



Department of Energy
Washington, DC 20585

August 27, 2009

CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Eric D. Isaacs, Ph.D.
President, UChicago Argonne, LLC
Director, Argonne National Laboratory
9700 South Cass Avenue
Argonne, Illinois 60439

WEA-2009-04

Dear Dr. Isaacs:

Pursuant to section 234C of the Atomic Energy Act, as amended, 42 U.S.C. § 2282c, and Department of Energy (DOE) regulations at 10 C.F.R. Part 851, Worker Safety and Health Program, DOE is issuing this Final Notice of Violation (FNOV) to UChicago Argonne, LLC (UChicago Argonne) for violations of DOE's worker safety and health requirements. The FNOV is based upon the Office of Enforcement's November 25, 2008, Investigation Report and a careful and thorough review of all evidence presented to DOE by UChicago Argonne, including UChicago Argonne's original investigations, corrective actions, and response to the Preliminary Notice of Violation (PNOV). For reasons set forth in the enclosed FNOV, DOE finds no basis for modification of the PNOV.

Pursuant to 10 C.F.R. § 851.44, UChicago Argonne may petition DOE's Office of Hearings and Appeals for review of the enclosed FNOV. UChicago Argonne's petition must adhere to the procedural requirements established in Subpart G of 10 C.F.R. Part 1003, *Office of Hearings and Appeals Procedural Regulations*. If UChicago Argonne does not petition the Office of Hearings and Appeals within 30 calendar days of receipt of this FNOV, UChicago Argonne relinquishes any right to appeal any matter raised therein, and the FNOV will become a final order as provided by 10 C.F.R. § 851.43(c).

Sincerely,

John S. Boulden III
Acting Director
Office of Enforcement
Office of Health, Safety and Security

Enclosure



cc: William Brinkman, SC-1
Ronald Lutha, ASO
Steve Richardson, ANL
Stuart Meredith, ANL
Richard Azzaro, DNFSB

Final Notice of Violation

UChicago Argonne, LLC
Argonne National Laboratory

WEA-2009-04

The Department of Energy (DOE) conducted an investigation into the facts and circumstances associated with two incidents at the Argonne National Laboratory (ANL): a March 3, 2008, incident that resulted in the release of arsenic oxide into a laboratory room, and a March 11, 2008, incident that resulted in the overexposure of a laboratory researcher to carbon monoxide. The investigation identified multiple potential violations of DOE worker safety and health requirements by UChicago Argonne, LLC (UChicago Argonne).

On April 30, 2009, DOE issued a Preliminary Notice of Violation (PNOV) to UChicago Argonne with a proposed civil penalty of \$280,000 for four Severity Level I violations of 10 C.F.R. Part 851, *Worker Safety and Health Program*. DOE received UChicago Argonne's reply to the PNOV on May 29, 2009. In the reply, UChicago Argonne acknowledged the safety significance of the two events as well as their implications for institutional processes that are the basis for the PNOV. UChicago Argonne requested that DOE reconsider the corrective actions taken at all organizational levels in response to the events as supporting evidence for mitigation of the proposed civil penalty. UChicago Argonne also asked DOE to consider the appropriateness of the number of PNOV findings such that the Final Notice of Violation (FNOV) would reflect a consolidation of the four violations into two.

DOE thoroughly considered UChicago Argonne's reply and finds that the requested adjustments are not warranted. When evaluating the request for mitigation, DOE considered the factors that warrant mitigation for worker safety and health violations, including early self-identification, timely reporting, and prompt, comprehensive, and effective corrective action. UChicago Argonne had prior knowledge of the noncompliances associated with the Experiment Safety Review process as a result of an assessment that was performed in the Material Sciences Division (MSD) in 2007. UChicago Argonne also had the opportunity to self-identify and correct noncompliances associated with the MSD Chemical Hygiene Plan when the plan was reviewed in January 2008. Further, UChicago Argonne did not develop and implement prompt, comprehensive and effective corrective actions to address the noncompliances associated with the arsenic and carbon monoxide events. A complete set of UChicago Argonne corrective actions was not submitted to DOE until January 2009, almost 10 months after the events occurred. In the meantime, in December 2008, UChicago Argonne performed a self-assessment of Experiment Safety Review process improvements in MSD. The assessment identified that initial corrective actions were not effectively implemented in that the division did not ensure that: (1) subject matter experts (SME) were appropriately engaged in the work planning and control process to support hazard identification and abatement; (2) standard operating procedures were adequate to support experimental operations; and (3) employees had completed the required

training. This represents a continuing problem in effectively correcting deficiencies cited in this FNOV. Finally, UChicago Argonne's corrective action plans for the events do not address two items cited in the PNOV: (1) lack of standard operating procedures for select carcinogen use (violation II(A)), and (2) lack of low flow alarms or flow monitors for laboratory fume hoods (violation II(E)).

DOE also evaluated UChicago Argonne's request for consideration of violations III and IV in the PNOV as substantively contained within the first two violations, and therefore violations III and IV should not be separately set forth in the FNOV. With respect to violation III, 10 C.F.R. Part 851 provides that training should be considered as a separate element of a contractor's worker safety and health program (WSHP) and not as a component of the hazard abatement process under § 851.22. Training generally is not considered a hazard control since the hazard is neither removed nor reduced. Training is a primary mechanism for communicating to workers the hazards and controls associated with their work activities. In addition, the basis for violation III extends beyond training deficiencies specific to the arsenic and carbon monoxide events. For violation IV, DOE concludes that the specific deficiencies identified are not equivalent to the hazard identification and control violations, but rather reflect a distinct failure to implement the requirements of the ANL WSHP through engagement of SME's and oversight of MSD experimental activities consistent with the ANL Environment, Safety and Health Manual.

For the foregoing reasons, DOE has determined that the enforcement action against UChicago Argonne should remain unchanged. Pursuant to 10 C.F.R. § 851.43(b), DOE now issues this FNOV to UChicago Argonne for four Severity Level I violations of DOE's worker safety and health requirements as set forth below.

Final Violations

I. Hazard Identification and Assessment

Title 10 C.F.R. § 851.21, *Hazard identification and assessment*, requires that “[c]ontractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness” and that “[p]rocedures must include methods to assess worker exposure to chemical, physical, biological, or safety workplace hazards through appropriate workplace monitoring; evaluate operations, procedures, and facilities to identify workplace hazards; and perform routine job activity-level hazard analyses. Contractors must perform these activities initially to obtain baseline information and as often thereafter as necessary to ensure compliance with these requirements.”

Title 10 C.F.R. § 851.24, *Functional areas*, requires that “[c]ontractors must have a structured approach to their worker safety and health program...” and that in implementing the structured approach, “[c]ontractors must comply with the applicable standards and provisions in Appendix A of this part, entitled *Worker Safety and Health Functional Areas*.” Appendix A, Section 2, *Fire Protection*, states that “[c]ontractors must implement a comprehensive fire safety and emergency response program to protect workers commensurate with the nature of the work that is performed,” and that “[a]n acceptable fire protection program...includes meeting applicable building codes and National Fire Protection Association [NFPA] codes and standards.”

NFPA 45, *Standard on Fire Protection for Laboratories Using Chemicals*, 2004 edition, establishes the following provisions for laboratory operations involving hazardous chemicals:

- Section 12.1.1.1 states that “[b]efore laboratory tests or chemical reactions are begun, evaluations of laboratory operations shall be made for hazards that can be encountered or generated during the course of work.”
- Section 12.1.1.2 states that “such evaluations shall include: the hazards associated with the properties and reactivity of the materials used and any intermediate and end products that can be formed; hazards associated with the operation of the equipment at the operating conditions; and hazards associated with the proposed reactions.” In addition, regular reviews of laboratory operations and procedures shall be conducted with special attention given to any change in materials, operations, or personnel.

Contrary to these requirements, UChicago Argonne failed to adequately evaluate experimental procedures involving arsenic and carbon monoxide (CO) to identify and assess the hazards. Specific examples are listed below:

- A. MSD did not develop and implement an experiment safety review for the material synthesis work involving the use of arsenic or the experimental procedures using CO. Section 21.2, *Experiment Safety Review*, of the ANL Environment, Safety and Health (ESH) Manual¹ requires each division conducting experimental activities to establish and maintain an experiment safety review process to identify and control workplace hazards. A draft experiment safety review for materials synthesis, dated September 27, 2007, was developed but was not approved by the MSD Director and the MSD Safety Review Committee as required by the applicable experiment safety review implementing procedures. The draft form also did not reflect the use of carcinogens such as arsenic. For the experimental procedures using CO, a draft document, *Safety Analysis and Standard Operating Procedures* (dated September 10, 2007), identified the inhalation and flammability hazards associated with CO. However, the document was not developed in accordance with the experiment safety review process, did not address the operations involving the use of CO in an unsealed glove bag, and was not reviewed by the appropriate MSD management.
- B. UChicago Argonne did not identify the following hazards and precautions associated with arsenic:
 - Classification as a select carcinogen²
 - Keep away from heat
 - A sublimation temperature of 615 degrees C (1139 degrees F)

¹ The *Argonne National Laboratory Worker Safety and Health Program/Integrated Safety Management System Description* (Rev. 1 – February 20, 2008) describes the policies and procedures that comprise the functional Worker Safety and Health Program at ANL in compliance with 10 C.F.R. Part 851 and incorporates the implementing requirements maintained in the *Argonne National Laboratory Environment, Safety and Health Manual* (latest revision).

² See 29 C.F.R. § 1910.1450(b) for the definition of a *select carcinogen*.

UChicago Argonne did not identify the exothermic reaction and pressure hazard or assess the risk associated with heating arsenic in sealed ampoules above its sublimation temperature. In addition, UChicago Argonne did not evaluate the ampoule used in the experiment for the pressure associated with arsenic at the planned temperature.

- C. UChicago Argonne did not evaluate and assess the potential for worker exposure to CO under the experimental conditions to ensure that exposures would be maintained below the regulatory action level. Section 4.2, *Chemical Hygiene Plan*, of the ANL ESH Manual requires line supervisors to evaluate, with the assistance of an industrial hygienist, the potential for employee exposure to hazardous chemicals and to document the evaluations. Section 4.3, *Laboratory and Chemical Safety*, of the ANL ESH Manual provides criteria for workplace monitoring, including regulatory requirements, the nature of the operation, toxicity and physical properties of the material involved, existing engineering controls, and experience with similar operations. Section 4.3 also requires the Division Director to ensure that information is provided to ANL industrial hygiene staff about the chemicals and amounts used, as well as the manner and frequency of their use. UChicago Argonne did not conduct workplace monitoring, provide information to industrial hygiene staff, or evaluate the potential for employee exposure consistent with these requirements.

Collectively, these deficiencies constitute a Severity Level I violation. As explained in 10 C.F.R. Part 851, appendix B, section VI(b)(1), “[a] Severity Level I violation is a serious violation. A serious violation shall be deemed to exist in a place of employment if there is a potential that death or serious physical harm could result from a condition which exists, or from one or more practices, means, methods, operations, or processes which have been adopted or are in use, in such place of employment.”

Civil Penalty - \$70,000

II. Hazard Prevention and Abatement

Title 10 C.F.R. § 851.22, *Hazard prevention and abatement*, requires contractors to “establish and implement a hazard prevention and abatement process to ensure that all identified and potential hazards are prevented or abated in a timely manner. For hazards identified during the development of procedures, controls must be incorporated in the appropriate procedure. For existing hazards, contractors must protect workers from dangerous safety and health conditions.”

Title 10 C.F.R. § 851.23, *Safety and health standards*, requires compliance with 29 C.F.R. Part 1910, *Occupational Safety and Health Standards*, which includes 29 C.F.R. § 1910.1450, *Occupational Exposure to Hazardous Chemicals in Laboratories*. Title 29 C.F.R. § 1910.1450(e) requires that “the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan” and that the plan “shall indicate specific measures that the employer will take to ensure laboratory employee protection.” This includes “standard operating procedures relevant to safety and health considerations are to be followed when laboratory work involves the use of hazardous chemicals; criteria that the employer will use to determine and implement control measures to reduce employee exposures to hazardous chemicals; and provisions for additional employee protection for work with particularly hazardous substances,

which include select carcinogens, reproductive toxins, and substances which have a high degree of acute toxicity.”

Title 29 C.F.R. § 1910.1450(e) also requires that “fume hoods and other protective equipment are functioning properly and that specific measures shall be taken to ensure proper and adequate performance of such equipment.”

NFPA 45, chapter 8 requires a permanently installed measuring device for airflow on chemical fume hoods that shall provide constant indication to the hood user of adequate or inadequate airflow. Consistent with this standard, Section 7.11, *Laboratory Ventilation and Air Cleaning*, of the ANL ESH Manual requires the installation of airflow indicators on new laboratory hoods.

Contrary to these requirements, UChicago Argonne failed to establish and implement proper hazard control and prevention measures to eliminate or abate the hazards associated with experimental procedures involving arsenic and CO. Specific examples are listed below:

- A. UChicago Argonne did not establish standard operating procedures for the use of arsenic, a select carcinogen. Section 4.5, *Chemical Carcinogens*, of the ANL ESH Manual requires the use of standard operating procedures for “all activities that involve the use of Class 1 or 2 carcinogens.” The MSD CHP (dated January 17, 2008) does not provide specific operating procedures for the use of carcinogens, and the CHP does not identify the use of any select carcinogens in MSD laboratories. The use of select carcinogens requires the establishment of a “designated area” and the use of containment devices such as fume hoods or glove boxes. These controls were not used or in place on the day of the incident.
- B. The muffle furnace used to heat the arsenic compound was not operated in a laboratory fume hood. The MSD CHP explicitly requires proper ventilation of ovens used for processing hazardous chemicals, and the MSD operating procedure for use of a muffle furnace (*Use of High Temperature Furnaces*, dated August 31, 1999) requires placement in a fume hood if an experiment may generate hazardous gases. When heated to decomposition, arsenic emits “highly toxic fumes” (ref. Science Lab.com material safety data sheet dated October 9, 2005). The MSD CHP also states that a chemical fume hood or approved containment will be used for operations with chemicals that have an American Conference of Governmental Industrial Hygienists Threshold Limit Value (TLV) of 50 parts per million (ppm) or less. Arsenic has a TLV of 0.003 ppm.
- C. UChicago Argonne did not establish criteria to determine and implement control measures to reduce employee exposure to asphyxiants or flammable gases and did not establish standard operating procedures for the use of CO.
- D. UChicago Argonne did not verify that the laboratory fume hood used for the CO experiments would adequately capture the CO released from the glove bag during the conduct of the experiments. The laboratory fume hood used for the glove bag operations was not evaluated prior to the start of work to validate its capability to contain the release of CO under the expected conditions of the experiment. Subsequent tracer gas studies under simulated experimental conditions performed by UChicago Argonne demonstrated that the laboratory

fume hood was not fully effective in controlling worker exposure to CO in the breathing zone.

- E. The laboratory fume hood used for the CO experiments was not equipped with a flow monitor or low flow alarm to inform the user of proper operation of this engineering control.
- F. The CO monitors installed in the laboratory room where the CO work was performed were not appropriate for the application and were not procured in accordance with the requirements contained in section 4.3 of the ANL ESH Manual. The CO monitors were designed for residential use and did not have an alarm response time appropriate for an occupational environment. In addition, the monitors were not evaluated by ANL industrial hygiene personnel for adequacy for this application consistent with the requirements of section 4.3 of the ANL ESH Manual.

Collectively, these deficiencies constitute a Severity Level I violation.
Civil Penalty - \$ 70,000

III. Training and Information

Title 10 C.F.R. § 851.25, *Training and information*, requires that “[t]he contractor must provide training and information for new workers; before or at the time of initial assignment to a job involving exposure to a hazard; periodic training as often as necessary to ensure that workers are adequately trained and informed; and additional training when safety and health information or a change in workplace conditions indicates that a new or increased hazard exists. In addition, it requires contractors to provide training and information to workers who have worker safety and health program responsibilities that is necessary for them to carry out those responsibilities.”

Title 29 C.F.R. § 1910.1450(b) defines the Chemical Hygiene Officer as an employee who is qualified by training or experience to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan.

Title 29 C.F.R. § 1910.1450(f) states that the employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area, and that such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. It also states that employee training shall include review of the physical and health hazards of chemicals in the work area, and the measures employees can take to protect themselves from these hazards, such as appropriate work practices, emergency procedures, and personal protective equipment.

Contrary to these requirements, UChicago Argonne failed to effectively train MSD employees on the provisions and requirements of the division's CHP, including procedures associated with the use of a select carcinogen (arsenic) or procedures associated with the use of asphyxiants or flammable gases. Specific examples are listed below:

- A. The Principal Investigator of the material synthesis experiment was not provided with training on carcinogen health hazards or appropriate control measures.

- B. The MSD employee performing the CO glove bag operation was not effectively trained on methods to ensure protection from the physical and health hazards present in the workplace, including specific procedures, work practices, and equipment necessary for proper instrument placement and glove bag deflation.
- C. The MSD ESH Coordinator was not adequately trained and qualified to manage the MSD laboratory safety program and carry out the responsibilities associated with the position. The MSD ESH Coordinator was not trained on the duties assigned to the position that are identified in the ANL ESH Manual and the responsibilities of the MSD Chemical Hygiene Officer for providing technical guidance in the development and implementation of the provisions of the ANL and MSD CHPs.

Collectively, these deficiencies constitute a Severity Level I violation.
Civil Penalty - \$70,000

IV. General Requirements

Title 10 C.F.R. § 851.10, *General requirements*, states that “the contractor must...ensure that work is performed in accordance with all applicable requirements of [10 C.F.R. Part 851] and with the worker safety and health program for that workplace.”

The *Argonne National Laboratory Worker Safety and Health Program/Integrated Safety Management System Description* (rev. 1 dated February 20, 2008) is UChicago Argonne’s approved worker safety and health program and establishes the framework for maintaining compliance with 10 C.F.R. Part 851 requirements. The program incorporates the ANL ESH Manual, and the ESH Manual assigns responsibilities for management, supervisors, and employees in the conduct and oversight of experimental work.

Section 1.1, *Argonne Environment, Safety and Health Responsibilities*, of the ANL ESH Manual assigns to laboratory management the responsibilities for establishing and ensuring the implementation of methods for performing work in accordance with applicable requirements. ANL ESH Manual Section 21.2, *Experiment Safety Review*, requires each division to “...establish safety standards or criteria for conducting experiments, designing related experimental apparatus, and completing safety reviews prior to performing proposed experiments.”

ANL ESH Manual, section 1.1 requires the director of Environment, Safety and Health/Quality Assurance Oversight (EQO) to perform oversight of ESH programmatic and support activities to evaluate effectiveness and compliance with federal, state, and local ESH laws and regulations and contractually imposed DOE directives; and verify the effectiveness of division implementation of ESH Manual requirements.

Title 29 C.F.R. § 1910.1450(e)(4) requires the contractor to “...review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.”

ANL ESH Manual, section 1.1 requires supervisors to...“ensur[e] that employees’ required training is kept up to date and that their JHQ [Job Hazard Questionnaire] is reviewed and updated on an annual basis or when an individual’s job functions change.”

Section 4.3, *Laboratory and Chemical Safety* of the ANL ESH Manual permits the installation of user-owned hazard monitors, but requires “[c]onsultation with the [CHO] prior to purchase...so that equipment with the necessary sensitivity and specificity can be obtained.”

Contrary to these requirements, UChicago Argonne failed to implement a worker safety and health program that ensured that experimental work activities were evaluated prior to the start of work and that validated the effectiveness of the experiment safety review process. Specific examples include the following:

- A. The MSD experiment safety review process did not incorporate requirements of section 21.2 of the ESH Manual for the preparation of standard operating procedures, use of management controls or periodic evaluations to ensure changes in operating conditions are reflected in experiment safety reviews, and provisions for design review of experimental apparatus. The CO and arsenic events illustrated deficiencies in the MSD experiment safety review process for the performance of specified functions by management, subject matter experts, and workers as follows:
 - The MSD ESH Coordinator did not perform an evaluation of MSD laboratory facilities for the new hazards associated with the introduction of arsenic and carbon monoxide.
 - The division Chemical Hygiene Officer did not review and concur on procedures involving the use of highly toxic materials and “Class 1” carcinogens (arsenic).
 - Subject matter experts were not engaged in the development and evaluation of the experiment safety reviews for the arsenic and carbon monoxide experiments.
 - MSD did not implement procedures to ensure that workers conducting the experiments were familiar with the hazards and controls associated with arsenic and carbon monoxide prior to the start of work.
- B. UChicago Argonne failed to verify that MSD incorporated the requirements in section 21.2 of the ANL ESH Manual in the development and implementation of an effective experiment safety review process.
- C. MSD failed to update the division’s CHP to reflect the introduction of carcinogens and asphyxiants into the laboratory and the evaluation of associated hazards and controls.
- D. UChicago Argonne’s ESH oversight functions failed to identify that the MSD experiment safety review process did not meet ANL Worker Safety and Health Program, ANL ESH Manual, and 10 C.F.R. Part 851 requirements. A UChicago Argonne Independent Assessment (dated May 18, 2007) of the work planning and control program of select divisions (including MSD) indicated that the experiment safety review processes at ANL met the requirements of Chapter 21, *Safety Analysis and Review* of the ANL ESH Manual. The

assessment found that line management oversight was sufficient to ensure that the work or activity proceeded as planned, and changes in work scope were thoroughly reviewed, analyzed, documented and approved before implementation.

- E. MSD did not ensure that the JHQ for the Principal Investigator conducting the material synthesis work was updated to reflect the use of carcinogens. The JHQ provides information for performing medical evaluations and surveillance, exposure monitoring, hazard assessment, training, and certifications.

Collectively, these deficiencies constitute a Severity Level I violation.
Civil Penalty - \$70,000

Administrative Appeal

Pursuant to 10 C.F.R. §§ 851.43(b) and 851.44(a), UChicago Argonne may petition DOE's Office of Hearings and Appeals for review of this FNOV within 30 calendar days of receipt of this FNOV. UChicago Argonne's petition must conform with the procedural requirements set forth in 10 C.F.R. Part 1003, *Office of Hearings and Appeals Procedural Regulations*, Subpart G, § 1003.70, et seq. If UChicago Argonne does not petition the Office of Hearings and Appeals for review within 30 calendar days of receipt of this FNOV, UChicago Argonne relinquishes any right to appeal any matter, and the FNOV will constitute a final order.

Civil Penalty Remittance

If UChicago Argonne decides not to contest the FNOV, the penalty of \$280,000 must be paid within 30 calendar days after receipt of this FNOV by check, draft, or money order payable to the Treasurer of the United States (Account 891099) and mailed to the Acting Director, Office of Enforcement, Attention: Office of the Docketing Clerk, U.S. Department of Energy, 19901 Germantown Road, Germantown MD 20874-1290. This FNOV will constitute a final order upon the payment of the civil penalty.



John S. Boulden III
Acting Director
Office of Enforcement
Office of Health, Safety and Security

Washington, DC
this 27th day of August 2009