EFDA GOAL ORIENTED TRAINING SCHEME

TASK AGREEMENT
WP08-GOT-ITER_PPE

Trainee Report
Reporting Period: January 2011 – August 2011

Entire Period of Research Training: September 2008 – August 2011

NAME OF TRAINEE:	**GAETANO AIELLO**
EMPLOYING INSTITUTION / TA PARTNER:	**KARLSRUHE INSTITUTE OF TECHNOLOGY (KIT), INSTITUTE FOR APPLIED MATERIALS - APPLIED MATERIALS PHYSICS (IAM-AWP), GERMANY**

Report on training actions

In August 2011 the trainee Gaetano Aiello finished his training activity in the framework of the ITER Goal Oriented Training Programme on Port Plug Engineering. The activity was devoted to materials, manufacturing and assembly of upper port plug structures, with particular application on the ITER Electron Cyclotron Resonance Heating (ECRH) upper port plug.

In the framework of the training programme some stays are foreseen in the involved industrial companies. The trainee carried out a stay at MAN company in Deggendorf from the 12th of January till the 2nd of February 2011. The front part of the upper launcher main frame is exposed to substantial nuclear heat loads up to 0.8 Wcm^{-3}. To meet the high cooling requirements, the front part is designated as a double wall steel structure with a specific cooling path for the water. Several manufacturing options are taken into account at KIT in order to find the best one in terms of mechanical and fluid dynamic performance, reliability, feasibility and costs. MAN company is in charge of building two prototypes of this double wall steel structure according to two different manufacturing techniques:

1. SS 316L prototype obtained from a single main body where the cooling path is made by deep hole drilling,
2. SS 316L prototype obtained from two parallel plates kept together by welded bolts and where the cooling path is made by welding ribs and baffles to the plates.

The trainee worked in the design of the second prototype using CATIA V5 and with the help of MAN experts, he performed the design of the prototype taking into account its real manufacturing process and DIN norms. The trainee also experienced the working activity in the manufacturing workshop, for instance taking part in the milling process of the first prototype to create the manifolds for the cooling path. After the stay, he carried on the design of the prototype at KIT.

Then, the trainee carried out a stay at REUTER TECHNOLOGIE company in Alzenau from the 2nd to the 21st of April 2011. The ECRH upper launcher counteracts the neoclassical tearing modes and the sawteeth instabilities of the ITER plasma by localized deposition of high power microwave beams. The microwaves are generated from gyrotrons and travel along transmission lines before reaching the plasma. Diamond window units are used for the microwave transmission as vacuum and tritium barriers towards the gyrotrons. They are made up by artificially grown CVD-diamond disks brazed to window housings and REUTER company is in charge of brazing one prototype of such a diamond window unit. The trainee experienced several welding techniques such as TIG welding, gas welding, laser welding and vacuum brazing. He studied the several welding methods by theory and was actively involved in some practical activities in the manufacturing workshop. For instance, with reference to

the vacuum brazing which is used for the diamond window prototype, he studied the welding parameters to be controlled, the various filler materials which can be used, etc. In the manufacturing workshop he also experienced milling, turning and grinding processes of components for vacuum chambers, cooling plates, etc.

In this reporting period, the trainee also performed CFD and thermo-mechanical analyses using respectively ANSYS CFX and ANSYS WORKBENCH for a double disk CVD diamond window unit, which was tested at the ASDEX Upgrade tokamak in Garching with a transmitted beam power of 580 kW at 140 GHz. The purpose of the analyses was to evaluate the thermal deformation and stress fields in the diamond disk.

Other activities related to meeting and training courses:

- Giving High Performance Presentations, 28-29 March 2011, Karlsruhe.
- Effective Negotiations, 30-31 March 2011, Karlsruhe.
- ANSYS Dynamics course, 2-3 May 2011, KIT Karlsruhe.
- 23rd Joint Russian-German Meeting on ECRH and Gyrotrons, 23-28 May 2011, Karlsruhe-Stuttgart-Garching. The trainee did a presentation on outgassing measurements for the ITER ECRH upper launcher.
- Vacuum and Cryo-technology course, 7-8 June 2011, Karlsruhe.
- Project Management, 9-10 June 2011, Karlsruhe.

References:

- P. Spaeh, A. Vaccaro, **G. Aiello** et al., Structural design and analysis of an ECRH launcher for JET, *Proc. 38th IEEE International Conference on Plasma Science and 24th Symposium on Fusion Engineering*, Chicago, Illinois, June 26-30, 2011.
- D. Strauss, **G. Aiello**, R. Chavan, S. Cirant et al., Preliminary design of the ITER ECH upper launcher, *Proc. 38th IEEE International Conference on Plasma Science and 24th Symposium on Fusion Engineering*, Chicago, Illinois, June 26-30, 2011.
- C. Sozzi, G. Giruzzi, M. Lennholm, A. Parkin, **G. Aiello** et al., Conceptual design of an ECRH system for JET, *Proc. 8th International Workshop Strong Microwaves and Terahertz Waves: Sources and Applications*, Nizhny Novgorod, Russia, July 9-16, 2011.
- G. Giruzzi, M. Lennholm, A. Parkin, **G. Aiello** et al., Objectives, physics requirements and conceptual design of an ECRH system for JET, Nucl. Fusion 51 (2011) 063033.

Finally with regard to the general performance of the trainee over the three years training, he reached most of the objectives defined in the career development plan. One deviation from the original work plan refers to the involvement of the trainee in simulation work using ANSYS tools. Another deviation is related to the secondments. Since the trainee spent many weeks in involved industrial companies, he did not carry out the stay at HAS in Budapest.

DATE:	**12 OCTOBER 2011**
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