SNS Credited Pulse Energy Limit System Conceptual Design*

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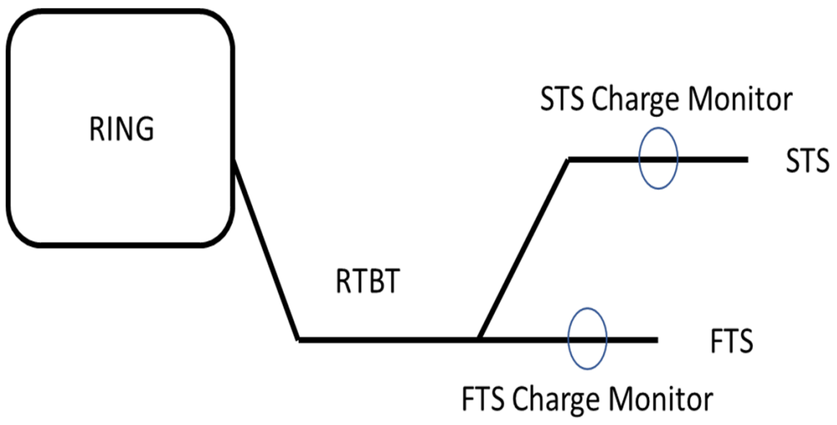
Abstract

The Controls Group at the Spallation Neutron Source (SNS) is designing a programmable signal processor based credited safety control that calculates pulsed beam energy based on beam kinetic energy and charge. The SNS Pulsed Energy Limit System (SPELS) must reliably shut off the beam if the average power exceeds 2.145 MW averaged over 60 seconds. This paper will cover the architecture and design choices needed to develop the system under the auspices of a programmable radiation-safety credit control. The authors will also introduce the concept of a graded failure approach that allows the credited system to continue operation in the presence of some faults.



$$P = R_{rate} E_b \int_{t_o}^{t_o+w} I(t)dt$$

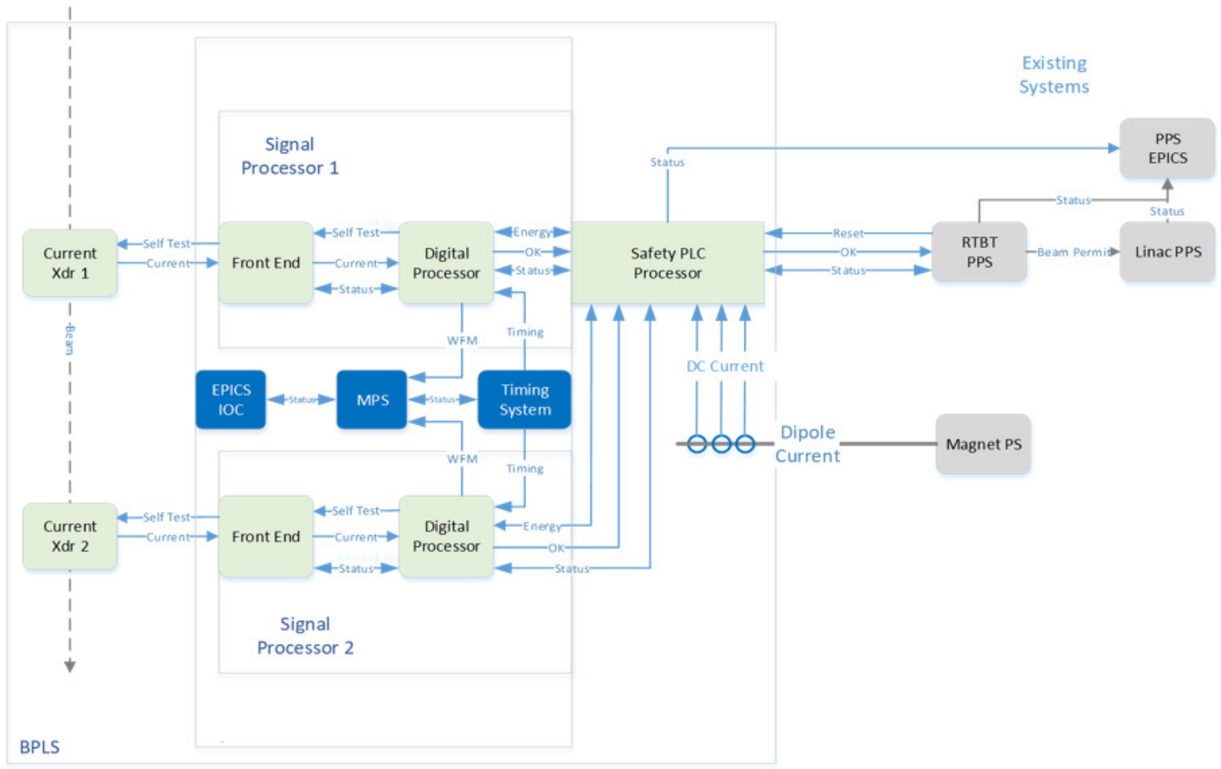
- PPU upgrade allows beam out of the ring at an average power of 2.8 MW
- Measure dipole current at FTS or STS beamlines to extract beam energy
- R_{rate} is known and is fixed.
- Use a fast-current transformer to measure the beam current $I(t)$.
- PPS power limit on FTS is 2.145 MW averaged over 60 sec.

PPU Beam Target Parameters

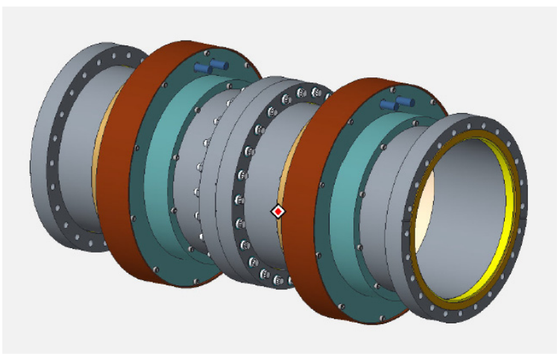
Nominal Current Pulse Width	$1.1 \pm 0.4\ \mu sec$
Nominal Rep Rate	60 Hz
Peak Current	100 A
Single Minipulse Current	38 mA
Bandwidth	$\leq 22\ MHz$

Fast CT Parameters

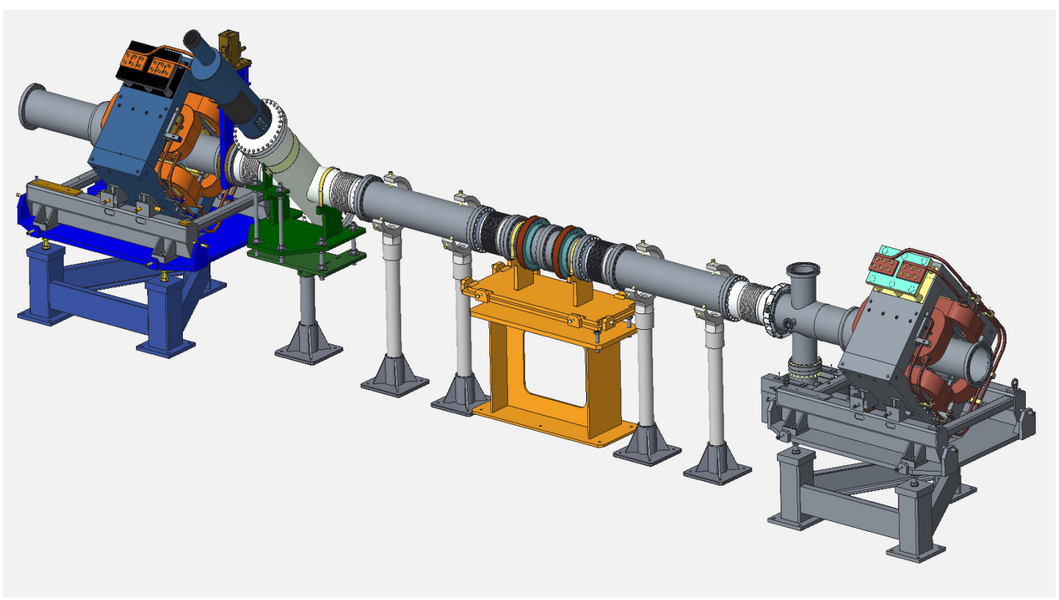
Applicable Frequency Range Main Winding	1 kHz – 22 MHz
Applicable Frequency Range Cal Winding	1 kHz – 16 MHz
Main Winding Magnitude Flatness	±0.5 dB
Cal winding Magnitude Flatness	±0.5 dB
Main Winding Phase Flatness	±10 degrees
Cal Winding Phase Flatness	±10 degrees
Peak Current	150 A
Transfer Impedance	0.25 V/A
Calibration – Main Winding Turns Ratio	1:1
Connectors	Type N
Isolation	Connectors are galvanically isolated from beamline
Cal and Main Winding Impedance	50±1 Ω
Shielding of CT assembly to outputs of CT	≥ -80 dB to 100 MHz
Droop	≥1±0.1 msec (≤0.1±0.01%/msec)



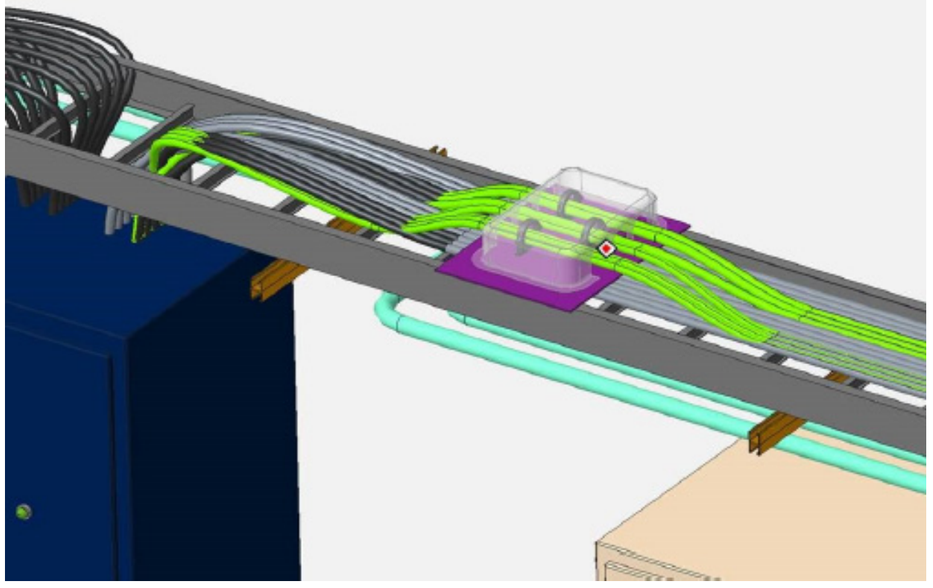
Beam Power Limiting System Block Diagram



Fast Current Transformers 1oo2



Beam Power Limiting System Beamline Devices



DCCT Dipole Magnet Measurement 2oo3

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