

Hall A SoLID Magnet Alarm Handler and Email Notification System

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This note describes the development of the alarm handler and email notification system for the CLEO magnet, which is to be used in the Hall A Solenoidal Large Intensity Detector (SoLID).

An alarm handler and email notification system was developed and implemented to notify expert users when critical variables of the CLEO magnet are out of set limits. Since the control and monitoring system is based on Rockwell Automation's Allen-Bradley programmable logic controllers (PLCs) [1], the alarm handler and e-mail notification system was developed using Rockwell Automation's FactoryTalk View Site Edition software.

The solenoid Alarm and Event server, Solenoid_AE, was created on the PHYCAD58 computer, which is currently the server computer for the Human Machine Interface (HMI) system [2] [3]. Solenoid_AE allows redundant server configurations, including the setup of the alarm severity ranges. Each alarm severity range—urgent, high, medium, and low—was set to different low and high values, Fig. 1.

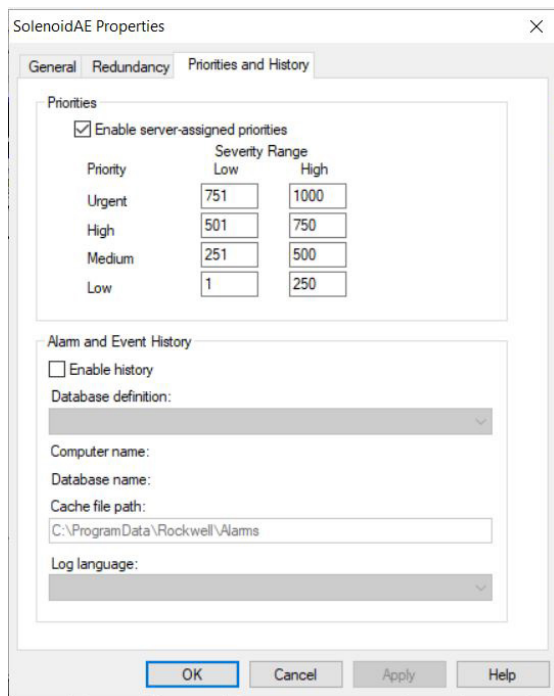


FIG. 1. Alarm severity ranges configured.

Three alarm tags were created in the Solenoid_AE server to simulate the signal readback from the sensors. Each alarm tag is associated with an alarm type—Digital, Deviation (analog), or Level (analog) alarm. PLC tags were created to simulate the signal readback from the sensors. A Boolean PLC tag was created to test a Digital Alarm and two real PLC tags were created to test the Deviation and the Level Alarms. For

the three different types of alarms, the alarm name, limits, severity, alarm message, and status tags are required, Fig. 2. Within the status tag configuration there is an option to set a Boolean PLC tag or Boolean HMI tag, either of which can be used as a trigger to announce the presence of an active alarm. The status tag is set to 1 when the monitored signal goes out of its limits.

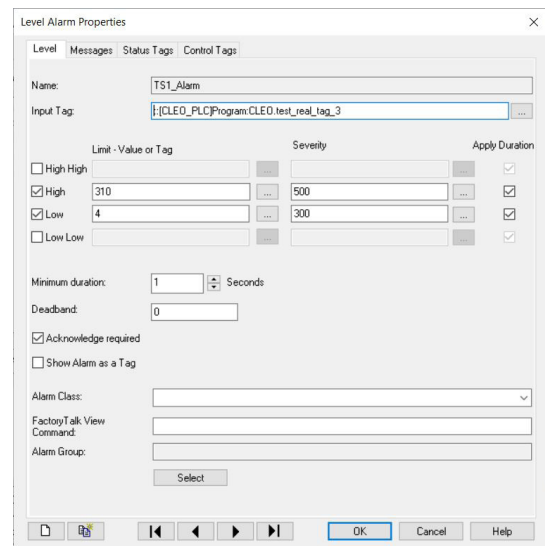


FIG. 2. Example of Level Alarm configurations.

The alarm tags for each alarm in the server can be used in the HMI application Alarm and Event Setup to provide a detailed alarm and event status. Figure 3 shows the alarms configured for the test.

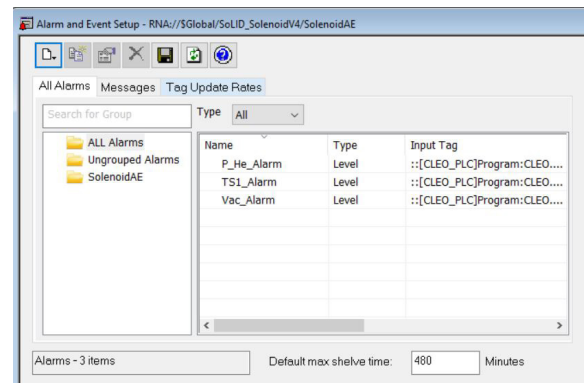


FIG. 3. Solenoid testing Alarm and Event Setup.

For the email configuration, an email server was created using the open, free software hMailServer Administrator,

which allows the setting of a Simple Mail Transfer Protocol (SMTP) user ID and a random client email account to test the sending and receiving of emails. The created account was implemented to set the SMTP user ID in FactoryTalk View ME Email Sender Control panel and to send email to expert users. Once tested, Jefferson Lab's SMTP account (smtp.jlab.org) was used to send the emails.

PLC routine Alarms_Setup was written to control sending and receiving of the email when an alarm is present. Alarms_Setup receives a Boolean bit set to 1 from Solenoid_AE, recognizing that an alarm is present, Alarms_Setup sets the necessary time to build the message, sets a Boolean bit to trigger the email sending action, and checks the handshake status bit; all the routine's actions are set to send only one email per each alarm event.

FactoryTalk View ME Email Sender Control's parameters—trigger, SMTP server IP address, SMTP port number, the SMTP user ID, sender email address, sender name, receiver email address or list, email message text, handshake status of the PLC or HMI tag, and failure code—were configured, Fig. 4. The trigger and handshake status are connected with the PLC tags created in Alarms_Setup. For the email message, a string HMI tag was linked. The string HMI tag depends on alarm type, facilitating a specific message to be sent.

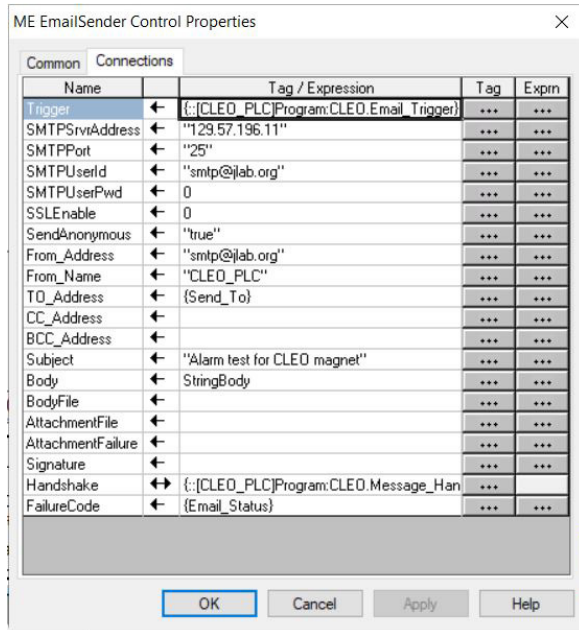


FIG. 4. FactoryTalk View ME Email Sender Control Properties.

For the test of the three types of alarms, a testing HMI screen was generated with controls and indicators to simulate the trip of alarms and the automatic email notifications. Tests were conducted to ensure the proper connections and synchronization of the alarm handler and email sender.

HMI screen *Solenoid Alarms and Email Controls*, Fig. 5, developed for the solenoid's low current test, shows details of the tripped alarms, such as condition, limits, severity, and a detailed message, and allows alarm acknowledgment. In the lower section of the screen, there are details of the email sent, such

as message text, email status indicators, email address, and a button to send an email manually, useful during debugging.

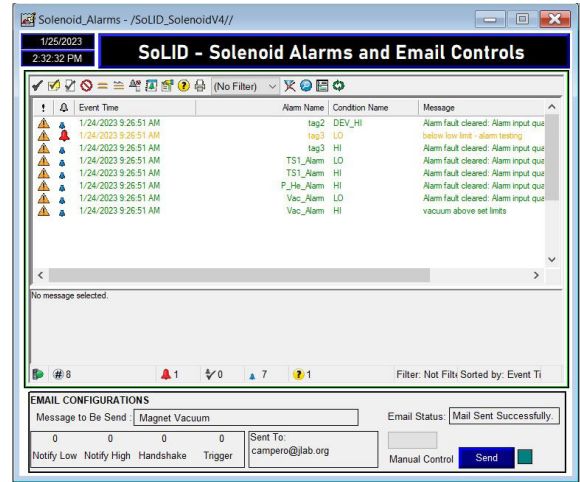


FIG. 5. *Solenoid Alarms and Email Controls* HMI screen.

The flowchart, Fig. 6 shows the sequence of the process.

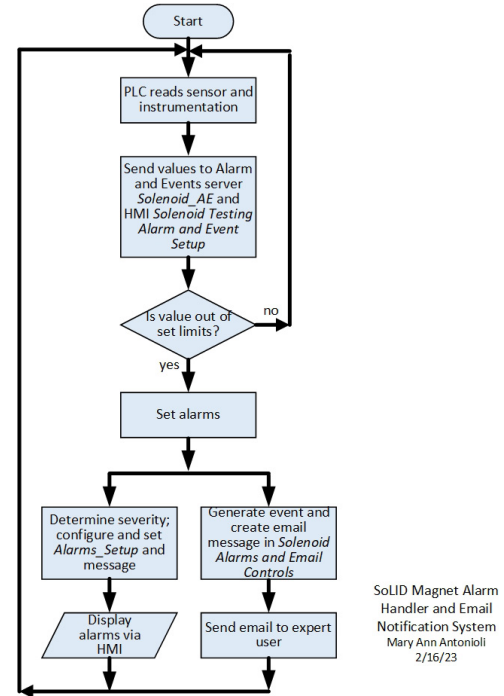


FIG. 6. Flowchart of alarm handler and email notification system.

To conclude, the development, implementation, and testing of the Hall A SoLID magnet alarm handler and e-mail notification system has been completed and is being used in the low current test of the CLEO magnet.

- [1] Pablo Campero, et al., *Hall A SoLID Solenoid*, DSG Note 2020-05, 2020.
- [2] P. Campero, et al. *Hall A SoLID Magnet Controls & Monitoring System*, DSG Talk 2020-15, 2020.
- [3] P. Campero, et al., *SoLID Solenoid HMI and CSS-BOY Screens for the Controls & Monitoring System*, DSG Talk 2020-38, 2020.