Linear Pulse Motor Type Control Element Drive Mechanism for the Integral Reactor

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ABSTRACT

The integral reactor SMART currently under development at Korea Atomic Energy Research Institute is designed with soluble boron free operation and use of nuclear heating for reactor start-up. These design features require the Control Element Drive Mechanism (CEDM) for SMART to have fine-step movement capability as well as high reliability for the fine reactivity control.

In this paper, design characteristics of a new concept CEDM driven by the Linear Pulse Motor (LPM) which meets the design requirements of the integral reactor SMART are introduced. The primary dimensions of the linear pulse motor are determined by the electro-magnetic analysis and the results are also presented. In parallel with the electro-magnetic analysis, the conceptual design of the CEDM is visualized and checked for interferences among parts by assembling three dimensional (3D) models on the computer. Prototype of LPM with double air-gaps for the CEDM sub-assemblies to lift 100kg is designed, analysed, manufactured and tested to confirm the validity of the CEDM design concept. A converter and a test facility are manufactured to verify the dynamic performance of the LPM. The mover of the LPM is welded with ferromagnetic material and non-ferromagnetic material to get the magnetic flux path between inner stator and outer stator.

The thrust forces of LPM predicted by analytic model have shown good agreement with experimental results from the prototype LPM. It is found that the LPM type CEDM has high force density and simple drive mechanism to reduce volume and satisfy the reactor operating circumstances with high pressure and temperature.

Key words: Integral Reactor, CEDM, Linear Pulse Motor