

反应堆工程

密度锁启动特性实验研究及计算验证

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摘要 以基于密度锁的非能动余热排出系统 (PRHRS) 为研究背景, 实验验证了密度锁自平衡启动方案的可行性。结果表明: 主回路流量接近平衡流量启动PRHRS时, 密度锁内冷热流体温度分界面将在不平衡力作用下向上或向下移动, 减小或增大了余热排出回路重位压差, 使密度锁内冷热流体温度分界面在新的位置达到受力平衡, 最终实现密度锁的自平衡启动, 以及余热排出回路与主回路的隔离。依据一维连续性方程、能量方程及动量方程建立数学模型, 用Matlab语言编程, 对密度锁启动过程进行了数值模拟分析, 证明了密度锁自平衡启动方案合理、有效。计算值与实验值符合较好, 用该程序可较好地模拟密度锁自平衡启动过程中系统的瞬态运行特性。

关键词 [密度锁](#) [自平衡启动](#) [数值计算](#)

分类号

Experimental Study and Numerical Calculation on Density Lock for Self-Equivalence Startup

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Abstract Based on the passive residual heat removal system (PRHRS) with density lock, the validity of self-equivalence startup for density lock was proved by experimental study. It is shown that the cold-hot liquid interface will move up or down because of the unbalance pressure between the PRHRS and primary loop during the startup process when the primary mass flow is close to the balance flow, which will make the gravity pressure difference in PRHRS become lower or higher, and the cold-hot liquid will be balance in new position. Finally the density lock starts up by self-equivalence, and PRHRS is separated from the primary loop. The Matlab code was used to analyze the startup characteristic of the density lock, and the process of self-equivalence startup for density lock was proved reasonable and effective. The numerical calculation results agree well with the experimental data, and the code is well to analyze the transient phenomenon during the self-equivalence startup process for density lock.

Key words [density](#) [lock](#) [self-equivalence](#) [startup](#) [numerical](#) [calculation](#)

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