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MARTIN MARIETTA

Cost Estimates for the Uranium-in-Soils Integrated Demonstration Field Screening Technologies

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Risk Analysis Section
Health Sciences Research Division

MANAGED BY
MARTIN MARIETTA ENERGY SYSTEMS, INC.
FOR THE UNITED STATES
DEPARTMENT OF ENERGY

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1. INTRODUCTION

1.1 BACKGROUND

The principal objective of the Uranium-in-Soils Integrated Demonstration (ID) is to develop an optimum integrated system of technologies for the removal of uranium substances from soil, which, through demonstration, has been proven in terms of cost reduction, waste minimization, risk reduction, and user applicability. The Performance Assessment Group furnishes a systematic evaluation process for the ID, provides information to support decision-making for future applications, and establishes whether the technologies are successful. The field screening technologies developed by the Characterization Group must be evaluated by the Performance Assessment Group for their adequacy in detecting uranium contamination. Sandia National Laboratory (SNL) is tasked to develop and apply the technical tools necessary to evaluate the field screening technologies within a cost/risk decision-making framework under the Technical Task Plan (TTP), "Cost/Risk Performance Assessment of Soil Characterization" (TTP AL231007). In support of this TTP, Performance Assessment Group members at the Oak Ridge National Laboratory (ORNL) developed cost estimates for the uranium field screening technologies, satisfying the first step in SNL's cost/risk performance evaluation process.

1.2 OBJECTIVE

The objective of this document is to describe the work conducted by the ORNL Performance Assessment Group members responsible for developing the cost analysis reports. The following information is provided in this report: 1) an explanation of the cost input questionnaires, which were sent to the developers of the field screening technologies and used by the cost estimator to acquire information and develop the cost estimates, 2) a description of the computer software package chosen to create the cost estimates, as well as why it was chosen, 3) a description of how the Uranium-in-Soils ID project is broken down structurally in terms of a work breakdown structure (WBS) for the cost estimates, 4) an explanation of the assumptions made by the cost estimator in developing the cost estimates, 5) a summary of the expected costs for each field screening technology, and 6) an explanation of how the cost analysis reports for a scenario evaluation (provided in the cost input questionnaires) were derived, as well as a summary of the scenario evaluation costs for each technology.

2. COST INPUT QUESTIONNAIRES

Cost input questionnaires were developed by the Performance Assessment Group and sent to developers of the four field screening technologies for the Uranium-in-Soils ID. To develop accurate and useful cost analysis reports, detailed cost estimates associated with constructing, operating, and maintaining the field screening equipment were necessary and were provided by the developers in the cost input questionnaires. A scenario evaluation was also included in the questionnaire to determine the cost to adequately characterize a hypothetical 1-acre site in a given timeframe.

Once these questionnaires were completed and returned to Performance Assessment Group members, cost estimates were created using COSTPRO and the Martin Marietta Energy Systems, Inc. (Energy Systems) Automated Estimating System (AES). The AES and COSTPRO software programs both act as spreadsheets which rely on the cost estimator for all cost inputs. Therefore, the estimator must be familiar with the relevant technologies to produce accurate cost estimates. After review of the cost analysis reports produced by the AES and COSTPRO programs, it was determined that COSTPRO would be the best software package to use for producing cost reports. The AES program, originally developed by the Energy Systems' Engineering Division for construction cost estimates, contains many lines that apply to Energy Systems' cost system only, which could lead to confusion if AES is the chosen system for the Uranium-in-Soils ID. In addition, COSTPRO is easier to revise and manipulate if revisions to the cost reports are necessary in the future.

3. COST ESTIMATION SOFTWARE

COSTPRO was the computer software package used to create the Uranium-in-Soils ID field screening technologies cost estimates shown in Appendix A. COSTPRO is a fully developed generic cost-estimating system that can be used to prepare cost estimates on projects from the planning stage through detailed design. The underlying approach is to use unit costs rather than historical costs. COSTPRO can be used for all types of wastes, including hazardous chemicals, mixed wastes, and radioactive wastes, and for all phases of environmental restoration work, including remedial investigations, feasibility studies, and remedial design and construction. The

code is a complete PC-based, commercial rewrite of the Los Alamos National Laboratory's (LANL's) cost estimating system; therefore, it is particularly well adapted for preparing cost estimates of U.S. Department of Energy (DOE) projects. The program is written in Fortran/C-Language and runs on a standard IBM-AT compatible or 386 with math coprocessor.

The program creates two basic files: 1) a take-off file that contains a description of the items to be costed, as well as the quantity and material, equipment, and labor costs for each item and 2) a project factors file that contains the descriptions of WBS codes and markups to be applied to the project. The COSTPRO report generation file references the information in the take-off and project factors files to create the report specified by the estimator. The reports, which can be generated through COSTPRO's sort schemes, are numerous and include several that the estimator can design according to project-specific requirements. The take-off extension report compiles the appropriate take-off items and provides the direct costs for the project, sorted and subtotaled according to the cost estimator's preference (see page 1 of the take-off extension report for the long-range alpha detector presented in Exhibit 1). The general cost summary (shown in Exhibit 2) applies the direct, general, and project markups (e.g., labor, overhead, profit, escalation, contingency, etc.) that are stored in the project factors file to the direct costs to obtain the project's total costs. The general cost summary can also be sorted and subtotaled according to the estimator's preference.

4. THE WORK BREAKDOWN STRUCTURE

The function of a WBS tree is to show the structural breakdown of a project. A schematic representation of the WBS for the Uranium-in-Soils ID field screening technologies, shown in Fig. 1, was developed by the cost estimator. This WBS represents the total expected costs of the four technologies. The first breakdown occurs into the Level 1 categories. Subsequently, these categories are further broken down into the subcategories of Level 2, Level 3, etc. COSTPRO allows the estimator to build personal WBSs from one or more of four WBSs provided by COSTPRO (Exhibit 1). For this project, the cost estimator arbitrarily used WBS 1 in COSTPRO to identify and categorize the characterization technologies. For the take-off items that define the expected costs of the technologies, WBS 3 was used to aid the estimator and anyone looking at the report to identify a specific technology (Exhibit 1). However, WBS 2 was not used for this

PF file: lradcone PR
TO file: lradcone TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE OFF EXTENSION

Sort: WBS1 Subtotal: 4 character

Job Number: 1 Change Order Number: 15:18:54 4/14/93
Project Title: Uranium Soils ID:Expected costs LR Alpha Detector Checked By:
Estimator: D Bouthat Abbrev: Location: ORNL

(Items with '#' have been adjusted by Job Factor and/or Equip Factor)

Item	Work Breakdown Structure 1	2	3	4	Trd ID	Job Fact	Acct Code	Contract Markup	Take Off Item Tag	Description	Quantity	Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Contract Cost	Item Direct Cost
1	0110		lra				0	0		Tractor to transport detector in the field - base price	1.0	ea		0.00	0	14000.00	14000	0.00	0	0	14000
2	0110		lra				0	0		Computer for the electronics	1.0	ea		0.00	0	3000.00	3000	0.00	0	0	3000
3	0110		lra				0	0		Electrometer for the electronics	1.0	ea		0.00	0	3000.00	3000	0.00	0	0	3000
4	0110		lra				0	0		Miscellaneous electronics equipment	1.0	ea		0.00	0	1000.00	1000	0.00	0	0	1000
5	0110		lra				0	0		Power supply (power inverter & storage batteries)	1.0	ea		0.00	0	1000.00	1000	0.00	0	0	1000
6	0110		lra				0	0		Detector component parts which make up detector assembly	1.0	ea		0.00	0	1000.00	1000	0.00	0	0	1000
	0110									Category Direct Cost					0		21000		0	0	24000
7	0111		lra				0	0		Daily rate for technician/operator from LANL	8.0	hr		20.00	0	0.00	0	0.00	0	0	160
8	0111		lra				0	0		Daily rate for scientist/spectroscopist from LANL	8.0	hr		125.00	1000	0.00	0	0.00	0	0	1000
	0111									Category Direct Cost					1060		0		0	0	1560

Exhibit 1. Page 1 of the long-range alpha detector take-off extension report.

CostPro Version 1.30.00 Page 1

PF File: Iradcone PR
TO File: Iradcone TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 4 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 16:18:54 4/14/93
Project Title: Uranium Soils ID:Expected costs- LR Alpha Detector Checked By:
Estimator: D Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	PM	ED&I	Cont	Category Direct Cost	Category Cntrct Markup	Escl	Project Markups PM	ED&I	Subtotal	Cont	Category Total Cost
0110	Equipment costs	0.0000	0.0000	0.0000	0.1000			0	0	0	2100		
	L.R. Alpha Detector					23000	0		23000				25300
0111	Daily Operating	0.0000	0.0000	0.0000	0.1000			0	0	0	156		
	Costs Alpha Detector					1560	0		1560				1716
0112	Daily Maintenance	0.0000	0.0000	0.0000	0.1000			0	0	0	4		
	Costs Alpha Detector					40	0		40				44
0113	Daily Site and	0.0000	0.0000	0.0000	0.1000			0	0	0	20		
	Sample Prep Alpha D					200	0		200				220
								0	0	0	2180		
	Project Total Cost					24800	0		24800				27280

Exhibit 2. General cost summary—long-runge alpha detector.

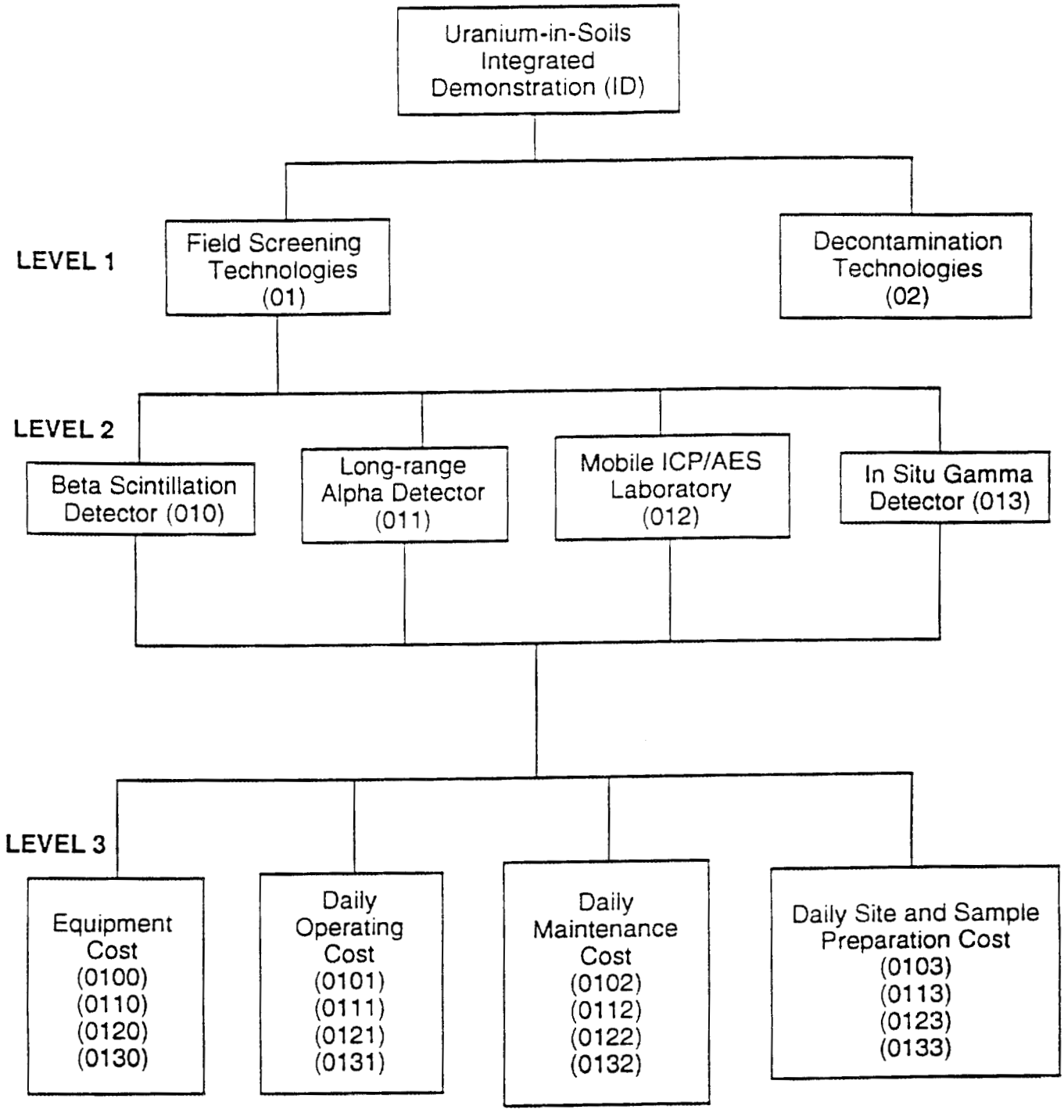

Fig. 1. WBS tree for field screening technologies.

project because it is normally reserved for the Construction Specifications Institute (CSI). The CSI format was designed to provide a standard arrangement for specifications of estimating take-off items for the construction industry.

The character strings and their titles were defined by the estimator in the COSTPRO project factors file for each field screening technology and can be shown on the general cost summaries, based on the estimator's preference. Referring to the WBS tree (Fig. 1), the numerals in the character strings increase by one with each level (moving down the tree). For example, Level 1 has two characters (e.g., 01), Level 2 has three characters (e.g., 010), and Level 3 has four characters (e.g., 0100). Level 1 for the Uranium-in-Soils ID technologies is entitled "Field Screening Technologies" and is arbitrarily defined by two characters (the character string 01). This category is further broken down in Level 2 into the field screening technologies, with their associated three character string values shown in parentheses: 1) beta scintillation detector (010); 2) long-range alpha detector (011); 3) mobile laser ablation-inductively coupled plasma/atomic emission spectrometry (LA-ICP/AES) laboratory (012); and 4) in situ gamma detector (013). Each technology was broken down by the estimator into the following four subcategories in Level 3, with their associated four-character string values shown in parentheses: 1) equipment costs (01x0, where x is the value zero, one, two, or three, depending on the technology); 2) daily operating costs (01x1); 3) daily maintenance costs (01x2); and 4) daily site and sample preparation costs (01x3). Therefore, as an example, equipment costs for the beta scintillation detector and long-range alpha detector were assigned character string values of 0100 and 0110, respectively. The take-off extension report for the long-range alpha detector (Exhibit 1) lists the equipment costs as items 1 through 6 (which total $23,000) in WBS 1 as character string 0110.

5. ASSUMPTIONS FOR THE COST ANALYSIS REPORTS

For purposes of this report, the cost estimator attempted to keep the assumptions used in developing the cost analysis reports consistent for each field screening technology. Although the four technologies are not necessarily in competition with each other because each measures different surface areas and different forms of uranium speciation. consistency must be maintained in developing the cost analysis reports. Therefore, these assumptions are explained so the reader will understand how the cost values on the cost analysis reports were determined.

An important assumption made by the Performance Assessment Group members is that the cost estimates should be based on the present state of the technology, not on what occurred during the field study at the Fernald site in the fall of 1992, or what is planned in the future for the field screening technologies. One advantage of COSTPRO is its ease in updating the take-off items that make up each cost estimate. Therefore, the cost analysis reports will be fairly easy to modify in the future when improvements or revisions are made to the technologies.

The operating costs, maintenance and replacement costs, and site and sample preparation costs for each field screening technology were calculated and reported as a daily rate. Labor rates for personnel to operate the equipment, which are shown as operating costs on the cost reports, are based on an 8-hour working day. This is believed to be more realistic than reporting hourly rates for operating costs because, in some cases (such as the beta scintillation detector) the scientist/spectroscopist did not have to provide 8 hours of support during a particular workday. Equipment costs for the technologies are exclusive and independent of their respective daily operating, daily maintenance and replacement, and daily site and sample preparation costs. Although it is appropriate to add the operating, maintenance and replacement, and site and sample preparation costs to get a daily rate, it is inappropriate to sum the equipment costs with these daily costs. Another assumption is that personnel at the DOE national laboratories who developed the field screening technologies would be operating the equipment, since they are familiar with the equipment and would be responsible for the work if they were asked to characterize a site.

Contingency is a project markup factor normally applied to cost estimates to account for any uncertainties or unforeseen occurrences, such as inflationary price trends, bad weather conditions, or possible material shortages associated with a project. A contingency rate of 10% was added to each category (equipment cost, daily operating cost, daily maintenance cost, and daily site and sample preparation cost) in calculating the expected costs for the field screening technologies. The *Means Site Work and Landscape Cost Data, 12th Annual Edition* states that contingencies are a matter of judgment and recommends using a contingency factor of 5% to 10% for calculating project costs. Because of the experimental and developmental nature of these technologies, as well as the Uranium-in-Soils ID in general, it was assumed that a 10% contingency rate would be the most appropriate for calculating the expected costs of the

technologies. However, for the *Scenario Evaluation—Cost Per Sample* and *Scenario Evaluation—Total Expected Cost* reports for each field screening technology, a 20% contingency rate was added to the direct costs. Based on discussions with various groups who conduct site characterizations, a 20% contingency factor is preferable for estimates involving the characterization of a hypothetical site because of the high degree of uncertainty involved in calculating the scenario costs.

The total daily maintenance cost for each field screening technology is the sum of two cost components: 1) the expected costs to maintain the equipment and 2) the expected costs to replace the equipment component parts (e.g., detector, electronics, etc.) once they become either worn out or obsolete. Both of these cost components were reported as a daily rate. In terms of the daily maintenance costs for the technologies, many assumptions were made concerning the replacement costs for the major components of the equipment. The following explains how the value of 200 days per year was determined for the daily replacement cost of the equipment: even though there are 250 workdays in a year, the equipment will probably only be used for 10 out of 12 months of the year because of extreme weather conditions such as cold and/or rain. Converting the 250 working days in a year to days/month results in 20.83 days/month (divide by 12). Therefore, subtracting the two months from the total yields approximately 208 usable days/year [250 - 2(20.83)] for the equipment. Finally, assuming approximately 8 days/year down time due to maintenance of the field screening equipment results in the value of 200 usable workdays per year used in the replacement cost calculations.

The number of years of usage for the equipment was based on input from the developers of the field screening technologies and opinions from personnel experienced in using similar equipment to conduct site characterizations at similar contaminated sites. For the beta scintillation, in situ gamma, and long-range alpha detectors, the assumption was made that the actual detector components of the field screening technologies would last 5 years before replacement is necessary. Factors such as extreme temperature operating conditions, moisture, and humidity contributed to the decision that a 5-year replacement time for the detector was reasonable. Another factor was that different equipment operators, with different levels of experience, will be using the equipment, which obviously will affect the equipment's treatment during operation and storage.

The electronic components associated with each field screening technology, such as computers, signal processors, amplifiers, and analyzers, were assumed to last 2.5 years before replacement is necessary. The assumption was made that computers used for these field screening technologies are standard equipment not originally designed to be subjected to outdoor field conditions (e.g., extreme temperature, humidity, and moisture). Therefore, computer replacement time should be shorter than that of the detector components. In addition, because of the rapidly advancing computer industry, the equipment and software presently used for each technology may need to be replaced as obsolete after 2.5 years, even if it is still operating efficiently in the field. Another assumption the Performance Assessment Group estimators made was the tractor used to maneuver the long-range alpha detector would last 10 years before needing replacement. The tractor represents a major portion of the field screening equipment's total cost; therefore, it was assumed that, with proper maintenance, the tractor should last 10 years before being upgraded or replaced. For the mobile LA-ICP/AES laboratory, the developer at Ames Laboratory estimated that the instrumentation should last 3 to 5 years before needing replacement. Therefore, the average value of 4 years was used to calculate the daily replacement cost for the instrumentation components.

Calculation of the daily replacement cost for the field screening technologies involves converting the present value of the equipment to a future value based on an assumed yearly inflation rate and the number of years the equipment is expected to last. A yearly inflation rate of 5% was used for all future value calculations. The following formula was used to calculate the future value of the equipment:

$$\mathbf{FV = PV\ (1 + i)^n}$$

where:

FV = the future value of equipment component;
PV = the present value of equipment component;
i = the yearly inflation rate; and
n = the number of years equipment is expected to last.

The daily replacement cost may then be calculated by dividing the future value by the number of days the equipment is expected to remain operable. The following example for the beta scintillation detector shows how the daily replacement cost of the sensor equipment was calculated:

Referring to the take-off extension for the *Uranium Soils ID: Expected Costs-Beta Scin. Detect.* COSTPRO report in Appendix A, the present value of the sensor is:

PV = 1225 + 3550 + 225 = \$5000 (fibers + photomultiplier tubes + amplifiers);
i = 5% (assumed yearly inflation rate); and
n = 5 years (for detector component);
therefore,
FV = $5000 (1 + .05)^5$ = \$6381.

Assuming the equipment will be used 200 days/year for 5 years,
Daily Replacement Cost of Sensor = 6381/(200 x 5) = \$6.38

6. EXPECTED COSTS FOR THE FIELD SCREENING TECHNOLOGIES

A summary of the expected costs for each field screening technology is provided in Table 1. A contingency rate of 10% was added to each of the four categories of costs to account for any uncertainties and unforseen occurrences associated with each of the field screening technologies. As stated earlier, the direct equipment costs shown in Table 1 are exclusive and independent of (and should not be summed with) their respective daily operating, daily maintenance and replacement, and daily site and sample preparation costs.

Table 1. Expected costs for the field screening technologies

PARAMETER	FIELD SCREENING TECHNOLOGY			
	Beta Scintillation Detector	**In Situ Gamma Detector**	**Long-Range Alpha Detector**	**Mobile LA-ICP/AES Laboratory**
Direct Equipment Costs	$15,000	$40,000	$23,000	$496,100
Daily Operating Costs	$1040	$1050	$1560	$1840
Daily Maintenance and Replacement Costs	$39	$73	$40	$442
Daily Site and Sample Preparation Costs	$200	$0	$200	$128
CONTINGENCY ADDED TO COSTS:				
Equipment Costs with 10% Contingency	$16,500	$44,000	$25,300	$545,710
Daily Operating Costs with 10% Contingency	$1144	$1155	$1716	$2024
Daily Maintenance and Replacement Costs with 10% Contingency	$43	$80	$44	$486
Daily Site and Sample Preparation Costs with 10% Contingency	$220	$0	$220	$141

6.1 BETA SCINTILLATION DETECTOR

The principal investigator for the beta scintillation detector is Alan Schilk at Pacific National Laboratory (PNL). Referring to character string 0100 on the general cost summary in Appendix A, the total direct equipment cost for the beta scintillation detector is $15,000, which includes the cost of the component parts that make up the sensor and the external electronics of the beta detector (Table 1). A daily operating cost of $1040, shown in character string 0101, is made up of the PNL rates for a technician and a scientist to work 8 and 4 hours, respectively, in the field. Appropriate overhead rates have been applied to the daily personnel rates shown in the cost analysis reports for all the field screening technologies. The expected total maintenance and replacement cost is shown in character string 0102. The maintenance cost for the beta detector is expected to be $200 a month. Based on the assumption of 200 workdays/year and 10 months of use (200 days/10 months), there are 20 workdays during the month. Therefore, the calculated daily maintenance cost equals $10 ($200 per month/20 workdays in a month). The daily replacement cost for the sensor, assuming a useful life of 5 years, is $6. The daily replacement cost for the external electronics, assuming a useful life of 2.5 years, is $23. Therefore, the sum of the daily maintenance cost and the replacement costs yields the total direct daily maintenance cost of $39. The only site and sample preparation activity associated with the beta scintillation detector is trimming the grass and weeds to approximately 1 inch high. The $200 value shown for the site and sample preparation cost in character string 0103 is based on a $25 per hour charge rate for a site maintenance crew member to cut any vegetation during an 8-hour workday.

6.2 IN SITU GAMMA DETECTOR

The principal investigator for the in situ gamma detector is Alan Schilk at PNL. Referring to character string 0130 on the general cost summary in Appendix A, the total direct equipment cost for the gamma detector is $40,000 (Table 1). This includes the cost of the high purity germanium detector, the external electronics, and the data acquisition and reduction software. The daily operating cost of $1050, shown in character string 0131, is made up of the PNL rates for a technician and a scientist to work 8 and 4 hours, respectively, in the field. Other daily operating costs include liquid nitrogen for the detector and gloves and a faceshield to be used while filling the liquid nitrogen reservoir. The expected total maintenance cost is expected to be the same as the beta detector ($200 a month). Assuming 200 days/year and 10 months of use, the calculated daily maintenance cost is $10. The daily replacement cost for the detector,

assuming a useful life of 5 years, is $36. The daily replacement cost for the electronic components and software, assuming a useful life of 2.5 years, is $27. Therefore, the total direct daily maintenance cost for the gamma detector is $73, shown in character string 0132 of the general cost summary (Appendix A). No site and sample preparation costs are associated with this technology.

6.3 LONG-RANGE ALPHA DETECTOR

The principal investigator for the long-range alpha detector (LRAD) is Duncan MacArthur at the LANL. Referring to character string 0110 on the general cost summary in Appendix A, the total direct equipment cost for the LRAD is $23,000 (Table 1). This includes the cost of the detector assembly, power supply, electronics, and the tractor used to maneuver the detector assembly. The daily operating cost of $1560, shown in character string 0111, includes the rates for a LANL technician and scientist to each work 8 hours in the field. Daily maintenance costs are shown in character string 0112. MacArthur stated that his maintenance costs for the 2 weeks of characterization at the Fernald site in the fall of 1992 were approximately $1000. These costs occurred because this was the first time the LRAD was field tested and included many last minute changes, such as broken wires, etc. Therefore, under normal operating conditions this value is probably high. The technology has improved since that time; therefore, MacArthur believed the maintenance costs for the LRAD should be approximately $200 a month, the same as the beta scintillation and in situ gamma detectors. The calculated daily maintenance cost of $10 is based on 200 days/year and 10 months of use. The daily replacement cost for the detector and power supply, assuming a useful life of 5 years, is $3. The daily replacement cost of $16 for the electronics is based on 2.5 years of useful life. The tractor is a major equipment expense and therefore, with proper maintenance, should have a useful life of 10 years. The tractor's daily replacement cost is $11. Therefore, the sum of the daily maintenance cost and replacement costs for the equipment yields the total direct daily maintenance cost of $40. The only site and sample preparation activity associated with the LRAD is trimming the grass and weeds. The $200 value shown for the site and sample preparation cost in character string 0113 is based on a $25 per hour charge rate for a site maintenance crew member to cut any vegetation during an 8-hour workday.

6.4 MOBILE LA-ICP/AES LABORATORY

The Mobile Demonstration Laboratory for Environmental Screening Technologies (MDLEST), currently demonstrating the LA-ICP/AES, is being developed by Marvin Anderson and Thomas Noble at the Ames Laboratory/Iowa State University. Referring to character string 0120 on the general cost summary in Appendix A, the total direct equipment cost for the mobile LA-ICP/AES Laboratory is $496,100 (Table 1). The equipment costs are broken down into three major areas: 1) instrumentation and automation, 2) the utilities to house and operate the equipment, and 3) safety equipment and training. The instrumentation and automation includes the AES, ICP, Nd-Yag laser, laser rastering system, laser focusing and optics, microwave dissolution system, four computers (three 386s and one 486), an ink jet printer, multicolor plotter, computer software, and an optical disk and drive. The utilities to house and operate the equipment include a 44-ft, fifth-wheel trailer, diesel truck, diesel generator, 1.5 horsepower water chiller, robotic accessory trailer, radio communications system, closed circuit television system, cellular telephone, and automatic valves and sensors. Safety equipment and training includes a commercial driver's license, Occupational Safety and Health Administration (OSHA) Hazardous Operations Waste Training, laser eye protection, window curtains, a hazardous gas detector, and a radio activity counter.

The daily operating costs (character string 0121) for this technology total $1840. The personnel rate of $200 per hour is based on four properly trained Ames technicians ($50/hour, including overhead) working in the mobile laboratory and the field. At the Fernald characterization demonstration conducted in the fall of 1992, Anderson stated that the hourly charge rate for personnel was $600. However, this figure reflects the salaries of more than four personnel and does not represent improvements to the mobile laboratory system implemented since the demonstration, which have helped lower the personnel rate to $200 per hour. Once the mobile laboratory is set up at the site, the hourly cost for operation is $30, resulting in a daily rate of $240. This includes generator fuel, truck fuel, instrumentation gases, cellular phone use, standard samples, and minor repair and maintenance costs for instrumentation, utility systems, and the truck and trailer.

The daily maintenance and replacement costs for the mobile ICP/AES laboratory are shown in character string 0122. Major repairs that require a manufacturer's representative should be

infrequent, and the cost for parts and labor was estimated at $10,000 per year. However, it should be noted that the current technology in the MDLEST, the LA-ICP/AES, has not needed any major repairs, so this is just an estimate. Assuming this equipment is used 200 days per year, the daily maintenance cost would be $50 ($10,000/200). The daily replacement cost for the instrumentation, assuming a useful life of 4 years, is $392. This value is based on a present value of $257,700 for the instrumentation components. Therefore, the total direct daily maintenance cost for the mobile ICP/AES laboratory is $442 ($50 + $392).

For site and sample preparation costs, a 12 in. × 12 in. sampling site is scraped bare of all vegetation, and large rocks are removed. The estimated cost for this effort is $16 per hour or approximately $4 per sampling site times the number of sampling sites, resulting in a daily rate of $128.

7. SCENARIO EVALUATIONS FOR THE FIELD SCREENING TECHNOLOGIES

A scenario evaluation was included in the cost input questionnaires sent to the developers of the field screening technologies to determine the cost to adequately characterize a hypothetical 1-acre site in a given timeframe. The hypothetical site was used as a storage area for uranium-contaminated scrap metal and drums containing mill tailings. Five years ago, the material and drums were removed, no remedial action was conducted, and the site was abandoned. The developers of the four technologies were given a maximum of 24 hours (three 8-hour working days) for sampling and other activities believed necessary to adequately characterize the site using their field screening technology. It is important to note that each developer was responsible for determining the number of samples taken (Tables 2 and 3) and the extent of sampling necessary to create an "adequate" characterization of the hypothetical site.

Two cost analysis reports were created for each technology based on responses to the scenario evaluation in the cost input questionnaire. The report, *Scenario Evaluation—Cost per Sample*, includes the costs associated with adequately characterizing the hypothetical site once the crew is set up and ready to begin characterizing the site. This estimate excludes all transportation,

lodging, and per diem costs for the crews operating the technology. The cost estimate reflects the minimum time that personnel need to be in the field while characterizing the site.

The second scenario cost analysis report, *Scenario Evaluation—Total Expected Cost*, includes the total costs to characterize the hypothetical site if an interested party asked each of the developers of the field screening technologies to provide a bid for site characterization. This report reflects a more realistic cost estimate than its counterpart: the *Scenario Evaluation—Cost Per Sample* report. The *Total Expected Cost* report includes the total cost to characterize the site from start to finish, or, in other words, from the time the technology developers leave their facility for the hypothetical site until they complete the characterization and return to their original destination. Therefore, travel costs and personnel salaries for the travel days to and from the site were included in the cost estimates. In addition, the labor cost for the additional hours personnel are required to be on the site were included in the *Total Expected Cost* scenario evaluation reports. For example, the technology developer stated that the PNL scientist using the beta scintillation detector is required to be in the field for only 4 hours during the 3 days of characterization (one day for establishing the sampling grid plus 2 days of sampling) (See *Scenario Evaluation—Cost Per Sample—Beta Det.* COSTPRO report in Appendix A). However, the scientist still has to be on the site while the sampling grid is being established, as well as during the 2 days of sampling. Therefore, an additional 36 hours (16 hours for travel plus 20 hours during the 3 days of characterization) of the scientist's labor costs were included in the *Scenario Evaluation—Total Expected Cost-Beta* COSTPRO report for the beta scintillation detector.

7.1 BETA SCINTILLATION DETECTOR

The developer of the beta scintillation detector reported that it would take 3 days to adequately characterize the hypothetical 1-acre site in the scenario evaluation. A PNL technician requires one day to establish a sampling grid and locate approximately 100 evenly spaced sample locations. The remaining 2 days would be devoted to sampling the site, including 16 hours for a PNL technician to collect the samples (including physically moving the sensor) and 4 hours for data reduction requirements by the PNL scientist. Referring to the *Scenario Evaluation—Cost Per Sample—Beta Det.* report in Appendix A, the minimum total direct cost (excluding travel and associated personnel costs shown in the total expected cost report) for characterizing the site is

$2438, or $24.38 per sample (2438/100). Adding a 20% contingency rate for any uncertainties associated with the project results in a total cost of $2926, or $29.26 per sample (2926/100). A summary of the *Scenario Evaluation—Cost Per Sample* report for each field screening technology is provided in Table 2.

The *Scenario Evaluation—Total Expected Cost—Beta* COSTPRO report includes 2 days of round trip travel costs since the site was assumed to be 250 miles from the developer's facility location. These travel costs include lodging for 4 nights, per diem for 5 days, and transportation in a company van for the two-member crew needed to operate the technology. In addition, 2 days (16 hours) at the PNL technician labor rate were included for the required travel days. Thirty-six hours of labor time for the PNL scientist were also included in the cost estimate because of the 2 travel days (16 hours) and the additional time (20 hours) that the scientist is on the site while the sampling grid is being established and during sampling. Referring to the *Scenario Evaluation—Total Expected Cost—Beta* report in Appendix A, the total direct cost to characterize the hypothetical 1-acre site for this scenario is $8898, or $88.98 per sample (8898/100). Applying a contingency rate of 20% to this figure results in a total cost of $10,678, or $106.78 per sample (10,678/100). A summary of the *Scenario Evaluation—Total Expected Cost* report for each field screening technology is provided in Table 3.

7.2 IN SITU GAMMA DETECTOR

The developer of the in situ gamma detector reported that it would take 2 days to adequately characterize the hypothetical 1-acre site in the scenario evaluation. A PNL technician requires one day to establish a sampling grid and locate approximately 20 evenly spaced sample locations. The technology developer stated that only one day of sampling was required to provide an adequate sampling of the site. During this one day of sampling, 3 hours are required for the PNL technician to collect the 20 samples and 2 hours are required for the PNL scientist to provide the data reduction. Referring to the *Scenario Evaluation—Cost Per Sample—Gamma Det.* report in Appendix A, the minimum total direct cost (excluding travel and associated personnel costs, etc.) for characterizing the site is $1083, or $54.15 per sample (1083/20). Adding a 20% contingency rate for any uncertainties associated with the project results in a total project cost of $1300, or $65.00 per sample (1300/20) (Table 2).

Table 2. Scenario evaluation—cost per sample

PARAMETER	CHARACTERIZATION TECHNOLOGY			
	Beta Scintillation Detector	**In Situ Gamma Detector**	**Long-Range Alpha Detector**	**Mobile LA-ICP/AES Laboratory**
Number of samples taken	100	20	100	44
Direct cost to characterize 1-acre site	$2438	$1083	$5560	$10,225
Cost per sample	**$24.38**	**$54.15**	**$55.60**	**$232.39**
Cost to characterize 1-acre site with 20% contingency	$2926	$1300	$6672	$12,270
Cost per sample, including 20% contingency	**$29.26**	**$65.00**	**$66.72**	**$278.86**

Note: The values shown for each screening technology are from the cost analysis reports, entitled *Scenario Evaluation—Cost Per Sample*, for each technology. This scenario represents the costs associated with adequately characterizing the hypothetical 1-acre site once the crew is setup and ready to begin characterization. These estimates exclude all transportation, lodging, and per diem costs for the crews operating the characterization technologies. In addition, these cost estimates reflect the minimum time that personnel need to be in the field while characterizing the site.

Table 3. Scenario evaluation—total expected cost

PARAMETER	CHARACTERIZATION TECHNOLOGY			
	Beta Scintillation Detector	In Situ Gamma Detector	Long-Range Alpha Detector	Mobile LA-ICP/AES Laboratory
Number of samples taken	100	20	100	44
Direct cost to characterize 1-acre site	$8898	$6973	$12,900	$15,465
Cost per sample	**$88.98**	**$348.65**	**$129.00**	**$351.48**
Cost to characterize 1-acre site with 20% contingency	$10,678	$8368	$15,480	$18,558
Cost per sample, including 20% contingency	**$106.78**	**$418.40**	**$154.80**	**$421.77**

Note: The values shown for each screening technology are from the individual cost analysis reports, entitled *Scenario Evaluation—Total Expected Cost*, for each technology. This scenario represents the total cost to characterize the hypothetical 1-acre site from start to finish, or in other words, from the time the technology developers leave their plant for the site until they complete the characterization and return to their original destination. Therefore, travel costs and personnel salaries while on travel would be included, as well as the labor cost for the additional hours personnel are required to be on the site.

The *Scenario Evaluation—Total Expected Cost—Gamma* COSTPRO report includes 2 days of round trip travel costs since the site was assumed to be 250 miles from the developer's facility location. These travel costs include lodging for 3 nights, per diem for 4 days, and transportation in a company van for the two-member crew needed to operate the technology. Twenty-one hours of labor time for the PNL technician were included in the cost estimate because of the 2 days of travel (16 hours) and the additional 5 hours he or she is on the site during the day of sampling. Additionally, 30 hours of labor time for the PNL scientist were included because of the 2 travel days (16 hours) and the additional 14 hours he or she is on the site while the sampling grid is being set up and during sampling. Referring to the *Scenario Evaluation—Total Expected Cost—Gamma* report in Appendix A, the total direct cost to characterize the hypothetical 1-acre site for this scenario is $6973, or $348.65 per sample (6973/20). Applying a contingency rate of 20% to this figure results in a total project cost of $8368, or $418.40 per sample (8368/20) (Table 3).

7.3 LONG-RANGE ALPHA DETECTOR

The developer of the long-range alpha detector reported that it would take 4 days to adequately characterize the hypothetical 1-acre site in the scenario evaluation—one day to establish the sampling grid and locate sample sites and 3 days to sample the site. An LANL technician requires one day to set up the sampling grid and locate approximately 100 sample locations. During the 3 days of sampling, the technician would drive the tractor and move the detector equipment, and the LANL scientist would collect readings, record the data, and plot these data at the end of each sampling day. Referring to the *Scenario Evaluation—Cost Per Sample—LRAD* report in Appendix A, the minimum total direct cost (excluding travel and associated personnel costs, etc.) for characterizing the site is $5560, or $55.60 per sample (5560/100). Adding a 20% contingency rate for any uncertainties results in a total cost of $6672, or $66.72 per sample (6672/100) (Table 2).

As with the scenario evaluations for the other technologies, the *Scenario Evaluation—Total Expected Cost—LRAD* report includes 2 days of round trip travel costs for the two-member LANL crew needed to operate the technology. These travel costs include lodging for 5 nights, per diem for 6 days, and transportation in a rental vehicle large enough to house the equipment (a U-Haul was used to transport the equipment to the Fernald site for the characterization study

in the fall of 1992). Two days (16 hours) of labor time for the LANL technician were included because of the required travel days. In addition, 24 hours of labor time for the LANL scientist were included in the cost estimate because of the 2 travel days (16 hours) and the additional 8 hours he or she is on the site while the sampling grid is being established. Referring to the *Scenario Evaluation—Total Expected Cost—LRAD* report in Appendix A, the total direct cost to characterize the hypothetical 1-acre site for this scenario is $12,900, or $129.00 per sample (12,900/100). Applying a contingency rate of 20% to cover any uncertainties results in a total project cost of $15,480, or $154.80 per sample (15,480/100) (Table 3).

7.4 MOBILE LA-ICP/AES LABORATORY

The developer of the MDLEST LA-ICP/AES reported that it would take 3 days to adequately characterize the hypothetical 1-acre site in the scenario evaluation. The item one direct cost of $13,200 shown on both COSTPRO scenario evaluation cost estimates includes: 1) salaries for the 4 personnel required to operate this technology for 5 days (3 days of field work and 2 travel days) and 2) laboratory and equipment amortization. Field work involves first developing a grid of 12 m × 12 m squares on the 1-acre site. Forty-four samples are then collected and analyzed in the mobile laboratory during the 3-day period. Referring to the *Scenario Evaluation—Cost Per Sample—LA-ICP/AES* report, 64 hours for the four technicians' 2 days of travel (2 days x 8 hours x 4 personnel) were subtracted from the cost estimate because travel costs were not included in any of the *Cost Per Sample* reports. The technology developer stated that the labor rate for a properly trained Ames technician was $50 per hour (including overhead). The total maintenance costs were used in the scenario evaluations for the other three field screening technologies. The total maintenance costs include the replacement costs for the equipment plus the daily maintenance costs to operate the equipment. However, for the MDLEST LA-ICP/AES technology, only the daily maintenance cost of $50 is included in the scenario cost estimates because the replacement cost for the instrument is covered under the laboratory amortization cost in item one of the scenario evaluations. Referring to the *Scenario Evaluation—Cost Per Sample—LA-ICP/AES* report in Appendix A, the minimum total direct cost (excluding travel and associated personnel costs, etc.) for characterizing the site is $10,225, or $232.39 per sample (10,225/44). Adding a 20% contingency rate for any uncertainties associated with the project results in a total cost of $12,270, or $278.86 per sample (12,270/44) (Table 2).

The *Scenario Evaluation—Total Expected Cost—LA-ICP/AES* COSTPRO report includes 2 days of round trip travel costs for the four-member Ames Laboratory crew needed to operate the technology. The labor cost for the four personnel during the 2 days of travel is included in the item one cost of $13,200. Other travel costs include lodging for 4 nights, per diem for 5 days, and transportation for the four Ames personnel. Two Ames technicians can travel in the diesel truck that pulls the fifth-wheel mobile laboratory and the other two personnel can use a company truck or van to travel to the site. Referring to the *Scenario Evaluation—Total Expected Cost—LA-ICP/AES* report in Appendix A, the total direct cost to characterize the hypothetical 1-acre site for this scenario is $15,465, or $351.48 per sample (15,465/44). Applying a 20% contingency rate for any uncertainties associated with the project results in a total cost of $18,558, or $421.77 per sample (18,558/44) (Table 3).

8. SUMMARY

This document describes the methodology used to develop the cost analysis reports for the uranium field screening technologies demonstrated in the fall of 1992 at the Fernald site for the Uranium-in-Soils ID. This work was conducted by Performance Assessment Group members at ORNL in support of TTP AL231007, "Cost/Risk Performance Assessment of Soil Characterization." Cost input questionnaires were developed and sent to the developers of the field screening technologies. After review of the questionnaires and verbal communication with each technology developer, cost estimates were developed for each technology. These estimates are subject to updates and revisions in the future as development of the field screening technologies continues for the Uranium-in-Soils ID.

COSTPRO, a commercial rewrite of the LANL's cost estimating system, was the computer software package used to create the cost estimates. Three cost analysis reports were created for each technology. The first report shows the technologies' expected costs, including its total direct equipment cost, daily operating cost, daily maintenance cost, and daily site and sample preparation cost. The other two reports were created based on the information gathered from a scenario evaluation included in the cost input questionnaire. The technology developers were given 24 hours (three 8-hour working days) to adequately characterize the hypothetical 1-acre uranium-contaminated site, which is located 250 miles away from the developers' facility. Each

developer was responsible for determining the extent of sampling necessary and the number of samples taken to create an "adequate" characterization of the hypothetical site. The report, *Scenario Evaluation—Cost Per Sample*, includes the cost to characterize the site once the crew is setup and ready to begin characterization. This estimate excludes all transportation, lodging, and per diem costs for the crews operating the technology, and it reflects the minimum time that personnel need to be in the field while characterizing the site. The second report created from the scenario evaluation, *Scenario Evaluation—Total Expected Cost*, includes the total costs to characterize the hypothetical site from start to finish, or in other words, from the time the technology developers leave their facility for the hypothetical site until they complete the characterization and return to their original destination. The cost estimate includes travel, lodging, and per diem costs, as well as labor costs for personnel while they are travelling and the additional hours the personnel are required to be in the field.

The following expected costs for the **beta scintillation detector**, as well as the expected costs for the other three technologies, include a 10% contingency rate for any uncertainties or unforeseen occurrences associated with this technology:

Direct Equipment Cost	=	$16,500
Daily Operating Cost	=	$1144
Daily Maintenance Cost (includes maintenance and future value replacement costs)	=	$43
Daily Site and Sample Preparation Cost	=	$220

The scenario evaluation cost estimate for the beta detector, as well as the scenario cost estimates for the other three technologies, includes a 20% contingency rate for any uncertainty associated with the scenario:

Scenario Evaluation—Cost Per Sample:

Total Cost to Characterize 1-acre Site	=	$2926
Cost Per Sample (100 samples taken)	=	$29.26

Beta Scintillation Detector costs (continued):

Scenario Evaluation—Total Expected Cost:

Total Cost to Characterize 1-acre Site	=	$10,678
Cost Per Sample (100 samples taken)	=	$106.78

The following costs are for the **in situ gamma detector**:

Direct Equipment Cost	=	$44,000
Daily Operating Cost	=	$1155
Daily Maintenance Cost	=	$80
Daily Site and Sample Preparation Cost	=	$0

Scenario Evaluation—Cost Per Sample:

Total Cost to Characterize 1-acre Site	=	$1300
Cost Per Sample (20 samples taken)	=	$65.00

Scenario Evaluation—Total Expected Cost:

Total Cost to Characterize 1-acre Site	=	$8368
Cost Per Sample (20 samples taken)	=	$418.40

The following costs are for the **long-range alpha detector**:

Direct Equipment Cost	=	$25,300
Daily Operating Cost	=	$1716
Daily Maintenance Cost	=	$44
Daily Site and Sample Preparation Cost	=	$220

Scenario Evaluation—Cost Per Sample:

Total Cost to Characterize 1-acre Site	=	$6672
Cost Per Sample (100 samples taken)	=	$66.72

Long-Range Alpha Detector costs (continued):

Scenario Evaluation—Total Expected Cost:

Total Cost to Characterize 1-acre Site	=	$15,480
Cost Per Sample (100 samples taken)	=	$154.80

The following costs are for the **mobile LA-ICP/AES laboratory**:

Direct Equipment Cost	=	$545,710
Daily Operating Cost	=	$2024
Daily Maintenance Cost	=	$486
Daily Site and Sample Preparation Cost	=	$141

Scenario Evaluation—Cost Per Sample:

Total Cost to Characterize 1-acre Site	=	$12,270
Cost Per Sample (44 samples taken)	=	$278.86

Scenario Evaluation—Total Expected Cost:

Total Cost to Characterize 1-acre Site	=	$18,558
Cost Per Sample (44 samples taken)	=	$421.77

APPENDIX A

COST ANALYSIS REPORTS FOR THE FIELD SCREENING TECHNOLOGIES

PF File: lradcone.PR
TO File: lradcone.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 4 characters

Job Number: 1 Change Order Number: 14:58:45 11/ 4/93
Project Title: Uranium Soils ID:Expected costs- LR Alpha Detector Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	0110		lra				0	0	Tractor to transport detector in the field - base price	1.0 ea		0.00	0.	14000.00	14000.	0.00	0.	0.	14000.
2	0110		lra				0	0	Computer for the electronics	1.0 ea		0.00	0.	3000.00	3000.	0.00	0.	0.	3000.
3	0110		lra				0	0	Electrometer for the electronics	1.0 ea		0.00	0.	3000.00	3000.	0.00	0.	0.	3000.
4	0110		lra				0	0	Miscellaneous electronics equipment	1.0 ea		0.00	0.	1000.00	1000.	0.00	0.	0.	1000.
5	0110		lra				0	0	Power supply (power invertor & storage batteries)	1.0 ea		0.00	0.	1000.00	1000.	0.00	0.	0.	1000.
6	0110		lra				0	0	Detector component parts which make up detector assembly	1.0 ea		0.00	0.	1000.00	1000.	0.00	0.	0.	1000.
	0110								Category Direct Cost				0.		23000.		0.	0.	23000.
7	0111		lra				0	0	Daily rate for technician/operator from LANL	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
8	0111		lra				0	0	Daily rate for scientist/spectro-scopist from LANL	8.0 hr		125.00	1000.	0.00	0.	0.00	0.	0.	1000.
	0111								Category Direct Cost				1560.		0.		0.	0.	1560.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	- - Labor - - Factor	Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
9	0112		lra				0	0	Daily Replacement costs for detector & power sup.-used 5 yr	1.0 day		0.00	0.	3.00	3.	0.00	0.	0.	3.
10	0112		lra				0	0	Daily Replacement cost for electronics 200 days/yr & 2.5 yr	1.0 day		0.00	0.	16.00	16.	0.00	0.	0.	16.
11	0112		lra				0	0	Daily Maintenance costs for LRAD Assume used 200 d/yr	1.0 day		0.00	0.	10.00	10.	0.00	0.	0.	10.
13	0112		lra				0	0	Daily Replacement costs for tractor 200 days/yr & 10 yrs	1.0 day		0.00	0.	11.00	11.	0.00	0.	0.	11.
	0112								Category Direct Cost				0.		40.		0.	0.	40.
12	0113		lra				0	0	Daily rate to crop grass and weeds at each sample location	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
	0113								Category Direct Cost				200.		0.		0.	0.	200.
									Project Direct Cost				1760.		23040.		0.	0.	24800.

PF File: lradcone.PR
TO File: lradcone.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 4 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 14:58:45 11/ 4/93
Project Title: Uranium Soils ID:Expected costs- LR Alpha Detector Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
0110	Equipment costs - L.R. Alpha Detector	0.0000	0.0000	0.0000	0.1000	23000.	0.	0	0	23000.	2300	25300.
0111	Daily Operating Costs-Alpha Detector	0.0000	0.0000	0.0000	0.1000	1560.	0.	0	0	1560.	156	1716.
0112	Daily Maintenance Costs-Alpha Detector	0.0000	0.0000	0.0000	0.1000	40.	0.	0	0	40.	4	44.
0113	Daily Site and Sample Prep-Alpha D.	0.0000	0.0000	0.0000	0.1000	200.	0.	0	0	200.	20	220.
								0	0	0	2480	
	Project Total Cost					24800.	0.			24800.		27280.

PF File: scencsad.PR
TO File: scencsad.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15: 5:41 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - LRAD Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	- - Labor - - Factor	Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		lra				0	0	Crop grass and weeds to 1 inch high for the 1-acre site	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
2	01		lra				0	0	Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
3	01		lra				0	0	Cost for technician to drive tractor & move detector-3 days	24.0 hr		70.00	1680.	0.00	0.	0.00	0.	0.	1680.
4	01		lra				0	0	Cost for scientist-data reduction & 100 samples taken-3 days	24.0 hr		125.00	3000.	0.00	0.	0.00	0.	0.	3000.
5	01		lra				0	0	Maintenance costs associated with LRAD Used 3 days	3.0 day		0.00	0.	40.00	120.	0.00	0.	0.	120.
	01								Category Direct Cost				5440.		120.		0.	0.	5560.
									Project Direct Cost				5440.		120.		0.	0.	5560.

PF File: scencsad.PR
TO File: scencsad.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
secondary Subtotals on 0 Charscters

Job Number: 1 Change Order Number: 15: 5:41 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - LRAD Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	PM	EDhI	Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	PM	ED&I Subtotal	Cont	Category Total Cost
01	Cost/sample to characterize 1-acre site	0.0000	0.0000	0.0000	0.2000	5560.		0.	0	0 5560.	0 1112	6672.
								0	0	0	1112	
	Project Total Cost					5560.		0.		5560.		6672.

PF File: scenlrad.PR
TO File: scenlrad.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:11:25 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - LRAD Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	- - Labor - - Factor	Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		lra			0	0		Crop grass and weeds to 1 inch high for the 1-acre site	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
2	01		lra			0	0		Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
3	01		lra			0	0		Cost for technician to drive tractor & move detector-3 days	24.0 hr		70.00	1680.	0.00	0.	0.00	0.	0.	1680.
4	01		lra			0	0		Cost for scientist-data reduction & 100 samples taken-3 days	24.0 hr		125.00	3000.	0.00	0.	0.00	0.	0.	3000.
5	01		lra			0	0		Maintenance costs associated with LRAD Used 3 days	3.0 day		0.00	0.	40.00	120.	0.00	0.	0.	120.
6	01		lra			0	0		Transportation costs to site, assuming 500 miles round trip	500.0 mile		0.00	0.	0.28	140.	0.00	0.	0.	140.
7	01		lra			0	0		Transportation costs to rent vehicle(s) to transport to site	1.0 ea		0.00	0.	2000.00	2000.	0.00	0.	0.	2000.
8	01		lra			0	0		Lodging costs for 2 crew members for 5 nights at $60/day	5.0 day		0.00	0.	120.00	600.	0.00	0.	0.	600.
9	01		lra			0	0		Perdiem costs for 2 crew members for 6 days at $40/day	6.0 day		0.00	0.	80.00	480.	0.00	0.	0.	480.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
10	01		lra				0	0	Personnel costs for the 2 days of travel for LANL technician	16.0 hr		70.00	1120.	0.00	0.	0.00	0.	0.	1120.
11	01		lra				0	0	Additional hours for scientist while on the site and travel	24.0 hr		125.00	3000.	0.00	0.	0.00	0.	0.	3000.
	01								Category Direct Cost				9560.		3340.		0.	0.	12900.
									Project Direct Cost				9560.		3340.		0.	0.	12900.

PF File: scenlrad.PR
TO File: scenlrad.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:11:25 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - LRAD Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
01	Costs-Characterize	0.0000	0.0000	0.0000	0.2000			0	0	0	2580	
	1-acre site in 24 hr					12900.	0.			12900.		15480.
								0	0	0	2580	
	Project Total Cost					12900.	0.			12900.		15480.

PF File: betacone.PR
TO File: betacone.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 4 characters

Job Number: 1 Change Order Number: 15:17:16 11/ 4/93
Project Title: Uranium Soils ID:Expected costs-Beta Scin. Detect. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	- - Labor - - Factor	Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	0100		Bet				0	0	Fibers for the sensor	1.0 ea		0.00	0.	1225.00	1225.	0.00	0.	0.	1225.
2	0100		Bet				0	0	Scalers for the external electronics	1.0 ea		0.00	0.	3500.00	3500.	0.00	0.	0.	3500.
11	0100		Bet				0	0	Photomultiplier tubes for the sensor	1.0 ea		0.00	0.	3550.00	3550.	0.00	0.	0.	3550.
12	0100		Bet				0	0	Amplifiers/Preamps. for the sensor	1.0 ea		0.00	0.	225.00	225.	0.00	0.	0.	225.
13	0100		Bet				0	0	Coincidence modules for the external electonics	1.0 ea		0.00	0.	1750.00	1750.	0.00	0.	0.	1750.
14	0100		Bet				0	0	Signal Processing Package for the external electronics	1.0 ea		0.00	0.	4750.00	4750.	0.00	0.	0.	4750.
	0100								Category Direct Cost				0.		15000.		0.	0.	15000.
7	0101		Bet				0	0	Daily rate for technician/operator from PNL	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
8	0101		Bet				0	0	Daily rate for scientist/spectro-scopist from PNL	4.0 hr		120.00	480.	0.00	0.	0.00	0.	0.	480.
	0101								Category Direct Cost				1040.		0.		0.	0.	1040.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	- - Labor - - Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
3	0102		Bet				0	0	Daily Replacement costs for sensor eq. 200 days/yr & 5 yrs	1.0 day		0.00	0.	6.00	6.	0.00	0.	0.	6.
4	0102		Bet				0	0	Daily Replacement cost for electronics 200 days/yr & 2.5 yr	1.0 day		0.00	0.	23.00	23.	0.00	0.	0.	23.
9	0102		Bet				0	0	Daily maintenance costs for Beta Det. Assume used 200 d/yr	1.0 day		0.00	0.	10.00	10.	0.00	0.	0.	10.
	0102								Category Direct Cost				0.		39.		0.	0.	39.
10	0103		Bet				0	0	Daily rate to crop grass and weeds at each sample location	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
	0103								Category Direct Cost				200.		0.		0.	0.	200.
									Project Direct Cost				1240.		15039.		0.	0.	16279.

PF File: betacone.PR
TO File: betacone.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 4 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:17:16 11/ 4/93
Project Title: Uranium Soils ID:Expected costs-Beta Scin. Detect. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	PM	ED&I	Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	PM	ED&I Subtotal	Cont	Category Total Cost
0100	Equipment costs - Beta Detector	0.0000	0.0000	0.0000	0.1000	15000.	0.	0	0	15000.	1500	16500.
0101	Daily Operating Costs-Beta Detector	0.0000	0.0000	0.0000	0.1000	1040.	0.	0	0	1040.	104	1144.
0102	Daily Maintenance Costs-Beta Detector	0.0000	0.0000	0.0000	0.1000	39.	0.	0	0	39.	3	43.
0103	Daily Site and Sample Prep-Beta Det	0.0000	0.0000	0.0000	0.1000	200.	0.	0	0	200.	20	220.
								0	0	0	1627	
	Project Total Cost					16279.	0.			16279.		17907.

PF File: scencsbd.PR
TO File: scencsbd.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:22:47 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - Beta Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	- - Labor - - Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		Bet				0	0	Crop grass and weeds to 1 inch high for the 1-acre site	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
2	01		Bet				0	0	Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
3	01		Bet				0	0	Cost to establish & take approx. 100 samples-PNL operator	16.0 hr		70.00	1120.	0.00	0.	0.00	0.	0.	1120.
4	01		Bet				0	0	Cost to provide data reduction from PNL scientist	4.0 hr		120.00	480.	0.00	0.	0.00	0.	0.	480.
5	01		Bet				0	0	Maintenance costs associated with beta detector-used 2 days	2.0 day		0.00	0.	39.00	78.	0.00	0.	0.	78.
	01								Category Direct Cost				2360.		78.		0.	0.	2438.
									Project Direct Cost				2360.		78.		0.	0.	2438.

PF File: scencsbd.PR
TO File: scencsbd.TA

Martin Marietta Energy Systems
Oak Ridge. Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:22:47 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - Beta Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	PM	ED&I	Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	PM	ED&I Subtotal	Cont	Category Total Cost
01	Cost/sample to char-	0.0000	0.0000	0.0000	0.2000			0	0	0	487	
	acterize 1-acre site					2438.	0.			2438.		2926.
								0	0	0	487	
	Project Total Cost					2438.	0.			2438.		2926.

PF File: scenbeta.PR
TO File: scenbeta.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:28:41 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - Beta Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	- - Labor - - Factor	Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		Bet				0	0	Crop grass and weeds to 1 inch high for the 1-acre site	8.0 hr		25.00	200.	0.00	0.	0.00	0.	0.	200.
2	01		Bet				0	0	Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
3	01		Bet				0	0	Cost to establish & take approx. 100 samples-PNL operator	16.0 hr		70.00	1120.	0.00	0.	0.00	0.	0.	1120.
4	01		Bet				0	0	Cost to provide data reduction from PNL scientist	4.0 hr		120.00	480.	0.00	0.	0.00	0.	0.	480.
5	01		Bet				0	0	Maintenance costs associated with beta detector-used 2 days	2.0 day		0.00	0.	39.00	78.	0.00	0.	0.	78.
6	01		Bet				0	0	Transportation costs to site, assuming 500 miles round trip	500.0 mile		0.00	0.	0.28	140.	0.00	0.	0.	140.
7	01		Bet				0	0	Lodging costs for 2 crew members for 4 nights at $60/day	4.0 day		0.00	0.	120.00	480.	0.00	0.	0.	480.
8	01		Bet				0	0	Perdiem costs for 2 crew members for 5 days at $40/day	5.0 day		0.00	0.	80.00	400.	0.00	0.	0.	400.
9	01		Bet				0	0	Personnel costs for the 2 days of travel for PNL technician	16.0 hr		70.00	1120.	0.00	0.	0.00	0.	0.	1120.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	- - Labor - - Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
10	01		Bat				0	0	Additional hours for scientist while on the site and travel	36.0 hr		120.00	4320.	0.00	0.	0.00	0.	0.	4320.
	01								Category Direct Cost				7800.		1098.		0.	0.	8898.
									Project Direct Cost				7800.		1098.		0.	0.	8898.

PF File: scenbeta.PR
TO File: scenbeta.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:28:41 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - Beta Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
01	Costs-Characterize	0.0000	0.0000	0.0000	0.2000			0	0	0	1779	
	1-acre site in 24 hr					8898.	0.			8898.		10678.
								0	0	0	1779	
	Project Total Cost					8898.	0.			8898.		10678.

PF File: gammacon.PR
TO File: gammacon.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 4 characters

Job Number: 1 Change Order Number: 15:37:19 11/ 4/93
Project Title: Uranium Soils ID:Expected costs-In-Situ Gamma Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	0130		Gam		0		0	0	High Purity Germani. Detector, including liquid nitro reserv.	1.0 ea		0.00	0.	27500.00	27500.	0.00	0.	0.	27500.
2	0130		Gam		0		0	0	Multichannel analyzer for the electronics	1.0 ea		0.00	0.	4650.00	4650.	0.00	0.	0.	4650.
3	0130		Gam		0		0	0	Software - Data Acquisition and reduction software	1.0 ea		0.00	0.	2000.00	2000.	0.00	0.	0.	2000.
4	0130		Gam		0		0	0	Support tripod for the high purity germanium detector	1.0 ea		0.00	0.	500.00	500.	0.00	0.	0.	500.
5	0130		Gam		0		0	0	Bias supply for the electronics	1.0 ea		0.00	0.	3025.00	3025.	0.00	0.	0.	3025.
6	0130		Gam		0		0	0	Amplifier for the electronics	1.0 ea		0.00	0.	2325.00	2325.	0.00	0.	0.	2325.
	0130								Category Direct Cost				0.		40000.		0.	0.	40000.
7	0131		Gam		0		0	0	Daily rate for technician/operator from PNL	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
8	0131		Gam		0		0	0	Daily rate for scientist/spectro-scopist from PNL	4.0 hr		120.00	480.	0.00	0.	0.00	0.	0.	480.
9	0131		Gam		0		0	0	Liquid nitrogen used daily - Approx. $0.85/L & 20 L/wk	1.0 day		0.00	0.	5.00	5.	0.00	0.	0.	5.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct cost	Item Direct cost
10	0131		Gam				0	0	Gloves and Face Shield-for nitrogen $100/pair-month repl	1.0 day		0.00	0.	5.00	5.	0.00	0.	0.	5.
	0131								Category Direct Cost				1040.		10.		0.	0.	1050.
11	0132		Gam				0	0	Daily Replacement costa for detector 200 days/yr & 5 yrs	1.0 day		0.00	0.	36.00	36.	0.00	0.	0.	36.
12	0132		Gam				0	0	Daily Maintenance costs for Gamma Dst. Assume used 200 d/yr	1.0 day		0.00	0.	10.00	10.	0.00	0.	0.	10.
14	0132		Gam				0	0	Daily Replacement cost-electronics and software-used 2.5 yr	1.0 day		0.00	0.	27.00	27.	0.00	0.	0.	27.
	0132								Category Direct Cost				0.		73.		0.	0.	73.
13	0133		Gam				0	0	Daily site and sample preparation costs for gamma det.	0.0		0.00	0.	0.00	0.	0.00	0.	0.	0.
	0133								Category Direct Cost				0.		0.		0.	0.	0.
									Project Direct Cost				1040.		40083.		0.	0.	41123.

PF File: gammacon.PR
TO File: gammacon.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 4 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:37:19 11/ 4/93
Project Title: Uranium Soils ID:Expected costs-In-Situ Gamma Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
0130	Equipment costs - Gamma Detector	0.0000	0.0000	0.0000	0.1000	40000.	0.	0	0	40000.	4000	44000.
0131	Daily Operating Costs-Gamma Detector	0.0000	0.0000	0.0000	0.1000	1050.	0.	0	0	1050.	105	1155.
0132	Daily Maintenance Costs-Gamma Detector	0.0000	0.0000	0.0000	0.1000	73.	0.	0	0	73.	7	80.
								0	0	0	4112	
	Project Total Cost					41123.	0.			41123.		45235.

PF File: scencsgd.PR
TO File: scencsgd.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:46: 4 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - Gamma Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		Gam				0	0	Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
2	01		Gam				0	0	Cost to establish & take approx. 20 samples-PNL operator	3.0 hr		70.00	210.	0.00	0.	0.00	0.	0.	210.
3	01		Gam				0	0	Cost to provide data reduction from PNL scientist	2.0 hr		120.00	240.	0.00	0.	0.00	0.	0.	240.
4	01		Gam				0	0	Maintenance costs for the gamma detector-used 1 day	1.0 day		0.00	0.	73.00	73.	0.00	0.	0.	73.
	01								Category Direct Cost				1010.		73.		0.	0.	1083.
									Project Direct Cost				1010.		73.		0.	0.	1083.

PF File: scencsgd.PR
TO File: scencsgd.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:46: 4 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - Gamma Det. Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
01	Cost/sample to characterize 1-acre site	0.0000	0.0000	0.0000	0.2000	1083.	0.	0	0	1083.	216	1300.
								0	0	0	216	
	Project Total Cost					1083.	0.			1083.		1300.

PF File: scengamm.PR
TO File: scengamm.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:49:38 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - Gamma Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	- - Labor - - Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		Gam				0	0	Establish sampling grid & locate sample sites	8.0 hr		70.00	560.	0.00	0.	0.00	0.	0.	560.
2	01		Gam				0	0	Cost to establish & take approx. 20 samples-PNL operator	3.0 hr		70.00	210.	0.00	0.	0.00	0.	0.	210.
3	01		Gam				0	0	Cost to provide data reduction from PNL scientist	2.0 hr		120.00	240.	0.00	0.	0.00	0.	0.	240.
4	01		Gam				0	0	Maintenance costs for the gamma detector-used 1 day	1.0 day		0.00	0.	73.00	73.	0.00	0.	0.	73.
5	01		Gam				0	0	Transportation costs to site, assuming 500 miles round trip	500.0 mile		0.00	0.	0.28	140.	0.00	0.	0.	140.
6	01		Gam				0	0	Lodging costs for 2 crew members for 3 nights at $60/day	3.0 day		0.00	0.	120.00	360.	0.00	0.	0.	360.
7	01		Gam				0	0	Perdiem costs for 2 crew members for 4 days at $40/day	4.0 day		0.00	0.	80.00	320.	0.00	0.	0.	320.
8	01		Gam				0	0	Additional hours for technician while on the site and travel	21.0 hr		70.00	1470.	0.00	0.	0.00	0.	0.	1470.
9	01		Gam				0	0	Additional hours for scientist while on the site and travel	30.0 hr		120.00	3600.	0.00	0.	0.00	0.	0.	3600.
	01								Category Direct Cost				6080.		893.		0.	0.	6973.
									Project Direct Cost				6080.		893.		0.	0.	6973.

PF File: scengamm.PR
TO File: scengamm.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:49:38 11/ 4/93
Project Title: Scenario Evaluation - Total Expected Cost - Gamma Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
01	Costs-Characterize	0.0000	0.0000	0.0000	0.2000			0	0	0	1394	
	1-acre site in 24 hr					6973.	0.			6973.		8368.
								0	0	0	1394	
	Project Total Cost					6973.	0.			6973.		8368.

PF File: icpcone.PRF
TO File: icpcone.TAK

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 4 characters

Job Number: 1 Change Order Number: 15:55:38 11/ 4/93
Project Title: Uranium Soils ID:Expected costs- MDLEST LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd cost	Const Equip Rate	Const Equip Ext'd cost	Sub Cntrct cost	Item Direct cost
1	0120		ICP	Ins		0	0		Instru. & Automation Atomic Emission Spectrometer (AES)	1.0 ea		0.00	0.	95000.00 95000.	0.	0.00	0.	0.	95000.
2	0120		ICP	Ins		0	0		Inetru. & Automation Nd - Yag laser	1.0 ea		0.00	0.	75000.00 75000.	0.	0.00	0.	0.	75000.
3	0120		ICP	Ins		0	0		Instrumentat.- Laser Rastering S. & Laser focusing & optics	1.0 ea		0.00	0.	9500.00 9500.	0.	0.00	0.	0.	9500.
4	0120		ICP	Ins		0	0		Instru. & Automation Inductively coupled argon plasma (ICP)	1.0 ea		0.00	0.	45000.00 45000.	0.	0.00	0.	0.	45000.
5	0120		ICP	Ins		0	0		Instru. h Automation Microwave dissolution system	1.0 ea		0.00	0.	17500.00 17500.	0.	0.00	0.	0.	17500.
6	0120		ICP	Ins		0	0		Instru. & Automation 3-386 pc computers	3.0 ea		0.00	0.	1300.00 3900.	0.	0.00	0.	0.	3900.
7	0120		ICP	Ins		0	0		Instru. & Automation Optical disk and drive	1.0 ea		0.00	0.	3500.00 3500.	0.	0.00	0.	0.	3500.
8	0120		ICP	Ins		0	0		Instru. & Automation Ink jet printer & Multicolor plotter	1.0 ea		0.00	0.	1200.00 1200.	0.	0.00	0.	0.	1200.
9	0120		ICP	Ins		0	0		Instru. & Automation Computer Software	1.0 ea		0.00	0.	5000.00 5000.	0.	0.00	0.	0.	5000.
10	0120		ICP	Utl		0	0		Utilities to house equipment- 44 foot 5th wheel trailer	1.0 ea		0.00	0.	136000.00 136000.	0.	0.00	0.	0.	136000.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Acct	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Labor Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
11	0120		ICP	Utl			0	0	Utilities- Diesel truck for 5th wheel trailer - 2 yr lease	1.0 ea		0.00	0.	20400.00	20400.	0.00	0.	0.	20400.
12	0120		ICP	Utl			0	0	Utilities - Diesel generator	1.0 ea		0.00	0.	10500.00	10500.	0.00	0.	0.	10500.
13	0120		ICP	Utl			0	0	Utilities - 1.5 hp Water chiller	1.0 ea		0.00	0.	8500.00	8500.	0.00	0.	0.	8500.
14	0120		ICP	Utl			0	0	Utilities - Robotic accessory trailer	1.0 ea		0.00	0.	8000.00	8000.	0.00	0.	0.	8000.
15	0120		ICP	Utl			0	0	Utilities - Radio communications system	1.0 ea		0.00	0.	8000.00	8000.	0.00	0.	0.	8000.
16	0120		ICP	Utl			0	0	Utilities - Cellular telephone	1.0 ea		0.00	0.	200.00	200.	0.00	0.	0.	200.
17	0120		ICP	Utl			0	0	Utilities - Closed circuit television system	1.0 ea		0.00	0.	9500.00	9500.	0.00	0.	0.	9500.
18	0120		ICP	Utl			0	0	Utilities - Automatic valves, sensors, etc.	1.0 ea		0.00	0.	20000.00	20000.	0.00	0.	0.	20000.
21	0120		ICP	Saf			0	0	Safety equipment and training cost for Ames technicians	1.0 ea		0.00	0.	8900.00	8900.	0.00	0.	0.	8900.
26	0120		ICP	Ins			0	0	Instru. & Automation 1-486 pc computer	1.0 ea		0.00	0.	2100.00	2100.	0.00	0.	0.	2100.
27	0120		ICP	Utl			0	0	Utilities to house and operate equip.- Miscellaneous eqpt.	1.0 ea		0.00	0.	8400.00	8400.	0.00	0.	0.	8400.
	0120								Category Direct Cost				0.		496100.		0.	0.	496100.
19	0121		ICP				0	0	Daily rate for 4 properly trained AMES technicians	32.0 hr		50.00	1600.	0.00	0.	0.00	0.	0.	1600.
20	0121		ICP				0	0	Daily operating cost Gen.& truck fuel, instr. gases, etc.	8.0 hr		30.00	240.	0.00	0.	0.00	0.	0.	240.

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	- - Labor - - Rate	Ext'd Cost	Material Rate	Ext'd Cost	Const Equip Rate	Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
	0121								Category Direct Cost				1840.		0.		0.	0.	1840.
22	0122		ICP			0	0		Minor Maintenance costs covered under $30/hr oper. cost	1.0 ea		0.00	0.	0.00	0.	0.00	0.	0.	0.
23	0122		ICP			0	0		Daily Maintenance costs for MDLEST Assume used 200 d/yr	1.0 day		0.00	0.	50.00	50.	0.00	0.	0.	50.
24	0122		ICP			0	0		Daily Replacement costs for instrument 200 days/yr & 4 yrs	1.0 day		0.00	0.	391.54	392.	0.00	0.	0.	392.
	0122								Category Direct Cost				0.		442.		0.	0.	442.
25	0123		ICP			0	0		Daily rate to scrape vegetation bare,etc. 12in x 12 in areas	8.0 hr		16.00	128.	0.00	0.	0.00	0.	0.	128.
	0123								Category Direct Cost				128.		0.		0.	0.	128.
									Project Direct Cost				1968.		496542.		0.	0.	498510.

PF File: icpcone.PRF
TO File: icpcone.TAK

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 4 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:55:38 11/ 4/93
Project Title: Uranium Soils ID:Expected costs- MDLEST LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	PM	ED&I	Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	PM	ED&I Subtotal	Cont	Category Total Cost
0120	Equipment costs -	0.0000	0.0000	0.0000	0.1000			0	0	0	49610	
	MDLEST LA-ICP/AES					496100.	0.			496100.		545710.
0121	Daily Operating	0.0000	0.0000	0.0000	0.1000			0	0	0	184	
	Costs-MDLEST ICP/AES					1840.	0.			1840.		2024.
0122	Daily Maintenance	0.0000	0.0000	0.0000	0.1000			0	0	0	44	
	Costs-MDLEST ICP/AES					442.	0.			442.		486.
0123	Daily Site and	0.0000	0.0000	0.0000	0.1000			0	0	0	12	
	Sample Prep- ICP/AES					128.	0.			128.		141.
								0	0	0	49851	
	Project Total Cost					498510.	0.			498510.		548361.

PF File: scencsic.PR
TO File: scencsic.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 charactere

Job Number: 1 Change Order Number: 15:57:10 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Brkdwn Structure 1	2	3	4	Ttd ID	Job Flag	Acct	Cntrct Markup Tag	Taka-Off Item Description	Quantity Unit	Factor	Labor Rate	Labor Ext'd cost	Material Rate	Material Ext'd cost	Const Equip Rate	Const Equip Ext'd cost	Sub Cntrct Cost	Item Direct cost
1	01		ICP				0	0	Total cost for 44 samples-grid site, salaries, lab amort.	44.0 samp		0.00	0.	300.00	13200.	*0.00*	0.	0.	13200.
2	01		ICP				0	0	Less personnel costs for 4 technicians for 2 days of travel	-64.0 hr		50.00	-3200.	*0.00*	0.	0.00	0.	0.	-3200.
3	01		ICP				0	0	Maintenance costs for the WLEST for the 3 sampling days	3.0 day		*0.00*	0.	50.00	150.	0.00	0.	0.	150.
4	01		ICP				0	0	Cost for the on-site generator fuel used in 3 sampling days	3.0 day		0.00	0.	25.00	*15.*	0.00	0.	0.	*75.*
	01								Category Direct Cost				-3200.		13425.		0.	0.	10225.
									Project Direct Cost				-3200.		13425.		0.	0.	10225.

PF File: scencsic.PR
TO File: scencsic.TA

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:57:10 11/ 4/93
Project Title: Scenario Evaluation - Cost Per Sample - LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character string	Brkdwn Category Title	Rates Eecl	PM	EDhI	Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	PM	ED&I Subtotal	Cont	category Total
01	Cost/sample to characterize 1-acre site	0.0000	0.0000	0.0000	0.2000	10225.	0.	0	0	10225.	2045	12270.
	Project Total Cost					10225.	0.	0	0	10225.	2045	12270.

PF File: scenicp.PRF
TO File: scenicp.TAK

Martin Marietta Energy Systems
Oak Ridge, Tennessee

TAKE-OFF EXTENSION

Sort: WBS1 Subtotal: 2 characters

Job Number: 1 Change Order Number: 15:58:37 11/ 4/93
Project Title: Scenario Evaluation-Total Expected Cost-LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

[Items with '#' have been adjusted by Job Factor and/or Equip Factor]

Item	Work Structure 1	2	3	4	Trd ID	Job F	Act	Cntrct Markup Tag	Take-Off Item Description	Quantity Unit	Factor	Labor Rate	Labor Ext'd Cost	Material Rate	Material Ext'd Cost	Const Equip Rate	Const Equip Ext'd Cost	Sub Cntrct Cost	Item Direct Cost
1	01		ICP				0	0	Total cost for 44 samples-grid site, salaries, lab amort.	44.0 samp		0.00	0.	300.00	13200.	0.00	0.	0.	13200.
2	01		ICP				0	0	Lodging costs for 4 crew members for 4 nights at $60/day	4.0 day		0.00	0.	240.00	960.	0.00	0.	0.	960.
3	01		ICP				0	0	Perdiem costs for 4 crew members for 5 days at $40/day	5.0 day		0.00	0.	160.00	800.	0.00	0.	0.	800.
4	01		ICP				0	0	Transportation costs for MDLEST, assuming 500 miles round trip	500.0 mile		0.00	0.	0.28	140.	0.00	0.	0.	140.
5	01		ICP				0	0	Cost for the on-site generator fuel used in 3 sampling days	3.0 day		0.00	0.	25.00	75.	0.00	0.	0.	75.
6	01		ICP				0	0	Transportation for other 2 technicians-500 miles round trip	500.0 mile		0.00	0.	0.28	140.	0.00	0.	0.	140.
7	01		ICP				0	0	Maintenance costs for the MDLEST for the 3 sampling days	3.0 day		0.00	0.	50.00	150.	0.00	0.	0.	150.
	01								Category Direct Cost				0.		15465.		0.	0.	15465.
									Project Direct Cost				0.		15465.		0.	0.	15465.

PF File: scenicp.PRF
TO File: scenicp.TAK

Martin Marietta Energy Systems
Oak Ridge, Tennessee
GENERAL COST SUMMARY

Sorted by WBS 1 Summarized on 2 Characters
Secondary Subtotals on 0 Characters

Job Number: 1 Change Order Number: 15:58:37 11/ 4/93
Project Title: Scenario Evaluation-Total Expected Cost-LA-ICP/AES Checked By:
Estimator: D. Douthat Abbrev: Location: ORNL

Character String	Brkdwn Category Title	Rates Escl	Rates PM	Rates ED&I	Rates Cont	Category Direct Cost	Category Cntrct Markup	Project Markups Escl	Project Markups PM	Project Markups ED&I Subtotal	Project Markups Cont	Category Total Cost
01	Costs-Characterize	0.0000	0.0000	0.0000	0.2000			0	0	0	3093	
	1-acre site in 24 hr					15465.	0.		15465.			18558.
								0	0	0	3093	
	Project Total Cost					15465.	0.		15465.			18558.

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