

## The European supplied components of the ITER Vacuum Pumping Systems

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The ITER Vacuum Pumping systems are designed to pump hydrogen isotopes, including tritium, helium and impurities. With respect to these systems, the EU is responsible for the in-kind supply of 8 torus-, 2 cryostat-, 3 Heating Neutral Beam- (HNB) and 1 Diagnostic Neutral Beam- (DNB) cryopumps, their 14 Cold Valve Boxes (CVBs) and the cryolines between them up to delivery to the ITER site. In addition, the Leak Detection and Localization (LD&L) systems are also part of the EU's supply.

The design of these systems has progressed well towards build to print status over the past 4 years with the exception of LD&L, where the results of a significant R&D program are required to define the conceptual design. The torus and cryostat cryopumps are technically challenging because they incorporate an inlet vacuum valve capable of controlling the pumping speed provide significant He pumping capability, need to regenerate very fast and require to be instrumented to give information for performance and inventory control. In addition, effective, reliable and fast LD&L capability is vital for the high availability of ITER. In order to fully define the related Procurement Arrangements (PAs) and minimize any technological, programmatic or cost risks, a 1:1 Pre-Production cryopump (PPC) has been planned to be built and tested as well as a series of necessary R&D activities will need to be performed. These activities will address all technological challenges, specify the instrumentation needs of these Vacuum Pumping systems and analyze their performance under the complex demands of ITER, for normal and abnormal scenarios, with the aim to optimize and validate the design incorporating all necessary features, safety provisions and remote handling requirements.

This paper will analyze the main technical requirements of the EU Vacuum Pumping PAs and show the significant progress achieved to date. It will also discuss the related tritium compatible design, quality needs for tritium containment, planning and procurement strategy up to delivery. In addition, the content and timing of the identified R&D activities, the manufacture and testing of the PPC and the required acceptance tests will be described.