Designation: ~~E2150 – 09~~ E2150 – 13

Standard Classification for Life-Cycle Environmental Work Elements—Environmental Cost Element Structure[1]

This standard is issued under the fixed designation E2150; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This standard establishes a classification of the comprehensive hierarchical list of elements for life-cycle environmental work. The classification is based on the Interagency Environmental Cost Element Structure (ECES).[2] Elements, as defined here, are major components common to environmental projects.[3] The elements represent the life-cycle activities for environmental projects regardless of the project design specification, construction method, technology type, or materials used. The classification serves as a consistent reference for cost estimating, analysis, and monitoring during the various phases of the project life cycle. Using ECES ensures consistency, over time and from project to project, in the cost management and performance measurement of environmental projects. It also enhances reporting at all phases of a project, from assessment and studies through design, construction, operations and maintenance (O&M), and surveillance and long-term monitoring (SLTM).

1.2 This classification applies to all environmental work, including environmental restoration, waste management, decontamination and decommissioning (D&D), surveillance and long-term monitoring, and technology development.

1.3 The use of this classification increases the level of standardization, uniformity, and consistency of collected environmental project costs. Such uniformity and standardization allows for ease of understanding project costs, provides a common "cost language" for sharing and comparing cost information, and allows for easier analysis and calibration of cost data. This standard classification can be used as a checklist of activities to be completed in environmental projects.

1.4 Guide E2637 is intended to facilitate the application of the ECES to any environmental remediation project, without regard to project size.

2. Referenced Documents

2.1 *ASTM Standards:*[4]

E631 Terminology of Building Constructions

E833 Terminology of Building Economics

E2637 Guide for Utilizing the Environmental Cost Element Structure Presented by Classification E2150

2.2 *ASTM Adjunct:*[5]

Adjunct E2150 ~~Environmental Cost Element Structure at Levels 3, 4, and 5 and Definitions,~~Adjunct to ~~ASTM Standard~~ Classification E2150~~, Standard Classification for Life-Cycle Environmental Work Elements—Environmental~~ : Environmental Cost Element Structure at Levels 3, 4, and 5 and Definitions

3. Terminology

3.1 *Definitions*—For ~~definition~~definitions of general terms used in this classification, refer to Terminology E631, and for general terms related to building economics, refer to Terminology E833.

3.1.1 *Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)*—Also known as "Superfund," CERCLA prescribes actions, and regulatory requirements for reducing risks to human health and the environment resulting from releases or threatened releases of hazardous substances into the environment.

---

[1] This classification is under the jurisdiction of ASTM Committee E06 on Performance of Buildings and is the direct responsibility of Subcommittee E06.81 on Building Economics.

Current edition approved ~~April 1, 2009~~Sept. 1, 2013. Published ~~November 2009~~October 2013. Originally approved in 2001. Last previous edition approved in ~~2004~~2009 as ~~E2150 – 04.~~E2150 – 09. DOI: ~~10.1520/E2150-09.~~10.1520/E2150-13.

[2] ECES was developed by the Interagency Environmental Cost Engineering Committee to increase effectiveness of cost management for federal environmental projects.

[3] The use of the term "cost element" in Classification E2150 differs from that within the UNIFORMAT II family of standards.

[4] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[5] Available from ASTM International Headquarters. Order Adjunct No. ADJE2150A. Original adjunct produced in 2002. Adjunct last revised in 2009.

3.1.2 *Resource Conservation and Recovery Act (RCRA)*—A congressional mandate that requires the management of regulated hazardous waste and requires that permits be obtained for facilities (both private and public) that treat, store, or dispose of hazardous waste.

3.1.2.1 *Discussion*—

RCRA also establishes standards for these facilities and requires corrective actions (for example, remediation) of past releases of hazardous waste from regulated waste management units.

3.2 *Acronyms:*

3.2.1 *AST*—Aboveground Storage Tank

3.2.2 *CERCLA*—Comprehensive Environmental Response, Compensation, and Liability Act

3.2.3 *CLP*—Certified Laboratory Procedure

3.2.4 *CMS*—Corrective Measure Study

3.2.5 *COA*—Code of Accounts

3.2.6 *CWM*—Chemical Warfare Materials

3.2.7 *D&D*—Decontamination and Decommissioning

3.2.8 *DOE*—Department of Energy

3.2.9 *(EC)*^{2}—Environmental Cost Engineering Committee

3.2.10 *ECAS*—Environmental Cost Analysis System

3.2.11 *ECES*—Environmental Cost Element Structure

3.2.12 *EM*—Environmental Management

3.2.13 *EPA*—Environmental Protection Agency

3.2.14 *ER*—Environmental Restoration

3.2.15 *FRTR*—Federal Remediation Technologies Roundtable

3.2.16 *FS*—Feasibility Study

3.2.17 *HRS*—Hazard Ranking System

3.2.18 *HTRW*—Hazardous, Toxic, and Radioactive Waste

3.2.19 *LTSM*—Long-Term Surveillance and Maintenance

3.2.20 *O&M*—Operations and Maintenance

3.2.21 *OECD*—Organization of Economic Cooperation and Development

3.2.22 *PA/SI*—Preliminary Assessment/Site Investigation

3.2.23 *RA*—Remedial Action

3.2.24 *RACER*—Remedial Action Cost Estimating Requirement (System)

3.2.25 *RCRA*—Resource Conservation and Recovery Act

3.2.26 *RD*—Remedial Design

3.2.27 *RFA*—RCRA Facility Assessment

3.2.28 *RFI*—RCRA Facility Investigation

3.2.29 *RI*—Remedial Investigation

3.2.30 *SLTM*—Surveillance and Long-Term Monitoring

3.2.31 *S&M*—Surveillance and Maintenance

3.2.32 *SM&A*—Sampling, Monitoring, and Analysis

3.2.33 *USACE*—U.S. Army Corps of Engineers

3.2.34 *UST*—Underground Storage Tank

3.2.35 *WBS*—Work Breakdown Structure

3.2.36 *WM*—Waste Management

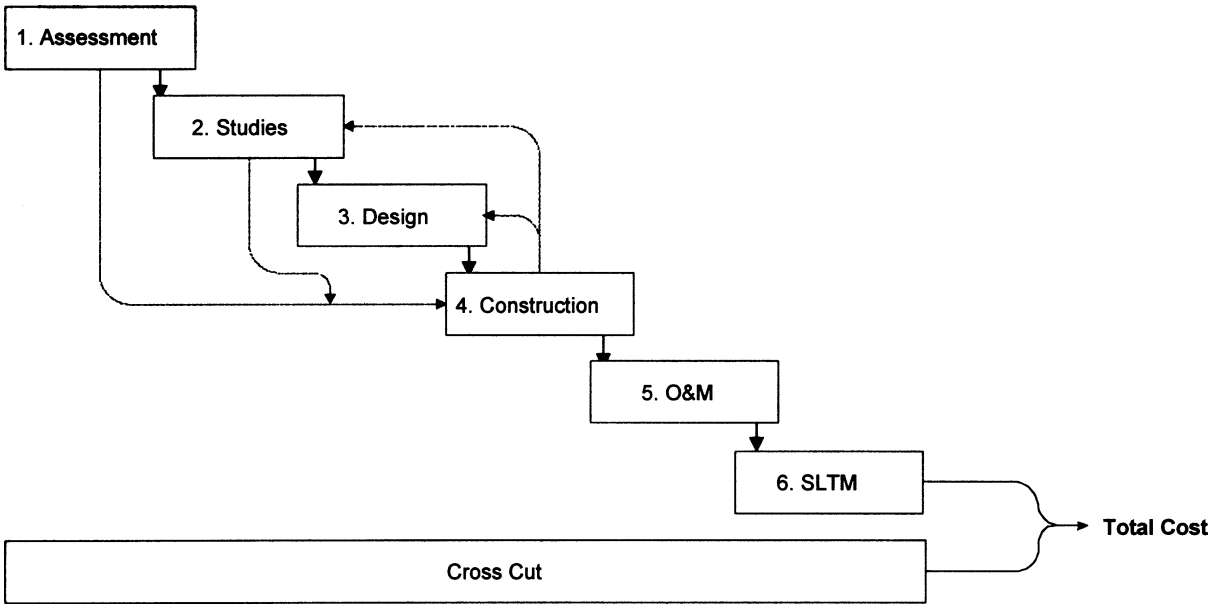

FIG. 1 Level 1 Life-Cycle Phases

4. Significance and Use

4.1 This classification identifies and hierarchically arranges the work elements, activities, and tasks required for environmental projects. This classification increases the level of communication and allows for more effective exchange of cost and performance data between environmental projects.

4.2 This classification defines environmental work elements as major components of environmental projects. It is the common thread linking activities and participants in an environmental project from initial planning through operations and maintenance, D&D, and SLTM.

4.3 The users of ECES include program and project managers, cost estimators, and cost analysts in both the public and private sector.

4.4 This classification uses an increased level of standardization, uniformity, and consistency that provides a common basis for comparing, analyzing, and calibrating cost data. This classification can also be used as a checklist of project activities to be completed.

4.5 Use this classification when:

4.5.1 Developing a company-specific Code of Accounts (COAs) for capturing and reporting cost early in the project development for more effective project controls and management. COA is a logical breakdown of a project into controllable elements for the purpose of cost collection, control, and reporting. COA is organized at lower detailed levels that summarize to higher levels and is company or site, or both, and project-specific.

4.5.2 Developing a work breakdown structure (WBS) early in the project development for proper management of the project. The WBS provides a framework for managing the cost, schedule, and performance objectives of a project. This framework allows the project to be separated into logical components and makes the relationship of the components clear. The WBS defines the project in terms of hierarchically related action and product-oriented elements. Each element provides logical summary points for assessing technical accomplishments and for measuring cost and schedule performance.

4.5.3 Supporting programs and project functions. Use ECES for bid solicitation, collection, and evaluation; communicating project data between installations or agencies and industry; cost and schedule estimating; historical cost and schedule data collection; historical project data collection for technology deployments and project conditions; validating and calibrating cost estimates and software tools; and establishing and disseminating best practices and lessons learned.

4.6 The hierarchical nature of the classification allows for collecting data using more detailed lower level elements or for summarizing data at higher levels.

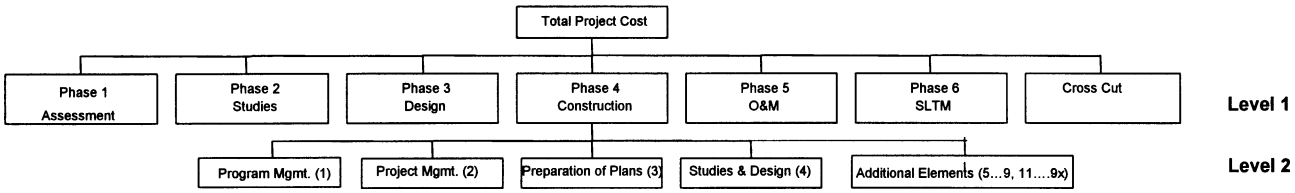

FIG. 2 Hierarchical Organization of ECES Classification Standard

4.7 ECES, as described in this classification, is being included in the Remedial Action Cost Estimating Requirement (RACER)[6] system and the Environmental Cost Analysis System (ECAS).[7] RACER is used for estimating cost and ECAS is used to collect, maintain, and analyze the cost of completed projects. Federal agencies performing environmental work intend to incorporate the ECES.

5. Basis of Classification

5.1 In environmental management work, the life cycle of the project is represented by six different regulatory phases. With minor variations in the definitions, these life-cycle phases apply to most or all environmental projects including environmental restoration, waste management, decontamination and decommissioning, ordnance and explosive retrievals, underground storage tanks (USTs), and aboveground storage tanks (ASTs). In addition to the six regulatory life-cycle phases, a Cross Cut cost category was added to address costs not attributable to a particular phase or to a specific project. Fig. 1 shows the life-cycle nature of environmental phases. As can be seen from Fig. 1, the phases may not be linear and their sequencing may be iterative since results from one phase may require the execution of earlier phases again, to meet the regulatory requirement. Additional information on each of the six Level 1 phases is provided in Fig. X1.1 of Appendix X1. The six regulatory life-cycle phases are Phase 1 (Assessment), Phase 2 (Studies), Phase 3 (Design), Phase 4 (Construction), Phase 5 (Operations and Maintenance), and Phase 6 (Surveillance and Long-Term Monitoring). Cross Cut covers all phases of the lifecycle.

5.2 Whereas Level 1 depicts the life-cycle phases or timeframe of environmental work, Level 2 of the classification represents the major work elements that need to be performed in an environmental project. There are thirty-four major work elements included in Level 2 of the classification. In addition, there is an "Other," element available for those unique or special tasks that cannot be described closely by available elements. "Other" elements are designated by .9x numbering system. For the purposes of this standard, only two levels are discussed, but more detailed levels are available. Fig. 2 illustrates a sample Level 2 for the Construction phase. Fig. 3 represents a matrix of the Level 1 elements and how they apply to each of the Level 2 categories. Phases 1–6 are listed by their phase number. The cross cut category is listed as "X."

5.3 As seen from Fig. 3, the columns on the left-hand side have been reserved for Level 1 life-cycle phases. The numbers in these columns provide a general guidance on the applicability of that phase to the Level 2 major work elements that are shown in the two columns under the Major Work Elements heading. For example, the Level 2 element, Preparation of Plans, is marked with numbers 1, 2, 3, 4, 5, and 6 in the left-hand columns. This means that this element can be applied or conducted during Phases 1–6. If any of the numbered rows under the column entitled Cross Cut is marked with letter "X," then that element is cross-cutting and the costs apply to more than one phase. The numbers are not necessarily all inclusive or definitive. There may be cases where an element may be applicable to a phase that is not marked or may be marked and not applicable for that specific project. This structure is flexible, and the user can use other phases even though they are not marked in the columns.

5.4 Positioned between the Cross Cut column and Level 2 is the Sub-Project Identifier that uses the alphabetical designations from a to z. The purpose of the Sub-Project Identifier is to allow users to differentiate between similar tasks that have the same designation number. For example, there may be two different Disposal Facility/Process, 4.13 (Level 1—Phase 4 and Level 2—element .13) to be constructed. To distinguish the first facility from the second, the letters "a" and "b" (that is, "4.a .13" and "4.b .13") could be used to designate the first and second facility respectively. The use of the Sub-Project Identifier is not typical in many environmental projects, but it is included to provide flexibility to the structure.

6. Description of Environmental Cost Elements

6.1 The following describes the Level 1 phases. These descriptions outline what elements are generally included and, as appropriate, provide guidelines on what is not included. Generic definitions of the phases are included as are more specific application of the life-cycle phases to various types of environmental projects. Additional information on each of the six Level 1 phases is provided in Fig. X1.1 of Appendix X1.

6.1.1 Below is a generic definition of Level 1 phases.

6.1.1.1 *Phase 1: Assessment*—Assess and inspect site and prepare site inspection reports.

[6] RACER is a parametric cost estimating tool for environmental projects.

[7] ECAS ~~is being~~ was developed by U.S. Department of Energy and is being used to capture ~~cost~~ the costs of completed environmental projects. Please contact ~~Bryan Skokan at 301-903-7612 for more~~Allen Moe at 513–246–0230 or Kevin Barry at 513–246–1371 for further information.

Level 1								Level 2	
Ph 1 (1)	Ph 2 (2)	Ph 3 (3)	Ph 4 (4)	Ph 5 (5)	Ph 6 (6)	Cross Cut (X)	Sub. Proj.	Major Work Elements	
1	2	3	4	5	6	X		.01	PROGRAM MANAGEMENT, SUPPORT & INFRASTRUCTURE (Optional -Installation/Complex Wide Activities)
1	2	3	4	5	6	X		.02	PROJECT MANAGEMENT & SUPPORT (Operable Unit/Solid Waste Management Unit)
1	2	3	4	5	6	X		.03	PREPARATION OF PLANS
1	2	3	4	5	6			.04	STUDIES/DESIGN & DOCUMENTATION
1	2	3	4	5	6	X		.05	SITE WORK
1	2	3	4	5	6	X		.06	SURVEILLANCE & MAINTENANCE
1	2	3	4	5	6	X		.07	INVESTIGATIONS & MONITORING/SAMPLE COLLECTION
1	2	3	4	5	6	X		.08	SAMPLE ANALYSIS
1	2	3	4	5	6	X		.09	SAMPLE MANAGEMENT/DATA VALIDATION/DATA EVALUATION
	2	3						.10	TREATABILITY/RESEARCH & DEVELOPMENT
			4	5				.11	TREATMENT PLANT FACILITY/PROCESS
			4	5	6			.12	STORAGE FACILITY/PROCESS
			4	5	6			.13	DISPOSAL FACILITY/PROCESS
			4					.14	ORDNANCE & EXPLOSIVES REMOVAL & DESTRUCTION (CWM is included in Treatment Plant/Facilities WBS X.11 & Technologies WBS X.20-X.30)
			4		6			.15	DRUMS/TANKS/STRUCTURES/MISC. & REMOVAL
			4	5	6			.16	AIR POLLUTION/GAS COLLECTION & CONTROL
			4	5	6			.17	SURFACE WATER/SEDIMENTS CONTAINMENT, COLLECTION, OR CONTROL
			4	5	6			.18	GROUNDWATER CONTAINMENT, COLLECTION, OR CONTROL
			4	5	6			.19	SOLIDS/SOILS CONTAINMENT (e.g., CAPPING/BARRIER) COLLECTION, OR CONTROL
			4	5				.20	LIQUIDS WASTE/SLUDGES (e.g., UST/AST) COLLECTION AND CONTAINMENT
			4	5				.21	IN SITU BIOLOGICAL TREATMENT
			4	5				.22	EX SITU BIOLOGICAL TREATMENT
			4	5				.23	IN SITU CHEMICAL TREATMENT
			4	5				.24	EX SITU CHEMICAL TREATMENT
			4	5	6			.25	IN SITU PHYSICAL TREATMENT
			4	5				.26	EX SITU PHYSICAL TREATMENT
			4	5				.27	IN SITU THERMAL TREATMENT
			4	5				.28	EX SITU THERMAL TREATMENT
			4	5				.29	IN SITU STABILIZATION/FIXATION/ENCAPSULATION
			4	5				.30	EX SITU STABILIZATION/FIXATION/ENCAPSULATION
			4	5				.31	FACILITY DECOMMISSIONING & DISMANTLEMENT
1	2	3	4	5				.32	MATERIAL HANDLING/TRANSPORTATION
1	2	3	4	5	6			.33	DISPOSAL
			4	5				.34	AIR-EMISSION AND OFF-GAS TREATMENT
1	2	3	4	5	6	X		.9X	OTHER (Use Numbers 90-99)

FIG. 3 Level 1 and Level 2 Classification Matrix

Project Type	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Phase 6
CERCLA	Preliminary Assessment/Site Investigation (PA/SI)	Remedial Investigation/ Feasibility Study (RI/FS)	Remedial Design (RD)	Remedial Action (RA)	O&M	Post Closure Surveillance and Long-Term Monitoring
RCRA	RCRA Facility Assessment	RCRA Facility Investigation/ Corrective Measure Study	Design portion of Corrective Measure	Corrective Measure	O&M	Post Closure Surveillance and Long-Term Monitoring
Waste Mgmt.	Preliminary Planning – Waste/Special Materials Operations	Pre-conceptual Design/Research and Development	Waste Management Facility Design	Waste Management Facility Construction	Waste Management Facility O&M	On-site Storage/Disposal Facility Surveillance and Long-Term Monitoring
D&D	Pre-Decommissioning Actions	Facility Shutdown/ Decommissioning and Research and Development	D&D Design	D&D Construction/ Actions	D&D O&M	Post Closure Facility Surveillance and Long-Term Monitoring

FIG. 4 Generic Description of Phases by Project Type

6.1.1.2 *Phase 2: Studies*—Risk assessment, characterization and investigations, development and analysis of treatment or remediation options, and treatability studies.

6.1.1.3 *Phase 3: Design*—Engineering design and pre-construction activities of treatment or remediation alternatives.

6.1.1.4 *Phase 4: Construction*—Construction of selected treatment or remediation alternatives. Includes start-up, but excludes operations.

6.1.1.5 *Phase 5: Operations and Maintenance*—Includes all operations and maintenance, after startup and testing, for the selected treatment or remediation alternatives. Examples of O&M activities include inspection of facilities or areas, cost of utilities, preventive and corrective maintenance, operations of the equipment and facilities, cost of consumable materials, performance testing, replacement parts, and other miscellaneous activities.

6.1.1.6 *Phase 6: Surveillance and Long-Term Monitoring*—Activities, conducted after remediation, such as monitoring, repairing and replacing parts, record keeping, maintenance, and other activities that are required to maintain an adequate level of human health and environmental protection from hazardous and radioactive waste residues.

6.1.2 The Cross Cut category includes overhead or program-wide activities that are required to implement environmental projects but which are not specific to a distinct project or phase. The designation X in Level 1 is used to represent those activities that are not readily segregated into ~~Phases 1–6.~~ Phases 1–6. These activities are not generally associated with individual projects, but are essential in order to plan and implement the collected projects that comprise the majority of the program. These activities apply to both government/owner and prime contractor.

6.1.3 The six phases described in 6.1.1.1 – 6.1.1.6 apply to all environmental projects including environment restoration, waste management, and facility decontamination and decommissioning projects, but there are slightly different definitions for each. Fig. 4 provides examples of how the phases apply to various project types. The examples are not in any particular order.

6.2 The following sections describe the major elements of work established at Level 2 of the cost classification. These descriptions indicate what items are included or not included for the element and refer to those elements that are more applicable. Also note that some of the definitions refer to Level 3 or 4 elements that are available, but not currently included in this standard. Each element presented below includes the phase number and applicable definition, a list of subordinate elements, and supplemental notes where required.

6.2.1 *(.01) Program Management, Support, and Infrastructure:*

6.2.1.1 *All Phases*—This element includes expenses for main office personnel, overhead, and contract activities associated with the development of plans and programs for environmental restoration, compliance, waste management, pollution prevention, and other environmental management activities. Program support includes services rendered by offices and agencies in support of program planning such as legal, community relations, procurement, and contracting. Contract procurement activities, when the individual projects are unknown, would be included in this element. Program infrastructure includes overhead elements such as insurance, interest, fees, rent, warehousing, building maintenance, and equipment maintenance, required to implement