

## **Environmental Cost Analysis System Data Formulation - 10288**

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### **ABSTRACT**

The Department of Energy (DOE) Office of Environmental Management (EM) has developed a web-accessible database for its own use to collect cost data from completed EM projects called the Environmental Cost Analysis System (ECAS). The database contains both cost and parametric data, i.e., the metrics defining the scope associated with the costs. Its database structure allows a user wanting to estimate or analyze an upcoming activity to access past cost and parametric data arranged as "ECAS Projects" that contain scope similar to that activity under analysis. ECAS project costs are stored and reported using the Environmental Cost Element Structure (ECES) developed by the DOE Applied Cost Engineering (ACE) team in coordination with the Federal Remediation Technologies Roundtables' (FRTR) Environmental Cost Engineering Committee (EC<sup>2</sup>). The EM Consolidated Business Center (EMCBC) is now using an initial version of ECAS with screening and reporting functions to support its Cost Estimating and Analysis efforts. The ECAS database currently includes data from the Rocky Flats, Mound, and Fernald Closure Projects and the Oak Ridge-Melton Valley Remedial Action projects, capturing approximately \$7 billion of environmental clean-up work.

### **INTRODUCTION**

DOE Office of Environment Management (EM) is implementing its Best in Class Project Management (BICPM) initiative to improve its management of DOE's cleanup projects. As part of the BICPM, a root cause analysis was developed and Recommended Priority Actions (RPAs) were identified. RPA-19B recommended development of an EM historical project cost database.

The Office of Cost Estimating & Analysis (OCE&A) provides independent cost estimating, scheduling, cost analysis support, and related services to support EM at the Consolidated Business Center (CBC) in Cincinnati, OH. It has worked with other DOE offices over the last several years to collect actual data from its EM projects to support its ongoing cost estimating and cost analysis efforts. In 2008 OCE&A developed the current form of the Environmental Cost Analysis System (ECAS), consisting of a web-accessible database built using Microsoft Sequel Server and hosted on an EM test environment server at the Savannah River Site (SRS). ECAS relies on lessons learned and data from previous EM cost collection efforts, captures costs for completed EM projects, and was designed to fulfill the requirements of RPA-19B.

The ECAS database was modified in 2009 and now includes extensive cost and parametric data derived from four major EM projects to support use by DOE estimators on future cost estimates and analyses. Three of these EM projects (Rocky Flats, Mound, and Fernald) were site closure projects and include data ranging from the detailed Decontamination and Decommissioning (D&D) and Environmental Restoration (ER) cleanup activities to site management and overhead functions. The fourth, the Oak Ridge-Melton Valley Remedial Action projects, was a major Oak Ridge cleanup effort that included detailed activity-level data. The total cost of all of these projects exceeds \$7 billion.

Our challenge in developing ECAS is to accommodate a wide range of project types (e.g., D&D, Waste Management [WM]) that vary in scope from small isolated projects to highly integrated mega-projects. The available cost data and secondary project parameters also varies greatly in detail and structure. ECAS was developed with the flexibility to handle this disparate data and has analytical tools to codify it consistently. Each project has a story and ECAS provides a means to tell that story to the user in a consistent and logical way.

ECAS includes actual cost data (mostly from accounting databases), secondary project “parameter” data (e.g., independent non-cost variables that drive costs), and descriptive information providing qualitative information on cleanup activities. The data has been arranged (i.e., “normalized”) to allow a user to access it at various levels of aggregation, but without needing an intimate understanding of the underlying site WBS from which the data was derived. This is accomplished by organizing the cost and parameter data using the Environmental Cost Element Structure (ECES) and so-called “ECAS Projects.” The result provides an adjustable level of detail that allows an analyst to create cost factors, cost estimating relationships, and models tailored to the specific project to be estimated or analyzed. Thus the ECAS database is not a cost estimating *program*; it provides historical data an experienced estimator can use in developing relationships to address a wide variety of topics.

A key feature in data accessibility has been the organization of the data by “ECAS Project.” EM projects are generally extensive, site-wide Environmental cleanups that literally take large industrial complexes often back to a “pre-development” state. Each site is complex with its own unique features. There will never be another project exactly like the Rocky Flats, Mound or Fernald site closures, and overall data at the site level does not provide sufficient resolution (i.e., dividing the \$4.1B Rocky Flats Closure Project (RFCP) cost by 3.5M ft<sup>2</sup> [SF] does not really provide useful information). All lower-level site cost and parameter data for these site closures was organized by site Work Breakdown Structure (WBS). To develop accurate data for future analyses or estimate required intimate knowledge of how the site had organized its work. We believed requiring a data user to be an expert in all of the data-generating sites would result in the data being used either inaccurately or not used at all. This led to a need to allow a user to intuitively identify scope within ECAS that was similar to the work that was being estimated or analyzed. Our approach was to define “ECAS Projects” within the site data.

We subdivided the closure projects into specific elements of scope, with the sum of the ECAS Projects equaling the total direct site closure scope. The RFCP was divided into 78 ECAS Projects; the Fernald Closure Project (FCP) was divided into 36 ECAS Projects; the Mound Closure Project (MCP) was divided into 28 ECAS Projects; and Oak Ridge Melton Valley was divided into 13 ECAS Projects, all mapping back to the each site’s WBS. The principal criteria for an ECAS Project was ease of use by the ECAS user, providing consistent groupings of scope that ECAS users could pull up and compare to support their cost estimating and analysis work. The ECAS Project needed to be established around a scope that a user could readily recognize. To that end the ideal ECAS Project has the following criteria:

- Be of substantial size (i.e., >\$500,000)
- Have distinct spatial and temporal boundaries
- Have definable/high pedigree actual costs and parameters
- Be managed as single entities
- Be vertically integrated (e.g., have PM, design, execution, and closeout elements)
- Contain the same type of remediation (e.g., not mix GW pump-and-treat, capping, and D&D in the same project)
- Includes the entire project life cycle from work plan through closeout

Note that this is the ideal; many of the ECAS projects meet some but not all of these criteria.

The discussion of the ECAS system is organized into four elements in this paper: database content and structure; the data normalization process; data access/ECAS reporting, and; ECAS data use, with a final section describing future efforts to improve the ECAS system. The database content and structure describes the types of data present and its functional organization. The normalization process describes the process an *analyst* uses to develop, arrange, and prepare the data for input. The following sections describes the database reporting processes a *user* employs to access current data, and examples of the way the data can be used. As a point of terminology, an *analyst* is always the person normalizing and inputting ECAS data and a *user* is accessing and using the data.

## **ECAS DATABASE – CONTENT AND STRUCTURE**

The ultimate usefulness of ECAS depends on the data it contains. Determining what data to include and how to organize it so that it would be useful was an effort that required several iterations, various compromises, and input from numerous contributors and an ECAS collaborative team (the Team). Several issues that the Team needed to address before it could process raw (source) cost and parameter data into ECAS database input included the future user access effort, the level and types of data available, and the data organization.

We identified two major tradeoffs inherent in processing of data into a more accessible condition (e.g., cost factors or other relationships). More analyst effort is required to take the data to a more accessible state, but correspondingly less user effort is required to apply it to an estimate. Also, as data becomes more processed it may lose potentially relevant information, such as size of project, contaminant types, and data variability among projects. The Team made a conscious decision in our normalization process to process the data sufficiently for a user to access a wide variety of information, but not need to become intimately familiar with the sites from which the data was derived, to develop credible cost analyses. The corollary was that developing data for analyses would require substantially more experience and effort on the user's part than if the data was available in cost factor format.

The content and format of ECAS came principally from the effort to organize the data from the RFCP, and was built around its cost accounting database, project estimating data to derive “non-waste” parameters, the waste tracking system to provide waste parameters, and project documentation and expert knowledge to provide qualitative data. We organized the data into a standard format based on several key elements:

- Separation of “direct” scope – i.e., that scope that can be associated with parametric data (e.g., area decontamination costs are a function of area SF) – from “indirect” scope that is less directly associated with parameters e.g., site finance and accounting.
- Organization of the direct scope into “ECAS Projects.” For example, the D&D of a contaminated building (involving planning, equipment removal, decontamination, and demolition activities) might be one project, excavation of a number of collocated VOC releases might be a second, and the removal a group of trailers and small office buildings might be a third.
- Use of the ECES as a code of accounts (similar to the Construction Specifications Institute [CSI] accounts used for construction) to identify the type of work in a consistent manner.

The data types in the ECAS database are shown in a simplified form in the Table I, Cost and Parameter Data, and in Table II, Project Descriptive Data. The data types in Table I include the cost and parameter values and the ECES and ECAS Project assignments that have been used to organize these values; a database record might contain values for each of the costs, a single non-waste parameter value, or a single waste parameter value.

The first nine fields of the cost data breakout show costs summarized from their accounting system-defined cost element (i.e., at RFCP, the approximately 36 accounting codes used to allocate costs for accounting purposes). These cost and labor categories allow a user to estimate categories of costs or develop model data at a more refined level than just overall costs. Prime contractor labor hours are also included; there was no reasonable way to collect subcontractor hours.

Table I. Cost and Parameter Data

<b>Data Type</b>	<b>Description(s)</b>
<b>Cost Data</b>	Total Actual Hours (prime contractor)
	Professional Labor Cost (prime contractor)
	Craft Labor Cost (prime contractor)
	Professional Services Cost (subcontractor-seconded labor)
	Other Subcontractor Cost (construction, fixed price, etc.)
	Equipment and Rental Cost
	Materials and Supplies Cost
	Fuel and Utilities Cost
	Profit and Overhead Cost
<b>Non-Waste Parameters</b>	Parameter value and unit of measure (e.g., 100 SF)
	Qualitative description of contaminant type and intensity
<b>Waste Parameters</b>	Parameter value and unit of measure (e.g., 100 SF)
	Waste Type (e.g., Low Level Radioactive Waste)
	Package type, treatment requirement, disposal TSD type
<b>ECES Designators</b>	ECES Designation (Levels 1-5 and description)
<b>ECAS Project</b>	ECAS Project Name (unique to each project)

The remaining fields in the record provide either parameter values or descriptive information. This allows a user significant additional estimate options (i.e., projection of waste volumes and categories from cost or non-waste parametric data). The final fields allow the roll-up of the cost and parameter data by ECES codes or ECAS Project. All of the shaded fields identify descriptive data assigned at the record level that will allow roll-up of values to summary levels (e.g., all of the RF Building 371 (B371) Project Low Level Radioactive Waste).

Additional descriptive information is available at the ECAS Project level, linked to the detailed data in Table I by the ECAS Project name. This descriptive information, shown in Table II, provides specific data on the ECAS Projects, enabling a user to evaluate data in the context of the project scope.

In Table II the project name cross references data between the two tables; the Project Type, Type of D&D Project, Type of ER Project, and Type of WM Project allow for selection of project types (an example of the D&D project type is given in Attachment 1). By defining specific types

of project we can give the user a tool to quickly screen data. Additional data (i.e., complexity, structure/construction type, soil media type, and other information) provides descriptive data to allow user evaluation of similarities between the project that they are estimating and the ECAS Project represented.

By grouping scope into ECAS Projects we tried to optimize the number of projects to preserve fundamental project distinctions but avoid a proliferation of types that would result in groups with only a few projects each. An example of the results of this grouping for just the D&D ECAS Projects is shown in Attachment 1. Too few ECAS Project types would result in dissimilar projects being binned together (e.g., research reactors and commercial power reactors under “Reactors”); too many types would make it difficult for a user to screen potential projects.

Table II. Project Descriptive Data

<b>Project Attributes</b>	<b>Descriptor</b>
Gen. Project Info.	ECAS Project Name (unique for each project)
	Project Type (D&D, ER, Waste)
	Management, Technical, Regulatory, and Public complexity/risk
	Personal Protective Equipment Requirements
D&D Project Info.	Type of D&D Project (see Attachment 1)
	Structure type and construction type (e.g., multi-story concrete)
ER Project Info.	Type of ER Project
	ER Complexity-general, groundwater, surface water, soil
	Soil media type
	Ecological complexity
	Other issues - wetlands, wilderness, or cultural resources
WM Project Info.	Type of WM Project

We also had to limit the descriptive information to a relatively small set of “descriptors” to allow for sorting; this resulted in a loss of some detail in the information (e.g., we could note RCRA-organics or PCBs but not both). To remedy this we have developed a “Project Description” document for each ECAS Project so that the project-specific information is retained in more detail. Thus, if a user wanted detailed information on the one ECAS Project closest in scope to one he was estimating, he could screen the universe of ECAS Projects to the two or three closest using database data, and then review Project Descriptions from each of those projects to choose the one most representative. Access to ECAS Project Descriptions is not yet available on-line.

The data shown in these tables has been simplified for the purposes of explanation in this paper. The actual database consists of multiple tables, with record fields in addition to those shown in Table I and Table II that provide information such as indication of data reliability/validity, action beginning and ending dates (for escalation), application of various types of indirect costs to the direct costs, and fields to link the record back to the original site WBS.

### **ECAS DATA NORMALIZATION PROCESS**

The cost and parameter data in their raw form needed considerable processing before they could be placed in the ECAS database. The cost data from Rocky Flats, Mound, and Fernald each resided in accounting databases with hundreds of thousands of records. Each source record identified cost as well as information such as hours/worker/pay period, invoice payments (and

accruals and reversals), and similar data all containing relevant data such as WBS, charge numbers, accounting codes, descriptions of the work charged or item purchased, organization codes, etc. The waste data was derived from waste data management systems (“WEMS” at RFCP and other systems at other sites) that tracked each container managed. Other parameter and descriptive data was available in different forms, such as cost estimates, baseline scope, and regulatory and closeout documents.

The ECAS database structure was developed in parallel with the development of the Rocky Flats data; in a sense, the database was developed to accept the Rocky Flats data as much as the data was inputted into the database. As we were incorporating the data into the ECAS database from our second site, the Melton Valley Remedial Action projects, we recognized the need for a more rigorous process. The Team developed an ECAS User’s Manual as the basis of implementing configuration control, controls on data input, and instruction on data access. Although a work in progress, the User’s Manual contains detailed procedures covering data normalization; a diagram showing these procedures and how they interact is shown in Fig. 1, ECAS Data Normalization Procedures. We developed a training approach and implemented the use of these procedures in normalizing entering the data that was very useful in incorporating data from the Mound and Fernald Closure projects.

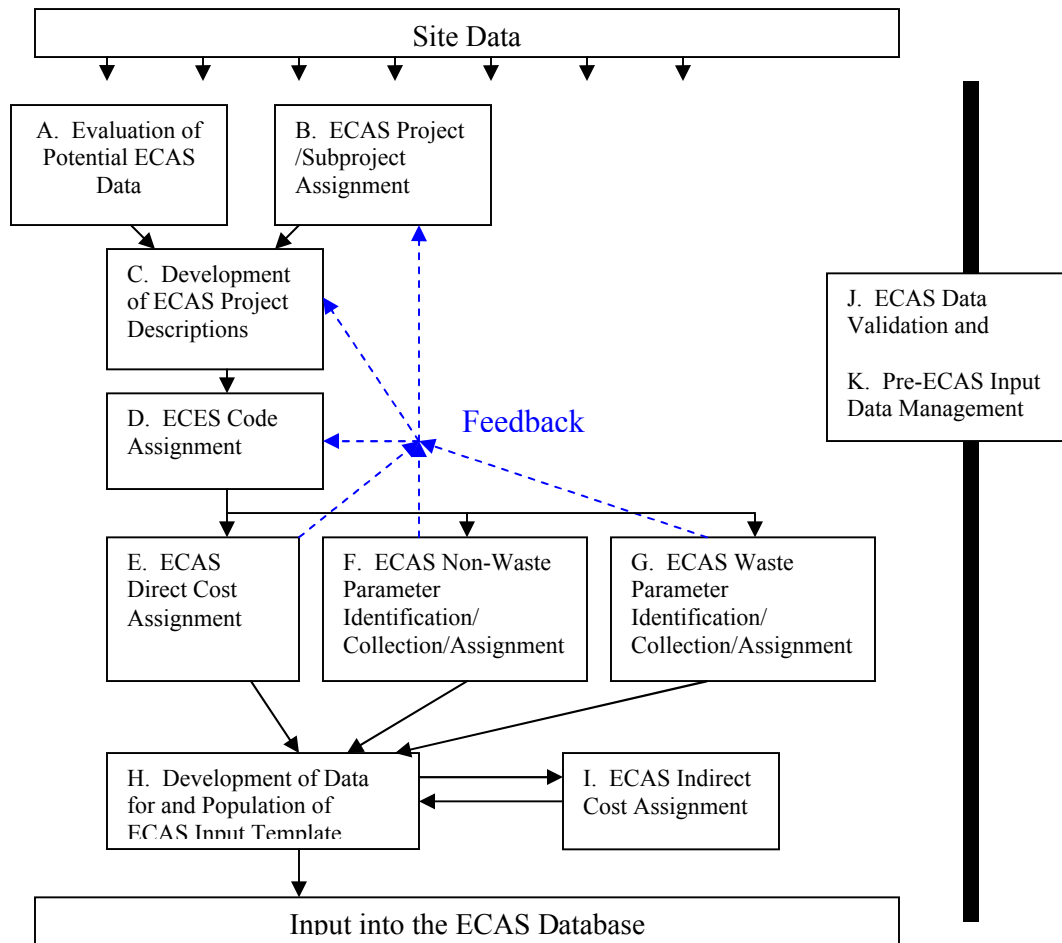


Fig. 1, ECAS Data Normalization Procedures

The process of reducing this data into information suitable for ECAS begins with data analysis, an iterative effort where site data is collected, analyzed, gaps identified, and efforts made to collect data to fill the gaps. A second concurrent activity is to define the ECAS Projects, necessary at this stage to focus the data collection. Draft ECAS Project Descriptions are developed as a way to collect parametric (as opposed to cost) data on projects and provide a traceable reference for such data.

In parallel, ECES codes and ECAS Project names are assigned to cost data, usually at the charge number level. This effort is also iterative in that as more information is developed the charge numbers might be reassigned to different ECAS Projects or assigned to a different ECES classification. Microsoft Excel© pivot tables and/or Microsoft Access© queries were used to summarize data – all costs for charge numbers sharing a single ECES code and ECAS Project descriptor were added together. The result was a table containing consolidated cost data of the types summarized in Table I, with between several hundred and several thousand records.

Once a cost table exists we insert scope values – i.e., waste and non-waste parameters – into the table based on the ECAS Project; in some cases we have been able to subdivide that scope into “subprojects” (e.g., different “Sets” in the D&D of a large plutonium building) and build that functionality into the database. The parameters are identified as “primary” parameters restricted to specific units of measure for different project types (e.g., SF for all D&D projects) and “secondary” cost-driving parameters that would provide additional information but would not always be required (e.g., glovebox or process tank volume). Defining and identifying the appropriate cost-driving parameters is a significant effort and sometimes results in reorganization of ECAS projects. The result was an “input table” containing the Table I and Table II information for all site activities.

Once an initial input table has been completed there are numerous reviews and validations. Direct costs were used to develop “indirect” costs to identify the “overhead” that DOE must pay to achieve the ECAS Project scope. These indirect costs include site management, finance and accounting, security, utilities, waste disposal, essential site services and similar costs – costs for which the cost-driving independent variable is direct cost, not a non-cost parameter. The final step is incorporation of the data from the “input table” into the ECAS database proper, a step that confirms that the data is in the correct format. The available data from the Mound and Fernald Closure projects was normalized and added to ECAS in 2009.

The completion of the normalization process for the Mound and Fernald closure site data allowed us evaluate how well our normalization process performed, with initial highlights of our lessons learned given below. The lessons learned process is currently ongoing.

- Evaluate data in detail and collect as much as possible prior to the start of the normalization process, since collecting and processing the data concurrently results in inefficiencies
- Assign a dedicated point of contact with knowledge of and connections to the site, and give them an incentive to provide project information and achieve completion of data input
- Start with an initial ECAS Project assignment, and establish an interim milestone to confirm/correct assignments based on feedback
- Only include ECAS Projects that were principally completed in the Closure Project timeframe

- Develop the Project Descriptions early in the process to ensure that parameters are appropriately applied to ECAS Projects
- Establish a template for the Project Descriptions and adhere to it
- Assignment of ECES codes to scope is problematic; a larger set of examples needs to be developed to assist code assignment to assure consistency. This is a larger problem than just for the ECAS database, and impacts DOE's ability to use the ECES code of accounts
- Definition of scope based on the charge number description is often insufficient to define ECES codes; additional review of accounting data (e.g., subcontractor payment data) is sometimes necessary
- The mechanics of processing costs into ECAS input (template) format are straightforward once ECES codes are assigned; this was less difficult than expected
- Ability to retrieve this data from closed projects is the weak point of the ECAS process
- Lack of input from the Mound waste system (WIDS) resulted in larger ECAS Project waste volume uncertainties
- Cross-referencing between ECAS Projects and waste database scope is difficult and requires someone with site knowledge
- Need to maintain traceability to source documents
- Although difficult to explain, assignment of indirect costs turned out to be a straightforward process

#### **ECAS ACCESSIBILITY – DATA REPORTING**

To access the ECAS data, a web-based Microsoft Sequel Server reporting function was developed. This allows ECAS users to access the ECAS data at various levels of summarization but with limited additional computational functionality. To develop additional reporting functionality (i.e., developing additional cost factors, estimating relationships, or modeling data) we are using a customer-driven approach: We are allowing a limited group of reviewers and users access to the database and, as they become familiar with the content and their uses of the data in their work, we will build in additional functionality based on those uses.

The website currently includes the following reporting formats:

- Project Overview
- Deactivation and Decommissioning Summary Report
- Deactivation and Decommissioning Detail Report
- Environmental Restoration Summary Report
- Environmental Restoration Detail Report
- Waste Management Summary Report
- Waste Management Detail Report
- Nuclear Material Operations Summary Report
- Nuclear Material Operations Detail Report
- ECES Report
- All Data Report

These formats allow a user to first select whether the data desired is from a D&D, ER, or WM ECAS project. The ECAS user can then narrow a search to one or more sites, ECAS Project groups, ECAS projects, and ECAS Project type. The summary reports consolidate costs and give a cost per unit (e.g., all D&D ECAS Projects are described in cost per SF). The detail reports provide additional costs and parameters at the subproject and ECES code levels. The ECES



report allows selection of just one or more ECES codes and the “All Data” report includes additional data (e.g., site WBS codes and parameter “pedigree” or quality of the cost information). The reports are tables that may either be printed or exported into an XML, CSV, TIFF, PDF, Web Archive, or Microsoft Excel© formats. The capability also exists for selected users to develop “ad-hoc” reports. These ad-hoc reports use additional computational functionality inherent in Sequel Server to develop specific cost factors or model input data values that could be accessed by any web site user. We expect to take advantage of this feature as users develop routine data manipulation needs.

## **ECAS DATA USE**

Since our intent in developing ECAS was to provide numerous types of data in an accessible format, we are continuing to define different ways to use the data. EM Cost estimators can use ECAS to research past costs for various projects not only as a cost estimating tool but as an aid in the validation of new estimates. For example, an ECAS user looking to develop data might take the following approach to identify data on the decommissioning of a “Plutonium/Enriched Uranium Processing Facility”:

- Choose the type of work (D&D, ER, WM) at the summary level,
- Sort that data to display all ECAS D&D Projects with the “Plutonium/Enriched Uranium Processing Facility” Project Type Detail with summary costs/SF (see *Summary Cost Factor Evaluation* below)
- Compare available information to select which projects he/she wants to use for data (in the future he/she would be able to access Project Descriptions for each project),
- Select relevant projects, and access and download relevant data,
- Develop ECAS project-level factors (see *ECAS Project Level Factors* below); stop if sufficient,
- Drill down deeper: subprojects, ECES codes, costs, parameters, and
- Develop detailed cost factors or model input data (see *ECAS “Like-Project” Analysis*)
- Use some combination of the above to build an estimate containing a number of scope elements that can be resolved into component ECAS Projects

The following serves to present how the analysis would proceed using the ECAS data.

### **Summary Cost Factor Evaluation**

The search for this Project Type Detail will yield a table with the values shown in Table III, Plutonium/Enriched Uranium Processing Facility Summary Data. Note that the values shown have been rounded and the ECAS report also shows activity end dates and escalated values. This table might be suitable for developing a programmatic estimate for a D&D project and provides information to support further refining of a search (i.e., the structure type and construction type). Since the data on building size and cost is available, plots like that in Fig. 2, Plutonium/Enriched Uranium Processing Facility Summary Data Plot, could be drawn, which might provide a better support for a programmatic analysis.

Table III. Plutonium/Enriched Uranium Processing Facility Summary Data

ECAS Project	Structure Type	Construction Type	Area (KSF)	Direct Cost (\$M)	Cost/ Area (\$/SF)
RF B371 D&D	REINFORCED CONCRETE	MULTIPLE STORY 1 LEVEL BGS	370	240	649
RF Plutonium Lab D&D	REINFORCED CONCRETE	HIGH BAY FACILITY	40	40	1,000
RF B707 D&D	REINFORCED CONCRETE	MULTIPLE STORY 1 LEVEL BGS	240	150	625
RF B771 D&D	REINFORCED CONCRETE	MULTIPLE STORY 1 LEVEL BGS	220	180	818
RF B776 D&D	STEEL FRAMED, SIDING	MULTIPLE STORY 1 LEVEL BGS	250	160	640

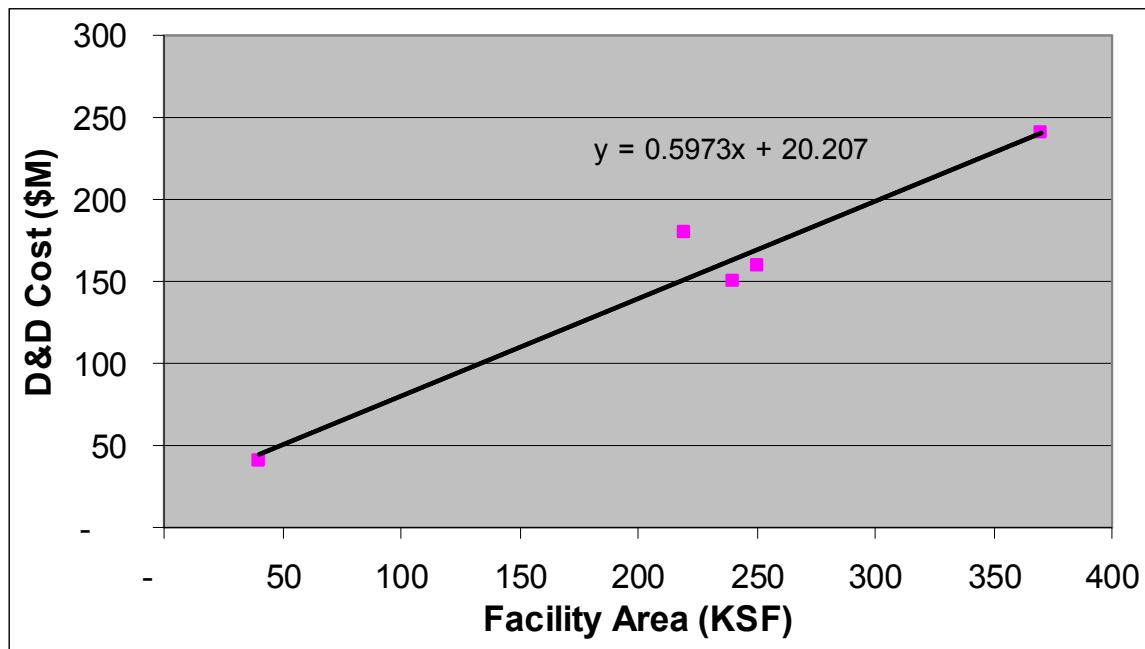


Fig. 2, Plutonium/Enriched Uranium Processing Facility Summary Data Plot

### ECAS Project Level Factors

Proceeding further into the database would allow a user to develop additional information. Accessing data from the D&D Report Details option for all Plutonium/ Enriched Uranium Processing Facilities yields a spreadsheet of 5,176 rows and 36 columns, providing cost (total cost only) and parameter data on all such ECAS Projects. This might allow analysis based on cost driving parameters other than building gross square feet.

One common factor associated with plutonium facilities is gloveboxes, with the ECAS parameter being glovebox volume. The analysis in Fig. 3, Plutonium/Enriched Uranium Processing Facility ECAS Project Costs vs. Glovebox Volume, plots the cost by glovebox volume. This plot shows two different Glovebox volumes in two different groupings, one for RF B371 and RF B771, and one for RF B707 and RF B776. (The fifth project, RF B559, was a much smaller plutonium

laboratory, a combination of the two types.) Upon further analysis the former two projects decommissioned facilities that did plutonium recovery using nitric acid processes and the latter two projects decommissioned facilities that manufactured plutonium metal products.

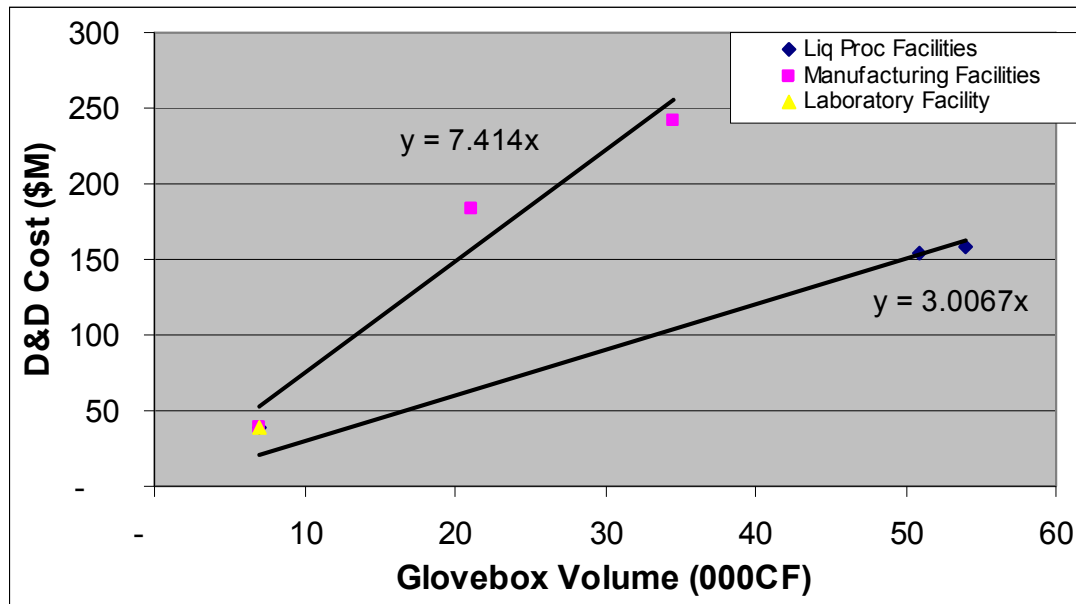


Fig. 3, Plutonium/Enriched Uranium Processing Facility ECAS Project Costs vs. Glovebox Volume

This analysis both shows the ability to develop a separate factor (project cost/glovebox volume) that could be used to support or validate a programmatic estimate; it also provides a way of analyzing data to focus on a building that might best support a like-building analysis. Note

#### ECAS “Like-Project” Analysis

Another approach to using detailed ECAS data is the “like-project” approach, where a user has identified a project that is most similar to the project that he is estimating or analyzing. In this case let us assume that through looking at the detailed project data and perhaps ECAS Project Descriptions the user has decided that the RF B371 D&D ECAS Project is the best analogue to his project. The user may then export data at a variety of levels; such as summary data shown in Table IV, RF B371 Cost vs. ECES Code Data, Table V, RF B371 Non-Waste Parameter vs. ECES Code Data, and Table VI, RF B371 Waste Parameters.

Use of data such as that in Table IV would provide information on the cost of different scope elements (as indicated by the ECES Codes/Descriptions). Cost factors for particular elements, like “Radiological Inventory Categorization for D&D” (i.e., characterization) might be developed by dividing \$3,474,206 by the total SF (366,498) shown in Table V, or could be derived as a percentage (i.e., 2%) of the total direct project cost.

The use of non-waste cost-driving parameters was shown above in Fig. 3. Additional data is available to estimate removal costs or quantities for other parameters such as process tankage, process and non-process duct, and other items shown in Table V, RF B371 Non-Waste Parameter vs. ECES Code Data. Finally, the waste generation from decommissioning and environmental

restoration projects is consistently difficult to estimate; such values are available on a SF basis as shown in Table VI, RF B371 Waste Parameters.

Table IV. RF B371 Cost vs. ECES Code Data

ECES Code			ECES Description	Total	Percent of Project Cost
.02	.01		Project Management/Support/Administration	91,290,862	52%
.02	.03		Regulatory Interaction	39,170	0.0%
.02	.14		Project Safety and Health	4,788,753	2.7%
.03	.01		Workplan	15,925,049	9.1%
.04	.12		Decontamination/Dismantlement Project Designs	100,555	0.1%
.04	.13		Facility Design	315,639	0.2%
.05	.01	.03	Temporary Facilities	1,027,235	0.6%
.05	.04		Dismantling or Demolition of Non-Usable, Clean Balance of Plant Systems	1,022,423	0.6%
.05	.12		Railroad Tracks and Crossing	170,806	0.1%
.06	.03	.02	Facility/Building Maintenance	1,858,360	1.1%
.06	.03	.04	Major Facility Repairs	3,004,139	1.7%
.08	.00		SAMPLE ANALYSIS	649,559	0.4%
.11	.07		Environmental Management High Hazard/Remote Treatment Front-End	24,161,515	13.8%
.15	.02		Tank Removal	286,670	0.2%
.15	.04		Asbestos Abatement	163,945	0.1%
.20	.03		Pumping/Draining/Collection	425,676	0.2%
.24	.12		Neutralization	775,500	0.4%
.31	.02		Deactivation	11,340,170	6.5%
.31	.05	.02	Isolation of Lines Entering and Exiting the Building	39,780	0.0%
.31	.07		Radiological Inventory Categorization for D&D	3,474,026	2.0%
.31	.08		Preparation and Decontamination for Area and Equipment	1,852,688	1.1%
.31	.17		Removal of All Other Facilities, or Entire Contaminated Facility	12,334,723	7.0%
Grand Total				175,047,243	100%

Thus the “like-project” approach can provide a basis for parametric analysis. Since these factors could be expected to vary based on the project, spending the necessary time to determine both the closest fit within the ECAS database and also potential differences between the project to be estimated and the ECAS Project is required.

Note that ECES code .02.01 contains numerous costs in addition to project management office scope, including items such as worker idle time, worker training, subcontract management, and consumables or equipment not attributable to other ECES elements. The actual cost of managing the project were a much smaller percentage of the total cost.

Table V. RF B371 Non-Waste Parameter vs. ECES Code Data

ECES Code			ECES Description	Value	Unit of Measure	UOM /SF
.00	.00	.00	Summary of Total Building Floor Area	366,498	SF	1.000
.31	.09	.03	Cutting, Sizing, and Removal - Piping	212,276	L Ft	0.579
.31	.09	.04	Cutting, Sizing, and Removal - Tanks	38,694	CF	0.106
.31	.09	.91	Cutting, Sizing, and Removal - Gloveboxes	34,554	CF	0.094
.31	.09	.92	Cutting, Sizing, and Removal - Duct	418,755	SF	1.143
.31	.09	.93	Cutting, Sizing, and Removal - Plenums	71,028	CF	0.194
.31	.09	.94	Cutting, Sizing, and Removal - Conduit	526,560	L Ft	1.437

Table VI. RF B371 Waste Parameters

Waste Type	Value	Unit of Measure	Unit of Measure/SF
RCRA Hazardous	182	CF	0.000
PCB	814	CF	0.002
Low-Level Waste (LLW)	2,597,883	CF	7.088
Mixed LLW (LDR Compliant)	251,922	CF	0.687
Mixed LLW (non-LDR Compliant)	18,768	CF	0.051
TSCA Waste	81	CF	0.000
Transuranic Waste	92,822	CF	0.253
Controlled, non-hazardous waste	312	CF	0.001
Sanitary Waste	20,077	Ton	0.055

### ECAS NEXT STEPS

There are several activities that are under way to improve the ECAS data content and functionality. These include:

- Completing project descriptions for all ECAS projects to provide a user the capability to refine his search for the most relevant data for his analysis or estimate. This will include addition the additional ability to access the ECAS Project Descriptions from our web site.
- Identifying better ways to consistently apply ECES codes to site cost data. This will include working with other DOE organizations that are applying ECES codes to work scope to ensure that the codes are being uniformly applied.
- Upgrading our data verification and validation process. The work to date has created a database where cost and parameter value totals are equal to source data, but the formality necessary to validate the data needs to be implemented.
- Continue to work to add functionality. We will work with our customers to better understand the uses of the ECAS data, and where specific analyses or calculations are routinely performed we will develop ways to include those in our reporting functions.
- Work with other DOE Offices to ensure ECAS data can complement their cost and parametric data management.
- Migrate the database from the SRS servers to CBC servers in Cincinnati, OH.
- Explore useful cost estimating relationships inherent in the data. If an relationships, e.g., “Enriched Uranium Processing Facility” \$/SF or “Glovebox Removal” \$/volume are likely to be of value to the user community, then suggested equations may be developed.

For additional information on topics in this paper, contact P.C. Sanford at [sanfordp@hotmail.com](mailto:sanfordp@hotmail.com). Access to the ECAS database itself is restricted to those authorized by OCE&A.

**Attachment 1, ECAS D&D Project Types**

D&D Project Type	BUILDING TYPE	PROJECT TYPE DETAIL	Units of Measure (UOM)
	B Typ 1		
		Transite/High Asbestos Non-Radioactively-Contaminated Building	SF
		Coal/Oil Power/Steam Plant	SF
		Commercial/Industrial Non-Nuclear Facility(ies)	SF
		Office Building(s)	SF
		Non-contaminated Equipment	SF
		OTHER Type 1	SF
	B Typ 2	Parameter Values	
		Plutonium Storage Facility	SF
		Reactor - Test/Small Experimental	SF
		LLW Tanks w/ Sludge	SF
		LLW Tanks w/o Sludge	SF
		Contaminated Chimney/Stack	SF
		Low-Level Laboratory Facility	SF
		Generic Radiological Facility(ies)	SF
		Generic Radiological Facility(ies)-Extensive Loose Contamination	SF
		Solid Waste Packaging Facility	SF
		Contaminated Exterior Equipment	SF
		Waste Storage Facility (Packaged Waste Only)	SF
		OTHER Type 2	SF
	B Typ 3	Parameter Values	
		Reactor - Weapons Production/Commercial	SF
		Spent Fuel Reprocessing Facility	SF
		Plutonium/Enriched Uranium Processing Facility	SF
		Remote Waste Treatment (Liquid/Solid)	SF
		Semi-Remote Waste Treatment Facility	SF
		Spent Fuel Basin w/ Sludge	SF
		Spent Fuel Basin w/o Sludge	SF
		Uranium Enrichment Facility	SF
		HLW Tanks w/ Sludge	SF
		HLW Tanks w/o Sludge	SF
		High-Rad Laboratory/Hot Cell Facility	SF
		OTHER Type 3	SF