If you are using a printed copy of this procedure, and not the on-screen version, then you MUST make sure the dates at the bottom of the printed copy and the on-screen version match. The on-screen version of the Collider-Accelerator Department Procedure is the Official Version.

C-A OPERATIONS PROCEDURES MANUAL

2.5.2.1 Procedure to Monitor the Intensity Limit Portion of the RHIC ASE

Hand Processed Changes

HPC No.	Date	Page Nos.	Initials

Approved: ***Signature with Date on File***
Collider-Accelerator Department Chairman Date

P. Ingrassia

2.5.2.1 Procedure to Monitor the Intensity Limit Portion of the RHIC ASE

1. Purpose

1.1 The purpose of this procedure is to provide instructions to MCR staff to limit particle losses during RHIC operations in order to comply with the Beam Intensity Operational Safety Limits (OSL) found in C-A OPM 2.5.2 RHIC Accelerator Safety Envelope Parameters.

1.2 This procedure authorizes MCR staff to use the Beam Loss Account Manager (BLAM) to monitor RHIC OSLs.

1.3 This procedure authorizes the MCR staff to cycle the RHIC beam stops (G1BS & G2BS) whenever it is thought that entire energy of the beam is intercepted by the beam stops.

2. Responsibilities

2.1 The Operations Coordinator is responsible for the execution of this procedure.

2.2 Accelerator physicists are responsible for responding to requests from the Operations Coordinator to terminate beam delivery when asked to do so.

2.3 MCR Operators are responsible for monitoring the Alarm Display Task (ADT).

2.4 The cognizant software developer is responsible for controlling the configuration of the BLAM application.

3. Prerequisites

3.1 The uxf1 and uxf3 beam current transformers must be operational.
The transformers w (wxf1), x (xxf1), and y (yxf1) cannot be declared operational without first threading ions through them.

3.2 The RHIC loss monitors and circulating beam current transformers must be working for BLAM as well as the PostMortem, and LossAnalysis servers.

3.3 The “RHIC Alarm Page” must be operational.

3.4 The GPMs BeamLossAccountBlue.mon and BeamLossAccountYellow.mon must be displaying the RHIC BLAM inputs for a period of one hour or greater.

4. Precautions

4.1 None

5. Procedure

5.1 Required software tools

5.1.1 Verify the BLAM server is running .

5.1.1.1 BLAM may be found at StartUp/Servers/RHICManagers/BeamLossAccountingManager

5.1.2 Changes to the BLAM software are not permitted without the approval of the cognizant physicist or designee.

5.1.2.1 The date and time changes are made to the BLAM source code shall be documented using the same standard procedures and practices used by the Controls group for all of their applications.

5.1.2.2 BLAM parameters are available via pet. To control the parameter configuration, the file is stored in a non-public location.

5.2 Required Instrumentation

5.2.1 The appropriate transformer must be operational for the planned evolution.

5.2.1.1 uxf1 and uxf3 must be operational. The operation of wxf1 can be determined as ions are threaded through it.

5.2.1.2 wxf1 must be operational to thread ions through the x and y arcs. The operation of xxf1 and yxf1 can be determined once beam has been threaded through them.

5.2.2 For BLAM operation, the circulating beam transformers and 80% of the loss monitors must be operational in each RHIC ring

5.3 **BLAM** Alarms designed to ensure compliance for losses in a RHIC CONTROLLED area.

Note 1:
BLAM is a sophisticated application that takes credit for particles cleanly dumped in the beam dumps. Particles that are registered in loss monitors at locations other than the beam dumps will contribute to the hourly loss. BLAM gives increasing weight to particles lost at high energy.

5.3.1 IF you observe on the RHIC ADT
a LEVEL 3 **blue(yellow):50% of allowed hourly loss (WARNING)** alarm, THEN 50% of the allowable limit of the ions being accelerated are assumed to have been lost at a point in RHIC or in the X or Y arc.

5.3.1.1 The alarm serves as a warning and the alarm will not clear from the screen until sufficient time passes during low loss operation such that the hourly average goes below the threshold.

Note 2:
The DOE approved ASE limit (OPM 2.5.2 paragraph 5.1) is $5x10^{11}$ Au ions at 120 GeV and 5 $x10^{13}$ protons at 300 GeV. While the Radiation Safety Committee (RSC) further studies the impact of the higher intensities it has limited the total current in the RHIC (see 5.3.2.1 below). This procedure enforces that restriction.

5.3.2 IF you observe on the RHIC ADT
a LEVEL 4 **blue(yellow):90% of allowed hourly loss (ERROR)** alarm, THEN 90% of the allowable limit of the ions being accelerated, are assumed to have been lost at a point in RHIC (paragraph 5.3.2.1) or in the X or Y arc (paragraph 5.3.2.2).

5.3.2.1 The OC shall prohibit injection of ions into the RHIC until the LEVEL 4 alarm clears from the ADT screen AND sufficient time passes such that $3.6x10^{11}$ Au ions, $3.3x10^{13}$ protons, or an equivalent number of other ion at injection, cannot be lost in the RHIC in one hour, OR

5.3.2.2 The OC shall prohibit injection of ions into the RHIC until the LEVEL 4 alarm clears from the ADT screen AND sufficient time passes such that $3.6x10^{11}$ Au ions, $3.3x10^{13}$ protons, or an equivalent number of other ions at injection, at injection, cannot be lost in the arc(s) in one hour.

5.3.3 IF you observe on the RHIC ADT
a LEVEL2 **blue(yellow)LossStatusM:missing credit for blue(yellow) loss** alarm, THEN the post-mortem loss analysis system may not have reported whether or not the loss was clean, and if credit can be applied for the loss.

5.3.3.1 The OC shall continue with operations while investigating whether or not the post-mortem system is reporting properly.

5.4 Monitoring Railroad Avenue.

5.4.1 IF you observe on the AGS Alarm Display a Level 4 NM401 RCS.NMON401 RANGE ERROR alarm, THEN the chipmunk on RailRoad Avenue is alarming at 80% of the allowable dose rate permitted in an uncontrolled area.

5.4.1.1 After **ONE** such event

- investigate the source of the problem.
  - Operate with only six bunches per ring if necessary during diagnostics
  - Review the PostMortem loss monitor data and contact the LossMonitor Systems Cognizant Physicist for assistance
  - Review orbit data and contact the cognizant accelerator physicist for assistance.
- Contact the Liaison Physicist for assistance and the Radiation Protection Physicist to inform him of the situation.
- Do not resume normal operation until the source of the problem is found and the problem fixed, OR if given explicit permission by the RSC Chairperson and the C-AD Associate Chairperson for Safety, to resume "normal operation"

5.5 Erroneous Data -- Using Current Transformers to determine validity of data.

Note 3:
For unknown reasons, a pulse measuring ~10E40 may be added to the integrated total which operations uses to regulate the amount of beam dumped and stay under OSLs outlined in this procedure. A pulse of this magnitude is physically impossible.

Note 4:
Incorrect data is defined as a pulse that reads greater than 1E12 on the AtR current transformers. Or increases on the RHIC DCCT of more than a factor of two after RHIC injection is complete.

5.5.1 IF an incorrect data point is observed, THEN compare AtR current transformers with RHIC current transformers to determine if the data is erroneous. IF current transformer data is erroneous, THEN continue operation.

5.5.1.1 Plot AtR RHIC current transformer data, for the fill in question, as shown in Attachment 8.1 "Sample Plot showing RHIC and AtR Current Transformers"

5.5.1.1.1 Get blam.blam:yellowIonsCirculatingM:value from LogView/RHIC/BeamLossAccountYellow.logreq

5.5.1.1.2 Get blam.blam:blueIonsCirculatingM:value from LogView/RHIC/BeamLossAccountBlue.logreq

5.5.1.1.3 Get uxf1, uxf3, wxf1, yxf1, xxf1 from LogView/Ags/Extraction/FEB/UWXYxfmrs.logreq

5.5.1.2 IF the RHIC blue/yellow current transformer gives incorrect data, THEN compare the blue/yellow transformer with xxf1/yxf1 and wxf1.

5.5.1.3 IF the xxf1/yxf1 current transformer gives incorrect data, THEN compare xxf1/yxf1 with wxf1 and the RHIC blue/yellow current transformer.

5.5.1.4 IF the wxf1 transformer gives incorrect data, THEN compare wxf1 with uxf3/uxf1 and xxf1/yxf1.

5.5.1.5 Compare the transformer giving incorrect data against two other transformers (as in paragraphs 5.5.1.2, 5.5.1.3, or 5.5.1.4).

5.5.1.5.1 IF the transformer giving incorrect data is not a RHIC DCCT, THEN the OC shall make note of the comparison results in the OC log and BLAM **arc loss** alarms may be ignored for the present fill.

5.5.1.5.2 IF the transformer giving incorrect data is a RHIC DCCT, THEN BLAM must be corrected.

5.6 IF the RHIC beam stops, G1BS and/or G2BS, are thought to have intercepted all or part of the circulating beam, THEN

5.6.1 Open and close the beam stops <u>several</u> times using the pushbutton on the RHIC PanelView at MCR_2 to determine whether the energy loss of the beam has caused the beam stop to deform.

5.6.1.1 IF the beam stop readbacks indicate that they both can be opened and closed repeatedly, then they have not been deformed.

5.6.1.2 IF the beam stop readbacks indicate that one or both beam stops cannot be opened and closed repeatedly, THEN cease operations and contact, the Access Controls Group Group Leader, the Radiation Safety Committee Chairperson, and the Chief Mechanical Engineer.

5.7 RHIC beam current transformer alarms.

IF you get a ***yi2-xf3.dvmctrl:dcctBeamM*** range error alarm or a ***bi2-xf3.dvmctrl:dcctBeamM*** range error alarm on the RHIC ADT, then you may be in violation of the ion number limit of the RHIC OSL in C-A OPM 2.5.2.

5.7.1.1 Determine if the current transformer is behaving correctly.
5.7.1.2 IF the current transformer is found to be behaving correctly, THEN
- 5.7.1.2.1 Determine the beam energy. The limiting number of ions is quoted in OPM 2.5.2 for full energy operation. The alarm is set for THAT limit.
- 5.7.1.2.2 IF the beam is at full energy, THEN contact the RHIC Liaison Physicist (LP), explain the situation, and ask for permission to continue to operate.
- 5.7.1.2.3 The OC shall record the outcome of the conversation with the LP in the OC shift log.

6. Documentation

6.1 Operations Coordinator's shift log.

7. References

7.1 C-A OPM 2.5.2 "RHIC Operational Safety Limits /Accelerator Safety Envelope"

8. Attachments

8.1 Sample Plot showing RHIC and AtR Current Transformers

Attachment 8.1
Sample Plot showing RHIC and AtR Current Transformers