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Title:	CONFINEMENT DEVELOPMENT AT PRAD
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Form 836 (7/06)

CONFINEMENT DEVELOPMENT AT PRAD

ABSTRACT:

The WX-3 pRad team manages confined firing activities at the LANSCE proton radiography facility for dynamic experiments. These activities involve design and staging of the confinement strategy and the explosive assembly design and staging is based, in large part, on observation of experimental evidence of explosive damage patterns for a given assembly, and comprise an essential tool for effective damage mitigation.

Confinement development at pRad

2011 3rd International Workshop on High-Energy Proton Microscopy (Oct 27-28 2011)

W. Vogan McNeil, for the WX Explosives Operations Team at pRad

LA-UR-

pRad Collaboration

pRad Core Team: C. Espinoza, J. Heidemann, B. Hollander, J. Lopez, R. Lopez, F. Mariam, M. Marr-Lyon, G. McMath, F. Merrill, C. Morris, M. Murray, P. Nedrow, A. Saunders, C. Schwartz, D. Tupa, J. Tybo, W. Vogan McNeil

LANSCE; P-25 (Subatomic Physics); P-23 (Neutron Science & Technology); WX-9 (Shock & Detonation Physics); WX-7 (High Explosives Science & Technology); W-14 (Weapons Test Engineering); W-6 (Detonator Technology); W-5 (Experimental Device Engineering & Assembly); X Theoretical Design

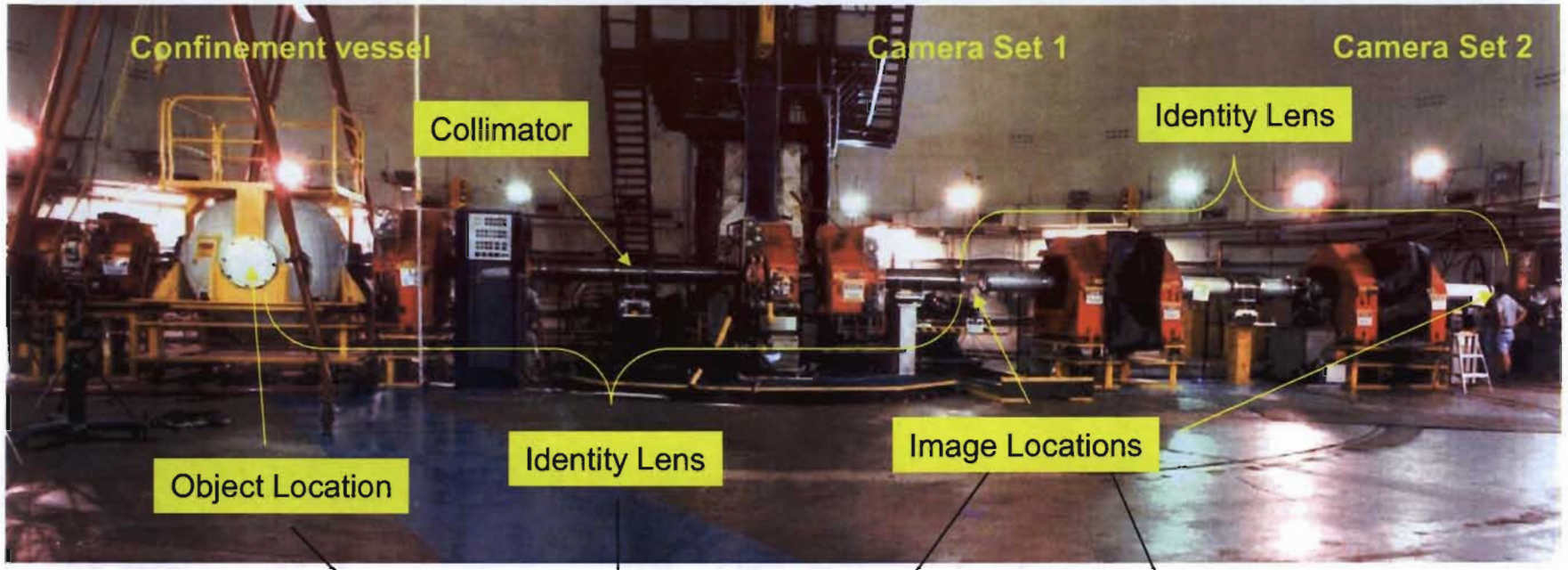
Image courtesy M. Marr-Lyon

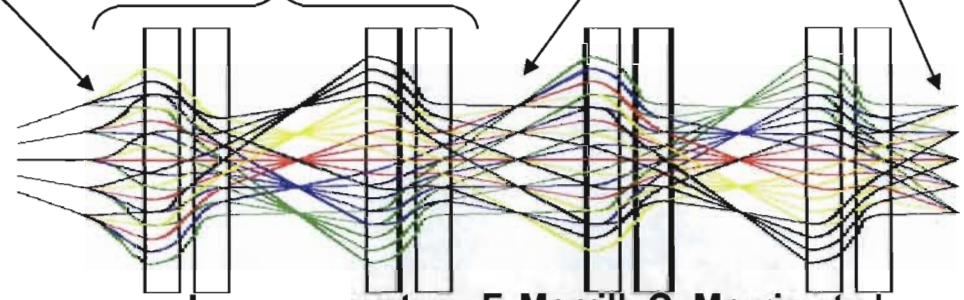
The pRad firing point addresses many collaboration needs…

- High-explosive physics
- Material dynamics
- User experiments
- Programmatic experiments

Image courtesy M. Marr-Lyon, F. Merrill, C. Morris, et al.

pRad Facility at LANSCE





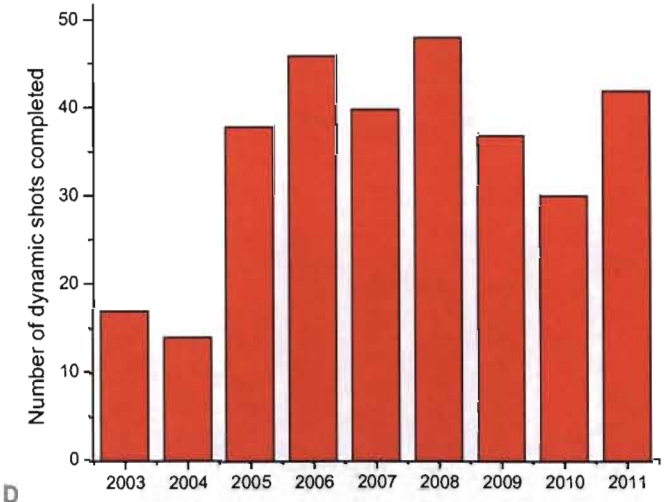
Images courtesy F. Merrill, C. Morris et al.

Capabilities: Shot rate accommodation

Image courtesy F. Merrill, C. Morris et al.

HIGH EXPLOSIVES (HE) OPERATIONS TEAM ACTIVITIES:

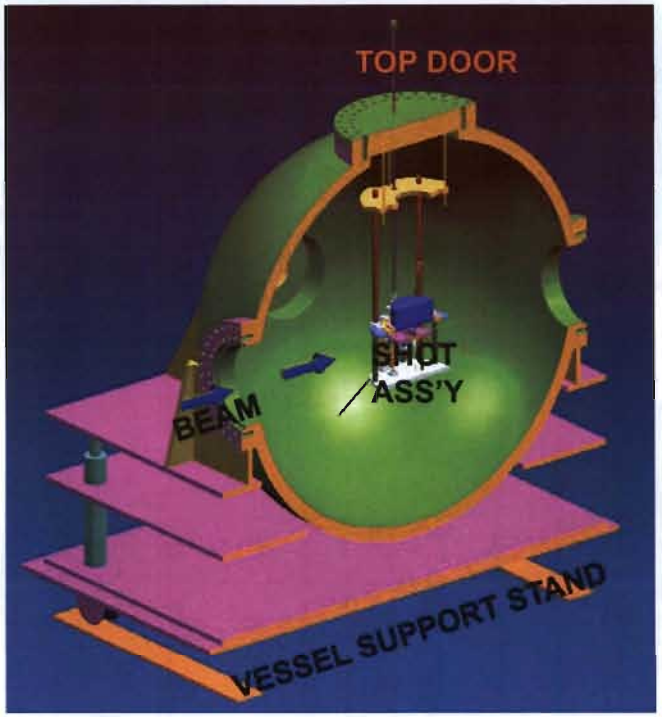
- HE Safety
- Incorporate experiment design into firing point
  - Coordinate preparation
  - Timing and firing
  - Coordinate explosives shipment
- Receive, install, execute shot at pRad
- Maintain vessel health
  - Post-shot surveillance
  - Proofing for fragment production and blast



Capabilities: Staging the firing point

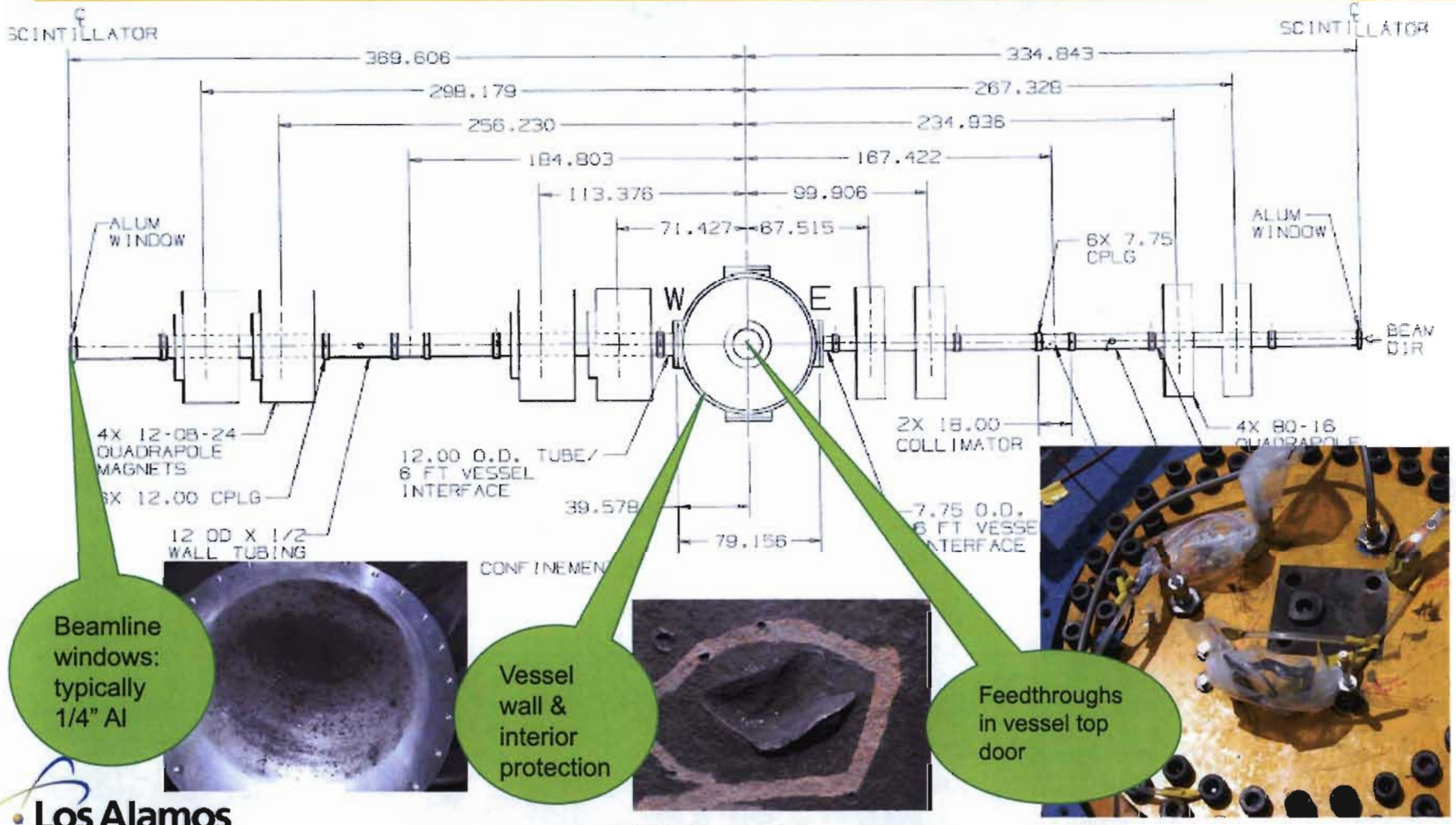
- **Administrative load limit at pRad: 10 lb TNT equivalent**
- **pRad shots are "proofed" to ensure sufficient confinement by vessel / beamline**

Images courtesy R. Valdiviez, P. Flores, J. Straight et al.



- 6-foot vessel: 2"-thick steel-walled (A537)
- post-shot purging protocol
- shot mounted from top door

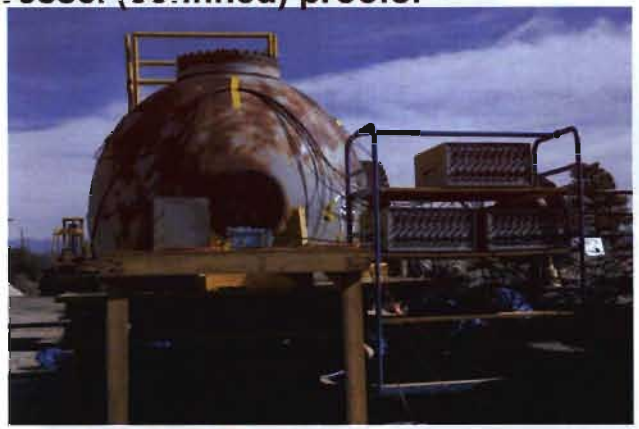
Aspects of the pRad confinement system that must be considered when staging for a shot include:



Proof shots: diagnosing damage ahead of time

FRAGMENTS:
Outdoor (non-confined) proofs:

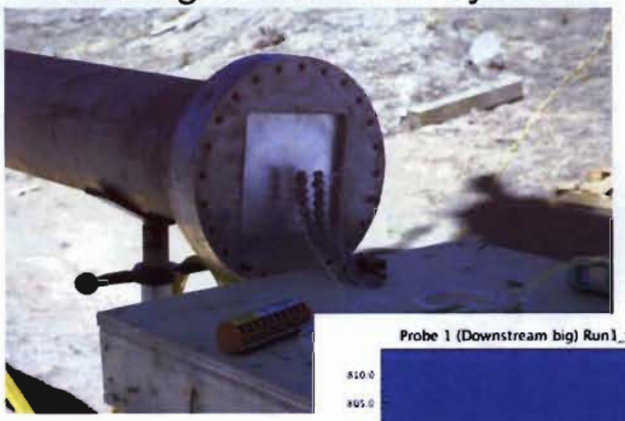
BLAST:
Vessel (confined) proofs:

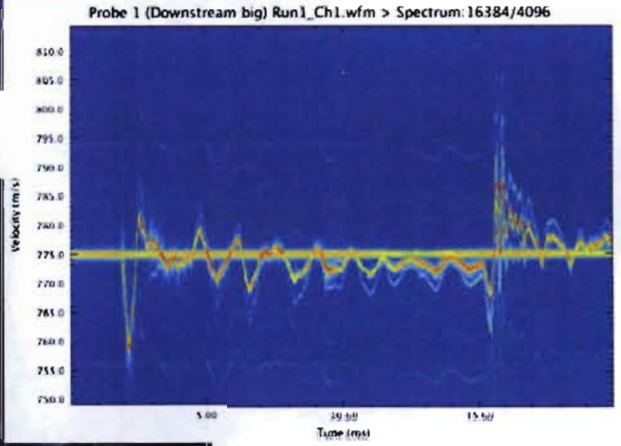


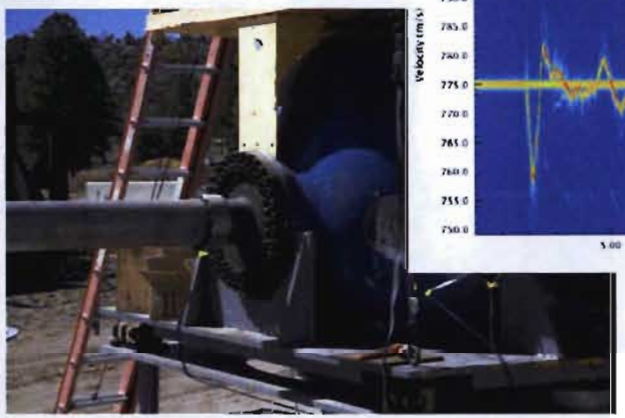
Images courtesy M. Marr-Lyon, J. Straight

Blast proof shots in the vessel:

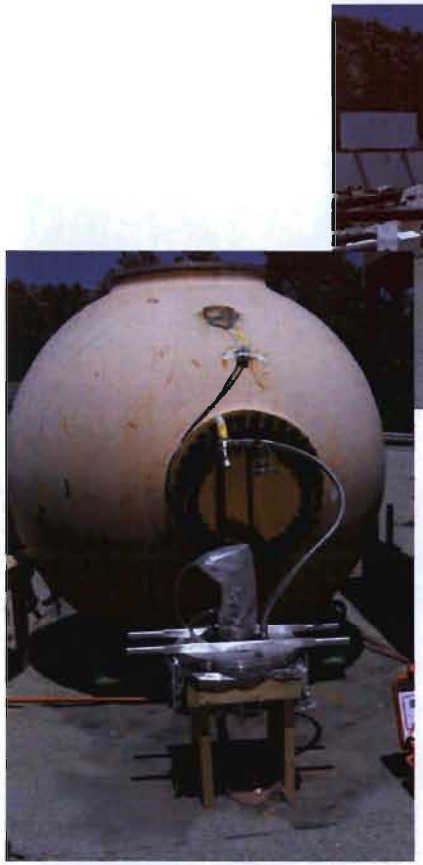
Measuring confinement system response to blast:

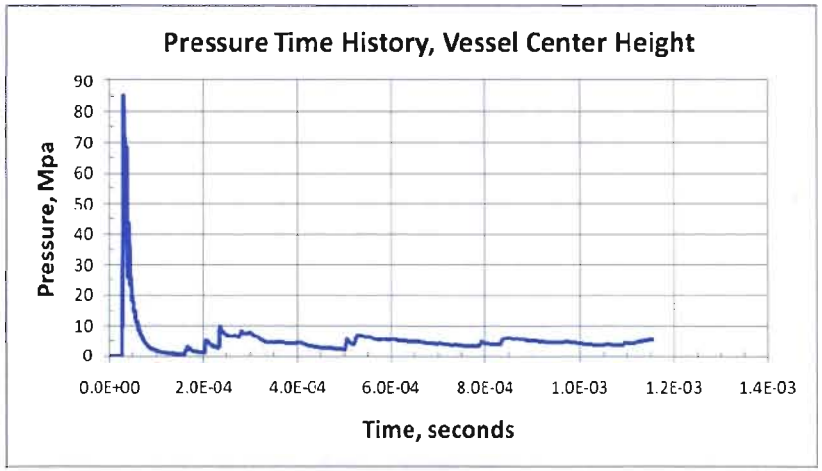






Proofing specific parts of a confinement system: Using a small vessel to replicate parts of the loading profile of a larger vessel





Reference: Valdiviez, R., Sandoval, P. P., and McNeil, W. V., "The Design, Analysis, Testing, and Use of a Small Confinement Vessel for Material Shock Physics Experiments," presented at ASME 2011 Pressure Vessels and Piping Division Conference, paper number PVP2011-57129, July 2011.

Proofing shots: The Vessel Shredder. Setup:

HE in mounting assembly

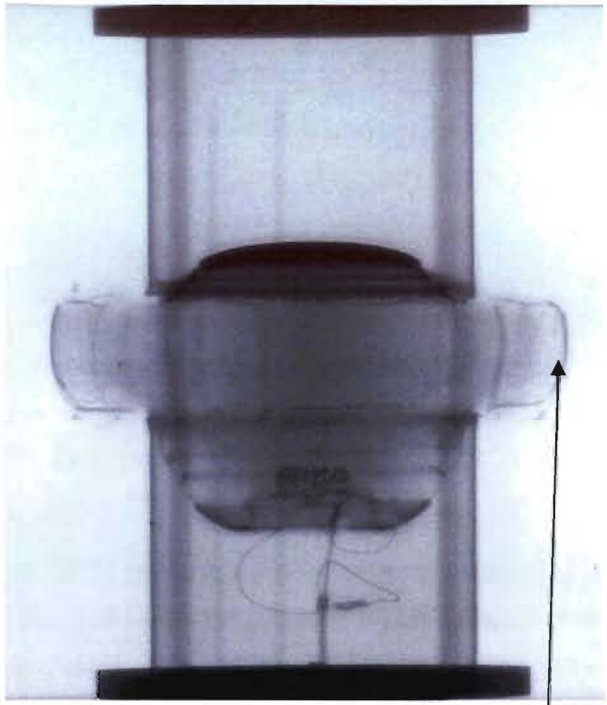
Aluminum can housing placed around HE

Images courtesy M. Marr-Lyon

½" Al witness plates

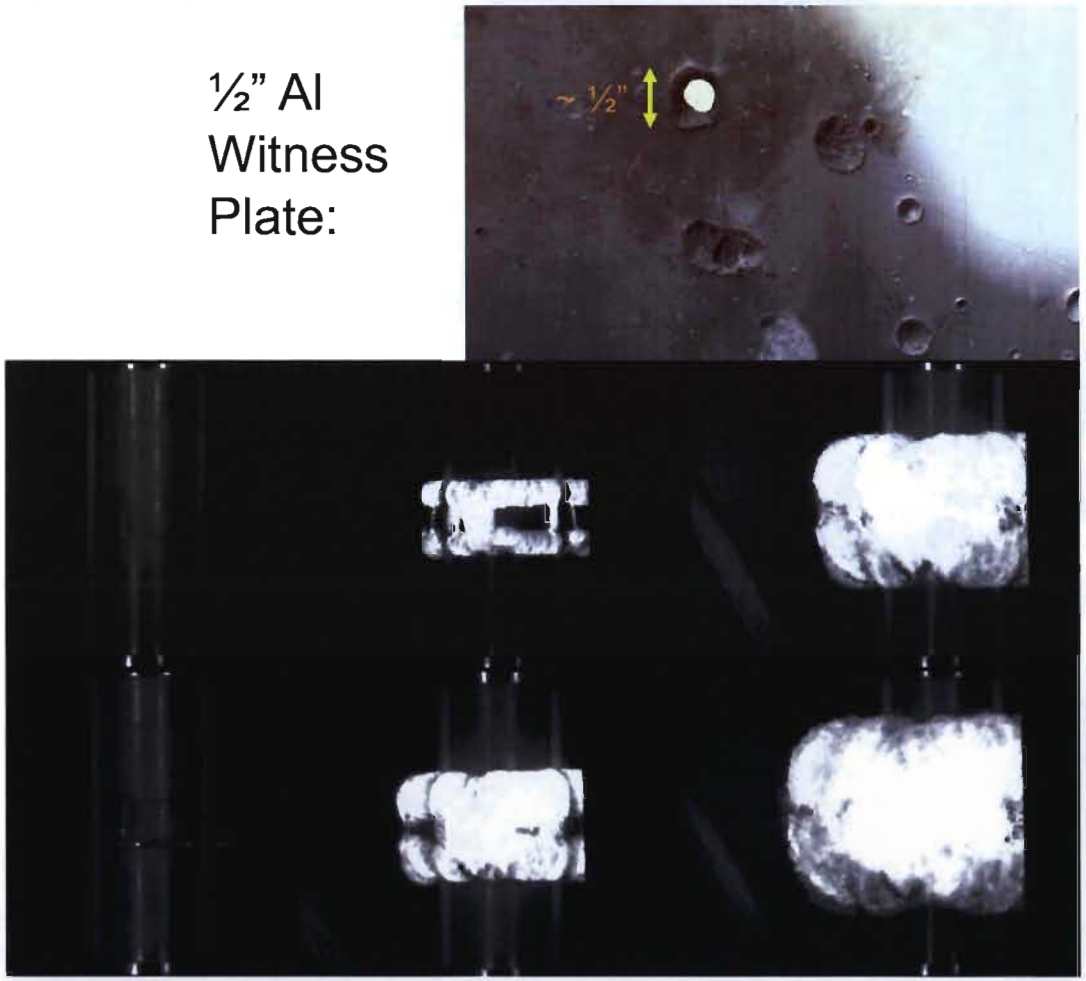
Proofing shots: The Vessel Shredder. The diagnostics:

Images courtesy M. Marr-Lyon

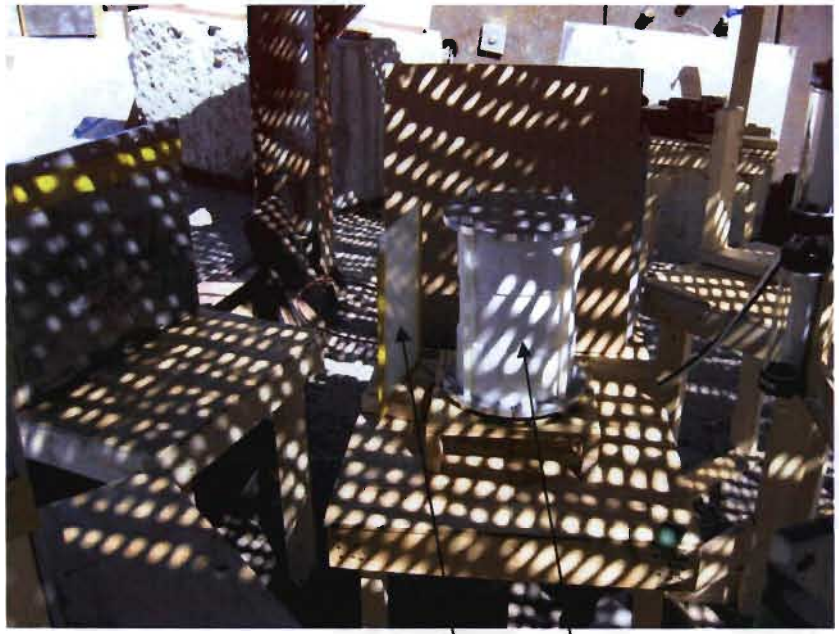


aluminum fragment

½" Al Witness Plate:



Proofing shots: The Vessel Shredder.
Using proof data to design mitigation strategy:



Glass mitigation layer

PVC housing

Glass

No glass

Post-shot witness plate

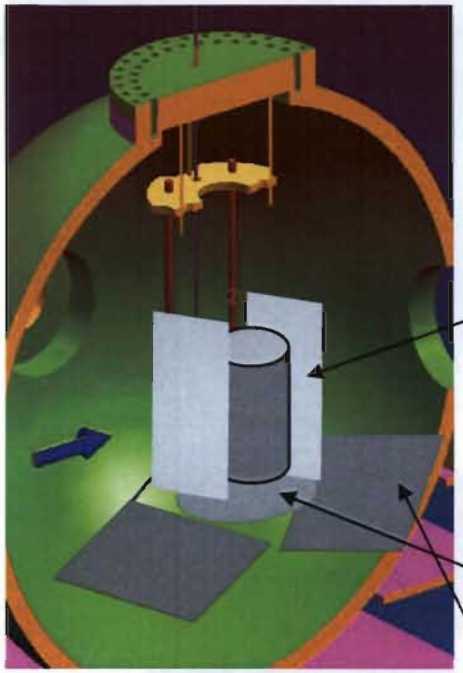
Images courtesy M. Marr-Lyon

Glass is not the universal mitigation strategy, however…

Images courtesy M. Marr-Lyon

Common mitigation strategies

Images courtesy J. Garcia, P. Flores, M. Marr-Lyon, W. Tuzel et al.

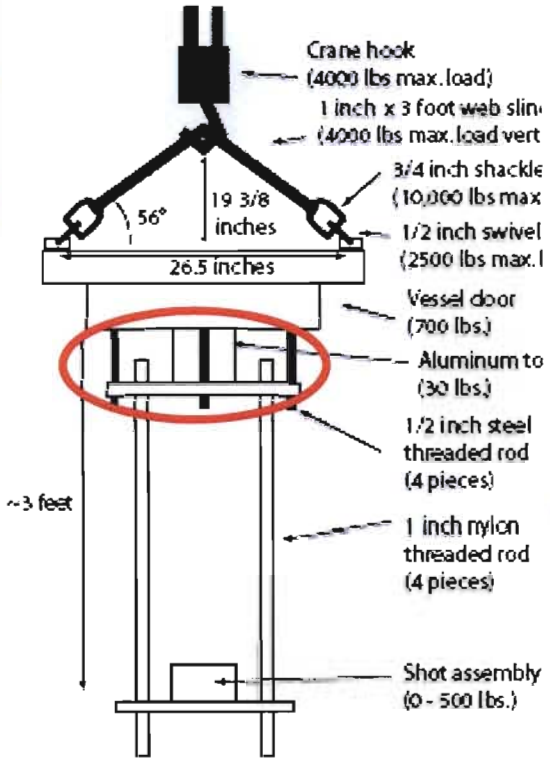


Glass and/or Al plates to protect beamline

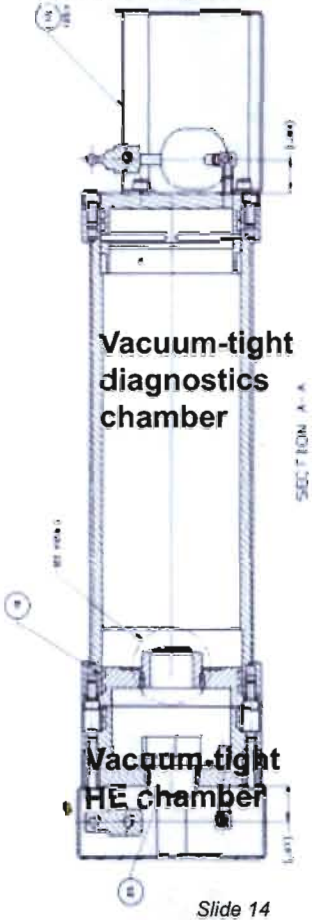
Baffle plates

Plates of RHA steel, Al line bottom of vessel

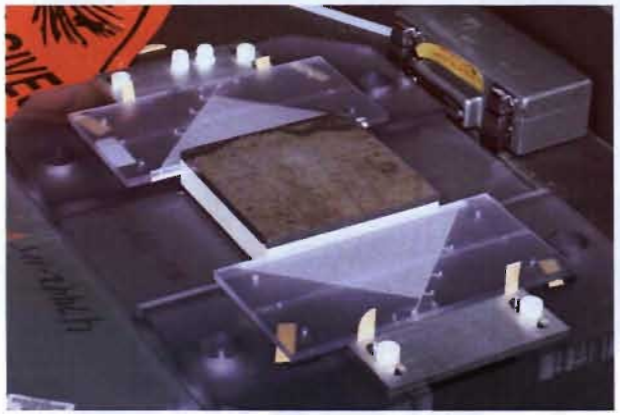
pRad "top-hat"



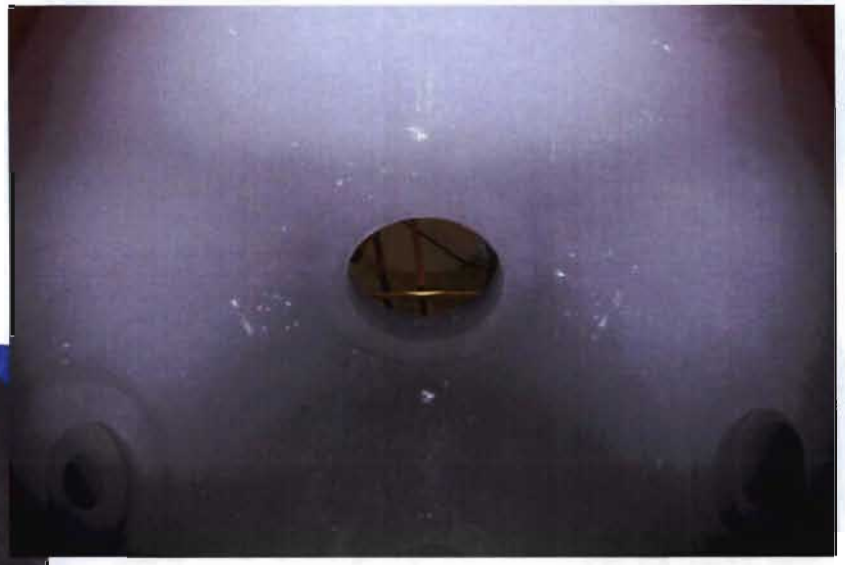
Confined confinement



Post-shot: Damage observations



Sandwich assembly



Post-shot: Damage to area around top port of vessel

Post-shot: Baffle plate above shot

Images courtesy M. Marr-Lyon

Post-shot: Identifying vessel damage

Depth: ~ 0.2"

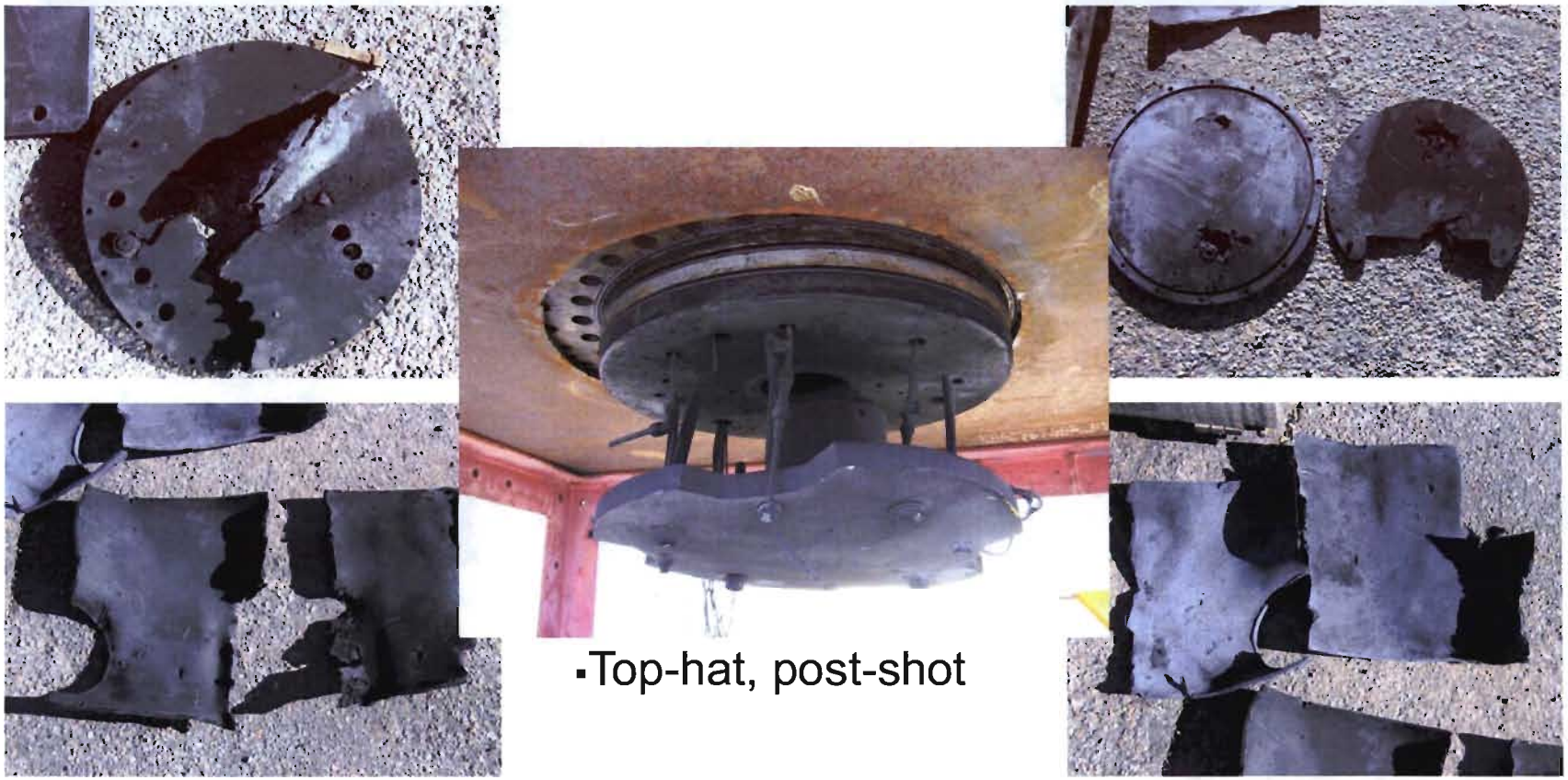
- Images courtesy M. Marr-Lyon

Proof shot in a vessel: damage observation

Al can configuration

Armor plates
staged around can
on shot stand mounted
from top door

Proof shot in a vessel: damage observation



- Top-hat, post-shot

Ongoing capabilities development

- The pRad firing site is a premier location to perform experiments relevant to HE and shock physics, modeling, dynamic material properties, hydrodynamic phenomena, diagnostic development, programmatic goals

-Image courtesy M. Marr-Lyon

Videos: Proof shots in vessels