

Global Expression of Interest
For
Engaging Organizations / Companies
As
Consortium Partner
In
Downstream Oil and Gas Sector

Ref no: BHEL- HPVP / 2020-01

Issued by:

Bharat Heavy Electricals Limited, having registered office at
BHEL House, Siri Fort New Delhi-110049 and

Also office at

BHEL HPVP, Visakhapatnam-500032
(hereinafter referred to as 'BHEL')
INDIA

DISCLAIMER

All information contained in this EOI provided / clarified are in good interest and faith. The information contained in this Expression of Interest document or subsequently provided to Applicant(s), whether verbally or in documentary or any other form, by or on behalf of BHEL, is provided on the terms and conditions set out in this EOI and such other terms and conditions subject to which such information is provided.

The purpose of this EOI is to provide interested parties with information that may be useful to them in the formulation of their application for qualification and subsequent selection pursuant to this EOI. This EOI is not an offer by BHEL to the prospective Applicant(s) or any other person. This EOI is neither intended nor shall it be construed as creating or requiring any ongoing or continuing relationship or commitment with any party or person. This is not an offer or invitation to enter into an agreement of any kind with any party.

Though adequate care has been taken in the preparation of this EOI document, the interested firms shall satisfy itself that the document is complete in all respects. The information is not intended to be exhaustive. Interested Agencies are required to make their own enquiries and assumptions wherever required. Intimation of discrepancy, if any, should be given to the specified office immediately. If no intimation is received by this office by the date mentioned in the document, it shall be deemed that the EOI document is complete in all respects and firms submitting their interest are satisfied with the EOI Document in all respects.

The issue of this EOI does not imply that BHEL is bound to select and shortlist Applicant(s) for next stage or to enter into any agreement(s) with any Applicant(s). BHEL reserves all right to reject any applications submitted in response to this EOI document at any stage without assigning any reasons thereof. BHEL also reserves the right to withhold or withdraw the process at any stage. Neither BHEL nor its employees and associates will have any liability any loss, expense or damage which may arise from or be incurred or suffered in connection with anything contained in this EOI document or any matter deemed to form part of this EOI document, the information and any other information supplied by or on behalf of BHEL. BHEL accepts no liability of any nature whether resulting from negligence or otherwise howsoever caused arising from reliance/use of any statements/information contained in this EOI by the Applicant. BHEL is not making any representation or warranty, express or implied, as to the accuracy or completeness of any information/statements made in this EOI.

The Applicant shall bear all its costs associated with or relating to the preparation and submission of its Application including but not limited to preparation, copying, postage, delivery fees, expenses associated with any demonstrations or presentations which may be required by BHEL or any other costs incurred in connection with or relating to its Application. All such costs and expenses will remain with the Applicant and BHEL shall not be liable in any manner whatsoever for the same or for any other costs or other expenses incurred by an Applicant in preparation or submission of the Application, regardless of the conduct or outcome of the EOI.

1.0 About Bharat Heavy Electricals Limited

Bharat Heavy Electricals Limited (BHEL) is a Central Public Sector Enterprise, wherein Government of India is holding 63.06% of its equity. It is an integrated power plant equipment manufacturer and one of the largest engineering and manufacturing companies of its kind in India having a turnover of about USD 5 billion. The company is engaged in the design, engineering, manufacture, construction, testing, commissioning and servicing of a wide range of products and services for the core sectors of the economy, viz. Power, Transmission, Industry, Transportation, Renewable Energy, Oil & Gas and Defence with over 180 product offerings to meet the needs of these sectors.

Since its inception in 1964, BHEL has been the solid bedrock of evolution of India's Heavy Electrical Equipment industry. BHEL has a mammoth 20,000 MW per annum capability for manufacturing of power generation equipment. A widespread network of 16 manufacturing units, 2 repair units, 4 regional offices, 8 service centers, 1 subsidiary, 4 overseas offices, 6 joint ventures, 15 regional marketing centers and current project execution at more than 150 project sites across India and abroad corroborates the humongous scale and size of its operations. BHEL has extensive stainless steel and aluminium fabrication facilities.

With key focus on project execution, the worldwide installed base of power generating equipment supplied by BHEL has exceeded 178 GW. BHEL's 54% share in India's total installed capacity and 58% share in the country's total generation from thermal utility sets (coal based) as of March 31, 2017 stand a testimony to its valuable contribution towards nation building. BHEL's global competitiveness has established its footprint in all the inhabited continents with references in 82 countries.

The high level of quality & reliability of BHEL products is a testimony to its adherence to international standards by acquiring and adapting some of the best technologies from leading companies in the world including General Electric, Siemens AG, Mitsubishi Heavy Industries Ltd. etc., together with technologies developed in its own R&D centers. BHEL invests more than 2.5% of turnover on R&D and innovation.

BHEL has been designing and manufacturing rolling stock for rail and urban transportation. BHEL has also been manufacturing Motors, Power electronics and Controllers for various transportation applications at its various factories. BHEL also has a Battery Packaging facility for space applications.

More details about the entire range of BHEL's products and operations of BHEL is attached as Annexure-1 and also can be obtained by visiting our web site www.bhel.com.

Heavy Plates & Vessels Plant [HPVP] , Visakhapatnam

After being a subsidiary of BHEL for five years, the erstwhile Bharat Heavy Plates & Vessels (BHPV) was merged with BHEL on 30.08.2013. The new name of BHPV after merger with BHEL is “Heavy Plates & Vessels Plant” (HPVP) which is 16th manufacturing unit of BHEL located at Visakhapatnam, Andhra Pradesh, India.

HPVP is engaged in design, engineering, procurement, manufacture, supply, erection, testing and commissioning of various sophisticated equipment and systems for core business sectors like Power, Refineries, Fertilizers, Petrochemicals, Steel Plants, Oil & Natural Gas etc.

HPVP’s product range includes Heat Recovery Steam Generators (Triple Pressure re-heat HRSGs), Coal/Oil/Gas fired power boilers up to 200MW eq., Aux. boilers, Deaerators, etc. in power business., Pressure Vessels, Columns, Fired Heaters, Heat Exchangers, Air Fin Coolers, LPG Bullets, LPG Spheres, LPG Mounded Bullets, Storage Tanks, Reactors in refinery business. Compact heat exchangers are also being supplied by BHEL HPVP as a premier product in aviation sector.

2. Intent of Expression of Interest (EOI):

India being one of the fastest growing economies in the world, offering a wide range of opportunities. Government of India envisions India as a key engine of global growth, and is putting in place various supporting initiatives to make India a US\$ 5 trillion economy. Downstream Oil & Gas Sector opportunities presents a lucrative business proposition for India in Refinery & Petrochemical Sectors. BHEL, which is one of the largest engineering enterprises in the country, would like to enter into this EPC business with their vast experience in engineering, procurement and construction of power plants in India and in abroad.

The upcoming opportunities in EPC of Oil & refinery downstream packages are expected approximately to be of 100 billion dollars in next 10 years. BHEL would like to tie-up with leading EPC players for addressing this huge opportunity in any of the following mode either on long term basis or on case to case basis.

- Joint Working
- Joint Bidding through Consortium Partners
- Joint Venture
- Technology transfer and business sharing

BHEL through its different manufacturing units have been supplying different equipment and packages in Oil and Gas industries. BHEL's Visakhapatnam manufacturing unit is supplying refinery products like Pressure vessels, columns, Fired heaters etc. to various refinery customers like ONGC, IOCL, HPCL, HRRL & BPCL either directly or through EPCC contractors like M/s Petrofac, L&T etc. BHEL is also enlisted with M/s EIL for products like columns & Pressure vessels heat exchangers, fin fan coolers and fired heaters. BHEL's other manufacturing units at Hyderabad and Bhopal are also supplying process gas compressors, heat exchangers, air coolers. As on date for some of the packages like compressors and fired heaters. BHEL is undertaking complete design, procurement, manufacturing, erection and commissioning of various equipment and systems.

It is observed that the BQC (bidder qualification criteria) of some of the refinery process plant enquiries allowing power plant experience for qualification as the prime bidder by engage engineering sub-contractor as is not having experience of residual process design in refinery process plant. BHEL in this kind of tenders are getting qualified.

For some of the critical refinery packages, the BQC is not allowing BHEL's power plant experience. However, BHEL is getting qualified as a member of the consortium partner. With BHEL's vast refinery product supply capability and its huge resources in construction management would like to engage with a lead partner as a member of consortium on case-to-case basis.

Through this EOI, BHEL intend to explore the possibility of identifying and short-listing of lead EPC bidder who will be fulfill the BQC requirement as prime bidder and willing to accept BHEL as their member of consortium partner with a mutually agreed scope split in supply and construction.

3. Area of partnership

BHEL is actively seeking for partnerships with a lead EPC partner who are also looking for a most experienced, technically suitable partner having good manufacturing, construction and execution experience.

BHEL is flexible to share the responsibilities with the lead consortium EPC partner and would like to support the lead bidder to achieve bigger tasks with a suitable partnership agreement. BHEL would like to tie up with the lead bidder on case to case basis by signing the consortium agreement with a clear scope matrix.

4. Bidder's Qualification Criteria:

Interested EPC partner to meet the following criteria

- I. The interested lead consortium partner should have successfully executed and completed One EPC/EPCC/ LSTK Contract with single point responsibility, involving "Project Management, Detailed Engineering, Procurement, Construction, Pre-commissioning and Commissioning/ Commissioning Assistance" for at least one new Process Unit in Hydrocarbon Sector (Refinery/Petrochemical Plant/On-shore Gas and/or Oil Facility / Off-Shore Gas and/or Oil Facility / LNG (Liquified Natural Gas) Facility), fertilizer sector or metallurgy sector.
- II. The above contract must have been commissioned within the last 10 years. Also such contract referred should have been in operation for at least 1 (one) year after commissioning.
- III. in EPC bidders meeting the above two criterion can furnish the additional information like their experience in refinery process plants like Hydrocracker Unit/OHCU (Once through Hydro-Cracker Unit), Diesel Hydro-Treating Unit, VGO Hydro-Treating Unit, Fertilizer Plant (Ammonia / Urea), CGO Hydro-Treating Unit, Wax hydrotreating, Hydro Finishing , Sulphur Recovery Unit , Hydro Cracker Unit/ Residue Hydrocracking Unit, Atmospheric Distillation and /or Vacuum Distillation Unit (AVU)/ Condensate Distillation Unit, Fluid Catalytic Cracking Unit/ RFCC (Residue Fluidized Catalytic Cracking) Unit/ Indmax Unit, Isomerization Unit (ISOM) • Naphtha Hydro-Treater / Continuous Catalytic Reforming Unit/ Catalytic Reforming Unit • Diesel Hydrosulphurization / Diesel Hydro-Treating Unit , Ethylene Cracker Unit • Delayed Coker Unit • VGO Hydro-Treating Unit • Hydrogen Unit • Naphtha Cracker Unit/ Gas Cracker Unit • Coker Gas Oil Hydro-treater Unit • Aromatic Complex (Comprising of Naphtha Hydro Treater/ Continuous Catalytic Reformer/ Isomerization/ Xylene Fractionation / Para-Xylene Recovery) • Polymer Unit: Polypropylene (PP) or High Density Polyethylene (HDPE) or Linear Low Density Polyethylene (LLDPE) /Swing • Purified Terephthalic Acid (PTA) Unit • Ethylene Glycol (EG) • Linear Alkyl Benzene (LAB) • Fertilizer Plant (Ammonia/Urea) • Onshore Oil or Gas processing Facility • Offshore Oil or Gas processing Facility • LNG facility.
- IV. EPC contractor having experience any other process plants not covered above can also indicate in their proposals.

- V. Annual Turnover, Net worth and commercial experience also to be indicated by the prospective EPC contractors.

6. Identification & shortlisting process for EPC lead partner

- I. The EOI process involves seeking willingness of interested parties who make an application in response to this EOI. At the end of this process, BHEL intends to invite interested Applicant(s) for further deliberations.
- II. Responses to EOI are to be submitted in English only.
- III. Notwithstanding anything contained in this EOI, BHEL reserves the right to accept or reject any Application and to annul the EOI Process in whole or part, at any time without any liability or any obligation for such acceptance, rejection or annulment, and without assigning any reasons thereof.
- IV. BHEL reserves the right to verify all statements, information and documents submitted by the Applicant in response to the EOI. Any such verification or lack of such verification by BHEL shall not relieve the Applicant of his obligations or liabilities hereunder nor will it affect any rights of BHEL.
- V. The EOI process shall be governed by, and construed in accordance with, the laws of India and the Courts at New Delhi shall have exclusive jurisdiction over all disputes arising under, pursuant to and/ or in connection with the EOI process.
- VI. All costs incurred for participation in the EOI shall be borne by the Applicant (s).
- VII.** Further information can be obtained at the address below during 9.00 to 16.30 hrs. local time. Bidders can also raise queries through email.

Mr. A.Madhusudan,
Sr. Manager / Marketing
Administrative Building, 1st floor,
BHEL, Visakhapatnam,
Hyderabad-530012
Andhrapradesh, India.
Tel: +91-0891- 6681239
Email :amadhu@bhel.in

7. Information to be submitted along with EOI

Interested parties are requested to submit their technical and financial credentials along with other relevant information in the form of documents listed below by Post/Email.

- i. Company Brochures
- ii. Profile of company indicating type of business and experience of EPC works covering projects, capacity, year of award and year of completion.
- iii. Annual turnover and balance sheet of company for last 5 years
- iv. Organization structure, key responsible persons, their experience in EPC work.
- v. Duly filled in EOI form. Annexure-A. Organizations / company to indicate the nature of EPC services.
- vi. Questionnaire (3 sheets) duly filled in
- vii. Specific tie-ups with any of the EPCCs/PMC/EPCMs if any.

The details submitted by the Applicant(s) shall be complete in all respects and BHEL may seek clarifications / additional information as considered necessary. Such clarifications/additional information must be provided within 7 days of BHEL request.

8. EOI information as called for in sl. No 7 shall be reached to BHEL address as indicated in sl. No 6 on or before 4th Aug 2020., 2.00 pm



EOI Form
[Annexure-A]

Firm's ref. No:

Date :

Subject: Response to EOI for Consortium Partner:: EPCC business in refinery.

In response to your EOI, we are pleased to submit the details of our firm as below

1.	Name of the firm						
2.	Name of the CEO						
3.	Address of firm where work is executed						
4.	Contact Details Mobile / Phone No & Email						
5.	Turnover and net worth in last 5 years						
	Financial year					Turnover	Net worth
6.	Details of project experience in last 10 years						
Sl. No.	Description of package, its capacity	Name of customer	Nature of Engineering work	Date of award	Contractual Date Of completion	Actual Date of completion	Completion certification

Any Other information:

(Sign & Company Seal)
Authorized Signature

Cpmapany Details

Sl.No	Description		
1	Name of company		
2	Date of Incorporation		
3	Name of CEO		
4	Postal address for communication		
5	Registered Address		
6	Contact Person Details		
	Name		
	Designation		
	Phone no		
	Email ID		
	Mobile No.		
7	Annual Turnover details	Financial year	Amount
	1		
	2		
	3		
8	Profit & Loss details	Financial year	Profit/Loss
	1		
	2		
	3		
9	Net worth as on last day of Preceding financial year		
10	Do you represent a parent company whom you are reporting to ?		
11	Organization structure		
12	Company product profile with location of operations across world		
13	Man power details and their competency	<i>Furnish the list (attach supporting doc. Seperately)</i>	
14	List of Key personnel and their Resume	<i>Furnish the list (attach supporting doc. Seperately)</i>	
15	Quality ,Safety and HSE accreditations	<i>Furnish the list (attach supporting doc. Seperately)</i>	
16	Your company exclusive tie-up with any EPC players which prohibits your company to participating with BHEL		
	Name of partner		
	Nature of agreement		
	Name of Package		
	Effective from		
	Valid up to		

Sl.No	Description		
17	Enlistment of your company with various PMCs in EPC business		
	Name of company		
	Valid up to		
18	Did any of company the imposed black list on you (if applicable)		
	Company Name		
	Reason		
	Valid up to		
19	Licensors with whom company is willing to work with (not exhaustive)	Yes/No	If no ., reasons for not working with the licensor
	Axens (IFP)		
	BP		
	CB&I (Chevron Lummus)		
	ConocoPhillips		
	DuPont		
	ExxonMobil		
	GTC Technology		
	GTC Technology		
	Huntsman		
	KBR		
	LyondellBasell		
	Shell		
	Universal Oil Products(UOP)		
20	List of Licensors with whom company is <u>Not willing</u> to work with (not covered in Sl. No 19 above) if any	Name	Reason
21	Do you have any legal disputes with any of the companies		

[illegible]



CAPABILITIES

&

FACILITIES



Contributing to Create a New India

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1) BHOPAL

1.1) Centre of Excellence-Hydro Machines

Centre of Excellence-Hydro Machines at Bhopal unit, is fully dedicated facility for R&D activities of hydro turbines and lift irrigation pumps backed by a team of highly trained engineers and latest technological tools. It is equipped with a sophisticated and modern laboratory to evolve highly efficient hydro turbine profile designs by mathematical modelling and design-vetting and further detailed studies by experimental model tests.



Centre of Excellence-Hydro Machines at Bhopal.

COE-HM is accredited by National Accreditation Board for testing and calibration laboratories for testing of hydro turbine and pump models. It is recognised by Department of Scientific & Industrial Research (DSIR), Government of India as in-house R&D group for hydraulic design and development of hydro turbines. COE-HM is equipped by a CFD centre which forms the basic back-bone of hydraulic design and optimization of hydro turbine and pump profiles for achieving Internationally competitive designs.



Model Test Rig at Centre of Excellence-Hydro Machines

It is equipped with a high-performance blade cluster with super-computing power for high speed number crunching and solving huge problems. COE-HM is also equipped with three universal test stands capable of testing entire range and all types of Hydro turbines/pumps (Francis, Kaplan, Pelton, bulb, reversible pump-turbines and pumps).

The laboratory is equipped with latest measuring instruments and technical advancements and consistently complies with IEC 60193 standards. COE-HM also has a dedicated group for turbine field efficiency testing at site in accordance to IEC 60041. It also has an in-house manufacturing facility for accurate manufacturing of hydro turbine model components.

1.2) Manufacturing and Testing Facilities for Transformers

BHEL is one of the first manufacturer of power transformer in India catering to the need of domestic and overseas utilities since 1961. The facilities at Bhopal unit are today equipped with state-of-the-art design, manufacturing and testing facilities for manufacturing of transformers and reactors up to 1200 kV class. The facilities are equipped with fully air-conditioned winding bay/enclosures with winding machines having load capacity up to 30 tons.

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Transformers - Final Assembly Platform



Transformers - Vertical Winding Machine

There are pre-coil assembly platforms as well. Core shop is equipped with in-house slitting and cropping facility for core laminations. Assembly bay, equipped with assembly platforms and vapour phase drying ovens, is also pressurised to keep it dust free. Ultra-high voltage laboratory is fully equipped to conduct all type test and routine test on transformer and reactors. Along with power transformers, BHEL has long experience of supplying various ratings of instrument transformers, capacitors and bushings.

1.3) Traction Machines Engineering Division/Transportation Group

Traction Machines Engineering Division/Transportation Group at Bhopal unit has state-of-the-art design, development, manufacturing and testing facilities for electrics (viz. AC traction motor, DC traction motor, alternators and auxiliary machines) and train set system. The facility also caters requirement of electrics for oil field (AC & DC oil rig motors, oil rig alternators) and defence application.



Traction Motor Assembly Facility

The group has been a pioneer in design and engineering for supply of electrics to meet the demand of Indian Railways and various other customers. BHEL has been a reliable supplier of electrics as well as a partner of Indian Railways in development of new locomotives and EMUs. Its design centre is equipped with dedicated latest modern gear hobbing and 3D coordinate measurement centres for manufacturing of gears with highest level of precision. With the help of advanced software, new designs are analysed and checked for various design parameters.



Traction Motor Test Setup

The facility is equipped with latest CNC machining centres to meet accuracy and precision requirement of finally manufactured product at component level itself. Its shop is equipped with state-of-the-art dust free air-conditioned winding facility and vacuum pressure impregnation plants to meet ultimate electrical performance requirement of machines. For overall system testing, Centre for Electric Transportation (CET) is a unique facility envisaged to act as focal point for systems-oriented research in the area of electric transportation.

1.4) Thermal Group

Design Capability: Turbine Team carries out all engineering activities and uses specialized proprietary software for the thermal design and analysis of data. Team is associated with the manufacturing group in performing the functional test on computerized test setup for testing various components and systems of thermal and nuclear plants. Team has the capability to conduct Performance Guarantee Test of the steam turbines as per applicable international codes and its acceptance norms. Heat Exchanger Team carries out all engineering activities of HP heaters, condensers, MRS and allied heat exchangers, pressure vessels, etc. This group is a member of Heat Transfer Research Institute (HTRI) of USA and has accreditation of ASME-U stamp.

Significant Manufacturing Capabilities: Computerised functional test setup for testing of LP valve with LP servo-motors for 700 MW nuclear turbines, turbine casing distortion removal/straightening facility for 500 MW IP turbines through specialized heating process, turbine rotor bend removal/straightening facility for 120 MW HP rotor, in-situ shot peening and glass bidding facility, CNC horizontal borer with head mounted on 8 m long bed and with vertical traverse of 3.5 m, track mounted NC horizontal boring machine with two heads mounted on 30 m long bed with vertical traverse of 10 m and 6 m and capable of machining along vertical axis, special turbine head for machining of diaphragm stages of HP turbine casings of 700 MW nuclear plants, CNC multi-spindle drilling machine with 8-spindles for drilling plates up to 120 mm thickness with drilling capacity of hole dia up to 40 mm capable of travels along X axis of 8000 mm and Y-axis of 5000 mm, twin spindle CNC deep hole drilling machine for drilling of holes up to 30 mm dia in plates up to 600 mm thickness with travels along X of 4000 mm and Y of 2000 mm and performance evaluation test setup for heat-exchangers used for cooling oil particularly OFWF coolers used for transformer oil cooling thus ascertaining product compliance as per design requirements.



Special Turbine Head for Diaphragm Machining



CoE-PE Variable Frequency Drive System

2) EDN - BENGALURU

2.1) State-of-art Facility for Solar Cell Manufacturing

A state-of-art multi-crystalline solar cell manufacturing facility has been established in the Electronics Division, Bengaluru. This is one among the most advanced and sophisticated facility in the country with robotics-based automation for wafer handling and a processing capability of 3000 solar cells per hour. The level of automation incorporated in this solar cell line ensures that wafers are not handled by hand. This line has a capability for processing multi-crystalline wafers of 156.75 mm square dimension with a thickness of 200 (+/-20) microns. Process and utility equipment of the line are designed with advanced technical features which will ensure reliability, quality and safety of process operation. Special safety features for speciality gases and chemicals are incorporated in the machines. This facility also includes an exclusive integrated services complex housing process utility equipment for chilled water, air conditioning plant and compressed dry air.



Automated In-line Metalisation (Screen Printing) Stations of Solar Cell Manufacturing Facility



Acid Texturing Station of Solar Cell Manufacturing Facility



Low Pressure Diffusion Furnace of Solar Cell Manufacturing Facility

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2.2) Centre of Excellence for Power Electronics and IGBT & Controller Technology



CoE-PE RTDS Facility



CoE-PE Variable Frequency Drive System

The Centre of Excellence for Power Electronics and IGBT & Controller Technology has been established at Electronics Division, Bengaluru, to cater for the development needs for transportation electronics with an objective to absorb technologies from collaborators, rationalise the hardware, understand and use latest simulation software in design of power electronics circuits, indigenisation of items, subsystems and systems of IGBT based technology, IGBT device characterisation, type testing of equipment and functional testing requirements while executing commercial contracts. The major facilities include back-to-back testing of IGBT based systems, gate driver evaluation facility, real time testing of power circuits/controllers using real time digital simulator (RTDS), IGBT tester, controller for locomotives and EMU system, EMI/EMC testing for burst and surge testing.

2.3) Centre of Excellence for Control and Instrumentation



CoE-C&I Testing Software



CoE-C&I Model Test Facility

In order to match the current technology and upcoming challenges in the field of control and instrumentation (C&I), a Centre of Excellence for Control and Instrumentation has been established at Electronics Division, Bengaluru. The capabilities of the centre includes core developments in DCS hardware and software, development and testing of hardware, software, interfaces and systems, incremental development on hardware and software for modules for C&I, DCS in related area of power plant SCADA, simulating and troubleshooting facilities for site reported problems in DCS, security and maintenance of software and systems, and pre-release testing of software. The centre is equipped with a model test setup which is useful in testing new features that are asked as part of contract specifications and is also helpful in simulating site conditions and to diagnose issues reported from sites.

3) HARIDWAR

3.1) Design Software Tools

Design software tools are extensively used to simulate a virtual image of the real installation or product is created. HEEP/Haridwar unit extensively employs the best among industry design and analysis tools to achieve 3D full featured solid modelling, dynamics, and for analysis purposes. The designs adhere to international standards and codes.

3.2) Machining Facilities

The HEEP/Haridwar unit is equipped with state-of-the-art modern CNC and heavy-duty machines for machining complicated shapes and contours to a high degree of precision. These facilities are supported by material handling facilities for large sized and heavy components, material testing and inspection facilities which ensure quality product manufacturing. Highly skilled manpower having diverse experience in manufacturing technology, cutting tools and CAM based CNC programming is also a great asset to the plant's machining capability. The unit has various CNC machines catering to diverse machining requirements for turbines and generators up to 1000 MW as well as small sized, intricate jobs. The unit also houses a dedicated machining block which caters to machining of turbine blades and turbo-generator cooling blades of lengths up to 1000 mm. This centre is capable of machining intricate shapes and contours for various sizes and types of blades at a mass scale involving diverse metallurgies and meeting stringent requirement of accuracy, tolerances and overall quality.



CNC Slot Cutting Machine

3.3) Fabrication Facilities and Welding Technology

The world class fabrication facility at HEEP/Haridwar unit is equipped with heavy rolling machines, plasma cutting machines, horizontal boring machines, vertical boring machines, deep hole drilling machine, heat treatment furnaces with testing facilities. The unit has developed around 400 welding procedures for different materials covering thickness up to 250 mm which adhere to international codes and standards and has developed expertise to weld and join materials of diverse metallurgies with similar as well as dissimilar metallurgies, especially for AUSC technology.



The unit can handle materials starting from generic materials to copper-based alloys, aluminium bronze, brass, aluminium and exotic materials like titanium, nickel-based alloys, clad steels with titanium. Major facilities being employed at the fabrication shop include hot wire narrow gap TIG welding machine, weld overlaying facility, groove stellite machine, CNC flame and plasma cutting machines, 3-roll and 4-roll bending machine, 1000 T hydraulic press, CNC brake press, 1.8 MW bogie hearth furnace, to name a few.

3.4) Advanced Production and Testing Facilities

HEEP/Haridwar unit is equipped with advanced equipment to ensure production of supercritical turbines, electrical machines like turbo generator, exciters, permanent magnet generators, AC motors, etc. These include coil and insulation manufacturing shop, moulding shop, vacuum impregnation plant, brazing facility, balancing facility and testing facility for large size turbo-generators and auxiliaries.



The unit also takes up constant endeavours to upgrade its manufacturing setup to match the best in class in the world to keep it abreast with ever challenging technology advancements and product portfolio diversification.

3.5) Key Capabilities in Defence & Aerospace Production

BHEL takes pride in manufacturing the 76/62 super rapid gun mounting (SRGM) for Indian Navy. Over the years, HEHP/Haridwar unit has developed expertise in fabrication of aluminium alloys, special grade alloy steels, bronze, copper and dissimilar materials, and established excellent precision machining facility for complex and intricate profile in components made of titanium alloy, aluminium alloy, special grade alloy steel, bronze within close tolerances. Capabilities for surface protection treatments and special treatments have been established. The unit is set to take up jobs for defence and aerospace sector catering to prestigious customers like Indian Navy and ISRO.

3.6) Testing and Research Facilities

In-house facilities at HEHP/Haridwar unit are equipped to perform mandatory routine, type tests and customer specified supplementary tests on all products. In addition to testing facilities at all the manufacturing shops, there are dedicated NDT Laboratory, Central Plant Laboratory, Metals Research Laboratory and Generator Research Institute, located in the plant premises to support the product engineering, quality control and meeting testing requirements of our products. The services offered include material testing, investigational services, calibration, vendor development and performance enhancement. Electrical Calibration Laboratory under Central Plant Laboratory is NABL accredited as well.

3.7) Facilities and Capabilities of CFFP

Central Foundry Forge Plant (CFFP) is a strategic facility located in Haridwar unit. It caters to the needs of steel castings and forgings for power plant equipment, defence, steel plants, ship building, cement mills, mining industries, etc. It has the capacity to manufacture single piece castings weighing up to 60 MT (integral), 120 MT (cast weld) and forgings up to 34 MT in different material grades. CFFP has also recently developed and established IN625 alloy casting. Apart from having all general foundry and forge facilities, CFFP is well equipped with various specialized facilities including electric arc furnaces, secondary refining facility for liquid metal and associated vacuum tanks, forging presses of 2650 T and 9000 T capacities, heat treatment furnaces up to 100 T capacity, vertical shaft furnaces with air, water, mist and oil quenching facility and CNC machines. In addition to this, CFFP has state-of-the-art simulation software for both castings and forgings.



CFFP Molten Metal Pouring into Ladle



CFFP Heat Treatment on Rotor Shaft

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It has NABL accredited facilities for destructive testing including mechanical, metallography and spectroscopy laboratories along with gas analysis and H₂/O₂ measuring instruments, as well as non-destructive testing, including ultrasonic, radiography, magnetic particle and dye penetrant testing. CFFP is also equipped with in-house radiography testing facility, residual stress measurement facility for forgings, XRF & X Ray analysers and creep testing facilities.

3.8) Capabilities at Pollution Control Research Institute



PCRI External View



PCRI Laboratory

Pollution Control Research Institute (PCRI), is an OHSAS and ISO 9001 certified institute, set up by the Department of Heavy Industry (Government of India), under United Nations Development Programme (UNDP), at the Haridwar unit. The institute is equipped with latest analytical facilities for carrying out studies related to environmental pollution and control. This institute is recognized by Ministry of Environment and Forests and Central Pollution Control Board. PCRI is Member of CHD 032 Environmental Protection Sectional Committee of BIS. The National Mission for Clean Ganga (NMCG) has also nominated PCRI as Class-A Ganga Monitoring Centre (GMC) for carrying out water quality monitoring studies on River Ganga. The institute is actively engaged in providing services for environmental clearance of power projects, preparation of environmental statement of industries, conducting environmental monitoring for regulatory requirements and consultancy services.

4) HYDERABAD

4.1) Blade Manufacturing Facility

State of the art CNC 5-axis turbine blade manufacturing setup was established at blade shop at Hyderabad unit with integrated air conditioning plant and standalone compressed air facility. The automation systems incorporated on these machines helps in manufacturing the turbine blades with minimal operator interference. The machine allows the machining of the blade from bar stock in a single setup.



CNC-5 Axis Two Spindle Machine

The precision and accuracy of these machines helps to work on tighter tolerances required to be achieved on critical turbine blades. Better surface finish and faster material removal rates are achieved on these rigid machines. The available machines vary according to the size of the blades that can be machined and number of spindles on each machine.

4.2) Heavy-duty Gas Turbines



CNC Creep Feed Grinding Machine

Centre of Excellence – Gas Turbine Buckets and Nozzles: This facility has been established at Hyderabad unit for in-house manufacturing of gas turbine buckets and nozzles. It is equipped with special purpose machines, CNC creep feed grinding machine and CNC twin ram EDM machine, for machining the super alloy material and CMM machine for inspection of the jobs. The CNC creep feed grinding machine, which is used for in-house manufacturing of aero buckets of GTs, employs a deep cut and high metal removal rate and features a low feed rate.

The CNC twin ram EDM machine is used for in-house manufacturing of GT nozzles. The twin rams of the machine help in machining chord length and seal slots on the concave side and convex sides of the nozzles in single set up. Machining is carried out by electric discharge machining with graphite electrodes. These special purpose machines are best fit for machining super alloy materials with close tolerances.

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4.3) Electrical Machines

The Electrical Machines group in Hyderabad unit manufactures turbo generators for gas, coal and nuclear based power plants, defence and strategic applications. These turbo generators are for both indoor and outdoor applications designed as per customer specific requirements. Some of the state-of-the-art facilities include unique special purpose machines like CNC rotor slotting machine, CNC centre lathes of capacity up to 80 T, CNC horizontal machining centre, CNC vertical turning lathes and CNC horizontal boring machines, CNC 540° transposition of generator stator Roebel bars, 6-axis CNC tapping machines, global vacuum pressure impregnation (GVPI) system and rotor dynamic balancing facilities ranging from 2 T to 120 T. Services are provided in areas like in-situ critical diagnostic tests, life assessment studies, strong support for field engineering services and reliable service-after-sales.

4.4) Switchgear

State-of-the-art facility for Robotic Plasma Coating: A state-of-the-art facility for robotic plasma coating (using plasma spray technology) has been established in switchgear shop at Hyderabad unit. This is one amongst the most advanced and sophisticated facility which is used for thermal barrier coating on combustion components of gas turbines, ceramic coatings on washers and chromium carbide coatings on spindles for compressors. These coatings are made using a robot with 6-axis rotation movement with accuracy of $\pm 0.07\text{mm}$ and a tilting cum rotating table with loading capacity of 400 kg.

4.5) Design Capabilities of HE&F Division

Heat Exchanger and Fabrication (HE&F) division at Hyderabad unit, offers entire gamut of heat exchangers in the regenerative cycle of a thermal power plant like condenser, ejector, gland steam condenser, drain cooler, LP heater and deaerator. This division has an excellent engineering, manufacturing and testing capabilities to offer tailor made solutions by customising, re-engineering there by developing new variants of heat exchangers to suit the unique and challenging requirements of each customer order, be it greenfield, brownfield or R&M projects. To be a global player in heat exchangers, this division has obtained international accreditations and has foot prints in more than 10 countries world over. Apart from conventional cutting and welding facilities, this division is equipped with specialised facilities like narrow gap welding machines, CNC SAW welding machines, CNC deep hole drilling machines, plasma cutting machines, CS plate cutting machine and hydraulic four roll machine. Other facilities include hydro testing system, functional testing facilities for lube oil systems and heat treatment facilities for heat exchanger shells.

4.6) Manufacturing Capabilities of Pumps Division

Pump shop at Hyderabad unit has facilities to manufacture all types of centrifugal pumps used in thermal power stations. It is equipped with a CNC milling and drilling gantry machine for machining of inner casing of boiler feed pump, which has a high accuracy and a concentricity of 10 micron in one-meter length, as well as CNC vertical borer machines for machining of outer casing and casing cover of pumps.

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It also has facility for hydraulic pressure testing of components up to 1000kg/cm². There are latest testing facilities for testing of sub critical and super critical pumps used in power plant application as per international standards and in-line with world class practices. Pumps testing have well established data acquisition system for capturing and controlling of test loop systems from control room and verification of computed results with the performance curves.

4.7) Turbines and Compressors

The Turbine and Compressor manufacturing facilities include heavy-duty CNC gantry drilling machines, which are one of its kind as large sized jobs can be machined on them. These machines have vertical head, universal head and facing plate as special attachments so that most of the operations can be done in one setup. PP milling, drilling, threading and GBC roughing of steam turbines casings are being done on these machines in single set up.



Machining of big base frames of centrifugal compressors is also being done on these machines. Other major facilities in the shop include heavy-duty CNC horizontal centre lathes which are used for machining of steam turbine rotors, compressor shafts and GT components, CNC vertical lathe (double column) used for rough and finish turning of components like steam turbines and compressors, and 5-axis blade milling machines with single spindle, two spindles and three spindles. 125 T balancing tunnel in the shop is used for balancing TG rotors and utility turbine rotors up to 500 MW.



5) JHANSI

5.1) Locomotive Manufacturing Facilities

3-axis CNC bogie frame machine, mounted with CNC system, is a unique machine equipped with universal head which can be used for angular drilling, boring, milling and facing. It is used for complete bogie frame machining for various locomotives. The maximum job envelope is 5800x2750x940. It is also equipped with automatic tool changer with 40 different tools in the magazine.



3-axis CNC Bogie Frame Machine

The special features of this network-ready machine are automatic job measurement system, automatic tool length measurement system, cam port for diagnostics and bi-directional up/down loading of software/programmes through external hardware. A CNC bogie machining centre is also being used in the locomotive manufacturing shop for bogie frame machining for various locomotives. In India, apart from Indian Railways, these machines are available only with BHEL. These two CNC systems can also be used for manufacturing products and systems for defence applications.



CNC Bogie Frame Machine

6) TIRUCHIRAPPALLI

6.1) Centre of Excellence – Coal Research Centre

The Coal Research Centre has been established at the Tiruchirappalli unit to take up R&D activities specially focusing on deep understanding of Indian/imported coals with a view to determine its blending parameters including characterization to improve existing/contemporary technologies and develop new process/ system/ technologies to achieve lower environmental emission.



CoE Coal Research Centre

The major activities of the centre are generating and providing advanced coal analysis data to BHEL's boiler design engineers, root cause analyses for overcoming fuel related issues in coal based thermal power plants, analytical support for clean coal technology projects and establishment of a comprehensive coal databank for domestic and imported coals. The centre will also be a platform for interaction with experts of national and international research centres and laboratories, training of manpower, conducting of workshops for acquiring and dissemination of advanced knowledge and skills.

6.2) Centre of Excellence for Advanced Fabrication Technology



CoE Advanced Fabrication Technology

The Centre of Excellence for Advanced Fabrication Technology has been established at the Tiruchirappalli unit to develop and introduce highly productive advanced welding processes and technologies to improve quality and productivity of fabrication shops and to enhance R&D capability through addition of state-of-the-art research facility.

The facilities include friction stir welding system, CNC gantry welding system, laser hybrid welding system, pulsed SAW system, water jet cutting system, thermal cycle simulator, welding simulation facility.

6.3) Solution Heat Treatment Furnace with Quenching Facility

The LPG-fired 12MT solution heat treatment furnace with built-in automated quenching facility has been commissioned at Power Plant Piping Unit, Thirumayam. The pulse-firing controlled furnace has 24 self-recuperating burners. This facility has been set up to provide heat treatment for temperature range up to 1175 degrees celsius and is being primarily utilized for handling inconel pipes required for advanced ultra-supercritical (AUSC) projects. A dedicated quenching tank of 225 K litres capacity set up along with the furnace provides for quick quenching operation required to carry out annealing for AUSC related piping products. The furnace can also be used for conducting other processes including stress relieving and normalizing.



Solution Heat Treatment Furnace with Quenching Facility

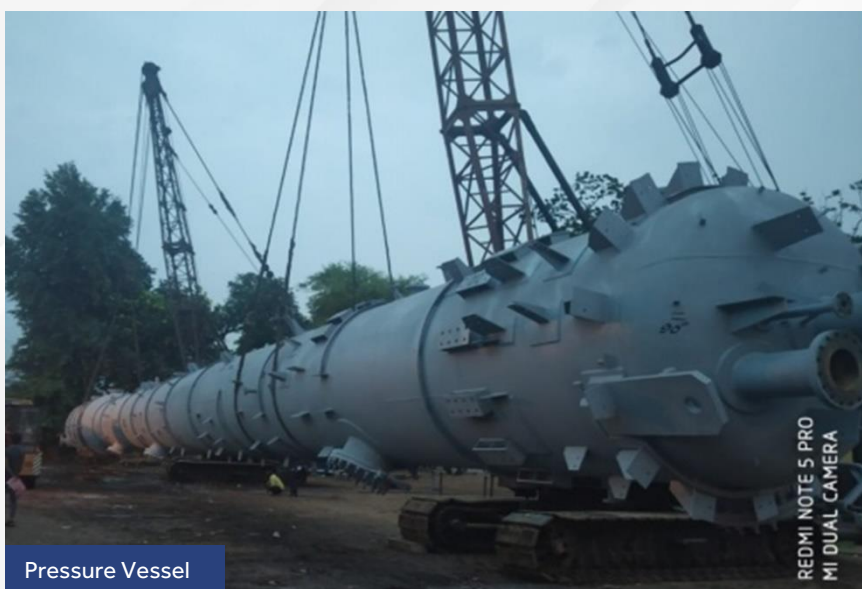
7) VISHAKHAPATNAM

HPVP/Vishakhapatnam unit caters to the need of different EPCC packages like crude distillation unit (CDU), vacuum distillation unit (VDU), purge gas recovery unit for oil & gas sector and process equipment for industries. Its capabilities and experience cover thermal and mechanical design of high pressure and heat transfer static equipment using parameters provided by process licensors. For transporting over-dimensional vessels, it has a sea-front manufacturing base from where ODC equipment can be transported directly after manufacturing by sea route to its national and international customers. The shops in the unit has various state-of-the-art machinery like bending/rolling machines, shearing machines, gas and plasma cutting machines, welding facilities, and gas and oil-fired large heat treatment furnace to handle complete range of product profile. The unit has a monopoly in India in designing and manufacturing of compact finned heat exchangers for aerospace applications. The facility has been certified with AS 9100 Quality Management System by M/S Novostar. Its R&D division is equipped with sophisticated measuring instruments and unique facilities like vacuum brazing furnace, fin forming machine, differential pressure testing facility and oil circulation test unit.

The R&D division is closely engaged in developing environment control system, liquid circulation system, liquid control units and other types of heat exchangers along with DRDO.



Distillation Column



Pressure Vessel

8) RANIPET

8.1) Fan Testing Station

Fan testing station with state-of-the-art technology to measure and conform the performance as per international standard BS EN ISO 5801 and AMCA 2010 has been set up at Ranipet unit. both centrifugal fan and axial fans can be tested with the facility available. The test track is equipped with necessary ducts and automatic throttling device to provide necessary system resistance requirement through pressure and volume.



Fan Testing Station

The test tracks of various sizes dia 400, 800, 1400, 2800, 3500 & 4500mm are used to test all application fans such as forced draft, primary air, induced draft fan of 250, 500, 600, 660, 700, 800 & 1000 MW power plant and booster fan for FGD application of all models. Very high capacity 3000 kW motor with VFD and necessary torque transducers are equipped to measure power consumption by the fan and to conform the efficiency of design as per standard.

8.2) State-of-the-art Gate Testing Station

A state-of-the-art guillotine gate testing stand (station) is established in Ranipet unit. This is the biggest and most rugged testing stand for guillotine gates in India. The tower structure is built up to a height of 50 meters. A maximum of two guillotine gates can be mounted on the structure at any given time. The gate stand is used to perform open/close (functional test) or leak tightness type tests for very large size gates. the gate stand is used to test guillotine gates of very large sizes of FGD applications for up to 1000 MW rating.



Gate Testing Tower

8.3) Flanging Machine

Generally, a flange on a cone or a cylinder will be fabricated and welded on it. But the flanging machine installed at Ranipet unit can do these types of fabrication of a flange at the apex of cone or a flange at the end of a cylinder with greater ease and with an improved geometry. This machine saves fabrication time by eliminating a joint either by welding or by riveting and also saves some material by way of combining the developments of individual components.



A fully automated hydraulically operated machine provided with part programs in the memory, can form incrementally the required shapes with in its capacity with much ease. Built-in with the advanced safety for operators, this is an eco-friendly machine as it doesn't need any coolant or produce any scrap.

8.4) Electro-Static Precipitator – Collecting Electrode Roll-Forming Line

A high-speed roll forming machine for manufacturing of collecting electrode, which is the main component of electrostatic precipitator (ESP), has been set up at Ranipet unit. This is a fully automated one with a fly shear, which eliminates the momentary stoppage for shearing. The manpower requirement is minimal with only two persons required till stacking. This helps in meeting the supply requirement in a very short time.



8.5) Key Seating Machine

The internal key way is generally done in a slotting machine. Any slotting machine will have a limitation called throat depth, which will limit the maximum diameter of the component that can be accommodated in the machine. But, in any of the precision and rotating component that has to transmit a very high torque, the usual challenge is in two fronts, viz, accommodating the job in the machine and the geometry and finish of the key way. The key seating machine installed at Ranipet unit, is of a unique construction for very large and heavy job, which cannot be accommodated in generic slotting machines. In addition, the accuracy, geometry and the surface roughness will be far superior to a conventional machine or methods. This is a CNC controlled, state-of-the-art machine with proprietary software. The job setup in this machine is very easy and fool-proof, which takes care of the centering automatically.

9) CORPORATE R&D, HYDERABAD

Centres of Excellence

- To enhance the operational efficiency of the power plants based on the accumulated domain knowledge over several years, a state-of-the-art Centre of Excellence for Simulators (COE-S) has been established at Corporate R&D, Hyderabad. The COE-S not only highlights the extant power plant simulation capabilities of BHEL, but would also play a vital role in large-scale commercialisation activity in this advanced area. It has the facility for carrying out dynamic simulation studies for combined-cycle cogeneration plants and thermal power plants. The COE-S is capable of developing operator training simulators, carry out dynamic simulation studies and analyse operational problems and propose best possible solutions.
- The Centre of Excellence for Permanent Magnet Machines (COE-PMM) has been established at Corporate R&D, Hyderabad, to carry out advanced research work in this new technology area and develop special PM machines to cater to the need of various power plants, industries, applications in railways, strategic applications and wind power generation. The state-of-the-art facilities established at the COE-PMM includes 80 kJ high voltage impulse magnetiser with special coils and fixtures, B-H curve tracer for characterising magnets at various temperatures, and instrumentation systems for testing, recording, analysis and design optimisation.
- The Centre of Excellence for Computational Fluid Dynamics (COE-CFD) has been established at Corporate R&D, Hyderabad. This facility has enhanced BHEL's capability in the field of computational fluid dynamics (CFD), which is an important tool capable of giving designers valuable insights into the behaviour of fluid flow in complex geometries. With advanced software and manned by technically capable and trained personnel, the COE-CFD will cater to a wide variety of products of the power and industrial sectors. It houses the server with high-performance cluster computing facility. CFD application software with latest versions are available.
- The Centre of Excellence for Surface Engineering (COE-SE) has been set up at Corporate R&D, Hyderabad. The COE-SE is equipped with a host of advanced equipment for surface treatment and coating like the latest robot-controlled laser hardening and cladding system, which is one of the unique facilities in India, in addition to robotic thermal spray, image analyser, macro-micro hardness tester, on-line control and monitoring system of thermal spray parameters and mechanical grit recovery system. The COE-SE will act as a major facility for BHEL's frontier research projects for exploring the use of nano materials for surface engineering applications.
- The Centre of Excellence for Machine Dynamics (COE-MD) has been established at Corporate R&D, Hyderabad, to bring together capabilities in the areas of rotating machine condition monitoring and expert diagnostics, as well as enhancement of expertise in the areas of machine dynamics like vibration, noise, tribology, and stress/strain analysis. Establishment of

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computer aided engineering facility in the centre helps in developing simulation studies for effective design evaluation of power plant equipment. The centre is equipped with advanced telemetry system for blade vibration monitoring, special seals development facility and test rig for simulating mechanical disturbance faults for verifying vibration diagnostic rules.

- The Centre for Intelligent Machines and Robotics (CIMAR) has been established at Corporate R&D, Hyderabad. The CIMAR is equipped with advanced equipment and software for continuing R&D in manufacturing automation, with the objectives of cycle time reduction, enhancement of productivity and quality, cost reduction and import substitution. Besides these, it will also develop new products and processes for effective utilisation of high cost production infrastructures like CNC machines and computer aided inspection setups. Expertise is available in the fields of advanced CNC part programming for 3-axis and 5-axis CNC machining, post processor development for any CNC machine tool configurations and application-oriented developments in robotics.
- The Centre of Excellence for Compressors and Pumps (COE-CP) was set up at Corporate R&D, Hyderabad, to create facilities in terms of engineering design capabilities and experimental facilities with the focused aim of improving these two products which have sustainable growth potential over the years to come. The basic objectives of this COE-CP are multifold namely product orientation, efficiency enhancement, capability enhancement, product development suiting to variety of applications and service parameters, design automation, seamless integration of CAD-CAM and advanced test capabilities.
- The Centre for Nano Technology (CNT) was established at Corporate R&D, Hyderabad, to explore the application of nano materials in products and systems relevant to BHEL. Material development for power plant components, nano structured coatings for wear and other applications, electrical insulating materials, solar cells, carbon nano tube applications, nano fluidics, fuel cells, nano material synthesis and nano sensors, are being explored at this facility. Major facilities are setup for nano scale measurement, characterisation and analysis, fabrication and nano powder synthesis.
- The Centre of Excellence – Ultra High Voltage Laboratory (COE-UHV) established at Corporate R&D, Hyderabad, has two distinct functional areas – high voltage dielectric test facility and centre for assembly of gas-insulated substation (GIS) modules in controlled environment. This laboratory facilitates testing of all GIS modules as per IEC standards and helps in reducing the development cycle time of GIS equipment.
- The Centre of Excellence for Advanced Transmission Systems (COE-ATS) has been established at Corporate R&D, Hyderabad, for addressing technologies related to bulk power transmission emanating from growth of energy generation in India. The centre is involved in developing technologies pertaining to HVDC, UHVAC up to 1200 kV, reactive power management, substation automation, wide area protection (WAP), etc.