

# Task Agreement **WP10-ITM-EDRG:**

## ***Experimentalists and Diagnosticians Resource Group (EDRG)***

### **Task under Task Force Leadership**

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#### **Required Resources**

The Implementation of the EDRG work programme for 2010 is estimated to require a minimum of 3.25 Ppy under Baseline support and 2.25 Ppy under Priority Support in order to be able to provide a minimum level of project fulfilment of the deliverables and milestones. The overall resources under priority support for the ITM Task Force are determined by the Work Programme, but the breakdown

between projects within ITM is left to be optimised by the Task Force Leader in order to satisfy project requirements while taking into account the resources made available by Associations. Furthermore the resources under baseline support shown in the Work Programme are meant to be preliminary. For these reasons, the manpower requirements stated in the project descriptions should be viewed as indicative. Tasks are generally collaborative in character or form parts of a larger structure where timely delivery and coordination is of importance. Support and training on the ITM framework and tools will be available and time for the participation shall be allocated in addition to Task activities.

In the analysis of the answers to the Call, the ITM-TF will do its best to promote collaborative efforts between associations as well as between individuals in the different tasks. This is to provide internal peer review, quality of work and to develop a stronger sense of community ownership for the developed tools. However, and in order to reduce fragmentation and related administrative burden, if smaller tasks are shared between Associations, care should be taken that no individual's total contribution to a project becomes too small.

## Priority Support

The tasks:

- **WP10-ITM-EDRG-ACT3 : 3D machine description (12pm)**
- **WP10-ITM-EDRG-ACT4 : Coordination of plasma control activities (3pm)**
- **WP10-ITM-EDRG-ACT6 : Synthetic diagnostics – 3D reflectometry modelling framework (12pm)**

are formed under priority support. **A total of 27pm has been assigned to EDRG activities.**

A new feature of the 2010 implementation of the ITM-TF work programme is the focused use of coordinated joint activities as integral part of the work. These joint activities will be organised in working sessions and code camps (working sessions supported by the integration team) and supported under mobility. All contributors to the Task Force are strongly encouraged to participate in relevant working sessions and code camps. For activities falling under Priority Support, participation to these joint activities is obligatory. The list of coordinated activities for the EDRG group, tentative time and duration are provided in the table below.

## Implementation

All software development is expected to be implemented on the ITM-TF gateway, [www.efda-itm.eu](http://www.efda-itm.eu), under the provisions of the Gateway User Agreement (attached). The latter was agreed to by the EFDA-SC in June 2008. The Gateway User Agreement details access and sharing mechanisms for the software developments within ITM-TF. Furthermore, the ITM-TF will provide a collaborative software development environment, based on Gforge, to support the development of individual programs and at the same time ensure that Quality Assurance and traceability criteria for the ITM project are adhered to.

## Intellectual Property Rights Monitoring

In agreement with the EFDA-SC decision (June 2008), and as described in the Gateway User Agreement, the ITM-TF will monitor IPR relating to contributed codes. In particular, the ITM-TF will maintain a record of contributions made to any Software through collaborative Tasks within the ITM-TF. All such modifications remain fully available to the contributing Associate provided contributors are acknowledged though the principles stated in the ITM-TF license. A Rights of access form (attached) is required for all codes being contributed. For any given code, this document states the current list of contributors, the code's ITM-TF Responsible Officer and technical reference(s) that should be used in publications involving the code.

## Project Background

### Introduction to the Experimentalist and diagnosticians resource group

The consolidation of the validated suite of simulation tools that the ITM aims to provide for ITER and existing experiments requires a strong interaction with the experimentalists and diagnosticians fusion community. The former are promoted by the Experimentalist and Diagnosticians Resource Group (EDRG). Acting as a contact point within the ITM towards the full range of experiments and some of the EFDA Topical Groups and Working Group initiatives, the EDRG group promotes the provision of a machine independent approach to modelling, to encompass realistic operational conditions and to facilitate verification and validation of the modelling codes. The groups action comprises developing a comprehensive set of Machine descriptions and data mappings to access experimental databases, the coordination of the overall plasma control activities to be carried within the ITM-TF and in liaison with other EFDA initiatives and the development and integration of synthetic diagnostic modules, covering as broad range of European fusion devices as possible

### Relation to Experiments

The EDRG group has direct interfacing with all fusion experiments engaged with the ITM-TF effort, assisted by task assigned Contact Persons. Coordination with JET is dealt at the TFL level. The completion and extensions of the Machine Descriptions (a device descriptor) and Data Mappings (bridging experimental databases signals to the ITM-TF datastructure) are one essential aim in order to enable a comprehensive modelling building on a particular device. Plasma Control and Validation&Verification coordination activities also rely on the valuable contribution from the experiments.

## Overall Milestone

To provide a privileged contact of the ITM-TF as a whole with experimental devices engaged with the ITM-TF, incorporate comprehensive machine descriptions and data mappings from these devices encompassing an increasing number of diagnostic data and integrate a suitable suite of synthetic diagnostics that assist the overall ITM code validation and “real-time” discharge evolution control.

## Continuity – Task relations

The connection between 2009 tasks and those planned for 2010 are given in the following table.

2009 Task		Status in 2010
ITM-09-TFL2-EDRG-T1: Contact Person in Fusion experiments	→	WP10-ITM-EDRG-ACT1: Continued in Baseline Support
ITM-09-TFL2-EDRG-T2: Machine descriptions and data mapping	→	WP10-ITM-EDRG-ACT2: Continued in Baseline Support
ITM-09-TFL2-EDRG-T3: Coordination of plasma control activities	→	WP10-ITM-EDRG-ACT4: Coordination of plasma control activities
ITM-09-TFL2-EDRG-T4: Diagnostic related activities	→	WP10-ITM-EDRG-ACT5: Diagnostic related activities
ITM-09-TFL2-EDRG-T5: Synthetic diagnostics – 3D reflectometry modelling framework	→	WP10-ITM-EDRG-ACT6: Synthetic diagnostics – 3D reflectometry modelling framework

Some new tasks are planned for 2010

New Tasks in 2010	
ITM-09-TFL2-EDRG-T3: 3D Machine description	Implement a 3D description for the first wall of participating devices with adjustable detail level from master CAD drawings and including chemical, thermal, electrical and mechanical properties.

### Coordinated activities

Type of activity <sup>59</sup>	Topic, aims and intended audience <sup>60</sup>	Participants <sup>61</sup>	Length <sup>62</sup>	Tentative Date <sup>63</sup>	Tasks involved <sup>64</sup>
WS	Developmenty of 3D machine description IMP12, IMP3, EDRG	20	3 days	April 2010	IMP12-ACT6 IMP3-ACT3 EDRG-T3
WS	Mid-term assessment of control activities status and roadmap evaluation. ITM associated task contributors and Feedback control experts + possible WG contributors.	15	2 days	28 June	ISIP-ACT12 IMP12-ACT2 EDRG-ACT4
Code Camp	Hands-on session on how to integrate control schemas into the ITM platform using SCICOS and Simulink; RT workshop C++ code generation from Simulink schema, CPO datastructure wrapping and FC2K actor generation. Very useful to stimulate contributions from WG and control experts.	15	3 days	June, just after the WS	ISIP-ACT12 IMP12-ACT2 EDRG-ACT4
WS	Interfacing of equilibrium modules with the erc3D code package. Joint effort from ERCC team and IMP12	~6	2-3days	5-7 July	EDRG-ACT6, IMP12-ACT1
WS	Integration freeboundary equilibrium+feedback	25	1 week	19-23 July	IMP12-ACT2 IMP3-ACT1 EDRG-ACT4

<sup>59</sup> Activity is either: Project Meeting, Working Session or Code Camp, or OTHER (need then further description). In this context a Code camp is a working session with ISIP support.

<sup>60</sup> Overview of the activity scope and aims (i.e., what should be achieved) and audience (i.e., who should participate and benefit)

<sup>61</sup> Indicative number of participants expected to participate

<sup>62</sup> Length of the activity in calendar days

<sup>63</sup> Indicative starting date for activity

<sup>64</sup> A list of tasks within ITM that are directly linked to this activity.



	code in ETS IMP12 , ETS, EDRG				ISIP-ACT12
WS	Code validation/benchmark ing by interfacing with turbulence spectra	~6	5days	6-10 Dec.	EDRG-AT6 IMP4-ACT6

## WP10-ITM-EDRG-ACT1: Contact Person in fusion experiments

### Type of support available for the task: Baseline Support

### Description of work

A local responsible officer from each of the participating major European experiments is envisaged. The called contact person will provide the liaison between the affiliated laboratory and the ITM and will be in charge of:

- i) Coordinating the machine description (MD) and data mapping activities to be carried out in the affiliated laboratory by designated staff (see WP10-ITM-EDRG-ACT2,T3).
- ii) Proposing verification and validation (V&V) activities to be carried on the experimental data of the affiliated laboratory, in collaboration with the relevant IMPs of ITM.
- iii) Coordinate the development of ITM-TF tools within the Associations once workflows and tools are set for release.

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>65</sup>
Report	01/01/10	31/12/10	Report on V&V activities proposed and agreed to take place	
Report	01/01/10	31/12/10	Report on the progress made on the MD&DM	
Report	01/06/10	31/12/10	Report on the ITM-TF tools home development/integration.	

### Resources, skills and needs

**Requested manpower/skills:** Close support representatives of each of the participating experiments are requested for this task.

**Existing Commitments:** Representatives from JET, TS, AUG, MAST, TCV, FTU, COMPASS committed for 2009. Renewal is envisaged with a stronger role expected namely on V&V activities as ITM-TF tools are maturing.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)

### External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER....) : where appropriate, V&V activities should build on previous (or foreseen) related undertaking.

<sup>65</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.

## WP10-ITM-EDRG-ACT2: Machine Descriptions and data mapping

**Type of support available for the task: Baseline Support**

### Description of work

Machine descriptions and data mapping build the backbone of the ITM datastructure, enabling simulations on each device to be performed. Completion and revisions (if appropriate) of the machine description version 4.07a and coming developments, for all participating devices and new devices that haven't yet taken part, is asked for. Developments will include, among others, more complete antenna datastructure and other heating and current drive systems, 2D vessel qualifying for discontinuous elements, necessary adjustments to the pfsystems CPO and additional diagnostic CPOs to be developed (EDRG-T5).

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>66</sup>
MD complete	01/01/10	31/03/10	Provide validated MD file for current version if unavailable/incomplete	Incomplete MD implies limited exploitation of ITM-TF tools
MD update	01/04/10	31/12/10	Provide validated MD file for new versions of the MD.	IMP3 2D codes for discontinuous wall elements.
DM complete	01/01/10	31/03/10	Provide validated DM file for current version if unavailable/incomplete	Incomplete DM implies limited exploitation of ITM-TF tools
DM update	01/04/10	31/12/10	Provide validated DM file for new versions of the DM.	

### Resources, skills and needs

**Requested manpower/skills:** Experimentalists from each of the participating experiments are requested for this task. Estimated 3pm per device (30pm) is expected to be distributed throughout the year.

**Existing Commitments:** Representatives from TS, AUG, MAST, TCV committed for 2009 (uneven response) although a matching engagement up on renewal from all participating experiments is longed for.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)

### External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER...): collaboration from JET to be extended to 2010. Collaboration from ITER also encouraged.

<sup>66</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.



## WP10-ITM-EDRG-ACT3: 3D Machine Description

**Type of support available for the task: Priority Support**

### Description of work

Providing a full 3D description of a fusion device first wall is a major endeavour. The work to be carried out in this task should therefore follow the tentative breakdown:

- a) Provision of a tool able to read a master CAD drawing and perform adjustable defeaturing on the output walls surface (STL format).
- b) Report on acceptability of the defeatured surface mesh considering requirements of: MC codes, RWM codes, other.
- c) Full scale mesh development for devices.
- d) Adaptation of the 3D wall mesh to the GRID-CPO framework.

Participation to relevant coordinated activities is required.

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>67</sup>
Numerical tool	01/01/10	28/02/10	Provision numerical tool for reading/defeaturing	
First trials	01/03/10	30/04/10	First trial defeaturing reports reflecting on requirements	
Defeated meshes	01/05/10	31/09/10	Defeated meshes of pending type for some devices.	IMP3-ACT3
Mesh into GRID CPO	01/09/10	1/12/10	Adapt mesh to GRID-CPO structure.	

### Resources, skills and needs

**Requested manpower/skills:** Experts on CAD file post-processing (expected 9pm); experts on ITM-TF datastructure (3pm expected)

**Existing Commitments:** Essentially a new task although initially envisioned in the 2009 WP but not carried out due to lack of manpower.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)
WS	April 2010	0.5	Joint assessment of the requirements of 3D datastructures in equilibrium, stability, transport and machine geometry

### External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER....) : Drawing offices from participating experiments to provide CAD files and collaborate on the validation of defeatured meshes.

<sup>67</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.

## WP10-ITM-EDRG-ACT4: Plasma control activities

**Type of support available for the task: Priority Support**

### Description of work

An integrated suite of modelling tools targeting the simulation of a magnetically confined plasma discharge, in realistic free boundary equilibrium experimental conditions, requires the integration of plasma feedback control elements. Specifically, plasma position and shape feedback controllers and actuators as well as active magnetic feedback systems for MHD control are foreseen in the ITM platform. A control expert is therefore called to coordinate the activities related to control within the ITM:

- Feedback plasma position&shape control using Free-boundary equilibrium codes
- Extension to MHD plasma control
- SCICOS based Control toolbox deployment and integration of existing or newly developed control schemas based on Simulink.
- Paving layout for prospective PCS layout

Provide an external connection to other EFDA related control activities and coordinated the collaborative effort. Building on 2010 response from Associations on general information about feedback control schemes in use, plans for scheme integration in view of prototype KEPLER workflow development should be discussed.

Participation to relevant coordinated activities is required.

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>68</sup>
Control schemas	01/05/10	31/05/10	Preliminary roadmap for control schema integration	ISIP – Simulink integration trials + control toolbox progress (~June-10)
Report	1/07/10	15/07/10	Preliminary Progress Report on overall IMP activities + external connection + WS/code camp.	
Report	15/11/10	30/11/10	Final report + suggested roadmap for 2011.	

### Resources, skills and needs

**Requested manpower/skills:** Experts in plasma position/shape and MHD feedback control and in modelling of plasma evolution are requested (3pm).

**Existing Commitments:** Continued task from 2009 where 0.33ppy were allocated.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)
WS+Code camp	28 <sup>th</sup> June	1	Mid-term assessment of control activities status and roadmap evaluation. Disseminate ITM-TF control effort to other EFDA WG contributors. Hands-on session on how to integrate control schemas into the ITM platform using SCICOS and Simulink. Stimulate contributions from WG and control experts.
WS	19 July	1	Assist IMP3 on the Integration freeboundary equilibrium+feedback code in ETS

<sup>68</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.



## External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER....) : Evident synergies with EFDA Feedback Control WG and MHD-TG to integrate new control schemas and thus enrich the ITM-TF tool set that will be in use in Associations. Assistance from control experts in supporting the control dedicated ITM-TF tasks is essential.

## WP10-ITM-EDRG-ACT5: Diagnostic related activities

**Type of support available for the task: Task Agreement**

### Description of work

Extension of the present set of CPOs characterizing diagnostic data to provide the necessary coverage of coming V&V activities needs. In particular, *Strike point, Bremsstrahlung, LIDAR, neutral particle analyser, X-ray* and *fusion product* diagnostics are requested. In view of both the verification and validation of ITM-TF codes and preparing for real-time discharge evolution capabilities, the opportunity for the adaptation/integration on the ITM platform of the appropriate synthetic diagnostics will be explored.

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>69</sup>
Diagnostics datastructure	01/02/10	30/04/10	Develop datastructure for additional diagnostics	
Code inventory	1/01/10	15/03/10	Code Inventory on Synthetic diagnostics developed at each Association.	
Synthetic diagnostic integration	01/01/10	31/12/10	Adaptation/integration of synthetic diagnostic modules in the ITM platform (throughout the year).	

### Resources, skills and needs

**Requested manpower/skills:** Expert diagnosticians to develop diagnostic CPOs (overall effort 3pm since filling the MD is carried out in EDRG-T2). Synthetic diagnostic integration (6pm)

**Existing Commitments:** Continued task from ITM-09-TFL2-EDRG-T4 where 1.05ppy were allocated.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)

### External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER...) : Evident synergies should be promoted between the Data Analysis and Calibration Techniques WG (auspices of the Diagnostic TG, see task **WP10-DIA-05-01**) and the ITM-TF regarding the synthetic diagnostics integration assistance in diagnostic datastructure development.

<sup>69</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.

## WP10-ITM-EDRG-ACT6: Synthetic diagnostics - 3D reflectometer modelling framework

**Type of support available for the task: Priority Support**

### Description of work

Building on what was achieved during 2009, the following activities are planned : optimization of the finite difference kernel; Parallelization of the kernel code module; Continuation of the parallel effort of developing alternative solvers and, where appropriate, their implementation in the code; Extension of the interface module to allow integration with ITM equilibrium codes; Implementation of “realistic” numerical turbulence models; General integration of the code into the ITM framework; Development of the complementary code suite and post-processor tool-box.

In addition, a series of programmes will be undertaken, including: Extensive validation and verification of the code, including benchmarking activities; Simulation studies with ITER relevant geometries and parameters; Continue the programme of physics and fundamental issue studies.

### Deliverables:

Title	Start date	End Date	Deliverable(s) (precise definition)	Dependent activities <sup>70</sup>
	01/01/10	01/07/10	Optimization/Paralellization	
	01/07/10	31/07/10	Interface module to integrate ITM eq. codes	
	01/08/10	31/10/10	General code Integration into the ITM	
	1/10/10	31/12/10	Code verification/validation and interfacing with turbulence models/spectra	

### Resources, skills and needs

**Requested manpower/skills:** The 3D full-wave reflectometry simulation code requires a computer scientist specialized in parallel programming (1 ppy) but the task can be split up between different individuals to cover the necessary areas of expertise and deliverables.

**Existing Commitments:** Continued task from 2009 where 1.37ppy was allocated.

### Code Camps or other coordinated activities

Type of effort	Start date	Length (in weeks)	Expected outcome/relation to deliverable(s)
WS	5 July	3 days	Outline and preliminary testing of equilibrium code integration
WS	6 Dec.	5 days	Testing interplay of erc3D code with turbulence codes and preliminary analysis of the effect of turbulence spectra

### External connections/requirements

Please note any dependencies, needs or synergies with EFDA or other activities: (JET, TG, ITER....) : This task develops under the auspices of the European Reflectometry Code Consortium group.

<sup>70</sup> Please describe any tasks or activities that a) this deliverable needs as a prerequisite or b) depend on this deliverable being finalized.