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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**
Washington, DC 20004-2901



August 25, 2011

The Honorable Thomas P. D'Agostino
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Mr. D'Agostino:

The staff of the Defense Nuclear Facilities Safety Board (Board) reviewed technical procedures and their implementation by Babcock & Wilcox Technical Services Y-12, LLC (B&W) at the National Nuclear Security Administration's (NNSA) Y-12 National Security Complex (Y-12) during April 26–29, 2011. A strong conduct of operations program requires a sound set of technical procedures and strict adherence by the users to ensure that safe operation of the facility is maintained. This review was motivated, in part, by several reports during the past year related to poor conduct of operations, in general, and poor execution of procedures, in particular. In some cases, safety issues have resulted. During the review, the staff identified additional examples of weaknesses in procedures and their use by B&W personnel that have the potential to jeopardize the safety of workers and possibly that of the public and the environment. The Board is concerned that these issues point to systemic problems with the safe execution of nuclear operations and management oversight of these activities. The Board is encouraged by planned actions to address these issues.

The enclosed report describes shortcomings identified by the Board's staff with respect to the development, quality, and execution of technical procedures and is provided for use by Y-12 Site Office and B&W personnel in developing and implementing process improvements associated with safe execution of nuclear operations at Y-12.

Continuing and unresolved weaknesses in conduct of operations and technical procedures has an adverse impact on the safety of nuclear operations. Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report and briefing within 6 months of receipt of this

letter that details NNSA's assessment of the effectiveness of B&W's actions taken to date to address the weaknesses identified in the enclosed report, as well as the path forward to resolve any newly identified issues.

Sincerely,

A handwritten signature in black ink, appearing to read 'P. S. Winokur' with a stylized flourish at the end.

Peter S. Winokur, Ph.D.
Chairman

Enclosure

c: Mr. Theodore D. Sherry
Ms. Mari-Jo Campagnone

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

July 1, 2011

MEMORANDUM FOR: T. J. Dwyer, Technical Director

COPIES: Board Members

FROM: T. Hunt

SUBJECT: Technical Procedures, Y-12 National Security Complex

This report documents a review of a sample of technical procedures and their implementation by Babcock & Wilcox Technical Services Y-12, LLC (B&W) at the Y-12 National Security Complex (Y-12). This review was performed by members of the staff of the Defense Nuclear Facilities Safety Board (Board) J. Anderson, D. Campbell, T. Hunt, and R. Verhaagen and outside expert D. Boyd during the week of April 25, 2011. The Board's site representatives, W. Andrews and D. Kupferer, also participated in the review.

Background. This review was undertaken to address several issues identified during the past year related to the adequacy of technical procedures and their use by B&W at Y-12. The Board's site representatives at Y-12 have periodically reported on placekeeping deficiencies and concerns associated with the number of precautions and limitations in procedures at the site. Several events also have occurred at Y-12 in which operators failed to comply with procedural direction or a procedure was written such that the user could not perform it safely and effectively.

Most significant, in June 2010 a small fire occurred during a routine dismantlement operation in Building 9204-2E, in which personnel were using a hammer and chisel to disassemble a depleted uranium component in a ventilated hood. Sparks from a uranium chip ignited a solvent-laden cloth that operators had left on the work table. This event occurred as the result of a procedural violation. In October 2010, during the process of dismantling a weapon component in Building 9204-2E, operators knowingly skipped a step in the operating procedure that involved performing nondestructive assay of materials. Performing this assay is a nuclear criticality safety (NCS) requirement, and B&W identified this event as an NCS deficiency.

Both B&W and the Y-12 Site Office (YSO) have implemented corrective actions to address the underlying causes of these issues. YSO has assigned an additional facility representative to Building 9204-2E, and B&W has increased surveillance and oversight by the Nuclear Safety Operations group. Based on observations of the Board's staff described

below, it is apparent that these corrective actions have not yet been effective in determining or addressing the root causes for the issues associated with these deficiencies in conduct of operations. Following the staff's review—during the Board's visit to Y-12 the week of May 16, 2011—B&W and YSO management briefed the Board on details of their path forward, as well as initiatives on providing placekeeping guidance, reducing precautions and limitations in procedures, and improving training in conduct of operations.

The on-site portion of the staff's review consisted of an in-brief with site personnel to discuss processes for developing and implementing procedures, interviews with personnel responsible for preparing and implementing procedures, and observations of work in which technical procedures were used to direct the actions taken. The staff observed the execution of technical procedures—including System Operating Procedures (SOPs), Product Specification Procedures (PSPs), and Job Performance Aids (JPAs)—in the Highly Enriched Uranium Materials Facility (HEUMF), Buildings 9212 and 9215 (Enriched Uranium Operations), and Building 9204-2E (Beta 2E). The staff also performed tabletop reviews of several procedures prior to and during the site visit.

Use of Technical Procedures. Users are to follow technical procedures as written and are not to deviate from them unless the procedure specifically allows doing so. The guidance in both the Department of Energy (DOE) and B&W documentation is that if a procedure cannot be used as written, the activity must be stopped until the issue has been resolved. The Board's staff noted that operators do not always use the procedures for guidance or follow them in a step-by-step manner. Likewise, the staff did not observe significant supervisory involvement in reinforcing correct behaviors and mentoring and championing rigorous compliance with expectations for the use of and adherence to procedures. Moreover, some of the procedures reviewed were not optimally executable, making them less likely to be used by the workers when performing their tasks or more likely to be used incorrectly.

Adherence to Procedures—As stated in the B&W ConOps Manual, Y-14-001, *Conduct of Operations Manual*, safe and secure operations depend on adherence to procedures. Adherence to procedures means understanding the purpose, scope, and intent of a procedure and following its direction; the user performs all actions as written in the sequence specified. The Board's staff noted cases in which operators skipped steps during operations in HEUMF and Beta 2E, due to either not placekeeping or not referring to the procedure before taking action. The staff also observed instances of operators working outside the bounds of the procedure by performing undocumented actions in HEUMF (e.g., scanning container bar codes, using unauthorized tools, and manipulating a skid table). In addition, the staff witnessed steps being performed out of the written sequence without authorization during assembly and dismantlement operations in Beta 2E.

Placekeeping—As noted in DOE Standard 1029, *Writer's Guide for Technical Procedures*, a best practice to minimize the potential that a worker will skip a procedural step or perform it more than once during the execution of complex, infrequently exercised, or safety-consequential procedures is the use of placekeeping. The B&W ConOps Manual requires that operators employing a continuous-use procedure utilize a placekeeping method as necessary.

The majority of operators performing continuous-use procedures observed during the staff's review did not mark each step as being completed before proceeding to the next step. Making placekeeping a firm requirement during the performance of both continuous-use and reference-use procedures would enhance the use of procedures. B&W has not yet defined a clear expectation for what constitutes adequate placekeeping or identified exactly when placekeeping is necessary.

Reader-Worker Protocol—Under the reader-worker protocol, one worker (reader) communicates actions to another by reading individual procedure steps. The reader-worker protocol relies on effective two-way communication for safe and successful execution of a task. The staff noted cases in which workers implementing the reader-worker protocol while performing a continuous-use procedure failed to repeat back or paraphrase the read step, contrary to B&W management's stated expectation and guidance in the B&W ConOps Manual. The staff also noted cases in which operators performed steps before the reader had read them, the positioning of the reader with respect to the operator hindered formal communications, and the operator did not report successful completion of a step to the reader.

Preparation for Use of Procedures—The B&W ConOps Manual requires that continuous-use procedures be reviewed before any step or group of steps is performed. The staff noted that operators failed to review a continuous-use JPA for casting operations before performing steps.

Quality of Technical Procedures. B&W implements the various types of procedures noted above depending on the nature of the operation, each of which utilizes a unique format and contains varying levels of detail. For example, casting operations use primarily JPAs, while assembly and dismantlement operations use more-detailed SOPs. The Board's staff evaluated the relationship between potential human error and such procedural problems as poor organization and formatting, lack of clarity and consistency, and other deficiencies related to usability. The staff noted numerous cases in which procedures were noncompliant with local or federal direction and guidance or were inconsistent with industry best practices.

Precautions and Limitations—DOE Standard 1029 states that precautions and limitations "affect the entire procedure or occur at more than one point in the procedure" and "inform users of hazardous conditions and their potential effects." The staff identified numerous issues associated with the identification and implementation of precautions in SOPs:

- The Board's site representatives have reported on, and the staff witnessed during its review, the excessive number of precautions in some procedures. It is not unusual for a procedure to have 50 or 100 precautions. This number of precautions is contrary to guidance in DOE Standard 1029, which recommends "[avoidance] of generic precautions that are part of a job description." The staff found some of the precautions to be unnecessary because they are inapplicable or generic in nature, refer to only one action in the procedure, or do not involve a hazard to personnel or equipment. Additionally, the large number of precautions means that only a small subset can be reviewed during a pre-job brief, even though operators are required by

the B&W ConOps Manual to be familiar with all precautions before performing a task.

- Some precautions appear as notes in the performance section of the procedure. This is an indication that a precaution is incorrectly categorized or that the note should be a warning or caution, and is contrary to guidance in DOE Standard 1029.
- The staff noted cases in which procedures do not reference the corresponding precaution after an action step in the performance section which implements a criticality safety requirement, as required by B&W's Technical Procedure Authoring Tool (TPAT).
- Some precautions failed to specify the hazardous conditions and potential effects as outlined in DOE Standard 1029 and the TPAT.

Allowance to Perform Steps Non-Sequentially—In accordance with the B&W ConOps Manual, “the procedure user shall perform procedure steps and sections sequentially, unless procedural guidance indicates otherwise.” A procedure usually includes a statement or note before the step(s) that need not be worked in the order specified. However, the Board's staff found that the guidance statements that ultimately allowed noncompliance with the written steps were varied and sometimes ambiguous. The following is an example of unclear wording in an operating procedure that increases the possibility of workers misinterpreting the intent: “All sub-sections...may be performed concurrently...or in any order, or repeated, as required, unless otherwise noted or as directed by the Supervisor.” In some cases, steps or substeps that were procedurally allowed, via a note, to be worked non-sequentially could only be performed in the order written (e.g., a group of steps in a secondary extraction procedure to process product required some steps to be completed before others could be accomplished).

Vague Terms—DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*,¹ provides guidance to ensure that procedures are “technically correct and the wording and format are clear and concise.” DOE Standard 1029 and the TPAT go on to discourage excessive use of vague terms (e.g., “as necessary,” “as needed,” “as directed,” and “approximately”) because these terms are subject to interpretation. However, the staff noted overuse of these terms in several procedures, which ultimately degraded the clarity of these procedures; in a secondary extraction procedure for Building 9212, for example, the terms “as necessary” and “as directed” were used about 50 times.

Level of Detail—The language of procedures needs to be clear and the level of detail appropriate for the operators' skill, experience, and training. Examples of inadequate detail and direction included a step in an assembly procedure that failed to specify the amount of time required for the vacuum fixture vacuum check to be satisfactory and a step in an evaporator

¹ At the time of the review, B&W had implemented DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*. At the time of this report, B&W has completed full implementation of DOE Order 422.1, *Conduct of Operations*, which supersedes DOE Order 5480.19. Both Orders contain similar requirements regarding the development and implementation of technically accurate procedures as referenced throughout this report.

procedure to observe the reading on a flow indicator without defining an action based on that reading.

Notes, Warnings, and Cautions—Notes provide supplemental information, while warnings and cautions provide information essential to the safe performance of work. To ensure proper awareness, DOE Standard 1029 recommends that all of these annotations be placed on the same page as and immediately before the action step(s) to which they apply. The staff found cases in which notes and cautions were on the page prior to the applicable step(s), as well as cases in which action steps should have been placed as warnings (e.g., secondary extraction procedure), and notes should have been upgraded to cautions because of the potential for damage to equipment (e.g., a procedure for reduction furnace operations).

One Action per Step—DOE Order 5480.19 states that procedural steps are to be limited to one action. The staff identified steps that contained two separate and distinct actions.

Use of “Ensure”—According to the definitions in DOE Standard 1029 and the TPAT, the action verb “ensure” is to be used in technical procedures to “confirm that an activity or condition has occurred.” B&W procedures routinely use “ensure” to direct action—setting the expectation to the operator, wrongly in some cases, of the current condition—when a more precise verb (e.g., “close,” “rotate,” “start”) could be used. One Building 9212 procedure used “ensure” about 80 times.

Branching and Referencing—Branching and referencing in a procedure send the user to another procedure or section of the base procedure, and sometimes back to the original branching location. Generally, since branching and referencing increase the likelihood of operator error, their use is discouraged by DOE Standard 1029 and the TPAT. The staff identified cases in which procedures failed to follow the guidance concerning branching and referencing. Specifically, some procedures that were “branched to” do not have a step directing the user to return to the original location. Other branching procedures failed to provide the section and section title to which the user was being referred.

Special Tools and Supplies—The special tool list is intended to ensure that workers in a hazardous environment have proper tools and supplies to perform their task, thus minimizing exposures due to work stoppages and slowdowns. In some cases, this list included ordinary craft tools such as wrenches, flashlights, and hard hats, as well as unquantified and undimensioned nuts, washers, and bolts. Another procedure failed to identify all of the special tools needed to complete the task satisfactorily.

Development of Technical Procedures. The staff discussed the processes for developing, revising, reviewing, and approving technical procedures with B&W personnel. The staff identified the deficiencies and areas for improvement described below.

Job Performance Aids—JPAs are one-page technical procedures that specify how to accomplish a single task. The stated advantage of using these procedures in lieu of a standard procedure (e.g., SOP) is that they are easier to develop and revise since they contain only a

performance section (i.e., no precautions, prerequisites, etc.). The staff believes such a distilled procedure with abbreviated steps and involving increased dependence on training increases the chances of performance errors because of a lack of adequate detail and integration and, thus, JPAs should be used judiciously. Normally, a standard procedure is broken down into sections that define a single, specific task and provide the appropriate sequencing for complex operations. Complex operations that instead use numerous JPAs for discrete tasks (e.g., casting operation in E Wing of Building 9212) lack integrating and sequencing information that would be provided by a standard procedure and increase the likelihood of performing steps out of order or skipping them entirely.

Integration of Multiple Procedures—B&W’s process for procedure control does not utilize sequencing documents or flow charts and thus lacks a formal means of integrating multiple procedures, technical/machining specifications, JPAs (see above), and so on. This deficiency could become particularly problematic when operators are transitioning between procedures under highly stressful conditions. DOE Standard 1029 suggests that “flow charts are useful for viewing the sequence and hierarchy of the activities required to complete the process.” Further, combining a series of shorter procedures (e.g., JPAs) into a longer procedure (e.g., an SOP) would reduce the overall number of interfaces. Integration is also an issue when a series of operations encompasses multiple organizations (e.g., production and material management), but there is no clear hand-off from one procedure to the next.

Subject Matter Experts (SMEs)—SMEs have many responsibilities associated with the development, change, and approval processes for procedures. B&W has not implemented a formal process for identifying individuals who can serve as SMEs and has not clearly linked this role to a training and qualification program. By virtue of being assigned to an organization—and irrespective of experience and knowledge—individuals are automatically considered “qualified” to review procedures.

Procedure Modification Requests—The backlog of procedure changes awaiting incorporation into a revised procedure remains high (about 400). In many cases, numerous outstanding changes, some more than 6 months old, await incorporation into revised technical procedures. DOE Order 5480.19 recommends that procedures be revised if changes have been outstanding for more than 6 months or if a procedure is affected by more than five changes. B&W does not implement this guidance and has more than 200 change requests that are more than 6 months old. B&W management noted to the staff that one of the reasons for the backlog is the shortage of process engineers and procedure writers.

Use Category—The TPAT describes what information should be on the cover page of every procedure. Although B&W issued a standing order in April 2010 to include the use category marking and it was evident on the cover page of every procedure the staff reviewed, the TPAT does not document this requirement.

Process Engineers/Procedure Writers. B&W’s process engineers provide technical content for each technical procedure. Procedures are assigned to process engineers based on their specific areas of expertise. The procedure writer, on the other hand, is responsible for the

format and organization of the technical procedure, as well as incorporation of approved procedure modification requests.

B&W management's stated expectation is that process engineers will spend a significant amount of time observing the execution of procedures for which they are responsible. However, these expectations are not documented in a procedure or in the process engineers' roles and responsibilities, and no metrics exist with which to track time spent in the field. Discussions between the staff and workers and process engineers revealed that some process engineers do not consistently or frequently spend time watching the performance of procedures for which they are responsible. In addition, there is no expectation that the procedure writers spend time in the field. Very few actually have the necessary training to obtain access to operational areas.

Conclusion. Problems associated with the development, quality, and use of procedures can lead to operator errors that have the potential to jeopardize the safety of workers and possibly that of the public and the environment. The weaknesses identified by the staff indicate systemic issues associated with the development and implementation of technical procedures. These issues are particularly concerning given past issues related to procedures and conduct of operations and the apparent ineffectiveness of corrective actions taken by B&W and YSO. The path forward for addressing these issues will require concentrated management attention and execution of a comprehensive approach to achieve lasting improvements.