Advanced Photon Source
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Advanced Light Source
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National Synchrotron Light Source II

Stanford Synchrotron Radiation Lightsource
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Linac Coherent Light Source
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Beamline Value Engineering

-Introduction-

October 5, 2016
SLAC-SSRL

Agenda – Beamline Value Engineering

Items for Discussion

- *Goals*
- *Format and schedule*
- *Identification of issues to target*

Start with a Value Engineering Example

National Synchrotron Light Source II (NSLS-II) Project

PPS Beam Line Interlock Improvements

Aug. 2, 2016

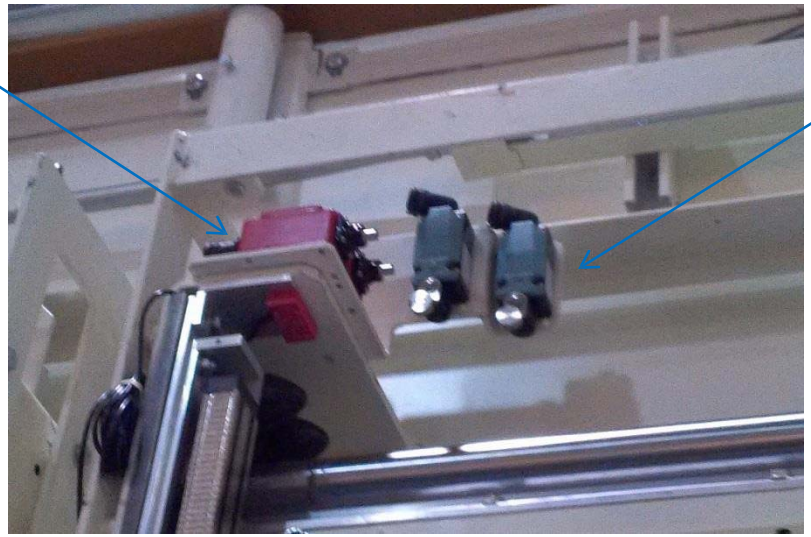
Scott Buda

Changes to the Hutch PPS

- Single chain search implementation- The B chain will process the button inputs and monitor the search of the beam line enclosures. The A chain will receive a signal from the B chain that the search was successful. Both chains will continue to have the same secure logic.
- The B chain will control the search beacons and sounder.
- The mechanical door switches will be replaced with magnetic coded switches. Increased reliability and reduction of installation effort.
- Replace B chain magnetic reed switch with switch incorporated in mag lock assembly.
- Field wires will be directly wired to I/O modules where practical eliminating intermediate terminal blocks and wires.

Value Engineering

- Replace dual mechanical switches with single magnetic 2 N.C. Switch for each chain.
  - Reduces installation cost and time.



Value Engineering

- Replace magnetic reed switch with switch incorporated in mag lock assembly.
  - Reduces installation cost and time.

existing reed switch

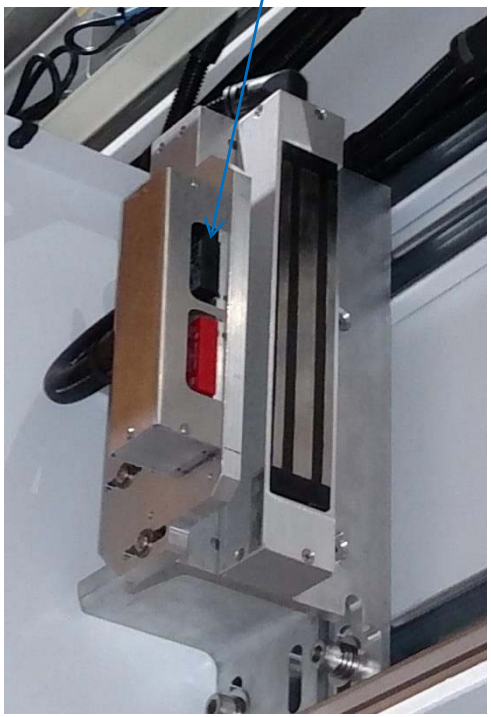
door position actuator magnet

new reed switch

Value Engineering

IMPROVED DOOR SWITCH DESIGN

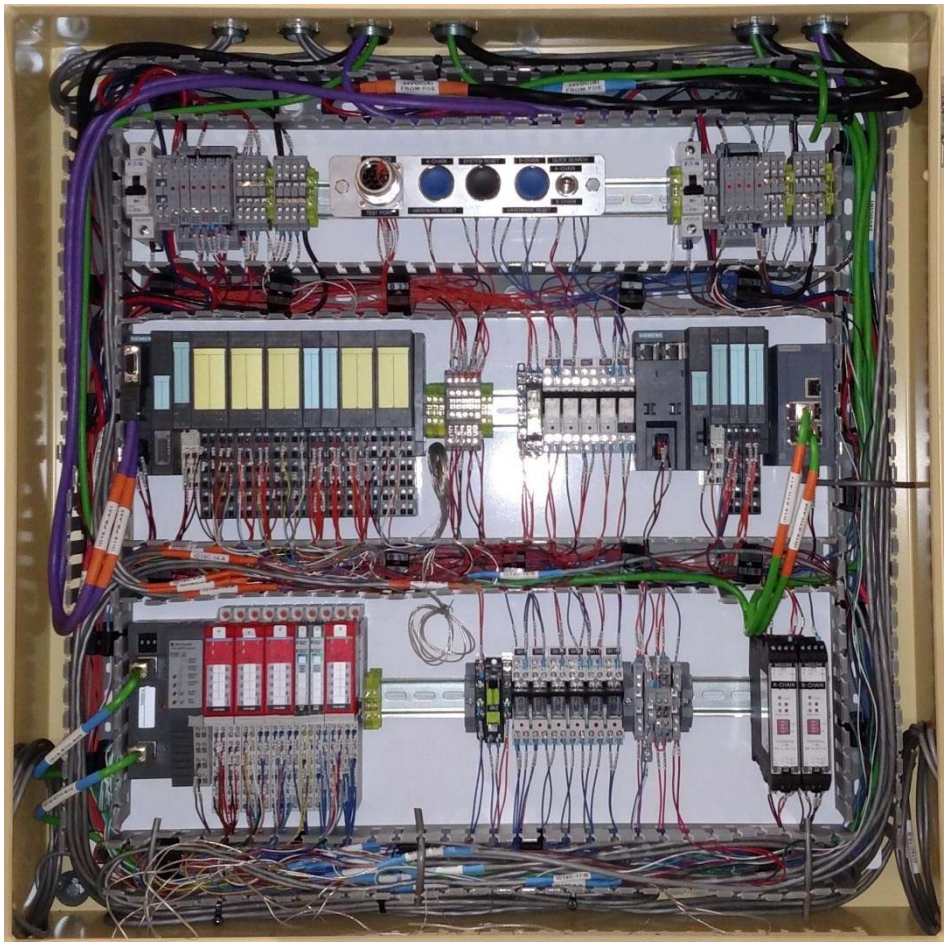
NEW DOOR SWITCHES



SWITCH ACTUATORS

Value Engineering

REDUCED TERMINAL COUNT, DIRECT WIRING TO MODULES FROM FIELD COMPONENTS



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Background and objectives

- NSLS-II Instrument Development Improvement
- Opportunities across the DOE facilities
  - Common framework for discussing Beamline projects
  - Utilize best practices across the complex
  - Get the best value for the investments made

<u>Objectives and Discussion points</u>

- Introduction to NSLS-II activities
- Discussion of similar work at other facilities
- Potential framework for information exchange
- Shared workshops (round tables?) on targeted areas

NSLS-II Engagement principals

- Advanced Beamlines for Biological Investigations with X-rays Project
  - Lonny Berman Project Manager
    - **Leading Instrument Execution Plan Development Task Force (IEPD)**

- NSLS-II EXperimental Tools Project
  - Steve Hulbert Project Manager

  - Jeff Keister Deputy Project Manager

- Beamlines Developed by NSLS-II Portfolio
  - Julian Adams Portfolio Manager
    - **Leading Ray Tracing Standards Task Force**

- NSLS-II Partner Beamlines Portfolio
  - Andrew Broadbent Portfolio Manager
    - **Leading planning for HEX and MRE**

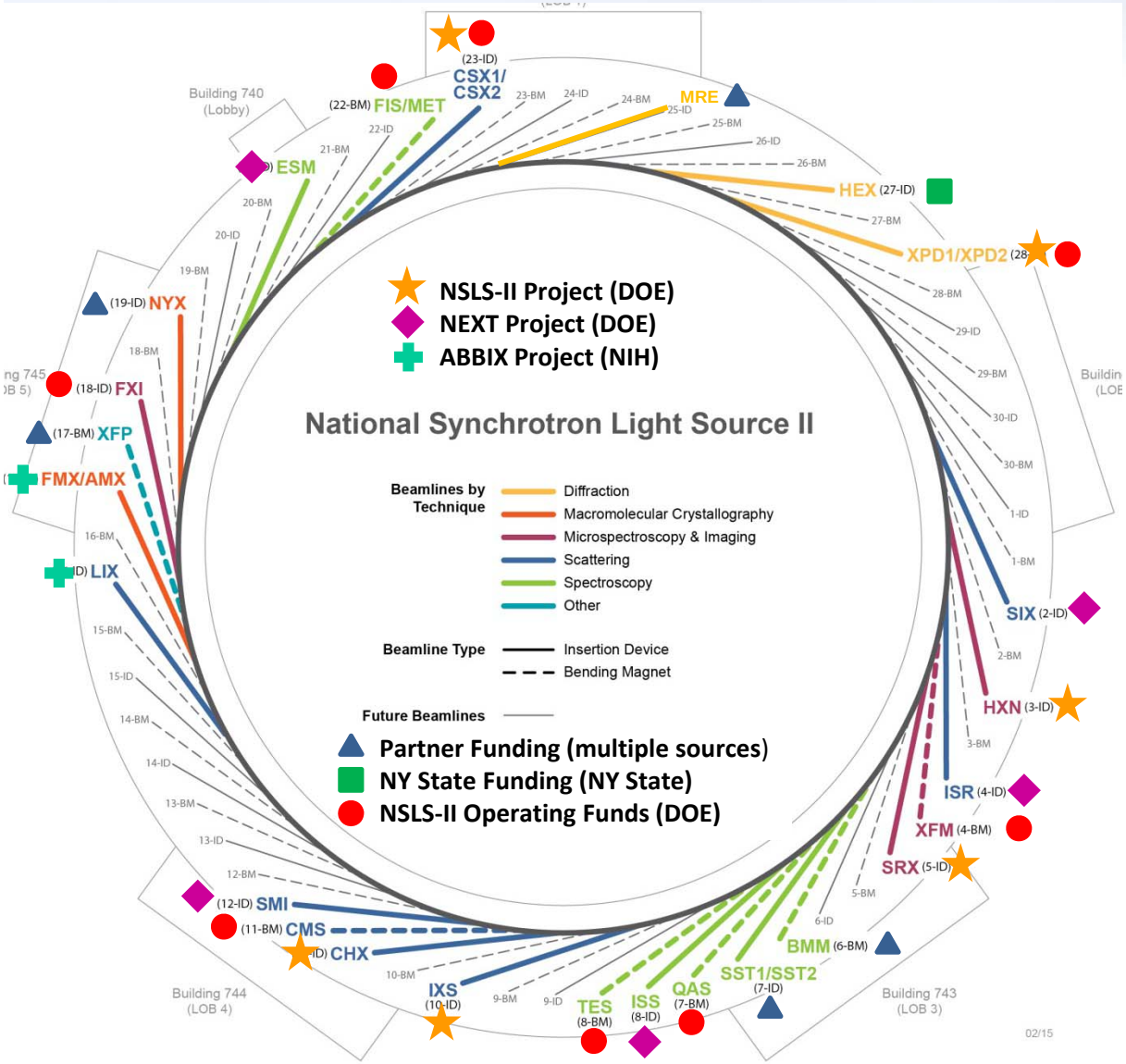
Elements of charting future instrument delivery

Scope executed by NSLS-II in these engagements is roughly $60M in FY16

Beamline Construction Status

- ABBIX *(3 beamlines)*
  - Beamlines are substantially complete *except ….*
  - FMX KB HFM has not met requirements (not inclined to relax specification)
  - Resolution of last FMX mirror will set project completion (no earlier than Nov 16)
- NEXT *(5 beamlines)*
  - Major installations continued; Accomplished ~$9.2M of work (Mar-June)
  - EAC based on bottom up ETC is now $87.5M
  - ISS, ISR and ESM have taken first light and met objective flux KPPs – 'In-service'
- Beamlines Developed by NSLS-II (8 beamlines)
  - Updated portfolio baseline to reflect agreed funding level after CR was resolved
  - CMS and TES both met their PEMP notable (ready for commissioning) and have taken first light
- NSLS-II Partner beamlines *(5 beamlines)*
  - XFP completed its IRR in June
  - NIST beamline IRRs likely to be delayed (funding/NIST procurement issues)
  - NYX tracking for IRR this fall – Schedule is very challenging
- New Engagement Development *(~7+ beamlines under consideration)*
  - HEX and MRE planning initiated
  - IEPD taskforce for five new engagements underway (based on 2015 BDP call)

NSLS-II Beamline Portfolio



Soft X-Ray Scattering & Spectroscopy

23-ID-1: Coherent Soft X-ray Scat (2015)
23-ID-2:Coherent Soft X-ray Spectr & Pol (2015/2016)
21-ID: Photoemission-Microscopy Facility (2017)
2-ID: Soft Inelastic X-ray Scattering (2017)
22-BM: Magneto, Ellipso, High Pressure IR (2018)

Complex Scattering

10-ID: Inelastic X-ray Scattering (2015)
11-ID: Coherent Hard X-ray Scattering (2015)
11-BM: Complex Materials Scattering (2016)
12-ID: Soft Matter Interfaces (2017)

Diffraction & In Situ Scattering

28-ID-1: X-ray Powder Diffraction (2015)
28-ID-2: X-ray Powder Diffraction (2017)
4-ID: In-Situ & Resonant X-Ray Studies (2017)
27-ID: High Energy X-ray Diffraction (2020)
25-ID: Materials in Radiation Environments (2020?)

Hard X-Ray Spectroscopy

8-ID: Inner Shell Spectroscopy (2017)
7-BM: Quick X-ray Absorption and Scattering (2016)
8-BM: Tender X-ray Absorption Spectroscopy (2017)
7-ID-1: Spectroscopy Soft and Tender (2017)
7-ID-2: Spectroscopy Soft and Tender (2017)
6-BM: Beamline for Mater. Measurements (2017)

Imaging & Microscopy

3-ID: Hard X-ray Nanoprobe (2015)
5-ID: Sub-micron Res X-ray Spec (2015)
4-BM: X-ray Fluorescence Microscopy (2017)
18-ID: Full-field X-ray Imaging (2018)

Structural Biology

17-ID-1: Frontier Macromolecular Cryst (2016)
17-ID-2: Flexible Access Macromolecular Cryst (2016)
16-ID: X-ray Scattering for Biology (2016)
17-BM: X-ray Footprinting (2016)
19-ID: Microdiffraction Beamline (2017)

Instrument Development Improvement

- Objectives
- WBS and Instrument Divisions
- Round Table Discussions
- Process Map and topics highlighted in construction group meetings
- Recommendations
  - Refine ideas on process improvement opportunities
  - Develop internal plan for pursuing opportunities
  - Discuss the ideas w/DOE facilities (5-way meeting Oct 2016)
  - Hold 'kick-off' meeting at BNL as part of a round robin series (like the hackathons)?

Objectives and Plans

- Cultivate the Capability to develop ~3 beamlines per year
  - Need a reproducible process
  - Predictable cost and schedule
  - As cost effective as can be reasonably accomplished
  - Consider entire life cycle of an instrument
- NSLS-II evaluation of current state
  - Started with Project/Portfolio managers considering issues in current work
  - Turned out to be heavily weighted to process and practice, with some technical VE opportunities identified
  - Expand discussion to beamline leaders and technical staff
  - *Value Engineering Round Tables*
- Coordination with DOE peers
  - Develop a common understanding of beamline development process and costs
  - Capture and adapt best practices where possible
  - Share development information and data where practical
  - Provide some level of uniformity (standardization)

Instrument Development Improvement

- By end of CY 2016 will have developed 17 ports (19 Simultaneous Endstations)
  - 6 NSLS-II Project (CSX1/CSX2, XPD, HXN, SRX, IXS, CHX) - 2 ABBIX (LIX, AMX/FMX)
  - 5 NEXT (ISS, ESM, ISR, SMI, SIX) - 2 BDN (CMS, TES)
  - 2 Partners (XFP, NYX)
- Working to capture lessons looking to the future
  - Informal discussions on cost of NSLS-II beamlines as compared with others
  - In Construction group discussions started with 'traditional' VE questions
    - Some opportunities have been identified and certainly others exist yet to be explored
    - Found much of the discussion actually centered on process improvements
- Activities undertaken or planned – judged to be high impact areas in need of attention
  - Self Assessment on Controls (Spring 2015)
  - Requirements Capture and Analysis Tool (Spring 2016)
  - Ray Tracing Practice Task Force (May 2016)
  - Value Engineering Round Tables
    - Organize 'Divisions' around our now standard WBS to collect information
    - Charrette broad crosscut of staff to capture current state practice and possible improvements
- Evaluating next round of instrument development
  - Instrument Execution Plan Development Task force (Charged May 2016)
  - Will guide the selection of the next instruments to be built on NSLS-II Operating

Beamline Work Breakdown Structure

- Have developed a standard WBS to use for beamline construction going forward
- Captures all work to construct a beamline regardless of funding source
- In addition to using WBS for specific engagements, use it as the headings for 'Divisions' parallel to those used for Conventional Construction

	XYZ Beamline
01	XYZ Management
02	XYZ Design
02.01	XYZ Conceptual Design
02.02	XYZ Preliminary Design
02.03	XYZ Final Design
02.04	XYZ R&D Program
03	XYZ Beamline Construction
03.01	XYZ Photon Delivery System Procurement and Fabrication
03.02	XYZ Photon Delivery System Installation and Test
03.03	XYZ End Station Procurement and Fabrication
03.04	XYZ End Station Installation and Test
04	XYZ Beamline Infrastructure
04.01	XYZ Hutches
04.02	XYZ Mechanical Utilities
04.03	XYZ Electrical Utilities
04.04	XYZ EPS
04.05	XYZ PPS
05	XYZ Accelerator Infrastructure
05.01	XYZ Front End
05.02	XYZ Source
05.03	XYZ Straight
06	XYZ Controls
06.01	XYZ Basic System Controls
06.02	XYZ Instrument Applications
07	XYZ Conventional Facilities
07.01	XYZ Conventional Facilities Design
07.02	XYZ Conventional Facilities Construction
07.03	XYZ Conventional Facilities Commissioning
08	Special Equipment

Beamline Information Divisions

Beamline Construction

01	Management
02	Design
02.01	Conceptual Design
02.02	Preliminary Design
02.03	Final Design
02.04	R&D Program
03	Beamline Construction
03.01	Photon Delivery System Procurement and Fabrication
03.02	Photon Delivery System Installation and Test
03.03	End Station Procurement and Fabrication
03.04	End Station Installation and Test
04	Beamline Infrastructure
04.01	Hutches
04.02	Mechanical Utilities
04.03	Electrical Utilities
04.04	EPS
04.05	PPS
05	Accelerator Infrastructure
05.01	Front End
05.02	Source
05.03	Straight
06	Controls
06.01	Basic System Controls
06.02	Instrument Applications
07	Conventional Facilities
07.01	Conventional Facilities Design
07.02	Conventional Facilities Construction
07.03	Conventional Facilities Commissioning
08	Special Equipment

Organize information and activities around these divisions

- Cost estimates
- Value engineering documentation
- Round table discussions

Round Table Discussions Pre-work

For each area we decide to pursue by a round table:

- Appoint facilitator
- Facilitator reaches out to stakeholders in the topical (division) area
  - Should include customers as well as doers (e.g. include Scientists, Engineers, Techs, Designers, Support Staff) as appropriate
- Compile a set of current state definitions
  - Scope identified for discussion (should align with WBS/Division definitions, or sub-definitions)
  - Outline executed work to date (how many done so far, what vendors (if appropriate), experiences on our basis of estimate, actual costs where known)
- Compile a set of possible areas for improvement discussion
  - What problem is being addressed by the suggestion
  - How might it improve the characteristics of the system to be evaluated
- Share the 'pre-work' information (SharePoint site?)

Round Table Discussions - Meeting

Starting from the pre-work deck or information

- Facilitator should set meeting time and solicit further suggestions
  - Corrections to definitions
  - Additional topics or issues that should be considered
  - Suggestions for improvements
- Holding the meeting
  - Facilitator should be supported by a knowledgeable note taker
  - Walk through the deck as a discussion aid - ideally having people together in the room will help spark some ideas
  - Capture any new suggestions to be pursued
  - Attempt to rank order issues for improvements
    - Easy/cheap to do
    - Greatest potential improvement

Round Table Discussions – Follow up

- Post notes from the face to face round table discussion
- Facilitator should propose follow-up actions that are implied
  - Could be need for another meeting(s) to clarify some important point
  - Could refer further development of topics (that take additional resource) to management (and indicate this is what will be done)
  - Post date for any follow up actions
- Possible Round Table Dispositions
  - Could decide things are for now good enough – no action at this time
  - Could indicate reference to management for follow up action (when that would happen and what resources would be needed)
- In general would like the round tables to be a 'one-off' (not standing committees)
  - Meet and complete their tasks of gathering/discussing info
  - Record information for action
  - Revisit as a new exercise at a later date if needed

Round Table Discussion Facilitators

Beamline Construction

01	Management	EDJ – Process Kick-off
02	Design	May need further sub-division
02.01	Conceptual Design	JA – Ray tracing taskforce follow-up?
02.02	Preliminary Design	
02.03	Final Design	
02.04	R&D Program	
03	Beamline Construction	
03.01	Photon Delivery System Procurement and Fabrication	LEB/SLH on X-ray/Soft x-ray instruments?
03.02	Photon Delivery System Installation and Test	
03.03	End Station Procurement and Fabrication	
03.04	End Station Installation and Test	
04	Beamline Infrastructure	
04.01	Hutches	AB Hutch development and cost model
04.02	Mechanical Utilities	CS
04.03	Electrical Utilities	
04.04	EPS	
04.05	PPS	JA/GF?

First crack from prior meetings

Round Table Discussion Facilitators

05	Accelerator Infrastructure	
05.01	Front End	AB/GF
05.02	Source	LEB
05.03	Straight	
06	Controls	
06.01	Basic System Controls	RF
06.02	Instrument Applications	RF/Stuart/Elaine?
07	Conventional Facilities	EDJ/MF?
07.01	Conventional Facilities Design	
07.02	Conventional Facilities Construction	
07.03	Conventional Facilities Commissioning	
08	Special Equipment	

First crack from prior meetings

Process Map

- Chart phases of instrument development
  - Study and Design Process
    - Assume engagements have been pre-vetted from a science perspective
    - Study activities undertaken to narrow the scope and define schedule and cost
    - Many of our existing processes have room for standardization and improvement
  - System and Component Design Process
    - Transition between the development and construction phase
    - Some process improvement identified
    - Opportunities for standardizing on designs
  - Integration Process
    - Preparing to bring the components together in the field
    - Lots of opportunity to capture and reuse experience from previous engagements
    - Again standardization in processes for scope and cost management identified
  - Transition to Operations
    - Needs much more emphasis in the early stages of planning
    - Clarification of documented turnover (perhaps in stages) to operation responsibility
    - Focus of current work across several engagements (esp ABBIX and NEXT)

Study and Design Process

- Project Management Planning
  - Early BAT formation (eq CD-1 or earlier)
  - Address Organizational bottlenecks
  - Define mission for a particular engagement early
  - Utilize standardized processes for
    - WBS organization and development
    - Schedule development
    - Standard initial document sets
- Roles in Project Execution
  - Element of the project planning as usual
  - Extend to defining turnover to operations roles
- Scope definition standards and upfront review
  - As complete as possible, but also identify what you don't know (and when you expect to know it)
- Develop costing libraries (with back-up)
- Work up criteria for make or buy decisions and factor into planning
- Design process standardization
  - Ray tracing
  - Shielding analysis
  - Sector assignments
- Make more effective use of internal mini-design reviews

System and Component Design

- Project Plan Development
  - Early milestone identification (at system level)
  - Special system specifications
  - Identification of DTS support as early as possible
  - Definition of the controls scope and resources (part of the turnover planning)
  - Make better use of specialist SMEs in the design process (e.g. optics, controls subspecialties…)
- Standard or reference designs library
  - Controls
  - Utilities systems (both simplification and standardization) e.g. Cryocoolers, pumping, ….
- PPS Design
  - Examine drivers for the current design basis
  - Challenge those that seem unproductively burdensome
  - Traditional VE of the components and systems to reduce time/effort from specification to installation
- Contractors and Contracts
  - Introduce Risk assessment as part of the Best Value analysis
  - Processes for procurements – examine and improve where possible (credit card/debit card for example)
- Debriefs on WBS elements as they complete
  - Don't wait to the end to capture and transmit lessons learned
  - Close associated accounts and contracts as soon as possible so it doesn't pile up at the end

Integration Process

- Cost Estimates
  - More complete identification of scope or design maturity (to set contingency expectations)
  - Careful consideration of labor types and estimate (LOE or touch labor with labor factor)
  - Improve depth of cost library for similar historic work
- Coordination
  - Lots works well, but still room for better planning
  - Widely shared services like riggers and survey could benefit from more advanced planning
  - Installation, especially common systems scope (utilities, PPS, EPS)
    - Improved estimates
    - Schedule coordination (not flipping between jobs)
- Configuration Management
  - Lots of process, but still lagging in tracking design changes
  - Examine a graded approach to make sure changes are readily captured and documented
- Labor oversight and cost control
  - Adequate supervision
  - CAM approval on timesheets
  - Improvements for accuracy (and speed) of time recording

Transition to Operations

- Scope Definition
  - Should follow on from planning at the earliest stage of the engagement
  - Systematically review the scope throughout the evolution of the engagement
  - Clarify finishing work vs Scientific commissioning
- Roles and responsibilities
  - Work out responsibilities and transition of cost from the engagement to operations
- Process Definition
  - Mature the definitions of the processes for handover to operations
  - Clarify the responsibilities and costing during the interlocking phase of commissioning (complete beamline, start commissioning capabilities)
- Turnover Document(s)
  - KPPs or other turnover criteria agreed up front
  - Turnover document would be like a traveler for handoff to Operations
  - Detailed commissioning plan with check-list could be good basis
  - Include the scope validation as part of the turnover
    - WBS and WAD comparison
    - Tests or functionality report
    - R2A2 map (who transfers what to whom)
  - Lots of this is getting done, but isn't systematically planned or captured from one Beamline to the next

Discussion

- Examples from other facilities
- Does WBS/Division approach seem sensible and a good framework for information sharing?
- Topical meeting between facilities?
- Based on experience from other facilities what would be good topics
- Formats for complex wide meetings
  - Narrow VE topic / hackathon?
  - Round robin meeting series