

SNS Division Review

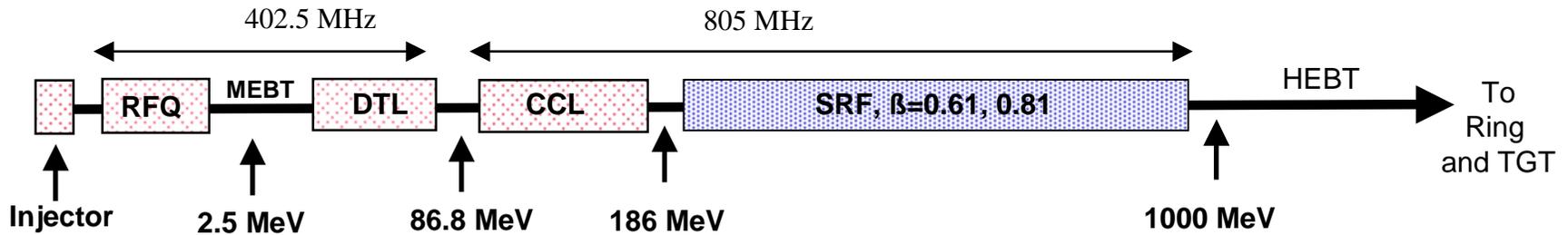


SNS Diagnostics

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December 5-6, 2001

LANL diagnostics deliverables



MEBT

5 WS (elec. only)
6 BPM (elec. only)
2 SI&Col (act. only)

DTL

5 WS
10 BPM
6 CM (p/u only)
5 ED/FC

D-plate (7.5 MeV)

1 WS
3 BPM
1 CM
1 ED/FC
2 SI&Coll emit
1 Phosphor screen
1 8 seg. halo scraper
1 Beam stop / F-Cup

CCL

8 WS
12 BPM
2 CM (p/u only)
1 ED/FC

SCL

32 WS (16 elec.)
32 BPM
1 CM

HEBT

3 WS (dumps)
22 BPM (elec. only)

RTBT

1 Harp

Key

WS = wire scanner
BPM = beam position monitor
SI&Col = slit and collector emittance station
CM = current monitor
ED/FC = energy degrader & Faraday Cup

Requirements summary



<i>Device</i>	<i>Requirement</i>	<i>Status</i>
BPM	Quantity = 57 pickups, 85 elec. Accuracy = 1% aperture radius. Beam current = 10 – 56 mA	PDR, part of FDR, 2 DTL pickups delivered, CCL & SCL prototypes in fab., prototype electronics.
WS	Quantity = 49 pickups, 38 elec. Accuracy = 10% width meas. Beam current = 10 – 56 mA, 50 – 100 μ s, 10 Hz.	PDR, prototype actuators, prototype electronics.
CM	Quantity = 10 pickups, no elec. Accuracy = 1% of full scale Beam current = 10 – 56 mA	DTL pickups on order. CCL / SCL pickups being specified.
ED/FC	Quantity = 7 Beam current = 10 – 56 mA, 50 μ s, 1 Hz.	Design in progress.
Harp	Quantity = 1 pickups, 1 elec. Accuracy = 10% width meas., 0.5 mm pos'n meas.	Design in progress.
D-plate	Quantity = 1	PDR, final design in progress.

Physics input



- **Past design reviews have pointed out the lack of input from physics and commissioning teams on the diagnostics requirements and placements.**
- **Physics and commissioning are now catching up:**
 - ▶ DTL commissioning plans, including the plan for the D-plate, are now detailed (<http://www.sns.gov/projectinfo/operations/commissioning.htm>).
 - ▶ CCL BPM placements refined based on CCL steering studies (Nath, Crandall).
 - ▶ WS accuracy expectations (Jeon, Plum tech note).
 - ▶ CCL WS accuracy requirements and placements refined by DTL to CCL matching studies (Jeon, Stovall, Assadi tech note).
 - ▶ Harp accuracy requirement (RTBT interface workshop, 20/Sep/01).

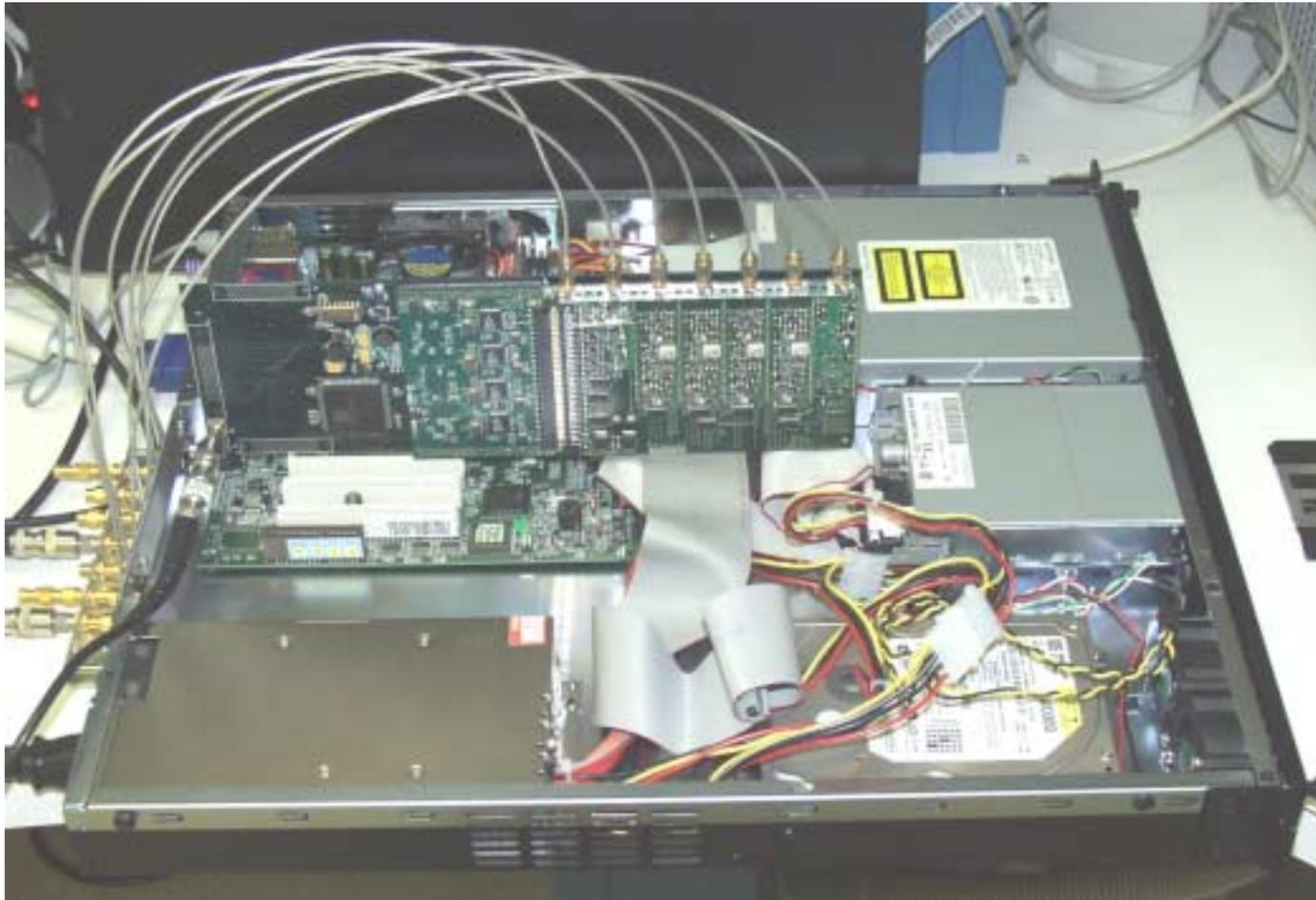
BPMs



- Two DTL pickups to be delivered Dec/01.
- Prototype CCL and SCL pickups now in fab.
- Electronics in prototype stage.
- Six electronics units to be delivered to LBL Jan/02.

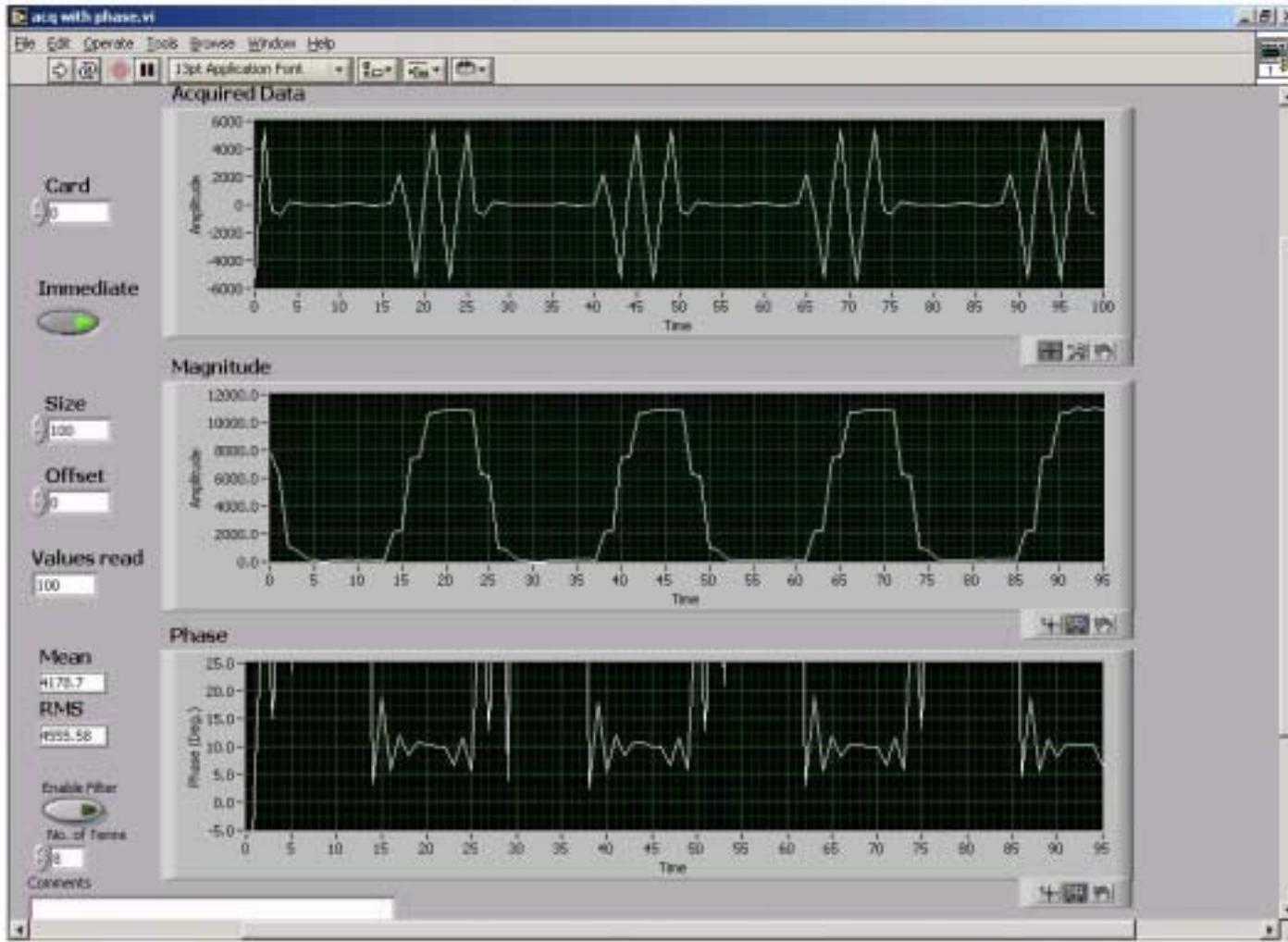


BPM chassis



Prototype signal processor PCI card mounted in 1U rack-mounted PC.

BPM waveforms



Simulation of
300 ns beam
pulse.

Top: digitization
of the down-
converted signal.

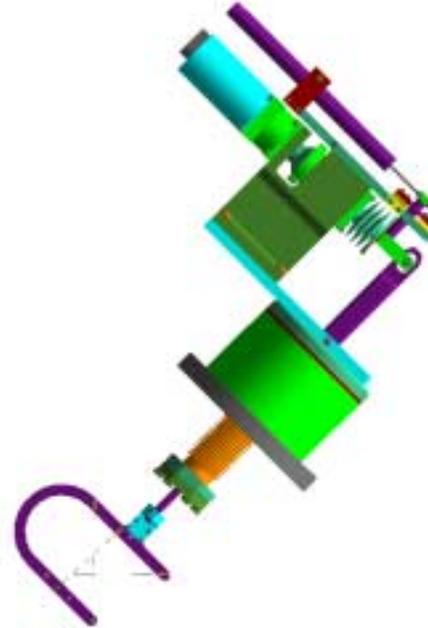
Middle:
Amplitude
measurement.

Bottom: Phase
measurement.

Wire scanners



- Prototype DTL/CCL actuator recv'd and tested (bellows failed). (No impact on delivery schedule.)
- Prototype SCL actuator received 3/Dec.
- 3 signal wires (x, y, and diagonal).
- Electronics in prototype stage.
- Six electronics units to be delivered to LBL early January.
- Beam power limited to 50 – 100 μ s, 10 Hz.



SNS WS signal processor electronics

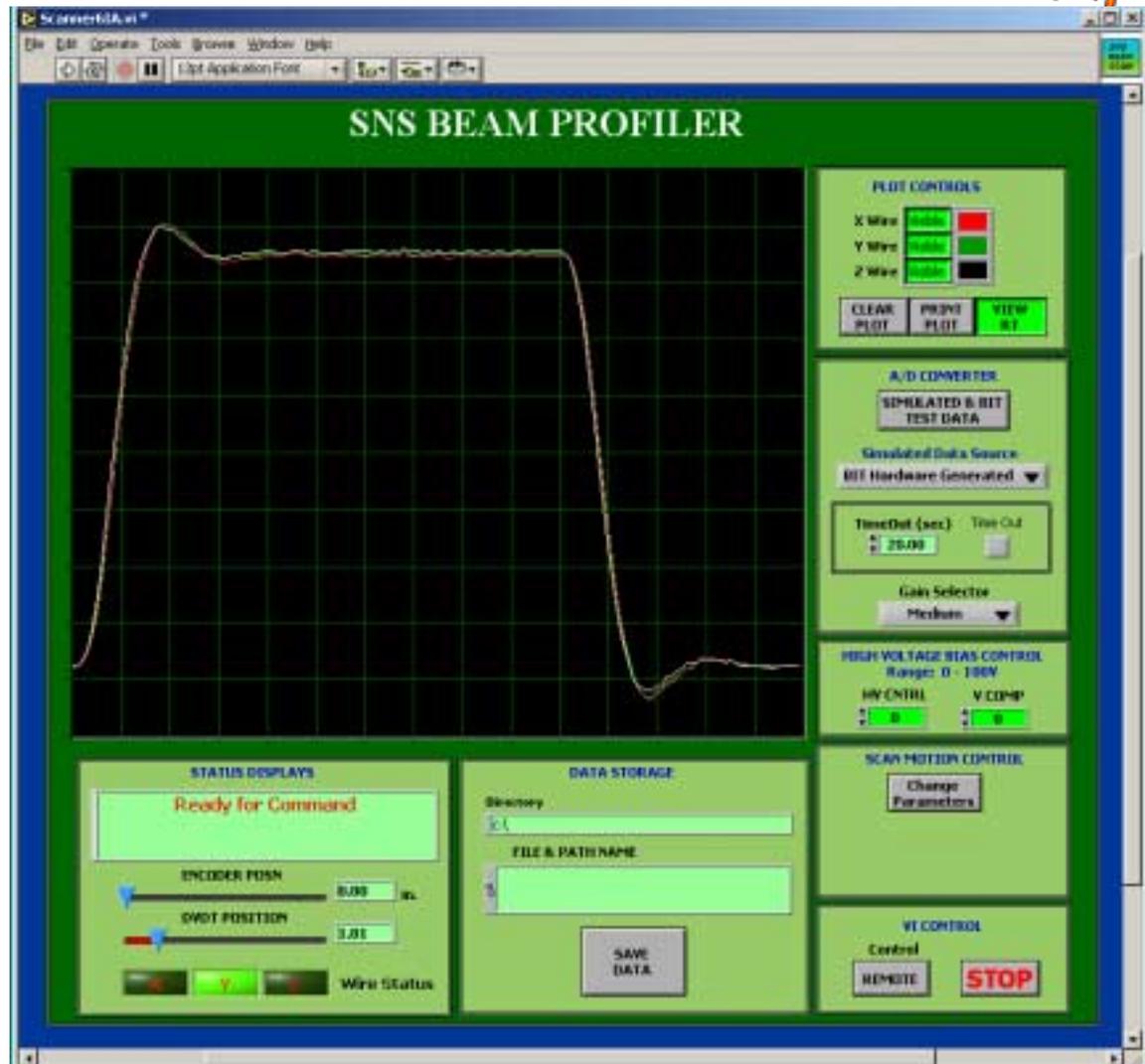


Prototype signal processor in 1U rack-mounted chassis.

Example of WS self-test



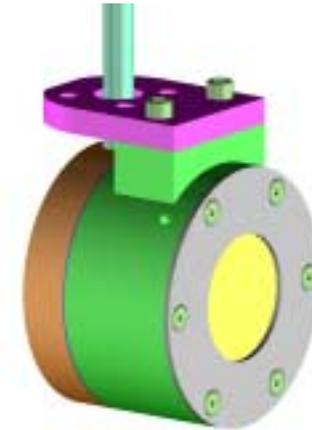
- 100 μ s pulse capacitively coupled into front end.
- Three separate channels are displayed.



Energy degrader / Faraday Cups



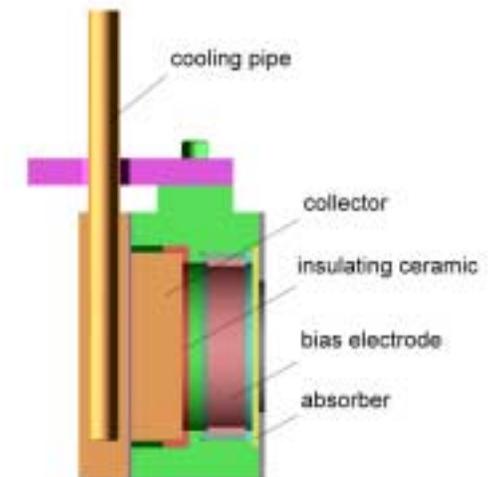
- Both energy degrader and Faraday Cup are mounted on single actuator.
- First 3 units use graphite energy degrader. Rest use copper.
- Thermal properties modeled with finite element code.
- Beam power limited to about $50 \mu\text{s}$, 1 Hz.
- Graphite insert in Faraday Cups for high peak temperatures in transient response.
- Final design is now in progress.



Integrated energy degrader and Faraday Cup



Graphite insert for Faraday Cups



Current monitors



- LANL is responsible for toroids only.
- In-vacuum DTL toroids have been ordered. Beam boxes and DTL tank endwalls are now in fab or out for bids.
- CCL and SCL outside vacuum toroid specification is in progress.
- Transition region vacuum break and housing have been designed.



DTL CM

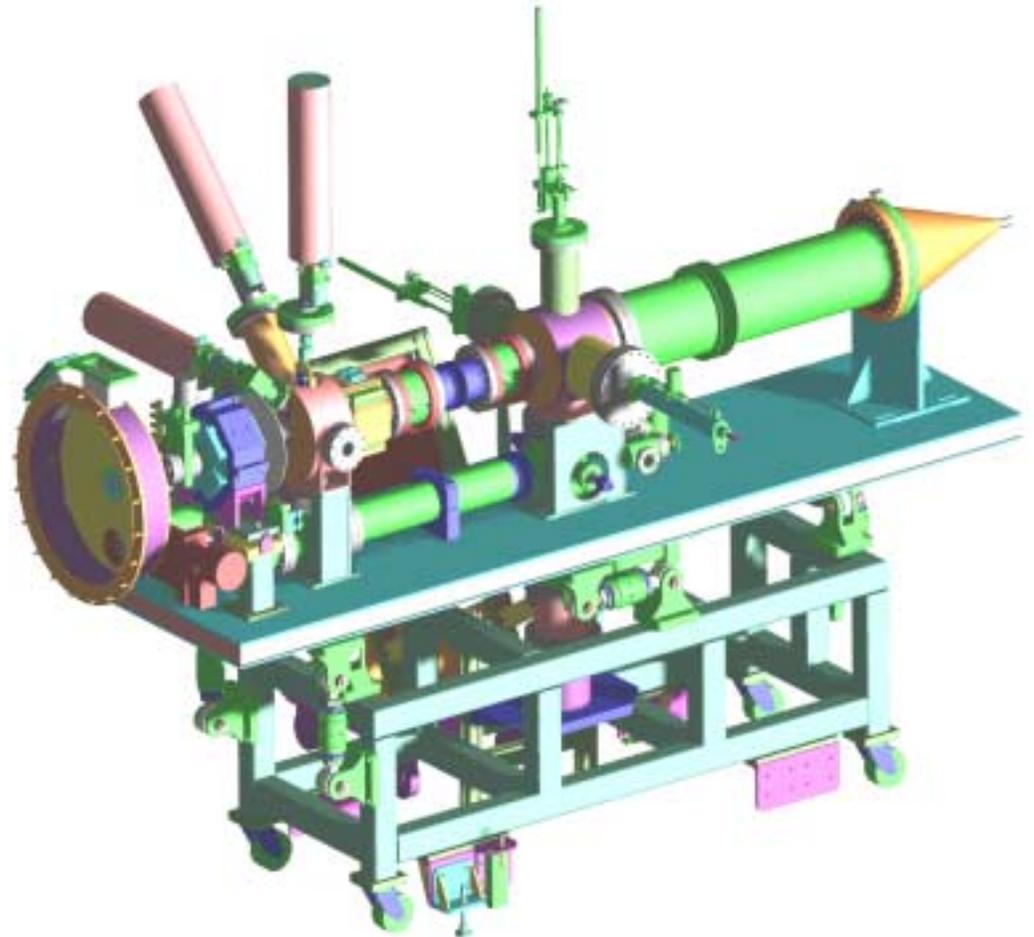


CCL / SCL CM

D-plate



- Used to commission linac up to 7.5 MeV (after DTL tank 1).
- Last chance to operate linac at full beam power.
- Final design is now in progress.



D-plate (7.5 MeV)

- 1 WS
- 3 BPM
- 1 CM
- 1 ED/FC
- 2 SI&Coll emit
- 1 Phosphor screen
- 1 8 seg. halo scraper
- 1 Beam stop / F-Cup

D-plate measurements



■ Full power (16 kW)

- ▶ Test and develop the front end systems (ion source, low energy beam transport, RFQ, medium energy beam transport (MEBT)).
- ▶ Measure DTL tank 1 transmission.
- ▶ Measure beam energy by time of flight (TOF).

■ Reduced power (10 Hz, 50 μ s pulse)

- ▶ Measure emittance with slit and collector method.
- ▶ Determine phase and amplitude set points of DTL tank 1.
- ▶ Measure wire scanner beam profiles.

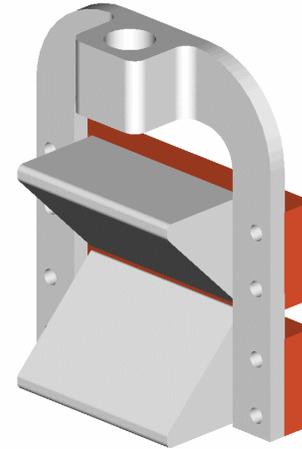
■ Low power

- ▶ Test permanently mounted diagnostics in the DTL beam box.
- ▶ Accommodate DTL beam aperture scans.
- ▶ Test DTL tank 1 beam steering magnets.
- ▶ Measure phosphor screen beam profile.

MEBT slit and collector



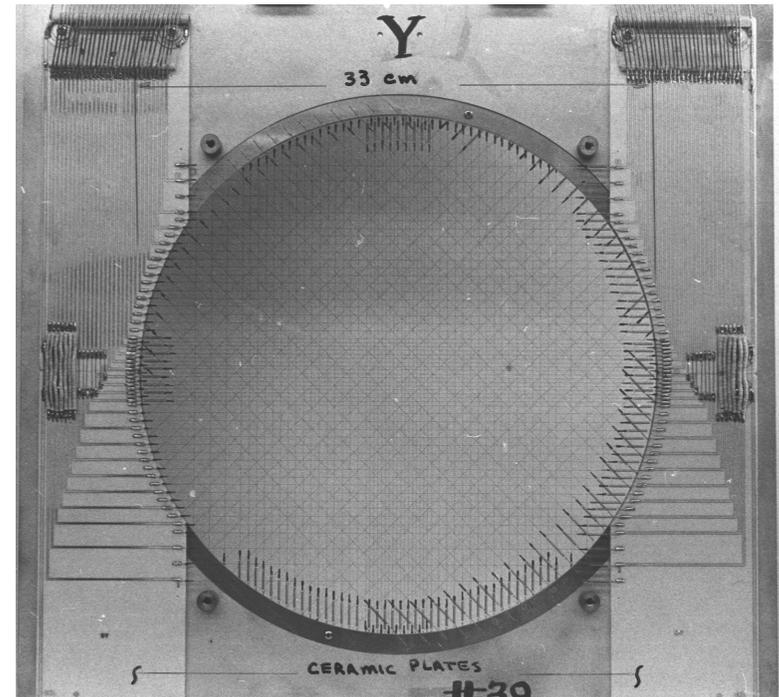
- LANL is responsible for delivery of actuators and the heads (slits and collectors).
- It is a challenge for these devices to withstand even $50 \mu\text{s}$, 1 Hz beam pulses.
- Slits will be made of graphite.
- The collector will likely be a clone of the LANSCE design.
- Design is on hold while beam box issues are being resolved.



RTBT harp



- Design is based on the LANSCE 13" harps.
- Ceramic printed circuit board, 4-mil SiC wires mounted with hooks and springs.
- Three signal planes to resolve x-y correlations.
- About 99 signal wires with various spacings and spans.
- Electronics will be off the shelf VME/CAMAC.
- ORNL will probably choose to add a couple more insertable harps a few meters upstream of the main (fixed) harp.



Design review status



System	PDR	FDR
BPM	27/Feb/01	DTL p/u 19/Sep/01 rest ~ Feb/02
Wire scanner	17/Jul/01	~ Feb/02
ED/FC	~ Jan/02	~ Mar/02
CM	BNL will arrange	
D-plate	18/Jul/01	~ Feb/02
Harp	~Fall/02	~Spring/03
MEBT slit & coll	on hold	

Handoff strategy



- Handoff strategy has been developed and documented.
- First units are developed and tested here at LANL.
- Rest of units are accepted at ORNL.
- M. Plum to move to ORNL for one year to complete handoff and to assist in linac commissioning.

Spallation Neutron Source
Acceptance Strategy

Page 1 of ___ WBS Number _____ C__ Top 40 Items ISS QA Level ___ (opt) Rev ___

Title: RFMpl base system

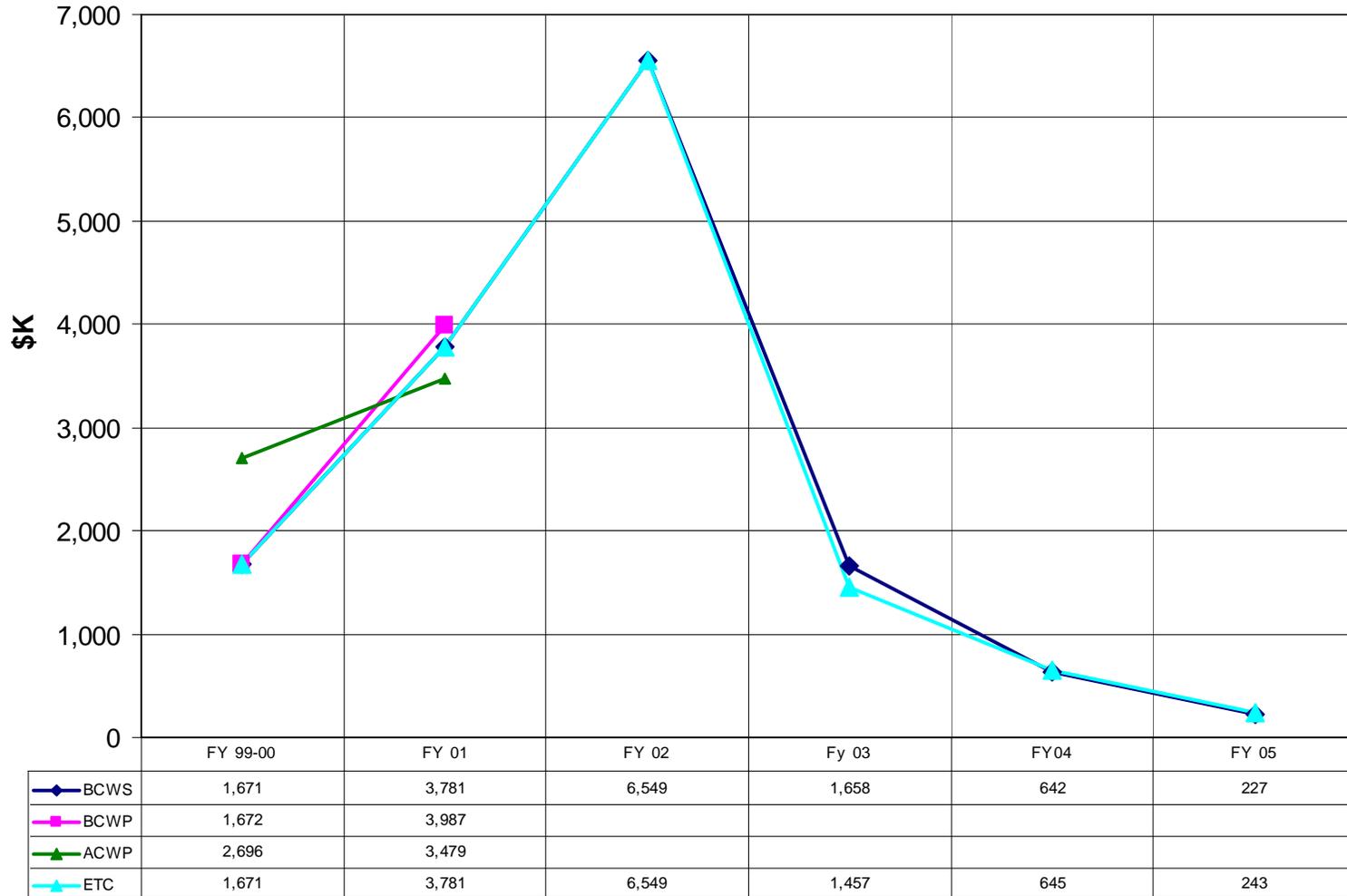
Description: _____

Originator: _____ Lab: _____

#	Function	Location	Responsibility	Verified by	Date
01	<p>Background information: The RFM system consists of four major components:</p> <ul style="list-style-type: none"> a) The beamline device (electrode assembly) b) Cabling c) Network attached device (NAD) consisting of a PC and associated recording hardware, analog and digital boards, link interface, power connection via SAGGIT O, auxiliary electronics (i.e. RF reference channel) and software (client driver, LabVIEW VIs, dll, stub for access interface, SGT software, gate array image, initialization files, etc) d) In-built floor interface: schematics, block diagrams, PCD/SCAD files, converted source code, gate array code, system configuration and initialization data, ICD, user manual, test procedures and software, troubleshooting guide, installation procedure, Test Report/ QA records (Transfer), turn-out-of-procedure, cable data, vendor-provided documentation. <p>Notes on responsibility: LANL has responsibility for the overall system design. Responsibility for the components is as follows:</p> <ul style="list-style-type: none"> • MEBT electrodes: LLNL • DTCCCL electrodes: LANL • SCL electrodes: LANL with additional help by JLab • WERT electrodes: SML • Cabling: MEDT/STL/COUHERT cables: LANL, RingWRT cables: SML • NADs, including LabVIEW VIs and client access software: MEDT/DTCCCL/COUHERT: LANL (includes support from LANL), RingWRT: SML • Cable plant testing and verification: ORNL • In-database order installation and preparation: ORNL • SAGGIT O and network cabling: ORNL • User interface software: ORNL • Documentation: The partner lab responsible for each component provides in-built documentation for that component. System documentation (user manual, cabling data, etc) is provided by LANL, as a test article and then maintained by ORNL in the project website and Oracle database. Cabling data including specifications, length, termination, and 				

FORM SNS-11 (9-98)

Diagnostics budget profile



What's next?



- **During FY'02 we will move from the design and prototype phase to the fabrication phase.**
- **FY'02 deliveries**
 - ▶ BPM and wire scanner electronics to LBL January 2002.
 - ▶ D-plate to ORNL summer 2002.
 - ▶ DTL BPM pickups Dec. 2001, summer 2002.
 - ▶ DTL-1 beam box WS and ED/FC summer 2002.
- **During FY'03 we will be working on delivering, installation, and testing.**
- **M. Plum to move to ORNL for diagnostics handoff and linac commissioning summer 2003 – summer 2004.**

Conclusions



- **We have a good working relationship with ORNL and the other partner labs.**
- **We have a well defined handoff strategy.**
- **The beam diagnostic instrumentation is either in the prototype or the final design stage.**
- **We are on schedule to deliver instrumentation that meets all requirements.**