



Department of Energy

Washington, DC 20585

March 30, 2021

Dr. Thomas Zacharia
Laboratory Director
UT-Battelle, LLC
Oak Ridge National Laboratory
1 Bethel Valley Road
Oak Ridge, Tennessee 37830

NCO-2021-01

Dear Dr. Zacharia:

The Office of Enterprise Assessments' Office of Enforcement has completed its investigation into the facts and circumstances associated with the outer fuel element failure that occurred on November 13, 2018, at the High Flux Isotope Reactor (HFIR), located at the Oak Ridge National Laboratory (ORNL). UT-Battelle, LLC (UT-Battelle) contracts the manufacture of fuel elements for HFIR to BWXT Nuclear Operations Group, Inc. (BWXT NOG) at the BWXT NOG facility in Lynchburg, Virginia. UT-Battelle documented the noncompliances revealed by this event in the Department of Energy (DOE) Noncompliance Tracking System under report NTS-SC-OSOUTB-X10HFIR-2019-0008750, *Performance Degradation of the Outer Fuel Element at HFIR*, on March 8, 2019. DOE provided the results of the Office of Enforcement's investigation to UT-Battelle in a report dated August 17, 2020. An enforcement conference was convened on September 29, 2020, with you and members of your staff to discuss the report's findings and UT-Battelle's response.

When the event occurred on November 13, 2018, reactor operators promptly initiated a manual shutdown of HFIR after noting abnormal readings in several primary plant indicators (though they were still within operating parameters). After completion of the post-shutdown cooling requirements, UT-Battelle opened the HFIR pressure vessel for defueling and observed deformation of several fuel plates in the outer fuel element. No anomalies were identified on the inner fuel element. UT-Battelle did not detect any worker or public radiation doses as a result of this event.

DOE views this event as significant because of the importance of the safe operation of HFIR, a hazard category 1 nuclear facility. The Office of Enforcement's investigation identified two potential noncompliances with DOE nuclear safety requirements in the areas of supplier oversight and independent assessments.

In accordance with 10 C.F.R. § 820.23, *Consent Order*, the Office of Enforcement has elected to resolve any potential noncompliances with requirements enforceable under 10 C.F.R. Part 820, *Procedural Rules for DOE Nuclear Activities*, through execution of a Consent Order. In deciding to enter into this Consent Order, DOE placed considerable



weight on UT-Battelle's comprehensive investigation of the event and development of appropriate corrective actions to improve UT-Battelle's oversight of the HFIR fuel element manufacturing process and independent assessment of the organizations tasked with ensuring this oversight was performed adequately. UT-Battelle's corrective actions appear adequate to address the potential noncompliances associated with this event and prevent recurrence.

DOE reserves the right to re-open this investigation if DOE later becomes aware that UT-Battelle provided any false or materially inaccurate information. Further, if there is a recurrence of nuclear safety deficiencies similar to those identified in this Consent Order, or a failure to complete all action items as prescribed in the Consent Order (or other related actions that UT-Battelle subsequently determines to be necessary) to prevent recurrence of the identified issues, then the Office of Enforcement may pursue additional enforcement activity. The Office of Enforcement, the Office of Science, and the ORNL Site Office will continue to closely monitor UT-Battelle's implementation of DOE nuclear safety requirements until the issues associated with this Consent Order are fully resolved.

Enclosed please find two signed copies of the Consent Order. Please sign both, keep one for your records, and return the other copy to the Office of Enforcement within 1 week from the date of receipt. Please follow all instructions specified in the enclosure. By signing this Consent Order, you agree to comply with all of the terms, including payment of the monetary remedy, specified in Section IV of the Consent Order, and in the manner prescribed therein.

If you have any questions concerning this Consent Order, please contact me or Mr. Jacob M. Miller, Director, Office of Nuclear Safety Enforcement, at 301-903-7707.

Sincerely,



Kevin L. Dressman
Director
Office of Enforcement
Office of Enterprise Assessments

Enclosure: Consent Order (NCO-2021-01)

cc: Johnny Moore, SC-OSO
Debbie Jenkins, UT-Battelle

Enclosure

In the matter of) Report No. NTS-SC-OSOUTB-X10HFIR-2019-0008750
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UT-Battelle, LLC)
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**CONSENT ORDER INCORPORATING AGREEMENT BETWEEN THE
U.S. DEPARTMENT OF ENERGY AND UT-BATTELLE, LLC**

I

UT-Battelle, LLC (UT-Battelle) is responsible for the management and operation for the Department of Energy's (DOE) High Flux Isotope Reactor (HFIR) located at the Oak Ridge National Laboratory (ORNL). UT-Battelle is the prime contractor under Contract No. DE-AC05-00OR22725 (Contract) entered into with the DOE ORNL Site Office (OSO). UT-Battelle contracts the manufacture of fuel elements for HFIR to BWXT Nuclear Operations Group, Inc. (BWXT NOG) at the BWXT NOG facility in Lynchburg Virginia.

II

On November 13, 2018, reactor operators promptly initiated a manual shutdown of HFIR after noting abnormal readings in several primary plant indicators (though they were still within operating parameters). Following reactor shutdown, reactor operations staff monitored radiation indications to verify that they were decreasing to normal values and obtained primary coolant system water samples for isotopic analysis. The isotopic analysis revealed the presence of fission products (notably iodine), indicating a potential breach of the fuel cladding. Other fission product barriers remained intact. UT-Battelle did not detect any worker or public radiation doses as a result of this event.

On November 15, 2018, after completion of the post-shutdown cooling requirements, UT-Battelle opened the HFIR pressure vessel for defueling and observed deformation of several fuel plates in the outer fuel element. No anomalies were identified on the inner fuel element.

UT-Battelle reported the noncompliances associated with the outer fuel element failure in DOE's Noncompliance Tracking System (NTS) under report NTS-SC-OSOUTB-X10HFIR-2019-0008750, *Performance Degradation of the Outer Fuel Element at HFIR*, on March 8, 2019.

In response to the event, and recognizing its safety significance, DOE's Office of Science conducted an independent investigation into the cause of the failed fuel element. The results of the Office of Science investigation were documented in the *Final Investigation Report on the Fuel Element Failure at the High Flux Isotope Reactor which occurred on 13 November 2018*, dated May 2019. The report documented the cause of the event, recommended corrective actions, and assessed the adequacy of the operator and management response to the event. The report stated that the investigative team could not find any evidence that a fuel assembly had ever been rejected by UT-Battelle for not meeting acceptance criteria. The team also noted that for the past 15 years, the average number of nonconformances per fuel assembly documented by BWXT NOG during manufacture and either resolved or dispositioned as acceptable by UT-Battelle had increased significantly. As a result, the team expressed the belief that there was a sense of complacency and lack of depth in UT-Battelle's oversight and management of the HFIR fuel fabrication/inspection process.

The outer fuel element failure prompted UT-Battelle to review plant conditions at HFIR and the fuel element manufacturing process at BWXT NOG. UT-Battelle's review resulted in two reports: *Causal Analysis Report for NTS-SC-OSOUTB-X10HFIR-2019-0008750 Performance Degradation of the Outer Fuel Element at the High Flux Isotope Reactors (HFIR)*, dated May 2019, and *Oak Ridge National Laboratory HFIR OFE-488 Fuel Element Failure Causal Theory Evaluation Final Report*, dated December 2019. The Causal Analysis Report focused on determining the root and contributing causes of the event. The Causal Theory Report focused on evaluating 68 potential causal theories to determine the direct cause of the fuel element failure.

The Office of Enforcement found the UT-Battelle causal analysis to be comprehensive, except that UT-Battelle did not identify the independent assessment potential noncompliance documented in the DOE investigation report. UT-Battelle developed corrective actions that were provided to OSO, including the 19 corrective actions identified in the NTS report. In reviewing these corrective actions, the Office of Enforcement noted that they appear adequate to address the direct, root, and contributing causes and the potential noncompliances.

In addition to participating in UT-Battelle's review, BWXT NOG performed its own review of the HFIR fuel element manufacturing process, including machining, assembly, and welding. BWXT NOG's review was documented in the report *HFIR Cycle 483 Event-BWXT Investigation Review, Management Assessment, and Corrective Actions*, finalized January 2020.

The Office of Enforcement found BWXT NOG's analysis to be adequate. BWXT NOG developed corrective actions that included actions that had been assigned by UT-Battelle.

The Office of Enforcement noted that several of those corrective actions were continuations of actions that had been initiated before the event, showing that BWXT NOG management had already recognized and was proactively addressing these issues. Specifically, BWXT NOG had already identified and was working to correct several of the organizational and programmatic contributors to the HFIR event before the event occurred. The Office of Enforcement noted that, as a whole, BWXT NOG's corrective actions appear adequate to address the direct, root, and contributing causes and prevent recurrence.

On December 5, 2019, pursuant to 10 C.F.R. § 820.21(a), the Office of Enforcement initiated an investigation into the facts and circumstances associated with the outer fuel element failure. The Office of Enforcement conducted the onsite portions of the investigation at ORNL from February 11 through February 13, 2020, and at the BWXT NOG facility from March 3 through March 5, 2020. The Office of Enforcement's investigation identified two potential noncompliances by UT-Battelle with DOE nuclear safety requirements in the areas of supplier oversight and independent assessments. DOE provided the results of the investigation to UT-Battelle in a report dated August 17, 2020, and an enforcement conference was convened on September 29, 2020.

In a January 15, 2020, letter to the Office of Enforcement, UT-Battelle requested a Consent Order to settle the matter under investigation. In that letter, UT-Battelle stated that "settlement through Consent Order is appropriate based on our performance in the following areas: (1) demonstrated a consistent history of noncompliance reporting across security, worker safety and health, and nuclear safety programs; (2) demonstrated history of thorough event investigations, effective corrective actions and commitment to continuous improvement; (3) prompt and thorough reporting of circumstances related to the HFIR fuel degradation event; (4) comprehensive investigation and analysis of event causes, as well as timely development of corrective actions designed to address not only issues specific to the event, but also associated vendor oversight responsibilities; (5) transparent communication and interaction with the Oak Ridge National Laboratory Site Office (OSO) and Office of Science Program Office regarding the underlying incidents and our proposed path; and (6) Successful restart of the HFIR reactor after a comprehensive readiness assessment was conducted by DOE." UT-Battelle's corrective actions were grouped in the following categories: (1) reactor operations, (2) fuel manufacturing, and (3) standards for nuclear operations. These corrective actions cover among others reactor operations alarm response systems, the radiological monitoring system, an evaluation of any impact on the HFIR safety basis, fuel manufacturing process development and qualification, and fuel quality inspections.

III

Pursuant to 10 C.F.R. § 820.23, at any time during enforcement proceedings, DOE may resolve any or all outstanding issues with a Consent Order if the settlement is consistent with the objectives of the Atomic Energy Act of 1954, as amended, and DOE nuclear safety requirements enforceable under 10 C.F.R. Part 820, *Procedural Rules for DOE Nuclear Activities*.

To resolve potential noncompliances with DOE nuclear safety requirements and in consideration of UT-Battelle's investigation, causal analyses, and associated corrective actions taken since the submission of the NTS reports referenced above, which DOE found to be comprehensive and appropriate, DOE has elected to enter into settlement. DOE and UT-Battelle have reached agreement to resolve this matter through execution of this Consent Order.

IV

Accordingly, the terms of this Consent Order are as follows:

In consideration of the mutual agreements set forth in this section, the sufficiency and adequacy of which are acknowledged by DOE and UT-Battelle (hereinafter the "Parties"), the following terms represent agreement by the authorized representatives of the Parties to resolve by settlement the potential noncompliances at HFIR, in lieu of an enforcement action that DOE may issue pursuant to 10 C.F.R. § 820.24.

1. UT-Battelle shall fully complete and implement all of the following actions:
 - a. Within 12 months of the Effective Date of the Consent Order, UT-Battelle shall complete all the corrective actions to which UT-Battelle committed in the NTS (as of February 12, 2021) and in ORNL/RRD/INT-162, *Oak Ridge National Laboratory Research Reactors Division Corrective Action Plan in Response to Outer Fuel Element Failure*, Revision 2, dated October 2019.
 - b. Within 12 months of the Effective Date of the Consent Order, UT-Battelle shall perform an effectiveness review of BWXT NOG's corrective actions taken to address the deficiencies in the HFIR fuel manufacturing process and provide results of the effectiveness review to the DOE Offices of Enforcement and Science (including OSO).
 - c. Within 18 months of the Effective Date of the Consent Order, UT-Battelle shall additionally ensure completion of an independent effectiveness review (conducted by personnel outside of UT-Battelle and BWXT NOG) of the UT-Battelle corrective actions mentioned in 1.a above and provide results of the independent effectiveness review to the DOE Offices of Enforcement and Science (including OSO).
2. UT-Battelle shall pay the amount of \$170,000, reflecting an agreed-upon monetary remedy in lieu of the issuance of an enforcement action with the proposed imposition of a civil penalty pursuant to 10 C.F.R. § 820.24.
3. UT-Battelle agrees to return a signed copy of this Consent Order, within 1 week from the date of receipt, via email, to the Director, Office of Enforcement (officeofenforcement@hq.doe.gov).

4. The Effective Date of this Consent Order shall be the date upon which UT-Battelle signs this Consent Order.
5. UT-Battelle shall remit the monetary remedy of \$170,000 by check, draft, or money order payable to the Treasurer of the United States (Account Number 891099) within 30 calendar days after the Effective Date of this Consent Order. Payment shall be sent by overnight carrier to the address identified in item 3 above. To remit the monetary remedy by electronic funds transfer (EFT), please have your accounting department contact the Office of Enforcement's Docket Clerk at (301) 903-2493 for EFT wiring instructions. This Consent Order will constitute a final order upon the filing of the reply.
6. This Consent Order shall constitute a full and final settlement of the potential noncompliances identified in the referenced NTS reports, subject to the following:
 - (a) UT-Battelle's payment of the monetary remedy in accordance with item 5 above;
 - and (b) UT-Battelle's completion of all actions set forth in item 1 above to the satisfaction of DOE.
7. "No cost," as defined in the Federal Acquisition Regulation, 48 C.F.R. § 31.205-47, incurred by, for, or on behalf of UT-Battelle relating to coordination and cooperation with DOE concerning the investigation of matters covered by this Consent Order shall be considered allowable costs under the Contract. However, costs incurred by, for, or on behalf of UT-Battelle relating to the development and implementation of corrective actions, including costs associated with the effectiveness reviews required under item 1 above, may be considered allowable costs under the Contract.
8. This Consent Order does not preclude DOE from re-opening the investigation or issuing an enforcement action under 10 C.F.R. § 820.24 with respect to a potential noncompliance if: (a) after the Effective Date (as defined in item 4 above), DOE becomes aware of any false or materially inaccurate facts or information provided by UT-Battelle; (b) there is a recurrence of nuclear safety deficiencies similar to those identified above; or (c) UT-Battelle fails to complete all actions identified in item 1 above in a timely and effective manner to prevent recurrence of the identified issues.
9. Any modification to this Consent Order requires the written consent of both Parties.
10. UT-Battelle waives any and all rights to appeal or otherwise seek judicial or administrative review of the terms of this Consent Order. DOE retains the right to judicially enforce the provisions of this Consent Order by all available legal means.
11. This Consent Order is issued pursuant to DOE's authority under Section 234A of the Atomic Energy Act of 1954, as amended (42 U.S.C. § 2282a), and the implementing provisions of Part 820 governing enforcement of DOE nuclear safety requirements.
12. Pursuant to 10 C.F.R. § 820.23(d), this Consent Order shall become a Final Order 30 calendar days after the signed copy, referenced in item 3 above, is filed by the Office

of Enforcement's Office of the Docketing Clerk unless the Secretary of Energy files a rejection of the Consent Order or a modified Consent Order.

On behalf of my respective organization, I hereby agree to and accept the terms of the foregoing Consent Order.


FOR U.S Department of Energy



Date 3/30/21

Kevin L. Dressman
Director
Office of Enforcement
Office of Enterprise Assessments

FOR UT-Battelle, LLC

 Date 3/31/21

Dr. Thomas Zacharia
Laboratory Director
UT-Battelle, LLC