

Bruce Hamilton, Chairman
Jessie H. Roberson
Joyce L. Connery

**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



June 23, 2020

The Honorable Dan Brouillette
Secretary of Energy
US Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Secretary Brouillette:

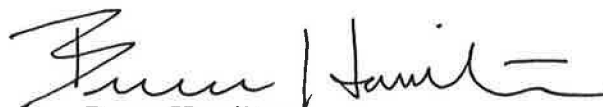
Our staff reviewed the weapon response development process and the resulting technical basis documentation prepared for the W88 weapon program by one of the design agencies, Los Alamos National Laboratory. During this review, our staff also evaluated the technical basis associated with changes in the categories of weapon response consequences NNSA approved in DOE Limited Standard DOE-NA-STD-3016-2018, *Hazard Analysis Reports for Nuclear Explosive Operations*. These changes were the subject of the Board's September 7, 2018, letter to Secretary Perry.

Based on our staff's review, we find the revised consequence definitions and their application in developing the W88 weapon response documentation to be technically justified. However, we note that the conservatism of weapon response information developed for weapon programs whose characteristics differ from the W88 will depend on how the responsible design agency applies the revised consequence definitions.

We also note for your consideration the lack of independent federal review of the weapon response technical basis and associated weapon response summary document used in developing the safety basis for nuclear explosive operations at the Pantex Plant. DOE/NNSA directives do not define expectations for such federal oversight, and NNSA's role centers on project management instead of validating the quality and technical content of design agency weapon response products. We encourage DOE/NNSA to consider establishing requirements for federal oversight of the weapon response process. As the design agencies apply the revised consequence definitions in DOE Standard 3016 across other weapon programs, adequate federal oversight of the weapon response process could assure consistent and conservative implementation.

The enclosed report, provided for your information and use, expands upon these topics and identifies other opportunities to bolster the technical underpinnings of the Pantex safety basis.

Yours truly,

A handwritten signature in black ink, appearing to read "Bruce Hamilton". The signature is fluid and cursive, with a long horizontal stroke at the end.

Bruce Hamilton
Chairman

Enclosure

c: Ms. Lisa E. Gordon-Hagerty
Mr. Joe Olencz

Review of the W88 Weapon Response Technical Basis

The Defense Nuclear Facilities Safety Board's (Board) staff conducted a review of Los Alamos National Laboratory's (LANL) weapon response development process, as well as the technical basis supporting the current W88 weapon response summary document (WRSD) and recent weapon response consequence definition changes in Department of Energy (DOE) Limited Standard DOE-NA-STD-3016-2018, *Hazard Analysis Reports for Nuclear Explosive Operations*. The staff team identified the following observations and opportunities for improvement:

LANL Weapon Response Process and W88 WRSD Technical Basis

Generally, LANL technical basis documents support the rules provided in the W88 WRSD. Based on the staff team's review, LANL personnel acknowledged a number of needed corrections to weapon response rules. LANL promptly transmitted an Information Engineering Release to notify the Pantex Plant of these weapon response changes.

The staff team identified several cases where assertions contained in higher-level technical basis documents lacked well-defined traceability to supporting references. Additionally, the staff team noted several instances of extrapolation across weapon programs or data sets due to the unavailability of directly applicable data. LANL could improve and better defend the basis for extrapolation for some of these instances.

The staff team noted that certain LANL weapon responses rely on assumptions regarding the presence or absence of grit capable of leading to a high explosive reaction during impact/drop events at Pantex. The W88 weapon responses LANL transmitted to Pantex do not discuss these assumptions in detail sufficient to determine the maximum acceptable grit amount/size for some weapon responses. As a result, control of grit may be subject to Pantex interpretation, and nuclear explosive operations may deviate from the conditions assumed in LANL weapon responses.

The staff team noted a lack of federal oversight of the design agency processes used to develop weapon response information and the resulting products (e.g., WRSD and supporting technical bases). This situation stems from the fact that DOE and National Nuclear Security Administration (NNSA) directives do not define expectations for such oversight functions. NNSA-provided expectations—for example, R023, *Establish and Maintain Authorization Basis for Nuclear Explosive Operations*—relate more to project management. Given the fundamental importance of these products in the formulation of the Pantex safety basis, the staff team concludes that safety assurance for nuclear explosive operations would be improved if DOE/NNSA established requirements for federal oversight of the weapon response process.

Technical Basis for Weapon Response Consequence Definition Changes

The staff team reviewed the technical basis LANL prepared to support recent changes to DOE Standard 3016, which included redefining the consequences of events involving main charge high explosive reactions and introducing *aerosolized dispersal* as a category of weapon response. The staff team concluded the information to be technically defensible and supportive of the revised weapon response consequence definitions. LANL staff performed the following analyses in support of the revised definitions:

- LANL organizations with subject matter expertise in advanced computer modeling performed multiphysics simulations of high explosives detonating near special nuclear material. These simulations were representative of the various physical arrangements encountered in postulated accidents that could occur during Pantex operations. LANL captured all relevant physical phenomena and used appropriately bounding assumptions. The simulations demonstrated minimal aerosolized dispersal of special nuclear material during detonations of noncontiguous high explosive charges (i.e., nuclear material and explosive separated by a certain distance).
- LANL staff performed a calculation to determine a bounding respirable release fraction for plutonium oxide following an explosively driven mechanical release without additional burning. Production of respirable plutonium oxide is proportional to the surface area of the exposed plutonium, which is likewise proportional to the size of pieces generated in an explosive event. Facility humidity also contributes to the reaction kinetics, albeit more slowly. LANL assumed bounding values for both of these terms. Results of the LANL calculation indicated that explosively driven mechanical releases at Pantex would be unlikely to challenge the evaluation guideline.

The staff team reviewed a summary of W88 weapon response rules impacted by the consequence definition changes in DOE Standard 3016. As summarized below, the staff team found that LANL based the W88 weapon response rules on a conservative application of the revised definitions of weapon response consequences.

- LANL binned events as *aerosolized dispersal* if detonation of high explosives contiguous with special nuclear material was possible, including failures of special tooling where separated components could regain a contiguous configuration. As supported by its technical basis, LANL only binned high explosive main charge detonations as a low-order consequence (e.g., worker safety) for scenarios with sufficient separation between the special nuclear material and the high explosive. The staff team evaluated LANL's technical justifications for binning accident scenarios and found them appropriately conservative.
- Due to the uncertainty associated with deflagration-to-detonation transitions in conventional high explosives, LANL treated all main charge deflagration scenarios as a detonation. This approach yields conservative results.

The conservatism of weapon response rules developed in the future for other weapon programs will depend on how the responsible design agency applies the revised consequence definitions. Particularly for weapon programs whose characteristics differ from the W88, the conservatism of the weapon response rules could be impacted by different assumptions about deflagration-to-detonation transitions and by different treatment of scenarios that depend upon a separation distance between high explosives and special nuclear material to avoid aerosolized dispersal. Adequate federal oversight of the weapon response process could assure consistent and conservative implementation of these assumptions across the design agencies.