Date: November 23, 1992

Minutes of the AGS Radiation Safety Committee

Subject: RHIC: Dose Limits, Beam Loss, and Transfer Line Losses. BTA & RHIC Co-injection Safety System.

Meeting Date: November 2, 1992

Present: D Beavis, H Brown, A Etkin, C Flood, JW Glenn, E Lessard, A McGeary, S Musolino, K Reece, A Stevens, M Harrison, T Malinowski, A Soukas, R Witkover, & E Zitvogel.

Summary

The Committee did not review the upstream end of W line as this part of the line "is not part of the RHIC project". Nor was the U line feeding this line reviewed as the responsible individual/group was not identified.

Some of the committee was not comfortable with the 160 mRem in low occupancy, uncontrolled areas for a design basis fault.

The concept of the Co-injection interlock was approved. The 10% blind time for each subsystem is not acceptable.

Meeting Minutes

Steve Musolino presented proposed criteria for prompt radiation limits on annual dose equivalent associated with the RHIC site (Attachment #1). One of these criteria -- 160 mrem per 2000 hour year for DBA (Design Basis Accident) faults in low occupancy regions accessible by non-radiation workers -- was a subject of some controversy. There was a difference of opinion centered on the question of whether - should a fault actually occur which resulted in an exposure to a non-rad worker of between 100 and 160 mrem - existing DOE regulations would require that this occurrence be reportable. (ES&H Standard 1.1.0 could be interpreted that this would be an "Off-Normal" occurrence.) There is no guidance in the Lab ES&H Standard 1.3.3 on "On site" general public exposure, nor does Musolino think there are government regulations regarding "faults". It was not clear if there will be a procedure for determining, after the fact, the radiation generated or if anyone was in the fault area - to ascertain if indeed there was an exposure.

Mike Harrison presented an overview of the "Beam Loss Scenario" in the RHIC collider (Attachment #2). He emphasized that there is no known mechanism for the DBA fault allowance, which is loss of the entire beam on a single magnet near the limiting aperture or 1/2 of the entire beam on any other magnet. In approximately 10 years of FNAL operation the entire beam at full energy has been lost twice; both times over many magnets as would be expected from basic physics principles. "Expected" faults quench magnets at a loss level of 10^-4 of the entire beam.

Alan Stevens presented numerical estimates of the Beam Loss Scenario (Attachment #3). Several concerns/questions, all associated with the Transfer Line (TL) operation, were expressed:

(a) The scope of the RHIC project defines the beginning of the TL to be near the beginning of the W-line. A stripping foil exists well upstream (in the U-line) which may cause loss comparable to or greater than the 0.05% local loss assumed in the TL. Responsibility for this (U-line) region must be specified.

(b) Should a "Commissioning Scenario" for the TL be created at this time? [The Beam Loss Scenario" explicitly excludes commissioning as a subject addressed.]

(c) Collimators are being considered in the TL. Clearly such collimators are a source of potential loss greater than 0.05%. Their existence must be addressed.

(d) There was concern that only allowing two full beam faults per year may overly restrict operation. Several Committee members expressed the opinion that a judgment on the credibility of fault rate requires a description (which was not presented) of how power-supply fault conditions inhibit injection to the TL and whether the equipment protection inhibits would eliminate most, if not all, of these faults.

E Zitvogel presented the BTA Co-injection system (Attachment # 4). It will provide an interlock on a large increase in beam current. Each subsystem consists of: a beam current transformer, with a test winding; signal conditioning, integration, and comparitor circiuts; and fail safe, self-test, and latching logic. With two of these circuits, the design goal to make the system as reliable as a "Dual, Hard Wired, Fail-safe System" should be met.

For the SEB, when set up for Heavy Ions, it is felt that even one pulse of full [6x10^13] beam must be made "impossible" (equivalent to to a dual hard-wired system). An equivalent system is the "zero degree beams energy limit" which prevents the full proton beam from being delivered to unshielded areas. A detailed analysis of the problems caused by a fault was not made, but prevention eliminates the need for this major review. If excessive injected beam is detected, SEB extraction must be interlocked off in a fully redundant fashion. Thus each subsystem must have an independent interlock output. The effects interlock must be completed during the 0.4 sec. acceleration portion of the AGS cycle.

For RHIC injection, one bunch of high intensity protons is acceptable, as this bunch, if faulted, would only cause 12 mRem at the fault location. Thus to meet AGS criteria of 25 mRem. per fault, the system must interlock extraction off before the third bunch is extracted. For operations reasons, it would be desirable if the next bunch was inhibited with an electronic system.

All controls for this system are behind lockable panels, in addition all settings, and changes, must be logged.

The committee felt that the self-test function should be at a signal level well below the interlock level and thus not need to disable the interlock during the test.

The response may saturate to a lower differential gain at input currents larger than the interlock levels but must be signal valued, not dropping for any possible current. The allowable calibration error for these subsystems is 10% as this system is to prevent gross excursions of intensity not provide a close limit on beam.

Examination of the integrator reset circuit found that each system would be "off line" for 10% of the time (5 usec every 50 usec.) Redundancy would be lost 20% of the time and if the two subsystems were asynchronous, the whole system would be disabled 1% of the time. This was not acceptable to the committee. There was no consensus of an acceptable upper limit on dead time. Any dead time must be justified in detail.
Suggested solutions included:

- Longer integration time, this could reduce subsystem dead time by an order of magnitude or so, but would not eliminate the problem.
- Adding a second integrator to each board to operate while the other is being reset would solve the problem, but would be a big redesign.
- External timing could assure both subsystems are on-line when needed, but assuring that they always are synchronous with beam is another difficult system.
- A third subsystem, with all running synchronously, would assure at least two were active at any time; but there are only two transformers in the beam line.

The Quality Control level of the system as a whole must be QA-1. Components may be of a lower level as proper, reviewed, design will make a QA1 system. The question of whether "high reliability" components should be used is deferred to a design review committee.

Time did not permit Glenn to present proposed guides to the electronic design reviewers of this system.

Outstanding Items:

- Responsibility for the U-line region must be specified.
- A "walk-through" of the TL was scheduled for 11 am on Friday, Nov. 6.

Attachments (file only):

- #1 - "Design Criteria for Prompt Radiation Limits on the RHIC Site", with transparencies.
- #2 - "Beam Loss Scenario in RHIC" (draft 9/11/92), transparencies not available.
- #3 - Transparencies for A. Stevens talk.
- #4 - BTA Co-Injection System.

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