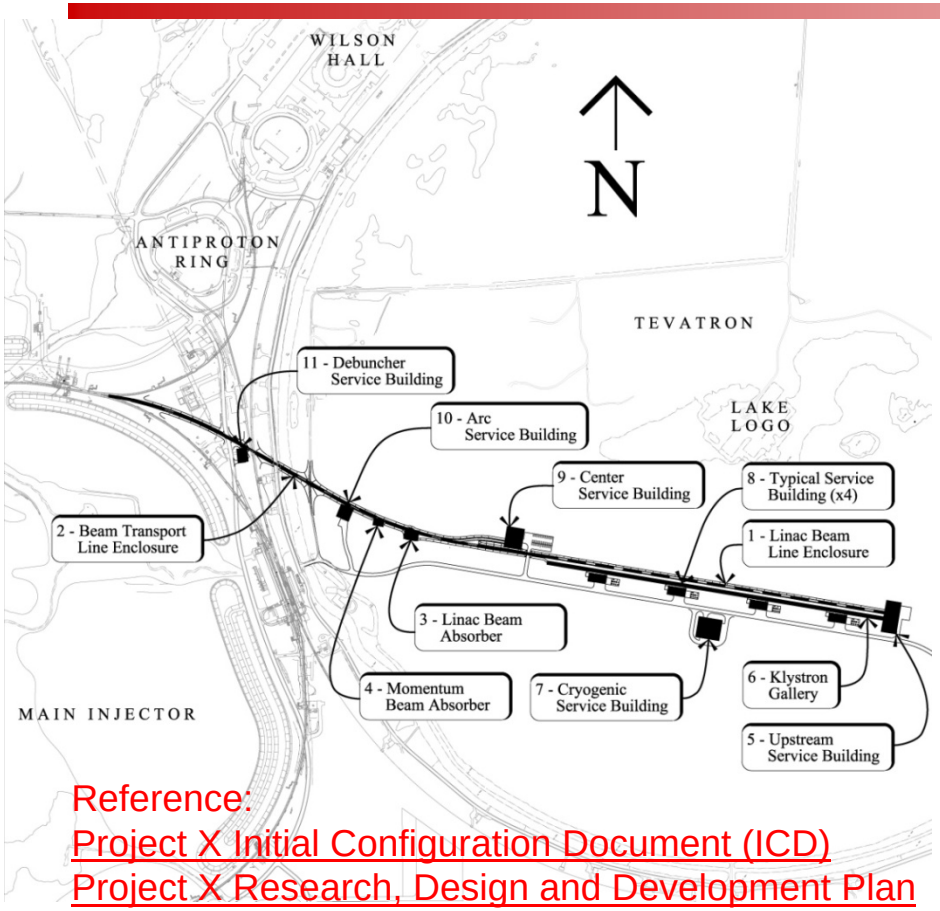
Director's Review of the Project X Cost Range Estimate: Conventional Facilities

Project X Director's Review
March 16, 2009

Outline

- Scope of Estimated Work
- Boundary Conditions /Assumptions
- Project Cost Estimate
- Project Schedule
- Technical Risks/Associated Cost Exposure
- Potential Technical Revisions
- Role of Outside Collaborators
- Summary

Project X Scope of Estimated Work



Item No.	Facility Name	Function	Contents
1	Linac Beam Line Enclosure	Below-grade enclosure for equipment/controls for linac H- accelerator components	H- source, RF cavities, magnets, beam instrumentation and utilities
2	Beam Transport Line Enclosure	Below-grade enclosure for H- beam transport from Linac Beam Line Enclosure to Main Injector	Beam transport magnets, momentum collimators and utilities
3	Linac Beam Absorber	Below-grade enclosure for equipment/controls for linac H- abort components	Concrete block and steel shielding and utilities for linac abort system
4	Momentum Beam Absorber	Below-grade enclosure for equipment/controls for momentum beam absorber components	Concrete block and steel shielding and utilities for momentum beam absorber components
5	Upstream Service Building	Building for personnel/equipment access for installation and operation of low-energy support equipement and tech space	Electrical equipment and controls, utility services and H- source support equipment
6	Klystron Gallery	Building for equipment for RF power generation	Klystrons, modulators, controls and utility dervices
7	Cryogenic Service Building	Building for equipment for helium refrigerator plant	Compressors and helium cold boxes
8	Typical Service Building	Building for LCW pumps, electrical services, power supplies and controls	Heat exchangers, pumps, electrical equipment, power supplies and controls
9	Center Service Building	Building for personnel/equipment access for installation of linac	Crane bay, hatch and staging area
10	Arc Service Building	Building and enclosure for correction power supplies and controls	Power supplies and controls
11	Debuncher Service Building	Building and enclosure for debuncher RF modulator and klystron magnet power supplies and controls	Klystron modulator, power supplies and controls

Reference:
Project X Initial Configuration Document (ICD)
Project X Research, Design and Development Plan (RD&D Plan)
FESS Preliminary CDR Drawings

Scope of Estimated Work

Underground Elements

- **Linac Beam Line Enclosure** ~ 2200 ft long
- **Beam Transport Line Enclosure** ~ 3000 ft long
- **Linac Beam Absorber (**2.1 MW?? beam power)
- **Injection Line Beam Absorber** (10-100kW?? beam power)

Above Grade Buildings

- **Upstream Service Building** connected to Klystron Gallery
- **Klystron Gallery** ~ 2200 ft long
- **Cryogenic Service Building** for the superconducting linac
- **Pump Service Building** for LCW pumps, heat exchangers
- **Center Service Building** for access to beamline enclosures
- **Arc Service Building** (corrector power supplies, beam instrumentation)
- **Debuncher Service Building** (klystron, modulator, magnet power supplies/controls)

Utilities

- **HV Electrical Power** from MSS 5.3 MW?? – backfed from KRS
    - Conventional Power, Machine Power, Cryogenic Power – separate feeders
- **CHW & CHWR - Chilled Water** from CUB for 2.1 MW?? heat rejection
- **ICW - Industrial Cooling Water** from C-0 Corridor for fire protection
- **DWS - Domestic Water** from C-0 Corridor for facilities
- **Sanitary Sewer** from C-0 Corridor for facilities
- **Site Work and Infrastructure** (new roads, parking lots, wetland mitigation, etc.)

Scope of Estimated Work

Planning

- Project Plan
  - Develop Technical Design Report (TDR)
  - Develop Conceptual Design Report (CDR)
- Site Development – Master Planning of Project X facilities within existing and future experiments (Mu2E, Dusel, MI-65 Expansion, G-2, etc.) site requirements
  - Develop Master Plan of Main Injector site area
  - Work across several collaborations to develop lab-wide infrastructure needs
- Site Characterization Studies
  - Wetland delineation
  - Floodplain determination
  - Habitat/Archeological study
  - Watershed/groundwater study
- Wetland Mitigation – Perform cost analysis comparison for wetland mitigation for mitigating wetlands onsite or buying credits off site
  - Study mitigation strategies for on-site mitigation
  - Study mitigation strategies for buying mitigation credits off-site
  - Post CD-0, conduct NEPA scoping meeting with DOE, meet with Army Corps of Engineers to understand mitigation ratio requirement
  - Perform cost analysis

Scope of Estimated Work

Planning (Cont'd)

- Space Management (One-for-One Replacement Requirement)
  - Study Space Management options for demolishing buildings/enclosures on the Fermilab site – determine which buildings/enclosures can be demolished and to what extent decontamination is required
  - Study Space Management options for purchasing credits from other DOE lab sites
  - Develop demolition packages, if required
- Environmental Assessment
  - Begin NEPA Process - Develop NEPA execution plan
  - Create Environmental Assessment (EA) Documents
- Architect/Engineer and Construction Manager Selection
  - Determine Conceptual Design, Preliminary Design, Final Design, Independent Review timelines
  - Develop design resource schedules
  - Perform A/E selection
  - Perform Construction Manager selection
- Project Reviews
  - Prepare and participate in CD level reviews
  - Prepare internal design reviews

Project X Scope of Estimated Work

Scheduling

Project Schedule

- Develop Project Construction Schedule
- Apply Earned Value Analysis (EVA) techniques as required by PEP

Construction Phasing

- Develop construction phasing plan, determine required construction packages, for example:
  - Site Prep (rough grading, temp. utilities, survey monuments, piezometers, etc.)
  - Wetland Mitigation
  - Main Injector and MI-65 Enclosure Tie-ins
  - Electrical Feeder Upgrade
  - Underground Enclosures
  - Buildings and Outfitting
  - Cooling Pond Upgrades
- Prepare preliminary design packages for each construction package

Scheduling Existing Facilities (Linac, Booster, Antiproton, Tevatron) remain active or in "hot spare" mode, and thus eliminate reuse of existing capabilities, such as cooling, power

- Work between divisions/sections/departments to determine status of existing facilities throughout the RD&D phase and beyond
- Provide feedback to divisions/sections/departments regarding the needs of the project as it relates to existing facilities and infrastructure needs

Scope of Estimated Work

Design

Base Plan Development
- Perform field survey and develop base plan of existing topography
- Create base map of existing utilities, roadways, structures, etc.
- Create conceptual, preliminary and final design drawings and specifications

Beam Layout options incorporated into preliminary/final design
- Complete several iterations of beamline scripts during preliminary design development
- Complete cost analysis of several options including the location of injection in Main Injector and tunneling under MI-65
- Finalize beamline arrangement and civil construction layouts

Shielding Assessment
- Create Radiation Safety drawings in support of the shielding assessment
- Maintain existing radiation drawings during design development

Alternate Configuration Document (ACD) - Support development of alternative designs into existing facilities and infrastructure
- Provide civil engineering in support of the ACD
- Provide costing and scheduling support of alternate designs

Scope of Estimated Work

Design (Cont'd)

Injection Abort Design - Determine if large injection abort required (significant civil construction required) or if it fit into existing tunnel near MI10

- Perform study of injection abort requirements (space, utilities, shielding, etc.) to determine extent of facility expansion required
- Develop options for housing within existing Main Injector Enclosure or build new facility

Infrastructure Review

- Determine demand characteristics and impacts of new facility on existing infrastructure incorporating the needs of current and new experiments
- Perform preliminary design for upgraded infrastructure facilities

Sustainability

- Develop LEED checklist
- Incorporate "green" design principles into building design and efficiency as appropriate

Boundary Conditions & Assumptions

- Primary interfaces with other systems
  - See FESS Scope Document
- Anticipated inputs from other efforts
  - Beamline as frozen at ICD (Dec. 2008) – will be revised
  - Absorber Design
  - Building General Arrangements
- Any other assumptions
  - Estimate based on current Initial Configuration Document
  - Current layout based on early Proton Driver development drawings

Reference:
FESS Scope Document

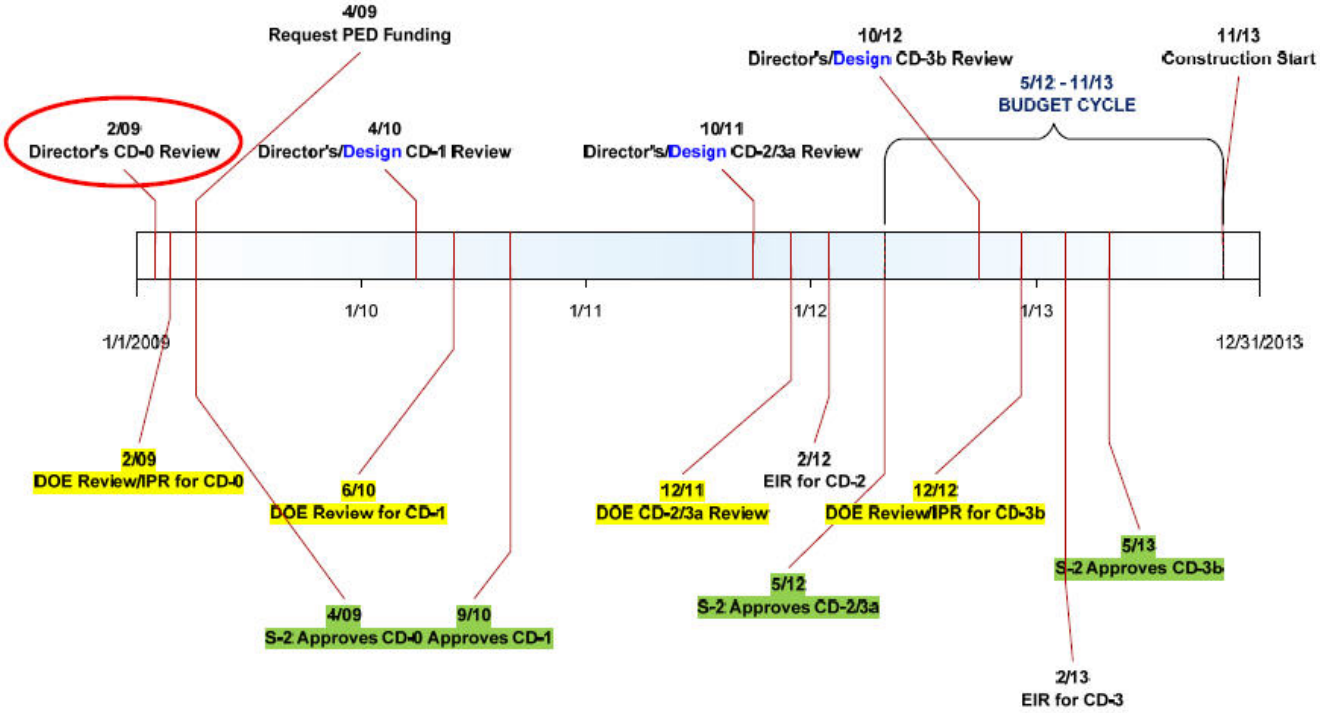
Project X Project Cost Estimate

- This is NOT a baseline estimate. The configuration will undoubtedly change over the life of the project.
- Estimate is presented in FY2009 dollars for M&S with no overheads, and in dollars for effort.
- This is not a technical review. The committee is not asked to judge whether your system will work, only if it is complete and reasonably estimated. They will however be looking at technical risk as a component of cost, and you will be asked to identify risks that might translate into cost impact.
- The cost estimate may change with possible minor variations thereof based on the ICD. We are not yet addressing the Alternate Configuration Document - ACD (there will be plenty of opportunity to review that in the future).

Reference:
FESS Construction Cost Estimate
FESS Labor Funding Schedule
FESS RD&D Labor Schedule
Project X M&S and Labor Spreadsheets

Project Schedule

CD-0 Spring 09, PED funds FY11



Reference:
Project X Overall Schedule

Technical Risks

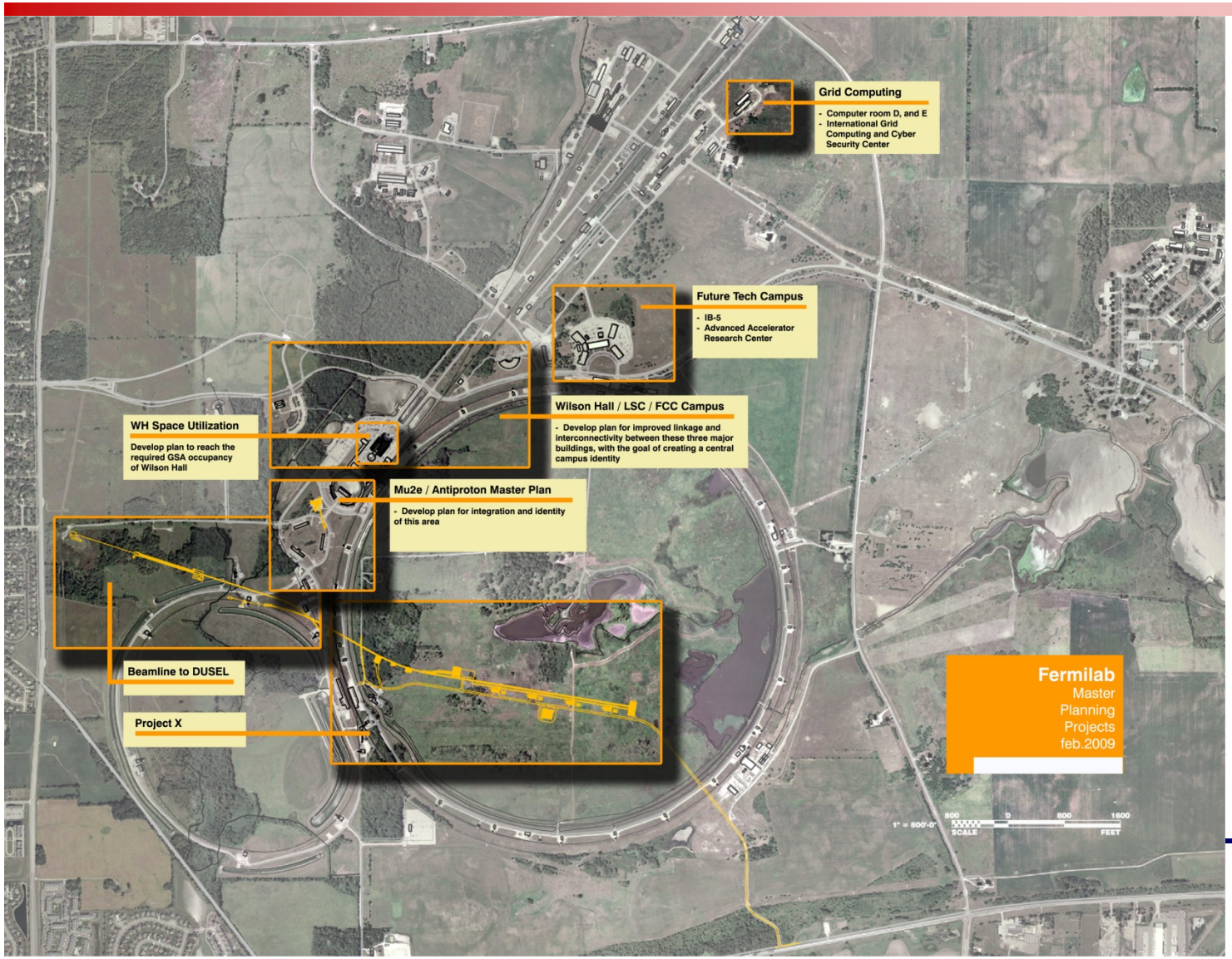
- Conventional Construction techniques are similar to utilized and proven construction methods previously executed at Fermilab. Construction of all below-grade enclosures consists of conventional open-cut type construction techniques.
- The proposed site plan has been optimized for the accelerator requirements. Future layouts will consider existing topography, sustainability, watersheds, vegetation, natural habitat, and wetlands and will be thoroughly addressed in the Environmental Assessment for this project.

Potential Technical Revisions

- Potential technical revisions and potential effect on the bottom line
  - Interface with existing and future facilities
  - Absorber design requirements
  - Beamline arrangement
  - Utility Upgrade requirements

Reference:
FESS Master Plan

Potential Technical Revisions



Collaborators

- Various Architectural and Engineering Firms
  - Preparation of Conceptual, Preliminary and Final Design Documents
  - Provide Construction Management support

Summary

- Cost estimates are based on FY09 dollars and based on current ICD. Indirects and escalation are applied outside this WBS level.
- Construction Cost Estimate based on cost data taken from Means Cost Estimating Guides, square foot costs, historical data, expert opinion and recent construction history at Fermilab.
- Construction Cost Estimate is considered a Class 5 (Order of Magnitude) with a 2% level of definition.
- Engineering estimates assumes the following as a percentage of construction costs:
  - Conceptual Design – EDIA @ 5%
  - Preliminary and Final Design - EDIA @ 20%
  - Construction - EDIA @ 10%

Summary

- Project Schedule assumes construction start 11/13.
- Project Schedule assumes FNAL and subcontract A/E's are available as needed.
- Early starts on long-lead permitting and approval documents
- Construction methods are similar to utilized and proven construction methods previously executed at Fermilab.