SNS Control System

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Outline

- **Overview**
- **Challenges**
- **Plans**

Scope of Work

- **Instrumentation and Controls, Timing, Machine Protection, Personnel Protection**
  - **SNS Accelerator**
  - **Cryogenics**
  - **RF Test Facility**
  - **Target**
  - **Instrument PPS**
  - **Conventional Facilities**
- **High level applications provided by Physics Group**
- **Diagnostics provided by Beam Instrumentation Group**

Control System Overview

- Large, EPICS based system
- Highly distributed
- Standards defined early in the project
  - EPICS 3.14.8.2
  - VME
  - IOCs - MVME 2100s, 5100s
  - Allen Bradley ControlLogix PLCs
  - Oracle RDB
  - EDM
  - PLC based PPS
  - CISCO network hardware

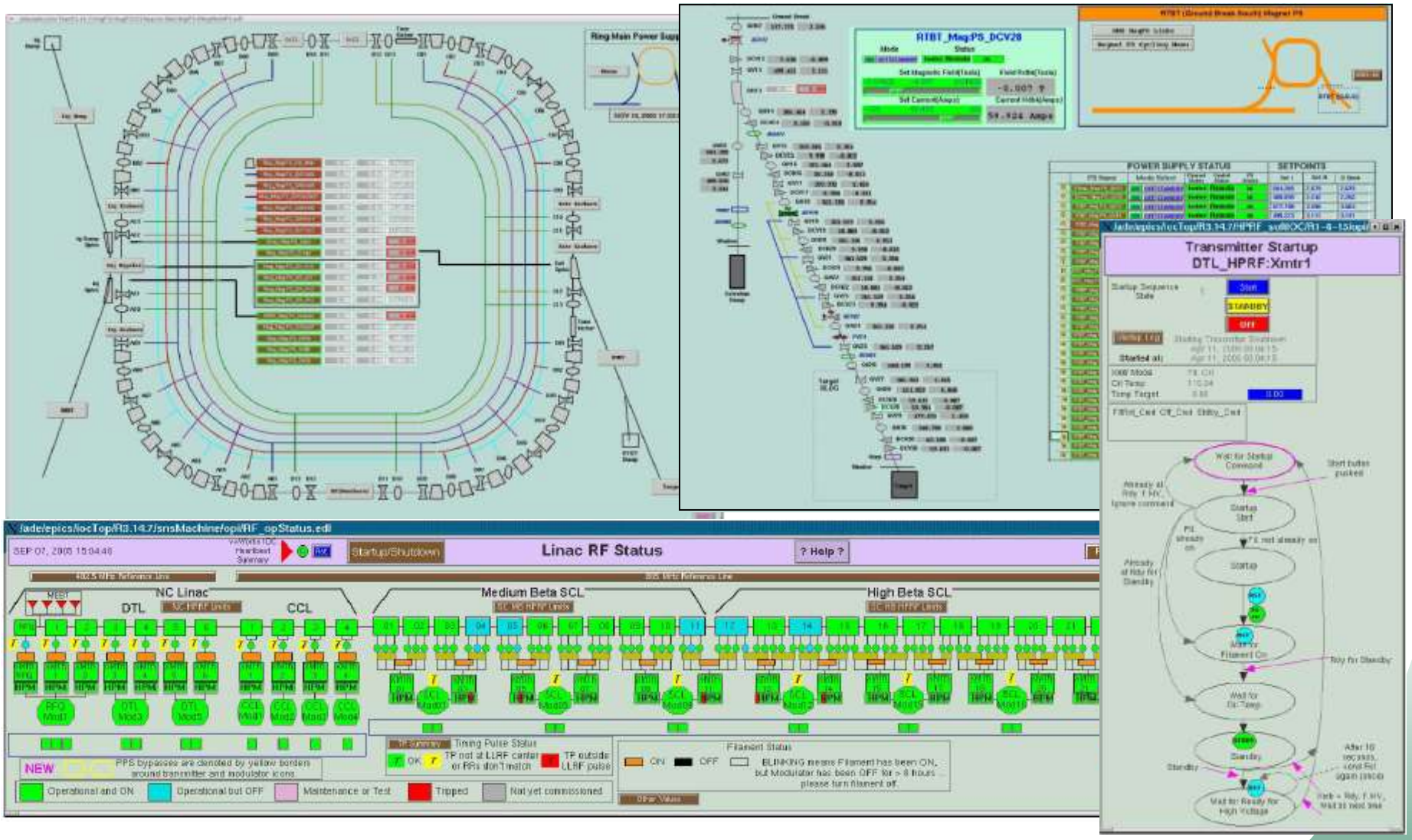
Architecture

How Big Is It?

- ~180 VME IOCs
- ~80 Soft IOCs
- ~300 Diagnostics IOCs ???
- ~500,000 Process Variables, including ~125,000 for diagnostics
- Estimated 100,000 channels
- SNS has the largest operational EPICS control system in the world

Control Room

User Interfaces



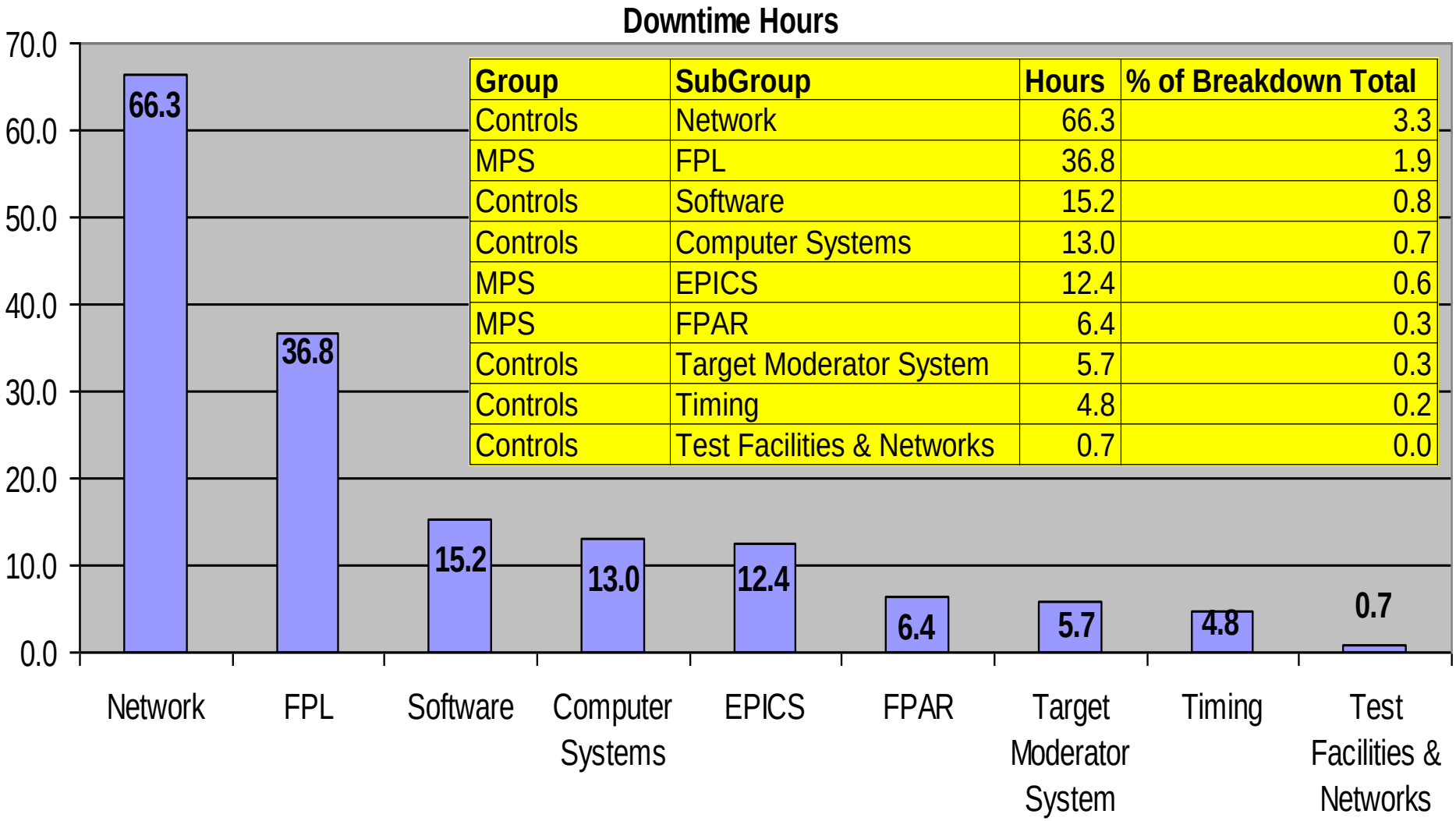
Challenges

- **Continue to develop and upgrade control system elements without disrupting machine operations**
- **Improve availability**
- **Requires**
  - **Greater discipline, structure, planning**
  - **More rigorous configuration control**
  - **More complete documentation and communication**

Availability

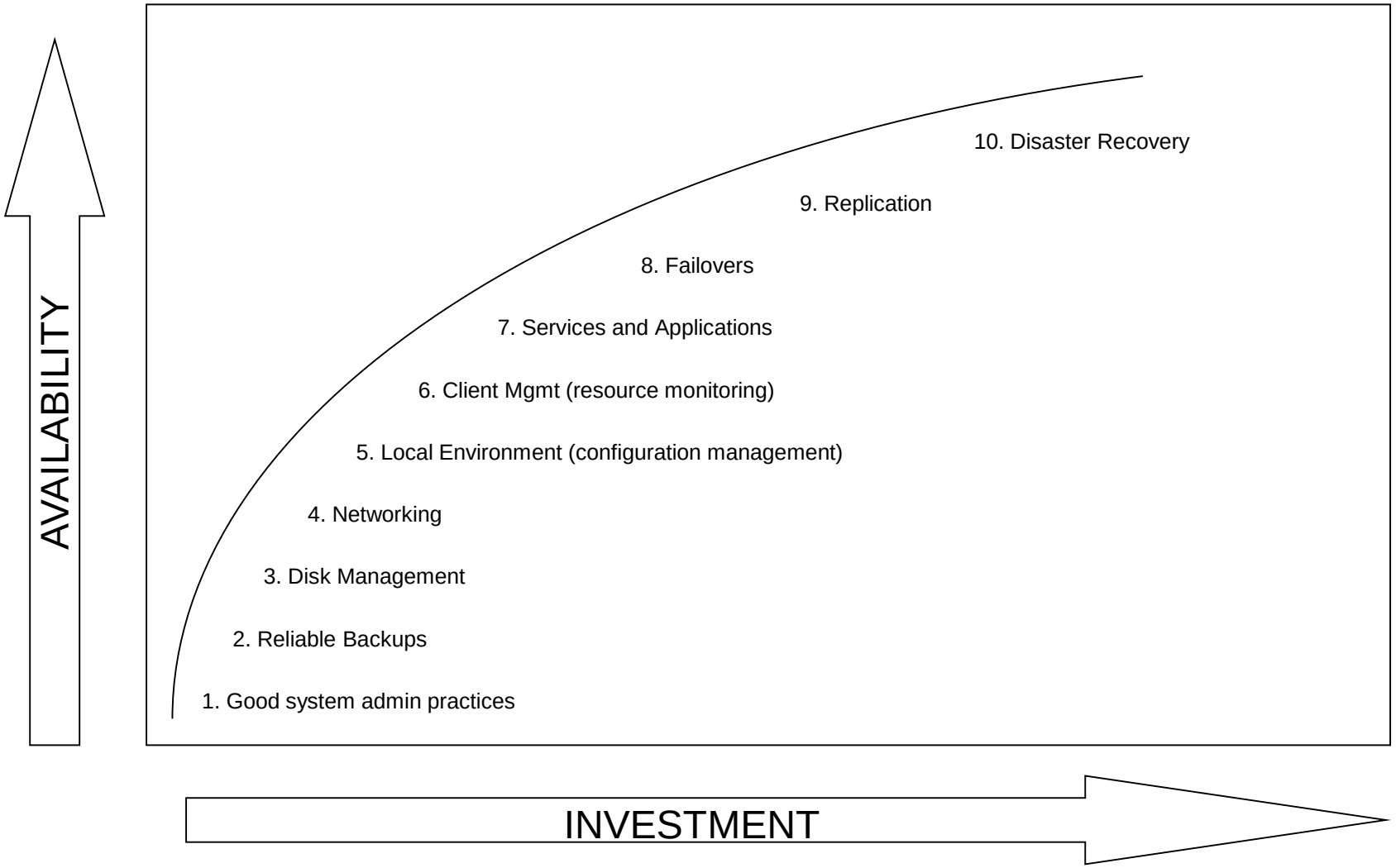
- Goal for 2008 – cut downtime in half
- For FY07, control system, including MPS and PPS
  - 180.3 hours down
  - 9.1% of all downtime
  - 3rd largest contributor to downtime

Controls/MPS downtime by subgroup



Group	SubGroup	Hours	% of Breakdown Total
Controls	Network	66.3	3.3
MPS	FPL	36.8	1.9
Controls	Software	15.2	0.8
Controls	Computer Systems	13.0	0.7
MPS	EPICS	12.4	0.6
MPS	FPAR	6.4	0.3
Controls	Target Moderator System	5.7	0.3
Controls	Timing	4.8	0.2
Controls	Test Facilities & Networks	0.7	0.0

Availability - We should learn from industry



The Availability Index (adopted from Blueprints for High Availability)

Availability

- First steps
  - Analyze causes of past downtime and target improvements to address biggest loss and highest frequency problems
  - Build on a solid foundation and minimize risk in the event of a failure
    - Harden infrastructure – backups, patching, file organization, reproducibility after reboots
    - Improve configuration control and documentation

Archiving

- **Currently**
  - **Store ~2000 samples/sec**
  - **Sampling ~80000 channels**
  - **Uses ~170 GB/month**
- **Issues**
  - **Data Maintenance tasks are time consuming or impractical**
    - **Removal of selected channels or time ranges, organization of disk space.**
  - **No way to add data beyond process variable samples**
    - **Example: Periodically computed beam statistics**
  - **No data mining tools**

Archive Plan

- **Extend available storage**
  - **Controls Group bought 30 TB for new SNS HP EVA storage array of IT Group**
- **Develop new Archive System**
  - **Data stored in relational database (Oracle)**
  - **Sampling Engine implemented in Java**
    - **Tests show performance of 8000 samples/sec. (4 times what we need)**
    - **Prototype reads existing configuration files; handles about half of the operational setup without any problems**
    - **Ongoing work: Support all data types, check stability, add configuration tools**
    - **Improve GUI uses CSS**

Alarms

- Alarms based on automatically generated EPICS IOC logic
- Monitors ~12,000 Process Variables
- Displayed using EDM
- Logged to a relational database
- Selected alarms are audibly annunciated in the CCR
- Problems
  - Original implementer is gone
  - System works, but is difficult to maintain and expand
  - Getting from a summary alarm indication to the root cause often requires drill down through numerous screens
- No quick fix – plan to assemble a group of people (Controls & Operations) to map a path forward

RDB

- No EPICS provision for configuration database
- We have lots of information stored in Oracle database
- Inconsistently used
- Long term goal
  - All control system configuration information to be stored and updated in RDB
  - All applications use RDB as the definitive source of static information

Projects

- AIP
  - Timing
  - PPS Segmentation
  - Vacuum System
- Control System Studio

AIP

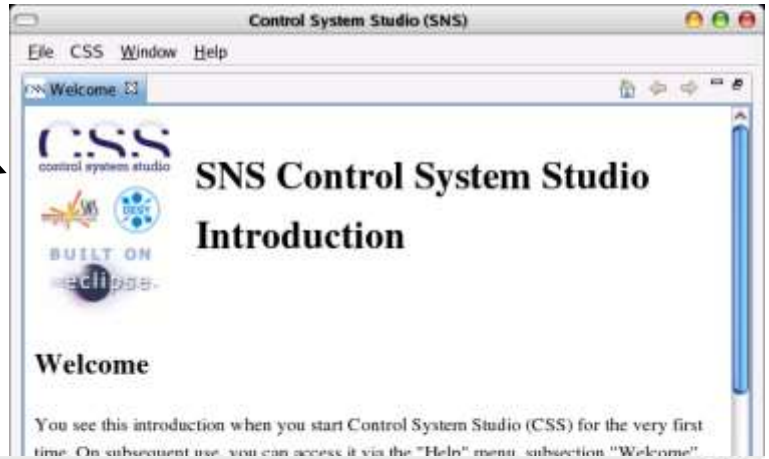
- **Timing**
  - **Improve maintainability and reliability (any downtime?)**
  - **Reduce number of modules**
  - **Design 3 new timing system boards**
  - **Master – replaces 20 existing VME cards (1)**
  - **Receiver - FPGA based board (25)**
  - **Fan-out – distributes low jitter signals to new receivers (4)**
- **Vacuum**
  - **Improve maintainability and reliability (any downtime?)**
  - **Current system uses custom chassis and interlock modules**
  - **Replace 7 custom chassis with standard PLCs**

Control System Studio

- New infrastructure for developing applications
- Facilitates interoperability between applications and a common look and feel.
- Collaboration with DESY to provide better control system tools:
  - Based on Java instead of Unix/C/X11
  - Preference Pages instead of environment variables
  - Consistent Online Help
  - Flexible deployment options
  - Support more than just EPICS
- Work performed at SNS
  - Implemented EPICS PV Tree, Data Browser, and some key CSS core components
  - SNS users can download onto office PC (Windows, Mac, Linux)
  - Basis for Archiver transition

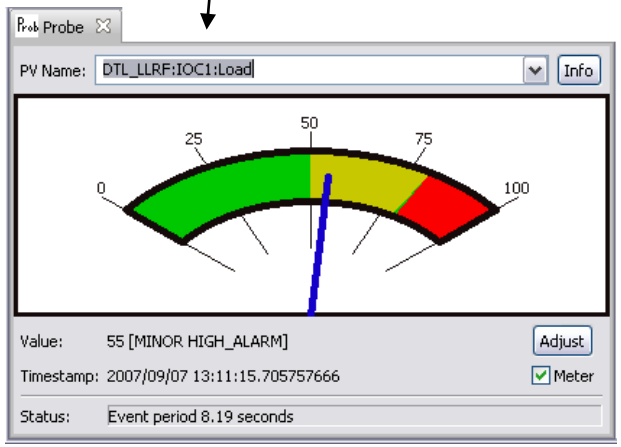
Control System Studio Snapshots

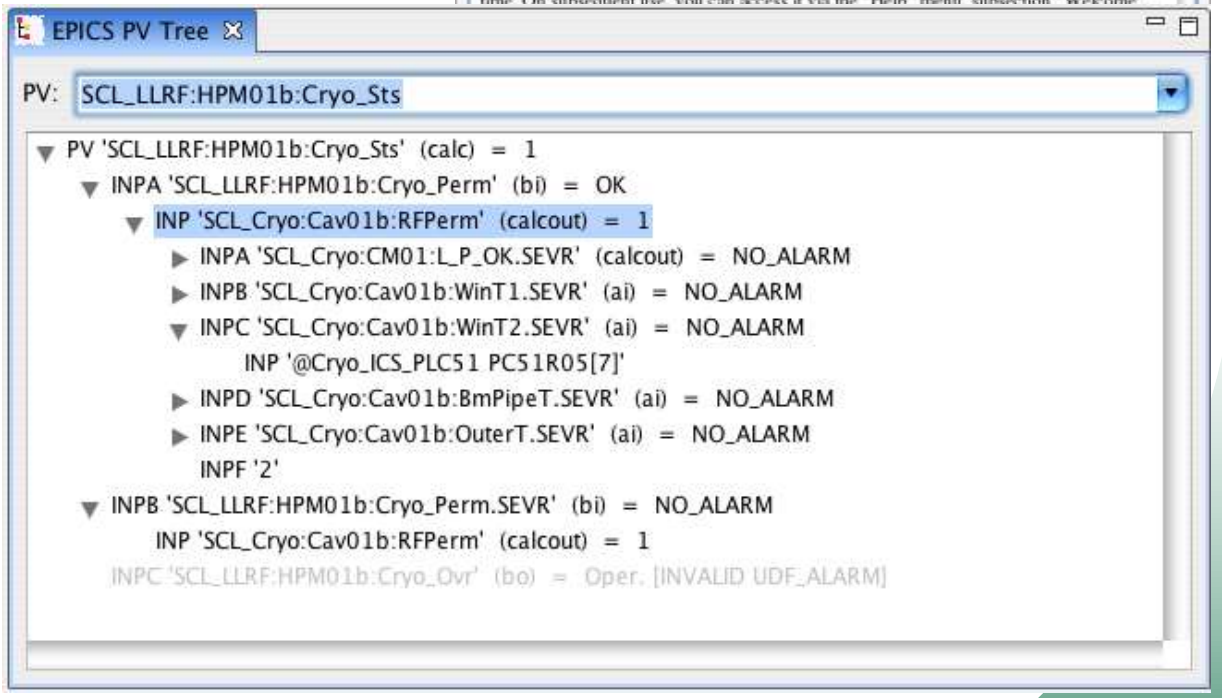
SNS-specific settings & intro



Trace inputs of EPICS record

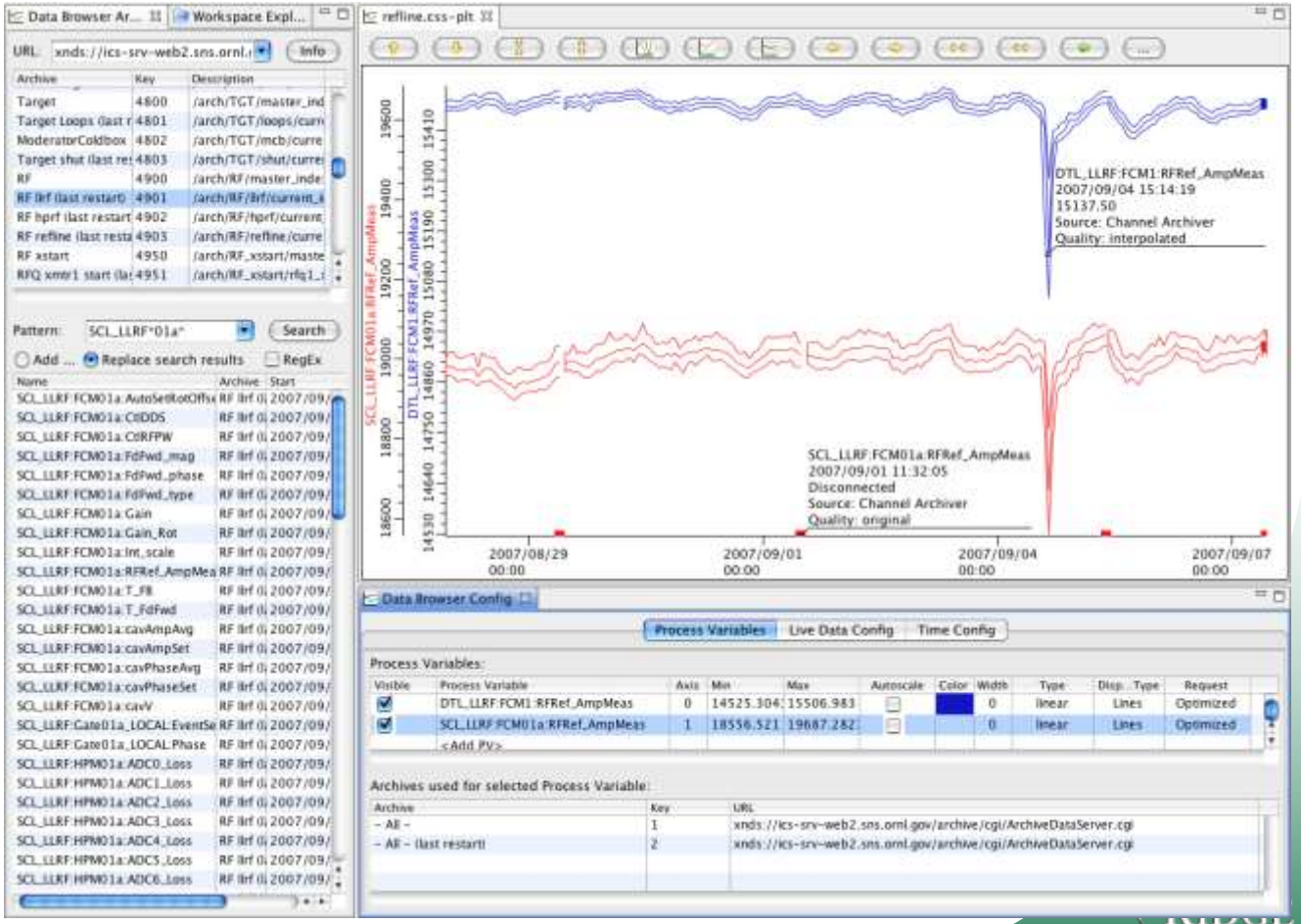
Probe into one PV





Control System Studio

- **Client provides integrated access to**
  - **Data from current and new archiver**
  - **Live data**



Summary