Modelling Support to ITER's Fuel Cycle Plant

Project Overview

DBD has been awarded a Framework contract to supply modelling support to the fuel cycle plant for the ITER project at Cadarache, France. The initial Framework contract covers 2 years and aims to provide information to support the design of the fuel cycle plant and the associated equipment in ITER.

Scope of Work

ITER required a high level model that provides information on the rate of transfer and the rate of accumulation of the reactor fuels and products as they are transferred around the different processing areas of:

- Fuelling, comprising gas puffing and pellet injection
- Neutral Beam Injection (NBI)
- Vacuum Vessel (VV)
- Torus Cryopump systems (TCP)
- Cryogenic Viscous Compressors (CVC)
- Tokamak Exhaust Purification (TEP)
- Isotope Separation System (ISS)
- Storage and distribution (SDS)

The technical challenges in this model arise from the many discontinuous operations of the fusion reactor, the short batch operating times of many process plant items together with the processes taking place at the end of each day to enable the succeeding day's experimental work to commence.

This modelling task forms the first of an anticipated suite of models that will add further peripheral, but important, processing areas to the model. Once the early stages of work are completed, it is likely that the modelling work will change to support the detailed design and control of the integrated fuel cycle plant.

DBD Deliverables

DBD has assembled a versatile flowsheeting tool, together with the descriptive code to describe, at a high level, the operations for these processing areas. The Flowsheeting tool allows a wide range of parameters to be modified in the model and the results compared between different runs.
The model, operating at 1Hz frequency covering a whole day's operating time, integrates Excel spreadsheet applications with a database in order to allow data management in the database and calculation routines to be developed in Excel.

The Results

This approach has a number of substantial advantages:

- Simplifies model modification thereby allowing progressive addition of detail to the modelled processes according to the importance of that area of the overall model

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- Allows further modules to be added to the model without undue disruption to the existing model
- Provides a more explicit and easier QA process for verifying workbooks compared to traditional spreadsheet applications
- Allows the results of many runs to be collected and analysed so that the most effective combinations of parameters can be determined
- Speeds up the rate of model delivery

This approach will inform ITER upon the best combinations of buffer tanks, Fuel Storage (Getter beds), processing capacities and operating plant parameters to specify for the fuel cycle plant.

Following completion of the first stage of the modelling work, DBD are currently being instructed to begin new development work to add enhancements to the existing model and will provide training and contractor support to ITER. Enhancements to the code will enable ITER to complete a series of NBI system studies and will facilitate a study of the handling of gases emptied from the ISS Columns.

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