

Construct for Life Cycle Cost (LCC) Elements in Assessing Environmental Impacts on DHS Projects

by

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for

2011 Annual Transportation Research Board (TRB) Conference

Authorship Caveats

The opinions represented are solely the position of the author and do not represent an official DHS position on such matters.

The observations, thoughts and views regarding tailored application of a Work Breakdown Structure (WBS) to R&D programs are those of the author.

The intent of this presentation is not a tutorial on WBS, but instead on what should be considered prior to and during execution of a R&D-oriented project that may involve many environmental cost impact considerations across the system life cycle.

Balancing Requirements

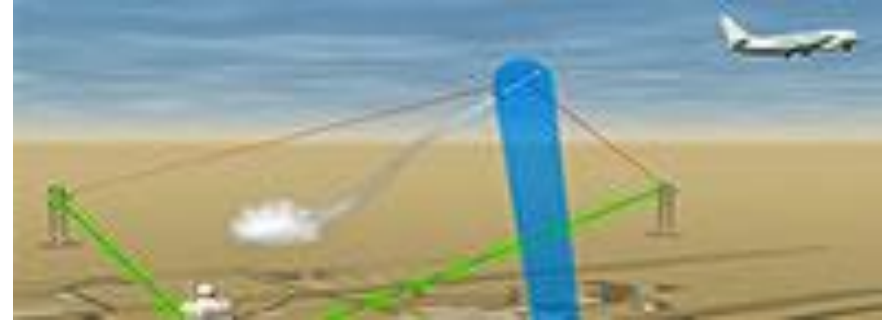


Laws & Regulations Across Key Environmental Impact Areas

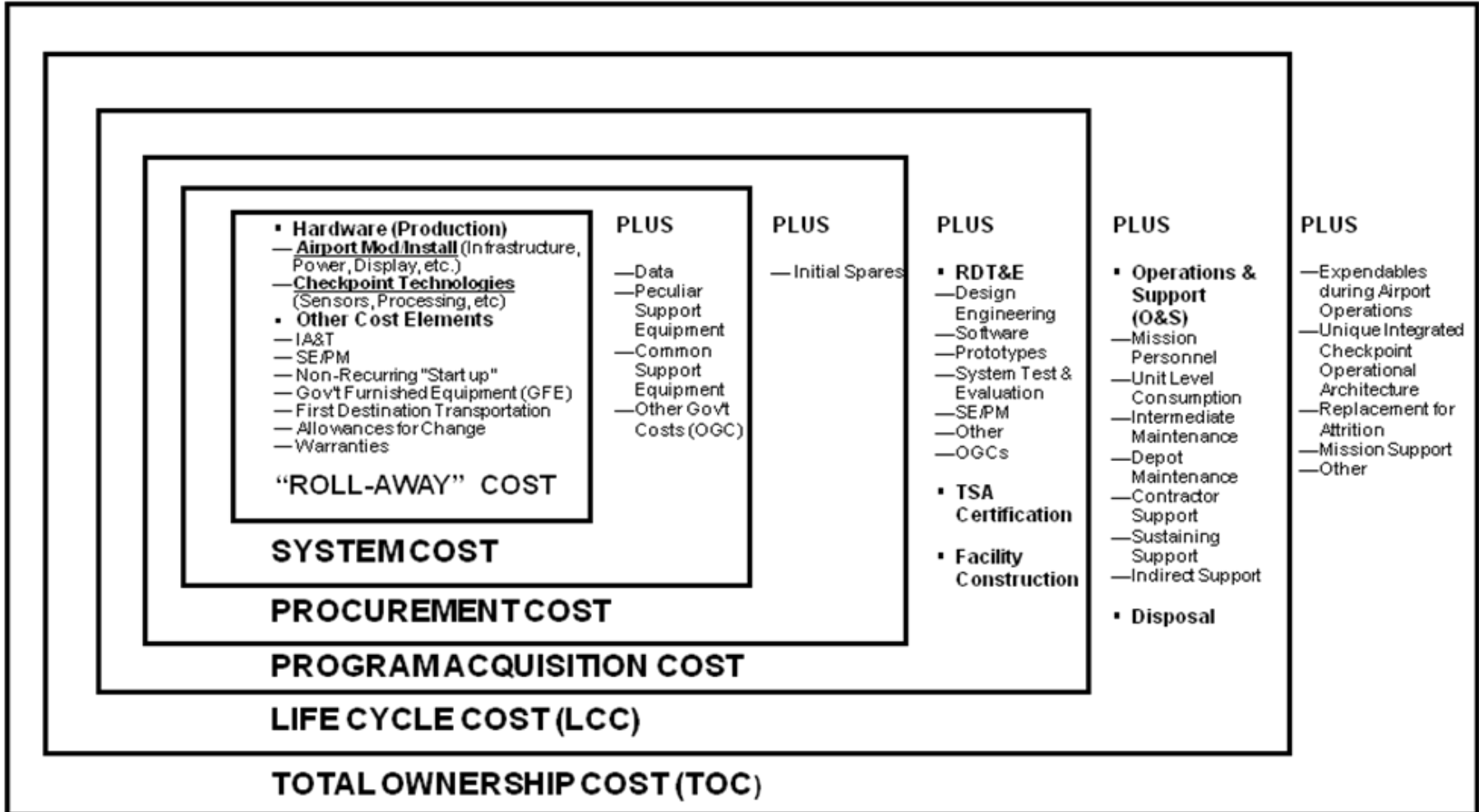
- Air Quality (CAA, NAAQS, EPA, ...) [1/2]
- Coastal Resources (DOT, ...) [2]
- Farmlands (FPPA, USDA NRCS,) [2]
- Flora & Fauna (ESA, MMPA, DOT,) [1/2]
- Floodplains (DOT, FEMA,) [2]
- Geology & Soil Resources (...) [1/2]
- Hazardous Materials, Pollution Prevention & Solid Waste (SARA, RCRA,) [1]
- Historical, Architectural, Archeological & Cultural Resources (ACHP, ARPA, ...) [2]
- Land Use (ASNA, ...) [2]
- Natural Resources & Energy Supply (DOE,) [2]
- Noise (ASNA, DOT, FAA,) [1/2]
- Socioeconomic Conditions, Environmental Justice & Disproportionate Population Effects (URARPAPA, DOT, HHS,) [2]
- Utilities and Transportation (DOT, ...) [2]
- Visual Impacts and Light Emissions (DOT, ...) [1/2]
- Water Quality (FWPCA, CWA, EPA,) [1/2]
- Wetlands (RHA, DOT, USACE, ...) [2]
- Wild and Scenic Rivers (NRI, DOI, BLM,) [2]
- Microwave Radiation (OSHA, FCC, ANSI,) [1/2]

Common & Site-Specific Key
[1] = Implementation Wide
[2] = Site-Specific

DHS System Examples



Overarching Cost Considerations



- WBS must be product-oriented (i.e., broken down by critical sub-systems and hardware / software components)
- WBS should depict the complete scope of the project to be an effective tool for communication across all stakeholders
- WBS represents a deliverable-oriented hierarchical decomposition of the work to be executed
 - Organizes and defines the total scope of the project
 - Subdivides the project work into smaller, more manageable pieces
 - ‘Work packages’ tend to be work contained in the lowest WBS levels and where cost, schedule and scope baselines are fixed
- WBS must track to the agreed to SOW and IMS
- Subs and IWOs should use same WBS structure / definitions as Prime
- WBS Dictionary that addresses code-of-account identifier, SOW, Responsible organization, Standards to be followed, etc. should exist

* Work Breakdown Structure

Example WBS for RDT&E

1 Program X RDT&E WBS	
1.1	PROGRAM MANAGEMENT (PM)
1.1.1	EXECUTIVE LEADERSHIP & ST
1.1.2	DATA MANAGEMENT (DM)
1.1.3	QUALITY ASSURANCE (QA)
1.1.4	BUSINESS OPERATION INTEGRATION
1.1.5	CONTRACT MANAGEMENT TEAM
1.1.6	SUBCONTRACTS MANAGEMENT TEAM
1.1.7	PROGRAM PLANNING
1.2	SYSTEMS ENGINEERING (SE)
1.2.1	SEIT MANAGEMENT
1.2.2	SYSTEM ENGINEERING
1.2.2.1	SYSTEMS ENGINEERING STAFF
1.2.2.2	REQUIREMENT ANAL & VERIFY
1.2.2.3	MODELING & SIMULATION
1.2.2.3.2	MISSION ANALYSIS
1.2.2.3.3	SYSTEM MODELING
1.2.2.3.4	VIRTUAL BATTLEFIELD SIMULATION
1.2.2.4	RELIABILITY, AVAILABILITY, & MAINTAINABILITY
1.2.2.5	OTHER - ILLITIES
1.2.2.5.1	SAFETY PROGRAM
1.2.2.5.2	ENVIRONMENTAL COMPLIANCE
1.2.2.5.3	HAZARDOUS MATERIAL PROGRAM
1.2.2.5.4	PRODUCIBILITY ENGINEERING
1.2.2.6	LIFE CYCLE COST (LCC)
1.2.3	SYSTEM INTEGRATION
1.2.3.1	SYSTEM INTEGRATION & VERIFICATION
1.2.3.2	INTERFACE MANAGEMENT
1.2.3.3	SYSTEM ARCHITECTURE
1.2.3.3.1	SYSTEM SYNTHESIS
1.2.3.3.2	HARDWARE ARCHITECTURE
1.2.3.3.3	PROCESSING ARCHITECTURE
1.2.3.3.4	HMI ARCHITECTURE
1.2.4	SYSTEM TEST
1.2.4.1	TEST PLANNING
1.2.4.2	TEST ENGINEERING
1.2.5	CONFIGURATION MANAGEMENT
1.2.6	RISK MANAGEMENT
1.3	C3I
1.3.1	ENGAGEMENT CONTROLLER ASSEMBLY (ECS)
1.3.1.1	ENGAGE & EXEC PROCESSOR
1.3.1.2	ECS PROCESSOR HARDWARE
1.3.1.2.1	ENGAGEMENT COORDINATION SW
1.3.1.2.2	ENGAGEMENT MANAGEMENT SW
1.3.1.2.3	OBJECT TRACK & DISCRIMINATION SW
1.3.1.2.4	MISSION REPORTING SW
1.3.1.2.5	C2 ENGAGEMENT SIMULATION
1.3.2	OPERATOR STATION SUBSYSTEM (OSS)
1.3.2.1	OSS ELECTRONICS HARDWARE
1.3.2.2	SOFTWARE
1.3.2.2.1	OSS S/W DISPLAY CONTROL
1.3.2.2.2	OSS S/W SIMULATION
1.3.2.2.3	COMMAND COST CONTROL SW
1.3.3	COMMUNICATIONS
1.3.3.1	TOWER/STRUCTURE
1.3.3.2	MICROWAVE DEVICES

1.3.3.3	COMMUNICATIONS HW
1.3.3.4	FCC FREQUENCY COORDINATION
1.3.3.5	COMM LICENSES (I.E. VX WORKS OS)
1.3.4	NATIONAL OP CENTER CONTROL
1.3.4.1	COMPUTING AND DISPLAY HW
1.3.4.2	SYSTEM MANAGEMENT SW
1.4	LASER SYSTEM (LS)
1.4.1	MANAGEMENT / SEIT
1.4.1.1	WIPT MANAGEMENT
1.4.1.2	SYSTEMS ENGINEERING/SEIT
1.4.1.3	EFFECTOR DESIGN
1.4.2	CENTRAL PROCESSOR SUBSYSTEM (CPS)
1.4.2.1	EFFECTOR EXEC CONTROLLER
1.4.2.1.1	GBL SW EXEC SERVICES
1.4.2.1.2	GBL SW MISSION SIMUL
1.4.2.1.3	GBL SW MAINTENANCE & DIA
1.4.2.1.4	GBL SW LOGS SVCS
1.4.2.1.5	GBL SW COMM
1.4.2.2	LGGS CONTROLLER ASSEMBLY
1.4.2.2.1	LASER CONTROLLER PROCESSOR
1.4.2.2.2	SOFTWARE
1.4.2.2.2.1	PLAN & CONTROL LASER SW
1.4.2.2.2.2	LASER SIMULATIONS SW
1.4.2.3	BCS CONTROLLER ASSEMBLY
1.4.2.3.1	PROCESSOR HARDWARE
1.4.2.3.1.1	OBCS CONTROLLER PROCESSOR
1.4.2.3.1.2	BASC CONTROLLER PROCESSOR
1.4.2.3.1.3	BDAC CONTROLLER PROCESSOR
1.4.2.3.1.4	HRSP CONTROLLER PROCESSOR
1.4.2.3.2	SOFTWARE
1.4.2.3.2.1	OBCS CONTROLLER SW
1.4.2.3.2.2	BEAM ALIGNMENT & STABILIZATION ASSEMBLY (BASA)
1.4.2.3.2.3	TELESCOPE CONTROL (BDAC)
1.4.2.3.2.4	HRSP SHARED (APERTURE) SW
1.4.2.3.2.5	HRSP OFF (AXIS) SW
1.4.2.3.2.6	INERTIAL PLTFM CONT&GE-LO
1.4.2.3.2.7	OBCS RELATED SIMULATIONS
1.4.2.4	RESEARCHED
1.4.2.5	CPS INTEGRATION
1.4.2.6	CPS MGMT & SYS ENG
1.4.2.6.1	ST CPS MGMT & SYS ENG
1.4.2.6.2	MS CPS MGMT & SYS ENG
1.4.3	BEAM CONTROL SUBSYSTEM (BCS)
1.4.3.0	BCS MANAGEMENT & SYSTEM
1.4.3.1	HIGH POWER OPTICS ASSY (HPOA)
1.4.3.2	BEAM DIRECTOR ASSEMBLY (BDA)
1.4.3.3	ACQUISITION & TRACK ASSEMBLY (ATA)
1.4.3.4	STRUCTURAL SUPPORT ASSEMBLY (SSA)
1.4.3.5	VIBRATION ISOLATION ASSEMBLY (VIA)
1.4.3.6	BEAM ALIGNMENT & STABILIZATION ASSEMBLY (BASA)
1.4.3.7	OPTICAL DIAGNOSTICS ASSEMBLY (ODA)
1.4.3.8	BCS AUXILIARY EQUIPMENT
1.4.3.9	BCS INTEGRATION

1.4.4	LASER GAIN GENERATOR SUBSYSTEM (LGGS)
1.4.4.0	LGGS PM, SE & DESIGN
1.4.4.0.1	LGGS PROJECT MGT & SE
1.4.4.0.2	LGGS DESIGN
1.4.4.1	GAIN GENERATOR ASSEMBLY (GGA)
1.4.4.2	RESEARCHED
1.4.4.3	PRESSURE RECOVERY ASSEMBLY (PRA)
1.4.4.4	GBL MANIPULATOR ASSEMBLY (GMA)
1.4.4.5	LGGS SUPPORT STRUCTURE
1.4.4.6	LGGS INTEGRATION
1.4.5	AUXILIARY EQUIPMENT SUBSYSTEM (AES)
1.4.5.0	ETS DESIGN
1.4.5.1	RESEARCHED
1.4.5.2	ANCILLARY EQUIPMENT
1.4.5.3	RESEARCHED
1.4.5.4	RESEARCHED
1.4.5.5	ETS DATA CABLES
1.5	FLUID SUPPLY SUBSYSTEM
1.5.1	MANAGEMENT/SEIT
1.5.2	ISO CONTAINER SUBSYSTEM
1.5.3	BEAM STORAGE SUBSYSTEM
1.5.3.1	TANKS
1.5.3.2	MOUNTING STRUCTURES
1.5.3.3	FSS SUBSYSTEM ENGINEERING & DESIGN
1.5.4	FLOW CONTROL SUBSYSTEM
1.5.4.1	FLOW CONTROL VALVES
1.5.4.2	FIRE VALVES
1.5.4.3	LASER FLOW CONTROL
1.5.4.3.1	LASER FLOW CONTROL PROCESSOR
1.5.4.3.2	LASER FLOW CONTROL SW
1.5.4.3.3	CABLE AID HARNESS
1.5.4.4	FLOW CONTROL VALVE ASSEMBLY/FL
1.5.4.5	FCS SUBSYSTEM ENGINEERING & DESIGN
1.5.5	RESEARCHED
1.5.6	FSS INTEGRATION
1.6	INTEGRATED LOGISTICS & SUPPORT PLANNING (IL&S)
1.6.1	ILS MANAGEMENT
1.6.2	RESEARCHED
1.6.3	RESEARCHED
1.6.4	PERSONNEL & MANPOWER
1.6.4.1	OPERABILITY TRAINING PLANNING
1.6.7	CONTRACTOR SUPPORT PLANNING
1.6.7.1	CONSUMABLES PLANNING
1.6.7.2	SPARES & REPAIR PARTS PLANNING
1.6.8	FACILITIES PLANNING
1.6.9	MANUFACTURING PLANNING
1.6.A	DEPLOYMENT PLANNING
1.7	MDT
1.8	FACILITIES (BUILDING COSTS)
1.8.1	PRODUCTION FACILITY
1.8.1.1	PRODUCTION BUILDING CONSTRUCTION COST
1.8.2	PROTOTYPING AND PRODUCTION FACILITY
1.8.2.1	PRODUCTION BUILDING CONSTRUCTION COST
1.8.3	EMPLACEMENT SITE FACILITIES
1.8.3.1	LASER SITE PERMITTING, ZONING
1.8.3.2	MUNICIPAL ZONING

= Environmental Impact Area

Environmental Cost Impact Examples to Consider in WBS

Phase	Tasks/Environmental Items	Requirements	Duration	Person-Months
Siting and Screening Efforts	Off-Site Data Gathering (pre-visit)	Prepare for siting; look at existing conditions in candidate areas; identify regulatory agencies and data sources	3-4 weeks	0.4-1.0
	Site Visit and In-Person Data Gathering	View and document existing conditions of candidate areas; meet with local agencies as needed/available	2-3 weeks	0.4-1.0
	Site Screening and Identification	Apply screening criteria; coordinate with agencies (see below); integrate findings with all siting considerations (incl. non-environmental)	2-3 months	0.4-1.2
Review and Assessment	Environmental Impact Statement (EIS) per Airport	Prepare assessment to comply with NEPA, including possible special studies (listed below) and public coordination	12 months	8-12.0
	Air Quality Study	Assessment of project's impact to air quality and identification of control technologies to mitigate potential impacts	1-3 months	0.7-1.3
	Natural Resources Study	A natural resources study may be required, which may include inventories and assessments regarding multiple fields of study, including those related to the flora, fauna, hydrologic, geologic, and energy resources	1-3 months	0.7-1.4
	Endangered Species Survey	An Endangered Species Survey may be required to assess the presence, populations, and distribution of endangered, threatened, and candidate species or designated critical habitat; such studies may include long-term monitoring and development of mitigation plans	1-6 months	0.8-1.5
	Biological Assessment/ Biological Opinion	A Biological Assessment may have to be prepared if it appears that a threatened or endangered species may be affected by a project; a Biological Opinion may have to be issued	1-6 months	0.6-1.2
	Floodplain Delineation and Analysis	Floodplain limits may have to be investigated when the reliability of existing data may be questionable; other analyses may also be required to determine specific floodplain impacts and mitigations	1-2 months	0.7-1.5
	Cultural Resource Study	A Cultural Resources Study may be required involving the inventory and assessment of potential risks and impacts of a proposed project or plan to historical, architectural, archeological, and cultural resources	1-3 months	0.8-1.5
	Noise Analysis	A noise analysis may be required to assess existing noise conditions within a project (or potentially affected) area and to predict, model, or monitor the effects of project-related noise impacts; such studies may include long-term monitoring and development of noise mitigation plans	1-3 months	0.8-1.5
	Environmental Justice Study	An environmental justice study may be required to determine if there is a disproportionately high and adverse environmental burden to minority and low-income populations; such studies may include development of mitigation plans	1-3 months	0.8-1.6

R&D Project WBS 'Lessons Learned'

- Understand Project Technical Objectives, Risks, Budget and Sensitivities as early as possible
- Spend as much time as necessary to get the right level WBS in place
- Environmental Cost Impacts can exist throughout the System Life Cycle and across many WBS elements
- Complexities of Project and impacts to Budget are not known a priori (but trying to be Omniscient helps!)
- Be mindful of 'products' from each WBS Element and what other WBS Elements depend on them
- Many transportation-related projects present a major challenge in developing a comprehensive WBS

Dilbert “Estimating Cost”



This happens more often than you realize!

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- Certified Cost Estimator/Cost Analyst (SCEA)
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BACK-UPS

The Department of Homeland Security (DHS) has a whole range of projects for protecting critical infrastructure and the US from dangerous goods. DHS uses qualitative and quantitative based analyses to determine the resource allocation needed for meeting the most significant threats, vulnerabilities, and potential consequences. Many DHS projects involve state-of-the-art technologies for end-user applications with many schedule, cost, and statute constraints. One constraint involves identifying and estimating the magnitude of the impacts, if any, to the environment. An Environmental Impact Statement (EIS) or Environmental Assessment (EA) is often required as part of the project approval decision process. An EIS or EA is in itself a schedule and cost resource in which its cost should also be part of the system or capability assessment of alternatives methodology.

As such, it is very important to formulate a comprehensive Work Breakdown Structure (WBS) that addresses the engineering and environmental issues, since both are relevant to formulating complete LCC estimates for a new system or capability alternative being considered for implementation. Summit Engineering Group (SEG) performed these kinds of analyses on several DHS projects for protecting commercial aircraft from missiles using on-board and on-airport approaches.

Airports and airlines using various airports have to address environmental issues (sometimes different sides of the problem) and thus require a reasonable WBS-based construct for determining viable 'engineering' solutions and the most the cost-effective alternative, all capturing applicable environmental impacts. SEG will address the WBS construct itself in its presentation.

Example WBS for Production

2	Program X Production WBS
2.1	PROGRAM MANAGEMENT (PM)
2.1.1	EXECUTIVE LEADERSHIP & ST
2.1.2	DATA MANAGEMENT (DM)
2.1.3	QUALITY ASSURANCE (QA)
2.1.4	BUSINESS OPERATION INTEGRATION
2.1.5	CONTRACT MANAGEMENT TEAM
2.1.6	SUBCONTRACTS MANAGEMENT TEAM
2.1.7	PROGRAM PLANNING
2.2	SYSTEMS ENGINEERING (SE)
2.2.1	SEIT MANAGEMENT
2.2.2	SYSTEM ENGINEERING
2.2.2.1	SYSTEMS ENGINEERING STAFF
2.2.2.1	REQUIREMENT ANALYSIS & VERIFICATION
2.2.2.2	MODELING & SIMULATION (RESERVED)
2.2.2.3	RELIABILITY, AVAILABILITY, & MAINTAINABILITY
2.2.2.4	OTHER UTILITIES
2.2.2.4.1	SAFETY PROGRAM
2.2.2.4.2	ENVIRONMENTAL COMPLIANCE
2.2.2.4.3	HAZARDOUS MATERIAL PROGRAM
2.2.2.4.5	PROBABILITY ENGINEERING
2.2.2.5	LIFE CYCLE COST (LCC)
2.2.3	SYSTEM INTEGRATION
2.2.3.1	SYSTEM INTEGRATION & VERIFICATION
2.2.3.2	INTERFACE MANAGEMENT
2.2.3.3	SYSTEM ARCHITECTURE (RESERVED)
2.2.3.4	HMI ARCHITECTURE (RESERVED)
2.2.4	SYSTEM TEST
2.2.4.1	TEST PLANNING
2.2.4.2	TEST ENGINEERING
2.2.4.3	MDT STAGE
2.2.5	CONFIGURATION MANAGEMENT
2.2.6	RISK MANAGEMENT
2.2.7	MDT SE
2.2.8	MDT SUPPORTABILITY
2.3	CTI
2.3.1	ENGAGEMENT CONTROLLER ASSEMBLY (ECS)
2.3.1.1	ENGAGE & EXEC PROCESSOR
2.3.1.2	ECS PROCESSOR SOFTWARE
2.3.1.2.1	ENGAGEMENT MANAGEMENT SW
2.3.1.2.2	OBJECT TRACK & DISCRIMINATION SW
2.3.1.2.3	MISSION REPORTING SW
2.3.1.2.4	C2 ENGAGEMENT SIMULATION
2.3.2	OPERATOR STATION SUBSYSTEM
2.3.2.1	OSS ELECTRONICS HARDWARE
2.3.2.2	SOFTWARE
2.3.2.2.1	OSS SW DISPLAY CONTROL
2.3.2.2.2	OSS SW SIMULATION
2.3.2.2.3	COMMAND POST SIMULATION SW
2.3.3	COMMUNICATIONS
2.3.3.1	TOWER/STRUCTURE
2.3.3.2	MICROWAVE SERVICES
2.3.3.3	COMMUNICATIONS HW
2.3.3.4	FCC FREQUENCY COORDINATION
2.3.3.5	COMM LICENSES (I.E. VX WORKS OS)
2.3.4	NATIONAL OP CENTER CONTROL

2.3.4.1	COMPUTING AND DISPLAY HW
2.3.4.2	SYSTEM MANAGEMENT SW
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2.4.1	MANAGEMENT / SEIT
2.4.1.1	WIPT MANAGEMENT
2.4.1.2	SYSTEMS ENGINEERING/SEIT
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2.4.2	CENTRAL PROCESSOR SUBSYSTEM (CPS)
2.4.2.1	EFFECTOR EXEC CONTROLLER
2.4.2.1.1	GBL SW EXEC SERVICES
2.4.2.1.2	GBL SW MISSION SIMULATION
2.4.2.1.3	GBL SW MAINTENANCE & DIAGNOSTICS
2.4.2.1.4	GBL SW LOGGING SERVICES
2.4.2.1.5	GBL SW COMM
2.4.2.2	LGGS CONTROLLER ASSEMBLY
2.4.2.2.1	LASER CONTROLLER PROCESSOR
2.4.2.2.2	SOFTWARE
2.4.2.2.2.1	PLAN & CONTROL LASER SW
2.4.2.2.2.2	LASER SIMULATIONS SW
2.4.2.3	BCS CONTROLLER ASSEMBLY
2.4.2.3.1	PROCESSOR HARDWARE
2.4.2.3.1.1	OBCS CONTROLLER PROCESSOR
2.4.2.3.1.2	BASC CONTROLLER PROCESSOR
2.4.2.3.1.3	BWCS CONTROLLER PROCESSOR
2.4.2.3.1.4	HRSP CONTROLLER PROCESSOR
2.4.2.3.2	SOFTWARE
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2.4.2.3.2.4	HRSP SHARED (APERTURE) SW
2.4.2.3.2.5	HRSP OFF (AXIS) SW
2.4.2.3.2.6	INERTIAL PLTFM CONT&GE-LO
2.4.2.3.2.7	OBCS RELATED SIMULATIONS
2.4.2.4	RESEARVED
2.4.2.5	CPS INTEGRATION, ASSEMBLY, & TEST (IA&T)
2.4.2.6	CPS MGMT & SYS ENG
2.4.2.6.1	ST CPS MGMT & SYS ENG
2.4.2.6.2	MS CPS MGMT & SYS ENG
2.4.3	BEAM CONTROL SUBSYSTEM (BCS)
2.4.3.0	BCS MANAGEMENT & SYSTEM
2.4.3.1	HIGH POWER OPTICS ASSEMBLY (HPOA)
2.4.3.2	BEAM DIRECTOR ASSEMBLY (BDA)
2.4.3.3	ACQUISITION & TRACK ASSEMBLY (ATA)
2.4.3.4	STRUCTURAL SUPPORT ASSEMBLY (SSA)
2.4.3.5	VIBRATION ISOLATION ASSEMBLY (VIA)
2.4.3.6	BEAM ALIGNMENT & STABILIZATION ASSEMBLY (BASA)
2.4.3.7	OPTICAL DIAGNOSTIC ASSEMBLY
2.4.3.8	BCS ANCILLARY EQUIPMENT
2.4.3.9	BCS INTEGRATION
2.4.4	LASER GAIN GENERATOR SUBSYSTEM (LGGS)
2.4.4.0	LGGS PM, SE & DESIGN (RESERVED)
2.4.4.1	GAIN GENERATOR ASSEMBLY (GGA)
2.4.4.2	RESEARVED
2.4.4.3	PRESSURE RECOVERY ASSEMBLY (PRA)

2.4.4.4	GAS MANIFOLD ASSEMBLY (GMA)
2.4.4.5	LGGS SUPPORT STRUCTURE
2.4.4.6	LGGS INTEGRATION
2.4.5	AUXILIARY EQUIPMENT SUBSYSTEM
2.4.5.0	ETS DESIGN
2.4.5.1	CONTAINER PROCUREMENT/FABRICATION, & INTEGRATION
2.4.5.2	ANCILLARY EQUIPMENT
2.4.5.3	RESEARVED
2.4.5.4	RESEARVED
2.4.5.5	ETS DATA CABLES
2.4.A	SYSTEM INTEGRATION
2.4.A.2	SYSTEM INEGRATION
2.5	FLUID SUPPLY SUBSYSTEM (FSS)
2.5.1	FSE MANAGEMENT/SEIT (RESERVED)
2.5.2	ISO CONTAINER SUBSYSTEM
2.5.3	FUEL STORAGE SUBSYSTEM
2.5.3.1	TANKS
2.5.3.2	MOUNTING STRUCTURES
2.5.4	FLOW CONTROL SUBSYSTEM
2.5.4.1	FLOW CONTROL VALVES
2.5.4.2	FIRE VALVES
2.5.4.3	LASER FLOW CONTROL
2.5.4.3.1	LASER FLOW CONTROL PROCESSOR
2.5.4.4	FLUX FLOW CONTROL VALVE ASSEMBLY/FL
2.5.5	RESEARVED
2.5.6	FSS INTEGRATION
2.6	MDT SUBSYSTEM HARDWARE
2.7	INITIAL SPARES
2.8	FACILITIES
2.8.1	LOGISTICS FACILITY
2.8.1.1	LOGISTICS BUILDING CONSTRUCTION COST
2.8.2	EMPLACEMENT SITES
2.8.2.1	LASER EMPLACEMENT SITE LAND LEASE FOR CONSTRUCTION
2.8.2.2	LASER EMPLACEMENT SITE CONSTRUCTION
2.8.2.3	MDT EMPLACEMENT SITE TOWER LEASE
2.8.2.4	LASER EMPLACEMENT SITE PHYSICAL SECURITY
2.8.3	OPERATIONS CENTER
2.8.3.1	OPERATIONS CENTER LAND LEASE FOR CONSTRUCTION
2.8.3.2	DOC CONSTRUCTION
2.8.4	LOCAL SUPPORT DEPOT
2.8.4.1	LOCAL SUPPORT DEPOT LAND LEASE FOR CONSTRUCTION
2.8.4.2	LOCAL SUPPORT DEPOT CONSTRUCTION
2.9	DEPLOYMENT & INSTALLATION
2.9.1	LAC&X DEPLOYMENT & INSTALLATION COST
2.9.1.1	PACKAGING
2.9.1.2	TRANSPORTATION
2.9.1.3	REASSEMBLY
2.9.1.4	CERTIFICATION TEST
2.9.2	MDT DEPLOYMENT & INSTALLATION COST
2.10	MDT OTHER GOV COSTS
2.11	MDT SUPPORT FROM OTHER GOV ORGANIZATIONS

= Environmental Impact Area

Example WBS for O&S/Disposal

3	Program X O&S WBS
3.1	MISSION PERSONNEL
3.1.1	OPERATIONS
3.1.1.1	OPERATIONS STAFF
3.1.1.2	FAA CONTROL TOWER PERSONNEL (RESERVED)
3.1.1.3	AIRPORT SECURITY PERSONNEL (RESERVED)
3.1.2	MAINTENANCE
3.1.2.1	MATERIAL COSTS
3.1.2.1.1	COMM MAINTENANCE MATERIAL COSTS
3.1.2.1.2	LASER MAINTENANCE MATERIAL COSTS
3.1.2.2	LABOR COSTS
3.1.2.2.1	COMM MAINTENANCE STAFF
3.1.2.2.2	LASER MAINTENANCE STAFF
3.1.3	IMPACT OF HAVING A SYSTEM DOWN (RESERVED)
3.1.4	SUPPLY SUPPORT
3.1.4.1	FACILITIES MANAGEMENT
3.1.4.2	INVENTORY MANAGEMENT
3.1.5	MDT PERSONNEL
3.2	UNIT LEVEL CONSUMPTION
3.2.1	FIRE UNIT
3.2.1.1	REACTANT COSTS
3.2.1.2	LASER ELECTRICITY COSTS (VACUUM PUMPS / BACKUP GENERATORS / C2 ELECTRONICS)
3.2.1.3	HEAT EXCHANGER WATER
3.2.1.4	BACKUP GENERATOR DIESEL
3.2.1.5	SCRUBBER MATERIAL (reserved)
3.2.2	MDT UNIT
3.2.2.1	MDT UNIT LEVEL CONSUMPTION
3.3	CONTRACTOR SUPPORT
3.3.1	MAINTENANCE & REPAIR (RESERVED)
3.3.2	REPLENISHMENT SPARES
3.3.3	MDT CONTRACTOR SUPPORT
3.4	SUSTAINING SUPPORT
3.4.1	TEST/SUPPORT EQUIPMENT (TE/SE) REPLACEMENT/MAINTENANCE
3.4.2	MODIFICATION PROCUREMENT (RESERVED)
3.4.3	SOFTWARE MAINTENANCE
3.4.4	SYSTEM ENGINEERING AND PROGRAM MANAGEMENT
3.4.4.1	PROGRAM MANAGEMENT
3.4.4.1.1	CONTRACTORS PROGRAM OFFICE

3.4.4.1.2	CONTRACTOR PROGRAM OFFICE BUDGETING AND FINANCIAL CONTROL
3.4.4.1.3	CONTRACTOR PROGRAM OFFICE PROCUREMENT AND SUBCONTRACTING
3.4.4.1.4	TOTAL OWNERSHIP COST ANALYSIS
3.4.4.1.5	SECURITY MANAGEMENT
3.4.4.2	SYSTEMS ENGINEERING
3.4.4.2.1	TECHNICAL SUPPORT
3.4.4.2.1.1	ARCHITECTURAL TECHNICAL SUPPORT
3.4.4.2.1.2	BCS TECHNICAL SUPPORT
3.4.4.2.1.3	C31 TECHNICAL SUPPORT
3.4.4.2.1.4	LASER TECHNICAL SUPPORT
3.4.4.2.2	SYSTEMS ENGINEERING EFFECTIVENESS MODELING AND SIMULATION
3.4.4.2.3	CONFIGURATION MANAGEMENT
3.4.4.2.4	RISK MANAGEMENT
3.4.5	SUPPORTABILITY
3.4.5.1	RELIABILITY/MAINTAINABILITY SUPPORTABILITY
3.4.5.2	SAFETY AND HEALTH HAZARDS
3.4.6	LASER SITE PERMITTING FEES
3.4.7	MDT SUSTAINING SUPPORT
3.5	INDIRECT
3.5.1	PERSONNEL SUPPORT
3.5.1.1	INITIAL TRAINING (NOT COVERED IN RDT&E)
3.5.1.1.1	OPERATOR TRAINING
3.5.1.1.2	MAINTENANCE TRAINING
3.5.1.1.3	SUPPLY SUPPORT TRAINING
3.5.1.2	TRAINING (FOLLOW-ON)
3.5.1.2.1	OPERATOR TRAINING
3.5.1.2.2	MAINTENANCE TRAINING
3.5.1.2.3	SUPPLY SUPPORT TRAINING
3.5.2	MDT INDIRECT
3.6	FACILITIES
3.6.1	EMPLACEMENT SITES
3.6.1.1	LASER EMPLACEMENT SITE LAND LEASE COST
3.6.1.2	MDT EMPLACEMENT SITE TOWER LEASE COST
3.6.2	DEPOT
3.6.2.1	DEPOT BUILDING LAND LEASE COST
3.6.3	NATIONAL OPS CENTER
3.6.3.1	NATIONAL OPS BUILDING LAND LEASE COST
3.7	MDT OTHER GOV COSTS

4	Program X Disposal WBS
4.1	DEPLOYED HARDWARE REMOVAL
4.1.1	SCRUBBER MATERIAL REMOVAL
4.1.2	EMPLACEMENT SITE DEMOLITION
4.1.3	MDT REMOVAL / DISPOSAL

= Environmental Impact Area

Environmental Cost Impact Examples to Consider in WBS (Cont'd)

Phase	Tasks/Environmental Items	Requirements	Duration	Person-Months	
Review and Assessment (continued)	Social Impact Assessment	A Social Impact Assessment may be required to assess impacts on the day-to-day quality of life of affected persons and communities; such studies may include development of mitigation plans	1-3 months	1.0-2.5	
	Traffic Analysis	A traffic analysis may be required to assess existing traffic conditions and to evaluate effects of project-related traffic impacts; such studies may include monitoring and development of traffic mitigation plans	1-3 months	1.0-2.5	
	Visual Impact Analysis	A visual impact analysis may be required to evaluate the suitability and compatibility of project components	1-3 months	1.0-2.0	
	Land Use Study	A land use study may be required to evaluate the suitability and compatibility of project components	1-3 months	1.2-2.5	
	Water Quality Study	A Water Quality Study may be required to assess water quality in the area of a proposed project and potential effects resulting from project activities; such studies may include long-term or continuous monitoring and development of mitigation and water quality protection plans	1-3 months	1.2-3.0	
	Wetland Delineation and Analysis	A Wetland Delineation and Analysis may be required to identify the locations and edges of wetlands, assess wetland values and impacts, and develop mitigation plans	1-3 months	1.0-2.6	
	<i>Environmental Due Diligence Audit (EDDA) Process</i>				
	Phase I	Prepare a Phase I Liability Assessment for every property acquired	1-3 months	0.8-2.0	
	Stormwater - National Pollutant Discharge Elimination System (NPDES) Construction Permit	If VE APS facility construction requires a land disturbance of one acre or more, a permit will be filed under the NPDES storm water program (likely with state)	2 months	1.0-3.0	
Stormwater or Erosion Control - possible local or regional permits	There may be regional or local stormwater or erosion control permitting that could be required	1-3 months	1.0-2.5		

Environmental Cost Impact Examples to Consider in WBS (Cont'd)

Phase	Tasks/Environmental Items	Requirements	Duration	Person-Months
Permitting and Approvals for Deployment	Dewatering - NPDES Permit for Construction Dewatering	Depending on the depth to groundwater and whether dewatering activities are anticipated, a NPDES Construction Dewatering Permit may be required (likely through state)	2 months	1.0-2.5
	Dewatering - possible local or regional permits	There may be regional or local dewatering permitting that could be required	1-3 months	1.5-2.5
	Clean Air Act Permitting	Must be reviewed for consistency with state of federal implementation plans; also must be evaluated for applicability and conformance with the General Conformity Rule	2-6 months	0.8-2.0
	Clean Water Act: Section 404 Permit	If project would result in the discharge of dredged or fill material into waters of the U.S. or wetlands, then a Section 404 permit may have to be obtained from the ACOE or state	2-6 months	1.5-4.0
	Clean Water Act: Section 401 Water Quality Certificate	If a NPDES or a Section 404 permit is required, a water quality certificate (WQC) may be required from the state to comply with Section 401 of the Clean Water Act	2-6 months	1.4-5.0
	Other state, regional or local wetlands requirements	In addition to the Section 404/Section 401 permitting processes, there may be additional wetland permitting or review requirements	1-3 months	1.5-3.0
	Section 10 of the Rivers and Harbors Act	If there will be construction of any structure in or over any navigable water of the U.S. with the potential to affect the course, location, condition, or capacity of the water body, authorization would be required from the ACOE under Section 10 of the Rivers and Harbors Act; this may be incorporated into the Section 404 permit, if applicable	2-6 months	1.0-4.0
	Hazardous Substances and Materials	If it there will be generation, transport/transfer, or storage of hazardous substances/materials (including fuel storage tanks and oil products), the state environmental departments or regional authorities should be consulted regarding regulatory, reporting, or permitting requirements (may involve RCRA, CERCLA, EPCRA, or SPCC)	1-2 months	1.0-3.0
	Coastal Zone Management Consistency Review	If sites are within a coastal area where the state has an approved coastal zone management (CZM) program, the project may have to undergo a CZM consistency review	2-3 months	0.8-1.7
	Coastal Barriers Resources Act Exemption	If sites occur on land within the Coastal Barriers Resources Act (CBRA) system, the action must receive an FWS exemption from the provisions of the CBRA	2-3 months	0.8-1.7
	Section 7 of the Wild and Scenic Rivers Act	If sites are near designated or study rivers under Section 7 of the Wild and Scenic Rivers Act, a determination must be obtained from the appropriate agencies	1-2 months	0.6-1.3
	Floodplains	Individual state or regional authorities should be consulted for floodplain implications and review or permitting requirements	2-4 months	0.7-2.3

Environmental Cost Impact Examples to Consider in WBS (Cont'd)

Phase	Tasks/Environmental Items	Requirements	Duration	Person-Months
Permitting and Approvals for Deployment (continued)	Farmland Protection Policy Act (FPPA)	If sites have the potential to affect FPPA-regulated farmland, coordination is required with the USDA NRCS regarding consistency with the FPPA	3-9 months	0.7-6.0
	Migratory Bird Treaty Act	If sites may result in harm to migratory birds, their eggs or nests, a special permit would be required from the Secretary of the Interior	3-6 months	0.8-4.0
	Section 1424(e) of the Safe Drinking Water Act	If project may result in the contamination of an aquifer designated by the EPA as a sole or principal drinking water resource for the area, the EPA should be consulted to determine any applicable permitting or mitigation requirements	2-4 months	0.6-2.2
	Historic and Archeological	The State Historic Preservation Officer (SHPO) should be consulted for each site regarding potential concerns, reviews, or approvals required pertaining to historic, archeological, and cultural resources	2-6 months	0.6-1.8
	Non-Hazardous Waste	Non-hazardous solid waste requirements vary from state to state; therefore, the state environmental department or regional authorities should be consulted for applicability and associated requirements	1-4 months	1.2-3.0
	Wildlife, Other	As needed, authorities should be consulted regarding other wildlife statutes which may apply to the project	1-4 months	0.6-3.0