DOE Standard Work Breakdown Structures and Historical Databases - Process, Challenges and Status

Department of Energy Cost Analysis Symposium

20 May 2010

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Technomics
The Science of Informed Decision Making

Objective

- Describe the process used to develop standard Work Breakdown Structures for DOE projects
- Describe the process used to develop a historical DOE cost database
  - Identify/illustrate challenges encountered
  - Provide current status and future activities of these projects

Agenda

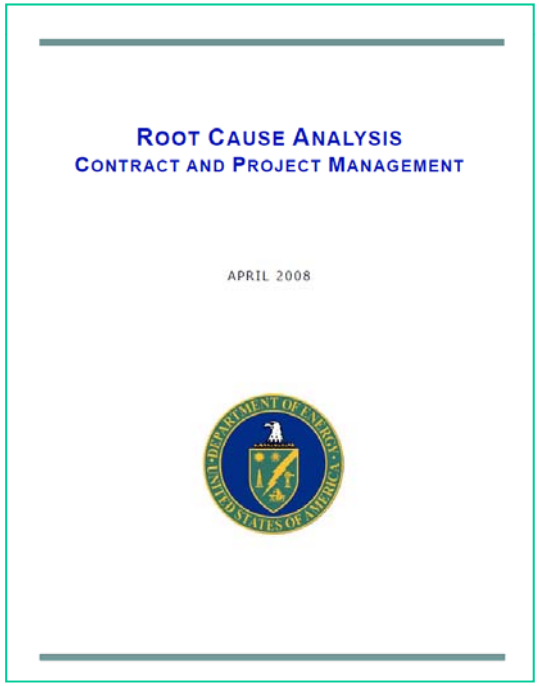
1. Background
2. Standard WBS
3. Historical Database
4. Conclusions

<u>Disclaimer</u>
Charts contain real data on DOE projects. Some charts may have been sanitized in the interest of protecting proprietary data.

1. BACKGROUND

Background

- Root Cause Analysis: Contract and Project Management, April 2008
  - 143 issues identified were consolidated to 60 issues and then prioritized.


ROOT CAUSE ANALYSIS
CONTRACT AND PROJECT MANAGEMENT

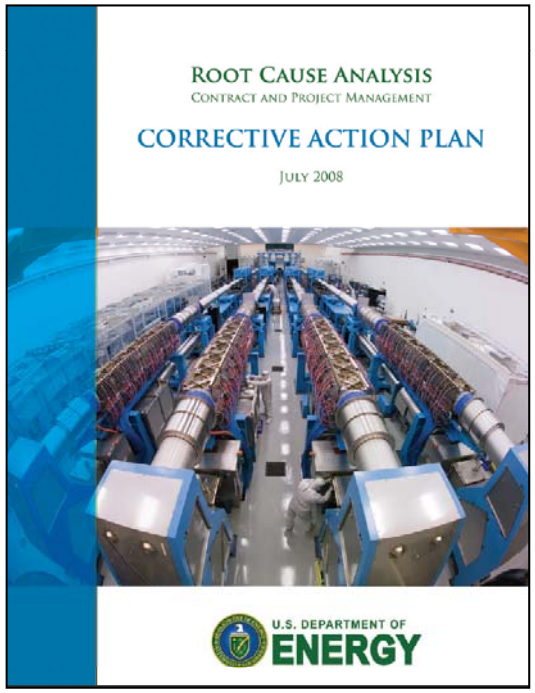
APRIL 2008

Issue #5:
"Contracts for projects are too often awarded prior to the development of an adequate independent government cost estimate."

Associated Root Causes:
- Lack of policy or standards
- Lack of qualified personnel
- Lack of databases with current or historical information

Background

- Corrective Action Plan, July 2008
  - Established eight corrective measures to address the top 10 issues identified in the root cause analysis.
    - Corrective Measure #5 addresses RCA Issue #5



<u>Corrective Measure #5</u>:
"Establish and implement a federal independent government cost estimating capability, including the development of appropriate policy and standards, allocation of required resources, and compilation of unit cost labor and material databases."

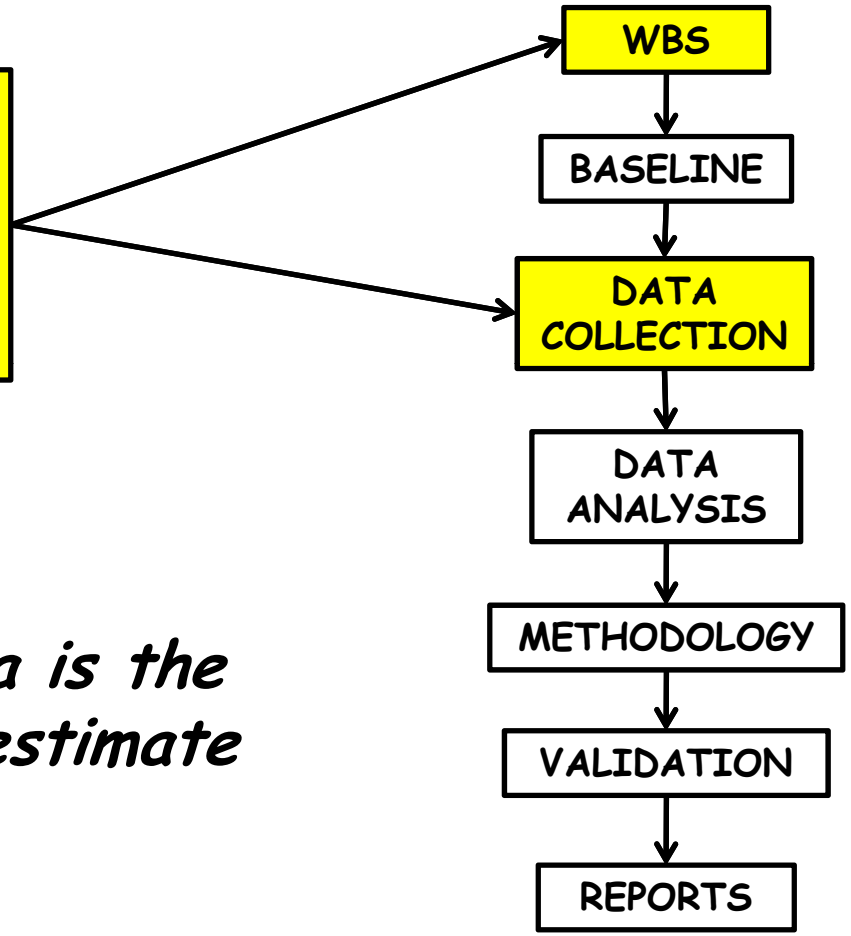
<u>Core Components of this Corrective Measure</u>:
- Develop historical cost database to improve cost estimating accuracy.

<u>Expected Outcomes</u>:
- Historical project cost information used as benchmarks for future projects.

Intersection with the Cost Estimating Process*

<u>Core Components of this Corrective Measure</u>:

- Develop historical cost database to improve cost estimating accuracy.



Quality historical data is the foundation of a good estimate

* ***Cost Estimating Process adapted from the Society of Cost Estimating & Analysis (SCEA), Cost Estimating Body of Knowledge (CEBoK)***

2. STANDARD WBS

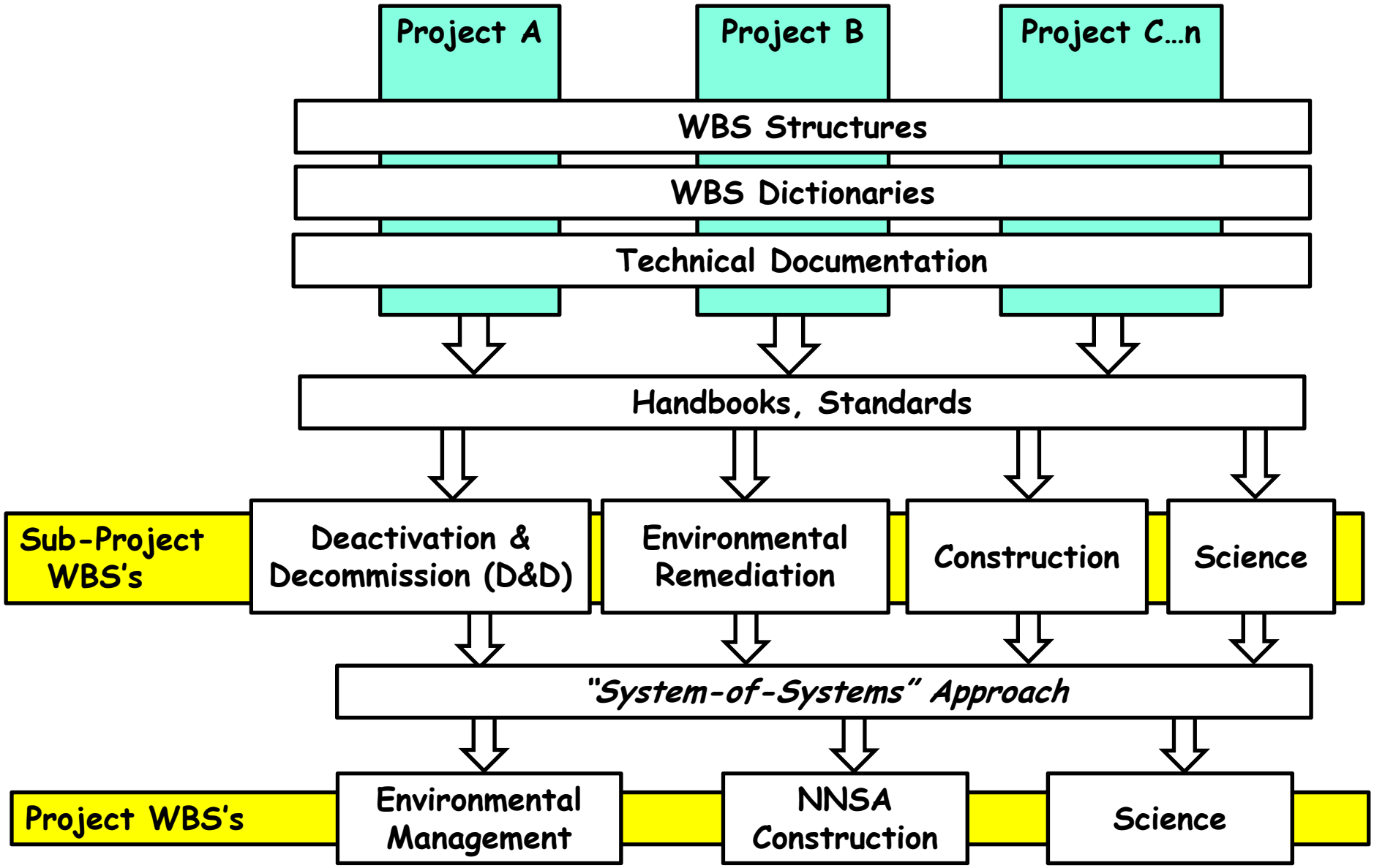
Defining the Structure

- GAO Cost Estimating and Assessment Guide "Best Practices"
  - Product-Oriented WBS
    - Segregates products into components.
    - Clarifies relationships between products.
  - Standardized WBS
    - Enables an organization to collect and share data among programs.
    - Results in more accurate and consistent estimates and leads to more efficient program execution.
    - Facilitates the development of cost estimating relationships.

Defining the Structure

- What is a WBS?
  - Society of Cost Estimating and Analysis (SCEA), Cost Estimating Body of Knowledge (CEBoK)
    - Displays and defines the system/program to be developed as a product-oriented family tree
    - Includes hardware, software, support, data and facility elements
    - WBS should encompass complete life cycle of the system/program

Defining the Structure



Projects Reviewed - EM

- Rocky Flats Site Clean-Up and Closure
- Fernald Environmental Restoration & Closure
- Miamisburg Environmental Management Project
- Oak Ridge
  - Alpha-4 Complex (D&D)
  - Melton Valley Watershed Remediation (Soil & Groundwater Remediation)
  - U-233 Downblending and Disposition (Solid Waste Disposition)
- Hanford
  - River Corridor Closure Project (D&D)
  - Tank Farm Waste Feed and Closure Operations (Liquid Waste Disposition)
- Brookhaven
  - Graphite Research Reactor (D&D)
- Portsmouth
  - Gaseous Diffusion Plant (D&D)
- West Valley (D&D)
- Savannah River Site
  - Salt Waste Processing Facility (Construction)
- Moab
  - Uranium Mill Tailings Remedial Action (UMTRA) Project (Soil & Groundwater Remediation)

Project Type	Count
Site Closure	2
D&D	5
Remediation	2
Disposition	2
Construction	1
Total	**12**

Projects Reviewed - NNSA

- Oak Ridge
  - Highly Enriched Uranium Materials Facility (HEUMF) **(Construction)**
  - Compressed Air Upgrade **(System Upgrade)**
  - Potable Water System Upgrade **(Construction/System Upgrade)**
  - Steam Plant Life Extension Project (SLEP) **(System Upgrade)**
- Sandia National Lab
  - Microsystems and Engineering Sciences Applications (MESA) Complex - Microsystems Fabrication Facility (MicroFab), Microsystems Laboratory Facility (MicroLab), Weapons Integration Facility (WIF) **(Construction)**
- Savannah River Site
  - Waste Solidification Building (WSB) **(Construction)**
  - Mixed Oxide (MOX) Fuel Fabrication Facility **(Construction)**

Project Type	Count
Construction	4
Upgrade	3
Total	**7**

Projects Reviewed - Science

- Berkeley
  - Molecular Foundry **(Construction)**
- Brookhaven
  - Center for Functional Nanomaterials **(Construction)**
- Stanford
  - Linac Coherent Light Source (LCLS) **(Construction)**
  - International Linear Collider (ILC) **(Construction)**
- Oak Ridge
  - Spallation Neutron Source **(Construction)**
- Pacific Northwest National Laboratory (PNNL)
  - Physical Sciences Facility (PSF) **(Construction)**
- Princeton
  - National Spherical Torus Experiment (NSTX) **(Construction)**
- Fermi National Accelerator Laboratory
  - NOvA Neutrino Experiment **(Construction/Upgrade)**
- Jefferson Lab
  - 12 GeV Upgrade to Continuous Electron Beam Accelerator Facility (CEBAF) **(Construction/Upgrade)**
- International Fusion Materials Irradiation Facility (IFMIF) **(Construction)**

Project Type	Count
Construction	8
Upgrade	2
Total	**10**

Raw Data Structure Challenges

Example:
Rocky Flats Site Clean-Up and Closure
(over 3,000 elements)

WBS	Element Title
1	Rocky Flats Closure Project
1A	371 Complex Project
1AA	371 Closure
1AAA	Project Management
1AAA01	B371 Project Management
1AAB	Facilities Management
1AAB01	371/374 Cluster Compliance Surveillance
1AAB02	371/374 Cluster Maintenance
1AAB03	371/374 Cluster Operations Tech Support
1AAB04	371/374 Cluster Operations Management
1AAB05	Authorization Basis Development and Impl
1AAB07	Cooling Tower
1AAC	Deactivation
1AAC01	371/374 Cluster Deactivation/SNM Removal
1AAC02	Calcining B371 Sludge
1AAC03	Post PuSPS SNM Holdup Stabilization & Pk
1AAC04	Caustic Waste Treatment System
1AAD	Decommissioning
1AAD01	Bldg 371 D&D - Dismantlement (Sets Activities)
1AAD0101	Set 1 - (Attic North)
1AAD0102	Set 2 - (Attic South)
1AAD0103	Set 3 - (Nitric Acid Recovery 3517)
1AAD0104	Set 4 - (Nitric Acid Recovery 3571)
1AAD0105	Set 5 - (Nitric Acid Secondary)
1AAD0106	Set 6 - (Ion Exchange)
1AAD0107	Set 7 - (Pyro - Chem Area)
1AAD0108	Set 8 - (Wet Residue Sample/Repack)
1AAD0109	Set 9 - (Central Storage Vault)
1AAD0110	Set 10 - (Utility Scrubber)

Example:
Fernald Environmental Restoration & Closure
(over 300 elements)

WBS CODE	WBS DESCRIPTION
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1	FERNALD CLOSURE PROJECT - FCP
1.1	DEFENSE CLOSURE - FCP
1.1.1	PBS 13 SOLID WASTE & DISPOSITION
1.1.1.F	WASTE PITS
1.1.1.F.A	WASTE PITS MANAGEMENT
1.1.1.F.B	LOAD OUT OPERATIONS
1.1.1.F.C	SHIP/DISPOSAL OPERATIONS
1.1.1.F.D	NON TYPICAL WASTE
1.1.1.H	SILOS
1.1.1.H.A	SILOS MANAGEMENT
1.1.1.H.B	SILO 3
1.1.1.H.C	AWR
1.1.1.H.D	SILOS 1 & 2
1.1.1.H.E	WASTE DISPOSITION
1.1.1.H.F	MAINTENANCE
1.1.1.K	MIXED WASTE
1.1.1.K.A	MIXED WASTE MANAGEMENT
1.1.1.K.B	ORGANIC TREATMENT
1.1.1.K.C	INORGANIC TREATMENT
1.1.1.K.D	SAMPLE DISPOSITION
1.1.1.K.E	MIXED WASTE INCINERATION
1.1.1.K.F	HAZARDOUS WASTE
1.1.1.K.G	AWWT LIQUIDS
1.1.1.M	WASTE MANAGEMENT
1.1.1.M.A	WASTE MANAGEMENT
1.1.1.M.B	STORAGE / SHIPPING WAREHOUSING
1.1.1.M.C	TRASH DISPOSITION
1.1.1.M.D	ASBESTOS
1.1.1.M.E	RESIDUE
1.1.1.M.F	SOILS & SOIL-LIKE MATERIALS
1.1.1.M.G	THORIUM
1.1.1.M.J	URANIUM WASTE
1.1.2	PBS 20 SAFEGUARDS & SECURITY
1.1.2.P	SAFEGUARDS & SECURITY
1.1.2.P.A	SAFEGUARDS & SECURITY

Raw Data Structure Challenges

Example:
Rocky Flats Site Clean-Up and Closure
(over 3,000 elements)

Example:
Fernald Environmental Restoration & Closure
(over 300 elements)

Non-Standard WBS numbering

WBS	Element Title
1	Rocky Flats Closure Project
1A	371 Complex Project
1B	707 Complex Project
1C	B771/774 Closure Project
1D	B776/777 Closure Project
1E	Industrial and Site Services Project
1F	Material Stewardship Project
1G	Remediation Project
1H	Engr, Environ, Safety & Quality Programs Project
1J	Support Project
1T	Non-Closure Transactions
1V	Accounting Transactions
1X	Post Physical Completion Project

WBS	Element Title
1.0	Fernald Closure Project - FCP
1.1	Defense Closure - FCP
1.1.1	PBS 13 Solid Waste & Disposition
1.1.2	PBS 20 Safeguards & Security
1.1.3	PBS 30 Soil & Water Remediation
1.1.4	PBS 50 Non-Nuclear Facility D&D
1.1.6	PBS 101 Fernald Comm. & Regulatory Support
1.1.7	PBS 900 Pre-2004 Completions
1.2	Science & Technology / Other

Raw Data Structure Challenges

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Nuclear Facility D&D

Non-Nuclear Facility D&D

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Non-Standard WBS numbering

Indirect Activities

Nuclear Facility D&D

Non-Nuclear Facility D&D

Indirect Activities

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Contains construction

Non-Standard WBS numbering

Indirect Activities

Nuclear Facility D&D

Non-Nuclear Facility D&D

Indirect Activities

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1.1.7	PBS 900 Pre-2004 Completions
1.2	Science & Technology / Other

Non-Standard WBS numbering

Also includes non-nuclear D&D, area remediation, area level and site level project management

Contains construction

Indirect Activities

Nuclear Facility D&D

Non-Nuclear Facility D&D

Indirect Activities

Raw Data Structure Challenges

WBS	Element Title
1.2.1.1.03	Alpha-4 Complex Bldg/Facil No.9201-4
NC0005	Alpha-4 D&D Project Start
NC0500	SOW/Work Release
NC0499	EE/CA
NC0505	Prepare EE/CA
NC0510	BJC Review/Incorporate Comments
NC0515	Issue D0 EE/CA to DOE for Review
NC0520	DOE Review
NC0525	Incorporate DOE Comments for D1 EE/CA
NC0530	Clearance & Reproduction
NC0535	Submit D1 to DOE for Regs Review
NC0540	Transmit D1 to Regs for Review
NC0545	Submit D1 to Regs for Review
NC0550	Regs Review of D1 EE/CA
NC1005	SOW/Work Release
NC2005	SOW/Work Release for RmAWP
NC2004	Prepare/Issue RmAWP
NC1004	Action Memorandum
NC1010	Prepare Action Memorandum
NC2010	BJC Review/Incorporate Comments
NC2015	Prepare Removal Action Workplan
NC0555	Incorporate Regs Comments
NC0560	Clearance & Reproduction
NC0565	Submit Final EE/CA to DOE for Public Review
NC0570	Transmit Final EE/CA to Regs for Public Review
NC0575	Sub Final EE/CA to Regs for Public Notification
NC0580	Public Notification
NC0585	Public Review

Legacy Data Element Structure Challenges

- No clear definition of parent/child relationships
- Many "activity" or "process" oriented elements
- A lot of detail on administrative activities
- Little detail on actual "touch labor" activities

WBS Dictionary Challenges

- Varying levels of contextual completeness
  - Good Example

WBS Element	Element Name	Definition
1.1.3.G	Soil and Water	This WBS element covers the Remedial Design and Remedial Excavation and Restoration activities associated with at- and below-grade impacted materials site wide. This includes soil within the Operable Unit 1 boundaries, the Operable Unit (OU) 2 Waste Units, at- and below-grade Operable Unit 3 debris, soil within the Operable Unit 4 boundaries (except the silo berms), and soil in Operable Unit 5.

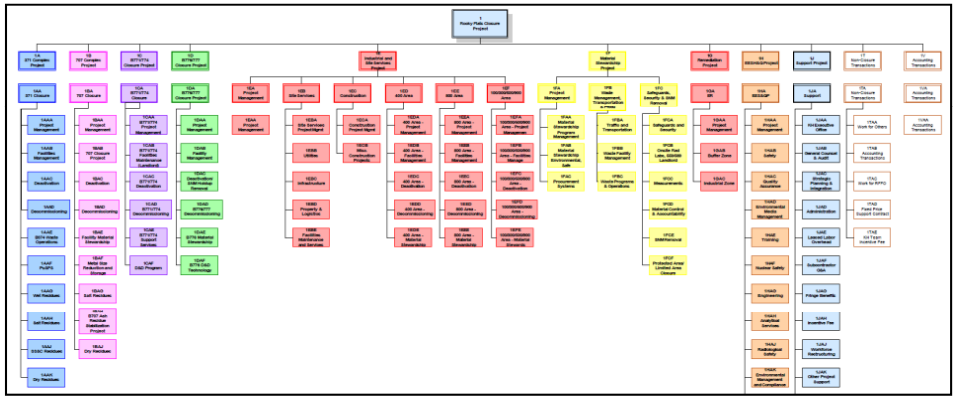
  - Bad Example

WBS Element	Element Name	Definition
1.07.02.01.01.02.02.02	Portal 16 Mods	Modify Portal 16

- Non-Existent Definitions
- Dictionaries that do not provide as much granularity as the data

WBS Challenges

- Traceability to/from the Project WBS to the technical documentation is typically a challenge



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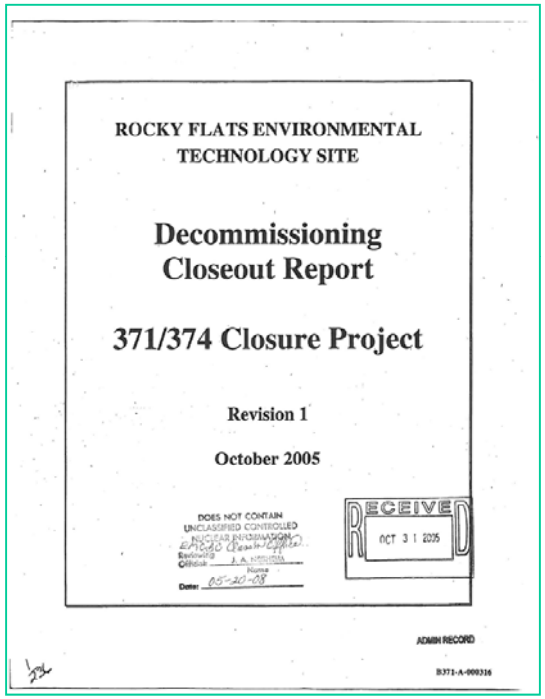


ROCKY FLATS ENVIRONMENTAL TECHNOLOGY SITE

Decommissioning Closeout Report

371/374 Closure Project

Revision 1

October 2005

DOES NOT CONTAIN UNCLASSIFIED CONTROLLED NUCLEAR INFORMATION

RECEIVED OCT 31 2005

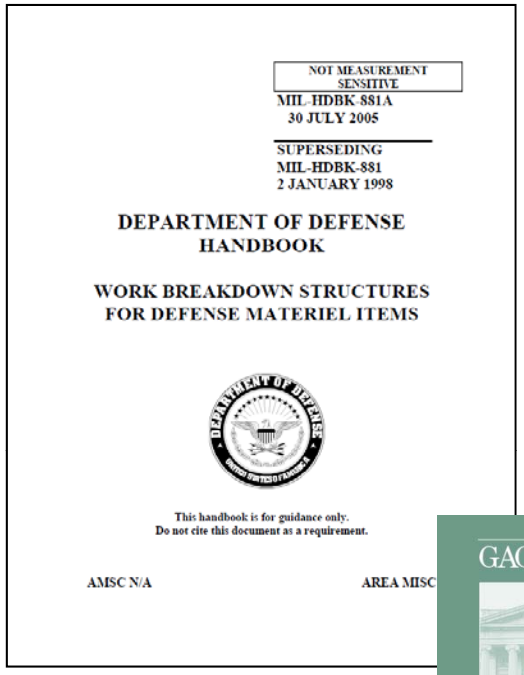
ADMIN RECORD

- The technical documentation can provide a good basis for development of a project-specific product oriented WBS

Sub-Project Standard WBS Development

ASTM Uniformat II Classification for Building Elements (E1557-97)

Level 1 Major Group Elements	Level 2 Group Elements	Level 3 Individual Elements
A SUBSTRUCTURE	A10 Foundations	A1010 Standard Foundations A1020 Special Foundations A1030 Slab on Grade
	A20 Basement Construction	A2010 Basement Excavation A2020 Basement Walls
B SHELL	B10 Superstructure	B1010 Floor Construction B1020 Roof Construction
	B20 Exterior Enclosure	B2010 Exterior Walls B2020 Exterior Windows B2030 Exterior Doors
	B30 Roofing	B3010 Roof Coverings B3020 Roof Openings
C INTERIORS	C10 Interior Construction	C1010 Partitions C1020 Interior Doors C1030 Fittings
	C20 Stairs	C2010 Stair Construction C2020 Stair Finishes
	C30 Interior Finishes	C3010 Wall Finishes C3020 Floor Finishes C3030 Ceiling Finishes
D SERVICES	D10 Conveying	D1010 Elevators & Lifts D1020 Escalators & Moving Walks D1090 Other Conveying Systems
	D20 Plumbing	D2010 Plumbing Fixtures D2020 Domestic Water Distribution D2030 Sanitary Waste D2040 Rain Water Drainage D2090 Other Plumbing Systems
	D30 HVAC	D3010 Energy Supply D3020 Heat Generating Systems D3030 Cooling Generating Systems D3040 Distribution Systems D3050 Terminal & Package Units D3060 Controls & Instrumentation D3070 Systems Testing & Balancing D3090 Other HVAC Systems & Equipment
	D40 Fire Protection	D4010 Sprinklers D4020 Standpipes D4030 Fire Protection Specialties D4090 Other Fire Protection Systems
	D50 Electrical	D5010 Electrical Service & Distribution D5020 Lighting and Branch Wiring D5030 Communications & Security D5090 Other Electrical Systems
E EQUIPMENT & FURNISHINGS	E10 Equipment	E1010 Commercial Equipment E1020 Institutional Equipment E1030 Vehicular Equipment E1090 Other Equipment
	E20 Furnishings	E2010 Fixed Furnishings E2020 Movable Furnishings
F SPECIAL CONSTRUCTION & DEMOLITION	F10 Special Construction	F1010 Special Structures F1020 Integrated Construction F1030 Special Construction Systems F1040 Special Facilities F1050 Special Controls and Instrumentation
	F20 Selective Building Demolition	F2010 Building Elements Demolition F2020 Hazardous Components Abatement



NOT MEASUREMENT SENSITIVE

MIL-HDBK-881A
30 JULY 2005

SUPERSEDING
MIL-HDBK-881
2 JANUARY 1998

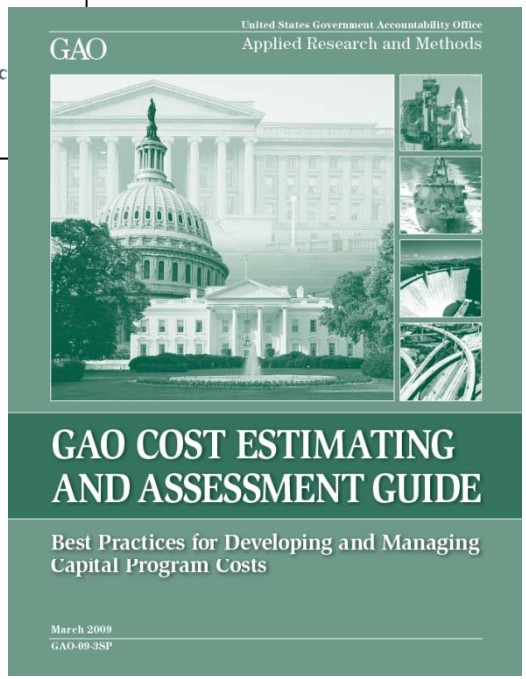
DEPARTMENT OF DEFENSE
HANDBOOK

WORK BREAKDOWN STRUCTURES
FOR DEFENSE MATERIEL ITEMS

This handbook is for guidance only.
Do not cite this document as a requirement.

AMSC N/A

AREA MISC



United States Government Accountability Office
GAO
Applied Research and Methods

GAO COST ESTIMATING AND ASSESSMENT GUIDE

Best Practices for Developing and Managing Capital Program Costs

March 2009
GAO-09-3SP

Sub-Project Standard WBS Development

Environmental Cost Element Structure (ECES)

- 31 pages, nearly 2,000 WBS elements

All Level ECES

Phases							2nd	3rd	4th	5th	Environmental Management
Ph1	Ph2	Ph3	Ph4	Ph5	Ph6	Ph8	Lvl	Lvl	Lvl	Lvl	
Assess.	Studies	Design	Cap. Const.	O&M	SLMT	Prog. Mgmt/ Infra.					ENVIRONMENTAL COST ELEMENT STRUCTURE
						$	.01	.00			**PROGRAM MANAGEMENT, SUPPORT & INFRASTRUCTURE (OPTIONAL)**
						$	.01	.01			**Personnel Resources**
						$	.01	.01	.01		Program Planning
						$	.01	.01	.02		Compliance Management
						$	.01	.01	.03		Pollution Prevention Management
						$	.01	.01	.04		Conservation/Environmental Program Management
						$	.01	.01	.05		Meetings and Interfaces
						$	.01	.01	.06		Budgeting and Financial Control/Tracking/Reporting
						$	.01	.01	.9x		Other
						$	.01	.02			**Program Support**
						$	.01	.02	.01		Training/Certification
						$	.01	.02	.01	.01	*HAZWOPER training*
						$	.01	.02	.01	.02	*Site orientation/emergency training*
						$	.01	.02	.01	.03	*Security training*
						$	.01	.02	.01	.04	*Ethics training*
						$	.01	.02	.01	.05	*Waste containment, handling, labeling, packaging, transportation*
						$	.01	.02	.01	.9x	*Other training and certification*
						$	.01	.02	.02		Public Affairs/Community Relations
						$	.01	.02	.03		Administrative Support
						$	.01	.02	.04		Procurement and Contracting-Equipment, Material, and Labor
						$	.01	.02	.05		Engineering and Supervision
						$	.01	.02	.06		Surveying and Quality Control
						$	.01	.02	.07		Legal Support/Regulatory Interaction
						$	.01	.02	.08		Medical/Health and Safety
						$	.01	.02	.08	.01	*Personnel dosimetry*
						$	.01	.02	.08	.02	*Personnel radiation counting*
						$	.01	.02	.08	.03	*Personal protective equipment/respirators/ventilators*
						$	.01	.02	.08	.04	*Industrial safety (heat, cold, stress, noise, odor monitoring; industrial hygiene, confined space, etc)*
						$	.01	.02	.08	.05	*First aid/emergency response*
						$	.01	.02	.08	.06	*General safety monitor*
						$	.01	.02	.08	.07	*Safety evaluation and investigations*
						$	.01	.02	.08	.08	*Dosimetry system (electronic and thermoluminescence dosimeter reader)*
						$	.01	.02	.08	.09	*Instrument calibration, Health and Safety QA/QC*
						$	.01	.02	.08	.10	*Medical examination*
						$	.01	.02	.08	.11	*Portal or access monitoring*
						$	.01	.02	.08	.12	*Criticality Safety Program*
						$	.01	.02	.09		Consultants and Experts
						$	.01	.02	.10		Human Resources
						$	.01	.02	.9x		Other
						$	.01	.03			**Program Infrastructure**
						$	.01	.03	.01		Cost of Ownership
						$	.01	.03	.01	.01	*Rent for office space and housing*
						$	.01	.03	.01	.02	*Fixed costs related to environmental work*
						$	.01	.03	.01	.03	*Ownership of temporary construction facilities*
						$	.01	.03	.01	.9x	*Other*
						$	.01	.03	.02		Interest and Fees and Cost of Money
						$	.01	.03	.03		Reserved for Future Use
						$	.01	.03	.04		General and Administrative
						$	.01	.03	.05		Award Fee
						$	.01	.03	.06		Fixed Fee
						$	.01	.03	.07		Support Services
						$	.01	.03	.07	.01	*Computer support/hotline*
						$	.01	.03	.07	.02	*Cafeteria/food services*
						$	.01	.03	.07	.03	*Cleaning/janitorial*
						$	.01	.03	.07	.04	*Laundry*
						$	.01	.03	.07	.05	*Transportation Services*
						$	.01	.03	.07	.06	*Mail Services*
						$	.01	.03	.07	.07	*Library Services*
						$	.01	.03	.07	.08	*Video and photography*
						$	.01	.03	.07	.9x	*Other*
						$	.01	.03	.08		Project Utilities
						$	.01	.03	.08	.01	*Telephone usage*

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- ECES Training Manual, Section IV "Caveats and Exceptions to Rule"
  - Caveat 1: "Some elements defined in different phases are performing the same activities…"
  - Caveat 2: "…the level of detail between elements is not the same."
  - Caveat 3: "…there are some elements with very similar names."
  - Caveat 4: "There is a likely possibility of differences in interpretation among the ECES developers and users."
  - Caveat 5: "Some of the elements do not have details below Level 3."

Sub-Project Standard WBS Development

Example: D&D Project

Level	WBS	Element Title
1	1.0	Facility Decontamination & Decommissioning (D&D) n
2	1.1	Facility
3	1.1.1	Facility Structure
4	1.1.1.1	Substructure & Foundation
4	1.1.1.2	Shell
4	1.1.1.3	Interiors
3	1.1.2	Facility Utilities
4	1.1.2.1	Electrical Systems
4	1.1.2.2	Heating, Ventilating, Air Conditioning (HVAC) Systems
4	1.1.2.3	Plumbing
4	1.1.2.4	Conveying
4	1.1.2.5	Fire Protection
4	1.1.2.6	Communication Systems
4	1.1.2.7	Monitoring, Detection & Access Control Systems
3	1.1.3	Furniture, Fixtures & Office Equipment
3	1.1.4	Process/Scientific/Technical Equipment
4	1.1.4.n	Process/Scientific/Technical Equipment n
3	1.1.5	Facility System Design & Engineering
2	1.2	Support Equipment & Facilities
3	1.2.1	Support Equipment
4	1.2.1.1	Material handling equipment (e.g., cranes)
4	1.2.1.2	Transfer equipment (e.g., fork trucks/trains/etc.)

Level	WBS	Element Title
4	1.2.1.3	Excavation equipment
4	1.2.1.4	Size reducing equipment (e.g., shear, shredd
4	1.2.1.5	Disassembly equipment (e.g., water jet cutte
4	1.2.1.6	Demolition equipment (e.g., manipulators)
4	1.2.1.7	HVAC equipment (e.g., hepa filtered contami
4	1.2.1.8	Volume reduction equipment (e.g., compact
4	1.2.1.9	Packaging equipment (e.g., supersacks, inter
3	1.2.2	Support Facilities
4	1.2.2.1	Temporary Facilities/Trailers
4	1.2.2.2	Assembly/Maintenance Facilities
4	1.2.2.3	Storage Facilities
4	1.2.2.4	Restroom Facilities
4	1.2.2.n	Support Treatment/Processing/Other Facility
2	1.3	Project Administration/Project Management
3	1.3.1	Technical Management
3	1.3.2	Facility Management
3	1.3.3	Contracts and Procurement Management
3	1.3.4	Cost & Schedule Management
3	1.3.5	Legal & Regulatory
3	1.3.6	Environmental Compliance, Safety & Health
3	1.3.7	Training
3	1.3.8	Security
2	1.4	System Design & Engineering

Other subproject WBS's developed: Facility Construction, Environmental Remediation, Science – Accelerator Equipment

System-of-Systems WBS Development

Compiles sub-project standard WBS's into a complete project

System (site) Level Elements

Level	WBS	Element Title
1	1.0	Site Environmental Cleanup Project
2	1.1	Site Environmental Cleanup
3	1.1.1	Site Decontamination & Decommissioning (D&D)
4	1.1.1.n	Facility D&D n
3	1.1.2	Environmental Remediation
4	1.1.2.n	Environmental Remediation Area n
2	1.2	Site Support Equipment & Facilities
3	1.2.1	Site Support Equipment
4	1.2.1.1	Material handling equipment (e.g., cranes)
4	1.2.1.2	Transfer equipment (e.g., fork trucks/trains/etc.)
4	1.2.1.3	Excavation equipment
3	1.2.2	Site Support Facilities
4	1.2.2.1	Temporary Facilities/Trailers
4	1.2.2.2	Assembly/Maintenance Facilities
4	1.2.2.3	Storage Facilities
4	1.2.2.4	Restroom Facilities
4	1.2.2.n	Support Treatment/Processing/Other Facility n
2	1.3	Site Work
3	1.3.1	Roads, Parking Lots and Walkways
3	1.3.2	Grading & Landscaping
3	1.3.3	Site Utilities
3	1.3.4	Site System Design & Engineering
2	1.4	Project Administration/Project Management
3	1.4.1	Technical Management
3	1.4.2	Facility Management
3	1.4.3	Contracts and Procurement Management
3	1.4.4	Cost & Schedule Management
3	1.4.5	Legal & Regulatory
3	1.4.6	Environmental Compliance, Safety & Health
3	1.4.7	Training
3	1.4.8	Security
2	1.5	System Design & Engineering

Insert Sub-Project WBS's as necessary

3. HISTORICAL DATABASE

Historical Database Process

- Data Collection
  - Cost, technical, programmatic
  - Primary data vs. secondary data (pedigree of the data)
- Data Validation
  - Completeness (do I have the whole onion?)
- Data Mapping
  - Map raw data to standard WBS
- Data Normalization
  - to constant dollars
- Data Compilation

Data Collection

Technomics

Phase 1: Closed Projects

EM	NNSA	Science
Fernald Environmental Restoration & Closure	Highly Enriched Uranium Materials Facility (HEUMF)	
Melton Valley Watershed Remediation	Microsystems Engineering for Strategic Applications (MESA)	
Miamisburg Closure Project		
Rocky Flats Site Clean-Up & Closure		

Phase 2: Closed and Ongoing Projects

EM	NNSA	Science
Hanford Waste Treatment Plant	TBD	Spallation Neutron Source
Hanford Groundwater/Vadose Zone remediation		LINAC
ORP Tank Farm Liquid Waste Stabilization and Disposition		Molecular Laboratory
SRS Salt Waste Processing Facility		TBD
INL Advanced Mixed Waste Treatment Project		
East Tennessee Technology Park D&D		
Paducah D&D		

Data Collection - Cost

- Data Sources
  - Raw accounting data
    - Fernald - by year
    - Rocky Flats
  - Cost Collection Reports
    - Melton Valley - by Subproject
      - ECES
      - Charge Account Level
    - MESA - High Level Cost Report
  - EVM data
    - HEUMF
    - Miamisburg - reported at the resource level

- Data Formats
  - Text Files
  - Excel Files
  - Adobe Files

Data Collection – Technical & Programmatic

- Data Sources
  - Facility Closeout Reports
    - Rocky Flats
  - Remedial Action Reports
    - Fernald
  - Cost Collection Reports
    - Melton Valley
  - Fact Sheet
    - Miamisburg
  - OSC Reports and Data Reports
    - Miamisburg

Data Validation

- Considerations
  - Data "Pedigree"
    - Level of factual accuracy related to the data artifact.
    - Degree that the source data has been normalized (i.e., compromised).
    - Ensure secondary sources are consistent with primary sources.
  - Internal consistency
    - Accurate vertical/horizontal calculations (e.g., Data subtotals align with hierarchical relationships.)
  - Completeness
    - Double counting and/or exclusions.
    - Relation to other sources of information.

Data Validation

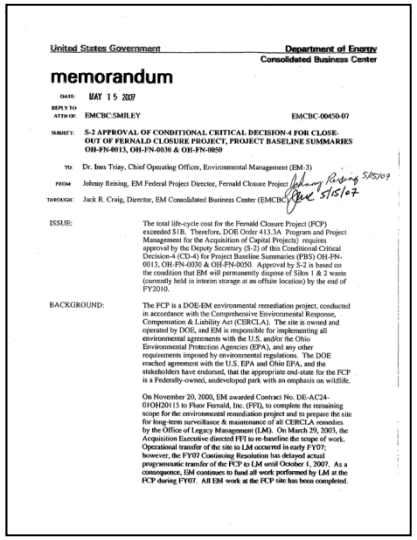
Project	Data Source	Pedigree	Internal Consistency*	Completeness
Fernald Environmental Restoration & Closure	EVM/Accounting Data	Excellent	N/A	Good
Melton Valley Watershed Remediation	Nov 2008 ECES Cost Report	Good	Fair	Good
Miamisburg Closure Project	EVM/Accounting Data	Excellent	N/A	Poor
Rocky Flats Site Clean-Up & Closure	EVM/Accounting Data	Excellent	N/A	Poor
Highly Enriched Uranium Materials Facility (HEUMF)	Oct 2009 CPR	Good	Fair	Excellent
Microsystems Engineering for Strategic Applications (MESA)	Aug 2008 Cost Report	Fair	Excellent	Excellent

- Notes:
  - Internal consistency: for MV and HEUMF, lowest level (children) elements are assumed to be correct and roll-ups (parent elements) are assumed to be incorrect.
  - Completeness: issues are a combination of missing data from predecessor contracts and/or discrepancies with secondary data sources.

Data Validation

- Completeness example – Fernald
  - *Accounting data total: $3,847,803,000*

CD-4 Approval Memo



United States Government — Department of Energy, Consolidated Business Center

memorandum

DATE: MAY 15 2007

REPLY TO ATTN OF: EMCBC:SMILEY — EMCBC-00450-07

SUBJECT: **S-2 APPROVAL OF CONDITIONAL CRITICAL DECISION-4 FOR CLOSE-OUT OF FERNALD CLOSURE PROJECT, PROJECT BASELINE SUMMARIES OH-FN-0013, OH-FN-0030 & OH-FN-0050**

TO: Dr. Inez Triay, Chief Operating Officer, Environmental Management (EM-3)

FROM: Johnny Reising, EM Federal Project Director, Fernald Closure Project — 5/15/07

THROUGH: Jack R. Craig, Director, EM Consolidated Business Center (EMCBC) — 5/15/07

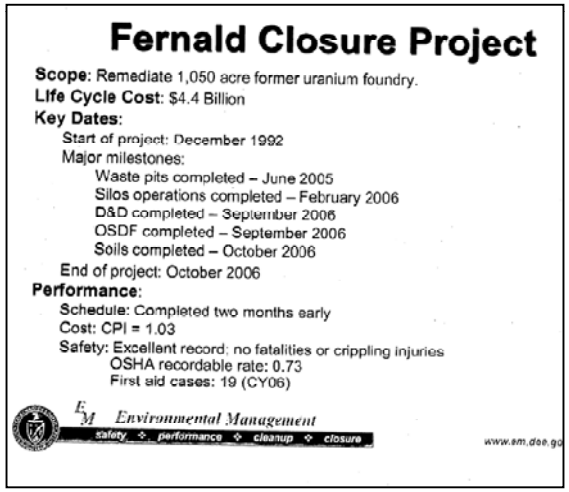
ISSUE: The total life-cycle cost for the Fernald Closure Project (FCP) exceeded $1B. Therefore, DOE Order 413.3A Program and Project Management for the Acquisition of Capital Projects) requires approval by the Deputy Secretary (S-2) of this Conditional Critical Decision-4 (CD-4) for Project Baseline Summaries (PBS) OH-FN-0013, OH-FN-0030 & OH-FN-0050. Approval by S-2 is based on the condition that EM will permanently dispose of Silos 1 & 2 waste (currently held in interim storage at an offsite location) by the end of FY2010.

BACKGROUND: The FCP is a DOE-EM environmental remediation project, conducted in accordance with the Comprehensive Environmental Response, Compensation & Liability Act (CERCLA). The site is owned and operated by DOE, and EM is responsible for implementing all environmental agreements with the U.S. and/or the Ohio Environmental Protection Agencies (EPA), and any other requirements imposed by environmental regulations. The DOE reached agreement with the U.S. EPA and Ohio EPA, and the stakeholders have endorsed, that the appropriate end-state for the FCP is a Federally-owned, undeveloped park with an emphasis on wildlife.

On November 20, 2000, EM awarded Contract No. DE-AC24-01OH20115 to Fluor Fernald, Inc. (FFI), to complete the remaining scope for the environmental remediation project and to prepare the site for long-term surveillance & maintenance of all CERCLA remedies by the Office of Legacy Management (LM). On March 29, 2003, the Acquisition Executive directed FFI to re-baseline the scope of work. **Operational transfer of the site to LM occurred in early FY07; however, the FY07 Continuing Resolution has delayed actual programmatic transfer of the FCP to LM until October 1, 2007. As a consequence, EM continues to fund all work performed by LM at the FCP during FY07. All EM work at the FCP site has been completed.**

Actual LCC = $2,902,761K

EM FPD "Lessons Learned" Presentation



Fernald Closure Project

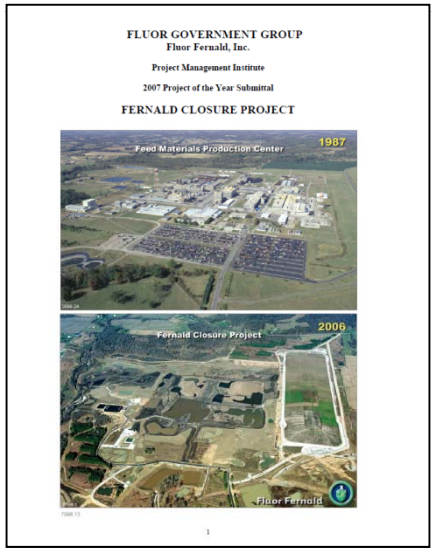
Scope: Remediate 1,050 acre former uranium foundry.
Life Cycle Cost: $4.4 Billion
Key Dates:
- Start of project: December 1992
- Major milestones:
  - Waste pits completed – June 2005
  - Silos operations completed – February 2006
  - D&D completed – September 2006
  - OSDF completed – September 2006
  - Soils completed – October 2006
- End of project: October 2006

Performance:
- Schedule: Completed two months early
- Cost: CPI = 1.03
- Safety: Excellent record; no fatalities or crippling injuries
  - OSHA recordable rate: 0.73
  - First aid cases: 19 (CY06)

EM Environmental Management — safety ❖ performance ❖ cleanup ❖ closure — www.em.doe.go

LCC = $4.4 Billion

Flour Fernald, Inc.
2007 Project of the Year Submittal

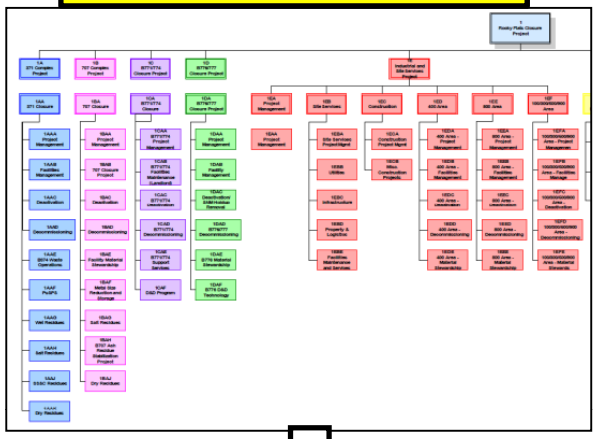


FLUOR GOVERNMENT GROUP
Fluor Fernald, Inc.
Project Management Institute
2007 Project of the Year Submittal
FERNALD CLOSURE PROJECT

Contract Total = $4,301,268,566

Data Mapping

Raw Data Elements



Target WBS(s)

Level	WBS	Element Title
1	1.0	Facility Decontamination & Decommissioning (D&D) n
2	1.1	Facility
3	1.1.1	Facility Structure
4	1.1.1.1	Substructure & Foundation
4	1.1.1.2	Shell
4	1.1.1.3	Interiors
3	1.1.2	Facility Utilities
4	1.1.2.1	Electrical Systems
4	1.1.2.2	Heating, Ventilating, Air Conditioning (HVAC) Systems
4	1.1.2.3	Plumbing
4	1.1.2.4	Conveying
4	1.1.2.5	Fire Protection
4	1.1.2.6	Communication Systems
4	1.1.2.7	Monitoring, Detection & Access Control Systems
3	1.1.3	Furniture, Fixtures & Office Equipment
3	1.1.4	Process/Scientific/Technical Equipment
4	1.1.4.n	Process/Scientific/Technical Equipment n

- Reduce to children elements only

- Reduce to children elements only
- Add "non-allocable" elements at each level

Parent WBS #	Associated "Format 1" Data Description	"Curr Mo" Data Description
1.07.02.01.01.03.01.02	Building S/C PIDAS Area	PIDAS Area Change Orders
1.07.02.01.01.03.01.02	Building S/C PIDAS Area	PIDAS Area Change Orders (2)
1.07.02.01.02.01	Project Planning & Prototype Efforts	PIDAS Criteria
1.07.02.01.01.03.01.01	PIDAS Title I & II Design & Sandia Support	PIDAS Title I Design-AE Subcontrac
1.07.02.01.01.03.01.01	PIDAS Title I & II Design & Sandia Support	PIDAS Title I&II Design-BWXT ENG
1.07.02.01.01.03.01.01	PIDAS Title I & II Design & Sandia Support	PIDAS Title II Design-AE Subcont
1.07.02.01.01.03.01.01	PIDAS Title I & II Design & Sandia Support	Sandia MOU-BWXT Engineering
1.07.02.01.01.03.01.04	PIDAS Title III Design	PIDAS Title III Design
1.07.02.01.01.03.01.02	Building S/C PIDAS Area	Building S/C PIDAS Area
1.07.02.01.01.03.01.02	Building S/C PIDAS Area	DH Perform CBJV Pidas Scope Work
1.07.02.01.01.03.01.03	PIDAS Electrical Direct Hire	Direct Hire PIDAS Electrical

WBS	Element Title	Level
1.1.1.1	Substructure & Foundation	4
1.1.1.2	Shell	4
1.1.1.3	Interiors	4
1.1.1.4	Not Allocable	4
1.1.2.1	Electrical Systems	4
1.1.2.2	Heating, Ventil ditioning (HVAC) Systems	4
1.1.2.3	Plumbing	4
1.1.2.4	Conveying	4
1.1.2.5	Fire Protecti	4
1.1.2.6	Communi ems	4
1.1.2.7	Monit ction & Access Control Systems	4
1.1.2.8	No	4
1.1.3	, Fixtures & Office Equipment	3

Data Normalization

- Raw data converted to constant FY10 dollars using current DOE escalation rates
  - Appropriation categories
    - Nuclear: apply to NNSA and EM construction
    - Scientific Laboratory: apply to Science construction
    - Admin/Warehouse: apply to NNSA, EM, or Science non-nuclear, non-scientific laboratory construction
    - Remediation/D&D: apply to EM remediation/D&D
- Normalization process dependent on raw data
  - Historical data accumulated by year
    - Apply indices corresponding to each year of data
  - Historical data not accumulated by year
    - Identify midpoint of effort and apply corresponding index

Data Compilation

- Currently in Excel
- All projects in one file
- Then Year (TY) and Constant (FY10) dollars
- Ability to view data across projects
- Supports data analysis

4. CONCLUSIONS

Conclusions

- Creating standard product from previous non-standard effort is difficult
  - Many obstacles exist in developing standard WBS's and historical databases
  - Some obstacles have been navigated, others have not
- Much progress has been made to date
- More progress and challenges remain
- Database utility will continue to increase as more data is added on both completed projects as well as current projects

Success of this effort is critical to the future of DOE cost estimating

Questions?

Technomics

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