

PIP II Straight Ahead Dump Requirements and Specifications

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The PIP II straight ahead dump is going to be located at the end of PIP II Linac and its purpose is to stop the beam used for Linac tuning. During commissioning the dump will be used for stopping the Linac beam at intermediate energies: 32 MeV and 177 MeV. Phase tuning of SRF Linac cavities initially requires transporting a 2 MeV beam with reduced intensity from the RFQ to the dump. As SRF cavities sequentially are energized and tuned, the beam energy on the dump gradually will increase from 2 MeV to the desired energy. The maximum expected beam duty factor on this Dump is 0.055%. It assumes 0.55 msec pulses with a repetition rate of 1 Hz. Shorter pulses can be used to tune the beam dynamics in the Linac at a higher repetition rate. The minimum Linac energy that satisfies the KPPs is 600 MeV while the optimum energy is 800 MeV. The 1,000 MeV energy is considered an upgrade.

The Straight Ahead Beam Dump requirements are outlined in the Table below:

Energy (MeV)	Max. Peak Current(mA)	Max. Pulse Length at maximum peak current	Peak Power (KW)	Average Power (KW)
2	2	100	4	0.01
32	2	550	64	0.04
177	2	550	354	0.19
800	2	550	1600	0.9
1000	2	550	2000	1.13

In order to meet the above requirements with a safety margin, the Beam Dump design requirements are specified to accommodate an average Beam Power of 2 KW.

Operating scenario: *Being able to abort 2KW of Linac Beam for 4 hrs. Here the Linac energy is assumed to be 1000 MeV.*

Exposure during beam Commissioning: During commissioning the exposure at each of the intermediate energies is expected to be $2.0E18$ H- over a period of 40 days.

Total beam exposure: *We assume 4 hrs of Linac beam studies per week and 42 weeks of beam running per year for a total exposure of $4.2E18$ H-/year.*

Replaceability: *We would like the ability to replace the Beam Line Dump. This should be incorporated in the design from the beginning. The use of rails for Beam Dump installation and replacement is considered.*

Lifetime: *At this time a design lifetime of 10 years seems adequate. It is anticipated that the PIP II Linac will be upgraded to an energy higher than 1 GeV so the Straight Ahead dump will have to be replaced.*

Diagnostics and Instrumentation: *The temperature of the Beam Dump will be monitored by thermocouples incorporated in the Dump. The beam to the Dump will be monitored with a beam toroid. Wire scanners will be used to measure the beam size before the Dump.*

Interlock/MPS: *The beam in the beam toroid will be integrated and will be part of the beam safety envelope preventing beam to be aborted after exceeding a yearly limit.*

Beam Window: *A beam window will be required at the end of the Linac to isolate the beam vacuum from the Beam Dump. The beam window should be designed to withstand the continuous abort of the beam for 4 hrs. The beam size at the window is expected to have a sigma of 2.5mm. The total number of aborted pulses per year is 604,800.*