Dusts in ITER: Diagnostics and Removal Techniques

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Dusts will be present in ITER and will represent an issue in terms of safety. As a matter of facts, dusts will be created by interaction of the plasma with the in-vessel materials and will be thus made of carbon, beryllium and tungsten. They will be activated, tritiated and chemically toxic.

Safety limits have been set in order to reduce these dust hazards. The first set of limits is based on a limitation of the radiological impact on environment in case of dust spreading. Tungsten has been used as representative of ITER dust because it is the most radiologically hazardous of the plasma facing materials. Thus the mobilisable dust inside the vacuum vessel has to be limited to few hundreds of kilograms of carbon, beryllium and tungsten.

The objective of the second set of limits is to ensure that the dust chemical reactivity is adequately controlled. Indeed this reactivity is greatly enhanced on the hot surfaces of the divertor in case of steam ingress, oxidation of the metals, beryllium in particular, leading to hydrogen production and possible explosion. The dusts on the hot surfaces of the divertor should not exceed few kilograms of carbon, beryllium and tungsten.

Some calculations have shown that the dusts limits inside the vacuum vessel could be reached in about 500 plasma pulses, and in any case before the assumed replacement of the divertor for planned maintenance. Thus techniques for dust diagnostics and removal need to be developed for ITER to ensure that the set of safety limits are fulfilled.

To minimize the impact on the machine operation time, these techniques have to be elaborated considering the ITER vacuum vessel constraints if entering the machine (magnetic field, radiation, vacuum and temperature) or to be non invasive. This paper will present a strategy that could be developed at different periods of the machine operation (during/between pulses and during short or long maintenance periods) in order to monitor the dust inventory build-up. This strategy relies on the use of a set of complementary techniques for dust diagnostics and removal.

Number of words in abstract: 341

Keywords:
Technical area: 62. Materials issues in chamber technologies Safety and waste management
Special session: Not specified
Presentation: No preference
Special equipment: No special equipment