Design Features for High Temperature Gas baking of ITER Divertor to Remove Tritium from Dust

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High temperature gas baking of the ITER Divertor is part of the operational strategy to remove tritium from dust that has accumulated on the Divertor plasma facing surfaces during plasma operation. The cooling water channels of the Divertor are utilized to deliver high temperature fluid to increase the temperature of the Divertor plasma facing components during both water and gas baking operations. The Tokamak Cooling Water System (TCWS) supplies the cooling water to the Divertor cooling water channels during normal plasma operation. Periodically the Divertor surfaces are backed using TCWS water at 240°C and 4.4 MPa at a flow rate that is 10% of the nominal flow rate. To enhance the effectiveness of tritium removal from dust, baking using gas at 350°C and 1.0 MPa is performed when required to proceed to subsequent plasma operation phase.

In ITER, the dust that accumulates on the Divertor plasma facing surfaces originates from the plasma interaction with the plasma facing components. The tritium that accumulates on these surfaces–are mostly absorbed in the Be dust and co-deposited layers. This accumulation of tritium represents the main radioactive source term inside the plasma chamber of the Vacuum Vessel. The concern is that accumulated tritium could potentially be mobilizabled during accidents thus challenging the ITER primary and secondary confinement features designed to minimize any potential risk of tritium release to the environment. Even under the most severe accident scenarios, the postulated releases are well below acceptable limits. Tritium in the dust and in the co-deposited layers is considered to be mainly concentrated in the Divertor area. Gas baking of the Divertor is considered as one method that will further reduce the radioactive source term available for potential release.

Therefore, ITER has adopted a wider strategy to control and remove both the dust and accumulated tritium in the co-deposited layers inside the VV plasma chamber to ensure the accumulated tritium inventory is well below the safety limits (dust ≤ 1000 kg and tritium ≤ 1 kg).

The gas baking of the Divertor to remove tritium augments the removal of dust removed by the remote handling cleaning system. Both the remote handling and gas baking will be utilized in a broadened strategy to remove tritium after each shutdown.

The Tritium removal shall rely on the capability to perform the wall-cleaning via suitable techniques and by baking the In-vessel components at high temperature.

The best compromise to permits a very effective tritium desorption from the VV has been found baking the Divertor, by using a suitable gas at 350°C, whilst the VV and Blanket are both baked by using water respectively at 200°C and 240°C.

The paper presents the baking strategies for the entire In-vessel components, and specifically for the Divertor, the modification of the Drying Systems of the TCWS to also permit gas baking at higher temperature.

The results of the piping stress analyses performed to asses the higher thermal expansion will be also presented.

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