3. NUREG-1 537, Part 1, Section 4.6 recommends that an application should justify the assumptions and methods, and validate results. Discuss the BLOOST code transient analysis in additional detail including the quantitative values of the major parameters that enter the analysis. This should include the flux peaking factors used to represent the hottest fuel rod.

Please see the attached "BLOOST Code Validation Report" which provides more detail regarding the assumptions and methods of the BLOOST code. The "BLOOST Code Validation Report" also discusses a benchmarking study performed at the Sandia TRIGA Annular Core Pulse Reactor (ACPR).

Report Redacted due to
General Atomics requirement
"GA proprietary information"

5. NUREG-1537, Part 1, Section 13.1.2 provides guidance to the licensee to identify all potential methods whereby excess reactivity could be accidentally inserted into the reactor to cause an excursion. Please discuss these potential methods and evaluate those found to be credible. At a minimum, analyze a ramp insertion of reactivity of the most reactive control rod (not the transient rod) at its maximum insertion rate, starting from the most limiting power level. Evaluations should include discussion of the model, assumptions, and calculation results.

A ramp insertion of reactivity resulting from the withdrawal of a control rod may be caused by operator error or instrument malfunction. In order to determine power as a function of time during a linear reactivity increase, a single delayed neutron group model with a prompt jump approximation is used:

$$\frac{P(t)}{P_o} = (e^{-\lambda t})[\frac{\beta}{\beta - \gamma t}]^{(1+\frac{\lambda\beta}{\gamma})}$$

where P(t) is the power at time t, P_o is the initial power level, β is the total delayed neutron fraction (0.007), λ is the one group decay constant (0.405 sec^{-1}), t is time, and γ is the linear insertion rate of reactivity.

Control rod data for the AFRRI TRIGA reactor is shown in Table 1.

Table 1. Control rod data for the AFRRI TRIGA reactor in core position 500.

Rod	Total Worth ($)	Total Withdrawal Time (sec)	Average Insertion Rate ($/sec)
Transient	2.89	29.0	0.0997
Safety	2.65	39.4	0.0673
Shim	2.74	36.1	0.0760
Regulating	3.01	34.8	0.0865

For the reactivity insertion accident, starting power levels of 100 W and 1.0 MW were considered. The SCRAM set point was assumed to be 1.09 MW, and a 0.5 second delay time was assumed between reaching the SCRAM set point and actual release of the control rods. In addition to the single control rod withdrawal scenario, the simultaneous withdrawal of all four control rods was also analyzed as a worst case.

Table 2. Summary of ramp insertion of reactivity for AFRRI TRIGA control rods.

Rod Withdrawn	Starting Power	Time until Release of Control Rods (sec)	Total Reactivity Inserted at SCRAM ($)
Transient	100 W	9.77	0.98
	1.0 MW	1.23	0.13
Safety	100 W	13.5	0.92
	1.0 MW	1.53	0.11
Shim	100 W	12.23	0.93
	1.0 MW	1.43	0.11
Regulating	100 W	10.99	0.95
	1.0 MW	1.32	0.12
All Rods	100 W	3.51	1.16
	1.0 MW	0.74	0.25

In all cases, including the simultaneous withdrawal of all control rods, the total reactivity insertion is well below the pulse reactivity insertion limit of $3.50 (2.45% Δk/k), thus safety of the reactor would not be adversely impacted.

6. NUREG-1537 Part 1, Section 13 provides guidance to the licensee to discuss potential accident scenarios. Section 13.1.5 of the SAR presents the results of an analysis of a reactivity insertion of $0.51. Justify the magnitude of this assumed reactivity insertion in comparison with the maximum reactivity insertion associated with any single experiment.

The following analysis will replace the reference to a reactivity insertion of $0.51 of the SAR:

The failure of an experiment or experiments could result in instantaneous insertion of reactivity. The worst possible case would be the prompt addition of $3.00 (2.1% Δk/k) within the reactor core. The Technical Specifications establish that the sum of the absolute reactivity worths of all experiments in the reactor and in the associated experimental facilities shall not exceed $3.00 (2.1% Δk/k). The instantaneous insertion of $3.00 (2.1% Δk/k) to the reactor core as a result of a worst case reactivity insertion is bounded by the analysis of the $3.50 (2.45% Δk/k) pulse limit and would not result in any adverse safety conditions within the AFRRI TRIGA core.