Requirement analysis using critical thinking

Functional & operational requirment

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| Team ID | PNT2022TMID43285 |
| Project name | IoT Based Safety Gadget for Child Safety Monitoring and Notification |
| Maximum Mark | 2 Marks |

# Best Practices in Mission-Assured, Mission-Critical, and Safety-Critical Systems

## Requirements

Requirements group under three primary headings: Operations, Functions, and Performance.

Operational Requirements
Operational requirements pertain to the scenarios within which the product will operate. Operational requirements usually cover the following concerns:

- Mission profiles
- Infrastructure needed
- Logistics and maintenance
- Responsible party for generating the requirements
- Environment

    Shock

    Vibration

    Corrosion

    Humidity

    Temperature range

    Radiation

**Functional Requirements**

Functional requirements pertain to the physical plant and situations within which the product will reside. Functional requirements usually cover the following concerns:

- Interfaces (ICDs)—Human, mechanical, electrical, software, special (e.g., optics)
- Mechanical—Size, shape, weight, volume, density
- Electrical—Power sources, distribution
- Responsible party for generating the requirements

**Performance Requirements**

Performance requirements pertain to the metrics and parameters that describe the product's capability. Performance requirements usually cover the following concerns:

- Responsible party for generating the requirements
- Sensor parameters
  Measurand
  Speed of transduction—samples per second
  Span
  Full-scale output
  Linearity—%, SNR
  Threshold
  Resolution—ENOB
  Accuracy—SNR
  Precision
  Sensitivity—%
  Hysteresis
  Specificity
  Noise—SNR, % budget
  Stability
- Data throughput
  Bytes or samples per second
  Data transmission protocol
  Data storage
  Control

- Operation
  Electrical—Power consumption, efficiency, signal integrity
  Mechanical—Strength, motion required
  Structural—Capability to withstand environments in mission profiles
  Optical
- Calibration
- Dependability
  Reliability
  Maintainability
  Testability
  Fault tolerance
  Longevity
- Power consumption
- Dissipation and cooling
- Electromagnetic compatibility (EMC)
  Conducted susceptibility
  Radiated susceptibility
  Conducted interference
  Radiated interference

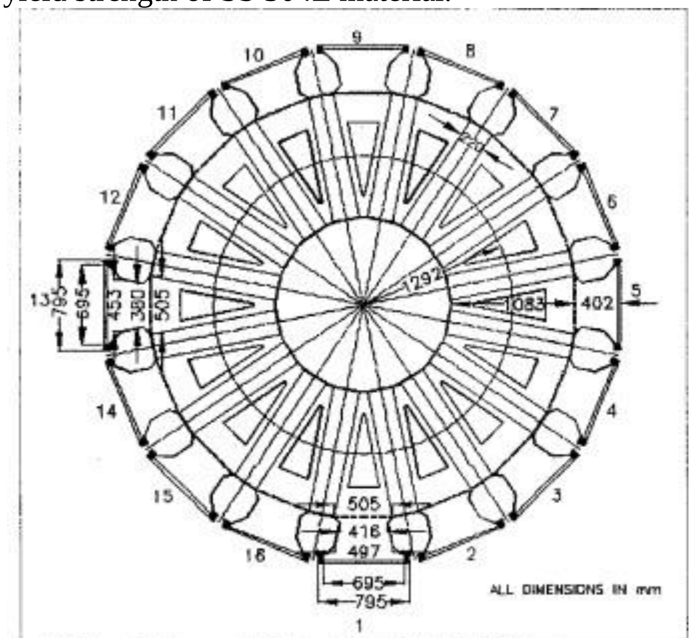
# Design of vacuum system and support structure for plasma facing components of SST1 Tokamak

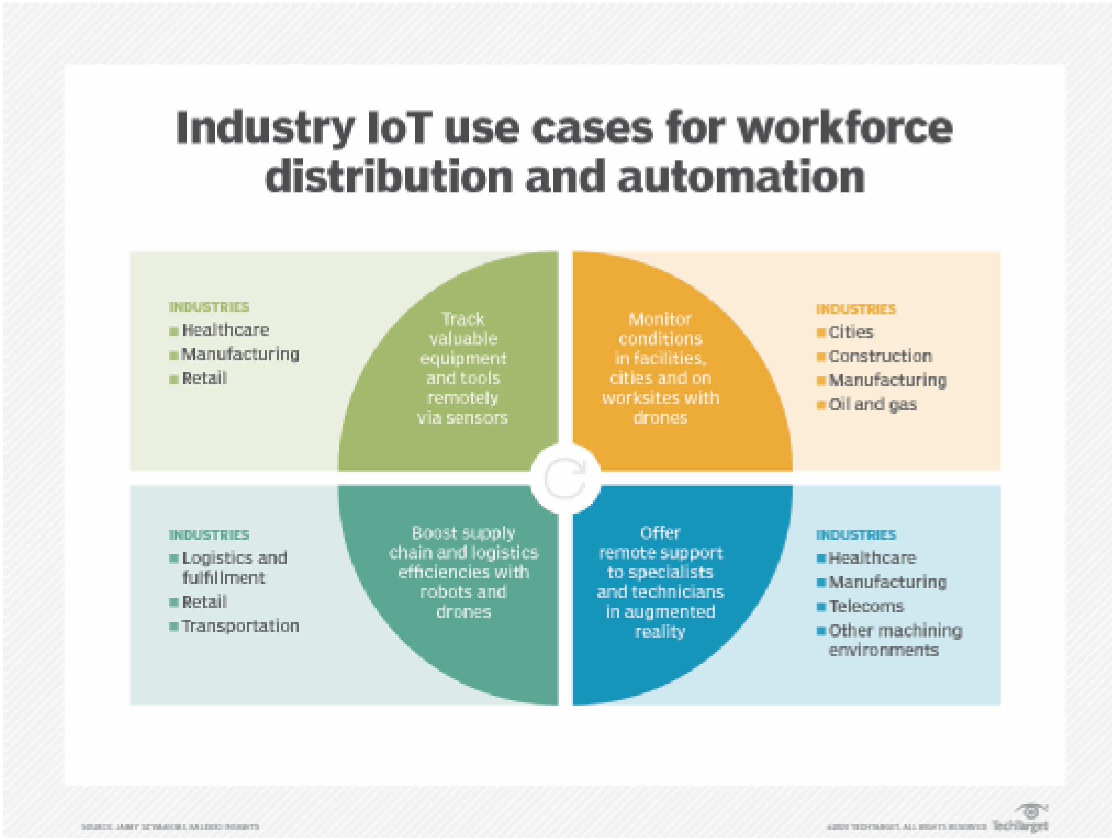
## 2.1 Vacuum vessel

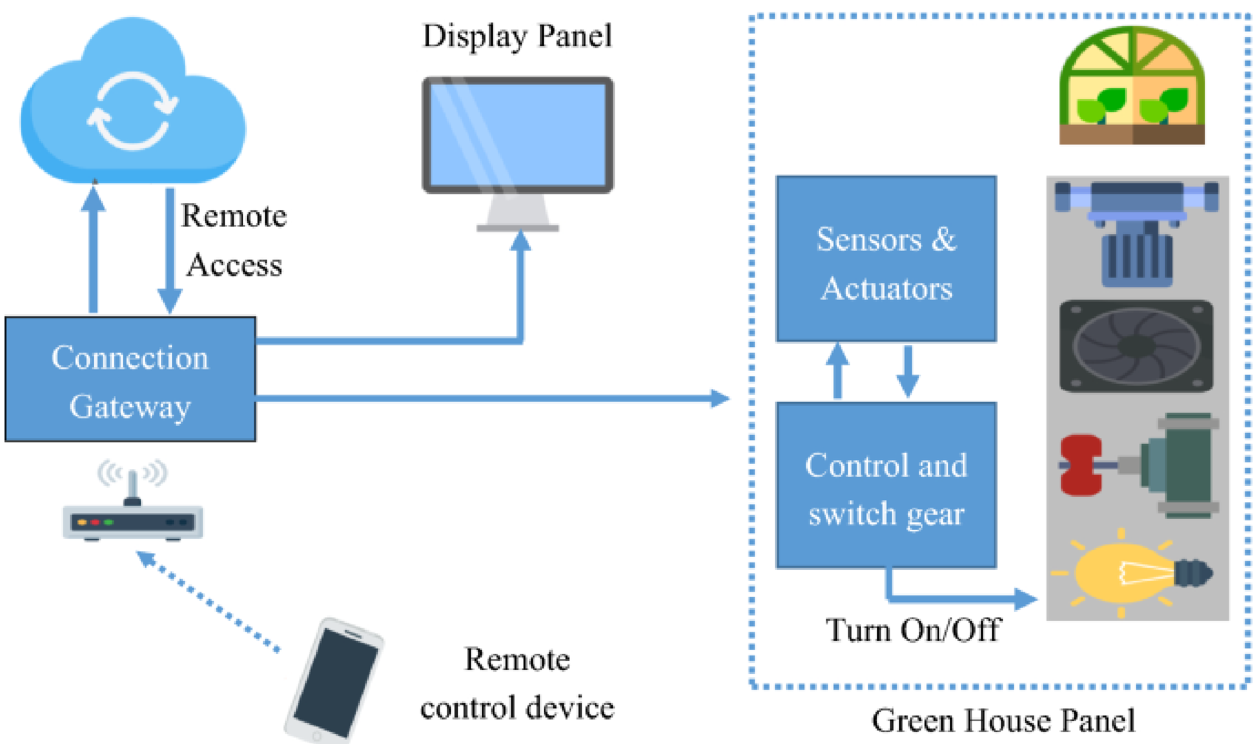
The design and operational requirements are (a) vessel should be UHV compatible, (b) vessel temperature will be 475 K during baking and 425 K during wall conditioning, (c) vessel and radial ports must have enough space for human entry inside the vessel and (d) vessel L/R time constant should be as large as possible to shield the superconducting coils from time varying magnetic field generated due to plasma movement. The estimated L/R time constant of only vacuum vessel is $7 \times 10^{-3}$ s. The vessel should be modular to remove and insert the vessel module if required for repair of a coil or vessel. This demands the insitu UHV welding of vessel modules. Vessel is made up of sixteen wedge shaped sectors which are joined together by sixteen interconnecting rings to form a complete torus. Each wedge sector contains two vertical ports and one radial port.

The material of vessel is SS 304L. The volume of the vessel upto port openings is 16 $m^3$ and the surface area exposed to UHV is 68 $m^2$. Figure 2 shows the top view of the vessel. The wall thickness of vessel is 10 mm and that of port is 6 mm. The inlet pressure and temperature of nitrogen gas to maintain the vessel at 475 K will be 5 bar and 550 K respectively with 287 $W/m^2K$ heat transfer coefficient between gas and the tube wall. It may not be possible to carry out GDC between plasma discharges due to superconducting toroidal magnetic field coils.

For this ECR plasma wall conditioning is planned. The stresses developed on the vessel wall due to internal and external pressure of 850 torr are calculated using pressure vessel design codes [1]. The estimated collapsing pressure is about 10 bar with 10 mm wall thickness. Also, the calculated average maximum stress with 10 mm wall thickness is about 18 times less than the yield strength of SS 304L material.




Industry IoT use cases for workforce distribution and automation
INDUSTRIES
Healthcare
Manufacturing
Retail
Track valuable equipment and tools remotely via sensors
Monitor conditions in facilities, cities and on worksites with drones
INDUSTRIES
Cities
Construction
Manufacturing
Oil and gas
INDUSTRIES
Logistics and fulfillment
Retail
Transportation
Boost supply chain and logistics efficiencies with robots and drones
Offer remote support to specialists and technicians in augmented reality
INDUSTRIES
Healthcare
Manufacturing
Telecoms
Other machining environments
TechTarget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Connection
Gateway
Sensors &
Actuators
Control and
switch gear
Turn On/Off
Remote
control device
Green House Panel