<table>
<thead>
<tr>
<th>Nature</th>
<th>COMPTE RENDU DE REUNION</th>
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<tr>
<td>Titre / Title</td>
<td>EFDA Goal Oriented Training Programme</td>
</tr>
<tr>
<td></td>
<td>Tokamak System Integration Kick Off Meeting</td>
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<tr>
<td>Auteur(s)</td>
<td>L. Doceul, P. Messina</td>
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Participants

- **EFDA** : Harman Jon
- **CEA** : Doceul Louis, Keller Delphine, Messina Patricia
- **IPP.CR** : Hron Martin
- **ENEA Fra** : Di Gironimo Giuseppe

Destinataires

- Participants +
- DIRSIPP

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<th>Date</th>
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<tr>
<td>P. Messina</td>
<td>31/10/12</td>
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<tr>
<td>Vérificateur(s) / Reviewer(s)</td>
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<td>31/10/12</td>
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<td>31/10/12</td>
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<tr>
<td>J. Bucalossi</td>
<td>31/10/12</td>
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</table>
The GOT TSI Kick Off Meeting has been held conformingly to the agenda, the power point presentations are compiled hereafter.

The aim of goal oriented training program and its ad equation with the original EFDA call has been recalled.

The associated planning has been presented, showing that all the work programmes will be started by the beginning of 2013.

All the Work Programmes and the associated candidates have been presented except for WP4 for which the candidate choice remains to be confirmed (beginning of December).

The courses and events for 2013 have been confirmed, CEA has to organise a common training session on Codes on the CEA site conformingly to the EFDA agreement.
CEA has to take the opportunity of this common training to organise in the same week the visit of the tokamak Tore-Supra and, if possible, the ITER site.
The 2013 progress meeting during which all the trainees will present their work will take place during the same week.

The trainee sharing during 2013 has been discussed:
CEA proposes a trainee sharing with WP5 at ENEA (Italy) and W7X (Germany)
ENEA proposes a trainee sharing with WP3 at CEA (France) and VTT (Finland)
IPP.CR proposes a trainee sharing with WP2-3 at CEA (France) or WP5 (Italy) second half of the year

The GOT TSI site web has been presented:
The EFDA logo has to be added,
ITER, VTT and W7X representative persons have to be identified,
WP4 and WP5 pictures have to be sent to Patricia,
The web site is foreseen to be published in December.

EFDA will send a form (IDM-EFDA user account), to the all the members of the training program in order to upload documents.

For each WP, the first deliverable will be the carrier development plan which is to be produced when each trainee is hired.
KICK OFF MEETING GOT4 TSI
TOKAMAK SYSTEM INTEGRATION

Participants:
EFDA : Harman Jon
CEA: Doceul Louis, Keller Delphine, Messina Patricia
IPP.CR : Hron Martin
ENEA Fra : Di Gironimo Giuseppe

AGENDA

I Introduction
13:30 Welcome; approval of agenda Doceul Louis
13:40 Aims of the GOT TSI Doceul Louis

II Work package Description and associated recruitment status
14:00 CEA WP2 Doceul Louis
14:15 CEA WP3 Keller Delphine
14:30 IPP.CR WP3 Hron Martin
14:45 ENEA.Fra WP4 Di Gironimo Giuseppe

III Course and event for next year
15:00 Proposition Each participant

IV Trainees sharing between partner association and/or industry
15:10 Proposition Each participant

IV Miscellaneous
15:20 First deliverable, Financial, ....Each participant

15:30 End of meeting
AIM OF THE GOT TSI

OBJECTIVE
In the specific case of this training, the objective is to develop system engineers with experience in integration and commissioning of tokamak systems.

SCOPE
This training will allow the European fusion programme to have experienced people to carry out the integration, assembly and commissioning of tokamak systems within ITER.

TRAINING ACTIVITIES
- Participate in the life cycle (design to commissioning) of the tokamak components
- Get a detailed look at the assembly plan of the existing machines
- Advanced training on the CATIA system to prepare and manage Digital Mock-ups. Use of specific tools for kinematics and assembly (i.e. DELMIA)
- Participate to the restart activities of an existing tokamak (planning, control room, commissioning)

WORK PACKAGES
Consortium of 3 associations (CEA, ENEA, IPP-CR) under CEA Coordination

<table>
<thead>
<tr>
<th>Work Packages</th>
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</thead>
<tbody>
<tr>
<td>WP1 (CEA) Network Management</td>
</tr>
<tr>
<td>WP2 (CEA) Life cycle from the engineering design to commissioning of a major in vessel component of Tore-Supra</td>
</tr>
<tr>
<td>WP3 (CEA) Maintainability associated to ITER Component Lifecycle</td>
</tr>
<tr>
<td>WP4 (IPP-CR) Restart activities of COMPASS tokamak</td>
</tr>
<tr>
<td>WP5 (ENEA Fra) Virtual prototyping and virtual maintenance of FAST tokamak components</td>
</tr>
</tbody>
</table>
The proposed network will totally fit with the overall objectives as it suggests in the training the following cross-activities:

- Participate in the life cycle (design to commissioning) of the main components in a tokamak system (WP2, WP3, WP4 and WP5);

- Get a detailed look at the assembly plan of the existing machines, with special care on the assembly phases with their mechanical requirements as well as the use of special tools for the study of assembly tolerances and the methods of determining special reference points for components alignment (WP2, WP3, WP5);

- Advanced training on the CATIA system to prepare and manage Digital Mock-ups. Use of specific tools for kinematics and assembly (i.e. DELMIA) including the use of virtual reality platforms and associated equipments (WP3, WP5):

- Participate to the restart activities of an existing tokamak (WP2, WP4)
  - Be involved in the planning
  - Be trained in one of the control room main functions
  - Be involved in the commissioning of a tokamak system
In the frame of WP2, the trainee will be involved in the life cycle (from design to commissioning) of the divertor to be installed in the Tore-Supra Tokamak in the frame of the WEST project. To do so he will be incorporated in the IPM (French acronym of Ingénierie des Projets Mécaniques) team.

Life cycle from the engineering design to commissioning of a major in vessel component of Tore-Supra

Divertor implementation for the WEST project
WP2 DESCRIPTION

Involvement in mechanical engineering and Tokamak integration issues - 15 months
He will participate more and more actively with the project team to the WEST project. In particular, he will take part to these specific activities: mechanical design, finite element thermo-mechanical analysis, technical specification, management specification.

Involvement in Tokamak integration issues - 2 months
Concerning Tokamak integration issues, case studies will be applied to ITER and W7X and visiting period will be planned in both facilities.

Manufacturing and assembly issues - 15 months
The trainee will also take an active part in the manufacturing activities in relation with a major component of a Tore-Supra upgrade: Prototyping, Contracting, Manufacturing follow-up issues with industrial suppliers.
A training period with an industrial partner (such as CNIM -1 month) on relevant topics is planned during the training program in order to address design studies and component manufacture.

Technical programme in IPP.CR Laboratory - 2 months
CATIA design of components of COMPASS diagnostic and heating system. In particular, the trainee shall participate in design of objective support and shift for the Thomson scattering diagnostics. Further, the trainee shall be involved set-up of a server repository of the tokamak models under Catia (Enovia).

Technical programme in ENEA Fra Laboratory - 2 months
The program will be focused on modelling of FAST Tokamak components in CATIA V5 environment and on Remote Handling simulations of FAST Tokamak components in Virtual Environment. Fundamentals of Robust design methodologies and Design of Experiments (DoE) techniques, useful during concept design activities in VR, will be also provided to the trainee.

BATAL Tristan: Nuclear Engineer

Background:
2012 : Engineer Arts et Métiers Paristech (mechanical engineering school), Paris, France.
2012 : Master Nuclear energy, option « decommissioning and waste management »
2011 : Master Mechanical Engineering Modelling, BME (Budapest university of technology and economics), Master thesis: « Dynamical investigation of an automatic ball balancer ».

Training period:
2012: IAEA (International Atomic Energy), 6 months, Vienna, Austria. Participation in the "Iraq Decommissioning Project" with the IAEA Iraqi government to its decommissioning projects (dismantling techniques and implementing agencies of safety and self-control). Participation in the development of new safety standards of the IAEA.
2011: Stage, CEA / INES (Commissariat à l'Energie Atomique and Alternative Energy / National Institute of Solar Energy), 5 months, Chambéry, France. Development of a measurement system for concentrated solar flux for solar thermodynamic plant. This course has led to the filing of a patent.
Maintainability associated to ITER Component Lifecycle using virtual reality: Application on a real tokamak Tore Supra

CEA IRFM Tokamak Tore Supra will be turned into a divertor configuration to address the challenge of tungsten plasma facing components of ITER (WEST project). In the framework of WP3, the trainee will be involved in the life cycle (from design to commissioning) of Tore Supra. To do so he will be incorporated in the IPM (french acronym of Ingénierie des Projets Mécaniques) team.

Training period:

• To study VR based approaches for the disassembly and assembly of new components inside Tore Supra.

• To perform and use the results of 3D scanning: integration inside the CAD database to overlap the real to the virtual mockup (retroengineering).

• To take into account fabrication and welding defaults into the numerical mock up to simulate the assembly of new components inside the machine.

• To generate several virtual assembly sequences with concepts of assembly tools.

• These virtual sequences will be reviewed in the VR platform and compared. The optimal one will be chosen.

• To take into account maintenance constraints in the design and integration of components inside the machine (optimal integration for optimal maintainability). This will be done through simulations.

• These scenario will be validated on the real tokamak Tore Supra. Several iterations could be done between simulation and real mock ups to improve simulations softwares.
WP3 DESCRIPTION

Involvement in mechanical engineering and Tokamak integration issues - 15 months
He will participate more and more actively with the project team to the WEST project. In particular, he will take part to these specific activities: Technical specification, mechanical and component design, assembly procedures and concepts of tools, maintenance impact on design and maintainability.

Involvement in Tokamak integration issues - 2 months
Concerning Tokamak integration issues, case studies will be applied to ITER and W7X and visiting period will be planned in both facilities.

Development of maintenance strategies - 15 months
For each kind of components to repair in the overall machine, there will be common maintenance aspects and specific activities. The trainee (with the help of integration experts) will identify and detail the operations and associated features: Components Maintenance Procedure and Plan definition (hands-on operations). Use and adapt VR tools to design the overall maintenance scenario. Standardization of maintenance assembly procedures. Evaluations of maintenance times and application to real environment. These procedures will be generalized to ITER Tokamak when validated on Tore Supra WEST.

This development should be done with each partners involved in the program in order to take benefit of this time to try standardising the maintenance procedures.

Technical programme in IPP.CR Laboratory - 2 months
During the 2 months mission the trainee programme will concern on CATIA design of components of COMPASS diagnostic and heating system. In particular, the trainee shall participate in design of lower hybrid heating system support structure. Further, the trainee shall be involved set-up of a server repository of the tokamak models under Catia (Enovia).

Technical programme in ENEA FrA Laboratory - 2 months
The trainee will be hosted 2 months. The program will be focused on modelling of FAST Tokamak components in CATIA V5 environment and on Remote Handling simulations of FAST Tokamak components in Virtual Environment. Fundamentals of Robust design methodologies and Design of Experiments (DoE) techniques, useful during concept design activities in VR, will be also provided to the trainee.

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WP3 DESCRIPTION

PILIA Arnaud: Mechanical Engineer

Background:
2011-2012 : Engineer at EDF, France (planification and team coordination)
2010 : Mechanical engineer at EDF, France (mechanical and seismic analysis tools for nuclear power plants pipings)
2010 : Mechanical engineer diploma (ENSMM : Mechanical sciences, electronic and electrotechnics and control).

Training period:
2011 : Training for the operation of nuclear power plant (REP 1300 MW).
2011 : Training on OPX2 R2 et R4 (planification tool).
2011 : habilitation for PR1 (entry in controlled zones) and SR2 (Nuclear safety).
2011 : Electrical habilitation (H0, B0).

Softwares:
ANSYS, CATIA V5, C/C++, Matlab, OPX2, Pspice, VBA.
**WP12-GOT-GOT4TSI**

“Tokamak System Integration”

**Work Package 4**

Restart activities of COMPASS tokamak

Association: IPP.CR

M. Hron and COMPASS team

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**COMPASS tokamak**

- construction of new building at IPP Prague

December 2007 - December 2008
- installation of COMPASS at IPP Prague:
  - new power supply system, CODAC, diagnostics

February 2009
- start of operation at the IPP Prague

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<th>Value</th>
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<tr>
<td>Elongation</td>
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<td>P\textsubscript{NBI}</td>
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Activities according to the Call for Participation

GOT programme for COMPASS addresses the following activities:

Participate to the restart activities of an existing tokamak

be involved in the planning

be trained in one of the control room main functions

be involved in the commissioning of a tokamak system

Recruitment

Task agreement WP12-GOT-GOT4TSI

Training & Project Management

To ensure competition and a good choice of candidates, the trainee positions will be openly advertised in Europe-wide media (e.g. CORDIS, ERACAREERS database of the Commission, as well as journals with special services for young researchers) and on the web-pages of the partners. Of course, existing contacts with universities will also be used to increase publicity. Regular progress meetings are planned to check the status of the selection process.

The selection of the trainees will be based on their excellence related to the field of training and on their determination to take benefit from the special training measures, i.e. secondments to other laboratories and participation in training courses and seminars. The decision on the selection remains with the employing institution; however, the partner laboratories which will host the trainee will have to agree.

Candidates:
master or Ph.D. diploma (plasma physics / physical or electrical engineering);

basic knowledge of tokamak physics; less than 5 years of professional experience.

Goal:
gain experience in tokamak operation with specialization in planning and restart as well as in systems commissioning.
Courses

Introduction to fusion physics and fusion technology
Introduction to ITER design (Assembly, remote handling, maintenance, …)
Introduction to control engineering
COMPASS CODAC system
Plasma position control

Training

Control room training (8 months)
Commissioning of power supply system (8 months)
Planning of the restart and operation activities (4 months)
Relation between the plasma modelling and the experiment (10 months)
Technical programme in CEA Laboratory (2 months)
Technical programme in ENEA Fra Laboratory (2 months)
Programme in W7X laboratory and at ITER (1+1 month)
Virtual prototyping and virtual maintenance of FAST tokamak components

**Work Package 5**

**Work Package 5 Objectives**

- To study VR-based approaches allowing the choice of the optimal design solutions of a tokamak subsystem according to maintenance requirements, as well as to structural requirements.
- To study the maintainability of a FAST sub-system.
- To generate several virtual prototypes and concept solutions that will be successively analyzed and tested in the Virtual Reality Lab through a participatory design approach.

**Association:** ENEA Fra

Associated Partner: Associations: CEA, IPP.CR
Companies / Industrials: VTT Research Center in Tampere Finland, CREATE
Universities: University of Naples Federico II
### Work Programme

**R&D ON THE FAST DIVERTOR AND FIRST-WALL ENGINEERING DESIGN – 14 months**
The trainee will analyze the Remote Handling operations of the FAST divertor and first-wall.

**DEVELOPMENT OF MAINTENANCE STRATEGIES – 15 months**
The trainee will analyze the operations about the Maintenance procedure, the use of VR tools, the standardization of maintenance/assembly procedures.

**TECHNICAL PROGRAMME IN CEA LABORATORY – 2 months**
The trainee will study the simulation of maintenance scenario and the Remote Handling simulations of ITER Tokamak components in the virtual reality room of the CEA fusion institute.

**TECHNICAL PROGRAMME IN IPP.CR LABORATORY – 2 months**
The trainee shall participate in the design of a diaphragm in the NBI heating beam duct and he will be involved in the setup of a server repository for tokamak models in CATIA (Enovia).

**TECHNICAL PROGRAMME IN VTT RESEARCH CENTER – 1 month**
The trainee will study the simulation of maintenance scenarios and on Remote Handling simulations of the ITER divertor.

**INVOLVEMENT IN TOKAMAK INTEGRATION ISSUES – 2 months**
The trainee will study some test cases concerning Tokamak integration issues to apply to ITER and W7X and he will visit both facilities.

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### FIRST YEAR (2012-2013)

#### COURSES
- Fusion physics and fusion technology
- Geometric Modeling and Virtual Prototyping
- Robust Design and Design of Experiments (DoE)
- Finite Element Method and structural analyses
- Object-oriented Programming Language (i.e. C++)
- 3D CAD modelling tools: CATIA V5, Solidworks
- FEM tools: Ansys
- DMU kinematic simulation tools: DELMIA
- FAST design (Assembly, remote handling, maintenance,...)
- Robotics

#### MOBILITIES

<table>
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<th>Training Activities</th>
<th>Period</th>
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<td>AT CEA</td>
<td>28&lt;sup&gt;th&lt;/sup&gt; April-28&lt;sup&gt;th&lt;/sup&gt; June 2013</td>
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**ENEA**

![ENEA Logo]

**CREATE**

![CREATE Logo]

**WP5 TARGETS**

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SECOND YEAR (2013-2014)

COURSES
- Maintenance of Nuclear Plants
- Nuclear codes and standards (RCC-MR, RCC-MX, ASME...)
- Remote handling.

MOBILITIES
TRAINING ACTIVITIES AT IPP
Period: 24th February – 28th March 2014

THIRD YEAR (2014-2015)

COURSES
- Remote Handling
- Risk analysis (FMECA=Failure Modes, Effects and Critically Analysis)
- Vacuum technologies in a nuclear environment

MOBILITIES
TRAINING ACTIVITIES AT ITER
Period: 23rd February – 27th March 2015

TRAINING ACTIVITIES AT W7X
Period: 21st April - 22nd May 2015
COURSE AND EVENT FOR NEXT YEAR

Basic training activities
(1st year)

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<th>CEA WP3</th>
<th>IPP.CR WP4</th>
<th>ENEA Fra WP5</th>
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<td>CODES* (1 week)</td>
<td>CODES* (1 week)</td>
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<tr>
<td>IPP.CR</td>
<td>COMPASS operation hands-on (2 weeks)</td>
<td>COMPASS operation hands-on (2 weeks)</td>
<td>COMPASS operation hands-on (2 weeks)</td>
<td>COMPASS operation hands-on (2 weeks)</td>
</tr>
<tr>
<td>ENEA Fra</td>
<td>Geometric Modelling and Virtual Prototyping (1 week)</td>
<td>Geometric Modelling and Virtual Prototyping (1 week)</td>
<td>Geometric Modelling and Virtual Prototyping (1 week)</td>
<td>Geometric Modelling and Virtual Prototyping (1 week)</td>
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Proposition for 2013

CEA propose to organise a common (all WP) training session on codes at CEA Cadarache (France) and to organise a Tore-Supra and perhaps ITER site visit.

IPP.CR proposes to organise a common (all WP) training session operation hands on COMPASS at IPP.CR Prague first half of 2014.

ENEA proposes to organise a common (all WP) training session on geometric modelling at ENEA Create Napoli first half of 2015.

COURSE AND EVENT FOR NEXT YEAR

Advanced training activities
(2nd & 3rd years)

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<th>CEA WP2</th>
<th>CEA WP3</th>
<th>IPP.CR WP4</th>
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<td>QA (1 wk)</td>
<td>COMPASS commissioning (1 wk)</td>
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<td>IPP.CR</td>
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<td>VR-T (1 wk)</td>
<td>DELMIA (1 wk)</td>
<td>RD (1 wk)</td>
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Proposition for 2013

CEA proposes a training session on ANSYS and CATIA for WP2 and WP3

IPP.CR proposes a training session on CATIA and COMPASS commissioning for WP4

ENEA proposes a training session on CATIA, VR-T, DELMIA and RD for WP5
**Proposition for 2013**

**CEA** proposes a trainee sharing with WP5 at ENEA (Italy) and W7X (Germany)

**IPP.CR** proposes a trainee sharing with WP2-3 at CEA (France) or WP5 (Italy) second half of the year.

**ENEA** proposes a trainee sharing with WP3 at CEA (France) and VTT (Finland)

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**MISCELLANEOUS**

**GOT TSI web site**

First deliverable, Financial, ....