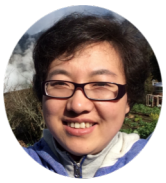

Survey and Test Environment for ITER EPP#12 Electrical Components

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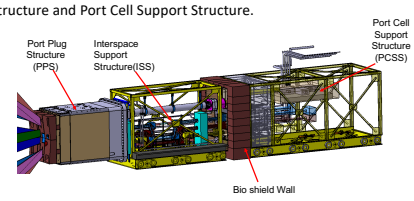
ABSTRACT: The purpose of Equatorial Port Plug 12(EPP#12) is to provide common platform, support/container for five diagnostic plant systems and one glow discharging cleaning system(GDC). As port integrator, a team from Institute of Plasma Physics Chinese Academy of Sciences(CASIPP) performs the design work. The Instrument and Control(I&C) is an important part of system design. The main I&C functions will be implemented include temperature measurements of the port structures, electrical heater with temperature control during baking of windows and providing spare input measurement channel. The integrator should provide the embedded temperature sensors, associated cabling, electrical connectors and electrical feedthrough. Most electrical components will be deployed in port plug structure which Vacuum Quality Classification (VQC) is VQC1A, the highest level. All the electrical components in port plug structure should have high vacuum compatible and compliant to ITER Vacuum handbook. In this paper, we present the survey and research of electrical components for ITER EPP#12. And the design and implement of a test environment for electrical components which is based-on ITER CODAC is also described.

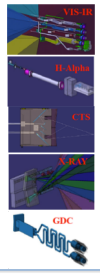
System Overview

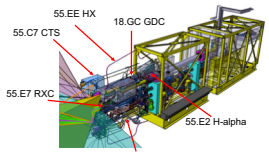
- The purpose of equatorial port plug 12 is to provide common platform, support/container for five diagnostic systems and one discharging cleaning system.
- It consists of three assemblies: Port Plug Structure, Interspace Support Structure and Port Cell Support Structure.



Tenant Systems Integrated in EPP#12

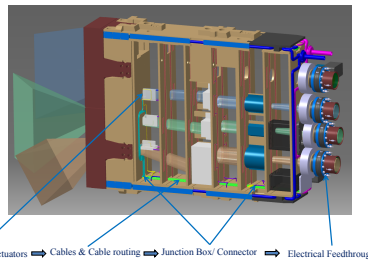
Tenant Systems





DSM1	55.G1.C0 Vis/IR
	55.E2.C0 H-Alpha
DSM2	55.E7 Radial X-ray Camera
	55.EE Hard X-ray Monitor
	18.GC Glow discharge system
DSM3	55.C7 Collective Thomson Scattering

In-PP Electrical Components



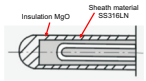
In-PP Electrical Needs

- Working Temperature : 20℃ - 240±10 ℃
- ITER Vacuum Quality Classification : VQC1A
- Radiation at the back of DSM (including plasma and cooling water effects)
  - Neutron flux : 1011 n/cm2/s ;
  - Neutron fluence : 1.7*1018 n/cm2;
  - Gamma dose : 100 mGy
- Alignment accuracy : 2mm
- Remote Handling Compatibility

Type	Architecture	Signal	Qualities
LP/LF	Mineral Twisted Pair	15	22
	N Type Thermocouple, mineral	70	70
MP/LF	Mineral Twisted Pair	12	12
HP/HF	50 ohm, Coaxial Cable	1	1

Thermocouple

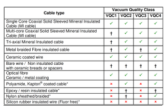
- Thermocouple Type
  - Type N (NiCrSi+-NiSi-)
- Sheath material
  - 316L, VQC1, Vacuum handbook Appendix3 Accepted Materials

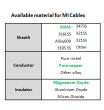


- Hot junction type
  - Insulated, The hot junction is insulated from the sheath
  - Insulation material : MgO/Al_2O_3

Extension Cables

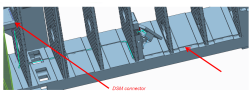
- Chemical resistance of sheath material (Radiation and Fire Resistance)
- Abrasion and vibration resistance
- Vacuum Requirements
  - High vacuum compatible(outgassing, Paschen effect, etc.)
  - Compliant to vacuum handbook: ITER Vacuum Handbook Appendix10



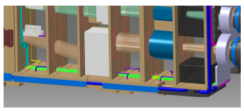


Cable Routing

- Rectangle-shape cable routing proposal



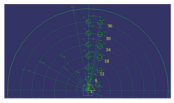
- Straight channel cable routing proposal



Electrical Connector

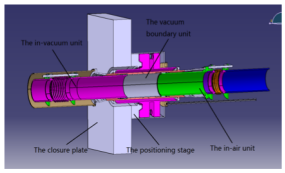
Electrical Connector requirements

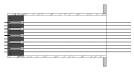
- Three type of connector
  - High Power/High Frequency (HP/HF)
  - Middle Power/Low Frequency(MP/LF)
  - Low Power/ Low Frequency(LP/LF)
- Remote Handling compatible

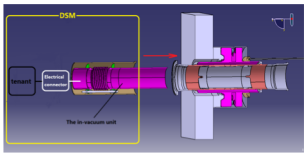


- LEMO Thermo Connector

Electrical Feedthrough







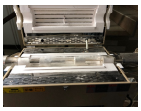
Electrical Components Test Tool

Main Function

- To use ITER Integration kit (Mini-CODAC, PSH, Network Switch) and Slow Controller(PLC) to set up test environment.
- To test the performance of electrical components(Thermocouples, Extension Cables and Electrical Feedthrough) under difference condition(operation 70℃, baking 240℃).

Mini-CODAC & PSH

Slow Controller



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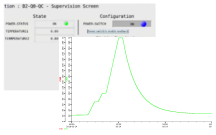

Future

- The initial test of electrical components was done in normal temperature and under baking temperature. To consolidate these selection, the next steps will be:
  1. The long distance testing
  2. The radiation resistant testing

The second step requires to find a facility to provide suitable test environment and will be expensive. So it may be test together with the electrical feedthrough.

Acknowledgement

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