

## Plant Design and Detail Engineering Services

### 1.1 Technical Capabilities in Plant Design & Detail Engineering Services

#### 1.1.1 Plant Layout, Piping Design & Engineering

- Design of complete fluid based Plant Layout including generation of:
  - Piping & Instrumentation Diagrams (P&IDs)
  - Composite Equipment and Piping / Tubing Layout Drawings (GAs)
  - Layout Drawings for Structures, Cable Trays and Ducts
  - Piping / Tubing Isometrics and Spools
  - Reports including Line List, Valve List, Instrument List, Bill of Materials etc.
- Design and Detail Engineering of Equipment, Piping / Tubing and Supports to Piping / Tubing
  - Equipment design using ASME Section VIII, API, NEMA, TEMA etc.
  - Piping / Tubing design and stress analysis using ANSI, ASME Section III, European & other codes for weight, thermal, wind and other static loads
  - Piping / Tubing Support design and analyses (including ASME Section III)
  - Evaluation of existing piping installations and modifications
  - Design and stress analysis of fiberglass reinforced piping (FRP)
- Design and analysis of piping / tubing systems, structures and equipment (mechanical and electrical) for all types of dynamic loads, as applicable, including:
  - Pump excitation
  - Fluid hammer
  - Safety valve release
  - Seismic (earthquake)
  - Slug flow
  - Other impact and shock loads
- Analysis of Nozzle connections
  - Nozzles on vessels, exchangers and tanks
  - Nozzles for pumps, compressors and turbines
- Computational Fluid Dynamics (CFD) for determination of flow characteristics in Piping & Ducting systems and Mechanical equipment

#### 1.1.2 Preparation of Intelligent P&IDs and 3D Plant Model

- Customization of 2D and 3D plant design software to suit project requirements
- Intelligent P&ID database development and drafting using P&ID software and generation of reports such as line list, valve list, equipment list, instrument list etc.
- Creation of 3D plant model comprising of civil / structures, equipment, piping / tubing, ducting, cable trays, supports etc.
- Generation of plot plans, GA drawings, layout drawings, isometrics, spools detail drawings for supports and reports such as Bill of Materials from 3D model
- Conversion of 2D drawings to 3D model
- Attachment of information to intelligent P&IDs and 3D models
- Integration of P&IDs and 3D models with client's in-house and third party software
- Walk-through, animation of construction sequences and progress monitoring
- Animation of dismantling and assembly sequences for equipment

### 1.1.3 Civil & Structural Design & Analysis

- Layout of Concrete & Steel Structures in 3D
- Structural Design & Analysis
- Design and Qualification of Supports to Equipment, Ducting and Cable Trays
- Design and Qualification of Embedded Parts
- Generation of GA drawings, joint detailing, fabrication drawings, BOM etc.

### 1.1.4 Electrical Design

- Equipment Sizing
- Power Distribution Schematics
- Layout of Electrical Buildings
- Lighting, Earthing & Lightning Diagrams
- Electrical & Drive Data Sheets
  
- Selection & Sizing of Cables
- Layout of Electrical Cable Trays and Supports
- Layout of Electrical Buildings in 3D for High Tension / Low Tension Switchgear, Panels / Desks etc.
- Cable Routing and Scheduling
  
- Outdoor Switchyard / Substation Design
- Combined Heat & Power generation and synchronization
- Generation of Connection Diagrams
- 3D Layout and Extraction of Drawings & Bill of Quantities
- Layout of Substations in 3D including extraction of drawings

### 1.1.5 Control & Instrumentation (C&I) Design

- Identify relevant information from P&IDs
- Layout of Instruments, Junction Boxes & Control Panels
- Instrument and Control Valve Lists
- Instrumentation Data Sheets
  
- Loop Diagrams
- Input / Output (I / O) Lists
- Selection & Sizing of Cables
- Layout of C&I Cable Trays and Supports
- Cable Routing and Scheduling
  
- Hookup Drawings & Installation Accessories
- Modeling of Instruments
- 3D Layout and Extraction of Drawings & Bill of Quantities
- Check for consistency between Process & Model and Clash Detection

## 1.2 Partial List of Plant Design and Detail Engineering Projects

Sl. No.	Client & Project	Nature of work
<b>Fossil Fuel Power Plants</b>		
1	TOSHIBA Plant Systems & Services, Hyderabad, India - LANCO Kondapalli CCPP Stage 2 and 3.	Piping detailed design, pipe stress analysis, support detailing and generation of drawings for three units of a combined cycle power plant.
2	Toshiba Thermal & Hydro Power Systems Company, New Delhi, India - Kashipur CCPP Phase 1	Piping detailed design, pipe stress analysis, support detailing and generation of drawings for 225 MW Gas based combined cycle power plant.
3	Alstom Power, New Delhi.	3D design of plant layout and piping systems for a fossil power plant
4	Associated Power Team Ltd., Hyderabad, India - Bushan Steel	Steam Turbine Area – 3D design, pipe stress analysis, piping layout and generation of piping support drawings & isometrics
5	Associated Power Team Ltd., Hyderabad, India - Pan African Paper Project	Steam Turbine Area – 3D design and piping layout and generation of Isometrics
6	Associated Power Team Ltd., Hyderabad, India - Orissa Sponge Iron Ltd.	Steam Turbine Area – 3D design, pipe stress analysis, piping layout and generation of piping support drawings & isometrics
7	Associated Power Team, Hyderabad, India - Usha Martin Project	Steam Turbine Area – 3D design, pipe stress analysis, piping layout and generation of piping support drawings & isometrics
8	BHEL Haridwar, India	3D Plant Design Software Customization (over 20 man-months) & 3D Design of Electrical Equipment.  Piping layout design in 3D, for Integral Piping System for 250MW & 500 MW Steam Turbines
9	BHEL Piping Center, Chennai, India	3D Plant Design Software Customization (over 35 man-months) and 3D Design of Rihand power station high-energy lines to generate Fabrication Isometrics in BHEL's format.
10	BHEL, Trichy, India	3D Plant Design Software Customization and 3D Design of Fossil Boilers for 220 MW and 500 MW Power Plants
11	BHEL, Ramachandrapuram Hyderabad, India	Performed 3D design of equipment, structures and piping, pipe stress analysis, pipe support detailing and generation of GA drawings, isometrics and Bill of Materials for the Steam Turbine / Gas Turbine / Boiler Feed Pump / Gas Booster Compressor areas of 180+ captive / combined cycle / fossil power plant projects.  Also performed 3D Plant Design Software Customization (over 60 man-months) to meet BHEL's design standards and procedures

Sl. No.	Client & Project	Nature of work
12	BHEL Project Engineering Management, New Delhi, India	<p>Performed 3D design of equipment, piping and structures and generation of GA drawings, isometrics and bill of materials for 40+ captive / combined cycle / large scale fossil power projects.</p> <p>Also performed 3D Plant Design Software Customization (over 270 man-months) to meet BHEL's design standards and procedures</p>
13	BHEL Transmission Business Group, New Delhi, India	Performed 3D Software Customization (over 30 man-months) to automate the design and layout of Substations and to generate all required drawings and reports from the 3D models of Substations.
14	Godavari Engineering Ltd, India – GEI project	Steam Turbine Area – 3D design and piping layout and generation of isometrics and bill of materials
15	Mecal s.r.l., Madrid, Spain	Piping Analysis, Selection of Support types & location and Support drawings for piping systems of a Combined Cycle Power Plant
16	M N Dastur & Company, Chennai, India – ONGC's OPAL Dahej Project	Piping Design and Analysis for High Energy lines, 3D design for the complete plant, Pipe support detailing and generation of GA drawings, isometrics and reports from the 3D model for a 180 MWe Combined Cycle Power Plant
17	Thermal Systems Pvt. Ltd., Hyderabad, India - Sriram Energy Systems	Boiler Area – 3D design, pipe stress analysis, piping layout and support design and generation of isometrics and support drawings including BOMs.
18	Thermal Systems Pvt. Ltd., Hyderabad, India	Piping stress analysis and generation of isometrics with Bill of Materials for Godavari Ispat Project
19	Tata Consulting Engineers, Mumbai, India	3D Plant Design Software Customization (over 25 man-months) to meet their design standards.

## Sample List of Projects (cont')

Sl. No.	Client & Project	Nature of work
<b>Oil &amp; Gas Plants</b>		
1	Engineers India Limited, Chennai	3D design and extraction of drawings for: <ul style="list-style-type: none"> <li>• HPCL Mumbai Refinery</li> <li>• HPCL Vizag Refinery - FCCU Revamp</li> <li>• IOCL Panipat Refinery</li> </ul>
2	Engineers India Limited, New Delhi	3D Plant Design software customization (over 110 man-months) to meet EIL's oil and gas industry standards and to automate 3D modeling of EIL's pipe supports, generation of support drawings with BOMs and support markings on GA drawings and isometrics  3D design & extraction of drawings for ATU & SWS units of Mangalore Refinery & Petrochemicals Ltd.  3D design of North Shore Australian Salt project and extraction of drawings
3	L&T (OGSP Division), Mumbai, India	3D design for DHDS Unit of IOCL's Mathura Refinery & proposed changes to avoid clashes.
4	Malaysia Shipyard and Engineering (MSE), Johor Bahru, Malaysia	<ul style="list-style-type: none"> <li>• 3D Plant Design software customization (over 15 man-months)</li> <li>• 3D design and extraction of drawings and spools for the following offshore platforms: <ul style="list-style-type: none"> <li>▪ External Turret Mooring for Yoho FPSO for Exxon Mobil E-11K Platform for Shell Oil</li> <li>▪ Helang Central Platform for Nippon Oil</li> </ul> </li> </ul>
5	Sime SembCorp Engineering (SSE), Johor Bahru, Malaysia	<ul style="list-style-type: none"> <li>• 3D Plant Design software customization (over 20 man-months)</li> <li>• Development of integrated inspection system</li> <li>• 3D design and extraction of drawings and spools for the following offshore platforms: <ul style="list-style-type: none"> <li>▪ Guntong-E unit for Exxon Mobil</li> <li>▪ ANCSI CPU for Petronas Carigali</li> <li>▪ Burga Raya Platform for Talisman</li> </ul> </li> </ul>
6	Techicas Reunidas, Madrid, Spain	Piping analyses and support selection for CSPC, Nanhai Petrochemical Plant in China
7	Technip / FARC Italia, Rome, Italy	Piping analyses and support selection for Corinth Refinery expansion project in Greece
8	Triune Projects Pvt. Ltd., New Delhi, India	3D design and generation of GA drawings and isometrics for Offshore Oil Exploration Vessel / Platform in Angola, Western Africa.

Sl. No.	Client & Project	Nature of work
9	Valdel Engineers & Constructors, Bangalore, India	3D design and extraction of drawings for the CDSP area of Bina Refinery project of Bharat Oman Refineries Limited.
10	Valdel Engineers & Constructors, Bangalore, India - Wadi-latham Project for Occidental Petroleum, Oman	Design and engineering involving piping design, layout in 3D, piping analyses, pipe support design and generation of GA drawings, isometrics and MTO from 3D plant model for the Crude Stabilization unit.
11	ANVIL Corp., Bellingham, USA.	Piping analysis, selection of support types & location and support markings on isometrics for Chevron Salt Lake City Refinery project.
<b>Process / Chemical Plants</b>		
1	Chemtex, Mumbai, India	Piping Analysis for a process plant in China
2	De Smet Chemfood Engineering, Bangalore, India & Antwerp, Belgium	Piping Analysis of steam lines including support selection and detailing for De Smet food processing plants worldwide.
3	Eka Chemicals, Sweden 105 TPD Integrated Chlorine dioxide plant in China	Routing of pipelines including selection and location of pipe supports and development of 3D (PDMS) model of the Tank Farm area and detailing of pipe supports.
4	Ershigs, Bellingham, Washington, USA	Pipe stress analyses for FRP piping systems for Tennessee Valley Authority (TVA)  Generation of FRP piping spool drawings from isometrics
5	Indo-Berolina Industries Chematur (Engg & Consultancy) Ltd. Mumbai, India	Equipment modeling and layout, piping design and layout, pipe stress analysis and support detailing for Chematur Sweden's Isocyanate project
6	Keren Projects, Israel Agan Biological Waste Water Treatment Plant	Development of piping layout drawings (plan and sections) and generation of isometrics (with BOM) involving 28 P&IDs (by Bayer Technologies) for a Tank farm area with over 500 pipelines of CS, SS and Polypropylene materials.
7	L&T, ECC, Chennai, India	3D design and extraction of GA and isometric drawings for Hindustan Zinc Ltd. project.
8	Stebbins Chemipulp – Jenssen Inc., USA	3D piping layout, piping analysis, pipe support design and preparation of support drawings for a SO <sub>2</sub> plant of Saudi Arabian Oil Company (ARAMCO)
9	Thermal Systems Pvt. Ltd., Hyderabad, India – Dahej Smelter Plant	Waste heat recovery steam generator of a smelter plant- 3D design, piping flexibility analysis, piping layout and support design, generation of isometrics and support drawings including BOMs for piping and supports.
10	UHDE, Mumbai, India	3D design for SAFCO-IV (Saudi Arabian Fertilizer Company)

## 1.3 Software used for Design and Detail Engineering Projects

The following software systems are currently used by the Engineering Department for executing Plant Design and Detail Engineering projects.

### 1.3.1 3D Plant & Piping Design Software and its Interfaces

- **For 3D Plant & Piping Design**
  - PDMS, PEGS, REVIEW Reality and Query Access
  - PDS modules
  - AutoPlant modules
  - CADMATIC modules
- **Interfaces from 3D Plant Design software to Pipe Stress software**
  - PDMS to CAEPIPE / CAESAR II Interface
  - PDS to CAEPIPE / CAESAR II Interface
  - SmartPlant 3D to CAEPIPE / CAESAR II Interface
  - AutoPlant to CAEPIPE / CAESAR II Interface
  - CADMATIC to CAEPIPE / CAESAR II Interface
  - CATIA to CAEPIPE / CAESAR II Interface
  - PCF to CAEPIPE / CAESAR II Interface
- **Interface between 3D Plant Design software**
  - PDMS to CADMATIC and vice versa (including transfer of attributes)

### 1.3.2 Structural Design Software and Interfaces

- **For Structural Design and Analysis:**
  - STAAD.Pro
  - CAEFAME
- **Interface between 3D Plant Design software and Structural Analysis software**
  - PDMS to STAAD.Pro and vice versa
  - CADMATIC to STAAD.Pro

### 1.3.3 Pipe Stress Software and Interfaces:

- **For Pipe Stress Analysis**
  - checkSTRESS
  - HOTclash
  - CAEPIPE
  - CAESAR II
  - PIPESTRESS (only for nuclear piping systems)

- **Interfaces between Pipe Stress software**

- CAEPIPE to CAESAR II Interface
- CAESAR II to CAEPIPE Interface (built into CAEPIPE)
- CAEPIPE to PIPESTRESS Interface

#### 1.3.4 Pipe Flow Analyses and related Interfaces to Pipe Stress software

- CAEFLOW
- Interface from CAEFLOW to CAEPIPE
  
- PDMS to CAEFLOW Interface
- PDS to CAEFLOW Interface
- SmartPlant 3D to CAEFLOW Interface
  
- AutoPlant to CAEFLOW Interface
- CADMATIC to CAEFLOW Interface
- CATIA to CAEFLOW Interface
- PCF to CAEFLOW Interface

#### 1.3.5 Nozzle and Lug Attachment Stress and Flexibility software

- CAENOSLS and CAELUG

#### 1.3.6 3D Ship Design software and Interfaces

- **For 3D Ship Design (Hull and Outfitting)**
  - TRIBON modules
- **Interfaces from 3D Ship Design software to Pipe Stress software**
  - TRIBON to CAEPIPE / CAESAR II Interface

#### 1.3.7 Drafting Software

- AutoCAD
- MicroStation
- OverCAD DWG compare

#### 1.3.8 Project Management

- MS Projects

#### 1.3.9 Interface between CAD Systems and 3D Plant Design software

- 3D.DXF to PDMS
- Stereo lithography (STL) to PDMS



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## Management Team

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### Experience arranged in chronological descending order

#### Dr. G.V. Ranjan, Director - Engineering Analyses & Software Development

- B. Tech, Aeronautical Engineering, IIT Madras, 1972
- MS & PhD, Applied Mechanics, Stanford University, California, 1974 & 1976
- Over 38 years' experience (as of March 2015)
  - 19 years of Engineering & Failure Analysis services to industrial plants
  - 19 years of engineering software and related services
- In-charge of Engineering Analyses and Software Development activities; also oversees operations including new business development and international markets
- Honors / Publications
  - EPRI Nuclear Fuel Cladding Failure Committee (ex-member)
  - US-NRC Nuclear Containment Shell Buckling Committee (ex-member)
  - PVRC Shell and Reinforced Opening Committees (ex-member)
  - Over 25 Technical Papers in international journals
  - Technical paper based on PhD thesis adjudged the best in American bi-centennial Year 1976 by American Institute of Aeronautics and Astronautics.
  - Co-authored Welding Research Council (WRC) Bulletin 297, internationally used for the design of pressure vessel nozzles
- Conducted over 60 "Piping Design and Analysis" seminars and workshops worldwide since 1988, using pipe analysis software CAEPIPE / PIPESTRESS

#### A.R. Subramanya, Sr. Vice President - Piping & Plant Layout Engineering

- B. E. in Mechanical Engineering, Mysore University
- M. Tech. in Mechanical Engineering, IIT Kanpur
- Post Graduate Diploma in Management, Bombay University
- 46+ years of experience (as of March 2015)
  - 10+ years with SST India
  - 17 years with Tata Consulting Engineers nationwide in Engineering (Mechanical) Design and Project Management for fossil fuel/ combined cycle power plants, nuclear power stations, paper & pulp, refinery and other process plants
  - 8 years with Montreal Engineering, Mumbai and Chemical India Corp., Mumbai on refinery, atomic power projects and petrochemicals.
  - 4 years at Canadian Met-Chem Consultants, Bangalore on Iron Ore processing plant
  - 2 years with Haroon Engineering in Saudi Arabia on LPG bottling and solid waste management plants
  - 3 years in chemical and fertilizer plants
  - 2 years of teaching graduate engineers

### **R.P. Sudarsan, Vice President - Civil & Structures**

- Chartered Civil Engineer (Institution of Engineers, India) - 2004
- Fellow in Civil Engineering - 1994
- MIE in Civil Engineering - 1986
- AMIE in Civil Engineering - 1971
- Over 49 years of experience (as of March 2015)
  - With SST India since May 2013
  - 8 years with Valdel Engineers and Constructors
  - 2 years with Fitchner Consulting Engineers
  - 38 years with Nuclear Power Corporation of India Limited. Last position as Additional Chief Engineer in-charge of Design and Analysis of concrete and steel structures for 220 MWe and 540 MWe nuclear power stations
  - Rich experience in design & engineering of concrete and steel structures for power and process plants
  - Member of Safety Review Committees for NPCIL and Atomic Energy Regulatory Board
  - Authored a number of technical papers on design of civil and structures

### **K M Shirolkar, Vice President - Mechanical**

- BE (Mechanical) from Nagpur University, 1970
- Post-Graduate course (1 year) in Nuclear Engineering from BARC, Trombay, 1971
- Over 42 years of experience (as of March 2015)
  - 7 years with SST India
  - 35 years with Nuclear Power Corporation India Ltd. (NPCIL)
    - Last position as Chief Engineer in-charge of “Operation and Design Support” to 14 operating nuclear power stations in India
    - Spent 10 years in the Design & Engineering of 540 MWe PHWR Tarapur nuclear power plant
    - Rich experience in process design & engineering, equipment & piping layout; designed & fabricated special heat-exchangers and pumps to replace imported ones
    - Member of Safety Review Committees for NPCIL and Atomic Energy Regulatory Board

## **M. S. Randhawa, Vice President – Electrical and Instrumentation & Control**

- B. Sc. (Engg) in Electronics from Punjab Engineering College, 1970
- Post-Graduate course (1 year) in Nuclear Engineering from BARC, Trombay, 1971
- Over 44 years of experience (as of March 2015)
  - 7 years with SST India
  - 37 years with Nuclear Power Corporation India Ltd. (NPCIL)
    - Last position as Associate Director (Electrical & Instrumentation Procurement), for Pressurized Heavy Water Reactors (PHWR) of 220 MWe and 540 MWe capacities
    - Worked over 30 years in the design, development and indigenization of Instrumentation & Control systems for 220 MWe and 540 MWe power plants
    - Life Member of Indian Nuclear Society