



Engineered Structural Armor ^{SAND2008-1737P} Cost-Effective Hybrid Material Designs

Kevin Fleming

Leanna Minier

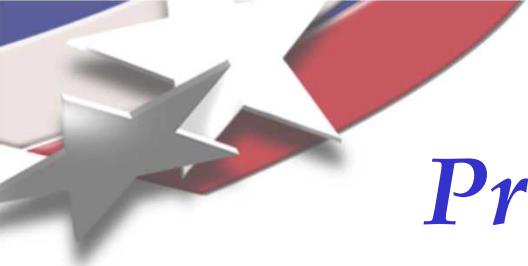
Mark Allen

Jerry Stofleth

Timothy Brown

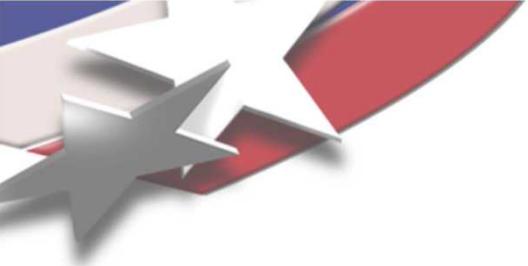
Brian Melof

Sandia National Laboratories-New Mexico



Overview of Presentations & Discussions

- Provide information to USG about Sandia and it's mission in National Security. (Strategic Alignment)
- Briefly describe Sandia's science & engineering capabilities in the areas of asset vulnerability, and how armor ties into our mission.
- Discuss possible ways we (Sandia/USG) can develop armor using government and industrial partnerships
- Understand/discuss USG's business interests, and their ideas for a strategic partnership with Sandia (*Roundtable discussions will follow the presentations*).



Could Structure Armor Address This Threat?

Michael Chertoff, Secretary of Homeland Security, Oct. 19, 2007:

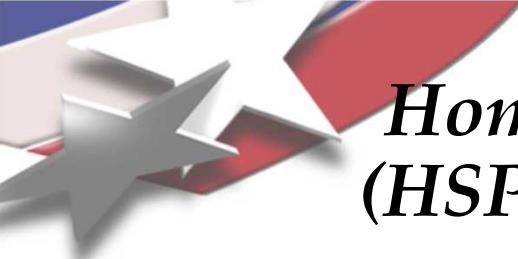
*"You know, in some ways, the discussion of IED threats is the discussion of terrorism because although we can conceive of a terrorist attack that would be focused on a biological infection or some kind of a chemical spray, the reality is the vast majority of terrorist attacks are conducted with bombs. And of those, the vast majority are improvised explosive devices. **So the very essence of what we do in fighting terrorism in a way is a challenge to the issue of IEDs.**"*





Overview of National Concerns

- **“Domestic & imported Terrorist activities are predicted to increase.”**, Washington Post, 10-2007
- **Successful IEDs demonstrated as effective, get global coverage, and reinforce terrorist attacks.**
- **Successful IED attacks may/will severely damage US economy, stocks, spending, etc. (ex. 9-11)**
- **Many vulnerable targets are structures:** transportation, energy production/storage, historical buildings, DC areas, schools, churches, communications bldg., financial structures, etc.
- **Significant funding committed to counter terrorist IEDs, with funding increases in 2009.**



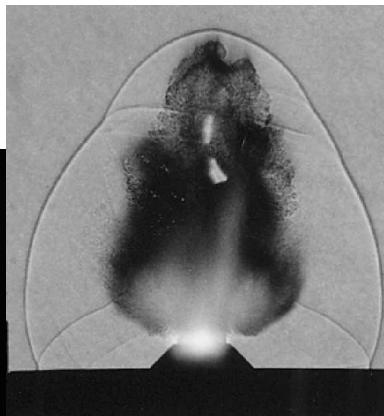
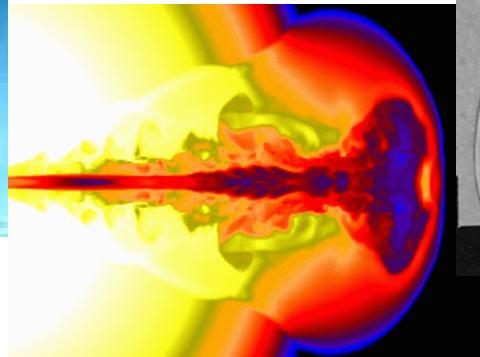
Homeland Security Presidential Directive (HSPD-19) Addresses IED threats in the US

- (2/12/2007) HSPD-19 states "*With our open and free society, this threat will be a challenge because of the ready availability of potential IED materials and components, evolving tactics for employment, and the ease with which instructions can be found to create them for numerous operational requirements and targets. These challenges are addressed and mitigated by the directive's focus on a layered security strategy----deter, prevent, and detect.----- ensure that protection and response efforts effectively neutralize or mitigate attacks should they occur.*"



Why is Sandia National Laboratories Interested in Developing Armor?

- After 9-11, Sandia was called upon by Department of Energy (DOE), and other government agencies to assess vulnerabilities of federal and civil structures. Armor is one method of blast protection
- Sandia is regarded as a world-leader in impact simulation, blast/failure analysis of engineered structures.
- Sandia's mission directly addresses upholding national security.





Does Armor Design & Industrial Partnerships Tie to Sandia's Goals?



Sandia's highest goal is to become the laboratory that the U.S. turns to first for innovative, science-based, systems-engineering solutions to the most challenging problems that threaten peace and freedom for our nation and the globe.

When we achieve our highest goal, we are widely recognized as a national leader in preventing technological surprise, in anticipating threats, in providing innovative, science-based, systems-engineering solutions to our nation's most challenging national security problems, and in managing the Laboratories in a way that inspires customer confidence.

The excitement and importance of our work, our exemplary work environment, our partnerships with academia, industry, and other partners, and our record of historic contributions help us to attract exceptional staff. Our employees are recognized by their professional peers for their outstanding contributions.



Sandia's Highest Goal "is to become the laboratory that the U.S. turns to first for innovative, science-based, systems-engineering solutions to the most challenging problems that threaten peace and freedom for our nation and the globe."



What are the Goals of Developing Advanced Armor?

- Provide innovative, cost-effective design/creation of armor. (Sandia and Industrial Partner)
- Use Sandia's science/engineering capabilities to model, design, develop (not fabricate) advanced structure armor.
- Work with government and industrial partners to blend armor designs **with *realistic production capabilities and optimized armor cost.***





Mission-Driven Laboratory With Many Agency Partnerships & Contacts



We serve many agencies of the US Government with:

- **Design and development:** nonnuclear portions of US nuclear weapons
- **Production:** advanced components
- **Safety, security, use control**
- **Treaty verification,** nonproliferation, counterproliferation
- **Advanced military technologies**
- **Energy and environment**
- **Homeland security, countering weapons of mass destruction**



Four Mission Areas-----

Armor Development Fits into All of Them

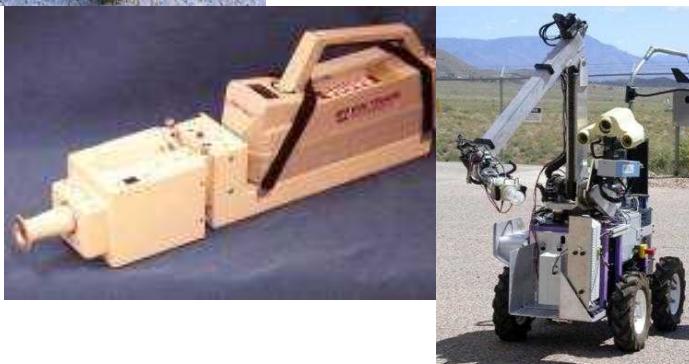


- *Nuclear Weapons*
- *Defense Systems and Assessments*
- *Energy, Resources, and Nonproliferation*
- *Homeland Security and Defense*

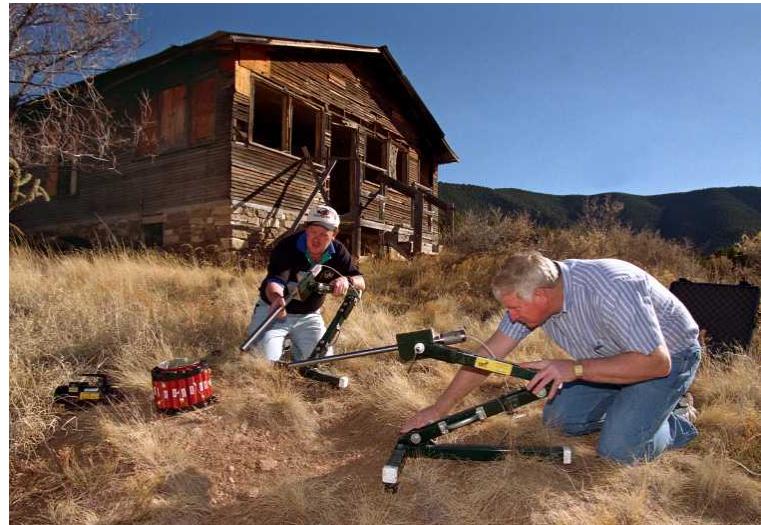


Sandia's Science & Engineering Advances Explosives Mitigation "Detect, Discover, Protect"

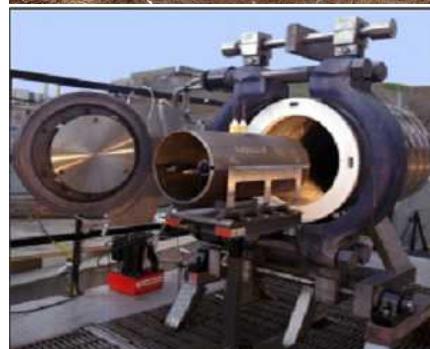
Armor Plate Protection



Explosives Detection System



PAN Disruptor



Chem/Bio Destruction

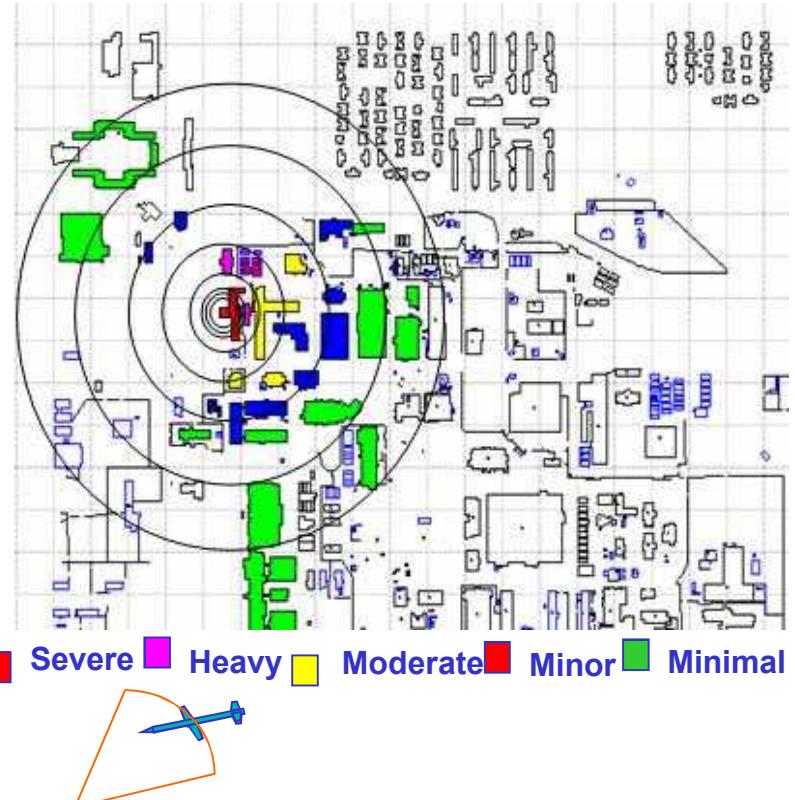


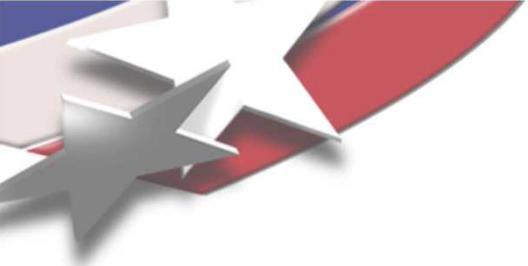
Predictions of Blast Area Damage Will Aid in Effective Armor Design

Explosives effects analysis

- Vulnerability analysis
- Blast Mitigation, consequence reduction

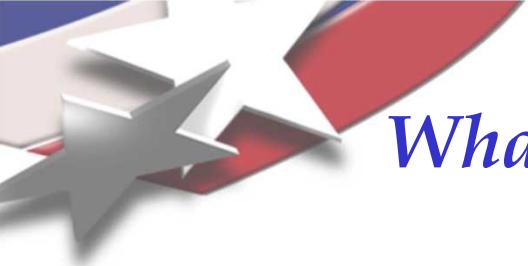
“Knowing the building response to blast is the first step to producing effective armor.”





What Steps are Needed to Create Structure Armor?

- Vulnerability assessment of structures and surrounding access points. Detailed models of materials, armor response to blast, fragmentation (engineering models).
- Develop hybrid armor/production model to provide a product that can be realistically manufactured.
(work closely with industrial partner for this effort).
- Materials science, engineering, test validations of armor that is within limits of industrial manufacturing.
- Develop on-going users database for end product (provides optimal armor design for the structure).



What are the End Results & Capabilities?

- A high-performance armor, using the best science, engineering, and manufacturing capabilities available. (In-process monitoring to ensure QC).
- An armor that, depending on the need, can be applied to existing and new construction, including other uses.
- An armor that significantly increases the protection of structures, and significantly reduces the level of vulnerability of National Assets and personnel.
- A dynamic partnership that is capable of rapidly responding to the design/manufacturing of new armor applications.



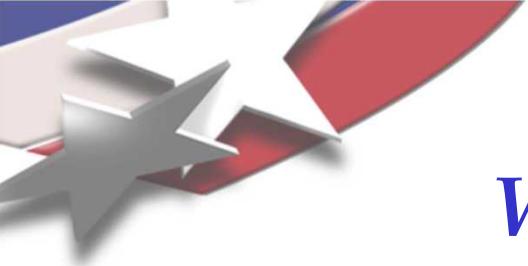
Why Use Mineral-Based Composites in the Design of Structure Armor?

- Large-scale mineral mining is potentially cost effective relative to synthetics mfg.
- Mineral fracture planes, crystalline geometries, compression (absorption of energy), can potentially yield novel composite armor performance.
- Multiple mineral/binder geometries (*modeled, engineered, performance validated*), provides a large suite of impact/blast/ballistic/fire & flame mitigation.



Does a Strategic Alliance Between Sandia and USG Make Sense?

- Sandia has world-class detonation & material modeling, test validation capabilities and experience.
- We have a good reputation with government, and industrial partners. (See CRADA Slide)
- Our experience adds credibility to constitutive blast models, armor designs and performance validation.
- Sandia works with numerous military & other government entities that may have potential interests in utilizing this potential armor material.



Is USG a Potentially Well-Matched Strategic Partner?

- 100+ years experience with mineral-based products.
- Highly respected in the home & industrial building supply markets and is also international supplier.
- USG continually diversifying their product lines. (Fibrock, Durock, Securock, etc.)
- Potentially, CRADA, and Work For Others (WFO) provides conduits for USG to partner with Sandia.



Summary of Presentation and Positive Benefits Pursuing an Alliance

- IED attacks in the US are a real threat to our National Security.
- Armor development fits well into Sandia's mission.
- Sandia can provide the science & engineering to aid in the development of advanced armor.
- Strategic partnership with industrial corporation optimizes potential to develop high performance armor.
- **Protection of National Assets, and citizens, is priceless!**



Sandia is Cognizant That Industrial Partners Want Strategic Costing

Re-Tooling Cost Money!



Flexible composite fabricated using similar techniques USG uses for their panel products



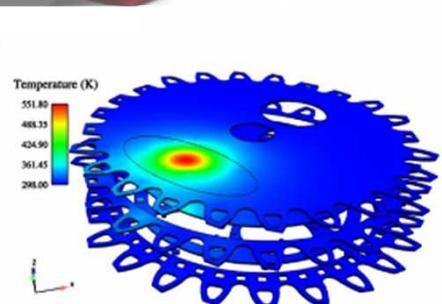
Panel ready for impact

“Witness Plate” dent.
Armor provided significant protection

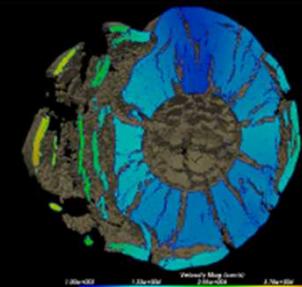
“Reality Check” Without armor,
Projectile punched through plate,
and 18” into hard-packed soil.



Let's Explore the Possibilities!



Engineering Sciences

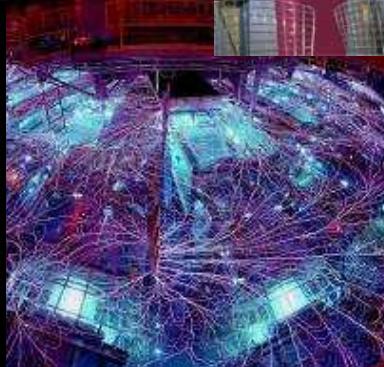


USG

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