THE DESIGN OF THE ENHANCED GAS COOLED REACTOR (EGCR)

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Summary

The long-term interest in fast reactors continues, as always, to be for the best utilisation of fuel reserves. However, the need for such fuel utilisation is not pressing. The development of FR using liquid sodium as the coolant has established the system's viability but with some way to go to demonstrate high reliability of the current LMFR designs, and without an economic advantage over alternative established nuclear systems, there is no incentive to proceed to build. Now, the choice of coolant for the fast reactor is being reconsidered in the light of changes to the requirements and priorities that led, in the early days of fast reactor development, to the selection of sodium as the preferred fast reactor coolant. On this basis reconsideration has been given in the UK to gas cooled fast reactors.

A preliminary concept for the Enhanced Gas Cooled Reactor (EGCR) has been studied, based upon the developed technologies of the liquid metal fast breeder reactor (LMFBR) and the UK's Advanced Gas Cooled Reactor (AGR). EGCR is a carbon dioxide cooled fast reactor and comprises a single reactor with a thermal power of about 3600MW in a single pre-stressed concrete pressure vessel. Enhanced passive safety features are provided and a debris tray included.

The conceptual design and its principal features are described in this paper. The engineering studies to arrive at the conceptual design are summarised and the differences from the AGR reactor are highlighted. Considerable simplification is possible in comparison to the LMFBR and the AGR. The design is supported by the extensive and successful operation of the AGR's which now regularly achieve very high availability.

A thermal-hydraulic study has been carried out to settle the primary circuit parameters and operating limits. From the developed AGR technology the necessary roughening characteristics of the fuel pin cladding have been determined. The high burn-up, high damage-dose cladding material PE16 developed in the UK for LMFBR's can be adopted as the reference cladding material.

With MOX fuel EGCR has a very good core performance, and can achieve a breeding gain of over 0.2, a long operating cycle of 24 months, and a high burnup of 150GWd/t. The core design also offers considerable flexibility in safety, performance, and breeding or

burning characteristics compared to the LMFBR and is capable of accommodating a wide range of concepts from a high breeding core to a dedicated minor actinide-burning core.

Preliminary safety analysis confirms the good transient behaviour of the core during reactivity faults, depressurisation faults, and during decay heat removal. Similar safety provisions to the LMFBR can be adopted and a level of safety at least as good as current reactors can be anticipated. Unlike LMFBR, EGCR does not have a potentially rapid coolant phase-change driven reactivity fault, nevertheless, a debris tray is installed below the core inside the PCRV.

Preliminary costing studies show that EGCR can be competitive with LWRs. The EGCR concept also shows development potential for cost reduction and future requirements.