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C3Or3D-05: Overview of Design Developments for Condensable Vapor Devices for ITER

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The ITER, meaning "the way"in Latin, aims to achieve sustainable fusion energy through self-heating plasma with a gain ≥ 10. The United States is one of the seven members of this prestigious project, which is in the advanced stages of construction in the south of France. The vacuum systems at ITER are critical to the project as they handle the evacuation and exhaust of the gases from the tokamak machine. The ITER Roughing Pump System (RPS), which is part of the vacuum system, consists of a series of roughing pumps and provides a means to evacuate all gases or mixtures of gases originating from the tokamak. These gases are then appropriately transferred to other systems such as the Tokamak Exhaust Processing (TEP), De-tritiation System (DS) or Heating, Ventilation and Air Conditioning (HVAC). These exhaust gases contain helium, isotopes of hydrogen and their combinations. Additionally, they contain water (H2O) and its isotopes such as heavy water (Deuterium Oxide, D2O) and tritiated water (T2O). The Condensable Vapor Devices (CVD), which are part of the RPS, are designed to separate such water content in order to protect downstream pumps and transfer the water to TEP for further processing. The CVDs operate on the principle that a cooling fluid (i.e., liquid nitrogen) cools the exhaust process gas from the tokamak, causing the water present in the process gas to condense and freeze, thereby trapping it in the CVD. The CVDs are then regenerated to release the trapped water molecules, which are sent to the TEP.
The present article will describe the technical requirements, challenges, and design progress made so far in the development of the CVDs.

Keywords: ITER, Vacuum systems, Roughing Pump Systems, Condensable Vapor Devices, cryogenic water traps

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Author: CHOUKEKAR, Ketan (Oak Ridge National Laboratory)

Co-authors: Mr TIPPENS, Jared (Oak Ridge National Laboratory); Mr SMITH, Charles (Oak Ridge National Laboratory); Ms JOSHI, Bhumika (INOX India Limited); Mr PATEL, Kirit (INOX India Limited); Mr KANZARIA, Hiren (INOX India Limited); Mr PANCHAL, Dhawal (INOX India Limited); Mr VYAS, Hardik (INOX India Limited); Mr KALLA, Rajat (INOX India Limited)

Presenter: CHOUKEKAR, Ketan (Oak Ridge National Laboratory)

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