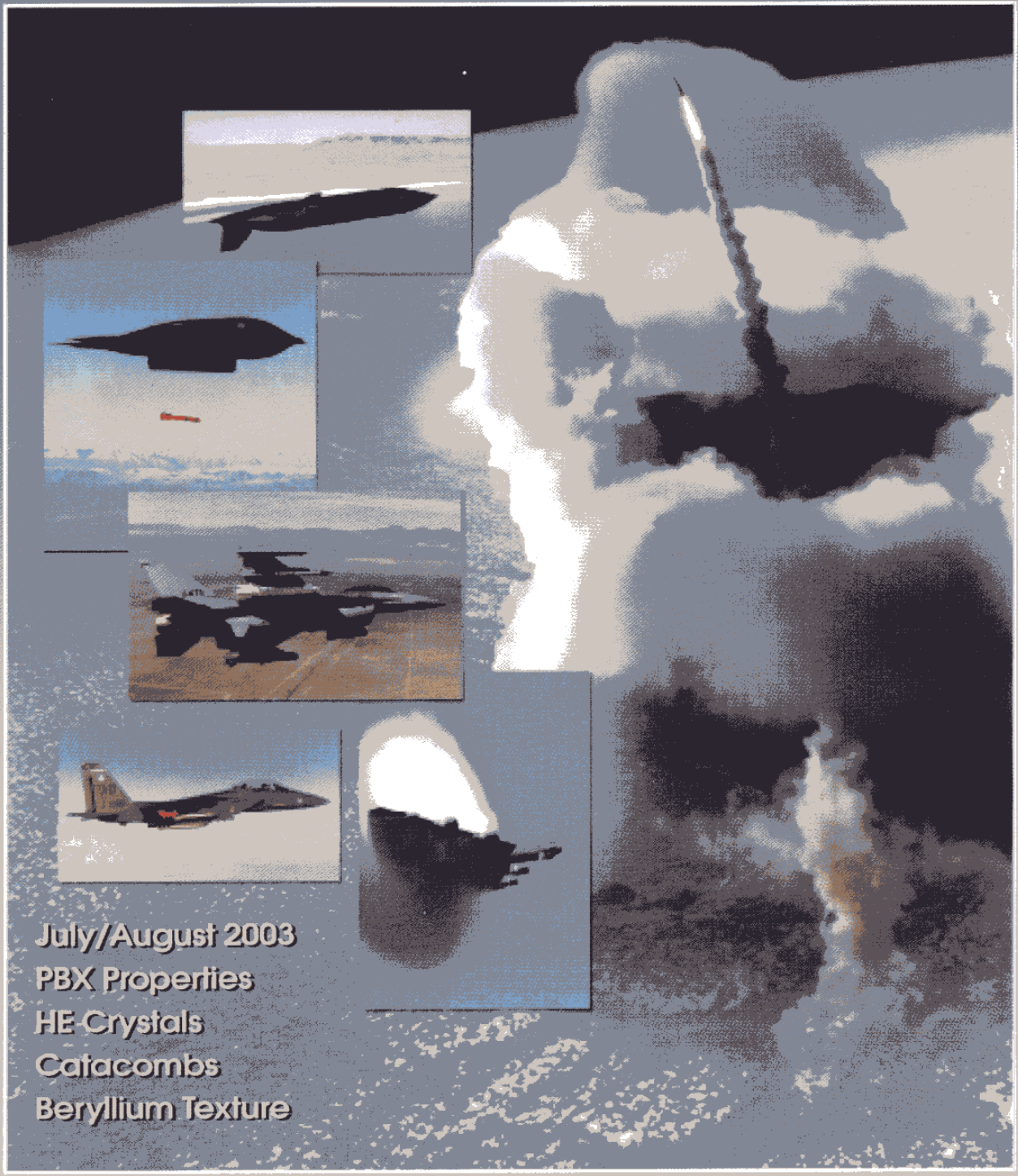
nuclear weapons journal



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PBX Properties

HE Crystals

Catacombs

Beryllium Texture

Weapons Science and Engineering at Los Alamos National Laboratory

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About the cover: The Laboratory continues to provide for the nation's deterrent by maintaining reliable warheads for the existing strategic and tactical delivery platforms. Los Alamos is committed to providing a continuing deterrent as the nation's requirements evolve in the 21st century.

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Point of View

Richard Mah
Associate Director
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Job #1: Stockpile Stewardship

Stockpile Stewardship is the top priority for the nuclear weapons program at Los Alamos National Laboratory. As stewards of the nation's nuclear weapons stockpile, our focus is on maintaining high confidence in the safety, security, reliability, and performance of the warheads in the enduring stockpile.

Los Alamos is the Design Agency for five weapon systems in the enduring stockpile: B61, W76, W78, W80, and W88. The United States has not built a new nuclear weapon since 1989, and the design life of these warheads is limited. As warheads approach the end of their design life, the stewardship challenges increase. Currently, two Los Alamos systems, the B61 and the W76, are scheduled for refurbishment through Life Extension Programs (LEPs).

Weapons system refurbishment is managed under the Phase 6.X Process through the Project Officers Group (POG) and the Nuclear Weapons Council (NWC); Phase 6 of the acquisition process is Quantity Production and Stockpile. The Phase 6.X Process guidelines are based on the management framework for the nuclear weapon acquisition process that was established by DOE—in agreement with the DoD—and used for over 40 years to design and build the nation's nuclear arsenal. The 6.X phases are

- 6.1 Concept Assessment,
- 6.2 Feasibility Study and Option Down-Select,
- 6.2A Design Definition and Cost Study,
- 6.3 Development Engineering,
- 6.4 Production Engineering,
- 6.5 First Production, and
- 6.6 Full Production.

The B61 and the W76 are in Phase 6.3 of their LEP refurbishment schedules.

B61 LEP

The B61 is a family of strategic and tactical nuclear bombs. Modifications (Mods) 7 and 11, which are scheduled for refurbishment, are strategic bombs carried by the B-52 and the B-2 bombers. Mods 3, 4, and 10 are tactical bombs carried by the F-15 and the F-16 fighters. The B61 design incorporates insensitive high explosive and enhanced nuclear detonation safety features. Components being refurbished include the canned subassembly and associated seals, foams, pads, and cabling. These secondaries were built before 1970 for the B61-0/-1 and were originally designed for an 8-year life; however, an in-production process change later extended the estimated design life to 20 years.

Phase 6.2/6.2A life extension studies on the B61-7/-11 began in December 2000 and were completed in August 2002.

In November 2002, the NWC granted approval to proceed to Phase 6.3. These activities include completing the engineering development of the life extension options that were recommended as a result of the Phase 6.2/6.2A study and subsequent POG down-selection. Phase 6.3 also will require developing and providing complete engineering releases for various components and subsystems to the production facilities, in conjunction with concurrent engineering, to ensure that designs being developed can be produced.

Production engineering (Phase 6.4) is scheduled to begin in the first quarter of FY04, and the first production unit (Phase 6.5) is planned for 2006.

W76 LEP

The W76 is a strategic nuclear warhead that is carried in the Mark 4 (Mk4) reentry body on Trident I C4 and Trident II D5 submarine-launched ballistic missiles on Ohio-class submarines. The W76 design

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Security: Modeling Entry and Exit Inspections

By using Analytical System Software for Evaluating Safeguards and Security (ASSESS) and either Monte Carlo simulation or Joint Combat and Tactical Simulation (JCATS) modeling tools, S-1 conducts vulnerability analyses, compiles force-on-force exercise validation data for vulnerability modeling, and develops the Site Safeguards and Security Plan.

To enhance the utility of ASSESS and JCATS, we presented a graded approach to controlling access to mission-critical facilities in Modeling the Effectiveness of Entry/Exit Inspections (LA-UR-03-2000). A generic model can be used to quantify (1) the probability of detecting the transport of illicit, prohibited, or unauthorized materials or documents past an inspection point (detection models); (2) the amount of illicit, prohibited, or unauthorized materials or information transported before detection occurs (loss quantification); and (3) the effects of traffic on entry/exit inspections (traffic models). We obtain values for the model's parameters from automated login/logout data, performance test data, and reasonable assumptions; we have found that the model applies equally well to both entry and exit inspections and can be used for inspections of personnel, equipment, or a combination of personnel and equipment.

We have identified the parameters that affect each detection model, the relationships between models, and the equations and formulas used to calculate detection probabilities. In vulnerability analysis, it is also important to quantify the amount of material or information that could be lost prior to detection and the effects of traffic intensity on the probability of detection, and we also have techniques to calculate those quantities.

Ultimately, these formulas and techniques establish three main strengths. They will (1) put evaluation of entry/exit inspections on a firm objective footing, (2) allow a trained professional to discover the strengths and weaknesses of entry/exit inspections, and (3) aid organizations in modeling the effectiveness of entry and exit inspections. ✹

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***Point of View** continued from page 1*

incorporates conventional high explosive and enhanced nuclear detonation safety features.

Development began in 1973, and the W76 was fielded in 1979 with an original design life of 20 years. However, the Navy projects the life of Ohio-class submarines to extend until 2042 and requires that the warheads on the Trident missiles be available during this period.

The NWC approved the W76 refurbishment in 1998, and Phase 6.2/2A was initiated to review weapon components and subsystems and to evaluate their ability to meet all performance requirements for an extended service life. This effort was completed in only 15 months.

The NWC granted conditional approval to begin Phase 6.3 activities in March 2000 and final, unconditional approval in December 2000. A comprehensive refurbishment of the W76, including the primary and secondary, is planned to support the extended lifetime of the weapon system. Planned Phase 6.3 activities for the refurbishment will include small-scale energetic tests, full-scale hydrodynamic tests, joint ground tests, joint flight tests, physics modeling and calculations, and material studies.

Production engineering (Phase 6.4) is scheduled to begin in the third quarter of FY05. Delivery of the first production unit (Phase 6.5) is planned for the fourth quarter of FY07.

Top Priorities

The LEPs for the W76 and the B61 are top priorities for the weapons program at Los Alamos. Our B61 and W76 teams are aggressively attacking these challenging projects and look forward to an exciting and rewarding time during the upcoming years. These refurbishments will exercise nearly all the capabilities of Los Alamos and the entire nuclear weapons complex and will ensure the robustness of the US strategic nuclear deterrent well into the future.