System engineering approach in the EU Test Blanket Systems Design Integration

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Two EU Test Blanket Systems (TBS) are foreseen to be installed and tested at ITER [1]. The work on their conceptual design carried out by the Test Blanket Module Consortia of Associates (TBM-CA) advances in last years. The complexity of the TBS that consists of TBM set with shield, cooling system, tritium extraction system, coolant purification system, data acquisition and control system, pipe forest, ancillary equipment unit, port cell and hot cell assembly, transport and maintenance equipment, calls for additional designers attention and demands increasing and diverse integration activities.

The paper reveals how the TBM-CA applies the system engineering methods ([2] - [4]) in all stages of the TBS design integration. Completed so far integration engineering tasks cover among others status and initial set of TBS operating parameters, planning of the monitoring and control of the TBS interfaces and planning of the TBS baseline documentation. Most of the attention is devoted to the establishment the HCLL and HCPB TBS baseline, TBS break down into subsystems, identification, definition and management of the internal (inside TBS) and external (with ITER systems) interfaces, development of the TBS product break down structure (PBS), establishment and management of the required TBS baseline documentation infrastructure.

Definition and selection of the TBS subsystems plays a crucial role in the further design and in the management of their interfaces. For this reason several options have been considered and evaluated using specific criteria. Thus an optimum TBS breakdown into subsystems is selected and subsystems IDs are assigned before the interfaces identification to take place. Than the TBS internal interfaces Interface Control Documents (ICDs) and parameters are listed. Thus the base for the further definition and documentation of the internal interfaces is set up. Process of the TBS internal and external interfaces management that covers the planning, definition and description, verification and review, non-conformances and deviations, and modification and improvement processes and is based on the TBM-CA QA procedures is developed and described. Process of interfaces review is developed and described, identifying the actors, input, activities and output of the review. Status of the ITER documentation of TBM (PBS 56) interfaces is also reported - ITER ICDs and Interface Sheet describing TBS external interfaces are referenced. Finally the relations and interactions of system engineering processes with TBM configuration management and TBM-CA Quality Management System are discussed.

- [2] System Engineering Handbook, NASA/SP-2007-6105 Rev 1, December 2007
- [3] System Engineering Manual, National Airspace System, US FAA, US, Version 3.1 06/06/06
- [4] System Engineering Fundamentals, US DoD, January 2001

^[1] L. Boccaccini, "The Conceptual Design of the EU Test Blanket Systems", invited paper at this conference