

User Interface Capabilities for Control Systems



Kay Kasemir

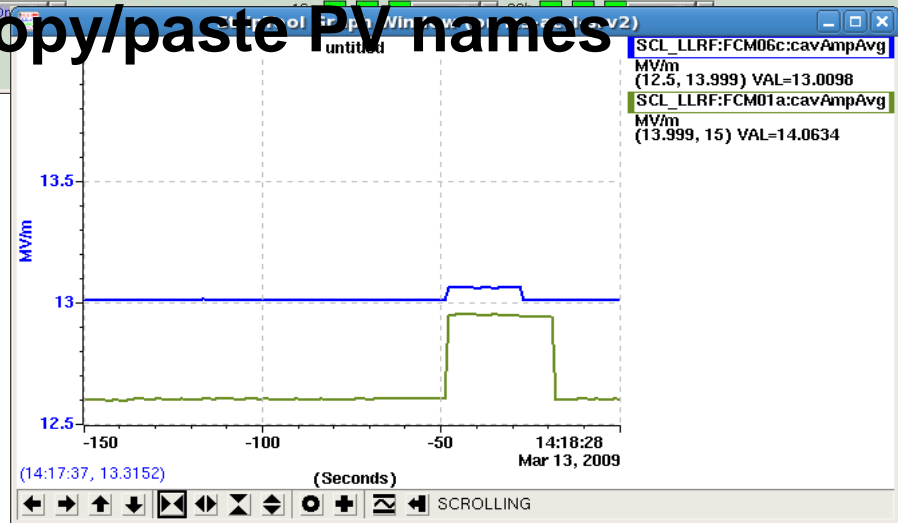
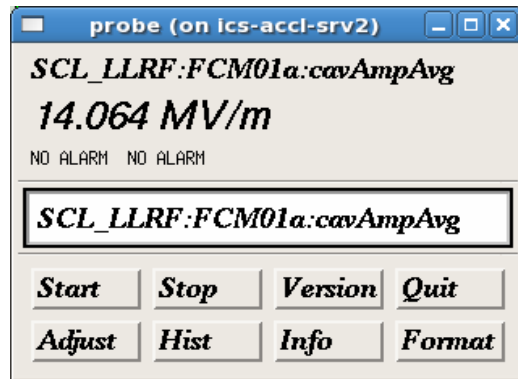
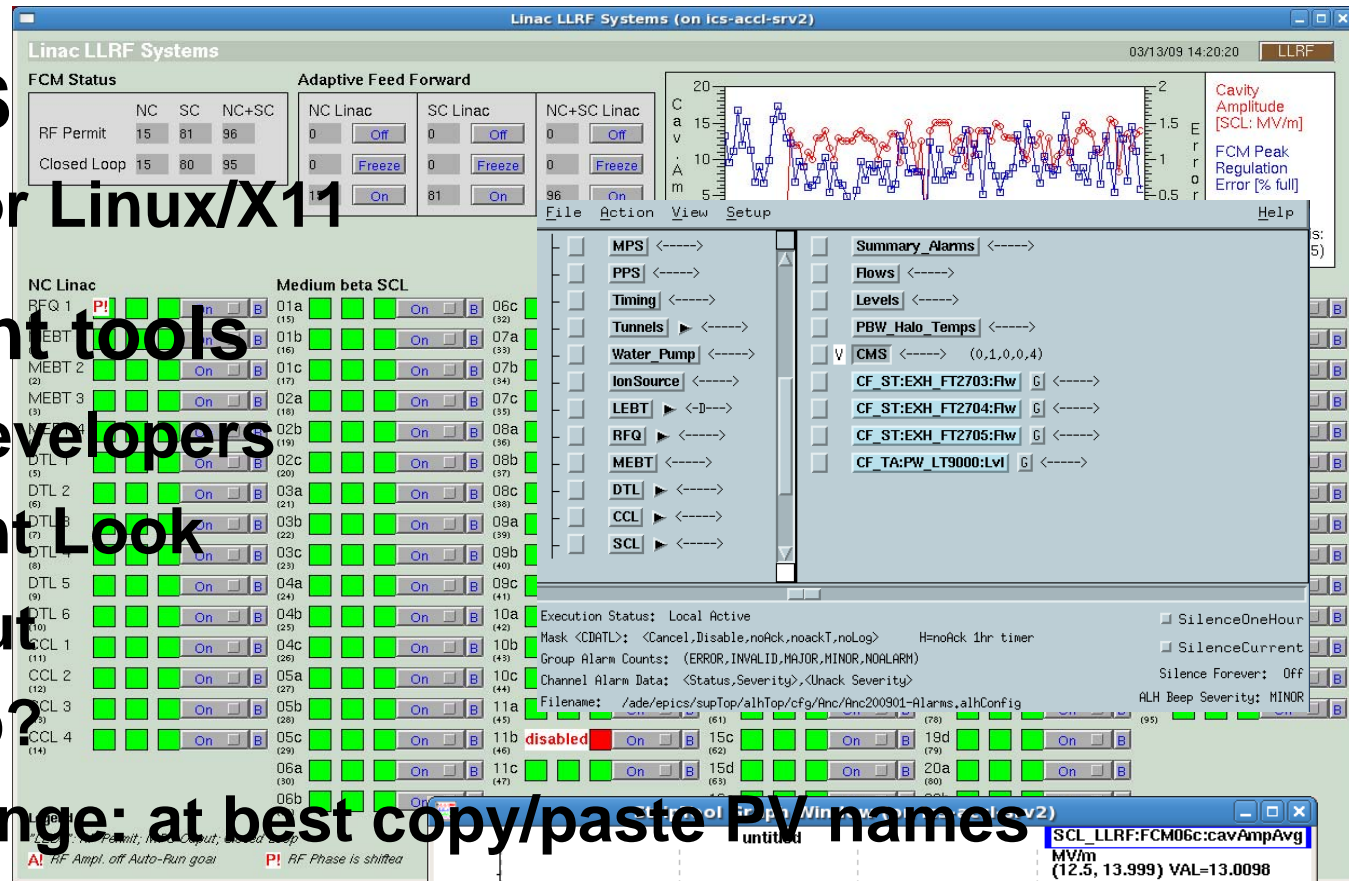
kasemirk@ornl.gov

**Based on the work of
Matthias Clausen's group at DESY,
Xihui Chen, Dave Purcell,
Delphy Armstrong at ORNL,
others**

PAC, May 2009

Existing Accelerator Control System UI

- ... for EPICS
 - primarily for Linux/X11
- Many disjoint tools
 - Different developers
 - Inconsistent Look
 - Static layout
 - Online help?
 - Data exchange: at best copy/paste PV names



User Experience Elsewhere

- **Multi-purpose tools**
 - MS Office, Web Browser
- **Easy data exchange**
 - Email Spreadsheet, save-as-HTML, ...
- **Everything “clickable” and configurable**
- **Online help, tool-tips, “wizards”**
- **Links to related information**



Control System UI Trends

- **Localized use of LabVIEW, Matlab, Qt, Web technology**
- **Growing number of sharable Java code**
 - **Individual Applications**
 - Control Panel Editor for DOOCS, TINE, TANGO (<http://jddd.desy.de>)
 - **Toolkits**
 - XAL for rapid Physics Application Development (<http://www.ornl.gov/~t6p/Main/XAL.html>)
 - **Integrated Framework**
 - Control System Studio (<http://css.desy.de>, <http://ics-web.sns.ornl.gov/css>)

Java

- **Advantages**

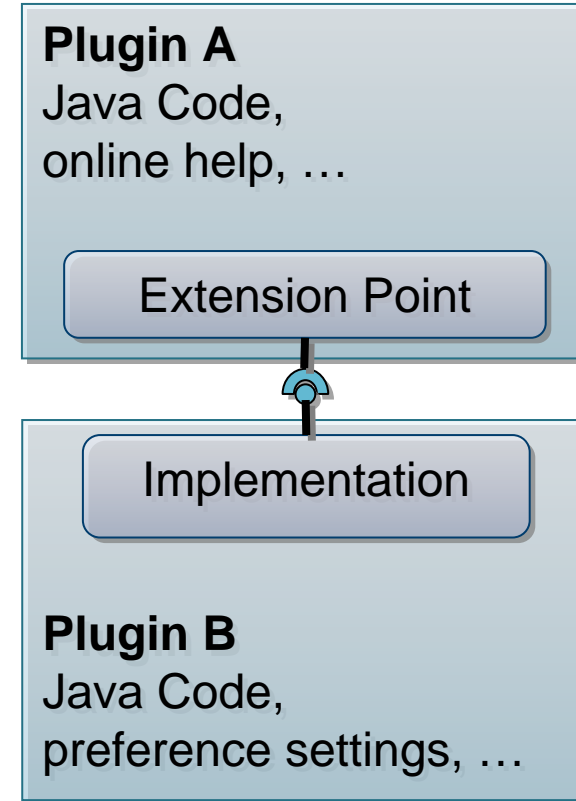
- Portability (MS Windows, Linux, Mac OS X)
- Truly outstanding free IDEs (Eclipse, Netbeans, ...)

- **However...**

- How to run?
 - Scripts to set CLASSPATH & run java
 - Somewhat differs from native application (task bar icon, name in process list)
- Can still end up with disjoint applications

Eclipse Java Framework

- **Plugin JARs**
 - CLASSPATH management
- **Launcher**
 - Native to Operating System
 - On-demand plugin dependency loading
- **Extension Points**
 - Define and document APIs
 - Dynamically locate implementations
- **Rich Client Platform (RCP)**
 - Workbench
 - Multi-document UI, File browser, Online help, Preferences, ...
 - Almost everything offers extension points
 - Menus, file type associations, views, ...

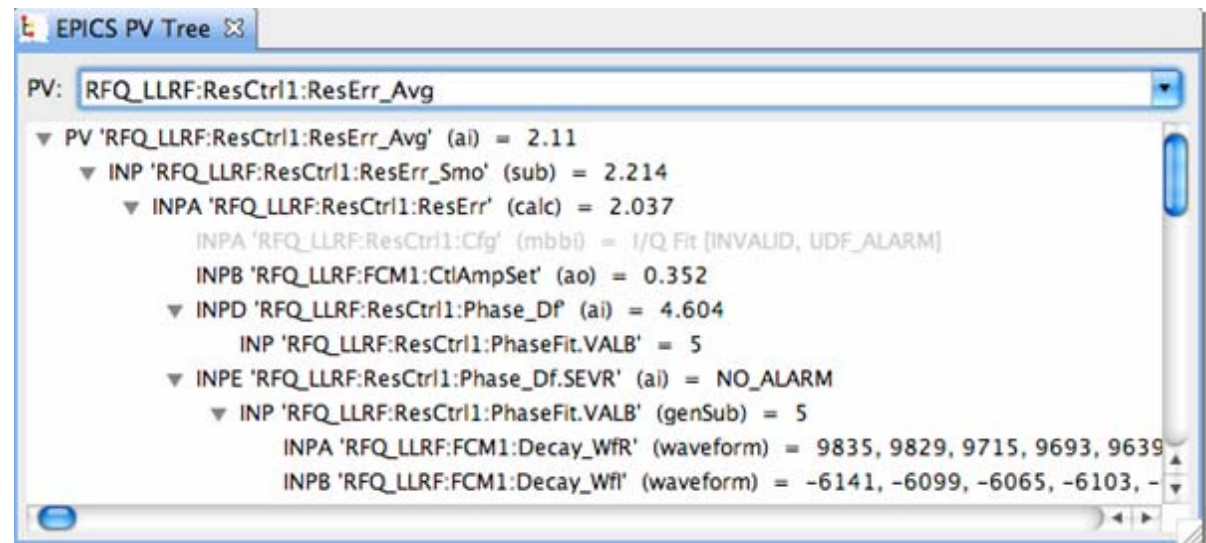
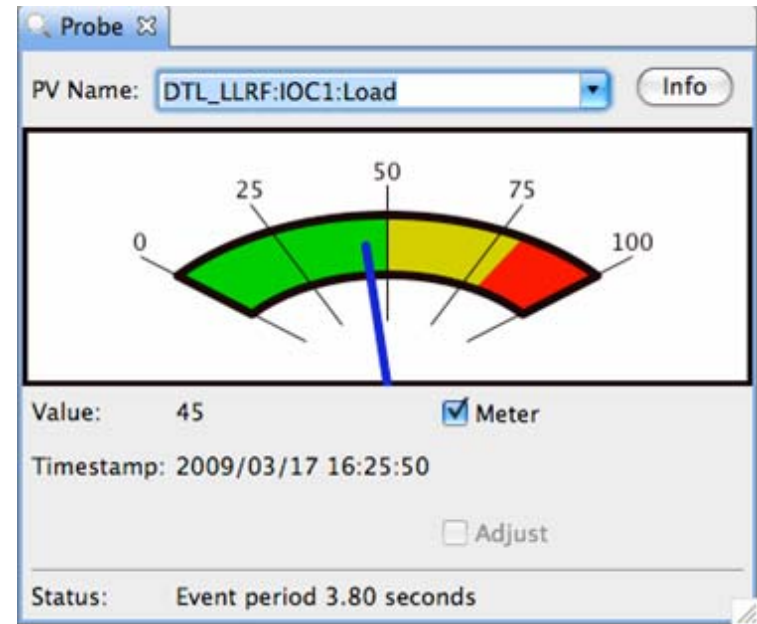


Control System Studio = RCP +

- **Data types for Control System**
 - PV Name
 - Value with Timestamp, ...
- **Extension points for**
 - live PV access to e.g. EPICS
 - historic data from various archives
 - writing to site-specific Logbook
 - authentication and authorization via e.g. LDAP

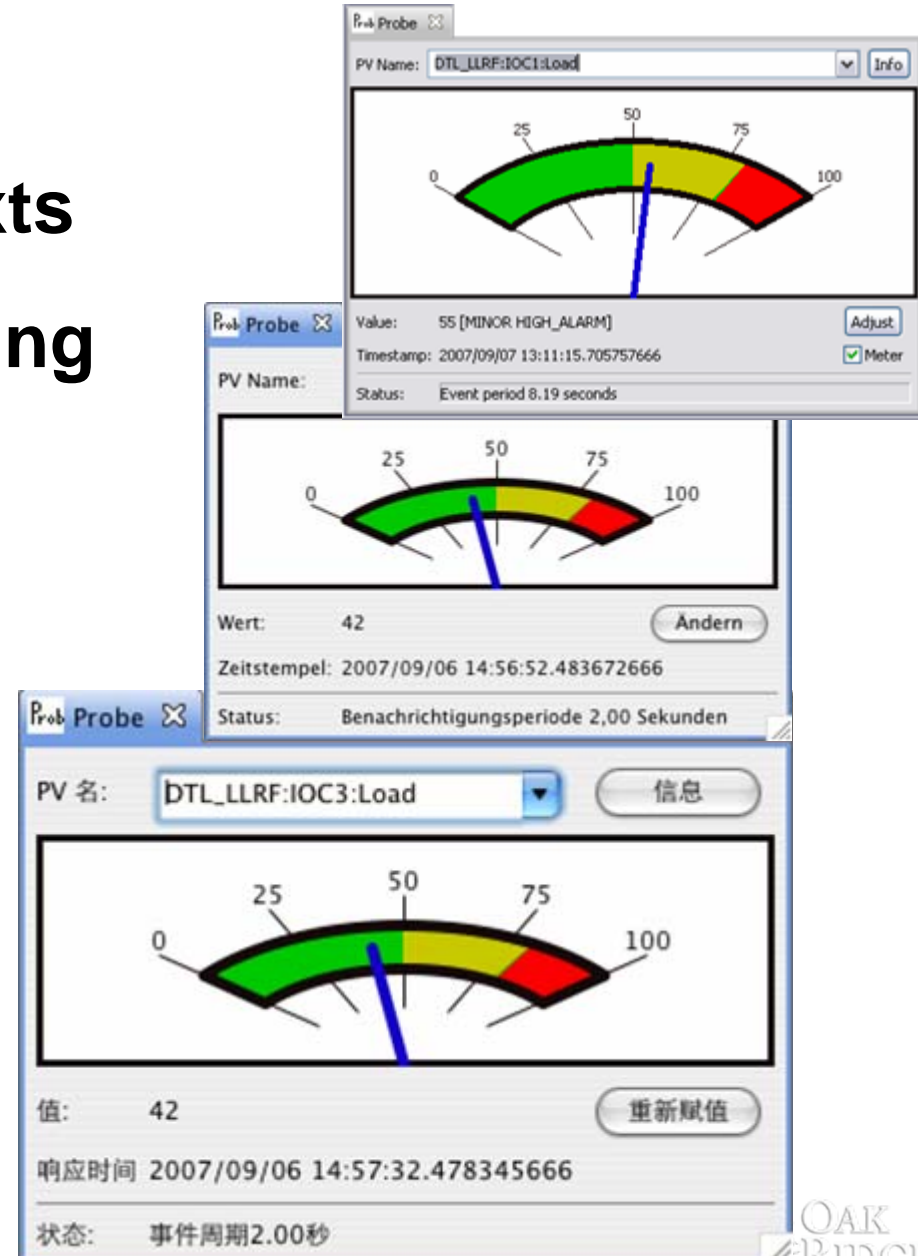
Simple CSS Tools

- **Probe**
 - Current value of a PV
- **EPICS PV Tree**
 - Trace PV links
- **Little things**
 - Resize
 - Scrollbars
 - Drop-downs keep previous entries



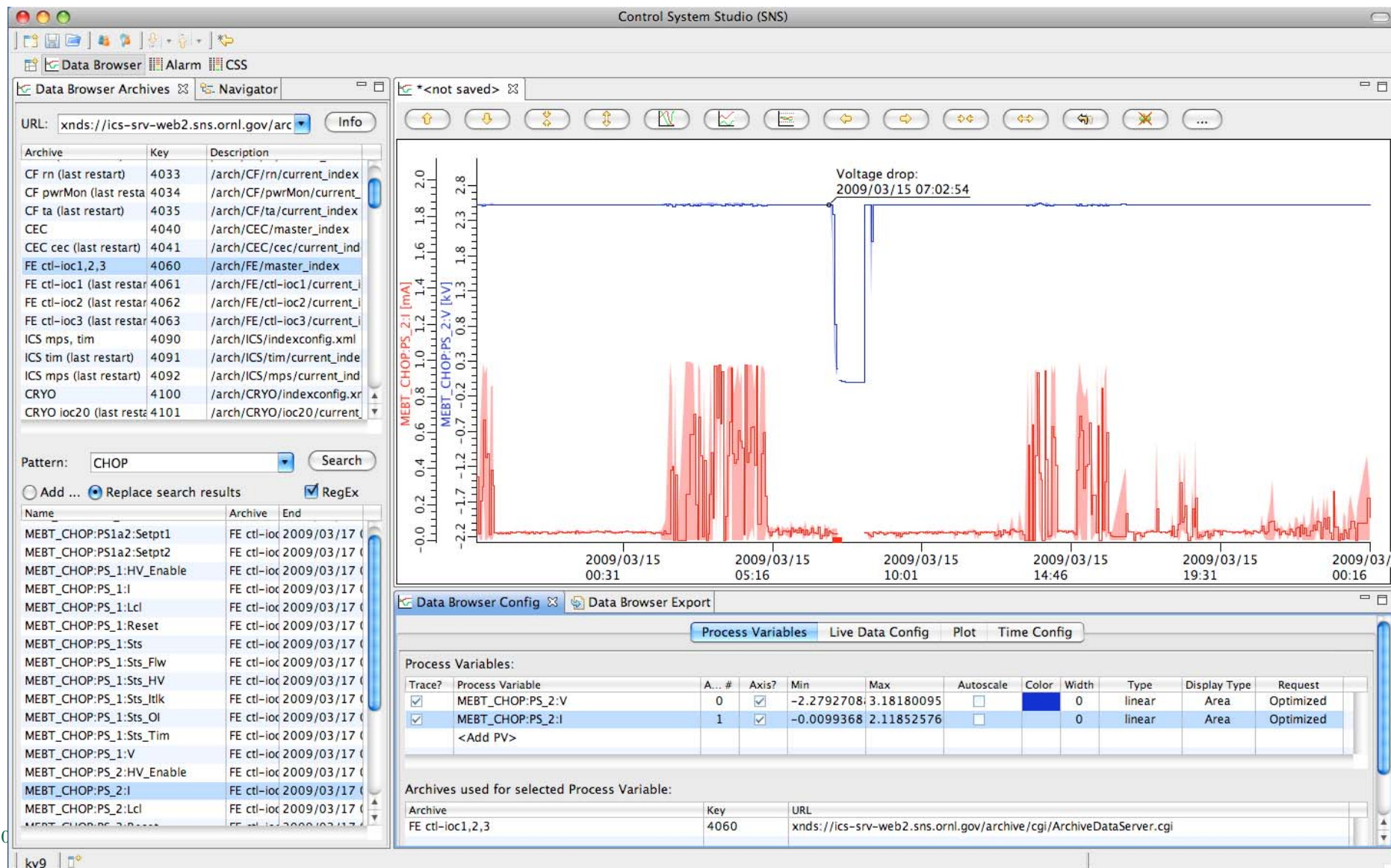
Eclipse Benefits: Localization

- IDE helps to localize texts
- Runtime follows operating system settings
- CSS Translations
 - All: (US) English
 - Most: German
 - Few: French, Chinese



Data Browser

Plot 'live' and historic data over time



SNS Alarm System

Tabular or Tree view

The interface displays a hierarchical tree view of alarm areas on the left and a table view of current and acknowledged alarms on the right.

Alarm Tree (Left Panel):

- Area: BeamPermit (MAJOR/major-ack'ed/LOLO_ALARM)
 - PV: FE_MPS:MIOC1A:status_sum (MAJOR/major-ack'ed)
 - PV: ICS_Tim:Gate_BeamOn:Switch (MINOR/minor-ack'ed)
- Area: CF (MINOR/MINOR/HIGH_ALARM)
- Area: Diagnostics (OK/OK/OK)
- Area: HP_Mod_Smoke (OK/OK/OK)
- Area: HP_Mod_V_Mon (OK/OK/OK)
- Area: HPRF_PLC_Check (OK/OK/OK)
- Area: HPRF_Rack_Sts (OK/OK/OK)
- Area: ICS (OK/OK/OK)
- Area: MPS (OK/OK/OK)
- Area: PPS (OK/OK/OK)
- Area: Timing (OK/OK/OK)
- Area: Tunnels (OK/OK/OK)
- Area: Water_Pump (OK/OK/OK)
- Area: IonSource (OK/OK/OK)
- Area: LEBT (OK/OK/OK)
- Area: RFQ (OK/OK/OK)
- Area: MEBT (MAJOR/MAJOR/LOLO_ALARM)
- Area: DTL (OK/OK/OK)
- Area: CCL (OK/OK/OK)
- Area: SCL (OK/OK/OK)
- Area: HEBT (MAJOR/major-ack'ed/LOLO_ALARM)
- Area: RID (OK/OK/OK)
- Area: Ring (OK/OK/OK)
- Area: RTBT (OK/OK/OK)
- Area: Target (INVALID/invalid-ack'ed/READ_ALARM)
- Area: Test (OK/MAJOR/HIHI_ALARM)
 - System: LLRF (OK/OK/OK)
 - PV: Instr_BmLn:XXSTATE5216A:Sts (OK/OK/OK)
 - PV: RFQ_Vac:Pump2:Pressure (OK/MAJOR/HIHI_ALARM)
 - PV: RFQ_Vac:Pump3:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump4:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump5:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump6:Pressure (OK/MINOR/HIGH_ALARM)

Alarm Table (Right Panel):

Current Alarms

PV	Description	Time	Current Severity	Severity	Status	Value
CF_KL:DIWS_AIT4303B:Rs	CF_KL:DIWS_AIT4303B:Rs	2009/03/17 16:10:06	MINOR	MINOR	HIGH_ALARM	18.5
RFQ_Vac:Pump2:Pressure	Demo pump 2	2009/03/17 16:09:46	OK	MAJOR	HIHI_ALARM	9.0
RFQ_Vac:Pump6:Pressure	Demo pump 6	2009/03/17 16:09:44	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump5:Pressure	Demo pump 5	2009/03/17 16:09:44	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump4:Pressure	Demo pump 4	2009/03/17 16:09:44	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump3:Pressure	Demo pump 3	2009/03/17 16:09:44	OK	MINOR	HIGH_ALARM	5.0
MEBT_CHOP:PS_2:V	mebbit chopper power supply two voltage fault	2009/03/16 19:05:10	MAJOR	MAJOR	LOLO_ALARM	0.000

Acknowledged Alarms

PV	Description	Time	Current Severity	Severity	Status	Value
TMod:Summary_MPS:Alarm	Moderator System MPS Trip	2009/03/16 19:05:09	INVALID	invalid-ack'ed	READ_ALARM Ready	
MEBT_CHOP:PS_1:V	mebbit chopper power supply one voltage f	2009/03/16 19:05:10	MAJOR	major-ack'ed	LOLO_ALARM	0.000
HEBT_Coll:CT2:Cond	HEBT_Coll:CT2:Cond	2009/03/16 19:05:10	MAJOR	major-ack'ed	LOLO_ALARM	0.017
FE_MPS:MIOC1A:status_sum	MPS Beam permit	2009/03/17 16:05:00	MAJOR	major-ack'ed	LOLO_ALARM	2
ICS_Tim:Gate_BeamOn:Switch	Beam awf	2009/03/17 16:04:59	MINOR	minor-ack'ed	STATE_ALARM Shifted	

Callouts:

- Select by Name, Description:** Points to the search filter in the Alarm Table.
- Sort by Time, Severity, ...:** Points to the sort options in the Alarm Table.
- Acknowledge:** Points to the checkmark icon in the Alarm Table header.

CSS PV Exchange

- PVs in any CSS Tool
 - Context Menu → Select other PV Tools
 - Opens other tool with that PVs
- Facilitated by Eclipse mechanism
 - Tools don't know each other;
no manual configuration

The screenshot displays the CSS PV Exchange interface. On the left, there are two panels: 'Current Alarms' and 'Acknowledged Alarms'. The 'Current Alarms' panel shows a list of alarms with columns for PV, Description, Time, Current Severity, Severity, Status, and Value. The 'Acknowledged Alarms' panel shows a similar list of acknowledged alarms. A context menu is open over the 'Current Alarms' panel, showing options for the selected PV: 'MEBT_CHOP:PS_2:V'. The menu includes options like 'Check MEBT PS 2 Chopper', 'MEBT Chopper PS 2 Screen', 'Logbook...', 'Acknowledge', 'Copy Pv Name to Clipboard', 'CSS', 'Configure Item', 'Auto-size Columns', 'Alarm Perspective', 'Data Browser', 'Data Browser View', 'PV Table', 'Rack View', 'PV Utility', 'PV Fields Viewer', 'Probe', and 'EPICS PV Tree'.

PV	Description	Time	Current Severity	Severity	Status	Value
RFQ_Vac:Pump2:Pressure	Demo pump 2	2009/03/17 16:48:10	OK	MAJOR	HIHI_ALARM	9.0
RFQ_Vac:Pump6:Pressure	Demo pump 6	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump5:Pressure	Demo pump 5	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump4:Pressure	Demo pump 4	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump3:Pressure	Demo pump 3	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
FE_MPS:MIOC1A:status_sum	MPS Beam permit	2009/03/17 16:46:28	MAJOR	MAJOR	LOLO_ALARM	2
ICS_Tim:Gate_BeamOn:Switch	Beam awf	2009/03/17 16:46:27	MINOR	MINOR	STATE_ALARM	Shift
CF_KL:DIWS_AIT4303B:Rs	CF_KL:DIWS_AIT4303B:Rs	2009/03/17 16:10:06	MINOR	MINOR	HIGH_ALARM	18.5
MEBT_CHOP:PS_2:V	mebbit chopper power supply two voltage fault				LOLO_ALARM	0.00

PV	Description	Time
TMod:Summary_MPS:Alarm	Moderator System MPS Trip	2009/03/17 16:48:10
MEBT_CHOP:PS_1:V	mebbit chopper power supply one voltage fault	2009/03/17 16:48:08
HEBT_Coll:CT2:Cond	HEBT_Coll:CT2:Cond	2009/03/17 16:48:08

Alarm Table → Data Browser

Inspect history of PV, annotate

Alarm Tree

- Area: BeamPermit (MAJOR/major-ack'ed/LOLO_ALARM)
 - PV: FE_MPS:MIOC1A:status_sum (MAJOR/major-ack'ed/LOLO_ALARM)
 - PV: ICS_Tim:Gate_BeamOn:Switch (MINOR/minor-ack'ed/LOLO_ALARM)
- Area: CF (MINOR/MINOR/HIGH_ALARM)
- Area: Diagnostics (OK/OK/OK)
- Area: HP_Mod_Smoke (OK/OK/OK)
- Area: HP_Mod_V_Mon (OK/OK/OK)
- Area: HPRF_PLC_Check (OK/OK/OK)
- Area: HPRF_Rack_Sts (OK/OK/OK)
- Area: ICS (OK/OK/OK)
- Area: MPS (OK/OK/OK)
- Area: PPS (OK/OK/OK)
- Area: Timing (OK/OK/OK)
- Area: Tunnels (OK/OK/OK)
- Area: Water_Pump (OK/OK/OK)
- Area: IonSource (OK/OK/OK)
- Area: LEBT (OK/OK/OK)
- Area: RFQ (OK/OK/OK)
- Area: SCL (OK/OK/OK)
- Area: MEBT (MAJOR/MAJOR/LOLO_ALARM)
- Area: DTL (OK/OK/OK)
- Area: CCL (OK/OK/OK)
- Area: HEBT (MAJOR/major-ack'ed/LOLO_ALARM)
- Area: RID (OK/OK/OK)
- Area: Ring (OK/OK/OK)
- Area: RTBT (OK/OK/OK)
- Area: Target (INVALID/invalid-ack'ed/READ_ALARM)
- Area: Test (OK/MAJOR/HIHL_ALARM)
 - System: LLRF (OK/OK/OK)
 - PV: Instr_BmLn:XXSTATE5216A:Sts (OK/OK/OK)
 - PV: RFQ_Vac:Pump2:Pressure (OK/MAJOR/HIHL_ALARM)
 - PV: RFQ_Vac:Pump3:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump4:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump5:Pressure (OK/MINOR/HIGH_ALARM)
 - PV: RFQ_Vac:Pump6:Pressure (OK/MINOR/HIGH_ALARM)

Alarm Table

PV	Description	Time	Current	Severity	Status	Value
RFQ_Vac:Pump2:Pressure	Demo pump 2	2009/03/17 16:48:10	OK	MAJOR	HIHL_ALARM	9.0
RFQ_Vac:Pump6:Pressure	Demo pump 6	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump5:Pressure	Demo pump 5	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump4:Pressure	Demo pump 4	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
RFQ_Vac:Pump3:Pressure	Demo pump 3	2009/03/17 16:48:08	OK	MINOR	HIGH_ALARM	5.0
FE_MPS:MIOC1A:status_sum	MPS Beam permit	2009/03/17 16:46:28	MAJOR	MAJOR	LOLO_ALARM	2
ICS_Tim:Gate_BeamOn:Switch	Beam awf	2009/03/17 16:46:27	MINOR	MINOR	STATE_ALARM	Shift
CF_KL:DIWS_AIT4303B:Rs	CF_KL:DIWS_AIT4303B:Rs	2009/03/17 16:10:06	MINOR	MINOR	HIGH_ALARM	18.5
MEBT_CHOP:PS_2:V	mebbit chopper power supply one voltage fault	2009/03/17 16:10:06	MAJOR	MAJOR	LOLO_ALARM	0.0

Data Browser

MEBT_CHOP:PS_2:V [kV]

Previous drop: 2009/03/15 07:02:54

Another pickup: 2009/03/16 07:55:42

21:44:56

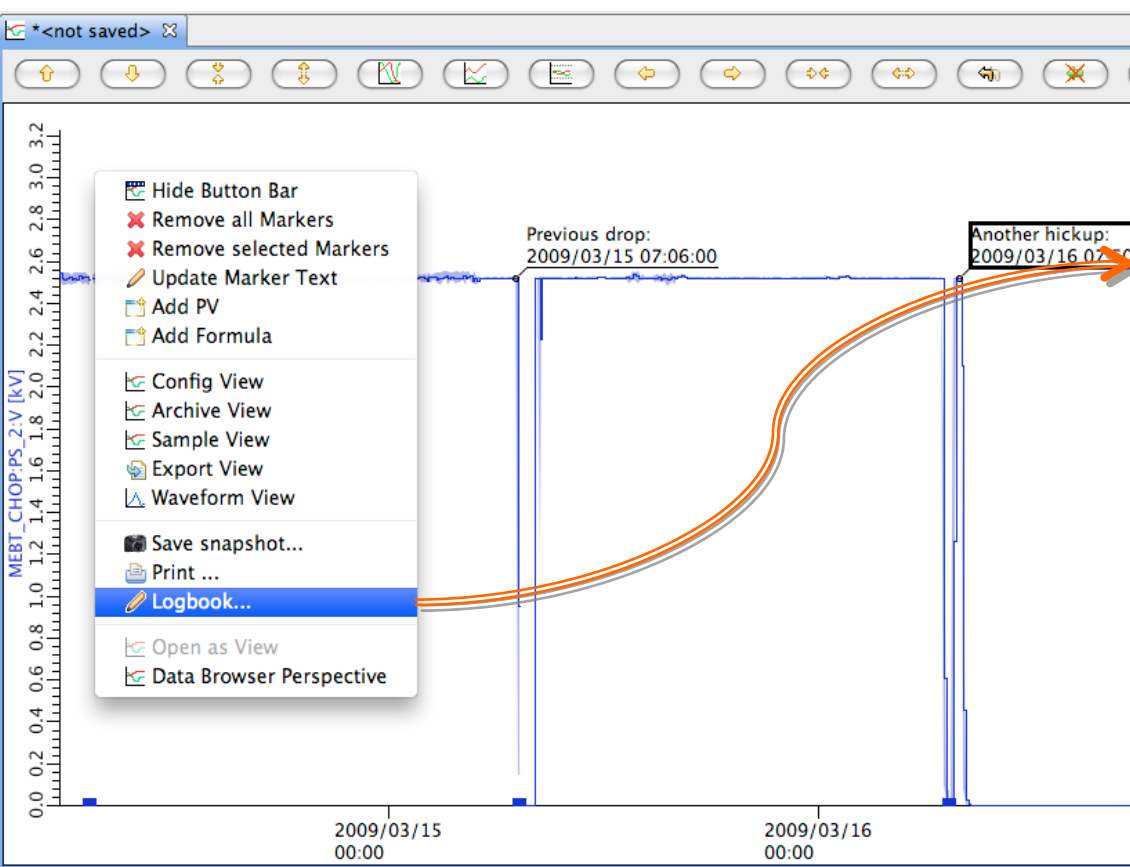
- Check MEBT PS 2 Chopper
- MEBT Chopper PS 2 Screen
- Logbook...
- Acknowledge
- Copy Pv Name to Clipboard
- CSS
- Configure Item
- Auto-size Columns
- Alarm Perspective

Data Browser

- Data Browser View
- PV Table
- Rack View
- PV Utility
- PV Fields Viewer
- Probe
- EPICS PV Tree

... → Data Browser → E-Log

**After inspecting alarm
PV's history, post
commented plot to E-Log**



Logbook Entry

Create electronic logbook entry

Enter user, password, maybe edit text.
Snapshot of current plot will be attached.

User name: Fred

Password:

Logbook: Electrical Systems

Title: Data Browser Snapshot

Text:

Just got another chopper trip.
This time was different, though,
because we did this and not that,
while before we tried that and not this.

Called Jim who suggested to wiggle
the blue cable before resetting

Attached image was created by Data Browser

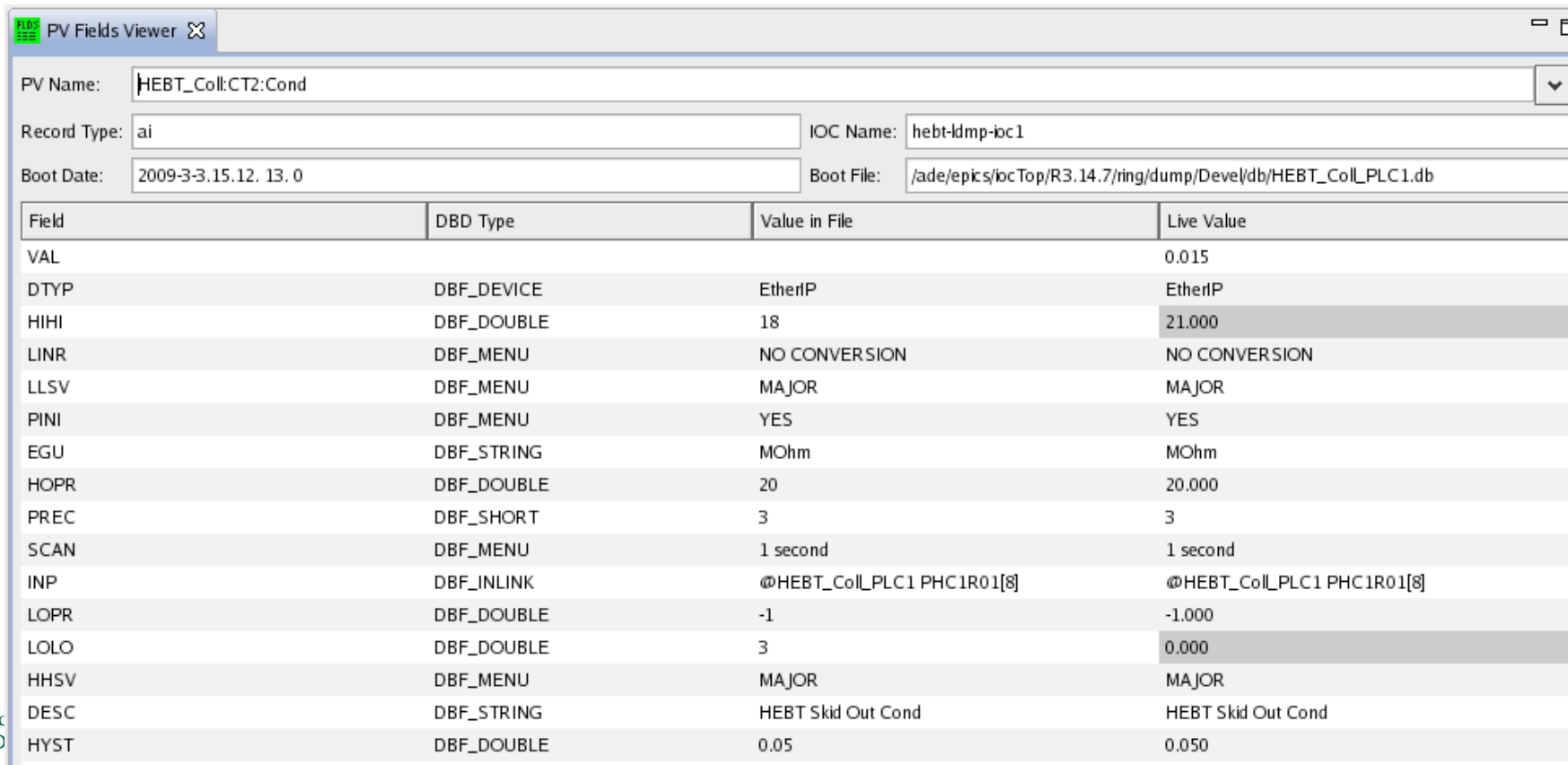
Attached Image...

Cancel OK

Site-specific Tools?

- **PV Utility**

- Detailed configuration info for a PV
 - @SNS: Info in Oracle, live data from EPICS
- Uses plugin to provide that info from e.g. site-specific RDB or LDAP or Device Server or ...



The screenshot shows the 'PV Fields Viewer' application window. At the top, the title bar reads 'F103 PV Fields Viewer'. Below the title bar, there are four input fields: 'PV Name: HEBT_Coll:CT2:Cond', 'Record Type: ai', 'IOC Name: hebt-ldmp-ioc1', and 'Boot Date: 2009-3-3.15.12. 13. 0'. Below these fields is a 'Boot File' field containing the path '/ade/epics/iocTop/R3.14.7/ring/dump/Devel/db/HEBT_Coll_PLC1.db'. The main part of the window is a table with four columns: 'Field', 'DBF Type', 'Value in File', and 'Live Value'. The table contains 17 rows of data for various fields like VAL, DTYP, HIHI, LINR, LLSV, PINI, EGU, HOPR, PREC, SCAN, INP, LOPR, LOLO, HHSV, DESC, and HYST.

Field	DBF Type	Value in File	Live Value
VAL			0.015
DTYP	DBF_DEVICE	EtherIP	EtherIP
HIHI	DBF_DOUBLE	18	21.000
LINR	DBF_MENU	NO CONVERSION	NO CONVERSION
LLSV	DBF_MENU	MAJOR	MAJOR
PINI	DBF_MENU	YES	YES
EGU	DBF_STRING	MOhm	MOhm
HOPR	DBF_DOUBLE	20	20.000
PREC	DBF_SHORT	3	3
SCAN	DBF_MENU	1 second	1 second
INP	DBF_INLINK	@HEBT_Coll_PLC1 PHC1R01[8]	@HEBT_Coll_PLC1 PHC1R01[8]
LOPR	DBF_DOUBLE	-1	-1.000
LOLO	DBF_DOUBLE	3	0.000
HHSV	DBF_MENU	MAJOR	MAJOR
DESC	DBF_STRING	HEBT Skid Out Cond	HEBT Skid Out Cond
HYST	DBF_DOUBLE	0.05	0.050

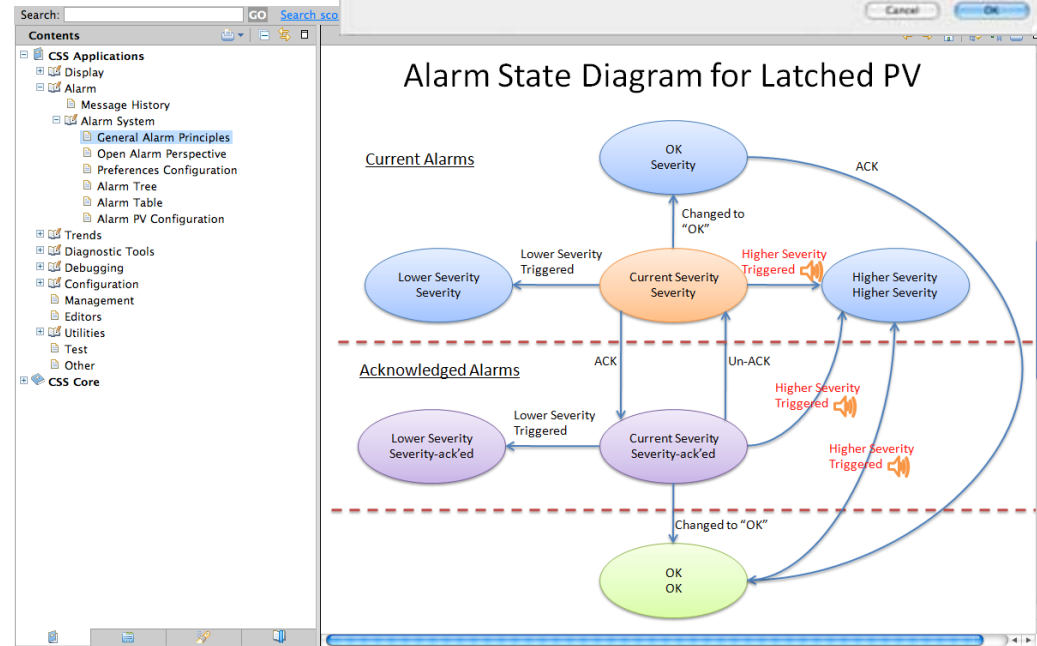
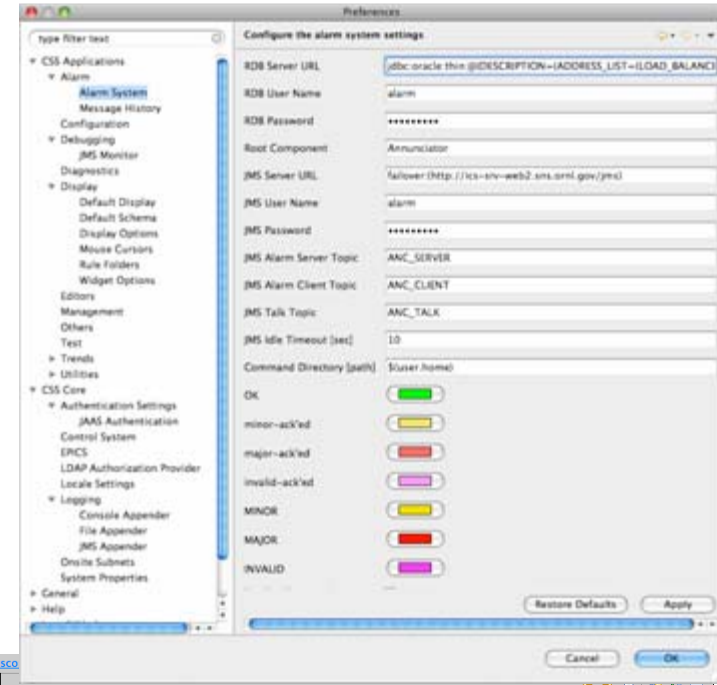
Synoptic Display

- **Operator Panel Editor & Runtime**
 - All common widgets
 - Alignment, Layers
- **Supports multiple PV types**
- **Every widget aspect can be 'dynamic'**
 - Change displayed value, color, position, size, font, ... based on PV



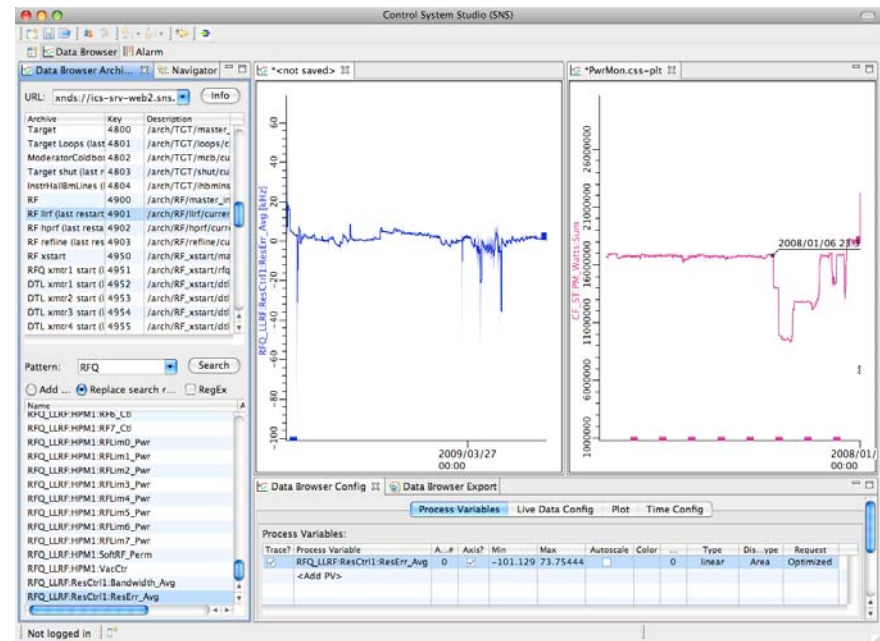
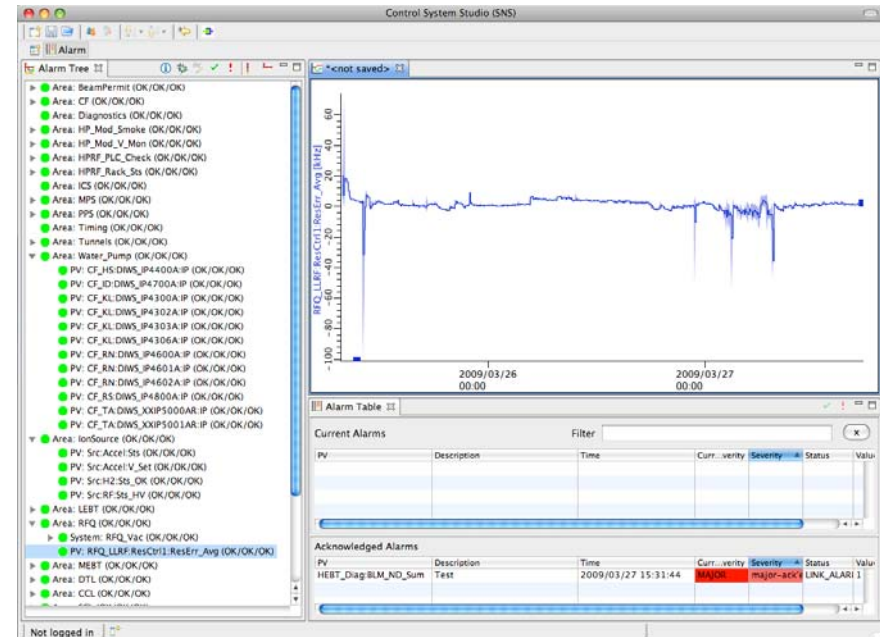
Integrated Help, Preferences

- **Uniform access to settings, searchable help**
 - Applications
 - Support Libraries
 - Logging
 - Control System access



Eclipse Benefit: Flexible Layout

- Panels can be closed, reopened, repositioned
- Multiple Perspectives
 - Name, Save, Restore
- Multiple document instances share same configuration panels



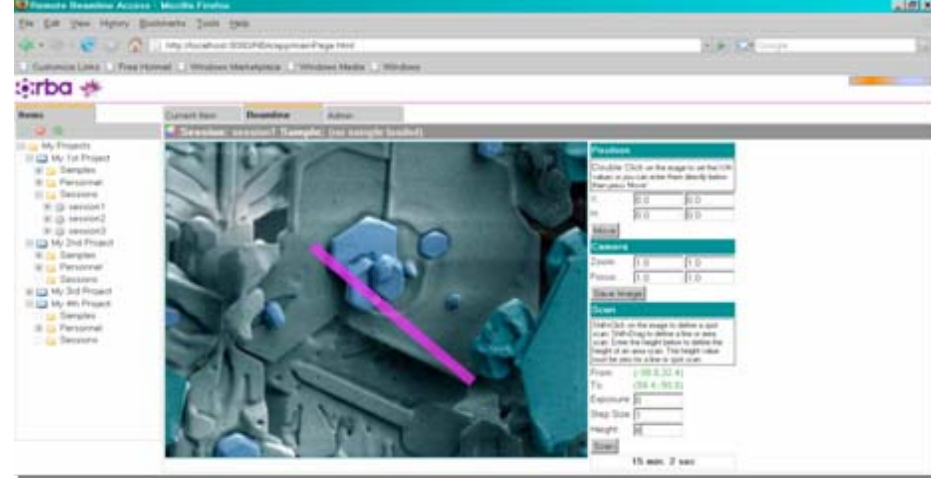
Site-Specific Packaging

- **Pick applications of interest**
- **Select/add support for your**
 - Data sources
 - Authentication
 - Authorization
- **Add custom “welcome” screen**



What about the Web?

- **Only needs browser:**
 - Google Mail, Documents
 - Canadian Light Source Remote Access
- **Speed?**
 - EPICS Web-CA web browser plugin for direct access to control system protocol (but: no longer pure HTTP)
- **JavaScript + Style Sheets + Server-side apps?**
 - Google Web Toolkit, Eclipse Rich Ajax Platform (RAP) might allow both rich clients and web applications from single-source Java



UI Trends Conclusion

- **Java provides OS portability**
- **Frameworks like Eclipse & CSS go beyond standalone, one-off applications**
 - Turn generic and site-specific applications into homogeneous tool
- **Challenge: Code beyond “works for me, now”**
 - Externalize strings
 - Plan for extensibility
- **Next Frontier: The Web**