

Title: Simplifying MSR Start-up Controller with Burnable Poison Salts

Authors: ^aSam J. Root, ^bDakota Roberson, ^aMichael McKellar

^aDepartment of Nuclear Engineering & Industrial Management, University of Idaho, Idaho Falls, ID

^bDepartment of Electrical & Computer Engineering, University of Idaho, Idaho Falls, ID

Abstract:

Fission product neutron poisons present a challenge in the design of a nuclear reactor controller. When poisons build up over the first few days of operation, negative poison reactivity is gradually inserted; this must be counteracted by inserting positive control reactivity. As an alternative to gain-scheduling during this period of poison build-up, this paper investigates the use of burnable poisons in a molten salt microreactor to minimize the need for unity point drift to keep the reactor critical. A numerical solving script is used to identify possible burnable poison cocktails with transmutation effective half-lives similar to the fission-yield rate of fission product poisons. Through this methodology, it is proposed that a fluoride salt of gadolinium enriched in its 155 and 157 nucleon isotopes be added to fuel salt upon initial start-up to avoid the need for a start-up gain-schedule.