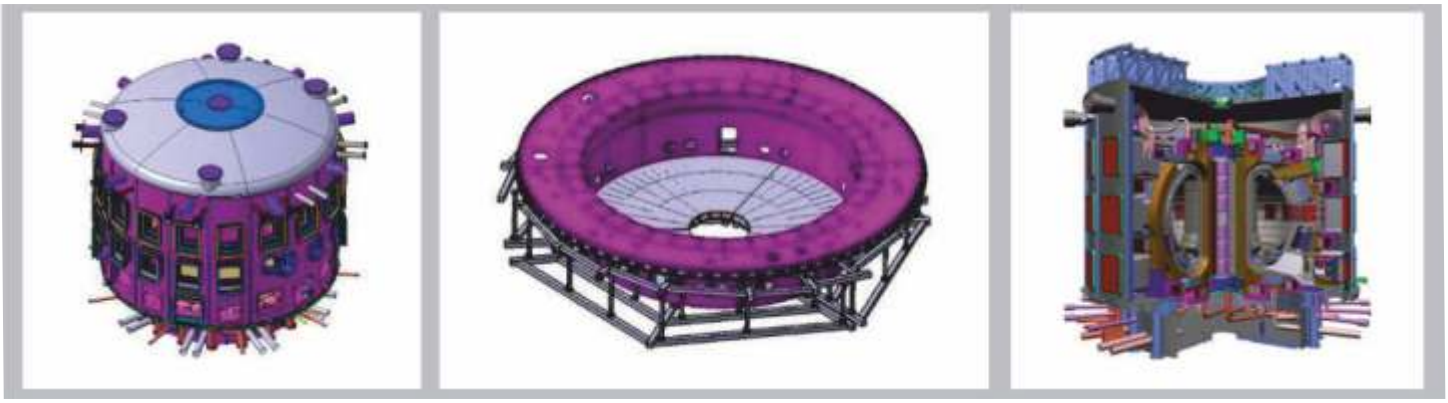
A 'Mech-in-India' Partner to the World's First Nuclear Fusion Reactor

DesignTech has had an opportunity to make valuable contributions in an internationally recognised multi-country collaborative project of building world's first Nuclear Fusion Reactor.



ITER (International Thermonuclear Experimental Reactor) is an international body that comprises of 7 countries coming together to build one of its kind experimental nuclear fusion reactor.

India's involvement

The Government of India nominated and funded an Indian agency, Institute of Plasma Research, Ahmedabad, to manage and oversee the execution of part of the project that was assigned to India. This state funded agency, formed a separate subordinate organisation, ITER-India to dedicatedly assign, manage, and review the tasks through the network of services partner vendors. ITER-India selected Pune-based DesignTech as one of the partner vendors to work in the field of and furnish mechanical designs, and conduct virtual validation of various systems and subsystems. DesignTech also had to extend the required manufacturing support and guidance to the systems manufacturing partner in India. These sub-systems were to be designed and manufactured in India and structurally integrated into the main reactor to be installed in France.

Having been consigned with the responsibility of 'design-for-manufacturing', DesignTech had to evaluate manufacturing feasibility of the parts of the sub-systems designed, and work with the manufacturing partner accordingly to support and guide them in manufacturing planning and execution.

This being the world's first experimental nuclear fusion reactor, lot of studies had to be conducted, numerous 'what-if' and worst case scenarios had to be considered.

Challenges

• **Lack of reference material:** Being the first of its kind project, there was no past reference material that could be used to understand and strategise the execution of such a vast and ambitious assignment. This being the world's first experimental nuclear fusion reactor, lot of studies had to be conducted, numerous 'what-if' and worst case scenarios had to be considered to anticipate and plan for the imminent challenges that could be encountered while executing this mammoth engineering venture.

• **Extensive Collaboration:** It wouldn't be an exaggeration to say that this could very much be one of the biggest concurrent engineering assignments in the world; requiring extensive collaboration and collective efforts with the organisations in other countries and IO (International Office), in terms of apprising other partners with updates on tasks progressions, regular knowledge and data sharing about key insights, learnings, findings, deviations if any, and discussing consequent improvisation of execution plans and strategies.

• **Project Management:** Concurrent engineering, manufacturing execution and reactor erection would require perfectly congruous tasks progression.

Seamless implementation of the project entailed breaking down of big tasks to the tiniest of details and minutest of action items with frequent monitoring and inspection.

Parameters for selecting DesignTech

DesignTech was chosen through a bidding process and after conducting detailed technical capabilities evaluation.

DesignTech was selected as a mechanical design and engineering partner charged with the responsibility of working on detailed product engineering including design, virtual validation and design-for-manufacturing of various sub-systems.

This required DesignTech to contribute in:

Design and Development:

• Ideation and conceptual designs of certain parts and components

• Preparation of detailed parametric and engineering designs through the reference data provided by the Principal Body – keeping in mind design guidelines, packaging and manufacturing aspects, product performance objectives, and logistics consideration to transport the manufactured parts to France to be integrated in the mainframe of the Reactor

Analysis and Simulation:

• Conducting detailed product design and engineering analysis through virtual tests and simulations to identify design fallacies or errors if any, evaluate systems functioning to predict failures and enhance performance.

• Performing Structural analysis and design optimisation was crucial to maintaining the overall structural integrity of the sub-systems so as to ensure and prevent any adverse causal compounding impact to the overall structure.

• Design Optimisation facilitated in streamlining agile and lean manufacturing processes through diligent use of resources thus helping to achieve greater operational efficiency

• The team of engineers had to use their expertise in the fields of advanced CAE applications such as electromagnetic analysis, thermal analysis, structural analysis (including static, modal and vibration analysis), piping simulations, and design-for-manufacturing for ensuring desired results and required quality output

Effects of manufacturing on the material properties of the products had to be also duly analysed to prevent design deviations.

Geometric Dimensioning and Tolerances analysis:

• The team had to work within extremely strict tolerances that limited the scope of deflection or warpage to be contained within the specified target in few millimetres. To ensure this level of high precision and accuracy, the team had to work on critical geometric dimensioning. This required the team to design the special fixtures that would be fabricated into the sub-system to withstand the anticipated forces and loads under all conditions and circumstances. Manufacturing processes, assembly mechanisms, and design constraints with respect to the peripheral structure had to be meticulously deliberated while working on these fixture designs. The structure had to be considered in its entirety while working on one of its aspects, making it an intellectually stimulating exercise.

• Considering the time and costs involved in reiterative designs and analysis processes, the team had to work on getting the designs right the first time, as the cost of error would be humongous.

Design-For-Manufacturing:

• Optimal manufacturing processes had to be configured after careful study of product designs. Effects of manufacturing on the material properties of the products had to be also duly analysed to prevent design deviations. In case of anomalies, manufacturing process had to be revisited, and redefined to achieve the desired output.

• Detailed manufacturing drawings had to be prepared and submitted to the other partner from India appointed by ITER-India that was tasked with the manufacturing responsibility. DesignTech worked closely with this Manufacturing partner to duly execute manufacturing operations based on the 'design-for-manufacturing' specifications of the sub-systems and fixtures that were worked out in conjunction with them.

Meeting Compliances standards:

• The team had to abide by all the requisite and stringent international and nuclear design codes, norms and standards such ASME and EJMA