

# MACHINE PROTECTION SYSTEM FOR TRIUMF'S ARIEL FACILITY

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## Abstract

Phase 1 of the Advanced Rare Isotope & Electron Linac (ARIEL) facility at TRIUMF is scheduled for completion in 2014. It will utilize an electron linear accelerator (eLinac) capable of currents up to 10mA and energy up to 75MeV. The eLinac will provide CW as well as pulsed beams with durations as short as 10uS. A Machine Protection System (MPS) will protect the accelerator and the associated beamline equipment from the nominal 500kW beam.

Hazardous situations require the beam to be extinguished at the electron gun within 10uS of detection. Beam loss accounting is an additional requirement of the MPS. The MPS consists of an FPGA based controller module, Beam Loss Monitor VME modules developed by JLAB, and EPICS -based controls to establish and enforce beam operating modes. This paper describes the design, architecture, and implementation of the MPS.

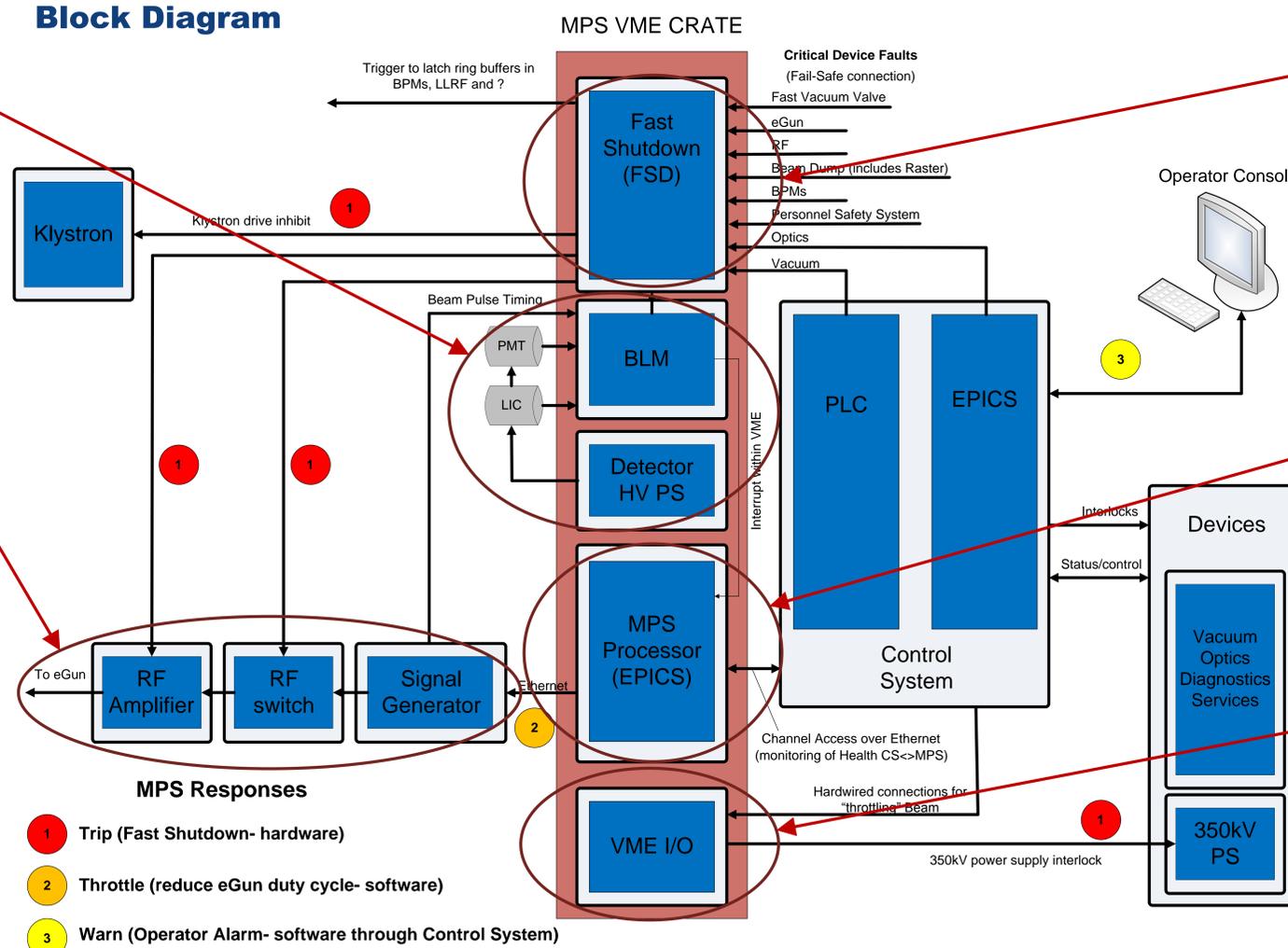
## Detector System

- Beam Loss Monitor Module (from Jlab)
- Photomultiplier Tubes
- Long Ion Chambers
- HV Power supplies

## MPS Controlled Devices

The eGun is the only device capable of meeting the 10uSec requirement of extinguishing the beam. This is accomplished by removing the RF. Tripping the RF Amplifier and blocking the 650MHz signal provides the redundancy. In addition the Klystron RF drive is removed.

## Block Diagram



- MPS Responses**
- 1 Trip (Fast Shutdown- hardware)
  - 2 Throttle (reduce eGun duty cycle- software)
  - 3 Warn (Operator Alarm- software through Control System)

## Fast Shutdown

Purpose built Module (FPGA based) provides <10uSec trip signal based on beam loss detectors and subsystem faults

## Control System Interface

VME based processor using EPICS Channel Access provides communication to the Control System for Operation Mode selection

A hard wired link provides a Fail Safe connection for the Control System to signal device problems and for the MPS to detect Control System issues

## eLinac Layout



## Responses and their associated Time Limits

Beam Loss Thresholds	Responses	Response Times
Catastrophic Beam Loss	1 Trip Fast Shutdown	10 uSecs
Beam Loss Too High	2 Throttle Reduce eGun duty cycle	<1 sec >100mSec
Chronic Beam Loss (Tolerable)	3 Warn Operator Alarm	>1Sec

↑ Increasing Beam Loss