Annex 1
EUROfusion Engineering Grants 2016
List of positions

1. DEVELOPMENT AND FABRICATION OF LI-BASED CERAMICS

Position ref. EEG-2016/01
Contact person: Lorenzo Boccaccini Lorenzo.boccaccini@kit.edu

Job Description:
For the development of the Helium-Cooled Pebble Bed (HCBP) Test Blanket Module (TBM) in ITER and the Breeding blanket design in DEMO critical design and R&D needs are identified in the development and fabrication of Li-based tritium breeding ceramics.

The selected option for the tritium breeding material of the EU HCPB breeding blanket concept is a ceramic tritium breeder in the form of pebble beds. The pebble bed must fulfil several requirements to ensure a safe and reliable operation. The material must sustain e.g. the thermomechanical stresses and irradiation effects induced under operating conditions and have a sufficiently high tritium breeding ratio along with a low tritium residence time. In addition high ^{6}Li enrichment (like in other breeder types like PbLi) is necessary to ensure the necessary T production. The material should be suitable for a simple recycling to ensure a reuse in the reactor and the overall costs of all processes (fabrication, ^{6}Li enrichment, recycling, etc.) including radioactive waste management should be competitive with other forms of breeders. Presently, mixed ceramic pebbles in the form of lithium orthosilicate (Li_4SiO_4) and lithium metatitanate (Li_2TiO_3) fabricated by a melt-based process are considered for the use in DEMO and in the ITER TBM.

The demonstration of fabrication mass upscaling and the qualification of the breeder ceramics for DEMO are of crucial importance and simultaneously a great technological challenge. The primary work will therefore focus on the further development of the fabrication process and on establishing a sound knowledge of the properties and behaviour of ceramic breeder pebbles in various qualification tests. Special emphasis will additionally be placed on recycling and Li-enrichment strategies.

This call aims at the development of good material knowledge and engineering skills on the fabrication process and the qualification of tritium breeding ceramics. The programme will provide the practical/experimental and theoretical background for the interdisciplinary issues, which are connected to this area. The applicant will be involved with the fabrication process as well as with the extensive characterization, evaluation and qualification of tritium breeding ceramics. In addition, the selected applicant will take part in experimental test campaigns. He/she will get access to necessary facilities of the involved laboratories. Close support and interaction with the WPBB Project teams are foreseen.

Main Work Package: WPBB
Interlinks with other Work Packages: WPTFV, WPSAE
Facilities to be used: Available fabrication and relevant testing facilities at different RUs.

2. DEVELOPMENT OF TRITIUM EXTRACTION/REMOVAL PROCESSES IN THE OUTER FUEL CYCLE OF A FUSION REACTOR

Position ref. EEG-2016/02
Contact person: Lorenzo Boccaccini Lorenzo.boccaccini@kit.edu

Job Description:

For the development of all the DEMO breeding blanket concepts, the extraction of tritium (T) from the breeder and its processing up to its delivery to the fuel cycle is critical for the achievement of T self-sufficiency conditions. High efficiencies are requested to avoid the formation of high T inventories in the loops and high local partial pressure in the blanket than can enhance the parasitic permeation of T in the coolant. Presently, several technologies for the T extraction from the breeders are still under evaluation.

In case of a liquid breeder like the eutectic Pb-16Li, the breeder is recirculated outside the reactor transporting the T generated by the fusion neutrons. Several technologies can be used to extract T from the liquid metal; gas-liquid contactor and gas stripping is a well-known technology, but has limited efficiency and is energy consuming. Permeators against vacuum are more promising, ensuring higher efficiency, a continuous process and an optimum input flow for the fuel cycle, but reliable permeation membrane still need to be developed. Alternative vacuum sieve tray shows potentiality of high efficiency, but is only at the early stage of its technological development for reactor size solutions.

In case of solid breeder blankets, the extraction of T is achieved purging the pebble beds in the blanket with a low pressure gas flow. The carrier gas (usually He) routes the T out of the reactor where it has to be removed from the gas flow. The removal process can be realised with an already industrial developed cryogenic technology using molecular sieve and/or cold traps depending of the HT or HTO forms of T; this is a batch technology requiring units both in operation and regeneration modes. Chemical composition of the purge gas is important to control the chemical processes. Advanced concepts using membranes and catalytic membrane reactors are considered as alternative promising continuous solutions reducing time constants and inventories.

This call aims at the development of good experimental and theoretical skills for the necessary R&D tasks and engineering skills for the design of the tritium extraction and removal systems at reactor scale. The programme will provide the practical/experimental and theoretical background for the interdisciplinary issues, which are connected to this area. The applicant will be involved with the experimental activity done in several EU laboratories as well as with the design groups responsible of the engineering of these systems. Close support and interactions with the WPBB Project teams are foreseen.

Main Work Package: WPBB
Interlinks with other Work Packages: WPTFV, WPSAE
Facilities to be used: Available fabrication and relevant testing facilities at different RUs.

3. DEMO CONTROL SIMULATIONS

Position ref. EEG-2016/03
Contact person: Wolfgang Biel w.biel@fz-juelich.de

Job Description

The development of the DEMO plasma control system shall be prepared and supported by performing numerical control simulations. The goal of these simulations is to achieve a quantitative understanding of the expected control accuracy under DEMO conditions, taking into account the actual properties of the measurements and actuators available.

This call aims at the development of good engineering skills and practical competences in the following areas:

- plasma diagnostic and control systems on existing fusion devices as well as the systems under development for ITER
- plasma control requirements for DEMO
- diagnostic and actuator properties to be expected for DEMO conditions
- existing control models and simulation tools as relevant to DEMO control simulations
- requirements for new development of control models for DEMO conditions where needed
- simulation of the dynamic behaviour of the DEMO plasma control system for a number of key control parameters, e.g., density and radiation in the core plasma
- definition of typical control accuracies (amplitude of control deviations), time constants (settling time) and control reliability (disruption rate) for DEMO conditions
- control margins needed against relevant operational limits which should be taken into account in the definition of the plasma scenario, in order to reliably avoid disruptions.

Eligibility: For this vacancy, candidates holding a Physics degree are also eligible.

Main Work Package: WPDC
Interlinks with other Work Packages: WPPMI, WPMAG, WPHCD, WPTFV, task force CD
Facilities to be used: n/a

4. DEMO DIAGNOSTICS DEVELOPMENT

Position ref. EEG-2016/04
Contact person: Wolfgang Biel - w.biel@fz-juelich.de

Job Description

The properties of the DEMO plasma control system will strongly depend on the availability of accurate measurements related to all relevant properties to be controlled. While a large number of diagnostic methods have been successfully developed and applied on existing fusion devices, their application on DEMO is facing severe limitations: First, all diagnostic front-end components on DEMO will be subject to extremely adverse conditions (e.g. high neutron and gamma fluxes and fluences, high fluxes and fluences of CX neutrals, high temperatures), and second the space for diagnostic implementation will be quite limited, in order to maximise the tritium breeding ratio and to preserve first wall integrity. As a consequence, DEMO control will have to rely on a limited number of diagnostic systems and channels, which are mounted in a retracted position and hence will provide only limited performance.

This call aims at the development of good engineering skills and practical competences in the areas of fusion reactor diagnostics and includes the following steps:

- Review of plasma diagnostic methods relevant to a fusion reactor, their technical realisation on existing fusion devices, and their performance properties (accuracy, time resolution, lifetime, reliability)
- Review of the needs for a complete suite of measurements providing sufficient input information for a reliable DEMO control under all foreseeable plasma conditions
- Assessment of possibilities and options for specific diagnostic implementation on DEMO, including assessment of the impact of the space consumption on tritium breeding rate and first wall integrity, and assessment of options for maintenance
- Specific conceptual studies on the development of a limited number of DEMO diagnostic systems
- Prediction of diagnostic performance under DEMO conditions for a selected DEMO diagnostics
- Lifetime assessment of diagnostic front-end components under DEMO conditions

Eligibility: For this vacancy, candidates holding a Physics degree are also eligible.

Main Work Package: WPDC
Interlinks with other Work Packages: WPPMI, WPBB, WPDIV, WPRM, WPMAG, WPHCD, WPTFV
Facilities to be used: n/a

5. DESIGN AND DEVELOPMENT OF ELECTRON CYCLOTRON WAVE (ECW) OR NEUTRAL BEAM INJECTOR (NBI) SYSTEMS.

Position ref. EEG-2016/05
Contact person: Minh Quang Tran - minhquang.tran@epfl.ch

Job Description
The design of Heating and Current Drive Systems with improved efficiency and reliability is an important area of research priority for DEMO and future fusion power reactors. This call aims at the training of a high level engineers or scientists in the field of Electron Cyclotron Wave (ECW) or Neutral Beam Injector (NBI) systems. As physics and engineering are interrelated in these complex systems (ECW or NBI), candidates with either an engineering or physics background are encouraged to apply.

ECW Systems
The candidate will first need to familiarize with the fundamentals of the interaction of ECW with tokamak plasma. She/he then will be trained in various specific domains related to the implementation of ECW in DEMO: gyrotron and its ancillary systems, transmission line, and launchers. For each components design activities will include numerical optimization of the components and testing. In the design of the system and other critical elements, attention must be put on aspects linked to the impact on Tritium Breeding Ratio (for the launchers), safety, remote handling and RAMI aspects. The laboratories associated with EUROfusion operate large ECW system and are active in the design of gyrotron and launchers for ITER. The successful applicant will have the opportunity to interact with expert teams and get hands-on experiences using the most modern ECW systems (e.g. W7-X or TCV). Participation in on-going scientific exploitation of EUROfusion tokamak (e.g. within the frame of WPM Medium Size Tokamak WP MST) is also foreseen.

NBI System
The NBI system for DEMO imposes constraints beyond those for ITER in fields such as reliability, efficiency, and maintenance. Research is needed in many fields such as development of negative ion sources which do not require the injection of Cesium, modeling of the beam, and the study of advanced concepts to improve the overall efficiency of the NBI, in particular the neutralization of negative beam. The successful applicant will have the opportunity to develop his skills in all these domains through interaction with groups working in advanced modeling, in experimental development of different source concepts and in efficiency enhancement methods (e.g. photo neutralization). She/he will have access to the ITER test facility of Padova as well as those in EUROfusion laboratories. In addition, the integration of an NBI in an electricity-producing reactor poses important challenges with respect to the impact on TBR, on neutronics, safety, and remote maintenance.

Eligibility: For this vacancy, candidates holding a Physics degree are also eligible.
Main Work Package: WPHCD
Interlinks with other Work Packages: WPMST, WPCD, WPPMI, WPBB, WPRM
Facilities to be used: RF and NBI facilities in existing RUs, tokamaks and stellarators

6. WIDE-RANGING ANALYSES FOR DEMO MAGNET DESIGN

Position ref. EEG-2016/06
Contact person: Louis Zani Louis.zani@cea.fr

Job description:
Magnet systems represent a crucial technology for magnetic confinement fusion devices and in particular for a Demonstration Fusion Power Plant (DEMO). Powerful magnetic fields are required for confinement of the plasma, and, depending on the magnetic configuration, for plasma initiation, ohmic heating, inductive current drive, plasma shaping, equilibrium, and stability control.

This call aims at the development of a broad range of engineering skills and development of practical experience in the areas of magnet mechanical structures, superconducting conductors R&D at all scales, magnets manufacturing processes and magnet system design top-level principles including auxiliaries (protection system, cryoplant). All these domains are interwoven and will be investigated according to their criticality in the project and the candidate's skills. The candidate will develop his/her skills on:

- Mechanical analyses for various load cases / design options for the DEMO magnet system. This shall include acquisition of engineering rules for the coarse dimensioning of magnets in operation conditions (top-level functional specifications). Finite Element Analysis to assess detailed designs.
- R&D work through design, fabrication and tests of samples related to conductor design. This shall include contributions to sample design from strand to conductor scale, contributions to sample fabrication (follow-up, commissioning etc…); and contribution to sample tests (electrical, hydraulics etc…) and their analysis
- Magnet system design, including conductor design, power supplies and protection system design, and cryoplant design
- Feasibility studies, involving consultations with experts and industrial knowledge to draw conclusive statements on manufacturing routes

The candidate will be embedded in a project-oriented team, and is required to spend time in various EU laboratories. As such, the candidate must be able to work in a group and rapidly adapt to different technical contexts.

Main Work Package: WPMAG,
Synergies with other Work Packages: WPPMI, WPBOP
Facilities to be used: Available SC magnet testing facilities in various research units

7. DIVERTOR HEAT SINK AND COMPOSITE MATERIALS

Position ref. EEG-2016/07
Contact person: Michael Rieth Michael.rieth@kit.edu

Job Description:
The development and qualification of radiation resistant structural and armour materials for high heat flux and high temperature components is one of the most challenging areas at the overlap between material science, materials engineering and engineering design including application and modification of rules and standards for design. The area is one of the most important priorities of the Fusion Roadmap Horizon 2020 and such activities are being implemented by the EUROfusion Consortium within the WPMAT Project.

This call aims at the development of good engineering skills and practical experience in the field of advanced high-heat-flux materials. The candidate is expected to familiarize him/herself with the very demanding design requirements for the main components in DEMO and will be able to perform tailor-made developments and optimization of advanced materials for fusion applications. The programme will provide the theoretical and practical/ experimental background for the complex interdisciplinary areas, which are connected to this area.

Skills will be developed in the following areas:
- Manufacturing of composite materials (fibre and particle reinforced, laminate structures, …) for heat sink, structural and/or functional applications
- Modelling of composite structures
- Characterization of microstructure (incl. thermal stability)
- Determination of thermo-mechanical and thermo-physical properties (database input, related to WPMAT-EDDI)
- Application related characterization (steady state thermal loads) of actively cooled components (interaction with training programme 1)
- Joining and component manufacturing (related to WPDIV)
- Operation and data acquisition from tests in high heat flux test facilities JUDITH 1 & 2, GLADIS
- Mechanical and thermo-physical testing
- Use of FEM-tool: ANSYS or equivalent

Main Work Package: WPMAT
Interlinks with other Work Packages: WPMAT-EDDI (Engineering Data & Design Integration) and WPDIV.
Facilities to be used: Available High-Heat-Flux test beds available in Europe, e.g, JUDITH, GLADIS, FE-200 (and other available HHF testing facilities)

8. EXPERTISE IN ADVANCED STEELS FOR PLASMA-NEAR COMPONENTS

Position ref. EEG-2016/08
Contact person: Michael Rieth Michael.rieth@kit.edu

Job Description
The development and qualification of radiation resistant ferritic steels with reduced activation (including use and further evolution of existing design rules for conditions of interest) and their application in a plasma-near environment is in the overlap between material science and materials engineering. It is one of the most important priorities of the Fusion Roadmap Horizon 2020 and such activities are being implemented by the EUROfusion Consortium within the WPMAT Project.

This call aims at the development of good engineering skills and the experience in the field of ferritic-martensitic steels. The candidate is expected to familiarize with the very demanding design requirements for the main components in DEMO and will be able to develop tailor-made enhancements and optimization of advanced materials for fusion applications. The programme will provide the theoretical and practical/experimental background for the complex interdisciplinary areas, which are connected to this area (from science-related metallurgy, microstructure features and their modelling towards processing and fabrication as well as issues related to qualification and future licensing).

Skills will be developed in the following areas

- Metallurgy, influence of chemical composition, and steel production
- Steel properties (under fusion relevant operation) and underlying mechanisms
- Thermodynamic phase calculation and related properties of complex alloyed steel
- Neutron damage and activation in steels: underlying phenomena, analysis, assessment, calculation (IREMEV), and effective countermeasures
- Codes and standards, material database, licensing, etc. (EDDI)
- Advanced processing and joining w.r.t. component fabrication and design (e.g. WPBB)
- State-of-the-art steel analysis, characterisation and damage assessment

Main Work Package: WPMAT
Interlinks with other Work Packages: WPBB, WPDIV.
Facilities to be used: Production, processing and fabrication facilities in industry, plus other relevant facilities available in European RUs.

9. FUSION PLANT DESIGN OPTIMISATION STUDIES

Position ref. EEG-2016/09
Contact person: Mark Shannon mark.shannon@euro-fusion.org

Job Description
The task of choosing an appropriate set of machine parameters and engineering technologies in a Fusion Power Plant involves trade-offs between the attractiveness and technical risk associated with the various design options. One of the crucial points is the size of the device and the amount of power that can be reliably produced and controlled in it. This is the subject of R&D and depends upon the assumptions on the readiness of required advances in physics (e.g., heat exhaust, choice of regime of operation, efficiency of non-inductive Heating and Current Drive (H&CD) systems, etc.), technology and materials developments.

This call aims at the development of good engineering skills in the area of fusion reactor design and in particular in the process of evaluating design options on the DEMO project to ascertain the benefits of understanding the relationship/s between particular parameter pairings or within interfaces with respect to their relative influence over critical performance targets and then to conduct an investigation on a particular pairing or interface. This represents an exciting opportunity to work within a team of Physicists and Engineers to optimise the conceptual design of the next generation fusion power plant. The role involves the assessment of different design aspects of the machine to deduce which opposing aspects should be studied in conjunction to define the best compromise. One of these design aspect pairings would then be executed by the candidate.

The candidate would develop System Engineering skills to resolve key plant requirements and resulting functions to elicit design aspects critical to overall performance targets, exercise analysis techniques to perform sensitivity studies in which chosen design aspect parameters are varied and be engaged with interface management, to understand and explore wider implications of design point compromises elsewhere in the machine design space.

In particular, the candidate is expected to

- work alongside experienced System Engineering & Integration engineers to elicit a list of key parameters and interfaces for the DEMO power plant;
- develop a list of key interfaces and parameter pairings that are perceived to be crucial to delivering key performance targets for DEMO. This is done by canvassing opinion and gathering information from past studies. Context and justification statements for each candidate pairing / interface should then be prepared.
- Devise the format for a prioritisation meeting to determine which candidates should be addressed as the highest priority.
- Become involved in the execution of at least one of the candidate areas of investigation, contriving a pathway to answering key questions about how systems affected by the pairing are helped or hindered as one parameter is varied against another. This work would involve numerical analysis engineering assessment studies.

Main Work Package: WPPMI
Interlinks with other Work Packages: All other WPs are involved in this task
Facilities to be used: n/a

10. FUSION PLANT NUCLEAR ANALYST

Position ref. EEG-2016/10
Contact person: Ulrich Fischer ulrich.fischer@kit.edu

Job Description
The scope of this call is to qualify a skilled young scientist as nuclear analyst capable of performing sophisticated nuclear analyses of the complex fusion technology systems/facilities using advanced computational methods and tools as required for the development of DEMO. This includes also the development of a broad system-level understanding of the principles adopted in the DEMO tokamak design to comply with neutronic requirements.

The selected candidates shall first familiarise with the subject of fusion neutronics including basic nuclear physics, nuclear data, neutron transport theory, the Monte Carlo technique and fusion reactor technology. Attendance of lectures/courses, the (extensive) study of the technical literature, and special instructions by experienced advisors/supervisors are anticipated. Second, the candidate, will learn or improve its ability to use computational tools which are in use for nuclear analyses. These include, first of all, Monte Carlo codes such as MCNP and TRIPOLI, nuclide inventory codes such as FISPACT, ACAB etc., code system such R2S and D1S for shut-down dose rate calculations, as well as CAD software such as SpaceClaim and geometry conversion tools such as McCad and MCAM.

Third, the selected candidates will study dedicated problems that need to be solved within the PPPT programme. This exercise will start with setting up a CAD neutronics model of DEMO using the SpaceClaim software, the conversion into a Monte Carlo simulation model using McCad/MCAM, testing and verification of the model, and finally the application in Monte Carlo transport calculations, as well as coupled activation and shut-down dose rate calculations.

It is expected that the candidate at the end becomes familiar with specific problems and suitable solution strategies as they are present in different PPPT work packages (e. g. BB, PMI, SAE, RM, DIV, MAG and MAT). These problems include issues of Tritium breeding, nuclear heating, radiation shielding and streaming, material activation, radiation damage and dose loadings.

It should be noted that this programme could be conducted in co-operation of more than one EUROfusion research institution with experienced neutronics teams, e.g. CCFE, CEA, CIEMAT, ENEA and KIT. The successful candidate will be enabled with such a training programme to conduct nuclear analyses of any level of difficulty in all fields relevant to the development of DEMO and provide expert advice to the designers in the different PPPT work packages.

Eligibility: For this vacancy, candidates holding a Physics degree are also eligible.

Main Work Package: WPPMI
Interlinks with other Work Packages: WPDIV, WPBB, WPMAG, etc
Facilities to be used: n/a

11. LASER WELDING AND CUTTING TOOLS

Position ref. EEG-2016/11
Contact person: Antony Loving antony.loving@ccfe.ac.uk

Job Description
Remote maintenance technologies are central to the realisation of fusion as a viable energy source. Operation of a tokamak over the periods of time required for a power plant will require routine replacement or maintenance of components and the size and irradiated state of these components precludes manual intervention. To allow replacement, the components require service connections to be disconnected and reconnected. Developing high speed, reliable cutting and welding systems is therefore essential for DEMO remote maintenance and laser cutting and welding is being developed as a method to achieve this. The application of this process is highly novel and the materials and technologies that can be applied are constrained; the limited access requires in-bore operation and the radiation levels require a low activation pipe material. Development of these systems involves the innovative application of welding, cutting and NDT (Non-Destructive Testing) methods and miniaturisation and integration into a remotely operable system suitable for a fusion reactor.

This call provides the opportunity for the candidate to enhance his/her skills by working in a recognised centre of excellence in remote handling and to develop good all round engineering skills in the following areas:

- Remote handling
- Welding techniques
- Laser welding and cutting and supporting fields such as optics
- Materials
- Post Weld Heat Treatment (PWHT)
- NDT techniques (such as volumetric inspection)
- Conceptual and mechanical design of deployment, alignment and clamping systems
- Integration within the maintenance system
- Development of prototypes and testing

The work is split into three phases and the successful candidate will be embedded in the RACE team at Culham Science Centre. In phase one RACE will be researching the requirements and technologies for cutting and welding systems and developing conceptual tool designs.
Phase two involves the design of proof of principle tools and validation tests to demonstrate the feasibility of the high risk areas of the project.
Phase three requires the testing and development of proof of principle tools where the performance of the tools will be evaluated and the design further developed.

This work will involve considerable time spent at Remote Applications in Challenging Environments (RACE) Centres and at partner organisation with specialist cutting and welding facilities.

Main Work Package: WPRM
Interlinks with other Work Packages: WPBB, WPMAT, WPDIV, WPSAE
Facilities to be used: RACE building; external facilities; research facilities within the EUROfusion Consortium

12. TRITIUM BEHAVIOUR

Position ref. EEG-2016/12
Contact person: Neill Taylor neill.taylor@ccfe.ac.uk

Job Description
Technologies related to the storage, handling and processing of tritium are key to any D-T fusion plant such as DEMO. As the main radiological hazard present in the facility, the control and confinement of tritium is essential for safety. The main systems involved are tritium storage, fuelling systems that supply tritium to the plasma, vacuum systems that extract the plasma exhaust, systems that separate the un-reacted hydrogen isotopes in this exhaust, and systems that extract and process the tritium generated in breeding blankets. Specialist ventilation atmosphere detritiation systems serve the rooms in which an airborne tritium contamination may occur. Also of importance is the retention of tritium in components inside the vacuum vessel, the potential mobilization of this in accidental conditions, and the paths by which this tritium could be released from the plant. The dispersion of released tritium in the environment, including in organically-bound form, and the potential paths to a dose uptake by members of the public, are behaviours that must be fully understood in order to properly characterize the hazards. Equally important is the removal of tritium absorbed into the materials of components being disposed of at end of life.

This call is aimed at developing an understanding of the behaviour of tritium and skills in the engineering of the tritium systems of a future fusion power plant, DEMO. The mechanisms of transport, retention, mobilization and release of tritium in plant systems, and the methods of modelling these in analyses, will be the basic areas in which expertise will be gained. A full appreciation of the environmental consequences of tritium release, and the assessment of this in impact studies, will also be obtained. The candidate will be involved in the engineering design of plant systems, focussing on the tritium safety aspects, particularly parts of the fuel cycle systems and the breeder blanket systems, such as those providing tritium extraction, tritium vacuum pumping, tritium recovery from coolants, tritium purification, isotope separation, tritium storage, fuel mixing and control. Safety analyses of the design of selected systems will be performed to assess the consequences of their failure. A comprehensive expertise in the safety engineering of tritium systems should be the outcome.

Main Work Package: WPSAE
Interlinks with other Work Packages: WPTFV, WPBB
Facilities to be used: n/a

13. DEMO FUEL CYCLE SYSTEMS INTEGRATION

Position ref. EEG-2016/13
Contact person: Christian Day Christian.day@kit.edu

Job Description
The fuel cycle in DEMO basically comprises an outer and an inner loop. The outer loop centres around the breeding blankets, which release a gas stream that contains the bred tritium. The blankets also require a cooling system that will take up tritium as well. Both streams, the coolant and the tritium extraction gas, have to be processed in the tritium plant. The inner fuel cycle supplies the plasma chamber with all chemical species needed - the fuel DT and gases for plasma control and enhancement – and, via the divertor system, extracts the plasma exhaust gas - the helium ash, unburnt fuel and spent plasma enhancement gases. The plasma exhaust is done via vacuum pumping systems that lead the gas to the tritium plant for further processing. The tritium plant is a big and complex chemical plant where the gas streams are separated and cleaned, and tritium is recovered from them. The fuel species are then stored and the wanted fuel gas mixture composition is provided.

The major tritium specific design driver is to minimize inventory. This has led in the last year to a novel and first-of-its-kind architecture of the tritium, fuelling and vacuum systems of DEMO, which now requires careful detail analyses.

This call aims at development of good engineering skills, building experience in the application of modern design tools for chemical plants in a nuclear environment and sound understanding of the DEMO fuel cycle. The successful applicant will first familiarize with adequate chemical engineering process and plant simulation software and establish a working platform. The studies will cover all three areas (tritium, matter injection, vacuum) and typical examples would be to investigate the (i) impact of batch vs continuous technologies, (ii) impact of piping, (iii) need for storage vessels, (iv) assessment of engineering limits etc. In some cases, this work will have to involve estimations based on computational fluid dynamics and vacuum gas dynamics, using appropriate commercial software. The outcome of this work flows into the development of a high level fuel cycle simulator which is ongoing in parallel. It shall also provide simplified correlations between properties of interest that can be plugged into modules for a systems code. The successful applicant will be closely involved in the TFV integration team located at KIT, but strong interactions with the other Research Units involved in the project will be required.

Main Work Package: WPTFV
Interlinks with other Work Packages: WPBB, WPSAE
Facilities to be used: n/a

14. THERMAL-HYDRAULIC ENGINEER IN SUPPORT OF DEMO PLANT DESIGN

Position ref. EEG-2016/14
Contact person: Marco Grattarola - marco.grattarola@ann.ansaldo.it

Job Description
Thermal-hydraulic analyses are performed in support of operation of nuclear fusion power plant with the aim of carrying out an effective and safe exploitation. The thermal hydraulic analysis of nuclear reactors is largely performed by what are known as "System Codes". These codes predict the flows in the complex network of pipes, pumps, vessels and heat exchangers that together form the thermal hydraulic systems of a nuclear reactor. Codes in this category include the US codes RELAP, MELCOR, TRAC and TRACE and the European codes CATHARE and ASTEC. They embody necessarily highly simplified models that in essence, solve one-dimensional forms of the conservation equations for mass momentum and energy. They necessarily make heavy reliance on empirical correlations for such things as frictional pressure drops. These codes have been used for many decades, and are now very well-established, and given this long process of refinement, they are able to produce remarkably accurate predictions of plant behaviour under both steady and transient conditions. However, such codes are fundamentally limited in that they are at heart only one-dimensional and in a fusion reactor there are plainly many important phenomena and locations where this one- dimensionality is not always a good approximation. There have been attempts to extend these System Codes to handle multi-dimensional effects. These have had some success, but there is naturally a trade-off between the fidelity of the representation and the computational complexity.

This call aims at the development of good engineering skills and experience on Thermal-Hydraulic Systems Analysis in Support of DEMO Plant Design. In particular, the candidate is expected to

- Work alongside experienced component and plant designers and safety experts.
- Prepare an integral plant model, in which each hydrodynamic system, heat structure, protection and control systems, and the components itself are developed individually, starting from the appropriate design information.
- Work on the review and qualification of appropriate heat transfer correlations, including limits of applicability
- Apply integrate plant simulation tools with ad-hoc modelling improvements e.g., full 3-D treatments to account for specific local geometries.
- Conduct thermal-hydraulic analysis of normal operation sequences and transient analysis and evaluate impact on Balance of plant components,
- Analyse the impact that design modifications in components or systems have on the interactive global operation of the plant and evaluate impact of improving plant availability

Ideally the candidate should have some knowledge of plant transient analysis, nuclear power plant thermal-hydraulics, heat transfer and reactor severe accident analysis.

Main Work Package: WPBOP
Interlinks with other Work Packages: WPBB, WPDIV, WPH&CD, WPDC, WPMAG
Facilities to be used: Available facilities in various RUs

15. LIQUID METALS (LI) ENGINEER IN SUPPORT OF THE IFMIF-DONES DESIGN

Position ref. EEG-2016/15
Contact person: Angel Ibarra - angel.ibarra@ciemat.es

Job Description
The WPENS project in the framework of the EUROfusion activities is aimed to further progressing the engineering design of the IFMIF-DONES facility, an intense fusion-like neutron source with the objective of qualifying the structural materials to be used in a DEMO reactor. The work being developed is complementary to the activities carried out in the IFMIF/EVEDA Project. IFMIF-DONES is based on the interaction of a 40 MeV deuteron beam with a flowing liquid Li generating a flux of neutrons by stripping nuclear reactions. The required neutron dose rate, induce a very high current accelerator (125 mA –the highest in the world for this kind of machines-) and a very high power handling requirements in the Li flow (5 MW) becoming also the largest Li loop never built.

Due to these characteristics, the facility, based on advance accelerator technologies to be used for fusion applications in the materials research, is a multidisciplinary facility in which very different technologies are required.

This position is aimed for the development of the candidates engineering skills in relation with the IFMIF-DONES facility and represents a unique opportunity to work within a team developing the associated technologies. The work will be focused on different aspects of the Li technologies, one of the key specific characteristics associated with the IFMIF-DONES but with a significant number of cross-cutting synergies with other Li application in fusion or with other liquid-metal technologies of great impact on other fusion-related components.

Different aspect of the Li technology will be considered in the development of the work including:
- Fluido-dynamics and thermohydraulic design of Li loops
- Li loop engineering including RAMI evaluation
- Li safety and waste management, including detritiation techniques
- Accident analysis, mostly linked to the Li loop
- Li impurities monitoring and extraction, including H isotopes
- Li flow and radiation diagnostics

Main Work Package: WPENS
Interlinks with other Work Packages: WPBB (for liquid metal technologies), WPSAE (for safety related aspects
Facilities to be used: Available facilities in various RUs

16. ENGINEERING OF PLASMA-FACING MATERIALS, EX-SITU MATERIAL STUDIES AND DIAGNOSTICS

Position ref. EEG-2016/16
Contact persons: M. Rubel rubel@fusion.kth.se, S. Brezinsek s.brezinsek@fz-juelich.de

Job Description
The successful candidate will work in an interdisciplinary field encompassing fusion-related material science & technology, engineering of PFC and wall diagnostics (spectroscopy and wall probes) for global characterisation for the quantitative assessment of life-time and fuel accumulation. The work can be divided into two main areas.
PFC engineering:

- component testing methods and assessment of results, QA of PFC, modelling of components with respect e.g. to active cooling, neutron activation. Handling of contaminated materials will be strongly addressed.

Global characterisation:

- practical material research techniques (microscopy/metallography, ion, electron and X-ray techniques): capabilities and limitations. Fuel accumulation determination with background on hydrogen in materials: surface and global contents of deuterium and tritium.

Eligibility: A recipient of a Master degree or Ph.D. in a university of technology can also be considered as an eligible candidate

EUROfusion Work Packages involved: WPJET2, WPPFC, WPMST1

Facilities to be used:

- *JET, AUG, WEST, and other machines where a direct insight into practical aspects of experimental procedures can be gained. Connection to W7-X to be established in order to prepare PSI studies in near future.*
- *Linear machines for Plasma Wall Interaction (PWI) studies: PSI-2, Pilot-PSI, Magnum-PSI*
- *High Heat Flux facilities: JUDITH-1 and JUDITH-2*
- *Laboratories for handling contaminated materials: Be Handling Facility at JET, hot cells (FZJ) and accelerators (VR, IST)*
- *Optical and laser laboratories*

- *Material research laboratories: e.g. microscopy, ion beam analysis methods, mechanical testing*

17. NUCLEAR AND TRITIUM MEASUREMENTS AND ANALYSES ON FUSION DEVICES (JET AND EUROPEAN NEUTRON FACILITIES), *1ST POSITION*

Positions ref. EEG-2016/17
Contact person: P. Batistoni paola.batistoni@enea.it

Job Description
The successful candidate will work in an interdisciplinary field encompassing

- fusion related neutron/γ-ray measurements, standard and innovative nuclear techniques, and numerical analyses for global characterisation of the radiation field in a fusion environment. The work can include one or more of the following main areas:
- Participation in neutronics benchmark experiments at JET in conjunction with DD and DT operations for the validation of nuclear codes used in ITER design (neutronics and activation codes, shutdown dose rate codes)
- Participation in experiments at JET on the calibration of neutron detectors at 14 MeV neutron energy, including pre-analyses, design of measurements, measurements and analyses of data

The work will be carried out at JET and at European laboratories hosting 2.5-MeV and 14-MeV neutron facilities (FNG, ASP, DPF-1000).

Eligibility: Scientists with an MSc or PhD in Physics can also apply.
EUROfusion Work Packages involved: WPJET3
Facilities to be used: JET, European 2.5-MeV and 14-MeV neutron facilities (FNG, ASP, DPF-1000)

18. NUCLEAR AND TRITIUM MEASUREMENTS AND ANALYSES ON FUSION DEVICES (JET AND EUROPEAN NEUTRON FACILITIES), *2^ND POSITION*

Positions ref. EEG-2016/18
Contact person: P. Batistoni paola.batistoni@enea.it

Job Description
The successful candidate will work in an interdisciplinary field encompassing

- tritium measurements to determine tritium retention and outgassing from JET plasma facing components, to track tritium within the JET fuel cycle and to participate in tritium accountancy. The successful candidate will be trained in the operation of the JET fuel cycle and benefit from the opportunity to participate in JET DT campaigns. The work can include the following main areas:
- Participation in tritium retention/outgassing measurements for JET plasma facing materials
- Participation in the implementation of tritium tracking and accountancy measurements and systems in advance of TT and DT operations at JET
- Participation in TT and DT experiments at JET including plant operation, data collection, analysis and reporting. Propose changes to improve the accuracy and/or efficiency of techniques and systems employed.

The work will be carried out at JET.

Eligibility: Scientists with an MSc or PhD in Physics can also apply.
EUROfusion Work Packages involved: WPJET3

Facilities to be used: JET

19. HIGH-POWER AND MICROWAVE ENGINEERING FOR ECRH SYSTEMS: PROTECTION AND RAMI STUDIES

Positions ref. EEG-2016/19
Contact person: A. Dinklage, andreas.dinklage@ipp.mpg.de

Job Description
The successful candidate will work in an interdisciplinary, unique field encompassing fusion-related high-power microwave engineering & technology and integration engineering for the improvement of reliability, availability, maintainability, inspectability (RAMI) and efficiency for the different system components: gyrotrons, high-voltage power supplies, transmission lines, launcher, operating system and protection systems. The protection of both the fusion device and components mainly concerns the detection of non-absorbed microwave power (stray-radiation, including that in the ECH launcher structures) and protection and mitigations measures for in-vessel components including diagnostics. The qualification of plasma break-down schemes has to take stray-radiation issues into account. The candidate will conduct the protection and RAMI studies on the ECRH-system of W7-X. This system is the first of its kind to allow 10 MW operation for 30 minutes, comparable with the planned ITER ECRH system. W7-X will use ECRH as the main plasma start-up method. ITER also foresees ECRH assisted plasma start-up. An ITER relevant 4.5MW ECRH system consisting of 9 gyrotrons (presently being upgraded for higher power in the X2 and X3 modes), ITER relevant HE_{11} (63.5mm diameter) evacuated transmission lines, and real-time controlled launching antennae, is presently operated at CRPP on the TCV Tokamak. The activities in the field of high power and microwave engineering will also include DEMO studies. The successful candidate will receive comprehensive training on the ECRH system on W7-X and TCV (CRPP), including investigation of plasma break-down and stray radiation detection and mitigation, including novel techniques for improvement of EC wave coupling. The candidate will be introduced to preparatory activity for the RAMI analysis on W7-X and TCV and will receive general training on microwave technology. The candidate is expected to lead the development of an ECRH plant model, ECRH control and protection systems and stray-radiation models in fusion devices (W7-X, TCV).

Eligibility: Candidates holding a physics degree are also eligible if the applicant has experience in high-power microwave technology.

EUROfusion Work Packages involved: WPS1, WPHCD, WPS2, WPMST1
Facilities to be used:

- *W7-X (Greifswald, Germany), TCV (Lausanne, Switzerland) and other machines where a direct insight into practical aspects of experimental procedures can be gained.*
- *Laboratories for gyrotron development at KIT (Karlsruhe, Germany).*

- *Laboratories for microwave engineering at Technical University Eindhoven (Eindhoven, The Netherlands) and University of Stuttgart (Germany) and cooperation with ITER-IO (Cadarache, France)*

20. SOFTWARE ENGINEERING: IMAGING SOFTWARE FOR FUSION DEVICES

Positions ref. EEG-2016/20
Contact person: A. Dinklage, andreas.dinklage@ipp.mpg.de

Job Description
The successful candidate will work in the strongly developing field of video data processing. The main accent of this engineering position lies in computer science to analyze and integrate different imaging data sources by modern software engineering tools in view of the requirements of steady-operation of fusion devices. The main work is to be performed on W7-X. Challenges lie in the processing of large amount of data for routine analyses but particularly novelty detection. Control and safety applications for real-time detection systems for integration in steady-state control and safety systems will be developed. Moreover, purely off-line analyses are to be assessed for periods of interest which, e.g. enter approaches for data compression techniques.

The candidate will apply leading edge software developments to specific applications such as: IR surveillance of components exposed to high heat-loads in the first experimental phase of Wendelstein 7-X and other devices, with assessment and implementation of FPGA imaging developments; and video diagnostics of plasma discharges up to very high pulse lengths. In-vessel video surveillance and the fast detection of destructive plasma events and plasma termination events (e.g. carbon blooms) are further aspects for the application of the software developments. All application aspects are of high relevance to the safe operation of ITER and future fusion devices.

The successful candidate will be provided with training on imaging software tools, training on the inclusion of imaging hardware in safety loops and training on the imaging data processing of streaming data, multi-core CPU, GPU and FPGA based processing. The candidate will be involved in the development of safety compliant software tools and the development of automated analyses of streaming data and data compression techniques.

The grant will be supervised in international, interdisciplinary teams

Eligibility: Candidates holding a degree in informatics or applied mathematics are also eligible if the applicant has experience in software-engineering work.

EUROfusion Work Packages involved: WPS1, WPMST1, WPPFC, WPJET1
Facilities to be used: *W7-X (Greifswald, Germany), WEST (Cadarache, France), JET (Culham, UK) and other machines where a direct insight into practical aspects of experimental procedures can be gained.*

21. DATA INFRASTRUCTURE FOR THE SCIENTIFIC EXPLOITATION OF EXPERIMENTS WITH MACHINE GENERIC TOOLS

Positions ref. EEG-2016/21
Contact person: G. Giruzzi, gerardo.giruzzi@cea.fr, G. Falchetto gloria.falchetto@cea.fr

The operation and scientific exploitation of the new generation of fusion devices such as JT-60SA and ITER, will require the usage of robust, maintainable and validated tools for data access and data handling. The Data and Analysis systems for these tokamaks are presently being devised, it is thus urgent for the fusion community to carry out extensive tests on the existing fusion machines.

Job Description
The project is focused on the technical development of modern tools for handling data, as well as documentation and analysis tools, aiming to support the operation and scientific exploitation of the new generation of fusion devices, such as JT-60SA and ITER. The work will involve both the prototyping of machine generic tools and their test for systematic analysis of EUROfusion experiments.

The successful candidate, having a software engineer profile or a PhD in Information Engineering, will work in strict contact with infrastructure support IT experts, experimental data and integrated modelling experts. Trainings will be provided on the data access and data management tools in use in existing experiments as well as on the EU Integrated Modelling and ITER Physics data models.
The work will start with an assessment of the present technologies and will then address the following areas:
- Data handling and data model, mapping mechanisms between different data models.
- data access tools for experimental data of present and future machines (Medium Size Tokamaks (MST), JET, WEST, JT-60SA, ITER)
- Visualization tools
- GUI for parameterization of post-processing and simulation workflows

Eligibility: candidates having a Master degree in software engineering or PhD in Information Engineering.

EUROfusion Work Packages involved: WPCD, WPSA, WPISA, WPMST1, WPJET1.

Facilities to be used: WEST, JET, MST devices

22. DESIGN AND ANALYSIS OF ADVANCED DIVERTOR CONFIGURATIONS

Positions ref. EEG-2016/22
Contact person: R. Albanese, raffaele.albanese@unina.it

Job Description
Heat-exhaust systems must be capable of withstanding the large heat and particle fluxes of a fusion power plant. The baseline strategy for the accomplishment of Mission 2 “Heat-exhaust systems” consists of reducing the heat load on the divertor targets by radiating a sufficient amount of power from the plasma and by producing “detached” divertor conditions. Such an approach will be tested by ITER, thus providing an assessment of its adequacy for DEMO. However, the risk exists that high-confinement regimes of operation are incompatible with the larger core radiation fraction required in DEMO when compared with ITER. Alternative solutions for the divertor are therefore necessary to provide a risk mitigation strategy for DEMO. These concepts will need not only to pass the proof-of-principle test but also an assessment of their technical feasibility and integration in DEMO. For this reason the WPDTT2 work package is supposed to provide a conceptual design of DTT (Divertor Tokamak Test facility), a facility for testing alternative divertor solution.
This call aims at the development of good engineering skills and the experience in the field of power exhaust. The candidate is expected to familiarize with the very demanding design requirements for the design and analysis of advanced divertor configurations in respect of their electro-mechanical feasibility for DTT and a DEMO class device. The programme will provide the theoretical and practical/experimental background for the complex interdisciplinary areas, which are connected to this subject.
Interactions with several EU Research Institutions engaged in alternative divertor designs and analyses and development are foreseen, together with work in existing medium-size tokamaks. Several tools for the analysis are available and their predictions can be tested on European and international machines with advanced configurations, e.g.., MSTs in Europe and EAST in China. The trainee will also interact with the teams of the Projects involved in this area (e.g., WPDIV, WPDTT1, WPDTT2, WPPFC and WPPMI) for the analysis of some specific aspects (electro-mechanical loads, thermal loads, fatigue, etc.) related to the design of the divertor components for advanced magnetic configurations.
Specific skills will be developed in the following areas

- Advanced magnetic configurations (e.g. snowflake)
- Edge parameters and their influence on divertor design
- Design and analysis of divertors taking account of several aspects (electrical, mechanical, thermal, neutron damage, fatigue, remote handling)

Main Work Package: WPDTT2
Interlinks with other Work Packages: WPDIV, WPDTT1, WPPFC, WPPMI
Facilities to be used: MST1 tokamaks in Europe and EAST in China

23. DIAGNOSTIC TECHNIQUES AND DIAGNOSTIC INTEGRATION ON TOKAMAKS

Positions ref. EEG-2016/23
Contact person: S. Coda, stefano.coda@epfl.ch

Job description
ITER is still an experimental reactor and will require extensive diagnostics for science, monitoring and control purposes. Diagnostics have traditionally been developed by physicists, but as many techniques have become standard, engineers and high-level technicians have increasingly been empowered to not only install, run and maintain the systems but also participate in their conception, development, calibration, etc.. There is every reason to believe that a large fraction of the ITER generation of diagnostics can be handled almost entirely by properly trained engineers. Examples of individuals with this profile do exist on MST1 tokamaks but are fairly rare. Nevertheless, their usefulness is readily apparent to insiders. Additionally, the reactor environment will raise issues related to long-pulse operation and nuclear activation – resulting in extensive remote-handling requirements – to a much greater degree than in any of today's nuclear-fusion facilities; also, plasma-facing materials (such as used in optical components, e.g.) are likely to be subject to much more severe erosion and deposition than in today's devices. The need to incorporate these concerns into the design and operation of diagnostics tilts the balance even further towards engineering expertise.
On one or more MST1 devices and/or JET and/or WEST, a diagnostic area would be chosen for each trainee, preferably out of the following predefined set: (a) spectroscopy, (b) soft and hard X-rays, (c) optical and infrared diagnostic techniques, (d) electrostatic and electromagnetic probes, (e) microwave techniques. The sets do possess wide overlaps to ensure that the training is sufficiently broad and cross-disciplinary. For example, a-b-c would share a mastery of tomographic inversion techniques, d-e would share the application of sophisticated analysis techniques such as bicoherence + wavelet analysis, etc.. Additional areas can be considered as the details of the grant are defined, provided they offer a similarly broad scope. The choice would ultimately depend on the individual's interests and temperament and would be agreed with the project sponsor.
The first 1-1.5 years would focus on training proper, whereas in the second half of the period the trainee would be expected to apply the acquired knowledge to develop (conceptually or concretely, depending on hardware budget constraints) or upgrade one or more systems, probably on a single tokamak.

Eligibility: Scientists with an MSc or PhD in Physics can also apply
EUROfusion Work Packages involved: WPMST1, WPMST2, WPJET1, WPJET2, WPJET4
Facilities to be used: JET, MST devices, WEST.

24. BERYLLIUM (BE) SAFETY: BE OPERATION ISSUES IN FUSION RESEARCH

Position ref. EEG-2016/24
Contact person: T. Jones, Timothy.Jones@ccfe.ac.uk

Job Description
The successful candidate will work in an interdisciplinary field encompassing Be safety, fusion-related technology, engineering and operations. He or she will be expected to become proficient on Be safety in an operational environment and summarise the exposure experience associated with specified tasks, eventually providing expert advice to JET, F4E and ITER. The work implies gaining knowledge of and/or experience in the following main areas:

- relevant international safety regulations and the latest initiatives pertaining to Be safety and the latest developments in Be toxicity research.
- participation in the design and production of engineered containment systems and the specification of respiratory and personal protective equipment.
- Gaining experience of workplace contamination control, personal exposure assessment techniques as well as Be analysis techniques.
- participation in establishing contacts with other users and specialist sources of knowledge on Be safety with a view to guiding the future safe use of Be in fusion research.

The work will be carried out at JET and at European laboratories and other fabrication facilities handling beryllium.

Eligibility: Engineers/Scientists with experience and/or qualification on, or interest in, occupational health, hygiene and safety.

Facilities to be used: *Laboratories for handling contaminated materials:*

- JET Be Handling Facility
- hot cells and accelerators at collaborating research units

25. DEVELOPMENT OF VACUUM VESSEL PRESSURE DIAGNOSTICS SUITABLE FOR HIGH NEUTRON FLUENCE ENVIRONS AND DESIGN OF T2 FUELLING SYSTEMS FOR FUTURE FUSION DEVICES

Position ref. EEG-2016/25
Contact person: T. Jones, Timothy.Jones@ccfe.ac.uk

Job Description
The successful applicant will work within the challenging engineering boundaries presented by the environments of both present and future fusion devices for vacuum pressure measurement and plasma fuelling.

- Participation in the engineering, implementation, commissioning and operation of a new tritium gas introduction system at JET
- Development and testing at JET of a DEMO relevant pressure measurement systems capable of withstanding high neutron fluence and other radiological interactions, whilst providing sufficient accuracy, reliability and longevity of operation. (Capacitance diaphragm type with remote electronics and Penning type gauges)
- Design and development of a residual gas analyser compatible with the requirements of future fusion experiments such as ITER and DEMO.

Facilities to be used: *JET*

26. REAL-TIME ENGINEERING ANALYSIS OF COMPLEX SYSTEMS

Position ref. EEG-2016/26
Contact person: T. Jones, Timothy.Jones@ccfe.ac.uk

Job Description
The successful candidate will develop a novel methodology for improving and coupling existing real-time monitoring codes. The work will start with the study of the JET divertor real-time thermal model, with the objective of improving its precision and accuracy when linked to the protection systems.
Machine protection systems have historically relied on real-time software, evaluating and combining different diagnostic measurements. Limits of operation are usually established during design by means of complex and time-consuming offline engineering analyses. One of the outcomes of those simulations is the definition of limit values for a simplified set of variables. These signals correspond to direct measurements or simple real-time computations during pulses.
New techniques are being applied at JET for incorporating real-time engineering analysis models of in-vessel components. The proposed project will extend these techniques in the following aspects:

- Improving critical machine limits by defining additional monitoring signals, such as surface and bulk temperatures, maximum strain and accumulated damage.
- System modelling of different components, integrating relevant complex coupled effects in a time dependant scheme.
- Extend its application to other areas of EUROfusion programme, such as WPDIV and the First Wall task under WPBB.

The project requires both experimental and theoretical knowledge of complex thermo-mechanical systems. It will involve analysing, modelling, and linking other processes such as (but not limited to) electromagnetics, hydraulics, and plasma deposition. In addition to those boundary conditions, sensitivity to the change in the model itself—geometry and material properties—might be required to study the consequences of aging effects produced by erosion, corrosion, creep and/or neutron damage.
It is expected that the candidate will interface engineering analysis, plasma operations, materials modelling, and control and data acquisition systems groups at the main host facility. Other EUROfusion facilities could as well be involved in the project. Present experimental data will be used for validation purposes. Day to day work in main host facility is required. Implementation and deployment will be done during shutdowns, and effectiveness of the upgrades shall be analysed during campaigns.

Facilities to be used:

- *JET as the primary host facility*

- *MAST-U and/or AUG or TCV for further validations, applications and comparisons*

27. DEVELOPMENT OF FUSION RELEVANT DETRITIATION PROCESSES ON AN INDUSTRIAL SCALE FOR THE PROCESSING OF 'REAL' FUSION WASTES AND MATERIALS

Position ref. EEG-2016/27
Contact person: T. Jones, Timothy.Jones@ccfe.ac.uk

Job Description
The successful applicant will work within Waste Management Group at CCFE to develop a new facility for the detritiation of 'real' fusion materials to recover tritium from tritiated materials.

- Recover tritium from fusion material and waste for reuse as fusion fuel.
- Optimise and validate the process/treatment for different material types by pre and post treatment characterisation through sampling and analysis.
- Demonstrate the hazard reduction and storage requirements for equipment stored for reuse.
- Re-categorisation of tritiated waste to facilitate disposal or material recycling.
- Establish the 'best available technique' (BAT) for management of fusion wastes.

The scope of this work not only has practical application to ensure appropriate environment management of existing JET waste liability reduction but is also directly relevant to future fusion experiments such as ITER and DEMO.

Facilities to be used: JET

28. PROCESS ENGINEER FOR THE WDS-ISS OF THE ITER TRITIUM PLANT

Position ref. EEG-2016/28
Contact person: Ion Cristescu ion.cristescu@kit.edu

Job Description
The Water Detritiation (WDS) and the Isotope Separation System (ISS) based on cryogenic distillation are the key systems of the ITER Tritium Plant as far as the tritium discharge into the environment and the tritium inventory are concerned. Therefore, considerable resources have been allocated to investigate and to experimentally prove the performances of the main components of the two systems operated in ITER relevant conditions.

This call aims at the development of good engineering skills and practical experience needed for the design, manufacture and the enhancement of the configuration of the two systems, having as main scope to accommodate the various requirements from the other ITER tritium plant systems that interface with it.

The applicant should have some project engineering experience, ideally related to tritium processing in the context of developing a water detritiation system based on the Combined Electrolysis Catalytic Exchange process, and also some background in the area of cryogenic distillation.

In view of detailed design, manufacture, installation and commissioning of ITER WDS and ISS, including the control and automation systems of the two processes, the process engineer will be trained and the skills will be developed in the following areas:

- Design of Chemical plants; electrolysis processes based on solid polymer electrolyte, Liquid Phase Catalytic Exchange process and hydrogen and oxygen processing will be the main topics of developments.
- Design of large cryogenic distillation systems including helium refrigeration units and enhancement of the design tools needed to develop the configuration of the cryogenic distillation columns cascades for hydrogen isotopes separation.
- Manufacturing of components for chemical plants and cryogenic distillation facilities; the candidate will also gain familiarity with relevant nuclear codes and standards relevant for ITER.
- Development of automation and control systems relevant for the chemical and cryogenic distillation plants.
- Management of large project in international environment and with very stringent requirements and quality control.

Main Work Package: n/a – the ITER WDS and ISS systems are different from what is being developed for DEMO

Interlinks with other Work Packages: WP-TFV

Facilities to be used: TRENTA facility at KIT-TLK

29. BERYLLIUM HANDLING, HEALTH AND SAFETY REGULATION IN NUCLEAR FUSION

Position ref. EEG-2016/29
Contact person: Hans-Christian Schneider hans-christian.schneider@kit.edu

Job Description
Beryllium expertise is needed for ITER and can be acquired in facilities producing, conditioning and investigating Beryllium and Beryllides. This call aims at the development of good skills and experience in the field of the risks associated with Beryllium in the production and conditioning process as well as in the state as n-irradiated, Tritium-containing material in the blanket of a Fusion reactor. The candidate is expected to familiarize with the legal conditions and the appropriate techniques to obtain permits for safe handling and storing routines.

Theoretical and practical skills will be developed in the following areas:

- Risks associated with Beryllium
- Limits of exposure for staff and civil persons and environment
- Techniques in safe handling and storing of toxic and radioactive material
- European and national law and regulations
- Principles of handling permits and surveillance by authorities
- Standards for chemical and radio-isotope laboratories

- Effects of alloying elements and impurities on toxicity and mechanisms of dispersion
- Changes in Berylliums physical properties under fusion relevant conditions
- Activation and Tritium formation under fusion relevant conditions
- Prediction of activation by FISPACT and measurement
- Tritium retention and release
- Permeation of Beryllium's Tritium inventory through barriers
- Methods for cleaning, decontamination, and disposal

- Practical work on Beryllium in conditioning process and in irradiated state
- State-of-the-art analysis, characterisation and handling techniques

Beryllium Handling, Health and Safety regulation expertise will be acquired along the development of fabrication technologies for Be n-multiplier materials.

The applicant should have an education in chemical / process engineering or materials engineering.

Main Work Package: n/a
Interlinks with other Work Packages: WPBB

Facilities to be used:	Be production, processing and characterization facilities in industry (Karlsruhe Beryllium Handling Facility, KBHF, of Goraieb Versuchstechnik on site), and at KIT (i.e., Fusion Material Laboratory, FML and Tritium Laboratory Karlsruhe, TLK)