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Safety aspects on the road towards fusion energy

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On the road toward fusion energy, ITER is the first fusion installation which will have enough radioactive inventory to be potentially dangerous for the public and the environment. As such, ITER has a licensed nuclear facility status and ITER Organization, the operator, has to follow a licensing process through which it has to demonstrate to the regulator that the installation is safe at all stages of its operation. In practice, the operator has to define technical, organizational and human provisions such as to prevent or adequately limit the risks of accidents and the disadvantages (exposure to ionizing radiation, environmental releases and waste) that the installation presents.

All installations which will be created after ITER in order to develop (DEMO...) then make use of fusion energy (PROTO...), will clearly also be installations for which the safety aspects will have to be taken into account. If this is not correctly done, it could be an obstacle (in terms of delay or additional cost) or a stop (no licensing) on the way to fusion energy. Perfectly mastered, it could also be a benefice for fusion power compared with other choices.

This paper begins with describing the safety features of fusion installations (first confinement barrier surrounded by large energy sources, plasma disturbances, explosion hazard...). Then, a state of progress of the ITER safety demonstration is provided: solved issues (the tokamak support design, accident within the neutral beam cell...), issues under IRSN's expertise (Explosion within the vacuum vessel, New Vacuum Vessel Pressure Suppression System...), issues to be solved (Detritiation system efficiency, radioprotection, hot cells, tritium and waste buildings...). Finally, a chapter is dedicated to the possible evolutions of the safety issues for the installations succeeding ITER on the road to fusion energy (decay heat removal, exposure to ionizing radiation, environmental releases...). General comments about dealing with these evolutions close this paper (safety from the earliest design stage, lessons learned, involvement of the regulator...).

Primary author: Dr PERRAULT, Didier (Institut de Radioprotection et Sûreté Nucléaire (IRSN))

Presenter: Dr PERRAULT, Didier (Institut de Radioprotection et Sûreté Nucléaire (IRSN))

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