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SUMMARY OF PROJECT

CRYOSCOPE IV. STUDIES AND ANALYSIS WORK FOR THE ITER CRYOGENIC SYSTEM ITER/RT/09/82/PMT - PR10001141

CRYOSCOPE IV

The evolution of the cryogenic requirements requires further investigation and optimisation of the plant design to ensure the plant capability to cover the static and dynamic heat loads.

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1 Abstract

This contract between ITER and the Contractor involves studies and analysis work for the ITER cryogenic system.

Two parts are considered within the contract.

The first part is dealing with the characterization of the cryoplant design solution providing the optimum in terms of energy consumption, investment costs and reliability. The aim is to validate the engineering solution by means of quasi-static and dynamic simulation validating the capability to deal with the highly pronounced variation of the heat loads during different operation scenarios.

The second part involves general cryo engineering support. This support should cover questions and topics ranging from thermo-fluid dynamics up to detailed engineering.

These studies are necessary as they will provide the information which is essential to design the cryogenic system adapted to the requirements of the ITER machine.

2 Background and Objectives

The evolution of the cryogenic requirements in the last year requires further investigation.
In order to optimize the overall architecture of the cryogenic system industry support is highly desirable. ITER Organization is interested to establish an engineering support. The highly developed cryogenic engineering expertise of industry partners should find application in general studies as well as possible detailed and specific issues.

3 Experience

The Contractor must have a proven record of more than 10 years experience in design, manufacturing and commissioning of large scale (several kW) helium refrigeration plants working at 3.7 Kelvin or lower temperature.

4 Scope of Work

This contract scope is the validation of a proposed cryoplant design solution via the following subtasks:

PART ONE

Subtask-1: Quasi static simulation (based on the technical design data of the components)

Subtask-2: Delivery of executable files allowing ITER team to repeat the static calculation as well as carrying out modifications on the ITER input data.

Subtask-3: dynamic simulation ZERO (tests on existing cryogenic installation)

Subtask-4: dynamic simulation I

Subtask-5: Delivery of executable files allowing ITER team to repeat the dynamic calculation as well as carrying out modifications on the ITER input data.

PART TWO

General Cryo engineering support

5 Work Description

Based on the input documents, data and requirements from ITER the Contractor shall review and propose the cryoplant design and validate the choices by quasi-static and dynamic simulations.

PART ONE

Subtask-1: Quasi static simulation (based on technical design data of the components)

1. Zero refrigeration load - maximum liquefaction - *off design case*
2. Low refrigeration load - low liquefaction - *off design case (Short term stand by – to be defined by ITER)*
3. Minimum refrigeration load - maximum liquefaction - *design case* (+ 3.7K *off design case*)
4. Maximum refrigeration load - minimum (or negative) liquefaction - *design case* (+ 3.7K *off design case*)
5. Average load - *design case* (+ 3.7K *off design case*)
6. Zero refrigeration load - maximum liquefaction - without LN_2 support - *off design case*
7. Maximum refrigeration load - zero liquefaction - without LN_2 support - *off design case*
8. Zero load - *off design case*
9. Cooldown (different phases – *to be defined by ITER*)

Special attention needs to be paid to the following issues:
The variation of the heat loads at the cryopump system (depending on the operation scenario the liquefaction and refrigeration load will change in different manner) and the gas management between different loops (4.5 K and 80 K cooling loops; during operation of the cryopumps a certain amount of helium from the 80 K loop will be used for the procedure of regeneration) and different refrigerators.

Subtask-2: Delivery of *.exe file allowing ITER team to repeat the static calculation as well as carrying out modification on the ITER input data.

Subtask- 3: dynamic simulation ZERO (tests on existing cryogenic installation)

In order to check the capability of the cryogenic installation to cope with varying heat loads and to validate the dynamic simulation model tests on other facilities are foreseen. For these tests heat load variations scaled from the ITER application will be used to show the dynamic behaviour of an existing installation compared to the behaviour predicted by the dynamic simulation. The aim is to prove the overall stability and ability of the dynamic simulation program to produce results closed to real operation scenarios. The contractor will provide engineering support to facilitate these tests.

Subtask-4: dynamic simulation I

The principal aim of this investigation is to simulate the behaviour of magnet and cryopump systems including cryoplant and cryodistribution during transient operation. Different dynamic scenarios will be simulated and the behaviour of the cryogenic system investigated. The requirements are as defined for the quasi static simulation but taking into account the speed of heat loads variation in each magnet and cryopump subsystems (ACB's)

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Subtask-5: Delivery of *.exe file allowing ITER team to repeat the dynamic calculation as well as carrying out modification on the ITER input data.

PART TWO

General Cryo engineering support

In order to optimize the overall architecture of the cryogenic system industry support is highly desirable. ITER Organization is interested to establish a continuous engineering support for investigation, calculation, design and test activities. Up to 20 hours per month could be required. The offer should list the cost for 20 hours per month and duration of 15 months of engineering support.