Automated Checking and Visualization of Interlocks

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http://isacwserv.triumf.ca/isac
Summary

- Background
- Interlock Specification
- Interlock Implementation
- Interlock Checking
- Interlock Visualization
ISAC Control System (Nov. 2001)

- 2000 Devices
- 6700 I/O channels
  - 4200 digital
  - 2500 analog
  - 40 motors
- 2 SUN Workstations (Application Servers)
- Console: 2 PC X-servers with 6 monitors
- 12 IOCs (VME, Motorola MV162)
- 4 PLC systems (Modicon Quantum Series)
- 15 RF control systems
- 52000 EPICS records
The PLC Interlock Problem

- 900 PLC-controlled devices (Modicon Quantum)
- Non-trivial interlocks
- EPICS supervises PLC (Modbus - Ethernet)

- How to keep PLC and EPICS displays in sync?
- How to assure quality?

Interlock Specification
Interlock Checking
dm Panel building
Interlock Specification

• Draft is done by controls group
• Must be readable by equipment specialist

• Use ISAC Device RDB (Paradox)
  ➔ Store interlock specification
  ➔ Generate specification document draft
  ➔ Have equipment specialist review
  ➔ Iterate and sign off
Interlock Specification

- Use “natural” language
- Matched to PLC implementation

Interlock to turn on:
(DTL:CG1A < HEBT:CG2 OR DTL:CG1A < 50 mTorr)
AND (HEBT:CG2 < 150 mTorr OR rough mode)

Trip:
None

rough mode: HEBT:IV0 closed AND HEBT:FV5 closed
AND HEBT:TP0 off AND HEBT:TP2 off
AND DTL:PV1 open
AND DTL:RV9 closed
AND HEBT:VV2 closed
....
Interlock Implementation
(Ladder Logic - MODSOFT)

- Device Interlock Summary
Interlock Checking

- MODSOFT Program format is proprietary
  ➣ Use ladder printout
Interlock Checking

1. RDB reports interlock to meta-file
2. Interlock check tool (PERL) analyzes Ladder logic printout to meta-file
3. Interlock check tool compares meta-files and reports differences

- Not a general solution
- MODSOFT specific
- Relies on some programming conventions
- Simplistic approach (only ANDed Ors)

*BUT*: successful verification of interlocks for 97% of devices
Interlock Visualization

• We use edd / dm
• Each device has a face-plate (device control panel), which displays detailed interlock state

1. Extend interlock check tool to produce panel meta-file
2. Panel builder (PERL) generates device panels
3. … and detail panels
Tools Summary

- ISAC Device RDB
- Modsoft Ladder Editor
- Interlock Check Tool
- Panel Builder
- Interlock Meta-file A
- Interlock Meta-file B
- Panel Meta-file
- Panel Builder
- Interlock Specification Document
- Interlock Check Report
- Device Panel
- Interlock Detail Panel
- ladder Print file
Interlock Visualization
(Device panel)
Interlock Visualization
(Detail Panel)
Summary

- Automated Interlock Checking
  - Quality Increase
  - Easy re-checking
  - 97% of devices with simplistic approach

- Automated Panel Build
  - Less maintenance
  - Operator sees what’s in the PLC

- Still to do
  - VME and CAN devices
  - Simpler interlocks
  - All info is in EPICS data base
Interlock Implementation

- “BAD” bit
Interlock Implementation

- Interlock detail