

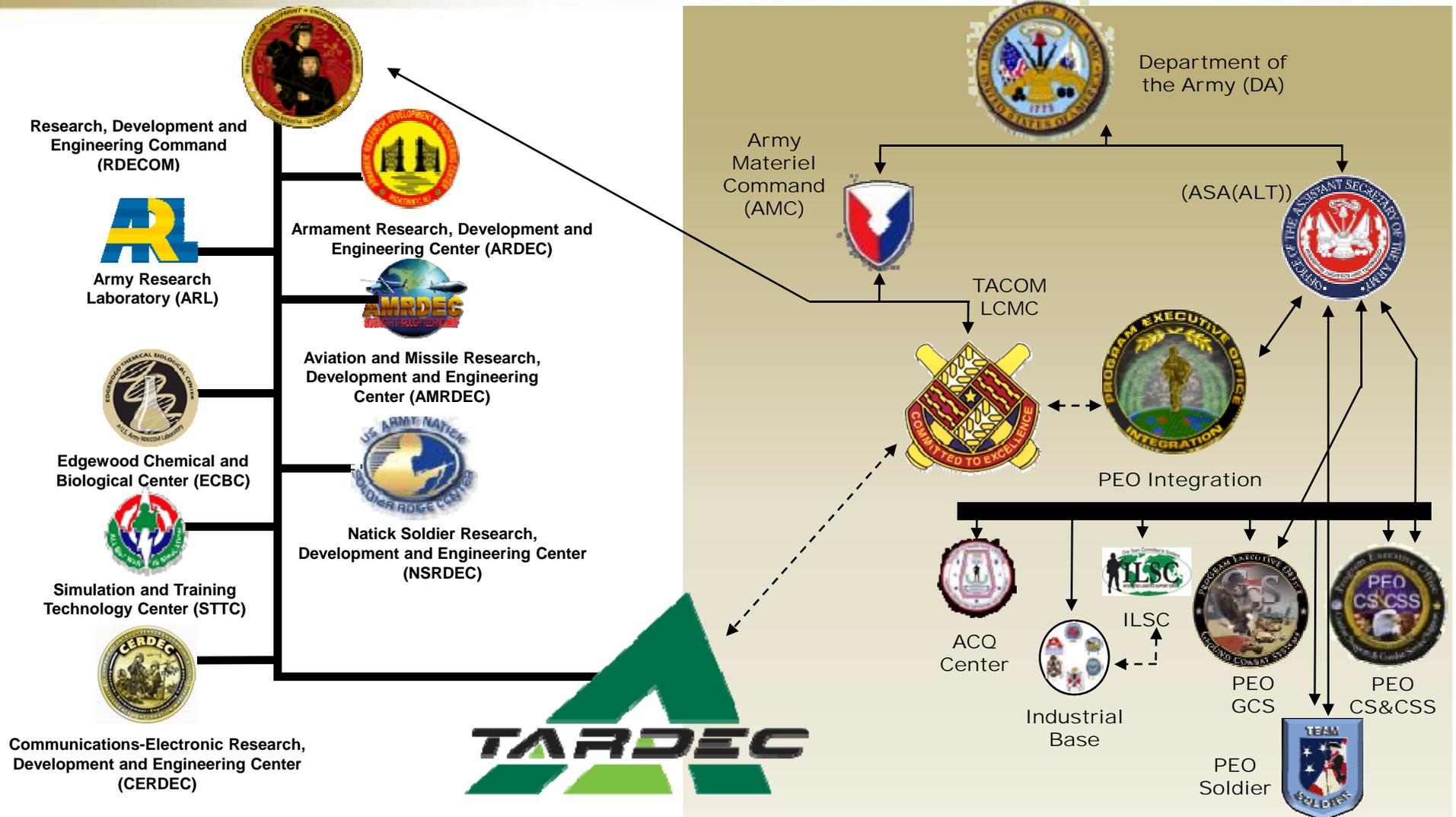


Vehicle and Crash Dummy Response to an Underbelly Blast Event



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

Risa Scherer
Chris Felczak
Steven Halstead
RDECOM-TARDEC



Reach back to over 8,500 Scientists and Engineers

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



Background



- Historically, the Department of Army has had difficulty educating industry and academia on the severity and speed of underbody blast events
 - Due to the sensitive nature of the work performed by the Department of Army and Department of Defense, data generated from testing military vehicles is CLASSIFIED, making it difficult to share the data
- To alleviate this problem, Research, Development and Engineering COMmand-Tank Automotive Research, Development and Engineering Center (RDECOM-TARDEC) fabricated a generic vehicle hull with the intent to:
 - Subject it to an underbody live fire test
 - Share the data publicly
 - Evaluate blast mitigating technologies
- RDECOM-TARDEC has partnered with US Army Aeromedical Research Lab (USAARL), US Army Research Laboratory (USARL) and Aviation and Missile Research Development and Engineering Center (AMRDEC) to conduct this test

- Test was conducted at AMRDEC at Redstone Arsenal, AL
- Several of the systems being placed on the hull were not yet validated in a live fire blast test prior to this test



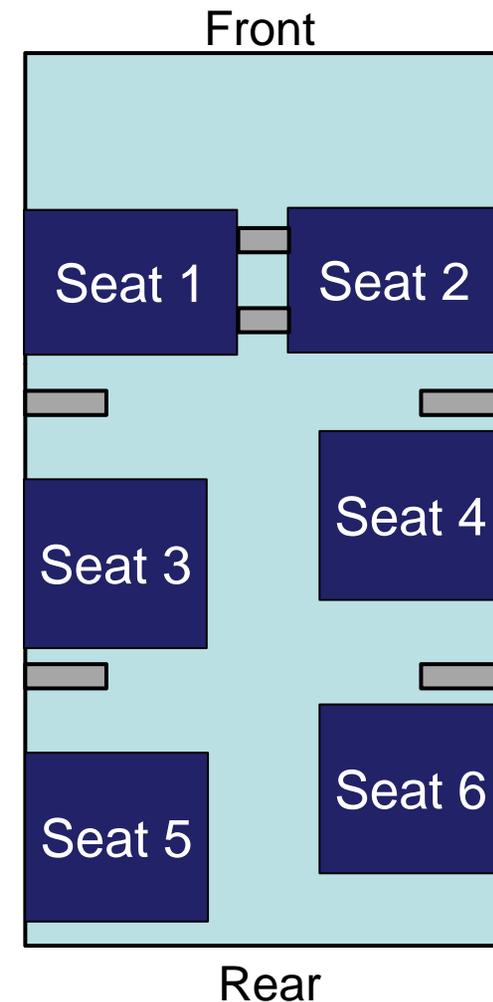
- Hull constructed to create “Worst Case Scenario” for a V-hull vehicle
 - More energy could have been transferred to vehicle if wheels/tracks, suspension, etc were present
- Generic Hull Characteristics:
 - V-Hull
 - Two forward facing seats (driver and commander) mounted to underbody support ribs
 - Four inward facing crew seats mounted to hull walls
 - Hull floor mounted to ribs which were connected to V-hull
 - Completely sealed windows, doors and back hatch
- The Hull was outfitted with:
 - Six instrumented Anthropomorphic Test Devices
 - Each ATD instrumented to record occupant injury data
 - Internal and external high speed cameras
 - To record gross vehicle motion and occupant kinematics
 - Onboard and Off-board Data Acquisition System (DAS)
 - To record vehicle motion in key locations (floor, roof, walls)

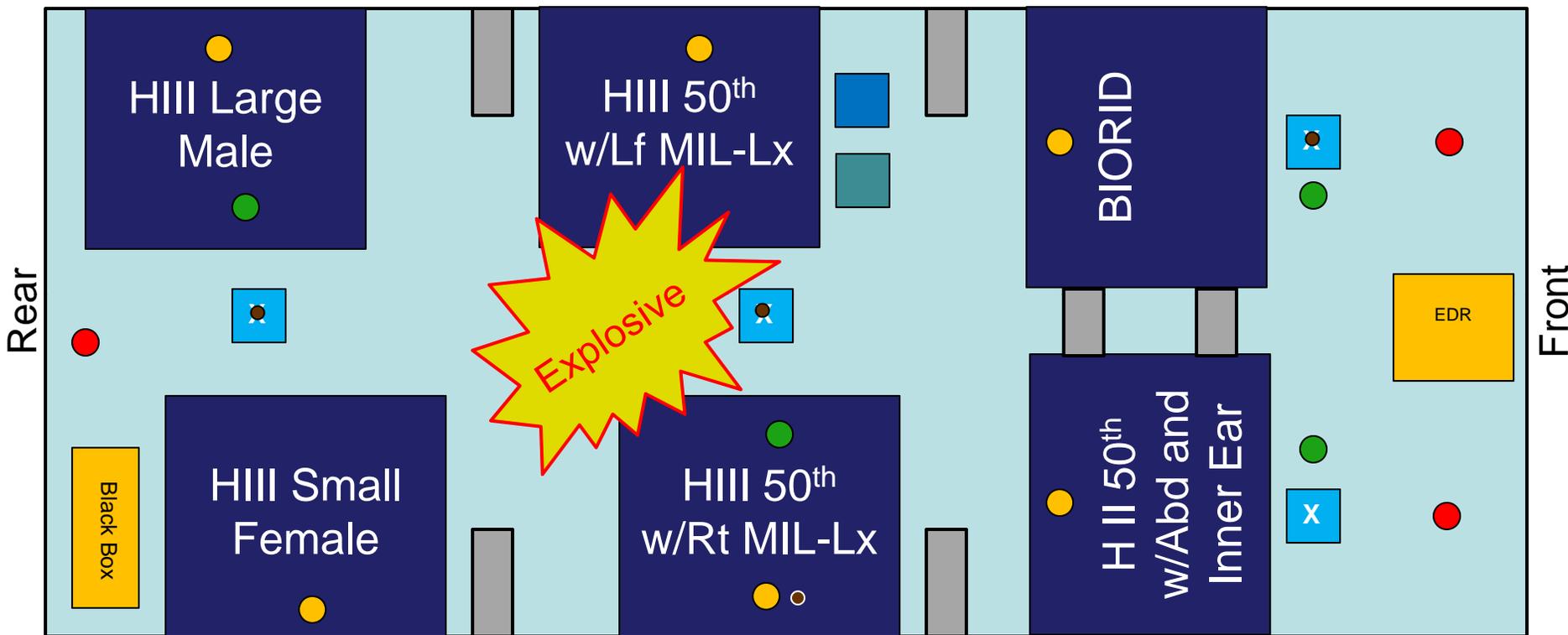


- The ATDs used in this test are:
 1. BIORID Dummy
 2. 50th percentile male Hybrid II ATD
 3. 50th percentile male Hybrid III ATD with DTS system
 4. 50th percentile male Hybrid III ATD with system
 5. 95th percentile male Hybrid III ATD with DTS system
 6. 5th percentile female I-dummy

- The vehicle data was recorded using several Data Acquisition Systems recording at a variety of sampling rates (1 ksps, 40 ksps, 50 ksps, 100 ksps, 1 Msps)

- Video footage recorded using:
 - Motion capture camera system (200 fps)
 - High speed cameras (1,000 and 2,000 fps)
 - Standard video camera (30 fps)

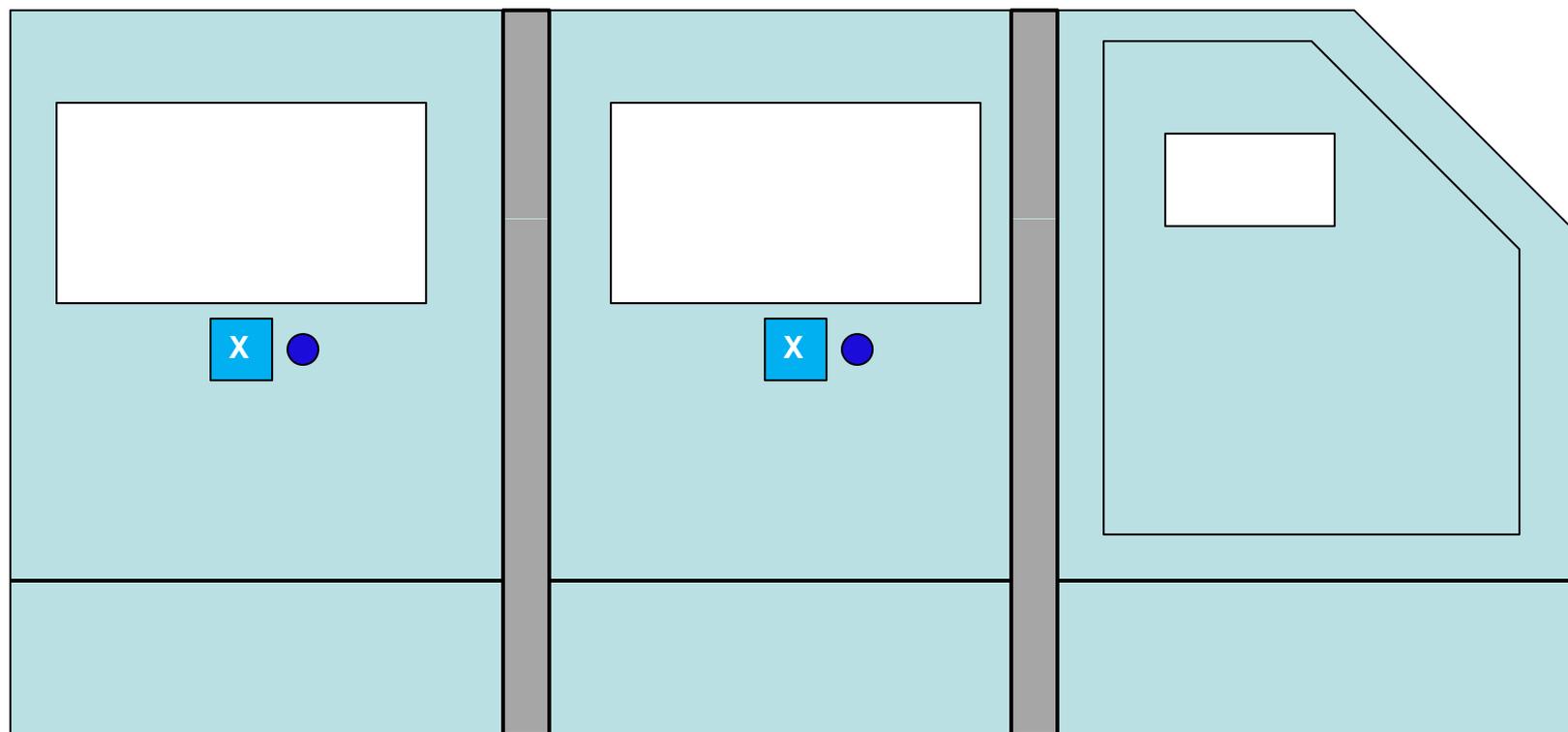




KEY:

- TSR
- 1-axis Accel (2k g)
- 1-axis Accel (20k g)
- 1-axis Accel – Floor mounted (60k g)
- Triax Accel – Floor mounted (60k g)
- Triax Accel (20k g)
- Triax Accel (2k g)

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

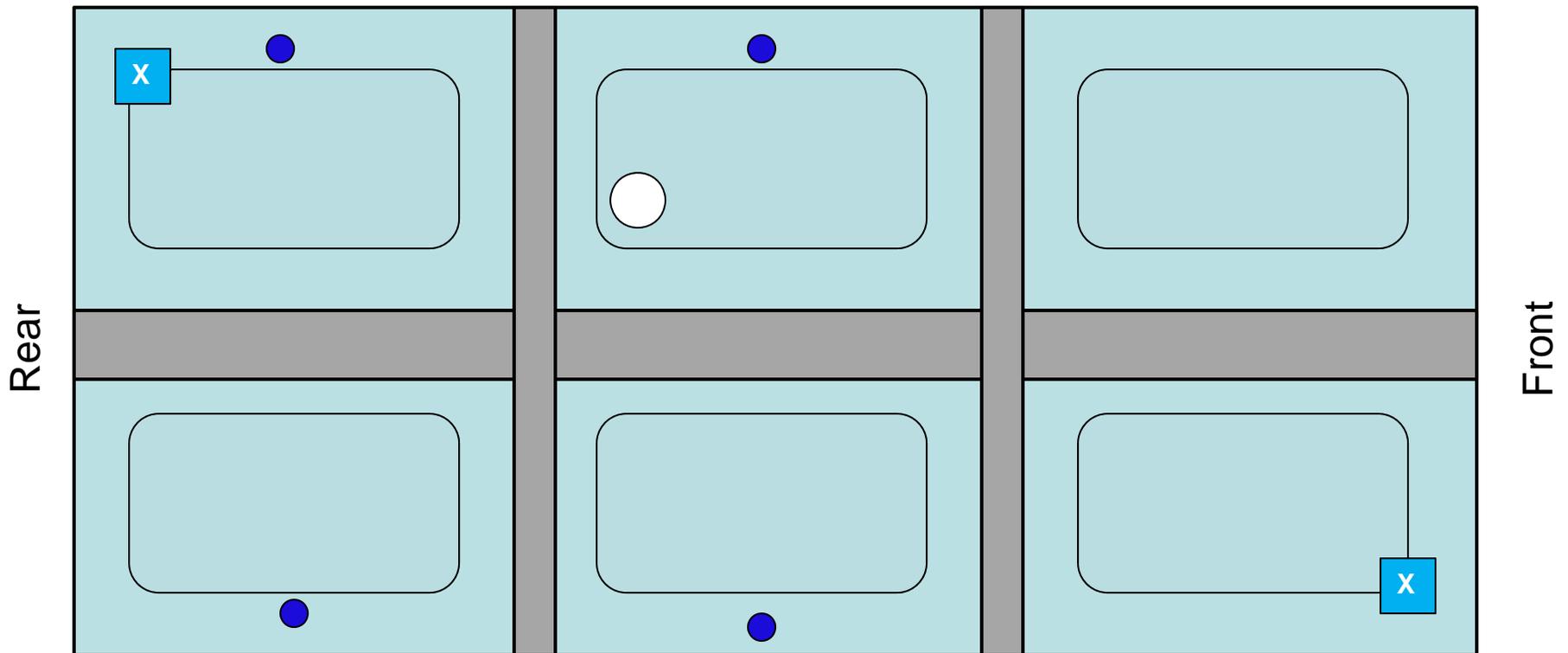


KEY:

X TSR

- Triax Accel
20k g (longitudinal)
60k g (vertical, lateral)

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.



KEY:

- TSR
- 1-axis Accel 6k g



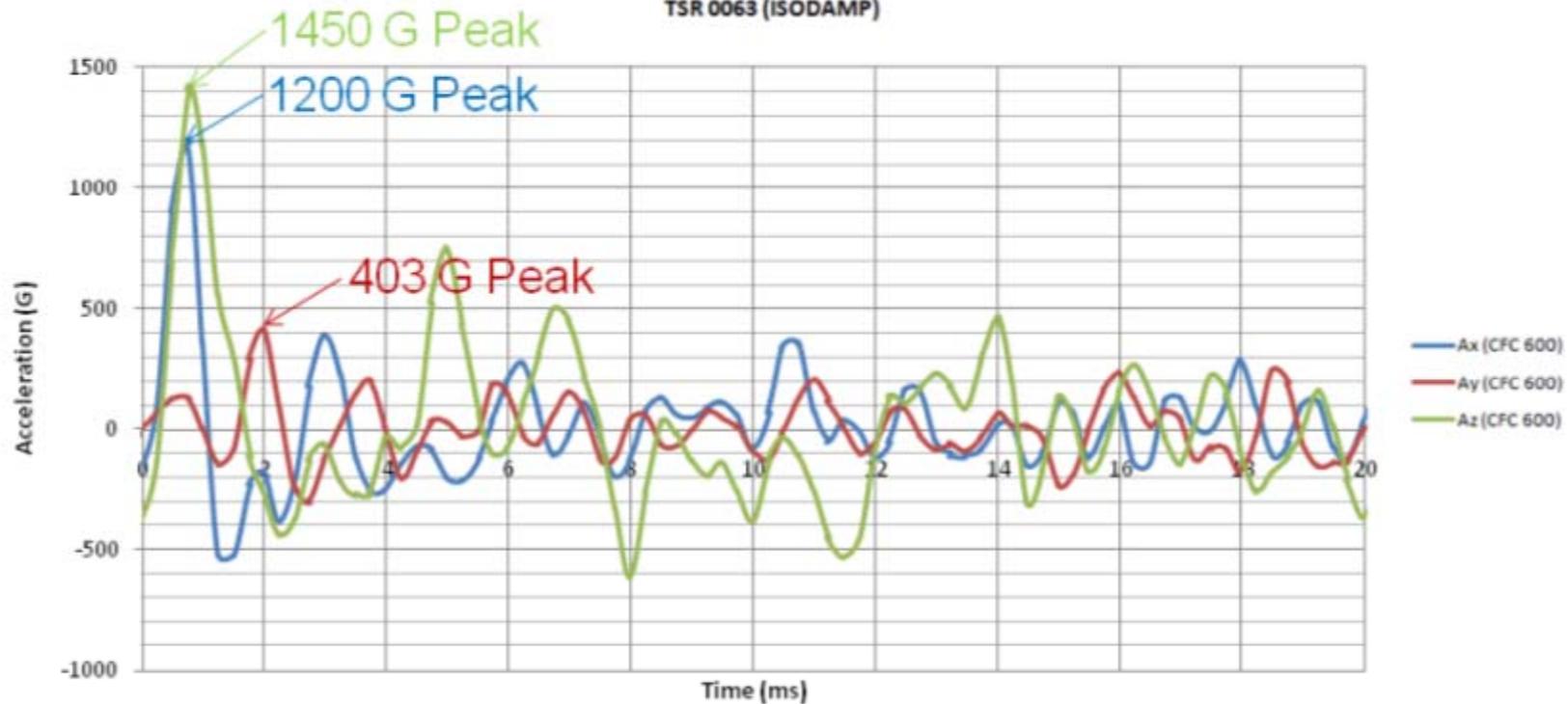


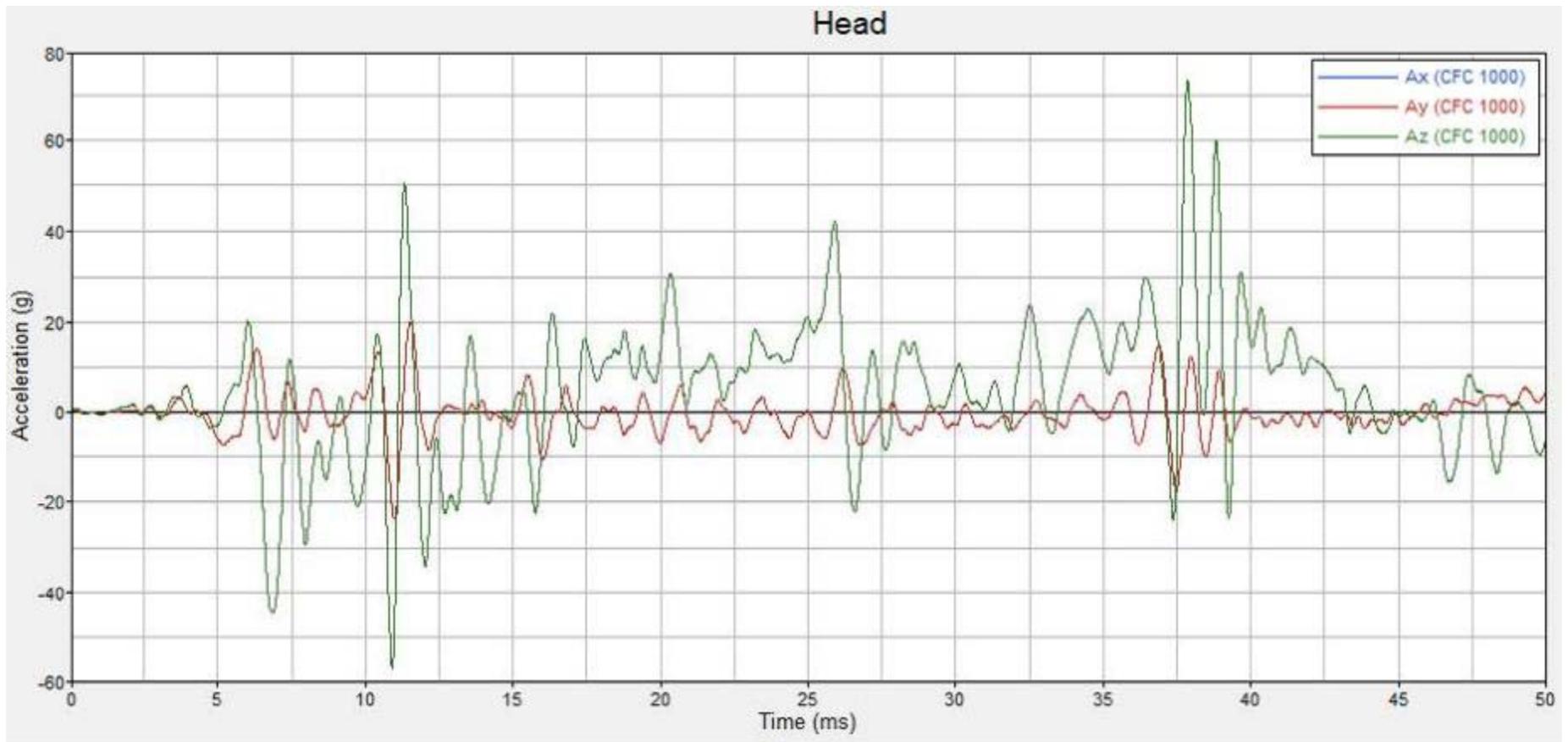
TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

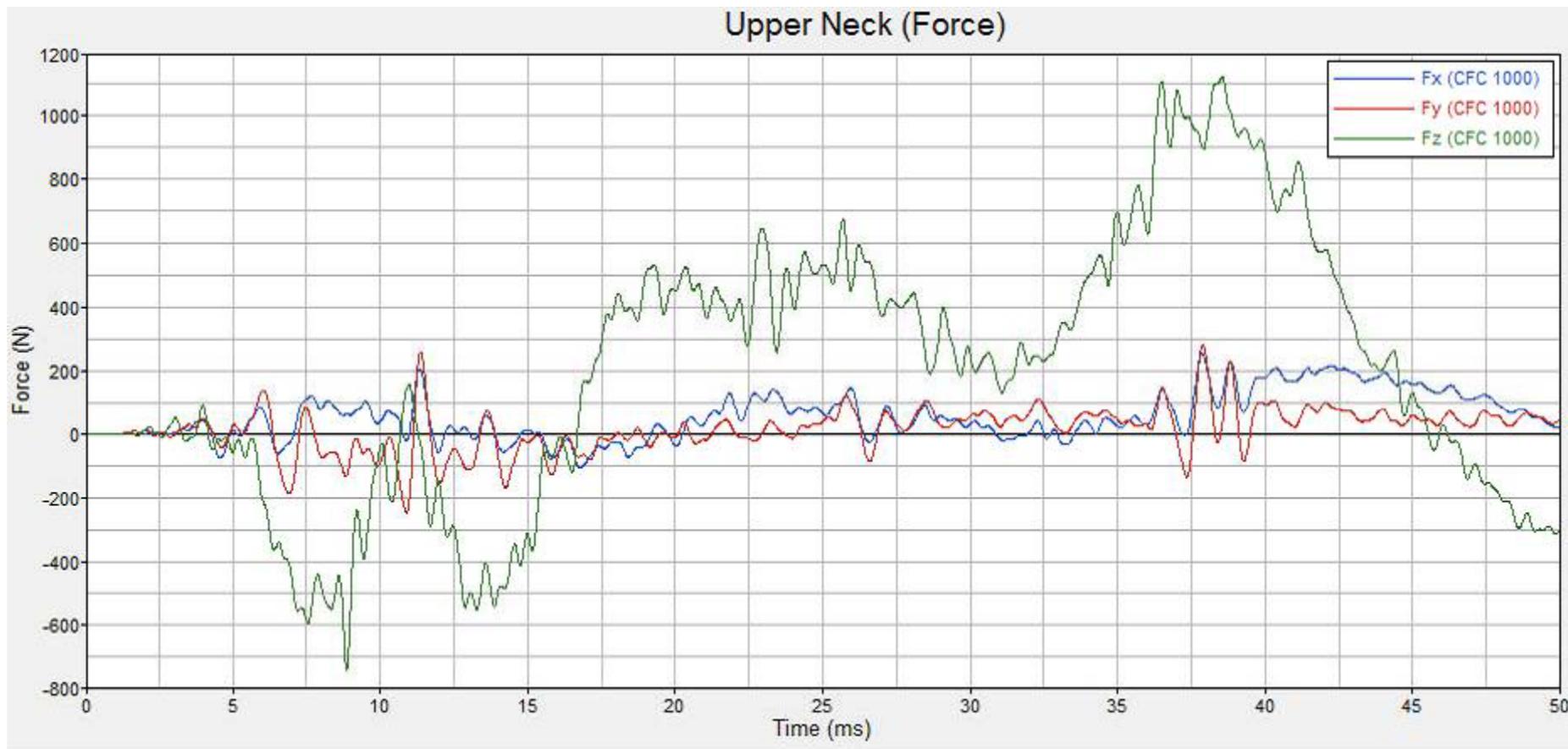


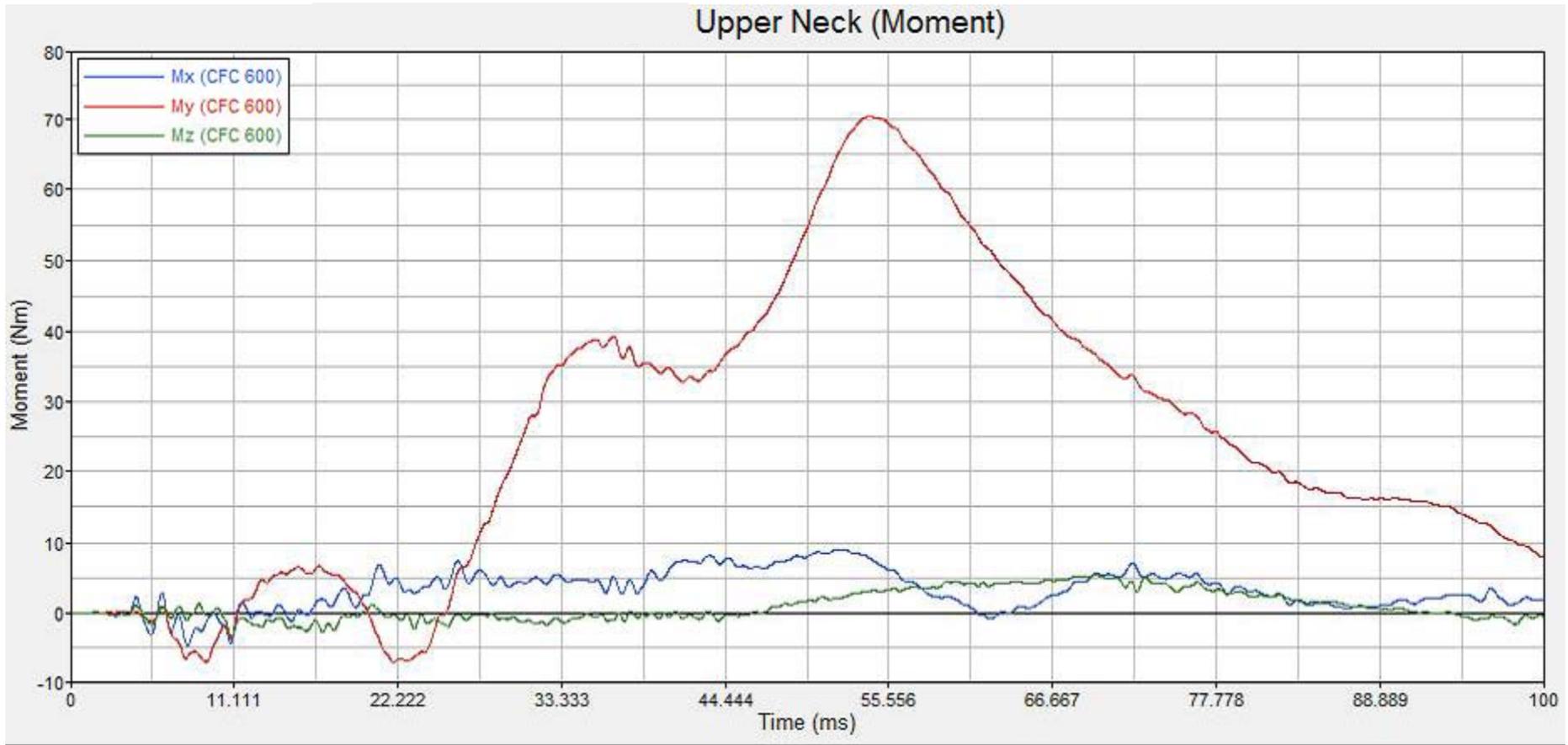


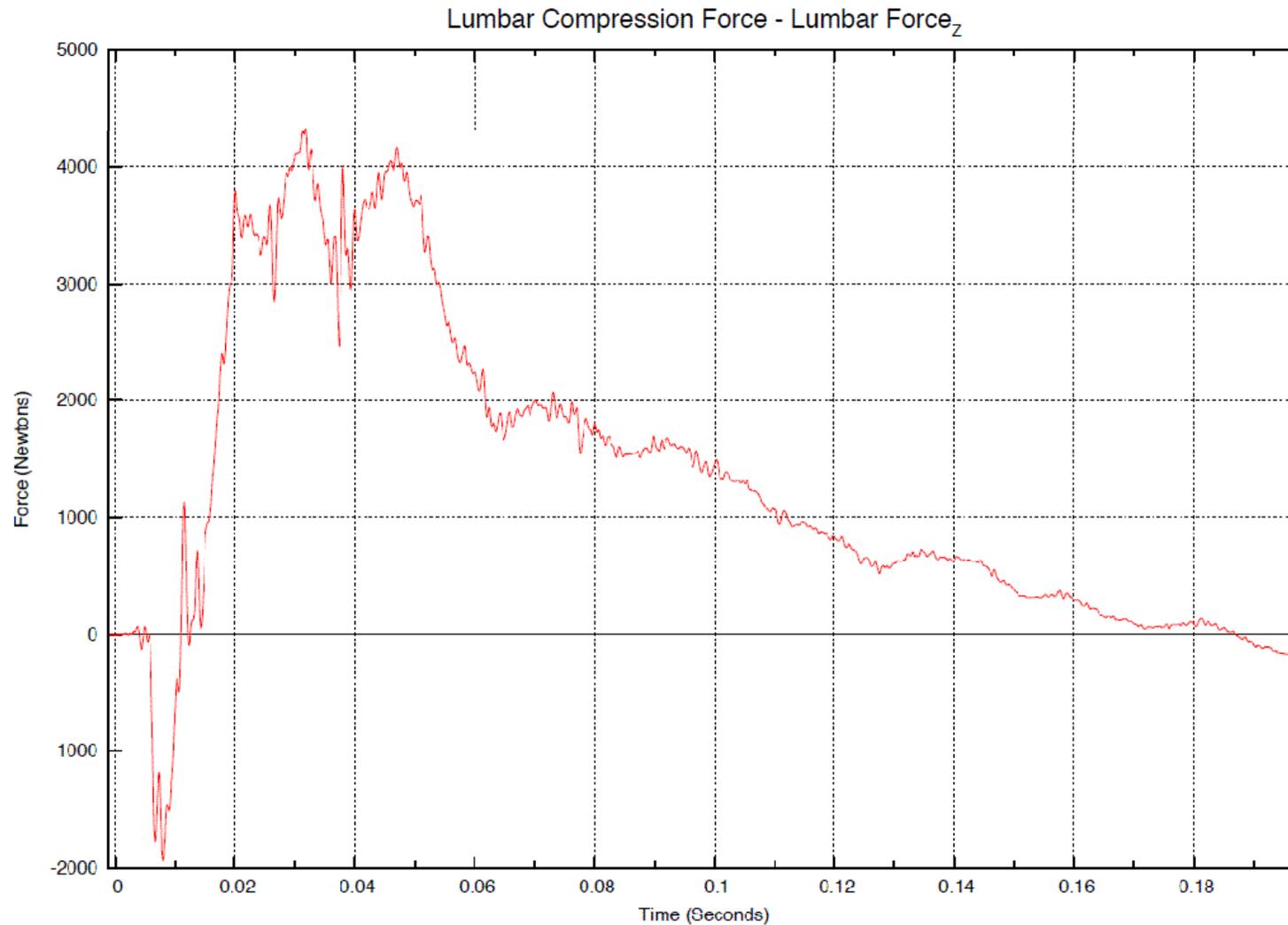
Center Floor Acceleration
TSR 0063 (ISODAMP)

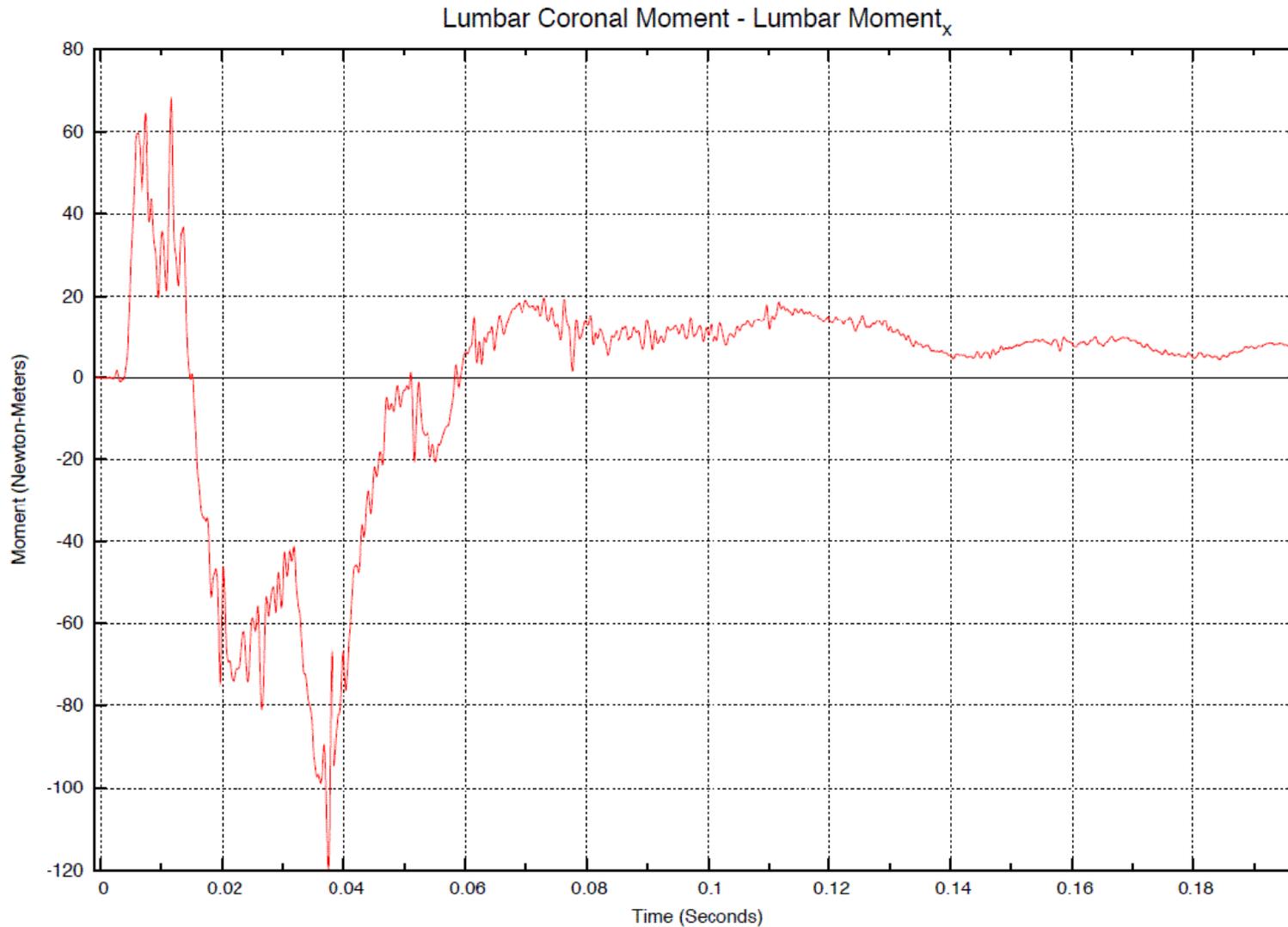


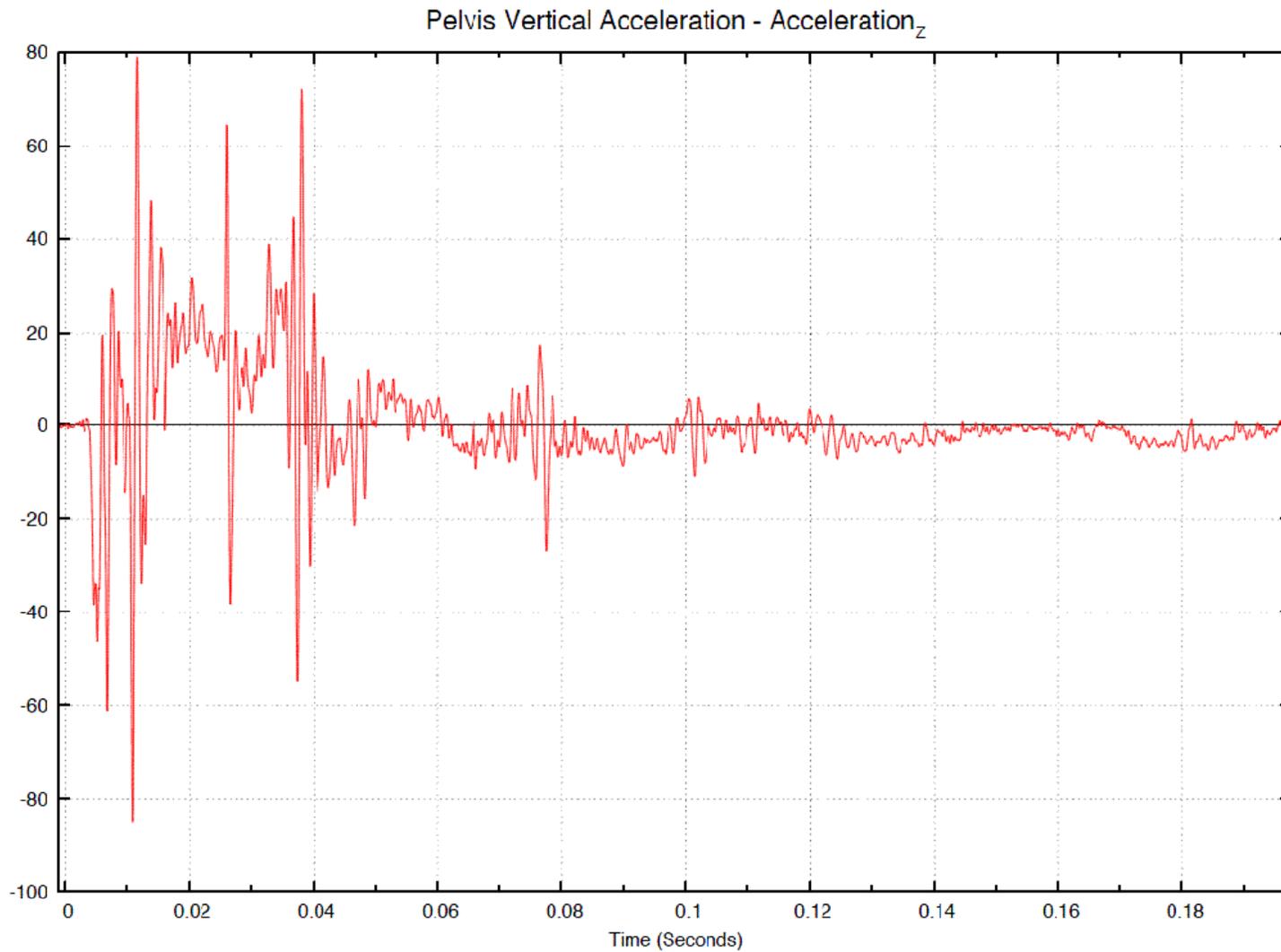




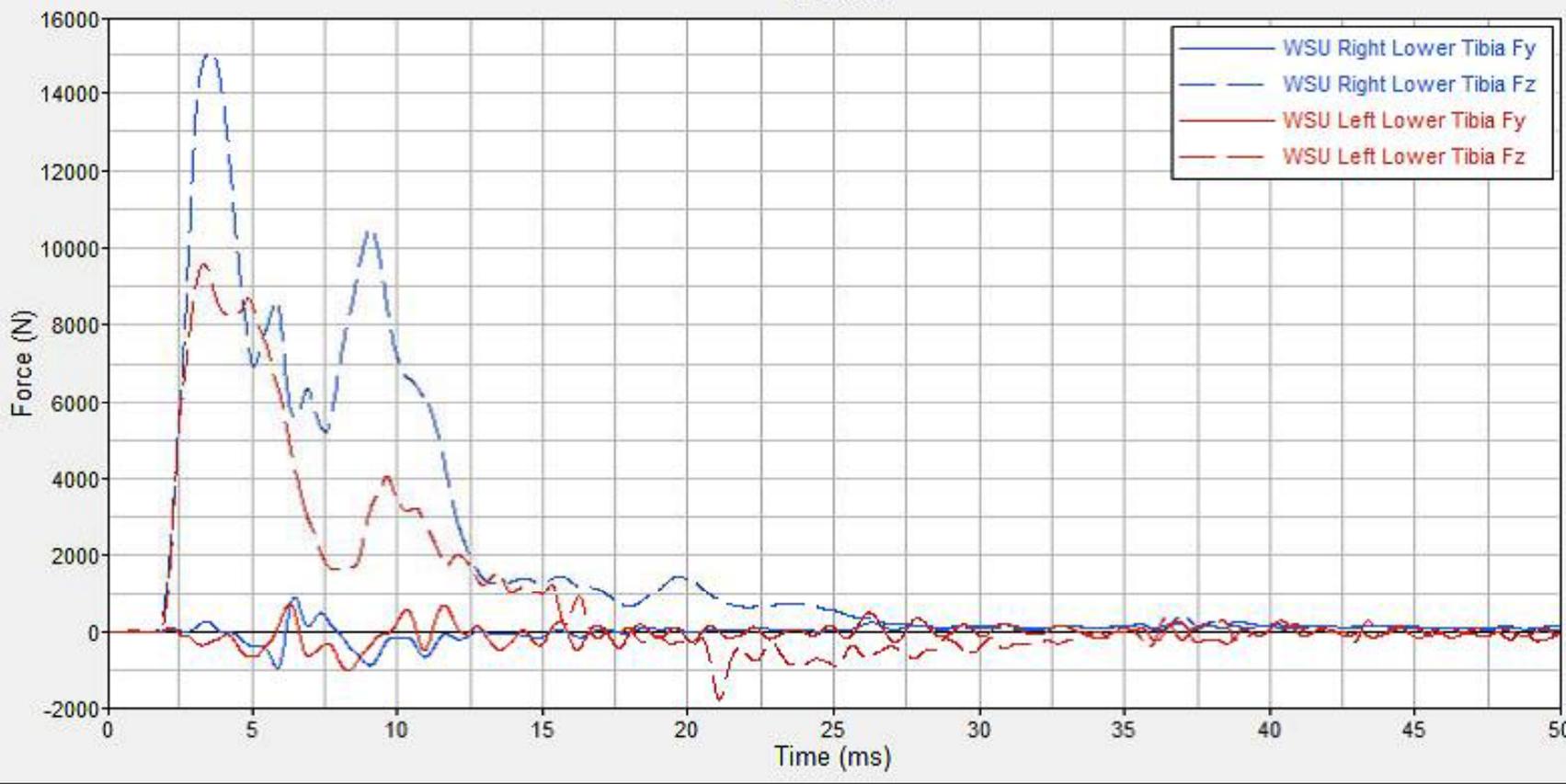




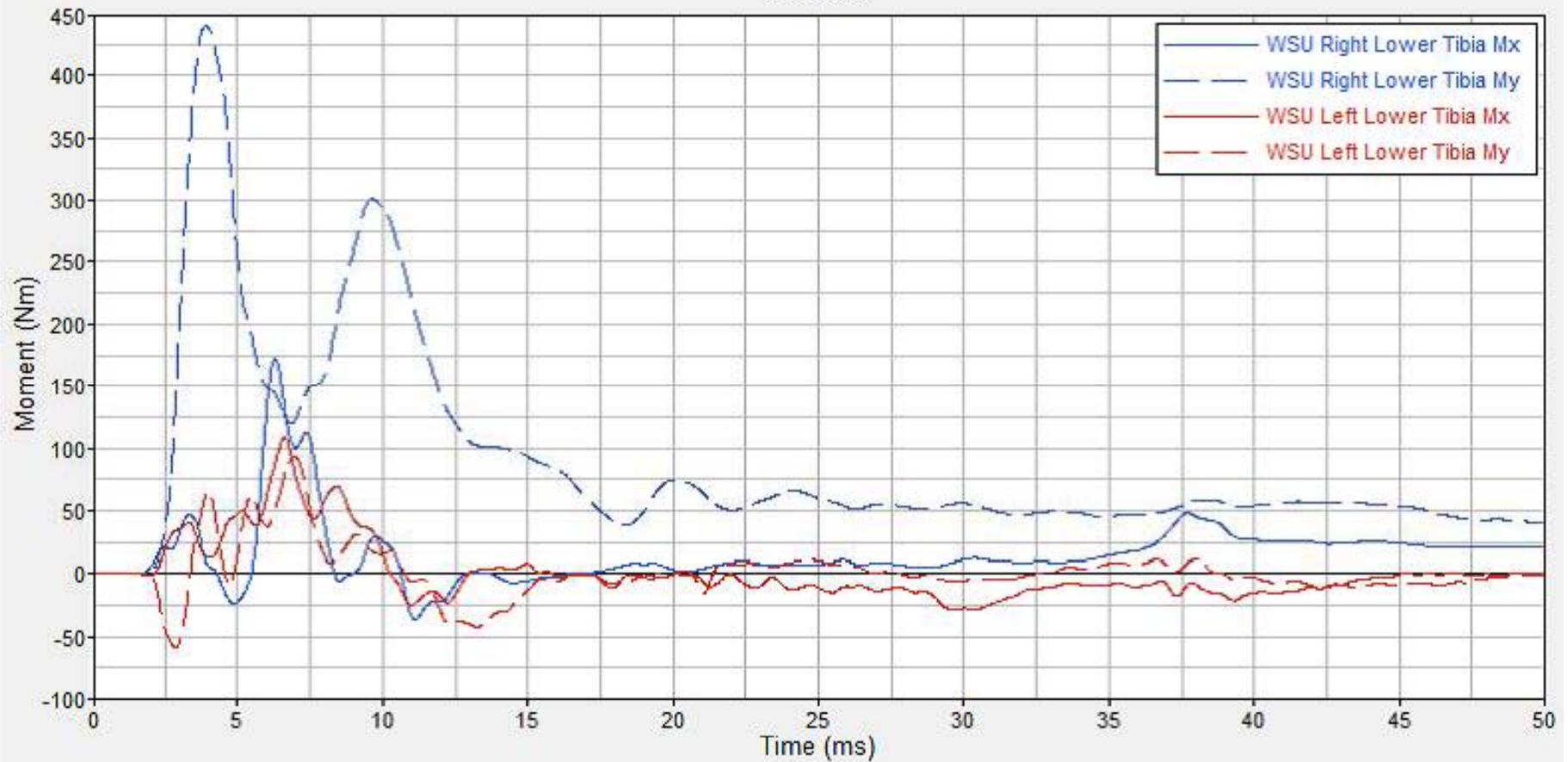




WSU Lower Tibia Comparison - Force
CFC 600



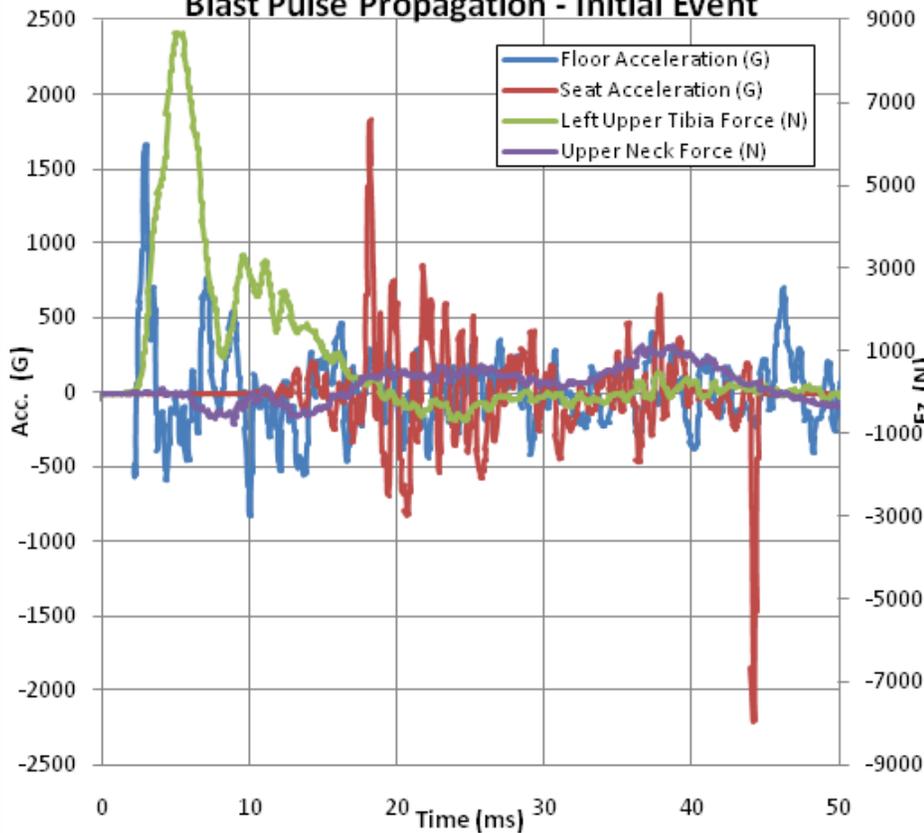
Lower Tibia Comparison - Moment
CFC 600



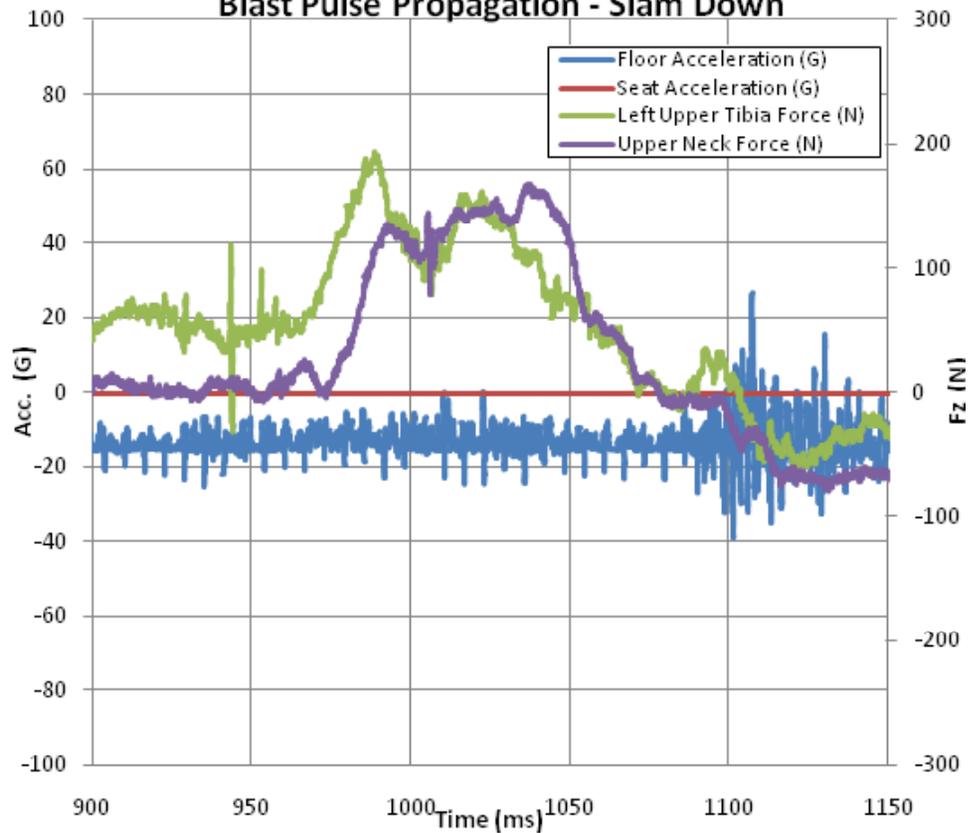
Blast Pulse Propagation



Blast Pulse Propagation - Initial Event

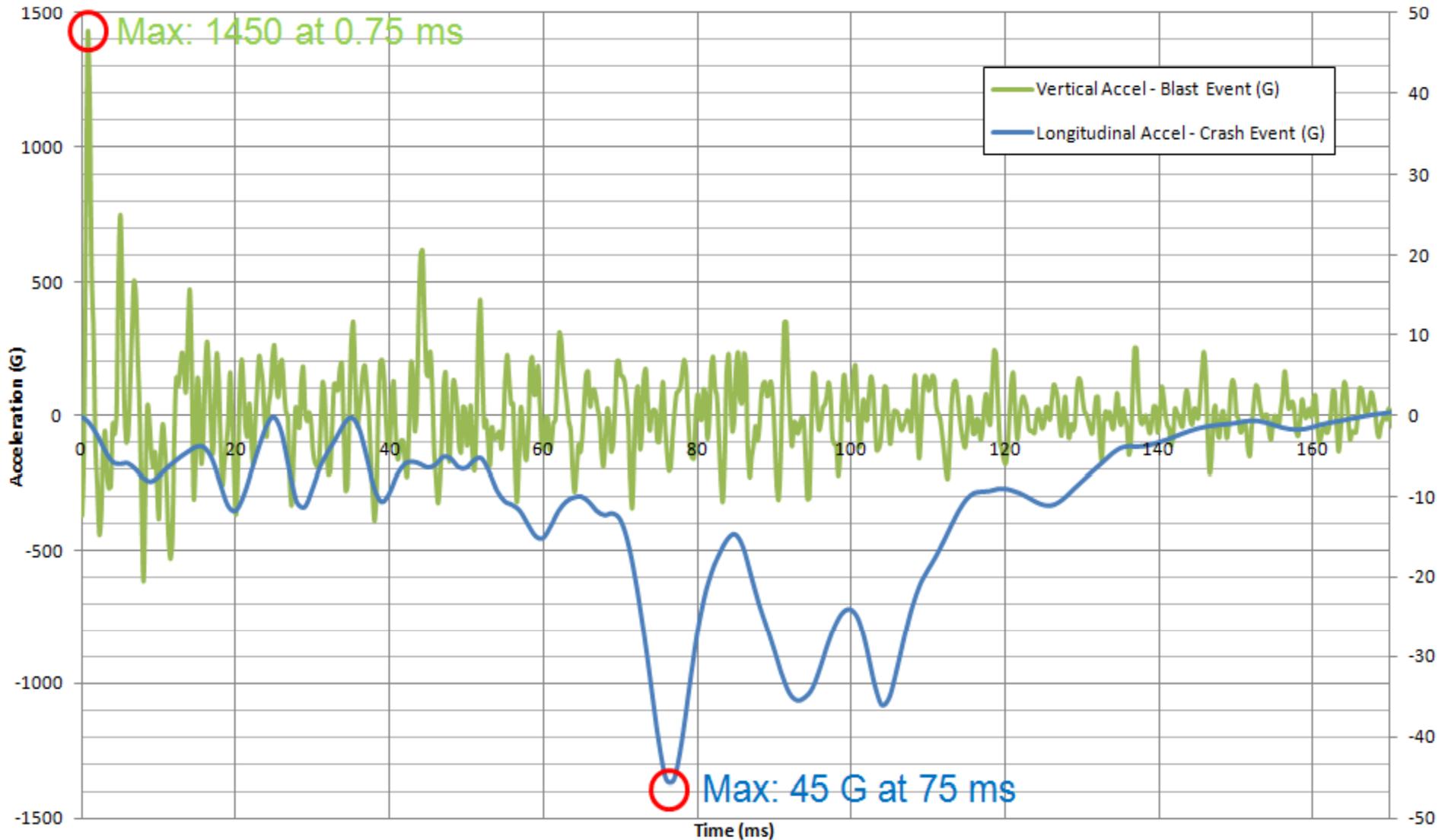


Blast Pulse Propagation - Slam Down





Blast vs. Crash Event Pulses

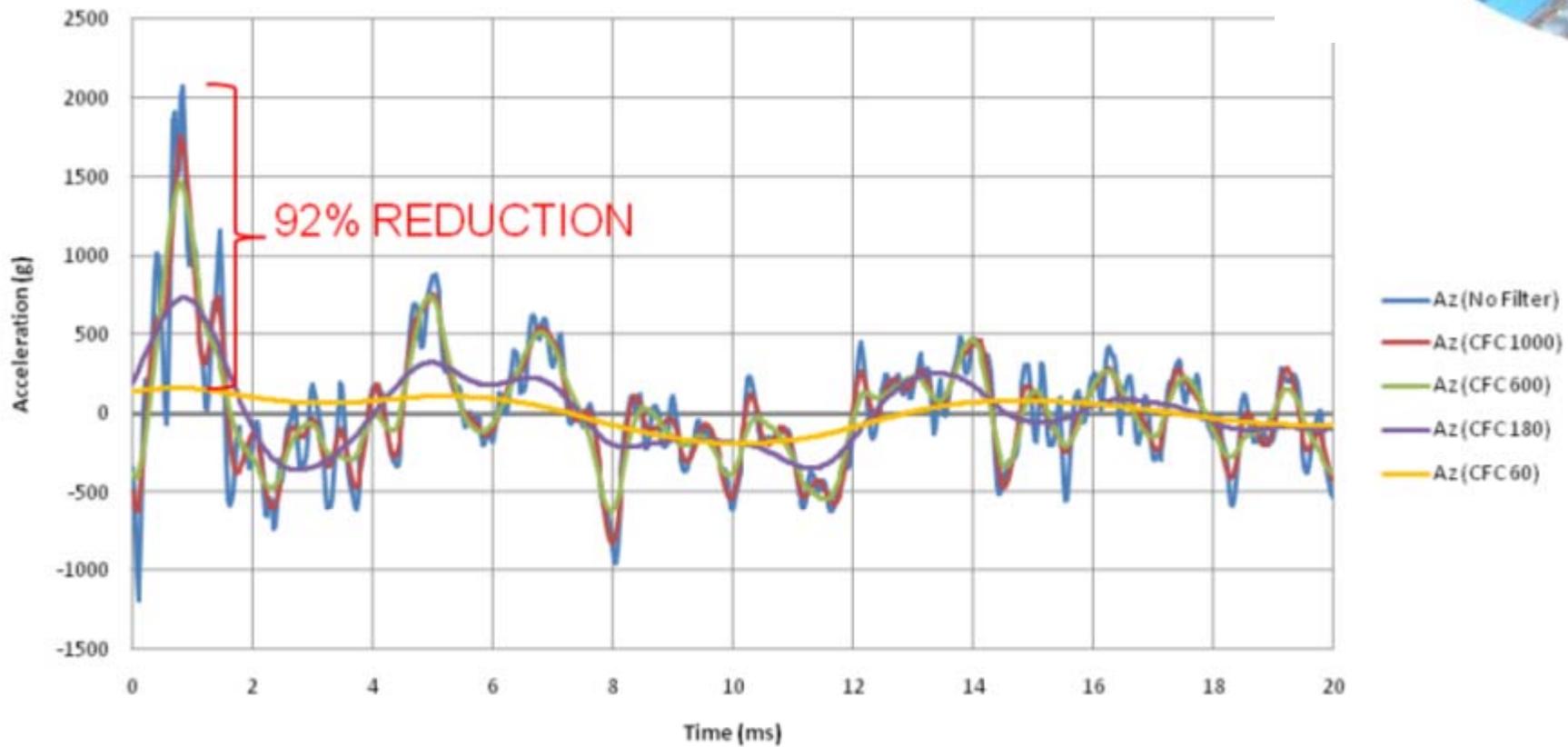


2010 Midsize Sedan– 40% offset crash data was obtained with permission from the Insurance Institute for Highway Safety

TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED. 23



Center Floor
Filter Comparison (TSR 0063)



- Blast events occur much faster, and at a much higher magnitude than crash events.
- Most technologies, as designed, for the commercial vehicle industry (airbags, shock absorbers), do not respond quickly enough to aid in mitigating the blast from vehicle occupants
- Instrumentation and standards require modification for use in blast testing
- More to come.....



TECHNOLOGY DRIVEN. WARFIGHTER FOCUSED.

- This testing was made possible with the assistance of:

- The USAARL Team
- The AMRDEC Team
- The USARL Team
- Wayne State University
- Diversified Technical Systems (DTS)
- Humanetics ATD Team
- Concurrent Technologies Corporation (CTC)
- Johns Hopkins University Applied Physics Laboratory (JHUAPL)
- The Cosworth America Team
- The VICON Motion Systems Team
- Virginia Tech



