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Radiation Protection and Licensing for an Experimental Fusion Facility: The Italian and European Approaches

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Abstract : An experimental nuclear fusion device could be seen as a step toward the development of the future nuclear fusion power plant. If compared with other possible solutions to the energy problem, nuclear fusion has advantages that ensure sustainability and security. In particular considering the radioactivity and the radioactive waste produced, in a nuclear fusion plant the component materials could be selected in order to limit the decay period, making it possible the recycling in a new reactor after about 100 years from the beginning of the decommissioning. To achieve this and other pertinent goals many experimental machines have been developed and operated worldwide in the last decades, underlining that radiation protection and workers exposure are critical aspects of these facilities due to the high flux, high energy neutrons produced in the fusion reactions. Direct radiation, material activation, tritium diffusion and other related issues pose a real challenge to the demonstration that these devices are safer than the nuclear fission facilities. In Italy, a limited number of fusion facilities have been constructed and operated since 30 years ago, mainly at the ENEA Frascati Center, and the radiation protection approach, addressed by the national licensing requirements, shows that it is not always easy to respect the constraints for the workers' exposure to ionizing radiation. In the current analysis, the main radiation protection issues encountered in the Italian Fusion facilities are considered and discussed, and the technical and legal requirements are described. The licensing process for these kinds of devices is outlined and compared with that of other European countries. The following aspects are considered throughout the current study: i) description of the installation, plant and systems, ii) suitability of the area, buildings, and structures, iii) radioprotection structures and organization, iv) exposure of personnel, v) accident analysis and relevant radiological consequences, vi) radioactive wastes assessment and management. In conclusion, the analysis points out the needing of a special attention to the radiological exposure of the workers in order to demonstrate at least the same level of safety as that reached at the nuclear fission facilities.

Keywords : fusion facilities, high energy neutrons, licensing process, radiation protection
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