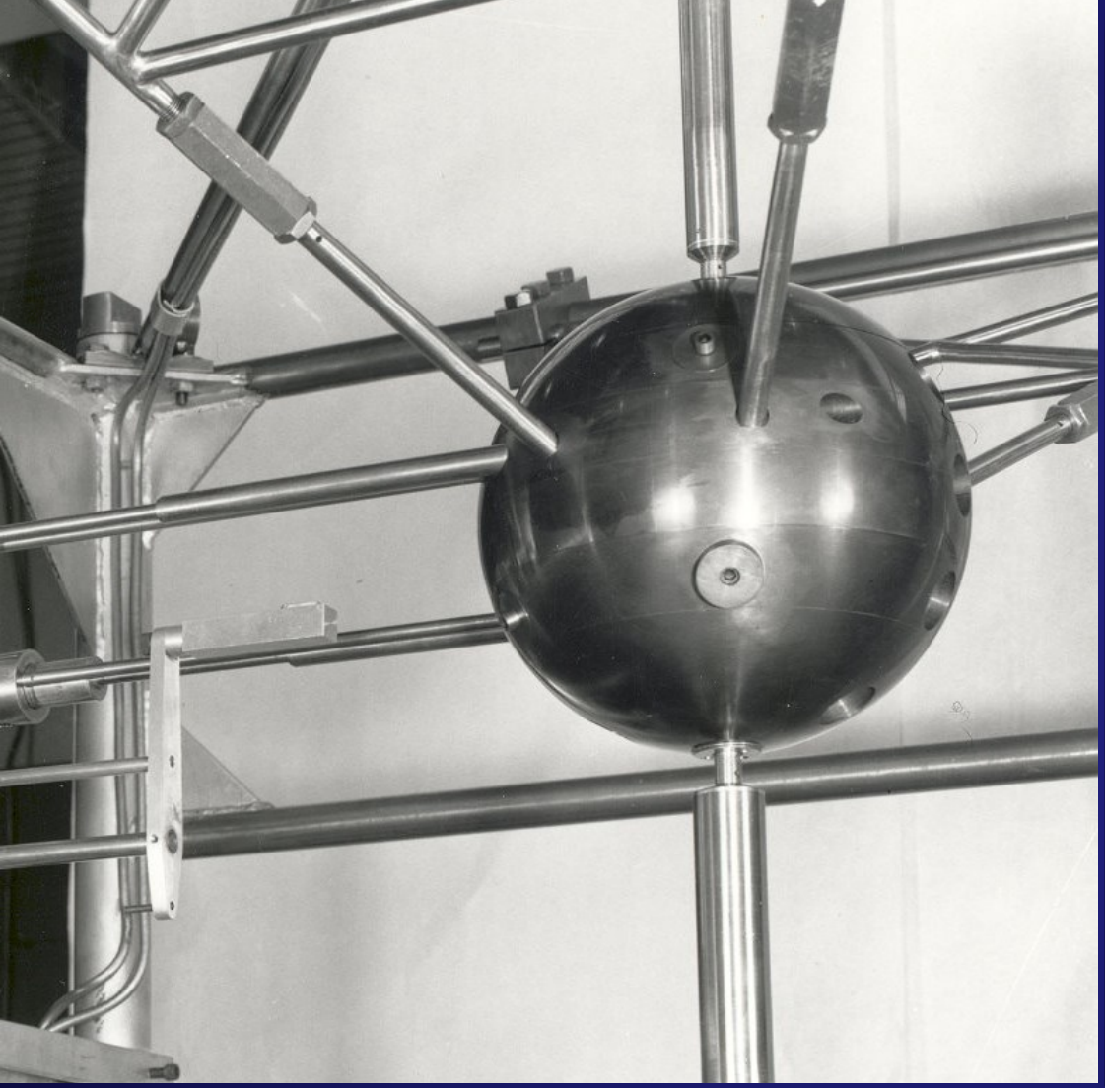

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Optimization of Binning Parameters in the Feynman Variance-to-Mean Method for Delayed Neutron Reinterrogation

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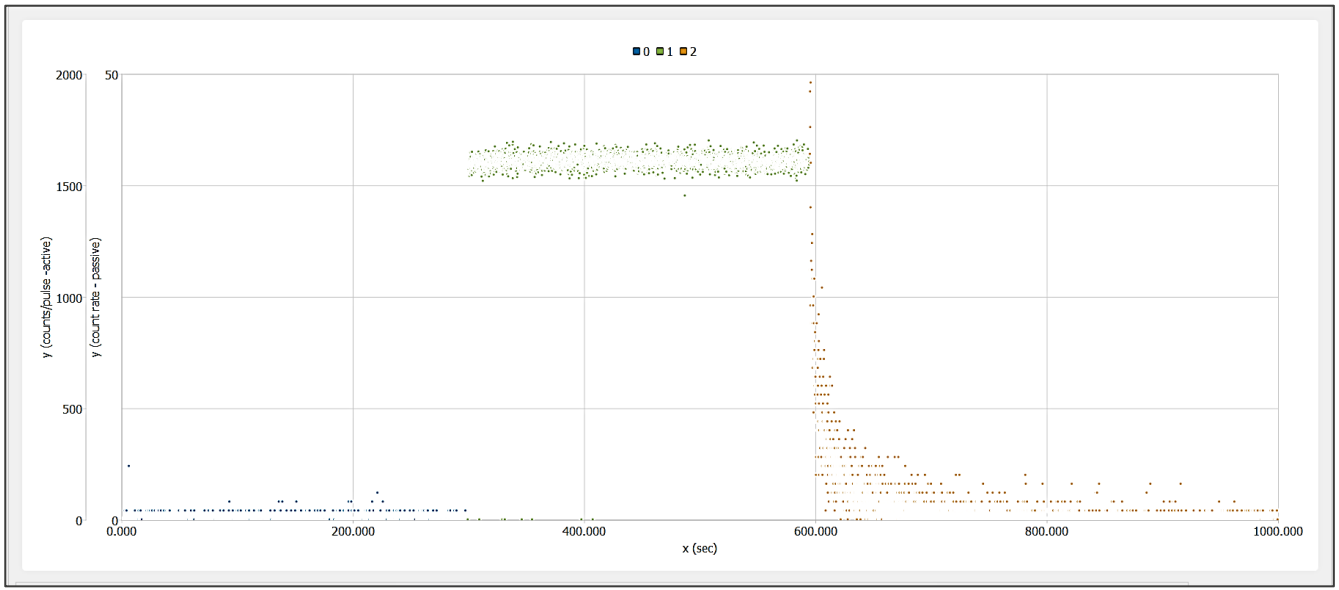
ANS Winter 2019

Personal Background

- **Educational Background**
  - University of Michigan
    - BSE in Nuclear Engineering, 2018
  - University of California, Berkeley
    - PhD student in Nuclear Engineering
- **Los Alamos National Laboratory**
  - NEN-2
  - Bill Myers
- **Research**
  - Optimizing parameters to use the Feynman variance-to-mean method for delayed neutron reinterrogation

Overview

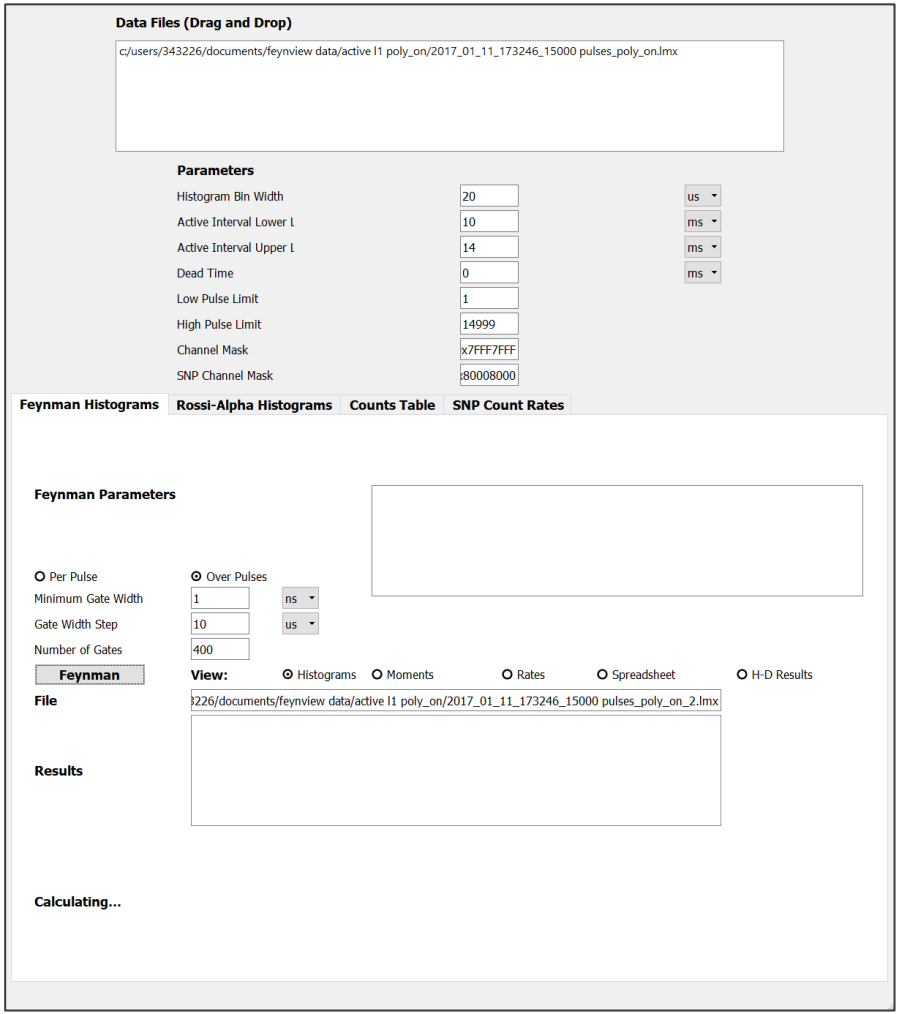
- **Delayed Neutron Reinterrogation**
  - Use pulsed neutron generator to activate material
  - Daughter products become delayed neutron precursors
  - Delayed neutrons re-interrogate material, allowing for analysis between pulses



Research Objectives

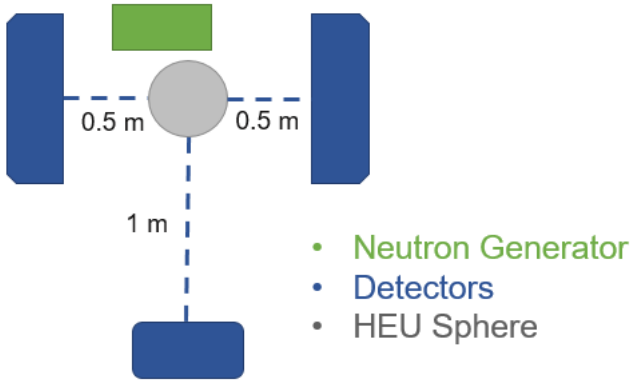
Testing FeynView

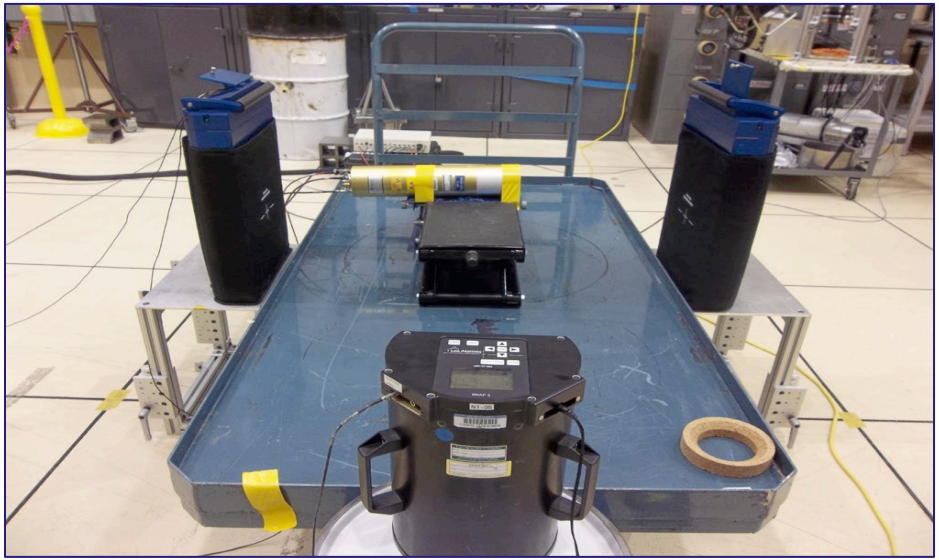
- Active interrogation data analysis software
- Writing user manual
- Determining optimal input parameters to allow for faster, more accurate determination of presence of SNM



Experimental Setup

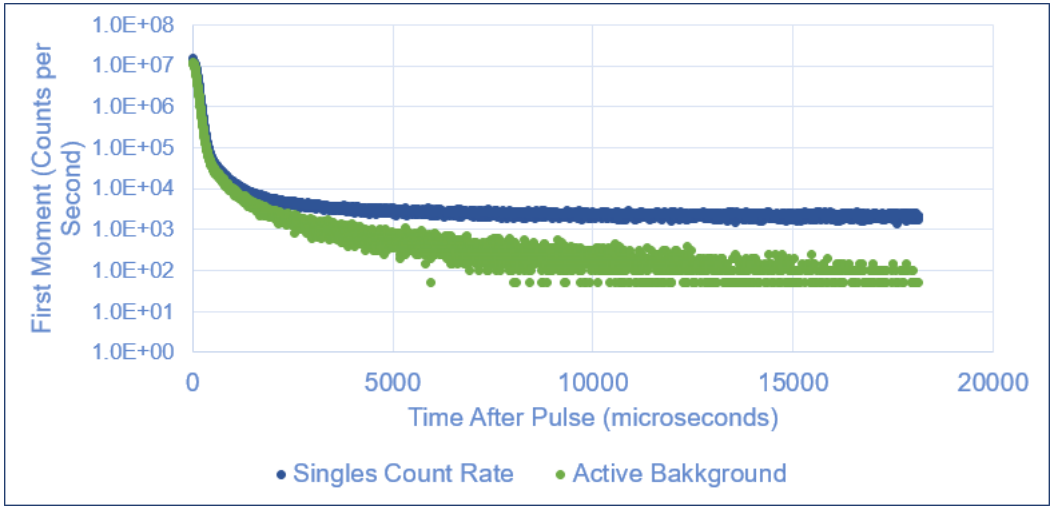
- Two NoMAD detectors 50 cm away from the SNM
- One SNAP III detector 100 cm away from
- Setup located 67 cm above the ground
- a Thermo Fisher P211 pulsed 14 MeV neutron generator (1E6 neutrons per pulse and 50 Hz) directly above SNM
- A 21.8 kg metal sphere of HEU (93 weight percent) assembled from the Rocky Flats (RF) uranium hemi-shells 3-30





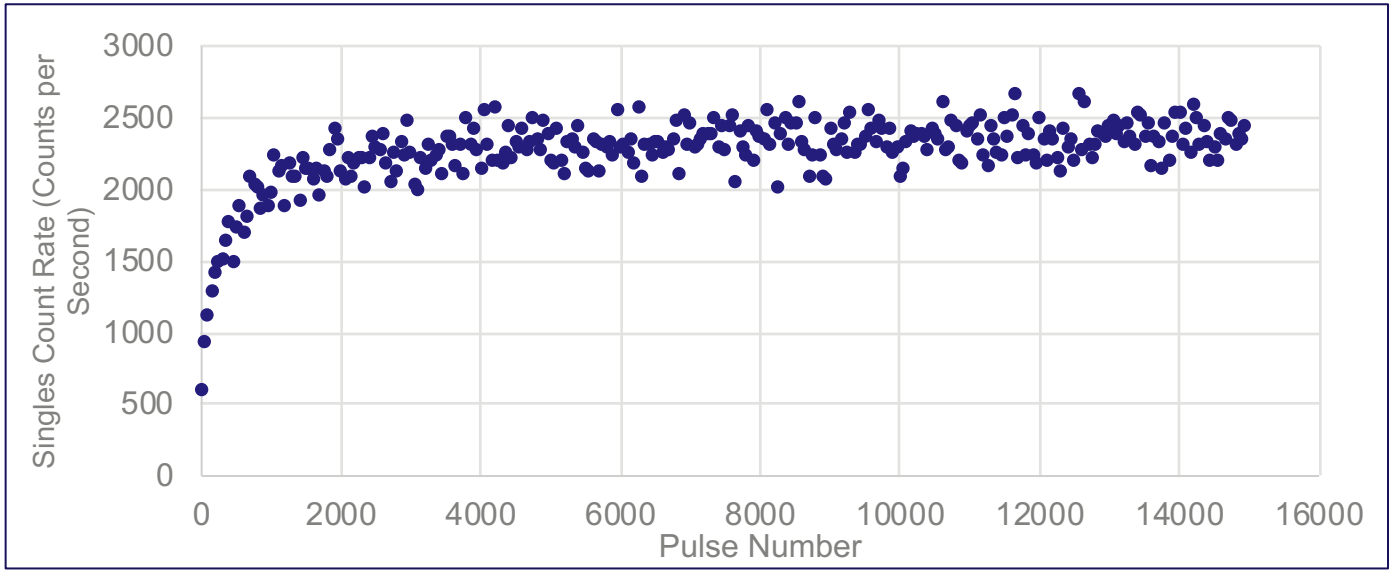
Research Approach

- **Produce Feynman histograms sequentially**
  - Varied active interval lower and upper limit used by 2 ms
    - Interval range from 0 to 18 ms to observe potential impact on rates and multiplicity
  - Observed count rate as a function of pulse to determine how many pulses are required to build up to steady state



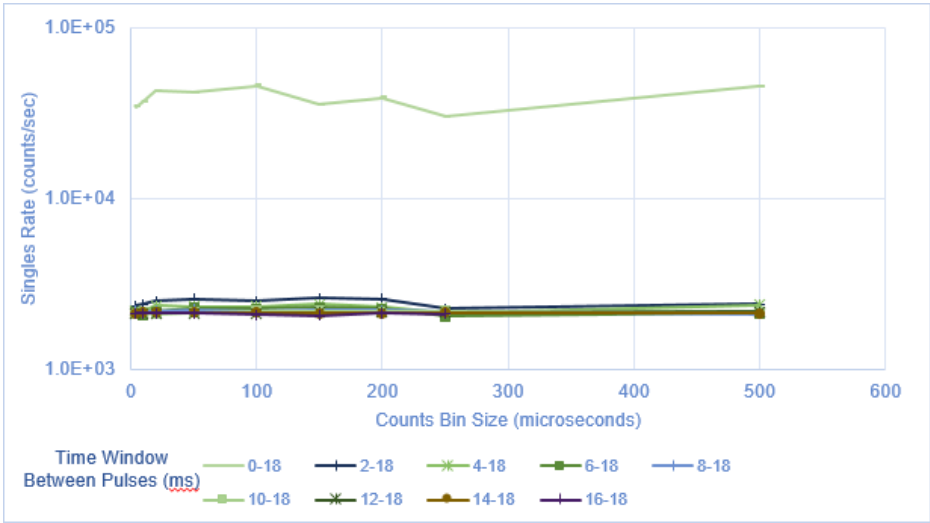
Results-Initial Pulse Used

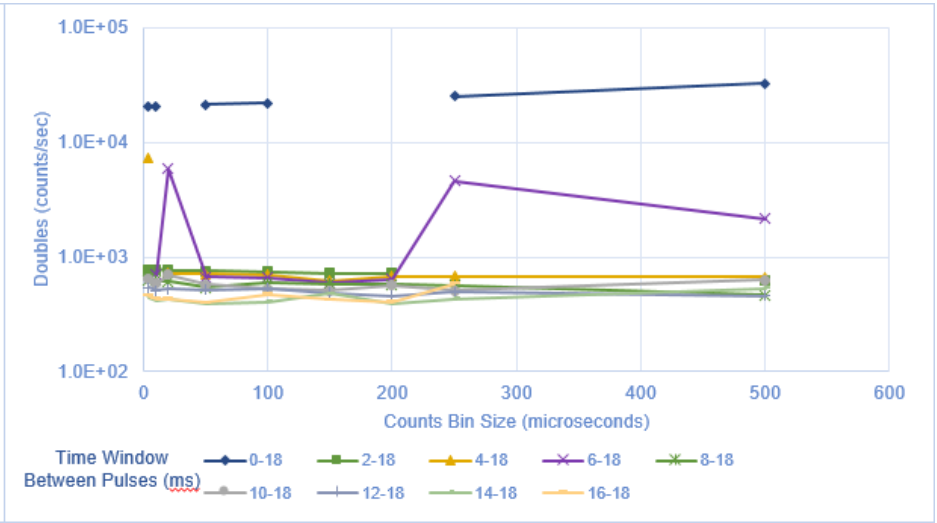
- To prevent biasing the results low, initial pulses before buildup has reached “steady state” need to be removed from calculations
- Depending on specific fit, near steady state precursor population requires wait time of 1500 to 2000 pulses



Results – Active Interval Binning

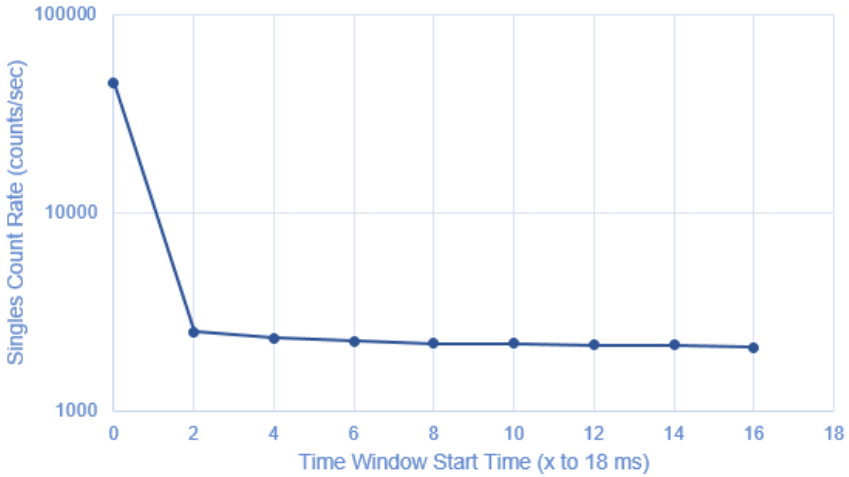
- Subdivision of counts into active interval bins has negligible effects on result
  - Minor differences due to bin sizes not perfectly matching with time window

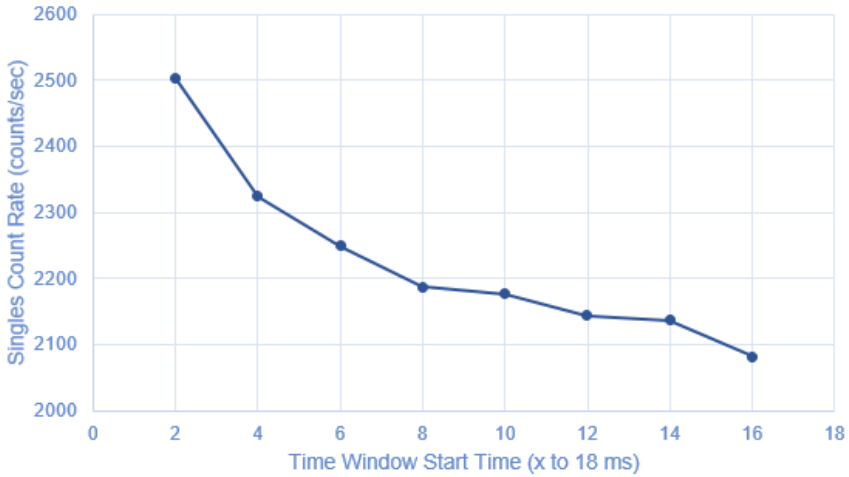




Results – Time Window

- To decrease noise from pulse die-away, data from the initial x milliseconds is neglected
- The first 6-8 ms have too large of variance, indicating noise from the pulse





Conclusions & Future Work

- For 50 Hz pulses:
  - Neutron generator is difficult to distinguish from HEU source within 6-8 ms of each pulse
  - Buildup to steady state precursor population requires waiting period of 1500 to 2000 pulses
  - Subdivision of counts into active interval bins has negligible effects on result, as expected

- Future Work
  - Determine whether any of these factors have effects on multiplicity
  - Determine the minimum time required to differentiate SNM from dummy sources
  - Test software using different source and neutron generator frequencies

Acknowledgements

- Jesson Hutchinson
- John Determan
- William Myers

- This work was supported in part by the DOE Nuclear Criticality Safety Program, funded and managed by the National Nuclear Security Administration for the Department of Energy.