Controls

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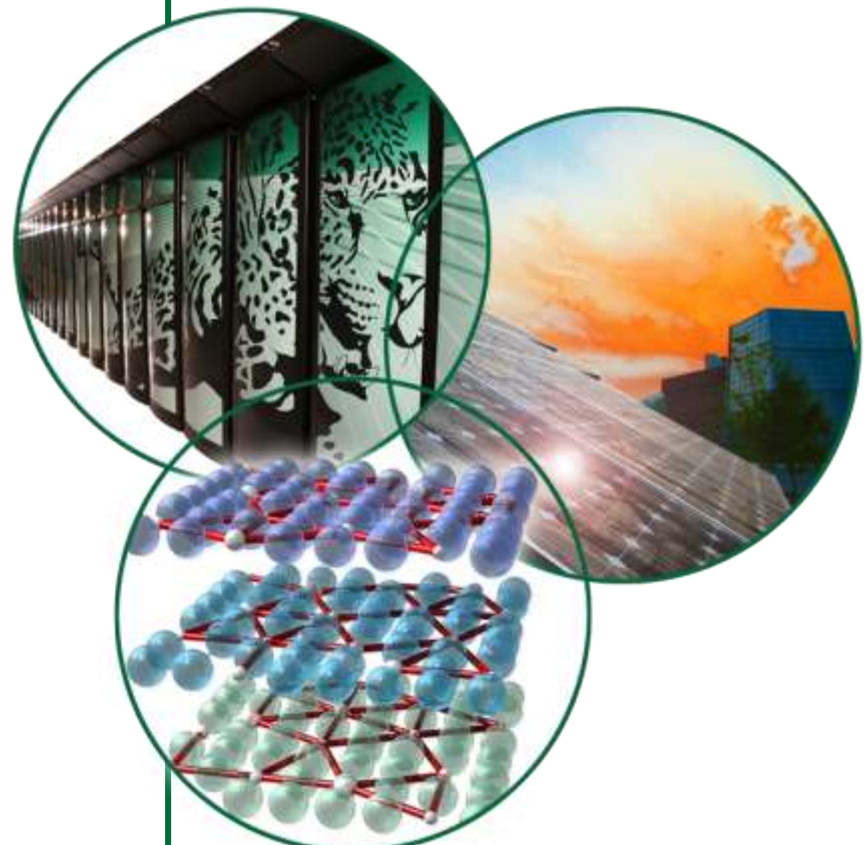
Controls Group Leader+

1/10/12



U.S. DEPARTMENT OF ENERGY

OAK RIDGE NATIONAL LABORATORY

MANAGED BY UT-BATTELLE FOR THE DEPARTMENT OF ENERGY

Outline

- Reorganization
- Issues from 2010 AAC
- Availability
- Cyber Security
- Progress & Plans
- Budget

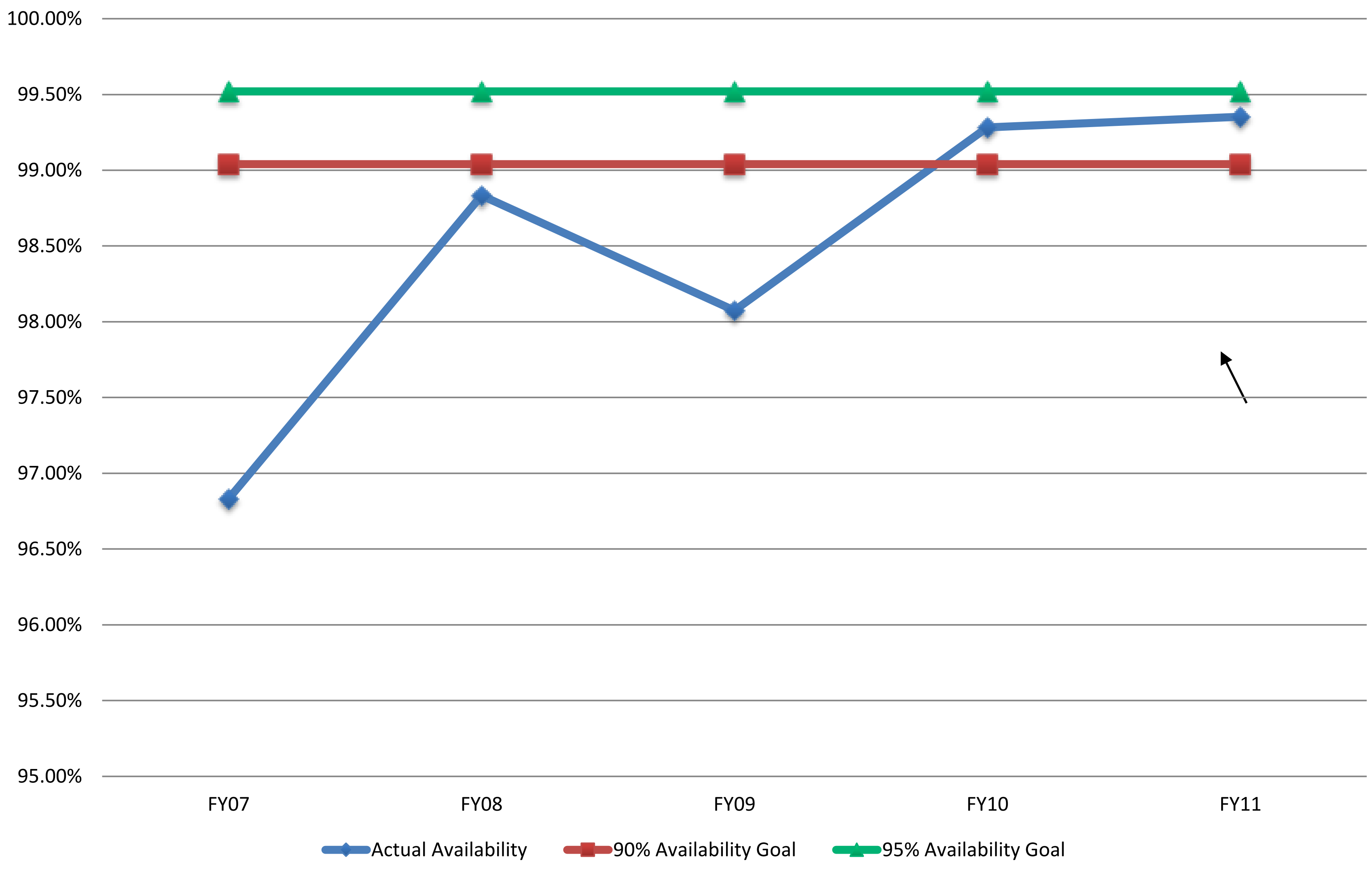
RAD Reorganization

- Created Data Operations composed of
  - Accelerator Controls Group
  - Instrument Data Acquisition and Controls Group
  - Instrument Data Management Group
  - SNS IT Group (largely matrixed from ORNL IT)
- Brings together ~70 people with related skill sets
- Opportunity to standardize instrument slow controls using methods that have proven reliable in the accelerator
- Some effort formerly spent on accelerator controls will used to augment instrument effort
- Challenge is to maintain accelerator availability with less manpower

Issues from 2010 AAC

- PLC/IOC/communication problems
  - ✓ PLC replacements and firmware upgrades were completed
  - ✓ No further problems
- MPS delay issue
  - ✓ Mitigations completed throughout machine
  - ✓ Subsequent periodic measurements confirm system continues to meet requirements
- LLRF Performance issue
  - ✓ Upgraded VME CPUs, VxWorks and EPICS
  - ✓ Successfully addressed loading issues
  - ✓ Provides upgrade path for other IOCs

Control System Availability FY07 – FY11



Cyber Security Challenges

- ORNL was the target of an aggressive cyber attack initiated via phishing e-mails in April 2011
- Malware eventually infiltrated a large number of ORNL computers and ORNL disconnected from the internet for 2 weeks
- Disconnected Integrated Control System (ICS) network from the ORNL enterprise network for over 4 weeks
- ICS and accelerator continued to operate normally and our computers were successfully protected
- No external access to the control system during this time
- Scanned BI Windows systems to ensure they were not compromised
- Reevaluated ICS firewall rules and selectively restored only as needed
- Two other less serious cyber events in FY11 also led to running the accelerator in isolation mode for short periods of time

Slow Controls Progress – Many Upgrades

- Accelerator
  - MEBT Solid State amplifiers
  - Resonance Cooling Control System
  - Momentum Dump air cooling
  - New Primary and Secondary Stripper foil systems
- Conventional Facilities (CF)
  - Cooling tower and chiller sequencing
  - Target building air handlers
  - Klystron building DIWS
- Instruments
  - Specialized gas management systems (3)
  - Vacuum and CF controls for new instruments (5)
  - Standardized/enhanced vacuum controls (5)

Slow Controls Plans

- Development for Accelerator
  – Improvements to CF DIWS and HVAC system controls
  – Spare RFQ test stand controls
  – CTF and spare cryomodule controls
  – New Ion Source RF solid-state amplifiers controls
  – Upgrade Target cooling water system H2/O2 analyzer systems
- Continued development for Instruments
  – New and enhanced vacuum controls
  – Specialized gas management system controls
  – Sample changer automation
  – New instrument slow controls in EPICS

Infrastructure Progress

- Replaced core routers and continued technology refresh of oldest 25% of network switches and servers for accelerator
- Additional UPS and back-up emergency generator being installed January 2012 (GPP project)
  - Augments overtaxed capacity
  - Improves fault tolerance
  - Decouples accelerator computing systems from enterprise IT systems
- Established internal network device management for Test Network and built Development Network
  - Allows local control of non-standard non-desktop devices
  - Reduces cyber risks from non-patchable devices
  - Facilitates testing outside of accelerator and enterprise networks
  - Reduces costs by eliminating overhead fees for unused IT services
    - Test Network ~$200K/year
    - Development Network ~100K/year

Hardware Progress

- Completed MPS modifications to ensure system responses time meets specification
- Noise mitigation efforts successful – very few noise related trips
- Observed developing trend of fiber optic link failures
  - Performing monthly measurements to track fiber performance and replace fiber links before failure
- Discovered design flaw in MPS that will allow an IC to fail silently
  - Performing checks every maintenance day to look for failed ICs until a design change is developed

Hardware Challenges

- Obsolescence
  - MPS and Timing systems contain components at or near end-of-life
  - On-going effort to address components according to spare levels, probability of failure and consequences of failure
- Timing
  - Master – replacement designed & built; testing in RFTF
  - Timing Receiver – replacement designed; 60 delivered, running unit tests, plan to run with new timing master in RFTF
  - Fiber-to-Fiber Fan-out – parts no longer available for repairs; < 10% spares; new design in progress
  - Fiber-to-Copper Fan-out – limited ability to repair; 10% spares; new design will follow fiber-to-fiber fan-out design
- MPS
  - Trigger Control Chassis - unique interface chassis with no spare; new chassis (and spares) designed, built, tested, installed in accelerator
  - System needs redesign to be sustainable for the future – resource limited

Protection Systems Progress

- Instruments
  - Installed IPPS' for new instruments: NOMAD, HYSPEC, VISION
  - New IPPS' use "safety" (SIL 3 rated) PLC equipment in lieu of the industrial PLC equipment used in the original designs
    - Currently no budget to upgrade existing PPS/IPPS PLC to SIL 3
  - Installed process monitoring system for the LH_2 experiment for FNPB
- Radiation monitor upgrade (Chipmunks)
  - To improve reliability (instabilities encountered with HV board and electrometer)
  - After extensive tests, 10 spare units were upgraded
  - New units will be deployed following an independent review
- Accelerator and Target
  - Adding redundant 24 VDC power supplies to PPS to eliminate downtime due to these failures (50% complete)

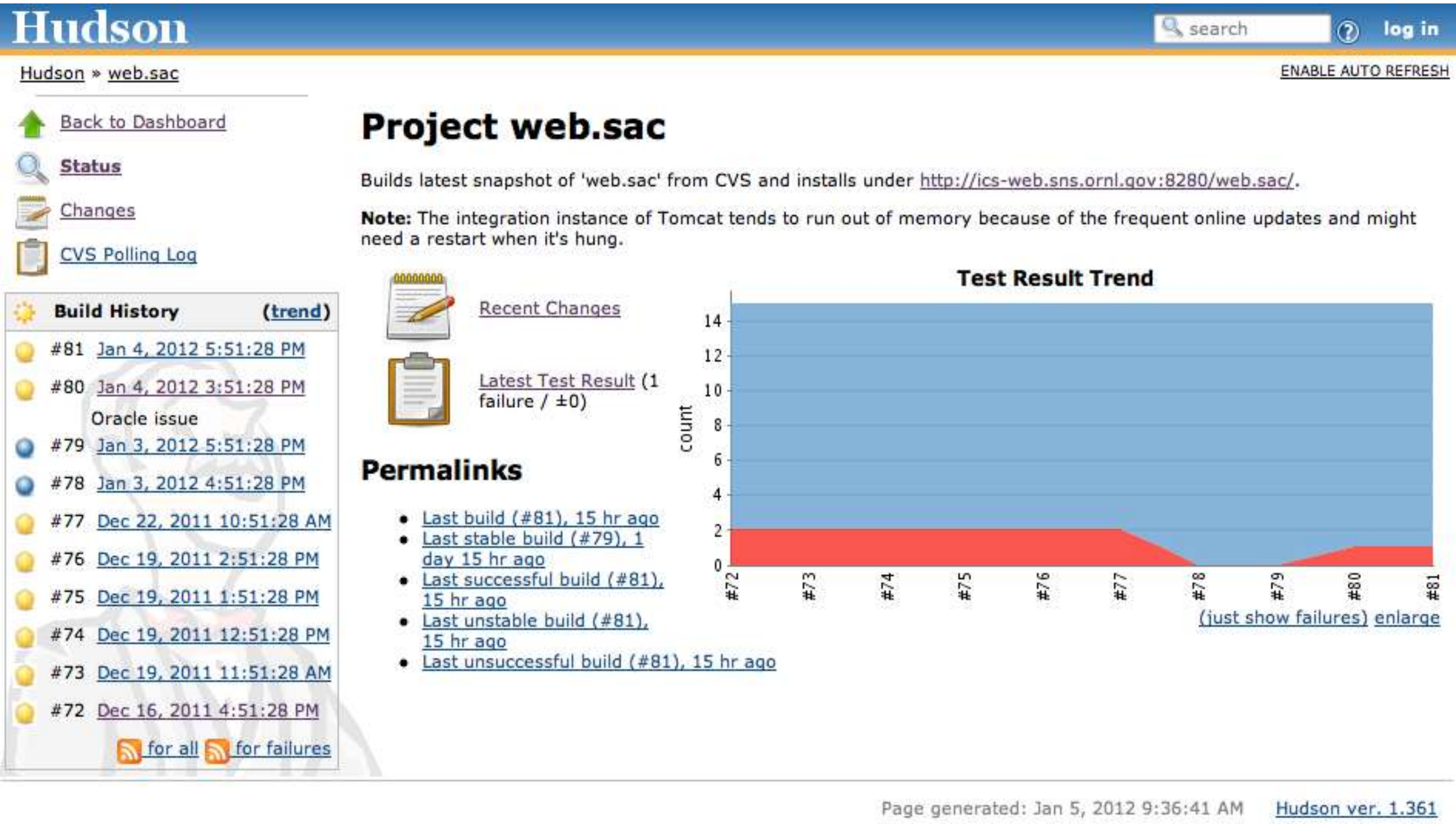
Protection Systems Plans

- Complete IPPS' for MaNDi and USANS
- Finalize testing/approval of Chipmunk upgrade
- Develop accelerator PPS PLC replacement testing procedures (minimize downtime in the event of a processor failure)
- Complete PPS redundant power supply upgrade
- Continue support for non-PPS instrument equipment (BL 11a AGES, BL 13b LH_2 Target monitoring)
- Continue support of existing operations
  - Annual certifications - PPS for accelerator and each instrument (13)
  - Radiation monitor testing & calibration
  - Oxygen monitor testing & calibration

Continuous Improvement

- Standardized IOC setup for VME and Linux IOCs to improve maintainability
- Hundreds of controls assets added to DataStream
- Developed approved Software Quality Assurance plans for controls and protection system software
- Developing Disaster Recovery Plan for accelerator controls
- Plan to adopt commercial product for PLC software version control (Asset Center)
- Developed boundary scan test adapter to facilitate consistent automated testing of new boards
- Using continuous integration testing framework (Hudson) for selected software projects (e.g. CSS)

Hudson



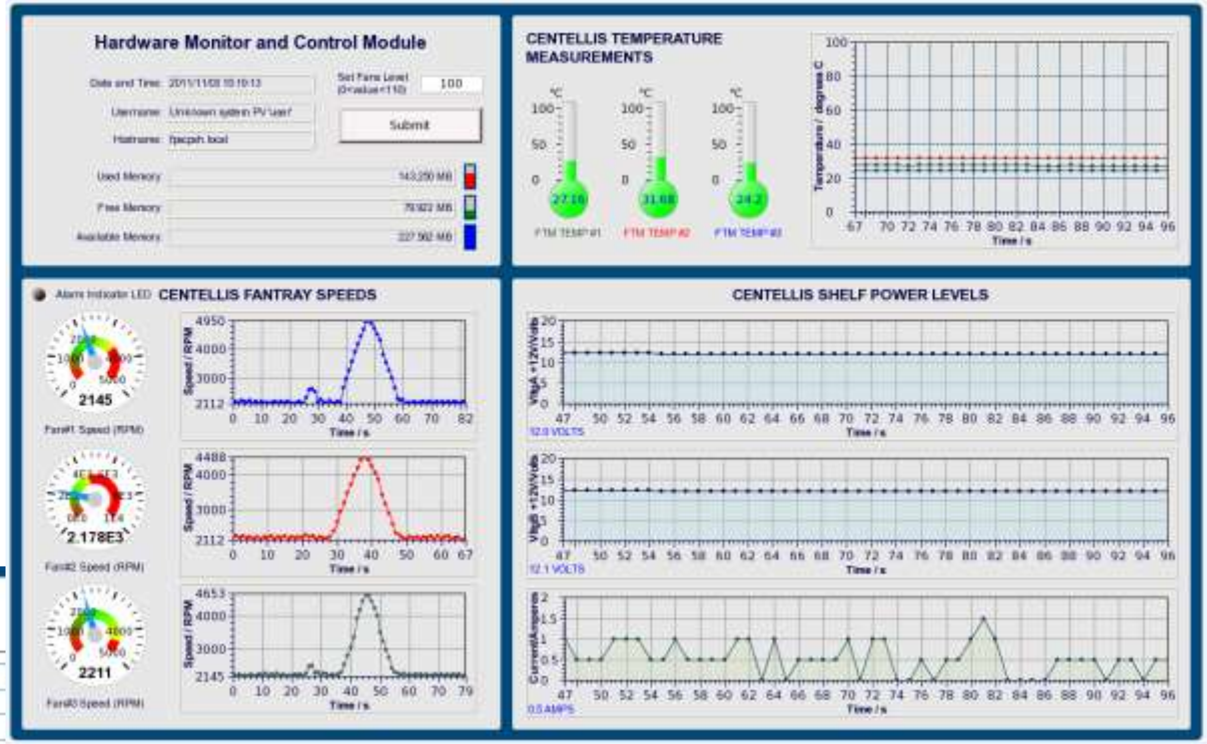
Hudson
search
log in
Hudson » web.sac
ENABLE AUTO REFRESH
Back to Dashboard
Status
Changes
CVS Polling Log
Build History (trend)
#81 Jan 4, 2012 5:51:28 PM
#80 Jan 4, 2012 3:51:28 PM
Oracle issue
#79 Jan 3, 2012 5:51:28 PM
#78 Jan 3, 2012 4:51:28 PM
#77 Dec 22, 2011 10:51:28 AM
#76 Dec 19, 2011 2:51:28 PM
#75 Dec 19, 2011 1:51:28 PM
#74 Dec 19, 2011 12:51:28 PM
#73 Dec 19, 2011 11:51:28 AM
#72 Dec 16, 2011 4:51:28 PM
for all
for failures
Project web.sac
Builds latest snapshot of 'web.sac' from CVS and installs under http://ics-web.sns.ornl.gov:8280/web.sac/.
Note: The integration instance of Tomcat tends to run out of memory because of the frequent online updates and might need a restart when it's hung.
Recent Changes
Latest Test Result (1 failure / ±0)
Permalinks
Last build (#81), 15 hr ago
Last stable build (#79), 1 day 15 hr ago
Last successful build (#81), 15 hr ago
Last unstable build (#81), 15 hr ago
Last unsuccessful build (#81), 15 hr ago
Test Result Trend
count
0
2
4
6
8
10
12
14
#72
#73
#74
#75
#76
#77
#78
#79
#80
#81
(just show failures) enlarge
Page generated: Jan 5, 2012 9:36:41 AM
Hudson ver. 1.361

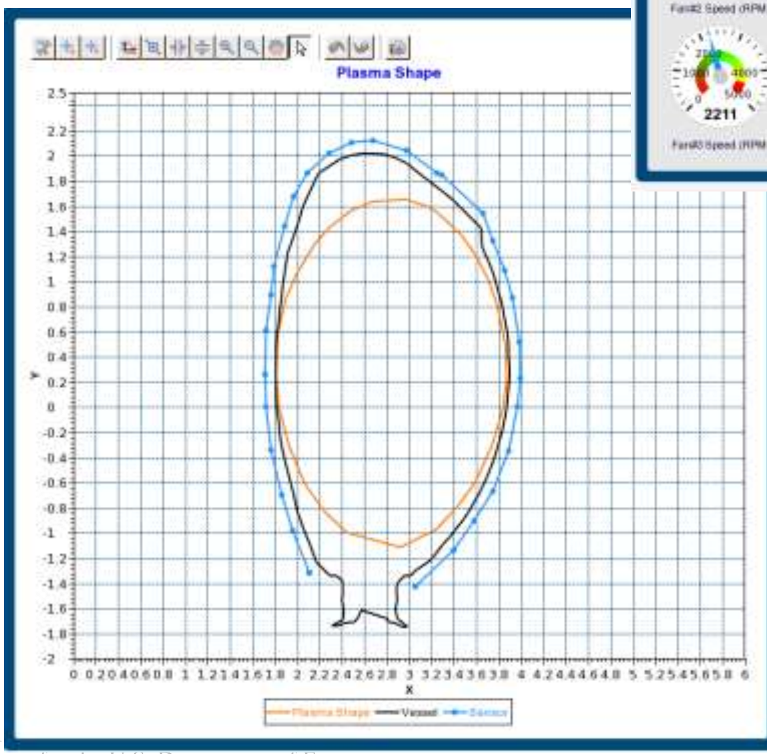
Software Progress - Control System Studio

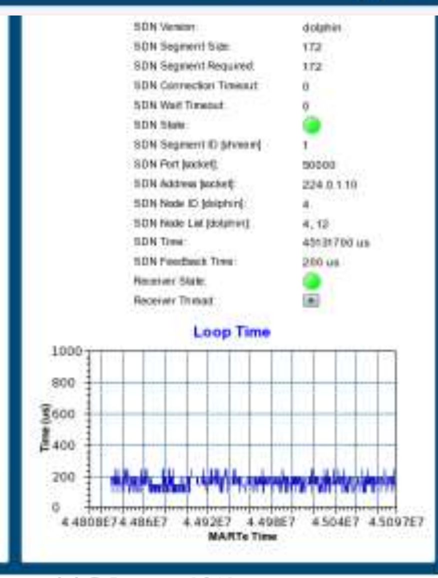
- Development continues on CSS
  - Next generation EPICS system toolset (archiver, archive viewer, alarm handler, OPI,…)
  - Integrated products provide a common look and feel
  - Enables interoperability between application
  - RDB configuration and logging
  - Quickly growing collaborative community

CSS @ ITER

ITER is a CSS User and Contributor





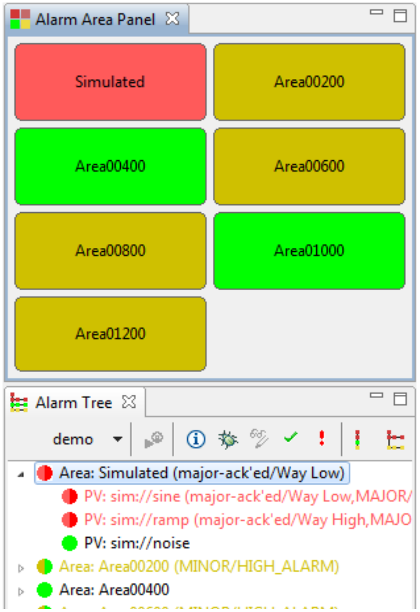


CSS Workshops

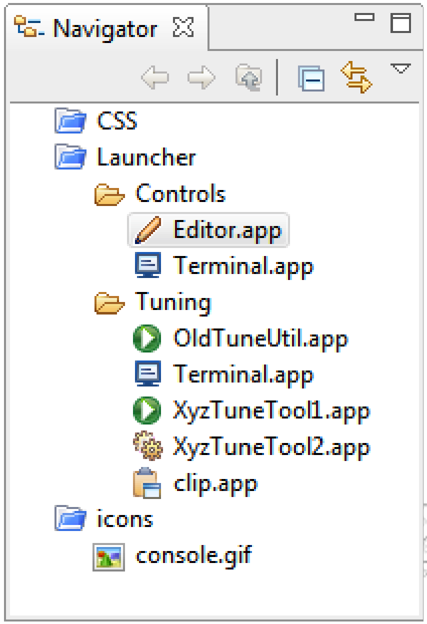
- KEK, J-PARC - Summer 2011
  - Alarm system demo w/ 50000 inputs
- CEA/Saclay - October 2011

- NSRRC, Taiwan - January 2012

New Alarm "Area Panel"

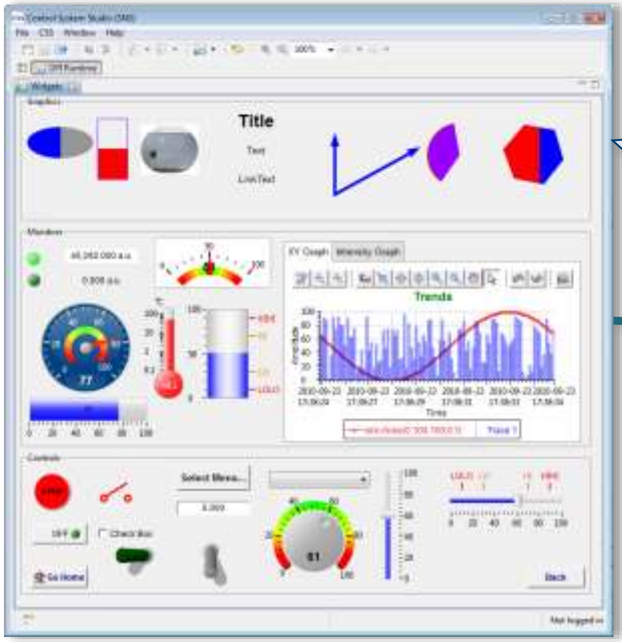


New "Application Launcher"



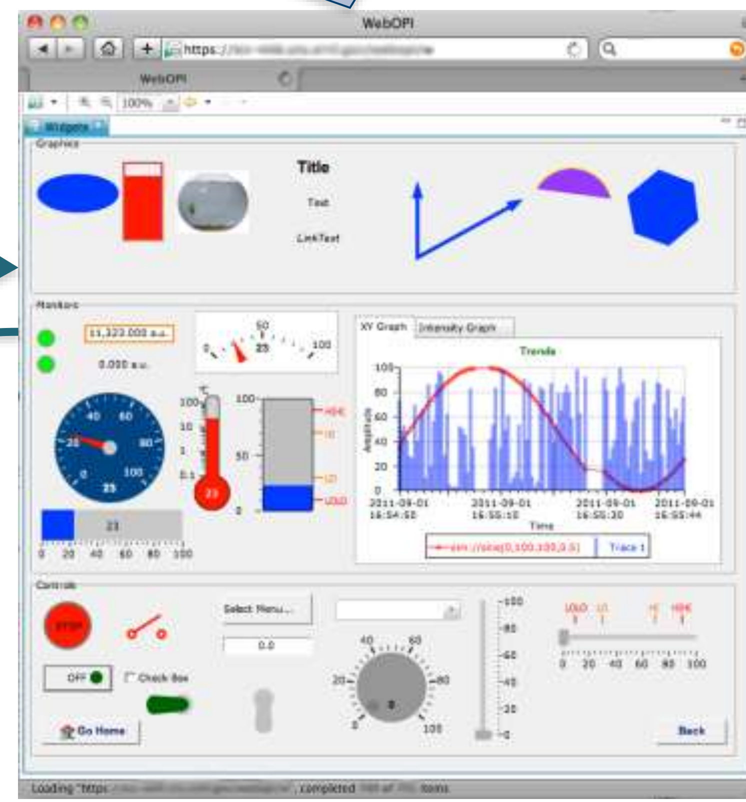
Remote Control System Monitoring

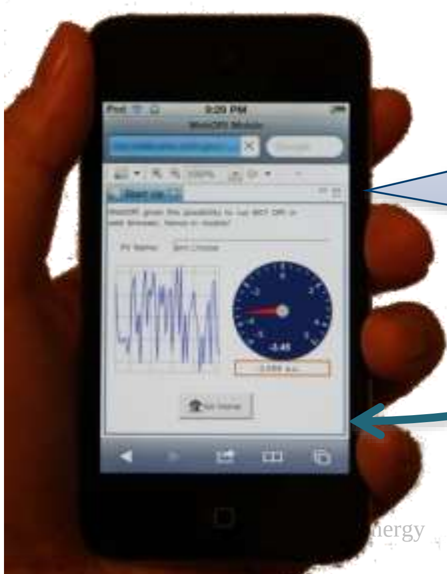
CSS OPI via the Web



Original CSS panel

99% same in web browser





Including smart phones

SNS Status Web Pages

Status

Overview | Beam | Target | Logbook | Shift | Experiments | Availability | Operators | Mobile | Other

As of Thursday, September 01, 2011 14:09:11
Manual Beam Switch Turned On
MPS Allows Beam
Continuous Shot Mode
To: Target, MPS: 1 mSec
Power at: 680.91 kW

As of 15:28:00 on 09/01/2011,
Reactor Power is at 0 MW
The reactor is currently shutdown for the end-of-cycle 437 refueling outage.
Startup for cycle 438 is currently planned for Monday, October 10.

Phone Numbers

SNS Central Control Room	[redacted]
SNS Instrument Hall Coordinator	[redacted]

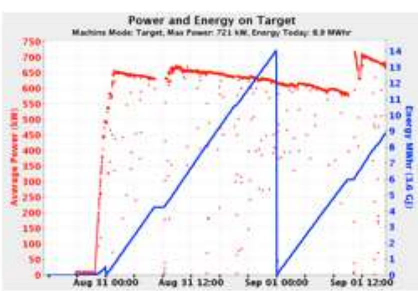
Who's Running it.

Employee	Title
[redacted]	Shift Supervisor
[redacted]	Accelerator Specialist
[redacted]	Accelerator Specialist
[redacted]	Operations Shift Technician
[redacted]	Radiation Control Technician
[redacted]	Instrument Hall Coordinator

Weather

Oak Ridge, TN
93 °F / 34 °C
Clear
at 02:53 PM
Advisory!
Click for Forecast

SNS Energy Plot



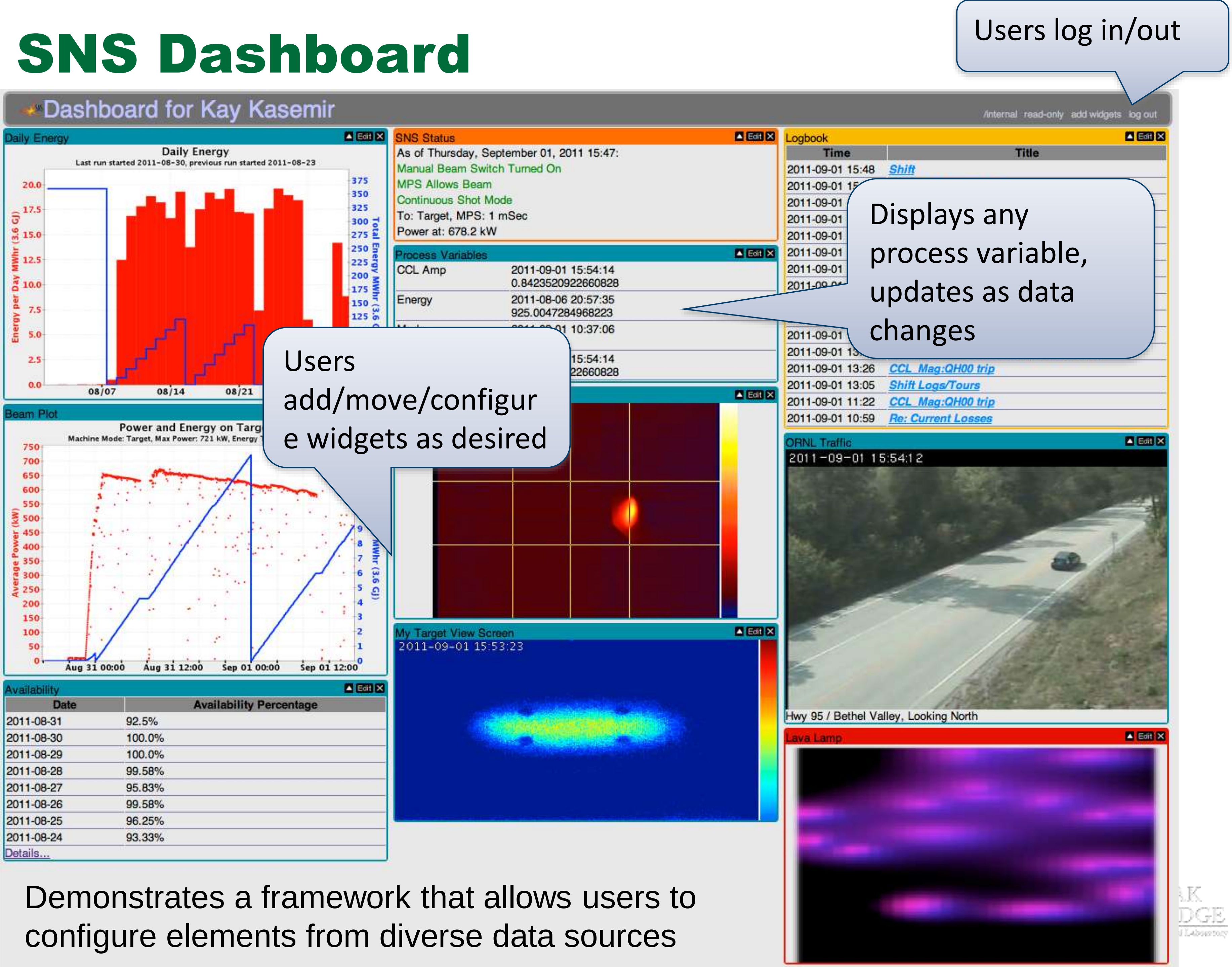
Accelerator Messages

Accelerator Status 2011-09-01 12:04	**Beam is on target at 700 kW.**
CP 1B repair 2011-08-22 14:16	**Upon completion of the RFQ Cryo Pump 1B repair/replacement, please type the following in an open terminal window (accl-oper privileges are all that's necessary): [accl-oper@ics-opi-ccr11 ~]$ caput [redacted]Summary_CP.INPB "RFQ_Va[redacted]S" This restores the status indicator for this device to the startmap geographical summation indications.**

Logbook

Time	Title
2011-09-01 14:29	Ring RF Station 13 repairs complete
2011-09-01 14:25	Re: Re: Ring BPM B08 not working
2011-09-01 14:22	Re: Re: Spark Counter Interlock
2011-09-01 14:06	Re: Spark Counter Interlock
2011-09-01 13:49	Target Module Upper Manifold Seal Pressure
2011-09-01 13:39	nitrogen delivery
2011-09-01 13:37	Spark Counter Interlock
2011-09-01 13:31	Re: RID Drain Tank High Level Indicator
2011-09-01 13:26	CCL_Mag:QH00 trip
2011-09-01 13:05	Shift Logs/Tours

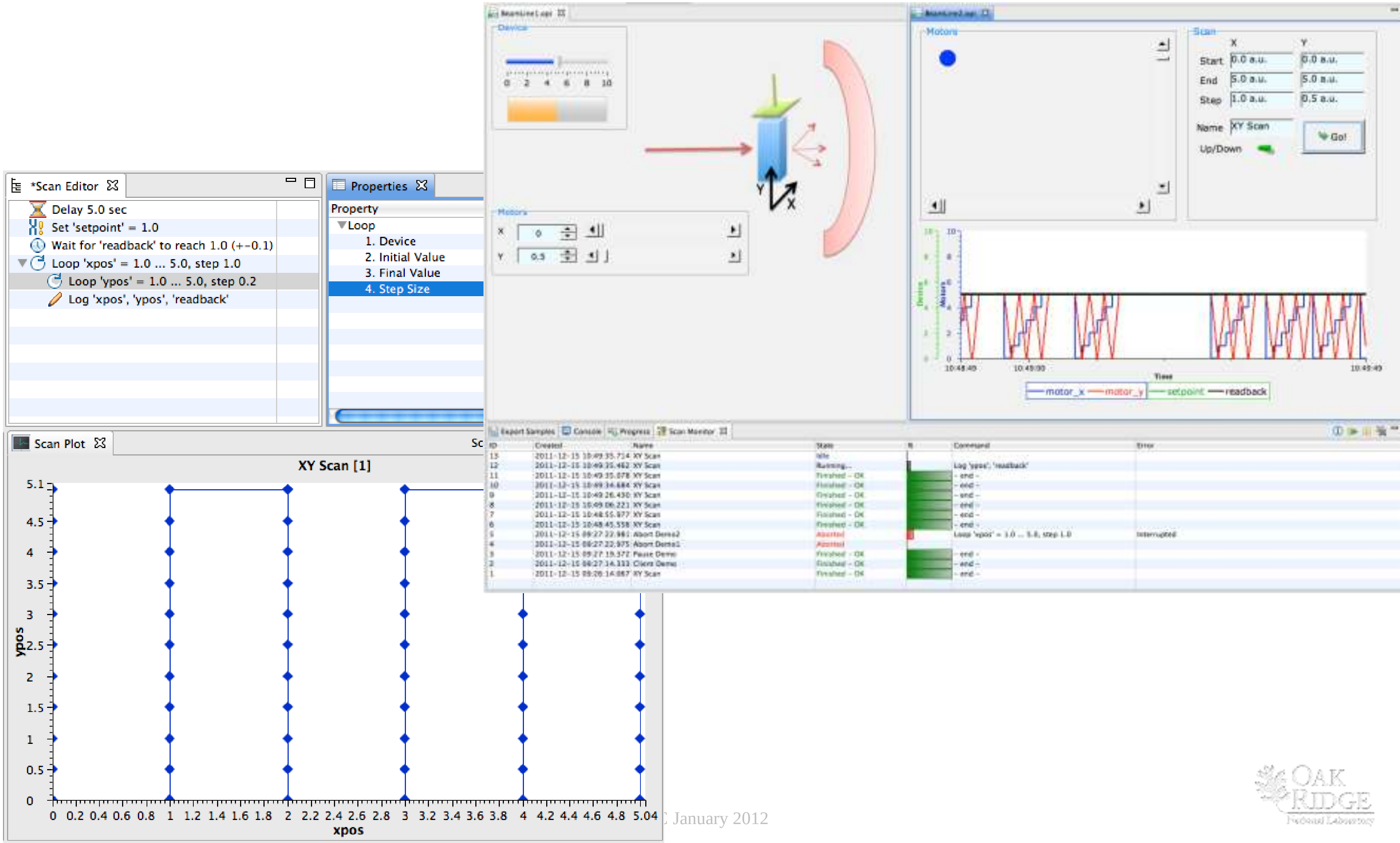
SNS Dashboard



Demonstrates a framework that allows users to configure elements from diverse data sources

Under Development: Scan Server

Extend capabilities of CSS to serve SNS Instruments



Budget

- Controls budget is dominated by labor costs (~85%)
- Labor budget reduced ~5+ FTEs (15%)
  - Two engineers took voluntary separation offer (12/11)
  - One engineer deployed for military duty for one year (12/11)
  - Selling ~2+ FTEs of engineering effort to other projects (ITER, FRIB) to fit within reduced labor budget while preserving access to critical skills
  - Diverting ~4 FTEs from accelerator controls to instrument work
- Procurement budget reduced ~200K (16%)
- Using students (5) to compensate for technician shortage

➢ Less labor available for accelerator controls work

Conclusions

- Control system is operating well; meeting operational needs and achieving availability goals
- Main challenge is to balance competing demands for limited resources
  - Accelerator, Target, CF
  - Instruments
  - ITER
  - FRIB
- While maintaining availability and living with much tighter budget

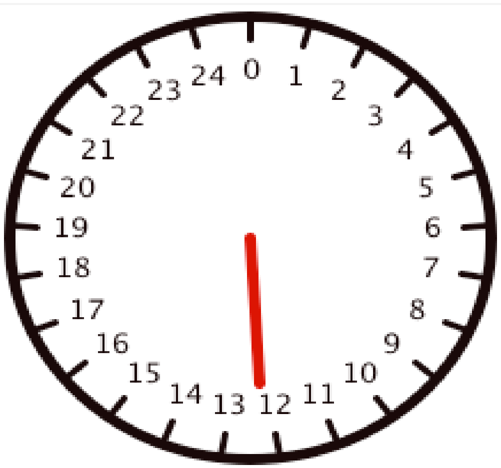
Conclusion - Do more with less ☺

CSS Clock

The control system environment has unique timing requirements. Most control systems include a specialized hardware timing system for this purpose, which provides the control system computers with event triggers and highly accurate time stamps.

The humans who are dealing with the control system, on the other hand, have so far been poorly integrated, and consequently often suffer from schedule pressure.

The CSS clock provides the people who interact with the control system with a highly accurate clock, fully integrated into the Control System Studio workbench.



In contrast to a layman's 24 hour clock, the CSS clock displays a 25 hour clock face, thereby providing CSS users with an extra hour each day at no additional charge! The above image was taken at what a non-CSS clock would consider 11:45 hours, whereas the CSS clock is clearly ahead of its time, displaying about 12:14 on the 25 hour scale.

Even better: You can change the clock's range from the default 25 hours via the preference pages.