EPICS Monitoring for RICH Aerogel Storage Dry Boxes

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Since remote monitoring with EPICS is ubiquitous at Jefferson Lab, an EPICS client was added to the cRIO monitoring system, which monitors the three dry boxes in which 43 Aerogel tiles for the RICH detector are stored. This note provides an overview of the setup.

The 43 aerogel tiles on-hand at Jefferson Lab for the RICH detector are kept in dry boxes manufactured by XDry, Fig. 1. These boxes provide a low-humidity (~5% RH) environment. The internal environment (humidity and temperature) of the boxes is measured by humidity sensors and RTDs. These instrumentation are monitored, locally and remotely, by a cRIO-based monitoring system [1] installed in the boxes' location. The boxes' drying units are controlled by built-in controllers.

FIG. 1. Three XDry dry boxes containing 43 aerogel tiles. The cRIO used for monitoring is on top of the left-most dry box.

The three dry boxes are connected to an uninterruptable power supply (UPS), which would provide limited runtime for the boxes if power was to be lost. The runtime depends on whether the boxes' drying elements are running and varies from ~60 minutes with no drying elements running, down to ~20 minutes with all three drying elements running.

If for any reason the dry boxes lose power, upon repowering they return to the humidity and temperature settings they had prior to the power outage. This capability was verified by disconnecting each box from the UPS and observing that when power was restored, the settings returned to their set points.

An Experimental Physics and Industrial Control System (EPICS) client was developed to run on the cRIO for remote monitoring by EPICS—a ubiquitous monitoring system at Jefferson Lab. The cRIO acquires temperature and humidity data for each dry box at 1 Hz frequency and calculates a one-minute moving average of the 60 most recent data points. The EPICS client publishes that average to an EPICS input-output controller (IOC) hosted on a Hall B PC in the Experimental Equipment Lab (EEL). This IOC enables data transmission from the cRIO's EPICS client to be accessible by the Accelerator and Hall B subnets.

To facilitate monitoring of the data from the cRIO, two user interfaces were made—one in Control Systems Studio (CSS) and one in Web Extensible Display Manager (WEDM). Both interfaces use EPICS' channel access protocol to read cRIO data over the network and display that data on a GUI.

The CSS GUI, Fig. 2, has been added to Hall B's CSS controls and monitoring suite clascss, which is used by staff and users to monitor and control detector systems in Hall B. As an additional method to use this CSS screen, the main overview for RICH was modified to include a menu option to the dry box screen under the hardware interlocks menu, Fig. 3. To access the CSS screen, users must log in to a Hall B server through Accelerator's network security firewall.
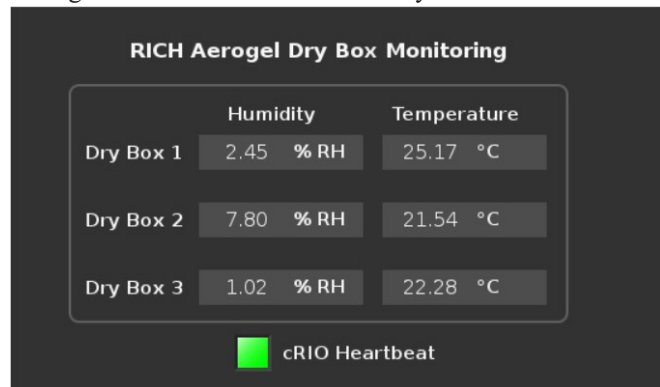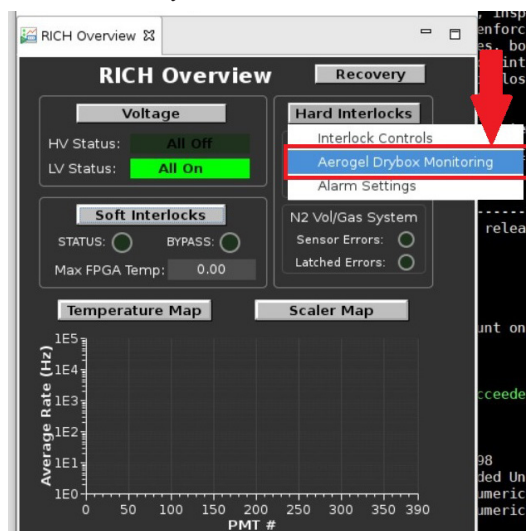

FIG. 2. CSS GUI for dry boxes.

FIG. 3. clascss's RICH overview screen with new menu option for dry box screen noted.

The WEDM GUI (Fig. 4) has been added to Accelerator's epicsweb, which is the WEDM server system. In contrast to CSS, all epicsweb screens are read-only with no control capabilities. To access the dry boxes' WEDM GUI, users only need to open the screen's URL [2] in any web browser and authenticate access with their CUE log in.
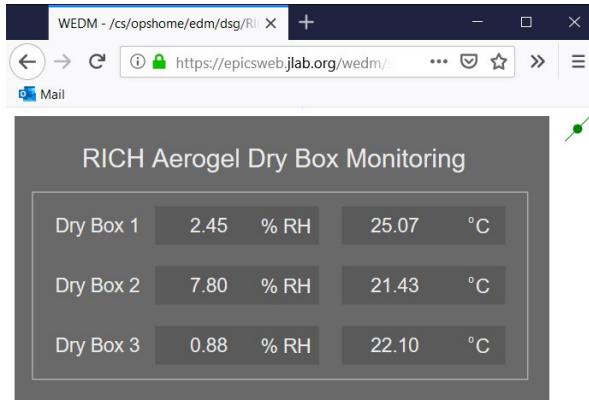

FIG. 4. WEDM dry box monitoring screen.

From the GUIs, it is observed that the internal humidity of each dry box does not exactly match their set points of 0.5 % RH. For Dry Box 1 and 3, this is due to the ±3.5% RH accuracy of the sensors (same type of sensor used in RICH's hardware interlock system). For Dry Box 2, the humidity is higher, 6% RH–8% RH, due to the box not being properly sealed. Evidence of this is the yellow tape seen on the box's front in Fig. 1.

In summary, an EPICS client has been added to the cRIO monitoring the environment in three XDry dry boxes containing a total of 43 Aerogel tiles. In addition to the client, two GUIs have been developed, one CSS and one WEDM, both of which enable remote monitoring of the dry boxes.

[1] M. A. Antonioli, et al., *Monitoring Software for RICH Aerogel Dry Boxes*, DSG Note 2020-06, 2020.
[2] https://epicsweb.jlab.org/wedm/screen?edl=%2fcs%2fopshome%2fedm%2fdsg%2fRICH-drybox.edl