



# **ACR-700 Coolant Void Reactivity**

**Ben Rouben**  
**Manager, Reactor Core Physics Branch**  
**Manager, ACR Physics**  
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# Design for Void Reactivity

- **The safety objective for the choice of the void reactivity in the ACR-700 is to provide a good balance of nuclear protection between loss-of-coolant accidents (LOCAs) and fast-cooldown accidents.**
- **The requirement stemming from this objective is to keep the power transient before reactor trip mild for all design basis accidents, including LOCA or steamline breaks.**



# Checkerboard Void Reactivity

- In the ACR-700, the design of the reactor coolant system consists of two passes in a figure-of-eight, with coolant flowing in checkerboard fashion in opposite direction in neighboring channels.
- In a loss-of-coolant accident (LOCA), one pass will generally void faster than the other.
- Different coolant density in neighboring channels leads to spectrum heterogeneity, which can result in a “checkerboard” void reactivity which can be different from the reactivity generated by the same average voiding but distributed uniformly in the core.
- Note that the “extreme” case of 100% coolant density in one pass, 0% density in the other does not physically occur.



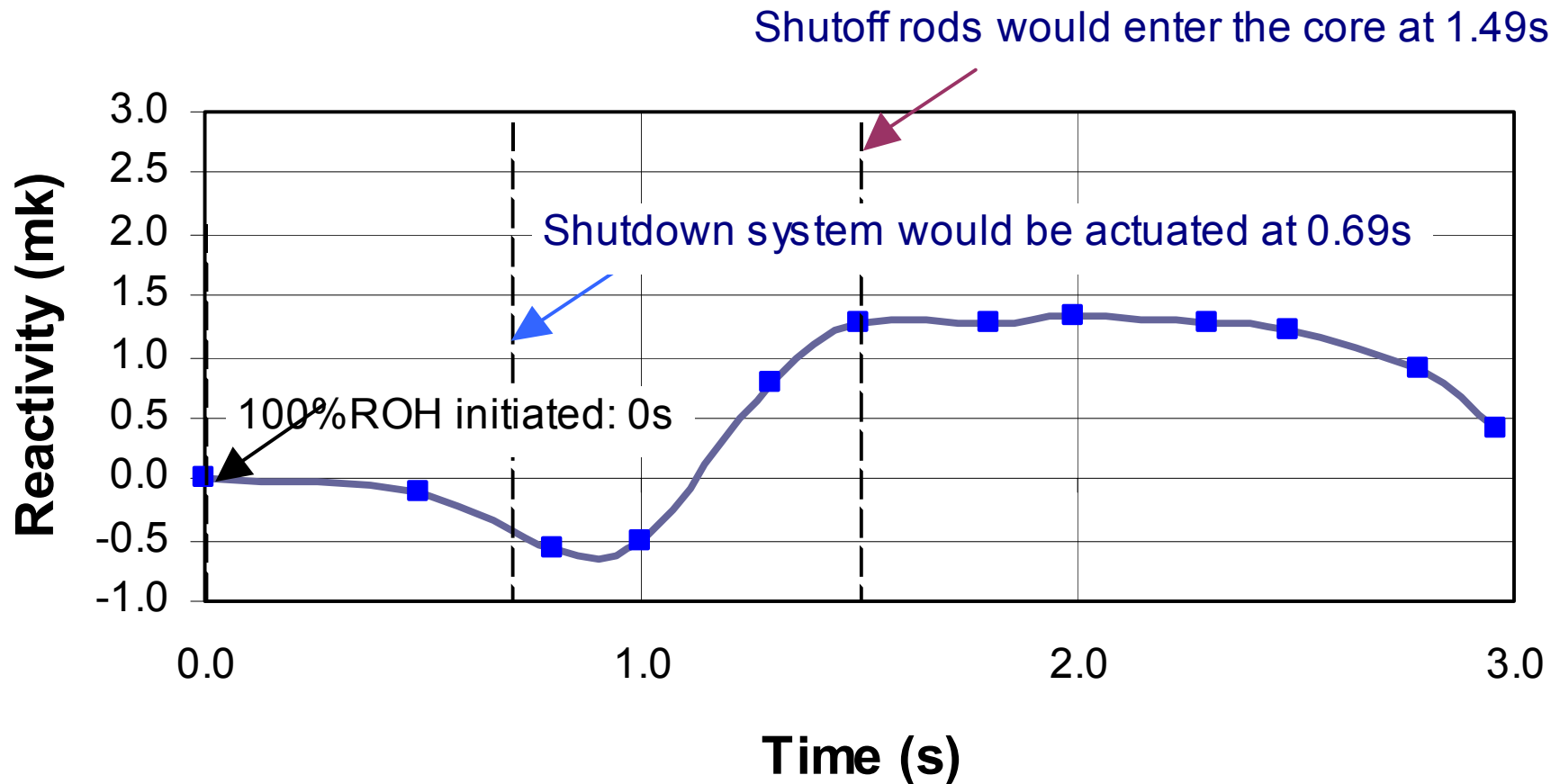
# LOCA Analysis

- The next two slides show our current results for:
  - the system reactivity in the first 3 seconds of a 100% Reactor-Outlet-Header-Break Large LOCA (void reactivity was calculated with MCNP)
  - the resulting core power transient without shutdown-system action.



# PRELIMINARY

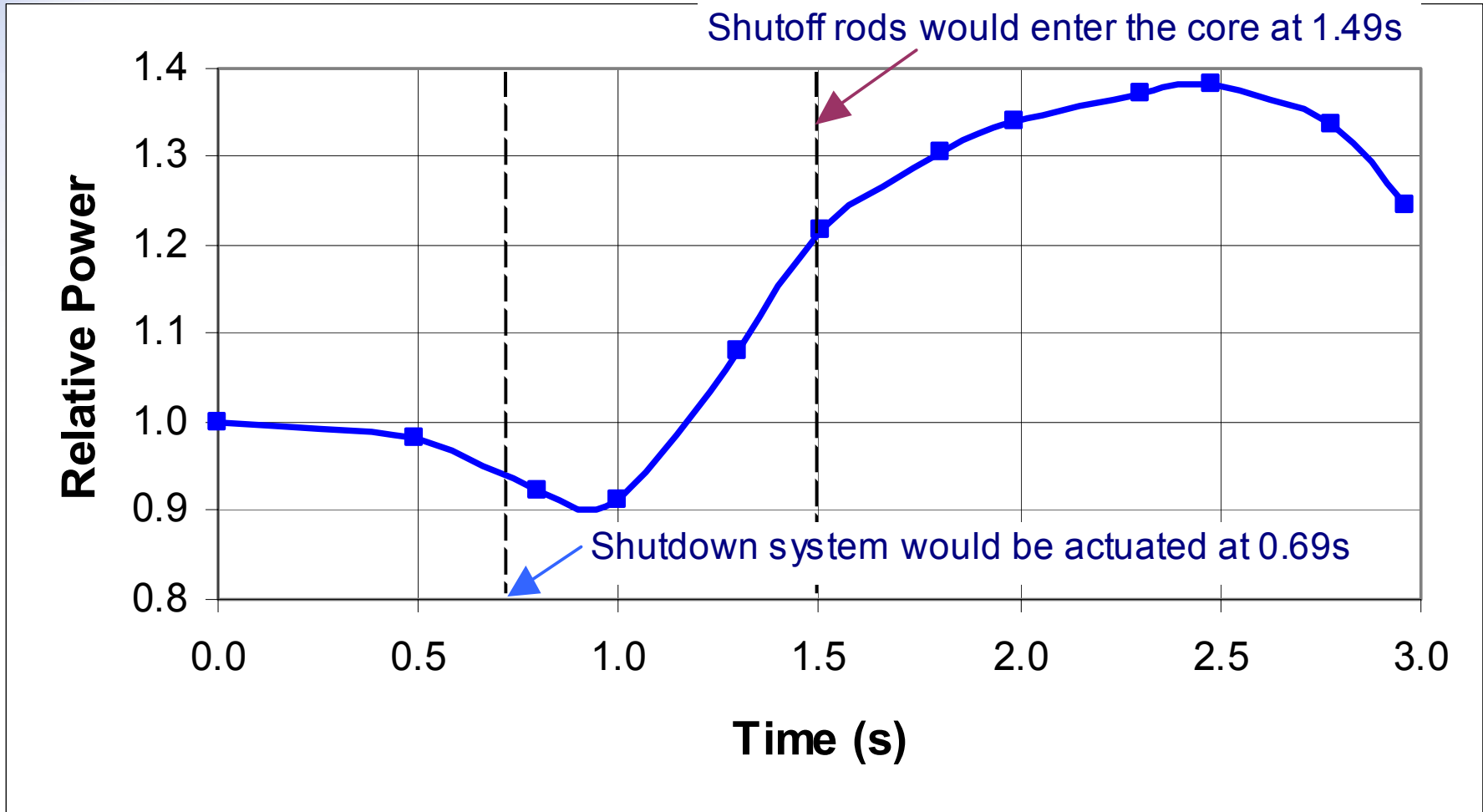
## 100% Reactor-Outlet-Header Break: Reactivity Transient





# PRELIMINARY

## 100% Reactor-Outlet-Header Break: Core-Power Transient





# Conclusions

- **MCNP gives us a good handle on the physics of checkerboard voiding.**
- **We are working to further develop other codes in our toolset to enhance their capability to model heterogeneity.**
- **The effect of checkerboard voiding in a LOCA is a mild power transient.**
- **The power transient is self-limiting and turns over within a few seconds.**



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