

# NSLS-II BEAMLINE EQUIPMENT PROTECTION SYSTEM

TUPHA095



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**Abstract:** The National Synchrotron Light Source II (NSLS-II) beamline Equipment Protection System (EPS) delivers a general solution for dealing with various beamline components and requirements. All IOs are monitored and controlled by Allen Bradley PLC. EPICS application and CSS panels provide high level monitoring and control.

## INTRODUCTION

NSLS-II is a state-of-the-art 3 GeV electron storage ring. The facility is designed to accommodate approximately 60 to 70 beamlines when fully built out. Currently around twenty beamlines are in operation and six are under development. The primary purpose of the beamline Equipment Protection System (EPS) is to protect the individual beamline components against x-ray damage, loss of vacuum, loss of coolant flow (water and liquid nitrogen), and elevated temperatures.

## NSLS-II BEAMLINE EPS DEVICES

NSLS-II beamline EPS monitors and interlocks the devices in the front end and the beamline. These devices include photon shutters, masks, slits, vacuum gauges, vacuum pumps, vacuum isolation valves, temperature sensors, water flow sensors, leak detectors, cryocooler valves, smoke detectors, and so on.

## NSLS-II BEAMLINE EPS HARDWARE DESIGN

The beamline EPS hardware is based on a Programmable Logic Controller (PLC). Each beamline at NSLS-II is designed to have its own EPS system which consists of only one PLC.

The EPS I/O signals can be divided into two categories based on their location and signal type. The EPS hardware is designed with these two categories of signals in mind.

### Intelligent Chassis

Each beamline has only one PLC, e.g. one controller, which resides in the intelligent chassis.



Figure 1. Intelligent Chassis Front/Rear Panel and Module Layout

### Vacuum Interlock Chassis

Additional vacuum interlock chassis are installed in vacuum controller racks, where needed.



Figure 2. Vacuum Interlock Chassis Front/Rear Panel and Module Layout

### Remote I/O Box

Remote I/O box solution is adopted for I/O signals distributed along beamline.

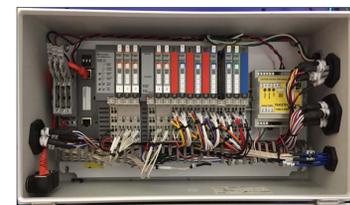


Figure 3. EPS remote I/O box module layout

### ArmorBlock

The 1732E ArmorBlock modules are mounted locally in the case of limited space and I/O signals.



Figure 4. 1732E ArmorBlock modules

## NSLS-II BEAMLINE EPS SOFTWARE DEVELOPMENT

NSLS-II beamline EPS software development can be divided into three aspects: PLC programming, EPICS IOC (Input/Output Controller) development, and OPI (Operator Interface) development.

### PLC Programming

The beamline EPS PLC is programmed with RSLogix 5000 version 20.01 to take protective actions in the case of detection of unfavourable conditions in the beamline. The 1768-L43 controller supports up to 16 tasks. In our case, two tasks run on the EPS PLC, continuous task (around 100Hz) and periodic task (5 Hz). The continuous task contains PPS logic, vacuum logic, and other time critical logic. The periodic task includes temperature, water, network and other routines where fast response time is not as critical.

### EPICS IOC Development

The NSLS-II EPS softioc runs on EPICS base 3.14.12.3 and shares the same host as other softioc. It is built based on EtherIP support which interfaces with AB ControlLogix 5000 PLCs via Ethernet. Besides that, it also contains autosave, iocstats, caputlog as these are defined in the NSLS-II beamline control standard IOC configuration.

### OPI Development

Control and monitoring of the PLC is available through the CSS OPI screens. The important EPS parameters/status are archived in EPICS Archiver Appliance.

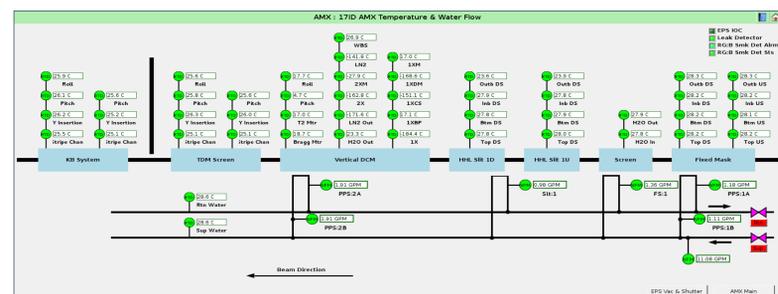


Figure 5. NSLS-II beamline EPS OPI example: AMX temperature and flow screen

## NSLS-II BEAMLINE EPS TESTS

Several types of tests are done on the beamline EPS system. Once the intelligent chassis and vacuum interlock chassis are received from the manufacturer, all chassis are checked prior to the installation in the rack to verify the proper wiring. After all of the field wiring is completed, the PLC logic program and GUIs are tested with customized dummy loads and simulators. The final test with the completed beamline is carried out before beam commissioning to make sure the hardware and software work properly.

## SUMMARY

The NSLS-II beamline EPS provides a robust, reliable and extensible solution for various beamline requirements. The two independent networks assure reliable status and control of hardware on a beamline. The remote I/O box and ArmorBlock provides an easy way for future expansion. The user friendly CSS GUIs provides detailed information to beamline scientists and users.