

Electrical Safety Program Review

25 June 2019

The shock event involving an Electrical Engineering Systems Department engineer in the South Injector Service Building on 26 April 2019 demands our utmost attention. The Investigation Report of 6 June 2019¹ describes the circumstances of the event.

This is the latest, and most serious, in a continuing series of electrical safety incidents at Jefferson Lab. Prior events were investigated and improvement actions taken. However, an inescapable fact remains that we have not yet achieved the level of electrical safety performance our research and development mission requires.

We must take a deeper and harder look at the underlying causes of these events so we can take decisive action and make this the last time a Jefferson Lab employee, user, contractor, or visitor comes in contact with hazardous electrical energy. I expect this review will address any aspect of our Integrated Safety Management System and safety culture that contributed to this event.

Of particular concern in this report were comments on pages 13 and 19 that imply working alone while engaged in hazardous tasks is required by our “minimal resources” and “lean nature of the organization”. Similarly concerning was the statement that the delay in recovering from a planned power outage somehow contributed to this accident.

All of our safety policies and training hold that a limitation of time or resources is never an acceptable rationalization for taking unnecessary risks. The very nature of our work is dynamic with constant schedule adjustments and this can never be allowed to justify short cuts, deviations, or diminish the responsibility of those managing the work to adjust accordingly.

I am hereby initiating an Electrical Safety Program Review and charging the review team with addressing the Judgement of Needs identified by the 6 June investigation report. I have studied the report carefully and traced the facts and causal factors to the Judgement of Needs but I have done so through the lens of our recent incident history and not this event alone.

I am extending the Judgement of Needs into lines of inquiry, identified below as review team tasks, to reveal the persistent underlying causes behind this and earlier events. *The primary objective of this review is to strengthen our safety culture, as opposed to solely focusing on more perfective improvements to prevent a recurrence of this exact event, or layering further process overhead in our work planning and control.*

¹Investigation Report, Continuous Electron Beam Accelerator Facility (CEBAF) Radio Frequency (RF) Separator Electrical Shock Event of April 26th 2019, A. Kimber (Team Lead), R. Nelson, R. Michaud, G. Perry, T. Kujawa, dated 6 June 2019

JON 1 - There is a need for Line Management to integrate human error analysis into the Work Planning and Control Process

We know workers everywhere deviate from approved plans and procedures and these deviations only become viewed as human error when something bad happens. Work Planning and Control is fundamentally about helping humans recognize the opportunity to make and avoid errors but even the best work planning and control process is inadequate if workers are rewarded for deviating from the approved plans and authorized controls.

The potential for human error was considered in the work planning and control of this event. ATLI 18899 and 18927 identified the correct hazard and appropriate mitigation but the integrity of the work planning and control process failed when a worker deviated from the approved plan and performed work on energized equipment within the restricted approach boundary without applying LTT. This evidently spontaneous decision moved the risk code from low (2) to high (4) and was enabled by a prior decision by a different worker to remove the permanent barriers days before the event.

Task 1 Why do our workers deviate from the approved work plan and controls? Is this behavior prevalent? Are there specific circumstances (times, areas, types of work) where deviations are more likely? Is the training and guidance we provide workers on how much authority they have to deviate from approved plans and controls clear and if not how should it be improved?

Task 2 Does our work planning and control process make it too difficult for our workers to follow the approved plan or too difficult to get approval to deviate from approved plans? What additional analysis of potential human errors in the work planning and control process would make deviations less likely?

Task 3 Is the risk rating system, upon which our work planning and control processes are based, adequate? Why did the workers not recognize and stop when the risk code moved from low to high with the removal of the temporary barrier over energized equipment? Would it be better to replace mitigated risk, which assumes workers stay within plan, with inherent risk since inherent risk makes no such assumption? Similarly, would removing the subjective probability dimension in the risk code lead to more accurate risk rating, control selection, and task oversight?

JON 2 - There is a need for the Electrical Engineering Group to evaluate the process for developing and implementing controls for off-nominal conditions

A deviation from planned work is one form of off-nominal condition. Further, this judged need transcends the Electrical Engineering Group and applies to all work across the Lab. Tasks 1 and 2 already address this need.

JON 3 – There is a need for Line Management to define expectations for supervision monitoring of tasks with high hazards

As addressed under Task 2, this work was not originally rated as high hazard and only became such when the worker deviated from the planned and approved task and decided to remove the temporary cover to energized equipment.

Task 4 What risk threshold is appropriate for increased supervisor oversight keeping in mind this work was not rated as high hazard? Should supervisors be required to be present at all such work for the duration, at start, or just randomly? Are supervisors qualified to oversee high hazard work and if not what standard should apply to add value in a safety oversight capacity? How would we keep this new requirement from creating a reverse incentive to accurately characterize high hazard work?

JON 4 – There is a need for Line Management to define conditions for temporary barriers/guards

The use of temporary barriers and guards is a common control measure and should be understood and described in the work plan. In this event the decision to remove the permanent equipment covers and use temporary, easily removed (or disturbed) covers, which in the end were not an effective barrier, was not described in the work planning and control documents nor is that a clear requirement of our current work planning and control process.

Task 5 To what extent should the use of temporary barriers/guards be described in our work planning and control process? Should there be limitations on the use of temporary barriers? In what circumstances are temporary barriers not allowed?

JON 5 – There is a need for Line Management to evaluate the process of turnover of work conditions

The turnover of work within and between groups is a common feature of operations at Jefferson Lab. In this instance, it appears from his statement employee T1 accurately described the condition of the HVPS and FDU when he turned over work to employee E1. The implication of the report is E1 did not fully appreciate the configuration when he approached the equipment and began troubleshooting.

Task 6 How is our work turnover or handoff requirement documented, how do we train employees, and are both adequate? Should we require a face-to-face handoff of work at the work site?

JON 6 – There is a need for Line Management to incorporate a review of safe work practices as a component of work group communications

This is already Lab policy but can always be improved. I endorse the continued responsibility of line management to review safe work practices in their regular work group communication and in particular share the lessons learned coming out of this event. Task 4 addresses this need.

JON 7 – There is a need for Line Management to ensure the implementation of Environmental, Safety, and Health (ESH) Manual safety requirements and procedures

This is already a Lab policy but can always be improved. I endorse the continuing requirement that line management is responsible for selecting and assigning only qualified employees and overseeing their compliance with all safety policies and procedures described in the ESH Manual. However, we recognize even the most comprehensive ESH manual is not a substitute for the application of good judgement at all organizational levels.

Task 6 Is the ESH Manual accessible and provide actionable guidance that enables our employees to work in a safe and efficient manner? If not, how can it be improved? To what extent does line management verify their workers understand and correctly apply the ESH Manual to their work?

JON 8 – There is a need for Line Management to define staffing requirements for work involving increased risk of hazard exposure

It seems apparent the employees did not plan or expect to drift from a low risk (RC 2) to high risk (RC 4) work that would require an Operational Safety Procedure (OSP) or in this case, Energized Electrical Work Permit (EEWP). Addressing the conditions that permitted this drift into high risk work is addressed by Task 1.

Nonetheless, this event does raise an important question about whether our existing policies for restricting employees from conducting work alone that is, or could drift into, high risk are adequate.

Task 7 What is our requirement limiting the hazard level of electrical work that can be performed by an employee alone and when is a second person required? Is this requirement adequate and consistent with best practices for electrical safety?

JON 9 – There is a need for the Environment, Safety, Health and Quality Division (EHS&Q) to assure current retraining requirements align with National Fire Protection Association (NFPA) 70E-2015

Task 8 The ESH&Q Division should immediately review and update as appropriate JSA training to align with contract requirements and best practices for electrical safety while incorporating the unique risks and conditions present at Jefferson Lab.

JON 10 – There is a need for Lab Leadership to evaluate whether too much emphasis is being placed on administrative controls, which are more vulnerable to error (as opposed to engineered controls).

The NIOSH hazard controls hierarchy is a core element of Prevention through Design that holds that systems are inherently safer when hazards are mitigated through engineered controls (when substitution or elimination are not practical) to lessen the dependence on administrative controls and PPE to protect workers.

It is notable the FDU chassis was designed, built, and accepted for use by Jefferson Lab without engineered controls such as interlocks to interrupt the HVPS when the integrity of the enclosure is broken and workers can be exposed to 27,000V. Further,

high voltage warning labels on the equipment do not appear to be consistent with industry standards. Engineered controls, such as interlocks on access panels, increase safety since any work on energized equipment requires a deliberate action to override the interlocks which would automatically require a High (RC 4) risk rating and EEWP approved by the Laboratory Director.

Task 9 What is the Jefferson Lab design standards for engineered controls and hazard warnings on systems with hazardous electrical energy? Are our standards consistent with regulatory requirements and industry best practices? Is the FDU compliant with the existing Jefferson Lab standard, regulatory requirements, or industry best practice and if not what actions should be taken? What is the extent of condition of engineered controls on other high hazard systems present across the Lab?

I am directing the Chief Operating Officer to organize a review team composed of a cross section of Laboratory management, subject matter experts, and front line workers. The team will address the lines of inquiry captured under these ten tasks and report back to me by 1 August 2019. Please give your full support to this endeavor.

Signed,



Stuart Henderson
Laboratory Director