Technical Specifications (In-Cash Procurement)

RH Telemanipulator Procurement - Technical Summary

Technical Summary for the Call for Tender process of the RH Telemanipulator System

TECHNICAL SUMMARY

RH Manipulator Supply Framework

Call for Nomination

Abbreviations and Acronyms

Abbreviation	Description
ART	Agile Robot Transporter
BRHS	Blanket RH System
CMM	

1 Purpose

The purpose of this document is to provide summary information for a Call for Nomination for the tender of a contract to supply a two arm Remote Handling (RH) Telemanipulator System to the ITER Organization.

This Call for Nomination is to seek companies interested in participating in the tender for the subject Contract.

2 Scope of the Contract

RH telemanipulators are a key component of the ITER RH System, and they are required in several of the RH task specific sub-systems. The different RH sub-systems can have different telemanipulator requirements in terms of size, reach, and payload.

The scope of this contract is for the supply of a two arm, radiation tolerant, electrical telemanipulator system that will initially be used for RH mock-up trials, and later will be integrated into the RH System for remote maintenance of the ITER machine. The specifics of the telemanipulator specification for this procurement will be derived from the RH ART (Agile Robot Transporter) sub-system requirements (see Annex A 7.2.4).

The telemanipulator system will need to satisfy ITER customisation requirements (described below). It is expected that the supplier has the ability to configure and tailor its telemanipulator product to meet the IO requirements. The contract scope, therefore, will cover:

- Detailing of the manufacturing design of the customised telemanipulator system,
- Manufacturing and testing of the telemanipulator system,
- Delivery and installation of the telemanipulator system at IO premises.

3 Background

ITER is a large-scale scientific experiment intended to prove the viability of nuclear fusion as an energy source, and to collect the data necessary for the design and subsequent operation of the first electricity-producing fusion power plant.

Once nuclear plasma operations have begun, the in-vessel environment will become a highly hazardous environment prohibiting human access, and the in-vessel maintenance tasks will be carried out fully remotely using remote handling systems. The operation of the RH systems will take place from a fully remote control room located outside the nuclear buildings.

ITER is being constructed in Europe, at Cadarache in the South of France (see www.iter.org for an overview of the ITER project). The ITER Organization (IO) is the nuclear operator, complying with the relevant French Laws and regulations, authorization, codes and standards applied to Basic Nuclear Installation (INB). IO is responsible for integrating the activities from the early stage of design, to the procurement, the assembly, commissioning and operation. Further background information is provide in Annex A.

6 RH Telemanipulator System Summary Specification

6.1 Telemanipulator System

The Telemanipulator System shall

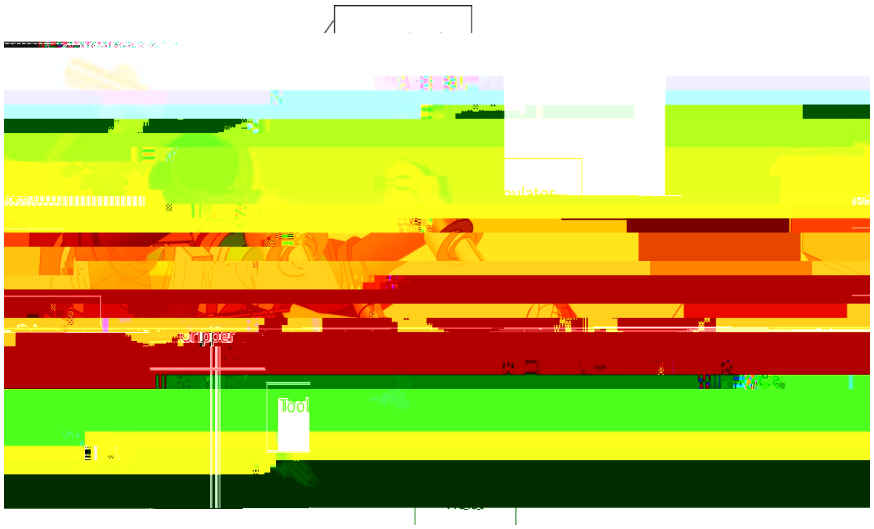

Figure 2. Concept of the ART Manipulator

The slave manipulator arms shall have 6 degrees of freedom (excl. grippers), 50kg payload capacity, and the bespoke dimensions as shown in the drawing below.

The slave manipulator arm workspace shall envelope a 1m sided cube.

The slave manipulator arms shall have grippers consistent with the handling of 50kg payloads.

The slave manipulator shall require electrical power only.

The slave manipulator arms shall provide means for rescue in case of single point failure.

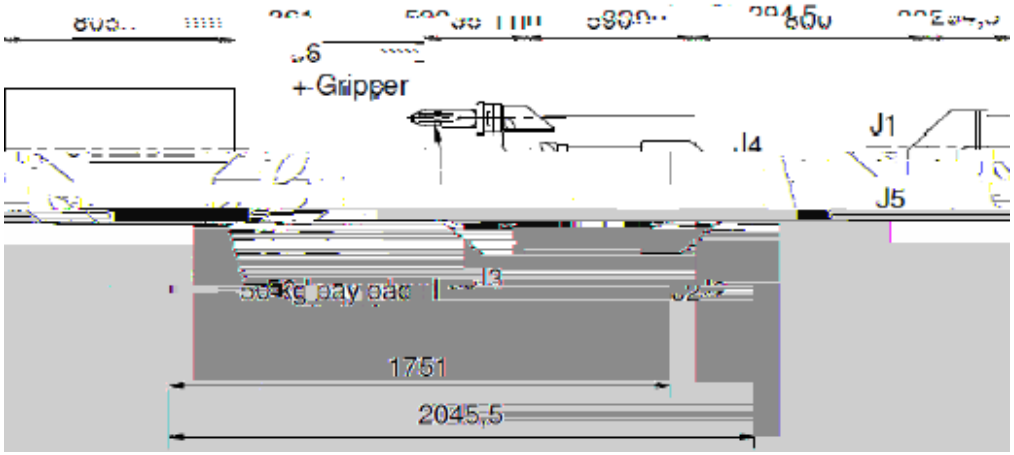

Figure 3. Required dimensions for the ART manipulator arms

The slave manipulator unit shall be capable of being folded to fit within the ART end-effector transfer trolley drawers (Internal LxWxH = 2000x1200x650mm).

Environment conditions	Between 20°C and 50°C, Relative humidity up to 60% Residual magnetic field up to 1mT
Power source	Electrical
Distance between master and slave	Up to 1 km
Communication between master and slave	LAN
Force reflecting	Essential
Reach	Minimum of 2m
Payload per arm (centre of gripper)	

Figure 8. Identification of some in-vessel components requiring maintenance

On the north side of the vacuum vessel, the Neutral Beam (NB) Cell contains multiple NB injector systems. The maintenance of these systems and other equipment in the NB Cell will also require the use of remote handling systems.

Figure 9. Identification of some NB Cell components requiring maintenance

The procurement of the ITER RH System involves 3 parties: the ITER Organization, the European Domestic Agency (F4E), and the Japanese Domestic Agency.

7.2.1 Blanket RH System

The Blanket RH System (BRHS) is used for the in-vessel replacement of the Blanket first wall and shield block modules. The Tool Manipulator sub-system is a dual arm manipulator that is transported inside the vessel by the Vehicle Manipulator.

Figure 10. Overview of the Blanket RH System

7.2.2

Figure 11. Overview of the Divertor RH System

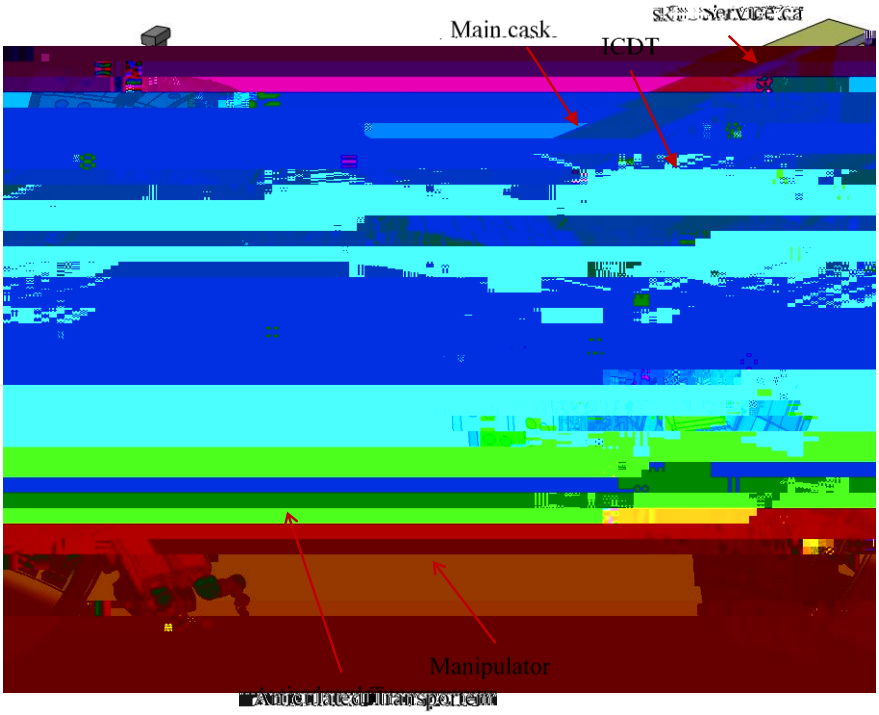

Figure 13. Overview of ART system with Manipulator as End-Effector

7.3 Telemanipulation at ITER

7.3.1 Control System

The Telemanipulator is the key RH tool for carrying out dextrous operations in a remote environment. At ITER the remote environments are spread over the Tokamak building (B11) and the Hot-Cell building (B21), and the control is from a fully remote control room in the Personnel Access Control Building (B24). The ITER Telemanipulator system is, therefore, an electrically linked master-slave device rather than a mechanically linked master-slave device.

The ITER Project has multiple potential remote maintenance activities at many different locations in the nuclear buildings, and the ITER RH System will contain a large set of devices to have the capability to perform these tasks. For any one shutdown campaign, only a sub-set of the maintenance activities will be needed, and only a sub-set of the RH System will be deployed. The RH System and RH Control Room need to have the flexibility to be configured to operate the required sub-set of the RH System needed for a specific ITER maintenance shutdown. Specifically, this means that the RH Control Room will have standardized work-cells, with standard hardware, that can be configured to operate any of the RH sub-systems.

The figure below shows the required distributed control system architecture in simplified form. The only communication between the different ITER buildings is through digital networks. The overall system will contain multiple master and slave devices. The ITER RH System will require a range of slave manipulators as each RH sub-system can have specific requirements in terms of space, kinematics, reach, load capacity. In the RH control room, however, it is highly desirable to have a standard master arm device.

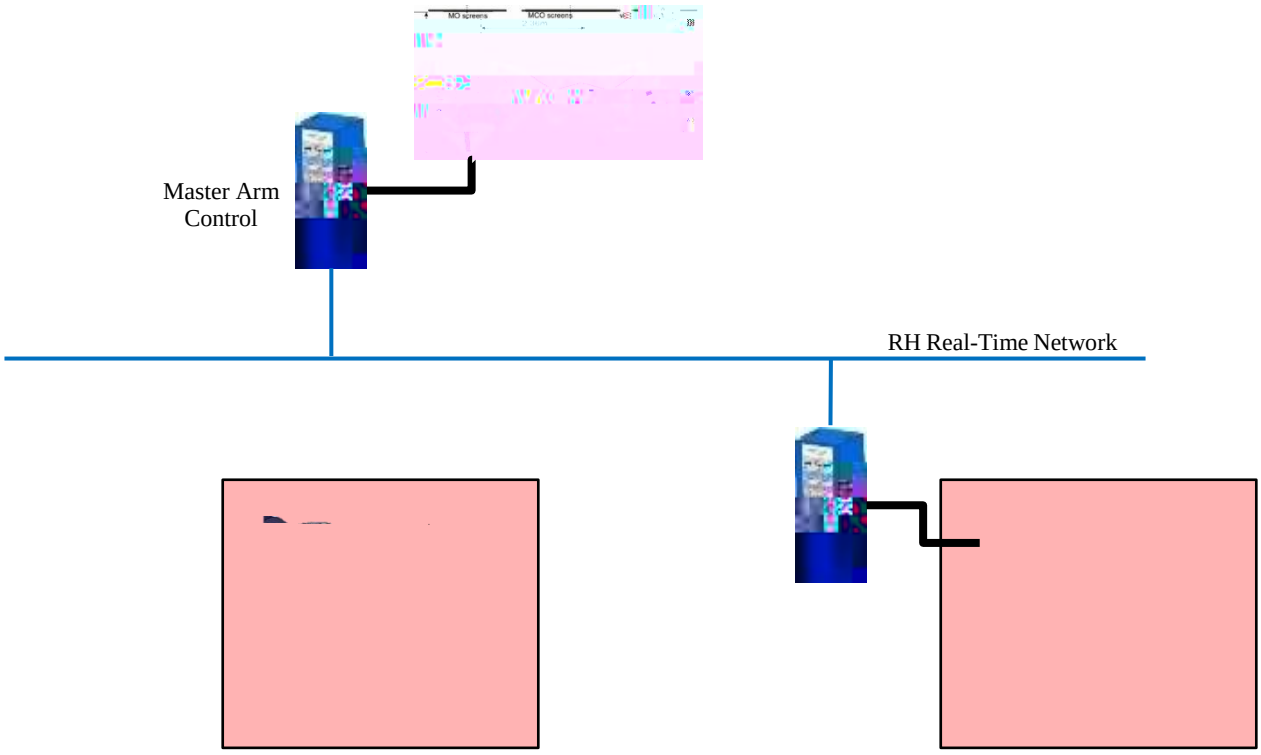

Figure 14. Distributed architecture for the ITER RH Telemanipulator system

7.3.2 Operations

The general objective of the Telemanipulator system is to provide human maintenance capabilities in the remote hazardous environment. The man-in-loop operation allows for a wide capability and flexibility for doing maintenance tasks and coping with variations in the task conditions. Typically a

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feedback telemanipulation system, together with a remote viewing system is used by the operator to perform tasks requiring interaction with the remote environment. The positioning of the telemanipulator does not need to be very precise since the operator can perform the tasks based on the relative positioning of the manipulator to the task. In some cases, automated motions may be used once a datum is established.