FUSION FOR ENERGY

The European Joint Undertaking for ITER and the Development of Fusion Energy
THE GOVERNING BOARD

DECISION OF THE GOVERNING BOARD ADOPTING THE WORK PROGRAMME FOR 2008 OF THE EUROPEAN JOINT UNDERTAKING FOR ITER AND THE DEVELOPMENT OF FUSION ENERGY

HAVING REGARD to the Statutes annexed to the Council Decision (Euratom) No 198/2007 of 27 March 2007 establishing the European Joint Undertaking for ITER and the Development of Fusion Energy (hereinafter "the Joint Undertaking") and conferring advantages upon it[1] (hereinafter "the Statutes") and in particular Articles 6(3)(d) and 11 thereof;

Having regard to the Financial Regulation of the Joint Undertaking[2] adopted by the Governing Board on 22 October 2007 (hereinafter "the Financial Regulation") and in particular Article 64 thereof;

Having regard to the Implementing Rules of the Financial Regulation[3] adopted by the Governing Board on 22 October 2007 (hereinafter "the Implementing Rules") and in particular Article 53 thereof;

Having regard to the Euratom 2008 Work Programme for Nuclear Research and Training Activities[4] adopted by the Commission on 29 November 2007;

Having regard to the comments and recommendations of the Executive Committee on the proposal for the work programme drawn up by the Director at its meetings of 22 November and 13 December 2007;

Having regard to the comments and recommendations of the Technical Advisory Panel on the proposal for the work programme drawn up by the Director at its meeting of 30 November,

Whereas:

(1) The Director should, in accordance with Article 8(4)(c), draw up an annual work programme;

(2) The Governing Board should adopt the work programme.

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1 O.J. L 90 , 30.03.2007, p. 58.
2 F4E(07)-GB03-11 Adopted 22/10/2007
3 F4E(07)-GB03-12 Adopted 22/10/2007
4 C(2007)5750 of 29/11/2007

THE GOVERNING BOARD OF THE JOINT UNDERTAKING HAS ADOPTED THIS DECISION:

Article 1

The Work Programme of the Joint Undertaking annexed to this Decision is hereby adopted.

Article 2

This Decision shall have immediate effect.

Done at Barcelona, 18 December 2007

For the Governing Board

Carlos Varandas

Chair of the Governing Board

ANNEX

WORK PROGRAMME 2008 OF FUSION FOR ENERGY

1. SCOPE

The European Joint Undertaking for ITER and the Development of Fusion Energy ('Fusion for Energy' or F4E) is a Joint Undertaking created under the Euratom Treaty by a decision of the Council of the European Union.

'Fusion for Energy' was established for a period of 35 years from 19th April 2007 and is situated in Barcelona, Spain. The objectives of 'Fusion for Energy' are threefold:

- Providing Europe's contribution to the ITER International Fusion Energy Project as the designated Domestic Agency for Euratom;
- Implement the Broader Approach agreement between Euratom and Japan as the designated Implementing Agency for Euratom;
- Prepare in the longer term for the construction of demonstration fusion reactors (DEMO).

In accordance with the Financial Regulation of 'Fusion for Energy', this work programme lays down the activities of 'Fusion for Energy' that are foreseen to be implemented and financed through the 2008 budget.

2. ASSUMPTIONS

The 2008 'Fusion for Energy' work programme is based on the following assumptions:

- That the ITER Procurement Arrangements for components on the critical path for ITER construction (buildings, magnets and vacuum vessel) will be proposed by the ITER Organisation, negotiated and signed according to the present schedule;
- That the Work Programme 2008 reflects the current understanding of the ITER Design and some modifications might be required in 2008 to adjust it to the forthcoming ITER developments;
- That the EU Schedule, with recent additions and modifications, was used as the basis for this document;
- That the activities and the associated budget have been presented here based on the current understanding of the ITER Project while the results of the ITER Design Review are being assessed;
- That the project plans presented in this document for the Broader Approach Activities (IFMIF/EVEDA, IFERC and the Satellite Tokamak Programme) reflect the Project Plans approved by the Broader Approach Steering

Committee. In addition that the ongoing re-baselining of the Satellite Tokamak device, requested by the BA SC, will not result in major schedule delays;

- In addition, that the R&D and Design work undertaken by F4E in order to support ITER in drafting procurement arrangements for built to print or detailed design or functional design level will be credited by ITER;
- The implementation 2008 will greatly depend on the availability of human resources during this period when the Fusion for Energy Joint Undertaking in Barcelona is starting its operation;

3. OVERALL OBJECTIVES

3.1. ITER

With respect to activities related to ITER, the main objectives of the 2008 Work Programme are as follows:

- The completion of the technical specifications in particular for magnets, vacuum vessel, buildings and site preparation;
- A number of Procurement Arrangements and pre-arrangements with the ITER Organisation are being prepared, the most important being in the following areas:
  - Toroidal Field (TF) Coils;
  - Poloidal Field (PF) Coils;
  - Vacuum Vessel;
  - Buildings;
  - Neutral Beam (NB) System
- As part of the implementations of the Procurement Arrangements, the awarding of a number of contracts related to components on the critical path according to the ITER Procurement schedule;
- The continuation of the preparation of safety and licensing documentation for ITER in Cadarache and related safety studies;
- The investigation of manufacturing methods and non-destructive tests of critical components from the technical point of view with the objective of minimising the cost and risk of not meeting the technical requirements (divertor, vacuum vessel, shield modules);
- The preparation of new facilities to test prototypes and components during the qualification process and construction respectively;
- The further activities for the preparation of the ITER site.

Particular effort has to be put in areas where design and R&D are still needed such as Remote Handling, ITER Test Blanket Modules (TBMs), Diagnostics, Heating and Current Drive (H&CD) Systems.

3.2. Broader Approach

With respect to activities related to the Broader Approach, the main objectives of the work programme 2008 are as follows:

Satellite Tokamak Programme:

- The re-baselining of the project in accordance to the decisions of the BA Steering Committee and the ensuing completion of the most urgently needed technical specifications
- The creation of the Euratom part of the Joint Team in Garching (Germany);
- For the EU part from the Voluntary Contributors, the definitions of procurement arrangements for the following areas: Cryostat (Spain), TF Coils and current leads (Italy, France, Germany), ECRF (Italy, France, Switzerland), Power Supplies (Italy, France).
- For the EU part from F4E, the definition and start of procurement for the Cold Test Facility required to test the TF magnet.

IFMIF/EVEDA Programme

- The programme includes activities in the fields of: preparation of site and buildings, design integration, test facilities, target facility, and accelerator facility. Furthermore, following the decision by the BA Steering Committee on 15 November 2007, participation to the expenses for EU members of project teams in Japan could be reimbursed by Fusion for Energy directly or through JAEA according to Art. 7.3 of the BA Agreement.
- The conclusion of procurement arrangements for the following areas:
  - Accelerator: (France Italy Spain)
  - Test Facilities: (Spain, Italy, France, Germany)

IFERC Project

- The programme includes activities in the fields of: preparation of site and buildings, and preparation of future activities under the sub-projects Computer Simulation Centre (CSC) and DEMO.

For all BA projects, procurement arrangements of EU responsibilities related to supplies from the Voluntary Contributors will be signed by the Director of the Joint Undertaking after a back-to-back procurement arrangement has been concluded with the Contributors concerned, so to ensure the fulfilment of the obligations of Euratom vis-à-vis the BA agreement. In addition, procurement arrangements executed in JA will also be signed by the Director of F4E in accordance with the provisions in the Broader Approach Agreement.

3.3. DEMO

With respect to activities related to DEMO, in addition those undertaken under the BA IFERC project, no specific activities are foreseen to be implemented during 2008.

4. EFDA TECHNOLOGY ACTIVITIES TO BE TRANSFERRED TO 'FUSION FOR ENERGY'

The responsibility for the technical follow-up of tasks and contracts implemented under the European Fusion Development Agreement (EFDA) relevant for the activities of F4E and not completed by end 2007 will be transferred to F4E.

5. EXECUTIVE SUMMARY

This Executive Summary is based upon the detailed description of 'Fusion for Energy' activities described in Annex I.

5.1. ITER

5.1.1. Main Procurement Arrangements (PA) in preparation

- TF Winding Packs and Case Finishing;
- TF Conductor;
- PF Conductor;
- Vacuum Vessel;
- PF Coils Fabrication Building;
- NB System in view of the establishment of the NB Test Facility.

At this stage no further details can be provided on the PAs, since this process is at the very beginning and interactions with the ITER Organisation on this topic are just starting.

5.1.2. Main Calls for Tender expected to be launched

Linked to Procurement Arrangements:

- Magnets TF Conductor (including Strands);
- Magnets TF Winding Packs (half size double pancake);
- ITER Grade Stainless Steel for Vacuum Vessel manufacturing;
- Divertor Carbon Fibre Composites;
- Architect Engineer Contract for the follow-up of PF Coils Fabrication Building;
- Detailed Design and Construction of the PF Coils Fabrication Building;
- First procurement contracts for the NBTF: ion source power supplies, auxiliary systems (e.g. cooling and cryogenics), etc.

Not linked to Procurement Arrangements:

- Services Distribution Networks on the ITER Site Contractors Areas.

5.1.3. Design and R&D activities in support of ITER

5.1.3.1. Machine Systems

- **Magnets**. A number of development and preparation activities will be carried out in support of the ITER Organisation's decision of manufacturing half size double pancake for TF conductor and Winding Packs. This should reduce risks and uncertainties during production. The corresponding procurement which are on the critical path to ITER construction should be launched before the end of 2008.
- **Vacuum Vessel**. A number of development and preparation activities will be carried out to allow the call for tender for the Vacuum Vessel to be launched in the fourth quarter of 2008. Being also on the critical path of the ITER construction the corresponding contract should be placed before mid 2009. In addition, some R&D tasks may directly lead to cost-savings during manufacture.
- **Shielding Blankets**. Significant changes on the ITER blanket design are expected from the ITER Design Review. The activities planned on Blanket Shield Modules for the year 2008 have therefore been limited to the development and further optimization of the Be to CuCrZr joint.
- **Divertor**. In 2008 the main objectives are related to the completion of the prequalification phase for the divertor procurement. The preparation of the procurement specification will start.
- **Remote Handling (RH)**. In 2008 the design and R&D activities will focus on the development of functional specifications and interfaces for the facilities, prototypes and components to be built in EU: the Divertor Test Platform, the Transfer Cask, the In-Vessel Viewing System and the Neutral Beam RH System.

5.1.3.2. Diagnostics, Plasma Engineering, Heating & CD and CODAC

- **Diagnostics**. The 2008 work programme should continue with co-ordinated activities, already started by EFDA, on each of the procurement packages related to the eight diagnostics systems to be built by EU. The diagnostic-specific development activities will be supported by a comprehensive programme of R&D on common critical components and of port-plug engineering and diagnostic integration. The priority emphasis of the 2008 work programme will be given to components that require early installation, have interfaces with long-lead tokamak components, have lengthy manufacturing times, or are critical to the overall design of the diagnostic systems and port plugs.
- **Plasma Engineering**. The activities in this area can be divided into activities related to:
  - Plasma control & impact on plant design. The activities to be launched in 2008 will respond to the issues emerging from the ITER Design Review, as well as maintain the continuity in the development effort in the areas of plasma scenarios and control, in support to the finalization of the ITER design and procurement, and in support to integration.

- First wall and material studies and implications for Plasma Facing Components design. The activities will concentrate on the evaluation of the consequences of the revised load specifications for ITER, the design and specification of plasma facing materials/components on Plasma Wall interaction issues, especially those related with the nuclear aspects of the device, namely Tritium retention, Tritium removal and Dust production and measurement

- **Electron Cyclotron Upper Launcher**. The EU has to procure for ITER 4 EC Upper Launchers, dedicated to MHD control. The activities in 2008 will concentrate on the finalization of the design of all launcher components, on the definition of the testing requirements and on preparation for tender. Collaboration is envisaged with US and Japan, that are designing and procuring other subsystem of the EC ITER plant with interfaces and/or commonalities with the Upper launcher.

- **Electron Cyclotron Power Sources**. The development of the European gyrotron for ITER, already started under EFDA, will continue in 2008, with the refurbishment of the first prototype and the design and testing activities aimed at improving its performances. The design of the fall back solution of a 1 MW, cylindrical cavity, gyrotron will also continue.

- **Ion Cyclotron Antenna**. The main activities to be launched in 2008 include the continuation of the antenna design (from conceptual towards detailed design), already started under EFDA, and testing of critical components of the design. In parallel, a revision of the procurement package to adapt it to the new antenna design is required.

- **Neutral Beam System**. The work in 2008 focuses on: the establishment of the NB Test Facility (NBTF), the design and preparation of specifications for the procurement of the NBTF components and the R&D work on negative ion based Neutral Beam, in particular the ½ size ITER RF ion source with extraction.

- **CODAC**. The activities of F4E in this area need to be defined in conjunction with the IO. It is foreseen that some studies related to CODAC architecture will start in 2008.

5.1.3.3. Plant Systems

- **Vacuum Pumping and Fuelling**. The activities in 2008 will focus on the upgrading of the TIMO2 facility and the first acceptance/performance tests of the Torus Exhaust Cryopump prototype; continuation of TRANSFLOW tests with different ITER-relevant cross-sections and geometries, manufacture of prototype HNB cryopanels, conceptual design of Cold Valve Boxes (CVBs), production of the P&IDs for the roughing pump system and design and test of tritium compatible roughing pumps (Roots pump and screw pump or other combination of pumps).

- **Cryoplant and cryodistribution**. The work in 2008 focuses mainly on: preliminary design of the cryoplants interconnection box, routing of cryogenic lines, procurement of cryogenic test loop, optimisation of cryoplants design,

preparation of technical specification for the procurement of cryoplant subpackages.

- **Tritium Plant**. In 2008 the following activities are planned: finalising the system study and the detailed mechanical design of ITER Isotope Separation System (ISS) and ITER Water Detritiation System (WDS), including overpressure- and overtemperature controls as well as HAZOP studies.
- **Test Blanket Modules (TBM)**. The work in 2008 focuses on the optimisation of the design of Helium Cooled Lithium Lead (HCLL) and Helium Cooled Pebble Bed (HCPB) TBMs, the development of fabrication technologies, the execution of dynamic and thermo-mechanical tests and the engineering design of the helium cooling system, the tritium extraction system, the coolant purification system and the LiPb loop.
- **Materials Development**. The work focuses on three materials:
  - EUROFER with emphasis on i) characterisation of irradiated EUROFER, (ii) qualification and improvement of joining technologies, iii) development of materials data base and design rules and iv) compatibility issues (coatings, corrosion and hydrogen).
  - EUROFER ODS (Oxide Dispersion Strengthened) with emphasis on: i) improvement of fracture properties, ii) development of fabrication processes and the joining techniques and iii) irradiation campaigns to determine the oxide particle stability.
  - SiC/SiC composites: Development and characterisation for use in flow channel inserts.

5.1.3.4. Buildings

- **Reinforced Concrete and Steel Frame Buildings:**
  - The IO has to provide the functional technical specifications, including interface aspects, such as space limitations, access restrictions, services available, etc. The IO has to provide also the reference conceptual design; alternative designs that satisfy the functional technical specifications will be considered by the IO in the assessment of the offer. F4E uses the functional design as it is provided and is responsible to develop detailed design, and via the contracting of an Architect Engineer (A/E in the following) and the construction companies, the fabrication, construction, and shop drawings.
  - The design requires further development to pass from the present 'conceptual' to 'preliminary' status, allowing the writing of the functional technical specifications that shall form the basis of the contracting of detailed design and construction. To bring the design to the level required to be passed to the A/E for detailed design, the IO is presently launching a 'pre-A/E contract' financed by the Commission under the F4E provisional 2007 Work Programme.
  - In general, the 'pre-A/E contract' is expected to cover all aspects of design and integration. Yet, a number of critical design aspects resulting from the ITER Design Review shall require further work to be contracted directly by F4E in areas such as evaluation of stray magnetic field and modelling of non-ferromagnetic reinforcements, development of codes and standard

special sections for the use of non-ferromagnetic rebar materials. The commitments required for these activities are not included under this section but are associated to the general costs of the Engineering Support Division (see Engineering Analyses and Code and Standard).

- Activities in support of the cost evaluations, independent from the one produced by the pre A/E contract, will be conducted and focused on the objective to contain costs by comparative evaluations of options.

- **Power Supply Systems**. The work in 2008 focuses on supporting ITER for the preparation of the specifications.

- **Waste Treatment and Storage and Radiological Protection**. The EU commitment in this area is to provide on the basis of functional specifications for on-site treatment of waste and the equipments for personnel radiological protection. Though the actual procurement is not on the critical path, a preliminary design is needed earlier to complete the regulatory files and to develop the interface with the Host Country Facilities for waste storage (activities are complementary to safety studies)

5.1.3.5. Engineering Support

The budget presented under this section is related to the services provided by the F4E "Engineering Support" Division. They are horizontal activities provided across the different project areas.

- **Engineering Analyses.** As a result of the modification to the ITER baseline requirements following the ITER Design Review, a number of engineering analysis are required to support procurement activities of F4E in view of minimising cost and obtaining the desired performance: Mechanical Stress analyses, Civil Engineering Stress analyses, Electromagnetic analysis and Neutronics analysis (beyond the ones indicate at the entry 'TBM/IFMIF Nuclear Data and Neutronics Analyses').

- **Code and Standards**. Implementation of code and standards as needed for urgent contracts specifications (including Revision of the Structural Design Criteria for ITER Components and Structural Design and Construction |Criteria for Buildings).

- **Technology and Fabrication Methods**. Implementation of the qualification programme requested for the construction of the vacuum vessel. No specific commitments are allocated to this line of activity and specific resources shall be derived from procurement areas on specific need.

- **Safety**. The work focuses on: continuation of model development and supporting experiments for combined hydrogen/dust explosions, busbar arcing, and corrosion products generation and transport; continuation of EU Test Blanket Modules safety assessment; supporting safety analyses for ITER licensing and studies on waste management.

- **Nuclear Data.** The activities in 2008 in support of ITER, Test Blanket Modules (TBMs) and DEMO include:

- Further development and benchmarking of European Fusion Files (EFF) and European Activation Files (EAF), development and validation of advanced neutronics methods and tools, integral activation experiments.
- Detailed analyses of performed neutronics experiment for the HCLL mock-up. Neutronics analysis of Be and solid and liquid breeders aiming at the determination of the activation effect and activity inventory caused by possible impurities (U, Co, Bi, Po, Tl).

5.1.3.6 Activities resulting from ITER Design Review

Based on the result of the ITER Design Review it is envisaged that some voluntary activities will be carried out in support of the IO to reach a new ITER Baseline.

5.1.3.6 Voluntary Contributions of the EU Associates, coordinated by EFDA

In the framework of the ITER activities, Europe is also carrying out some physics R&D work on items that are currently not included among the ITER Procurement Packages. Such activities are financed through voluntary contributions of the EU Associates, coordinated by EFDA. EFDA indicates that the elaboration of the ITER relevant programme of activities will be done in close collaboration with F4E to ensure the closest match to the ITER needs. These activities include among others, development of ITER relevant diagnostics, heating and current drive systems, detritiation systems, coordinated activities on Plasma Scenario Development for ITER, scenario modelling and R&D activities on specific physics issues.

5.2. Broader Approach

5.2.1. Procurement Arrangements to be concluded for components to be provided by EU

- Satellite Tokamak Programme
  - Cryostat (Spain): including completing design and technical specifications for the Cryostat.
  - Magnet (Italy and France): complete qualification for the TF conductor and finalise technical specifications to initiate the procurement of the conductor, the casings raw material , the tooling and the coil windings.
  - ECRF (Italy, France, Switzerland): Gyrotrons, Magnets, and Power Supplies.
  - Current Leads (Germany): HTS Material procurement, test facility.
  - Coil Power Supplies/QPS (Italy, France):.
  - Cryogenic system (France): although no hardware procurement contracts are foreseen in 2008, industrial studies will have to be performed in preparation for procurements to be started in 2009.
- IFMIF/EVEDA
  - Accelerator: Injector (France)
  - Accelerator: RFQ (Italy)

- Accelerator: RF Sources amplifiers (France)
- Accelerator: RF Sources Power Supplies (Spain)
- Test Facilities: Low Pressure Helium Loop (Spain, Italy, France, Germany)
- Irradiation of mock-ups in fission reactor (Spain, Italy, France, Germany))

- IFERC
  - No such procurement arrangements are foreseen in 2008.

5.2.2. Calls for tender to be launched: Satellite Tokamak Programme

- Satellite Tokamak Programme

  Cold Test Facility (F4E): complete the call for tender and contract for the cold test facility (design activities and initial procurements).

- IFMIF/EVEDA

  None

- IFERC

  None

5.3. DEMO

Very few activities, mainly related to materials development, are currently foreseen to be carried out by the Joint Undertaking related to DEMO, in addition to the activities foreseen in the Test Blanket Module programme associated with ITER.

6. ROADMAP OF 2008 ACTIVITIES

This roadmap is based upon the detailed description of technical activities provided in Annex I and the reference numbers provided in the tables below refer to the corresponding sections.

6.1. Summary (in k€)

Ref.	Budget	Activities	Grants[5]	Procurement	Cash
6.1	3.1	Procurement in support of ITER		119 480	
6.2	3.1	Contribution in cash in support of ITER			30 961
7.1	3.1	Design and R&D in support of ITER, Credited by ITER	21 450	44 230	
3.1		**Total ITER Construction**		**216 121**	
7.1	3.2	Design and R&D in support of ITER, Not credited by ITER	13 860	9 755	
3.2		**Technology for ITER and DEMO**		**23 615**	
8.1	3.3	Activities in support of Broader Approach		2000	
3.3		**Technology for Broader Approach**		**2 000**	
3		**Total operational expenditure**		**241 736**	

6.2. Roadmap of procurements activities in support of ITER

Reference	Title	Number of Contracts	Type of Contract	Date to Launch Calls	Indicative Budget (k€)
1.1.1.1	ITER Toroidal Field (TF) Conductor	4	Supply and Follow-up	Q1/Q2	
1.1.1.1	TF Winding Packs (TFWP) material and tooling	2	Supply and Follow-	Q2	

[5] R&D and demonstration activities to be funded at up to 40% of the total eligible cost (i.e. ≥60% to be contributed by the beneficiaries of the grants)

			up		
1.1.1.2	ITER Grade Stainless Steel for Vacuum Vessel (40% of total Procurement)	4	Supply	Q1/Q3	
1.1.1.3	Carbon Fiber Composites for Divertor Inner Vertical Target high heat flux region	1	Supply	Q2	
1.1.2.1a	Architect Engineering – PF coils Fabrication Building	1	Service	Q1	
1.1.2.1b	Detailed Design and Construction – PF Coils Fabrication Building	1 to 3	Works	Q3	
1.1.2.1c	Consultancies for the preparation of the Architect Engineer Contracts	1	Service	Q1	
1.1.4	Site Preparation (main services and selected infrastructures)	1	Works	Q2	
	TOTAL				**119,480**

6.3. Contribution in cash in support of ITER

Reference	Title	Number of Contracts	Type of Contract	Date to Launch Calls	Indicative Budget (k€)
1.2.1	Contribution for Management of ITER Organization	-	Cash	Q1	17,700
1.2.2	Contribution to Japan procurement Allocation	-	Cash	Q1	13,261
	TOTAL				**30,961**

6.4. Roadmap of design and R&D activities in support of ITER

6.4.1. Credited by ITER

Reference	Title	Indicative Budget Grants (k€)	
2.1.1.1	Finalisation of the design and the preparation of the procurement specifications for ITER Magnets	1,250	
2.1.1.2	Manufacturing, achievement of the technical requirements and possible cost saving of the ITER Vacuum Vessel	925	
2.1.1.3.A	Shielding Blankets: Optimization and characterization of the Be to CuCrZr joining technique and HIP fabrication process	1,560	
2.1.1.3.B	Divertor: Support to prepare Cassette and inner Vertical Target Call for Tender and activities for the preparation of PFCs procurements	630	
2.1.1.4	Remote Handling to meet ITER procurement plans	1,600	
2.1.2.1	Diagnostics: design and R&D on eight procurement packages, common critical components, port-plug engineering and diagnostic integration	3,650	
2.1.2.2	Plasma Engineering: activities on plasma control and First wall and materials.	785	
2.1.2.3	Heating & Current Drive: EC Upper Launcher including prototypes, EC Power Sources and Power Supplies, IC Antenna components, NB System, NB Test Facility	6,300	
2.1.3.1	Vacuum Pumping and Fuelling: support activities for prototype Torus cryopump, for vacuum pumping, for NB cryopump and cold valve boxes, for roughing pump trains	870	
2.1.3.2	Cryoplant and Cryodistribution: Cryogenic test loop, Flow dynamic analysis, design optimization, process eng. Review, cryogenics manual	240	
2.1.3.3	Tritium Plant: activities in support of Isotope Separation Sys, Water Detritiation Sys.	1,360	

2.1.4.2	Buildings – Power Supply sys – Qualification, support to procurement activities	No grants	
2.1.5.1	Engineering Support: electromagnetic, mechanical and neutronic analyses, structural design criteria for in-vessel components and buildings	590	
2.1.5.3	Safety: R&D/Design in support of ITER licensing	1,690	
2.1.5.4	Waste Treatment and Storage and Radiological Protection: Preliminary Design	No grants	
TOTAL BUDGET GRANTS (k€)			**21,450**
TOTAL BUDGET PROCUREMENTS (k€)			**44,230**

6.4.2. Not Credited by ITER

Reference	Title	Indicative Budget Grants (k€)	
2.1.1.1	Finalisation of the design and the preparation of the procurement specifications for ITER Magnets	150	
2.1.1.2	Manufacturing, achievement of the technical requirements and possible cost saving of the ITER Vacuum Vessel	1,850	
2.1.1.1.3A	Shielding Blankets: Optimization and characterization of the Be to CuCrZr joining technique and HIP fabrication process	No grants	
2.1.1.4	Remote Handling to meet ITER procurement plans	260	
2.1.2.3	Heating & Current Drive: EC Upper Launcher including prototypes, EC Power Sources and Power Supplies, IC Antenna components, NB System, NB Test Facility	830	
2.1.2.4	CODAC: system definition activities	200	
2.1.3.3	Tritium Plant: activities in support of Isotope Separation Sys, Water Detritiation Sys.	110	
2.1.3.4	Test Blanket Modules	4,270	
2.1.3.5	Materials developments: EUROFER, EUROFER ODS, SiC-SiC	2,310	
2.1.4.1	Buildings: Pre A/E Design Activities	No grants	
2.1.4.2	Buildings - Power Supply sys.: Preparation of functional specifications, Qualification, support to procurement activities	130	
2.1.5.1	Engineering Support: electromagnetic, mechanical, neutronic and civil eng. Analyses, structural design criteria for in-vessel components and buildings	200	
2.1.5.3	Safety: R&D/Design in support of ITER EU Test Blanket Modules	220	
2.1.5.4	Waste Treatment and Storage and Radiological Protection: Preliminary Design	No grants	

2.1.5.5	Nuclear data: development of tools and validation in support of ITER and TBM activities	330	
2.1.6	Activities resulting from the ITER Design Review	3,000	
TOTAL BUDGET GRANTS (k€)			**13,860**
TOTAL BUDGET PROCUREMENTS (k€)			**9,755**

6.5. Roadmap of activities in support of Broader Approach

Reference	Title	Number of Contracts	Type of Contract	Date to Launch Calls	Budget (k€)
3.1	Cold Test Facility for Satellite Tokamak TF coils	1 2-3	Service Works	Q2	2,000
TOTAL					**2,000**

ANNEX 1
DETAILED DESCRIPTION OF 'FUSION FOR ENERGY' ACTIVITIES

1. PROCUREMENTS ACTIVITIES IN SUPPORT OF ITER

All of the activities listed in this chapter are to be implemented through contracts awarded pursuant to a F4E procurement procedure. The procurements referred here after are directly related to the components to be installed in the ITER machine. Procurements required for R&D activities are included into Section 7.

1.1. ITER

The level of detail (BTP: Build-to-Print; DDS: Detailed Design Specification; CD: Conceptual Design; FS: Functional Specification) of the Procurement Packages as prepared by ITER is as follows.

Procurement Packages	Level of Detail
TF Magnet Windings	BTP/DDS
TF Magnet Structures (10%)	BTP/DDS
PF Coils (5 out of 6)	BTP/DDS
TF Magnet Conductor (20%)	BTP/FS
PF Magnet Conductor (13%)	BTP/FS
Main Vessel incl. blanket manifolds and hydro connectors (80%)	BTP/DDS
Blanket First Wall (30%)	BTP
Blanket Shield (10%)	BTP
Divertor Cassette & Integration	DDS
Divertor Inner Target	DDS
Divertor RH Equipment	FS
Transfer Cask System (50%)	FS
Viewing/Metrology Sys	FS
NB RH Equipment	FS
Diag-Plasma Position Reflectometer	FS

Diag-Core Plasma Charge Ex. Recombination Spectroscopy	FS
Diag-Radial Neutron Camera & Eq. Visible/IR Viewing Sys	FS
Diag-Core Plasma Lidar Thomson Scat.	FS
Diag-Bolometers and Pressure Gauges	FS
Diag-Magnetics Diagnostics	FS
Diag-Thermocouples	FS
Diag. In-Vessel Diag. Service	FS
EC Upper Launcher (88%)	BTP
EC Radio Frequency Power Sources (31%)	FS
EC Power Supplies (92%)	FS
IC Antenna (88%)	BTP
HNB-Assembly & Testing (100%)	FS
HNB-Beam Source and HV Bushing (41%)	BTP
HNB-Beamline Components (100%)	BTP
HNB-Pressure Vessel & Magnet Shielding (76%)	DDS
HNB-Active Correction & Compensation Coils (100%)	DDS
HNB Power Supply for HNB (31%)	FS
Cryopumps (88%)	BTP+CD
Leak Detection (88%)	FS
Cryoplant (50%)	FS
Isotope Separation Sys (88%)	DDS
Water Detritiation Sys (88%)	DDS
Reinf. Concrete Buildings	FS
Steel Frame Buildings	FS
Pulsed Power Supply	FS
SS Power Supply	FS

Waste Treat.& Rad. Protection	FS

1.1.1. Machine Systems

1.1.1.1. Magnets

The Procurement Package of the ITER Toroidal Field (TF) Conductor and Winding Pack manufacturing are in the critical path of the construction schedule. Due to the TF conductor design revision and the subsequent qualification expected in spring/summer 2008, the contracts can be placed earliest in summer 2008. This requires starting the call for tender and contract negotiation in parallel to the qualification action.

The EU part of the ITER TF Conductor Procurement Package consists of the procurement of about 80 tons of Nb_3Sn strand, 50 tons of Cu strand, 18 km of stainless steel jacket and in performing the cabling, the butt welding of the jacket and the jacketing of the cable using the pull-through / roll-down technique. Only the first stage of this procurement is included into WP2008. Additional conductors to be delivered as spares based on ITER request are under negotiation.

The Procurement package for TF Winding pack consists of Toroidal Field Coil Winding Packs (including Radial Plates & Covers) for 9 ITER TF Coils and 1 Prototype/Spare. The conductors will be supplied by the EU and other ITER Parties. The work consists of winding the conductors into double pancakes, performing the heat treatment to form the superconducting compounds in the strand and then to insert the pancakes in the radial plate. Seven of these double pancakes stacked and impregnated together form a TF Winding Pack. Considering the relative long time needed to set-up of the manufacturing facilities, the procurement should be started as soon as the design has been fixed.

The ITER Organisation has proposed to conclude a Pre-Procurement Arrangement prior to the actual Procurement Arrangement to manufacture the mock-up double pancake; tools needed for the mock-up could be used for the production of the coils. The ITER Organisation could postpone the actual PA signature to 2010, waiting for the ½ size double pancake results (see under "Design and R&D Activities-Magnets"); therefore it is foreseen for 2008 to take only an option for the procurement of the radial plate's material and start manufacturing of the winding tools.

1.1.1.2. Vacuum Vessel

Procurement of the ITER Grade Stainless Steel for Vacuum Vessel (VV) manufacturing. The industry studies on cost and schedule have identified that the present procurement time for forgings is up to 18 months and for plates about one year. This leads to a significant delay on the delivery time for the VV sectors with respect to the previous estimation. To avoid such delay the procurement of the material needed in the first period of the manufacturing phase is planned. A risk assessment is in progress.

1.1.1.3. Divertor

Procurement of the Carbon Fiber Composites (CFC) for Divertor Inner Vertical Target high heat flux region. According to the EU Procurement Schedule, a part of the first batch of CFC material needs to be available for the manufacturing of Plasma Facing Component prototype (starting on mid 2010). Considering the long production time, typically in the range of 18 months, the material should be ordered during 2008. The total amount of CFC's will be procured in one order and the material shall be delivered in typically in 3 batches. It is worth noting that, at the moment, the EU reference CFC grade has not yet been defined.

1.1.2. Buildings

1.1.2.1. Reinforced Concrete Buildings and Steel Frame Buildings

The construction of the so-called Reinforced Concrete Building and Steel Frame Buildings is totally within the scope of the EU contribution. The EU commitment includes the detailed design and execution of the works.

In 2008 the only procurement is the PF Coil Fabrication Building.

(a) Architect Engineering Contract for the PF coils Fabrication Building

A contract for the follow-up of the detailed design preparation and of the construction and the regulatory file preparation and follow-up of the PF coils fabrication building. The support will start with the assistance in the phase of "Call for Tender" for this activity.

(b) Contract for the Detailed Design and Construction of the PF Coils Fabrication Building

The construction of the PF Coil Fabrication building is on the critical path and has been anticipated with respect to the construction of the overall ITER complex. The Technical Specifications for Design and Build Contract have been prepared and are under verification. Specialised equipments (cranes, clean areas and associated equipments) may be contracted separately.

(c) Consultancies for the preparation of the Architect Engineer Contracts

In view of the times required to reach the F4E full operational capacity in the area of Buildings, resources are allocated for consultancy work on specific subjects of the design and construction of the ITER buildings. These consultancies shall allow F4E to react timely to the design changes and details that are going to be developed by the 'pre-A/E contract' and to support the preparation of the specifications of the Architect Engineer Contracts for the Reinforced Concrete Building and Steel Frame Buildings.

1.1.3. Site Preparation

Preparation in the Contractors' areas of the main services (roads, electrical, water, sewage, telecommunications) and selected infrastructures (concrete batching plant, transformers etc.).

1.2. Contributions in Cash to the ITER Organisation and to Japan

1.2.1. Contribution to the ITER Organisation

This corresponds to the annual EU share of the contribution in cash to the ITER Organisation for its management, to be adopted during the next ITER Council

1.2.2. Transfer of procurement responsibility from, Euratom to Japan

Fusion for Energy will make a financial contribution to Japan according to this transfer of procurement responsibility under the supervision of the ITER Organisation. The agreement with Japan foresees the payment after the acceptance of delivery and certification of the value by ITER. Considering this imposes long delays, 'Fusion for Energy' shall provide advance payment after conclusion of the corresponding procurement arrangement between Japan and the ITER Organisation. The 2008 amount is only for advance payments.

2. DESIGN AND R&D ACTIVITIES IN SUPPORT OF ITER AND DEMO

All of the activities listed in this chapter are normally to be implemented through the awarding of grants and procurements. In addition these activities are mostly subject to an acceptance by ITER Organisation to credit them. All the listed activities are Priority 1.

Tables in Sections 9.1 and 9.2 provide the budget values for the activities respectively credited and not credited by the ITER Organisation.

2.1. ITER

2.1.1. Machine Systems

2.1.1.1. Magnets

The activities are related to the tasks required for the finalisation of the design and the preparation of the procurement specifications. To meet the ITER procurement plans, the necessary activities to be implemented and/or initiated in 2008 in the Magnets area include:

- Manufacture of large scale mock-up using radiation resistant cyanate ester based resin

  A new radiation resistant resin system has been qualified for the impregnation of Toroidal TF Coils, where the performance of the standard epoxy resin is not sufficient. Mixing of the components is needed.

- Carry out cold test facility preparation for TF coils

  The need of a TF test facility for final acceptance cold test has been identified. The design of such facility is planned to be carried out in 2008.

- Manufacturing of the Sub-size TF coil double pancake (TFCDP)

  A scale 1:2 of the TFC DP shall be manufactured to assess the feasibility of the TF double pancake. The conductor will be the final one and the number of groves will be reduced. The aim is to check the radial plate manufacturing, the

deformation of the conductor after heat treatment and the conductor transfer. The final tools for bending the conductor can be used in the manufacturing process and validation of the over all manufacturing cycles can be carried out.

- Carry out design work for magnet components

  The magnets are still under analysis and it is likely that some modifications are needed.

- Mechanical qualification of conductor and structural materials

  The new strand as well as the cables needs to be qualified for use at 4 K. This includes both tensile tests and fatigue crack growth tests.

- Coil electrical testing and transient analysis

  The assessment of the electrical tests on coils started in 2006 and it will continue. This work includes TF coils and PF coils.

- Analysis and interpretation of ITER coils

  The coil analysis started with the EFDA programme in 2006 and will continue. This work is carried out for PF and CC coils.

- Carry out manufacturing trials of magnet components

  The manufacturing trials of the magnet components (e.g. electrical break) will be conducted.

- Characterization of ITER strands

  In order to have input for modelling the new conductor design and assess the SULTAN test result, strand characterization will be conducted.

- Manufacture and SULTAN test of TF Conductors

  TF conductors with the revised design need to be qualified.

- TC Coil Case closure welding

  Welding trials are needed for the reduction of the risks

Grants

	Title	Deliverables	Indicative time of call launch
Credited by ITER	Manufacture of large scale mock-up using radiation resistant cyanate ester based resin	Detailed design of the mock-up and manufacturing plan Construction of the mock-up	Q2/Q3
	Carry out cold test facility preparation for TF coils	Detailed design of the facility Testing plan	Q2/Q3
	Mechanical qualification of conductor and structural materials	Report of the study	Q2/Q3
	Coil electrical testing and transient analysis	Report of the study	Q2/Q3
	Analysis and interpretation of ITER coils	Report of the study	Q2/Q3
	Characterization of ITER strands	Report of the study	Q2/Q3
Not credited by ITER	Manufacture and SULTAN test of TF Conductors (back-up solution)	Report of the study	Q2/Q3
	TF Coil Case closure welding	Finalisation of the manufacturing drawings	Q2/Q3

Procurements

	Title	Deliverables	Indicative time of call launch
Credited by ITER	Manufacture of large scale mock-up using radiation resistant cyanate ester based resin	Detailed design of the mock-up and manufacturing plan Construction of mock-up	Q2/Q3
	Carry out cold test facility preparation for TF coils	Detailed design of the facility Testing plan	Q2/Q3
	Large scale mock-up double pancake ½.	Finalisation of the manufacturing drawings Manufacture of the samples	Q2/Q3
Not Credited by ITER	TF Coil Case Closure Welding	Manufacture and testing of the samples Welding parameters for case closure welding	Q2/Q3

2.1.1.2. Vacuum Vessel (VV)

The following tasks are necessary to prepare the manufacturing phase and to guarantee the achievement of the technical requirements and possibly cost saving.

- Weld Distortion Control of VV segment manufacture

  The manufacture of the VV sectors requires tolerances not normally considered for such a large and complicated structure. Completed R&D indicates that it will only be possible to achieve the tolerances (1) using advanced (SYSWELD) computational tools supported by small validation mock-ups and (2) using stress reducing measures during the welding operations. Further activities in 2008 include optimising the process in order to optimise methods suitable to achieve the tolerance required.

- Qualification of Ultrasonic Testing (UT) Inspection Procedures one-side butt welds for ITER VV for RCC-MR

  The performed R&D for inspection of one-sided welds by UT has produced in the laboratory a new set of tools, the technology for which needs to be

implemented to the industrial inspection application, including the full qualification for use on the VV sectors under the RCC-MR Code (the reference code for VV design and manufacturing). These welds are required for closure of the box section and ITER has stipulated 100% efficiency, which cannot be reached without these exceptional measures.

- Local Vacuum EB weld system development

  The ITER specification requires that all of the 1750 inner shell-to-housing joints be carried out by E-Beam welding. However the limited availability of sufficiently large facilities means that this activity would cause a bottleneck in the production. The rotational symmetry configuration allows the application of Local Chambers to implement these E-B welds. This activity includes the design of a simple local vacuum system specifically for the ITER VV and the preparatory work needed to specify the system to a point where it can be fully put out to tender. In addition, some welding trials will be carried out to verify a method of EB welding the housings without the problem of through power impacting the inner parts. Without this work, it will not be possible due to time constraints, to carry out the work within the main contract.

- VV sector welding preparation

  At the 4th VV procurement meeting, Barcelona, Nov 12-14, 2007, F4E proposed to take over responsibility for the sector welding activity at Cadarache. This critical path and technically very challenging responsibility implies that the previous successful R&D work with Hybrid laser welding and the Welding robot must be extended with the view to later implementing a sector welding demonstration facility. The welding work to improve productivity by a factor of 10 will involve the further development of the Hybrid laser process to improve stability and reduce sensitivity, especially to hot cracking. The R&D will also demonstrate the welding test qualification to RCC-MR code requirements.

- HIP material and cold-formed products validation

  The compatibility of this activity on the time schedule for procurement of the VV needs to be clarified. In the VV construction, there are several high cost drivers. An important one is the high cost of the material and another is the high amount of welding with their concomitant complications, cost and distortion implications. The use of HIPed products for groups of housings and shell is proposed to ease both of these problems. This task will validate the use of HIPped products for the VV construction.

- Materials evaluations and database

  Evaluation of materials data, collection and assessment of data from development work, to assist in specifications. A task to organize material properties into the database and/or look over Intellectual Property rights in the material database.

- Corrosion issues

  Further development of a road map for required R&D and addressing the corrosion issues identified. Many critical corrosion issues have been identified by EFDA, IO and associations due to the shared cooling water loops. It involves experimental studies at different temperatures and relevant water chemistries on

joints between different materials, welds and geometrical changes such as pipe bends.

- Powder hip qualification

  Irradiation and testing of the powder hipped material and joints following the EFDA qualified production route to ensure that powder the low oxygen treatment gives satisfactory results after ITER relevant irradiation.

- Prepare Procurement Specification

  Design activity and support for ITER to prepare the technical specification. Some design activity is still needed and support for ITER to prepare the technical specification is also planned. It is also important that the current ITER activity of revising (increasing) the EM loads on the VV be verified by Europe. The ANSYS models must be properly checked for stability and correctness, since any delay in this matter will reflect in schedule problems due to the interface with the French Authorities.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Corrosion issues	Results of Experiments and Tests on Rig with different geometries	Q3/Q4
	Materials evaluations and database	Organize material properties into the database Review Intellectual Property rights	Q2/Q3
	VV sector welding preparation	Welding Robot Development Local Machining Robotic Demonstration Welding studies	Q3/Q4
	Qualification of Ultrasonic Testing (UT) Inspection Procedures one-side butt welds for ITER VV for RCC-MR	Analysis of RCC-MR requirements Fabrication of Test Coupons Technology transfer of UT techniques from Phoenix and CEA Demonstration of UT field trials with industrial equipment	Q2/Q3
Not credited by ITER	Weld Distortion Control of VV segment manufacture	Results of SYSWELD model of one Segment Use of Ultrasonic Techniques to Control Distortion	Q1/Q2
	Local Vacuum EB weld system development	Results of Design Study for System Results of Welding trials	Q1/Q2
	HIP material and cold-formed products validation	Results of Design Study for System Results of HIPping trials	Q2/Q3

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Technical Specification Preparation	Drawings Spec	Q3/Q4
Not Credited by ITER	None		

2.1.1.3. In-vessel Components

A. Shielding Blankets

Significant changes for the ITER blanket design are expected from the ITER Design Review. The activities planned on Blanket Shield Modules for the year 2008 have therefore been limited to the optimization and characterization of the Be to CuCrZr joining technique and HIP fabrication process. The programme includes the following main activities:

- Thermal fatigue testing and high heat flux testing of FW mock-ups fabricated last year with improved Be/CuCrZr joints, of irradiated FW mock-ups and of FW mock-ups fabricated for the definition of acceptance criteria for the FW series production,
- transportation of irradiated FW mock-ups from Dimitrovgrad (RF) to Juelich (D) for post irradiation high heat flux testing,
- continuation of Be/CuCrZr joining development including alternative joining technique for fabrication cost reduction and repair techniques,
- continuation of the CuCrZr power-solid HIP development to make easier the fabrication route for complex FW panels as those next to the NBI openings,
- ultrasonic testing of Be coated FW mock-ups to check the effect of thermal fatigue or high heat flux tests on the Be/CuCrZr joints,
- pre-industrialisation of the HIP fabrication process for the FW and Shield components,
- Be waste disposal from FW mock-ups after destructive examination.

Grants

	Title	Deliverables	Indicative time of Call Launch
Credited by ITER	High heat flux testing of FW mock-ups	Test report	Q2
	Transportation of irradiated mock-ups	Delivery of mock-up	Q1
	Thermal fatigue testing of FW mock-ups	Test report	Q3
	CuCrZr powder-solid HIP development	Manufacture of FW mock-ups Study and fabrication reports	Q1
	Continuation of Be/CuCrZr HIP joining development	Manufacture of FW mock-ups Study and fabrication reports	Q4
Not Credited by ITER	None		

Procurements

	Title	Deliverables	Indicative time of Call Launch
Credited by ITER	Ultrasonic testing of Be-coated FW mock-ups	Test report	Q1
	Pre-industrialisation of the HIP fabrication process for the FW	Manufacture of mock-ups Study and fabrication report	Q2
	Be/CuCrZr joint repair technique	Manufacture of mock-ups Study report	Q3
	Be waste disposal from FW mock-ups	Report on material sampling Material disposal	Q1
Not Credited by ITER	Production of Ag-free braze alloy and development of fast brazing technique	Production of the braze alloy Fabrication report Development work report	Q3
	Pre-industrialisation of the HIP fabrication process for the Shield	Manufacture of mock-ups Study and fabrication reports	Q2

B. Divertor

The activities will be in support to the writing of procurement specifications and to the preparation of the detailed procurement drawings in order to be ready for launching the Cassette and Inner Vertical Target call for tender.

Moreover, there are activities associated with the finalization of the remaining items related to the design and the manufacturing technologies for the procurement of the plasma facing components (PFCs), which include:

- High heat flux testing of CFC and W monoblocks.

  This activity is necessary to increase the high heat flux experimental data base related to components manufactured by using a new available CFC.

- Destructive examination of EU qualification prototypes and mock ups.

  This task is aimed at providing information on the high heat flux behaviour of the EU qualification prototypes. The manufacturing and testing of such components is part of the divertor procurement strategy.

- Development of diagnostics able to predict the occurrence of critical heat flux (CHF) in the divertor plasma facing components.

  This activity was foreseen by EFDA and has been recently mentioned in a top level ITER Deputy Director document.

- Manufacturing of tungsten qualification prototypes.

  This activity is aimed at assessing the possibility to replace CFC armour in the high heat flux part of the vertical targets.

- Characterization of alternative CFC material.

  This activity is aimed at characterizing CFC under development in time for the call for tender for the procurement of the CFC.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Support to the writing of the Cassette Body procurement specification	Interim report on the analysis of ITER specs. Final report including the final version of the document (2009)	Q2
	Support to the writing of the Inner Vertical Target procurement specification	Interim report on the analysis of ITER specs. Final report including the final version of the document	Q1
	Preparation of high heat flux testing of CFC and W mock ups: IR examinations and test set up.	Interim report on infra red testing Final Report	Q1
	Destructive examination of EU qualification prototypes and mock ups	Interim report on cutting plan Final Report	Q3
	Development of diagnostics for critical heat flux	Initial report on diagnostic set up Final Report	Q2
	Characterization of alternative CFC material.	Initial report on test procedures Final Report	Q1
Not credited by ITER	None		

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Analysis of ITER Specs for Cassette Body. Revision and preparation of the detailed procurement drawings	Interim report on the analysis of ITER specs. Final report including the final version of detailed drawings.	Q2
	Analysis of ITER Specs for Inner Vertical Target. Revision and preparation of the detailed procurement drawings	Interim report on the analysis of ITER specs. Final report including the final version of detailed drawings.	Q2
	High heat flux testing of CFC and W mock ups (testing execution)	Initial report on test set up Final Report	Q2
	Manufacturing of tungsten qualification prototypes	Initial report on manufacturing and qualification protocols Final Report	Q2
Not credited by ITER	None		

2.1.1.4. Remote Handling

For the procurement of the remote handling (RH) equipment the ITER Organisation will issue functional specifications. These must be complemented by the definition of a set of interface requirements, in particular the geometrical interfaces of the components to be handled, the VV ports and ducts, hot cell, building, etc. and therefore still a significant effort by Europe, in liaison with the ITEROrganisation, in terms of design, finalisation of the interfaces, prototyping and testing is required. To meet the ITER procurement plans, the necessary activities to be implemented and/or initiated in 2008 in the RH area include:

- Review and assessment between F4E and IO of the RH procurement packages: scope, spares, interfaces, integration and standardisation.
- Execution of RH trials within the Divertor Test Platform (DTP2) facility using the prototype Cassette Multi-functional Mover (CMM), Second Cassette End-

Effector (SCEE) and start of tests with CMM mounted manipulator, together with further DTP2 sub-system developments driven by the trials programme;

- In parallel and in combination with the activity below, start of a major enhancement to the DTP2 facility structures (VV divertor region mock-up and Cassette mock-up) to provide an additional 53° toroidal section in which to test future prototypes (see next point) and match the latest evolutions of the ITER component designs;
- Design, specification and initiation of the procurement process (call-for-tender) for further RH equipment prototypes to be tested within DTP2, namely Cassette Toroidal Mover (CTM), Standard Cassette End-Effector (SCEE), Central Cassette End-Effector (CCEE) and (to be confirmed) divertor cooling pipe cutting, welding and inspection tooling;
- Design of the standardised ITER Air Transfer System (ATS) for the RH Transfer Casks, together with design and specification of a sub-sized ATS prototype in preparation for a procurement process in 2009;
- Modelling and simulation of Transfer Cask Systems operating in the ITER Tokamak and Hot Cell Buildings
- Design of the ITER In-Vessel Viewing System (IVVS) within ITER specified boundary conditions and geometrical interfaces, and specification of a prototype system for later procurement (during 2009); possible lab tests on an upgraded IVVS probe mock-up.
- Continuation of design activities for the ITER Neutral Beam RH system, to be ready for specification for procurement of the ITER system to be started during 2009;
- Progressive irradiation and performance testing of off-the-shelf components already selected for use in RH system prototypes to qualify them for use in the real ITER systems.
- To be confirmed: in liaison with the ITER Organisation, and coordinated with other parts of the 2008 workprogramme, there will be synergies and combination with activities related to ITER hot cell maintenance tasks, like test in Divertor Refurbishment Platform and studies of maintenance for DIA, Heating plugs, Test Blanket Module.

The tables here below are indicative and subject to refinements, reshuffling and modifications.

In 2008 there should be only preparation of hardware procurements via industrial contracts to be placed during 2009, therefore at the moment there are no provisions for industrial contracts. Other tasks that could require industrial support like design studies are at the moment foreseen as performed by F4E in combination with 40% Grant contracts. All this has to be re-analysed during F4E start-up phases in 2008 and things could organised differently; for example, part of the near term DTP2 upgrades described in activity 7.1.1.4a above could require an industrial procurement.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	DTP testing and first upgrades (MAM mounted on CMM)	Test reports Specifications Manufacturing drawings DTP2 hardware	Q1-Q2
	DTP2 further upgrades (platform extension, movers' and pipe tooling prototypes)	Specifications and drawings (tender packages)	Q1-Q2
	Studies on transfer cask path in the ITER building and on rescue scenarios; start of preparation of tender packages for ATS prototype	Reports	Q1-Q2
	Gathering of requirements for final IVVS system Specification of IVVS prototype and start of preparation of tender package Lab-test new series	Specifications and drawings Test report	Q1-Q2
	Gathering of requirements for NBI RH, and feedback to/from NBI design. Start of engineering design of NBI RH	Specifications and drawings	Q2
Not Credited by ITER	Irradiation tests on RH components Hot cell studies/tests	Reports	Q1-Q2

2.1.2. Diagnostics, Plasma Engineering, Heating & CD

2.1.2.1. Diagnostics

The eight diagnostic procurement packages the EU is likely to supply to ITER, pending the final sharing agreement, include the following diagnostics and diagnostic components:

- Plasma position reflectometer (in procurement package EU5.5.2.1)

- Core-plasma charge-exchange recombination spectroscopy (CXRS) (in EU5.5.2.2)
- Radial neutron camera and equatorial visible/IR wide angle viewing systems (in EU5.5.3.11)
- Core-plasma LIDAR Thomson scattering (in EU5.5.3.14)
- Bolometers and pressure gauges (in EU5.5.4.21)
- Magnetics diagnostics (in and ex-vessel) (in EU5.5.1.22)
- Thermocouples (in-vessel and inner-divertor target) (in EU5.5.1.22 and EU5.5.1.27)
- Diagnostic in-vessel diagnostic services (EU5.5.5.30)

In addition to diagnostics, the procurement packages include five port plugs, into which EU diagnostics and non-EU diagnostics need to be integrated. Furthermore, several diagnostics have components that are to be integrated into port plugs provided by other parties. Apart from port-plugs, diagnostics also have interfaces with and are to be installed in the vacuum vessel, divertor and outside the vacuum vessel.

Diagnostic-specific development activities need to be supported by a comprehensive programme of R&D on common critical components and of port-plug engineering and diagnostic integration. The priority of the 2008 work programme will be on components that require early installation, have interfaces with long-lead tokamak components, have lengthy manufacturing times, or are critical to the overall design of the diagnostic systems and port plugs.

In 2008, the following specific activities are foreseen:

- *Design and R&D on components common to several procurement packages.* The engineering design of the representative port-plug structures should be completed during 2008 as part of a cross-party activity coordinated by the ITER Organisation, which may also require a certain amount of R&D and prototyping to be initiated. In addition, integration of EU and non-EU supplied diagnostics in the EU-supplied diagnostic port plugs will be required for optimization of and space trade-offs for individual diagnostics, and for diagnostic design to proceed. Neutronics calculations are also required for the optimization of diagnostic integration and meeting constraints on neutron streaming. Design and R&D on common components such as diagnostic first mirrors and windows are required. In particular, on diagnostic first mirrors experimental exposure and characterization, modelling of the environment and erosion/deposition processes, and development and testing of cleaning and mitigation techniques will be undertaken. R&D on diagnostic window assemblies (are nominally procured by Fund) may also be required, in the interest of the EU-supplied diagnostics.
- *Design for specific procurement packages.* Coordinated design activities on the eight diagnostics included in the EU diagnostic procurement packages and in-vessel services will build on the preliminary designs achieved under EFDA, by detailing designs, engineering analysis, and performance analysis in relation to the measurement requirements. The activities will address in particular feasibility, critical components, interfaces with other tokamak systems (such as the vacuum vessel and divertor). In the port-based packages, the emphasis will be

on the ability of front-end components to survive in the ITER environment, shutters, cooled mirror mounts, and provisions for exchanging critical components. Although the focus will be on the critical components, the overall design must also be progressed to the appropriate level to ensure the overall compatibility and performance of the diagnostic. Contributions will be made to the writing of the procurement specifications by the ITER Organisation in relation to these procurement packages.

- *R&D for specific procurement packages.* R&D will be pursued on diagnostic components which have to be qualified urgently or that affect significantly the designs or feasibility of specific diagnostics. These include in-vessel waveguide manufacture and waveguide joints, a waveguide/antenna mock-up, development and qualification of bolometers, pressure gauges and magnetics sensors, detector and laser technology for the LIDAR diagnostic, alternative technologies for the transfer of visible and IR light in the visible/IR wide-angle viewing system, and development of solutions for in-vessel wiring and wiring conduits. It is expect that industrial R&D will be initiated on a number of components, such as in-vessel diagnostic cables and bolometers. Irradiation testing will be undertaken for the development of radiation-hard diagnostic components and their qualification for the ITER environment. Components include in-vessel services (cables, feedthroughs and connectors), mirrors, window assemblies, optical fibres and various sensor types (such as bolometers, magnetics sensors, pressure gauges and thermocouples).

No procurement of diagnostic hardware is foreseen in 2008.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Engineering analysis on diagnostic port plugs	Detailed design of representative port plugs	Q1
	Urgent design and R&D on critical parts of the diagnostic procurement packages and common topics, including R&D on first mirrors and irradiation testing	Design activities R&D on critical components Assist the ITER IO in writing procurement specifications	Q2
	Design and R&D for the diagnostic procurement packages, including diagnostic integration into port plugs	Design activities R&D on diagnostic components Assist the ITER IO in writing procurement specifications	Q3
Not credited by ITER	None		

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Industrial R&D on diagnostic components, such as in-vessel wires and bolometers	Manufacture of prototypes	Q3
Not credited by ITER	None		

2.1.2.2. Plasma Engineering

A. Plasma Control

The activities to be coordinated by F4E in this area will focus on the support to the finalization of the ITER design and procurement, and on support to procurement (including analysis of non-conformities of "plasma-sensitive" components) and integration, This requires maintaining the effort in the areas of plasma scenarios stability and control, resistive wall mode control (RWM), disruption analysis and disruption mitigation, control, etc.. Most of these activities should start promptly in 2008 but they will be ongoing activities to support and analyze the evolution of the ITER design, especially for the PF/TF systems, power supplies as well as vacuum vessel and PFCs.

Approximately 7ppy of design and R&D will be required for the EU's contributions in this area in 2008. The Plasma Control activity shall concentrate on the identification and early resolution of issues that might have impact on the design and procurement of plasma-related sub-systems. More specifically,

- Continuation of the analysis & optimization of **ripple in ITER**, especially related to TBM design and operation;
- **Plasma fuelling & pumping,** including compatibility of ELM moderation with the pumping system, pumping speed with and without plasma, cryo-cycles etc.;
- **Operation scenarios**. Design and simulation of different plasma operation scenarios (such as low power/commissioning scenarios, key reference operation scenarios, termination scenarios for machine protection), definition of main interfaces with subsystems (in particular, heating and current drive systems, diagnostics, CODAC, power supply), derivation of equilibrium database for sub-systems design interfaces; integration of the H&CD systems in the scenarios is also part of this topic;
- **Control: Plasma stabilization and control**. Derivation and analysis of linear models describing the vertical (n=0) and pressure-driven kink (n=1) instabilities that include the 3D coupling with eddy currents (passive stabilization) and active currents (active control). This activities should also include the development and implementation of an integrated modelling of magnetic diagnostics – control systems to assess, in particular, the effect of noise (plasma-generated or from external sources) on plasma control performances;
- **Power supply and control**. Development and implementation of an integrated modelling of power supply system - control systems to assess, in particular, the impact of ITER PF and CC power supply dynamics and limits on control;
- **Magnets AC losses**. Development of an AC loss model to be analysed by close-loop simulations of the plasma control system the magnets heat loads due to control actions. Assessment of the implications on control system design of AC loss (bandwidth, noise rejection etc.);
- **Disruptions**. Modelling and analysis of disruptions and VDEs (including runways and halo currents) plus compilation of disruption database for subsequent electro-magnetic and stress analysis of different machine components. Model validation against experiments.

Please note that this area is likely to have to respond to urgent R&D requests from the ITER Organisation, not foreseen now, and therefore should have access to resources allocated for this scope (not included in the present work programme proposal)

B. First wall & materials

The activities cover R&D areas which are, in most part, not included in the ITER procurement packages but are necessary for the design, specification and qualification of plasma facing components and the operation of the device. These include:

- Characterization and modelling of plasma facing components in interaction with the plasma, particularly under ITER-like transient power loads.
- Development of Tritium removal methods
- Study of dust formation, T retention and dust removal (in collaboration with safety)
- Development of in-situ diagnostics of erosion, redeposition and tritium retention (in collaboration with diagnostics)
- Studies on the formation of mixed-materials and consequences for ITER operation

Activities related to the first bullet are ongoing in the EU and in collaborations between the EU and RF and EU and US. For the other points listed here, some R&D is in progress on the EU, but more focussed effort is required in the 2008-2012 period, addressing explicitly the ITER Organisation's needs in the area of T retention, removal and detection.

The key topics that are expected to be addressed within these areas in the 2008 work programme are:

- **Effects of revised plasma loads on ITER plasma facing material/components (especially during transients) and possible design optimisation.** This will include both: i) numerical studies of plasma facing material/component performance and compatibility with plasma operation under the revised plasma loads and ii) experimental studies of plasma facing material behaviour under transient loads, with emphasis on high-cycle and relatively low magnitude (compared to melting/ablation limits) power fluxes.
- **Determination of Tritium retention and rates for materials in ITER-like conditions.** This will be centred on experimental studies of the consequences for T retention of ITER-specific features: a) Surface temperature, b) Neutron irradiation and c) Formation of mixed-materials. The studies can make use of available n-irradiated samples in fusion reactors and will have to deal with Be-containing materials.
- **Development of Tritium removal techniques for application in ITER.**. So far, the effort in this area has been concentrated in the removal of Tritium from carbon-rich deposits. Given the present uncertainties regarding the use of carbon-based PFCs, it is necessary to start developing T removal techniques for both Be, W (and the compound that they can form in ITER) that can be applied in the ITER environment (temperature range, radiation background, magnetic

field, etc.) and for the conditions expected (namely, neutron-irradiated materials, etc.).

- **Development of techniques for Dust detection and measurement in ITER.** Determining the production of dust in ITER steady-state and transient plasma conditions and the locations where it will accumulate requires the development of experimental techniques which can be implemented in ITER and of computer models which can reliably predict the formation and behaviour of dust in ITER.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	PF system analysis & compatibility with plasma control	Analysis of PF coils and PS performance against requirements Identification of possible improvement	Q1
	Coil performance analysis (including AC losses)	Analysis results vs requirements Identification of possible improvements	Q2
	Disruption & load analysis – impact of/on component design	Results vs. specifications Impact on ITER system design (in-vessel & control)	Q2
	ITER system analysis (pumping, heating, et)	Analysis of system integration	Q3
	Evaluation of T retention an dust production for ITER	Estimate of T retention & dust for specific conditions	Q3
Not credited by ITER	None		

2.1.2.3. Heating & Current Drive

A. EC Upper Launcher

The 2008 work programme for the procurement of the EC Upper launchers for ITER continues and complements the ongoing R&D activities, scheduled for completion in

the last quarter of 2008. Although the launchers are "built-to-print", it is assumed that all R&D, testing, preparation of the TS, manufacturing drawings, etc will be carried out by the EU, and this should be eligible for ITER credit. Since the 2008 resources need to be committed in advance of the Procurement Agreement, it should be considered as part of pre-procurement activities. The manpower estimates assume that the F4E will outsource most of the technical work

The following activities are included in the EC Upper Launcher 2008 work plan:

- Design and R&D of mm-wave components, structural & auxiliaries (including preparation for testing)
- Support to design & R&D
- Windows qualification (including procurement of disk & window housing)
- Preparation of Final Technical specifications

More specifically:

- **Design and R&D of mm-wave components, structural & auxiliaries (including preparation for testing)** This includes: finalization of urgent detailed design not completed in the TW6 work, including interfaces; design and R&D of auxiliary systems and acquisition of prototypes where necessary (example: mm- wave compatible, tritium compatible isolation valves); design and acquisition of a high-power mm-wave prototype beam line; final prototype of the steering mechanism; manufacturing tests of critical structural components (like the double wall structure of the port plug)
- **Support to design & R&D:** This includes the continuation of the work for launcher performance analysis, launcher control system, and collaboration with Japan and US
- **Window R&D disk and assembly procurement for testing:** The Torus CVD diamond window is the first "hard" tritium barrier for the launcher. This activity is to test CVD diamond disks and window structures before finalization of the technical specifications and procurement.
- **Preparation of Technical Specification** –in preparation of procurement: this activity will start in 2008, and will include the final specifications of the CVD diamond windows. Additional resources for the finalization of the design for Technical specification, QA and interface management may be required in 2009

It should be noted that as a consequence of the ITER Design review a revision of the interface boundary between launchers (EU responsibility) and Transmission Lines (US responsibility), with a subsequent revision of the procurement package, will be carried out. Technical input for the update of the Upper Launcher Procurement Package has been requested by the ITER Organisation by March 2008, and will affect the detailed list of components (as well as the design), while the cost impact is expected to be small.

The 2008 work plan does not include main procurement.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Specific design & R&D for mm-wave & structural components	Design in support of prototypes for functional & manufacturing tests	Q3
	CVD window qualification, support for prototype	Qualification plan Support to the production of prototypes	Q2
	Specific support for TS	Draft Technical specifications	Q3
	Analysis support to design & collaboration with other DAs	Performance analysis of designs & options Reports on inter-DA collaboration	Q3
Not credited by ITER	None		

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Industrial R&D on EC Upper launcher CVD window	Manufacture prototype	Q2
	Industrial R&D on EC Upper launcher components (including steering mechanism and plug sections)	Manufacture prototypes	Q3
Not credited by ITER	None		

B. Electron Cyclotron (EC) Power Sources and Power Supplies

The development of the European gyrotron for ITER will continue in 2008 in order to meet the decision point in 2009 between the continuation of the 2 MW programme or the implementation of the 1 MW cylindrical gyrotron back-up option, placed along the track of the project schedule. This includes the preparation of the detailed RF design of the 1 MW gyrotron, the procurement of a spare CVD window, the support at the experimental activities on the pre-prototype gyrotron, the supervision of industrial contracts.

In addition, it is expected that some direct support to the ITER procurement activities will be requested by IO. This can of course be only roughly estimated in the absence of inputs from the IO.

The industrial contract for the refurbishment of the first 2 MW gyrotron prototype, for the procurement of a spare CVD window (this activity was previously part of the F4E WP 2007) and for engineering activities in anticipation of the second prototype, e.g. redesign of the collector, is expected to be placed by the end of 2008.

In addition, the contract of the industrial, CW, dummy load is also expected to start in 2008.

Grants

	Title	**Deliverables**	**Indicative Time of Call Launch**
Credited by ITER	Design activities with Associates for preparation FS Support to IO for preparation of PA	Technical reports with results of the design activities Final PA to be prepared with ITER	Q1-Q3
Not credited by ITER	None		

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Supply of diamond window Supply of gyrotron refurbishment and industrial design activities Supply of industrial CW dummy load	Delivery of the items included in the contract	Q1 – Q3
Not credited by ITER	None		

C. Ion Cyclotron (IC) Antenna

In July 2007, as part of the ITER Design Review, the Heating and Current Drive working group WG6 made a recommendation for the concept selection for the ITER ICRH antenna. This recommendation, which was endorsed by the EU, implies significant changes in the design of the antenna compared to the 2001 baseline. One of the major changes is that the matching system is now external to the antenna port plug.

In the procurement packages the EU was procuring the antenna plug and therefore the matching components internal to it. New procurement packages will have to be defined, addressing in particular if the matching system is to be procured by the EU or by the US. Depending on this decision, the detailed R&D requirements and budget profile will be adjusted. Both antenna and matching system were "built to print" components.

Work is in progress to finalize the conceptual antenna design and to make it comply with the concept selection guidelines. The EFDA/IT Tasks for this activity have started in July 2007 and are due to completion in November/December 2007.

In parallel to the design work, a detailed plan of the R&D required to produce the ICRH antenna built to print design is under preparation. The budget estimations in this document are based on preliminary results of this work, and more detailed budget and timescale information will be available in December 2007.

The activities foreseen for the first half of 2008 include R&D of components of the design, as listed below, as well as further work towards a detailed design.

- Faraday shield: The R&D will include validation of the design and fabricability of the bars.
- RF/vacuum windows material choice and bonding: The JET design requires replacement of the titanium inner core for use in ITER. The material for the replacement inner core is not clear at this stage, and an R&D programme on materials will be needed to verify the effectiveness of the chosen material.
- Construction of a new **scaled down** mock-up for antenna and matching system testing
- Grounding scheme: The mechanical design that will be proposed for the port plug grounding (shape memory alloy & bi-metallic RF gasket between modules) will be tested
- Core conductor tests
- Copper electroplating of complex parts

The list is preliminary and detailed information will be available in December 2007.

No procurement is foreseen in 2008.

Grants

	Title	**Deliverables**	**Indicative Time of Call Launch**
Credited by ITER	Detailed design of ITER IC antenna and design analysis	Design and analysis reports	Q1
	Specific design & R&D for mm-wave & structural components	design in support of prototypes for functional & manufacturing tests	Q2
	Specific support for TS	Draft Technical specifications	Q1/Q2
	Reduced scale RF mock-up	RF characterisation of the antenna system	Q1
Not credited by ITER	None	None	

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Vacuum window R&D	Evaluation of suitable bonding methods - achieve required tolerance Effect of hydrogen embrittlement on titanium alloys Material property confirmation	Q1 (2), Q2 (3)
	Faraday screen protection bars R&D	Validate design and fabrication procedure	Q2
	RF grounding actuator	Development of enabling technologies Build and test prototype	Q1 /Q3
	Strap R&D	Build and test prototypes	Q2 /Q3
	Compact heat exchanger	Etching process development Build and test prototype	Q1 / Q3
	Core conductor	Proof of design concept	Q2
	Honeycomb port plug structure	Build and test prototypes	Q3
	Vacuum compatible devices	Build prototypes	Q2
	Plating of RF components	Evaluation of European industrial capability Manufacturing, qualification and test of prototype	Q1/ Q2
Not credited by ITER	None		

D. Neutral Beam (NB) System

- Design and R&D activities

  The design work for the establishment of the NBTF infrastructures (e.g. cooling and cryogenic systems, etc) and the design and procurement of the NBTF components will continue to be supported in 2008. In particular, design and preparation of the procurement specifications for the NB power supplies, vessels and beam line components, etc. In addition, the design work in support of ITER of other NB components not needed at the NBTF, like confinement and shielding components, active and passive magnetic shielding, etc, but part of the European scope of procurement will also be continued.

  Support is also required for the follow-up of all the industrial contracts, e.g. procurement of ion source and its power supplies.

  The on going R&D work in European Laboratories for the development of the RF ion source, now adopted in the new ITER baseline, and accelerator concepts, the ITER decision between MAMuG and SINGAP still pending, will continue.

  The procurement activities for the establishment of a half-size ITER RF ion source with low voltage extraction will be conducted.

  Some specific R&D activities will be required for the development of manufacturing procedures to be applied to the fabrication of NB components, including welding between copper or copper alloy parts and stainless steel pipes, fatigue tests, electrical insulation of the RF drivers.

  Some industrial support to F4E in the analysis of costs and schedule is included.

  It is also expected that some direct support to the ITER procurement activities will be requested by the ITER Organisation.

- Preparation of the NB Test Facility (NTBF) (Procurement)

  In 2008, it is expected that the establishment of the NB Test Facility will fully enter in its executive phase. Important industrial contracts are therefore expected to start both for the NBTF infrastructures (e.g.cryogenic system, cooling system, pumping system) and the procurement of the first components of the NB system. In particular the procurement of the main components for the Ion Source Test Facility, (the ion source power supplies, the RF driven ion source, etc.) will start in 2008.

  Contracts for the procurements of components for the NB test facility maybe placed with the Japanese Industry, following investigation of actual costs of those components. At present, no such contract is foreseen to be placed during 2008.

  It should be noted that, in accordance to agreement reached with the IO, some components will be procured making use of funds from the ITER R&D budget.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Design of infrastructures for NBTF, design of components for NB system, manpower for R&D and support to ITER	Final report with the details of the design	Q1-Q3
Not credited by ITER	Preliminary R&D activties	Technical report on the outcome of the activities	Q1 - Q2

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Manufacturing of components for the NB tests facilities (NBTF+ISTF)	Delivery of components	Q1 – Q3
Not credited by ITER	Components for the RF ion source test facility (ELISE) Additional R&D with industries supervised by Associations and support to F4E	Delivery of components Technical Report on activities	Q1 - Q2

2.1.2.4. CODAC

General support activities for the system definition will be provided in order to be ready to interface the local controllers in the EU PP with the CODAC developed by ITER.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None		
Not credited by ITER	Start work for the definition of the architecture of CODAC. Provide technical support for the rational design and implementation of local controllers	Report on CODAC architecture Report on local controller design &integration	Q2

2.1.3. Plant Systems

2.1.3.1. Vacuum Pumping and Fuelling

The work in 2008 is divided in the following areas:

- Activities in support of Prototype Torus Cryopumps (PTC)
- Activities in support of Vacuum Pumping
- Activities in support of Neutral Beam (NB) cryopump and Cold Valve Boxes (CVB)
- Activities in support of roughing pump trains

Activities in support of PTC will focus in 2008 on:

- Upgrade of the TIMO2 facility, taking into account that it is the only available EU facility that can be used for testing 1:1 torus cryopumps. ITER proposes cryopump operation at lower inlet temperatures (4.3K instead of 4.5K). This requires an upgrading of TIMO2 to allow testing the presently fabricated ITER prototype torus cryopump under these conditions.
- Support development/design of the vacuum/cryopump instrumentation. Preliminary studies on integration of some vacuum/cryopump control and instrumentation system with CODAC.
- Acceptance tests of the Prototype Cryopump.

Activities in support of Vacuum Pumping will focus in 2008 on:

- Updating of ITER Vacuum Handbook
- Continuation of TRANSFLOW tests with differently shaped cross-sections: Continue the work with the TRANSFLOW facility to provide more data in the transitional flow range for ITER-relevant cross-sections and geometries. Measurements for reference and large height/width ratio (NBI neutralizer slot

geometry) ducts shall be performed with different gas species. Surface changes of the ITER pumping duct walls will also be investigated.

- Study of the effects of disruption mitigation gas flows on the vacuum pumping systems. Quantify in details the performance of the ITER torus exhaust and NBI pumping systems to provide the limitations of the pumping system to cope with a disruption mitigation event. Different gases will be considered and the injected total gas amount varied.

Activities in support of NB cryopumps and CVB will focus in 2008 on:

- Thermal simulation studies for optimisation of manifolds with respect to flow distribution of cryogens and minimisation of pressure loss in HNB cryopump.
- Manufacture prototype mockup (4 pieces 0.25m wide, 1 m high mock-up cryopanels for operation in parallel) of the NBI cryopanels.
- Fatigue tests on bellows for the HNB cryopanels.
- Production of a conceptual design for the remaining types of CVBs.
- Further R&D to qualify design techniques and CVB components.

Activities in support of roughing pump trains will focus in 2008 focuses on:

- Preparation of functional specifications of roughing pump systems.
- Optimisation study for combination of most suitable pumps in roughing pump sets with full reconsideration of previous studies and recent developments in ITER IO.
- Produce P&IDs for the roughing pump sets, the pipe work, valves and instrumentation in the Switch-over glove box. Perform necessary calculations to demonstrate the required pumping speeds for the various gas mixtures with the chosen pumps.
- Design and produce Roots pump with ferrofluidic seals, magnetic drive and all metal housing. Test its pumping behaviour with various inactive gas mixtures and write cost assessment.
- Follow up all activities of industrial partner for design, manufacture, testing and cost assessment of Roots pump (approximately 1000 m^3/h) and write full specification for tender action.
- Design and produce a screw pump with ferrofluidic seals, magnetic drive and all metal housing (or other type of pump).
- Follow up all activities of industrial partner for design, manufacture, testing and cost assessment of 250 m^3/h screw pump and write full specification for tender action.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Activities in support of PTC	Final Report: Up-grading of TIMO2 facility Report: Acceptance tests of the Prototype Cryopump.	Q1/Q3
	Activities in support of ITER	Updated ITER Vacuum Handbook. Development/design of vacuum/cryopump instrumentation. Final Report: Experimental validation of the conductance code for ITER piping. Final Report: Impact of disruption mitigation gas flows on the vacuum pumping systems.	Q1/Q3
	Activities in support of NB cryopumps and CVBs	Optimisation study on flow distribution and pressure loss in manifolds in HNB cryopumps. Final Report of fatigue tests on bellows for the HNB cryopanels. Final Report on the conceptual design of the CVBs.	Q1/Q2
	Activities in support of roughing pump trains	Functional specification of the roughing pump systems. Final Report: Optimisation study of roughing pump sets. P&IDs for roughing pump sets, pipe work, and instrum. in the switch-over glove box.	Q1
Not credited by ITER	None	None	

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Activities in support of roughing pump trains	Design and produce a Roots pump with ferrofluidic seals, magnetic drive and all metal housing Design and manufacture a screw pump with ferrofluidic seals, magnetic drive and all metal housing. Follow up of design, manufacture, testing and cost assessment of Roughing pumps.	Q2
	Activities in support of NB cryopumps and CVBs	Manufacture of prototype mockup of the NBI cryopanels.	Q3
Not credited by ITER	None	None	

2.1.3.2. Cryoplant and Cryodistribution

The work is divided in the following areas:

- R&D and support activities to ITER
- R&D in support of cryoplants and Cryogenic System Design Review
- Preparation of cryoplants procurement package

The work in 2008 focuses with respect to R&D and support activities to ITER on:

- Numerical flow-dynamic cooling analysis for different plasma scenarios
- Numerical flow-dynamic analysis for transient modes
- Routing of cryogenic lines and cryoplant termination box preliminary design
- Procurement of the cryogenic test loop for the validation of variable heat loads mitigation strategy

The work in 2008 focuses with respect to R&D on cryoplants and Cryogenic System design Review on:

- Optimisation of cryoplants design according recommendations from CRYO-2 tasks in 2007

- Review of process and flow diagrams, process and instrumentation diagrams and operation modes

The work in 2008 focuses with respect to preparation of cryoplants procurement package on:

- Technical Specification for the procurement of cryoplant sub-packages
- Cryogenics Manual including baseline documentation for the cryogenics system procurement and manufacturing

Grants

	Title	**Deliverables**	**Indicative Time of Call Launch**
Credited by ITER	Cryogenic Test Loop	Detailed engineering, procurement follow up and installation	Q1
	Numerical flow dynamic analysis	(i) Numerical flow-dynamic cooling analysis for different plasma scenarios and (ii) transients (cool down, quench recovery, filling, warm up, etc..)	Q1 (i) Q3 (ii)
Not Credited by ITER	None	None	

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Procurement of Cryogenic Test Loop	Delivery of hardware	Q1-Q2
	Optimisation of cryoplant design	Report on the design optimisation	Q2
	Process engineering review	Process and Flow diagrams	Q1
	Cryogenics Manual	Delivery of the manual	Q2-Q3
Not Credited by ITER	None	None	

2.1.3.3. Tritium Plant

The work in 2008 is divided in the following areas:

- Activities in support of Isotope Separation System
- Activities in support of the ITER Water Detritiuation System

Activities in support of Isotope Separation System will focus in 2008 on:

- Test of a further type column packing (CY) for the Isotope Separation System. The presently on-going tests showed a too high tritium inventory for first studied packings requiring a further test.
- Taking account of ongoing revisions to the ITER fuelling rate and other essential inputs, finalization of the system capacity for ISS
- Studies on overpressure and overtemperature protection for ISS
- Safety studies (HAZOP) for ISS
- Completion of component mechanical design (fabrication drawing available) for ISS
- TRIMO development; benchmarking of the code predictions of tritium inventory and dynamic response against experimental results in order to reduce risk for the ISS design

Activities in support of the ITER Water Detritiation System will focus in 2008 on

- Finalization of the system capacity for WDS
- Studies on overpressure and overtemperature protection for WDS
- Safety studies (HAZOP) for WDS
- Completion of component mechanical design (fabrication drawing available) for WDS
- TRIMO development; benchmarking of the code predictions of tritium inventory and dynamic response against experimental results in order to reduce risk for the WDS design

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	**Design and R&D for Isotope Separation System**	Finalization of the system capacity	Q1
		Test of a further type column packing (CY) for the Isotope Separation System.	Q1
		Studies on overpressure, overtemperature protection and completion of component mechanical design	Q3
Not credited by ITER		TRIMO development	Q1
Credited by ITER	**Design and R&D for Water Detritiation System**	Finalization of the system capacity	Q1
		Studies on overpressure, over-temperature protection	Q3
		Safety studies (HAZOP)	Q3
Not credited by ITER		Benchmarking of experimental results against TRIMO	Q1

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	**R&D for Water Detritiation System**	Completion of WDS component mechanical design	Q1
Not Credited by ITER	None		

2.1.3.4. Test Blanket Modules (TBM)

The activities to be launched in 2008 include:

- TBMs & TBMs mock-ups design and analyses. HCLL (Helium Cooled Lithium Lead) and HCPB (Helium Cooled Pebble Bed) TBM Systems analyses and TBMs design optimization (including instrumentation integration, tritium cycle modelling, ITER test sequence definition, study of a vertical configuration of the HCPB TBM, etc.). Detailed design of 1/3 TBMs mock-ups for preparation of fabrication plans. Industry support for the design of 1/3 TBMs mock-ups. Analysis of the TBMs with respect to ESPN and Codes & Standards.
- TBMs integration in ITER: Detailed systems integration studies in ITER Port Plug, Port Cell and Hot Cell and delivery of detailed technical interfaces requests to ITER (space, RH, etc.). Complementary analyses of ripple induced by TBMs and assessment of the efficiency of mitigation measures (correction coils, location of the TBM, etc.).
- TBMs box fabrication development and qualification: Activities for the development of Eurofer box fabrication technologies will depend on the availability of Eurofer presently under procurement. Some intermediate process development could also be done with 9%Cr steel. If sufficient Eurofer is available, the following activities will be launched: Fabrication of 2 cooling plates using TIG+HIP (combined tungsten inert gas welding plus hot isostatic pressure) and laser+HIP processes. Development of alternative fabrication technology for a bent HCPB cooling plate. Fabrication of FW & Covers test mock-ups (welding+HIP / 2-step HIP / tube forming+HIP) up to medium size bent mock-up. Fabrication feasibility mock-ups for back manifold. Development of TBM welding simulation tool/models. Investigation of the use of EB for thick EUROFER plate welding. Fabrication of a dedicated clamping tool for welding of TBM assembly mock-ups.
- Functional material development and qualification: Detailed definition and preparation for realization of Post Irradiation Examination (PIE) of irradiated beryllium/beryllide samples from HIDOBE-01 irradiation campaign. Design of irradiation experiment for the newly developed OSi ceramic. Design of facility

for production of Be and beryllide for HCPB blanket applications. Further development and characterization (structural) of Be pebbles using small grain Be and advanced Be-alloy (Be12Ti). First development of an ab-initio modelling tool describing Be behaviour under irradiation. Update of the PbLi properties database. Further studies of the Eurofer corrosion under strong magnetic field. Further technology development of anti-permeation/corrosion coatings.

- Test facilities development and construction: Preliminary testing of EBBTF loop performances. Upgrade of the DIADEMO PbLi/He facility in particular with the procurement of a He circulator.
- Design and development of TBMs ancillary systems in ITER: Detailed engineering design of the Helium Cooling Systems (HCS) and integration in the TCWS building. Testing of H extraction systems in TRIEX and analysis of results. Engineering design of TMS/TES (tritium measurement system and tritium extraction system) for HCLL and HCPB and integration in Tritium Building. Engineering design of the coolant purification system (CPS) and integration in Tritium building. Engineering design of PbLi loop (including T extraction column) and integration in Port Cell.
- Development and qualification of predictive tools, design and R&D on TBMs sensors: Further fluid dynamic testing of back-plate manifold for HCLL and HCPB. Design of a HCPB Breeder Unit (BU) experiment. Predictive thermo-mechanical analysis of the pebble bed behaviour in HCPB BU. Further development and validation of pebble bed code system. Design of a HCLL Breeder Unit experiment. Development of EM-code models and sensors. Development of neutronics models and detailed analysis of uncertainties in view of assessing the margins in Tritium self-sufficiency. Tritium cycle modelling and tritium sensors development. First steps in the development of a Magneto Hydro Dynamic (MHD) code for simulating PbLi flow in Breeder Blankets. Further experiments on MHD on TBM mock-up.
- Project management and technical support: 'Port Master' management, 'TBM Leaders' management, building and maintenance of the TBMs project baseline and technical interfaces with ITER including technical documentation.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None		
Not credited by ITER	TBMs design & analyses	HCLL EM/IN-TBM & systems analyses HCPB EM/PI-TBM & system analyses HCLL EM/IN-TBM CATIA drawings HCPB EM-PI-TBM CATIA drawings	Q1
	TBMs mock-ups design & analyses	Detailed design and analyses of HCLL 1/3 TBM mock-up Detailed design and analyses of HCPB 1/3 TBM mock-up Fabrication drawings for box mock-ups	Q1
	TBMs integration in ITER	Interface specifications with RH Interface specification with HC Interface specification with PP Interface specification with Port Cell	Q1
	Fabrication of TBMs sub-components test mock-ups	Fabrication of CP test mock-up(s) Fabrication of FW/cover test mock-ups Fabrication of SP test mock-up	Q2
	Development of TBM box assembly by welding	TBM box welding simulation model Applicability of EB for thick EUROFER plates welding Back manifold mock-up(s)	Q2
	~~Be/Be-alloy~~	~~Definition PIE HIDOBE-01~~	~~Q1~~

Not credited by ITER	development & production	Design production facility Be/Be-alloy Development & characterization Be/Be-alloy	
	Breeder development & characterization	Design of irradiation experiment for new OSi PbLi database update	Q1
	Corrosion studies & mitigation development	Experimental stutdy of EUROFER corrosion under magnetic field Technological development of anti-corrosion coating	Q1
	Test facilities development/upgrade	Preliminary tests report on EBBTF Upgrade of DIADEMO	Q1
	TBMs ancillary systems	Detailed engineering design HCS Detailed engineering design TMS/TES Detailed engineering design CPS Detailed engineering design PbLi loop	Q1
	Predictive tools and sensors	Thermal-hydraulic models development and qualification Design of BUs experiments Pebble bed thermo-mechanical models development & qualification EM models and sensors configuration Tritium cycle code & sensors development Neutronics models and analyses of uncertainties MHD code development & qualification	Q1
	Project management & technical support	TBMs project technical baseline including ITER interfaces database and project technical documentation	Q1

Not Credited by ITER	Project management & technical support	'Port Master' technical data base & report of activities 'TBM Leaders" technical database and report of activities	Q3

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None		-
Not credited by ITER	TBMs design & analyses	Industry support for the design of 1/3 TBM mock-ups	Q2
	TBM box assembly by welding	Fabrication of a dedicated clamping tool for welding 6-cells mock-up	Q2

2.1.3.5. Materials Development

The activities in 2008 shall include EUROFER, ODS (oxide dispersion strengthened) EUROFER and SiC-SiC composites for functional applications.

(A) EUROFER

Material characterization and investigation of performance limits of both base material and welds for use in TBM have highest priority. Individual tasks to be performed are listed for material characterization, fabrication qualification, data base and technological issues individually below:

Material characterization for TBM use.

- Acceptance tests and mechanical characterisation of EUROFER heat procured in 2006.
- Post irradiation experiments of irradiated EUROFER & EUROFER joints (previously launched campaigns).
- New irradiation experiments on various EUROFER joints (1-3 dpa).
- Microstructural characterization of irradiated material using SANS (Small angle neutron scattering) and, TAP (atomic probe tomography) techniques.

Material irradiation issues for DEMO,

- Irradiation of Fe-54 enriched EUROFER samples (~ to 20-30 dpa) to assess the He-effect.

- Studies on He-effects through n-irradiations and multi-ion beam experiments.

Fabrication Qualification.

Qualification of weld properties. In depth studies of different fabrication processes, weld-geometries and heat-treatments are needed to determine design allowable quantities and reliability of the component. New joining techniques (diffusion bonding, solid HIP), never been used in nuclear components and not included in any existing code framework have to be fully qualified from scratch. Tasks to be launched include:

- Metallurgical and mechanical characterization of welds (different plate thickness and joining technologies), i.p. qualification of diffusion bonded EUROFER.
- Fabrication of welds (different plate thickness & methods) for irradiation campaigns.
- Improved reliability of welds by improved technology (eg thermally by pre- and post-HT during fabrication).
- Neutron analysis & local welding modelling (to quantify effect of residual stresses and distortions during welding and of post weld heat treatment).
- Development of qualification procedures for new joining technologies not yet included in the ITER SDC (Structural Design Code), eg diffusion bonding and hybrid processes. Support of industry needed.
- Continuation of investigation on irradiation performance limits of welded material (technologies not yet investigated like hybrid methods).

Development of Materials Data Base and Design Rules

TBMs will be operated in the region of non-negligible creep, which implies that "high temperature" rules have to be applied. These rules currently are not within the ITER codes and standards and have to be developed, justified and verified.

Tasks to be launched include

- Update Data Base and Structural Design Criteria Appendix A.
- Development of design rules for structural materials with low ductility.
- Development of HT (high temperature) design rules with special emphasis on validation experiments.
- Studies on fracture-toughness (ductile-to-brittle-transition) modelling aiming to implement rules in SDC.
- Activities on coatings, corrosion, compatibility (continuing work form TW6) should include:
- Investigations on hydrogen trapping mechanism in structural materials and weld joints for modeling of hydrogen embrittlement
- Characterization and measurement of diffusion coefficients, permeability and solubility of H (-isotopes). Studies on compatibility with LiPb using existing loops for modeling purpose.

- Characterisation of advanced coatings (W, Er and Al based). i.p. mechanical properties and corrosion resistance.

(B) EUROFER ODS steel

Issues and near-future activities will focus on fracture properties fabrication processes, investigations on reliable joining techniques. Tasks to be launched include:

- Improvement of fabrication processes for ODS-EUROFER (e.g. of milling processes).
- Studies on the stability of the oxide particles under irradiation and high He & H concentrations (to verify the ability of trapping He near the oxide particles).
- Joining technology development for ODS/ODS and ODS/conventional EUROFER;
- Permeation & corrosion studies.

(C): SiC-SiC as functional material ('SiC-dual')

A fabrication contract was placed in March 2007 to produce SiC-dual materials with low thermal and electrical conductivities for use in flow channel inserts. Tasks for its characterisation to be carried out in 2008 include

- Measurement of electrical and thermal conductivities,
- Measurement of elastic and mechanical properties (tensile strength, shear strength) and delamination.,
- Compatibility with Pb-Li (possible infiltration would change electrical and thermal conductivity).
- Start neutron irradiation campaign and PIE representative of the in-service conditions in TBM.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None	None	
Not credited by ITER	Qualification of EUROFER for TBM use	Qualification program for base and weld material including compatibility issues Irradiation campaigns for weld qualification Development of rules to be applied for EUROFER Various others	Q2/Q3
	Development: EUROFER ODS	Optimisation of mechanical properties Improvement of fabrication processes Studies on stability of nano-clusters	Q2/Q3
	Development of SiC-Dual	Qualification of SiC-Dual material fabricated by industry in 2007/2008	Q2/Q3

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None		
Not credited by ITER	Industry contract in support of design code development	Applicability of design-codes for EUROFER welds	Q2

2.1.4. Buildings

2.1.4.1. Reinforced concrete and Steel Frame Building

All the design activities for buildings are going to be included in the pre A/E contract to be placed by IO and covering all the scope of work needed to reach the level of preliminary design from which EU can take over the detailed design as part of its in-kind contribution. Resources are required for independent cost and schedule evaluations and verifications.

Procurements

	Title	**Deliverables**	**Indicative Time of Call Launch**
Credited by ITER	None		
Not Credited by ITER	Independent expertise on cost, schedule and selected technical issues	Technical, costing and scheduling reports	Q1

2.1.4.2. Power Supply Systems

The main activities foreseen in the areas of the AC Pulsed Power and SSEPN systems during 2008 are in support of ITER for the procurement. While some of these activities have been preliminarily identified (e.g. preparation of functional specifications for the first Procurement Arrangements, qualification of components with respect of operation in presence of magnetic field), it is also expected that some additional direct support to the ITER procurement activities will be requested by IO during the year.

Grants

	Title	**Deliverables**	**Indicative Time of Call Launch**
Credited by ITER	None		
Not credited by ITER	Support for following up of the qualification contract and supervision	Technical Reports on the follow-up and supervision	Q1-Q3

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Support to IO for preparation of PA	Final PA to be prepared with ITER	Q1-Q3
Not credited by ITER	Qualification of components in presence of magnetic field Costs and schedule analysis	Reports of the tests Report with details of costs and schedule analysis	Q2-Q3

2.1.5. Engineering Support

2.1.5.1. Engineering Analyses (temporarily including Code and Standards)

As a result of the modification to ITER baseline requirements, it is foreseen to launch a number of engineering analysis in support of the modifications required and their cost optimization.

In 2008 the following areas of activity are foreseen:

- **Mechanical Stress Analysis** (Magnets, Vacuum Vessel, Blanket, Divertor);
- **Civil Engineering Stress Analysis** (Seismic Design of Buildings and design optimisation of structural elements);
- **Electromagnetic analysis** (simulation of ferromagnetic materials and passive conductive loops in the ITER buildings to evaluate effects on plasma performance and shielding);
- **Neutronics analysis** in support of evaluation of radiation fields in tokamak complex for the evaluation of radiation shielding needs, requirements for components qualification under ionising radiation, evaluation of radiation doses for operators and maintenance personnel.

For Code and Standards the following activities are foreseen:

- Completion of the code and standard work on the preparation of the In-Vessel Components Code for the design verification of all ITER in vessel components;
- Integration to the preparation of code and standards for buildings;

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Electromagnetic analyses framework contract	Report of tasks on em analyses	Q2
	Mechanical analyses framework contract	Report of tasks on mechanical analyses	Q3
	Neutronic analysis framework contract	Report of tasks on neutronic analyses	Q3
Not Credited by ITER	Electromagnetic analyses framework contract	Report of tasks on em analyses	Q2
	Mechanical analyses framework contract	Report of tasks on mechanical analyses	Q3
	Neutronic analysis framework contract	Report of tasks on neutronic analyses	Q3

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Electromagnetic analysis of in-vessel components	Report of em analyses	Q3
	Mechanical analyses	Report of mechanical analyses	Q3
	Civil engineering structural analyses	Report of civil structural analyses	Q3
	Structural design criteria for in-vessel components	Revision of the code	Q1
Not Credited by ITER	Electromagnetic analysis	Report of em analyses	Q3
	Mechanical analyses	Report of mechanical analyses	Q3
	Revision of structural design criteria for buildings	Report on the revision work on the criteria	Q1

2.1.5.2. Technology and Fabrication Methods

The implementation of the qualification programme requested for the construction of the vacuum vessel (QA programme for Non Destructive examination Methods and Welding qualification according to requirements of the revised version of RCC-MR). Resources are already allocated in the relevant procurement areas and shall be transferred to this line of activity as needed.

2.1.5.3. Safety

A. R&D in support of ITER licensing

ITER related "R&D" activities will include tasks dedicated to progress in knowledge of issues mentioned in the ITER Preliminary Safety Analysis Report RPrS and its supporting documents. The corresponding activities will concern:

- Combined hydrogen/dust explosion experiments for computer code models validation.
- In vessel dust management (mobilization, diagnostic, removal)
- Modelling of busbar arc behaviour and consequences and continuation of related small-scale experiments.
- Waste management studies for metal waste detritiation by melting with bubbling and with control (limitation) of tritium degassing out of the waste packages.

B. "Design" activities in support of ITER licensing

ITER related "design" activities will concern:

- The ALARA application to Occupational Radiation Exposure based on ITER design evolution.
- Computer code development for simulation of combined Hydrogen/dust explosion.
- Supporting safety analyses to follow the design evolution: Revision of some accident sequences, complementary accident sequence analyses, development and validation of safety relevant computer codes.
- ITER waste management and on-site storage studies.

C. Safety related activities for EU Test Blanket Modules

Safety assessment of EU Test Blanket Modules will continue to a level acceptable to obtain their license to operate. The activity will include development of computer codes and computer code models, and their validation, as requested by the licensing authority.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	R& D in support of ITER licensing	Report on combined H2/dust explosion experiments and on dust management	Q1
		Report on Busbar Arc (models & experiments)	Q2
		Report on Metal detritiation and tritium outgassing	Q1
	"Design" activities in support of ITER licensing	Report on Occupational Safety (ORE) and ALARA	Q3
		Report on supporting safety analyses to follow ITER design	Q3
		Report on combined H2/dust explosions computer code development	Q1
		Report on ITER waste management & on-site storage	Q1
		Report on development and validation of EU computer codes	Q3
Not Credited by ITER	Support and develop safety knowledge in the fusion community	Training sessions and Final Report	Q1
	Safety activities for EU Test Blanket Modules	Report on development of computer codes for EU-TBMs safety	Q2
		Report on safety assessment of EU TBMs	Q2

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Support design for dust explosion and dust management mock-ups	Final Report	Q1
	Occupational Safety (ORE) and ALARA	Final Report	Q3
	Supporting safety analyses to follow ITER design	Final Report	Q3
Not Credited by ITER	None		

2.1.5.4. Waste Treatment and Storage and Radiological Protection:

A preliminary design is needed to complete the regulatory files and to develop the interface with the Host Country Facilities for waste storage The design of the part of the facility regarding disposal of the non-radioactive waste needs to be anticipated with respect to radioactive waste since the plant construction activities are going to produce waste needing treatment.

The design activities will be coordinated with equivalent activities performed by the Host Country.

Procurements

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	Preliminary design of facility with details for a pert of it	Technical reports of design	Q1
Not Credited by ITER	Preliminary design of facility with details for a pert of it	Technical reports of design	Q1

2.1.5.5. Nuclear Data

The following activities are planned in 2008:

Development of tools, improvements/update of Nuclear Data and supporting experiments and validation in support of ITER activities

- Further development and upgrade of European Fusion File (EFF) and European Activation File (EAF) as a source of nuclear data for ITER, TBM and DEMO design and safety studies: General purpose data evaluations for $^{50, 53,54}$Cr.
- Benchmarking of the updated and extended Cr nuclear data evaluations.
- Development and validation of advanced numerical methods and computational tools.
- Integral benchmark experiments for data validation.

Nuclear Data studies/experiments in support of TBM activities

- Detailed evaluation and assessment of the performed neutronic experiments on the TBM-HCLL mock-up with emphasis on Tritium Production Rate (TPR), neutron and gamma ray flux and spectra, and nuclear data accuracy.
- Integral activation experiments covering activation of materials relevant to TBMs.
- Neutronic analysis of Be and ceramic breeder materials including possible impurities (e.g. U, Co) in fusion relevant neutron spectra to assess the formation of undesired activation products.
- Neutronic analysis of Pb-Li eutectic alloy in fusion relevant neutron spectra related to the formation of transmutation products (e.g. Bi, Po, Hg, Tl) aimed at determining acceptable level of the specific impurities.
- Development of measuring techniques for the TBMs and - if possibly – some additional measurements on the HCLL mock-up.

Nuclear analyses for design calculations as required by the ITER Organisation and IFMIF

The costs for these calculations are not included here as they are part of the various systems/components to be supplied in-kind to the ITER Organisation and IFMIF-EVEDA and part of specific design activities.

Grants

	Title	Deliverables	Indicative Time of Call Launch
Credited by ITER	None	None	-
Not credited by ITER	Development of tools, improvements of Nuclear Data and experiments/validation in support of ITER activities	Improvement and vali-dation of the EFF and EAF library Methods for Monte Carlo based uncertainty calcu-lations Calculation of cross sec-tions for Cr isotopes up to 60 MeV.	Q2
	Nuclear Data studies/experiments in support of TBM activities	Assessment of the performed neutronic experiments of the HCLL mock-up Integral activation experiments for materials relevant to TBMs Neutronic analysis of transmutation products of impurities in PbLi Development of measuring techniques for the TBMs	Q2

7.1.6 Activities resulting from the ITER Design Review

Based on the result of the ITER Design Review it is envisaged that some voluntary activities will be carried out in support of the ITER Organisation to reach a new ITER Baseline.

7.1.7 Voluntary contributions of the EU Associations, coordinated by EFDA

In the framework of the ITER activities, Europe is also carrying out some physics R&D work on items that are currently not included among the ITER Procurement Packages. Such activities are financed through voluntary contributions of the EU Associations, coordinated by EFDA. EFDA indicates that the elaboration of the ITER relevant programme of activities will be done in close collaboration with F4E to ensure the closest match to the needs of the ITER Organisation. These activities include among others, development of ITER relevant diagnostics, heating and current drive systems, detritiation systems, coordinated activities on Plasma Scenario

Development for ITER, scenario modelling and R&D activities on specific physics issues.

Diagnostic R&D includes the testing and validation of new/improved techniques, demonstration of routine use and demonstration of durability, reliability and robustness; in particular, in the area of the measurement of fusion products (alphas, gammas and neutrons) and plasma wall interaction diagnostics (thermography and erosion monitors). Some diagnostics can only be adequately tested at JET, given its unique capability to operate with Tritium and Beryllium.

Lower Hybrid Heating R&D includes the proposal to further develop actively cooled Passive Active Multi (PAM) junction launcher technology in view the design of an ITER LH launcher.

In the area of Plasma Wall Interaction, specific R&D activities will be carried out to the study plasma loads on ITER plasma facing material/components (especially during transients) and to determine Tritium retention rates in materials, approaching ITER conditions. Various detritiation techniques are studied in laboratory experiments and some in-situ demonstration done/foreseen on tokamaks. The purpose is to select the most adequate techniques and ultimately propose a choice to F4E for possible application on ITER.

Plasma scenarios applicable on ITER will be developed on the various tokamaks, with a strengthening of the integration of all achievable relevant conditions, including, in particular, those relating to the wall materials and power loads.

ITER scenario simulations have been conducted and should continue on the basis of specifications provided by ITER and passed through F4E.

2.2. DEMO

There are no specific activities foreseen for DEMO in addition to the activities in the Test Blanket module part (see chapter 7.1.3.4) and in the Materials Development part of the programme (see chapter 7.1.3.5) .

3. BROADER APPROACH

The European contributions to the Broader Approach Activities are financed to a large extent by contributions in kind from the following Members of F4E: France, Germany, Italy, Spain and Switzerland. Where no contribution by these Members is foreseen, the contribution will have to be financed by the F4E budget.

3.1. Contributions expected to be provided by Members of F4E:

For the contributions set out below to be provided by Members of F4E, Procurement Arrangements will be concluded in 2008 between F4E and the Japanese Implementing Agency, subject to the conclusion of corresponding back-to-back procurement arrangements between F4E and the Member concerned:

- Satellite Tokamak Programme

- Cryostat (Spain): including completing design and technical specifications for the Cryostat.
- Magnet (Italy and France): complete qualification for the TF conductor and finalise technical specifications to initiate the procurement of the conductor, the casings raw material , the tooling and the coil windings.
- ECRF (Italy, France, Switzerland): Gyrotrons, Magnets, and Power Supplies.
- Current Leads (Germany): HTS Material procurement, test facility.
- Coil Power Supplies/QPS (Italy, France):.
- Cryogenic system (France): although no hardware procurement contracts are foreseen in 2008, industrial studies will have to be performed in preparation for procurements to be started in 2009.

• IFMIF/EVEDA

- Accelerator: Injector (France)
- Accelerator: RFQ (Italy)
- Accelerator: RF Sources amplifiers (France)
- Accelerator: RF Sources Power Supplies (Spain)
- Test Facilities: Low Pressure Helium Loop (Spain, Italy, France, Germany)
- Irradiation of mock-ups in fission reactor (Spain, Italy, France, Germany))

F4E will also conclude Procurement Arrangements for contributions to be provided by Japan to the Broader Approach Activities. These Procurement Arrangements will have no financial impact on the budget of F4E.

3.2. Contributions by F4E

Cold Test Facility (F4E) : Being on the critical path, a budget is allocated for design activities and initial procurements for the cold test facility to be completed in the first half of 2008 to prepare for the cold test of the 18 coils to be provided by the EU to Japan. Being on the critical path of the Satellite Tokamak Programme schedule, the call for tender and contract for the cold test facility should be completed early in 2008.

ANNEX 2
ESSENTIAL SELECTION AND AWARD CRITERIA FOR PROPOSALS

As regards grant actions referred to in this work programme, the essential selection and award criteria, in accordance with Articles 165 and 166 of the Implementing Rules of the Financial Regulation, are:

Essential Selection Criteria

- The applicants' technical and operational capacity:

  professional, i.e. scientific and/or technological competencies, qualifications and relevant experience required to complete the action.

- The applicants' financial capacity :

  stable and sufficient sources of funding in order to maintain the activity throughout the action.

Essential Award Criteria

- Relevance of the proposal to the expected results.
- Quality of the proposal with regard to the objectives and priorities set out in this work programme and in the relevant call for proposals.
- Efficiency of the implementation as well as of the management structure and procedures in relation to the proposed action.
- Budget and cost-effectiveness in particular with regard to the objectives and the respected results.

With regard to the specific action, more details will be provided in the call for proposals. Evaluation scores and weighting will also be given in the call for proposals.

A proposal which does not fulfil the conditions set out in the work programme or in the call for proposals shall not be selected. Such a proposal may be excluded from the evaluation procedure at any time.

The timetable and indicative amounts for the actions are defined in this Work Programme.

ANNEX 3
MAXIMUM REIMBURSEMENT RATES FOR GRANTS

The upper limits for the reimbursement of eligible costs for grants are laid down in Article 153 of the Implementing Rules of the Financial Regulation of the Joint Undertaking and are summarised in the following table.

Research and technological development activities	40%
Demonstration activities	40%
Coordination and support actions	100%
Management, audit certificates and other activities	100%