

Beamline Controls

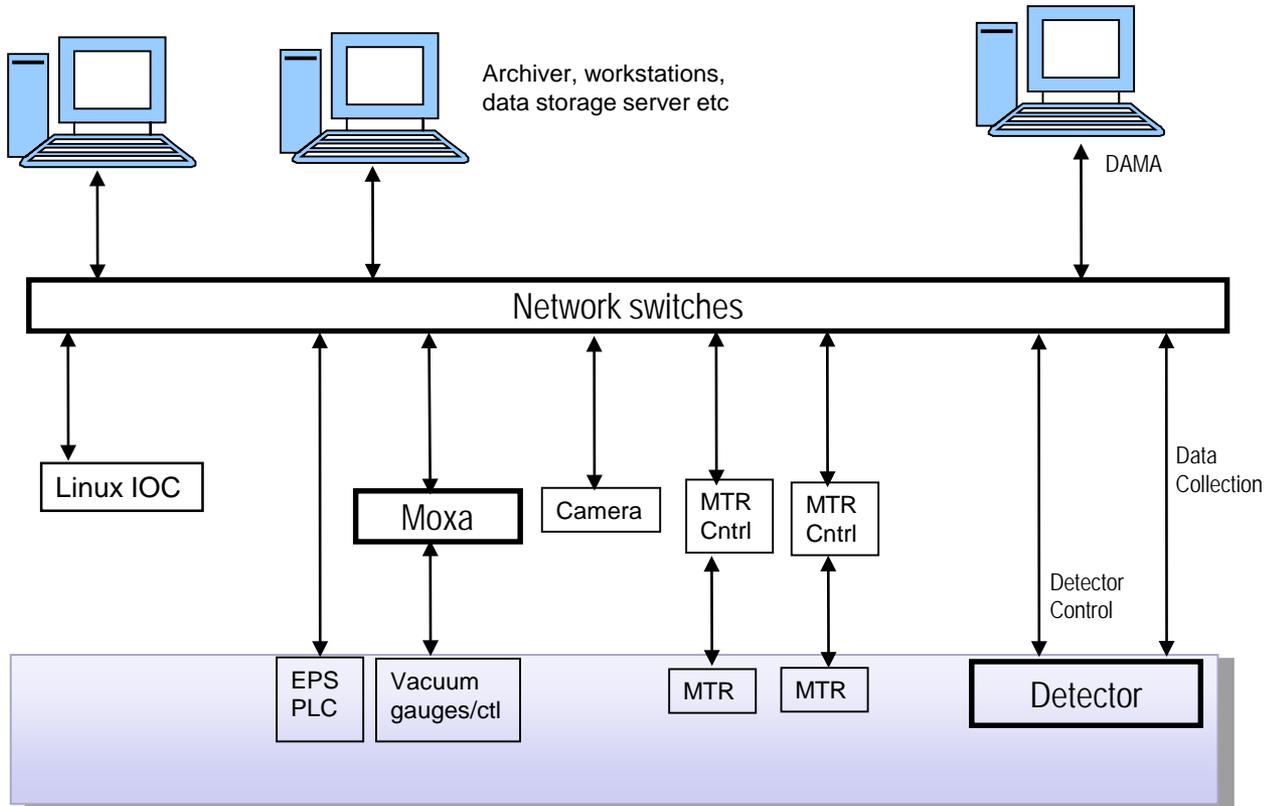
HEX FDR

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Beamline Controls Group Leader and CAM for WBS 7.05.06

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Scope



Major M&S Procurement: Total \$407k

- 3 Network switches
- 2 Linux IOC servers
- 1 archive server, 2 DAQ servers
- 6 workstations and large displays
- 11 motion controllers, 4 power supplies: to support 83 motion axes
 - Budget contains 11 PowerBrick-LV controllers
- 14 diagnostic cameras (6x webcams, 8x gigE cameras)
- 6 Moxa terminal servers (vacuum monitoring, serial devices)
- All cabling: motor/encoder, network, fiber

Controls Scope

- Control infrastructure
 - Install and configure network switches, ioc servers, archiver, workstations
 - Run and terminate all network fiber/cables
- Motion control
 - Delta Tau controller, configure pmac and motor tuning (may use powerbrick)
 - Motion EPICS IOC and CSS screens
- Vacuum control (monitoring)
 - Moxa connection (RS232) to all VGC/IPC
 - Vacuum IOC and CSS screens
- EPS requirements development: 42 DI, 26 DO and 56TC signals and action requirements (work with EPS group)
- Diagnostic controls:
 - Prosilica (or other) gigE cameras, webcam. CSS image displays
- Detector integration: IOCs and CSS in beamline controls scope

Controls scope - DAMA

- Detector integration:
 - Use of detector (Data acquisition) is in DAMA scope, ophys objects etc
- HEX will use standard NSLS-II data acquisition software, Bluesky
- 2360h of DAMA efforts in budget
 - Configuration and install of bluesky software
 - Customize/develop bluesky for HEX experiments
 - Will benefit from data acquisition experiences at other beamlines, e.g., FXI for tomography techniques

Example control instruments



Vacuum rack



Motion rack



Computing rack



Motor cabling

CSS Operator interface

Right-click PV → History

BPM Readout

Motion Control

IVU control from Beamline

CSS. Right-click PV → Logbook webpage created

Costs

- Basis of Estimates:
 - Standard costing sheets as used for other projects (NEXT, BDN) that have been successfully finished on cost and on schedule
 - Labor costs arise from historical costs on hours to finish similar activities on BDN and NEXT projects
 - M&S based on vendor quotes or PO for BDN beamline buildouts, expect to change only slightly as standardization will be enforced

BEAMLINE CONTROL LABOR (hours)	Ctrl-E	Ctrl-T	IT-E	IT-T	EPS-E	EPS-T	DAMA	DAMA	Note
	NE4	NE3	NA7	NE3	NE4	NE3	NA7	NS2	
Infrastructure and PDS Control									Assuming existing IOCs are available, minimum development
Control Design (spreadsheets)									
<i>rack layout</i>		96							
<i>cable studies, layout</i>					120				
<i>EPS requirements</i>	60				40				
<i>Motion parameters</i>	60								
<i>Network Architecture + planning</i>			40						
<i>CDR/PDR/FDR reviews</i>	40								
<i>Factory Acceptance Test</i>	80								
Motion Control									
<i>Motion config, tuning (PMAC)</i>	240	48							@ 2h/axis for tuning
<i>Motion IOC</i>	128								@ 8hr/controller
<i>PMAC PLC and Motion Programming</i>	160								assuming half of the controllers needs pseudoaxis programmed in Delta Tau, 20h each
<i>Full Range Motion Testing/Calibration</i>	240								@ 2h/axis
<i>Other motion devices</i>	160								eg. Piezo controllers
Diagnostics control									
<i>Camera GigE</i>	64		32	32					
<i>Webcam</i>	64								
<i>BPM – readouts</i>	24								BPM and other instr M&S in Beamline WBS
<i>Other Diagnostic Devices</i>	120								
Vacuum Control IOC and testing	80				40				10 gatevalves, 12 IP, IGC, RGA
Timing IOC and testing	80								
CSS development	320								
Installation									
<i>Cable Pull, termination</i>						600			@ 5hr/axis
<i>Controller install</i>						32			
<i>Network Installation config</i>			120	240					
<i>Server, workstation Installation config</i>			240	40					
Interface with accelerator control (gateway)	20								
Integrated testing and IRR prep	160								

Summary of Costs

WBS	WBS Name	Resource Type	Budgeted Units	Budgeted Cost
7.05.06.01	HEX Basic System Controls	Labor	4,490	\$575,707
		Nonlabor	407,080	\$458,362
7.05.06.02	HEX Instrument Applications	Labor	2,360	\$291,721
Grand Total			413,930	\$1,325,790

Controls Schedule

ActivityID	Activity Name	Original Duration	Activity % Complete	Start	Finish	Budgeted Labor Units	Budgeted Nonlabor Unit	Budgeted Total Cost	2019			2020			2021	
									FY19	FY20	FY21	FY19	FY20	FY21	FY21	
HEX Partner Beamline Rate Update																
	HEX Beamline	633		01-Mar-19	15-Apr-21	6850	407080	\$1,325,788								
	HEX Controls	633		01-Mar-19	15-Apr-21	6850	407080	\$1,325,788								
	HEX Basic System Controls	360		01-Mar-19	04-Aug-20	4490	407080	\$1,034,068								
	HEX16000	HEX Controls - Design	112	0%	01-Mar-19*	07-Aug-19	550	0	\$72,951							
	HEX16010	HEX Controls - Procure Basic Control M&S	60	0%	08-Aug-19	01-Nov-19	0	314880	\$352,323							
	HEX17890	HEX Controls - Procure DAQ Server	60	0%	08-Aug-19	01-Nov-19	0	38000	\$40,281							
	HEX17900	HEX Controls - Procure CUDA/GPU Unit	60	0%	08-Aug-19	01-Nov-19	0	46200	\$51,694							
	HEX16020	HEX Controls - Motion Control	188	0%	04-Nov-19	04-Aug-20	723	0	\$98,249							
	HEX16030	HEX Controls - Diagnostic Control	188	0%	04-Nov-19	04-Aug-20	320	0	\$42,189							
	HEX16040	HEX Controls - Vacuum Control IOC and testing	188	0%	04-Nov-19	04-Aug-20	120	0	\$16,543							
	HEX16050	HEX Controls - Timing IOC and testing	188	0%	04-Nov-19	04-Aug-20	80	0	\$11,029							
	HEX16060	HEX Controls - CSS development	188	0%	04-Nov-19	04-Aug-20	320	0	\$44,115							
	HEX16070	HEX Controls - Installation	188	0%	04-Nov-19	04-Aug-20	1077	0	\$111,417							
	HEX16080	HEX Controls - Interface with accelerator control (gateway)	188	0%	04-Nov-19	04-Aug-20	20	0	\$2,757							
	HEX16090	HEX Controls - Integrated testing and IRR prep	188	0%	04-Nov-19	04-Aug-20	160	0	\$22,057							
	HEX16100	HEX Controls - Detector Integration	188	0%	04-Nov-19	04-Aug-20	320	0	\$44,115							
	HEX16110	HEX Controls - End station instrumentation	188	0%	04-Nov-19	04-Aug-20	640	0	\$88,229							
	HEX16120	HEX Controls - Other endstation control tasks	188	0%	04-Nov-19	04-Aug-20	160	0	\$22,057							
	HEX16130	HEX Controls - FAT Travel	188	0%	04-Nov-19	04-Aug-20	0	10000	\$14,064							
	HEX Instrument Applications	173		05-Aug-20	15-Apr-21	2360	0	\$291,720								
	HEX17930	HEX IA - DAMA effort Start	1	0%	05-Aug-20	05-Aug-20	0	0	\$0							
	HEX16150	HEX IA - Data Aq - Development (Core Functionality)	171	0%	06-Aug-20	14-Apr-21	240	0	\$29,660							
	HEX17800	HEX IA - Data Aq - Integration with EPICS (Detectors)	171	0%	06-Aug-20	14-Apr-21	480	0	\$59,321							
	HEX17810	HEX IA - Data Aq - Integration with EPICS (Motion)	171	0%	06-Aug-20	14-Apr-21	40	0	\$4,943							
	HEX17820	HEX IA - Data Aq - Development (Experiment Plans)	171	0%	06-Aug-20	14-Apr-21	590	0	\$72,915							
	HEX17830	HEX IA - Graphical Elements Development (Plotting/UI)	171	0%	06-Aug-20	14-Apr-21	590	0	\$72,915							
	HEX17840	HEX IA - Data Aq - Installation	171	0%	06-Aug-20	14-Apr-21	20	0	\$2,472							
	HEX17850	HEX IA - Data Management Infra Config	171	0%	06-Aug-20	14-Apr-21	160	0	\$19,774							
	HEX17860	HEX IA - Data Management Infra Benchmarking & Testing	171	0%	06-Aug-20	14-Apr-21	160	0	\$19,774							
	HEX17870	HEX IA - Data Analysis Software Config & Deployment	171	0%	06-Aug-20	14-Apr-21	80	0	\$9,947							
	HEX17875	HEX IA - DAMA Effort Complete	1	0%	15-Apr-21	15-Apr-21	0	0	\$0							

- Based on the time needed to finish similar activities from NEXT/BDN (standard costing sheets)
- Activities are scheduled to meet the NYSERDA funding profile

Risks

HEX0601	Unavailability of software engineer	\$200,000	0.20	\$40,000
HEX0602	Overrun of control cables and installation costs	\$20,000	0.05	\$1,000
HEX0603	New detectors and sample environment controllers require extended software dev	\$60,000	0.20	\$12,000
HEX0604	Experiment control development problems (diffraction & imaging)	\$200,000	0.10	\$20,000

- We assume minimum development efforts – e.g., no new device drivers are expected to be developed
- The beamline controls and instrumentation requirements for HEX quite similar to that of XPD
- Slightly different from other beamlines is that HEX has white beam to hutch, radiation effects on control design will be captured by control engineers participation of all component design reviews
- We plan to send engineers in beamline controls group for Delta Tau training so we can better handle powerbrick controller that could be used for HEX
- HEX would benefit from experiences at other beamlines and continued enhancement of data acquisition and analysis software. Risk for data acquisition reduced from 0.2 -> 0.1

Summary

- Scope, cost and schedule for HEX beamline controls work are well understood
- Bottoms up cost estimate has been performed for this WBS. Our controls engineers have gained lots of experience with the buildout of ABBIX, NEXT and BDN beamlines
- The cost estimates based on previous projects are reasonable