



# THE ROLE OF THE CEBAF ELEMENT DATABASE IN COMMISSIONING THE 12GEV ACCELERATOR UPGRADE

Authors

T. Larrieu, M. Keesee, M. Joyce, C. Slominski, D. Turner

Jefferson Lab

# Outline

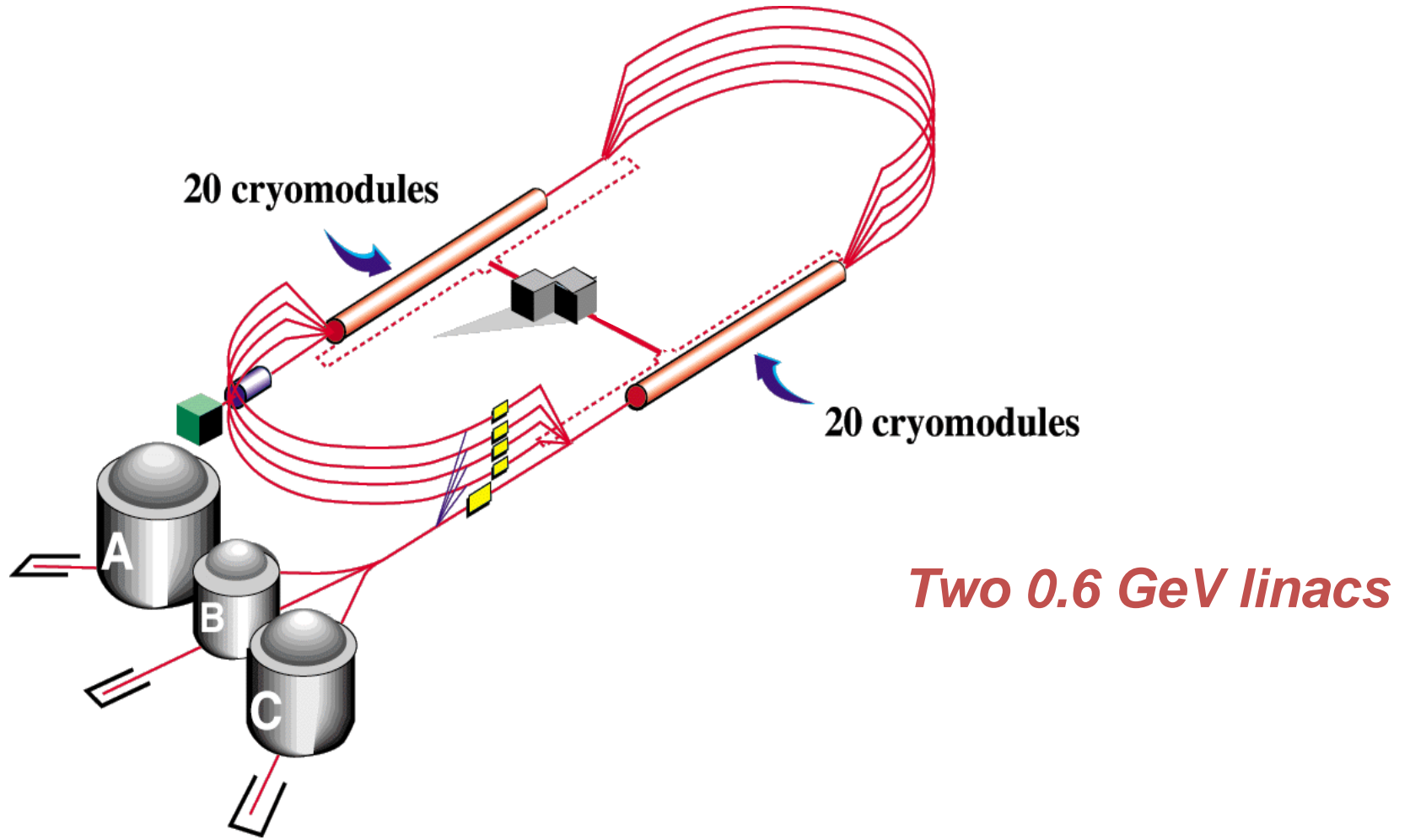
- Introduction
- Overview of the CEBAF Element Database (CED)
  - Design
  - Implementation
- The CED during commissioning
- The role of the CED during Operations

# Continuous Electron Beam Acceleration Facility

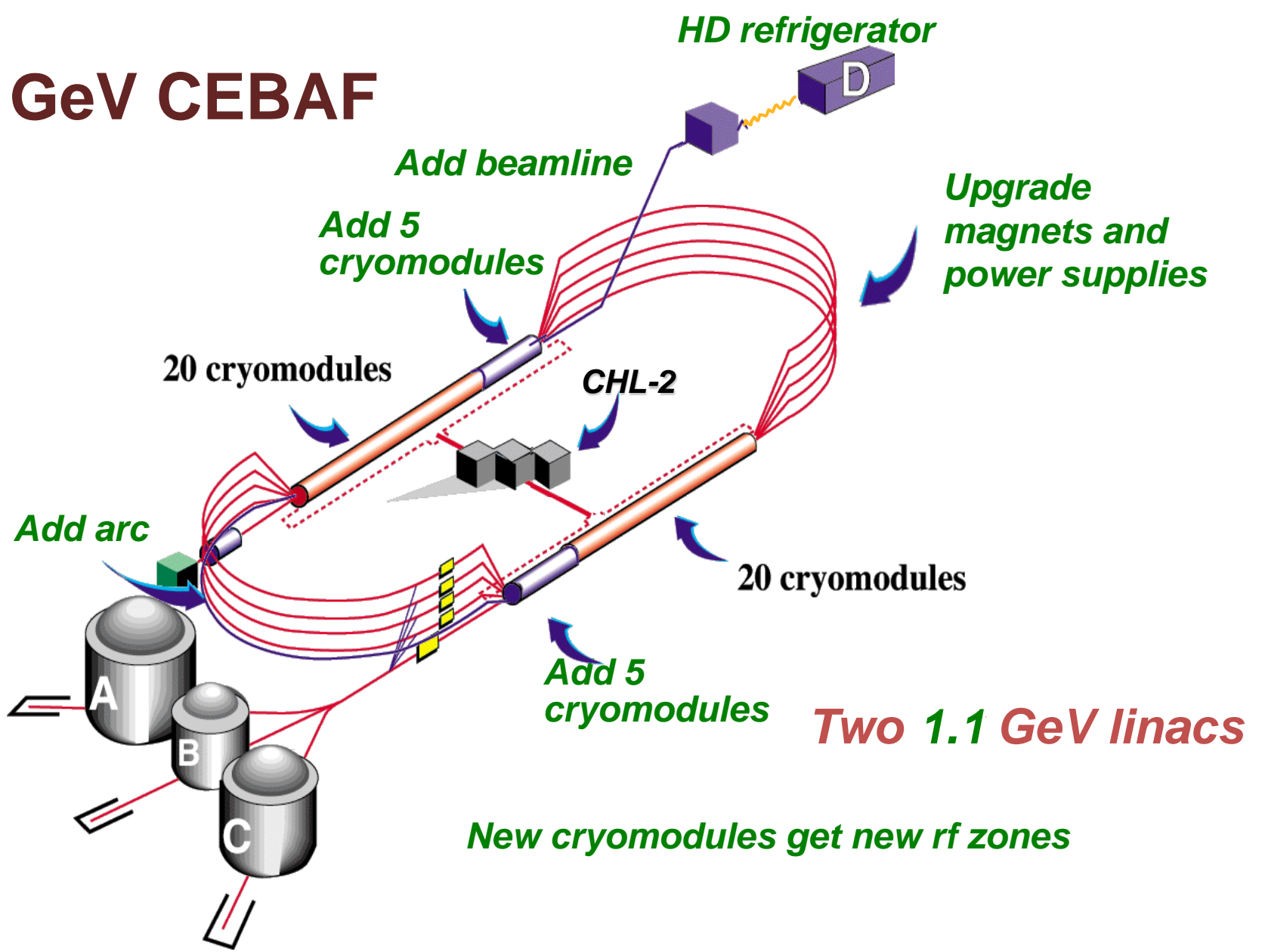


*Jefferson Lab's accelerator site*

# 6 GeV CEBAF



# 12 GeV CEBAF



# CED and the Upgrade

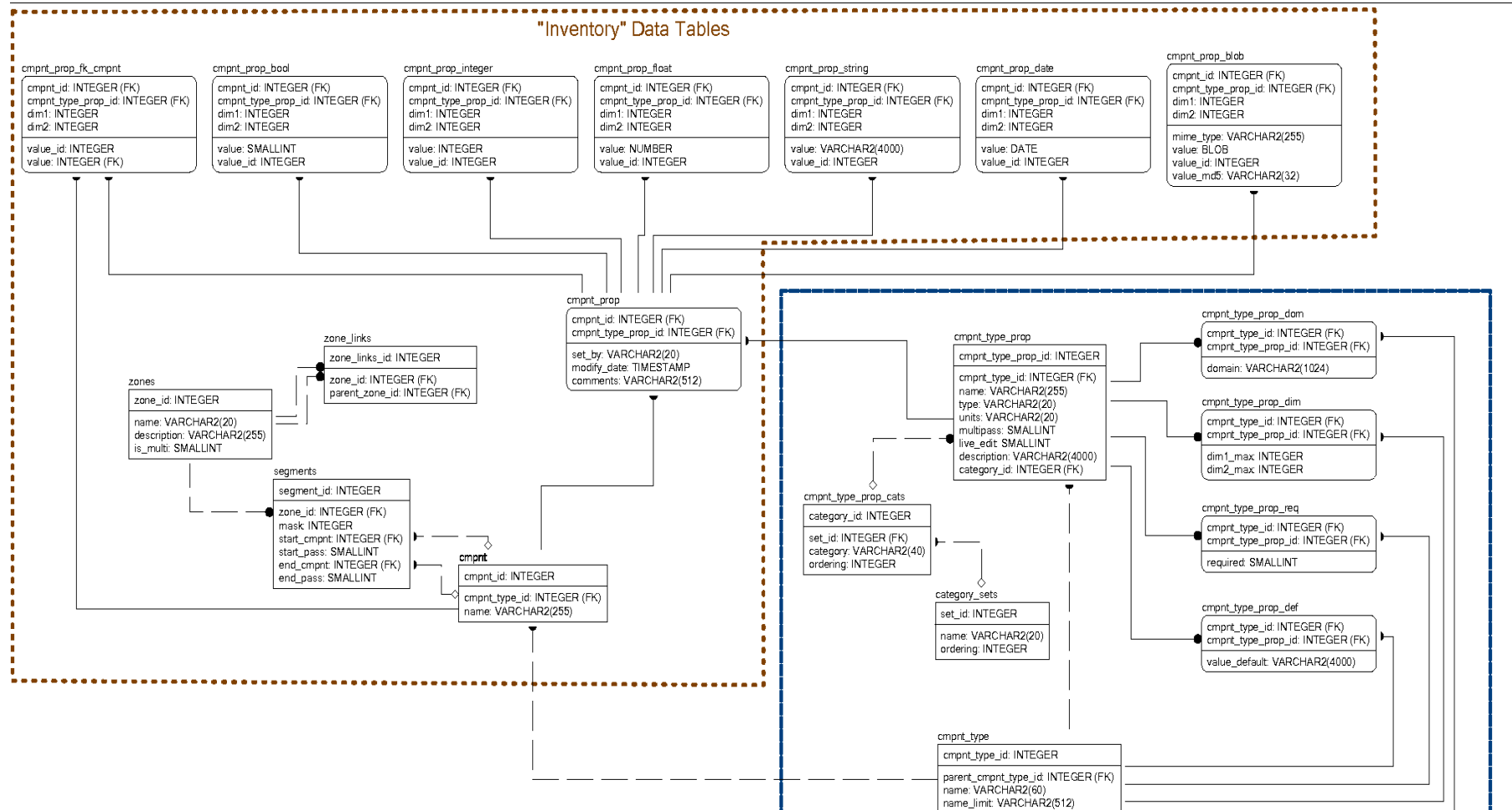
*The CEBAF Element Database (CED), designed before the upgrade as a settings management system to support model-driven machine configuration was extended in scope to support the upgrade project.*

- » *Hot Checkout*
- » *Screen Generation*
- » *Commissioning*

# CEBAF Element Database (CED) Scope

- Inventory and describe the elements needed to operate the CEBAF accelerator.
  - Physical Coordinates (x,y,z,s)
  - Design Parameters (twiss)
  - Control System Attributes (channel, EPICSName, etc.)
- Document Relationships among elements
  - Powered by
  - Housed by
  - Controlled by

# The CED's EAV/CR Schema



- Catalog tables defines types and their inheritance.
- Inventory tables stores element instance data.

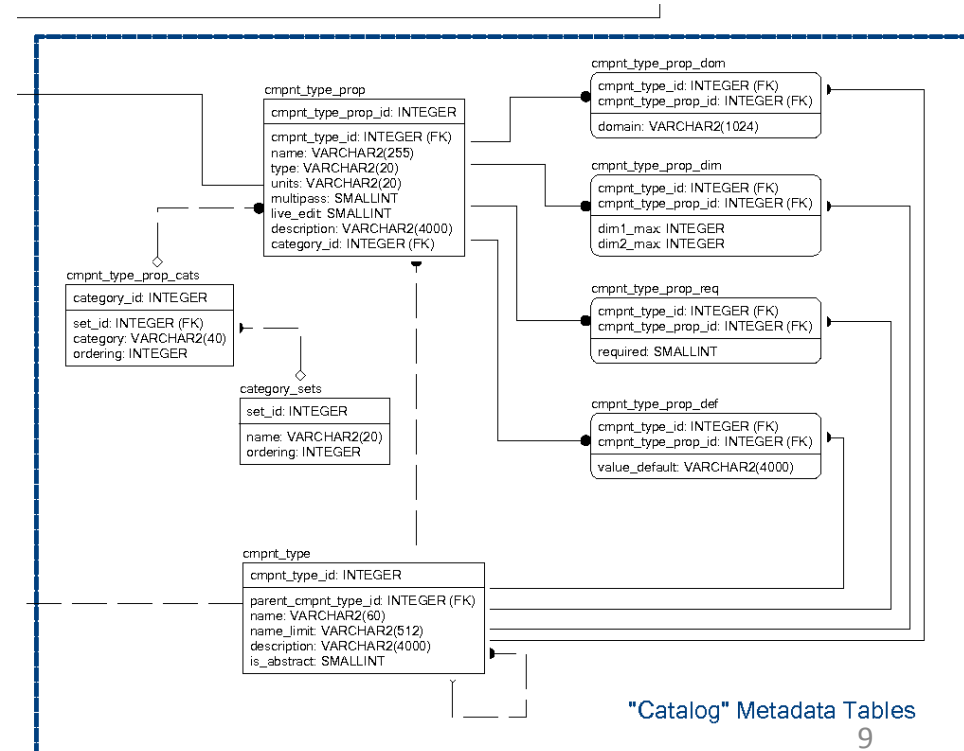


# Metadata Catalog Tables Define

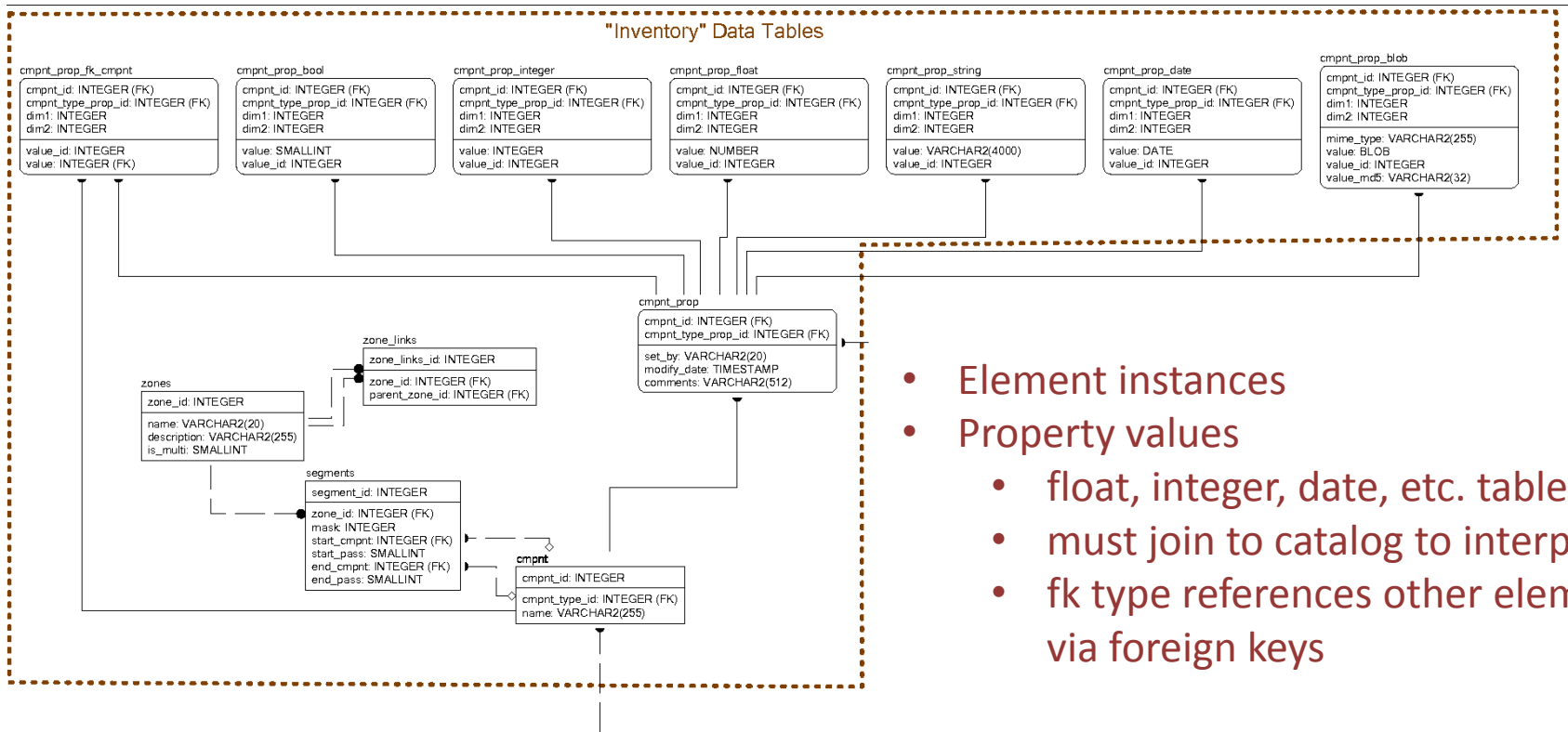
- Class Hierarchy
- Class Properties
- Class Property Attributes
  - Type (float, string, blob, fk, bool, date, list)
  - Required/Optional
  - Scalar or Vector Dimension
  - Default Value
  - Domain Constraints
  - Live Editable
  - Units
  - Multipass
- Subclasses inherit properties, but may override
  - Dimension
  - Required
  - Domain
  - Default

AccStyle Inventory (24 items)

Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [Harp](#) > [AccStyle](#)



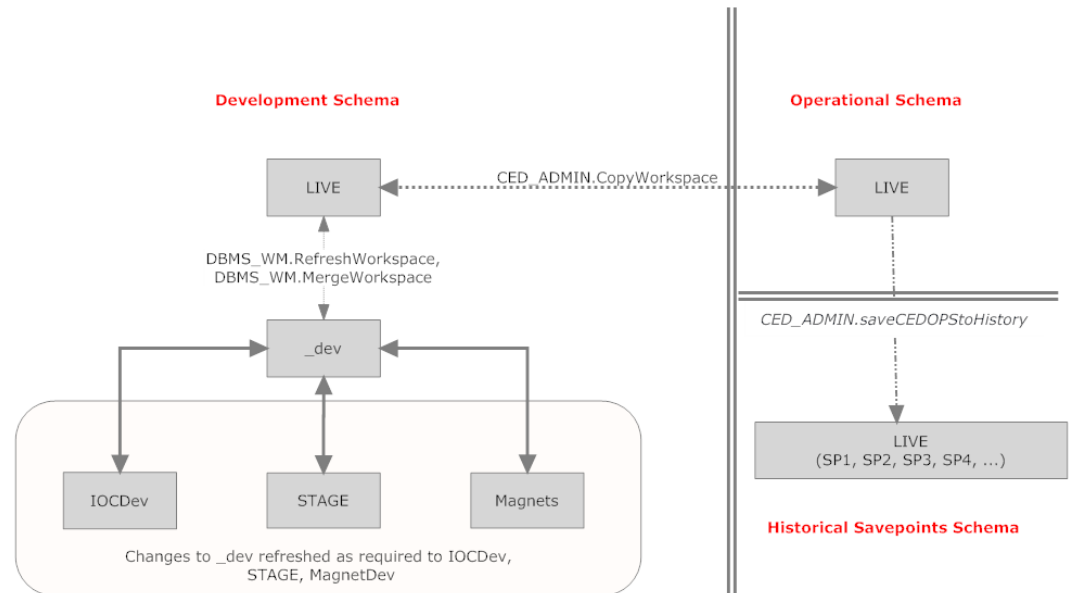
# Inventory Tables Store



- Element instances
- Property values
  - float, integer, date, etc. tables
  - must join to catalog to interpret
  - fk type references other elements via foreign keys

# CED Implementation

- Protected OPS Schema
  - Strict limits on “Live Edits”
- DEV Schema with Workspaces (Branches)
  - Branches where changes can be made and then merged.
  - Safely import data and test “what if” scenarios
  - Tools for merging, refreshing, and resolving conflicts.
- Read only History Schema
  - Automatic and Named Savepoints
  - Efficiently stores only row differences.



Software Tools can seamlessly utilize any schema/workspace/savepoint:

```
ced -wrkspc OPS -inventory -t Harps
ced -wrkspc STAGE -inventory -t Harps
ced -wrkspc AutoSP93 -inventory -t Harps
```

# CED API

[Main Page](#) | [Namespace List](#) | [Class Hierarchy](#) | [Class List](#) | [File List](#) | [Namespace Members](#) | [Class Members](#) | [File Members](#)

## CED Library (cedlib) Class Hierarchy

[Go to the graphical class hierarchy](#)

This inheritance list is sorted roughly, but not completely, alphabetically:

- CED::BitDef
- CED::Catalog
- CED::CatalogFormatter
- CED::CategoryInfo
- CED::CatSet
- CED::CatType
- CED::CEDdb
- CED::CEDexcept
  - CED::CEDpermit
  - CED::DropFailed
  - CED::NullArg
- CED::Ciformatter
- CED::Dependency
- CED::Element
- CED::ElemProp
- CED::Filter
  - CED::DateFilter
  - CED::MaskFilter
    - CED::AreaFilter
    - CED::ZoneFilter
  - CED::NameFilter
    - CED::GlobFilter
    - CED::RegexpFilter
  - CED::PropertyFilter
    - CED::AggregateFilter
  - CED::TypeFilter
- CED::FilterSetManager
- CED::Inventory
- CED::InvOut
  - CED::InvOutTabular
    - CED::InvOutTable
- CED::Layout
- CED::Lineage
- CED::MimeReader
- CED::MultiPass
- CED::NameTree
- CED::Properties
  - CED::PropertyPrompter
  - CED::PropertySet
- CED::Property
- CED::PropertyDef
- CED::PropertyHolder
- CED::PropShop
- CED::PropVal
  - CED::UnaryVal
  - CED::VectorVal
- CED::Segment
  - CED::FilterSegment
  - CED::LayoutSegment
- CED::Stream
- CED::TypeItem
- CED::TypeTree
- CED::User
- CED::Zone

- Necessity for dealing with complex, abstract schema.
- Implemented once in C++.
  - Also tested and debugged once!
- Script language library wrappers built w/SWIG for:
  - Perl
  - PHP
  - Tcl

# CED Tools – Command Line Utility

```
ced -h inventory
```

Inventory of elements.

```
Usage: -inventory [-e<opt>...<opt>] [-p[<opt>...<opt>]] [-C<opt>]
[-t<opt>...<opt>] [-z<opt>] [-Ex<opt>...<opt>] [-Ea<opt>...<opt>]
[-cs] [-nx<opt>] [-ng<opt>] [-a<opt>] [-d<opt>] [-s<opt>] [-r] [-f<opt>]
[-x<opt>] [-ced<opt>] [-wrkspc<opt>]
```

e; Elements of interest

p; Properties desired

C; Properties desired by category

t; Filter by element type

z; Filter by geographical zone

Ex; Filter by property value expression

Ea; Filter by aggregate expression

cs; Case sensitive string property expression

nx; Filter by name pattern (regexp)

ng; Filter by name pattern (glob)

a; Filter by area

d; Filter by date of change

s; Sort property

r; Repeat multi-pass elements

f; Format of output; default = 0

x; Exclude from output

ced; CED login key

wrkspc; Workspace

Note: no elements specified means all (possibly filtered).

Note: filters ignored when individual elements specified.

Note: '-cs' ignored unless a string property expression is supplied.

Note: if '-p' is provided, '-C' is ignored.

Note: '-d' takes absolute (2011-03-15) or relative (-1w; a week ago) dates

and a property can be specified (-5d:Length).

Note: '-f'; 0. Basic 1. Aligned table 2. Spread sheet

Note: '-x' takes a single character for each item to be excluded;  
t-element type l-labels u-units c-element count.

- Manage Catalog
  - Create new classes
  - Add/Edit attributes
  - Define Zones
- Inventory Elements
  - Many filters
  - Easy-to-parse output formats
- Access any workspace
  - -wrkspc switch
- Excellent for shell scripts

# CED Tools – Web Interface

Jefferson Lab  
**CED**

Inventory | Zones | Catalog | Workspaces | Tools | Help

Current Session  
Workspace: IOCDev  
You are not logged in. [Login...](#)

Element Search  
  
[Advanced search...](#)

Inventory Contents  
[AccStyle](#)

AccStyle Type owners

Output Alternatives  
[AccStyle as XML Data](#)  
[AccStyle as Plain Text](#)  
[AccStyle as Tab-Delimited](#)  
[AccStyle as Expanded HTML](#)  
[AccStyle as Collapsed HTML](#)

### Requested Inventory (24 items)

AccStyle Inventory (24 items)  
Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [Harp](#) > [AccStyle](#)

[IHA0102](#)  
 [IHA0103](#)

Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [Harp](#) > [AccStyle](#) > [IHA0103](#)

[Coordinates](#) | [Design](#) | [Operations](#) | [Physical](#) | [Controls](#)

CWCurrent: 3-5 uAmps  
TuneModeCurrent: -25 uAmps

[IHA0107](#)

Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [Harp](#) > [AccStyle](#) > [IHA0107](#)

[Coordinates](#) | [Design](#) | [Operations](#) | [Physical](#) | [Controls](#)

#### Twiss

alphax	alphay	betax (meters)	betay (meters)	emitx (meters)	emity (meters)
47.0443	-2.00803	43.7237	1.93158	9.80343E-9	9.80323E-9

etapx	etapy	etax (meters)	etay (meters)	psix (radians)	psiy (radians)
0	0	0	0	5.51431	8.298

sigmax (meters)	sigmay (meters)
0.000653567	0.000137888

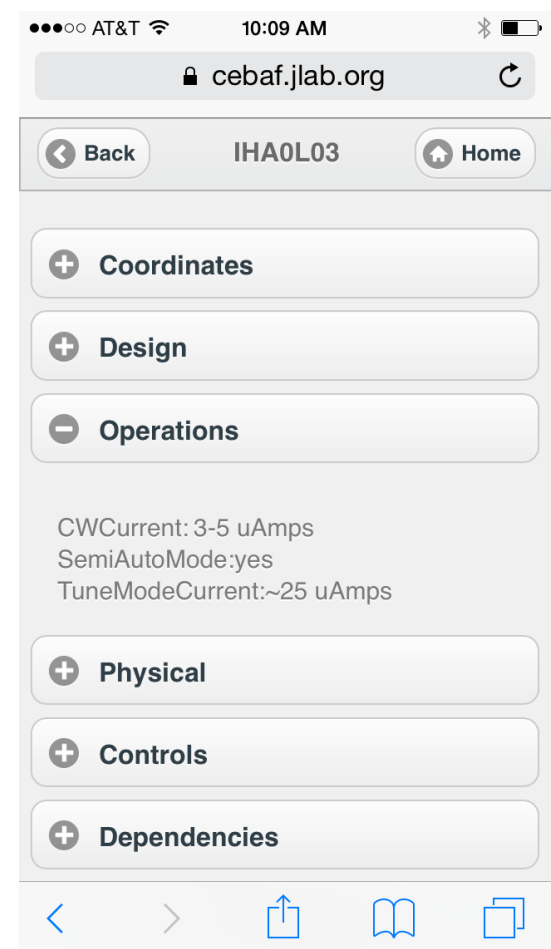
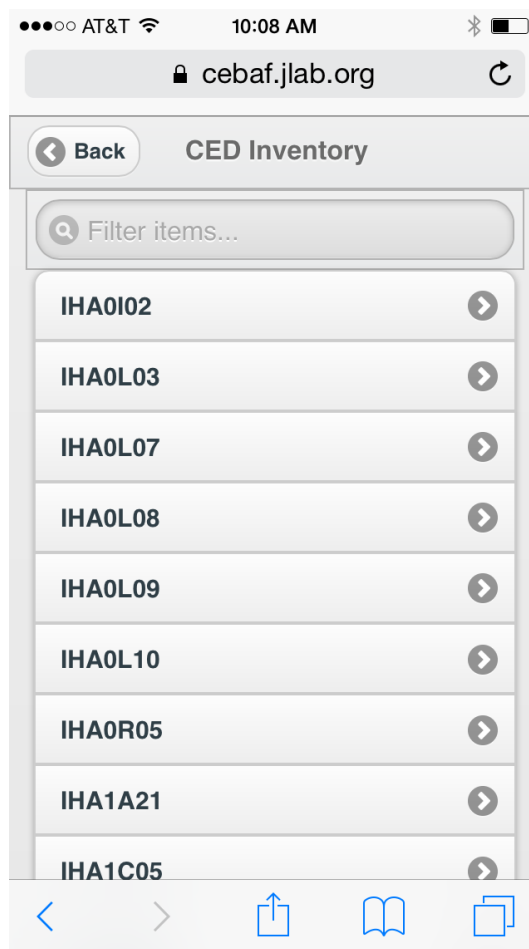
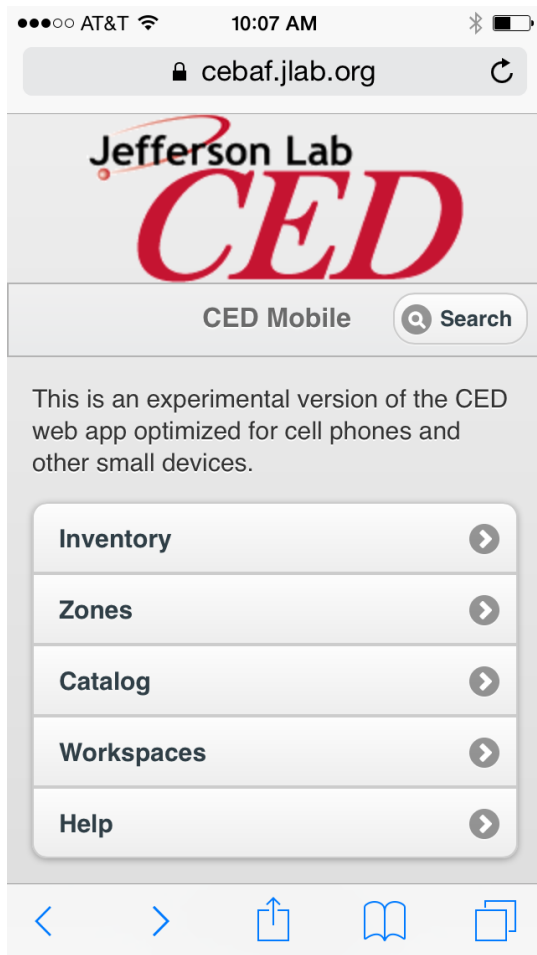
Elegant  
ModeledAs: MONITOR

Other

S (meters)
49.0724

- Built atop API in PHP
  - HTML pages and forms for humans
  - REST interface (json, xml, plain text)
- Auto-builds GUI entirely from metadata catalog
  - New classes immediately accessible.

# CED Mobile Web (beta)



# CED Event Server

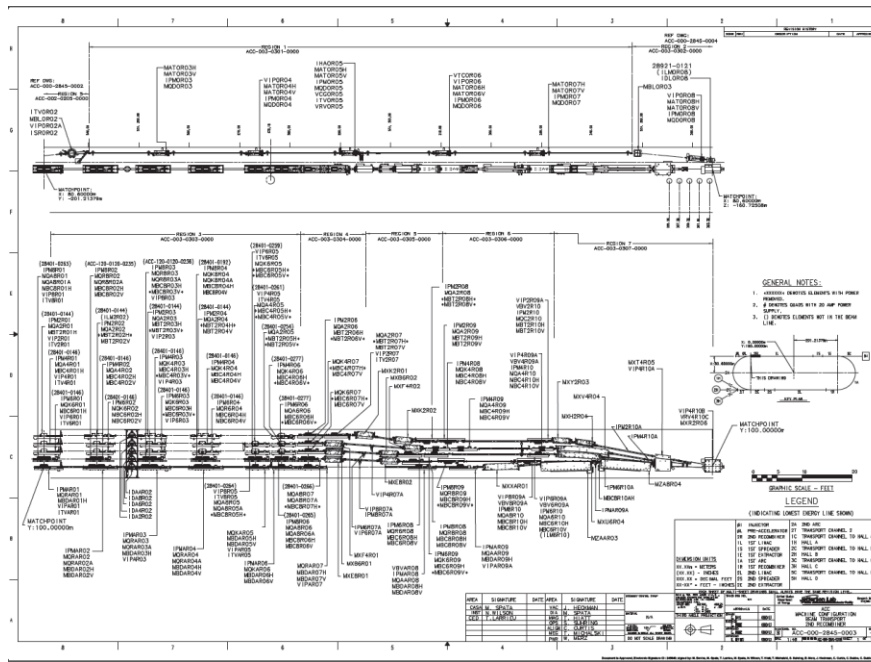
- Database trigger pushes CED change notifications to event server.
- Based on its rules, CED Event Server can:
  - Post message to OPS display wall.
  - Tell daemon processes to reload configuration.
  - Call ced2Epics to set process variable values.
  - Send email notification.
  - Make a logbook entry.





# The CED During Commissioning

- Field Verification of CED, Drawings, Tunnel.
- Hot Checkout (HCO) Element Inventory.
- Back-end for QR codes on hardware labels.
- Support creation of EPICS control screens (EDM).
- Generate Alarm Handler configuration files.



During the shutdown Region Coordinators were assigned to verify that the drawings, database, and tunnel hardware all match.



Jefferson Lab  
**CED**

Inventory | Zones | Catalog | Workspaces | Tools | Help

Current Session  
Workspace: OPS  
You are not logged in. [Login...](#)

Element Search

Advanced search...

Inventory Contents

**4ChBPM**

4ChBPM Type owners

Output Alternatives

4ChBPM as XML Data  
4ChBPM as Plain Text  
4ChBPM as Tab-Delimited  
4ChBPM as Expanded HTML  
4ChBPM as Collapsed HTML

**Requested Inventory (207 items)**

4ChBPM Inventory (207 items)  
Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [BPM](#) > [4ChBPM](#)

**IPM1A03**

Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [BPM](#) > [4ChBPM](#) > [IPM1A03](#)

Coordinates | Design | Operations | Physical | Controls | Dependencies

Model

ModelX:	79.4845 meters
ModelY:	102 meters
ModelZ:	212.916 meters
Model_Pitch:	0 degrees
Model_Roll:	0 degrees
Model_Yaw:	-11.25 degrees

**IPM1A05**

Lineage: [Elem](#) > [LineElem](#) > [BeamElem](#) > [Diagnostic](#) > [BPM](#) > [4ChBPM](#) > [IPM1A05](#)

Coordinates | Design | Operations | Physical | Controls | Dependencies

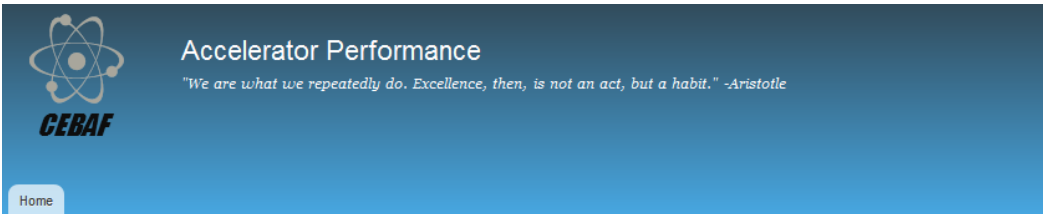
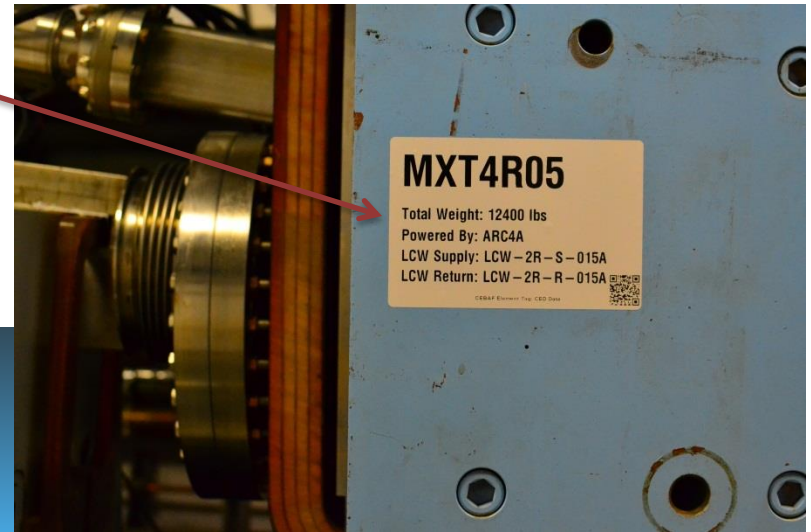
Model

ModelX:	78.0577 meters
---------	----------------



# QR Code labels on tunnel hardware

The QR Code can be scanned in the field with camera-equipped tablet



Home

User login

Username \*


Password \*

[Create new account](#)  
[Request new password](#)

Log in

MXT4R05

- Weight: 12400 lbs
- Powered by: [ARC4A](#)
- LCW Supply Valve: [LCW-2R-S-015A](#)
- LCW Return Valve: [LCW-2R-R-015A](#)



## Related Safety Information

**Potential Hazards**  
Submitted by rmichaud on Wed, 06/18/2014 - 15:39

[Electrical Safety Program](#)  
[PPE Program](#)

Links on the web page take the user to CED to find out what other elements share the same valves or power supply.

The Safety Group can provide additional information related to the element.

# CED inventory as basis of Hot Checkout.

## Hot Checkout

Readiness Signoff Checklists Links Reports Setup Help

theo Logout

### Readiness

Filter

Beam Destination: Inline Dump (SDL0R08)

Region:

Group:

Apply

Found 849 Components in Beam Destination "Inline Dump (SDL0R08)" (8 Masked Components)

- JLAB
- CEBAF
  - Beam Dumps
  - Control System
  - Cryo
  - Diagnostics
  - Facilities
  - Gun/Laser
  - Info Systems
  - Magnets
    - Box Supply
    - Trim Supply
    - Correctors
    - Dipoles (Trim Powered)
      - MBL0R01
        - Magnet Measurement
        - Installation
        - Vacuum
        - Alignment
        - DC Power
      - MBL0R02
      - MBL0R03
      - MBL0R04
      - MBO0I06
      - MDL0L02
      - MDS1101
    - EarthFieldCoil
    - Quads
    - Solenoid
    - Wien
    - LCW Valves
  - Operations
  - RF
  - Radiation Controls
  - Safety Systems
  - Vacuum

Status Key

- Ready
- Checked
- Not Ready
- Masked

Node Key

- Category/System
- Subsystem
- Component
- Group

- 8,252 HCO components from CED
- 245 checklists
- >18,000 readiness sign-offs

## Hot Checkout

Readiness Signoff Checklists Links Reports Help

Login

### Reports

#### Overall Status

Filter

Beam Destination: Beam to Hall D (5.5 pass)

Subsystem:

Region:

Group:

Apply

Found 15,266 Signoffs in Beam Destination "Beam to Hall D (5.5 pass)" (3 Masked Components)

Status	Count	Percent
Ready	9,908	~65%
Checked	5,057	~33%
Not Ready	301	~2%

# Screen Generation

- Impractical to update the ~6000 pre-upgrade .edl files by hand.
- Solution was to generate screen files programmatically using information in CED.
  - Created edllib to give programmers a qt-style library of widget and layout managers.
  - Built OTFLauncher to build screens flexibly based on CED queries

# OTFLauncher

- On-The-Fly Screen Launcher

```
OTFLauncher ioc iocreboot -system BPM -area  
A_Injector+A_NorthLinac
```



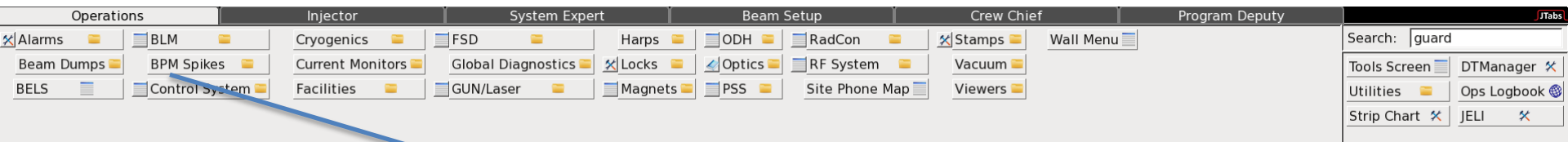
Window title: /cs/jtabs/edm/ioc/otf/theo\_ops100\_22240.edl

Page title: JTabs IOC Reboot Screen - Injector+NorthLinac - BPM 08Oct14 16:50:04

Name	Status	Rack	Heartbeat	Save & Restore		Reboot Controls				
iocinse4		IN03B23-34	2427400		06OCT14 06:37:55	10SEP14 14:36:46	Reboot reason <input type="checkbox"/>	>>>>	Reboot	10SEP14 14:33:35
iocnlse1		NL01B12-16	1309485		06OCT14 06:37:55	23SEP14 13:08:02	Reboot reason <input type="checkbox"/>	>>>>	Reboot	23SEP14 13:05:36
iocse1		NL01B15-18	1308148		26SEP14 07:38:00	06OCT14 06:48:14	Reboot reason <input type="checkbox"/>	>>>>	Reboot	23SEP14 13:27:09
iocse2		NL15B11-24	2431296		06OCT14 06:41:11	10SEP14 15:09:22	Reboot reason <input type="checkbox"/>	>>>>	Reboot	10SEP14 13:28:28
iocse3		NL27B13-16	2424822		06OCT14 06:41:15	10SEP14 15:23:03	Reboot reason <input type="checkbox"/>	>>>>	Reboot	10SEP14 15:16:19
iocse11		IN03B05-17	4163997		06OCT14 06:38:30	21AUG14 12:30:41	Reboot reason <input type="checkbox"/>	>>>>	Reboot	21AUG14 12:10:22
iocse12		IN03B08-20	5482520		06OCT14 06:38:59	06AUG14 07:28:19	Reboot reason <input type="checkbox"/>	>>>>	Reboot	06AUG14 05:54:48
iocse19		IN03B23-18	2427399		06OCT14 06:39:37	10SEP14 14:35:29	Reboot reason <input type="checkbox"/>	>>>>	Reboot	10SEP14 14:33:30

22

# “Jtabs” Menu



Operations->BPM Spikes

### Operations BPM Spike Menu

Absolute	Relative	Specialty Screens	Apps
Injector <select>	Injector <select>	Abs Spikes by Pass <select>	BPM History
North Linac <select>	North Linac <select>	<b>BPM Offset Summary</b>	Orbit Snaps
East Arc <select>	East Arc <select>	Injector <select>	
South Linac <select>	East Arc <select>	North Linac <select>	
West Arc <select>	Arc 1	East Arc <select>	
BSY <select>	Arc 3	South Linac <select>	
Halls <select>	Arc 5	West Arc <select>	
BSY Dump	Arc 7	BSY <select>	
	Arc 9	Halls <select>	
	BSY Dump		
<b>30Hz</b>	<b>30Hz Relative</b>		
Injector <select>	Injector <select>		
North Linac <select>	North Linac <select>		
East Arc <select>	East Arc <select>		
South Linac <select>	South Linac <select>		
West Arc <select>	West Arc <select>		
BSY <select>	BSY <select>		
Halls <select>	Halls <select>		
BSY Dump	BSY Dump		

OTFLauncher calls  
are behind menus.

# The CED During Operations

- Provide Configuration Control.
- Generate Accelerator models (elegant lattice files) for setup.
- Keep EPICS control screens (EDM) current
- Provide configuration information for High Level Applications (energy locks, orbit locks, Courant-Snyder tuning)



# Configuration Control

Jefferson Lab  
**CED**

Inventory | Zones | Catalog | Workspaces | Tools | Help

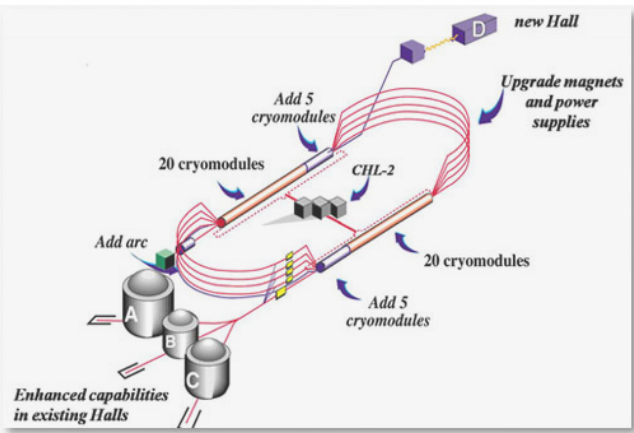
Current Session  
[Workspace](#): OPS  
You are logged in as theo.  
[Logout...](#)

Recent Merge Activity

2014-10-02 14:57  
Attach related Box Supply to each SRCCPS element.

2014-10-02 12:09  
Set housed\_by property of YA magnets

2014-10-01 17:06  
Import new Elegant deck containing BSY Dump line, Dogleg Changes, RTI elements.  
[previous updates..](#)




The diagram illustrates a particle accelerator configuration. It features a central horizontal beamline with several components labeled: '20 cryomodules', 'CHL-2', and 'Add 5 cryomodules'. A 'new Hall' (D) is shown at the top right, connected to the beamline. Below the beamline, there are three cylindrical components labeled A, B, and C, with the text 'Enhanced capabilities in existing Halls' below them. A 'new Hall' (D) is also shown at the top right, connected to the beamline. The text 'Upgrade magnets and power supplies' is written near the top right. The diagram also shows 'Add arc' and 'Add 5 cryomodules' labels.

Updates are merged into the operational configuration by CED administrators.

Current Session

Workspace: OPS  
You are logged in as theo.  
[Logout...](#)

Element Search


  
[Advanced search...](#)

## Workspace Merge

The worksheet on this page walks administrators through the multi-step process merging a workspace and if applicable installing it for OPS.

Checklist to copy DEV LIVE contents to OPS:

**The Admin Lock was acquired on 2014-10-03 09:52:00 by user theo - SRCCPS Updates**  
If you know the lock is no longer needed, you may remove it. [Remove Admin Lock...](#)

Check for newer LIVE EDITS...	<input type="button" value="Check..."/>	<a href="#">OK</a>
Get Live Edits...	<input type="button" value="Get..."/> <input type="button" value="Skip"/>	skipped
Refresh _dev Inventory...	<input type="button" value="Refresh..."/> <input type="button" value="Skip"/>	skipped
Audit _dev Workspace...	<input type="button" value="Perform..."/> <input type="button" value="Skip"/>	
Merge (or <a href="#">Selective Merge</a> ) _dev Workspace	<input type="button" value="Merge..."/> <input type="button" value="Skip"/>	
Audit DEV LIVE Workspace...	<input type="button" value="Perform..."/> <input type="button" value="Skip"/>	
Save OPS to History Snapshot...	<input type="button" value="Save..."/> <input type="button" value="Skip"/>	
Copy DEV LIVE to OPS...	<input type="button" value="Copy..."/> <input type="button" value="Skip"/>	

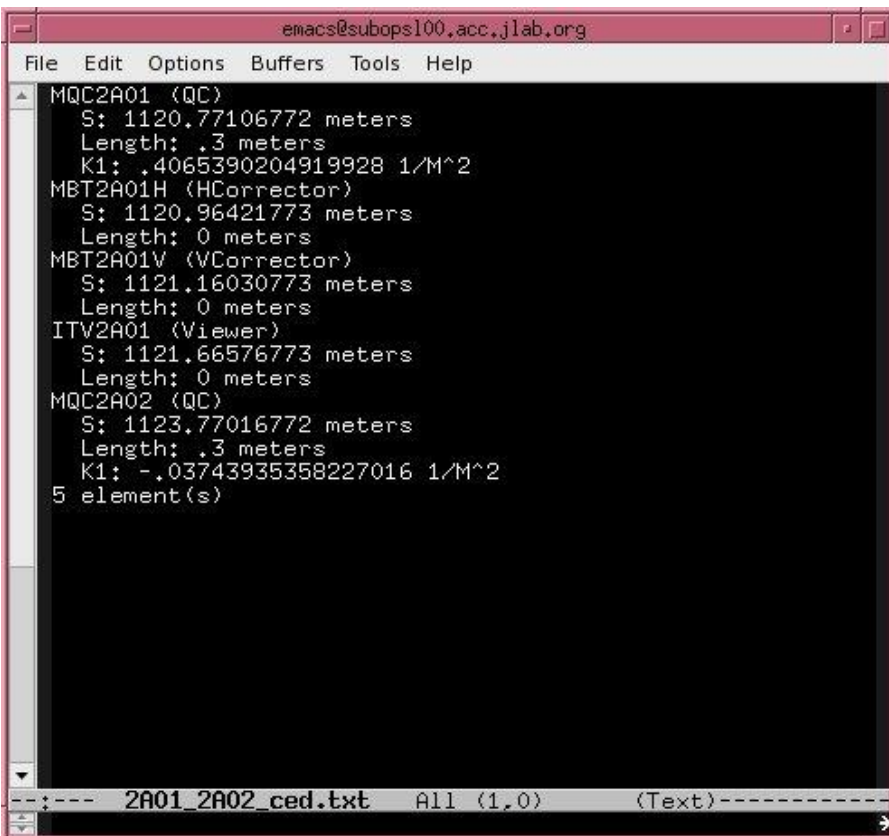
\*Don't forget to remove the Admin Lock when you are finished.

# Using CED, ced2elegant, and eDT

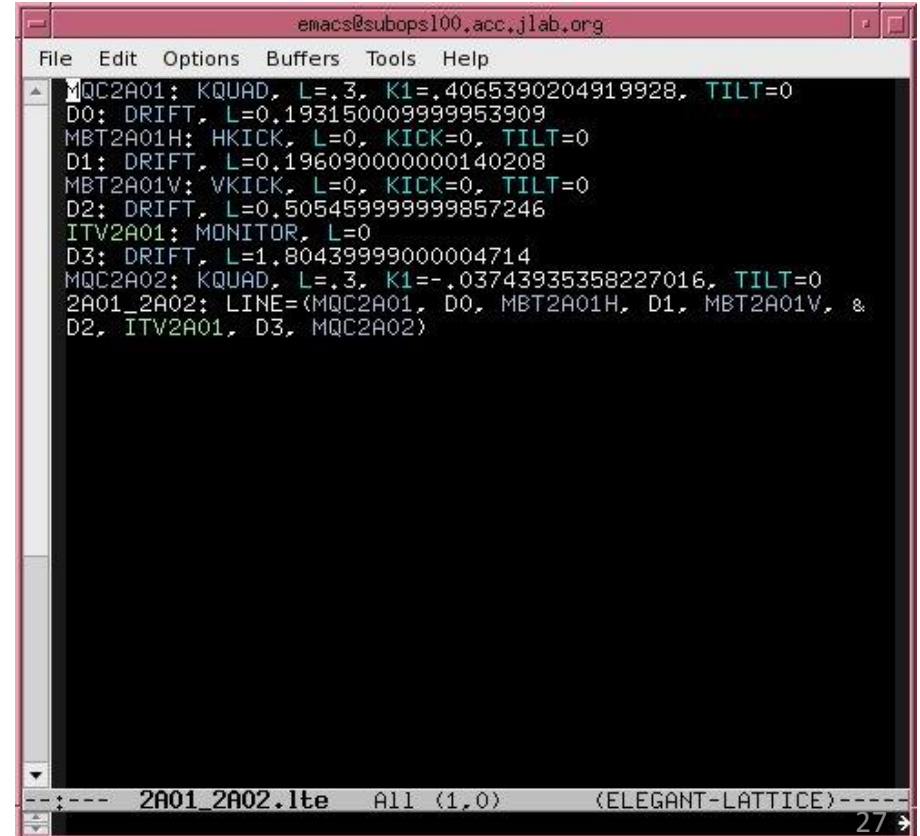
- The ced2elegant tool generates an ELEGANT lattice from elements in the CED. The user specifies a start and end element and the pass for each. The tool retrieves all elements from CED that exist between the two given elements, inclusive and builds an ELEGANT lattice file.

## CED Query

## ELEGANT Lattice



```
emacs@subops100,acc.jlab.org
File Edit Options Buffers Tools Help
MQC2A01 (QC)
S: 1120.77106772 meters
Length: .3 meters
K1: .4065390204919928 1/M^2
MBT2A01H (HCorrector)
S: 1120.96421773 meters
Length: 0 meters
MBT2A01V (VCorrector)
S: 1121.16030773 meters
Length: 0 meters
ITV2A01 (Viewer)
S: 1121.66576773 meters
Length: 0 meters
MQC2A02 (QC)
S: 1123.77016772 meters
Length: .3 meters
K1: -.03743935358227016 1/M^2
5 element(s)
```



```
emacs@subops100,acc.jlab.org
File Edit Options Buffers Tools Help
MQC2A01: KQUAD, L=.3, K1=.4065390204919928, TILT=0
D0: DRIFT, L=0.1931500099999953909
MBT2A01H: HKICK, L=0, KICK=0, TILT=0
D1: DRIFT, L=0.1960900000000140208
MBT2A01V: VKICK, L=0, KICK=0, TILT=0
D2: DRIFT, L=0.5054599999999857246
ITV2A01: MONITOR, L=0
D3: DRIFT, L=1.804399999000004714
MQC2A02: KQUAD, L=.3, K1=-.03743935358227016, TILT=0
2A01_2A02: LINE=(MQC2A01, D0, MBT2A01H, D1, MBT2A01V, &
D2, ITV2A01, D3, MQC2A02)
```

# Using CED, ced2elegant, and eDT

- Accepts lattice from ced2elegant as input.
- Calls LEM to obtain Linac gradient distribution and calculated Linac quad settings and applies them to the lattice.
- Uses ELEGANT to reoptimize TWISS parameters.
- Outputs a snap file that can be loaded onto the control system using standard tools such as burt.

**Step 1: Select an endpoint:**

INJ-R BSY2 BSY4 BSY6 BSY8 BSYA HALLA  
 HALLB HALLC HALLD BSY\_DUMP

**Step 2: Set up the MMS entries (or use the defaults from EPICS)**

Preinjector 3.130 MMSINJEGAIN 122.825 MMSLINJEGAIN 1090.000 MMSLINZEGAIN 1090.000  
 Hall A Pass 5 Hall B Pass 0 Hall C Pass 0 Hall D Pass 5.5

Reload MMS values from EPICS  
 (Currently using default MMS values from EPICS)

**Step 2a (optional): Select an SDDS file to overlay**

Selected file: None  
 Select File View File Deselect File

**Step 3: Click the "GO" Button below**

GO (i.e. Fetch Magnets and Design BDLs)

**Step 4: Do other stuff**

Reload Current BDLs Save/Download Design BDLs Save/Download Tuning Limits Print Selection Log Selection

Selected Magnets (click header buttons to sort, click and then double-click a magnet to deselect it)

Name	Usage	Design BDL	Current BDL	Absolute Diff	Percent Diff	S Coordinate
MCB1R00	Prohibited	6091.13	168.67	-5922.46	-97.23	718
MCB1R01	Prohibited	7765.63	168.67	-7596.96	-97.83	718
MQL1R02	V.Beta	-10948.82	-10104.79	844.03	-7.71	724
MQL1R03	H.Beta	12578.80	11237.42	-1341.38	-10.66	730
MQL1R04	V.Beta	-10570.32	-9506.42	1063.90	-10.06	738
MCB1R05	Prohibited	-5817.39	168.67	5986.06	-102.90	740
MQL1R06	H.Beta	18763.93	17249.00	-1514.93	-8.07	742
MQL1R07	Prohibited	-15450.12	-14497.80	952.32	-6.16	744
MX1R01	Dipole	-1328465.22	-0.00	1328465.22	-100.00	746
MX1R02	Dipole	1328465.25	0.02	-1328465.23	-100.00	747
MCN1R08	Prohibited	-22833.41	-21077.60	1555.81	-6.87	748
MQL1R09	Prohibited	13031.88	11848.40	-1383.48	-10.62	750
MCB1R10	V.Dispersion	-5953.00	168.67	6121.67	-102.83	756
MX1R04	Dipole	-1315487.79	-0.59	1315487.20	-100.00	758
MXQ1R06	Dipole	1315486.86	0.00	-1315486.86	-100.00	762
MXR2S01	Dipole	1448010.64	0.91	-1448009.73	-100.00	1012
MXH2S02	Dipole	-1448008.98	-0.98	1448008.00	-100.00	1020
MQL2S01	V.Dispersion	-14070.83	-1405.98	12664.86	-90.01	1022
MQA2S02	Prohibited	40440.78	1515.00	-38925.78	-96.25	1028
MQA2S03	Prohibited	-91873.35	1515.00	93188.35	-102.46	1029
MXK2S05	Dipole	1271472.73	0.76	-1271471.96	-100.00	1031
MXV2S06	Prohibited	-1271468.88	-0.74	1271468.14	-100.00	1033

**Progress (Most Recent Action at the Top)**

Fetching list of LEM quads  
 Fetching list doglegs from CED  
 Fetching MMS values from EPICS  
 Parsing usage color scheme  
 Connecting to CED workspace OPS

eDT GUI

# High Level

# Applications

csGUI ELEGANT - V0-7 OPS

Configure Expert 50Hz control FOPT Data FOPT compare Help Close

Status

Retrieving lattice with ced2elegant (This could take up to ~30 seconds)

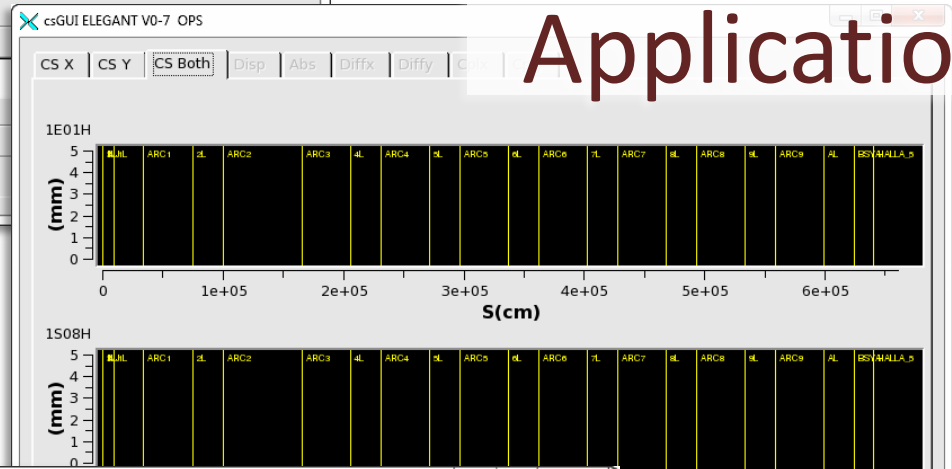
/cs/jtabs/edm/xSystem/off/theo\_ops100\_26434.edl

### Beam Energy Monitor

08Oct14 17:06:39

	dp/p bpm	dp/p corr	dp/p total	MeV	Target	Valid	
INJ	off on	0.00e+00	0.00e+00	0.00e+00	102.01	102.27	<span style="color: green;">●</span> <span style="color: red;">●</span>
ARC1	off on	0.00e+00	0.00e+00	0.00e+00	1011.74	1011.36	<span style="color: green;">●</span> <span style="color: red;">●</span>
ARC2	off on	0.00e+00	0.00e+00	0.00e+00	1920.74	1920.45	<span style="color: green;">●</span> <span style="color: red;">●</span>
ARC3	off on	0.00e+00	0.00e+00	0.00e+00	2829.56	2829.55	<span style="color: green;">●</span> <span style="color: red;">●</span>
ARC4	off on	0.00e+00	0.00e+00	0.00e+00	3749.35	3738.64	<span style="color: green;">●</span> <span style="color: red;">●</span>
ARC5	off on	0.00e+00	0.00e+00				
ARC6	off on	0.00e+00	0.00e+00				
ARC7	off on	0.00e+00	0.00e+00				
ARC8	off on	0.00e+00	0.00e+00				
ARC9	off on	0.00e+00	0.00e+00				
ARCA	off on	0.00e+00	0.00e+00				
HALLA	off on	0.00e+00	0.00e+00				
HALLD	off on	0.00e+00	0.00e+00				

Master switch  off  on



### LEM 9.2-1 - North Linac

Normal Bypassed RF Off

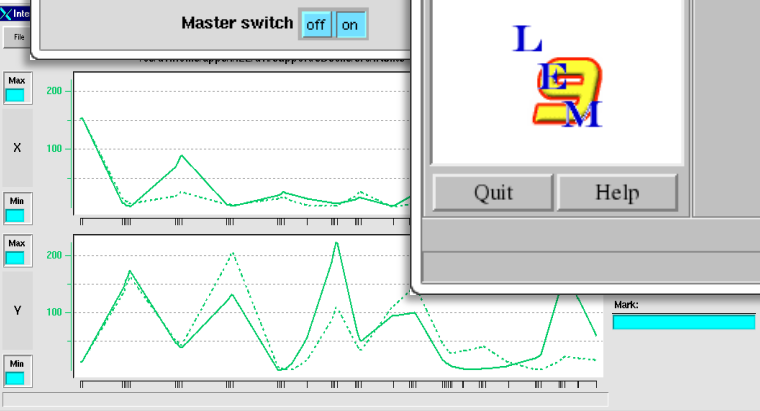
Energy Lock Fixed Energy

2	3	4	5	6	7	8	9	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺
☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺	☺

Energy (McV): 909.091 Fudge Factor: 0.99 Trips / Shift: [ ]

Current (uA): 500 Locks (McV): 4 Cryo (Watts): [ ]

Sniff Calculate Apply Info



ARC7 HL ARC8 HL ARC9 HL BEM/HALLA.5

5e+05 6e+05

ARC7 HL ARC8 HL ARC9 HL BEM/HALLA.5

5e+05 6e+05

ARC7 HL ARC8 HL ARC9 HL BEM/HALLA.5

5e+05 6e+05

BEM status active

BEM status BEM not active

2A BEM status BEM not active

Most Critical applications converted to CED for configuration

# Conclusion

- The Flexible EAV/CR design allows the CED content to evolve without changes to the database schema or API.
- Availability of an accurate database led to thorough hot checkout and meeting commissioning goals safely and on-time.
- The centralization and standardization on the CED yields new capabilities and efficiencies in screen and application development.

# CED Hardware

- Oracle 11gR2 (Standard Edition)
  - Dedicated Instance
  - Oracle Workspace Manager
- Redhat Enterprise Linux 6

# EAV/CR Trade-offs

- SQL Queries w/o API are complex
- Relies on API to enforce Domain constraints
- Performance challenges
  - Many tables must be joined for most queries