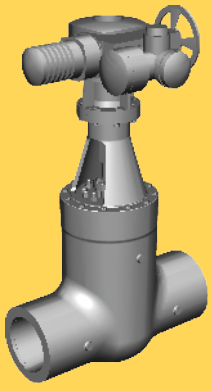
BHEL's valves production shops are equipped with state-of-the art CNC machines capable of performing intricate operations. Testing facilities include radiographic testing for castings and forgings, a full-fledged steam testing station for Safety Valves and Safety Relief valves, hydraulic test benches and an air-test station for conventional valves, besides hydraulic testing facilities for High Pressure Valves and testing facilities for Oil-field Equipment up to 22,500 psi.

Focus on quality

BHEL is known for its international Quality standards, has certified Quality Management Systems (ISO 9001:2008 CE), Environmental Management Systems (ISO 14001:2004), Occupational Health & Safety Management Systems (OHSAS 18001:2007), Information Security Management Systems (ISO 27001) and is well on its way towards Total Quality Management.

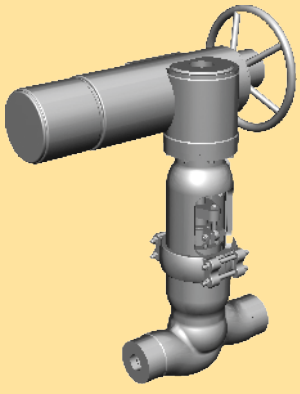
Continuous design improvements through in-house research & development (R & D), quality management systems and state-of-the-art precision manufacturing technology ensure that BHEL valves set the standards for quality and reliability.

Quality Assurance services are provided by a team of qualified scientists equipped with advanced diagnostic and measuring equipment including spectroscopes, high magnification microscopes, x-ray diffraction strain gauges besides fatigue and creep testing machines. Non-destructive testing facilities use X-rays up to 400 KV and isotopes up to 800 Curies. Precision gauges, tools and instruments are calibrated at BHEL's in-house nationally accredited Calibration Centre.



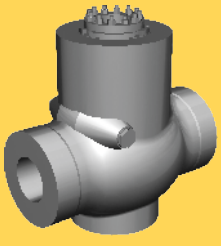
High Pressure Gate Valve

- Pressure Class: 1500 to 3500
- Material: WCC, WC9 & C12A
- Size: 2½" to 24"



High Pressure Globe Valve

- Pressure Class: 1500 to 3500
- Material: WCC, WC9 & C12A
- Size: 2½" to 10"

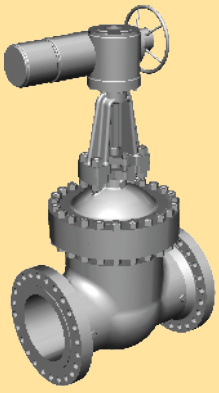


High Pressure Check Valve

- Pressure Class: 1500 to 3500
- Material: WCC, WC9 & C12A
- Size: 2½" to 24"

Re-heater Isolating Device

- Pressure Class: 500, 900, 1500
- Material: WCB, WCC, WC9, C12A
- Size: 18", 20", 22", 28", 30", 32"

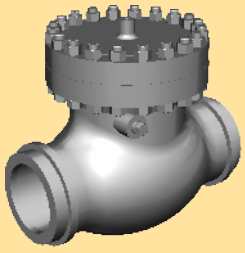


Cast Steel Gate Valve

- Pressure Class: 150, 300, 600
- Material: WCB, WC9, WCC, C12A & CF8M
- Size: 2" to 38"

Cast Steel Globe/ Regulating Valve

- Pressure Class: 300, 600
- Material: WCB, WCC, WC9, C12A & CF8M
- Size: 2" to 16"

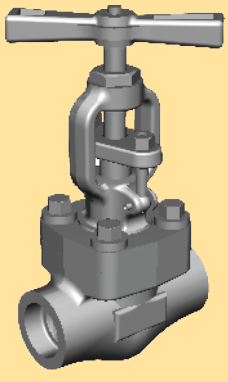


Cast Steel Non-return Valve

- Pressure Class: 150, 300, 600
- Material: WCB, CF8M, WC9, WCC
- Size: 2" to 38"

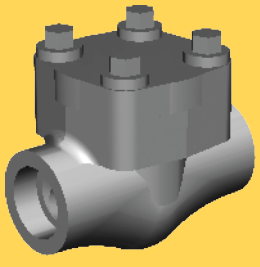
Forged Steel Medium Pressure Gate Valve

- Pressure Class: 800
- Material: A105, F316
- Size: ¼" to 2"



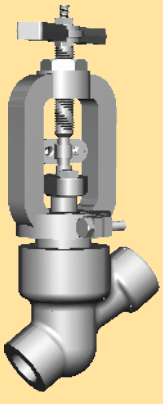
Forged Steel Medium Pressure Globe Valve

- Pressure Class: 800
- Material: A105, F316
- Size: ¼" to 2"



Forged Steel Medium Pressure Check Valve

- Pressure Class: 800
- Material: A105, F316
- Size: ¼" to 2"

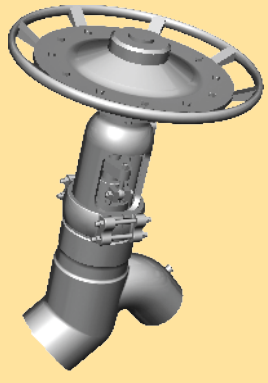


Y-type Globe Valve

- Pressure Class: 2500
- Material: A105
- Size: 2½"

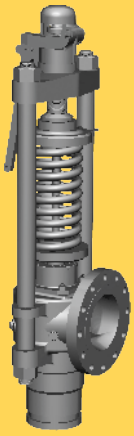
Forged Steel Blow Down Valve

- Pressure Class: 800, 1500, 2000, 2750
- Material: A105; Size: 1", 1½"
- Orifice: $^{1}/_{8}$" to 1"



Elbow Down Valve

- Pressure Class: 2000
- Material: WCC
- Size : 12"



Safety Valve

7000 Series
- Pressure: 600 to 5300
- Material: WCB, WC6, WC9 & C12A
- Size: 1½" to 6"

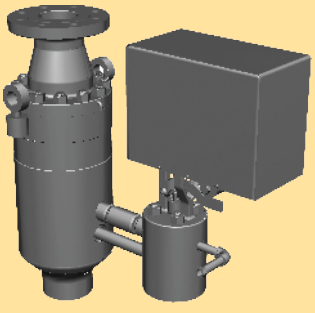
7800 Series
- Pressure Class: 300 to 900
- Material: WCB, WC6, WC9
- Size: 1¼" to 6"

Safety Relief Valve

9000 Series
- Pressure Class: 150 to 2500 psi
- Material: WCB, WC6, CF8M
- Size: 1" to 8"

Portable Relief Valve

- Pressure: 150 to 8000 psi
- Material: WCB, CF8M
- Size: ½" to 2"



Electrical Relief Valve

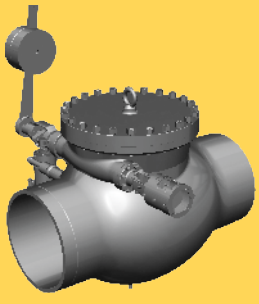
- Pressure Class: 1500, 2500, 3000 psi
- Material: WC9, C12A
- Size: 2½", 6"

Silencer

- Absorptive & Reactive type
- Insertion loss: 25 to 40 dbA
- Size: 500 to 2700 mm OD

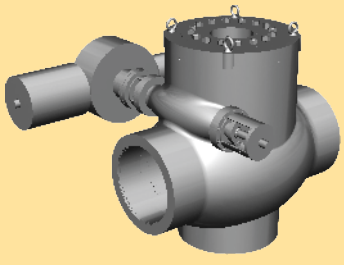
Angle Drain Valve

- Size: 25/40, 25/65, 40/50, 40/65, 50/65 & 65/100
- Ratings: C1500 to C3000 Spl
- Material: SA 105, F22 & F91



Quick Closing Non-return Valve

- Pressure Class: 150 to 900
- Material: WCB, WC6, WC9
- Size: 3" to 32"

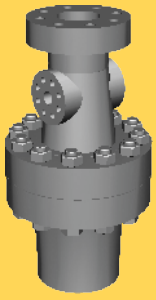


Cold Reheat Line Non-return Valve

- Pressure Class: 600, 900
- Material: WC6, WC9
- Size: 18", 24", 32"

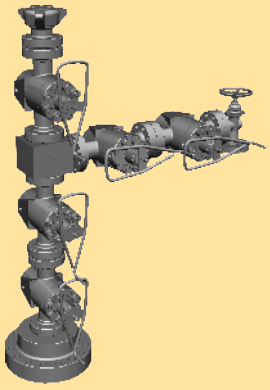
Pressure Gauge Valve

- Pressure Class: 1500 to 4000
- Material: SS 316
- Size: 3mm
- End conn. M20/G0.5/R0.5/0.5NPT



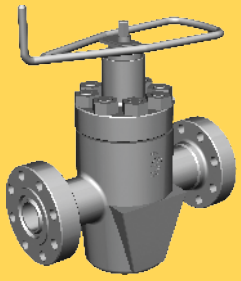
Well Head

- Pressure Rating: 2000, 3000, 5000, 10000, 15000 psi
- Two, Three & Four casing
- Single and Multiple string
- PSL: 1 to 4
- Material Class: AA through HH



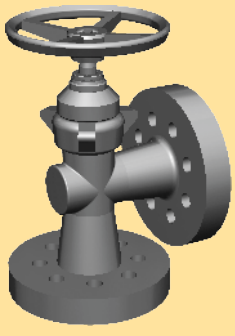
X-mas Tree

- Pressure Rating: 3000, 5000, 10000 psi
- Size: $2^{1}/_{16}$", 3 $^{1}/_{8}$", 4 $^{1}/_{16}$", $5^{1}/_{8}$"
- Single Arm, Double Arm
- PSL: 1 to 4
- Material Class: AA through HH



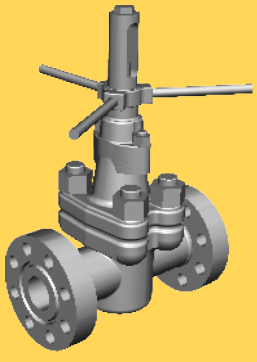
Full Bore Gate Valve

- Pressure Rating: 2000, 3000, 5000, 10000, 15000 psi
- Material: Alloy Steel
- Size: $1^{13}/_{16}$", $2^{1}/_{16}$", $2^{9}/_{16}$", $3^{1}/_{8}$", $4^{1}/_{16}$", $5^{1}/_{8}$"



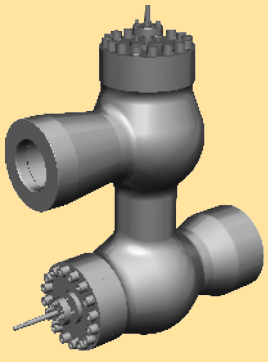
Adjustable Choke

- Pressure Rating: 5000,10000 psi
- Size: $2^{1}/_{16}$", $3^{1}/_{8}$", $4^{1}/_{16}$", $5^{1}/_{8}$" as per customer's requirement



Mudline Suspension

- Pressure: 5000 psi
- Size: $2^{1}/_{16}$" & $4^{1}/_{16}$"



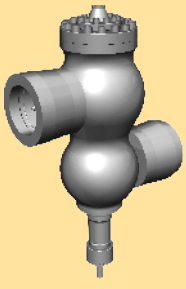
Low Pressure Turbine Bypass Valve

- Available for 110, 210 MW
- Turbine sets for 30% flow
- Hydraulic actuator operated with automatic controls

High Pressure Turbine Bypass System

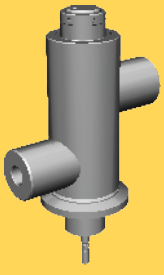
Angle-type HP Bypass Valve

- High Pressure turbine bypass valves
- Spray water valves
- Electro-hydraulic actuators
- Position feedback transmitters
- Proportional valves/Servo valves
- Hydraulic power packs



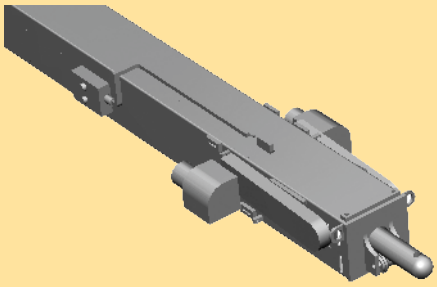
Z-type HP Bypass Valve

- Maximum Design Pressure: 280 kg/cm^2
- Maximum Design Temperature: 573^{o}C
- Standard Flow capacities: 30%, 60%, 65% and 100% of TMCR
- Designs for higher parameters/ Intermediate flow capacities available on request



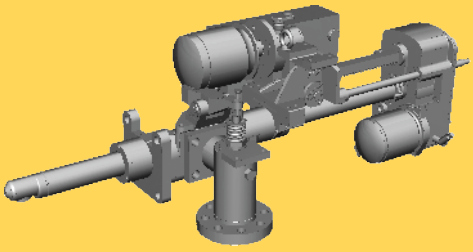
Spray Valves

- Maximum Design Pressure: 350 kg/cm^2
- Maximum Design Temperature: 300^{o}C
- Design for higher parameters available on request



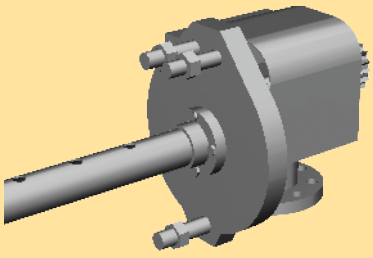
Long Retractable Soot Blower

- Travel up to 12.2 metres
- Blowing medium Steam/ Compressed Air
- Drive Electric motor/Air motor
- Non-Flame Proof & Flame Proof
- Models: LRS IE, LRD IE, LRD IIE, HRS IE, HRD IE, LRD IER, LRNR



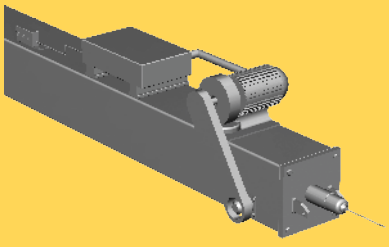
Wall Deslagger

- Travel 305 mm
- Blowing medium Steam/ Compressed Air/Water
- Drive Electric motor



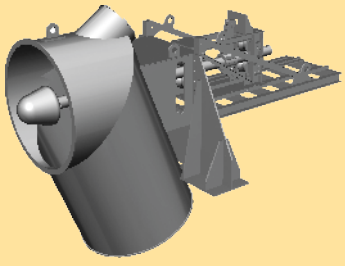
Rotary Soot Blower

- Blowing medium Steam/ Compressed air
- Drive Electric motor/ Air motor/Manual
- Non-Flame Proof & Flame Proof
- Blowing elements CS/SS



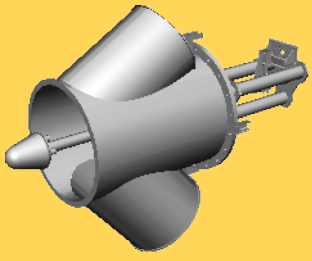
Temperature Probe

- Travel upto 7.2 metres
- Models Air cooled/Non-cooled
- Max. temp. measurement: 815°C with air cooling
- Drive Electric Motor



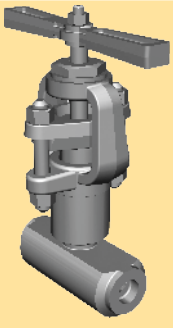
Ash Discharge Valve Seal-pot

- Located at Seal pot in CFBC boiler
- Lance Size: 135 mm
- Stroke: 300 mm



Ash Discharge Valve Combustor Chamber

- Used in Combustor chamber of CFBC boiler
- Lance Size: 75 mm
- Stroke: 300 mm



Forged Steel High Pressure Globe/Regulating Valve

- Pressure Class: 1500, 2500, 3000 SPL, 3000 LTD & 4500
- Material: A105, F22, F91, F316
- Size: ¼" to 2"

Forged Steel High Pressure Check Valve

- Pressure Class: 1500, 2500, 3000 SPL, 3000 LTD
- Material: A105, F22, F91, F316
- Size: ¼" to 2"

Floating and Trunnion type Ball Valves

- Rating: C300
- Seat: Metal Seated
- Size: 2" - 8"

Celebrating 50 Years of Engineering Excellence

BHEL Maharatna Company 1964 - 2014 50 Years

For more details, please contact:

Deputy General Manager

Marketing (Valves)

Bharat Heavy Electricals Limited

Tiruchirappalli - 620 014, Tamil Nadu, India.

Phone: 91-(0431)-2577563; Mobile: 94425 02690

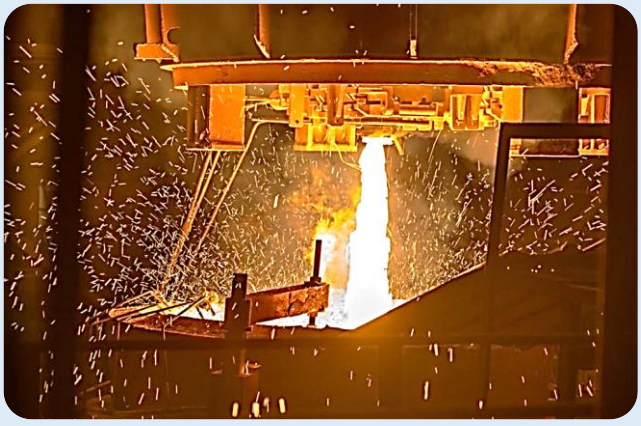
Email: boomi@bhel.in

CASTINGS & FORGINGS

भारत हेवी इलेक्ट्रिकल्स लिमिटेड
(भारत सरकार का उपक्रम)
Bharat Heavy Electricals Limited
(A Govt of India Undertaking)

CENTRAL FOUNDRY FORGE PLANT

CFFP



One Stop Solution
for your
Castings and Forgings requirements

ABOUT CFFP

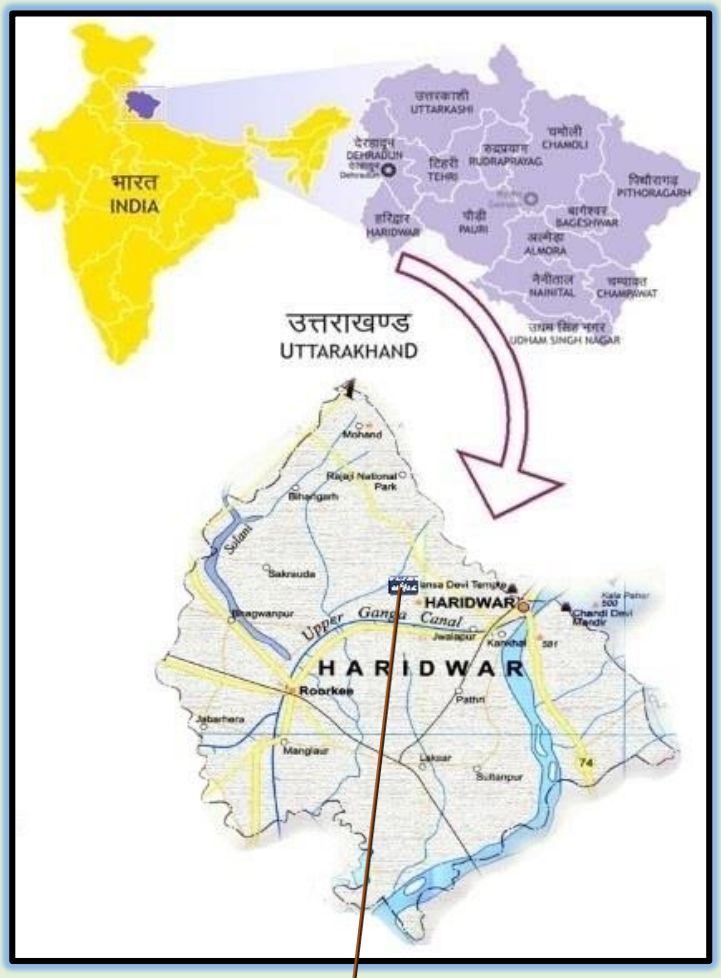
Central Foundry Forge Plant (CFFP) is a strategic unit of Bharat Heavy Electricals Ltd. (BHEL), a Public Sector Undertaking under Ministry of Heavy Industries located in Haridwar, Uttarakhand, India. We cater to wide needs of Steel Castings and Forgings for Power Plant equipment, Defense, Steel Plants, Ship Building, Cement Mills, Mining Industries etc.

We have capability to make steel Castings right from 0.5 MT up to 61 MT single piece weight and cast-fabricated Castings up to 120 MT weight and Forgings up to 34 MT in different material grades viz. Plain Carbon, Alloy, Creep Resistant, Stainless Steel, Super Critical steels and Advanced Ultra Super Critical Alloy 625. We also manufacture non-ferrous Castings like babbitt metal, phosphor-bronze Castings, stellite bushes, rods etc.

CFFP has also recently developed and manufactured 20.7 MT Alloy 625 Casting, World's heaviest in the category.

CFFP is all geared up to face new challenges of the future requirements of Castings and Forgings of clients.

LOCATION

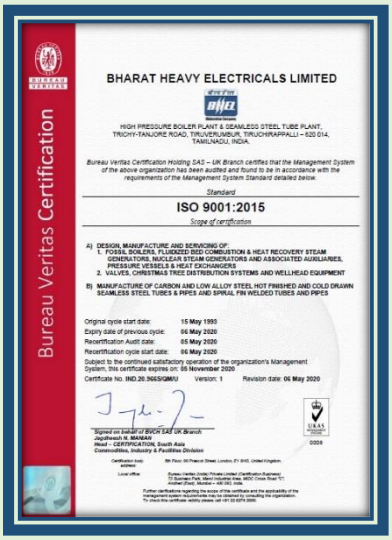


CENTRAL FOUNDRY FORGE PLANT

BHEL RANIPUR HARIDWAR

UTTARAKHAND

ACCREDITATIONS & MANAGEMENT SYSTEMS



ISO 9001:2015

ISO 14001:2015

OHSAS 18001:2007

ISO 50001:2011

BOILER CERTIFICATION

WELL KNOWN-FOUNDRY FORGE & STEEL MAKER

NABL ACCREDITATION

ACCOLADES

GLOBAL ENERGY MANAGEMENT AWARD

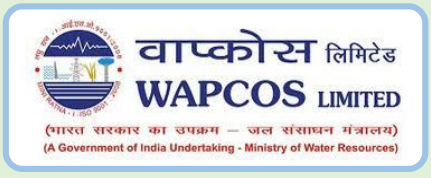
CMD TROPHY FOR ENERGY CONSERVATION

AWARD (BHEL)

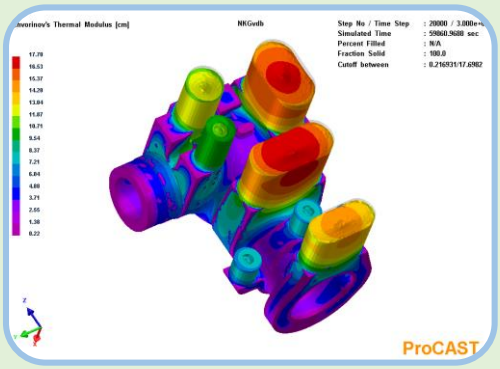
President Pranab Mukherjee presents the 'National Energy Conservation Award 2012' to B Prasada Rao, CMD, BHEL, in presence of Jyotiraditya M Scindia, Minister of State for Power (Independent Charge).

NATIONAL ENERGY CONSERVATION AWARD

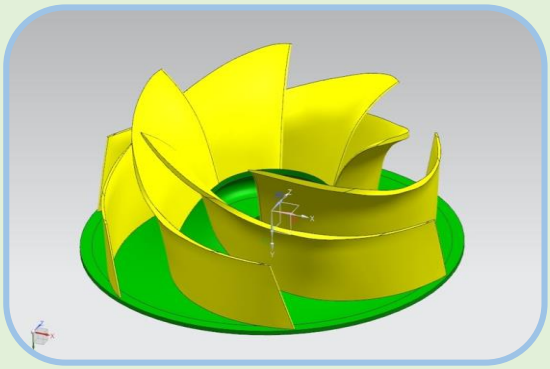
QUALITY ASSURANCE AND INSPECTION



TECHNICAL SUPPORT

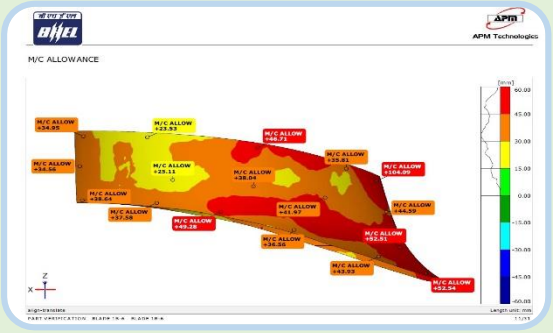


ProCast Simulation Software



3D CAD Support for Blades assembly

3D Scanning of Blade



Analysis-3D Scanning Report

Welding Research Institute- BHEL Tiruchirappalli

BHEL- R&D Hyderabad

TESTING FACILITIES

C/S Determinator

Co-60 Radiography Camera

MP Testing Machine

UT Testing Machine

BH Testing Machine

Universal Tensile Testing Machine

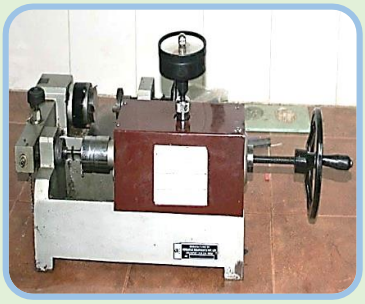
Micro Hardness Tester

Heat Treatment Lab- Furnace

Optical Microscope

Stress Rupture Testing Machine

Tubular Thermocouple calibration Furnace



Universal Sand Testing Machine

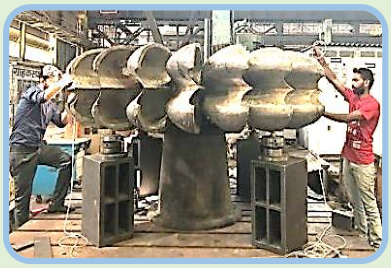
Sieve Shaker

Permeability Meter

Sand Rammer

CASTINGS – A GLIMPSE

HYDRO PROJECT COMPONENTS



Pelton Runner

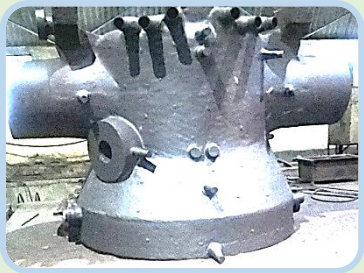
Francis Runner
Cast Fabricated

SV Door

Butterfly Valve Door

STEAM TURBINE COMPONENTS

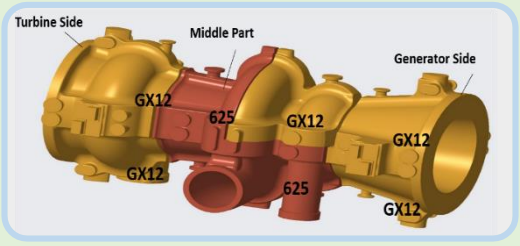
IP Outer Casing-500MW



HP Outer Casing Inlet End
660/800MW

IP Inner Casing 660/800MW

ADVANCED ULTRA SUPERCRITICAL COMPONENTS



IP Inner Casing-800MW

IP Inner Casing UH in Alloy 625

IP Inner Casing LH in Alloy 625

INDUSTRIAL TURBINE COMPONENTS

Outer Casing-Cast Welded

Inner Casing

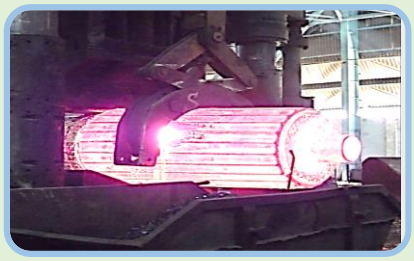
Outer Casing

SHIP BUILDING AND DEFENCE PROJECTS

A Brackets

Cover Casting

FORGINGS – A GLIMPSE



Ingot for Hydro Shaft

Compressor wheel for Gas Turbine

Labyrinth rings

Hydro Turbine Shaft

I P Rotor-500 MW

IP Rotor- 250MW

Hydro Shaft

Turbine Shaft

Bottom Shaft

Journal Shaft

Tube Sheet

RT Shafts

AS Rounds

LT Wheels

MAJOR FACILITIES

CNC Deep Hole Boring Machine

Plano Miller Machine

CNC Horizontal Boring Machine

CNC Vertical Boring Machine

Vertical Boring Machine

Band Saw Machine

Heavy Forge Press - 9000MT

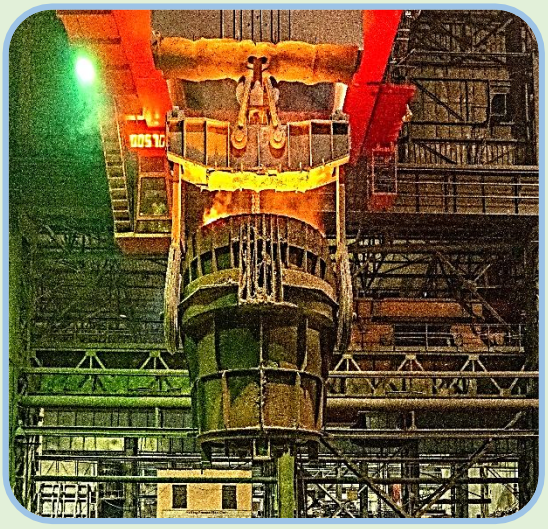
Medium Forge Press - 2650MT

Vertical Shaft Furnace

Electric Arc Furnace

Vacuum Arc Degassing

IN ACTION



Molten steel being transferred through ladle

Ingot under Forging

Ingot for Rotor Forging

CUSTOMER PROFILE

बी एच ई एल BHEL

एनटीपीसी NTPC

SMS group

एन एच पी सी NHPC

SIEMENS

एसजेवीएन SJVN

Mazagon Dock Limited

भारी वाहन निर्माणी, आवडी AVADI

UTTAM SUGAR

TATA STEEL WeAlsoMakeTomorrow

सेल SAIL

जी आर एस ई GRSE

बी ई एम एल beml NEW FRONTIERS. NEW DREAMS

LARSEN & TOUBRO

AFCONS

TATA MOTORS

STEEL GRADES OF CASTINGS AND FORGINGS

CASTINGS

NATIONAL/ INTERNATIONAL STANDARD	GROUP
ASTM A216-WCC/WCB /WCA, GP240GH, BS3100 GR A4	C- Steel
ASTM A148 Gr 50-80, G28MN6, IS2708 GR 1	1.5% Mn Steel
Gs22Mo4, Gs22Mo5,G17CrMov5-10, G17CrMo5-5, G17CrMo9-10, C6U-2 (SBL-2), GOST 977-88: Gr 08GDNFL, GX30NiCrMn174	Alloy Steel
GX5CrNi13-4 /ASTM A743 CA6NM	Stainless Steel
GX12CrMoVWNbN10-11	Supercritical with W
GX12CrMoVNbN9-1, C12A ASTM A217M Code Case 2192-5	Supercritical without W
ASTM A494(CW6MC)	Ni Based Super alloy
IS28-1985 Gr3, DIN 1705:G-CuSn12, DIN 1705:G-CuSn10, DIN 1705:G-CuSn5ZnPb	Cu based alloy
TLV 9977/02	Tin based alloy
Stellite-6	Cobalt based alloy

FORGINGS

NATIONAL/ INTERNATIONAL STANDARD	GROUP
20C8/C22+N, AISI 1020, A216, A266, 30C8, A668, 40C8/45C8, AISI 1040, 55C8	Plain Carbon Steel
20C15, SA105, SA350 LF2 CL-2, DIN 17103, 25C15, EN10083-1	Carbon Manganese Steel
25CrMo4, 16Mo3, 40CrMo4, 40Cr7Al10Mo2, EN24, 40Ni6Cr4Mo3, 31 Ni 10Cr 3Mo 6, SA182F22 CL 2, 11CrMo9-10	Alloy Steel
21CrMoNiV 5-7, 20CrMoVTiB4-10, 13CrMo4-5, 11CrMo9-10, SA182F12CL2	High Temp Alloy Steel
30CrMoNiV5-11	Turbine Rotor Grade
26NiCrMoV11-5, 33NiCrMo14-5,34XH1M, 34XH3M	Generator/LP Rotor Grade
X22CrMoV12-1, X20Cr13, X12Cr13, X5CrNi13-4 /ASTM A743 CA6NM	Martensitic stainless steel
A 182 F316L, A182 F321	Austenitic stainless steel
X12CrMoWVNbN10-1-1	Supercritical with W
X10CrMoVNbN9-1, X18CrMoNbVN11-1 +QT	Supercritical without W
Special Steel	Copper added steels

PLANT & MACHINERY

MAJOR MACHINING FACILITIES

DESCRIPTION	QUANTITY	TECHNICAL PARAMETERS
Center Lathe	1	Swing Over Bed : 1550 mm Swing Over Carriage :1200 mm Max. Distance b/w centers: 7000 mm Max. Weight of Job : 25 T
Center Lathe	1	Swing Over Bed : 1250 mm Swing Over Carriage : 900 mm Max. Distance b/w centers : 7000 mm Max. Weight of Job : 14 T
Center Lathe	1	Swing Over Bed : 1000 mm Swing Over Carriage : 710 mm Max. Distance b/w centers : 6000 mm Max. Weight of Job : 14 T
Deep Hole Boring Machine	1	Swing Over Bed : 1800 mm Boring Range :Ø 50 to 400 mm Max. Length of job : 8000 mm Max. Weight of Job : 30 T
Deep Hole Boring Machine	1	Swing Over Bed : 1800 mm Boring Depth : 10000 mm Boring Range :Ø 50 to 350 mm Max. Weight of Job : 45 T
CNC Horizontal Boring Machine	1	Boring Spindle Diameter : 200 mm W Travel : 1200 mm X Travel : 12000 mm Y Travel : 4000 mm Z Travel : 1200 mm Rotary Table Size: 3600 x 3600 mm Rotary Table Capacity : 80 T
Horizontal Borer	2	Spindle Diameter : 220 mm W Travel : 1600 mm X Travel : 6000 mm Y Travel : 2950 mm
Horizontal Borer	1	Spindle Diameter : 200 mm W Travel : 1000 mm X Travel : 6000 mm Y Travel : 3150 mm Z Travel : 1000 mm
Plano Miller	1	Max. Length of job : 8000 mm Max. breadth of job : 3000 mm Max. Height of job : 2000 mm Max. Weight of job : 65 T
CNC Vertical Borer	1	Max. Job Height: 3600 mm Table Diameter: 4500 mm Max. Weight of Job: 100 MT
Vertical Borer	1	Max. Diameter of job : 8000 mm Max. Height of job : 5000 mm Max. Weight of job : 125 T
Vertical Borer	1	Max. Diameter of job : 6400 mm Max. Height of job : 3200 mm Max. Weight of job : 125 T

MELTING FACILITIES

DESCRIPTION	QUANTITY	CAPACITY/TECHNICAL PARAMETERS
Arc Furnace	1	Capacity : 10 T
Arc Furnace	1	Capacity : 30 T
Arc Furnace	1	Capacity : 70 T
VAD	2	Capacity : 70 T
VOD	1	Capacity : 70 T
Active Oxygen Measuring Instrument	1	Measuring range : 0 to 50 PPM
Hydrogen Measuring Instrument	1	Measuring range : >0.7 PPM upto at least 12 PPM

FORGING AND HEAT TREATMENT FURNACES

DESCRIPTION	SIZE	LOAD
Forge Press		7500/ 9000 T
Manipulator for 7500/9000T Press		65 T
Forge Press		2650 T
Manipulator for 2650T Press		32 T
Heat Treatment Furnace	18 x 3.5 x 2.5 m	140 T
Heat Treatment Furnace	8 x 6 x 3 m	120 T
Heat Treatment Furnace	10 x 3.5 x 2.5 m	60 T
Heat Treatment Furnace	10 x 3.5 x 2.5 m	60 T
Heat Treatment Furnace	10 x 2 x 2.5 m	40 T
Heat Treatment Furnace	10 x 2 x 2.5 m	60 T
Heat Treatment Furnace	8 x 3 x 2 m	40 T
Heat Treatment Furnace	7 x 3 x 2 m	40 T
Heat Treatment Furnace	7 x 3 x 2 m	30 T
Reheating Furnace	10 x 3.4 x 3 m	150 T
Reheating Furnace	12 x 3 x 3 m	140 T
Reheating Furnace	9 x 3 x 3 m	120 T
Reheating Furnace	10 x 2.5 x 2.5 m	70 T
Reheating Furnace	10 x 2.5 x 2.5 m	70 T
Reheating Furnace	7 x 3.5 x 3.5 m	40 T
Reheating Furnace	6 x 2.5 x 2 m	30 T
Vertical Shaft Furnace	L10 xØ 1.8 m	30 T
Vertical Shaft Furnace	L5 xØ 1.2 m	10 T
Vertical Shaft Furnace	L10 xØ 1.8 m	40 T
Water Quenching Tank	9.7 x 4.5 x 3.1m	
Oil Quenching Tank	9.7 x 4.2 x (H) 2.1 m	

CONTACT US

CENTRAL FOUNDRY FORGE PLANT

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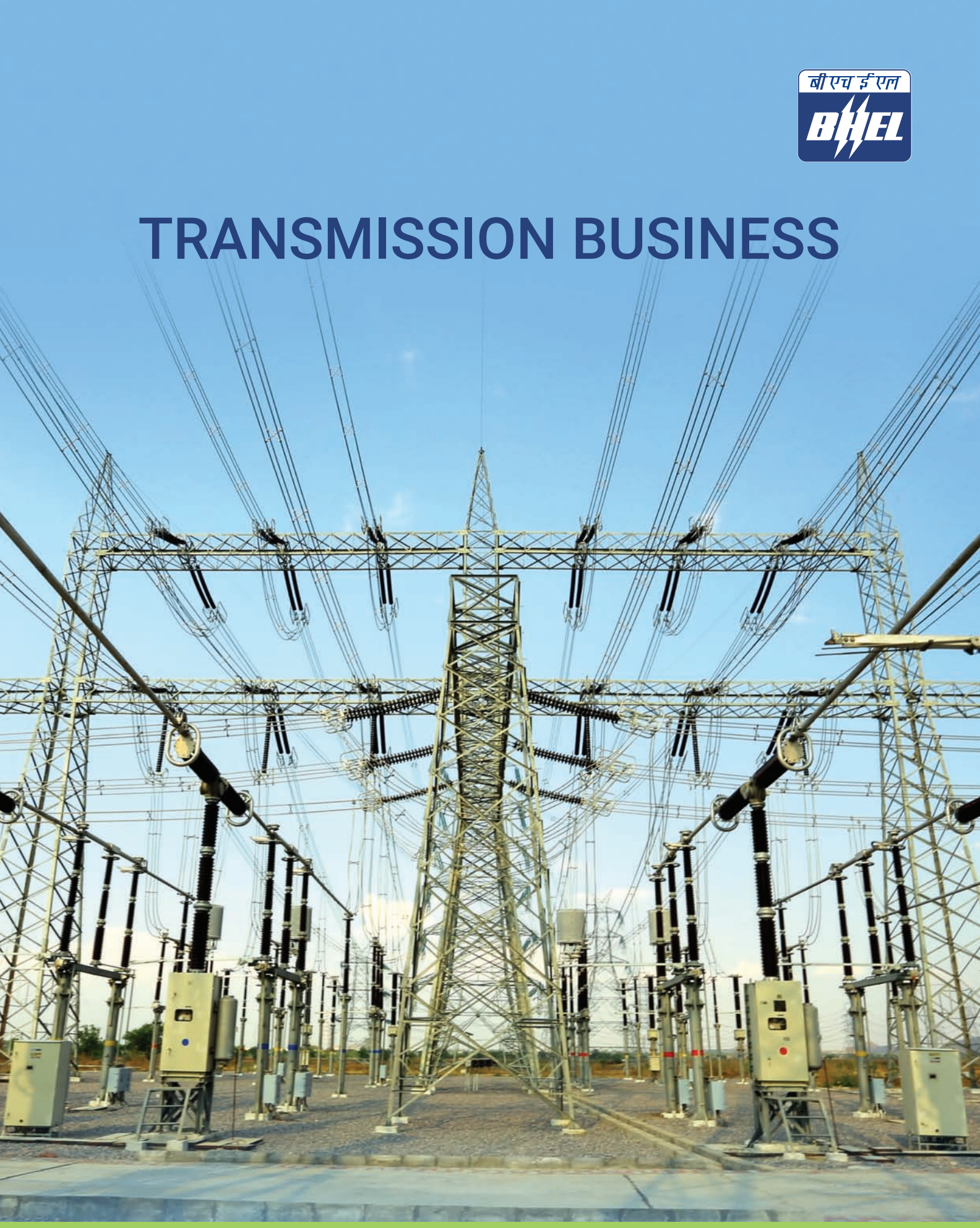
TRANSFORMERS
[TRANSMISSION PRODUCTS]

TRANSMISSION BUSINESS



Transforming Today for a Better Tomorrow

About BHEL

Established in 1964, Bharat Heavy Electricals Limited is an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing companies of its kind in India. The company is engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, services and systems for core sectors of the economy viz. Power Generation, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas, Water, Defence & Aerospace, and e-Mobility & Energy Storage Solutions.

BHEL's mammoth size of operations is evident from its widespread network of 17 manufacturing units, 2 repair units, 4 regional offices, 8 service centres, 1 subsidiary, 3 overseas offices, 5 joint ventures, 15 regional marketing centres and more than 150 project sites across India and abroad. BHEL has references in 82 countries in all the inhabited continents, with a global installed capacity of over 180 GW.

400 kV Switchyard at 2x800 MW Yeramarus TPS

40+
Years
of EPC Experience in Power Transmission

Commissioned
200+
Electrical Substations & 5 Major HVDC Projects

Supplied
5,00,000+
MVA
Transformer/Reactors

Valve hall at Agra converter station for ± 800 kV, 6000 MW North-East Agra HVDC project

BHEL in Power Transmission

A Powerful Presence of Over Four Decades

BHEL is the leader in the field of power transmission in India offering a wide range of transmission systems and products conforming to international quality standards.

Concept to Commissioning and Beyond...

Practising the philosophy of concept-to-commissioning and beyond, BHEL is committed to provide customer-oriented cost-effective transmission solutions and services as an EPC contractor for EHV substations, High Voltage DC (HVDC) converter stations and Power Quality & Stability Solutions (FACTS) backed by expert Power System Studies.

765 kV Substation at Raichur

EHV Substations:

In the field of substation projects, BHEL has a rich experience of more than four decades in setting up of EHV & UHV substations, switchyards both AIS and GIS types ranging from 33 kV to 765 kV for utilities and industries covering a vast array of applications:

- Grid Substations
- Industrial Receiving Substations
- Switchyards for Thermal, Hydro, Nuclear and Renewable Energy based Power Generating Stations

400 kV GIS Switchyard at North Chennai TPS

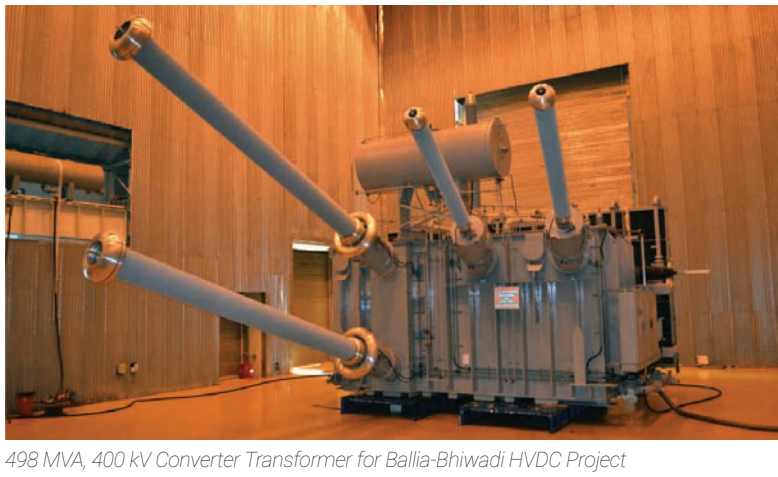
- HVDC Converter Stations and associated Switchyard

HVDC Systems and Products:

BHEL has executed numerous HVDC projects in India and has supplied own make major products like converter transformers, reactors, thyristor valves, control panels, capacitor banks, instrument transformers, insulators, SCADA etc.

Major HVDC projects executed by BHEL are:

- 1500 MW, ± 500 kV Rihand-Delhi HVDC project.
- 1500 MW, ± 500 kV Chandrapur-Padghe HVDC project.
- 200 MW, + 200 kV National HVDC Experimental Line.
- 2500 MW, ± 500 kV Balia-Bhiwadi HVDC Project
- 6000 MW, ± 800 kV North-East Agra UHVDC Project (World's largest multi terminal HVDC System).
- Currently executing 6000 MW, ± 800 kV Raigarh-Pugalur UHVDC project.



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

Flexible AC Transmission System (FACTS) solutions

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

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

- Fixed Series Compensation (FSC)
- Static VAr Compensation (SVC)
- IGBT based Static Compensators (STATCOM)
- Thryristor Controlled Shunt Reactor (CSR)
- Phase Shifting Transformer (PST)

Fixed Series Compensation Scheme at Ballabhgarh

Thyristor Controlled Shunt Reactor (CSR)

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

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

Innovations & Solutions...

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 at Kothagudem

Gas Insulated Switchgear (GIS)

BHEL has indigenously developed Gas Insulated Switchgear (GIS) up to 400 kV class. BHEL offers prompt after-sale services by its expert engineers and assures ready availability of crucial spares for the GIS.

BHEL make 400 kV GIS

Manufacturing Capability and Offerings

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

Power Transformers/Reactors

- HVAC Power Transformers for voltage 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
- 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/Merging Unit complied with IEC 61850 protocol

Switchgears

- Vacuum Circuit Breaker (3.3 kV - 33 kV)
- Gas Insulated Switchgear (GIS) up to 400 kV

Capacitors

- 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 bushings-52 kV to 525 kV for transformer application

500 MVA, 765/400 kV Auto Transformer at Greater Noida Substation

India's first 1200 kV Transformer at Bina Test Station

80 MVAR, 765 kV Shunt Reactor at Greater Noida Substation

Thyristor Equipment

- Thyristor Valves for HVDC transmission up to 800 kV

Thyristor Valves (for UHVDC application) under testing at STRI, Sweden

Insulators

- Disc insulators up to 1200 kV AC (530kN) & 800 kV DC (420kN) application.
- Hollow Porcelain up to 765 kV.
- Solid core insulators up to 400 kV.
- Long Rod Composite Insulators up to 765 kV AC (210kN) & ±800 kV DC (420kN) 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.

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.

Ultra High Voltage Testing Laboratory at Bhopal

A Trusted Partner

- A rich experience of more than four decades in Power Transmission.
- 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.

Bharat Heavy Electricals Limited

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Corporate Identity Number: L74899DL1964GOI004281

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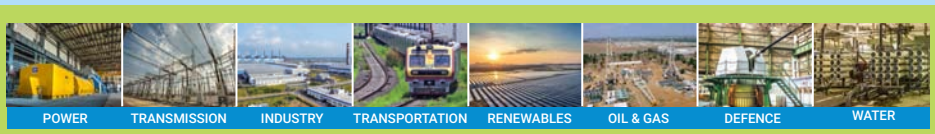


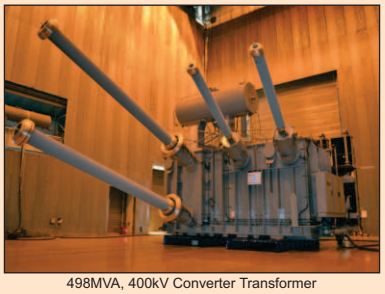
Powering Progress...Brightening Lives. Touching Every Indian Home

TRANSFORMERS, CAPACITORS, BUSHINGS

TRANSFORMERS

Product	Application
Power Transformers For Power station	
• Generator transformers 420 kV, 3 ph, 500 MVA & 765 kV, 1ph., 400 MVA	Power generation
• Auto transformers 420 kV, 3 ph., 1000 MVA 420 KV,1 ph , 600 MVA 765 kV, 1 ph., 1000 MVA 1200 kV,1 ph, 1000 MVA	Power transmission

295MVA, +/-800kV, Converter Transformer
For PGCIL NEA HVDC Project



498MVA, 400kV Converter Transformer
For PGCIL Balia-Bhiwadi HVDC Project

80MVR, 765kV, Single Phase Shunt Reactor

Converter transformers / Smoothing reactors Up to 600 MVA, ± 500 kV HVDC/ ±800 KV HVDC Up to 254 MVAr, 360 mH,1568 Amps, ± 500 kV HVDC Smoothing Reactors	HVDC transmission
Shunt Reactors Up to 150 MVAr, 420 kV, 3 Ph & 110 MVAr, 765 kV, 1 Ph	Controlling of reactive power
Controlled Shunt Reactors Up to 200 MVAr, 420 kV, 3 Ph, 200 MVAr, 420 kV, 1 Ph & 200 MVAr, 765 kV, 1 Ph	Flexible AC Transmission System

500MVA, 765kV I-Phase Interconnecting Transformer

333MVA, 1200kV I-Phase Interconnecting Transformer

1200kV CVT

TRANSFORMERS, CAPACITORS, BUSHINGS

Product	Application
Phase shifting transformers Up to 400 MVA, 400 kV, 3 Ph & 400 MVA ,400 KV , 1 Ph	Flexible AC Transmission System
Instrument transformers	Metering, protection
• Current transformers (up to 400 kV, 3600 Amps.)	
• Capacitor voltage transformers (upto 1200 KV)	Metering, protection & power line carrier communication at 30 kHz to 500 kHz

Pressurised Transformer Assembly Bay

Bushing Manufacturing Bay

Air Conditioned Transformer Winding Mfg. Bay

CAPACITORS

H.T. Capacitors for Motors (3.3 kV to 11 kV, delta connected capacitor banks) For Industries (cement / fertilizer)	Power factor correction
H.T. Capacitors for Shunt, Series & SVC (Static VAr Compensation), Harmonic filter & HVDC application (3.3 kV to 500 kV, 1Ph / 3 Ph capacitor banks) For Distribution line / Transmission line /substn.	Voltage regulation, PF correction, filtering of harmonics
Coupling Capacitor (33 kV to 800 kV, 4400 pF to 13200 pF) For Transmission line	Power line carrier communication at 30 kHz to 500 kHz

TRANSFORMERS, CAPACITORS, BUSHINGS

400 kV series Capacitor Bank for POWERGRID, FSC Wardha

Product	Application
Surge Capacitor for Generator & Transformers (11 kV to 40 kV, 0.125 µF to 0.25 µF)	Protection of surges
Roof Capacitor For Locomotive	PF correction

BUSHINGS

Oil impregnated paper (OIP) condenser bushings (52 kV to 525 kV)	Transformer
Special application bushings like oil-oil Wall bushings etc.	Cable box, Laboratories, Sub-stn

MAJOR HIGHLIGHTS

- 333 MVA, 1150/3 / 400/3/33kV, 1-ø, Auto Transformer for POWERGRID 1200 kV experimental line in 1200 kV UHVAC substation at Bina-India in 2011. (First Indian Manufacturer)
- 500 MVA, 765/√3/400/√3/33 kV, 1-ø, Auto Transformer for POWERGRID-India in 2011.
- 498 MVA, ± 500 kV HVDC Convertor Transformer for POWERGRID Balia-Bhiwadi HVDC transmission line project in 2011.
- 80 MVAR, 765 kV, 1-ø, Shunt Reactor for POWERGRID-India in 2011.
- 50 MVAR, 420 kV, 3-ø, Controlled Shunt Reactor installed at Bina substation of POWERGRID-India in the year 2001.
- 275MVA I-Phase, 765KV, Generator Transformer for BIDCO 3x660MW STPP at Lalitpur in the Year 2015.
- 105MVA I-Phase, 765KV, Interconnecting Transformer for BIDCO 3x660MW STPP at Lalitpur in the Year 2015.
- 500MVA I-Phase, 765KV, Interconnecting Transformer for Megha Engg. against UPPTCL Tr. Project in Year 2016.
- 80MVAR I-Phase, 765KV, Shunt Reactor for Megha Engg. against UPPTCL Tr. Project in Year 2016.
- 110MVAR I-Phase, 765KV, Shunt Reactor for BIDCO 3x660MW STPP at Lalitpur in the Year 2016.
- 295.1MVA, +/- 800KV HVDC Converter Transfomer for Powergrid North East Agra 6000MW HVDC Interconnecting Transmission Line Project in the year 2017

COMPRESSORS

Depletion Compressor installed at Oman

www.bhel.com

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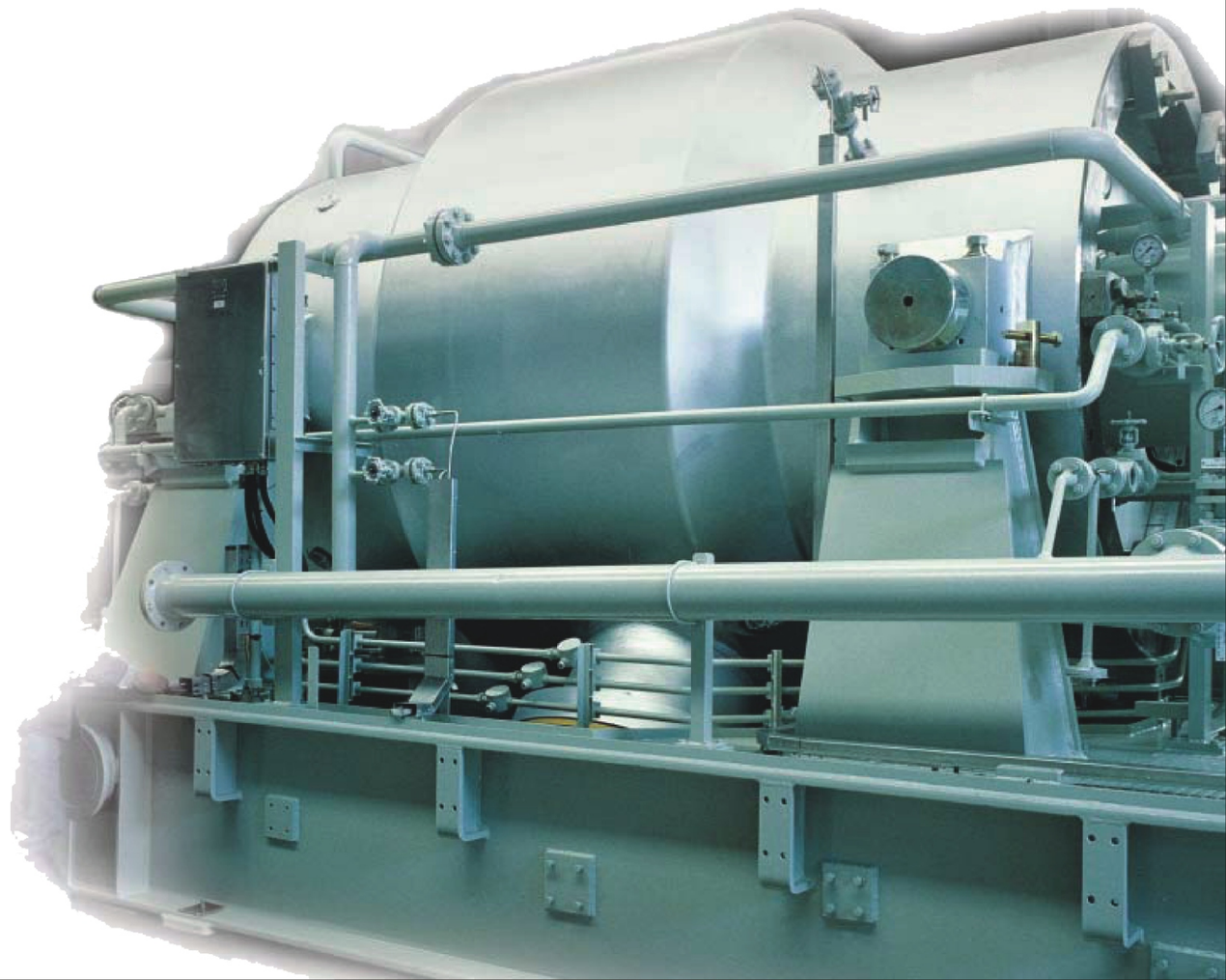
Bharat Heavy Electricals Limited

AKSHARA:08:10:1K:KJ

Bharat Heavy Electricals Limited

Centrifugal Compressors



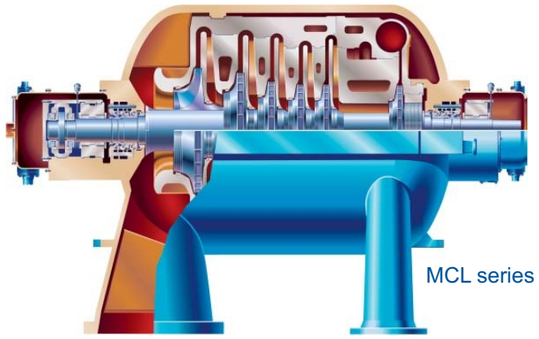
Centrifugal Compressors

Introduction

BHEL manufactures a complete range of centrifugal compressors for all major compression applications. They are used in oil & gas production, gas transportation, refinery and petrochemical industries, fuel gas boosting and other similar processes. Our licensor GE holds the record for centrifugal compressor applications having designed and manufactured the first high pressure compressor for ammonia and urea plants, the most powerful compressors for offshore applications (over 30,000 HP) and re-injection compressors with delivery pressures as high as 10,000 psi (700 bar).

Specific requirements are met by custom configuring each compressor using standardized advance technology components proven over a wide range of process conditions. This approach delivers reliable, high performance compressors for natural gas, refinery, petrochemical, and newer applications. Skilled staff of local engineers and technicians provides on-site technical support for installation, commissioning, overhaul, repair and maintenance of our equipment. Steam turbine, Gas turbine, Electric motor and VFD Systems can be provided for driving the compressors.

MCL series



MCL series

MCL compressors are designed in several sizes and pressure ratings to cover different applications. The compressor casing and diaphragms are either cast (cast steel) or fabricated.

The impellers and diffusers are selected from a wide range of standard stages in accordance with the application and desired performance.

The radial and thrust bearings are of the tilting pad type.

Shaft-end seals are mainly dry gas seals but can be labyrinths or oil film seals.

Inter-stage leakages are controlled by labyrinths (static or rotating) or abradable seals.

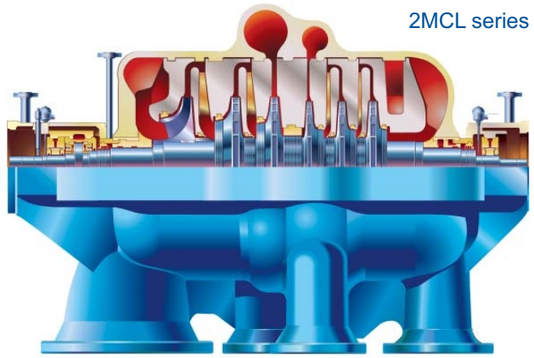
Double flow models (DMCL) are used to compress very high flows. This solution allows the casing size and speed to remain within an acceptable range to couple the compressor to drivers and/or other compressor casings.

Different washing options can be offered as desired.

Double stage models (2MCL) are used when intermediate cooling is required or when a process calls for two separate compression stages.

2MCL compressors have the same general features as the MCL type with the two compression stages in a back-to-back arrangement.

2MCL series



Additional side stream nozzles can be provided with the 3MCL model for special requirements such as in refrigeration applications . All connections can be oriented upward or downward to meet plant layout needs.

BCL Series

These compressors are designed to cover a wide range of applications and pressures (hydrogen mixtures, hazardous gases, high pressure).

Casings can be rolled steel or forged with one or two end covers bolted or secured by shear rings.

For improved performance, diaphragms are mostly machined.

Radial and thrust bearings are of the tilting pad type.

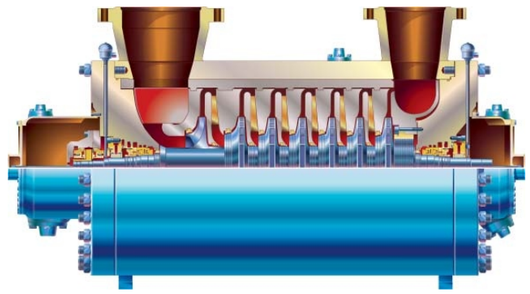
End seals are of the dry gas type. Other sealing solutions are also available.

In addition to conventional labyrinths, inter-stage seals can be abradable or honeycomb seals to optimize the overall performance of the machine.

In-line, back-to-back or double flow configurations are also available.

Materials are adapted to the process requirements. Based upon extensive experience in corrosive applications , specific materials are selected to withstand the various forms of corrosion present in sour or acid gas applications .

BCL series



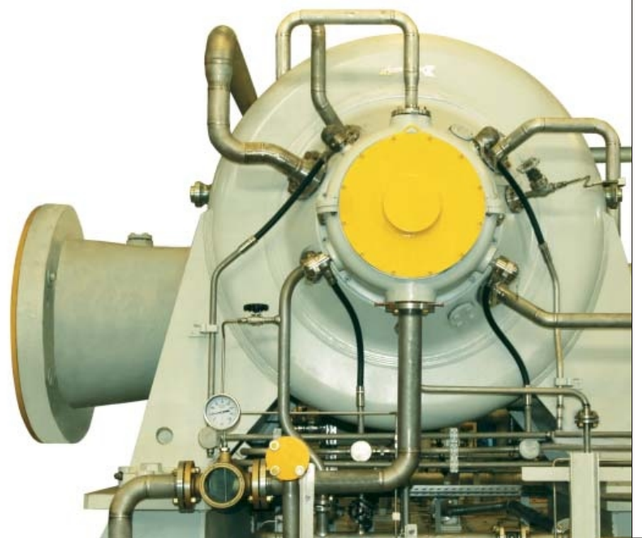
PCL series

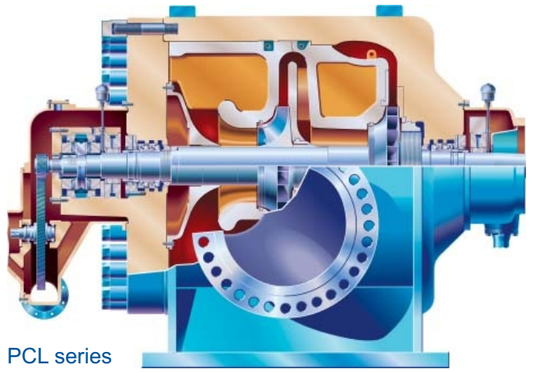
These compressors have been designed to meet the range of flow and compression ratios required by gas transportation stations.

A variety of standard casing sizes are available to cover a wide range of gas flow.

The same casing can house different numbers of impellers to optimize performance in terms of efficiency, compression ratio and operating range.

The compressor casings are made of forged steel to provide maximum material strength and metallurgical stability. Vibration-free operation is assured by positioning bearings at





PCL series

both casing ends which provides the necessary rigidity to the rotor.

Dry gas seals are normally used to prevent gas leakage.

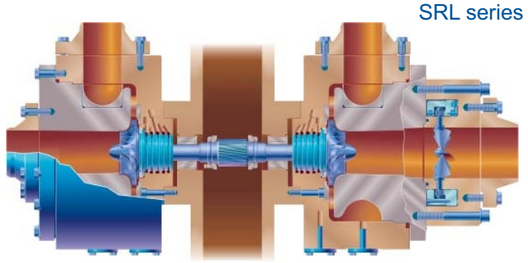
Floating bushing oil seals are also available on request.

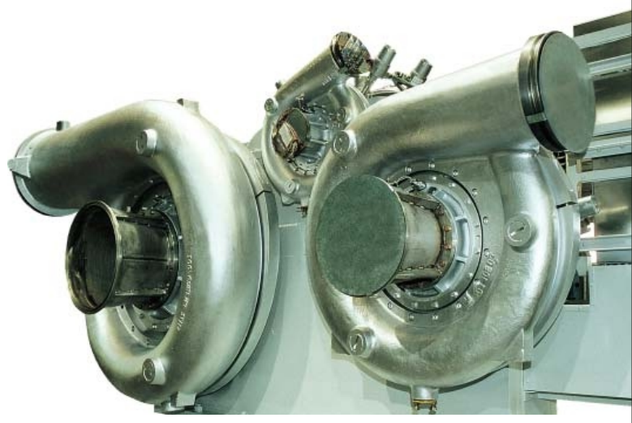
The suction and delivery nozzles are generally located opposite each other to meet station layout requirements. Axial inlet is also available when the pressure ratio allows for a single impeller.

SRL Integrally Geared Series

Integrally Geared Compressors are used in several petrochemical applications, either for low-flow/high pressure, or high-flow/low pressure conditions. This type of compressor has a bull gear and from one to four high speed pinions. One or two impellers can be mounted on each pinion-shaft. Optimal impeller speed and the ability to inter-cool compression stages guarantee very high efficiency. Due to its rugged mechanical design, this type of machine has a very high reliability and is easy to maintain. A large variety of gases can be handled by this compressor line with appropriate construction materials and seal systems. This line is designed for process air and gas service.

SRL series





Compressor Components

Casings

Depending on the compressor family the casings can be

- Horizontally split
- Vertically split

Horizontally-split casings consist of two half casings joined along the horizontal center-line. All connections such as suction and discharge nozzles, side stream nozzles (if any) and oil piping are normally fitted to the lower half so that the upper half becomes an easily removable cover. The casings may be cast or fabricated steel depending on the compressor duty, service temperatures, gas handled and compressor size.

Vertically split casings have different shapes and thickness depending on the pressure rating.

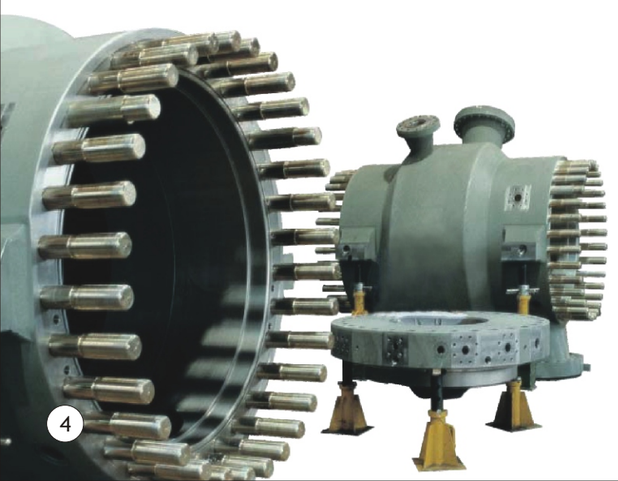
Casings up to 350 bars are steel cylinders with end covers either bolted or secured by shear rings. Nozzles can be welded to the casing or machined directly.

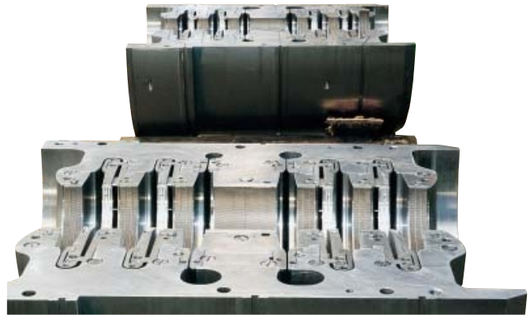
By removing the end cover it is possible to remove the rotor diaphragm bundle assembly and gain access to the internal components without removing the outer casing which remains connected to the plant piping package.

Diaphragms

Suction, intermediate and discharge diaphragms create the gas flow path within the stationary components. The suction diaphragm conveys the gas into the eye of the first impeller. Intermediate diaphragms perform the dual function of forming the diffuser passage (where gas velocity is transformed into pressure) and the return passage to channel gas to the eye of the next impeller. The discharge diaphragm forms the diffuser for the last impeller as well as the discharge volute. The diaphragms are usually horizontally-split.

In the small to medium sizes of the MCL series, the upper half of the diaphragms is fixed to the upper half casing to facilitate inspection, and for the large sizes, it is fixed to the lower half of the diaphragms, while the barrel family internals are assembled into a bundle which can be easily extracted from the casing.



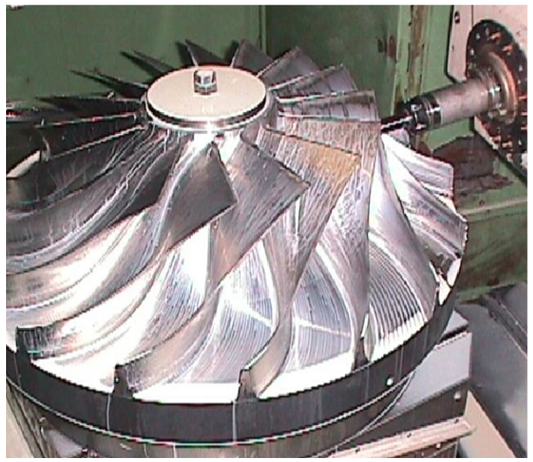


The diaphragms are made of cast, steel or stainless steel and machined.

Easily removable labyrinth seals are installed on the diaphragms at impeller shrouds, to prevent return flow from discharge to suction and on the shaft sleeves to eliminate inter-stage leakage.

Rotors

The rotor consists of shaft, impellers, sleeves, balance drum and thrust collar. Impellers are selected from a number of standard families. Each family groups a set of geometrically similar impellers with different flow coefficients to meet specific flow requirements. All geometries have been tested by the collaborator-GE. Impellers are shrunk on the shaft. Impellers may be either of the closed or open design. Closed impellers are made of



forged steel. Their blades may be welded to both the disc and the shroud or milled from a solid disc and welded to the shroud.

The blades are generally back-swept to different angles in accordance with the required performance.

Open impellers are machined from solid forgings.

Each impeller is dynamically balanced and over-speed tested before assembly.

The rotor is balanced after the assembly of each individual component on the shaft.

Seals

Shaft end seals eliminate or minimize the leakage of compressed gas or the entry of air into the compressor casing. Depending on the nature of the gas to be compressed and on the degree of sealing to be achieved, different types of seals may be used.

Labyrinth seals

They are used when the properties and pressure of a gas permit a minimal leakage. The labyrinths are made of light alloy or other corrosion-resistant material and are easily replaceable. The number of teeth and clearance depend on the operating conditions, as well as the geometry (plain, step, ring type, honey-comb, etc.). To minimize leakage, abradable seals are used. In this case the labyrinth teeth are fitted to the rotor and are in contact with an abradable material on the stator.

When no leakage whatsoever is permissible (poisonous or explosive gases, etc.) labyrinth seals are combined with extraction and/or injection systems.

Dry gas seals

Sealing is ensured by a gas lock created by the grooves machined into a rotating seal fitted on the rotor. Depending on the application it is possible to use gas taken off the compressor at different levels: first impeller diffuser, intermediate or discharge nozzles or an insert gas.

Hydrostatic and hydrodynamic forces balance to maintain a clearance of a few microns between the rotating seals and the stationary face. This very small clearance reduces gas leakage to a negligible amount.

Different patented solutions are available through technology transfer from GENP to temper the seals to prevent liquid or hydrate formation or for controlling the temperature of the seal.

Extensive experience has been accumulated on dry gas seal systems that have been developed to meet specific process requirements

Bearings

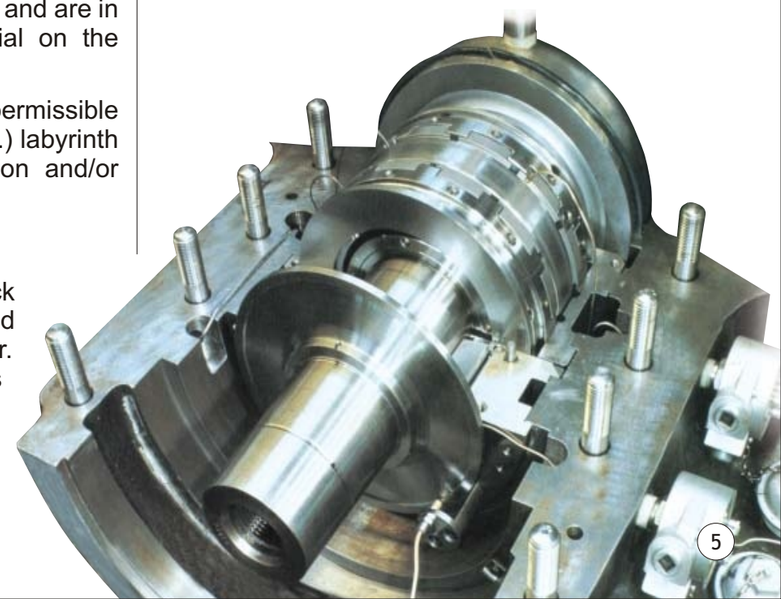
Hydrodynamic bearings

Journal bearings

Tilting pad bearings are generally used, and are normally equipped with thermocouples to monitor the bearing temperature.

Thrust bearings

Double-acting, tilting pad bearings with an equalizing device are typically installed. The bearing pads can be fitted with thermocouples for temperature monitoring.



Oil and Dry Gas Seal Systems

Oil systems

Pre-engineered solutions, designed in accordance with API 614 are implemented for continuous compressor operation. Integrating the experience from the large number of units in operation ensures high reliability and short cycle times.

The oil system can be a separate console or is integrated with compressor base plate for compact packages that are easy to install on-shore or off-shore locations.

The lube oil system provides lube oil to the radial and thrust bearing of the compressor, to the gear box, and to the driver (except for some gas turbines).

A seal oil system supplying filtered oil to the liquid film rings or to mechanical type seals at the required pressure and temperature can be provided upon request.

The seal oil system may also be combined with the lube oil system. In this case the same oil reservoir is used for both functions.

Dry Gas Seal systems

This provides the required buffer gas for the primary, secondary and tertiary seals, and the instrumentation to monitor the seals properly. Dry gas seal systems are engineered to suit specific machine requirements.

Control Systems

With extensive experience as a manufacturer of compressors and all types of drivers, and engineering and field services for compression stations, our specialized teams develop systems to control the equipment packages and the associated auxiliaries or processes as required.

Anti-surge protection and process control

Anti-surge control algorithms implemented within the control system are based on the knowledge acquired through our expertise as a leading compressor manufacturer and experience on hundreds of applications. Different control strategies are available to meet the needs of the application. All provide closed and open loop controls to react to small and large process disturbances. Different process control functions can be provided.

Test Facilities

Centrifugal compressors are carefully tested throughout the manufacturing process in order to guarantee a perfect match to their design criteria and to assure long lasting, continuous operation.

The following tests are typically carried out on components and assembled machines:

Casing - hydraulic pressure test
Impellers - ultrasonic and dye penetrant liquid tests, over speed testing
Impellers/rotors - over-speed testing
Mechanical run test

Optional tests may be performed based on the specific job requirements, such as :

-performance tests (with air or other gases in an open or closed loop)
-full load-performance tests (including flammable gases) to check rotor stability and the performance of the machine
-mechanical string test (with steam turbine, gas turbine or motor)

Many indoor test beds together with a sophisticated system for data acquisition and processing of test results are present at Hyderabad facilities.

We have the largest and most complete testing capability (VFD driven 8 MW electric motor drive) in the industry in India to perform tests under actual load and pressure conditions for compressor trains.

String test of gas turbine driven light end fractions compressor for Vijaipur

String test of motor driven compressor along with job lube oil system

String test of natural gas compressor driven by job motor for Marmul, Oman

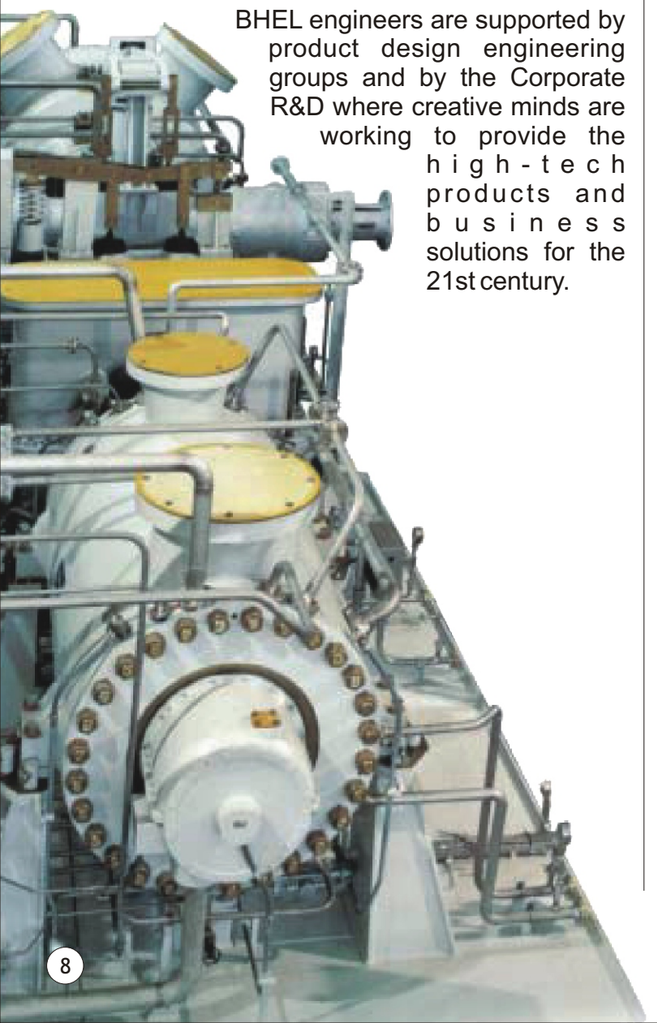
String test of Gas Lift Compressor train driven by motor for Lekhwair, Oman

Service

BHEL's business provides a complete set of services to support the entire centrifugal compressor product line. We offer an extensive portfolio of proactive and interactive service products such as condition-based maintenance, Conversions, Modifications and Uprates (CM&Us) complementing the traditional service offerings of OEM spare parts, repairs, and field services.

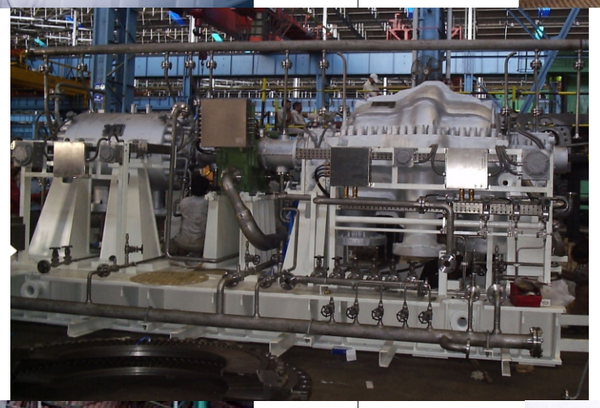
Regular customer training programs are organized for customer engineers to impart knowledge in equipment design philosophy , construction , assembly , operation and trouble shooting. Experienced faculty from the concerned disciplines provide the conceptual inputs backed up by shop visits.

BHEL engineers are supported by product design engineering groups and by the Corporate R&D where creative minds are working to provide the high-tech products and business solutions for the 21st century.

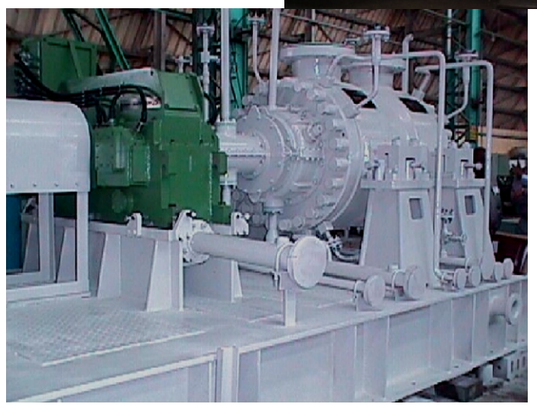


Refinery, Petrochemicals, Pipeline & Fertiliser

Fabricated wet gas Compressor for refinery application

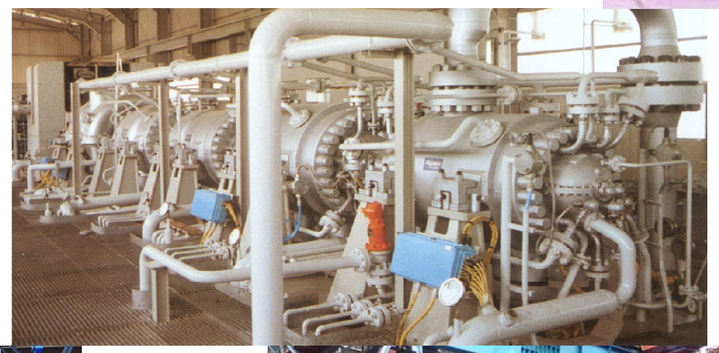


CO2 Compressor train for a fertiliser plant in France

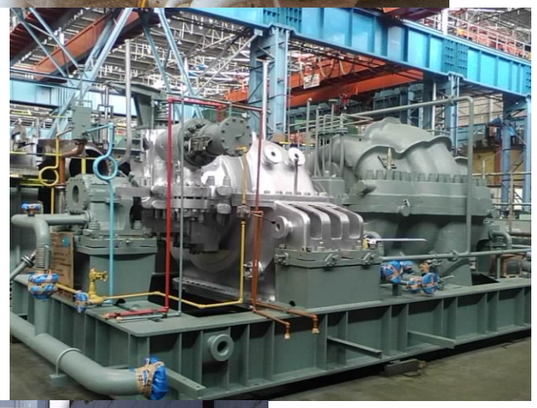


Isomerisation compressor for a refinery in Iraq

Double ended steam turbine driving LP & HP compressors for DHDT Service



4 casing Synthesis gas compressor train in a fertiliser plant



Steam turbine driven Wet Gas compressor for Refinery

Steam turbine driven H2 Recycle Compressor for motor spirit quality upgradation

Fabricated Compressor for inert gas application

SOLAR PHOTOVOLTAICS


बी एच ई एल
BHEL
SOLAR
WE DO IT ALL
Ground, Rooftop, Water, Space
Think Solar Think BHEL

About BHEL

Established in 1964, Bharat Heavy Electricals Limited is an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing companies of its kind in India. The company is engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, services and systems for the core sectors of the economy viz. Power, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas, Water, Energy Storage Solutions & e-Mobility, Defence and Aerospace.

BHEL's mammoth size of operations is evident from its widespread network of 16 manufacturing units, 2 repair units, 4 regional offices, 8 service centres, 1 subsidiary, 3 overseas offices, 5 joint ventures, 15 regional marketing centres and more than 150 project sites across India and abroad. BHEL has references in 83 countries in all the inhabited continents, with a global installed capacity of over 180 GW.

100 kW Grid-interactive Solar PV Plant at Lakshadweep

35+
years
of solar experience

1,198
MW
Solar Portfolio

105
MW
Cell Manufacturing Capacity

226
MW
Module Manufacturing Capacity

NTPC 5x50 MW solar PV plant at Kadiri - 50 MW EPC by BHEL

Harnessing the Sun ... since 1983

BHEL is one of the first engineering enterprises to manufacture solar photovoltaic (SPV) cells and modules in the country and was successfully able to demonstrate its capability even before the solar sector witnessed active growth and development in India.

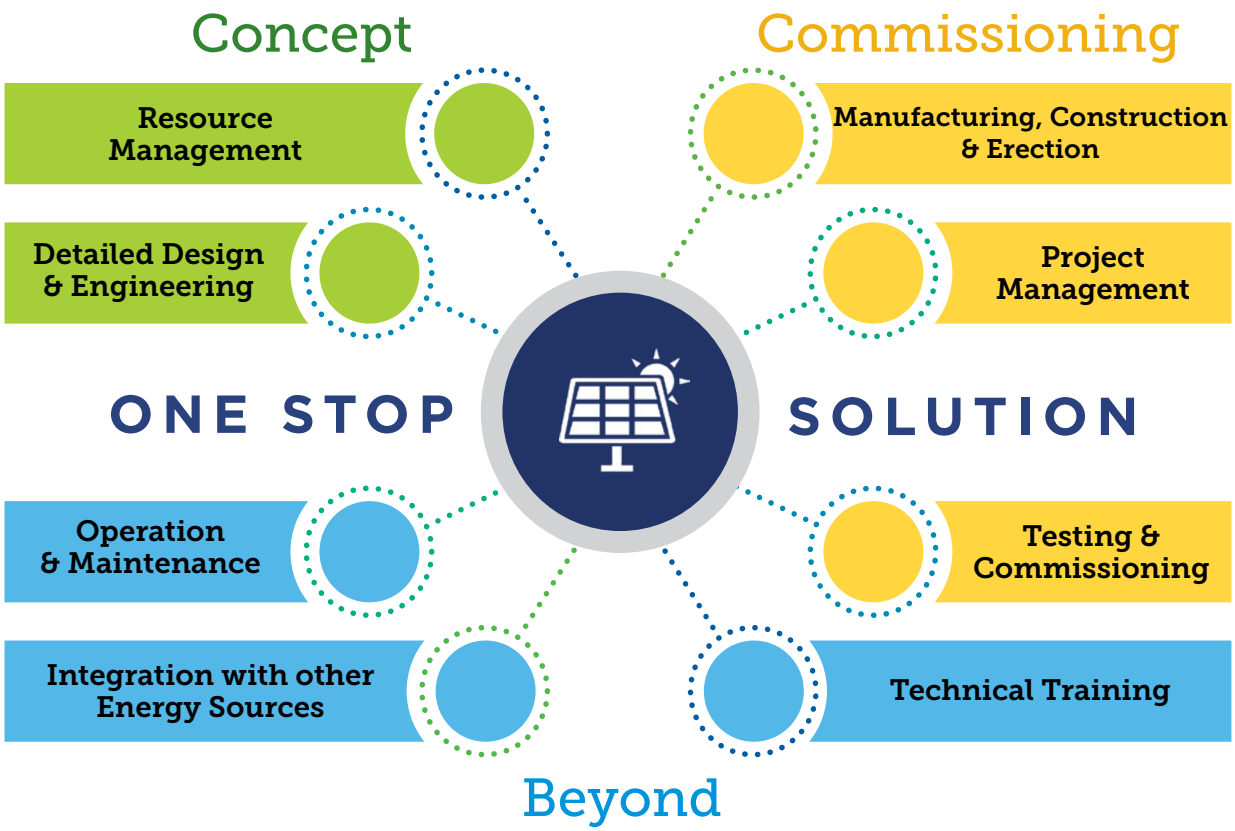
Since then, BHEL has been continuously developing its solar portfolio and today, is one of the few companies in India which provides end-to-end in-house solutions for all solar power needs - including conceptualisation, design, engineering, manufacturing, erection, testing, commissioning and O&M - with proven expertise
of over three decades.

Solar on ground, solar on rooftop, solar on water to solar in space - **We do it All !**

With state-of-the-art manufacturing facilities, best-in-class cell efficiency, a dedicated R&D centre and proven quality, support & assurance - BHEL is a one-stop solution for all your solar power needs.

Concept-to-Commissioning and Beyond...

Practicing the philosophy of concept-to-comissioning and beyond, our endeavour is to provide customer-oriented cost-effective solutions and services for the whole spectrum of solar energy.

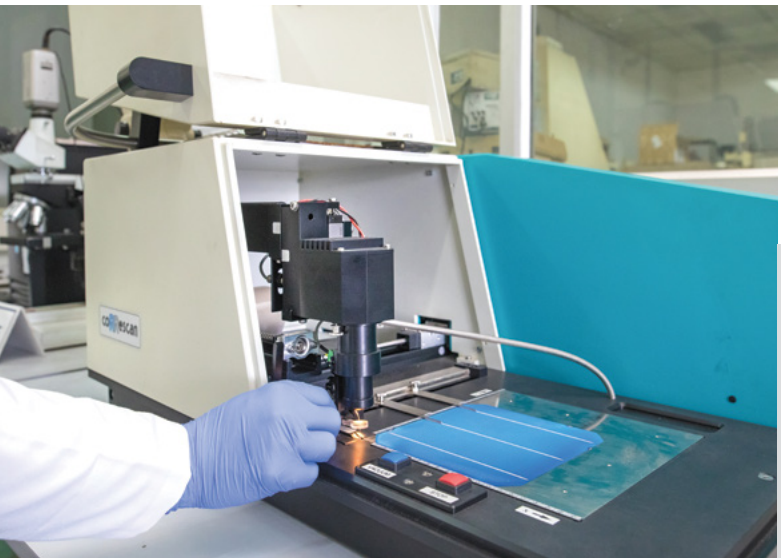


Manufacturing Capability

BHEL manufactures high-efficiency mono and polycrystalline silicon PV modules in its state-of-the-art production facility at Bengaluru. It is the only enterprise in India which posseses the capability of developing and manufacturing almost the entire range of equipment for solar PV plants, comprising:

- Cells - Mono/Polycrystalline
- Modules - Mono/Polycrystalline
- SCADA (Supervisory Control & Data Acquisition) System
- Solar Inverters (630 kW/1250 kW)
- Switchgear Panels (all kV ratings)
- Power Transformers (15 MVA and above)
- Passive Solar Tracking System

In addition to the above, BHEL has a dedicated facility for manufacturing space-grade panels and batteries.



Research & Development

BHEL has a dedicated industrial R&D Centre for PV at its Amorphous Silicon Solar Cell Plant (ASSCP) in Gurugram, Haryana. The centre is equipped with state-of-the-art facilities and testing characterization equipment. Its R&D team is engaged in developing high-efficiency silicon(Si) solar cells and process optimization.

At its R&D facility, BHEL has invented innovative and easy to use testing and process tools which include among others, single side etcher, diffused reflectance setup, calibration setup, plasma texturing setup, etc.

BHEL has also developed Passive Tracking System and the same is under field trials.

WE DO IT ALL

Ground Mounted

Customer-centric large scale utility power plants integrated with megawatt sized battery energy storage system (BESS).

Major References

Commissioned

- 75 MW SPV plant at GIPCL Charanka, Gujarat
- 65 MW SPV plant at NLC, Neyveli, Tamil Nadu
- 50 MW SPV plant at NTPC Kadiri, Andhra Pradesh and another 50 MW SPV plant at NTPC Mandsaur, Madhya Pradesh

Rooftop

- Rooftop portfolio of **around 25 MW**
- Grid-connected systems with net metering
- Hybrid with D.G. & Grid-synchronized systems
- Off-grid with battery backup

Major References

Commissioned

- 3.6 MW SPV plant, Surat Municipal Corporation, Surat - Gujarat
- 2 MW SPV plant, Indian Railway Organization for Alternate Fuels, DMW, Patiala - Punjab
- 1.5 MW SPV plants, ONGC Assam
- 1 MW SPV plant, Ordnance Factory (Rifle Factory), Ishapore - West Bengal

WE DO IT ALL

Canal Top

- In-house design and development of module mounting structure suitable for canal tops
- Patented design of BHEL makes optimum use of canal top space with a tiltable design
- Innovative concept of merging cable tray, walkway, fencing and illumination posts into the girder have reduced civil works, thereby increasing the viability of this design
- India's first seasonal-tilt canal top SPV plant of 1 MW capacity commissioned by BHEL at Bhimavaram, Andhra Pradesh

Floating Solar

- **219 MWp Floating SPV plants under execution**
- BHEL designed floating SPV power plants can be installed on City lakes /Reservoirs of hydel power Plants/Drinking /Irrigation water ponds
- The design uses recyclable, UV and corrosion-resistant HDPE (High density poly ethylene) floats

Solar Pumps

- Solar based water pumping systems for irrigation and drinking water purposes
- Supplied solar based water pumping systems in various villages of Punjab and remote locations of Arunachal Pradesh
- Major customers include M/s PEDA (Punjab Energy Development Agency), M/s APEDA (Arunachal Pradesh Energy Development Agency), M/s GWSSB (Gujarat Water Supply and Sewerage Board)

Space Grade Solar

- BHEL is the exclusive supplier of space-grade panels and batteries to ISRO (Indian Space Research Organization) for their space programs since 2001

Bharat Heavy Electricals Limited

Industry Sector, Integrated Office Complex,
Lodhi Road, New Delhi - 110003, India
Tel. No.: 011-41793 243/233/489, E-mail: solar@bhel.in

www.bhel.com

Registered Office: BHEL House, Siri Fort, New Delhi - 110049, India
Corporate Identity Number: L74899DL1964GOI004281

Powering Progress...Brightening Lives. Touching Every Indian Home

SPV MODULE TYPE: L24315P (MULTI - 24 V, 300 to 330 WATTS)

1. PV MODULE TYPE NO. : L24315P
2. CONFIGURATION : SINGLE GLASS LAMINATED TYPE WITH 72 NOS. OF 156.75 mm /157 mm (Typ.) MULTI CRYSTALLINE SILICON SOLAR CELLS (12*6) IN SERIES CONFIGURATION.
3. OVERALL SIZE : 1966 (±3) * 986 (±2) * 35 (±1) mm
4. WEIGHT : 22.5 Kg. (Typ.)
5. RFID Tag : As per MNRE Guidelines
6. MAJOR BILL OF MATERIAL

SL NO.	BILL OF MATERIAL	DETAILS
1	SOLAR CELL	MULTI CRYSTALLINE, HIGH EFFICIENCY, PID RESISTANT
2	SOLAR GLASS	ANTI REFLECTION COATED, LIGHT TRANSMISSION ≥ 93.5%
3	EVA SHEET	OPTICAL TRANSMITTANCE > 91%, PID RESISTANT, UV & WEATHER STABLE
4	BACK SHEET	THREE LAYERED STRUCTURE, FLUOROPOLYMER & PET BASED, THICKNESS MIN. 300 MICRONS
5	FRAME	ANODISED ALUMINIUM FRAME (ANODIZATION THICKNESS 18 ± 3 MICRONS)
6	JUNCTION BOX	IP 67 / IP 65 GRADE JUNCTION BOX WITH CABLES AND CONNECTORS (TUV CERTIFICATED), 1 KV

8. WARRANTY:

- Product Warranty: The modules are warranted for 5 years for failures due to material defects and workmanship.
- Performance Warranty: 90% of the peak power capacity at the end of 10 years and 80 % of the peak power capacity at the end of 25 years.

The warranty is subject to standard terms & conditions of sale and adherence by the customer to the installation & operation manual and instructions thereof.

9. TYPICAL ELECTRICAL CHARACTERISTICS at STC:

Type No.	Voc (V)	Isc (A)	Vmp (V)	Imp (A)	Pmax, Wp (Min.)	Module Efficiency, % (Min.)	Fill Factor (Min.)
L24315P-300W	44.83	8.89	37.49	8.00	300	15.4	≥ 0.70
L24315P-305W	44.92	9.00	37.50	8.13	305	15.7	≥ 0.70
L24315P-310W	45.10	9.11	37.52	8.26	310	15.9	≥ 0.70
L24315P-315W	45.30	9.12	37.61	8.38	315	16.2	≥ 0.70
L24315P-320W	45.34	9.23	37.65	8.50	320	16.5	≥ 0.70
L24315P-325W	45.44	9.32	37.68	8.63	325	16.7	≥ 0.70
L24315P-330W	45.68	9.44	37.75	8.74	330	17.0	≥ 0.70

NOTE:

1. Electrical specifications mentioned above are at Standard Test Conditions of 100 mW/sq.cm solar insolation (AM 1.5) and at 25 deg. C temperature.
2. Measurement repeatability of peak power output: ±3%.
3. Maximum System Voltage is 1 kV / 1.5 kV DC.

Abbreviation:

- OPEN CIRCUIT VOLTAGE (Voc), SHORT CIRCUIT CURRENT (Isc)
- VOLTAGE AT PEAK POWER POINT (Vmp)
- CURRENT AT PEAK POWER POINT (Imp)
- PEAK POWER OUTPUT (Pmax).

OIL FIELD EQUIPMENT

बी एच ई एल
BHEL
Maharatna Company

Golden Jubilee 1964 - 2014
50 Years

OIL RIGS

A GLOBAL ENTERPRISE PROVIDING ENGINEERING AND MANUFACTURING SOLUTIONS TO OIL AND GAS INDUSTRY FOR MORE THAN 3 DECADES

भारत हेवी इलेक्ट्रिकल्स लिमिटेड

BHARAT HEAVY ELECTRICALS LIMITED

REGD. OFFICE: BHEL HOUSE, SIRI FORT, NEW DELHI-110 049, INDIA
WEBSITE : WWW.BHEL.COM

INTRODUCTION

Bharat Heavy Electricals Limited (BHEL) is a pioneering engineering and manufacturing organization established in the year of 1964 by Government of India. Since its inception the organization has grown in many folds and is catering to core sectors of Indian economy viz. Power, Oil & Gas, and Transportation etc. BHEL is now having seventeen manufacturing facilities and plenty of service centers spread across India and abroad.

FIRST AC VFD RIG COMMISIONED AT ONGC RAJAHMUNDRY

BHEL started manufacturing Drilling Rigs in the year 1974 with the objective of catering to domestic Oil companies. Since then BHEL has supplied various types Land drilling Rigs which are still working in the fields. Initially BHEL had technical collaboration with the world renowned companies like M/ s. OILWELL, USA, M/ s. SKYTOP and M/s. Branham Industries Inc, USA for Hoisting and rotating equipment, Mast and substructures (for Land rigs) and Off-shore Derricks.

Over the years, BHEL has gained vast experience in Oil field equipment and became self-sustainable in packaging Drilling Rigs. The Rigs supplied by BHEL are known for their performance in the shallow fields of West part of India as well in the complex fields of KG Basin.

BHEL offers AC-SCR technology rigs, AC-VFD technology rigs, and Mobile rigs of different capacities. These Rigs are custom packaged with core engineering and design by BHEL. BHEL also offers individual equipment like Drawworks, Travelling blocks, Crown blocks, Swivels, Mud systems and Rig auxiliary systems. BHEL is also into Refurbishment and up-gradation of Rigs.

The Business at BHEL is purely driven by Customer satisfaction. BHEL is known for excellent after sales service in Indian Drilling industry. The core strength of the company is derived from its Human Resources and huge infrastructure in-house. Our objective is to offer durable products with high quality standards at competitive prices to the Industry.

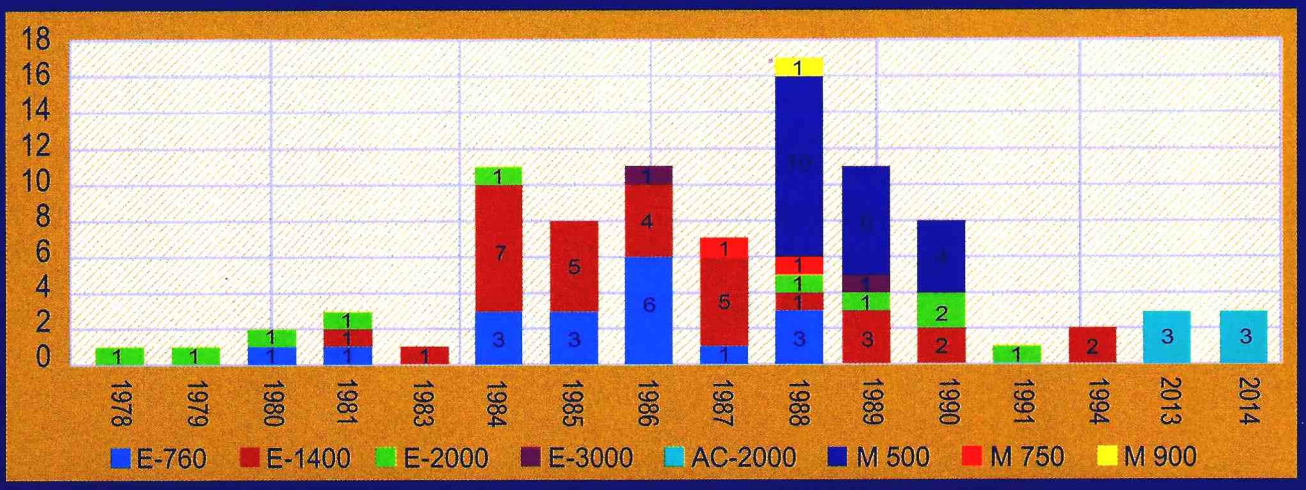
BUSINESS PORTFOLIO AND CHRONOLOGY

OIL RIG DIVISION

- COMPLETE LAND DRILLING RIG PACKAGE
- COMPLETE MOBILE AND WORK OVER RIG PACKAGE
- SUPPLY OF ALL RIG EQUIPMENT
- REFURBISHMENT AND UPGRADATION OF COMPLETE RIG PACKAGE AND RIG EQUIPMENT
- SUPPLY OF RIG SPARES FOR CONTINUOUS OPERATION
- AFTER SALE SERVICE SUPPORT

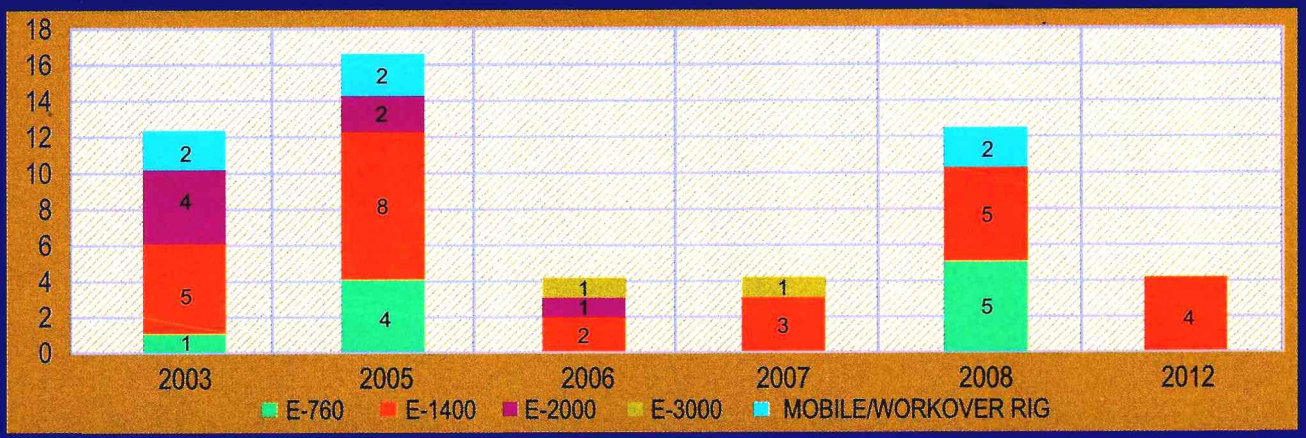
LAND RIG AND MOBILE RIG PACKAGES

CUSTOMER	E-760	E-1400	E-2000	E-3000	AC 2000	M 500	M 750	M 900	TOTAL
ONGCL	18	24	9	1	6	16	2	1	77
OIL		7	1	1		4			13



REFURBISHMENT AND UPGRADATION

CUSTOMER	E-760	E-1400	E-2000	E-3000	MOBILE RIGS	TOTAL
ONGCL	10	20	7	1	6	44
OIL		7		1		8



AC - VFD 2000 HP RIG

BHEL make AC VFD 2000 HP Rigs are designed for drilling depths up to 6100 meters. These rigs are equipped latest state of the art technology available in the Drilling industry. The main advantage of these rigs is improved efficiency resulting in less fuel consumption and savings in drilling costs. Also the comprehensive control system covering all necessary drilling tools makes is it more user friendly. Full control of the block is achieved through AC motors and VFD drives via a single joy stick, without any need for setting the brake separately. This feature helps to improve the tripping efficiency and simplify the task performed by the driller.

The Rig package includes:

MAST AND SUB-STRUCTURE:

Cantilever swing lift type Mast with clear height of 147 ft.
Base width at floor level is 35 ft.
Static hook load capacity is 1,000,000 lbs.
Wind load capacity with full pipe set back is 100 mph.
The package also includes basic accessories like Racking plat form, Crown block, Ladders, Mast raising and lowering sling lines, Pulley etc.

AC VFD 2000 HP DRAW WORKS :

Draw works is driven by 2 no's AC Induction motors connected to the drum through a gear box. The drum is grooved for 1 3/8" wire line. Air cooled Friction type disc brake mounted directly onto the drum shaft is used for parking and emergency purposes. Primary braking or block control is accomplished by regenerative (dynamic) braking through AC motors.

AC VFD DRAW WORKS

TRAVELLING ASSEMBLY:

Travelling Block & Hook rated for 500Ton dead load, PC 500 Swivel with 500Ton dead load rating and 367Ton API bearing rating at 100RPM forms Travelling Assembly.

VFD CONTROL HOUSE:

VFD control house accommodates Generator panels for 4 no's power packs, Rectifier units, Inverter cubicles for Draw works, Mud pumps IRD, chopper cubicles along with Control cabinet for comprehensive control of various Drilling tools.

VFD CONTROL HOUSE

DRILLERS CABIN

DRILLER CABIN:

Air conditioned driller cabin equipped with ergonomically designed driller's chair, joystick and touch screen monitors from which the driller can monitor, control and operate various tools like the draw works, top drive, mud pump and IRD. Primary controls of various tools are incorporated into Joy sticks.

TOP DRIVE SYSTEM:

Nov make TDS 11SA or equivalent Top drive system can be offered as a part of Rig package. Necessary retrofitting job in the Rig for installation of Top drive system shall be BHEL's responsibility.

TOP DRIVE SYSTEM

AC - VFD 2000 HP RIG

IRON ROUGH NECK:

Iron rough is provided for making in and breaking out of tubular connection from 4-½" to 8-½" OD and handle drill pipe from 3-½" to 6 5/8".

IRON ROUGHNECK

MUD PUMPS WITH AC MOTORS:

- Two no's 1700PT BPCL make triplex single acting pumps.
- Maximum per pump working pressure: 5000 Psi.

RIG ELECTRICS:

Apart from VFD Control house, the complete Rig power system shall be part of supply. It includes:

- Four no's AC-power packs consisting of 1180 HP, 1500 RPM engines and 1430 KVA, 600v, 3 Phase, 50 HZ, 0.7 PF alternators housed in a completely enclosed acoustic enclosure.
- MCC house for all Rig accessories – 1no.
- Rig lighting system – 1 set
- Complete Power and control cabling – 1 set

RIG INSTRUMENTATION :

The Rig Instrumentation system is intended for real time monitoring of various critical parameters while drilling. The system includes various field sensors, necessary cabling, central server and client work stations. The system is SCADA compatible for data transfer.

RIG INSTRUMENTATION

ROUND BOTTOM MUD TANK SYSTEM:

BHEL offers SOBM compatible Mud systems. The system consists of 6/7 no. of tanks each of 60 Cu.M capacity as mentioned below and 1 no. trip tank.

- One Shaker tank
- One Settling tank
- One Suction tank
- Three or four reserve tanks.

Each tank is equipped with sufficient number of agitators for proper churning of Mud.

Mud system also includes mud preparation system along with standard suite of solid processing equipment namely, Shale shakers, Mud cleaners, Desanders and Degassers.

* Number of tanks and mud capacity can be changed to customer's choice.

HIGH PRESSURE MUD PIPING:

Includes set of high pressure piping b/w Mud pumps and Gooseneck along with suitable standpipe manifold.

RIG AUXILIARY SYSTEMS:

The standard package includes Fuel system and Water system complete with necessary storage tanks and pumping units, Air system complete with compressors and storage vessels, BOP handling systems, air winches etc.

AC - SCR - 3000 HP RIG

BHEL make AC-SCR rigs are known for their long life and less down time. BHEL has complete know-how of AC-SCR technology and it is proven in the fields. Almost all the AC-SCR rigs being operated by M/s ONGC & M/s OIL were supplied by BHEL. These Rigs are proven for their performance with operational life more than 25 years.

BHEL offers four variants of AC-SCR rigs with drilling depths covering shallow & deep formations. The Rig package can be standard package or custom built to suit to individual customer requirements.

AC-SCR 3000HP Rig - For Drilling depths upto 9100 meters

MAST AND SUBSTRUCTURE

The standard AC-SCR 3000 HP Rig package includes,

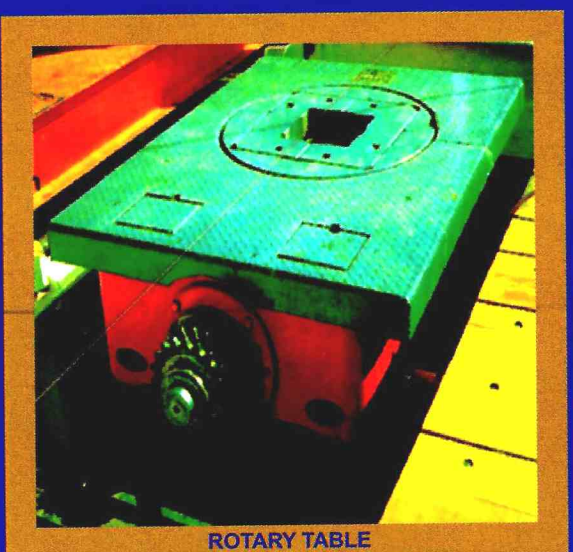
MAST AND SUB-STRUCTURE:
Cantilever swing lift type Mast with clear height of 152 ft.
Base width at floor level is 35 ft.
Static hook load capacity is 1,500,000 lbs.
Wind load capacity with full pipe set back is 100 mph.
The package includes basic accessories like Racking platform, Crown block, Ladders, Mast raising and lowering sling lines & Pulleys etc.

DC 3000 HP DRAW WORKS:
Draw works designed for 3000hp input power. It is driven by 3 no's of DC motors which possess superior speed-torque characteristics. The power transmission is through chains & sprockets. Standard DC Draw works carries Drive shafts for the Rotary and Catheads also. The drum is grooved for 1 1/2" wire line. Braking system consists of Eddy current brake as Auxiliary brake and Band/Friction type brake as Main brake.

TRAVELLING ASSEMBLY:
Travelling Block & Hook rated for 750Ton dead load, PC 650 Swivel with 650Ton dead load rating and 425Ton API bearing rating at 100RPM forms Travelling Assembly.

TRAVELLING BLOCK

B37 1/2" ROTARY TABLE:
This rotary comes with 37 ½" full opening dead load capacity of 650 tons. Rotary table with independent drive can also be offered.



ROTARY TABLE

AC - SCR - 3000 HP RIG

PC 650 SWIVEL:
Dead Load rating 650 tons. API bearing rating 425 tons at 100 RPM

MUD PUMPS WITH DC MOTORS:
- Three no's of 1600/1700PT triplex single acting pumps.
- Maximum per pump working pressure: 5000 Psi.

RIG ELECTRICS:
BHEL offers the complete Rig power system consisting of
- DC-Power Control Room which houses Generator panels for Rig power packs and SCR Drive units for Draw works, Mud pumps and IRD
- Six no's AC-power packs consisting of 1180 HP, 1500 RPM engines and 1430 KVA, 600v, 3 Phase, 50 HZ, 0.7 PF alternators housed in a completely enclosed acoustic enclosure.
- MCC house for all Rig accessories – 1no.
- Rig lighting system – 1 set
- Cables & fittings – 1 set

RIG INSTRUMENTATION :
- The Rig Instrumentation system is intended for real time monitoring of various critical parameters while drilling. The system includes various field sensors, necessary cabling, central server and client work stations.
- The system is SCADA compatible for data transfer via WITS.

ROUND BOTTOM MUD TANK SYSTEM:
BHEL offers SOBM compatible Mud systems. The system consists of 7 no. of tanks each of 60 Cu.M capacity as mentioned below and 1 no. trip tank.

- One Shaker tank
- One Settling tank
- One Suction tank
- Four Reserve tanks.

Each tank is equipped with sufficient number of agitators for proper churning of Mud.

Mud system also includes mud preparation system along with standard suite of solid processing equipment namely, Shale shakers, Mud cleaners, Desanders and Degassers.

* Number of tanks and mud capacity can be changed to customer's choice.

HIGH PRESSURE MUD PIPING:
Includes set of high pressure piping b/w Mud pumps and Gooseneck along with suitable standpipe manifold.

RIG AUXILIARY SYSTEMS:
The standard package includes Fuel system and Water system complete with necessary storage tanks and pumping units, Air system complete with compressors and storage vessels , BOP handling system , air winches etc.

COMPRESSOR UTILITY HOUSE

AC - SCR - 2000 HP RIG

The standard AC-SCR 2000 HP Rig package includes,

MAST AND SUB-STRUCTURE:

Cantilever swing lift type Mast with clear height of 147 ft.
Base width at floor level is 30 ft.
Static hook load capacity is 1,000,000 lbs.
Wind load capacity with full pipe set back is 100 mph.
The package includes basic accessories like Racking plat form, Crown block, Ladders, Mast raising and lowering sling lines & Pulleys etc.

DC 2000 HP DRAW WORKS:

Draw works is designed for 2000hp input power. It is driven by 2 no's DC motors which possess superior speed-torque characteristics. The power transmission is through chains & sprockets. Standard DC Draw works carries Drive shafts for the Rotary and Catheads also. The drum is grooved for 1 3/8" wire line. Braking system consists of Eddy current brake as Auxiliary brake and Band/Friction type brake as Main brake.

TRAVELLING ASSEMBLY:

Travelling Block & Hook rated for 500Ton dead load, PC 500 Swivel with 500Ton dead load rating and 367Ton API bearing rating at 100RPM forms Travelling Assembly.

B 27-1/2"ROTARY TABLE:

This rotary comes with 27-1/2" full opening/dead load capacity i s 500 tons. Alternative: B 37-1/2" rotary table can also be provided. Independent drive system can also be offered.

MUD PUMPS WITH DC MOTORS:

- Two no's of 1300/1400PT triplex single acting pumps.
- Maximum per pump working pressure: 5000 Psi.

RIG ELECTRICS:

BHEL offers the complete Rig power system consisting of

- DC-Power Control Room which houses Generator panels for Rig power packs and SCR Drive units for Draw works, Mud pumps and IRD
- Six no's of AC-power packs consisting of 1180 HP, 1500 RPM engines and 1430 KVA, 600v, 3 Phase, 50 HZ, 0.7 PF alternators housed in a completely enclosed acoustic enclosure.
- MCC house for all Rig accessories – 1no.
- Rig lighting system – 1 set
- Cables & fittings – 1 set

RIG INSTRUMENTATION:

- The Rig Instrumentation system is intended for real time monitoring of various critical parameters while drilling. The system includes various field sensors, necessary cabling, central server and client work stations.
- The system is SCADA compatible for data transfer, via WITS.

ROUND BOTTOM MUD TANK SYSTEM:

BHEL offers SOBM compatible Mud systems. The system consists of 6/7 no. of tanks each of 60 Cu.M capacity as mentioned below and 1 no. trip tank.

- One Shaker tank
- One Settling tank
- One Suction tank
- Three or four Reserve tanks.

Each tank is equipped with sufficient number of agitators for proper churning of Mud.

Mud system also includes mud preparation system along with standard suite of solid processing equipment namely, Shale shakers, Mud cleaners, De sanders and Degassers.

* Number of tanks and mud capacity can be changed to customer's choice.

HIGH PRESSURE MUD PIPING:

Includes set of high pressure piping b/w Mud pumps and Gooseneck along with suitable standpipe manifold.

RIG AUXILIARY SYSTEMS:

The standard package includes Fuel system and Water system complete with necessary storage tanks and pumping units, Air system complete with compressors and storage vessels, BOP handling systems, air winches etc.

AC - SCR - 1400 HP RIG

AC-SCR 1400HP Rig – For Drilling depths upto 4900 meters

The standard AC-SCR 1400 HP Rig package includes,

MAST AND SUB-STRUCTURE:

Cantilever swing lift type Mast with clear height of 142 ft.
Base width at floor level is 30 ft.
Static hook load capacity is 1,000,000 lbs.
Wind load capacity with full pipe set back is 100 mph.
The package includes basic accessories like Racking plat form, Crown block, Ladders, Mast raising and lowering sling lines & Pulleys etc.

DC 1400 HP DRAW WORKS:

Draw works designed for 1400hp input power. It is driven by 2 no's of DC motors which possess superior speed-torque characteristics. The power transmission is through chains & sprockets. Standard DC Draw works carries Drive shafts for the Rotary and Catheads also. The drum is grooved for 1 1/4" wire line. Braking system consists of Eddy current brake as Auxiliary brake and Band/Friction type brake as Main brake.

PC 425 SWIVEL:
Dead load rating 425 T.API Bearing rating 259 T at 100RPM.

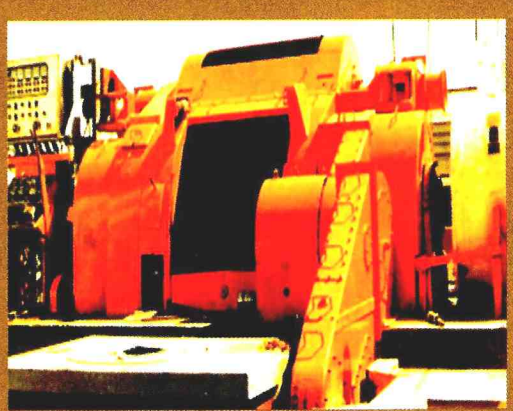
MUD PUMPS WITH DC MOTORS:

- Two no's of 1100PT triplex single acting pumps.
- Maximum per pump working pressure: 5000 Psi.

RIG ELECTRICS:

BHEL offers the complete Rig power system consisting of

- DC-Power Control Room which houses Generator panels for Rig power packs and SCR Drive units for Draw works, Mud pumps and IRD
- Four no's AC-power packs consisting of 1180 HP, 1500 RPM engines and 1430 KVA, 600v, 3 Phase, 50 HZ, 0.7 PF alternators housed in a completely enclosed acoustic enclosure.
- MCC house for all Rig accessories – 1no.
- Rig lighting system – 1 set
- Cables & fittings – 1 set



AC SCR DRAW WORKS

POWER CONTROL ROOM

TRAVELLING ASSEMBLY:

Travelling Block & Hook rated for 500Ton dead load, PC 425 Swivel with 425Ton dead load rating and 259Ton API bearing rating at 100RPM forms Travelling Assembly.

B- 27½" ROTARY TABLE:

This rotary comes with 27-1/2" full opening/dead load capacity i s 500 tons. Independent drive system can also be offered.

RIG INSTRUMENTATION :

- The Rig Instrumentation system is intended for real time monitoring of various critical parameters while drilling. The system includes various field sensors, necessary cabling, central server and client work stations.

- The system is SCADA compatible for data transfer, via WITS..

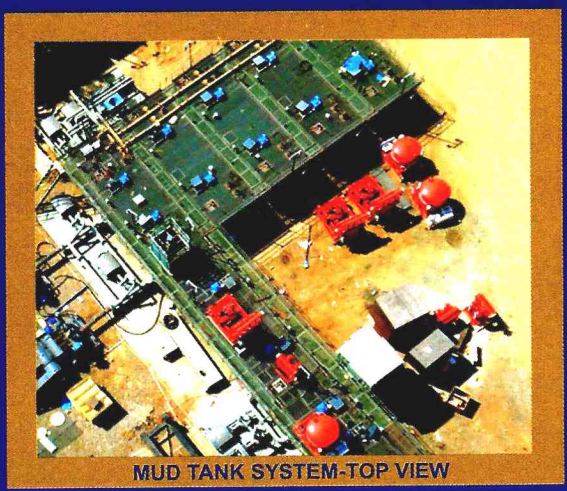
AC - SCR - 1400 HP RIG

ROUND BOTTOM MUD TANK SYSTEM:

BHEL offers SOBM compatible Mud systems. The system consists of 6 no. of tanks each of 60 Cu.M capacity as mentioned below and 1 no. trip tank.

- One Shaker tank
- One Settling tank
- One Suction tank
- Three Reserve tanks.

ROUND BOTTOM MUD TANK

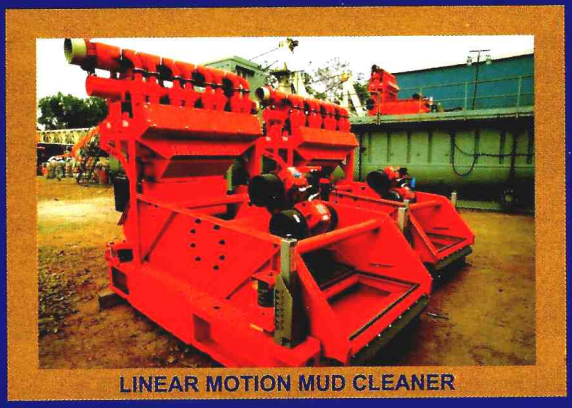


MUD TANK SYSTEM-TOP VIEW

Each tank is equipped with sufficient number of agitators for proper churning of Mud.

Mud system also includes mud preparation system along with standard suite of solid processing equipment namely, Shale shakers, Mud cleaners, Desanders and Degassers.

* Number of tanks and mud capacity can be changed to customer's choice.



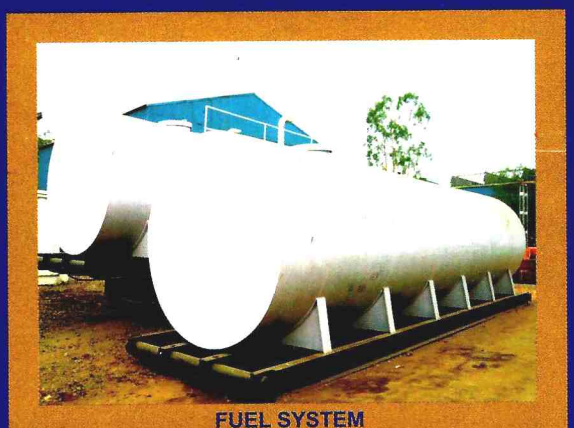
LINEAR MOTION MUD CLEANER

HIGH PRESSURE MUD PIPING:

Includes set of high pressure piping b/w Mud pumps and Gooseneck along with suitable standpipe manifold.

RIG AUXILIARY SYSTEMS:

The standard package includes Fuel system and Water system complete with necessary storage tanks and pumping units, Air system complete with compressors and storage vessels, BOP handling systems, air winches etc.



FUEL SYSTEM

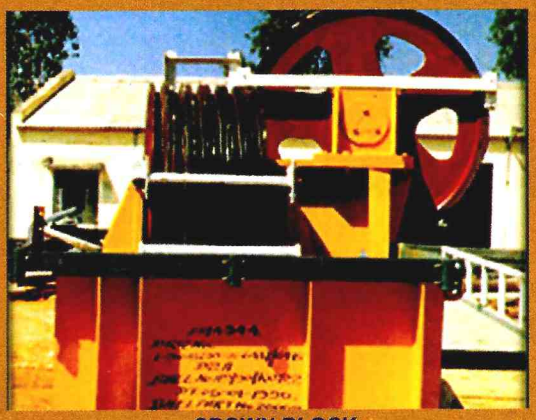
AIR WINCH

AC - SCR - 760 HP RIG

AC-SCR 760HP Rig – For Drilling depths upto 3600 meters

The standard AC-SCR 760 HP Rig package includes,

MAST AND SUB-STRUCTURE:
Cantilever swing lift type Mast with clear height of 142 ft.
Base width at floor level is 30 ft.
Static hook load capacity is 5,50,000 lbs.
Wind load capacity with full pipe set back is 100 mph.
The package includes basic accessories like Racking plat form, Crown block, Ladders, Mast raising and lowering sling lines & Pulleys etc.



CROWN BLOCK

DC 760 HP DRAW WORKS:
Draw works designed for 1000hp input power. It is driven by 2 no's of DC motors which possess superior speed-torque characteristics. The power transmission is through chains & sprockets. Standard DC Draw works carries Drive shafts for the Rotary and Catheads also. The drum is grooved for 1 1/4" wire line. Braking system consists of Eddy current brake as Auxiliary brake and Band/Friction type brake as Main brake.

MOTORISED CASING SPOOL

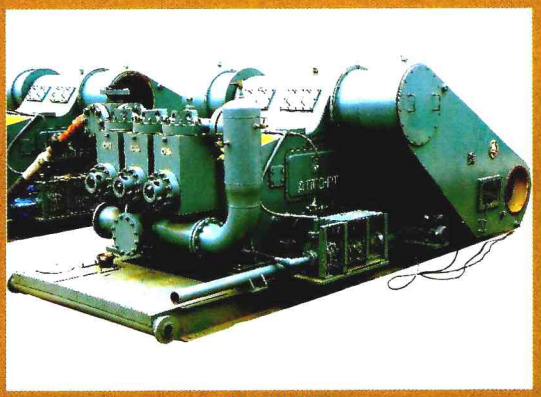
TRAVELLING ASSEMBLY:
Travelling Block & Hook rated for 350Ton dead load,.

B- 27½" ROTARY TABLE:
This rotary comes with 27-1/2" full opening/dead load capacity i s 500 tons. Independent drive system can also be offered.

PC 300 Swivel
Dead load rating 300 T.
API Bearing rating 192 T at 100RPM

SWIVEL

MUD PUMPS WITH DC MOTORS:
- Two no's of 850PT triplex single acting pumps.
- Maximum per pump working pressure: 5000 Psi.



MUD PUMP

AC - SCR - 760 HP RIG

RIG ELECTRICS:

BHEL offers complete Rig power system consisting of

- DC-Power Control Room which houses Generator panels for Rig power packs and SCR Drive units for Draw works, Mud pumps and IRD
- Three no's AC-power packs consisting of 1180 HP, 1500 RPM engines and 1430 KVA, 600v, 3 Phase, 50 HZ, 0.7 PF alternators housed in a completely enclosed acoustic enclosure.
- MCC house for all Rig accessories – 1no.
- Rig lighting system – 1 set
- Cables & fittings – 1 set

POWER PACKS

RIG INSTRUMENTATION:

The Rig Instrumentation system is intended for real time monitoring of various critical parameters while drilling. The system includes various field sensors, necessary cabling, central server and client work stations.

-The system is SCADA compatible for data transfer,

PRESSURE MONITORING SYSTEM

ROUND BOTTOM MUD TANK SYSTEM:

BHEL offers SOBM compatible Mud systems. The system consists of 6 no. of tanks each of 60 Cu.M capacity as mentioned below and 1 no. trip tank.

- One Shaker tank
- One Setting tank
- One Suction tank
- Three Reserve tanks.

Each tank is equipped with sufficient number of agitators for proper churning of Mud.
Mud system also includes mud preparation system along with standard suite of solid processing equipment namely, Shale shakers, Mud cleaners, Desanders and Degassers.

VACUUM DEGASSER

* Number of tanks and mud capacity can be changed to customer's choice.

HIGH PRESSURE MUD PIPING:

Includes set of high pressure piping b/w Mud pumps and Gooseneck along with suitable standpipe manifold.

RIG AUXILIARY SYSTEMS:

The standard package includes Fuel system and Water system complete with necessary storage tanks and pumping units, Air system complete with compressors and storage vessels, BOP handling systems, air winches etc.

MOBILE DRILLING AND WORK OVERRIGS

BHEL has supplied various types of mobile drilling and work over rigs. to M/s ONGC and M/s OIL in recent past. These rigs are designed for rugged operation and faster mobility. BHEL also has the capability to refurbish and upgrade existing Mobile rigs and Work Over Rigs.

The prime features of these rigs are:

- Carrier mounted draw works, engines, transmission and mast
- Self-propelled mechanical drive
- Telescopic mast

SPECIFICATION OF MOBILE RIG

DESCRIPTION	M 900	M750	M500
Mast Height	117 Feet	112 Feet	102 Feet
Sub structure height	17 Feet	15 Feet	15 Feet
Rated Static Hook Load capacity	365000 LBS	300000 LBS	240000 LBS
No.of Lines	10	8	8
Set Back	200000 LBS	200000 LBS	170000 LBS
Engine horse power capacity	800-950 HP	550-750 HP	475 HP

MOBILE RIG

QUALITY POLICY AND CERTIFICATIONS

QUALITY POLICY

IN ITS QUEST TO BE GLOBAL ENGINEERING ENTERPRISE, BHEL PURSUES CONTINUAL IMPROVEMENT IN THE QUALITY OF ITS PRODUCTS, SERVICES AND PERFORMANCE LEADING TO CUSTOMER DELIGHT THROUGH COMMITMENT, INNOVATION AND TEAM WORK OF ALL EMPLOYEES.

QUALITY OBJECTIVES

To meet the above Quality Policy the following objectives are defined:

To enhance

- Product/Service Quality by improving Key Processes.
- Value addition by reducing Cost of Quality
- Customer satisfaction by ensuring timely completion of projects and improved response.
- Performance of Suppliers.
- Manufacturing capability by Capacity augmentation .
- Human resources capability by upgrading skill and competence

ISO 9001:2008


BHARAT HEAVY ELECTRICALS LIMITED
HEAVY POWER EQUIPMENT PLANT
ISO 9001:2008

EMS-ISO-14001 : 2004


CERTIFICATE OF COMPLIANCE
INTERNATIONAL CERTIFICATION SERVICES PVT. LTD.
ENVIRONMENTAL MANAGEMENT SYSTEM of
BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad , Andhra Pradesh, India.
ISO 14001 : 2004
Scope: Design, Development, Production And Repair Of Steam Turbines, Gas Turbines, Turbo Generators And Exciters, Centrifugal Compressors, Pumps, High Voltage Switchgears, Offshore Oil Rigs And Accessories, Pulverising Mills, Pressure Vessels And Heat Exchangers And Production Of Ferrous And Non Ferrous Castings.
Registration No. : BR91/7974
Registered Date : 05th October, 2006
Transfer Date : 08th November, 2012
Issue Date : 16th November, 2012
Expiry Date : 05th October, 2015
JAS-ANZ
Director
International Certification Services
Accredited by Joint Accreditation System of Australia and New Zealand, Austral a

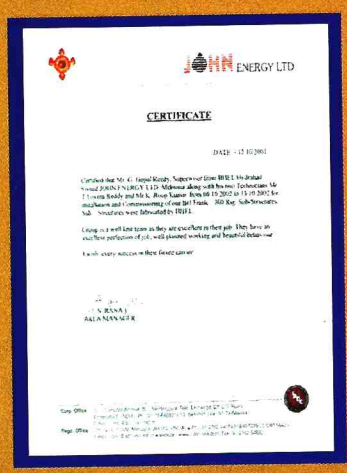
OHSAS- 18001:2007

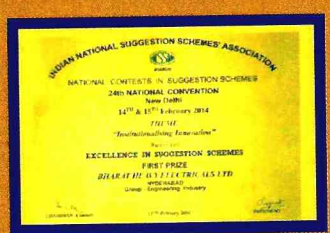

CERTIFICATE OF COMPLIANCE
INTERNATIONAL CERTIFICATION SERVICES PVT. LTD.
OCCUPATIONAL HEALTH AND SAFETY MANAGEMENT SYSTEM of
BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram, Hyderabad , Andhra Pradesh, India.
OHSAS 18001 : 2007
Scope: Design, Development, Production And Repair Of Steam Turbines, Gas Turbines, Turbo Generators And Exciters, Centrifugal Compressors, Pumps, High Voltage Switchgears, Offshore Oil Rigs And Accessories, Pulverising Mills, Pressure Vessels And Heat Exchangers And Production Of Ferrous And Non Ferrous Castings.
Registration No. : BOH91/7974
Registered Date : 19th October, 2007
Transfer Date : 24th July, 2012
Issue Date : 22nd August, 2012
Expiry Date : 18th October, 2014
JAS-ANZ
Managing Director
International Certification Services
Accredited by Joint Accreditation System of Australia and New Zealand

CUSTOMER APPRECIATION AND CII CERTIFICATES


OIL AND NATURAL GAS CORPORATION LTD.
DRILLING SERVICES
ANKLESHWAR ASSET: ANKLESHWAR
CERTIFICATE OF MERIT


OIL AND NATURAL GAS CORPORATION LTD.
DRILLING SERVICES
ANKLESHWAR ASSET, ANKLESHWAR
CERTIFICATE OF MERIT


JOHN ENERGY LTD
CERTIFICATE


INDIAN NATIONAL SUGGESTION SCHEMES' ASSOCIATION
NATIONAL CONTESTS IN SUGGESTION SCHEMES
24th NATIONAL CONVENTION
EXCELLENCE IN SUGGESTION SCHEMES
FIRST PRIZE

Maharatna Company

Golden Jubilee 1964 - 2014

UNIQUE SELLING POINTS AND API CERTIFICATIONS

- We are amongst very few companies in the world to have API Licences for more than 30 years without any break which demonstrates BHEL's firm adherence to Product Quality
- The best quality Raw material ensuring Rig Operational life of more than 25 years..
- Best in quality Prduct at competitive price.
- Huge fabrication facility for carry out fabrication work.
- Continuous availability of Rig operational spares for ensuring hassle free operation.
- Customisation redefined at BHEL as we cater to specific needs of Customer.
- Design automation software for complete analysis of Mast and Substructure.
- Highly knowledgeable and qualified after sales suport is available 24*7 just a call away for attending site urgencies.
- Compliance to international stringent Quality Standards in every dimension-people, proces, product and service(ISO-9001, ISO-14001, OHSAS-18001)
- We earn our customer trust from the quality of our products and services and thereby build relations for eternity.


Certificate of Authority to use the Official API Monogram
License Number: 6F-0046
BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram
Hyderabad, Andhra Pradesh
India
American Petroleum Institute
Effective Date APRIL 4, 2012
Expiration Date APRIL 4, 2015


Certificate of Authority to use the Official API Monogram
License Number: 7K-0021
BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram
Hyderabad, Andhra Pradesh
India
American Petroleum Institute
Effective Date APRIL 4, 2012
Expiration Date APRIL 4, 2015


Certificate of Authority to use the Official API Monogram
License Number: 8C-0064
BHARAT HEAVY ELECTRICALS LIMITED
Ramachandrapuram
Hyderabad, Andhra Pradesh
India
American Petroleum Institute
Effective Date APRIL 4, 2012
Expiration Date APRIL 4, 2015

VISION

A global engineering enterprise providing solutions for a better tomorrow

MISSION

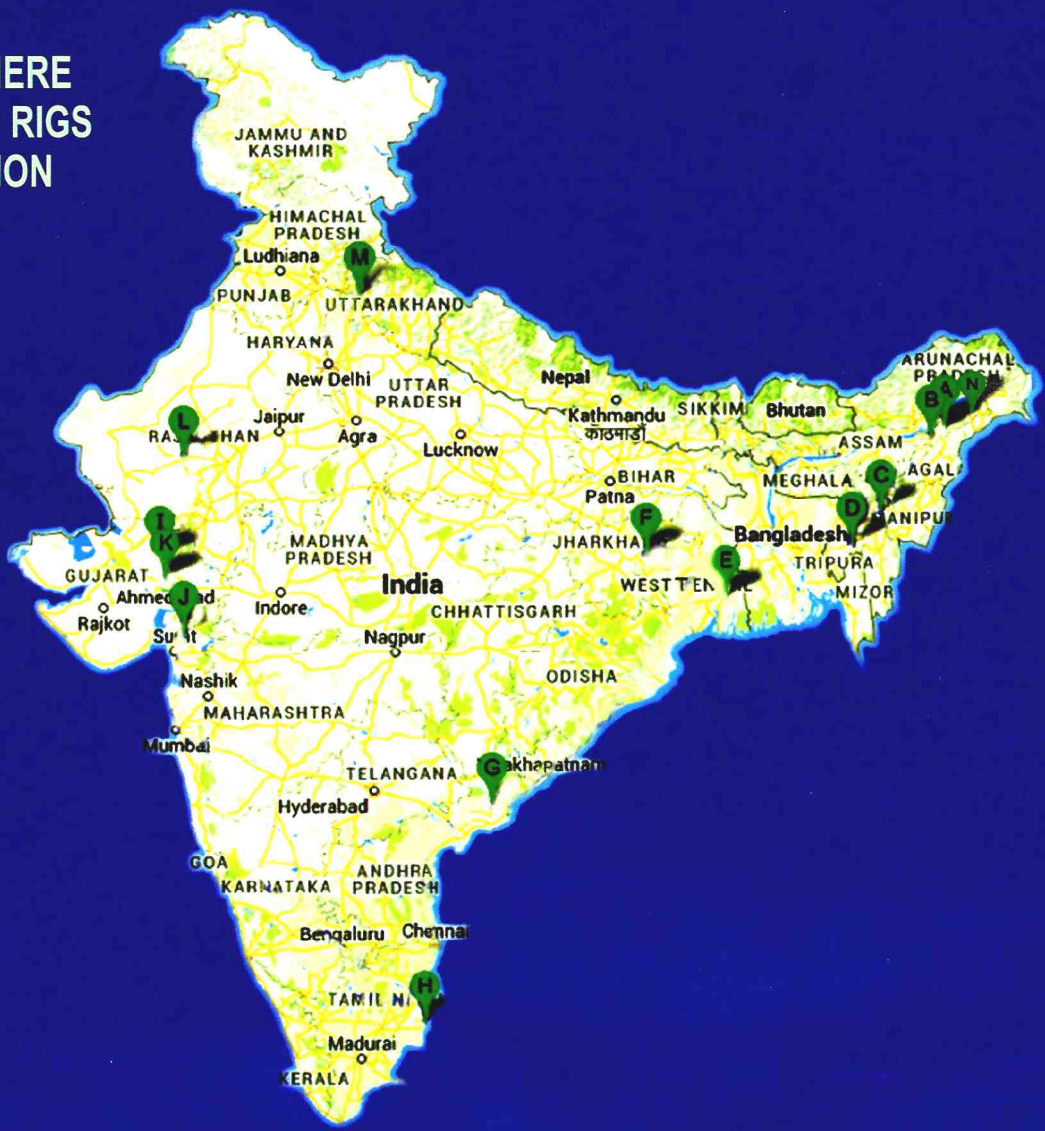
Providing sustainable business solutions in the fields of Energy, Industry & Infrastructure

VALUES

GOVERNANCE	:	We are stewards of our shareholders' investment and we take that responsibility very seriously. We are accountable and responsible for delivering superior result that make a difference in the lives of the people we touch.
RESPECT	:	We value the unique contribution of each individual. We believe in respect for human dignity and we respect the need to preserve the environment around us.
EXCELLENCE	:	We are committed to deliver and demonstrate excellence in whatever we do.
LOYALTY	:	We are loyal to our customers. To our company and to each other.
INTEGRITY	:	We work with highest ethical standards and demonstrate a behavior that is honest, decent and fair. We are dedicated to the highest levels of personal and institutional integrity.
COMMITMENT	:	We set high performance standards for ourselves as individuals and our teams. We honour our commitments in a timely manner.
INNOVATION	:	We constantly support development of newer technologies, product, improved processes, better service and management practices.
TEAM WORK	:	We work together as a team to provide best solution & service to our customers. Through quality relationships with all stakeholders we deliver value to our customers.

LOCATIONS WHERE BHEL SUPPLIED RIGS ARE IN OPERATION

- A Sivsagar
- B Jorhat
- C Silchar
- D Tripura
- E Kolkata
- F Bokaro
- G Rajahmundry
- H Karaikal
- I Mehsana
- J Ankleswar
- K Ahmedabad
- L Jodhpur
- M Dehradun
- N Duliajan



FOR ANY ENQUIRY ,PLEASE CONTACT :

ADDITIONAL GENERAL MANAGER (COMMERCIAL)
OIL RIGS, BHEL, HYDERABAD
E-MAIL: krisbadur-h@bhelhyd.co.in, Ph: 040-23183414

SENIOR ENGINEER (COMMERCIAL)
OIL RIGS, BHEL, HYDERABAD
E-MAIL: psranjan@bhelhyd.co.in, Ph: 040-23182487

ENGINEER (COMMERCIAL)
OIL RIGS, BHEL, HYDERABAD
E-MAIL: akashmultani@bhelhyd.co.in, Ph: 040-23182487

ADDITIONAL GENERAL MANAGER (IPM)
INDUSTRY SECTOR- BHEL, NEW DELHI
E-MAIL: ksrao@bhel.in, Phone: 011-41793241

DEPUTY GENERAL MANAGER (IPM)
INDUSTRY SECTOR – BHEL, NEW DELHI
E-MAIL: ranjank@bhel.in, Ph: 011-41793285

भारत हेवी इलेक्ट्रिकल्स लिमिटेड

BHARAT HEAVY ELECTRICALS LIMITED

REGD. OFFICE: BHEL HOUSE, SIRI FORT, NEW DELHI-110 049, INDIA
WEBSITE : WWW.BHEL.COM

OIL FIELD EQUIPMENT

BHEL Trichy is a pioneer in manufacture of Oil Field Equipment in India. Beginning from 1980 onwards, it has made significant inroads into Design, Manufacture, Testing and supply of various equipment utilised for drilling and production of oil and gas. The equipment are manufactured to the requirement of API 6A which is a globally accepted standard for such products. Also Pipeline valves to suit the requirements of API-6D has been manufactured and supplied to Oil Majors such as M/s Oil and Natural Gas Corporation (ONGC) and M/s Oil India Limited (OIL). Prestigious API 6A and API 6D Monograms have been obtained and sustained all through the years not only for Manufacture, but also for Repair and Remanufacture of used Oil Field Equipment.

WELLHEAD AND CHRISTMAS TREES

Well head and Xmas tree (XMT) are the primary pressure controlling equipment available in any Oil well. The Well head is an assembly of Casing head at the bottom, one or more Casing spools and a Tubing spool. They are stacked one over the other and serve to suspend and seal a casing string. The Concentric Casings used in wells to seal off the borehole are suspended using Hangers. The two types of hanger designs available are of Slip type and Mandrel type. The slip type supports a casing string in a casing head by gripping the pipe with wedge type members. The Mandrel type hanger supports the casing by means of a male or female thread.

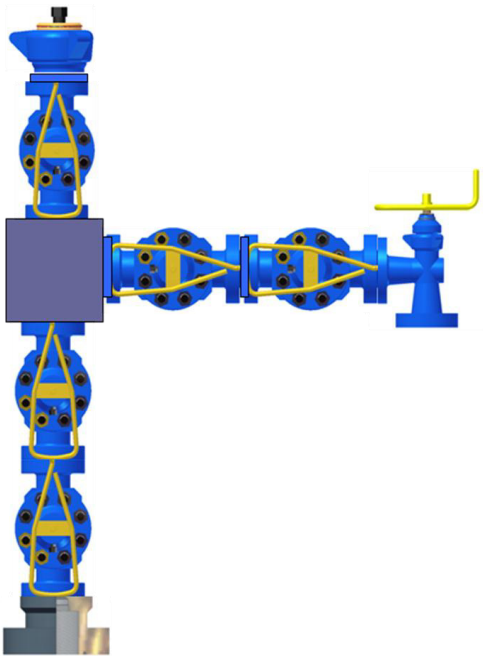
Oil and gas from the well flows through the tubing and the Christmas Tree Assembly. The Tubing Spool is used to suspend the tubing and to seal the annular space between the tubing and casing. The tubing spool is connected to the Christmas tree assembly through Tubing head adaptor or a bonnet. Wellhead designs are for various pressure and temperature rating, and are available to suit Two casing, Three casing, Four casing, Single

and multi-string configurations.

The Christmas Tree assembly is an assembly of special Full bore Valves and fittings attached to the top of Tubing Spool and is used to control well (oil) production. These valves are of Full bore design, that ensures Maximum unobstructed flow and the pressure drop through the valve is almost negligible, as that of a straight pipe. Also the flow path is a through bore, without obstructions, to enable free passage of well activating devices and process instrumentation through the valve. These valves may be manually operated or remote operation through actuators is also possible. The first valve that controls the fluid is the Lower master valve. Then fluid flows through Upper master valve and then the Wing valves. The valve installed at the top of the XMT is the Crown valve. The Choke is used to restrict and control flow rates from the well. This is achieved by means of Positive or Adjustable chokes. At appropriate locations of the Well head and XMT, Gage and test port provisions are made for Internal pressure measurement and to test sealing mechanism.

PRODUCT PROFILE

Oil Field Equipment presently in the range and scope of BHEL Product profile includes the following :



- Wellhead Equipment covering 3000psi, 5000psi, 10,000psi pressure rating with Two Casing, three Casing and four Casing Single andmulti-string configurations.
- Christmas trees suitable for 3000 psi, 5000 psi and 10,000 psi Single string and multi-string for sizes 2-1/16” to 3-1/8 inch.
- Valves and chokes including Single and Multiple completion valves, Actuated valves, chokes

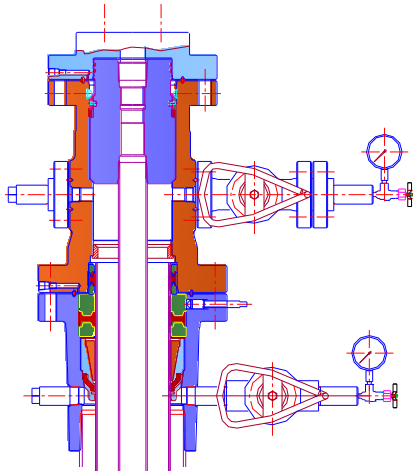
etc. for sizes 1-13/16 inch thru' 5-1/8 inch
for pressure rating 2000 psi to 10,000 psi.

- Choke and Kill Manifold for Pressure rating 5000 psi and 10,000 psi of sizes 3", 4" or as per customer's requirement.
- Mud valves for pressure rating from 2000 to 5000 psi. Sizes 2", 3" and 4".
- Connectors and Fittings covering Tubing head adaptors,Tees and Crosses,Adaptor and spacer spools, Loose connectors covering Weldneck connectors,Blind connectors, threaded connectors, etc.

PRODUCT FEATURES

WellHead and Xmas Trees :

- Casing Heads and Spools have full opening through bores meeting dimensional requirements of API.
- Controlled makeup Casing hangers permit maximumcasing string loads



Pressure actuated packing design enables sealing even at low pressure differentials.

- A complete line of tubing hangers is available to give a wide selection of completion choices.
- A wide range of Positive and Adjustable chokes with various seat and stem options.
- Quick Union connection feature in Cap and chokes enable easy
- Installation / dismantling in the event of Flow beans change or sending instruments.

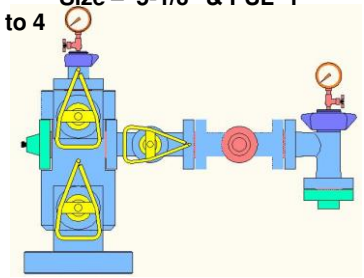
Full Bore Gate Valves :

- Precision ground tapered roller bearing ensures smooth and easy operation.
- Full bore design enables minimum pressure drop.
- Free floating seats maintaines a tight seal.
- Uniform load distribution enables reduced operating Torque.
- Bidirectional sealing permits Flow in either direction.
- Available in a variety of trim designations to suit various service conditions.

Oil Field Equipment–products

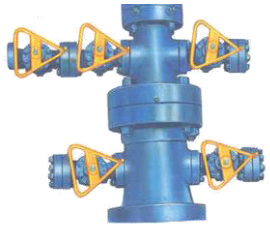
Y Block X Mas Tree

- **Pressure Rating 5000 psi**
- **Size – 5-1/8” & PSL 1 to 4**



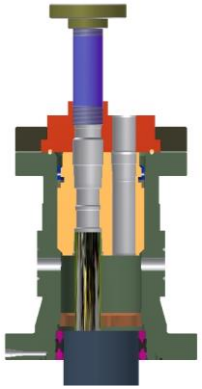
- Mono Block X Mas Tree
- **Pr. Rating 5000,10000 psi**
- **Size – 3-1/8”,4-1/16” and 5-1/8”**
- **PSL – 1 to 4**

- DUAL Block X Mas Tree
  - **Pressure Rating 5000,10000 psi**
  - **Size – 2-9/16”,3-1/8”,PSL – 1 to 4**

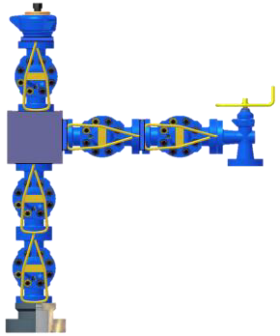


- Well head
- High temperature AND PRESSURE 10000 psi and 15000 psi
- MATERIAL CLASS AA-HH

Positive Choke
Pressure Rating 5000,10000 psi
Size 5-1/8”
Orifice Size 2”



ESP HANGER ARRANGEMENT
Pressure Rating 5000,10000 psi
Size 7-1/16” and 11”

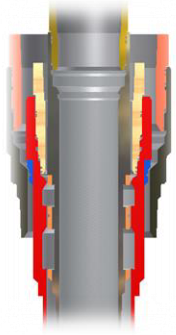


- X-mas tree
- High temperature AND PRESSURE 10000 psi and 15000 psi

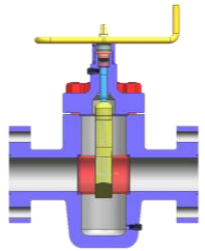
Material Class – AA - HH

Adjustable Choke

- **Pressure Rating 5000,10000 psi**
- **Size 3-1/8”, 4-1/16”**



- Mudline Suspension System
  - **Pressure Rating 10000 psi**
  - **Size 20”/18-5/8”,13-3/8” and 9-5/8”**



FULL BORE GATE VALVE
Pressure Rating 10000,15000 psi
Size 4 1/16”, 5 1/8” for material Class HH

HYDRAULIC FULL BORE GATE VALVE

- ✓ **PRESSURE RATING 2000,3000,5000,10000,15000 PSI**
- ✓ **SIZE 2 1/16”, 3 1/8”, 4 1/16”, 5 1/8”**

- Choke and kill manifold
  - **Pressure Rating 5000 and 10000 psi**
  - **Size 2-1/16”,3-1/8”**

BHEL PRODUCT PROFILE

PRODUCT PROFILE

INDIAN ENGINEERING GLOBAL ENTERPRISE

ENGINEERING SUSTAINABLE SOLUTIONS

ABOUT US

With a golden legacy of 50 illustrious years on its side, BHEL is one of the largest engineering and manufacturing companies of its kind in India, engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products, services and systems for core sectors of the economy, viz. Power Generation, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas, Water, Defence & Aerospace, and e-Mobility & Energy Storage Solutions with over 180 product offerings to meet the needs of these sectors. The establishment of BHEL in 1964 was with a mandate to achieve self-sufficiency in indigenous manufacture of heavy electrical equipment which has been duly accomplished.

BHEL, as a part of Pt. Jawaharlal Nehru's vision, was bestowed with the onus to make the country self-reliant in manufacture of heavy electrical equipment. This dream has been more than realised and the company's contribution to nation building endeavour is going to continue likewise. BHEL's mammoth size of operations is evident from its widespread network of 17 Manufacturing Units, 2 Repair Units, 4 Regional Offices, 8 Service Centres, 1 Subsidiary, 3 Overseas Offices, 5 Joint Ventures, 15 Regional Marketing Centres and more than 150 project sites across India and abroad. The total installed capacity base of BHEL-supplied equipment of 180 GW globally, speaks volumes about the contribution made by BHEL in the power sector.

BHEL has been adept at transforming itself in line with market requirements throughout its illustrious journey. Right from its incorporation in a protected market, to facing the pressures of a liberalized economy, including periods of slowdown in the economic environment, BHEL has evolved by transforming its strategies from product manufacturing to market orientation, achieving business excellence through portfolio restructuring and the current focus on sustaining growth through diversification.

Diversification in transportation, transmission, defence, water, renewables and e-mobility & energy storage solutions is the strategy adopted to maintain a balanced portfolio of offerings. This strategy of diversifying and capitalizing on new business opportunities stems from the commitment to innovation-led growth which is an indispensable part of BHEL's business model. The diverse R&D focus of the organization ranges from Advanced Ultra Supercritical thermal power plants to superconducting applications for electrical equipment. BHEL is one of the highest spenders on R&D in the Indian engineering field and has been consistently spending more than 2.5% of its turnover on R&D and innovation.

BHEL also has a widespread overseas footprint in over 82 countries with the cumulative overseas installed capacity of BHEL manufactured power plants at over 10,000 MW in Belarus, Bhutan, Egypt, Ethiopia, Indonesia, Kazakhstan, Libya, Malaysia, Nepal, New Caledonia, Oman, Rwanda, Sudan, Tajikistan, UAE and Vietnam.

The high level of quality & reliability of BHEL products and systems is an outcome of strict adherence to international standards through acquiring and adapting some of the best technologies from the world's leading OEM companies together with technologies developed in its own R&D centres. While all the manufacturing units and other entities of the company have been accredited to Quality Management Systems (ISO9001), major manufacturing units have also been accredited to Environmental Management Systems (ISO 14001) and Occupational Health & Safety Management Systems (OHSAS 18001).

PRODUCT PROFILE

THERMAL POWER PLANTS

- Capability for manufacture and supply of Steam Generators, Steam Turbines, Turbo Generators along with regenerative feed cycle up to 1000 MW capacities for fossil-fuel and combined-cycle applications.
- Air and water cooled Condensers, Condensate Extraction Pumps, Boiler Feed Pumps, Duplex Heaters, Valves and Heat Exchangers meeting above requirement of TG Sets up to 1000 MW.
- Energy Efficient Renovation and Modernisation (EE R&M) and Life Extension (LE) of old thermal power plants and Residual Life Assessment (RLA) studies.

NUCLEAR POWER PLANTS

- Engineering, manufacturing and supply of Reactor side components like Steam generator, Reactor header, End shield, special purpose Heat Exchangers, Pressure Vessels, Motors etc. for PHWR based Nuclear Power plants upto 700 MWe capacity.
- BHEL also provides complete solution to Secondary Side of Nuclear Power Projects and has capability to supply Turbines, Turbo Generators and Condensers, etc. for Nuclear Power Plants upto 700 MWe capacity.
- BHEL has the capability to design, manufacture and supply various components of both Reactor side and Secondary side for Nuclear Power Plant Projects upto 500MWe rating Fast Breeder Reactors (FBR)

GAS-BASED POWER PLANTS

- Gas turbines and matching generators ranging from 25 MW to 299 MW (ISO) rating tailored to meet specific needs with regard to plant layout, type of fuels, emission and noise requirements. The features of these machines include
- Capability to burn a variety of fuels, both gaseous and liquids.
- Mixed firing of many of these combinations of gases and liquids.
- Low exhaust emission levels upto 15ppm of NOx with Dry Low NOx (DLN) combustors.
- Gas turbine-based co-generation and combined-cycle systems for industry and utility applications.

HYDRO POWER PLANTS

- Custom-built conventional hydro turbines of Kaplan, Francis and Pelton types with matching generators, pump turbines with matching motor-generators upto 300 MW.
- Bulb turbine with matching generators up to 10 MW
- High capacity pumps along with matching motors for Lift Irrigation Schemes (up to 150 MW)
- Small hydro power plants 10- 25 MW unit rating capacity
- Electro Hydraulic Microprocessor based Digital Governor for conventional turbines
- Microprocessor based Digital Controller for lift irrigation schemes
- Static excitation systems for Hydro generators & motors
- Brushless exciter for Hydro generators & motors
- Renovation, Modernization and uprating of Hydro power plants
- Spherical (rotary) valves, butterfly valves and auxiliaries for hydro stations

SOLAR POWER PLANTS

- EPC solutions from Concept to Commissioning of Solar PV Power Plants:
- Grid Interactive systems with & without BESS (Battery Energy Storage System)
- Standalone systems
- Roof Top systems
- Hybrid systems
- Canal Top Systems
- Floating Solar power plants
- Solar based water pumping systems

DG POWER PLANTS

- HSD, LDO, FO, LSHS, natural gas based diesel generator power plants, unit rating of up to 20 MW and voltage up to 11 kV, for emergency, peaking as well as base load operations on turnkey basis.

DESALINATION AND WATER TREATMENT PLANTS

Complete Water Management Solutions for Power Plants, Industrial applications and Municipal Applications with different treatment technologies include: -

- Pre Treatment Plants (PT)
- Sea Water Reverse Osmosis (SWRO) Plants
- Demineralization (DM) Plants
- Membrane Based treatment for industrial applications
- Effluent Treatment Plants (ETP)
- Sewage Treatment Plants (STP) for Municipal applications
- Zero Liquid Discharge (ZLD) System

SYSTEMS AND SERVICES

- Power Generation Systems
  - Turnkey power stations/ EPC contracts.
  - Combined-cycle power plants.
  - Cogeneration systems.




- Captive power plants.
- Concept to Commissioning solutions for Solar Photovoltaic systems
- Modernization and renovation of power stations and RLA studies.
- Software packages including simulators for utilities.
- Erection, commissioning, support services, spares management and consultancy services for all the above systems.

INDUSTRIAL SYSTEMS

- Complete Coal Handling Plant and Ash Handling Plant including Civil & Structural, Mechanical, Electrical works and Automation systems
- Complete Mine Winder Systems
- Complete Electrics, Drives, Controls & Automation Systems for Processing & Compacting of Raw Materials, Iron Making, Primary & Secondary Steel Making, Casters & steel Finishing like Mills & process Lines for both long products & flat products
- Complete Raw Material Handling System including Civil & Structural, Mechanical, Electrical and Automation systems for Steel and other industries
- Complete Electrics & Automation Systems for High Current Rectifiers for Aluminium Smelters and Processing Mills for Aluminium Plants
- Automated Storage & Retrieval Systems (ASRS)
- Balance of Plant (BOP) for Hydro power plants

BOILERS

- Steam generators for utilities, ranging from 30 to 800 MW capacity, using coal, lignite, oil, natural gas or a combination of these fuels; capability to manufacture boilers with supercritical parameters up to 1000 MW unit size.
- Fuel Flexible boilers capable of all combination of blending / co-firing diverse qualities of imported/ indigenised coals, blending of lignite, petcoke, etc.
- Steam generators for industrial applications of the following types ranging from 40 to 450 T/Hour capacity, using coal, natural gas, industrial gases, biomass, lignite, oil, Bagasse or a combination thereof.
  - Pulverized coal / lignite fired boilers
  - Stoker fired boilers
  - Bubbling fluidized bed combustion (BFBC) boilers.
  - Circulating fluidized bed combustion (CFBC) boilers.
  - Heat-recovery steam generators (HRSG).
  - Chemical recovery boilers for paper industry, ranging from capacity of 100 to 1000 T/Day of dry solids.

BOILER AUXILIARIES

- Fans
  - Axial reaction fans of single stage and double stage for clean air application and dust laden hot gases applications up to 200°C, with capacity ranging from 40 to 1300m3/s and pressure ranging from 400 to 1,500 mmwc.
  - Axial impulse fans for both clean air and flue gas applications up to 200°C, with capacity ranging from 25 to 600m3/s and pressure up 300 to 700 mmwc
  - Single and double-suction radial fans (plate aerofoil bladed) for clean air and dust-laden hot gases applications up to 400°C, with capacity ranging from 4 to 660m3/s and pressure ranging from 200 to 3000 mmwc
- Air-Preheaters
  - Tubular Air Preheaters for industrial, utility boilers and CFBC boilers
  - Rotary regenerative Air-Preheaters for boilers of different types like Bisector, TriSector and QuadSector.
  - Large rotary regenerative Air-Preheaters for utilities of capacity up to 800 MW.
  - Air PreHeater for boilers with Selective Catalytic Reduction (SCR) for DeNox.
- Pulverizers
  - Bowl mills of slow and medium speed for coal fired thermal stations with capacity from 10 T / Hour to 120 T/ Hour catering to 60 MW to 1000 MW thermal power stations
  - Ball Tube mills for pulverizing low-grade coal with high ash content from 30 T/ Hour to 110 T/ Hour catering to 110 MW to 500 MW thermal power stations
  - Apart from strong presence in the Indian market for utility thermal power stations, BHEL also caters to the requirement of:
  - Steel Plants for Pulverised Coal Injection to Blast furnace
  - Cement Plants for coal pulverising
  - Fertilizers Plants for their captive power generation
- Electrostatic Precipitators (ESP)
  - Electrostatic precipitators of any capacity with outlet emission as low as 17 mg/Nm3 (efficiency up to 99.97%) for coal fired utility and industrial applications including Bio mass fired boilers, cement plants, steel plants, soda recovery boilers etc.
  - Bag Filters for Utility and Industrial applications.
  - Mechanical Dust Collector for SCR application
- Guillotine Gates & Dampers




- Guillotine gates with electric / pneumatic actuator. 100% leak proof with seal air.
- Bi-plane dampers with electric / pneumatic actuator. 100% leak proof with seal air.
- Louver dampers (Open close / Regulating) with electric / pneumatic actuator.
- Control dampers (Regulating) with electric / pneumatic actuator

➢ Flue gas desulphurization (FGD) systems
- Flue gas desulphurization (FGD) systems with sea water/ limestone slurry scrubber.
- Steel Chimneys for Heat Recovery Steam Generators (HRSG), Industrial Boilers, auxiliary boilers and other flue gas exhaust applications.

➢ Selective Catalytic Reduction (SCR) systems
- Ammonia Injection system
- Ceramic catalyst (Honeycomb & Plate type) for NOx emission control

➢ Selective Non- Catalytic Reduction (SNCR) systems
- Urea& Ammonia handling systems

SOOT BLOWERS

➢ Long retractable soot blowers (LRSB) for travel upto 12.2m
➢ Furnace temperature probe (FTP) for travel length 6.9m and 8.3m
➢ Long Retractable Non-rotating (LRNR) soot blowers with forward blowing for Air heaters
➢ Ash discharge valve for CFBC boiler application
➢ Soot blowers with integral starters
➢ Soot blower Sequential PLC control panel
➢ Rack type Long Retractable Soot blowers
➢ Wall blowers
➢ Rotary Soot blowers

VALVES

➢ High and Low-pressure Turbines Bypass Valves & hydraulic system for utilities and industrial application
➢ High and medium-pressure Valves, Cast and Forged Steel Valves of Gate, Globe, Non-Return (Swing-Check and Piston Lift-Check) types for steam, oil and gas duties up to 950 mm diameter, maximum pressure class 4500 (791 kg/cm2) and 650 °C temperature.
➢ Hot reheat and cold reheat Isolating Devices up to 900 mm pipe size class 1500 and steam of 650°C temperature.
➢ High capacity Spring Loaded Safety Valves for set pressure up to 372 kg/cm2 and temperature up to 630°C, and automatic electrically operated pressure relief valves for set pressure up to 210 kg/cm2 and temperature up to 593°C
➢ Safety relief valves for applications in power, process and other industries for set pressure up to 421 kg/cm2 and temperature up to 537° C.
➢ Reactive cum absorptive type vent Silencers maximum diameter of 2700 mm.
➢ Direct Water Level Gauges
➢ Angle Drain Valves - Single & Multi Stage for Turbine Drain Application
➢ Severe Service Control Valves for RH & SH Spray Lines
➢ Quick Closing Non return Valves for Extraction lines and Cold Reheat Non Return valves, up to 800mm diameter, 158 kg/cm2 pressure and 540°C temperature.

PIPING SYSTEMS

➢ Power cycle piping, Constant load Hangers, Variable spring Hangers, Hanger components, Low Pressure piping including Circulating Water Piping for power stations up to 1000 MW capacity including Super Critical sets
➢ Piping systems for Nuclear Power Stations, Combined Cycle Power Plants & Industrial boilers and for power plants in Process Industries

SEAMLESS STEEL TUBES

➢ Hot-finished and cold-drawn seamless steel tubes with a range varying from outer diameter of 19 to 133 mm and wall thickness of 2 to 14 mm, in carbon steel and low-alloy steels to suit ASTM/API and other international specifications including Rifled tubes and Spiral finned tubes.

STEAM TURBINES

➢ Steam Turbines of higher ratings upto 1000 MW for thermal Sets conforming to international Specifications.
➢ Steam turbines for 700MW, 500 MW & 236 MW with auxiliaries Nuclear Power Plants.

TURBOGENERATORS

➢ Turbogenerators of higher rating upto 1000 MW supercritical parameters.
➢ Turbogenerators for 270MW, 540 MW and 700 MW Nuclear Power Plants.

INDUSTRIAL SETS

➢ Steam Turbine based Captive Power Plants
- STG/Boilers/BTG/EPC: Unit rating upto 200 MW
- Non Reheat upto 120 MW unit rating
- Reheat upto 200 MW unit rating

➢ Gas Turbine based Captive Power Plants
- GTG/HRSG/EPC: Fr-5 (26 MW) to Fr-9E (126 MW)
- Open, Cogen & Combined Cycle




INDIAN ENGINEERING
GLOBAL ENTERPRISE
ENGINEERING SUSTAINABLE SOLUTIONS

CASTINGS AND FORGINGS

- Sophisticated heavy castings and forgings of creep resistant alloy steels, stainless steel and other grades of alloy steels meeting stringent international specifications for components of sub critical, supercritical and Ultra-super critical technology.

CONDENSER AND HEAT EXCHANGERS

- Surface Condenser:
  - 236 MW, 500 MW & 700 MW for Nuclear power plants
  - 12.5 MW Marine applications
  - Industrial Condensers
- Feed Water Heaters (HP Heaters, LP Heaters, Drain Coolers, Duplex Heater, De-Super Heaters, etc.)
  - Thermal : 7 to 500 MW (sub-critical) & 300-800 MW (super critical with single stream)
  - Nuclear 236 MW, 500 MW and 700 MW rating
- Moisture Separator & Reheater (MSR):
  - 236 MW, 500 MW & 700 MW Nuclear sets
  - Live Steam Reheater (LSR):
  - 500 MW FBR Nuclear sets
- Auxiliary Heat Exchangers for Turbo and Hydro Generators :
  - Air Coolers (Frame & Tube Type)
  - Oil Coolers (Shell & Tube Type and Plug In Type)
  - Hydrogen Coolers (Frame & Tube Type)
- Auxiliary Heat Exchangers for Transformers :
  - Oil Coolers (Shell & Tube Type Single Tube or Concentric Double Tube Type) (Frame & Tube Type)
- Auxiliary Heat Exchangers for General Application
  - Water - Water Coolers (Shell & Tube Type)
- Industrial Heat Exchangers for Cement, Sugar, Refineries, Petro-Chemicals & Fertilizers industries.
- Flash Tanks for thermal & nuclear sets
- Service Tanks, Storage Tanks & Pressure vessels for Thermal, Nuclear sets of all ratings & industrial applications
- CS/SS/Non-ferrous shell and tube heat exchangers and pressure vessels
  (For all applications irrespective of rating)
- Air-cooled heat exchangers for GTG uptoFr-9E, and Compressor applications of all ratings
- Steam jet air ejectors for all condensers upto 150 MW
- Deaerators from 7 MW to 800 MW
- Gland steam condensers 7 MW to 150 MW
- Gas coolers for all possible compressor applications
- Oil coolers- STG upto 150 MW, GTG uptoFr-9E,
- Generator Air coolers upto 150 MW STG and GTG up to 9 FA

PUMPS

- Pumps for various utility power plant applications up to a capacity of 1000 MW:
  - Boiler feed pumps (motor or steam turbine driven) and Boiler feed booster pumps.
  - Condensate extraction pumps.
  - Circulating water pumps (also known as Cooling water Pumps)

COMPRESSORS

- Multi stage Centrifugal compressors along with auxiliary system for various applications are manufactured and supplied with following configuration & parameters
  - Model –
  - Horizontally split type up to 40 bar design pressure
  - Vertically split type up to 350 bar design pressure
  - Capacity – 300000 m3/hr
  - Gas – Air, CO2, N2, H2, NH3, Natural Gas, Wet Gas, Propylene etc.,
  - Sealing system – Dry Gas Seal
  - Industry – Refineries, Fertilizers, Oil & Gas, Steel, Power and Natural Gas Transportation.
  - International standard – API 617
  - Testing capability – MRT, Performance test, Full load, full pressure full speed test, Complete Unit Test
  - Driver – Steam Turbine, Gas Turbine, Motor

SOLAR PHOTOVOLTAICS

- Mono/ Multi Crystalline Solar Cells (156 mm)
- Mono/ Multi Crystalline PV Modules (upto 330 Wp)
- Power Conditioning Unit (upto 1.25 MW)
- SCADA (Supervisory Control and Data Acquisition)
- Switchgear panels (all kV ratings)
- Power Transformers (15 MVA and above)
- Passive Solar Tracking System
- Space grade solar panels
- Space grade Batteries

AUTOMATION AND CONTROL SYSTEMS

- Steam Generator/ Boiler Controls including Boiler Protection
- Steam Turbine Controls
- Boiler Feed Pump (BFP) Drive Turbine Control
- Station Control and Instrumentation/ DCS
- Offsite/Off base controls/ Balance of Plant Controls
  - Ash Handling Plant (AHP)
  - Coal Handling Plant(CHP)
  - Water System for power plant
  - Mill Reject System (MRS)




- Condensate On-Load Tube Cleaning system (COLTCS)
- Gas Booster Compressor (GBC)
- Condensate Polishing Unit (CPU)
- Heating, Ventilation & Air conditioning (HVAC)
- Fuel Oil Unloading System (FOUS)

- Hydro Power Plant Control System
- Gas Turbine Control System
- Nuclear Power Plant Turbine & Secondary Cycle control system
- Nuclear Power Plant Primary Cycle Control Centre Instrumentation Package(CCIP)
- Power block of solar thermal power plant
- Industrial Automation
- Sub-Station Automation (SAS) and Supervisory Control & data Acquisition System (SCADA) for Substation & PV Plants
- Non-FST HVDC control panels
- Electrical Control System (ECS) for Refineries
- Energy Management System (EMS) for Power Plant
- Electrical Interface System for MV/LV Switchgear

POWER ELECTRONICS

- Excitation system
- AC Drive System
- Static Starters
- Induction Heating Equipment

TRANSMISSION SYSTEMS CONTROL

- EHV & UHV Sub-stations/switchyards both AIS & GIS type ranging from 33kV to 765kV.
- HVDC transmission systems.
- Flexible AC Transmission system (FACTS) solutions
  - Fixed Series Compensation(FSC)
  - Static VAR Compensation (SVC)
  - STATCOM
  - Controlled Shunt Reactor (CSR)
  - Phase Shifting Transformer (PST)
- Power system studies, Feasibility studies & Insulation Coordination
- Converter Valves and controls for HVDC & FACTS.

POWER SEMICONDUCTOR DEVICES

- Diodes- Ranging from 1400-4400V/250-2000A
- Thyristors- Ranging from 1400-7000V/150-4950A
- Rotating Diodes for Turbo generators.

SOFTWARE SYSTEM SOLUTION

- Merit Order rating
- Performance Analysis, Diagnostics & Optimization (PADO) for Thermal Utilities
- Performance Calculation & Optimization system
- OPC connectivity from DCS to third party systems
- Enterprise Asset Management System (EAMS)
- Enterprise Resource Planning (ERP)
- Operator Training Simulator
- Power House intranet software
- Alarm Analysis system
- Real Time Performance Data Monitoring system
- Historical Replay System

SWITCHGEAR

Medium Voltage Vacuum Switchgear of various types for indoor and outdoor applications for voltage ratings up to 36 kV and Gas insulated switchgears (36 KV, 145 kV, 420kV)

- Indoor switchgears up to 12 kV, 50 kA, 4000 Amp for thermal, nuclear, hydro and combined cycle Power Plant Projects
- Indoor switchgears up to 36 kV, 40 kA, 2500 Amp for Industries, solar power plants and refineries
- Indoor Compact switchgear 12 kV, 25 kA,1250 Amp for distribution system
- Outdoor Vacuum circuit breakers (12 kV, 25 kA, 1250 Amp / 36 kV, 25 kA , 2000 Amp / 25 kV, 25 kA, 1600 Amp) for distribution network/ track side railway application
- Outdoor pole mounted 12 kV Autorecloser / sectionaliser / capacitor switch for rural segment
- Gas insulated switchgears (36 kV, 40kA, 2500 Amp/ 145 kV, 40 kA, 2500 Amp/ 420kV,40kA, 3150 Amp) for transmission & distribution network, Refineries / hydro station / metro.
- SF6 circuit breakers ((145kV, 40 kA,3150A), (420 kV, 50kA,4000A))

BUS DUCTS

- Bus-ducts with associated equipment to suit generator power output of utilities of up to 800 MW capacity.

TRANSFORMERS & REACTORS

- Power transformers for voltage upto 1200 kV
  - Generator transformers (up to 500 MVA, 400 kV, 3 Ph / 400 MVA, 765 kV, 1 Ph/400 MVA, 400 kV, 1 Ph)
  - Auto transformers (up to 1000 MVA, 400 kV, 3 Ph / 600 MVA, 400 kV, 1 Ph / 1000 MVA, 765 kV, 1 Ph / 1000 MVA, 1200 kV, 1 Ph)
- Converter Transformers / Smoothing Reactors (up to 600 MVA , ±800 kV) / (up to 254 MVAr, ± 500 kV) for power station
- Shunt Reactors (up to 150 MVAr, 420 kV, 3 Ph / 110 MVAr, 765 kV, 1 Ph)
- Controlled Shunt Reactors for EHV applications.




- Phase Shifting Transformers (up to 500 MVA, 400 kV, 3 Ph; Up to 500 MVA 420 kV 1 Ph, PST (1500 MVA Bank in 3 Ph) for transmission lines
- Instrument transformers
  - Current transformers upto 400 kV
  - Electro-magnetic voltage transformers upto 220 kV
  - Capacitor voltage transformers (33KV to 1200 kV)
- Special Transformers
  - Rectifier transformer (Upto 120 kA, 132 kV)
  - Furnace transformer (Upto 33 kV, 60 MVA)
- ESP transformers up to 95 kvp, 1600 mA
- Smoothing reactors upto 3.3 mH , 2700 Amp.
- Dry Type reactor upto 300 mH , 120 Amp.
- DC Choke upto 0.5 mH , 4600 Amp.
- Dry type transformers up to 15 MVA 33 kV.
- Composite Monitoring System for Power Transformers

CAPACITORS

- H.T. Capacitors for Power factor correction (Motor Capacitors) 3.3 to 11 kV delta connected Capacitor banks
- H.T. Capacitors for Shunt, Series & SVC (Static VAR compensation), Harmonic filter & HVDC applications (3.3 kV to 500 kV, 1 Ph/ 3 Ph capacitor banks of rating 0.5 MVAr to 250 MVAr)
- Capacitor Divider for CVT
- Coupling Capacitor for PLCC
- Surge Capacitor for protection of Generators & Transformers (11kV to 40 kV)
- Roof Capacitor for traction locomotive
  - Capacitor Divider for CVT up to 1200 kV
  - Coupling Capacitor for PLCC upto 400kV

BUSHINGS

- 52 to 400 kV OIP condenser bushings for transformer applications
- 25 kV Locomotive bushings
- Special application bushings like Oil cable box, wall bushing, higher creepage, high cantilever load, High altitude bushing

ON LOAD TAP CHANGERS (OLTC)

On Load Tap Changer for various application like Power Transformer, Furnace Transformer, Station Transformer, Rectifier Transformer etc.

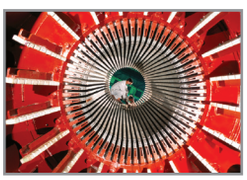
- On Load Tap Changer up to 765 kV class Transformer
- Off Circuit Tap Switch up to 765 kV class Transformer

CONTROL GEAR

- Industrial Control Gear
  - Electronic controllers for industries/ power plants
  - Digital Excitation control system (1000 A , 400 V DC/, 400 V DC with redundant thyristor stacks & DC field breaker)
  - Large current rectifiers with PLC Based digital controls
  - Digital Hydraulic/ compact Governors
  - Digital AVR (1 Ph, 300 V DC/ 3 Ph, 400 V DC)
  - Control panels and cubicles for applications in steel, aluminium, cement, paper, rubber, mining, sugar and petrochemical industries
- Contactors
  - LT air break type AC for voltages up to 660 V
  - LT air break type DC contactors for voltages up to 600 V
  - HT vacuum type AC for voltages up to 11kV
- Control and Relay Panels
  - Control & Protection Panels (up to 400 kV) For EHV Transmission projects
  - Synchronizing Trolley / Swing Panels
  - Protection panels for large Generators up to 800 MW for thermal, nuclear, hydro and combined cycle Power Plant Projects
  - Remote Control and relay panels for MV Switchgear
  - Turbine gauge panels for hydro sets
  - Outdoor type control panels and marshalling kiosks
  - Remote Transformer Tap-Changer Control panels
  - LT Switchgear, SCAP, Thyristor, RAPCON and STATCON Panels.

INSULATORS

- Porcelain Insulators
  - High-tension Porcelain Disc insulators for AC/ DC applications, ranging from 70kN to 420 kN electro-mechanical strength, for clean and polluted atmospheres, Suitable for application upto 1200kV AC & ±800kV HVDC transmission line & Sub-stations.
  - Hollow porcelains up to 765 kV for Transformers & SF6 circuit breakers.
  - Solid core insulators up to 400 kV for Bus Post & Isolators for substation applications.
- Composite Insulators
  - For 25 kV Railway Traction.
  - Long Rod insulator up to 765 kV for transmission lines.
  - Hollow Insulators upto 765 kV for Instrument Transformers.




- Wear Resistant Material (CERALIN)
  - Ceramic Liners for Wear Resistant Application in Thermal Power Station and other various applications.
  - Ceramic Liners for Ash Slurry Application.

INDUSTRIAL AND SPECIAL CERAMICS

- EWLI –Electronic Water Level Indicators used in Boiler Drum Water Level Monitoring (BHELVISION system)
- Ceramic and Tungsten Carbide Flow Beans for Christmas tree valves.
- Grinding Media for Pulverizing in Thermal Power Plant.

ELECTRICAL MACHINES

AC Squirrel cage, Slip ring, Synchronous, Variable speed motors; Industrial Alternators and Motors for Hazardous areas are manufactured as per range summarized below. Special-purpose machines are manufactured on request.

  - Voltage - AC - 415 V to 13800 V
  - Frequency - 50 Hz & 60 Hz
  - Enclosure - SPDP, TETV, TEFC, CACW, CACA & Duct Ventilated
- AC Machines for Safe Area Application
  - Induction Motors
  - Squirrel cage motors -150 kW to 22000 kW
  - Slip ring motors - 150 kW to 10000 kW
  - Synchronous motors- 1000 kW to 25000 kW
  - Variable speed Motors 150 kW to 22000 kW (Squirrel cage motors)
  - Variable speed Motors 1000 kW to 25000 kW (Synchronous motors)
- AC Machines for Hazardous Area Application (Fixed speed or with VFD)
  - Flame-proof squirrel cage Induction motors (Ex 'd') (150 kW to 1500 kW)
  - Non-sparking squirrel cage Induction motors (Ex 'n') (150 kW to 4000 kW (higher ratings on request))
  - Increased safety squirrel cage Induction motors (Ex 'e') (150 kW to 4000 kW (higher ratings on request))
  - Pressurized motors (Ex 'p') 150 kW to 22000 kW (Squirrel cage motors)
  - Pressurized motors (Ex 'p') 1000 kW to 25000 kW (Synchronous motors)
- Mill Duty Motors (150 kW to 5000 kW with speed base speed > 150 rpm) for steel mills.
- Industrial Alternators (Steam turbine, Gas turbine and Diesel engine driven) (1500 kVA to 25000 kVA)
- Induction Generators (300 kVA to 6000 kVA) for mini/ micro HEP.
- 2 Pole Gas Turbine driven Generators up to 330 MW and matching Exciters.
- 4 Pole Gas Turbine driven Generators up to 60 MW and matching Exciters.
- 2 Pole Steam Turbine driven Generators up to 330 MW and matching Exciters.
- 4 Pole Steam Turbine driven Generators up to 60 MW and matching Exciters.
- Permanent Magnet Based Generators up to 5 MW.
- Gas Turbine generators up to 270MW.

RAIL TRANSPORATION

- Transportation Systems
  - AC electric locomotives (upto 5000 HP, 25 kV AC)
  - AC-DC dual voltage electric locomotives
  - ACEMU Coaches
  - Metro Coaches
  - Urban Transportation Systems
  - Traction Propulsion Systems for:
    - → 6000 HP IGBT based AC Locomotives
    - → 25 kV 3-phase IGBT based AC Electrical Multiple Units (EMUs)
    - → Air-conditioned ACEMU
    - → 1600HP IGBT based AC/AC DEMU
    - → 25 kV 3-phase IGBT based MEMU
    - → 1600HP Multi-Genset Locomotive
  - Diesel-Electric Shunting Locomotives (upto 1400 HP)
  - Battery powered locomotive
  - OHE recording-cum-test car
  - Battery Powered Road Vehicles
  - Dynamic track stabilizers
  - Rail cum Road vehicle
  - Diesel Electric Tower Car
  - Utility vehicle

TRANSPORTATION EQUIPMENT

- Traction Converter
- Auxiliary Converter
- Vehicle Control Electronics
- Hotel Load Converter
- Traction Transformer (upto 5400 kVA) for conventional locomotives & upto (7775 KVA) for 3 phase drive locomotives.
- Traction transformers (upto 1050 KVA) conventional AC EMU/ MEMUs & (upto 1578 kVA) for 3 phase EMU
- AC Traction Motors (upto 1200 kW) for Locomotives & EMUs
- DC Traction Motors (upto 630 kW) for Locomotives & EMUs
- AC Traction alternators (upto 3860 kW) for Locomotives & EMUs




- Traction generators up to 2000 kW
- Motor Generator sets (upto 25 kW) for auxiliary requirements
- Auxiliary generators and exciters (upto 50kW)
- Eddy current clutch
- DC blower motors (upto 50kW) for dynamic braking system
- Traction gears and pinions
- Wagon (Upto 28 axle, 296 Tonne)
- Control Gear equipment for conventional Rolling Stock
- Control cubicles
- Traction Rectifiers
- Bogie Frame
- Wheel & Axle Assembly

DEFENCE AND AEROSPACE

- Super Rapid Gun Mount (SRGM) 76/62 gun for naval ships
- Integrated Platform Management system (IPMS) for naval ships
- Integrated Bridge System (IBS)
- Static Main Motor Generator (SMMG)
- Training Simulator for Vehicles, platforms, radars, weapons, missiles and Computer Based Training (CBT) for all defence and para-military forces
- Turret Casting for T-72 Tanks
- Casting and Forgings for ships
- Castings and Forgings for special application
- Compact Heat Exchangers for various aircraft platforms
- Fuel Tanks and other components for Launch Vehicles and Satellites.
- Steam Turbines for Strategic applications
- Permanent Magnet Frequency converters
- Reserve Propulsion motor drives
- Compact Brushless Alternators

E-MOBILITY & ENERGY STORAGE SYSTEM

- Electric Bus
- Powertrains for Electric Vehicles
- Charging Infrastructure for Electric Vehicles
- Grid Storage Solutions including Power conditioning unit (PCU) and SCADA

OIL FIELD EQUIPMENT

- Oil Rigs – On-shore drilling rigs with AC-VFD and AC-SCR technology for drilling up to depths of 9,000 metres, work-over rigs for servicing up to depths of 6,100 metres, mobile rigs for drilling up to depths of 3,000 metres, complete with matching draw-works and hoisting equipment including:
  - Mast and substructure
  - Rotating equipment : Draw works ; Rotary ; Swivels; Travelling Blocks
  - Independent Rotary drive unit
  - Mud System including pumps
  - Power packs and rig electrics
  - Rig instrumentation
  - Rig utilities and accessories
  - Refurbishment and up gradation of BHEL and Non BHEL make Oil Rigs
  - 3-phase Oil rig motor upto 1150 HP
  - DC Oil rig motors of all required ranges
  - Oil rig alternators of all required ranges
- Well heads and X-mas Trees up to 10,000 psi, Mud Line Suspension, Choke and Kill manifold, CBM Wellheads, DSPM H- Manifold Assembly, Mud valves, ESP hangers, Block type X-mas Trees & Landing Bases for Casing Heads.
- Oil Rig Controls
  - AC Power Control Room
  - DC Power Control Room
  - AC Power Pack upto 1430 kVA for DG sets
    - → AC Control Module
    - → DC Control Module
  - Driller's Console
  - Cable set, cable trays, cable box and crew room for oil rigs.
  - Mobile lightening Tower, Rig Lightening Tower
  - DG set for Oil rig application (63/ 250/ 380/500 KVA)
  - STATCOM for power Factor improvement in AC SCR Rigs

FABRICATED EQUIPMENT AND MECHANICAL PACKAGES

- Air separation Units for extraction of Nitrogen, Oxygen, Argon, etc.
- Cryogenic systems for liquid Nitrogen, Oxygen, Argon, etc.
- Cryogenic storage tanks, Mounded storage systems and storage spheres
- Column and Reactors for Petrochemical plants
- Pressure Vessels, Shell and Tube type and Air Fin Type Heat Exchangers
- Fired Heaters
- Purge Gas Recovery Unit for Fertilizer Industry




For enquiries and further information:

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BHEL

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Corporate Identity Number: L74899DL1964GOI004281

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