

## Minutes of Meeting:

**Subject:** SNS Front End (FE)/Drift Tube Linac (DTL) commissioning workshop.  
**Date:** Thursday 28 September 2000  
**Place:** Los Alamos National Laboratory  
**Attending:** G. Dodson, R. Keller, K. Reece, D. Rej, R. Shafer, T. Shea, J. Staples, J. Stovall, M. White

### Summary:

A small group of senior members of the SNS collaboration met to begin the process of formally defining beam issues of commissioning the SNS accelerator facility. Detailed presentations were given by John Staples (FE/LBNL) and Jim Stovall (DTL/LANL) and in-depth discussion by all provided a very good start to this on-going task. The following will include some repetition in ideas/concepts; due in part to “enthusiasm” for a specific topic and also for clarity.

Actions items include issues agreed to for implementation, further required documentation of physics requirements, necessary operating parameters, operating responses of beam diagnostics, etc. In each case, names (within this small gathering) were assigned. In most cases, these minutes are listed in “line-item” format.

### Discussion:

John Staples presented a detailed series of slides providing his (LBNL) view of the necessary sequential steps required to measure, correct and define the beam properties at the entrance of the RFQ and the exit of the MEBT section.

*[John will provide the overheads presented to K. Reece for distribution]*

Will the steering elements in the MEBT section provide orthogonal control in both transverse dimensions? There are 14 quads in this section in 11 families. [J. Staples]

LBNL has a scrapper (thin foil) immediately after the first quad (after the RFQ) to “clean-up” halo (this has a 180 degree phase advance to the chopper target).

Since the MEBT quads are tightly packed, LBNL will provide the actual “effective lengths” and gradients for proper database entry. [Staples]

With the FE on three girders, will alignment be difficult?

[Editorial aside: after the visit to LEDA, is it practical to place the entire FE on tracks (TBD type) to facilitate “backing-up” the entire unit and operating into a beamstop while parts of the Linac are not yet ready to operate with beam? This “may” allow an insertable Faraday Cup (FC) at this location – Keller/Staples]

The FE Diagnostic Plate (DP) will be capable of measuring transverse beam emittance at full current BUT ONLY at low power (< 100us) [Staples]

With several possible commissioning modes including very little beam, the question arose as to whether the FE could provide ~ 10ns beam with nominal beam properties [Keller, staples will measure both short pulse and a few beam currents].

It was recognized by all that there is presently no adequate beamstop at the end of MEBT to permit complete FE operation without transferring the beam to the DTL. [Editorial aside: is it possible to allow for slightly more space between the end of MEBT and D the first STL tank AND preserve 6-dimensional phase-space? [Staples, Stovall].

There is a general and immediate need to define the generic algorithms necessary for commissioning from “day one”. It is (I believe) our collective responsibility to provide these requests to the physics group, controls group and diagnostics group in order to have our “tools” available (and tested) when first required. These should be considered by all and forwarded to K. Reece ASAP.

These algorithms include the above noted steering algorithms but must be flexible such that they may be used in areas where the correction is (or is not) orthogonal. Also, they may be from strictly a magnetic element point of view or also the integrated matrix one must include in the algorithm due to RF de-focusing in the accelerating RF structures. Other obvious algorithms are; 1) quadrupole steering and correction, 2) orbit measurement and correction, 3) phase/energy relationships and control, 4) also general “tools” to incorporate “on-line User defined code” into specific measurements, adjustments, etc. The controls group must be prepared to respond to these requests for “temporary application/algorithms”. [Reece, Stoval, Staples, Shea, Wei]

An important question from/for all was the accuracy of the beam diagnostics for the various operating modes during commissioning and operation. [SNS/ASD –Reece, Dodson, White will provide a list of proposed machine modes to help answer this question]

Phase-probes and BPM’s processed at the 2<sup>nd</sup> harmonic (805 MHz) to provide beam energy (both absolute and relative) information. Will the accuracy of these measurements be sufficient/ [Shea].

Both the LEBT chopper and MEBT chopper waveforms (and readbacks) will be included in the Machine Protection System (MPS). The controls system must be able to monitor, archive and compare these waveforms to indicate “standard” operating characteristics.

In general, are the expected measurements intended to be one sigma or include tail/halo quantification? [Note: the “entire beam” profile in each phase space view could be a combination of two separate measurements, then merged to provide a comprehensive view] Also, John’s TRACE 3-D code is done to 5-sigma.

Empirical data from the FE should be taken (at one-sigma and into the halo if possible) for the scalar emittance and Twiss parameters at a few beam currents (e.g. 52mA => 15mA). There is (generally believed) no reason to probe the FE operation in detail at lower peak currents.

It is expected (John) that the RFQ will have an efficiency of ~ 93% but will yet be an adequate transverse emittance filter for MEBT beam.

There was a question (which actually applies globally to most accelerator devices) concerning the reproducibility of the ion source (IS). Specifically, could this be done procedurally to document and re-establish beam parameters, (if so, at what level of accuracy)? [Keller]

Alignment workshops must become specific to ensure the magnetic and RF centerlines are as required by the physics codes. [All]

As part of Jim Stovall's presentation, the question came up as to how we agree to re-adjust the MEBT bunchers after transporting beam through DTL tank#1. Note: LBNL does have a procedure to set the buncher phases and amplitudes in MEBT.

An SNS/ORNL action item was to be certain to have an operations team (from Oak Ridge) at LBNL during the initial commissioning process. Included should be personnel from Dodson's group, Shea, Danalov, Martin ? (new SNS/ORNL FE coordinator), controls staff and LANL representation.

Since the FE will be fully commissioned at LBNL, what range of operating parameters is considered to be necessary and/or critical/ [Keller, Staples, White] These parameters will then be re-confirmed at ORNL.

A full power (~ 17kW @ 7 MeV) beam stop was recommended by Jim Stovall so the entire FE plus DTL tank#1 could be documented at operating setpoints. This should not be difficult to incorporate into the (earlier) proposed "moveable" beamstop to be used in the phased Linac commissioning (although at lower power corresponding to the energy increase) [Reece]

In the LANL Diagnostics Plate (DP), measurements to be taken include phase and amplitude of DTL tank#1 compared to a BPM phase pick-up and the tank phase reference. LANL could also replace the fast Faraday cup (FFC) in their DP with a slit and collector for an emittance measurement. [Stovall, Shafer]

There was significant interest in pursuing the option of (temporarily) replacing (or adding to the drive mechanisms) the ability to insert (low power and properly phased) apertures in MEBT to produce a "pencil beam" for continued DTL tank#1 commissioning (most notably, DTL tank#1 acceptance scan)

Re-statement of some action items:

- beam resolution, accuracy low and high power requirements required by LBNL and LANL to commission (=> hand-off to SNS/ORNL) [Keller, Staples, Stovall, Shafer].

- LBNL will provide the thermal stress analyses (with the present geometry only) being done at LBNL to Shea for consideration when designing the “MEBT collimators” for pencil beam work.

Please feel free to correct or add statements to this document. Rod was (his usual self) and quickly provided his perspective of the meeting. I have intentionally not included them in this first pass; they will be incorporated after I receive comments, etc. from the other attendees.

Finally, we all recognized both the urgency of continuing this formal process but our mutual near-term time limitations. It is hoped that we could all meet once again to finalize the FE/DTL tank#1 process sometime in November. This would quickly (immediately after the new year) be followed by more DTL discussions (same group, slightly expanded).