ii. Beam Current Monitors

These monitors will be very sensitive "DC" transformers having a dynamic range large enough to measure the full circulating current with a resolution and long term stability of better than 10 μA. They will be used to monitor both the beam current and the current loss rate. Output from these units will be used in many control programs and will also be a source for a hard-wired beam abort trigger.

iii. Beam Loss Monitor System

The main functions of the Beam Loss Monitor (BLM) system for RHIC are:

1. To provide an abort signal to avoid quenching the superconducting magnets.
2. To provide a history (postmortem) of the losses preceding an abort to help identify the source of the problem.
3. To provide spatial and temporal loss data to assist in tuning the beam to reduce the losses. The RHIC BLM System will not be used for personnel protection.

The quench thresholds are taken as 2 mJ/g for "fast" losses and 8 mW/g for "slow" losses, where "fast" and "slow" are relative to the time-constant (100 msec) with which the cryogenic system can remove heat from the coils.

Data from the BLM system will be stored in a circular buffer which will stop on an abort to help diagnose the fault which led to the beam dump. The loss data in local memory will cover a period of about 10 sec, comparable to the BPM data.

The detectors will be placed at locations where they will be most sensitive to beam loss which might quench the magnets. The average spacing will be about 15 m. Relocatable units will be placed near injection or extraction equipment, or at temporary problem areas, where control of losses is especially critical. The distribution of detectors is shown in Table 8-3. The electronics will be located in 24 alcoves and houses around the RHIC tunnel in the same racks as the BPM electronics. By using a modular design significant system expansion can be provided by adding more VXI/VME cards or crates.

Table 8-3. Distribution of Detectors

Location	Per	Total
Standard Triplet	6	72
Standard FODO	7	84
Standard Arc	23	138
rf Region	8	8
Collimators/Scrapers	2	8
Snake/Spin Rotators	2	24
Beam Dumps	8	16
Injection Region	6	12
Relocatable Units	20	20
Total		382

Determining which beam was the source of the radiation could be useful but would not prevent both beams from being dumped. Since individual detectors will not have directional characteristics, it may be possible to use signals from adjacent detectors to determine directionality. It has been estimated that four decades of dynamic range would be required. This will be taken as the design goal but will not be a design requirement.

An ion chamber of the type used successfully on the Tevatron will be used as the detector. After conversion of the signal from a current to a voltage, the output will be processed in several ways. It will be directly available as an analog signal via the multiplexer. The time response for electron collection will be comparable to a single turn. The output of the front-end amplifier will also go to an integrator which will accumulate data over several turns before being digitized and placed into the circular buffer. The signal to the integrator will be filtered to correspond to the digitizing rate. This will be necessary if the four decade range is to be achieved.

The signal will also be fed through a circuit block which simulates the magnet quench time response and then to a comparator which will generate an abort signal on crossing a reference level. Any of the 382 detectors will be able to trigger a beam dump. However, since some detectors will be located near higher loss locations, levels will be individually settable for each detector. Up to 16

event drivel levels will be available which will allow for energy increase and operational flexibility. There will be separate trip levels for fast and slow losses. The slow loss abort may be generated from data in the local memory. Each unit will be able to be masked to allow higher loss during studies or to disable bad channels. An indication of which detector and loss mode triggered the abort will be available in a status word. A means of checking the abort system calibration will be provided.