

Design and manufacturing of the VV PHTS Primary HX (HX-1000), Volume control HX (HX-5001) and Decay HX (HX-2000)

Call for Nomination

Purpose

The purpose of this Contract is to design and manufacture the heat exchangers of the Vacuum Vessel Primary Heat Transfer System.

The heat exchangers shall be compliant with the French Order dated 30 December 2015 on Nuclear Pressure Equipment (ESPN) and the 2014/068 EU directive. The VV PHTS heat exchangers are classified as an ESPN equipment level N3.

The heat exchangers shall be shell-and-tube type.

The ITER Organization will act as Equipment Manufacturer as it pertains to the ESPN, which is the legal entity which assumes responsibility for the design, manufacture and inspection of a product to be marketed under its name as an item of pressure equipment, nuclear pressure equipment, or a nuclear pressure assembly. ITER will liaise with the Agreed Notified Body for the ESPN compliance assessment.

The supplier will be responsible of drafting the Nuclear Pressure Equipment (ESPN) and the 2014/068 EU directive required documentation, such as hazards and risk analysis, design notes and drawings, design notes justifying correct equipment behaviour for each possibility of damage from the different cases of load combinations, instruction manual as well as any other document that can be used to show compliance to the essential safety requirements.

The main design parameters of the heat exchangers are the following:

Volume Control HX (HX-5001): water/water heat exchanger

h.S: 29.4 kW/K

Rated power: 2.2 MW

P_{design}: 2.6 MPa

T_{design}: 240 °C

Fouling (process side): $50 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

Fouling (cooling side): $100 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

For the rated conditions

	Process side	Cooling side
Inlet temperature	195°C	31°C
Flow rate	4.8 kg/s	10 kg/s
Allowable pressure drop	0.1 bar	0.5 bar

Primary HX (HX-1000):

h.S: 268.8 kW/K

Rated power: 12 MW

P_{design}: 3.8 MPa

T_{design}: 240 °C

Fouling (process side): $50 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

Fouling (cooling side): $100 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

For the rated conditions

	Process side	Cooling side
Inlet temperature	103°C	31°C
Flow rate	170 kg/s	100 kg/s
Allowable pressure drop	0.5 bar	0.5 bar

Decay HX (HX-2000):

h.S: 7.6 kW/K

Rated power: 600 kW

P_{design}: 2.6 MPa

T_{design}: 240 °C

Fouling (process side): $50 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

Fouling (cooling side): $100 \cdot 10^{-6} \text{ m}^2 \cdot \text{K/W}$

For the rated conditions

	Process side	Cooling side
Inlet temperature	101°C	6°C
Flow rate	170 kg/s	24 kg/s
Allowable pressure drop	0.6 bar	0.5 bar

Background

The Tokamak Cooling Water System (TCWS) is the primary coolant system of ITER machine having the aim to remove the power generated by the plasma and transferred to dedicated components of the machine and to release it to the secondary coolant system.

The TCWS is based on three Primary Heat Transfer Systems (PHTSs): VV PHTS for cooling the Vacuum Vessel, IBED PHTS for cooling the in-vessel components and NBI PHTS for cooling the Neutral Beam Injectors.

The TCWS includes auxiliary systems as the Chemical and Volume Control System (CVCS), Draining and Refilling System (DRS), and Drying System (DYS).

The TCWS is designed to reject all the heat generated in the plasma and transmitted to the in-vessel components to the intermediate closed loop CCWS-1 (Component Cooling Water System 1) and then to the environment via the HRS (Heat Rejection System). TCWS release heat also to the Chilled Water System (CHWS).

In the ITER Plant Breakdown Structure (PBS), the Cooling Water System consisting of TCWS, CCWS, CHWS and HRS, is represented by the PBS 26. The level 2 and 3 of PBS 26 and the sub-systems belonging to TCWS are reported in Table 2.1.

The Vacuum Vessel Primary Heat Transfer System (VV PHTS) provides cooling and baking services by supplying demineralized water to the main channels of the vacuum vessel, field joints, port extensions and port stub extension field joints at the lower ports, and the neutral beam port extensions. The VV PHTS is designed to provide the primary confinement for Activated Corrosion Products and tritium entrained in the cooling water outside the Vacuum Vessel and maintains leak tight integrity during all operating modes. The VV PHTS heat exchangers perform the following functions:

- HX-1000: removes the power deposited to the vacuum vessel during plasma operation and cools down the vacuum vessel and its PHTS during baking
- HX-5001: cools down the letdown flow at the inlet of the volume control loop
- HX-2000: remove the residual power of the in-vessel components following a Loss Of Offsite Power.

Scope of work

The contract will include design, fabrication, inspection, examination, testing, certification, packaging, and shipping of the VV PHTS heat exchangers.

Timetable

The tentative timetable is as follows:

Tender submission	Sept 2019
Contract placement	Dec 2019
Completion of Contract	July 2022

Experience

The contractor and its personnel shall have adequate experience in manufacturing of heat exchangers in compliance with the 2014/068 EU directive and American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (B&PV) Section VIII, Division 2—2015 Edition or equivalent codes.

The contractor shall own a viable license of ASPEN, HTRI or similar design software and show demonstrated experience in heat exchangers design codes such as TEMA, CODAP or equivalent.

Candidature

Participation is open to all legal persons participating either individually or in a grouping (consortium) which is established in an ITER Member State. A legal person cannot participate individually or as a consortium partner in more than one application or tender. A consortium may be a permanent, legally-established grouping or a grouping, which has been constituted informally for a specific tender procedure. All members of a consortium (i.e. the leader and all other members) are jointly and severally liable to the ITER Organization.

The consortium groupings shall be presented at the pre-qualification stage. The tenderer's composition cannot be modified without the approval of the ITER Organization after the pre-qualification.

Legal entities belonging to the same legal grouping are allowed to participate separately if they are able to demonstrate independent technical and financial capacities. Candidates (individual or consortium) must comply with the selection criteria. The IO reserves the right to disregard duplicated reference projects and may exclude such legal entities from the pre-qualification procedure.