

# Preparing BNB for 20 Hz Operation

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Sometime this decade BNB will need to deliver beam at a rate of 20 Hz to keep up with the rest of the PIP-II-enabled accelerator complex of the future. This document describes what will need to change to facilitate transition from the current 15 Hz operation.

## The beamline

MBEX and the BNB horn are the only BNB devices that ramp at 15 Hz. All other devices are either run with DC power or are passive pickups.

### *MBEX*

MBEX, also known as B8511P, currently must ramp to its operational current, 1450 A, at 15 Hz to kick beam extracted from Booster to BNB. Its design current is 1600 A (per the MiniBooNE Switch Magnet Extraction Power Supply Controls Specification, published 2002). In the PIP-II era, the MBEX power supply will need to be replaced with one that runs DC.

Considerations were made to replace MBEX (an IDD type magnet) with permanent magnets, but the magnets needed are not available (two PDSs, two PDDs, or design a new permanent magnet), and there is likely not enough space in that part of the beamline to make this change.

### *The horn*

The BNB horn pulses at 15 Hz, which is controlled by the horn power supplies at the MI-12 Service Building. These power supplies will need to be replaced or upgraded along with the hardware that controls them.

## Data acquisition

BNB devices that must be read at 15 Hz include the horn stripline, toroids, multiwires, beam position monitors and beam loss monitors.

During the 20 Hz test conducted on September 16, 2020, the ACNET program, “Lumberjack”, was able to plot noise data from toroids and multiwires without missing points (there was no beam to monitor). Beam position monitors do not read noise when there is no beam, so there was no signal collected from them, as expected.

Lumberjack seemed to have about an 8-minute delay in reporting the beam loss monitor parameters. Controls experts note that this latency comes from the IRM’s (IRM641) CPU being interrupted by the next \$1D too soon after the \$0C + 49 mS delay triggered the reading (with only 1 mS to process). The IRM’s start trigger will have to be changed by controls experts for the next 20 Hz test.

For the record, the loss monitor parameters (E:LMxxx) and the TLI parameters (E:TLIxxx) arm on the \$1D and trigger after delays of 43 mS and 48 mS, respectively.

The BNB horn stripline pulses at 15 Hz, and the parameters (E:SLINEx) successfully read back with a 40 mS delay from the \$0C.

## Further investigation

Additional questions regarding 20 Hz operation:

The longest we can expect the IRM front ends processing the BPM (?) data to wait after data collection is 80 mS. This implies that we would skip every other 15 Hz event if we were to look at this data in real time, but we collect all of the expected data, according to Lumberjack. How does the request queue work? It seems like this would result in a runaway situation.

What are the timing parameters on E25 <8> BPM BLM and how are they used, if at all? What about E25 <10> DET\_M12?

Do the toroid timing parameters need to be changed for 20 Hz operation? How are those set? Are there any hardware changes that need to be made?

BNB is reportedly receiving new front ends for processing BPM data. Will the new hardware work with 20 Hz operation?