

HEX Beamline Infrastructure

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Outline

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- Schedule
- Risks
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HEX Beamline Infrastructure Overview

Scope

- Shielded hutches
- Mechanical & Electrical Utilities
- Equipment Protection System (EPS)
- Personnel Protection System (PPS)
- Control Station Furniture

Recent Scope Changes

- Since the PDR in 2018, significant scope changes were made to Beamline Infrastructure
 - Removal of the B-hutch
 - Removal of all associated infrastructure associated with the B-hutch (utilities, PPS, EPS)

Schedule

- Work began with the start of the development & procurement of the hutch enclosures in early 2018.
- The development, procurement, and installation of all beamline infrastructure is scheduled to finish in late CY 2021, after the completion of PPS certification and integration of EPS with the beamline.

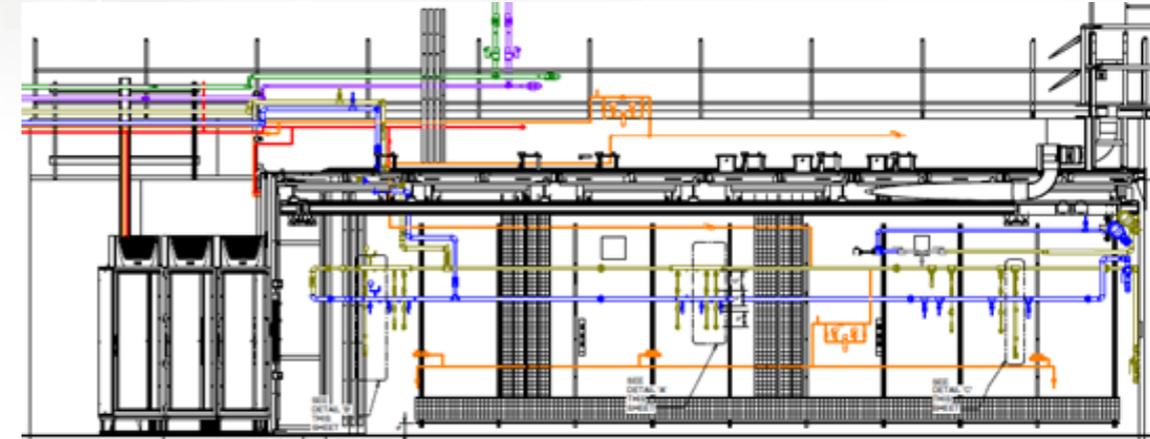
Cost

- Total cost for all Beamline Infrastructure is \$4.1M.
 - Hutches: \$2.1M
 - Mechanical Utilities: \$670k
 - Electrical Utilities: \$421k
 - PPS: \$769k
 - EPS: \$194k
 - Control Station Furniture: \$48k

WBS 7.05.04.02 Mechanical Utilities

Scope:

- Design, specification, procurement, fabrication, assembly, installation, & testing of beamline mechanical utilities.
- Structural utility support pylons and L-brackets,
- Equipment racks (including heat exchangers and all mounting provisions)
- De-ionized (DI) water system. with appropriate flow/temperature instrumentation.
- Process chilled water system.
- Gaseous nitrogen and compressed air systems.
- Exhaust system for experimental needs.
- Liquid nitrogen distribution system (including all service points, facility interfaces, emergency shutoff system, phase separators, etc).
- Filing of as-built drawings, safety reviews, oversight, and preparation for the IRR.
- HEX Mechanical Utilities has same scope, but larger scale than previous beamlines
 - 10 equipment racks
 - 5 hutches with DI water provisions
 - LN₂ service in 4 hutches, including satellite bldg.



Typical Mechanical Utilities Layout

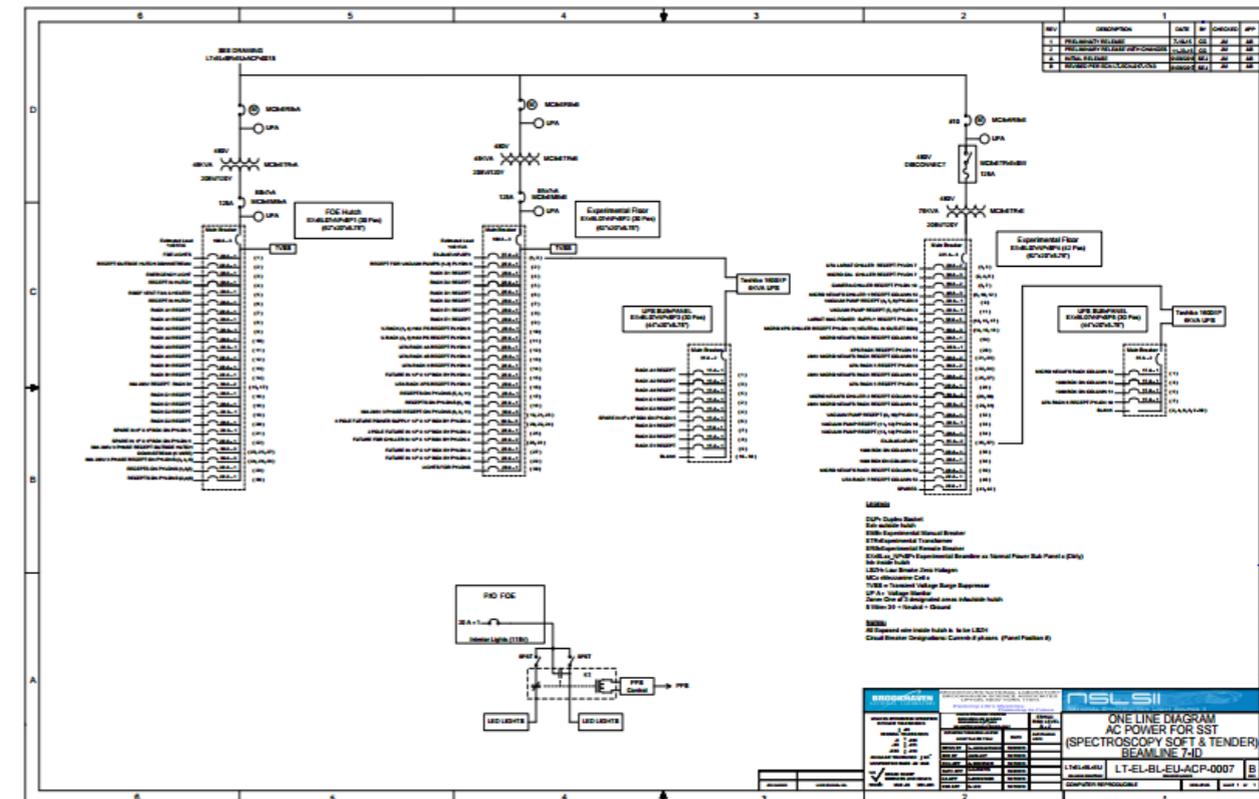


Typical Installation in an FOE at NSLS-II

WBS 7.05.04.03 Electrical Utilities

Scope:

- Design, procurement, installation, and testing of beamline electrical utilities.
- Installation of cable trays, conduits, utility power cables, power outlets, boxes and circuit breaker panels.
- Provisioning of power to equipment racks.
- Installation of all conduit and boxes for the Oxygen Deficiency Hazard (ODH) system inside the hutches.
- UPS system for the beamline.
- Wiring up and testing of hutch smoke detectors.
- Power and network provisions for beamline SAF monitors
- Electrical inspections, as-built drawings ,and preparation for the IRR.

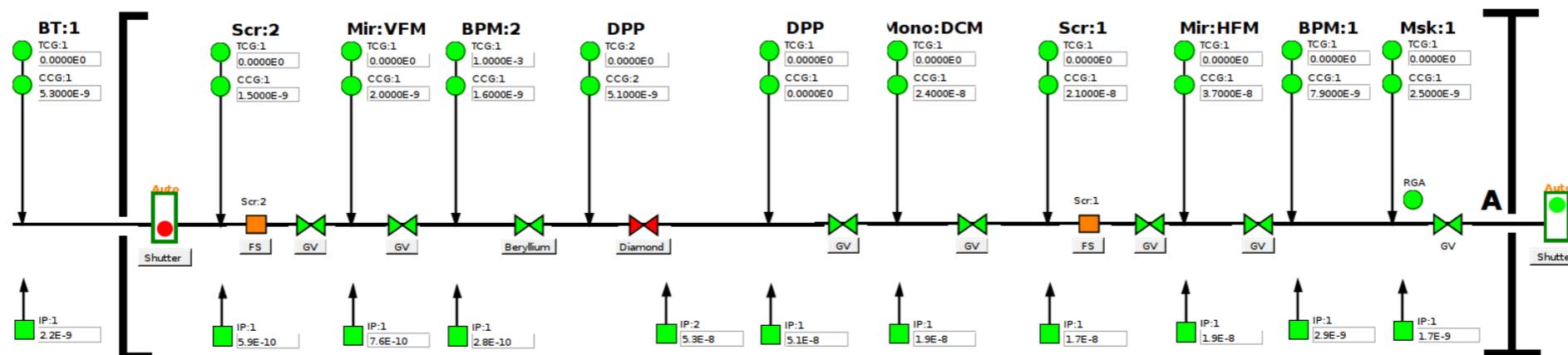


Typical schematic for beamline power distribution

WBS 7.05.04.04 EPS

Scope:

- Design, specification, procurement, fabrication, assembly, installation, and testing.
- Includes PLC, wiring, custom sensors, water leak detection systems inside the hutches, and integration of the rack smoke alarms.
- Installation and testing of cables & connectors to interface to the various water flow sensors, temperature sensors and the vacuum pump and gauge controllers used on the beamline (particularly in the white/pink beam sections).
- Development and implementation of PLC software
- Development of interface screens for EPICS Control System
- Filing of as-built drawings and preparation for the IRR.
- HEX EPS has same scope, but larger scale than previous beamlines
 - ~100 thermocouple sensors distributed throughout the beamline.
 - EPS DI water located in 3 hutches



Beamline EPS user interface (CSS) screen shown in EPICS

WBS 7.05.04.05 PPS

Scope

- Design, specification, procurement, fabrication, assembly, installation, & testing of beamline PPS
- Dual chain safety-rated PLC architecture (two manufacturers)
- Status of PPS functions available on local HMI and EPICS
- Redundant critical device configuration
- Doors and labyrinths monitored by redundant and diverse switches
- Interface to photon shutters & water flow circuits
- Tie-in to storage ring and front end
- Interior warning – revolving beacons and sirens
- Detailed interface control drawing provided for requirements
- HEX has same scope, but larger scale than previous beamlines
 - 5 hutches
 - 6 doors
 - 11 labyrinths
 - 5 hutches with PPS water
 - 4 photon shutters
- Recent design improvements & experience have reduced costs

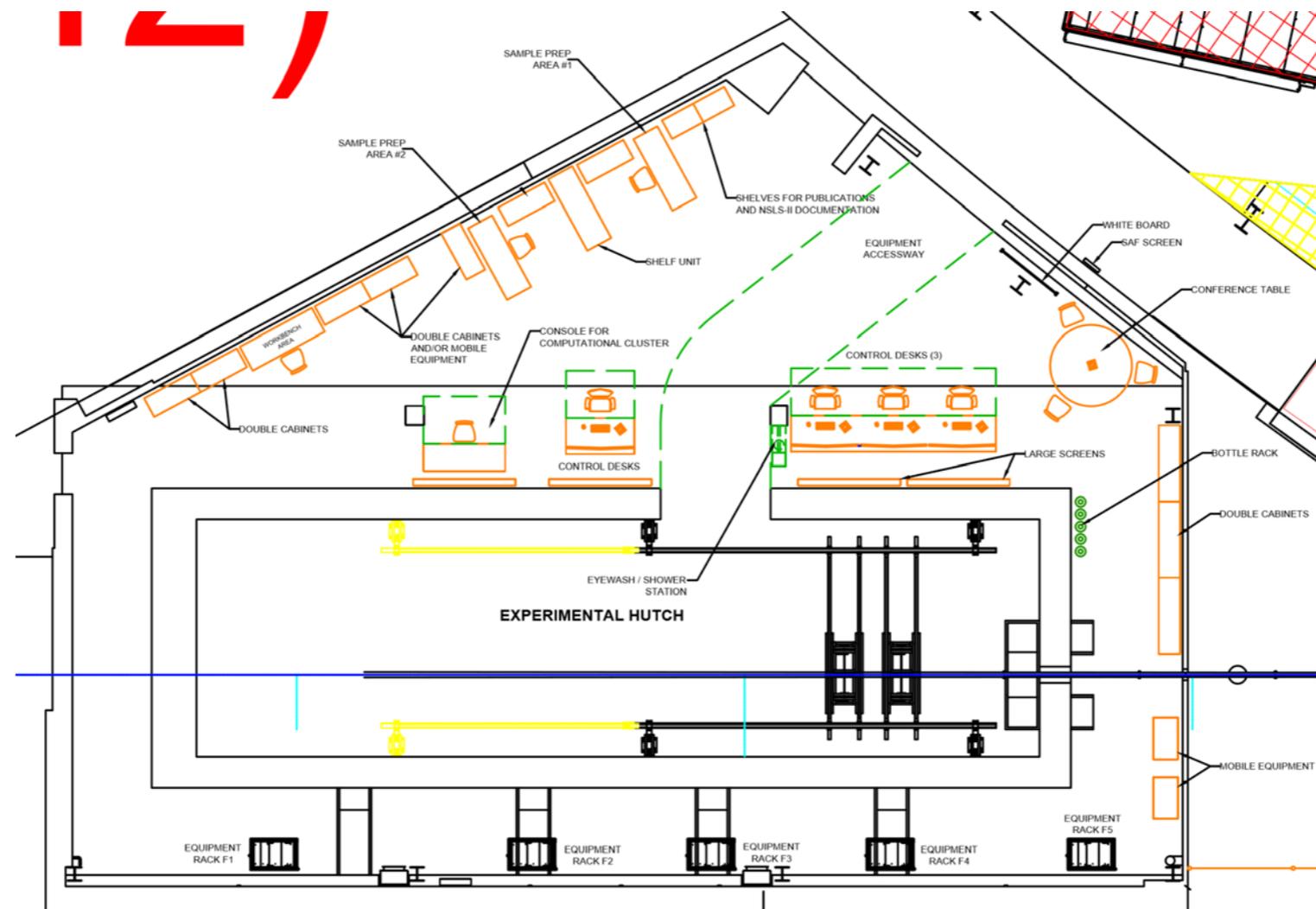


Bench assembled PPS panel

WBS 7.05.04.06 Control Station & Furniture

Scope

- Design, procurement, assembly, and installation of furniture for the beamline control station including partitions and their power and communications wiring.
- Desktop computers, screens and printers.
- SAF monitors
- Filing of as-built drawings and preparation for the IRR.



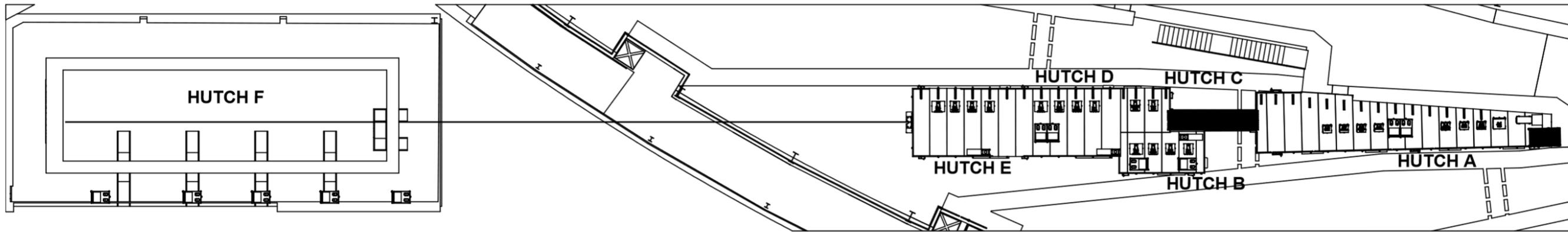
Current Schedule

Activity	2019												2020												2021											
	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Hutches	PDR																																			
		FDR																																		
		Fabrication																																		
							Install- Exp Floor																													
Electrical Utilities	Development																																			
									Procurements																											
										Installation																										
Mechanical Utilities	Development																																			
									Procurements																											
										Installation																										
PPS	Development																																			
			Procurements																																	
EPS										Development																										
Control Station																																				

- Hutches are currently in fabrication. First delivery scheduled for late Summer 2019.
- Initial development of Utilities & PPS will kick off this month.
- Schedule is based on projects with similar technical scope and resource requirements, and scaled accordingly
- Sufficient float in schedule, to mitigate risks of resource availability & procurement delays

Risks to Infrastructure Cost & Schedule

- Underestimated effort or underestimated scope could increase cost and/or schedule
 - Mitigation: Will use experienced personnel to develop requirements and by using actuals from previous similar projects at NSLS-II to inform HEX project on labor needs.
- Schedule delays can lead to inefficient use of labor (i.e. “standing army” costs)
 - Mitigation: Redirect utilities installation labor to HEX hutches that are finished and accepted by BNL.
 - Mitigation: Existing schedule can be modified to have some work done in parallel, rather than in series.
 - Example: start PPS installation before the completion of utilities.



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SYSTEM	DI WATER SYSTEM					
	Hutch A	Hutch B	Hutch C	Hutch D	Hutch E	Hutch F
PPS	MASK #1	-	MASK #7	MASK #8	MASK #9	MASK #10
	MASK #2/WB STOP			WB STOP	WHITE BEAM SHUTTER	WB STOP
	MASK #3					
	MASK #4					
	MASK #5					
	MASK #6					
	WHITE BEAM SHUTTER #1	-				
	WHITE BEAM SHUTTER #2					
EPS	DIAMOND WINDOW (3)		FUTURE CIRCUIT	FUTURE CIRCUIT	FUTURE CIRCUIT	FUTURE CIRCUIT
	FILTERS				DIAGNOSTICS	DIAGNOSTICS
	SIDE BOUNCE MONO*					
	WHITE BEAM SLITS					
	IMAGING MONO + WBS					
	FOCUSING MONO* + WBS					

Interface Control Drawing for DI Water

Conclusion

- HEX infrastructure WBS is well understood; scope is based on similar work that was previously completed at NSLS-II and scaled to meet the needs of HEX.
- Costing was performed with experienced CAMs, Scientists, and Engineers who are familiar with this work. Actuals from past projects were used to inform HEX costs.
- Infrastructure schedule was developed with integrated project team.
- Risks have been identified and assessed. Mitigations have been developed to minimize any effects on the overall project.
- Project remains well-positioned for success.