JLab Accelerator Safety – Compliance Maintenance Challenges

Prepared by Paul Gubanc, ES&H Director – April 27, 2025

<u>Purpose</u>: To identify on-going compliance maintenance challenges after the latest round of updates to JLab accelerator safety documents (listed below). These challenges represent the potential for compliance drift inherent to how these documents are configured. Going forward, ensuring on-going compliance will demand attentiveness to these challenges.

- Safety Assessment Document (SAD), Rev9a
- CEBAF-LERF Accelerator Safety Envelope (ASE), Rev10
- UITF ASE, Rev1
- CMTF ASE, Rev 0
- VTA ASE, Rev 0

<u>Context</u>: JLab has invested heavily over the last 6 months to develop and scrub the above listed documents and the subordinate implementing Operations Directives (ODs). Extensive efforts have been taken to ensure and overcheck the technical accuracy of, and consistent alignment between, the ASE's, the SAD, and the ODs. Notwithstanding these efforts, there are certain inherent aspects to how these documents were constructed which represent potential challenges to keeping these documents compliantly aligned.

Challenges:

- Separate SAD and ASE documents The DOE Accelerator Safety Order, 420.2D (and predecessors), prescribes that the SAD and DOE-approved ASE be separate and distinct. This introduces an inherent configuration management challenge to keep the SAD (the "mother document") and the ASEs (summary control documents) aligned. [It's worth noting that each DOE nuclear facility has only one consolidated documented safety analysis (DSA) which is DOE approved.]
- 2. Flowdown of Controls As written, the SAD begins with a narrative description of the accelerator systems and operations including a discussion of credited controls. In the second half of the SAD, numerous tabulations are provided which identify the selection of credited controls for various hazard scenarios. These credited controls are then excerpted for inclusion in the respective ASE. Each successive flowdown step introduces the potential for mis-alignment and the need for rigorous change control going forward.
- 3. **ASE Dependence on the SAD** As written, several of the DOE-approved controls in the ASEs refer back to the SAD for the technical details of compliance. Given that the SAD is contractor-controlled, this places some DOE-approved controls under the influence of the contractor which undercuts the intent of a DOE-controlled safe operating envelope. JLab's Unreviewed Safety Issue (USI) process will require

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meticulous attention to detail in reviewing SAD changes to ensure they do not encroach upon DOE's approved safe operating envelope.

- 4. **Centralized SAD & Separate ASEs –** The SAD has evolved to address six accelerators under one document. In some portions of the SAD each accelerator is discussed individually, in other locations they are discussed collectively. This introduces the potential for confusion when parsing out which language flows into the ASEs.
- 5. Word Choice for Understanding vs. Compliance The SAD includes multiple passages describing electron beam and electrical energy levels (e.g., amperages, power). The adequacy of safety controls depend upon these energy levels. When writing for understanding, its customary to use nominal values (e.g., 100 Kilowatts). When writing for compliance, it is essential to provide acceptable ranges because exact values are unlikely to ever be matched in practice (e.g., typically in the range of 90-110 Kilowatts but not to exceed 120 Kilowatts). The SAD has not been rigorously evaluated to identify potential compliance traps due to word choice.
- 6. **Currency of Hyperlinked References –** The SAD makes dozens of references (many hyperlinked) to other JLab procedures and directives including the ES&H Manual. As of this writing, the ES&H Manual contains 225 total documents of which about half are overdue for periodic review (typically every 3 years). This does not make these documents wrong or ineffective, only overdue for updating. ES&H Division is working a plan to update the ES&H Manual but this is resource constrained and will not be completed by the time the above listed accelerator safety documents become effective.
- 7. **Software Quality Assurance (SQA)** The DOE has robust and exacting rules regarding SQA. Although JLab safety system controls (e.g., the PSS) have been robustly and periodically tested, the SAD makes minimal mention to how the DOE SQA requirements are satisfied. (It is worth noting that less than a decade ago, the DOE nuclear safety community discovered a Microsoft Excel programming error which adversely impacted a nuclear facility's documented safety analysis.)
- 8. Experimental Readiness Review (ERR) Process The SAD/ASEs specifically identify the ERR process as a credited control because the ERR scope is expected to ensure the experiment operates within the approved SAD & respective ASE. Gubanc's 4/24/2025 review of the ERR procedures (ESH Manual Chapters 3120 & 3130) finds them less than precise in regard to this expectation. Additionally, the Experiment SAD (ESAD) may, in fact, be a better vehicle to achieve this compliance

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expectation. Lastly, SME Kyle Turner recommends against the crediting of the ERR from an auditing compliance perspective.

Path Forward

To address and eliminate the above challenges in a substantive way will require a comprehensive re-formatting of the SAD and ASE documents to make alignments cleaner and more direct. This will require a deliberate investment decision that is most likely beyond the scope of existing resources and their normal duties.

Until that can occur, the Safety Configuration Management Board (SCMB) and the Unreviewed Safety Issue (USI) process will be a key bulwark for protecting the alignment, integrity and interpretation of JLab's accelerator safety documents.