BEAM Loss Monitor Installation, Integration and Commissioning

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ORNL Diagnostic Group

June 7th, 2004

Outline

1. Schedule
2. System Requirements
3. DTL and CCL BLMs needed for the August run
4. BLM Distribution
5. Design Calculations
6. Detectors: Performance tested last run.
7. Front End Block Diagram and groups responsibilities
8. Data Acquisition
9. Summary

Integration– What's Wrong with this Picture?

Both BNL and ORNL controls and diagnostics groups feel we need to converge our efforts for the August -2004 commissioning run ASAP

Introduction and Summary:

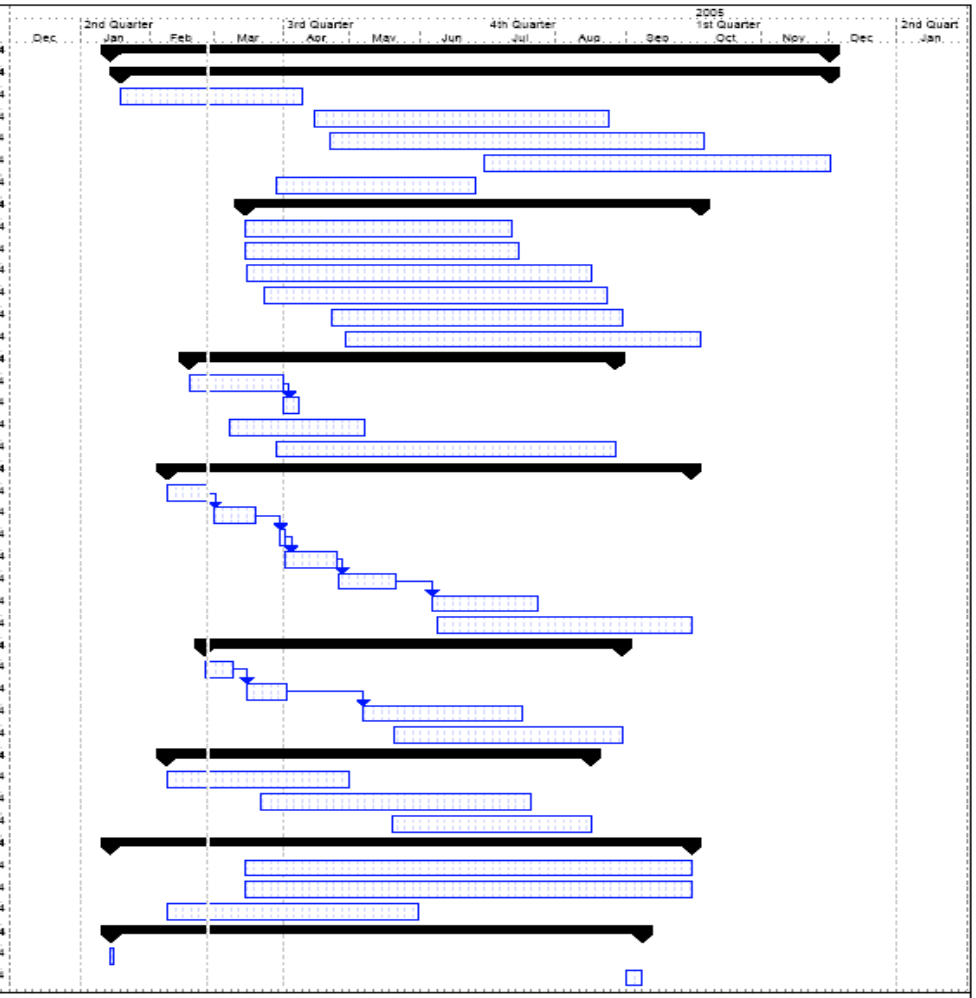
1) Ion chambers and NDs are commissioned. There Performance meet or exceed design.
2) The BLM system is ready for the CD-4 and is being readied for the 60 Hz Operation. (Electronics = Dave Gassner, Software and data acquisition= Larry Hoff.
3) The software for the August-04 run will be the one provided by the BNL.
4) The “value added” functionality will be tested by Andrei Liyu and Sasha Zhukov during the August Run. A dedicated Server might be needed (ORNL Diagnostic group’s responsibility for the FY05).
5) BLM software will go under QA testing starting July-15th-2004. [BNL Please comment of the timeline?]
6) Future Software and Hardware modifications need to be reviewed prior to implementation.

Concerns:

1) **Spares.**
2) **Obsolescence of components such as the CPU card.**
3) **Electromagnetic noise.**
4) **24/7 operation, beam loss accounting**
5) **etc**

BLM Schedule from DOE talk Given by Tom Russo

ID	Task Name	Duration	Start	Finish
1	**BLM**	**231 days**	**Thu 1/15/04**	**Wed 12/1/04**
2	**IonChamberDetector**	**228 days**	**Mon 1/19/04**	**Wed 12/1/04**
3	Receive30units-Eval&test	60 days	Mon 1/19/04	Fri 4/9/04
4	Receive295Units	95 days	Thu 4/15/04	Tue 8/24/04
5	Initialtesting&Spotknocking	121 days	Thu 4/22/04	Wed 10/6/04
6	ShiptoORNLaftertest	111 days	Wed 6/30/04	Wed 12/1/04
7	TestLeadshieldingatJLAB	66 days	Mon 3/29/04	Fri 6/25/04
8	**MountingHardware**	**147 days**	**Mon 3/15/04**	**Mon 10/4/04**
9	LinacCableTrayMounts	87 days	Mon 3/15/04	Mon 7/12/04
10	HEBT5"Strapmount	90 days	Mon 3/15/04	Thu 7/15/04
11	Sledmounts	111 days	Tue 3/16/04	Mon 8/16/04
12	RTBT8"StrapMount	110 days	Wed 3/24/04	Mon 8/23/04
13	MoveableBLMStands(19)	93 days	Fri 4/23/04	Mon 8/30/04
14	LeadShieldsforRFareas	113 days	Thu 4/29/04	Mon 10/4/04
15	**AFEChassis(14+1)**	**138 days**	**Thu 2/19/04**	**Fri 8/27/04**
16	Approve2FirstArticles	30 days	Thu 2/19/04	Wed 3/31/04
17	ShipFirstArticletoORNLforDTL	5 days	Thu 4/1/04	Wed 4/7/04
18	Receive13Chassisfromvendor	46 days	Mon 3/8/04	Fri 5/7/04
19	Test-Approve&Ship	111 days	Mon 3/29/04	Fri 8/27/04
20	**AFEModules(44+8)**	**170 days**	**Mon 2/9/04**	**Thu 9/30/04**
21	Completechecking finalrev	15 days	Mon 2/9/04	Fri 2/27/04
22	Fab&stuff1module	15 days	Mon 3/1/04	Fri 3/19/04
23	4modulesatORNLforDTLrun	2 days	Wed 3/31/04	Thu 4/1/04
24	ModuleTest(finalrev)	17 days	Fri 4/2/04	Sat 4/24/04
25	Placeorderfor50modules	20 days	Mon 4/26/04	Fri 5/21/04
26	Receivemodulesfromvendor	35 days	Mon 6/7/04	Fri 7/23/04
27	Test&Calibration	82 days	Wed 6/9/04	Thu 9/30/04
28	**MPS/FVMEModule(25+3)**	**134 days**	**Thu 2/26/04**	**Mon 8/30/04**
29	Completechecking	9 days	Thu 2/26/04	Tue 3/9/04
30	Placeorder	14 days	Tue 3/16/04	Fri 4/2/04
31	Receivemodulesfromvendor	51 days	Fri 5/7/04	Fri 7/16/04
32	Test	72 days	Fri 5/21/04	Mon 8/30/04
33	**FBLM(18+2)**	**137 days**	**Mon 2/9/04**	**Mon 8/16/04**
34	Receiveorderedparts	61 days	Mon 2/9/04	Fri 4/30/04
35	Assembly	88 days	Mon 3/22/04	Tue 7/20/04
36	Test	63 days	Thu 5/20/04	Mon 8/16/04
37	**Misc&systemparts**	**187 days**	**Thu 1/15/04**	**Thu 9/30/04**
38	Order&shipinter-rackcables	145 days	Mon 3/15/04	Thu 9/30/04
39	OrdershipChokes&breakoutpanels	145 days	Mon 3/15/04	Thu 9/30/04
40	Shipremainingcableconnectors	82 days	Mon 2/9/04	Mon 5/31/04
41	**ISEGVHQBias&supplies(46)**	**171 days**	**Thu 1/15/04**	**Wed 9/8/04**
42	36unitsshipped(SN87-122)	1 day	Thu 1/15/04	Thu 1/15/04
43	10unitsship	5 days	Thu 9/2/04	Wed 9/8/04



Project: BPM sched
Date: Fri 2/27/04

Task | Split | Progress | Milestone | Summary | Project Summary | External Tasks | External Milestone | Deadline

Page 1

System Requirements and Feb-2003 Results

Ring System Diagnostics AP Requirements (12/2000)							
Device	Location	Intensity [ppp]	Range	Accuracy	Resolution	Data structure	Comments
BLM (10 HZ)	Linac-Ring Sys	**1e7 - 2e14**	**1-1000 rem/h**	**1%**	**0.6% (0.5 r/h)**	**average at 10 Hz**	**of 1 W/m**
BLM (35 KHZ)	Linac-Ring Sys	**6e8 - 2e14**	**30-2.5e5 rem/h**	**1%**	**30 rem/h**	**once/10 turns**	
FBLM	SCL-to-HEBT		**1-1000 rem/h ?**			**inside mini pulse**	**fast; not calibrated**
	Ring		**1-1000 rem/h ?**			**intra turn**	**fast; not calibrated**

Faraday Cup Three is inserted. Poor Statistic on ND130 is due to signal level

	BCM200	BCM248	BCM11	ND224	ND160	ND130
Average	4.555E-03	4.325E-03	5.489E-03	**-4.886E+04**	**-2.371E+04**	**-1.536E+03**
Sigma	1.401E-04	1.196E-04	8.255E-05	1.674E+03	9.532E+02	2.498E+02
Sigma/Average, %	3.08%	2.77%	1.50%	3.43%	4.02%	16.27%
	Current, A			ND, bits		

PV requests from the Application Group [info from John Galambos]

Fast BLMs

Macropulse averages		
Loss averaged over the macropulse (mA)	**lossAvg**	**1**
Length of the averaged period (number of turns)	**tAvgLen**	**1**
Delay time from cycle start to beginning of average period (number of turns)	**tAvgDelay**	**1**
minipulse arrays		
Loss array, holding average over each minipulse (units??) (1)	**lossTBT**	**1**
Time delay from cycle start to the first array element (number of turns)	**tDelayTBT**	**1**
The sample period of each TBT array element, in units of turns. Normally = 1, need not be an integer.	**tSamplePeriod**	**1**
Fast waveform arrays		
Current array, holding average over a short period,typically < 1 micro sec (mA)	**fastArray**	**1**
Time delay from cycle start to the first array element (number of turns)	**tDelayFastArray**	**1**
The sample period of each TBT array element, in units of number of turns	**tFastArrayPeriod**	**1**
nArrayElements (settable)	**nFastArray**	**1**

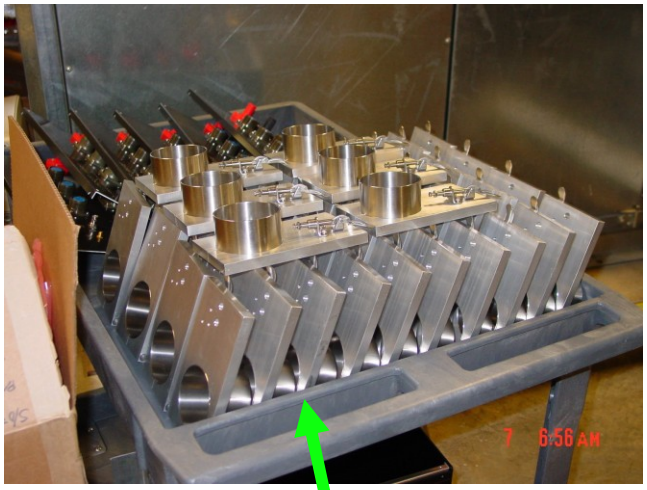
Slow BLMs

Last reading		
loss from last sample period (units ??)	**sLoss1**	**1**

Hardware for the August Run. [info from Dave Gassner]

40 Ion chambers
4 loaded IOC's (includes one dedicated for ISEG HV ps's in DTL)
15 ISEG HV supplies
3 AFE chassis
10 AFE modules (only 6 if there are no more ND's from INR)
4 MPS I/F boards
Interconnecting cables

We are getting ready for the August-2004 Run



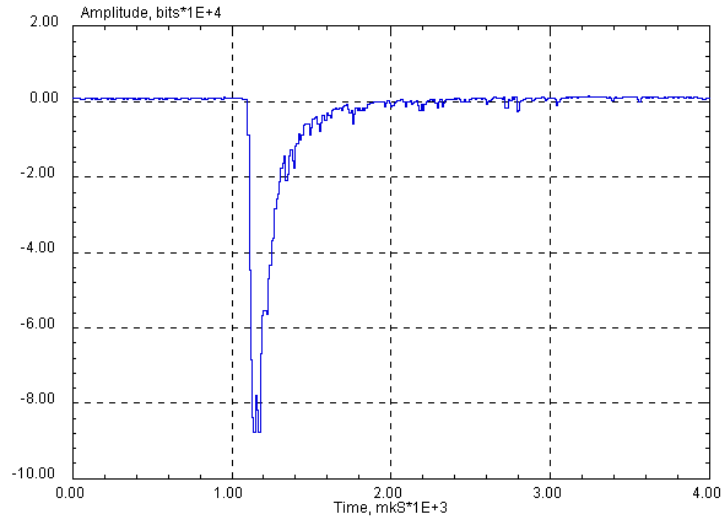
Stands and holders

Neutron Detectors

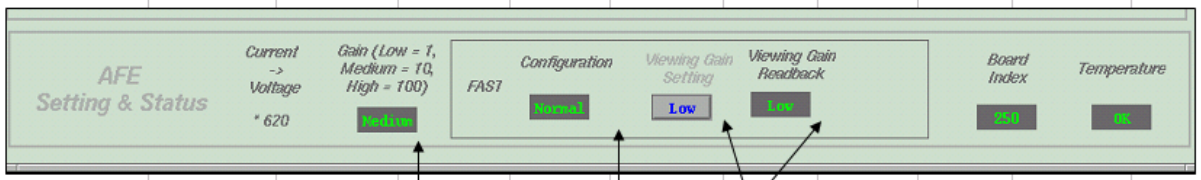
Thermal Neutron Detectors

25 Ion Chambers

Calibration of the Loss Monitor Detectors, Cross Calibration with TLDs



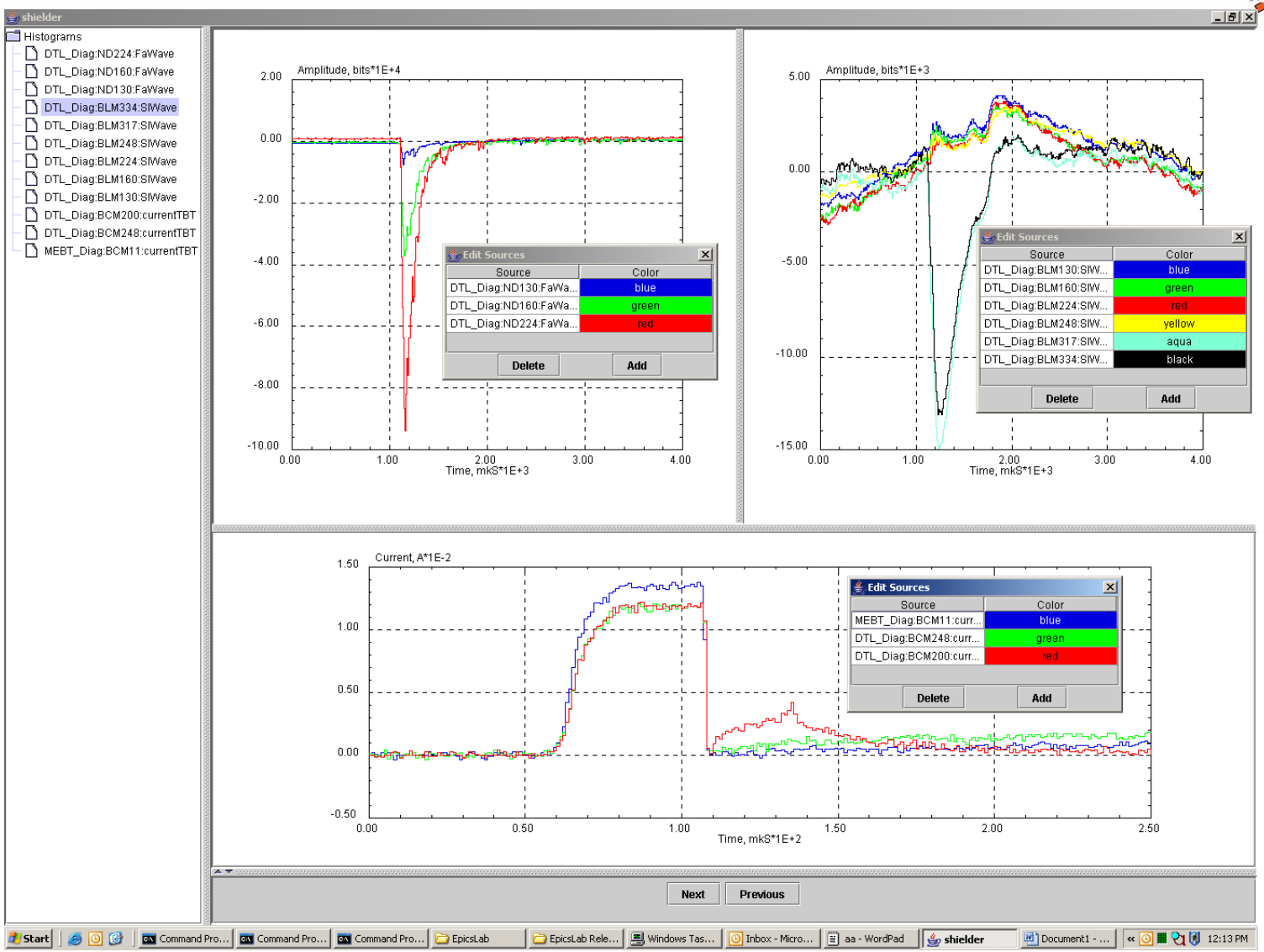
ND224 (-800V)			
		Coefficient	
Gain	Medium	10	
Configuration	Normal	1	
View Gain	Low	1	
		A ->mrem/s	bits->mrem/s
Raw ADC	1.30E+05		
Analog, V	3.10E-02		
Analog, A	5.00E-06		
Physical, mrem/s	7.90E+01	1.58E+07	6.08E-04



Gain		Configuration		View Gain	
High	100	Normal	1	High	10
Low	1	RTBT	100	Low	1
Medium	10				

Average cur	# of pulses	Total mrem	Average mrem/pulse	mrem/s	ND224max	BCMcur	Proposed mrem/s	bits ->mrem/s
14.95	3600	13	0.00361111	72.22222	1.30E+05	16.3	78.74396135	6.06E-04

Electromagnetic Noise is an issue – 10 bit from 24 bit.

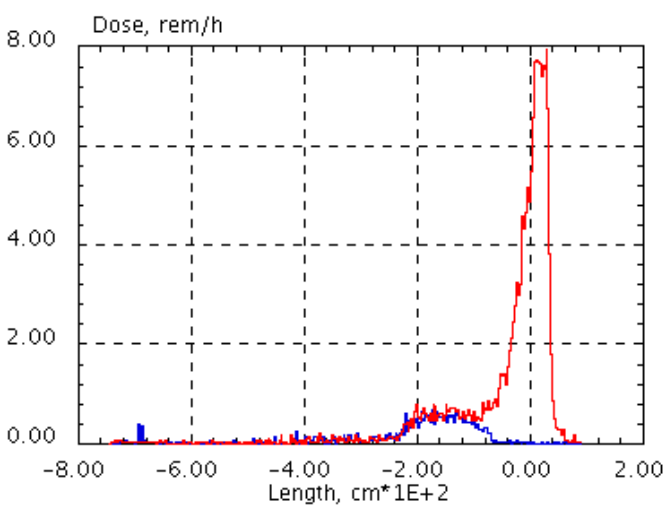


Performance of the Loss monitors improve as energy increases or Faraday Cups are inserted

Energy

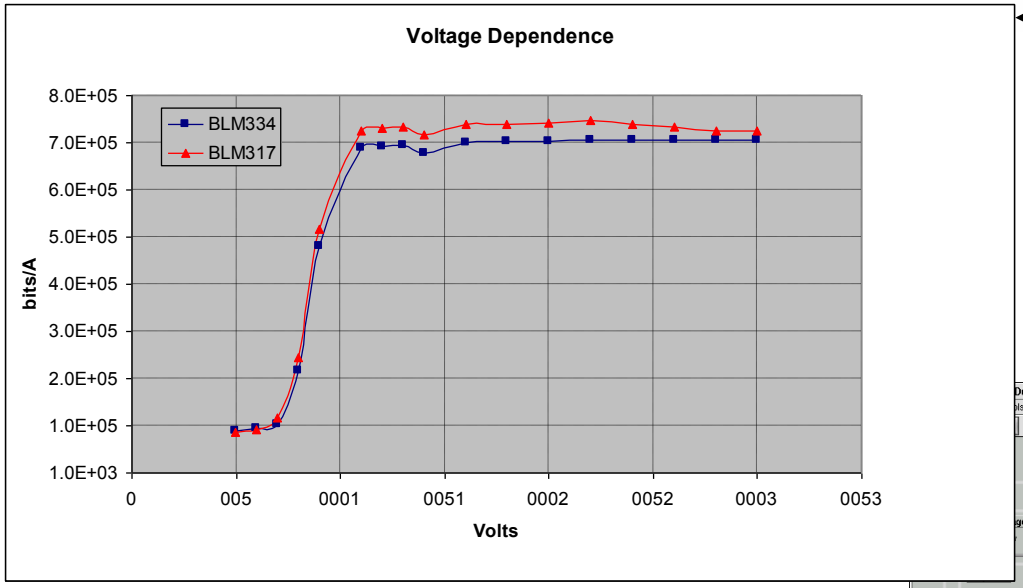
	Cu				Fe			
Ep, MeV	Low n born/p	High n out/p	Pout/p	N/p	Low n born/p	High n out/p	Pout/p	N/p
1000	1.213E+01	5.946E-01	1.343E-02	1.273E+01	1.015E+01	6.575E-01	1.520E-02	1.080E+01
600	6.265E+00	2.568E-01	5.000E-03	6.521E+00	5.264E+00	2.756E-01	6.100E-03	5.539E+00
300	1.907E+00	5.760E-02	9.000E-04	1.965E+00	1.594E+00	6.340E-02	9.000E-04	1.657E+00
189	7.737E-01	1.740E-02	7.000E-04	7.911E-01	6.351E-01	1.845E-02	5.500E-04	6.536E-01
140	4.189E-01	7.350E-03	6.500E-04	4.263E-01	3.610E-01	8.300E-03	3.000E-04	3.693E-01
100	1.968E-01	3.067E-03	2.667E-04	1.999E-01	1.743E-01	2.633E-03	2.000E-04	1.769E-01
80	1.321E-01	1.133E-03	2.667E-04	1.332E-01	1.125E-01	1.267E-03	2.333E-04	1.138E-01
50	5.120E-02	2.200E-04	6.000E-05	5.142E-02	4.508E-02	2.400E-04	1.800E-04	4.532E-02
30	1.675E-02	3.000E-05	1.300E-04	1.678E-02	1.599E-02	6.000E-05	1.700E-04	1.605E-02

	Al				Na			
Ep, MeV	Low n born/p	High n out/p	Pout/p	N/p	Low n born/p	High n out/p	Pout/p	N/p
1000	2.899E+00	1.174E+00	4.351E-01	4.073E+00	8.443E-01	8.135E-01	9.289E-01	1.658E+00
600	1.861E+00	6.638E-01	3.008E-01	2.525E+00	6.146E-01	5.153E-01	7.880E-01	1.130E+00
300	7.528E-01	1.749E-01	2.100E-03	9.277E-01	4.269E-01	2.949E-01	6.058E-01	7.218E-01
189	3.394E-01	5.515E-02	8.000E-04	3.946E-01	2.267E-01	1.096E-01	1.250E-03	3.362E-01
140	1.947E-01	2.185E-02	5.000E-04	2.166E-01	1.480E-01	5.070E-02	3.500E-04	1.987E-01
100	9.950E-02	7.100E-03	1.000E-04	1.066E-01	8.223E-02	2.037E-02	6.667E-05	1.026E-01
80	6.387E-02	3.467E-03	1.667E-04	6.733E-02	5.653E-02	1.193E-02	2.667E-04	6.847E-02
50	2.682E-02	5.600E-04	1.400E-04	2.738E-02	2.334E-02	2.460E-03	1.000E-04	2.580E-02
30	7.904E-03	4.600E-05	9.000E-05	7.950E-03	7.652E-03	2.680E-04	9.400E-05	7.920E-03

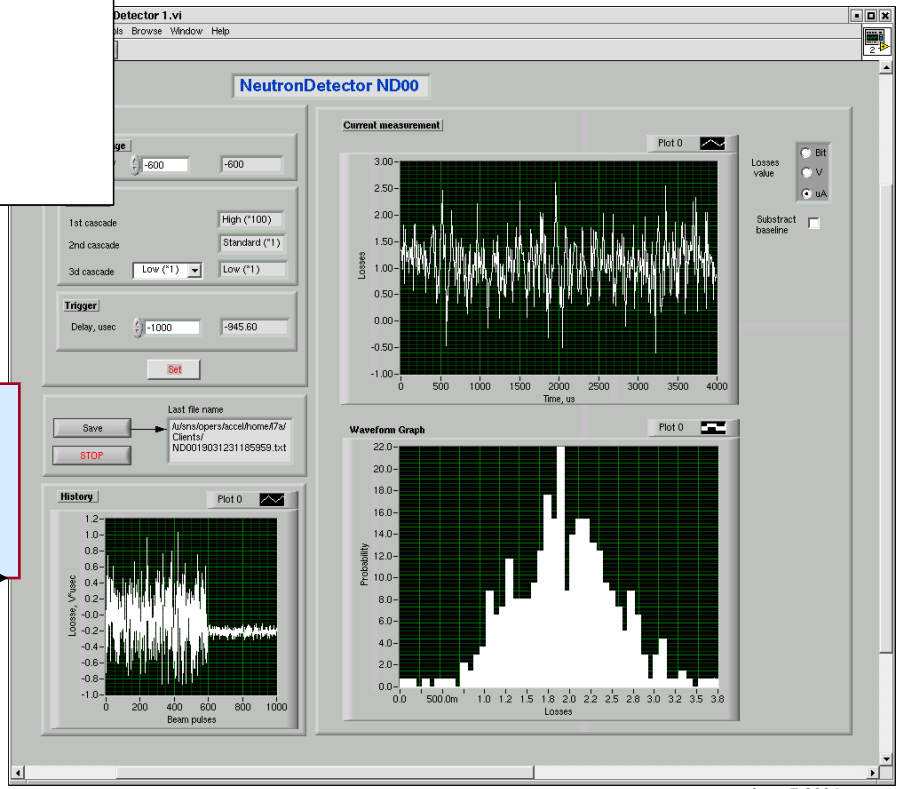


Faraday Cup/beam Stop Is inserted

Loss Monitor Testing on DTL-3

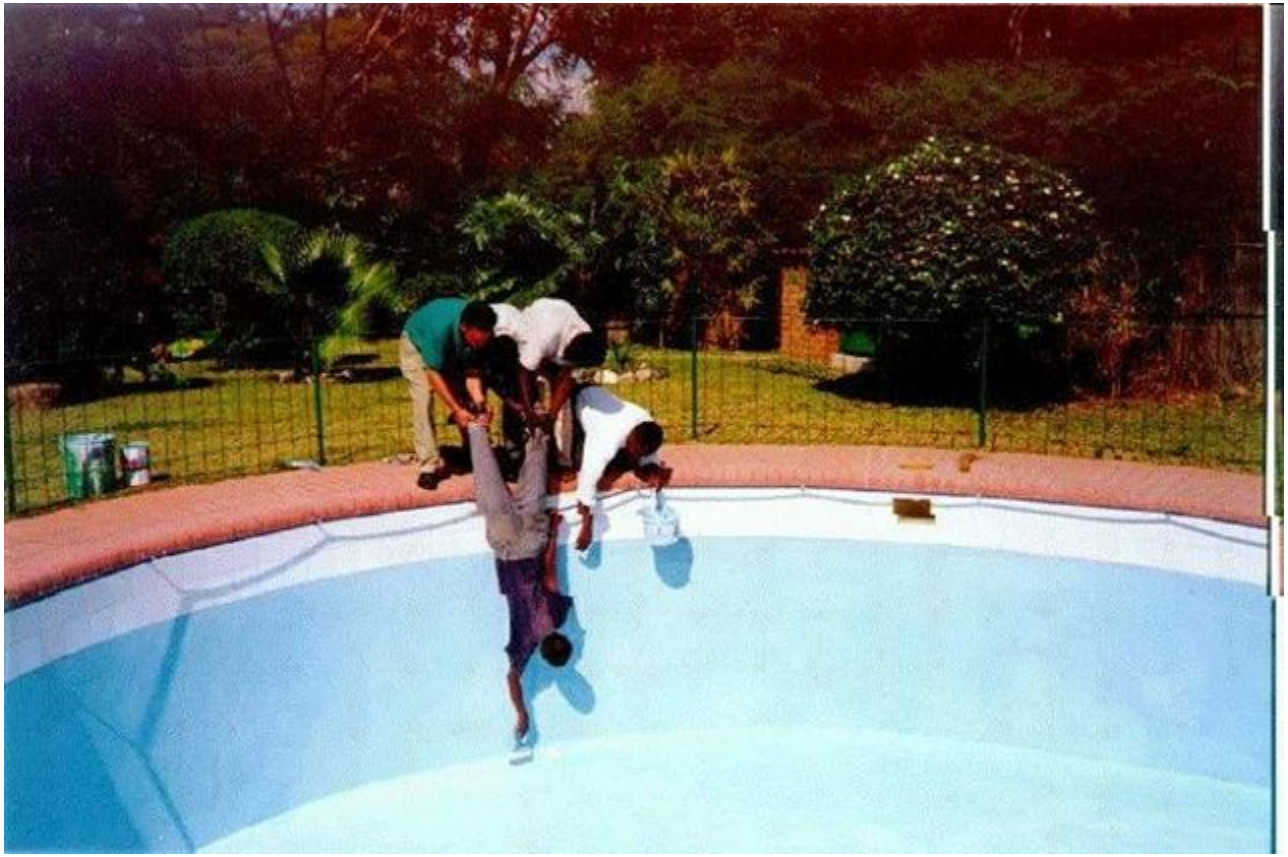


Voltage dependence of two Ion Chambers, the difference is due to the distance .



LabView Client-Server is being tested to reduce the CPU load on the Loss monitor IOCs plus value added information.

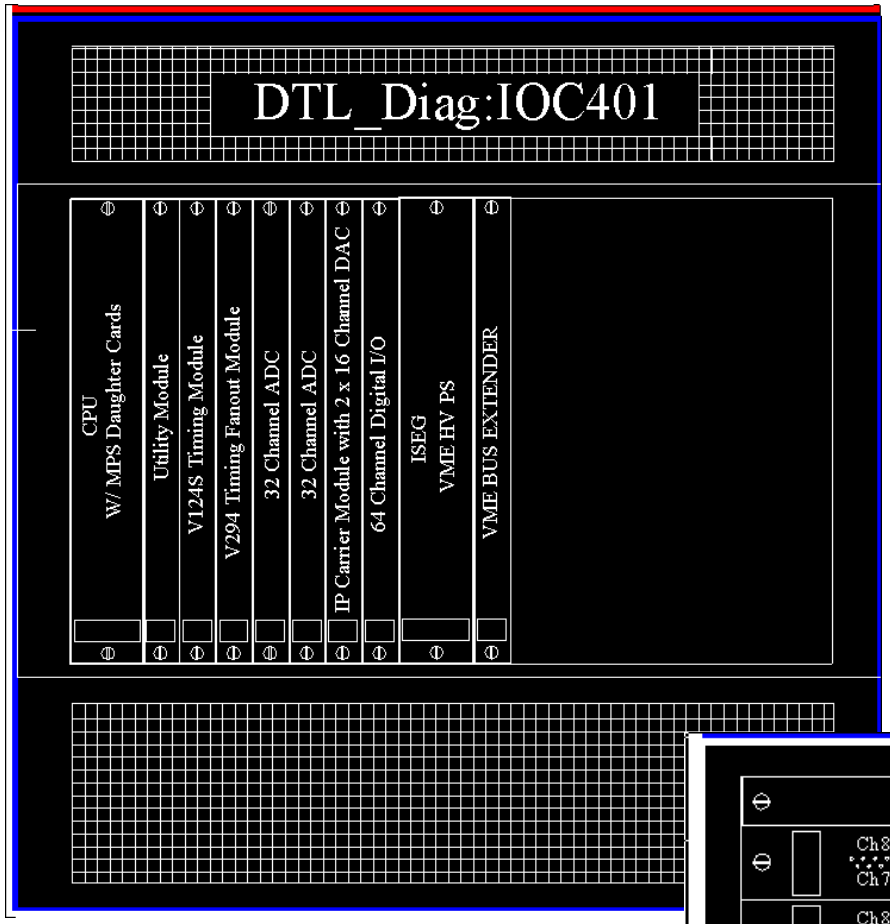
Inovation

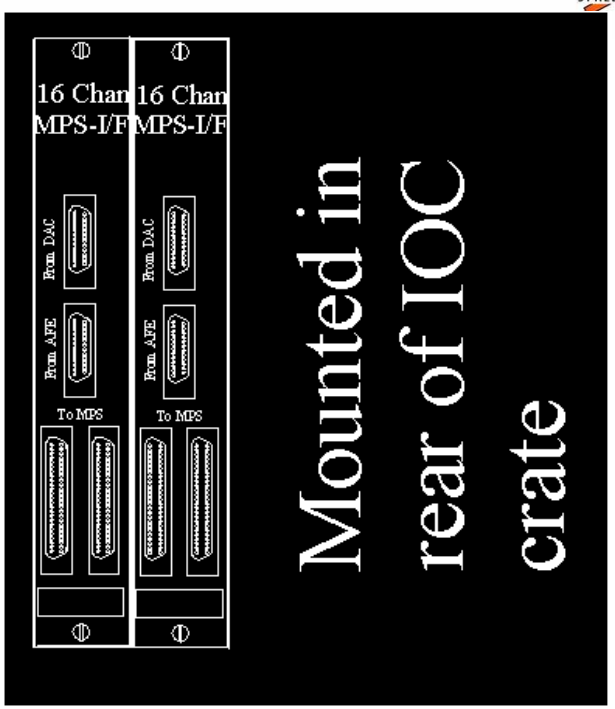


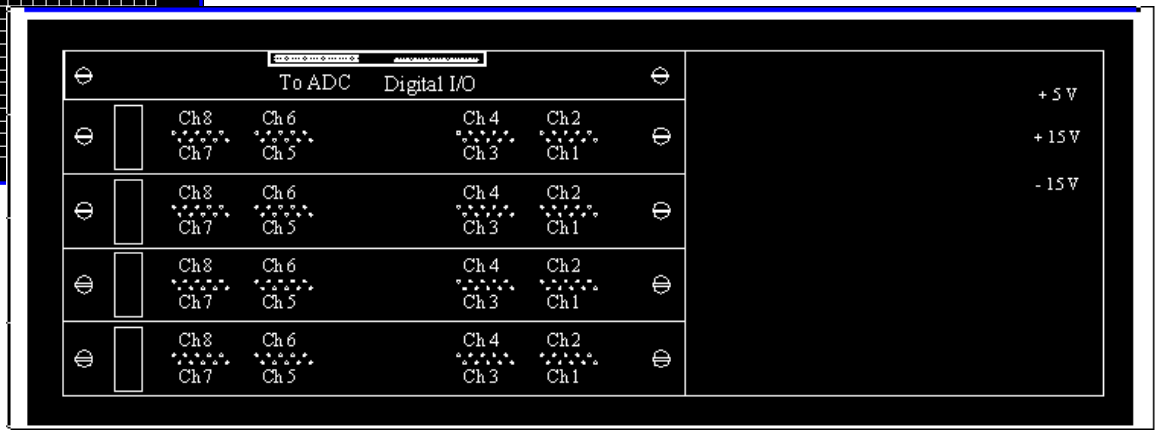
Next meeting: two weeks from now

Backup Material on the next three slides

BNL Designed Electronics for the Beam Loss Monitor System







SNS SPALLATION NEUTRON SOURCE

Physics Requirements

All instruments are designed to meet the following table. The score card is kept to improve, design, and implement the instruments. Piecewise commissioning allows us to implement a few systems and test their performance but we have the flexibility to improve and install the next generation devices with minimal cost impact at the next commissioning milestone.

TABLE 1. Physics requirements and measurements

Device	Location	Range	Accuracy Required	Experimental Results
BPM position	MEBT	+/- 0.5*apert	+/-.5mm	+/- 0.2 mm
	DTL	+/- 0.5*apert	+/- 0.125 mm	+/- 0.125 mm
BPM phase	MEBT	+/- 180 deg	+/-2 deg	+/- 0.1 Deg
	DTL	+/- 180 deg	+/-2 deg	+/- 0.2 Deg
BLM(35 kHz)	Ion	30-2.5e5 rem/h		2.40%
Neutron Detector	DTL	30-2.5e5 rem/h		3%
Faraday Cup	MEBT	50 mA	0.3%	0.25%
	DTL	50 mA	0.3%	0.25% (@20mA)
Wire	MEBT	+/- 15mm	10%	.15 mm
	DTL		10% (+/- 0.4 mm)	0.63 - 50. μA .13 mm jitter
Harp	DTL	+/- 10 mm		.08 mm
Laser wire	MEBT, DTL	+/- 15mm		Measure out to 3 sigma
BCM	MEBT-to-HEBT	15mA - 52 mA	+/- 1%	1%
	Ring-RTBT	15mA-100A	+/- 1%	--

SNS Diagnostics Deployment (proposed)

Operational
FY04
New to FY04
New to FY04
FY2004/5

MEBT
6 Position
2 Current
5 Wires
[2 Thermal Neutron]—9/04
[3 PMT Neutron] —9/04
1 Emittance
[1 fast faraday cup]—9/04
1 faraday/beam stop
D-box video
D-box emittance –9/04
D-box beam stop
D-box aperture
Differential BCM
[laser prototype]—9/04

IDump
1 Position
1 Wire
1 Current
6 BLM

RING
44 Position 2 Ionization Profile
70 Loss 1 Current
5 Electron Det. 12 FBLM
2 Wire 1 Beam in Gap
2 Video 1 Tune

EDump
1 Current 4 Loss
1 Wire

CCL
10 Position 9 Wire
8 Neutron
48 Loss 3 Bunch
1 Faraday Cup 1 Current

RTBT
17 Position
36 Loss
4 Current
5 Wire
1 Harp
3 FBLM

DTL
10 Position 5 Wire 12 Loss
5 Faraday Cup 6 Current
6 Thermal and 12 PMT Neutron

SCL
32 Position 86 Loss
8 Laser Wire
7 PMT Neutron

HEBT
29 Position 11 Wire
46 BLM, 3 FBLM
4 Current

D-Plate
2 Position 1 Current 2 Wire
7 Loss (4 PM and 3 Semi)
2 Faraday Cup 1 Bunch
1 Video 1 Halo 3 Neutron
1 Beam Stop Faraday Cup
1 Emittance (Slit and Collector)
Differential BCM

CCL/SCL Transition
2 Position 1 Wire
1 Loss 1 Current

LDump
6 Loss
6 Position
1 Wire