



Department of Energy
National Nuclear Security Administration
Washington, DC 20585

June 7, 2004

Mr. Dennis R. Ruddy
[]
BWXT Y-12
P.O. Box 2009
MS 8001
Oak Ridge, TN 37831-8001

EA 2004-04

Subject: Preliminary Notice of Violation and Proposed Imposition of Civil Penalty
\$82,500.

Dear Mr. Ruddy:

This letter refers to the recent investigation by the Department of Energy's (DOE) Office of Price-Anderson Enforcement (OE) of the April 2003 explosion event involving the Saltless Direct Oxide Reduction (SDOR) process, as well as continuing problems associated with Safety Basis compliance at the Y-12 site.

An Investigation Summary Report describing the results of that review was issued to BWXT Y-12 on December 22, 2003. An Enforcement Conference was held on January 22, 2004, in Germantown, Maryland, with members of your staff and you to discuss these findings. A Conference Summary Report is enclosed.

Based on our evaluation of these issues and information presented by BWXT Y-12 during the Enforcement Conference, the National Nuclear Security Administration (NNSA) has concluded that violations of the *Quality Assurance Rule* (10 CFR 830.122) have occurred. The violations are described in the enclosed Preliminary Notice of Violation (PNOV).

Section I of the PNOV addresses violations related to the April 2003 explosion associated with the SDOR process, which resulted from gram quantities of calcium metal/calcium oxide in a sealed container reacting with [radioactive material] powder and water. The unexpected reaction resulted in catastrophic failure of the container, glovebox containment failure, a glovebox fire, as well as a release of radiological material.

Section I.A notes violations of design control requirements in not having key elements of the SDOR design independently reviewed prior to its use. DOE/NNSA acknowledges

that engineering reviews were conducted for criticality safety, piping or component selection and design, general code compliance, and system compatibility with process materials. These reviews, however, did not independently verify or validate several key aspects of the SDOR dissolution design such as process chemistry, process flows, and mass transfer, including the associated design assumption of complete calcium reaction.

Also, a test and check-out plan was conducted for the SDOR process, but it focused on individual equipment component functionality and was not an integrated system test. Some of the test plan materials were surrogate materials. The surrogate and test materials had different quantities and properties (such as refined powders versus sintered granules) than the SDOR [radioactive material] and Ca/CaO feed materials. These differences negatively limited the effectiveness of the test as a validation test for the design aspects of process chemistry, process flows and mass transfer, including holdup and dissolvability/diffusion.

The BWXT Y-12 SDOR Accident Investigation Team (AIT) and Independent Management Investigation Team (IMIT), chartered to determine the causes of the accident subsequent to the event, also noted the following design control deficiencies in their investigation reports:

- There was no oversight from a production or independent chemical safety perspective. A rigorous independent design review of the facility was not conducted,
- Engineering design reviews focused on code compliance and not process functionality,
- The Test and Checkout Plan did not verify or validate all parameters affecting performance,
- Significant equipment and process changes were incorporated into the SDOR pilot facility without a formal design review.

Section I.B describes violations related to inadequacies in the hazards analyses applied to SDOR. Although BWXT followed its own procedures by using an Automated Job Hazards Analysis (AJHA), which is a checklist of possible hazards, and a review conducted by the Hazardous Materials Review Committee of a specific hazard involving system hydrogen evolution, those procedures and reviews were inadequate for the SDOR process since they did not include an analysis of chemical process hazards. DOE-HDBK-1100-96, *Chemical Process Hazards Analysis*, identifies several generally accepted methods for conducting process hazards analyses, including: What-If Checklist, Hazard and Operability Study, Failure Mode and Effects Analysis; and, Fault Tree Analysis. This Handbook is considered a DOE good management practice for chemical process activities.

The BWXT Y-12 SDOR investigation by the AIT and IMIT also concluded that there were a number of inadequacies in the hazards analysis performed for the SDOR process, including:

- The most significant controls that the investigation team found deficient were the management controls or processes that could have directed the project team to pursue a more rigorous chemical process safety analysis of equipment configuration.
- The AJHA and facility readiness process was not structured to identify hazards from upset process conditions in complex equipment configurations, and thus was not appropriate for the SDOR process.
- The risk assessments performed on the SDOR pilot facility did not identify the hazards associated with potentially unreacted material in the system or with placing the material in a sealed container.
- Of all of the analyses performed on the SDOR system, none of them focused on the identification and assessment of chemical process safety issues.
- The additional hazards posed by the differences between the bench-top and full-scale SDOR pilot systems were not fully addressed in the hazards identification system used for authorization of this project. Increased scrutiny of the differences between the bench-top operations and the full-scale demonstration facility may have resulted in the identification of these additional hazards and prevented this accident from happening or reduced its consequences.
- Although BWXT did not perform a chemical process hazards analysis for this new chemical process, the IMIT noted that many methods are available to conduct chemical process safety analysis, including “What-if/Checklist Analysis, Hazard and Operability (HAZOP) Analysis, failure modes and effects analysis, fault tree analysis, and event tree analysis.”
- The AIT concluded that a chemical process safety analysis such as a structured What-If analysis of the as-built equipment configuration would most likely have identified the hazards associated with the presence of unreacted calcium and calcium oxide in the sealed transfer container.

DOE/NNSA recognizes that the actual radiological exposures from the SDOR event were limited from this event, with the highest worker exposure being approximately 74 mrem. The use of depleted [radioactive material] made exceedance of the DOE annual exposure limits unlikely. However, potential exposures from this event could have been well above the assessed exposures were it not for the fortuitous nature of some of the event circumstances. DOE/NNSA has considered these potential consequences in its deliberations on these matters. Beyond this event, compliance with fundamental quality assurance controls such as independent design review and adequate procedures to ensure effective/appropriate hazards analysis is crucial to identifying problems such as those experienced in the SDOR event before they result in more serious events. It is important that BWXT Y12 implement changes to its design and work control processes to preclude the occurrence of safety significant events. To maximize the benefit of these changes, they should be based on a review of the current site-wide uses of the AJHA process to ensure that other situations do not exist in which a more comprehensive analysis process would be appropriate.

The violation described in Section II of the PNOV pertains to the continuing problem of violations of operational and technical safety requirements (OSR/TSR) as well as other Safety Basis requirements. DOE/NNSA recognizes that BWXT has undertaken various steps over the past several years in an attempt to improve performance in this area to acceptable levels. However, at least until recently, those actions had not been sufficient to address the problem and preclude recurring problems in this area. That concern was also communicated by the Y-12 Site Office (YSO) at various times between September 2002 and August 2003. The fundamental efforts BWXT Y-12 has started taking, since September 2003, to change worker behaviors with respect to the use of and compliance with such requirements are recognized, along with the designation of a Conduct of Operations Improvement Manager and a site-wide Conduct of Operations Improvement Plan. These steps appear to be comprehensive. However, DOE/NNSA is concerned that effective steps were not taken earlier in BWXT's term in managing the Y-12 site.

In order to emphasize the importance of maintaining the requisite quality assurance controls and the need to promptly and comprehensively address significant safety issues, I am issuing the enclosed PNOV and Proposed Imposition of Civil Penalty in the amount of \$82,500. The specific detail of the associated civil penalties is provided with each violation.

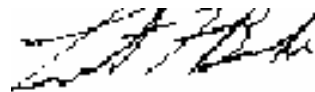
The violations described in Section I of the PNOV have been judged collectively to be a single Severity Level II problem. For these violations, DOE/NNSA has determined that 50 percent mitigation is warranted for corrective actions due to the extensive and thorough multiple investigation activities undertaken by BWXT Y-12 following the event, and the comprehensive efforts and lessons learned from the event. DOE/NNSA has concluded that no mitigation is appropriate for identification since the problems contributing to this event were self-disclosing.

For the violation described in Section II, DOE/NNSA has determined that no mitigation for timely self-identification or reporting is appropriate since the problem has been an ongoing one and DOE/NNSA had to express concern on multiple occasions with the continuing nature of the problem. Additionally, no mitigation for corrective action is given since the comprehensive corrective actions, although positive at this time as noted above, were not taken in a timely manner and their ability to remediate the deeper causes of persistent violations had not been demonstrated. DOE/NNSA has also observed in the last few months, the continuance of TSR/OSR violations even after the most recent corrective actions were put into place. DOE/NNSA could have cited as violations of work control requirements each of the occurrences of OSR/TSR and Safety Basis violations, but has exercised discretion and decided to respond in a manner that would focus on the timely and comprehensive correction of significant programmatic problems.

NNSA will continue to closely follow implementation of the corrective actions you have taken with the expectation of seeing continuing improvements in BWXT Y-12 design and work control processes as well as Safety Basis compliance.

You are required to respond to this letter and to follow the instructions specified in the enclosed PNOV when preparing your response. Your response should document any additional specific actions taken to date. Corrective actions will be tracked in the Noncompliance Tracking System (NTS). You should enter into the NTS (1) any additional actions you plan to take to prevent recurrence and (2) the anticipated completion dates of such actions. After reviewing your response to the PNOV, including your proposed corrective actions entered into NTS, DOE/NNSA will determine whether further enforcement action is necessary to ensure compliance with DOE nuclear safety requirements.

Sincerely,



Linton F. Brooks
Administrator
National Nuclear Security Administration

cc: J. Mangeno, NNSA
E. Beckner, NNSA
D. Crandall, NNSA
D. Beck, NNSA
S. Johnson, NNSA
D. Minnema, NNSA PAAA Coordinator
M. Thompson, NNSA
X. Ascanio, NNSA
W. Brumley, YSO
K. Ivey, YSO
M. Glasman, YSO PAAA Coordinator
C. Stair, BWXT Y-12 PAAA Coordinator
B. Cook, EH-1
A. Kindrick, EH-1
A. Acton, IG-33
R. Azzaro, DNFSB
P. Rodrik, OE
Docket Clerk, OE

**Preliminary Notice of Violation
and
Proposed Imposition of Civil Penalty**

BWXT Y-12
Oak Ridge Y-12 Plant

EA 2004-04

In October of 2003, the Office of Price-Anderson Enforcement (OE) conducted an investigation into the April 2003 Saltless Direct Oxide Reduction (SDOR) glovebox fire and multiple Safety Basis noncompliances at the Y-12 Plant.

Following an Enforcement Conference held on January 22, 2004, DOE/NNSA concluded that violations of DOE nuclear safety requirements have occurred. They are set forth below with the associated civil penalties. In accordance with 10 CFR 820, Appendix A, *General Statement of Enforcement Policy*, DOE National Nuclear Security Administration (NNSA) issues this Preliminary Notice of Violation (PNOV), with proposed civil penalty, pursuant to section 234a of the Atomic Energy Act of 1954, as amended, 42 USC 2282a, and 10 CFR 820.

I. Saltless Direct Oxide Reduction (SDOR) Glovebox Fire Event

A. Design Control Violations

10 CFR 830.122 (f) Criterion 6 requires that for design activities, contractors are to (1) "...verify or validate the adequacy of design products using individuals or groups other than those who performed the work..." and (2) "...verify and validate work before approval and implementation of the design..."

In addition, the BWXT Y-12 Quality Program Description (QAPD), Y60-101PD dated October 31, 2003, Program Commitment 3.6.5 echoes that requirement.

Contrary to the above, the SDOR pilot demonstration facility did not receive a complete design review or validation by individuals other than those who performed the work, and a complete design review and validation was not performed of the SDOR design prior to its implementation.

In particular, while mechanical engineering and criticality engineering design reviews were performed by individuals other than the original designer, no independent chemical process design review was performed to evaluate undesirable chemical reactions in the system, potential effects of desirable reactions that take place in undesirable locations in the system, system function, adequacy of instrumentation, or other process issues.

B. Work Process Violations

10 CFR 830.122(e)(1) requires that contractors "Perform work consistent with technical standards, administrative controls, and other hazard controls adopted to meet regulatory or contract requirements, using approved instructions, procedures, or other appropriate means."

Contrary to the above, prior to the April 2003 SDOR glovebox fire event, approved procedures and instructions used to control BWXT Y-12 technology development activities, including hazards analysis methods, were not adequate to control the SDOR associated hazards in that:

1. The site AJHA process was not an adequate analysis for this type of work activity since it focused on expected hazards associated with known job steps and was not structured to analyze complex chemical processing equipment designs and configurations. The AJHA is not a what-if or upset/accident scenario type process focused on the as built configuration.
2. The HMRC review was targeted at the hazard associated with hydrogen evolution and did not involve the review of other non-hydrogen related hazards.
3. Although the SDOR Pilot Facility involves a complex chemical process, the need for a chemical process hazards analysis was not established and none was conducted. Y-12 management requirements do not specify when such an analysis should be conducted.
4. The Y-12 work processes did not require adequate analysis of new processes or process elements as they progressed from conception to full-scale operations. Differences between bench-top and full-scale pilot facility configurations were not systematically evaluated for potentially new hazards as part of scale-up and configuration changes.

Collectively, these violations constitute a Severity II Level problem.
Civil Penalty – \$27,500

II. Safety Basis/Operational Safety Requirement/Technical Safety Requirement (OSR/TSR) Quality Improvement Deficiencies

10 CFR 830.122(c) requires that the contractor: “(1) Establish and implement processes to detect and prevent quality problems. (2) Identify, control, and correct items, services, and processes, that do not meet established requirements. (3) Identify the causes of problems and work to prevent recurrence as a part of correcting the problem.”

Contrary to the above, between November 2000 and September 2003, BWXT Y-12 efforts to identify causes and correct quality problems associated with OSR/TSR and Safety Basis compliance were not effective in precluding recurrence of this problem, as demonstrated by the following:

1. Upon assuming management and operating responsibility for Y-12 in November 2000, BWXT Y-12 undertook completion of corrective actions outlined in NTS--ORO-LMES-Y12NUCLEAR-1998-0006 to improve the long-standing poor performance in OSR/TSR and Safety Basis compliance at Y-12 when under the prior contractor's management.
2. In March of 2001 BWXT issued a verification report of corrective action effectiveness for this problem, concluding that the frequency of such OSR/TSR noncompliances was substantially reduced and that, therefore, corrective actions had been effective.
3. Despite the BWXT conclusion in 2001, between September 2002 and August 2003, the Y-12 Site Office (YSO) on several occasions communicated concerns with performance in the conduct of operations area, notably the continuing problem in safety analysis and TSR/OSR violations, and an apparent increase in such problems over the prior fiscal year.
4. BWXT Y-12 undertook a number of actions to improve performance in this area over the period of its management of Y-12. However, those actions were not sufficient to resolve the problem, since a continuing occurrence of such incidents was noted up to the time of the OE onsite investigation in October 2003.

The continuing programmatic problem of noncompliance with OSR/TSR and Safety Basis requirements represents a failure to take adequate quality improvement actions to correct the problem to prevent recurrence.

This violation constitutes a Severity II Level problem.
Civil Penalty – \$55,000

Pursuant to the provisions of 10 CFR 820.24, BWXT Y-12 is hereby required within 30 days of the date of the Preliminary Notice of Violation and Proposed Imposition of Civil Penalty, to submit a written statement or explanation to Linton F. Brooks, Administrator, National Nuclear Administration, 1000 Independence Ave., SW, Washington D.C. 20585-0270. Copies of the above reply should also be sent to the Director, NNSA Y-12 Site Office, as well as the Director, Office of Price Anderson Enforcement at one of the following addresses:

(if sent by U.S. Postal Service):

Director, Office of Price-Anderson Enforcement
Attention: Office of the Docketing Clerk
EH-6, 270 Corporate Square Building
U.S. Department of Energy
1000 Independence Avenue, SW
Washington DC 20585-0270

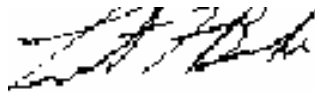
(if sent by overnight carrier):

Director, Office of Price-Anderson Enforcement
Attention: Office of the Docketing Clerk
EH-6, 270 Corporate Square Building
U.S. Department of Energy
19901 Germantown Road
Germantown, MD 20874-1290

This reply should be clearly marked as a "Reply to a Preliminary Notice of Violation" and should include the following for each violation: (1) admission or denial of the alleged violations, (2) any facts set forth in this PNOV which you believe are not correct, and (3) the reasons for the violations if admitted, or if denied, the basis for denial. Corrective actions that have been or will be taken to avoid future violations should be delineated with target and completion dates in OE's Noncompliance Tracking System. In the event the violations set forth in the Preliminary Notice of Violation are admitted, this PNOV will constitute a Final Order in compliance with the requirements of 10 CFR 820.24.

Any request for remission or further mitigation of civil penalty must be accompanied by a substantive justification demonstrating extenuating circumstances or other reasons why the assessed penalty should not be paid in full. Within the 30 days after the issuance of the PNOV and civil penalty, unless the violations are denied, or remission or additional mitigation is requested, BWXT-Y12 shall pay the civil penalty of \$82,500 imposed under section 234a of the Atomic Energy Act by check, draft, or money order payable to the Treasurer of the United States (Account 891099) mailed to the Director, Office of Price-Anderson Enforcement Attention: Office of the Docketing Clerk, at one of the above addresses. If BWXT Y-12 should fail to answer within the time specified, the contractor will be issued an order imposing the civil penalty.

Should additional mitigation of the proposed civil penalty be requested, BWXT Y-12 should address the adjustment factors described in section IX of 10 CFR 820, Appendix A.



Linton F. Brooks
Administrator
National Nuclear Security Administration

Dated at Washington, DC
This 7th day of June 2004

BWXT Y-12
April 2003 Glovebox Fire Event and
Safety Basis Compliance Issues

Enforcement Conference Summary

On January 22, 2004, Department of Energy (DOE) and National Nuclear Security Administration (NNSA) representatives held an enforcement conference with representatives from BWXT Y-12. The purpose of this conference was to discuss potential noncompliances associated with design and work control issues associated with the April 2003 Saltless Direct Oxide Reduction (SDOR) glovebox fire event, Safety Basis implementation deficiencies, and maintenance of emergency diesel generators (EDG). A list of conference attendees is attached. Material provided by BWXT Y-12 at the conference has been incorporated into the docket file.

Mr. Stephen Sohinki, Director of the PAAA Enforcement Office (OE), opened the proceedings with an overview of the conference's purpose and objectives as well as attendee introductions. Mr. Dennis Ruddy, President and General Manager of BWXT Y-12, initiated the Y-12 presentations. Mr. Ruddy discussed his commitment to improving nuclear safety performance at the site and provided an overview of the issues and topics to be presented.

The BWXT Y-12 presentation continued with discussions of the April 2003 SDOR glovebox fire event. Pam Horning, Engineering Division Manger for BWXT Y-12 led these discussions that summarized the event, post event investigations, and associated corrective actions.

Specifically, Ms. Horning asserted that BWXT Y-12 did not agree that potential violations of design control and work processes occurred as documented in the OE Investigation Summary Report. Ms. Horning stated that for SDOR design control issues, the above BWXT Y-12 conclusion was based the following:

- Design activities followed a graded approach in BWXT Y-12 design process
- The pilot facility was part of a systematic approach of verifying and validating the SDOR process design
- Specific elements of the design were validated by Y-12 Engineering Division
- Formal test and check out protocol validated specific equipment design elements

For the SDOR work control issues, the BWXT Y-12 conclusion was based on:

- The OE report acknowledging that SDOR work authorization generally met requirements
- A very comprehensive investigation was required to identify causes of this event and necessary improvements to site requirements
- BWXT Y-12 did not identify work processes as a PAAA violation in its NTS report because the company followed the approved Quality Assurance Plan and its implementing procedures.

BWXT Y-12 also submitted a white paper describing in more detail the above discussion points. Mr. Sohinki stated DOE/NNSA would consider the material presented and the associated white paper as part of the DOE/NNSA deliberations on the matter.

The meeting presentations continued with discussions on both Safety Basis compliance and EDG maintenance issues. Nancy Johnson, Conduct of Operations Improvement Program Manager for BWXT Y-12, led the discussions on Safety Basis compliance including a historical summary of the issue, previous corrective action weaknesses, current improvement initiatives, and an initial assessment of recent results.

The EDG maintenance presentation was led by Les Reed, the BWXT Y-12 Division Manager for Environment Safety & Health. Mr. Reed clarified confusion over the purpose of the generators concerning their safety function as previously described in both DOE occurrence reports and onsite OE interviews.

Mr. Sohinki then concluded the conference by indicating again that DOE and NNSA would consider the information and recommendations presented by BWXT Y-12 in their enforcement deliberations.

**BWXT Y-12
Enforcement Conference
List of Attendees**

Office of Price-Anderson Enforcement

Stephen M. Sohinki, Office Director
Peter D. Rodrik, Senior Enforcement Officer
Hank George, Technical Advisor

National Nuclear Security Administration/Y-12 Site Office

Y-12 Site Office

William Brumley, Manager
Ken Ivey, Acting Assistant Manger for Safeguards and Security

NNSA Headquarters

Samuel Johnson, Deputy Director Office of Operations and Readiness
Jeffery Underwood, Y-12 Site Lead

BWXT Y-12

Dennis Ruddy, General Manager, BWXT
James Elliott, General Counsel, BWXT
Nancy Johnson, CONOPS Improvement Manager BWXT
Les Reed, Division Manager ESH, BWXT
Pam Horning, Division Manager Engineering, BWXT
Darrel Kohlhorst, Division Head Manufacturing, BWXT
Michael Baker, Manager Technology Development, BWXT
Kevin Finney, Manager Applied Technology Division, BWXT
Conard Stair, PAAA Coordinator