

Lifetime Extension Program (LEP)

Executive Summary

JSR-09-334E

September 9, 2009

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1 Executive Summary

1.1 Study charge

This study of the Life Extension Program (LEP) for deployed U.S. nuclear weapons responds to the following charge.

“NNSA requests that JASON study LEP strategies for maintaining the U.S. nuclear deterrent in the absence of underground nuclear testing. This should include:

- Study the certification challenges associated with changes, to include accumulation of changes, made to a warhead¹ during its life.
- Compare the assessment and certification challenges of different LEP strategies ranging from refurbishment to replacement.
- Study proposed methods to measure the evolution of risk due to multiple changes during warhead life and initiated in LEPs.
- Study how NNSA can mitigate risks while maintaining a safe, secure and reliable nuclear deterrent. Comment on how the overall balance and structure of science, technology, engineering and production activities can be made to minimize future risk to the stockpile.
- Study the accumulated risks and uncertainties of the current Life Extension Program strategy. As already identified by a previous JASON study, risk areas include:
 - Linkage to UGT data,
 - Manufacturing changes that may unavoidably result in differences from the as-tested devices,
 - Increased surety² features, and
 - Thresholds to failure.”

NNSA provided the following definitions:

“Refurbishment (current implementation of LEP) - Very generally, individual warhead components are replaced before they degrade with components of (nearly) identical design or that meet the same “form, fit, and function.”

Warhead Component Reuse - Refers specifically to the use of existing surplus pit and secondary components from other warhead types. Approach may permit limited warhead surety improvements and some increased margins.

¹In this study “warhead” refers to the nuclear explosive package and associated non-nuclear components.

² Surety encompasses safety, security and use control.

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Warhead Replacement - Some or all of the components of a warhead are replaced with modern design that are more easily manufacturable, provide increased warhead margins, forego no longer available or hazardous materials, improve safety, security and use control, and offer the potential for further overall stockpile reductions.”

1.2 Findings

JASON was asked to assess the impacts of changes to stockpile warheads incurred from aging and LEPs. In response:

- **JASON finds no evidence that accumulation of changes incurred from aging and LEPs have increased risk to certification of today’s deployed nuclear warheads**

This finding is a direct consequence of the excellent work of the people in the US nuclear weapons complex supported and informed by the tools and methods developed through the Stockpile Stewardship program. Some aging issues have already been resolved. The others that have been identified can be resolved through LEP approaches similar to those employed to date. To maintain certification, military requirements for some stockpile warheads have been modified. The modifications are the result of improved understanding of original weapon performance, not because of aging or other changes. If desired, all but one of the original major performance requirements could also be met through LEP approaches similar to those employed to date.

- **Lifetimes of today's nuclear warheads could be extended for decades, with no anticipated loss in confidence, by using approaches similar to those employed in LEPs to date .**

The report discusses details and challenges for each stockpile system.

For each warhead, decisions must be made about including additional surety features. Findings regarding surety features are

- **Further scientific research and engineering development is required for some proposed surety systems.**
- **Implementation of intrinsic³ surety features in today's re-entry systems, using the technologies proposed to date, would require reuse or replacement LEP options.**
- **All proposed surety features for today's air-carried systems could be implemented through reuse LEP options.**

3i.e. inside the nuclear explosive package.

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- **Implementation of intrinsic surety features across the entire stockpile would require more than a decade to complete.**

Concerning methods for assessing evolution of risk and assessing the effects of multiple changes to a weapon, we find that

- **The basis for assessment and certification is linkage to underground test data, scientific understanding, and results from experiment.**
- **Quantification of Margins and Uncertainties (QMU) provides a suitable framework for assessment and certification.**
- **Increased scientific understanding enables reduced reliance on calibration, enhanced predictive capability, and improved quantification of margins and uncertainties.**

Regarding certification challenges for LEP strategies ranging from refurbishment to replacement, we find that

- **Assessment and certification challenges depend on design details and associated margins and uncertainties, not simply on whether the LEP is primarily based on refurbishment, reuse, or replacement.**

Concerning the overall balance and structure of science, technology, engineering and production

activities, and how to mitigate risk to the stockpile, we find that

- **Certification of certain reuse or replacement options would require improved understanding of boost.**
- **Continued success of stockpile stewardship is threatened by lack of program stability, placing any LEP strategy at risk.**

Surveillance of stockpile weapons is essential to stockpile stewardship. Inadequate surveillance would place the stockpile at risk. We find that

- **The surveillance program is becoming inadequate. Continued success of stockpile stewardship requires implementation of a revised surveillance program.**

We conclude this section with a concern. All options for extending the life of the nuclear weapons stockpile rely on the continuing maintenance and renewal of expertise and capabilities in science, technology, engineering, and production unique to the nuclear weapons program. This will be the case regardless of whether future LEPs utilize refurbishment, reuse or replacement. The study team is concerned that this expertise is

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threatened by lack of program stability, perceived lack of mission importance, and degradation of the work environment.

1.3 Recommendations

Our recommendations are as follows:

- **Determine the full potential of refurbishment, as exemplified by LEPs executed to date, for maintaining or improving the legacy stockpile.**
- **Quantify potential benefits and challenges of LEP strategies that may require reuse and replacement, to prepare for the possibility of future requirements such as reduced yield or enhanced surety.**
- **Strengthen and focus science programs to anticipate and meet potential challenges of future LEP options, including challenges associated with boost and surety science.**
- **Revise the surveillance program so that it meets immediate and future needs.**
- **Assess the benefits of surety technologies in the context of the nuclear weapons enterprise as a system, including technologies that can be employed in the near term.**