

## **Key Issues for the Safety and Licensing of Fusion**

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The safety and environmental characteristics of fusion as a power generating source provide important motivations for its development. The low stored energies, benign reaction products, absence of climate-changing emissions, and rapid termination of power excursions are amongst the features that naturally give fusion a safety advantage. But in order to license the construction and operation of a fusion power plant, a high degree of assurance of these benefits may be required. Although the regulatory regime in which future power stations will be approved is not well known, some requirements can be anticipated, particularly with the benefit of experience so far in preparations for the licensing of ITER.

Regulatory requirements for fusion power plant, as for any other large industrial installation, are likely to focus on hazards to the public and to workers at the plant, and on longer-term impacts on the environment. The extent to which these hazards can be reduced or avoided by inherent or passive features will be an important measure of attractiveness.

Over the past ten years, various studies of conceptual fusion power plant designs, as well as the engineering design of ITER, have included comprehensive analyses of safety and environmental performance. These have indicated that the accident potential in a fusion plant is indeed very low: the likelihood of an event leading to a public hazard is very low and the potential consequences are also very low. Occupational safety, while on a level comparable with other power-generation technologies, is an area where some improvement may be achieved by optimization of design with regard to maintenance requirements. This in turn depends on materials development to extend the lifetime of components. Operational releases to the environment from a fusion plant should be negligible, however at the end of life there remains a large volume of material that has been activated by neutrons. Most of this is at a low level of activation that decays rapidly, so that it no longer presents a radiological hazard and could be cleared from regulatory control. But full use of materials recycling may be necessary to avoid a small fraction of the total requiring disposal as long-term waste.

Each of these areas will be reviewed, with reference to previous studies of ITER and of power plants, in particular the recently completed Power Plant Conceptual Study in Europe. In the context of anticipated regulatory requirements, the key issues will be highlighted and discussed.