



Department of Energy

Washington, DC 20585

March 12, 2021

Dr. Stuart Henderson
Laboratory Director
Jefferson Science Associates, LLC
Thomas Jefferson National Accelerator Facility
12000 Jefferson Avenue
Newport News, Virginia 23606

WEA-2021-01

Dear Dr. Henderson:

This letter refers to the Department of Energy's (DOE) investigation into the facts and circumstances associated with deficiencies in Jefferson Science Associates, LLC's (JSA) implementation of DOE 10 C.F.R. Part 851 electrical safety program requirements and three events involving the incomplete implementation of hazardous energy controls at the Thomas Jefferson National Accelerator Facility (TJNAF). The DOE Office of Enterprise Assessments' Office of Enforcement provided the results of the investigation to JSA in an investigation report dated July 10, 2020. An enforcement conference was convened on August 7, 2020, with you and members of your staff to discuss the report's findings and JSA's response. A summary of the enforcement conference and attendance roster are enclosed.

DOE considers the deficiencies associated with the incomplete implementation of hazardous energy controls revealed by these events to be of high safety significance. The three events exposed weaknesses in JSA's implementation of the requirements of 10 C.F.R. Part 851, *Worker Safety and Health Program*, resulting in a high voltage electrical shock, causing an engineer to fall backward, lose consciousness, and suffer temporary impairment of both arms and legs, a near miss to a potentially serious laser injury, and a minor electrical shock to an information technology technician. Each of these events could have resulted in more serious injury or death, and they revealed deficiencies in: management responsibilities; hazard identification, assessment, prevention, and abatement; electrical safety; laser safety; training and information; and emergency response.

Based on an evaluation of the evidence in this matter, including information presented at the enforcement conference, DOE concludes that JSA violated regulatory requirements prescribed under 10 C.F.R. Part 851, *Worker Safety and Health Program*. Accordingly, DOE hereby issues the enclosed Preliminary Notice of Violation (PNOV) which cites three Severity Level I violations with a corresponding civil penalty (unmitigated) of \$99,000 per violation and three



Severity Level II violations with a corresponding civil penalty (unmitigated) of \$49,500 per violation. DOE considers these deficiencies to be self-disclosing and grants no mitigation for timely self-identification, consistent with DOE's worker safety and health enforcement policies.

JSA conducted investigations for all three hazardous energy control events and convened an electrical safety Director's Review. Each of the investigations as well as the Director's Review developed comprehensive corrective action plans to address the root causes and contributing factors identified in each of the reports. JSA evaluated the identified root causes and applied corrective actions more broadly to other hazards across TJNAF. The corrective actions developed by JSA for the three Severity Level I (hazard identification, assessment, prevention, and abatement; electrical safety; and laser safety) and three Severity Level II (management responsibilities; training and information; and emergency response and recordkeeping), if adequately implemented and maintained, are likely adequate to prevent recurrence of similar issues at TJNAF. In general, these actions appropriately address the specific judgements of need and conclusions associated with the Electrical Safety Director's Review. Therefore, DOE has granted partial mitigation of 50 percent of the civil penalties for the corrective actions addressing these violations.

In consideration of the mitigating factors, DOE calculated a mitigated civil penalty (prior to adjustment for fee reduction) of \$222,750 for worker safety and health violations. However, the DOE Thomas Jefferson Site Office withheld \$333,639.23 in conditional payment of fee from JSA in fiscal year 2019, for safety and health-related deficiencies, including those associated with the three events cited in this PNOV. Therefore, in accordance with 10 C.F.R. § 851.5(c) and DOE Acquisition Regulation 48 C.F.R. § 970.5215-3, *Conditional Payment of Fee, Profit, and Other Incentives – Facility Management Contracts*, DOE proposes no civil penalty for the violations cited in this PNOV.

Pursuant to 10 C.F.R. § 851.42, *Preliminary Notice of Violation*, you are obligated to submit a written reply within 30 calendar days of receipt of the enclosed PNOV and to follow the instructions specified in the PNOV when preparing your response. If you fail to submit a reply within the 30 calendar days, then in accordance with 10 C.F.R. § 851.42(d), you relinquish any right to appeal any matter in the PNOV, and the PNOV will constitute a final order.

After reviewing your reply to the PNOV, DOE will determine whether any further enforcement action is necessary to ensure compliance with DOE worker safety and health requirements. DOE will continue to monitor the completion of corrective actions until this matter is fully resolved.

Sincerely,



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

Enclosures: Preliminary Notice of Violation (WEA-2021-01)
Enforcement Conference Summary
Enforcement Conference Attendance Roster

cc: Joseph Arango, SC-TJSO
Christina Johnson, Jefferson Science Associates, LLC

Preliminary Notice of Violation

Jefferson Science Associates, LLC
Thomas Jefferson National Accelerator Facility

WEA-2021-01

A U.S. Department of Energy (DOE) investigation into the facts and circumstances associated with three hazardous energy control events that occurred between April and July 2019, at the Thomas Jefferson National Accelerator Facility, revealed multiple violation(s) of DOE worker safety and health requirements by Jefferson Science Associates, LLC (JSA). DOE provided JSA with an investigation report dated July 10, 2020, and convened an enforcement conference on August 7, 2020, with JSA representatives, to discuss the report's findings and JSA's response. The hazardous energy control events are summarized below, followed by the details of this Preliminary Notice of Violation (PNOV).

Event 1: High Voltage Electrical Shock

In the weeks before the event, an Inductive Output Tube (IOT) 1 of the Continuous Electron Beam Accelerator Facility radio frequency (RF) separator had intermittent problems. JSA determined that floating deck unit (FDU) faults had prevented the operation of IOT 1. An Accelerator Task List document was generated that addressed identifying the high voltage hazards, repairing the FDU, and returning IOT 1 to service. JSA deemed these tasks too time-consuming to address during the scheduled accelerator run period, so the system was reconfigured, allowing IOT 2 to power Pass 2 (i.e., a second orbit of the electron beam). The work to troubleshoot and repair the FDU was rescheduled for April 2019 (during the next scheduled accelerator down period), when more time would be available to complete repair activities.

During the week of April 15, 2019, repair work began on the FDU. To allow for testing and troubleshooting, the top cover of the FDU chassis was removed and was not replaced. The front cover of the FDU was also removed and was not re-secured with screws in between the repair tasks; instead, workers used nylon zip ties looped through existing slots to hang the front cover as a temporary barrier when the unit was unattended.

On April 26, 2019, an engineer was troubleshooting the FDU that powered IOT 1. The engineer, who was working alone at the time of the event, performed approved and authorized work, using a standard JSA work package. The engineer conducted a brief visual inspection of the unit and then, unable to determine the fault condition, lifted the front cover (held in place by nylon zip ties) to look inside the FDU. The engineer received a 27 kilovolt (kV) direct current (DC) electrical shock that traveled from one hand through the chest to the other hand, resulting in first and second-degree burns at the entry and exit points. The shock caused the engineer to fall backward, lose consciousness, and suffer temporary impairment of both arms and legs.

After regaining consciousness, the engineer was able to exit the building and summon help from an employee who was driving by. The engineer was escorted to Occupational Medicine and then taken by medical transport to a local hospital for treatment and observation.

Event 2: Student's Near-Miss Eye Exposure to a Class 4, 30W Laser¹

On June 7, 2019, a graduate student working in the Experimental Equipment Laboratory was tasked with measuring the laser power and wavelength of multiple Class 4, 30-watt (W) infrared laser systems. Laser fiber cables are checked using a magnifying laser fiber inspection scope. Two optical fibers were inspected at 200 times power magnification without incident. A third fiber, which was connected to an operating 30W infrared laser, ablated a portion of the student's laser safety glasses when the scope was held against the glasses for visual inspection of the fiber end. The student immediately pulled the scope away after observing an unexpected difference in brightness and color (from the first two inspected fibers). The difference indicated that the laser might have unintentionally been powered on. The laser was then powered down. The student attempted to report the incident to the lab supervisor, who was unavailable. The student left the work area and did not report the incident before leaving for the weekend. The following Monday, during the weekly status meeting, the student reported the incident to the lab supervisor. The student was taken to Occupational Medicine and evaluated for potential vision impairment and damage to the eye. No damage was observed.

Event 3: Electrical Shock While Troubleshooting a Desktop Computer

On July 8, 2019, an information technology (IT) technician was tasked with troubleshooting a desktop computer that routinely overheated. The technician attempted to turn on the computer, but it would not remain on long enough to run internal software diagnostics. The technician unplugged the computer and discharged electricity from the components by holding down the power button for 30 seconds before starting disassembly.

The technician removed the outer cowling and display screen and performed an inspection, which found no visible signs of the machine overheating. The technician checked for debris around two of the fans, but the third fan, located behind the central processing unit board, was inaccessible. To determine the functionality of the third fan, the technician again turned on the computer. All three fans appeared to be operating properly. Moving a hand over the machine, the technician checked for air movement and a heat source, inadvertently touching a solder point on the power supply and receiving an electrical shock with the maximum potential of 120 volts (V) alternating current.

After the shock, the technician took a short phone call, unplugged the computer, and informed the IT department management of the event. The manager instructed the technician to report to Occupational Medicine, where it was determined that tingling in the employee's arm justified

¹ Students are not covered under 10 C.F.R Part 851, *Worker Safety and Health Program*, unless employed by a DOE contractor or subcontractor; however, DOE contractors are required to address workplace hazards that could potentially affect contractor employees. For example, JSA is required to identify and abate hazards associated with optical fiber inspection using magnification equipment in the laboratory that is used by JSA employees in accordance with Part 851.

medical transport to a local hospital for treatment and observation. The technician was released from the hospital that evening, with no restrictions.

Pursuant to Section 234C of the Atomic Energy Act of 1954, as amended, and DOE regulations set forth at 10 C.F.R. Part 851 (Part 851), *Worker Safety and Health Program*, DOE hereby issues this PNOV to JSA. The violations cited in this PNOV include deficiencies in: (1) management responsibilities; (2) hazard identification, assessment, prevention, and abatement; (3) electrical safety; (4) laser safety; (5) training and information; and (6) emergency response. DOE has grouped and categorized the violations as three Severity Level I violations and three Severity Level II violations.

Severity Levels are explained in Part 851, Appendix B, *General Statement of Enforcement Policy*. Subparagraph VI(b)(1) states that “[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.”

Subparagraph VI(b)(2) states that “[a] Severity Level II violation is an other-than-serious violation. An other-than-serious violation occurs where the most serious injury or illness that would potentially result from a hazardous condition cannot reasonably be predicted to cause death or serious physical harm to employees but does have a direct relationship to their safety and health.”

In consideration of the mitigating factors, DOE calculated a mitigated civil penalty (prior to adjustment for fee reduction) of \$ 222,750 for worker safety and health violations. However, the DOE Thomas Jefferson Site Office withheld \$333,639.23 in conditional payment of fee from JSA in fiscal year 2019 for safety and health-related deficiencies, including those associated with the three events cited in this PNOV. Therefore, in accordance with 10 C.F.R. § 851.5(c) and DOE Acquisition Regulation 48 C.F.R. § 970.5215-3, *Conditional Payment of Fee, Profit, and Other Incentives – Facilities Management Contracts*, DOE proposes no civil penalty for the violations cited in this PNOV.

As required by 10 C.F.R. § 851.42(b) and consistent with Part 851, Appendix B, the violations are listed below. If this PNOV becomes a final order, then JSA may be required to post a copy of this PNOV in accordance with 10 C.F.R. § 851.42(e).

I. VIOLATIONS

A. Management Responsibilities

Title 10 C.F.R. § 851.10, *General requirements*, subsection (a), states that “[w]ith respect to a covered workplace for which a contractor is responsible, the contractor must: . . . (2) [e]nsure that work is performed in accordance with: (i) [a]ll applicable requirements of [10 C.F.R. Part 851]; and (ii) [w]ith the worker safety and health program for that workplace.”

Title 10 C.F.R. § 851.23, *Safety and health standards*, paragraph (a)(3), states that “[c]ontractors must comply with the following safety and health standards that are applicable to the hazards at their covered workplace...(3) Title 29 [C.F.R.] Part 1910, ‘Occupational Safety and Health Standards’.”

Title 10 C.F.R. § 851.23, *Safety and health standards*, subsection (a), states that “[c]ontractors must comply with the following safety and health standards that are applicable to the hazards at their covered workplace...(14) NFPA [National Fire Protection Association] 70E, ‘Standard for Electrical Safety in the Workplace,’ (2015).”

Title 29 C.F.R. § 1910.147, *The control of hazardous energy (lockout/tagout)*, subsection (c), *Periodic inspection*, subparagraph (6)(i), states that “[t]he employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of this standard are being followed.”

Thomas Jefferson National Accelerator Facility Document *10 CFR 851 Worker Safety and Health Program (WSHP)*, Rev. 5, dated October 2018, Section 3.1.1, states that “JSA leadership, managers, and supervisors are responsible for providing a place of employment that is free from recognized hazards that are causing or have the potential to cause death or serious physical harm to employees.” Section 3.1.7 states that “[s]upervisors identify environment, safety, and health (ES&H) training requirements based upon the work assignment and the potential for exposure to hazards through the on-line Job Task Analysis (JTA) tool, and ensure employees fulfill the training requirements.” In addition, Section 3.1.6 states that “[a] crosswalk of the requirements against established Jefferson Lab ES&H programs is found in Attachment 1 – Requirements Crosswalk Table.”

Contrary to these requirements and as evidenced by the following facts, JSA management failed to implement hazardous energy control requirements for tasks assigned to workers.

JSA did not ensure that equipment-specific procedures were reviewed annually and updated as required. As a result, updates were at the procedure owner’s discretion and were not always performed. For example, Jefferson Lab Document *RF Separator and IOT High Voltage Power Supply Shutdown & Discharge Procedure*, Number EES-PR-04-004, Rev. 4, dated May 20, 2008, was still in use at the time of the high voltage electrical shock event and referenced standard operating procedure A-05-034-SOP-REV1, which had expired on November 9, 2007.

Collectively, these deficiencies constitute a Severity Level II violation.

Base Civil Penalty – \$49,500

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$24,750

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

B. Hazard Identification, Assessment, Prevention, and Abatement

Title 10 C.F.R. § 851.21, *Hazard identification and assessment*, subsection (a), states that “[c]ontractors must establish procedures to identify existing and potential workplace hazards and assess the risk of associated workers injury and illness. Procedures must include methods to... (5) [e]valuate operations, procedures, and facilities to identify workplace hazards; and (6) [p]erform routine job activity-level hazard analysis.”

Title 10 C.F.R. § 851.22, *Hazard prevention and abatement*, subsection (b), states that “[c]ontractors must select hazard controls based on the following hierarchy: (1) [e]limination or substitution of the hazards where feasible and appropriate; (2) [e]ngineering controls where feasible and appropriate; (3) [w]ork practices and administrative controls that limit worker exposures; and (4) [p]ersonal protective equipment (PPE).” In addition, subsection (c), states that “[c]ontractors must address hazards when selecting or purchasing equipment, products, and services.”

WSHP, Section 3.1.3, states that “[t]he Jefferson Lab ES&H professionals are involved in the planning of maintenance and construction activities and experiments, as well as potential interactions between workplace hazards.”

WSHP, Section 3.1.4, states that “[o]nce hazards are identified, they are to be mitigated using a hierarchy of controls: elimination of hazard, substitution of a less hazardous process, engineered controls, development of procedures to control the hazard, and if necessary, required personal protective equipment.”

ES&H Manual Chapter 3210, *Work Planning, Control, and Authorization Process*, August 28, 2018, Revision 1.0, Section 1.0, *Purpose*, states that “[a]ll work requires forethought, planning, and authorization.” It also states that “[i]dentification of work hazards and understanding their risks is an essential part of this process.” In addition, Section 2.0, *Scope*, states that “[a] graded approach commensurate with the risk code assigned, programmatic impact, and quality assurance, is used to determine the level of rigor allotted for each activity.”

ES&H Manual Chapter 6410, *Laser Safety Program*, September 1, 2018, Revision 1.3, Section 4.1, *Laser Operational Safety Procedure*, states that “Class 4 laser light poses an unmitigated Risk Code >2; therefore, in accordance with ES&H Manual Chapter 3210 Work Planning, Control, and Authorization Process, a formal work control document is required for each piece of equipment or system, and the area where it is located.” In addition, Appendix T1, *Laser Operational Safety Procedure (LOSP)*, Section 1.0, *Purpose*, states that, “This Laser Operational Safety Procedure (LOSP) has been developed to ensure that hazard issues, identified through a Task Hazard Analysis, are adequately addressed, and appropriately mitigated, before activities involving lasers are approved or commence.” Contrary to these requirements and as evidenced by the following facts, JSA failed to adequately identify, evaluate, and implement appropriate controls for hazards associated with energized systems.

1. JSA’s process for screening work activity hazards did not accurately identify risk levels. The work planning entry for troubleshooting the RF separator (*Accelerator Task List ID 18927, Work on IOT 1-FDU*, approved March 13, 2019) identified the potential for exposure to voltage(s) up to 27kV if the system was not locked out. The high voltage electrical hazard(s) associated with the RF separator repair and troubleshooting activity was inappropriately rated at a pre-mitigated risk code 2 (i.e., low risk). As a result, the screening did not trigger the engagement of appropriate subject matter experts or the development of an operational safety procedure.
2. JSA did not implement methods to eliminate or administratively control the hazards associated with work activities in the Experimental Equipment Laboratory (i.e., visual inspection of optical fibers with a handheld FS200-SMA fiber inspection scope). The procedure for work in the laser laboratory, *Laser Operational Safety Procedure (LOSP) for the Polarized 3He Target Lab*, did not identify the task of examining optical fibers under magnification, evaluate the potential hazards associated with this task, evaluate the impact of magnification on the selection of PPE, or establish acceptable work practice controls to eliminate or mitigate those hazards.
3. JSA did not adequately evaluate potential hazard exposure scenarios in laser laboratory operations. The hazard assessment calculations for laser protective eyewear optical density requirements and for nominal hazard zones in the LOSP assume that the laser laboratory’s infrared diode lasers are operating at a maximum power of 30W. Multiple lasers in the lab are capable of operating at up to 50W and have been operated at energies of up to 38W.
4. JSA did not develop and implement procedures in the IT department to address the potential for electrical hazards for assigned work tasks; the lack of these procedures exposed employees to electrical hazards while performing troubleshooting tasks.

Collectively, these deficiencies constitute a Severity Level I violation.

Base Civil Penalty – \$99,000

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$49,500

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

C. Electrical Safety

Title 10 C.F.R. § 851.24, *Functional Areas*, subsection (b), states that “[c]ontractors must comply with the applicable standards and provisions in Appendix A to Part 851, *Worker Safety and Health Functional Areas*.” Appendix A, Section 10, *Electrical Safety*, requires implementation of a comprehensive electrical safety program appropriate for the activities at the site.

Title 29 C.F.R. § 1910.132, *General Requirements*, subsection (d), *Hazard assessment and equipment selection*, subparagraph (1)(i), states that “the [contractor] shall select, and have

each affected employee use, the types of PPE that will protect the affected employee from the hazards identified in the hazard assessment.”

Title 29 C.F.R. § 1910.335, *Safeguards for personal protection*, Subsection (a), *Use of protective equipment*, subparagraph (1)(i), states that “[e]mployees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed.”

Title 29 C.F.R. § 1910.335, *Safeguards for personal protection*, subparagraph (b)(2), *Barricades*, states that “[b]arricades shall be used in conjunction with safety signs where it is necessary to prevent or limit employee access to work areas exposing employees to uninsulated energized conductors or circuit paths. Conductive barriers may not be used where they might cause an electrical contact hazard.”

NFPA 70E, Article 110, *General Requirements for Electrical Safety-Related Work Practices*, Section 110.1(H), *Job Briefing*, states that “[b]efore starting each job, the employee in charge shall conduct a job briefing with the employees involved. The briefing shall cover such subjects as hazards associated with the job, work procedures involved, special precautions, energy source controls, PPE requirements, and the information on the energized electrical work permit, if required. Additional job briefings shall be held if changes that might affect the safety of employees occur during the course of the work.”

NFPA 70E, Article 120, *Establishing an Electrically Safe Work Condition*, Section 120.1(5), *Verification of an Electrically Safe Work Condition*, states: “[u]se...an adequately rated test instrument to test each phase conductor or circuit part to verify it is de-energized. Test each phase conductor or circuit part both phase-to-phase and phase-to-ground. Before and after each test, determine that the test instrument is operating satisfactorily through verification on a known voltage source.”

NFPA 70E, Article 130, *Work Involving Electrical Hazards*, Section 130.4(A), *Shock Risk Assessment*, states that “[a] shock risk assessment shall determine the voltage to which personnel will be exposed, the boundary requirements, and the necessary PPE in order to minimize the possibility of electric shock to personnel.”

NFPA 70E, Article 130, *Work Involving Electrical Hazards*, Section 130.7(A), *General*, states that “[e]mployees working in areas where electrical hazards are present shall be provided with, and shall use, protective equipment that is designed and constructed for the specific part of the body to be protected and for the work to be performed.”

NFPA 70E, Article 130, *Work Involving Electrical Hazards*, Table 130.7(C)(16), *Personal Protective Equipment (PPE)*, indicates that the minimum required PPE is Category 1, which has a minimum arc rating of 4 calories per centimeter squared (cal/cm²).

ES&H Manual Chapter 6200, *Electrical Safety Program*, November 18, 2018, Rev. 3.3, Section 3.5, *Responsibilities*, states that “Facilities management electrical engineer [will]

provide electrical distribution equipment with arc flash labels marked with the available incident energy, arc flash boundary, and the nominal system voltage.”

Contrary to these requirements and as evidenced by the following facts, JSA failed to effectively implement its electrical safety program in accordance with the applicable requirements of Part 851 and the JSA WSHP to ensure that workers were adequately protected from electrical hazards.

1. JSA did not ensure that appropriate PPE was selected for tasks associated with arc flash hazards. The *JSA RF Separator and IOT High Voltage Power Supply Shutdown & Discharge Procedure* (Number EES-PR-04-004, Rev. 4, May 20, 2008), did not incorporate the PPE changes of NFPA 70E (2015) and lists cotton clothing as an adequate form of PPE. The 2015 version of NFPA 70E does not permit cotton clothing to be worn as PPE when working with high voltage equipment.
2. JSA did not ensure that the chassis cover of the FDU was secured (i.e., with screws) before re-energizing the device. The cover was therefore ineffective in preventing direct access to the energized unit. Prior to Event 1, there were two periods of time when the FDU was left energized and unattended in the same configuration as on the day of the event (i.e., with the top cover removed and the front panel temporarily hung by looped plastic zip ties).
3. JSA did not ensure that the arc flash and shock hazard posting on the door to the HVPS identified the actual voltage applied to the two 40kV-rated DC capacitors. The posting listed capacitor voltage at 20kV DC instead of 27kV DC.
4. JSA did not specify the PPE to be worn while performing electrical work or troubleshooting the RF separator. Accelerator Task List 18972 (the work package document used during Event 1) listed “proper” work clothes and safety shoes as PPE; however, the specific PPE requirement was not identified. The equipment-specific procedure, *RF Separator and IOT High Voltage Power Supply Shutdown & Discharge Procedure*, Number EES-PR-04-004, also did not specifically identify what PPE was required. JSA assigned responsibility to the worker to determine the operational hazards and to select the required PPE.
5. JSA did not require pre-job briefings or specify the type of information employees should discuss during task handoffs. At approximately 2:00 PM on the day of Event 1, the two involved workers had a brief phone conversation concerning the status of IOT 1. Technician 1, the day shift worker troubleshooting IOT 1, called Engineer 1 to communicate that problems with IOT 1 continued, and that they were leaving for the day. JSA did not ensure that a formal process of identifying and communicating the hazards of IOT 1 was required during work transitions.

Collectively, these deficiencies constitute a Severity Level I violation.
Base Civil Penalty – \$99,000

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$49,500

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

D. Laser Safety

Title 10 C.F.R. § 851.23, *Safety and health standards*, subsection (a), states that “[c]ontractors must comply with the following safety and health standards that are applicable to the hazards at their covered workplace...(11) American National Standards Institute (ANSI) Z136.1, *Safe Use of Lasers* (2014).”

ANSI Z136.1, Section 4.4.4.2.2, *Factors in Selecting Full Protection Eyewear*, requires that the following factors be considered when selecting the appropriate laser eye protection to be used: “(a) laser power and/or pulse energy; (b) wavelength(s) of laser output; and ...(d) radiant exposure or irradiance levels for which protection (worst case) is required.”

ANSI Z136.1, Section 4.4.3.8, *Alignment Procedures (Class 3B and Class 4)*, requires the following actions to be taken: “... (c) wear laser eye protection and protective clothing to the extent practical.” In addition, Section 4.4.4.3, *Skin Protection*, states that “[s]kin protection can best be achieved through engineering controls. In some cases a laboratory jacket or coat may fulfill the requirement, although tightly-woven, flame-retardant fabrics provide the best protection for work with Class 4 lasers.”

ANSI Z136.1, Section 4.4.2.10.3, *Entryway Controls*, states that “[a]ll Class 4 laser controlled areas shall incorporate one of the following alternatives:

- “A non-defeatable (non-override) area or entryway safety control to deactivate the laser or reduce the output to levels at or below the applicable maximum permissible exposure (MPE) in the event of unexpected entry into the Laser Controlled Area.
- “A defeatable area or entryway safety controls if it is clearly evident that there is no laser radiation hazard at the point of entry.
- “Procedural area or entryway safety controls if interlocks are not feasible or are inappropriate. However, this option can be used only if all authorized personnel are adequately trained, adequate PPE is provided upon entry, a barrier is used to reduce radiation at the entryway to less than the MPE, and there is a warning device at the entryway indicating that the laser is energized and operating at Class 4 levels.”

ANSI Z136.1-2014, Section 4.4.3.5.1, *Indoor Laser Controlled Area Minimum Requirements (Class 3B or Class 4)*, states that “[a] Class 4 laser controlled area shall...(i) have the laser secured such that the exposed beam path is above or below the eye level of a person in any standing or seated position, if possible, except as required for medical use.”

ES&H Manual Chapter 6410, *Laser Safety Program*, September 1, 2018, Revision 1.3, Appendix T3, *Laser Personal Protective Equipment (PPE)*, Section 4.3, *Proper Work*

Clothes, states that “[c]ertain laser light can result in burns to the skin. Long sleeved shirts and pants, made of natural fibers are recommended when working with these types of lasers.”

ES&H Manual Chapter 6410, *Laser Safety Program*, September 1, 2018, Revision 1.3, Appendix T3, *Laser Personal Protective Equipment (PPE)*, Section 4.1, *Safety Glasses/Goggles*, states that “[l]aser protective eyewear (including glasses or goggles) is worn when engineering and administrative controls do not eliminate ocular exposure to below the maximum permissible exposure (MPE) level and during alignment procedures.” Eyewear selection is based on a variety of factors, including output wavelength(s), worst-case radiant exposure or irradiance levels for which protection is required, exposure time criteria, MPE level, and the optical density requirement for the eyewear filter at the laser output wavelength.

Contrary to these requirements and as evidenced by the following facts, JSA failed to effectively implement its laser safety program in accordance with the applicable requirements of Part 851 and the JSA WSHP to ensure that workers were adequately protected from laser hazards.

1. JSA did not adequately identify PPE controls for skin exposure during operations when laser power reduction is not practical or applied. Under the LOSP’s worst-case skin exposure scenario (i.e., exposure as the beam exits the optical fiber), operation of the 30W laser could expose skin to approximately 1000 times the MPE level. The LOSP describes the potential for irreversible skin damage from exposure to laser radiation, either by absorption of the energy, resulting in burns, or by photochemical effects disrupting the functionality of skin tissue. Conditions for a worst-case exposure existed during handling of the energized fiber before and during fiber examination. Conditions approaching a worst-case exposure also exist in the open beam path near the fiber optics output prior to significant beam divergence. The LOSP identified steps to reduce the laser exposure hazard during high-risk alignment activities (i.e. requiring hand-held placement of a photosensitive card in the beam path), including reducing laser power; however, the level of power reduction is not specified, and no PPE controls are identified for reducing skin exposure in the absence of laser power reduction. Instead, the LOSP instructs individuals to avoid placing hands or other parts of the body in the beam path. However, ANSI identifies skin protection options ranging from engineering controls to protective clothing.
2. JSA did not adequately identify hazardous zones of exposure to Class 4 lasers for operators and transient personnel. The LOSP establishes that the nominal hazard zones for the 30W lasers with fiber optic outputs and for the velocity laser are 6.7 meters (21.8 feet) and 16.8 meters (54.6 feet), respectively. The LOSP further specifies that the hazard zone is confined within the laboratory through the use of an interlock on the entry door (disconnecting power to the lasers when open); however, the interlock is designed to allow authorized personnel to bypass the system for up to 45 seconds when entering and exiting the laboratory. The interlock design accommodates the periodic entry/exit needed when an experiment is controlled remotely. Although authorized personnel are required to don protective eyewear before entry, no laser attenuation barriers exist between the

laser operations and the doorway. As a result, transient personnel may be in the line of sight of the open door and thus could be exposed to hazardous levels of laser energy without protection.

3. JSA did not ensure that open beam, class 4 laser operations were restricted to either above or below the eye level of personnel in the laboratory. The configuration of multiple lasers used in the target test lab involves an open beam path of approximately 15 feet between the source and target. Mounts for fiber-optic delivery of the beams and optics (e.g., lenses, mirrors) are installed on an optical table. The implemented configuration, contrary to the 51 inches beam height specified in the LOSP, resulted in three open beam paths (ranging from approximately 55 to 66 inches above floor level) at eye level while personnel are in a standing position within the laboratory.
4. JSA did not evaluate the adequacy of the prescribed protective eyewear in protecting the user(s) from potential exposure to the focused energy of a magnified laser beam, nor re-evaluate its adequacy after the event. A JSA investigation report on the June 7, 2019, event (PHY-19-0607, *Student Exposed to Laser while wearing Protective Eyewear*) notes that “[t]he inspection of laser fiber cables using a magnifying scope can present an eye hazard risk that is not factored into the selection of laser safety eyewear, and given this near-miss event and a similar event at [another DOE site], hazard awareness and controls for these activities need to be improved.” The ANSI standard defines the threshold limit of laser protective eyewear filters as the maximum average irradiance or radiant exposure at a given beam diameter for which a laser protective device provides adequate beam resistance, and also provides typical damage thresholds for various lens materials. However, the lens material of prescribed protective eyewear provided by JSA was insufficient to withstand the focused energy of a magnified laser beam without quickly sustaining physical damage and compromising its effectiveness.

Collectively, these deficiencies constitute a Severity Level I violation.

Base Civil Penalty – \$99,000

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$49,500

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

E. Training and Information

Title 10 C.F.R. § 851.25, *Training and information*, subsection (a), states that “[c]ontractors must develop and implement a worker safety and health training and information program to ensure that all workers exposed, or potentially exposed, to hazards are provided with training and information on that hazard in order to perform their duties in a safe and healthful manner.”

Title 29 C.F.R. § 1910.147(c)(7), *Training and communication*, subparagraph (i), states that “[t]he employer shall provide training to ensure that the purpose and function of the energy control program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees.”

NFPA 70E, Article 110, *General Requirements for Electrical Safety-Related Work Practices*, Section 110.2(D)(3), *Retraining*, states that “[r]etraining in safety-related work practices and applicable changes in this standard shall be performed at intervals not to exceed three years. An employee shall receive additional training (or retraining) if any of the following conditions exists...(2) New technology, new types of equipment, or changes in procedures necessitate the use of safety-related work practices that are different from those that the employee would normally use.”

NFPA 70E, Article 205, *General Maintenance Requirements*, Section 205.1, *Qualified Persons*, states that “[e]mployees who perform maintenance on electrical equipment and installations shall be qualified persons as required in Chapter 1 and shall be trained in, and familiar with, the specific maintenance procedures and tests required.”

Thomas Jefferson National Accelerator Facility Document *10 CFR 851 Worker Safety and Health Program*, Rev. 5, dated October 2018, Section 3.1.7, states that “Jefferson Lab has an ES&H training program in place to ensure that all workers exposed or potentially exposed to hazards are provided training in recognition and abatement techniques and requirements.”

Contrary to these requirements and as evidenced by the following facts, JSA failed to effectively train workers to understand the hazards associated with the tasks that they were performing.

1. JSA did not ensure that all electrical safety training curricula were updated to reflect the current changes to the NFPA 70E (2015) standard, nor did JSA ensure that employees received up-to-date training. For example, one employee’s training record showed that the arc flash and electrical safety training taken in 2013 had expired in 2016. The employee was permitted to perform assigned electrical duties despite having outdated and expired training. In addition, other site employees completed electrical safety awareness training in 2019, but that training program was last revised in 2006 and referenced the 2004 edition of NFPA 70E, which contained outdated information that did not reflect the most recent changes to the 2015 edition.
2. JSA did not establish an effective process for ensuring that employees received adequate training on hazards associated with their assigned work. A local job task analysis tool is intended to identify the hazards an employee may encounter as part of his/her assigned duties. A review of numerous employee job task analysis, revealed that hazards were not always adequately identified, so workers did not receive the required training based upon their work assignments and their potential for exposure(s) to specific hazards.
3. JSA did not implement an adequate training program for non-electrical workers, such as IT technicians, who may be exposed to electrical hazards. The electrical training at Jefferson Lab focuses on qualified electricians and does not cover specific electrical hazards that non-electrical workers may encounter.

Collectively, these deficiencies constitute a Severity Level II violation.
Base Civil Penalty – \$49,500

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$24,750

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

F. Emergency Response and Recordkeeping

Title 10 C.F.R. § 851.26(a)(2), *Recordkeeping and reporting*, requires contractors to “[e]nsure that the work-related injuries and illnesses of its workers and subcontractor workers are recorded and reported accurately and consistent with DOE reporting directives.”

Title 10 C.F.R. § 851 Appendix A.8 (g), *Occupational Medicine*, states, “occupational medicine services provider must determine the content of the worker health evaluations, which must be conducted under the direction of a licensed physician, in accordance with current sound and acceptable medical practices and all pertinent statutory and regulatory requirements.” In addition (g)(2)(iii) states, “[d]iagnostic examinations will evaluate employee’s injuries and illnesses to determine work-relatedness, the applicability of medical restrictions, and referral for definitive care, as appropriate.”

ANSI Z136.1 -2014, Section 6.1, *Examinations Following a Suspected or Actual Laser-Induced Injury*, states that, “[m]edical examinations shall be performed as soon as practical (usually within 48 hours) when a suspected injury or adverse effect from a laser exposure occurs.”

Thomas Jefferson National Accelerator Facility Document *10 CFR 851 Worker Safety and Health Program*, Rev. 5, dated October 2018, Section 3.1.8, states that “[r]equirements for recordkeeping and reporting are established in the Jefferson Lab ES&H Manual, based upon requirements established by the contract with DOE and upon management expectations. All work-related injuries and illnesses experienced by employees, users, and subcontractors are to be reported to the Jefferson Lab Occupational Medicine (OM) Department and the ESH&Q Reporting Officer.”

Contrary to these requirements and as evidenced by the following facts, JSA failed to establish an effective emergency response plan to ensure that employees effectively report workplace injuries or to ensure that adequate medical treatment is provided in a timely manner.

1. JSA did not ensure that employees understood the process for reporting electrical shocks in the workplace. Based on interviews conducted during the DOE investigation, employees were unaware of the importance of reporting shocks in a timely manner to ensure proper medical attention and JSA compliance with DOE reporting requirements.
2. JSA did not ensure that the LOSP specified procedures are adequate for notifying the supervisor and LSO, and for contacting the medical center (or local hospital), if there is direct or indirect exposure to laser radiation without appropriate eye protection. Further, the procedure does not take into account that exposures can occur with eye protection in use, such as when the eye protection is damaged. During Event 2, eye protection was

worn, but its effectiveness may have been compromised by the ablation of a portion of the lens during exposure to the laser beam. Additionally, due to unclear reporting requirements, the supervisor was not notified of the event until approximately 76 hours after its occurrence delaying notification to the LSO and the medical evaluation conducted by the physician on staff.

Collectively, these deficiencies constitute a Severity Level II violation.

Base Civil Penalty – \$49,500

Mitigated Civil Penalty (50 percent for adequate corrective actions to prevent recurrence) – \$24,750

Proposed Civil Penalty (as adjusted for fee reduction) – \$0

II. REPLY

Pursuant to 10 C.F.R. § 851.42(b)(4), JSA is hereby obligated to submit a written reply within 30 calendar days of receipt of this PNOV. The reply should be clearly marked as a “Reply to the Preliminary Notice of Violation.”

If JSA chooses not to contest the violations set forth in this PNOV, then the reply should clearly state that JSA waives the right to contest any aspect of this PNOV. In such case, this PNOV will constitute a final order upon the filing of the reply.

If JSA disagrees with any aspect of this PNOV, then as applicable and in accordance with 10 C.F.R. § 851.42(c)(1), the reply must: (1) state any facts, explanations, and arguments that support a denial of an alleged violation; and (2) discuss the relevant authorities that support the position asserted, including rulings, regulations, interpretations, and previous decisions issued by DOE. In addition, 10 C.F.R. § 851.42(c)(2) requires that the reply include copies of all relevant documents.

If JSA fails to submit a written reply within 30 calendar days of receipt of this PNOV, then pursuant to 10 C.F.R. § 851.42(d), JSA relinquishes any right to appeal any matter in this PNOV and this PNOV will constitute a final order.

Please send the appropriate reply by e-mail to: officeofenforcement@hq.doe.gov or by hardcopy to:

Director, Office of Enforcement
Attention: Office of the Docketing Clerk, EA-10
U.S. Department of Energy
19901 Germantown Road
Germantown, Maryland 20874-1290

A copy of the reply should also be sent to the Manager of the Thomas Jefferson Site Office.

III. CORRECTIVE ACTIONS

Corrective actions that have been or will be taken to avoid further violations should be delineated with target and completion dates in DOE's Noncompliance Tracking System.



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

Washington, D.C.

This 12th day of March 2021