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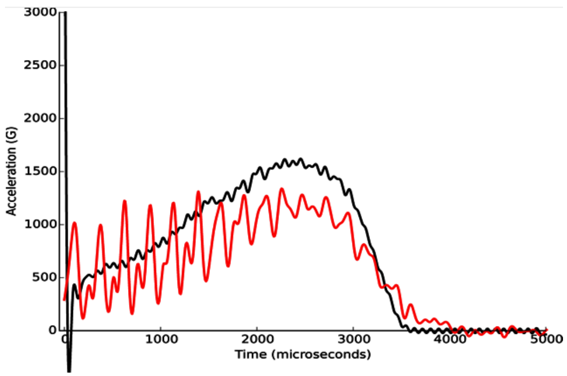

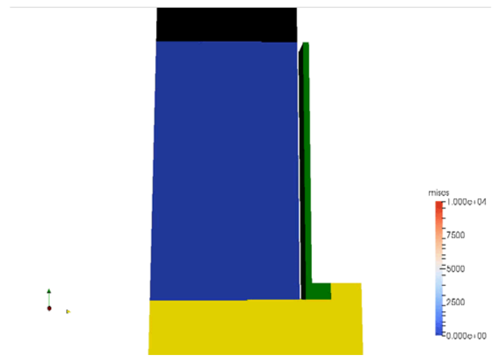

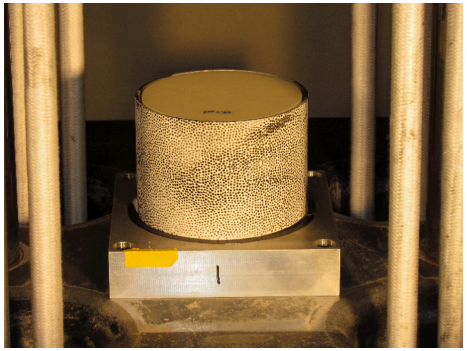

Validation of the TufFoam Material Model

Nick Kerschen (Mentor: Chris Hammetter)

1554 Intern Technical Exchange

7/23/2015

U.S. DEPARTMENT OF ENERGY

NNSA National Nuclear Security Administration

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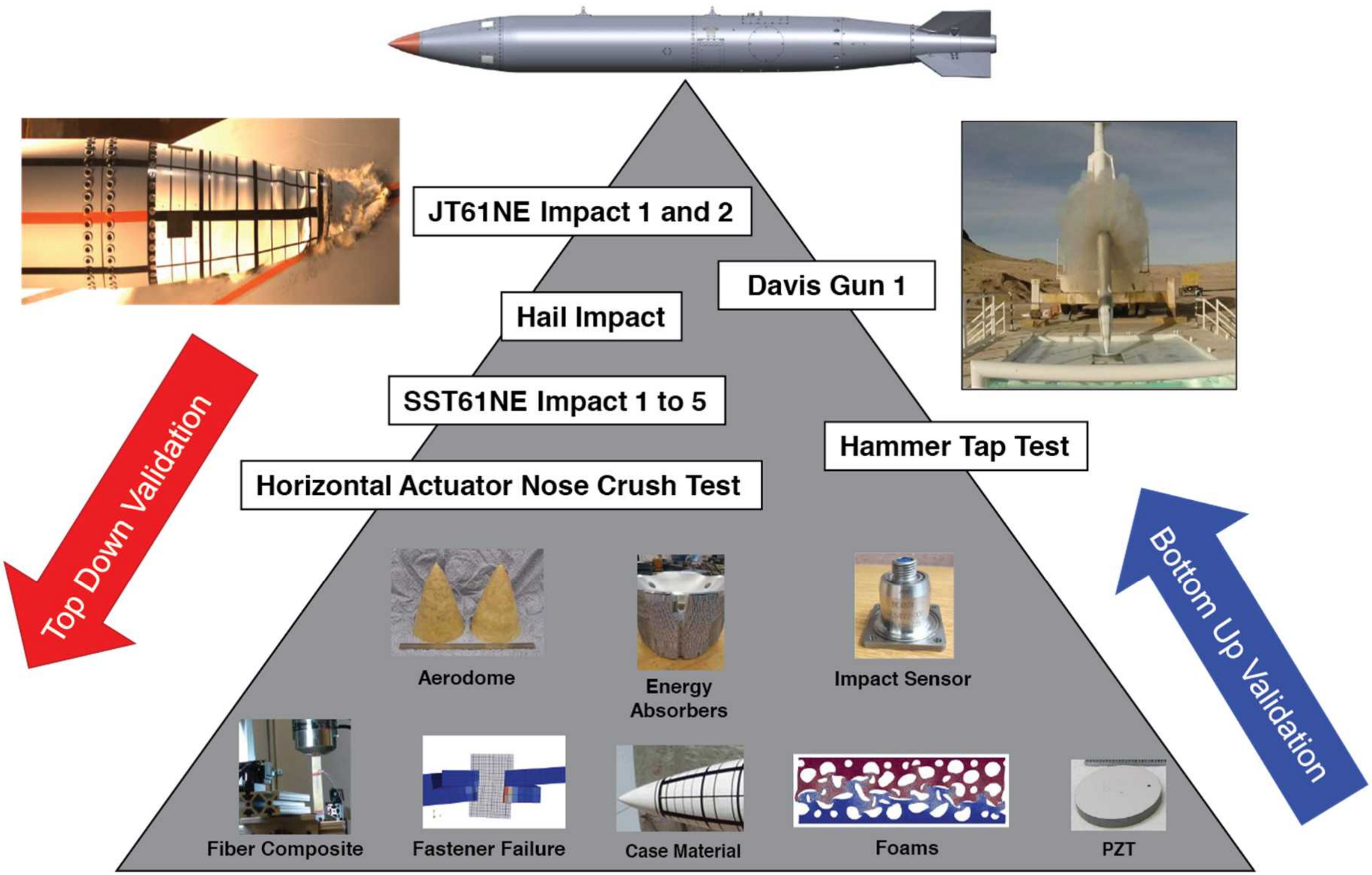
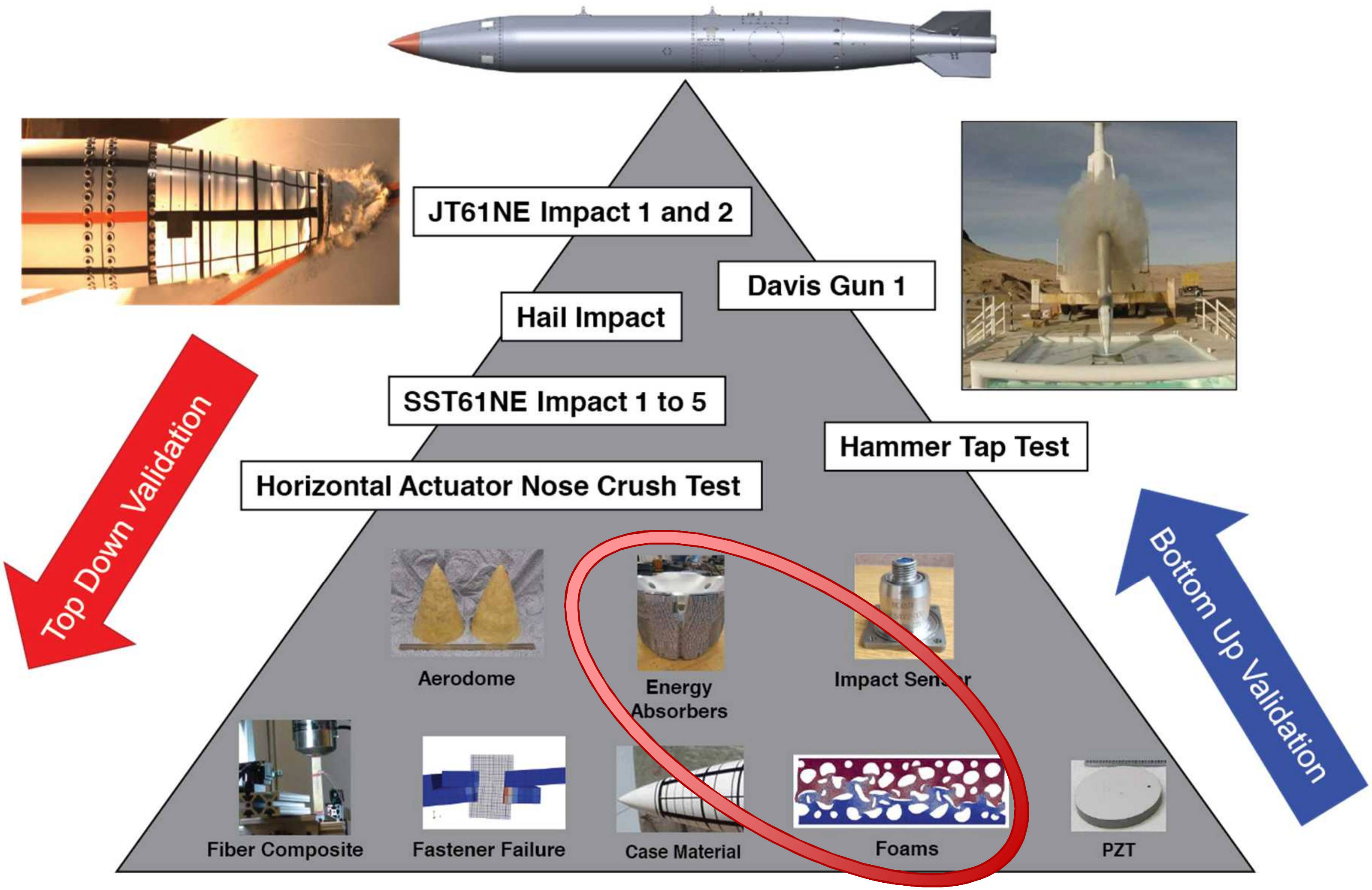
Motivation


JT61NE Impact 1 and 2
Davis Gun 1
Hail Impact
SST61NE Impact 1 to 5
Hammer Tap Test
Horizontal Actuator Nose Crush Test
Top Down Validation
Bottom Up Validation
Aerodome
Energy Absorbers
Impact Sensor
Fiber Composite
Fastener Failure
Case Material
Foams
PZT

Motivation



JT61NE Impact 1 and 2
Davis Gun 1
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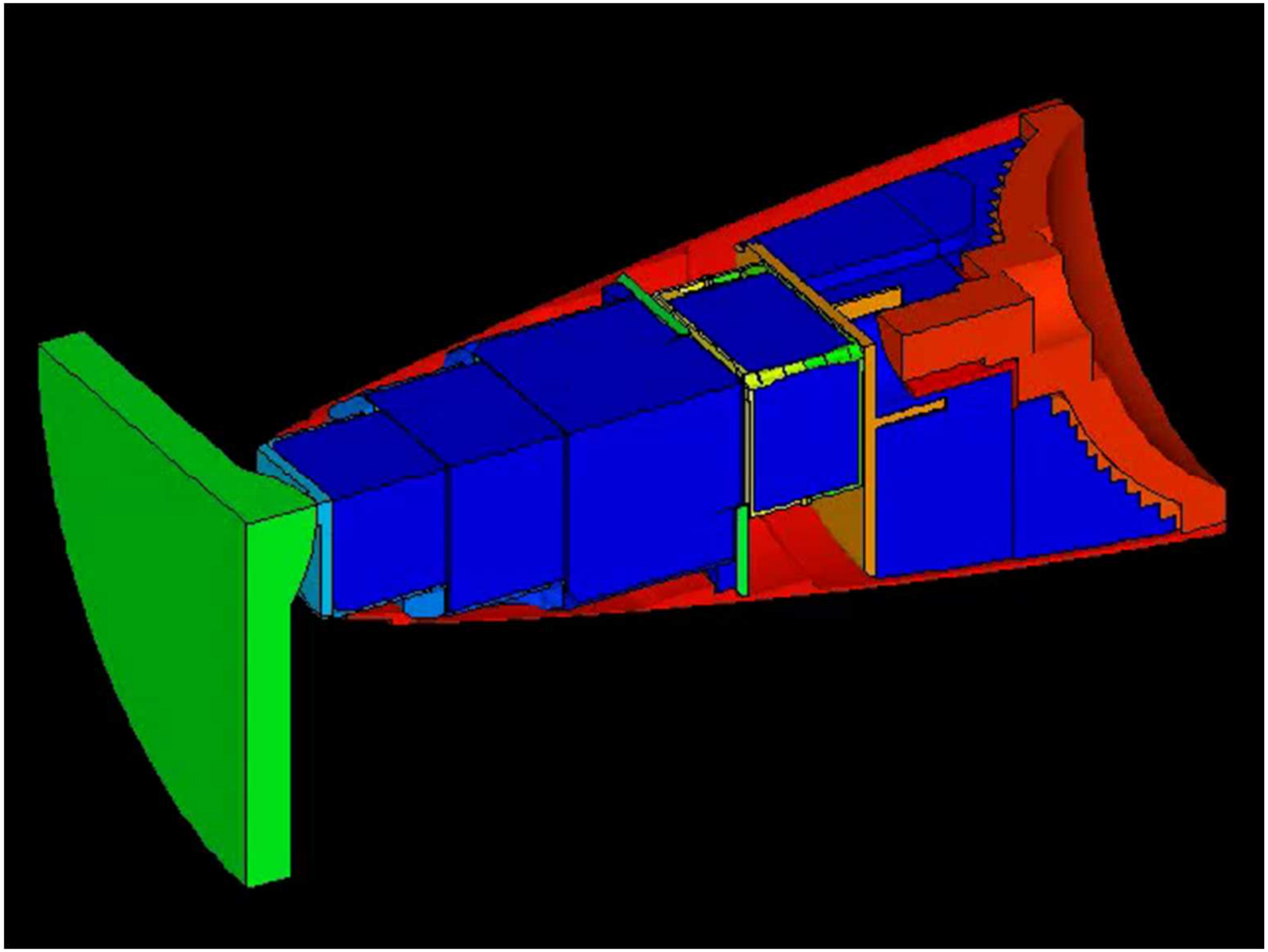
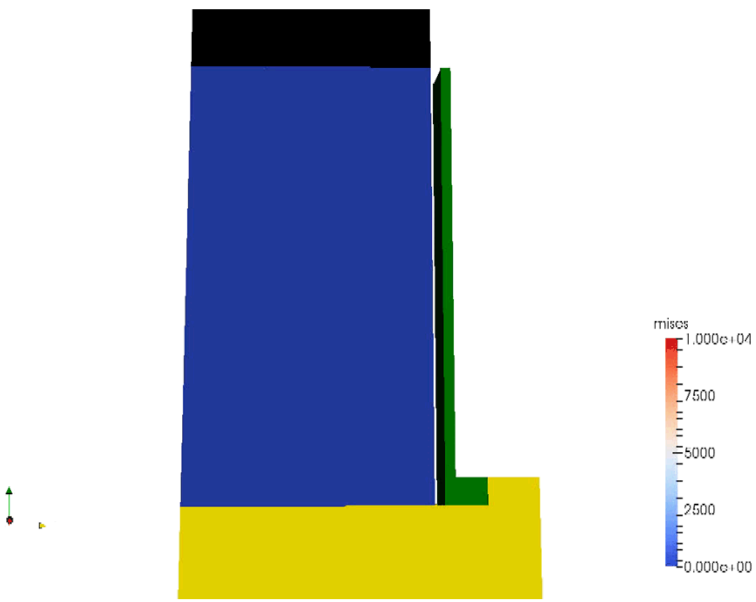
Common Radar Nose Model



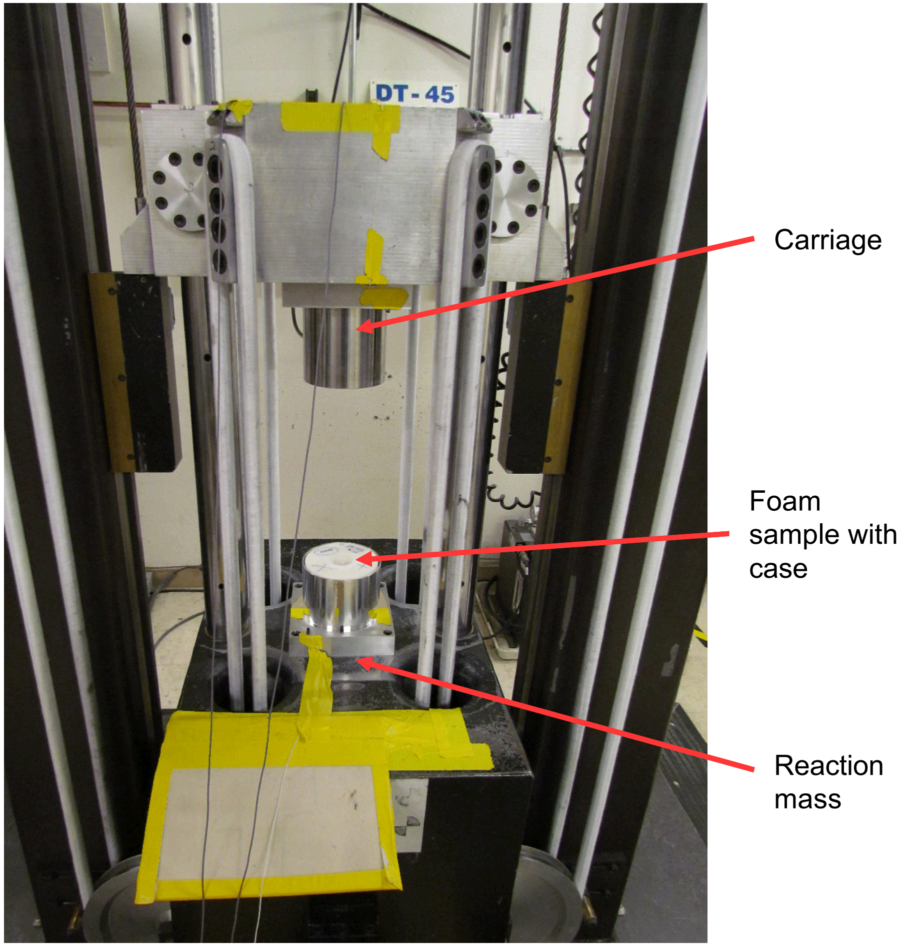
Problem Statement



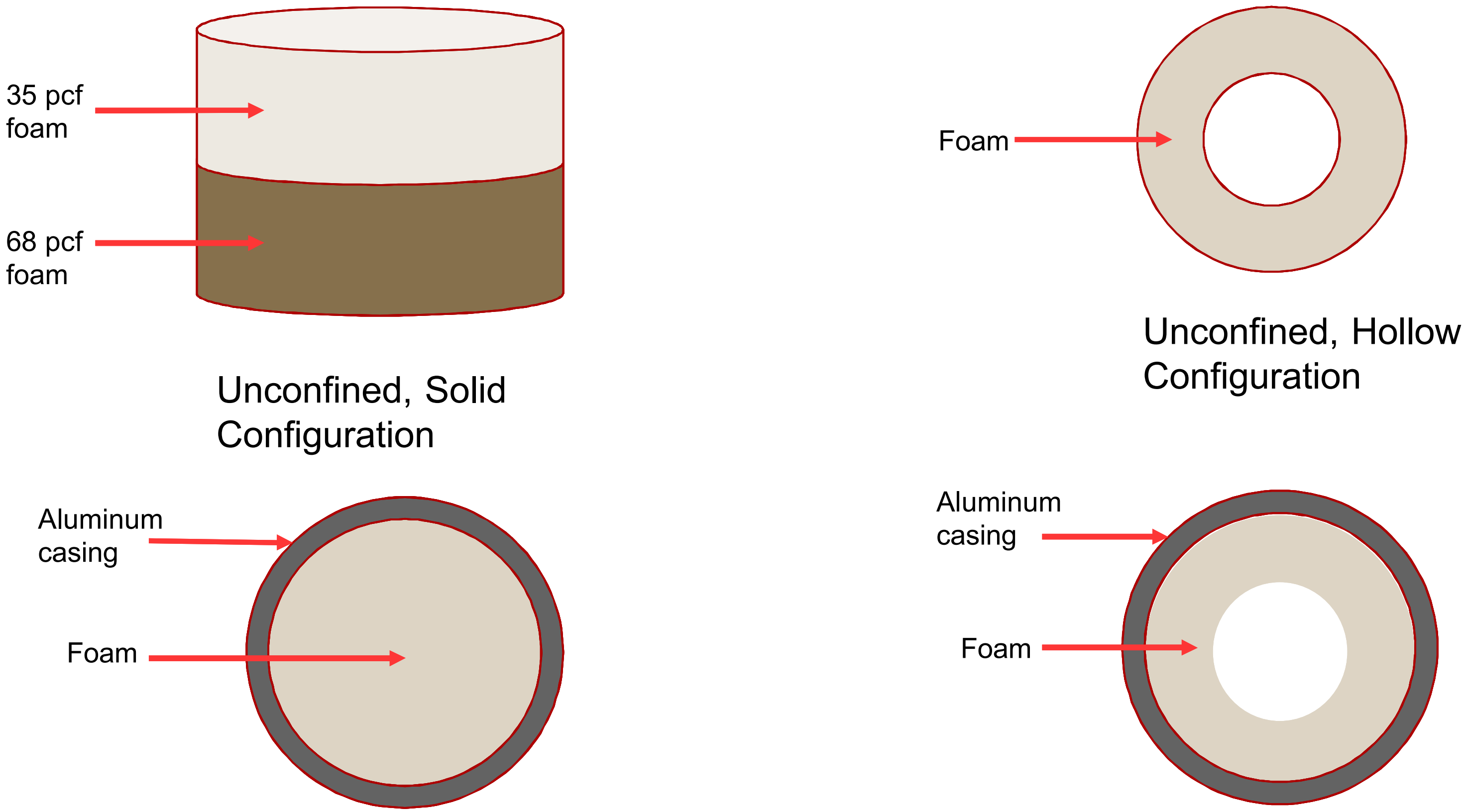
- To ensure a safe weapon and uphold “Always, Never” criteria, accurate knowledge about how the weapon will act in various scenarios is crucial
- Simulations are vital since we want to avoid testing a full weapon system
- Accurate foam model needed for full weapon nose cone model simulation

Experimental Testing

- Many drop table tests were run with different configurations and used as validation experiments
- Use of quasi-static experiments and simulations to calibrate foams



Test Configurations



Unconfined, Solid Configuration

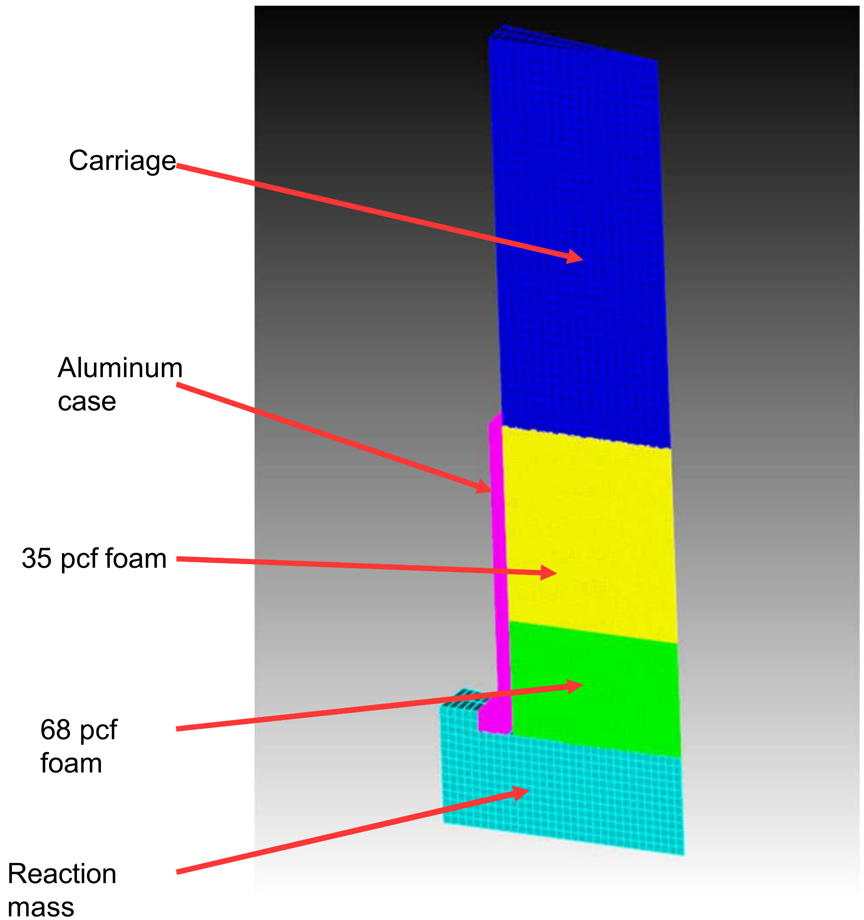
Unconfined, Hollow Configuration

Confined, Solid Configuration

Confined, Hollow Configuration

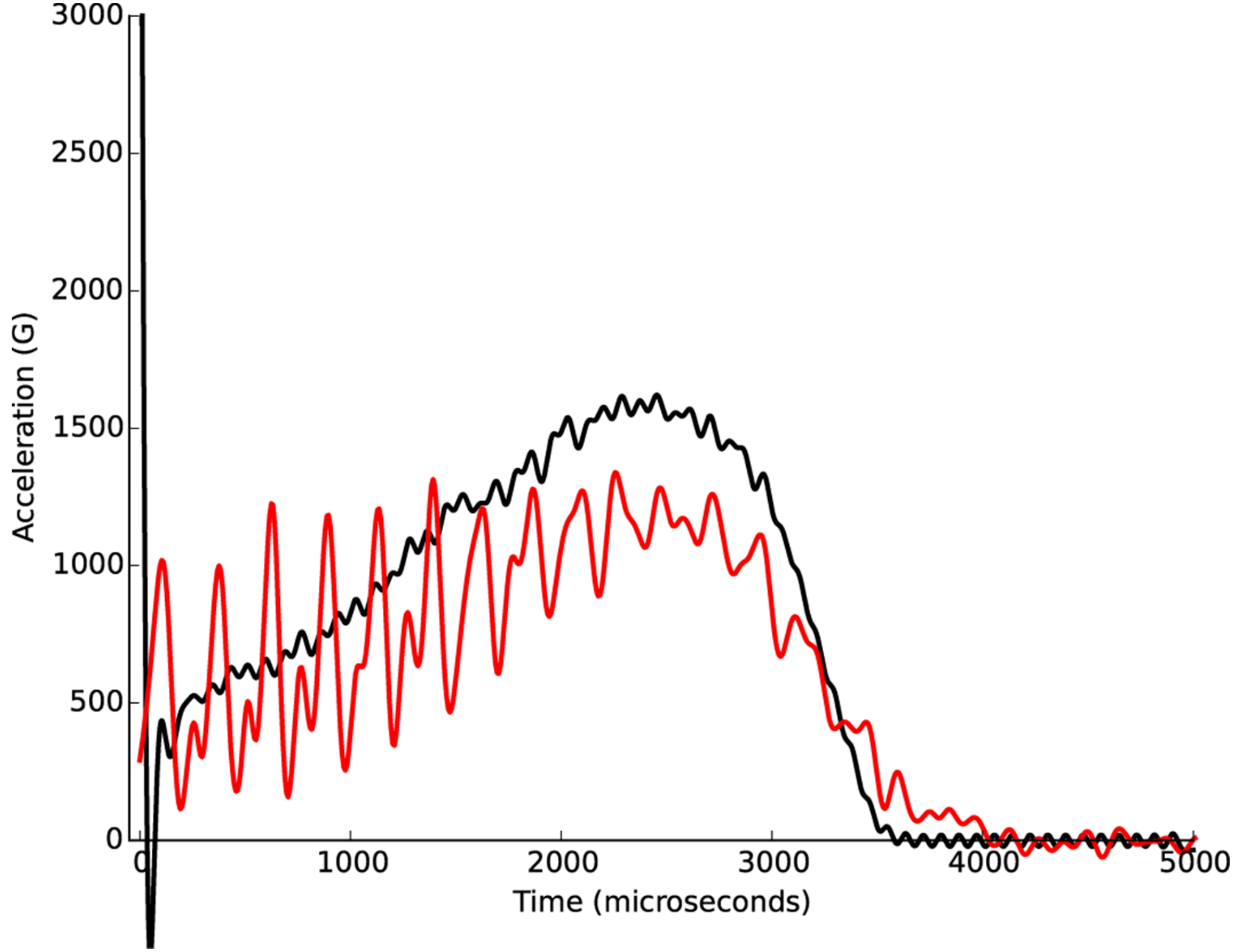
- All configurations were simulated at 23°C and 80°C.

Drop Table Model

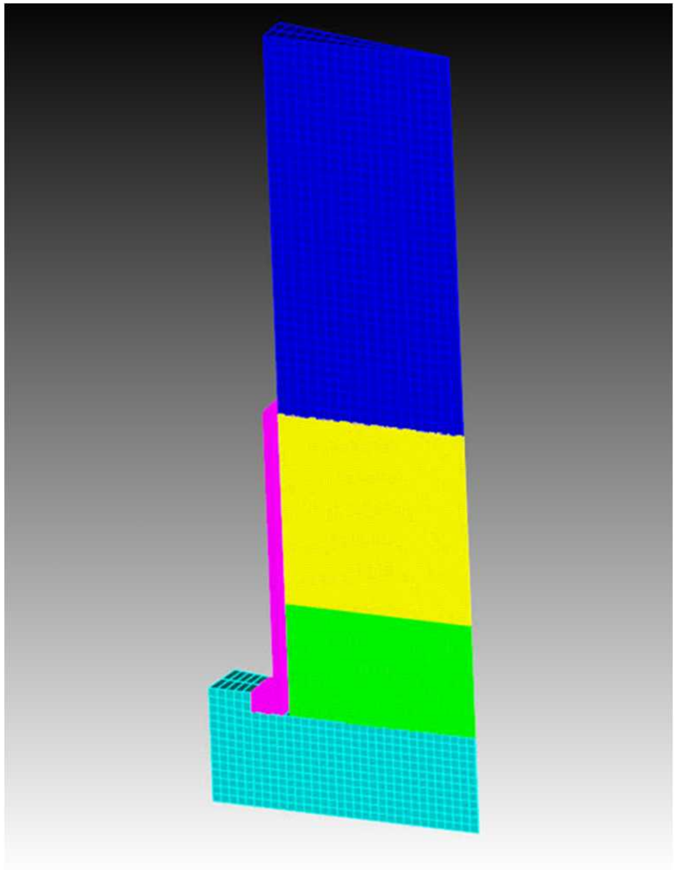


- In addition to making changes based on test configuration we also updated both 68 pcf TufFoam and Aluminum models, along with reaction mass representation
- To compare simulation to experiment we used carriage and reaction mass accelerations

Original Model

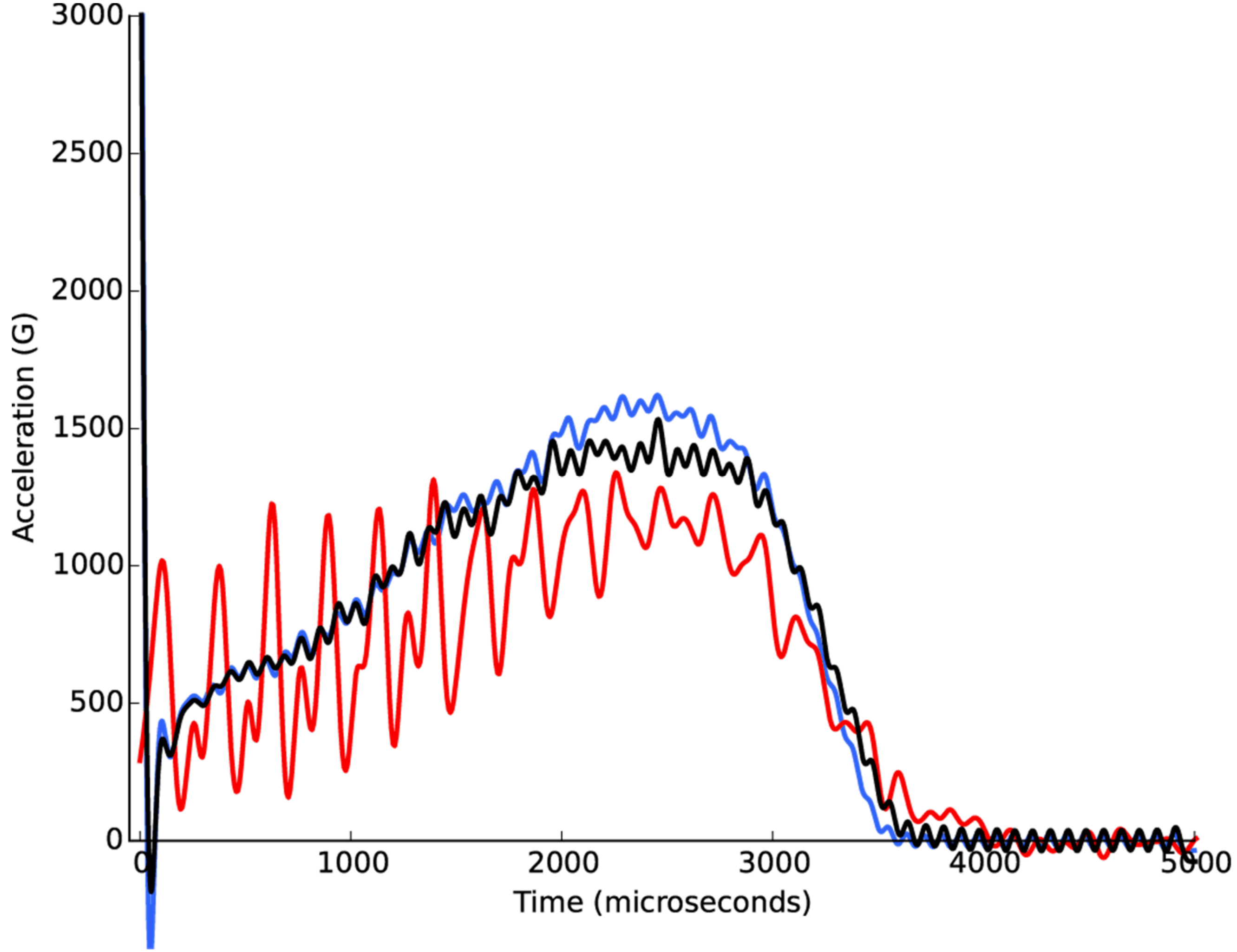


Removal of Reaction Mass B.C.

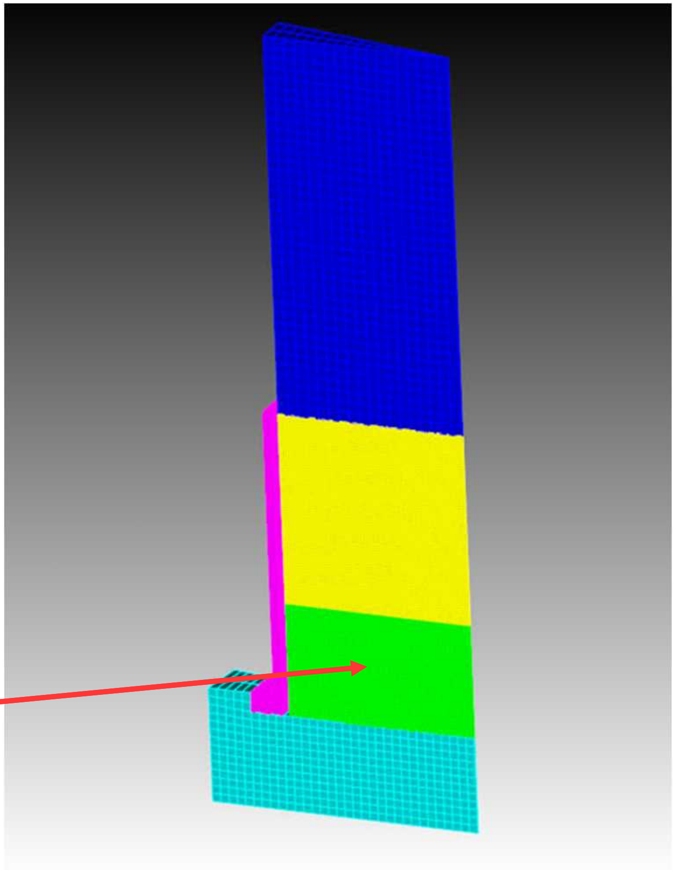


- Removed B.C. that fixed bottom face of reaction mass
- Changed density of reaction mass to make it equal to the weight of the reaction mass in the lab

Removal of Reaction Mass B.C.



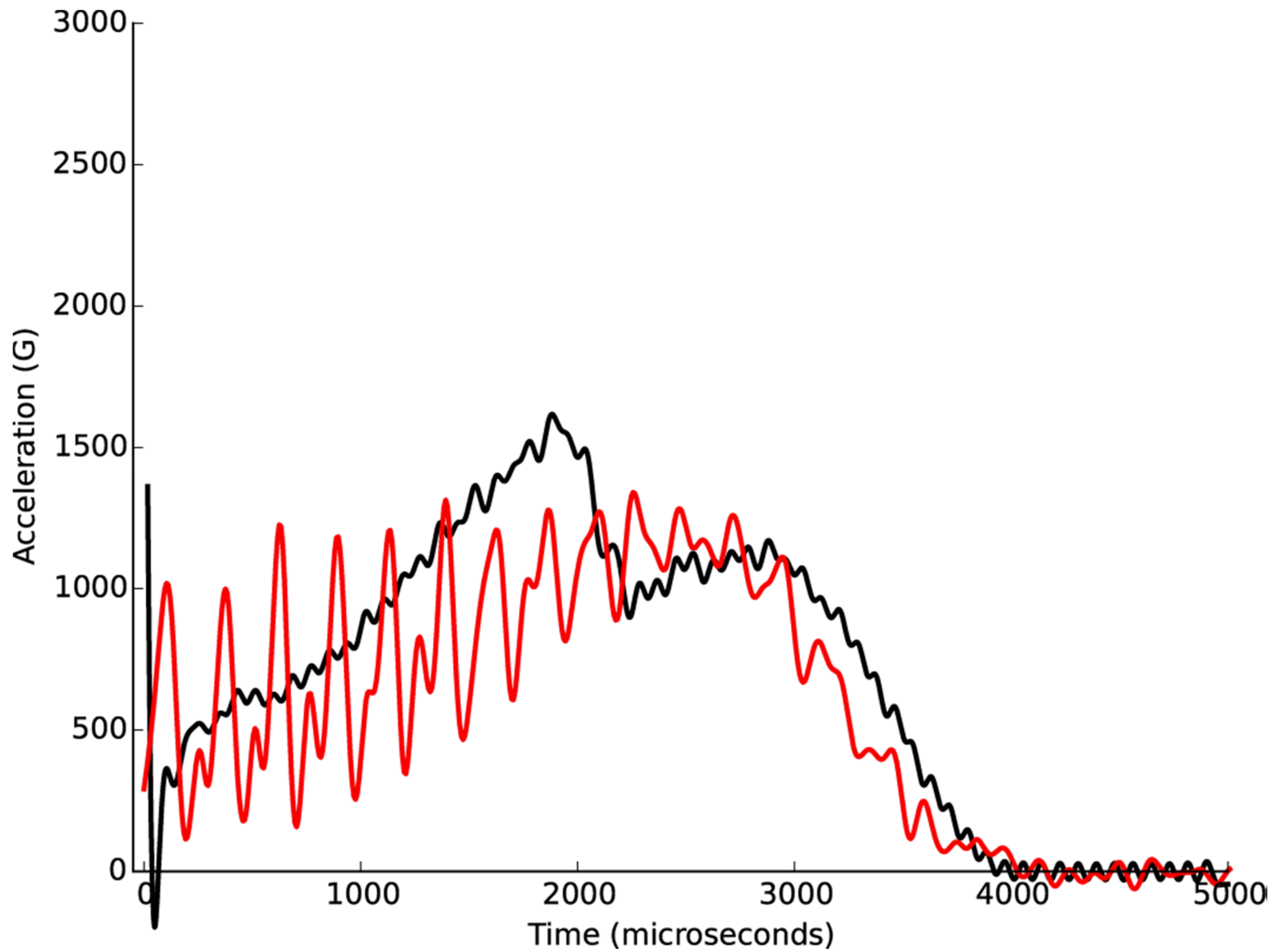
Addition of 68 pcf Foam Model



68 pcf foam

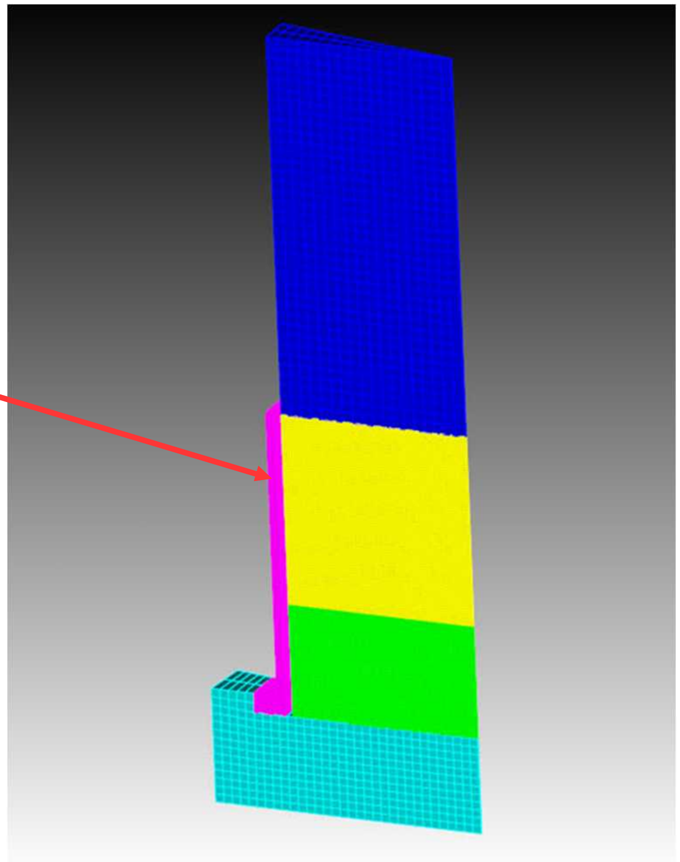
- Used the 35 pcf TufFoam model as a template
- Changed density and relative density to that of our 68 pcf foam

Addition of 68 pcf Foam Model



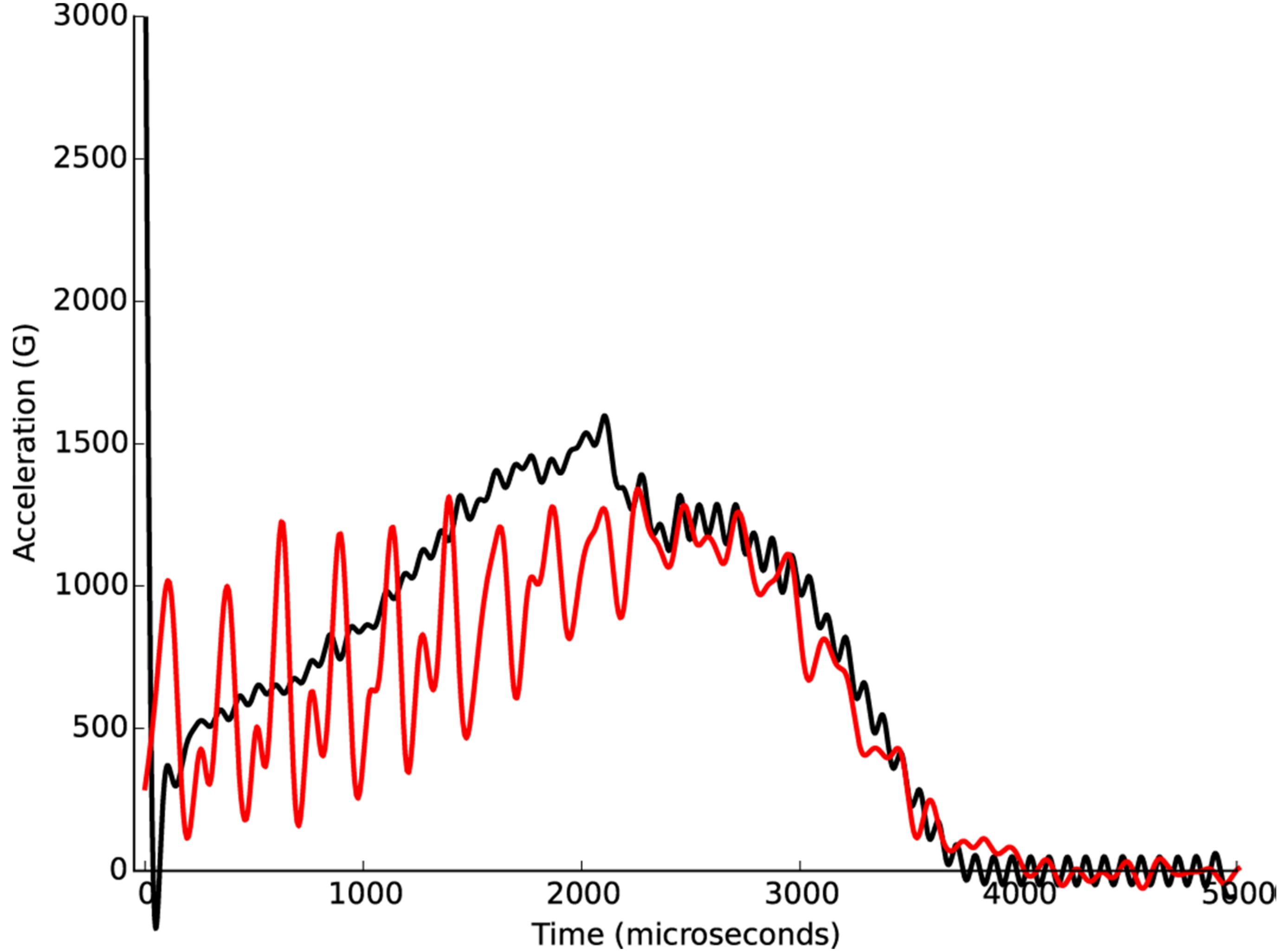
Addition of Aluminum Model

Aluminum
case

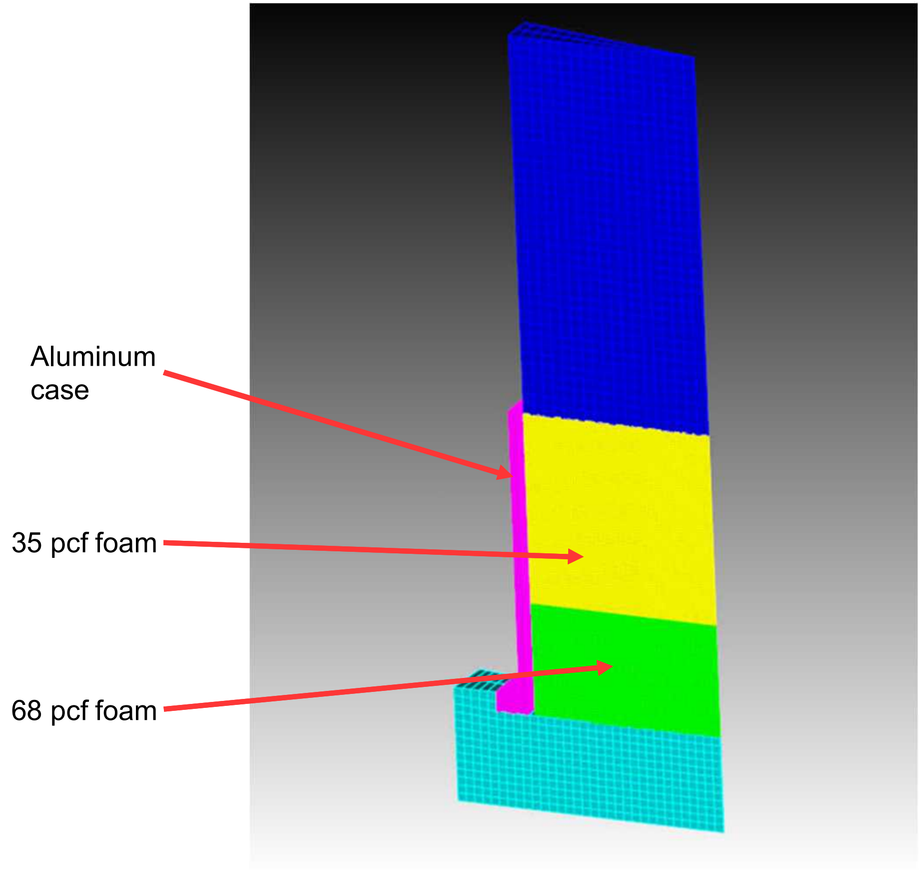


- Original model used a ductile fracture model for the Aluminum casing
- Input the calibrated multi-linear elastic plastic failure Aluminum 5083 model for the casing

Addition of Aluminum Model



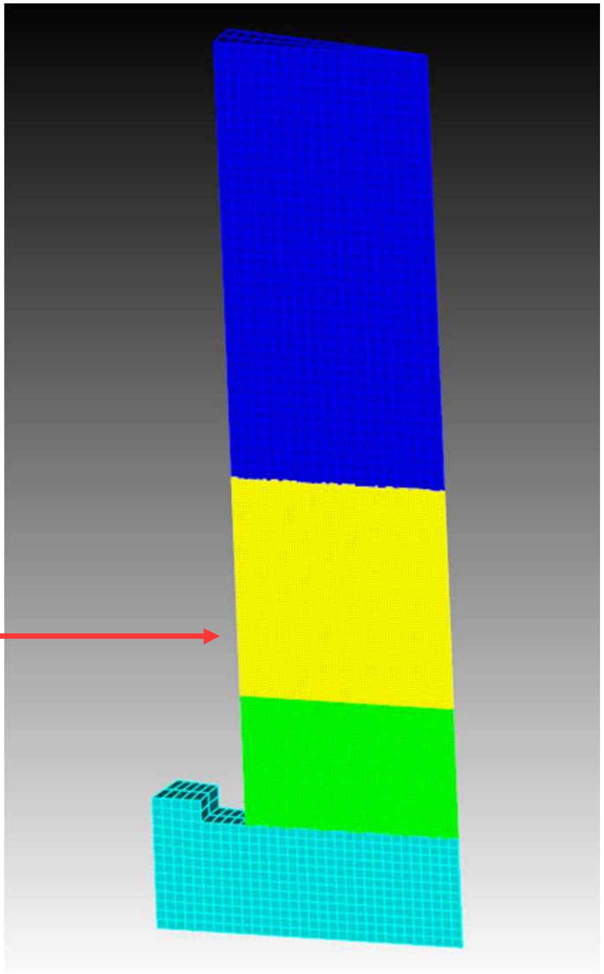
Drop Table Model



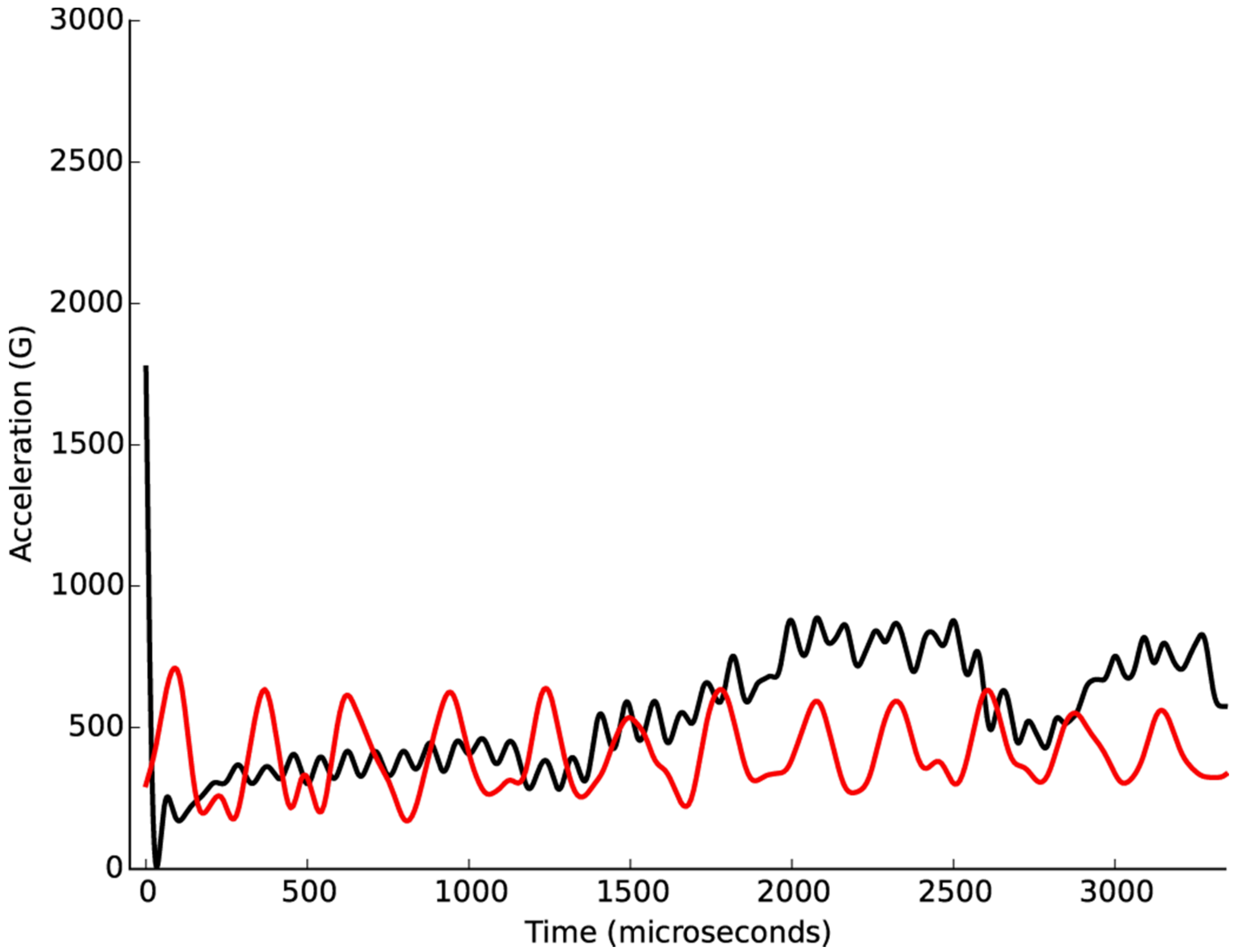
- Changed Cubit model as well as SIERRA parameters to accommodate the different test configurations
- Simulations were compared to a test of similar parameters
- From acceleration comparisons we can determine how well we have modeled the foam

Removal of Aluminum Casing

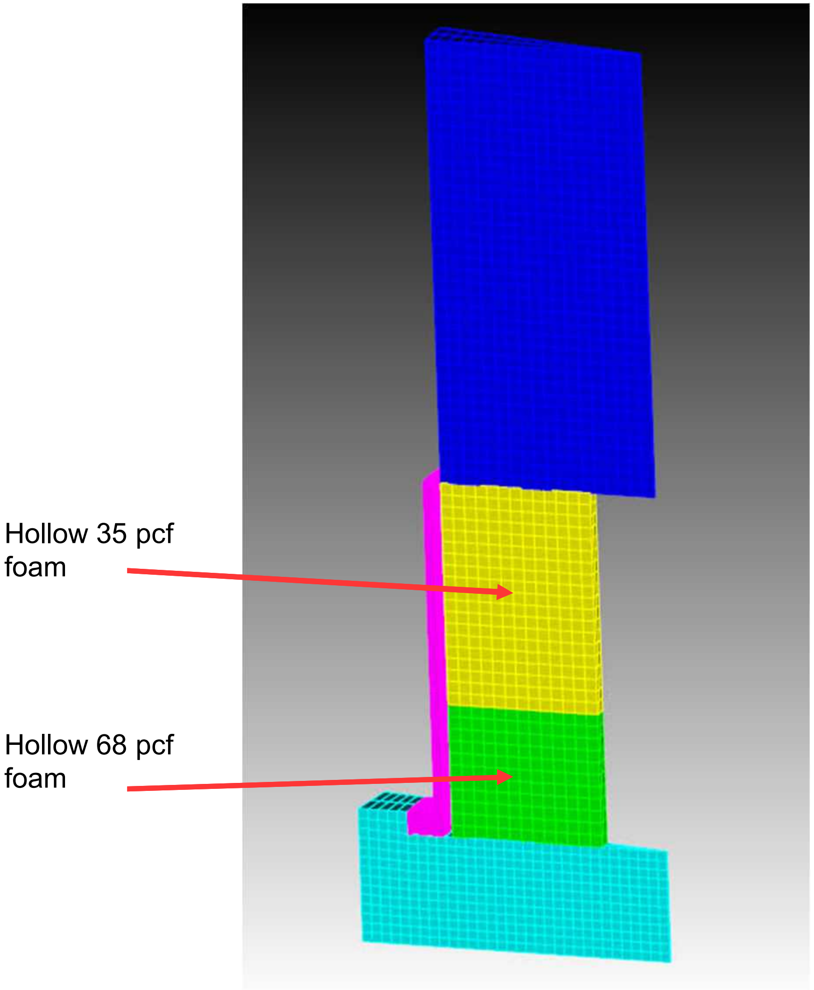
No aluminum
case

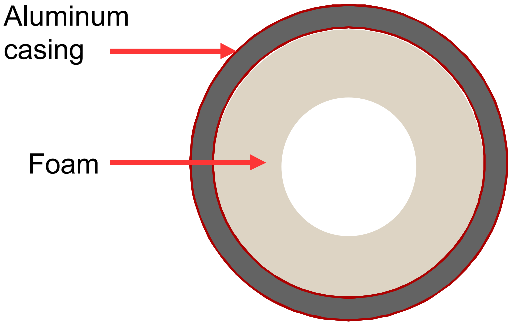


Removal of Aluminum Casing



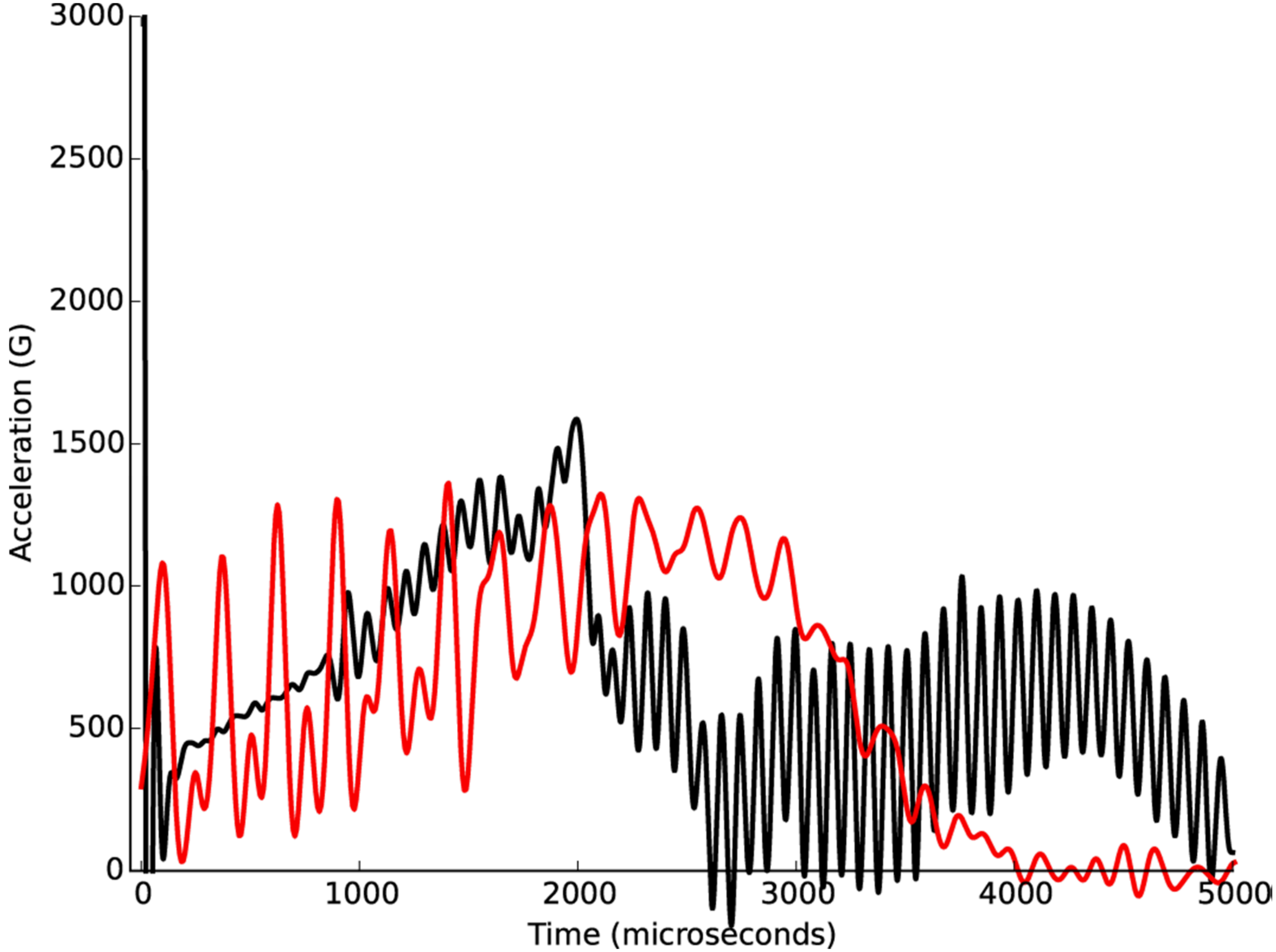
Hollow Model





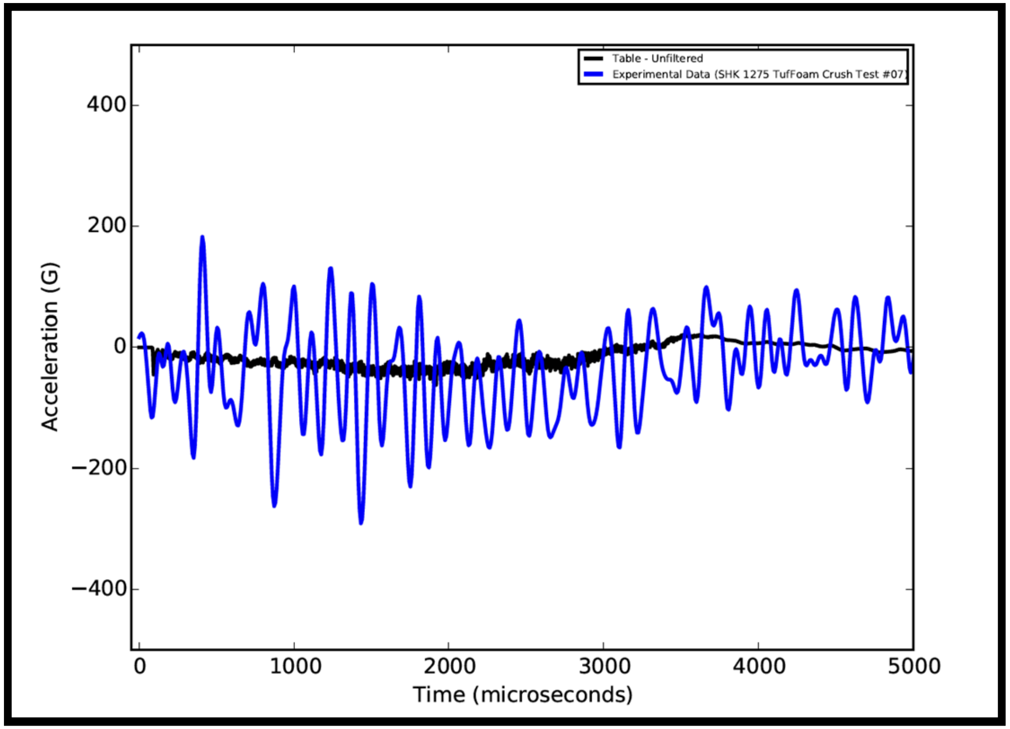
Confined, Hollow Configuration

Hollow Model



Accomplishments

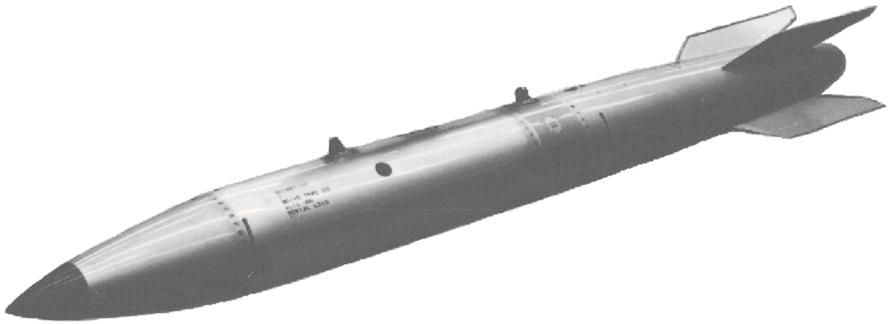
- We were able to get all test setups simulated
- Added an acceleration comparison graph for the reaction masses
- Began calibrating 68 pcf TufFoam model using quasi-static condition and data



Conclusion

- Change in temperature within our range doesn't have a large effect on simulation or experimental data
- Unconfined simulations were not as representative of experiments as the confined ones
- Progress was made towards a more accurate TufFoam model for use in full assembly simulations

Future Work Recommendations



- Fully calibrate 68 pcf foam model in quasi-static, encased environment
- Use calibrated 68 pcf model in conjunction with 35 pcf model in drop table simulations to validate TufFoam model