

THE CORROSIONAL AND NUCLEAR EFFECTS OF WATER INGRESS INTO THE PRIMARY CIRCUIT OF AN HTR-MODULE*

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Abstract

Water ingress into the primary circuit of a high-temperature reactor caused by a tube rupture of a steam generator is considered to be a major design basis accident due to the nuclear and corrosional consequences of steam in a hot, critical graphite core.

Both, the nuclear and corrosional effects of water ingress into the primary circuit of a modular HTR are explained and it will be discussed how by an appropriate core layout the reactivity effects of steam could be completely avoided. It will be shown that by reducing the heavy metal content of the standard pebble fuel element from 11.3 g to 7 g all possible reactivity effects can be held below reactivity disturbances which are caused by postulated rod ejections and for which counter measures have to be provided by the shutdown system anyway. Thus, for a modular HTR reactivity effects due to any water ingress into the core will be shown to be of negligible importance.

To limit and mitigate the fuel element corrosion and their associated consequences due to ingressed steam, several components and devices are incorporated into the plant of a modular HTR. These components and devices such as humidity detection systems, water separators in the helium purification plant, steam generator draining system, blower flap, ventilating systems and primary circuit relief valves are described and their influence on the fuel element corrosion will be discussed.

* At time of publication of proceedings only Abstract available.

Finally, results on corrosion rates, maximal fuel element burnup, water gas generation, pressure rise in the primary system and environmental dose rates will be given for design accidents as well as hypothetical accidents. It will be demonstrated that water ingress into the modular HTR will pose no grave problems to the reactor plant and its environment even if combinations of accidents are considered which have to be placed far into the hypothetical domain.