Background

The neutral beam system for ITER is composed of two Heating and Current Drive (H&CD) injectors and a diagnostic injector (with the possibility of a third H&CD injector in a later upgrade). The system is based on the acceleration of negative ions and each of the heating injectors is designed to deliver 16.5 MW to the plasma, giving a total of 33 MW of power (with an additional 16.5 MW if a third injector is installed).

In December 2009, CCFE won the three-year, €5.7 million grant jointly supported by Fusion for Energy (F4E, Barcelona) and the UK Engineering and Physical Sciences Research Council (EPSRC), to design ten of the sub-systems required to integrate the Heating Neutral Beam (HNB) system into the ITER assembly (see Figure 1).

Project objectives

Deliver detailed designs and technical specification for ten critical subassemblies that make up the ITER HNB System (see Figure 2).

Solution

The team adopted an approach based on the following phases:

- **Phase 0** - Functional specification development
- **Phase 1** - Development of conceptual and scheme designs
- **Phase 2** - Detailed design phase (including build-to-print drawings and technical specifications)

- Initial concepts supplied by ITER (via F4E) were base-lined and reviewed against performance, manufacturability and maintainability requirements
- Alternative, improved concepts have been generated and evaluated to select an optimum solution to take forward to the Conceptual Design Review (see Figure 3)
- Performance of the new concepts has been verified against many of the “key” operating conditions (using extensive hand calculations and finite element analysis)
Outcome

- Over 750 pages of requirements specifications and design description documents have been reviewed and approved by F4E and ITER
- Conceptual CAD models for ten HNB subsystems (over 500 parts) have been successfully incorporated into ITER's Product Lifecycle Management (PLM) system