SAND2008-2759P

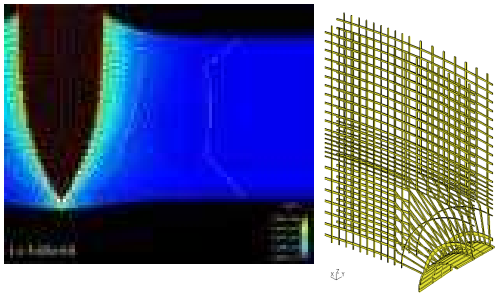
Sandia Science & Technology Collaborations With Russia

An Overview

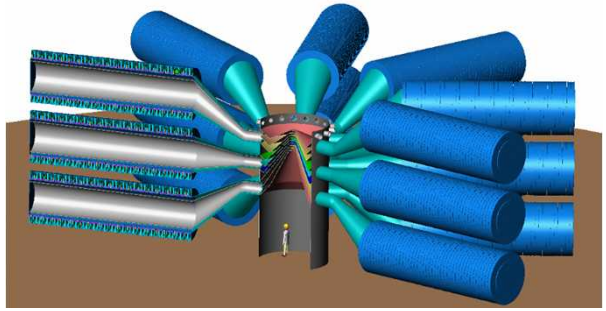
ASC

Pulsed Power

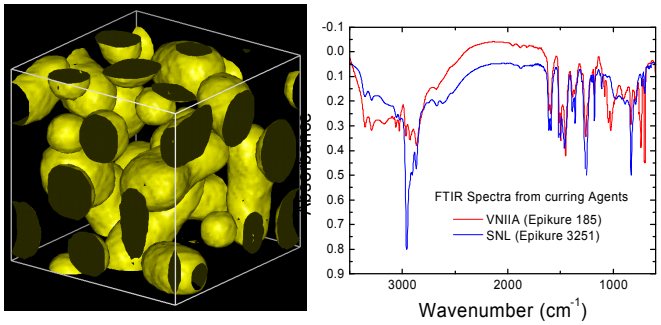
Materials Science



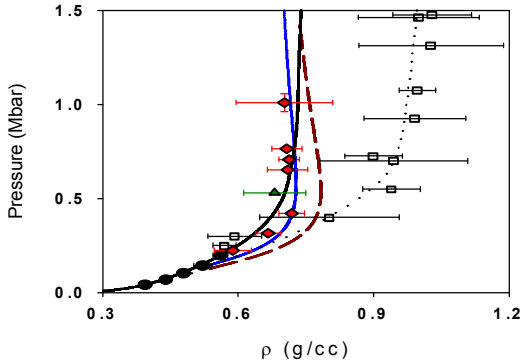
Impact dynamics modeling simulations



ZR/LTD



Sandia and VNIIA Polymer Mechanical/Thermal Decomposition Experiments



Equation of State (EOS) of Hydrogen and Deuterium from 1-3 Mbar Under Isentropic Compression

Sandia National Laboratories

Sandia Scientific & Technical Russian Engagement: Snapshot for FY08

Advanced Scientific Computing

VNIIA	Polymer Mechanical/Thermal Decomposition Experiments
VNIITF	Numerical Simulation of Wire Array Implosions and Development of Hybrid Codes for Modeling Petawatt Laser Interactions with Dense Plasmas
VNIIEF/ITMF	Scalability Assessment for Parallel Algorithms of Numerical Simulation
VNIIEF/ITMF	Molecular Dynamics Investigations of High Explosive Properties
VNIIEF/ITMF	Atomistic Study of Phonon Generation and Evolution During Dynamic Crack Propagation
VNIIEF/ITMF	Scalability Studies for Simulation Codes Based on Varying Models of Inter-processor Communications
VNIIEF/ITMF	Measurement of Time Instability of Parallel Computers
VNIIEF/NTC	Numerical MHD Simulation of Sandia Z Pinch Experiments
RAS/IPME	Multi-scale Modeling and Simulation of Phonon Transport and Evolution by Concentrated Heat Source (Laser Excitation) or Mechanical Loading
RAS/IPME	Modeling the Effects of Mechanics and Chemistry on Material Damage and Failure
RAS/JIHT	Extending Non-Equilibrium Molecular Dynamics Simulation Methods

Pulsed Power

RAS/HCEI	Complete design and construction of a 10-cavity LTD module

Materials Science

VNIIEF	Provide structural deformation data and analysis/modeling to validate Sandia accident response codes

Other

VNIIEF	Human factors in high risk nuclear facility operations

Sandia Scientific & Technical Russian Engagement: Benefit to the Nuclear Weapons Program

These contracts access premier capabilities at Russian Institutes, either in their Weapons complex or in their Academy of Sciences, which overlap with our interest areas.

Approach: engage broadly

assess progress and revisit potential value

prune

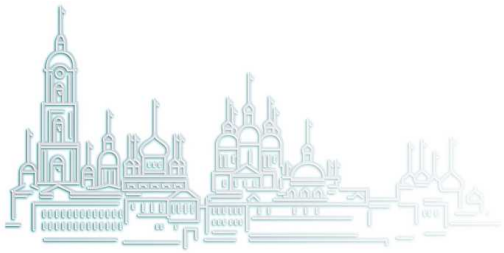
transfer successful starts to the benefiting program for full funding

Metrics for selection:

- World-class Russian expertise in the specific topical area
- Ability of the exchange to benefit Sandia either through tactical return in achieving program deliverables, or strategically in developing advanced capabilities which may be reasonably expected to have future tactical value
- Benefit balance between Sandia and the international partner
- Sandia NW commitment to fund this duration of investment for these anticipated returns

Engagement results have been directly applied to ASC and Pulsed Power mission areas.

Human Factors was transferred to the Office of Naval Research and to the NNSA Nuclear Safety R&D Working Group



Sandia Scientific & Technical Russian Engagement: What has worked and what has not

Worked

Broad impact: invigorated staff with expanded perceptions and world-class skill sets

Personal growth: staff advocates have overcome the barriers with enthusiasm to make the experience positive for them, for their careers, and for the laboratory.

Not Worked

Impediments: language, cultural differences in approach and expectations, export control, international procurement restrictions, extensive procedural delays, etc.

Conflict between tactical (investing in progress on near term goals) and strategic (the possibility of longer-term return from developing a world-class engagement).

Management Lessons Learned

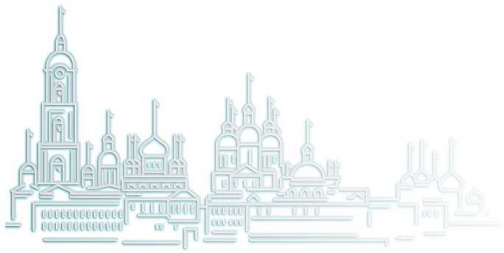
Motivate staff to engage world-class expertise on problems of S&T importance:

- To improve staff competence and skills
- To assist in mission success
- To prepare for future challenges

Identify world-class prospective employment candidates

Focus on fundamental science (avoid classification, critical path to product, and export control)

Recognize and reward staff who enable successful international collaborations



Sandia Scientific & Technical Russian Engagement: Future State Vision

1-year

1. A single NNSA POC for Russian S&T engagements, with clear expectations and funding allocations
2. Expand our knowledge of Russian skills, capabilities, and facilities to optimize engagement.
3. Move from strictly contractual procurements toward a portfolio which includes balanced collaborations

5-years

Expand the S&T scope of interactions to:

1. Materials Science: Theory and models of material dynamic and aging response.
2. Plasma Science: Modeling and experimental validation of non-LTE plasmas and high energy density science.
3. Nuclear Science: Theoretical and experimental nuclear properties and reactions.
4. Nano and Micro Science: Component and system design and performance modeling, verification, and validation.
5. System Software and Hardware: Parallel computing architectures and operating systems.
6. Computational Algorithms: General purpose algorithms and solvers for computer science and engineering applications.
7. Simulation Comprehension: Visualization techniques, data mining, feature extraction, and data motion.