Performance Simulation- Successes

- ASCI is developing a comprehensive, validated simulation based approach to use for hostile environment certification.

STS Certification Process

Normal, Hostile and Fratricide Environments

- X-ray Effects:
  Energy Deposition
  Spalling, Fracture
  Delamination
  Thermal
  Expansion
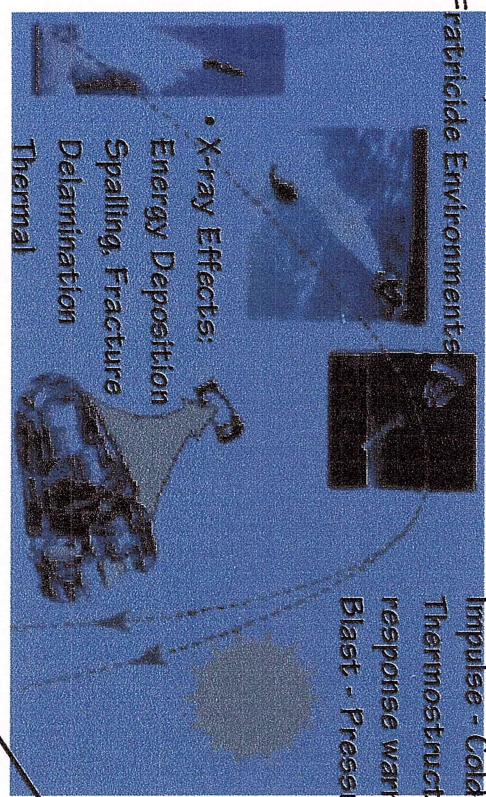
Reentry
Impulse - Cold x-rays
Thermostructural
response warm/hot x-rays
Blast - Pressure ball

- Certification Simulation for Mechanical
  Response of W76 Replacement
  NG (3×10^5 node hours on
  ASCI Red) performed
  in FY98

Shavano Project

Primary Code - LANL

Primary Code - LLNL

FPO
Classified

Virtual Aging- Successes

High Explosive

| 10 ns | 20 ns | 30 ns |
| 40 ns | 50 ns | 80 ns |

- Modeling leading experimental discovery
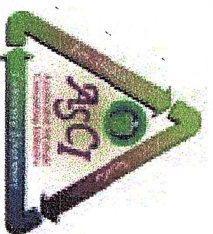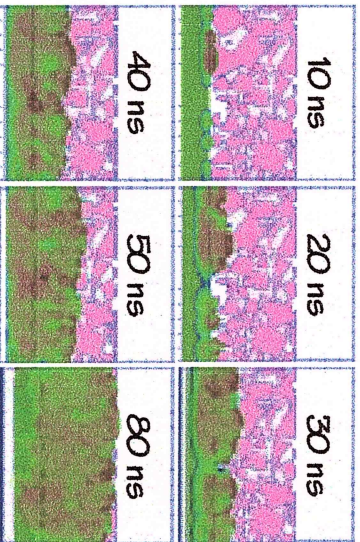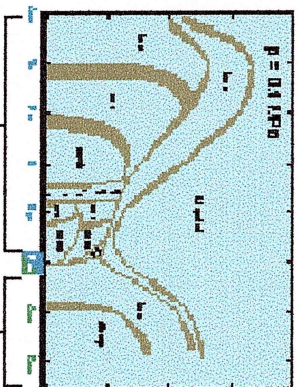
- Successfully predicted behavior of aging HE (W76 Fireset)
- Fine scale to physics coupled to engineering analysis currently available on ASCI Red, allows discovery of fundamentals of shock initiation

Plutonium

Improved Pu EOS

$\rho = 0.1 \, \mathrm{P_0}$
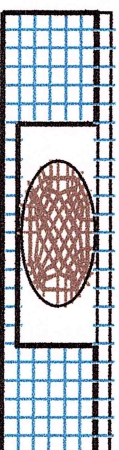
- Developed Pu aging simulation tools for atomic forces and structural phase transformations
- Did calculations of high pressure elastic constants for body centered cubic (bcc) Pu from first principles, resolving anomalies in historic test data

W76/W87 Butyl O-rings

- Microscopic chemistry drives lifetime uncertainties
- Developing the capability to predict loss of material integrity

Finite Element Analysis with JAS3D code

Sealing Force/Unit Length

13 kcal
16 kcal
19 kcal

Time (years)
0   100   200   300

Loss of O-ring sealing force as a function of time and activation energy at 27°C
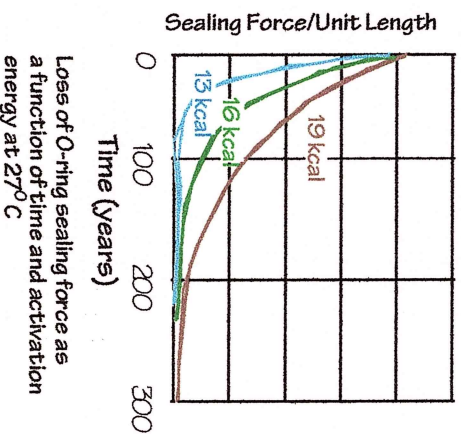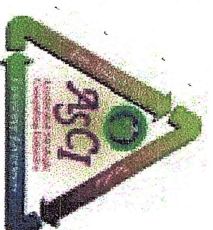
Non Nuclear Codes Roadmap ("Curve")

…3D – "more-complete-physics" – high fidelity simulation, has key milestones tied to stockpile requirements or expected aging & manufacturing requirements - i.e, Green Book or SDR

100,000 x	
10,000 x	Circuit physics Modeling with Aging Effects
1,000 x	Simulation Capability for Virtual Design of Full System Normal Environment Response
100 x	3D MP Electrical Device Physics
	Validated System/Component Response in Severe Combined Environments
	Rad Hard Full System/Full Response Certification
	Initial Determination of role of Micro-structure on Perf of NG Material
	Prototype System/Component Response in Severe Combined Environments
	W76 Power Management Circuit Model
10 x	Penetration Env Certification Capability
	Penetration Environment Certification (B61-11)
	Rad Hard for NG Mech Certification (W76)
	Neutron Generator Standoff (WPP)

96 97 98 99 00 01 02 03 04 05

100 TeraOpS

10/50 TeraOpS

TeraOpS Capability