Alarm System

Jan. 2022

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Alarm Fields in EPICS Records

```
# bi, bo
record(bi, "binary")
{
    # Alarm states
    field(ZSV,  "MINOR")
    field(OSV,  "MAJOR")

    # Display niceties
    field(ZNAM, "Marginal")
    field(ONAM, "Hopeless")
}
```



```
record(mbbi, "states")
{
    # Alarm states
    field(TWSV, "MAJOR")

    # Display niceties
    field(ZRST, "Off")
    field(ONST, "On")
    field(TWST, "Overheated")
}
```

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/ics/examples/20_alarms

Alarm Fields in EPICS Records

```
# ai, ao, calc, calcout, longin, longout, …
record(ai, "analog")
{
    # Alarm limits
    field(HIHI, "100")
    field(HHSV, "MAJOR")

    field(HIGH, "80")
    field(HSV,  "MINOR")

    field(LOW,  "20")
    field(LSV,  "MINOR")

    field(LOLO, "0")
    field(LLSV, "MAJOR")

    # Alarm hysteresis
    field(HYST, "5")

    # Display niceties
    field(HOPR, "110")
    field(LOPR, "-10")
    field(EGU,  "Fathoms")
    field(PREC, "1")
}
```
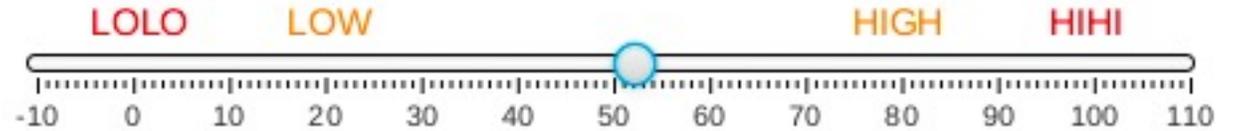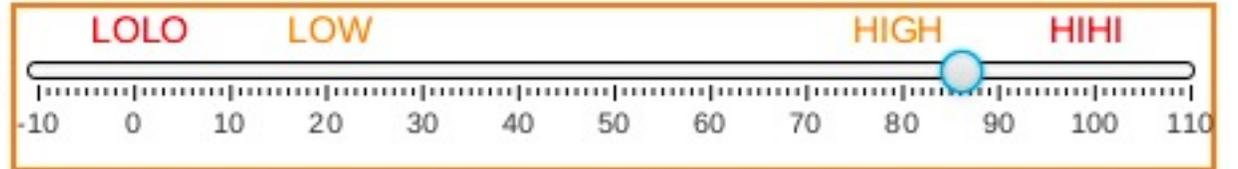

For historic reasons, need to set both
a) one or more alarm threshold
b) corresponding severity

/ics/examples/20_alarms

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Alarm Fields in EPICS Records

Perfectly fine

```
record(ai, "only_hihi")
{
    field(HIHI, "100")
    field(HHSV, "MAJOR")
}

record(ai, "only_high")
{
    field(HIGH, "80")
    field(HSV,  "MINOR")
}

record(ai, "only_low")
{
    field(LOW,  "10")
    field(LSV,  "MINOR")
}
```

Don't even think about it

```
record(ai, "high_as_hihi")
{
    field(HIGH, "100")
    field(HSV,  "MAJOR")
}

record(ai, "odd_order")
{
    field(HIHI, "100")
    field(HHSV, "MINOR")

    field(HIGH, "80")
    field(HSV,  "MAJOR")
}
```

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/ics/examples/20_alarms

EPICS PVs carry Values with Alarm Information
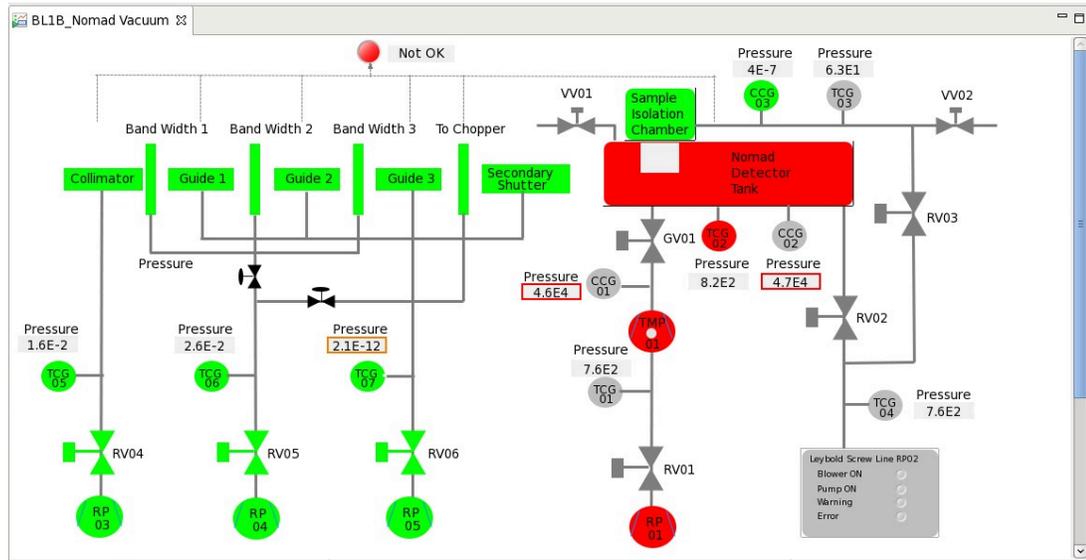
No alarm, MINOR, MAJOR

- Analog records:
  LOLO, LOW, HIGH, HIHI limits
- Binary records:
  0 or 1 state may alarm

Display Tools

- Indicate alarm state via border

What if nobody is looking at the screen at the time?

PV
VAL: 10
HIGH: 5
HSV: MINOR

IOC 1

PV
VAL: 20
HIHI: 20
HHSV: MAJOR

IOC 2

Alarm System Idea

Alarm System

1) Indicate alarms
2) Detail: Which PV? When? What value?..
3) Guidance
4) Related Displays
5) Keep alarms until acknowledged & cleared

"Check XYZ.
Try opening ABC.
Call Fred."

PV
VAL: 20
HIHI: 20
HHSV: MAJOR

PV
VAL: 10
HIGH: 5
HSV: MINOR

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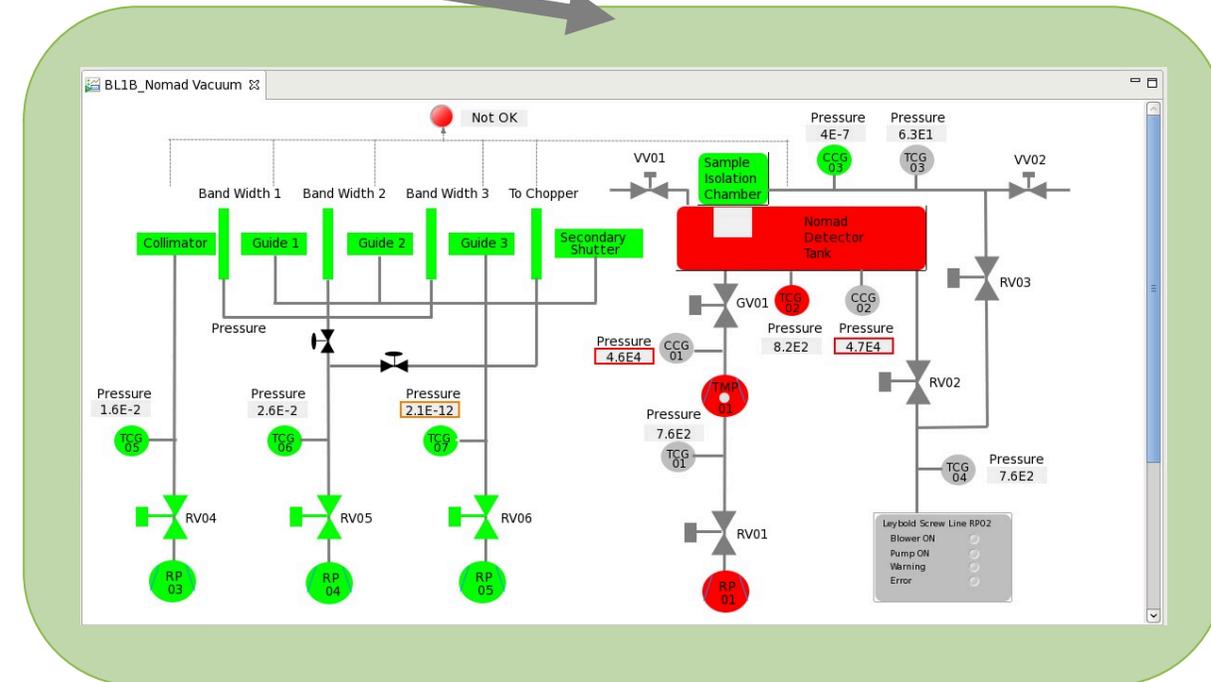
Basic Roles

- ## System Expert
  - Provide useful alarm levels
  - Explain what to to when alarm happens

- ## Control System Engineer
  - Configure alarm levels
  - Maybe create new alarm trigger PV
  - Create displays

- ## Operations Expert
  - Add alarm trigger PV to alarm system, with guidance and links to displays

- ## Operators
  - Handle alarms, helped by guidance

Implementation

CS-Studio Alarm UI

Alarm Server

Monitors PVs, updates current state

Apache Kafka

- Alarm Configuration
  - Which PVs to monitor
  - Guidance
  - Display Links

- Current State
  - Which PVs are in alarm?

PV

PV

PV

PV
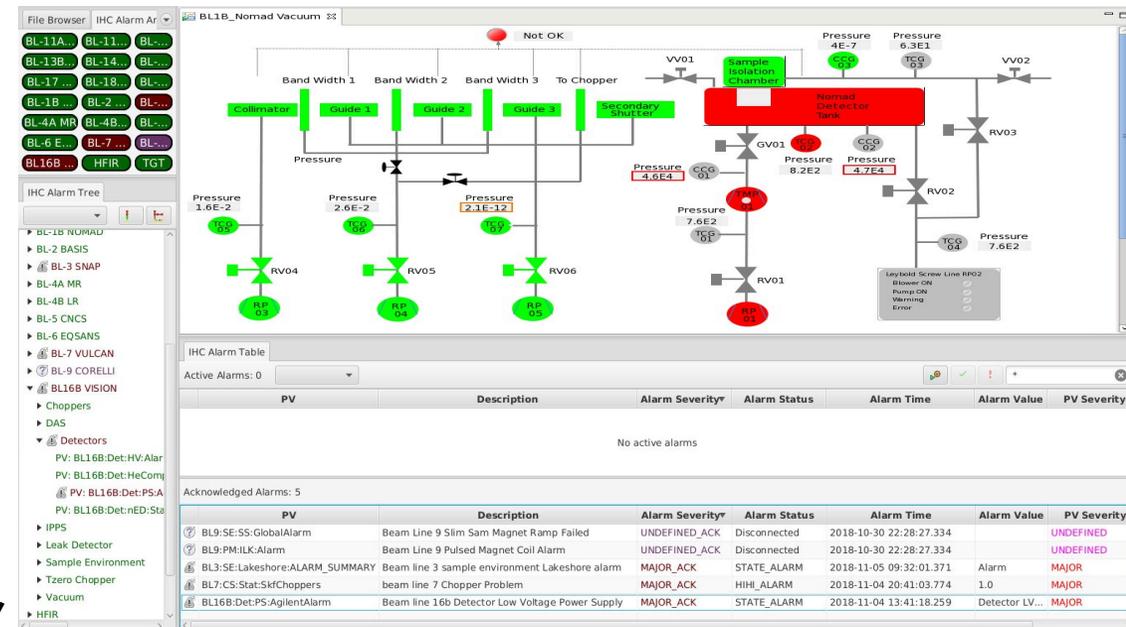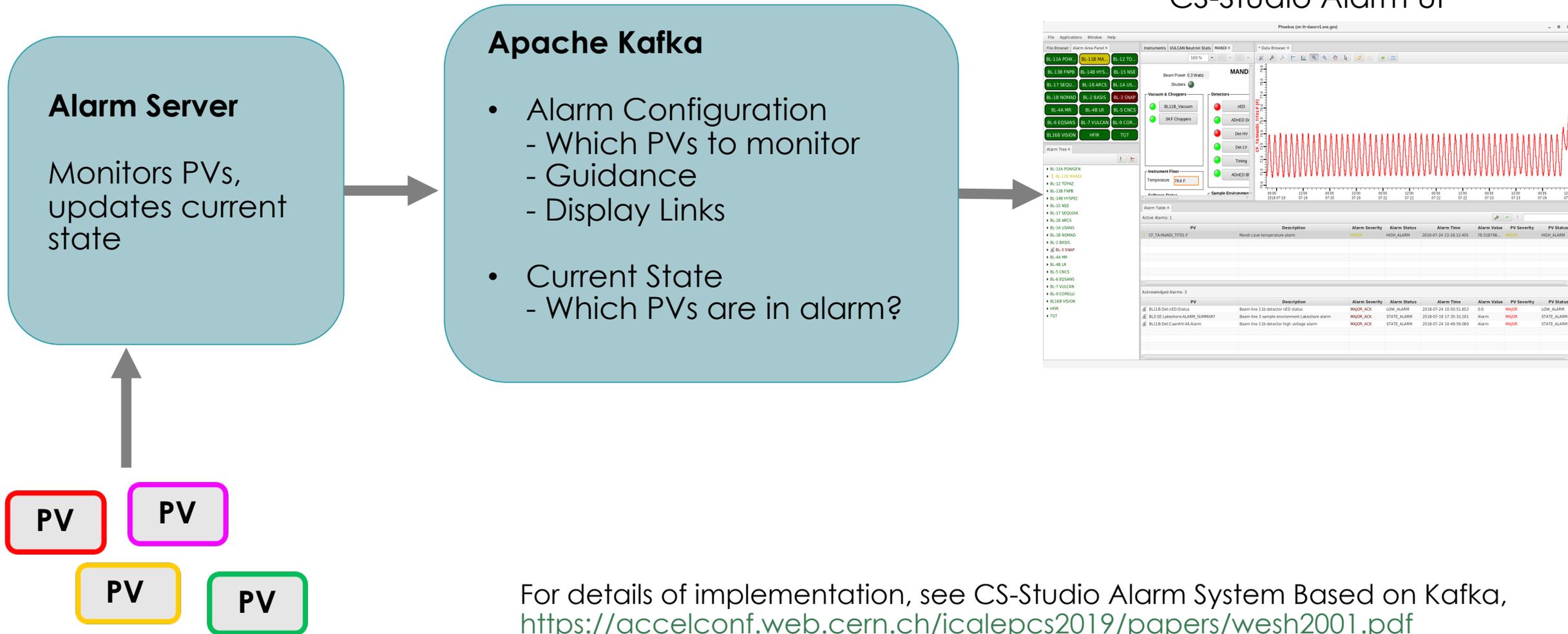
For details of implementation, see CS-Studio Alarm System Based on Kafka, https://accelconf.web.cern.ch/icalepcs2019/papers/wesh2001.pdf

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Initial Setup

https://github.com/ControlSystemStudio/phoebus/blob/master/app/alarm

1. Install Kafka (typically as Linux service)

2. Check that "Accelerator" config exists
    ```
    cd /ics/tools
    ./list_topics.sh
    ./monitor_topics.sh Accelerator
    ```

    If nothing shown:
    ```
    ./create_alarm_topics.sh Accelerator
    ```

3. Start alarm server (typically also as Linux service)
    ```
    cd /ics/tools/alarm-server-*
    ./alarm-server.sh
    ```

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Configuration for 'Fishtank'

- Open CS-Studio Applications, Alarm, Alarm Tree

- Right-click, Add Component
  - Node "Fishtank"
  - Add Guidance and Display link

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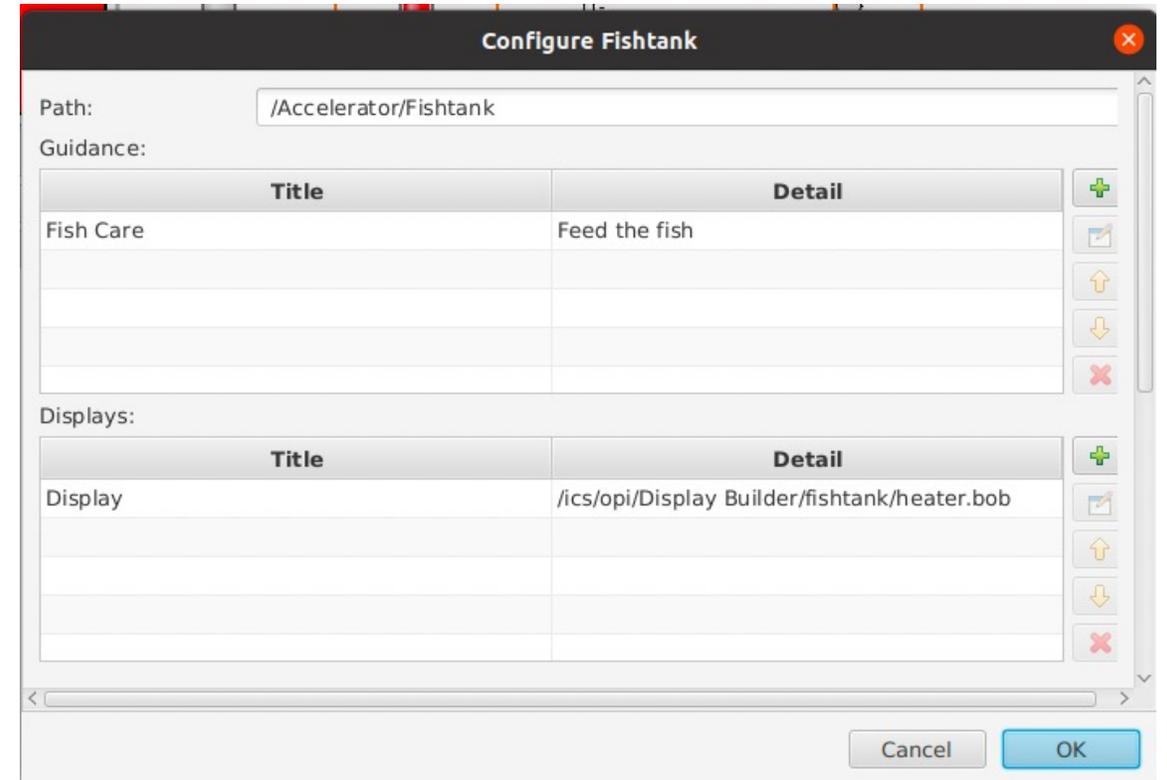
Configuration ...

- Right-click on new "Fishtank", Add Component
  - ❑ **PV** "training:heat_V"
  - ❑ **Description**

    Anything's better than the PV name
  - ❑ Specific **Guidance** and Displays

    Should have guidance. Otherwise, why is this an alarm?
  - ❑ Enabled? Latch? Annunciate?

    Usually: Yes, otherwise: Why bother?
  - ❑ Delay?

    Hack for noisy alarm trigger PVs
  - ❑ Automated Actions
    - ❑ mailto:fred@google.com
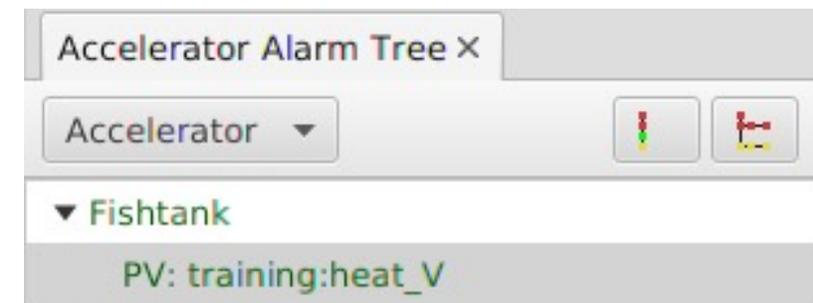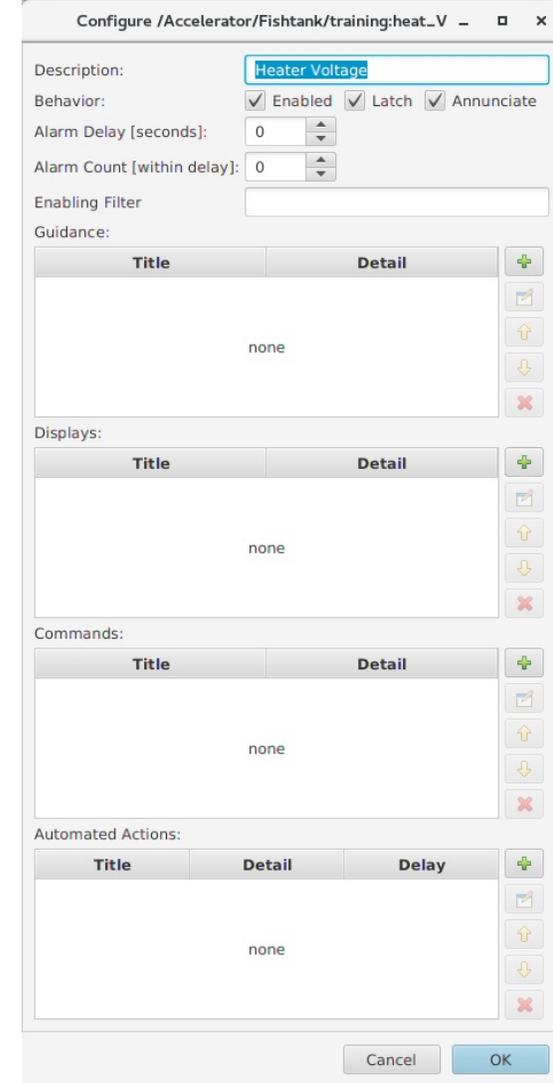
Example Alarm Workflow

- ## Cause an alarm

  `caput training:setpoint 60`

- ## Inspect Alarm
  - Watch as alarm is indicated
  - Open associated display

- ## Handle It
  - Acknowledge
  - Reduce setpoint
  - → Clear

Suggested "Alarm" layout:

*Alarm Tree to the left,
Alarm Table at the bottom,
both "locked"*
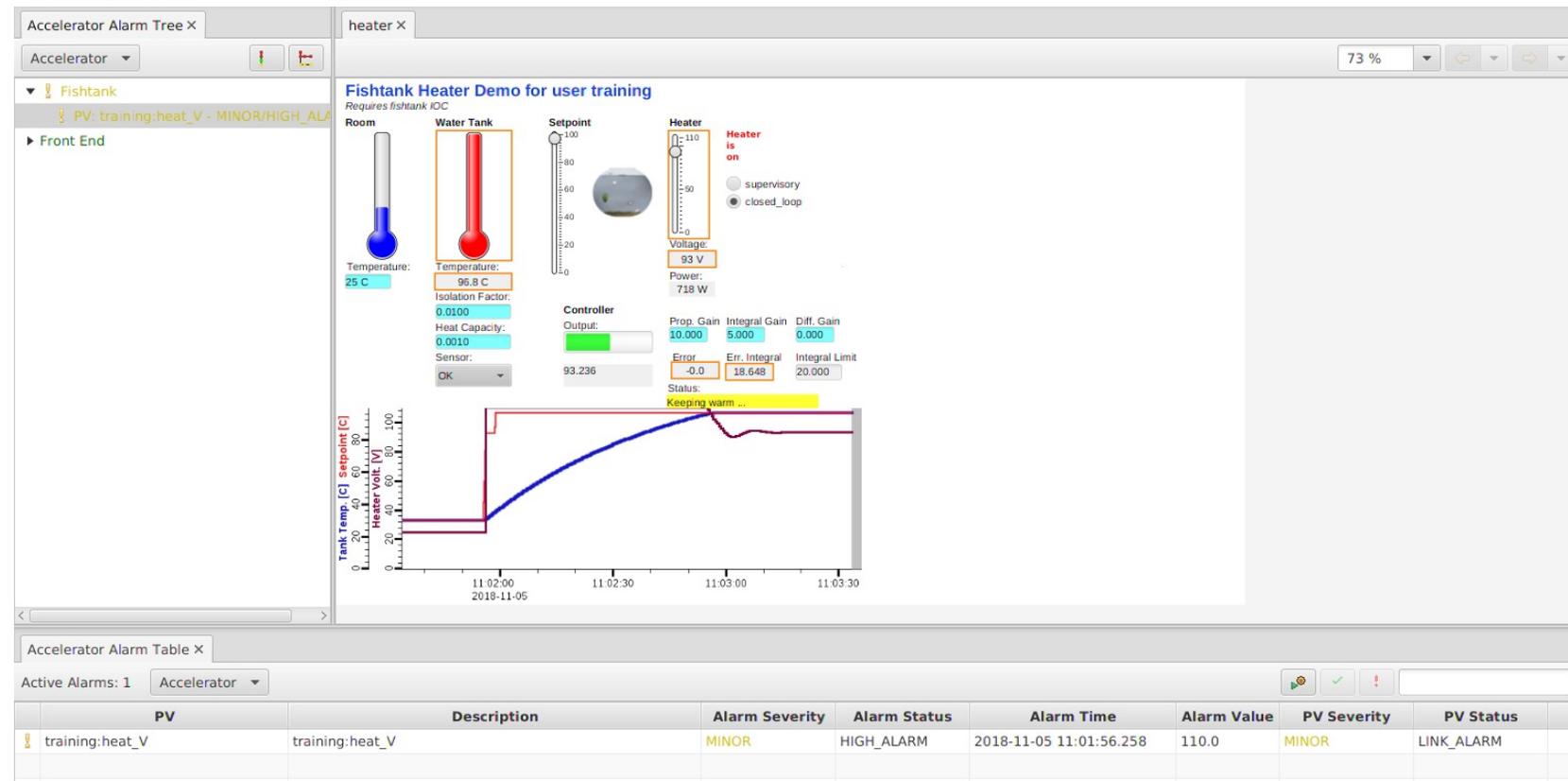
Alarm Tree

- Primary <u>configuration</u> tool
- Hierarchical
  - Guidance, Displays apply to sub-nodes

- Operational useful to
  - Check if numerous alarms originate in the same area
  - Acknowledge or disable complete subtrees

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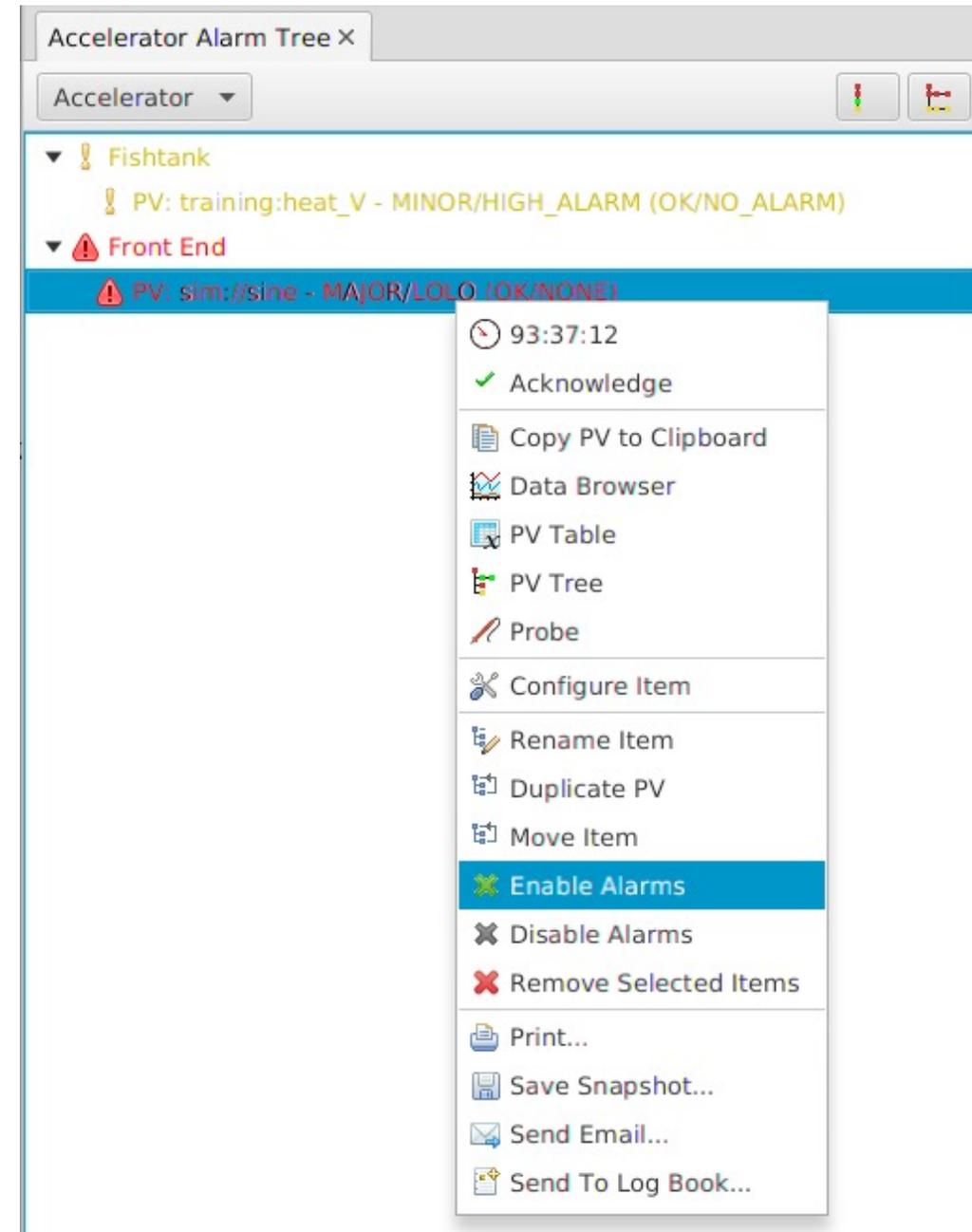
Alarm Table

- Primary <u>operations</u> tool
- Ideally empty
- View/sort/acknowledge alarms
- Open guidance and displays

Alarm Area Panel

Useful for 'Overview Displays'

Indicates 'across the room':

All OK?
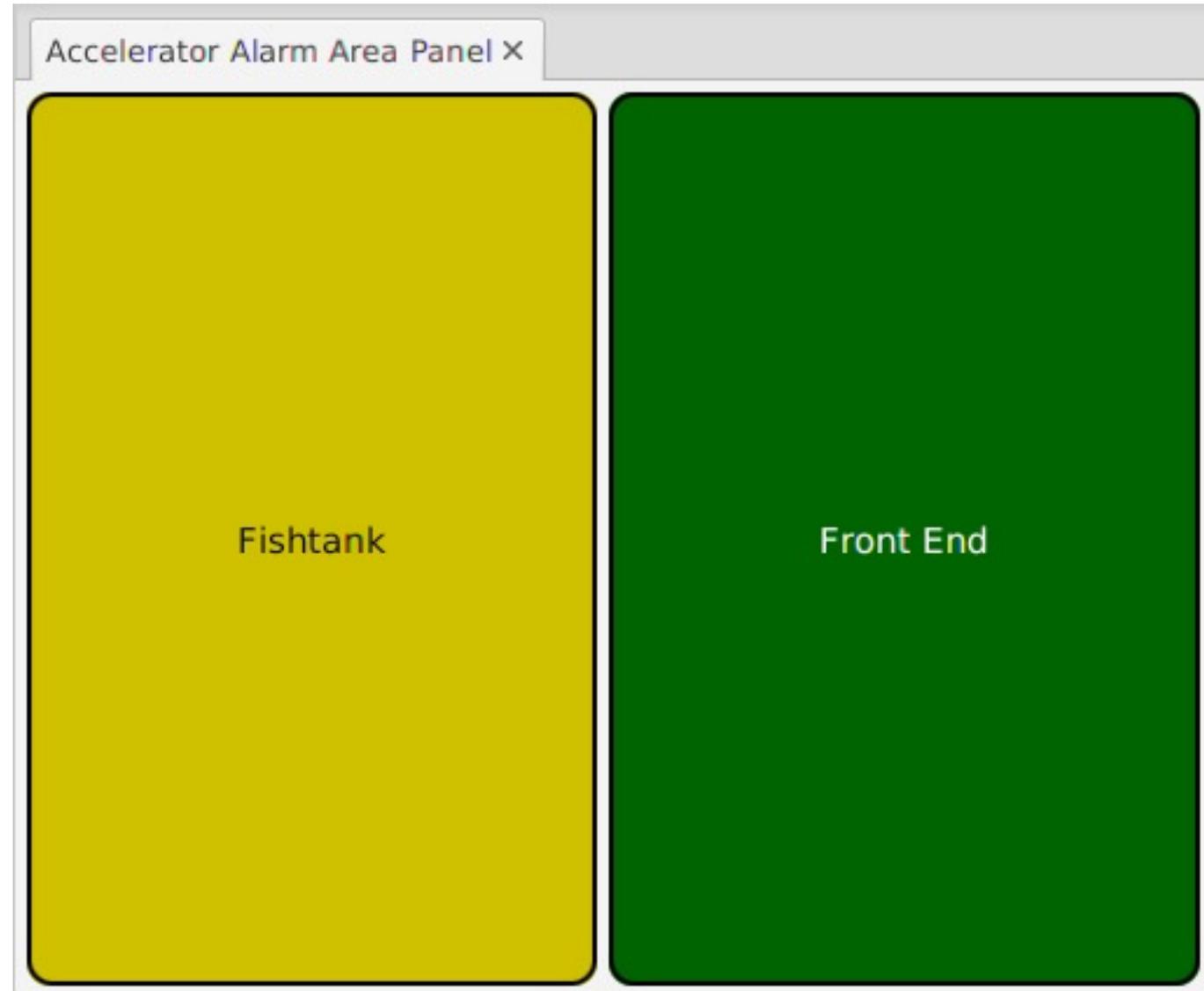
Alarm Annunciator

Annunciates the *description* of alarms

Basic "heads up" to check alarm table for details

Alarm System

- Alarm Server monitors PVs, tracks alarms
- Alarm Tree to configure
  - PV?
  - Guidance?
  - Displays?
- Alarm Table, Area Panel, Annunciator to use
  - Acknowledge
  - Open Displays

Suggested Layout with "locked" alarm panels