Distributed Phoebus Alarm System for the Electron-Ion Collider's Detection of Internally Reflected Cerenkov-Light Detector

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This note presents the test results that verify the distributed Phoebus alarm system (hardware and software) of the Electron-Ion Collider's Detection of Internally Reflected Cerenkov-Light (EIC DIRC) detector's laser interlock system is working correctly.

The Phoebus alarm system will be set up as a distributed system—EPICS client, EPICS softIOC, and user interface executing on their own Linux systems and communicating with each other via Ethernet.

The laser interlock system's schematic, Fig. 1, shows that status signals from the interlock PCB within the laser interlock enclosure [1] are monitored by the National Instruments cRIO, configured as an EPICS client (Linux system #1). The cRIO broadcasts the status signals as EPICS process variables (PVs) via Ethernet using EPICS channel access (CA).

An EPICS softIOC server (Linux system #2) receives the

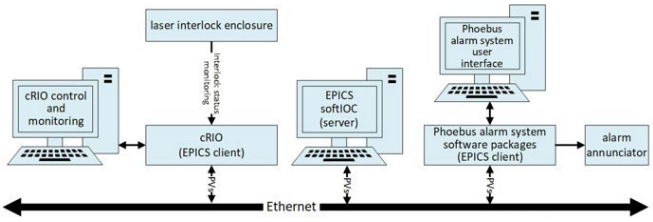

FIG. 1. EIC DIRC Phoebus alarm system test setup.

PVs from the cRIO and makes them available for monitoring on the network.

The Phoebus alarm software packages and user interface (Linux system #3) on the network monitor the PVs for alarm conditions.

The difference between the final version of the system and the version of the system for software development, testing, and debugging [2, 3, 4] is that a laser interlock signal simulator, specifically developed for the test, substitutes for the cRIO and the laser interlock enclosure because these units are not ready.

Figure 2 shows that the signal simulator executes as an EPICS client on Linux system #1. The simulator writes to the PV value field VAL in the PVs hosted by the softIOC EPICS user interface's server, Linux system #2. In addition to hosting the PVs, the softIOC stores the alarm limits and compares the status values provided by the simulator with the alarm limits and generates appropriate alarm field notices—if the simulated status value equals or exceeds the alarm limits, the notices for the alarm status and alarm severity are HIHI, HIGH, LOW, LOLO and major, minor, respectively, Fig. 3. The software packages in Linux system # 3 monitor the PVs for these alarm condition notices and if a PV is in an alarm state, the value is latched and the alarm time is recorded. The alarm is broadcast to the user interface and the annunciator [5]. The operations flowchart is shown in Fig. 3.

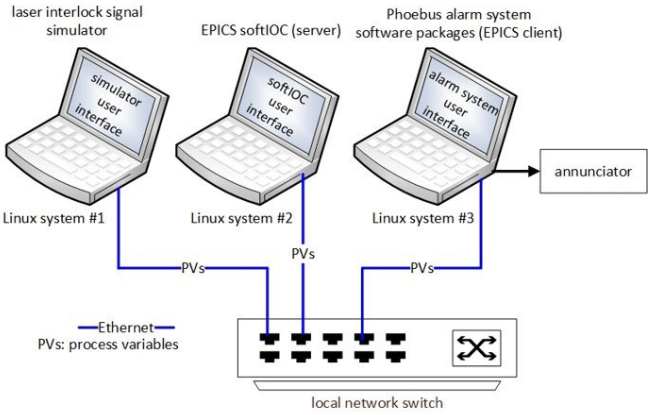

FIG. 2. EIC DIRC Phoebus alarm distributed system.

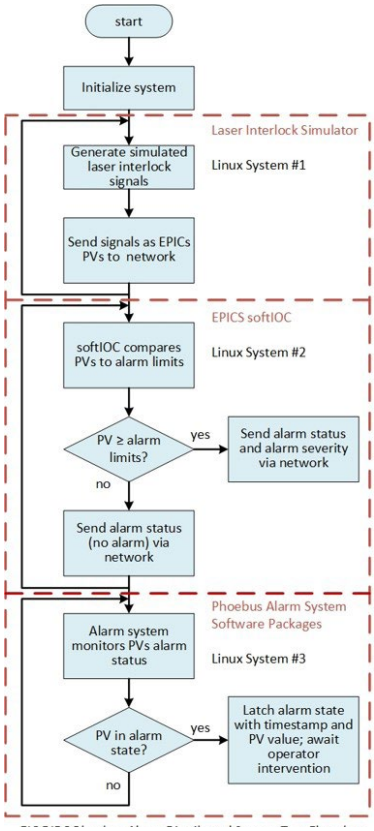

FIG. 3. Flowchart showing the sequence of operation.

To conclude, Fig. 4 shows a screenshot of the test result, which indicates the developed system is executing as designed.

FIG. 4. Screenshot of EPICS SoftIOC user interface showing the laser interlock status PV values greater than HIHI set value resulting in alarm status HIHI and alarm severity MAJOR.

[1] T. Lemon, et al., *Design and Features of the EIC DIRC Laser Lab's Laser Interlock System*, DSG Note 2023-01, 2023.

[2] P. Bonneau, et al. *Signal Simulator for Developing and Testing Phoebus Alarm System Software Packages for the Interlocks of the EIC DIRC Quartz Bar Laser Testing Lab*, DSG Note 2023-56, 2023.

[3] P. Bonneau, et al. *Development and Implementation of the Phoebus Alarm System Software Packages for the Laser Interlock System*, DSG Note 2023-49, 2023.

[4] P. Bonneau, et al. *Development of the CS-Studio Phoebus Alarm System for the EIC DIRC Laser Interlocks*, DSG Note 2023-43, 2023.

[5] P. Bonneau, et al. *Testing of the CS-Studio Phoebus Applications and Alarm System Core Programs*, DSG Note 2023-06, 2023.