Task Title: JW3-EP-ICRH and JW4-EP-ICRH: CONTRIBUTION TO ICRH COMPONENTS ANTENNA LIMITER

INTRODUCTION

The scope of the present project is the design and the manufacturing of the ICRH antenna limiter (figure 1) which was to be installed in the JET vessel during the 2004 shutdown.

The contractual activity on the antenna limiters was launched on May 2002 and consisted mainly for the first 1.5 years in designing, engineering, calculations, drawings and procurement specification for the limiter project.

This work is produced in close collaboration with the JET operator and the EFDA CSU JET and has been reported previously.

The task agreement for 2004 was oriented towards the manufacturing activities associated to this project.

2004 ACTIVITIES

CFC TILE MACHINING MONITORING

A contract was awarded by the commission, at the end of 2003, to Carbone Lorraine in Paris for the machining of the antenna limiter tiles (private & poloidal) and for the divertor replacement tiles.

The main activity on this task was the monitoring of this contract following the requirements of the EFDA CSU JET and the UKAEA quality insurance system.

The plasma facing side of every tiles was designed following a 3D contouring allowing for very precise shadowing of all edges in a variety of plasma configuration. Therefore the contour machining was directly processed from the CATIA drawing files. A limited quantity of graphitised Carbon Fiber Composites blocks were available. Consequently the quality plans of all tiles were directed as to allow for control & validation of graphite prototypes before machining the CFC blocks.

Figure 1 : Antenna limiter & divertor new configuration
Progress in manufacturing was followed by a monthly progress report from Carbone Lorraine as well as by monthly visits, to be added to the hold points decided on the quality plans.

The first divertor tiles were delivered in June 2004, the first poloidal limiter tiles in October 2004 and the last private limiter tiles in December 2004.

**SUPPORT STRUCTURE**

The Kick off meeting for the manufacturing contract of the support structuring took place in October 2003. The monitoring of this contract covered also the manufacturing of the metallic supporting structure for the divertor new load bearing septum replacement plate.

The manufacturing contract was allocated to R. Mulheisen Gmbh, a German company based closed to Frankfurt.

The first 4 month of the contract were mainly devoted to the paper work associated to the stringent specification which was written in accordance with the EFDA CSU Jet requirements and following the UKAEA quality Insurance.

After validation of all manufacturing drawing by CEA and approval of the quality plans, the purchase of raw material was allowed.

Close monitoring of the subcontracted company for the welding was done in collaboration with the UKAEA welding engineer allowing for a precise quality plan for all welds, in accordance with the UKAEA QA.

Over 5000 Items were machined for these limiters mainly in Inconel 625.

Other materials such as Alu bronze, Nimonic, Inconel 725 & Nickel 200 were also used.

All elements were fully checked on a 3D measuring device.

The close monitoring of this limiter involved checking all the different subcontractors and validating their quality insurance systems.

All monitoring reports were transmitted to the operator and commented during the numerous projects meetings.

**INSTALLATION**

Final delivery of the limiters done on December the 20th 2004.

Installation in the machined by the operator was scheduled for the first month of 2005 and started by manual set-up and adjustment of the supporting legs, before separate installation of the beams (poloidal & cross) by remote handling.

All tiles were also to be installed individually by the same means.

**CONCLUSIONS**

All tasks associated with the design and manufacturing of the poloidal ICRH limiters are achieved as well as the monitoring activity for divertor elements. The final paperwork is under process.

The specific design and technical achievements for this project were reported in the Venise 23rd SOFT conference.

**REPORTS AND PUBLICATIONS**


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INTRODUCTION

In the framework of the JET-EP project, proposal sent by the Association CEA Cadarache to develop a new diagnostic for thermography analysis was approved by EFDA in 2002. This system will allow to see a large section of the internal components in the vessel such as divertor, main chamber, ICRH antenna etc, aiming at measuring the surface temperature during normal operation and off normal events such as ELMs and disruption. This diagnostic is ITER relevant both for the technology used and for the physic outputs. This system will allow to evaluate the power deposition in the main chamber during transient events and could be used, in the future with implementation of a feed back control, for real time machine protection.

2004 ACTIVITIES

The scope of the work in 2004 was the following-up of the two Article 7 contracts launched in 2003 for procurement of an infrared camera and an endoscope.

The infrared camera and acquisition system have been manufactured without major problems.

Some technical difficulties occurred on the production of the infrared filters due to the strong optical requirements; the filters have finally been delivered within the specifications with a few months delay. IR camera has been delivered and tested in CEA Cadarache in November 2004. Software to interface the IR camera and the JET acquisition system is being developed and should be implemented during the first term of 2005.

Prior to the start of the work on the endoscope contract, additional work has been needed to clarify the interface with the JET machine. Then, detailed optical and mechanical designs have been produced by TNO. Further to final approval of the design by the project team, the manufacturing phase could start in November 2004.

Manufacturing phase is now finished for both contracts and the project is now a very likely to be ready in August 2005, as initially expected. Due to delay in the JET Shutdown Plan, the JET EP IRV would be now installed during the Restart and should be operational at the beginning of the C15 Campaign.

Figure 1 : Schematic layout of the Infrared Camera data acquisition system on JET
CONCLUSION

The manufacturing phase is over and we are now in the assembly and integration phase of the project. The JET EP IRV diagnostic is planned to be commissioned during summer 2005 and should be operational at the start of the C15 Campaign.

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