Zachary M. Prince
Department of Nuclear Engineering
Texas A&M University
College Station, TX 77843-3133, USA
phone: (360) 362 6622
e-mail: zachmprince@tamu.edu

April 5, 2018

Professor Sara A. Pozzi
Editor,
Elsevier Annals of Nuclear Energy

Dear Professor Pozzi,

Please find attached a copy of our manuscript titled "Multiphysics Reactor-core Simulations Using the Improved Quasi-Static Method" for submission to the *Annals of Nuclear Energy*.

In this paper, we revisit the improved quasi-static method (IQS) for its application to high order time discretizations and temperature feedback dynamics. We derive the IQS and IQS predictor-corrector method (IQS-PC) with the semi-analytical treatment of delayed neutron precursors and adiabatic heat-up. Temperature computation and feedback are treated on a separate time scale from shape and amplitude to increase the efficiency of nonlinear quasi-static process.

We show numerical results from four different test cases where we compare error from IQS computation and typical implicit discretization of the flux equation. A one-dimensional test was constructed to analyze error and nonlinear iteration convergence for IQS with up to fourth-order backward-difference-formulae discretization. IQS was applied to the TWIGL benchmark to show its performance with step doubling time adaptation. Analysis of the quasi-static treatment of temperature feedback are shown with results from the LRA benchmark and a test case from a model of the Transient Reactor Testing Facility.

IQS and IQS-PC were implemented into the MOOSE-Rattlesnake framework at Idaho National Laboratory in order to compute the results from the multi-dimensional examples.

Thank you for considering this manuscript for publication in the *Annals of Nuclear Energy*.

Best regards,

Zachary M. Prince, Jean C. Ragusa