NLC MPS Baseline Status Review

MPS Working Group

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MPS Requirements

Must protect equipment from beam related damage
- React to single pulse induced failures (SPIF)
- Enforce maximum allowable inter-pulse difference parameters (MAID)
- Enforce AVG-MPS parameters

Must be reliable and fail-safe
- provide fast shutoff path to beam delivery system
- add redundancy to critical protection paths: fast shutoff and radiation detection.

Must limit machine down time to a minimum
- automatically recover from SPIF, MAID, and AVG-MPS trips
- request and enforce non-SPIF generating diagnostic bunches; single bunch, low rep rate and ramp to full rep rate.

Must be easy to use
- provide user controls, displays and event logging
The MPS system consists of:

- Control System Software
- Data Acquisition System
- Control System Communications Network
- Algorithm Processors
- Radiation Detection System
- Temperature Detection System
- Fast Beam Abort System
- Latching Digital Input Modules
- Smart Analog Modules
- Sensors (radiation, temperature, water flow)
Functional Diagram

**Sequencer**

- SPIF IN
- MAID IN
- AVG_MPS IN

- Process

- Broadcast System
- Verification System

- Aborts
- Enlarger

- Hard Abort System
- Beam Permits

**User Interface**

- Displays
- Controls
- Logs

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Progress since last review

Work Breakdown Structure
- identified key system components
- generic component catalog sheets in progress
- materials and labor cost estimates in progress

R&D
- identified initial controls software R&D recurring and non-recurring tasks
- radiation detector evaluation in progress
- identified revisions to PIC module to conform to NLC requirements
- investigating PLC technologies for use with MPS

Group meetings
- weekly meeting to discuss design issues
Proposed NLC MPS R&D Projects

Radiation Detection
- PLIC electronics - design modular PLIC system
- PIC Module - redesign with faster, smaller more reliable circuit components. Reduce the number of available function to those that are actually used
- BLM ion chamber - evaluate Fermilab BLM design used in the Tevatron
- Semiconductor diodes - feasibility study for use in radiation environments

MPS Fast Abort System
- Use APS MPS modules as basis for the SPIF abort system?
- Provide hardware go/no go summaries for gun control using optical fiber
- How to add weighting to inputs spread over a large physical area
- How to integrate this data with MPS event reporting
- What are the physical layout demands on this system
- How to control actual Gun permissive and/or Master Pattern Generator
- Feasibility study to share Fast Abort System with BCS and PPS
- Determine design parameters for fast shutoff (current loop, clock loop, etc.)
Proposed NLC MPS R&D Projects (cont.)

MPS Data Acquisition Systems
- Decision to use COTS PLC solutions versus a custom system to collect data from local devices.
- CANbus - A/B Data highway - Modbus/Modbus plus - MIL-1553B - other?
- What computing system should be used to gather local summaries
- How much processing can be done locally and how much must be passed up for further processing
- What systems can be used in common with BCS/PPS

Porting SLC newMPS to EPICS
- Current SLC newMPS uses pSOS and custom SLAC code to operate
- Modify this code to run under VxWorks to simplify maintenance issues
- Use EPICS IOC tools for control signals event reporting and error logging
- Port SLC newMPS VMS applications to EPICS type applications
NLC System Specification

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Assumptions

- pSOS will be the real time operating system (for costing)
- SLC will be used as the control system (for costing)
- VME and CAMAC systems used for data inputs (for costing)
- 10 Mbit Ethernet will be used as the primary network interface
- MIL-1553B will be used as the local data acquisition network

Performance

- The Single Pulse Induced Failure (SPIF) system shall detect input faults and remove beam permits as late as 100μS before a potential beam is extracted from the damping ring.
- The Maximum Allowable Interpulse Difference (MAID) system shall gather data immediately after a beam crossing and prepare an output to either allow or inhibit the next beam extraction from the damping ring.
- The Average MPS system shall gather data immediately after a beam crossing and prepare an output to either allow or inhibit the next beam extraction from the damping ring. This gathered data might consist of information gathered on previous beam crossings.
- The MPS Algorithm Processors shall detect actual and hidden trips at the maximum beam rate but this information will be summarized and displayed in a limited manner to keep network usage down.
- The MPS Algorithm Processors shall process errors in real time but gather and meter the reports to keep network usage down.

Reliability

- The MPS system is to protect the machine itself so the cost of making MPS more reliable through redundancy or other measures shall not be more than the cost of the machine it is trying to protect.
- MPS is not fault tolerant since any fault is a problem and must cause a trip. MPS is fault intolerant and shall always completely shutdown machine actions when any MPS system function is compromised.

Operating Systems

- The current system uses pSOS for the Real Time Operating System (RTOS) and relies on a development environment residing on the VMS based central host.
- If the Control System Architecture dictates the use of EPICS, then MPS should migrate to VxWorks as the RTOS and UNIX/NT as the development/operational environment.

Computing Platforms

- The SLC system is based on the Motorola MVME167 VME based Single Board Computer. This is also a standard SBC for the EPICS system.
- The MPS system software should be as portable as possible to allow a move to more advanced SBCs as they become available.
- Programmable Logic Controllers could play a role in the NLC MPS system.

Built In Diagnostics

- The MPS system will have diagnostics built into the system to aid quick diagnostics.
- Automated end to end trip verification will be built into the system to allow the system to perform self-checks in the background to alert users to potential and real problems.
- The MPS systems will be designed to tolerate the physical and Electra-magnetic environment of the NLC.