Meeting Minutes

Linac Toroid Measurement Upgrade

Discussion of the Status and Signal Processing Requirements

North Linac, Bungalow Meeting Room
Thursday, October 27, 2011
10:00 am to 11:00 am

I.   In Attendance:

Mike Sliczniak,	AD/Controls Front End Programmer
William Marsh,	AD/Controls Application Programmer
Aisha Ibrahim,	AD/Instrumentation Design Engineer, Toroid Systems
Ning Liu,	AD/Instrumentation Design Engineer, Digitizer Module
Fernanda Garcia,	AD/Proton Source Linac/ Head
Craig Drennan,	AD/Proton Source Engineer

II.   Introduction

The meeting was called mainly to discuss the status of the hardware and software development. There was also an extended discussion of the signal processing, what is computed and what is delivered to the front-end.

The toroid data being request by the Linac is in 3 forms, for each channel.

1. One 16 bit beam intensity value (Particles per Pulse) which is computed from the sum of 1000 digitized toroid signal samples. The front-end processor will scale this value and sum it into the ever accumulating, 64 bit sum used by the Beam Budget Monitor application.

2. One 16 bit beam current value (Particles per Second) which is still being discussed as to how it is actually measured.

3. A full pulse beam current profile. This is either monitored with an ACNET type plotting function using the 1000 data points per channel, or it is an analog toroid signal teed off at the output of the Pre-amplifier and presented on an oscilloscope.

III.   Hardware and Software Status

- Starting at the toroids in the Linac beam line, Aisha stated that the work they are planning to do during the upcoming 2012 shutdown was to install the new toroids at the Momentum Dump and at the new RFQ front end source. There would also need to be some retermination of cables upstairs. Aisha mentioned that updating of the old toroid stands would likely need to be done sometime in the future, but stated that they had not planned on doing this during the 2012 shutdown.

- Aisha reported that the Preamplifier NIM modules were being assembled.

- Ning and Aisha reported that the Digitizers had been sent out to an assembly house to have the DC coupling, signal input circuits stuffed. The boards had been sent out approximately 2 weeks ago and that they are expected by in 1 or 2 weeks.

- There were no issues with rack space and crates.

- Mike Sliczniak stated that he had done a lot of work to speed up the front-end code and had been in consultation with Ning Liu. He stated that the data sampling scheme decided on was to sample at 80 MHz for 100 micro-seconds and then decimate the beam current profile data by a factor of 8 for delivery to the front-end processor. This would result in 1000 data points per channel delivered to the front-end. Mike believes that he can manage the full 1000 data points per channel with the front-end processor, in the crates where the toroid digitizers are being installed.

- Mike and William Marsh took some time before the meeting began to discuss the requirements of the Beam Budget Monitor Application. It was stated that the Linac Beam intensity value was a 16 bit number delivered from the Digitizer each beam cycle. Each intensity value is summed into a 64 bit accumulation value that is never expected to overflow, and is accessed by William's BBM application.

IV.   Signal Processing Discussion

- Craig Drennan reported that the Linac determined that it did not need a full current profile of 1000 data points, except in possibly one or two locations in the Linac. A temporary scope connection to the toroid signals would be enough. Aisha stated that the Pre-amplifier modules did not have buffered monitor outputs for a scope, and Ning confirmed that the Digitizer modules did not have DAC outputs. It is a question as to whether teeing off the Pre-amplifier output would provide and acceptable scope signal.

- Craig reported that, in place of the full 1000 point current profile, Linac would like a single, stable, low noise, calibrated current measurement from each toroid. This prompted much discussion on how to make this measurement. Aisha strongly advocated integrating the full signal and determining an average value for the beam current. This would provide a more stable value in the presence of noise. Fernanda Garcia pointed out the current Linac does have a noticeable rise time at the beginning of

the beam pulse. For short beam pulses, this slow rise would cause the "average" current to differ from the "steady state" or peak current value.

- A decision should be firmed up as to whether it is best to derive an average beam current, or make our best measurement of the steady state (flat-top) beam current. It is the steady state portion of the pulse that is delivered to the Booster, NTF and MTA.

- It was also noted that the length of the Linac pulse changes and that accumulating toroid signals beyond the time when there is no longer beam might also contribute error to the average current measurement.

- Craig Drennan proposed that start and stop integration trigger inputs be provided for allowing users to determine the best portion of the beam over which to measure the beam current. This proposal has not been accepted.

- Aisha Ibrahim said that she would write out her proposal for the signal processing so that Linac can understand it better.

- It still stands that the beam current signal will be sampled over the full 100 micro-second beam interval and summed and scaled into a 16 bit value, and delivered each cycle to the front-end processor to be summed into the Beam Budget monitor sum.

V.   Follow-up and References

Further meetings were not set at this time.

The meeting adjourned at 11:00 am.
Minute recorded by Craig Drennan