Summary Report Final Design Review
SNS LINAC
DTL Beam Position Monitor
10/19/01

Andrew Browman, LANSCE-DO and Michael Borden, LANSCE-2

1) As was discussed in the meeting, they might be well advised to devise some scheme such as a soft vacuum to enable the facility to operate if one of their BPM units develops a leak. (It also might not hurt to have such a capability for other items too!) *Browman*

LANSCE has an extensive retrofitted cryo-pumped "soft vacuum" system which pumps the sealing surfaces between the drift tubes and main RF tanks. And has also contracted with National Nuclear Corporation in the UK to license their technology of clay-epoxy leak sealing for water to air or water to vacuum leaks. This technique has been successfully used at ISIS and CERN. *Borden*

2) At least one entire BPM system really ought to be constructed (all the way to a position output on some computer system) so the dynamic range; linearity, stability, calibration and temperature dependence of the system can be documented using the standard wire techniques. If this is impossible, the total error budget (see Gilpatrick's efforts along these lines for suggestions) should be constructed to get a feel for the position sensitivity attainable. I suspect that the hoped for 100 microns may well be quite optimistic. It would be unfortunate, however, if at least a millimeter absolute could not be obtained, since my experience is that at or near this level the halos of the beam are affected. *Browman*

A walked-thru assembly checklist appears to be critical for proper assembly of these units. Cable location inside the BPM is particularly a concern during final welding. Final welding of stem parts may cause significant warping of the unit. Several tests should be conducted prior to committing to all of the drift tubes.*Borden*

3) The attenuation calculated between the enormous fields outside the drift tube and the modest fields in the BPM gap are quite impressive. I don't know exactly what this attenuation ratio depends on, but it might be appropriate to ensure that the system could handle, say, 10X the calculated 400 MHZ gap voltages without accuracy degradation in case the actual field shape outside the drift tube differs from the shape assumed in the calculations. *Browman*

4) Initially I was worried about the choice of polyethylene near the beam line due to its rather limited temperature range, however the presenters satisfied me that the operating temperature of the drift tubes was very modest so this should present no problems except, possibly, during beam spill conditions. I feel that long term deposition of a few tens of watts of beam power is probable, but not as much as 100 W. I would suggest that a quick calculation of the ΔT expected for about 10 W might be useful, although I expect that the calculation will show the effect is negligible. *Browman*

The BPM internal insulating components have been designed with radiation resistant materials. If beam tuning and spill limits are maintained these materials should last the lifetime of the facility. *Borden*

5) It was not clear to me how important the beam phase measurements were to this project. I fear that determining the absolute phase of the beam with long-term accuracy of 1-2° will be very difficult. If this is important, I suggest that the possibility of measuring the phase of the 400 MHz RF (using this apparatus-same cables, front end, etc.) be investigated, since it might well be more accurate to compare the relative phases of the RF and the beam using the same apparatus. One might also need to determine (at least roughly) the shape of the beam in order to achieve these accuracies. *Browman*

6) The BPM pickup seems rugged, conservatively designed and well thought out. *Browman*

7) The construction of these devices is quite complicated, but I see no reason why their performance should not be perfectly stable once they have been fabricated and tested. *Browman*

8) The team seems to me to have thought quite thoroughly about the problems of building these devices and I think they should go ahead and start construction and testing. I do see, however, that considerable work lies ahead after the BPMs are built before they can be integrated into a satisfactory system. *Browman*

9) Helium leak check the welded assemblies prior to water pressure testing. Water may freeze in small leaks during vacuum leak checking and pass a helium test. The helium leak test note on design drawings lists 10^{-3} Torr as being an acceptable vacuum. I would insist that this be at least 5×10^{-5} or 1×10^{-6} Torr gauged at the output of the BPM. *Borden*

10) Define how the water is going to be removed after pressure testing and consider anti-freezing the cooling passages prior to shipping. Trucks travel over mountain passes in winter, many-many accelerator components have been ruined by forgetting this step. *Borden*