

MIBLMS OPEN ACCESS CLIENT

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Abstract

The Open Access Client MIBLMS was created to calculate Main Injector, Recycler and Main Injector 8 GeV line beam loss convenience readings not already provided by the Beam Loss Monitoring systems. The Accelerator Controls Network device readings generated by MIBLMS assists the Accelerator Division Main Injector department in tracking beam losses over time. Alarms attached to some of these devices helps the Accelerator Division Operations department in monitoring beam loss as a whole and at specific locations.

1 Open Access Clients

Open Access Clients (OACs) are software front ends that run on the Accelerator Controls Network (ACNET) Java Data Acquisition Engines (DAEs). OACs are capable of populating ACNET device information including but not limited to readings, settings, statuses and alarms [1].

2 Beam Loss Monitors

The Main Injector and Recycler accelerators share one beam loss monitoring system. Losses measured by the beam loss monitors (BLMs) are attributed to either machine by the time at which the loss occurs. There are 251 BLMs spread around the Main Injector tunnel. The Main Injector 8 GeV line has its own BLM system. We monitor 32 BLMs in the 8 GeV line.

3 MIBLMS

The MIBLMS Open Access Client was created to help the Accelerator Division Main Injector department track beam loss in the Main Injector, Recycler and 8 GeV line. The OAC generates readings, settings, and statuses for many different types of ACNET devices.

3.1 Loss Sum Devices

Loss sum devices periodically sum all the BLMs integrated loss readings in a machine. Main Injector and Recycler had ring wide loss sums prior to the creation of MIBLMS. The readings for these devices were previously generated by comfort displays running on Main Control Room (MCR) consoles. MIBLMS has taken over the generation of these readings. The old readings updated on the end of beam event and were always one event behind. The new readings update at 15Hz and are no longer behind an event. Also, MIBLMS now calculates a loss sum device reading for the 8 GeV line. Refer to table 1 for details.

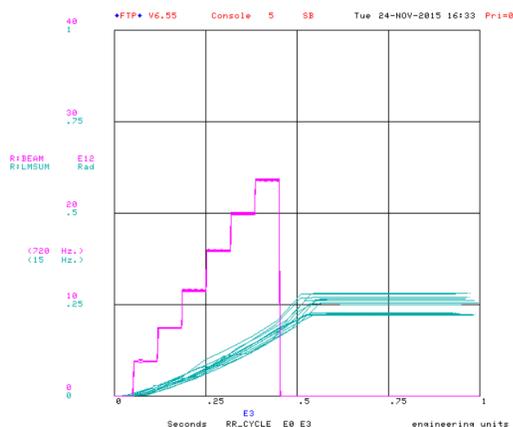


Figure 1: R:LMSUM Fast Time Plot (FTP) example

3.1.1 Ring Integrated Loss Sums

- [I,R]:LMSUM
 - Sums all the positive I:LI% or R:LI% device readings at a time
 - Capable of being plotted at 15 Hz
 - Alarmable but usually not monitored
- [I,R]:LMSUMN
 - Sums all I:LI% or R:LI% device readings at a time
 - Includes negative readings
 - Capable of being plotted at 15 Hz
- I:LM8SUM
 - Sums all positive 8 GeV beam loss device readings (rates) at a time
 - Capable of being plotted at 15 Hz
 - Alarmable but usually not monitored

3.1.2 Collimators Integrated Loss Sums

- [I,R]:LMCOLL
 - Sums all the positive I:LI% or R:LI% device readings at a time for that machines collimation region
 - Capable of being plotted at 15 Hz
 - Alarmable but usually not monitored
- [I,R]:LMRING
 - Sums all the positive I:LI% or R:LI% device readings at a time for every location in that machines collimation region
 - Capable of being plotted at 15 Hz

3.2 Loss Array Devices

Loss array devices sample each BLM's integrated loss reading and reflect that reading into the array at an index defined by the type of loss array device. The setting property for each index reflects the device index for the BLM sampled. Loss array devices are used to easily datalog the an events entire integrated loss readings with out having to specify each BLM on each event for datalogger requests. Refer to table 2 for details.

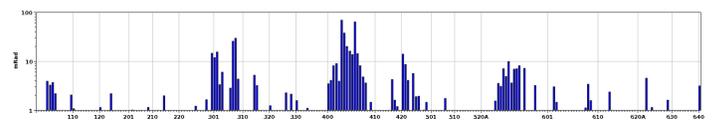


Figure 2: R:LMARY datalog example

3.2.1 Ring Integrated Loss Arrays

- [I,R]:LMARY[0:250]
 - Each index corresponds to the end of beam event integrated loss for a location, indices are ordered by their location in the tunnel

- The setting property for each index is the device index (primary units) or device name (common units) of the loss monitor used for that reading
- Used for datalogging losses on the same event pulse
- [I,R]:LMARYS[0:250]
 - Each index corresponds to the end of beam event integrated loss for a location, indices are ordered by largest loss to smallest loss
 - The setting property for each index is the device index (primary units) or device name (common units) of the loss monitor used for that reading
- I:LM8ARY[0:31]
 - Each index corresponds to the beam loss reading for a location, indices are ordered by their location in the tunnel
 - The setting property for each index is the device index (primary units) or device name (common units) of the loss monitor used for that reading

```

I30 Loss Array (Sorted) 0-39      SET  D/A  A/D  Con-U  PTools+
-<ECL>+ *E Cooling Losses      FS < 1> V
COMMAND
-<10>+
MAIN INT.. recycler.. 8 gev.....
-I:LMARYS Loss Array (Sorted)  I:LI308  103.83587 nRad
-I:LMARYS[1] Loss Array I:LI307  I:LI607B  98.968094 nRad
-I:LMARYS[2] Loss Array I:LI309  I:LI307  71.834755 nRad
-I:LMARYS[3] Loss Array I:LI607B  I:LI608F  13.100928 nRad
-I:LMARYS[4] Loss Array I:LI602C  I:LI309  9.4434881 nRad
-I:LMARYS[5] Loss Array I:LI608G  I:LI608H  7.81248 nRad
-I:LMARYS[6] Loss Array I:LI608F  I:LI602C  6.199904 nRad
-I:LMARYS[7] Loss Array I:LI525  I:LI608C  6.1097598 nRad
-I:LMARYS[8] Loss Array I:LI641  I:LI608G  5.8693762 nRad
-I:LMARYS[9] Loss Array I:LI621  I:LI608A  5.453712 nRad
-I:LMARYS[10] Loss Array I:LI522C  I:LI525  4.111568 nRad
-I:LMARYS[11] Loss Array I:LI110  I:LI608B  4.026432 nRad
-I:LMARYS[12] Loss Array I:LI401B  I:LI641  3.565596 nRad
-I:LMARYS[13] Loss Array I:LI403  I:LI621  3.4004321 nRad
-I:LMARYS[14] Loss Array I:LI231  I:LI522C  2.7944479 nRad
-I:LMARYS[15] Loss Array I:LI401A  I:LI401B  2.6692641 nRad
-I:LMARYS[16] Loss Array I:LI104  I:LI110  2.5841279 nRad
-I:LMARYS[17] Loss Array I:LI306B  I:LI403  2.4539199 nRad
-I:LMARYS[18] Loss Array I:LI631  I:LI401A  2.408848 nRad
-I:LMARYS[19] Loss Array I:LI311  I:LI231  2.288656 nRad
-I:LMARYS[20] Loss Array I:LI209  I:LI104  1.923072 nRad
-I:LMARYS[21] Loss Array I:LI507  I:LI306B  1.907808 nRad
-I:LMARYS[22] Loss Array I:LI522E  I:LI209  1.687696 nRad
-I:LMARYS[23] Loss Array I:LI608B  I:LI507  1.6276 nRad
-I:LMARYS[24] Loss Array I:LI608H  I:LI522E  1.6276 nRad
-I:LMARYS[25] Loss Array I:LI125  I:LI311  1.622592 nRad
-I:LMARYS[26] Loss Array (Sorted)  I:LI602  1.492384 nRad
-I:LMARYS[27] Loss Array I:LI227  I:LI402B  1.467344 nRad
-I:LMARYS[28] Loss Array I:LI337  I:LI631  1.422272 nRad
-I:LMARYS[29] Loss Array I:LI603  I:LI125  1.3621759 nRad
-I:LMARYS[30] Loss Array I:LI303  I:LI337  1.307808 nRad
-I:LMARYS[31] Loss Array I:LI608A  I:LI329  1.246992 nRad
-I:LMARYS[32] Loss Array I:LI329  I:LI227  1.231968 nRad
-I:LMARYS[33] Loss Array I:LI402E  I:LI603  1.156848 nRad
-I:LMARYS[34] Loss Array I:LI20E  I:LI205  1.111776 nRad
-I:LMARYS[35] Loss Array I:LI322  I:LI520E  1.096752 nRad
-I:LMARYS[36] Loss Array I:LI205  I:LI322  1.07672 nRad
-I:LMARYS[37] Loss Array I:LI119  I:LI303  95652801 nRad
-I:LMARYS[38] Loss Array I:LI315  I:LI119  91145599 nRad
-I:LMARYS[39] Loss Array I:LI302  I:LI331  89633602 nRad

```

Figure 3: I:LMARYS parameter page example

3.3 Loss Average Devices

Loss average devices sample a BLM's integrated loss reading and average that reading over a specified time. The devices ignore BLM readings that occur during a machine abort. Only BLM readings that occur when the machine state and BLM state match configuration devices' settings are included in the average. A minimum amount of samples within the specified time are needed to generate a loss average device reading else zero is returned. Loss average devices are primarily used for alarms that the Accelerator Operators monitor. Refer to table 3 for details.

3.3.1 Location Integrated Loss Averages

- [I,R]:LX[Location]
 - Each location has a one minute average integrated loss sampled on the end of beam
 - All locations are datalogged using an array parameter named I:LXARY[0:250]

- Only desired machine states are sampled, study cycles and/or uncommon events are ignored
 - * The array devices [I,R]:LXMSTS[0:63] determine which machine states are included. The index is the machine state, 0 for ignore, 1 for include
- Only desired blm node states (MI machine state) are sampled, study cycles and/or uncommon events are ignored
 - * The array devices [I,R]:LXBSTS[0:63] determine which blm node states are included. The index is the blm node state, 0 for ignore, 1 for include
- Machine aborts are not sampled into the average as to not skew the average
- Each location has its own alarm and alarm limits
- The setting property value shows the reading for the average at the time the alarm was nominalized
- All alarms are consolidated into either the I:LXLOSS or R:LXLOSS alarm consolidator as to not crowd the alarm screen when multiple locations are in alarm
 - * Individual alarms are mapped to an alarm list named MI_CONSOLIDATED. The MI_CONSOLIDATED alarm list is not monitored by the MCR. This keeps the alarm from appearing in both the consolidator and individually on the alarm screen
- Family devices exist for each machine, [I,R]:LXS

```

KJH          * 15:36:24          SNZ
RCNE1        <
LINAC        <
BOOSTER      <
  B: TTPS17
  B: TRX17
  B: MUP10T
MUPRR        <
  I:LXLOSS   I:LXLOSS
  R#H522     I:LI123
  R#H526     I:LI124
              I:LI607B
EXTBERMS     <
  F#MCDC
  S#MLAM1    S:MLAM1
  S#VH94     S:VH94
              S#PERMIT
MUN          <
  D:LUC10T
CONTROLS     <
  J:IRMS60
CRVO         <
  E:MC TPLA
  T:107475
FEVATR0N    <
  T:1071449
ACCPR0J     <
MISC        <
PSRBMS      <
  M:OUTHP   AP10 Outdoor Temp 50.68 DegF
  L:D7TOR   Module 7 Out Toro 26.04 mA
  E:MBRATE  MiniBooNE Intens1 8.8E+16 p/hr
  E:TRTSD   Num1 Tor TOT 16-b -0.00 E12
  E:TOTPUR  NUM1 Target Power 348.20 kW
  S:Q2SEM   G2 C333 Spare Cou 0 ppp
  F:MCISEM  MCISEM is an Ion 0 ppp
  F:MUISEM  MUISEM 0 ppp

```

Figure 4: I:LXLOSS alarm consolidator example

3.3.2 Integrated Loss Average Sums

- [I,R]:LXSUM
 - The sum of all the positive [I,R]:LX% readings
 - Alarmable, used as one of the primary metrics for loss monitoring
- [I,R]:LXC0LL
 - One minute average reading of positive [I,R]:LX% collimator readings
- [I,R]:LXRING
 - One minute average reading of positive [I,R]:LX% non-collimator readings
- [I,R]:LXC0LB
 - One minute average reading of positive [I,R]:LX% readings between collimators in that machines collimators region. This is a metric of well contained collimator losses are

3.4 Alarm Integrity Monitoring

Many of the device readings generated by the MIBLMS OAC have associated alarms. Some of those alarms are set up so that the Operators will be notified if machine losses exceed levels the Main Injector department has determined to be too high. To maintain the integrity of these alarms, MIBLMS monitors alarm blocks for select devices. If a change occurs (i.e. bypassed, limit is changed, etc) to alarms monitored then a timer begins to restore the alarm block to its original value. If the alarm block is restored before the timer is up, the timer is canceled and no change is made to the alarm block.

Table 1: Loss sum device descriptions

Device	Sample Event	Reset Event	Update Event	Units	Alarm	BLM Devices
I:LMSUM	E,0C,E,0	E,20,E,0 E,21,E,0 E,23,E,0 E,29,E,0 E,2A,E,0 E,2B,E,0 E,2E,E,0	E,0C,E,10	Rad	True	I:LI[100:641] (All)
I:LMSUMN	E,0C,E,0	E,20,E,0 E,21,E,0 E,23,E,0 E,29,E,0 E,2A,E,0 E,2B,E,0 E,2E,E,0	E,0C,E,10	Rad	False	I:LI[100:641] (All)
I:LMCOLL	E,0C,E,0	E,20,E,0 E,21,E,0 E,23,E,0 E,29,E,0 E,2A,E,0 E,2B,E,0 E,2E,E,0	E,0C,E,10	Rad	False	I:LI[230:309]
I:LMRING	E,0C,E,0	E,20,E,0 E,21,E,0 E,23,E,0 E,29,E,0 E,2A,E,0 E,2B,E,0 E,2E,E,0	E,0C,E,10	Rad	False	I:LI[100:229 + 310:641]
R:LMSUM	E,0C,E,0	E,E0,E,0 E,E1,E,0 E,E3,E,0 E,E9,E,0	E,0C,E,10	Rad	True	R:LI[100:641] (All)
R:LMSUMN	E,0C,E,0	E,E0,E,0 E,E1,E,0 E,E3,E,0 E,E9,E,0	E,0C,E,10	Rad	False	R:LI[100:641] (All)
R:LMCOLL	E,0C,E,0	E,E0,E,0 E,E1,E,0 E,E3,E,0 E,E9,E,0	E,0C,E,10	Rad	False	R:LI[613:619F]
R:LMRING	E,0C,E,0	E,E0,E,0 E,E1,E,0 E,E3,E,0 E,E9,E,0	E,0C,E,10	Rad	False	R:LI[100:612 + 620A:641]
I:LM8SUM	E,BD,E,0	E,BD,E,10	E,12,E,0	R/S	True	[B,I]:LM[VBCU:MLAMU] (All)

Table 2: Loss array device descriptions

Device	Sample Event	Update Event	Units	Alarm	BLM Devices
I:LMARY[0:250]	E,26,E,0	E,26,E,66	mRad	False	I:LI[100:641] (All)
I:LMARYS[0:250]	E,26,E,0	E,26,E,66	mRad	False	I:LI[100:641] (All)
R:LMARY[0:250]	E,E6,E,0	E,E6,E,66	mRad	False	R:LI[100:641] (All)
R:LMARYS[0:250]	E,E6,E,0	E,E6,E,66	mRad	False	R:LI[100:641] (All)
I:LM8ARY[0:31]	E,BD,E,0	E,BD,E,10	R/S	False	[B,I]:LM[VBCU:MLAMU] (All)

Table 3: Loss average device descriptions

Device	Sample Event	Update Event	Min Samples	Average Time	Units	Alarm	BLM Devices
I:LX[Location]	E,26,E,0	P,1000,TRUE	3	60000 mS	Rad	True	I:LI[Location]
I:LXSUM	E,26,E,0	P,1000,TRUE	3	60000 mS	Rad	True	I:LX[100:641] (All)
I:LXCOLL	E,26,E,0	P,1000,TRUE	3	60000 mS	Rad	True	I:LX[230:309]
I:LXRING	E,26,E,0	P,1000,TRUE	3	60000 mS	Rad	False	I:LX[100:229 + 310:641]
I:LXCOLB	E,26,E,0	P,1000,TRUE	3	60000 mS	Rad	True	I:LX[230:309]
R:LX[Location]	E,E6,E,0	P,1000,TRUE	3	60000 mS	Rad	True	R:LI[Location]
R:LXSUM	E,E6,E,0	P,1000,TRUE	3	60000 mS	Rad	True	R:LX[100:641] (All)
R:LXCOLL	E,E6,E,0	P,1000,TRUE	3	60000 mS	Rad	True	R:LX[613:619F]
R:LXRING	E,E6,E,0	P,1000,TRUE	3	60000 mS	Rad	False	R:LX[100:612 + 620A:641]
R:LXCOLB	E,E6,E,0	P,1000,TRUE	3	60000 mS	Rad	True	R:LX[613:619F]

References

- [1] J. Patrick, *Controls Overview; Java Open Access Clients*, Fermilab, Batavia, USA <https://beamdocs.fnal.gov/AD-private/DocDB/ShowDocument?docid=938>, 2003.