MICE: Controls & Monitoring

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ILLINOIS INSTITUTE OF TECHNOLOGY

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- B Purpose
- C Considerations

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Controls & Monitoring

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Definitions:

- Controls and Monitoring (C&M) is the software (and hardware) used as the human interface to all experimental apparatus
- Designer overall responsible party
- Developer develops EPICS interface
  - DL, Hanlet, Robinson
- Integrator integrates subsystem into MICE – Hanlet

Controls & Monitoring

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Definitions and Purpose:

- **Controls refers to:**
  - **user interface to equipment**
  - **proper sequencing of equipment**

- **Monitoring serves to:**
  - **protect equipment (early notification)**
  - **protect data quality**
  - **requisite for proper sequencing**

Considerations

MICE is a precision experiment. We intend to measure a 10% cooling effect with 1% precision.

Therefore it is imperative that we tightly control any systematic effects which could affect the data quality.

Considerations

- **Each subsystem C&M must be designed by the expert(s)**
- **C&M is developed by EPICS expert**
- **Must integrate into MICE C&M**
- **Desire uniform interfaces**
- **Must consider system resources**
- **Similar components amongst different kits yields robustness**

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Organization

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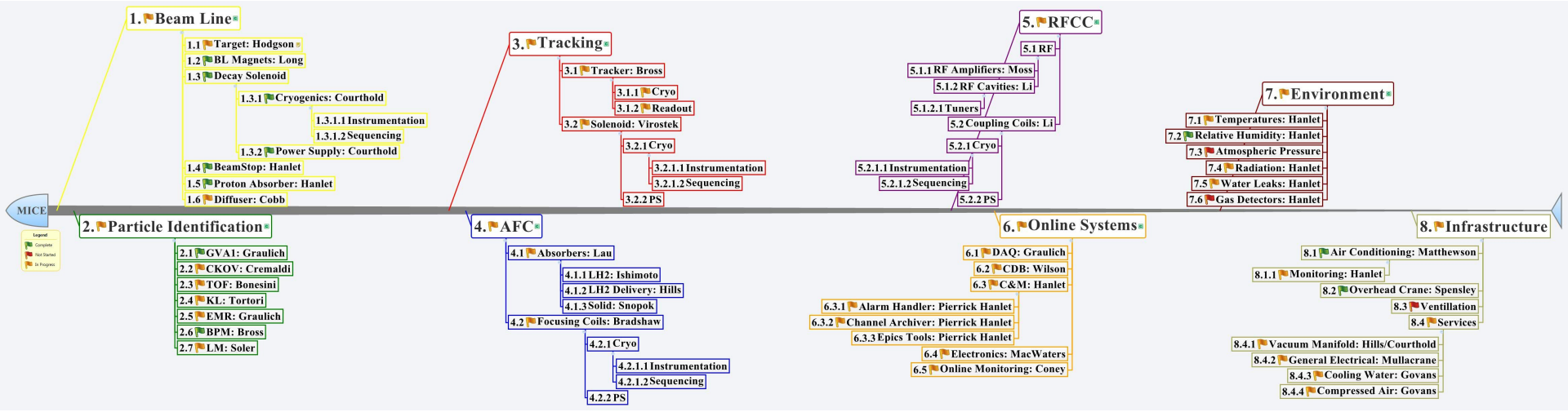
Beamline **Tracking** **RF** **Environment**



PID **Absorber** **Online** **Infrastructure**

Organization

Task divided into multiple systems:

- **Beamline:**
  - **Target, magnets, PA, DS, BS, Diffuser**
- **Particle ID**
  - **LM,TOF, CKOV, BPM, KL, EMR**
- **Environment monitoring**
  - **T, Humidity, radiation, water, He, …**
- **Online systems**
  - **DAQ—CDB—C&M interface, crates,network, …**

All this is part of Step I

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Future Organization

- **Tracking**
  - tracker and spectrometer solenoids
- **AFC**
  - absorber and focusing coils
- **RFCC**
  - RF cavities and coupling coils
- **Infrastructure**
  - Vacuum, power, compressed air, chilled water,...

Future Organization

Task divided into multiple systems:

- **Tracking** — **Steps II & III**
  - tracker and spectrometer solenoids
- **AFC** — **Step IV**
  - absorber and focusing coils
- **RFCC** — **Step V**
  - RF cavities and coupling coils

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Goals

MICE goes global

- to date, independent subsystems

The Configuration Database (CDB)

- memory of MICE
- all experimental parameters stored and loaded from CDB

All subsystems required to define states of operation

Goals: MICE States

Several Considerations:

1. Subsystem C&M designed by different collaborators, implemented by others
2. Must be integrated to ensure safe use of resources and operations
3. MICE operates in different states over differing time periods:
   1. “Off” -- shutdown/installation
   2. “Powered” -- ***not*** running
   3. “Standby” -- sleep over weekend
   4. “Testing” -- running w/DAQ for tests
   5. “Running” -- physics quality data taking

Goals: Device States

Different states requires different equipment (and data) monitoring requirements:

- **ignore many systems during shutdown state**
- **fewer systems ignored during sleep state**
- **nothing(?) ignored during data taking**
- **different parameters during testing or data taking?**
- **different alarms and different alarm limits**
- **different parameters and/or frequency to archive**

Example: PID HV

Simplest example:

	MICE States				
HV States	**Off**	**Powered**	**Standby**	**Testing**	**Running**
Off	X				
Powered		X	X	X	
Setting		X	X	X	
Testing		X	X	X	
Ramping		X	X	X	
Running					X

Example: Beamline DS

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Complex example:

Decay Solenoid		MICE States				
		Off	Powered	Standby	Testing	Running
Vacuum	Off	X				
	Powered		X			
	Standby		X			
	Pumping		X			
	Vacuum Ready		X	X	X	X
	Fault/Lost Vacuum		X			
Services	Off	X				
	Ready		X	X	X	X
Linde Refrigerator	Off	X				
	Powered		X			
	Compressor On		X			
	Cool-down		X			
	Warm-up		X			
	Refrigerator Ready		X	X	X	X
	Fault/Quench		X			
Cryogenics	Off	X				
	Powered		X			
	Safe Mode		X			
	Manual		X			
	Parallel Cool-down		X			
	Series Cool-down (pressure control)		X			
	L-He Level Control		X	X	X	X
Power Supply	Off	X				
	Powered		X			
	Circuit Breaker Closed		X	X		
	Ramp Enabled		X	X	X	
	Ramping		X	X	X	
	Stable		X	X	X	X
	Fault/Quench		X	X		

Example: H_2 Delivery

- Off
- On (with helium)
- Purge
- Helium Fill
- Helium Empty
- On (with H2)
- Hydride Bed Charge
- Purge
- H2 Fill
- H2 Empty

Thanks Matt !!!

MICE State Machines

Step IV Example (10,240) run:

Start run will require:

- Set magnet currents
- Set DS currents
- Set PA
- Set diffuser
- Set cooling channel magnets
- Absorber settings

All from CDB

- Verify tracker ready
- Verify BS, DAQ, network ready
- Check hall environment
- Start DATE

MICE State Machines

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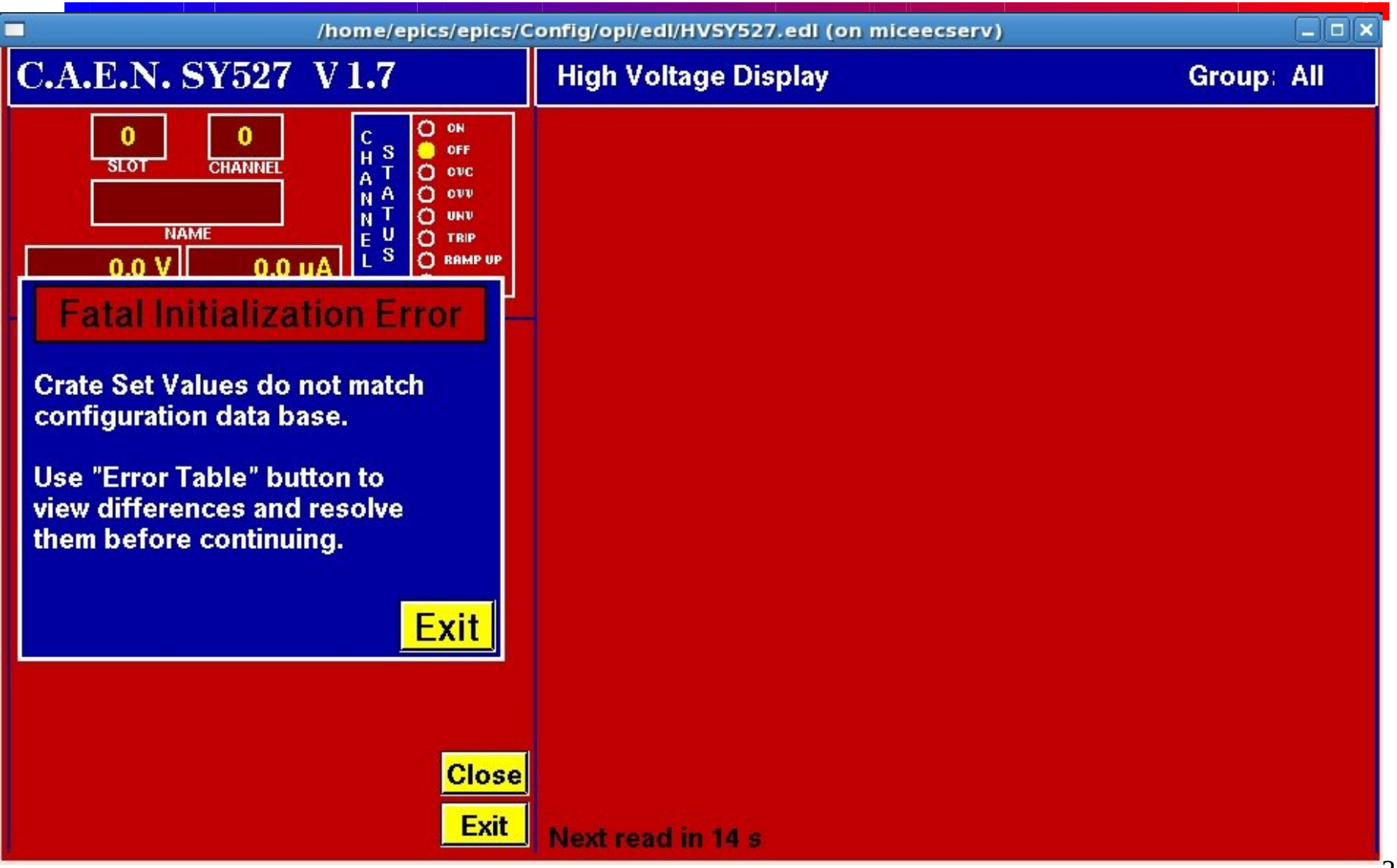
This must be properly planned !!!

MICE CDB Interface



MICE CDB Interface

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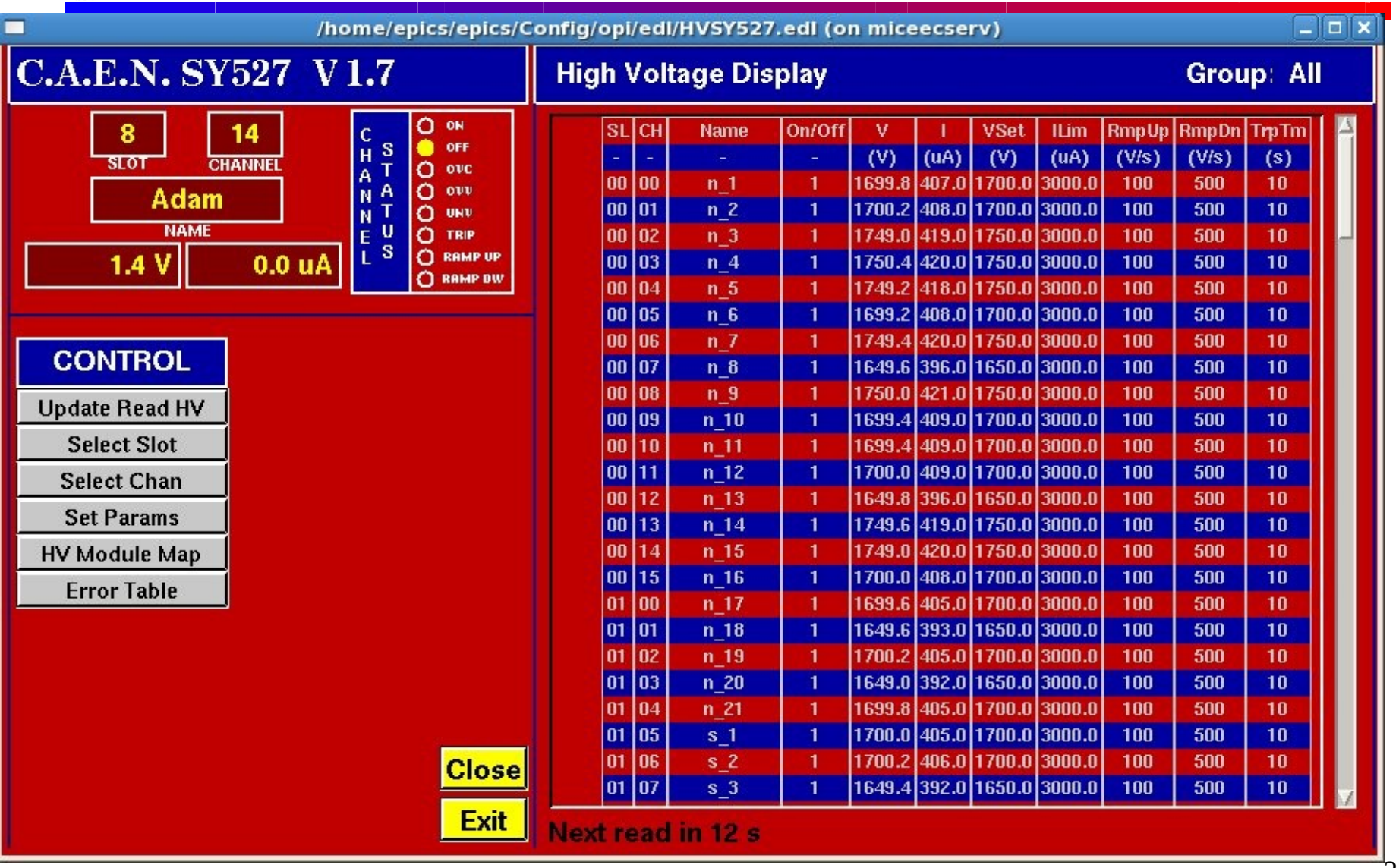

SL	CH	Name	On/Off	V	I	VSet	ILim	RmpUp	RmpDn	TrpTm
-	-	-	-	(V)	(uA)	(V)	(uA)	(V/s)	(V/s)	(s)
00	00	n_1	1	1699.8	407.0	1700.0	3000.0	100	500	10
00	01	n_2	1	1700.2	408.0	1700.0	3000.0	100	500	10
00	02	n_3	1	1749.0	419.0	1750.0	3000.0	100	500	10
00	03	n_4	1	1750.4	420.0	1750.0	3000.0	100	500	10
00	04	n_5	1	1749.2	418.0	1750.0	3000.0	100	500	10
00	05	n_6	1	1699.2	408.0	1700.0	3000.0	100	500	10
00	06	n_7	1	1749.4	420.0	1750.0	3000.0	100	500	10
00	07	n_8	1	1649.6	396.0	1650.0	3000.0	100	500	10
00	08	n_9	1	1750.0	421.0	1750.0	3000.0	100	500	10
00	09	n_10	1	1699.4	409.0	1700.0	3000.0	100	500	10
00	10	n_11	1	1699.4	409.0	1700.0	3000.0	100	500	10
00	11	n_12	1	1700.0	409.0	1700.0	3000.0	100	500	10
00	12	n_13	1	1649.8	396.0	1650.0	3000.0	100	500	10
00	13	n_14	1	1749.6	419.0	1750.0	3000.0	100	500	10
00	14	n_15	1	1749.0	420.0	1750.0	3000.0	100	500	10
00	15	n_16	1	1700.0	408.0	1700.0	3000.0	100	500	10
01	00	n_17	1	1699.6	405.0	1700.0	3000.0	100	500	10
01	01	n_18	1	1649.6	393.0	1650.0	3000.0	100	500	10
01	02	n_19	1	1700.2	405.0	1700.0	3000.0	100	500	10
01	03	n_20	1	1649.0	392.0	1650.0	3000.0	100	500	10
01	04	n_21	1	1699.8	405.0	1700.0	3000.0	100	500	10
01	05	s_1	1	1700.0	405.0	1700.0	3000.0	100	500	10
01	06	s_2	1	1700.2	406.0	1700.0	3000.0	100	500	10
01	07	s_3	1	1649.4	392.0	1650.0	3000.0	100	500	10

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Status and Schedule

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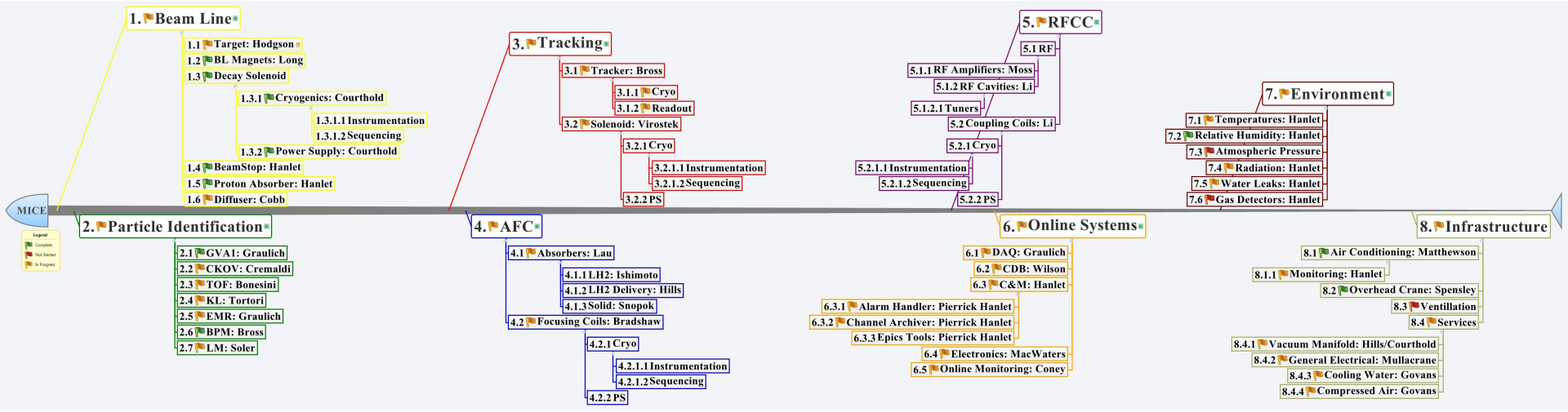

PID **Absorber** **Online** **Infrastructure**

Status

- **Beamline:**
  - Target, magnets, PA, DS, BS
  - Diffuser
- **Particle ID**
  - CKOV, BPM, KL
  - TOF, KL
  - LM, EMR
- **Environment monitoring**
  - T, Humidity, radiation, water flow, water leaks

Status

- **Online systems**
  - **DAQ—CDB—C&M: interface,crates,network, …**
- **Tracking System**
  - **Tracker (only AFE finished)**
  - **Spectrometer solenoids**
- **Absorber System (AFC)**
  - **Absorbers**
  - **Focusing coils**

Status

- RF System (RFCC)
  - Focusing coils
  - RF
- Infrastructure/services
  - What do we want here?

All subsystem owners have been contacted to initiate implementation of global plan

Next Steps:

Questions for subsystem owners:

		MICE States				
Decay Solenoid		Off	Powered	Standby	Testing	Running
Vacuum	Off	X				
	Powered		X			
	Standby		X			
	Pumping		X			
	Vacuum Ready		X	X	X	X
	Fault/Lost Vacuum		X			
Services	Off	X				
	Ready		X	X	X	X
Linde Refrigerator	Off	X				
	Powered		X			
	Compressor On		X			
	Cool-down		X			
	Warm-up		X			
	Refrigerator Ready		X	X	X	X
	Fault/Quench		X			
Cryogenics	Off	X				
	Powered		X			
	Safe Mode		X			
	Manual		X			
	Parallel Cool-down		X			
	Series Cool-down (pressure control)		X			
	L-He Level Control		X	X	X	X
Power Supply	Off	X				
	Powered		X			
	Circuit Breaker Closed		X	X		
	Ramp Enabled		X	X	X	
	Ramping		X	X	X	
	Stable		X	X	X	X
	Fault/Quench		X	X		

1)Are you the “designer”?

2)What are the states of your device?

3)What bits of kit have you purchases?

4)What do you still need to purchase?

Plan – Summer 2011

Goal is to have all existing subsystems finalized:

- **Operational states defined**
- **Alarm limits set accordingly**
- **Alarm limits for different states set and tagged in CDB**
- **Alarm limits read from CDB**
- **Archived data finalized**

Schedule

In the schedule that follows, the date considered is that of the first planned test of a subsystem.

The global magnet system C&M must be ready for the first operation of two magnets at RAL.

The codes used are:

PROGRESS	
0	not started
1	started
2	in progress
3	complete

PRIORITY	
0	none
1	highest
2	medium
3	lowest

Schedule

PROGRESS	
0	not started
1	started
2	in progress
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PRIORITY	
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SYSTEM	SUBSYSTEM	SUBSUBSYSTEM	OWNER	PROGRESS	PRIORITY	DATE
Beamline	Target		Hodgson	3	0	-
	New Target DAQ		Hodgson	2	3	01-06-2012
	BL Magnets		Long	3	0	-
	Decay Solenoid		Courthold	3	0	-
	Beamstop		Hanlet	3	0	-
	Proton Absorber		Hanlet	3	0	-
	Diffuser		Cobb	0	1	01-08-2011
PID	LM		Soler	0	2	?
	BPM		Bross	3	0	-
	GVA1		Graulich	3	0	-
	CKOV		Cremaldi	3	0	-
	TOF		Bonesini	2	1	15-06-2011
	KL		Torori	2	1	15-06-2011
	EMR		Graulich	2	1	15-06-2011
Online	DAQ		Graulich	2	1	15-09-2011
	DCB		Wilson	2	1	15-09-2011
	Online Monitoring		Coney	2	1	15-09-2011
	Electronics		MacWaters	2	1	15-09-2011
	C&M		Hanlet	2	1	15-09-2011
Environment			Hanlet	2	2	15-09-2011

Schedule

PROGRESS	
0	not started
1	started
2	in progress
3	complete

PRIORITY	
0	none
1	highest
2	medium
3	lowest

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SYSTEM	SUBSYSTEM	SUBSUBSYSTEM	OWNER	PROGRESS	PRIORITY	DATE
Tracking	Trackers		Bross	2	1	03-01-2012
	Spectrometer Solenoids		Virostek	2	1	27-10-2011
AFC	Absorbers					
		Solid	Snopok	?	?	?
		LH2	Ishimoto	2	1	01-07-2011
		LH2 delivery	Hills	2	2	01-09-2011
	Focusing Coils		Bradshaw	2	1	01-07-2011
RFCC	RF Amplifiers		Moss	2	2	01-09-2011
	RF Cavities		Li	?	3	?
	Coupling Coils		Li	?	3	?
Global Magnets	First SS & AFC		Preece/Courthold	1	3	06-01-2012
Infrastructure	Air Conditioning		Matthewson/Hanlet	3	0	-
	Overhead Crane		Spenseley	?	?	01-09-2011
	Ventillation		???	?	?	01-09-2011
	Services	Vacuum	Hills/Courthold	2	2	01-09-2011
		Electrical	Mullacrane	?	?	01-09-2011
		Cooling Water	Govans	?	2	01-09-2011
		Compressed Air	Govans	?	2	01-09-2011

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Potential Problems

- **C&M should be considered as an integral part of system development, *not* as an afterthought**
- **Designer is not developer**
- **Integrator is (usually) neither designer or developer**
- **Schedule dominated by subsystem delivery**

Summary

- New systems come online and are *(mostly)* accounted for
- Integration with CDB underway
- Still need input from subsystem owners

- *Integration for new systems requires proper planning*
- *Designer/Developer/Integrator not usually same person*