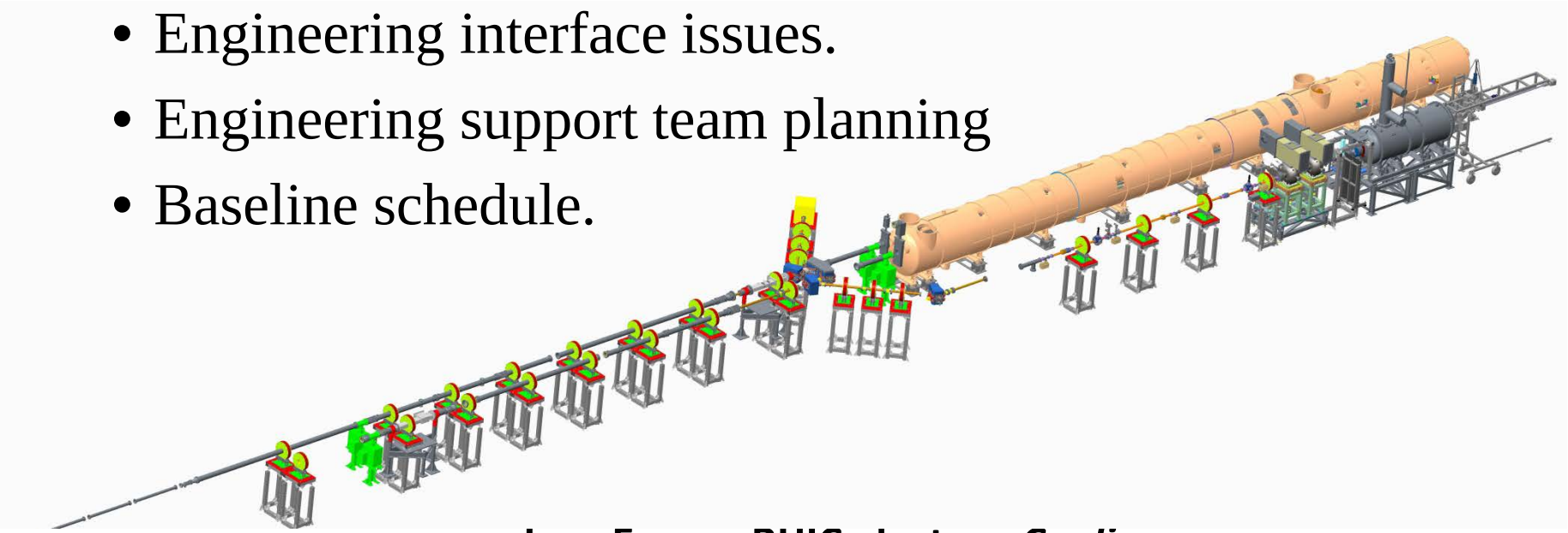
LEReC Engineering

J. Tuozzolo, C-AD Chief Mechanical Engineer
(LEReC Project Engineer)

Layout, Infrastructure, and Engineering

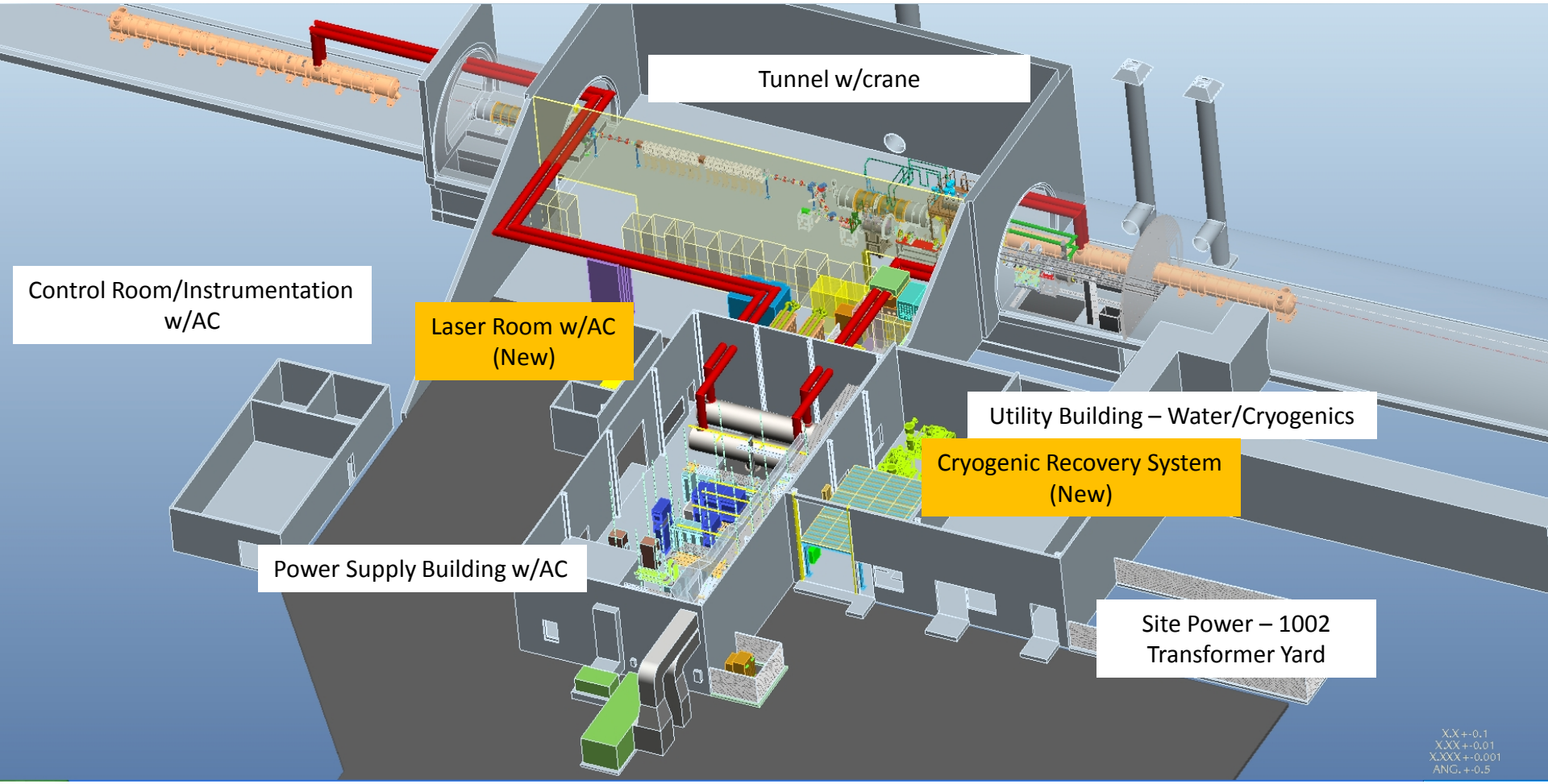
- IP 2:00 location - available.
- Engineering interface issues.
- Engineering support team planning
- Baseline schedule.



Low Energy RHIC electron *Cooling*

Location, Location, Location

RHIC 2:00 IP, BRAHMS and AnDY out, CeC to be completed 2016



Low Energy RHIC electron *Cooling*

Location, Location, Location

RHIC 2:00 IP

- Large open experimental area with crane
- Good access, removable shield door.
- Available space in both ring support buildings.
- Existing utilities, communication, and cable trays.
- Fire protection systems installed.
- Cryogenic tap installed.

Tunnel w/crane

Utility Building – Water/Cryogenics

Site Power – 1002 transformer yard

Power Supply Building w/AC

Easy Tunnel Access

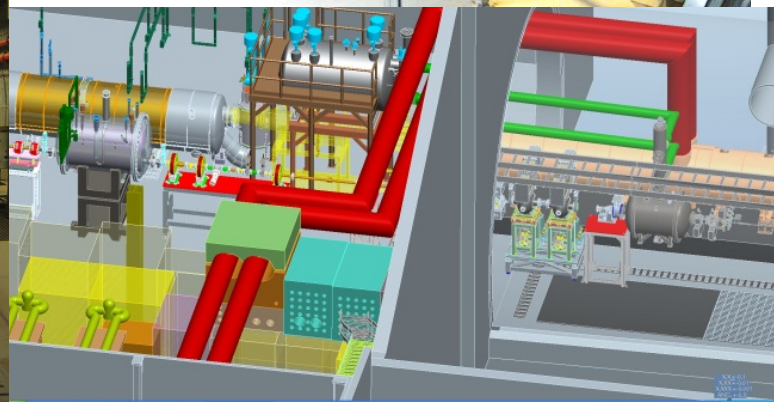
Water Systems

Low Energy RHIC electron *Cooling*

CeC PoP Preparation

Building preparation completed for CeC:

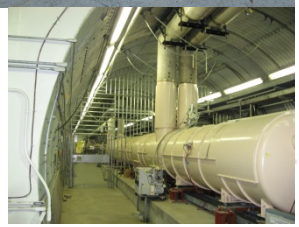
- Brahms shielding removed.
- Cooling water tower/water pumps installed.
- Shielding penetrations enlarged (Folz)
- 1002B RF Coax run installed (Folz, Randazzo)
- Laser building ordered (Folz, Sheehy)
- RF Power supply installed (Folz, Zaltsman)

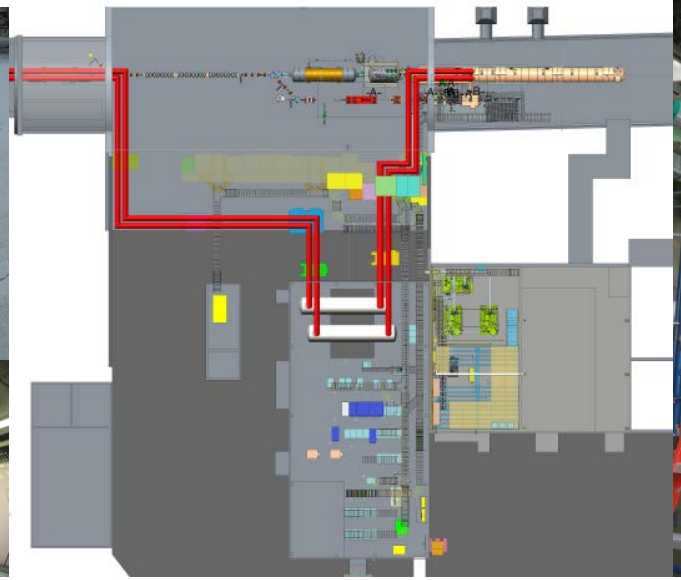


CeC PoP Preparation

Building preparation for CeC in progress 2013:

- Laser building installation (Folz, Sheehy)
- Quiet helium source for SCRF (Orfin, Soria)
- Cryogenic return compressor (Than, Soria, Folz)
- 1002A ODH system installation (Folz)
- Move AnDY equipment from 1002D (Folz)
- Cable tray installation (Folz)





Design Issues

CeC PoP test schedule/equipment available/interchangeable.

SCRF gun and cavity performance/RF system (Sergey's talk).

QHS performance – distance to gun/solenoid/accelerator cavity

2:00 or 1:00. Cryogenic design margin.

Beam dump design – 250kW

Beam line elements

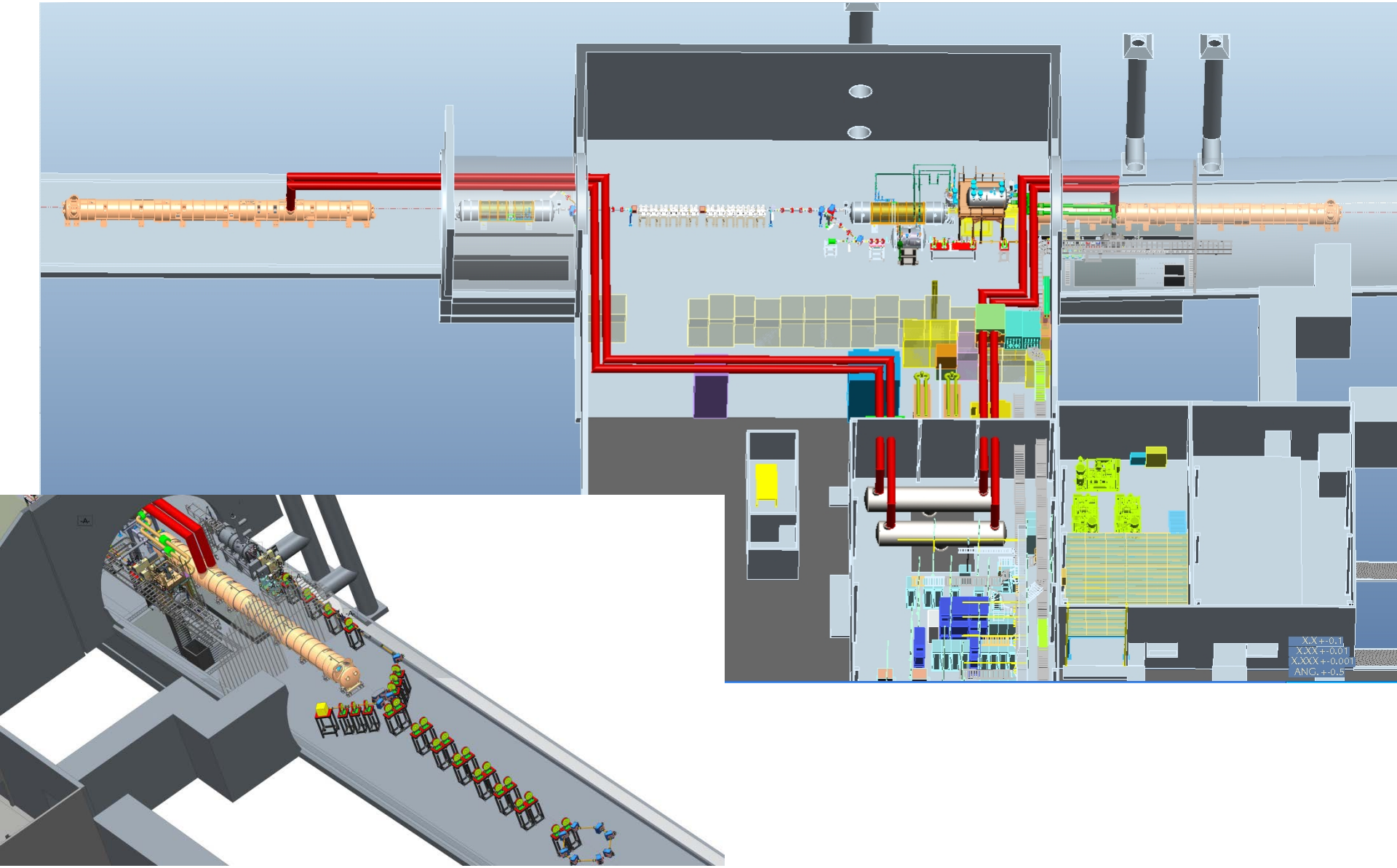
- Injection/extraction ebending magnets
- 180° turn configuration
- eFocusing solenoid magnets
- eBPM's
- eCorrector magnets

Magnet Power Supplies: solenoids, bends, and 180 return in series + individual corrector power supplies (CeC PoP).

RF Amplifier/power supplies (gun, accelerator, buncher)

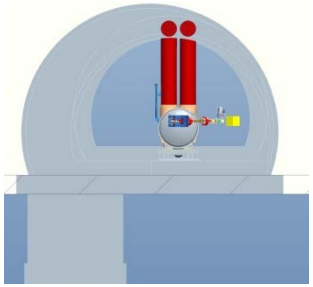
Magnetic Shielding: mu metal or solenoid windings

2:00 IP Left or Right

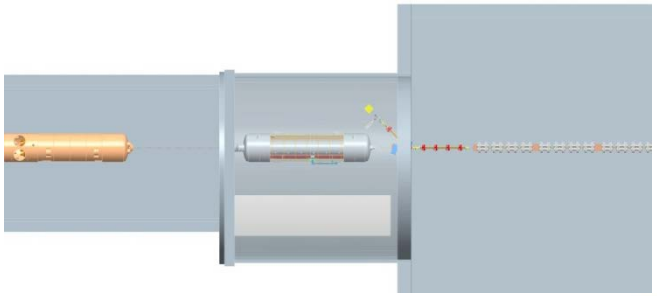


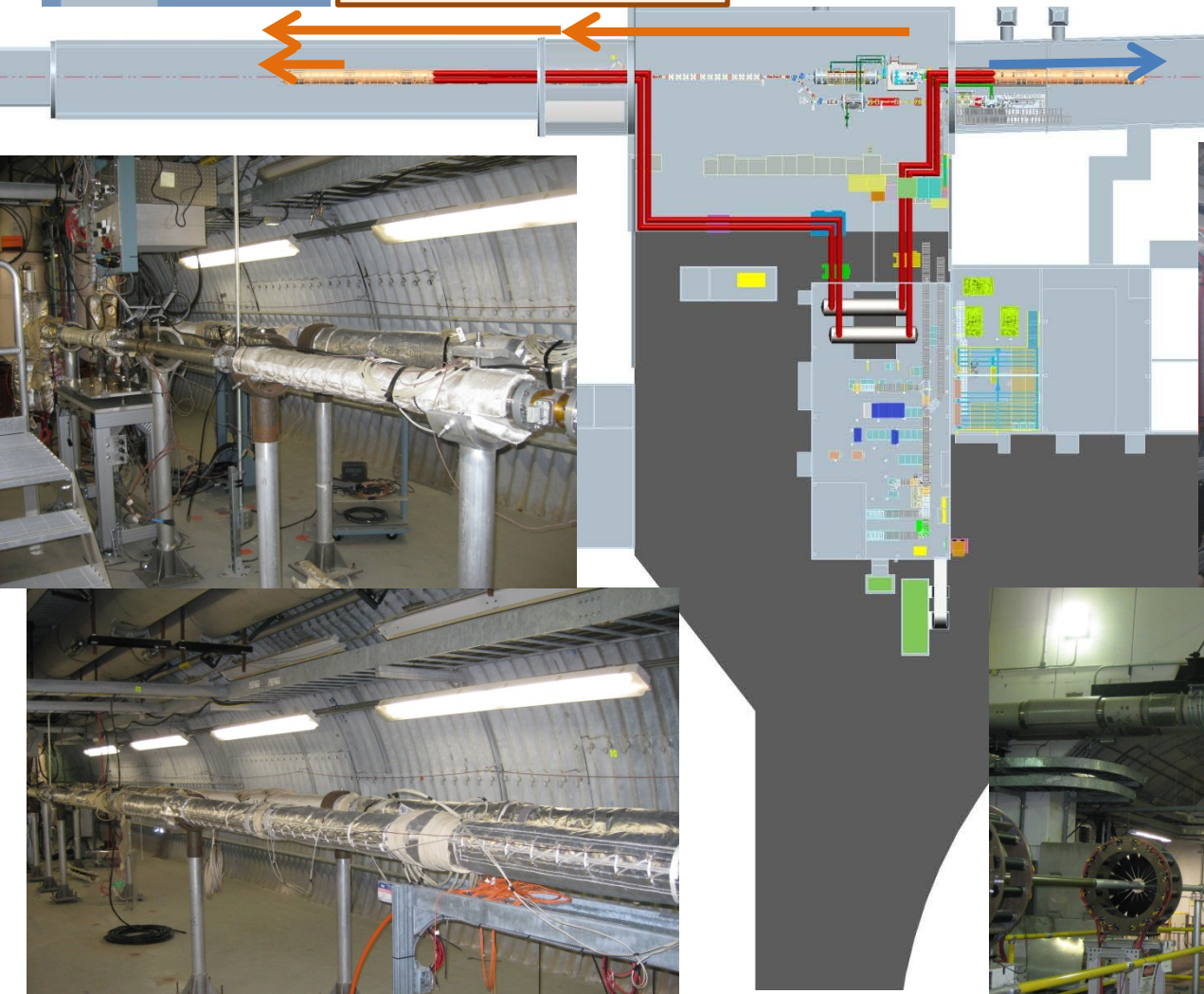
Low Energy RHIC electron *Cooling*

1:00 Tunnel

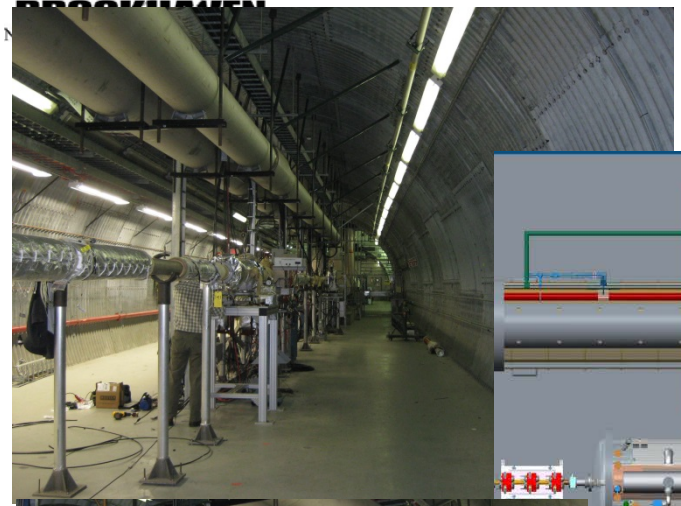


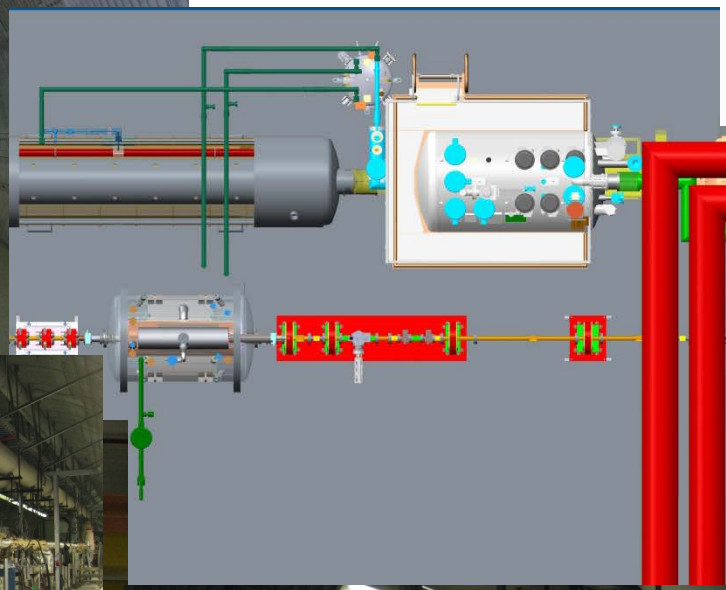
24m to larger tunnel
+ 32m to QHS

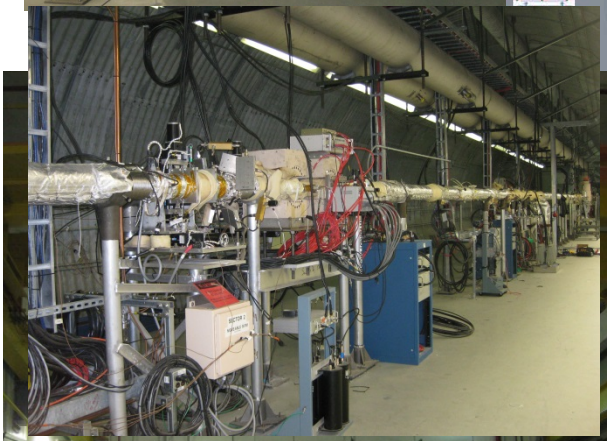




2:00 Tunnel





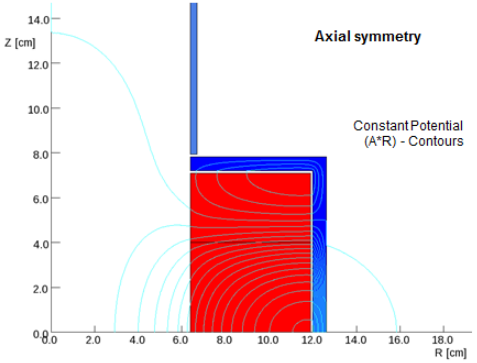


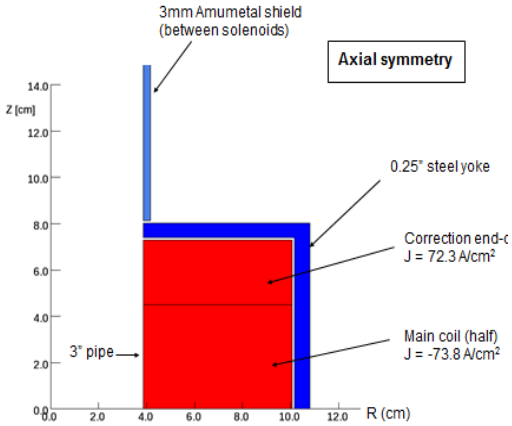
Low Energy RHIC electron *Cooling*

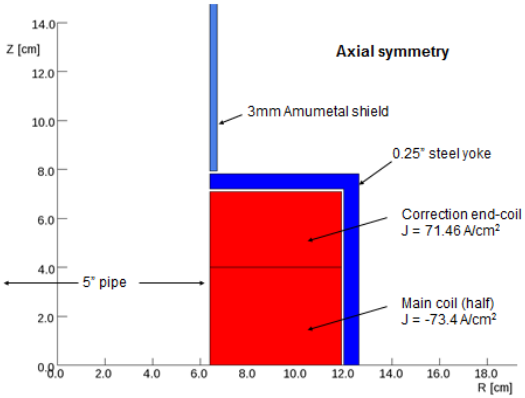
Design Issues

Beam line elements - eFocusing solenoid magnet and vacuum chamber
Magnet specifications: strength, length, aperture
Solenoid magnet every 2M

- 5” beam tube (standard RHIC size, better conductance – same ion pumps, available w/NEG coating).
- 3” beam tube – better solenoid field?
- Solenoid – wind on tube, clamp over steel shell
  Both modeled – little difference.







Low Energy RHIC electron *Cooling*

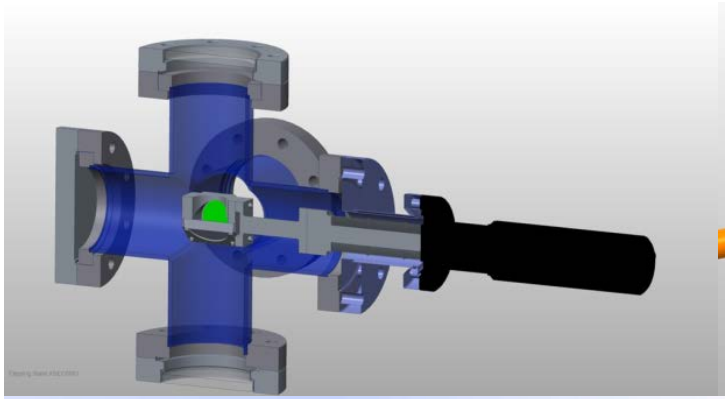
Design Issues

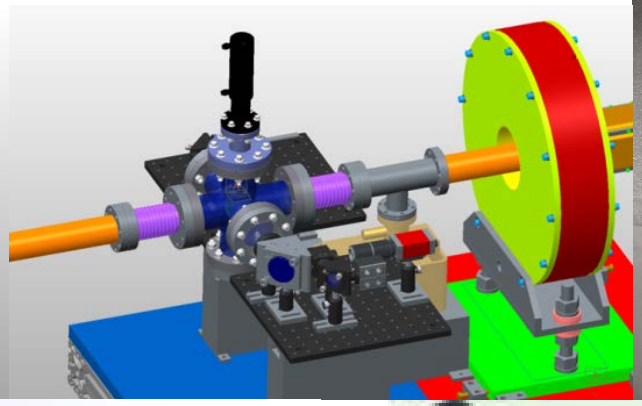
Corrector magnet: spacing, strength, length, aperture.

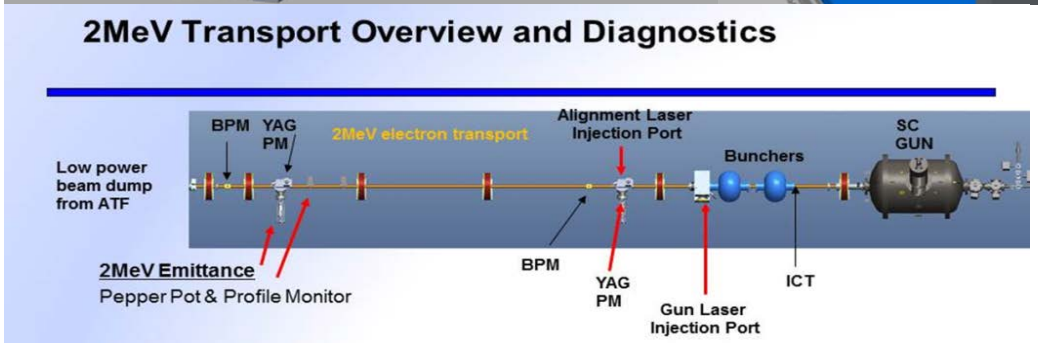
Bending/Alignment magnets TB Designed (5 inch aperture).

180° bend magnets TB D

180° bend instrumentation TB D (CeC PoP)







Low Energy RHIC electron *Cooling*

Design Issues

Cryogenic performance - Quiet Helium Source (QHS): 200 W.

Gravity fed helium supply and return.

Large cryostat for LEReC then for CeC PoP.

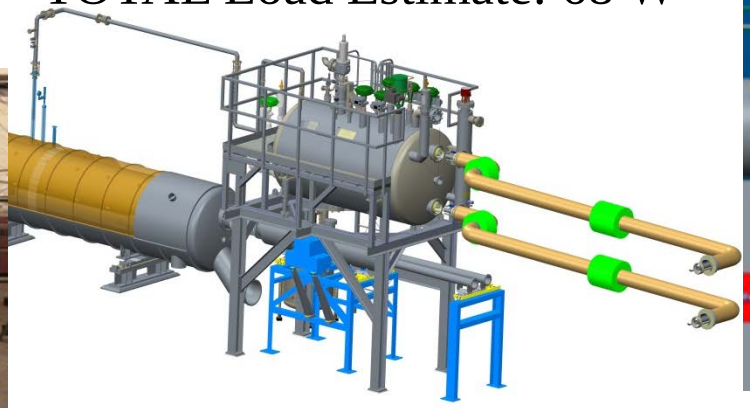
Fixed heat exchanger design – 100% design margin for CeC PoP.

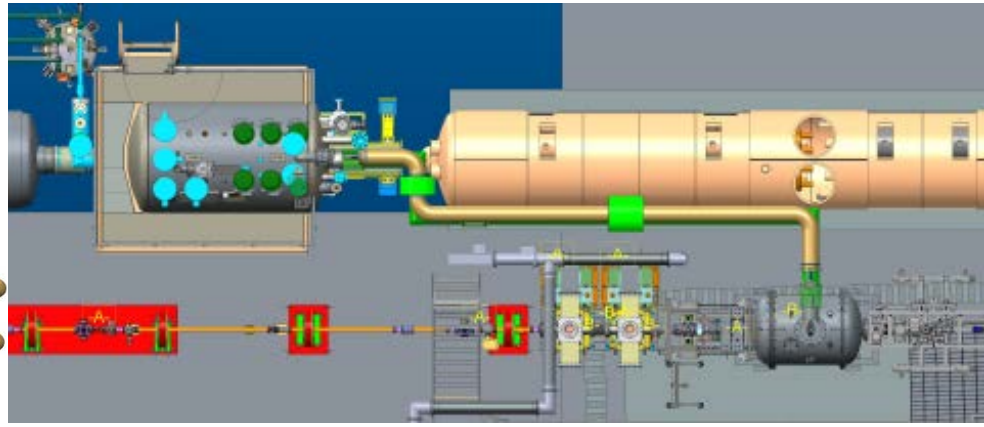
Can shorten transfer lines if needed.

112 Mhz Cavity RF Load Estimate: Dynamic = 50W, Static = 8 W, FPC = 2 W

Cryogenic transfer VJP: liquid supply = 2W, vapor return: 6W (8 meters → 1 W/m)

TOTAL Load Estimate: 68 W



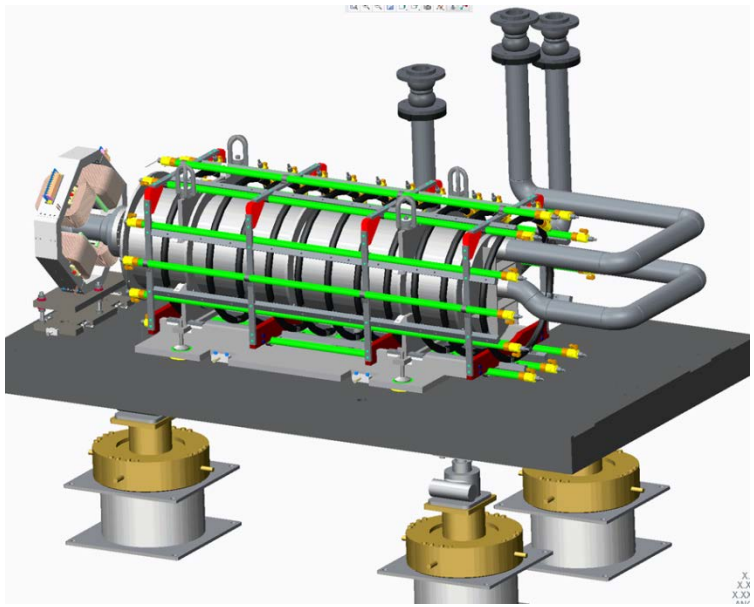


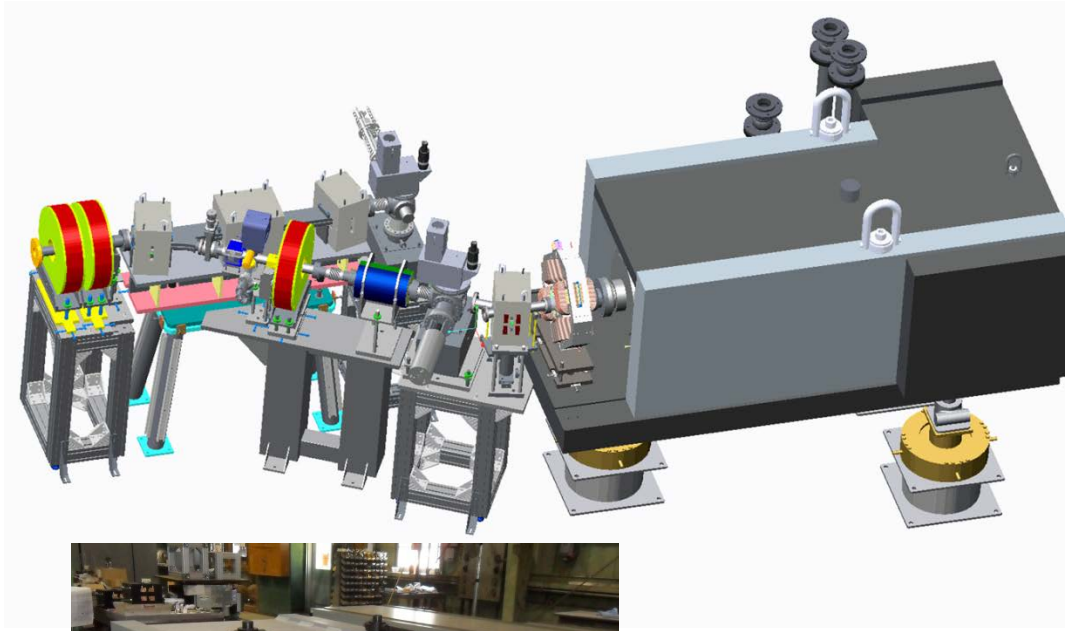
Low Energy RHIC electron *Cooling*

Design Issues

Beam Dump: 5.0 MeV electrons/0.25 MW power

Copy ERL Beam Dump: 2.5 MeV electrons/1.0 MW power

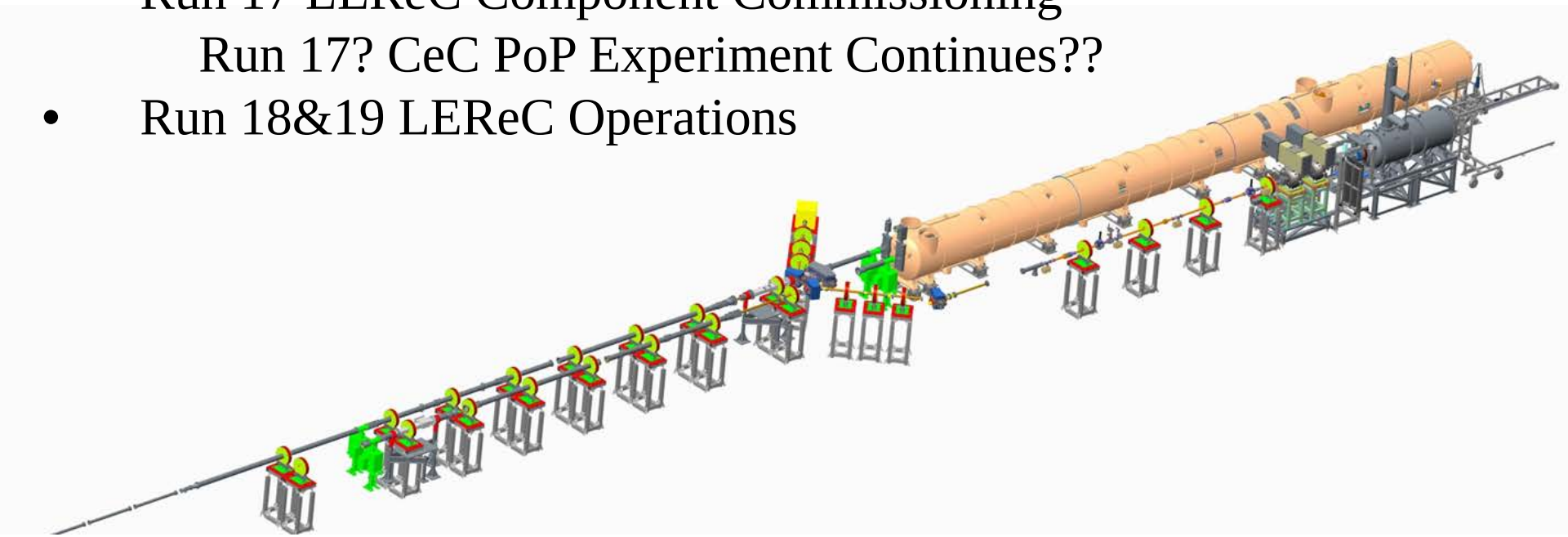




Low Energy RHIC electron *Cooling*

RHIC Program Timeline

- Run 14 CeC PoP Gun (and cryogenic system) Commissioning.
- Run 15 CeC PoP Beamline commissioning.
  Summer 2015 02:00 Q3/Q4 equipment move.
  Building/tunnel infrastructure improvements.
- Run 16 CeC PoP Experiment
  Summer 2016 Cavity and beamline installation.
- Run 17 LEReC Component Commissioning
  Run 17? CeC PoP Experiment Continues??
- Run 18&19 LEReC Operations



Low Energy RHIC electron *Cooling*

Timeline

FY2013 Physics approach/preliminary design approved.

FY2013 Design Safety Review Questionnaire completed.

FY2013 Initial 2:00 Layout and LEReC Lattice.

FY2013 SCRF Cavities physics design and performance specifications.

FY2014 Engineering “kick-off” meeting/assignments/start bi-weekly engineering meetings

FY2014 CeC gun cavity cryogenics commissioned, performance benchmark for quiet helium source.

FY2014 LECeC Lattice “frozen”, energy, intensity, location, component specifications.

FY2014 Engineering systems PDR, systems specifications, building requirements/system loads.

FY2014 Order SCRF Cavities/cryostat, SC solenoid, RF amplifiers, buncher system.

FY2014 Support building layout/equipment locations, cable tray, electrical service, AC & water loads.

FY2015 Detailed cryogenic component design BNL PCSSR – long lead procurements.

FY2015 Detailed beamline design, ASSRC/FDR – long lead component procurements.

FY2015 Support building modification design/contracts (2015 shutdown modifications)

FY2015 Move RHIC beamline components (2015 shutdown modifications)

FY2016 Receive and test LEReC beamline and cryogenic components

FY2016 2016 Shutdown installation LEReC beamline and cryogenic components

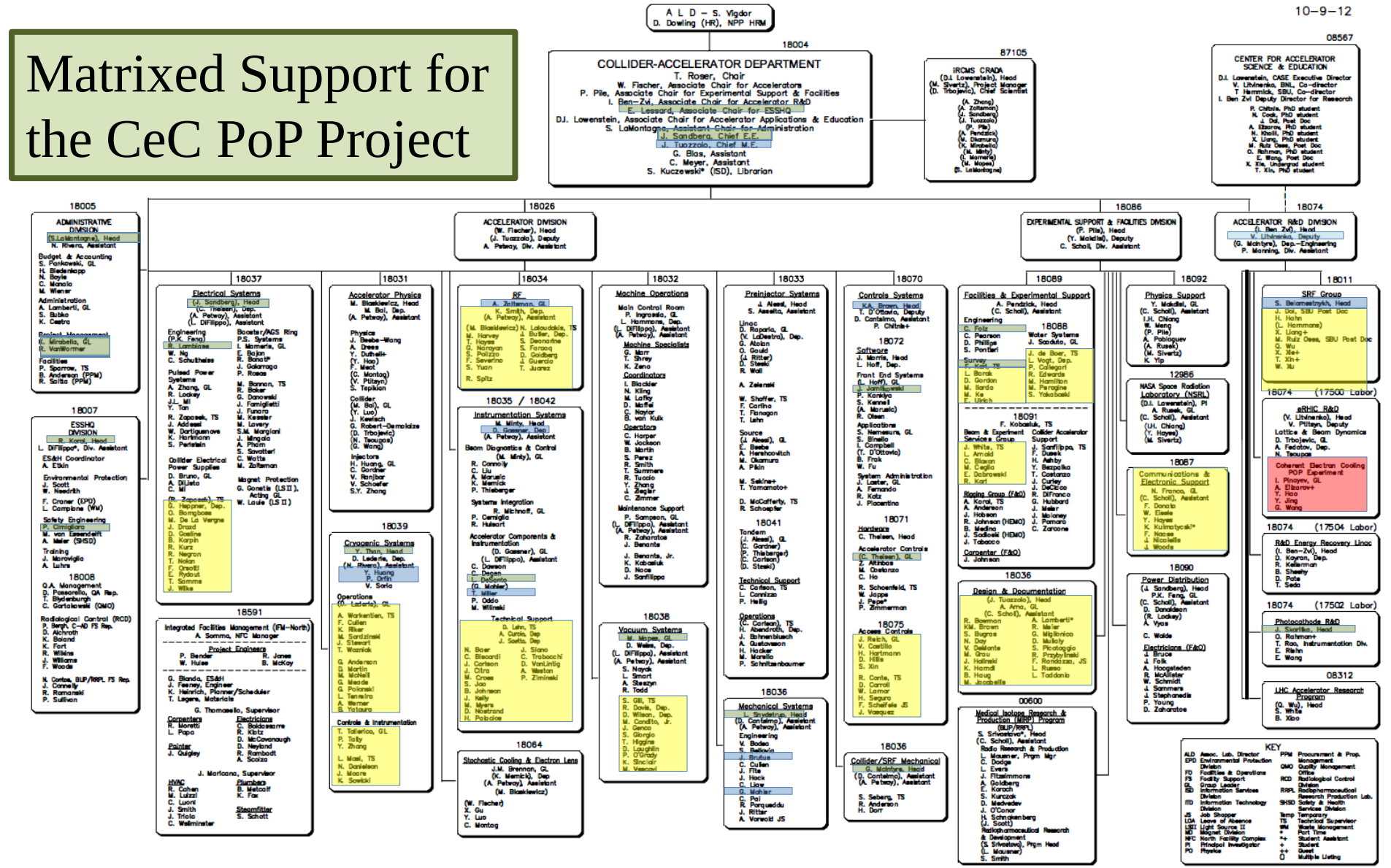
FY2017 Engineering commissioning for LEReC beamline and cryogenic components

FY2017 2017 Shutdown modifications/corrections to LEReC beamline and cryogenic components

FY2018 Operations (Run 18)

C-AD Engineering & Technical Support

Matrixed Support for the CeC PoP Project



Low Energy RHIC electron *Cooling*

Systems Engineers

Engineering Support
C-AD Accelerator, Facilities & Experimental Support, and R&D Divisions.

CeC layout – **B. Martin** (AD)
SRF – **S. Belomestnykh** (CeC, RD)
RF Systems PS and LLRF – **A. Zaltsman** (CeC, AD)
Cryogenics – **R. Than**, T. Tallerico, P. Orfin, J. Haung (CeC, AD)
Beamline (Magnets and Power Supplies) – G. Mahler, R. Lambiase (CeC, AD)
Diagnostics – **D. Gassner**, T. Miller, L. DeSanto (CeC, AD)
Drive Laser & Photocathode Development – **B. Sheehy** (CeC, RD)
Conventional Facilities – **C. Folz, J. Scaduto, P. Feng** (CeC, ESF)
Cathode Insertion Fixture – TBD
Cavity Tuners, Power Coupler, Laser Port – TBD
Beam Line and Insulating Vacuum Systems – **M. Mapes** (CeC, AD)
RF Buncher – TBD
Beam Dump – **L. Snydstrup** (CeC, AD)

Summary

- Physics/engineering co-ordination meetings are underway.
- Preliminary beam line design is underway.
- Site has been chosen/infrastructure.
- After review LEReC lattice will be frozen:

  SCRF system specifications

  Vacuum chamber/magnet specifications

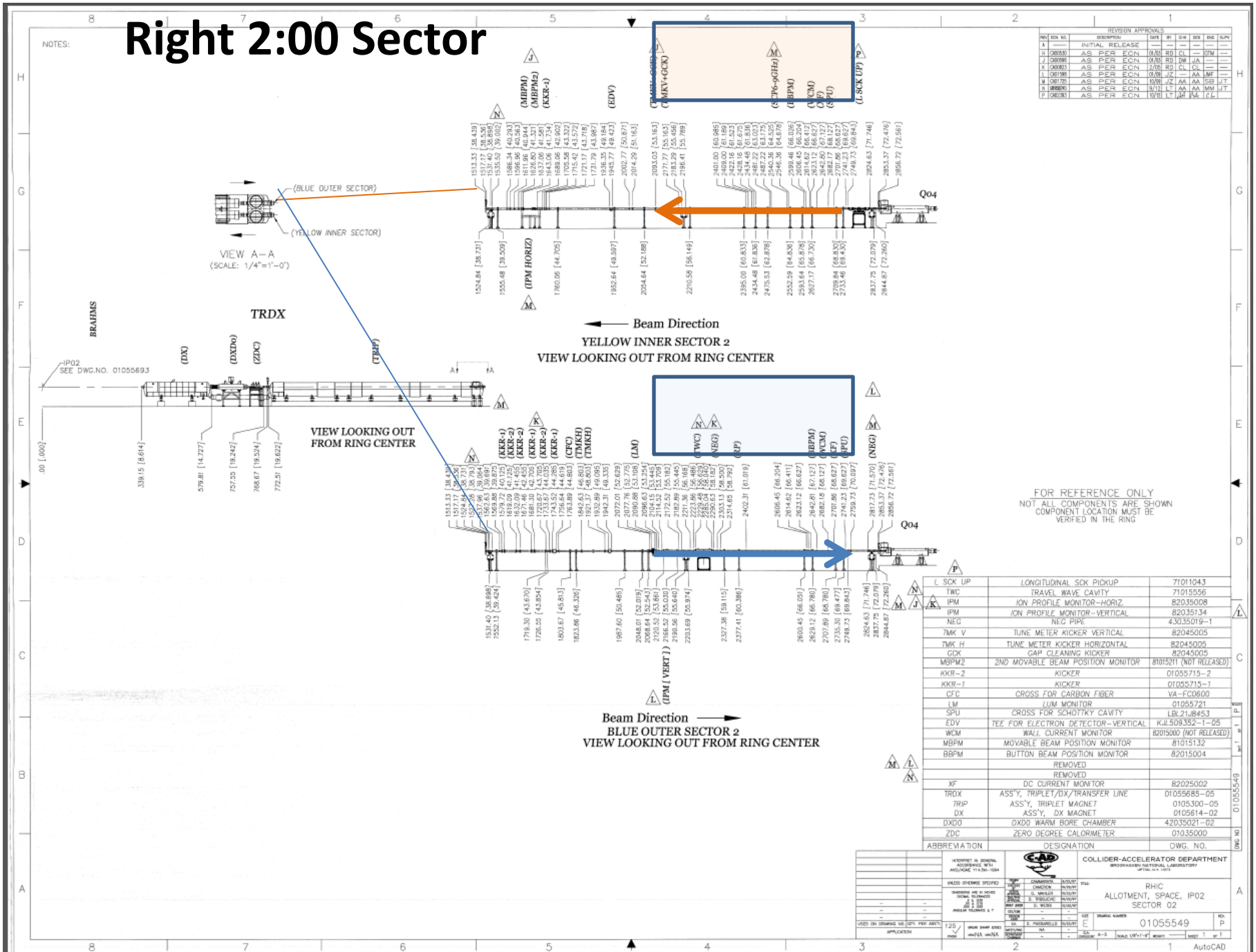
  e beam instrumentation

  HI beam instrumentation
- Engineering team to be finalized and assigned.
- CeC PoP SCRF Cavity and cryogenic system commissioned
- Finalize 1:00 or 2:00 location

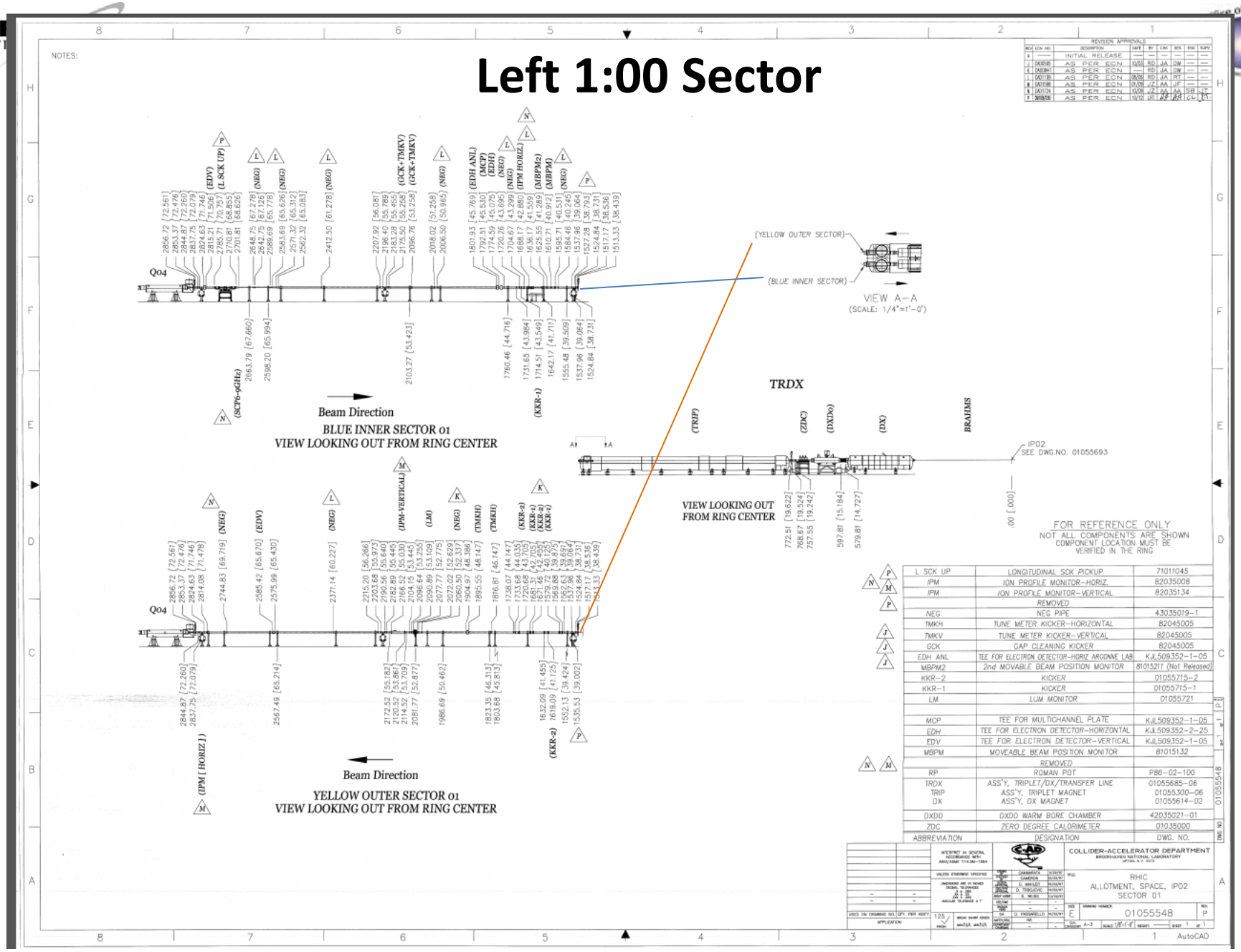
Tunnel Location Details

Sector 2									
Meters		Yellow Inner					Blue Outer		
from IP2		S-Coord		Label	Name		S-Coord		Label	Name
Q3									Q3	
38.4					Start of warm sector					Start of warm sector
					10 Hz GOF Magnet					10 Hz GOF Magnet
										0.25MBPM
41.0				MBPM2	Moveable BPM (LF Schottky)		2598.5		KKR-2	BBQ Kicker
					0.25m BPM BTF Pick-up					1M Pick-up
					Beam Loss Monitor					0.25MBPM
41.5		2597.9		IPM-H	Y-Ionization PM horizontal					
					Beam Loss Monitor					
42.0		2599.3		KKR-2	Hybrid Kicker		2599.1		KKR-2	PLL BBQ PU (Moveable)
44.0					**Start of LEReC Cooling Section**					
46.8							2601.04		TMKH	ARTUS Kicker Horizontal (start)
48.8							2603.04		TMKH	ARTUS Kicker Horizontal (end)
49.0		2605.2		EDV	Electron Det V				EDV	Electron Det V
53.0		2608		TMKV	ARTUS Kicker V(or B-by-B longit damper)				LM	Lumi-Mon (6-way cross only)
55.0		2610		TMKV	ARTUS Kicker V(or B-by-B longit damper)		2610.04		IPM-V	B-Ionization PM Vertical
										Beam Loss Monitor
56.0					**End of LEReC Cooling Section**					
56.6							2611.6		TWC	Traveling Wave Cavity
		2613			Future ARTUS Kicker V		2613			Future ARTUS Kicker H
		2615			Future ARTUS Kicker V		2615			Future ARTUS Kicker H
							2619			Future B-Ionization PM Vertical
61.8		2617.5		SC Long Pick-up (start)						
64.0				SC Long Pick-up (middle)						
66.0				SC Long Pick-up (end)						
67.0		2622		Button BPM			2622.7		Button BPM	
68.0		2623.5		WCM			2623.52		WCM	
68.6		2624.2		DCCT					DCCT	
69.0				HF Schottky PU					HF Schottky PU	
				Pin diodes (2)						
71.0				New Long SC pickup						
					End of warm sector					End of warm sector
Q4									Q4	

Right 2:00 Sector

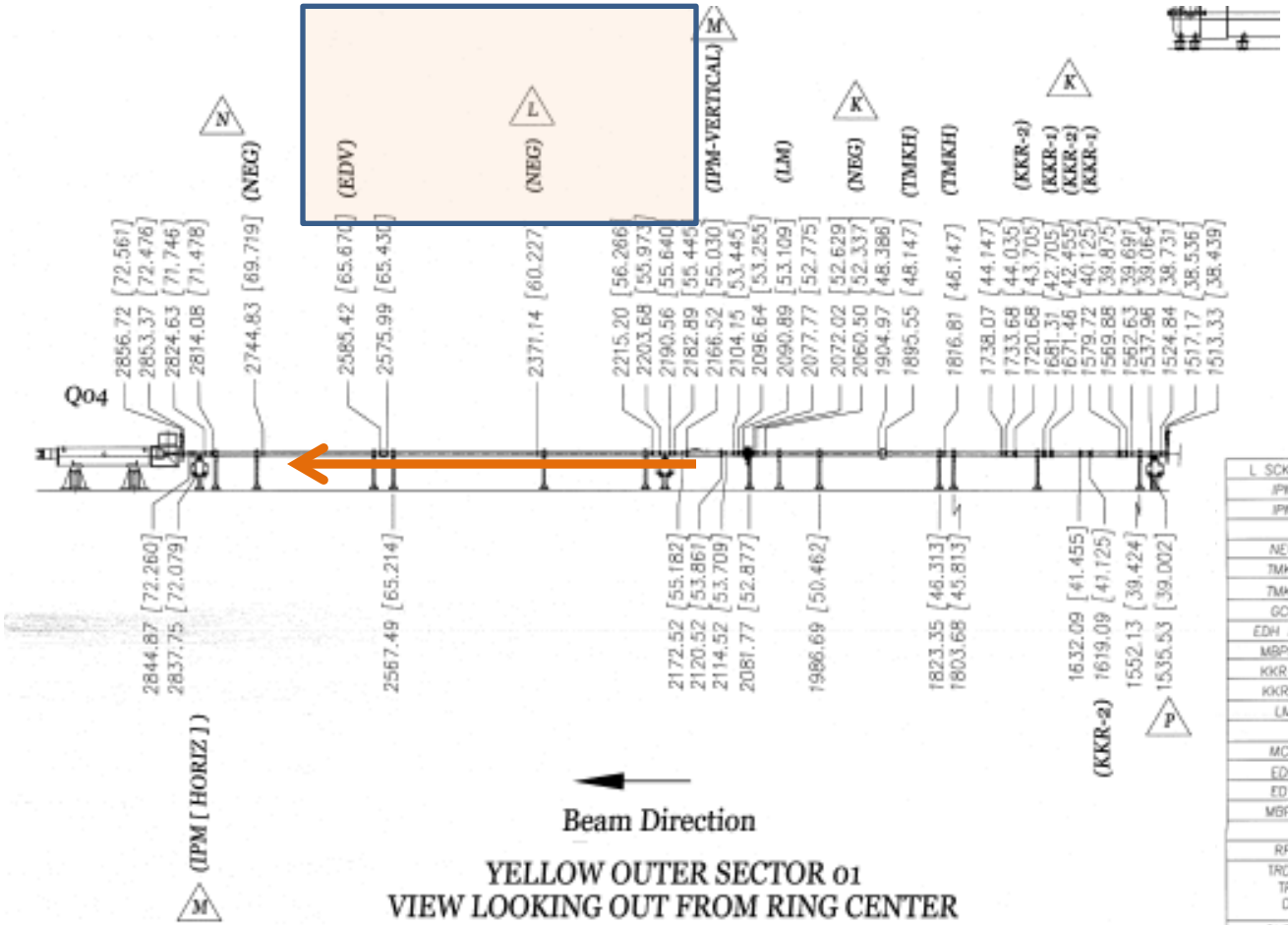


Left 1:00 Sector



Low Energy RHIC electron *Cooling*

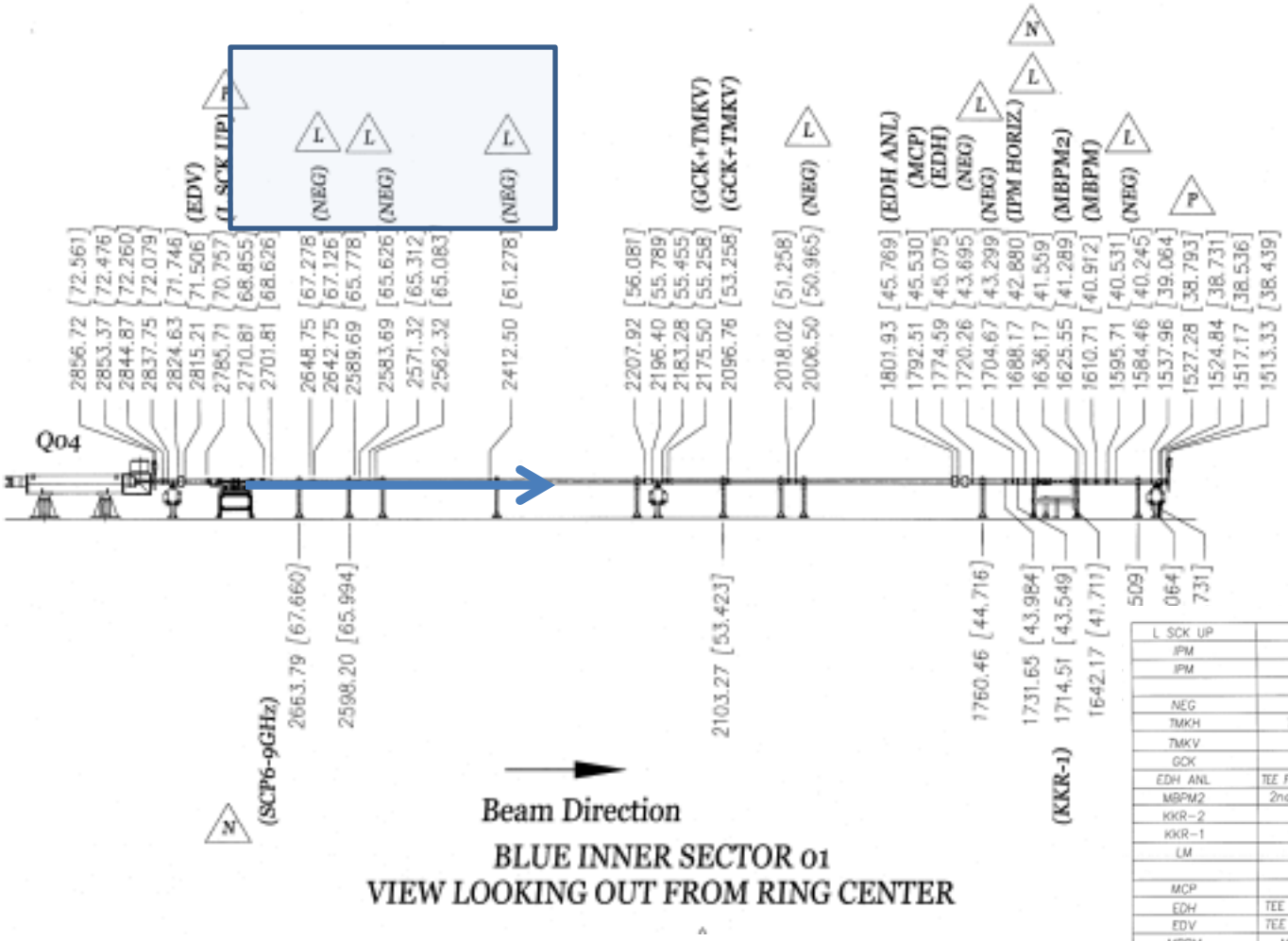
Yellow



L SCK UP	LONGITUDINAL SCK PICKUP	71011045
IPM	ION PROFILE MONITOR–HORIZ.	82035008
IPM	ION PROFILE MONITOR–VERTICAL	82035134
	REMOVED	
NEG	NEG PIPE	43035019–1
TMKH	TUNE METER KICKER–HORIZONTAL	82045005
TMKV	TUNE METER KICKER–VERTICAL	82045005
GCK	GAP CLEANING KICKER	82045005
EDH ANL	TEE FOR ELECTRON DETECTOR–HORIZ ARGONNE LAB	KJL509352–1–05
MBPM2	2nd MOVABLE BEAM POSITION MONITOR	81015211 (Not Released)
KKR–2	KICKER	01055715–2
KKR–1	KICKER	01055715–1
LM	LUM MONITOR	01055721
MCP	TEE FOR MULTICHANNEL PLATE	KJL509352–1–05
EDH	TEE FOR ELECTRON DETECTOR–HORIZONTAL	KJL509352–2–25
EDV	TEE FOR ELECTRON DETECTOR–VERTICAL	KJL509352–1–05
MBPM	MOVEABLE BEAM POSITION MONITOR	81015132
	REMOVED	
RP	ROMAN POT	P86–02–100
TRDX TRIP DX	ASS'Y, TRIPLET/DX/TRANSFER LINE ASS'Y, TRIPLET MAGNET ASS'Y, DX MAGNET	01055685–06 01055300–06 01055614–02
DXDO	DXDO WARM BORE CHAMBER	42035021–01
ZDC	ZERO DEGREE CALORIMETER	01035000
ABBREVIATION	DESIGNATION	DWG. NO.

Low Energy RHIC electron *Cooling*

Move Equipment Blue



L SCK UP	LONGITUDINAL SCK PICKUP	71011045
IPM	ION PROFILE MONITOR–HORIZ.	82035008
IPM	ION PROFILE MONITOR–VERTICAL	82035134
	REMOVED	
NEG	NEG PIPE	43035019–1
TMKH	TUNE METER KICKER–HORIZONTAL	82045005
TMKV	TUNE METER KICKER–VERTICAL	82045005
GCK	GAP CLEANING KICKER	82045005
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MBPM2	2nd MOVABLE BEAM POSITION MONITOR	81015211 (Not Released)
KKR–2	KICKER	01055715–2
KKR–1	KICKER	01055715–1
LM	LUM MONITOR	01055721
MCP	TEE FOR MULTICHANNEL PLATE	KJL509352–1–05
EDH	TEE FOR ELECTRON DETECTOR–HORIZONTAL	KJL509352–2–25
EDV	TEE FOR ELECTRON DETECTOR–VERTICAL	KJL509352–1–05
MBPM	MOVEABLE BEAM POSITION MONITOR	81015132
	REMOVED	
RP	ROMAN POT	P86–02–100
TROX TRIP DX	ASS'Y, TRIPLET/DX/TRANSFER LINE ASS'Y, TRIPLET MAGNET ASS'Y, DX MAGNET	01055685–06 01055300–06 01055614–02
DXDO	DXDO WARM BORE CHAMBER	42035021–01
ZDC	ZERO DEGREE CALORIMETER	01035000
ABBREVIATION	DESIGNATION	DWG. NO.

Low Energy RHIC electron *Cooling*