

OFFICIAL USE ONLY

JASON
MITRE

August 9, 2012

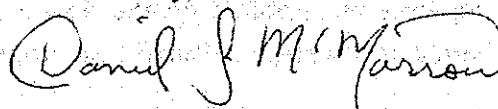
Mr. Maurice Pitt
P.E., Director
Stockpile Research, Development and Engineering
Division NA-12.4
1000 Independence Avenue, SW
Washington DC 20585

Dear Mr Pitt:

Please find attached the working paper you requested on the B61 Life Extension Program upgrade project. We have given the topic careful consideration and our observations are outlined in the working paper.

If you have any questions please call me or Roy Schwitters.

Sincerely,



Dr. Daniel J. McMorro
Director
JASON Program Office

DM/abh

Encl: Working Paper on B61

The MITRE Corporation
P.O. Box 1474
La Jolla, California 92038
858-459-9701

OFFICIAL USE ONLY

Official Use Only

JASON B61 Life Extension Program Nuclear Scope Review

August 9, 2012

Background

The Omnibus Conference Report 112-331 (15 December 2011) directed a JASON review of the nuclear scope of the B61 Life Extension Program (LEP). The Terms of Reference (TOR) provided by NNSA requested that JASON evaluate the B61 LEP nuclear scope to assess the following:

- The extent to which the nuclear scope is needed to enhance the safety, security, and maintainability of a refurbished B61
- Whether changes to the weapon will affect its long-term safety, security, reliability and military characteristics

The reference case for this review is Option 3B for the B61 LEP. This option has been selected by the Nuclear Weapons Council (NWC) for Phase 6.3 Engineering Development. The DoD Military Characteristic (MC) requirements were revised for Option 3B; the revisions are aimed at reducing technical uncertainties in achieving the military requirements. There are still uncertainties associated with the DoD Stockpile-to-Target Sequence (STS), the "tail-kit" for the B61, which is being managed separately from the rest of the B61 LEP, and environmental requirements associated with the new F-35 aircraft; they constitute part of the risk to be considered at this stage of the B61 3B program.

To inform this review, JASON was briefed on technical plans for the B61 LEP program at MITRE in McLean, VA during the 2012 JASON Spring Meeting (April 2012), and material specific to the 3B design was presented to JASON in La Jolla in June 2012. Representatives of the B61 teams from Sandia, LANL, and LLNL (peer review) and from NNSA were present at both sets of briefings.

JASON's Summary Conclusion

Considering both the nuclear and non-nuclear components, JASON assesses that Option 3B for the B61 LEP is considerably reduced in scope from the previously preferred Option 2C. Also, the scope is considerably reduced from some concepts presented to JASON during the course of earlier nuclear weapon studies that considered the B61 LEP. Overall, the actions contemplated for the Nuclear Explosive Package (NEP) in the 3B design are familiar to JASON from our previous work. The 3B design will enable a significant reduction in DoD maintenance by

Official Use Only

lengthening the limited life component exchange (LLCE) interval. This prudent action follows a proven path for life-extension and improvement of primary performance margin as employed for the W76-1 LEP. In addition, there are logical but modest enhancements to the safety and security of the refurbished B61 NEP. Selected NEP components will be remanufactured, refurbished, and reused to extend their lives to meet military requirements. There are no radical new technologies being introduced into the NEP that cause JASON to have a significant technical concern about certification. Most of the uncertainty regarding the ability to execute this LEP appears to derive from unpredictable funding and the attendant risk to the 2019 FPU schedule, rather than unsettled military requirements or new and unproven NEP technologies.

NEP Scope

The major components included in this review of the NEP scope are the primary, the secondary, and the gas transfer system.

Primary

The pit will be reused and will be given the same type of life-extending treatment as performed on the reused pit in the W76-1 LEP. The existing primary detonators will be replaced with a well-proven and safer type of detonator based on the design used in the stockpiled W88. The new detonators are essentially interchangeable with those employed in earlier versions of the B61 primary. The main charge insensitive high explosive (IHE) is being remanufactured. High explosives are organic compounds subject to aging and disassembly damage; it is prudent to replace them during any weapon life-extension program.

In total, these changes are reasonable. In conjunction with the new gas transfer system, the expected primary performance margin is large enough (relative to uncertainty in performance) to not raise concern about certification or longevity.

While the existing B61 margins relative to uncertainties are adequate, the new gas transfer system improves them and maintains relatively high values across the longer LLCE cycle in a well understood manner.

Official Use Only

Secondary

Results of surveillance and aging studies to date on the B61-4 secondary indicate that this component may need to be remanufactured for the B61-12. While not employing identical internal designs and materials, the scope of the remanufacturing operation at the Y-12 Plant is similar to what is being done in the W76-1 LEP. However, in the case of the B61-12, the quantity of secondaries to be remanufactured is much smaller than that needed for the W76-1 and reuse of some of the original secondaries "as is" has not been completely ruled out. Studies on options for reuse "as is" should continue and include the secondary from the B61-10, even though the yields are not exactly the same as the B61-4. There could be a capacity issue at the production plant with completion of the W76-1 LEP that now is planned to overlap the start-up B61-12 LEP by a few years, but this appears to be manageable if current schedules are maintained and there are no unforeseen problems. There is no known materials availability or compatibility issue involved with B61 secondaries.

Gas Transfer System (GTS)

Historically, GTSs have been designed by Sandia for LLNL NEPs and by LANL for its own NEPs. The B61 NEP is a LANL design; thus the GTS is considered to be part of the nuclear scope of the LEP. Advances in Acorn GTS technology have been a significant contributor to increasing the primary performance margin of the stockpile W76-1. The B61-12 LEP will benefit from the continued evolution of this technology, not only in primary performance margin, but also in extending the limited life component (LLC) exchange interval, which reduces maintenance requirements and attendant security risks.

Surety Features

Current stockpile versions of the B61 already have several surety features—e.g., IHE—that have been discussed in the context of "modernization" of other strategic stockpile systems. These features are maintained in the B61-12 design and thus do not materially affect the new scope of the B61 NEP.

In its 2010 report to DoD on Surety (JSR-10-103), JASON examined technical aspects of surety from an overall systems perspective across the US nuclear weapons enterprise. We note that the 3B option aligns closely with JASON's 2010 recommendations for B61 surety features to be included in the then-

Official Use Only

anticipated LEP. In our 2009 NNSA study on Life Extension Options (JSR-09-334), the “Light” option also corresponds closely to the 3B design.

Some improvements to B61 system safety performance are provided by new designs of components located outside the NEP in the 3B option.

Additional Comments

Schedule Risks

In developing the 3B plan, the FPU date for deploying the B61 on its new delivery aircraft—the F-35—has been delayed by the government from 2017 to 2019. The reasons for this include both funding limitations and programmatic delays in both programs. This delay adds to the importance for NNSA and the weapons laboratories to successfully meet the revised schedule, both for political reasons involving our NATO allies and in the light of the Pentagon’s already strongly expressed displeasure at the inability to complete the W76 LEP as scheduled. These concerns make it imperative for NNSA and the laboratories to develop a work program that gives highest priority to staying on schedule. In implementing important and desirable, but not essential, elements in the 3B program, there should be a clear understanding of their cost and impact on the production schedule. These elements should be prioritized in the event that unanticipated program delays or cost overruns are encountered that could threaten meeting the FPU milestone. Information on this issue was not available to JASON at the time of our brief review.

Peer Review

At both of our meetings with the B61 team, JASON was briefed on peer review of the NEP design being carried out by design experts from LLNL. This work appears to us to be professional, addressing key technical questions with a traceable process of written findings and responses taken by the design team.

It is less clear to us how peer review is conducted on components outside the NEP, and how results from the NEP peer review flow to management responsible for the overall B61 design and execution.

Official Use Only

Nomenclature

During the course of this review, we noticed that the short-hand nomenclature—the “Three R’s”—used by NNSA and the weapons laboratories to describe LEPs has changed from the time of our 2009 LEP report (referenced previously). In that report, JASON noted that real LEPs never conform to some simplistic definition built around words starting with the letter R. In the TOR for this study, there are also three R-words describing possible approaches to LEPs for weapon systems, but the definitions have changed since 2009! In addition, a new R-word (Refresh) seems to have been added to the vocabulary of LEPs. This is not helpful and can lead to additional confusion among people trying to understand these complex projects. We urge the NNSA community to drop the use of simplistic R-words overloaded with extra meaning to describe these programs with their complex sets of choices and priorities required to develop realistic and cost effective program plans.

Conclusion:

In conclusion, our answers to the questions posed in the TOR regarding modifications to the B61 NEP are:

- The changes to the NEP projected in the 3B design are modest, prudent, and should enhance the maintainability of the refurbished B61 while providing relatively large performance margins of this system without putting at risk its already substantial safety and security capabilities.
- The changes to the B61 NEP will extend the time between LLCE events, but otherwise are not expected to affect significantly its long-term safety, security, reliability, and military characteristics.