

In a net-zero carbon energy future, advanced nuclear reactors will help satisfy growing energy demand. Among promising advanced nuclear reactor concepts, [Molten Salt Reactors \(MSRs\)](#) have high potential due to high outlet temperatures, fuel utilization, and processing capabilities. While operating [MSRs](#), certain fission and transmutation products are controlled using fuel-salt processing. Traditionally, processing in [MSRs](#) is performed offline in batches – a portion of the fuel salt is (i) diverted from the main fuel-salt line, (ii) processed in isolation, and (iii) re-combined with the main fuel line. Instead of offline processing, online processing operates on the entirety of the fuel-salt. In offline processing, the equilibrium concentrations of products is limited by the portion of the fuel-salt diverted. However, in online processing, the equilibrium concentrations can be much lower as all of the fuel-salt is operated on. Through online processing, the lower concentrations extended component lifetime, improve neutron economy, and enable load following with dramatic power differentials. Our design uses the [Molten Salt Breeder Reactor \(MSBR\)](#) as a template and implements various elements to enable online processing and improve reactor performance. Through our design changes, we controlled the noble metal plate-out, increased thermal efficiency, removed fission gasses, and limited tritium levels.