

Memorandum

June 5, 2015

To: John Anderson, Jr

From: J. Donald Cossairt, Senior Radiation Safety Officer

Subject: Total Loss Monitoring (TLM) System Final Approval, Interlock Review # 109

In response to your request in your memorandum of April 16, 2015 and in accordance with the requirements of Article 1002 of the Fermilab Radiological Control Manual, I am issuing final approval of the TLM system as described in detail in your memorandum and the additional reference material supplied therewith. The completed Interlock Review Status Form (RP Form #19) is appended to this memorandum.

The development of this system represents a significant achievement and all those associated with this work should be congratulated on their achievements in developing this system. With that said, in our review of package supplied we identified some remaining areas of improvement that we will describe here. While we acknowledge that some of documents were submitted as “works in progress” and thus obviously subject to ongoing improvement and change, we offer some other comments as constructive criticism with the intent of promoting this package to be more clear for future reference. To keep our records clean, I request that a written response to the individual comments be provided as soon as practicable when consistent with completion of the work on this innovative system. Some of our comments are referenced to specific documents as provided with your April 16, 2015 memorandum.

Our comments are as follows:

1. There is a need for a list of items in the shielding assessment that rely on the TLM system that need to be completed or revised when TLM approval is issued.
2. One of the documents should provide in detail the process and standards in place for tuning and verifying the 1 watt meter⁻¹ loss threshold in real installations as the original requirements state. At present, neither the “System commissioning”

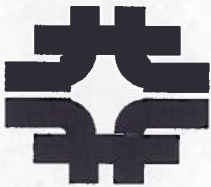
section of attachment 2 nor the “Booster TL Radiation Monitor Test Procedure” address this.

3. Reference 1, Paul Czarapata’s requirements document, does not specify the types of radiation that are detectable with the TLM. The radiation fields inside high energy proton accelerator enclosures are well-known to be mixed fields consisting of a variety of charged particles, photons, and neutrons. The TLM is likely to be intrinsically sensitive to the charged particles and photons but nearly insensitive to neutrons. While the nature of the mixed radiation fields present at the locations in which the TLMs will be placed is sufficient for them to provide a reliable detection of excessive beam loss, the documentation simply must be clear that this would not be true in radiation field primarily comprised of neutrons or other, more exotic, neutral particles.
4. The “Total Loss Monitor Test Procedure” and Reference 2 do not mention any requirements and/or standards for handling of the electronics with regards to contamination (e.g., finger prints, solder work, dust/dirt) on the board.
5. In Reference 3, “Preliminary Test Results...”, the energy scaling of radiation intensity used is known to be good for locations external to thick shields, or for radiation transport through multi-legged penetrations where the radiation field is dominated by neutrons. While it is likely to be roughly true qualitatively here, its applicability inside the enclosures should be demonstrated, either analytically, by using MARS simulations, or by citing a suitable published report.
6. Two of the documents, References 1 and 3, include discussions of issues related to fences on site, radiation signs, and the hardship of needing keys to access places deemed to be controlled for radiological reasons along with the need for vigilance and maintenance requirements for these controls. These situations already exist on this laboratory’s site as well as other accelerator labs. There is also commentary regarding “radiation exposure to the public”, or describing situations involving “uninformed public” etc. While they are most certainly part of the justification of need for the development of the TLM system, they do not belong in specifications or test procedures documents where they are irrelevant and may be misleading about the true function and quality of the system and its design.
7. It is understood that the test procedures provided are only drafts and they will be edited to be similar to the rest of the AD existing safety interlocks test procedure before submitting them for the final approval of the Booster interlocks.

8. There is a need to document the sensitivity of the TLM to flow rate and pressure variations, perhaps as encountered, for example, with splices, and to demonstrate why interlocking these two parameters is not necessary.
9. The usefulness of Reference 3 would be greatly enhanced if page numbers were incorporated.
10. Likely not intentionally, at several points the use and function of the TLM system is compared with the use and function of existing Fermilab prompt radiation detection and measurement instrumentation employed in the Fermilab radiation safety interlock system. From these discussions one could be led to the superficial, and technically incorrect conclusion that the TLM is also an instrument suitable for measuring absorbed dose as conventionally defined in the discipline of health physics. While the TLM can be viewed as an elegant means of measuring and detecting beam losses above a prescribed threshold, no studies have been presented to qualify the TLM as a radiation dose measuring device. It is highly recommended that the documentation clearly state this fact, perhaps in some overall document that draws this package together in its final form (see comment below).
11. It is presumed that this package of supporting documentation will be retained by the Accelerator Division in an indexed system of controlled documents suitable for updates and revision in accord with good records management practices.

ESH&Q File: Radiation Safety Interlock Reviews (TLMs, Review # 109)

Cc:
Sergei Nagaitsev
Paul Czarapata
Gary Lauten
Wayne Schmitt
Kamran Vaziri
Adam Olson
Martha Michels
Amber Kenney



Fermilab

ESH&Q Section

Interview Review # 109

Interlock Review Status

Division/Section Accelerator Division

Brief description of the interlock change. Final approval to use a new Total Loss Monitor in the RSIS. This system will be used in Accelerator Division beam line enclosures to limit beam losses. It will interface to the radiation safety interlock system using the existing Radiation Monitor Interface Card (Approved Interlock Review #87).

Reference memo(s) from ADESH department and documentation

- 1) Requirements for a Loss Monitoring System for Thinly Shielded Enclosures (Reference #1)
- 2) Ultra High Impedance Electrometer/Pulse Train Converter for measurement of Beam Losses. (AD537.4) (Reference #2)
- 3) Preliminary Test Results, Dynamic Range Requirements and TLM Electrometer Requirements for TLM Systems at Fermilab. (Reference #3)
- 4) TLM Engineering Design Specification
- 5) TLM Electrometer/Digitizer Front End Schematic (Attachment #5)
- 6) TLM Block Diagram (Attachment #1)
- 7) TLM Chassis Overview Document (Attachment #2)
- 8) TLM Mother Board schematic (Attachment #3)
- 9) CPLD Logic Diagram (Attachment #4)
- 10) Total Loss Monitor Detector System Assembly (ADDP-SH-2905)
- 11) Booster TLM installation Drawing
- 12) Total Loss Monitor Test Procedure (ADDP-SH-2902) (Attachment #7)
- 13) TLM Chassis Environmental chamber Test printout (Attachment #6)
- 14) TLM Chassis Log.
- 15) Booster TLM Radiation Monitor Test procedure (ADDP-SH-2904)
- 16) Booster Total Loss Monitor Detector Cable Test procedure (ADDP-SH-2903)

Preliminary Approval

Final Approval

Not Approved

Additional Comments: Final approval is given to use this device in the Radiation Safety Interlock System. This approval is granted with the caveats given in the attached memo by the Senior Radiation Safety Officer, Don Cossairt.

Signature of Laboratory Interlock Coordinator

6/3/15
Date

Signature of Radiation Physics Liaison

6/3/15
Date

Signature of Senior Radiation Safety Officer

6/4/15
Date

cc: RSO Interlock Coordinator Area Interlock Modification File