

NOV 18 1985

MEMORANDUM FOR: Malcolm R. Knapp, Chief  
Geotechnical Branch  
Division of Waste Management, NMSS

FROM: Frank A. Costanzi, Chief  
Waste Management Branch  
Division of Radiation Programs  
and Earth Sciences, RES

SUBJECT: REVIEW OF WORK PLAN FOR FIN D1003

We have reviewed the statement of work (SOW) for this project and have the following general comments:

1. Subtasks 1.1 and 1.2 appear to be a repetition of earlier research projects by the University of Arizona<sup>1</sup> and Ertec Western, Inc.<sup>2</sup> A similar compendium of exploration methods is contained in an LLNL report<sup>3</sup> on work performed for the DOE.
2. The contractor should be required to use subcontractors or consultants on an as-needed basis to provide expertise that they do not have in house.

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PDR MISC  
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NAME: EZurflueh	: AMurphy	: LBeratan	: FCostanzi	:	:	:
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Additional comments are contained in the attached mark-up of the SOW. If you have any questions on our comments, please contact E. G. Zurflueh at extension 74343.

Frank A. Costanzi, Chief  
Waste Management Branch  
Division of Radiation Programs  
and Earth Sciences, RES

Enclosure:  
Mark-up of SOW

References:

1. NUREG/CR-3143, vol. 1-4, Indirect Rock Mass Investigations for Optimizing Borehole Drilling Programs, the University of Arizona, October 1983.
2. NUREG/CR-3143, vol. 1,2, Information Needs for Characterization of High-Level Waste Repository Sites in Six Geologic Media, Ertec Western, Inc., May 1985.
3. UCRL-15141, Nuclear Waste Repository in Bedded Salt: Review of Geotechnical Measurement Techniques, Lawrence Livermore National Laboratory, 1980.

Distribution/R-2811:

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DCS/PDR	DRoss	LBeratan	FCostanzi
ESB Sbj/Rd	KGoller	EZurflueh	AMurphy

RES Files	
Subject File No.	R 2811
Task No.	
Report No.	
File No.	
NUREG No.	
Docket No.	
Rulemaking No.	
Other	
Return NRC-318	
to RES, Yes <input checked="" type="checkbox"/> No <input type="checkbox"/>	

OFC: ESB:dm	: ESB:SL	: ESB:BC <i>gld</i>	: WMB:BC	:	:	:
NAME: EZurflueh	: AMurphy	: LBeratan	: FCostanzi	:	:	:
DATE: 11/12/85	: 11/13/85	: 11/14/85	: 11/15/85	:	:	:
<i>597</i>	<i>4/100</i>					

PROJECT DESCRIPTIVE SUMMARY

DATE: August 14, 1985

PPSAS NO: 3112

PRIORITY: 1

OFFICE: NMSS

PROJECT TITLE: Technical Assistance in Geophysical Methods for Site Characterization

FIN NO: TBD

TYPE OF CONTRACT: RFP

CONTRACTOR:

ESTIMATED PERIOD OF PERFORMANCE:

PROJECT OFFICER: A. K. Ibrahim

FY BUDGET (\$K):	FY84	FY85	FY86	FY87	FY88
PRIOR:	281.9	0			
OPERATING:			125	200	150
FOLLOW-ON:					

DATES PREVIOUSLY APPROVED BY WMRG:

March 31, 1983

SCOPE OF WORK:

There are three objectives to this contract:

Objective 1:

(1) Monitor Site of M<sup>1</sup>  
The contractor will survey currently available geophysical surveying methods and data analysis techniques and prepare topical reports to be submitted to NRC.

Objective 2:

(2) Review DOE staff  
The contractor will provide technical assistance in the review and assessment of geophysical surveys (generally, regional exploration methods such as seismic reflection, aeromagnetism and gravity) performed by DOE contractors in site screening and site characterization investigations in basalt, tuff, salt, and crystalline rock. The review will assess the appropriateness and adequacy of the data acquisition and data reduction techniques employed by DOE. This task includes a review and evaluation of the applicable sections of the Site Characterization Plan (SCP) prepared by DOE for each medium.

but also, more site specific geophysical methods, such as borehole geophysics, etc.

3) *At the first meeting*  
Objective 3:

The contractor will provide direct technical assistance in the form of attendance at conferences, meetings and site visits. These conferences, meetings and site visits will relate directly to Objectives 1 and 2 and result in letter reports on and evaluations of geophysical subjects as they apply to HLW repository characterization.

USER NEED:

As stated in 10CFR60, the geologic setting for a HLW repository should exhibit an appropriate combination of conditions to provide reasonable assurance of isolation of the waste. For example, one of the conditions that may affect isolation is structural deformation (e.g., folding and faulting). Geophysical survey methods are used in characterizing such structural deformation in the near and far field of a high level nuclear waste repository.

*It is also vital that expertise in state-of-the-art geophysical techniques be applied to the review by NRC of DOE investigations of waste repository sites*  
It is vital that the NRC staff be kept informed of, and assessments be made of, new technology and of improvements in geophysical survey methods such as instrumentation, data acquisition and processing as they apply to repository siting and design. This contract will assure that the NRC staff will have up-to-date information on geophysical technology on a continuing basis and be able to apply it to site surveying and characterization evaluations.

PRODUCTS:

The contractor will provide the staff with reports of meetings and field trips; letter reports and topical reports *and a final report summarizing the contractor's evaluation of DOE's repository site reports.*

CONTINUATION OF PRODUCTS:

This project is a continuation of FIN D1003.

PRIOR AND CURRENT RELATED NRC PROJECTS:

There is one technical assistance contract, FIN D1003, "Technical Assistance in Geophysical Methods for Site Characterization", that defines and will assess geophysical methods for salt, tuff and basalt sites.

JUSTIFICATION FOR SOURCE SELECTED AND DISCUSSION OF ALTERNATIVES:

Not applicable

NRC OFFICE/REGION COORDINATION:

BENEFITS:

The products resulting from this contract will be used to assess the capabilities and limitations of geophysical methods and data analysis

techniques used by DOE to demonstrate waste isolation. The products will also be used to evaluate whether each of <sup>or not</sup> ~~the favorable and potentially adverse conditions, if present,~~ <sup>those conditions</sup> has been adequately characterized, and the extent to which each contributes to or detracts from isolation.

ascertain that  
all of the potentially adverse and favorable conditions have been identified, within the limits of the resolution of the techniques used, and

## STATEMENT OF WORK

TECHNICAL ASSISTANCE IN GEOPHYSICAL  
METHODS FOR SITE CHARACTERIZATION

FIN NO: TRD

B&amp;R: TBD

## 1.0 BACKGROUND:

As stated in 10CFR60, a geologic setting should exhibit an appropriate combination of conditions to provide reasonable assurance that the isolation of the waste will be met. For example, one of these conditions which may affect isolation is structural deformation such as folding, faulting, and igneous activity.

Geophysical survey techniques are tools used in characterizing such structural deformation in the near and far field of a high level nuclear waste repository.

Geophysical survey methods are also applied to resolve concerns in siting a repository, such as, fluid flow, constructability, and subsurface characteristics of the host rock.

Geophysical surveys may be performed at the surface, in boreholes, and underground in a test facility or in the repository during construction and operation. On a regional scale, geophysical survey techniques are capable of pinpointing structures such as faults, monoclines, anticlines and synclines. On a smaller scale geophysical surveys can extend knowledge of the fracture and physical characteristics of the rock outward from a borehole or drift (such as an underground testing facility) a few inches to many tens of feet depending on the physical properties of the rock.

In the near field, geophysical surveying methods are capable of defining fracture sets and faults, and variations in rock properties such as density and electrical conductivity, that may impact on determination of fracture flow and constructability. Fractures and faults that connect the repository with aquifers, if encountered during construction, could be the means of flooding the repository. Over the long term, they can be paths for rapid transport of released nuclides. Geophysical surveying techniques are the only investigative methods that can characterize large volumes of rock quickly and inexpensively. Such techniques are the only investigative methods that can characterize large volumes of rock quickly and inexpensively. Such techniques include seismic reflection and refraction, gravity, magnetics, magnetotellurics, resistivity and special applications such as geotomography. It is imperative that the NRC staff be informed of the latest geophysical survey and interpretive techniques and the ways that standard techniques can be adapted to the special needs of high-level waste repository characterization.

The products resulting from this contract will be used to assess the capabilities and limitations of geophysical methods and data analysis techniques used by DOE to demonstrate waste isolation. The products will also be used to evaluate whether or not each of the favorable and potentially adverse conditions, present, have been adequately characterized, and the extent to which each contributes to or detracts from isolation.



## 2.0 WORK REQUIRED:

The performing organization shall conduct a survey of <sup>airborne</sup> currently available geophysical surveying methods and data analysis techniques applicable to site screening and site characterization investigations (surface, borehole and underground) in the geologic media under consideration by DOE.

The performing organization shall provide technical assistance in the review and assessment of the geophysical program of investigation and interpretation conducted by DOE during the site screening of a proposed high level waste (HLW) repository and of plans for the use of geophysical techniques during site characterization.

In doing this work, the performing organization must document, in topical or letter reports to the NRC, its findings concerning the various geophysical surveying methods and data analysis techniques identified as potentially useful in characterizing the site. The reports shall include assessments of the strengths and weaknesses of the methods and techniques discussed and the limits of the corresponding data and interpretations, and recommend applications of each method or technique in site screening or site characterization.

For each site screening and site characterization document containing a description of a geophysical program completed or proposed by DOE, and furnished by the NRC Project Officer the performing organization shall provide the NRC a report detailing its review of the completeness and adequacy of the geophysical program described ~~and soundness of decisions made~~.

The purpose of this work is to help assure the NRC staff that adequate information is available to assess the geophysical investigation programs conducted by DOE and DOE contractors in site screening and site characterization. Specific products include 1) topical or letter reports discussing specific geophysical methods, 2) technical document reviews and 3) letter reports on attendance at workshops and technical meetings and conferences. These products will be used to help develop Site Characterization Plan (SCP) reviews, Site Issue Analyses and appendices to the NRC Site Characterization Analyses (SCA), and guidance to DOE.

### 2.1 Task 1:

The performing organization shall conduct a survey of currently available geophysical surveying methods and data analysis techniques.

Specific elements of this task are:

Subtask 1.1 The performing organization shall identify proven geophysical surveying methods and data analysis techniques applicable to the site

screening and site characterization programs. The topical report will state which of the methods and techniques identified are state-of-the-art (a method of proven technology but still developmental in field application; geotomography is such a method).

Subtask 1.2 The performing organization will identify the strengths and weaknesses of each method, the limits and uncertainties of corresponding data and interpretations, particularly as they pertain to each medium and site.

Subtask 1.3 The performing organization will identify and discuss reasonable modifications to the methods and techniques identified in Subtask 1.1 that would render that method or technique more useful in site characterization. An example might be the modification of the acoustic emission technique by establishing a three dimensional geophone array so that the exact location of fractures causing micro-seismic events could be computed.

Subtask 1.4 The performing organization shall analyze the cost benefit of each geophysical method identified compared to non-geophysical methods designed to obtain the same data, if a suitable non-geophysical technique exists. An example might be drilling a borehole or series of boreholes compared to a seismic refraction survey to evaluate the limits of a geologic unit.

*2 why is this necessary?  
Should be up to DOE*

Work in each subtask is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according on the reporting requirements specified in this SOW.

## 2.2 Task 2:

The performing organization shall provide technical assistance in the review and assessment of geophysical programs, and surveys and interpretations performed by DOE contractors in support of site screening and site characterization investigations. The review will assess the appropriateness of the data acquisition and data reduction techniques employed by DOE contractors and the adequacy of their interpretation of the data.

Specific elements of this task are:

Subtask 2.1 The performing organization shall review DOE and DOE contractor publications concerning geophysical investigations and interpretations.

Subtask 2.2 The performing organization shall review publications, other than those produced by DOE or DOE contractors, that concern geophysical investigations at the site.



Subtask 2.3 The performing organization shall review geophysical data and prepare alternative interpretations, as needed. Types of data would include seismic (reflection, refraction), gravity, magnetic, magnetotelluric and resistivity. Borehole geophysical techniques are included.

Of particular importance under this task is the review of the geophysical portions of site characterization documents.

The NRC Project Officer will supply the performing organization with all documents to be reviewed.

Work on this task is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according to the reporting requirements specified in this SOW.

### 2.3 Task 3:

The performing organization shall provide direct technical assistance in the form of attendance and participation as needed at conferences, the writing of technical positions and such other documents as needed, meetings and site visits and ancillary preparatory and follow-up meetings and consultations. These conferences, meetings and site visits will relate directly to tasks 1 and 2.

Work on this task is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according to the reporting requirements specified in this SOW.

### 2.4 Estimated Requirements

Task 1 Task one consists of the identification and assessment of industry standard and state-of-the-art geophysical survey methods and techniques and their applicability to the geologic screening and characterization of sites in media proposed by the DOE. It is estimated that this support will require one half man year in FY86 and one half man year in FY87.

Task 2 Task two consists of the technical review of appropriate sections of the site characterization documents such as the SCR. This task also requires a technical review of the results of those geophysical surveys performed for site screening (seismic, gravity, magnetic, magnetotelluric and heat flow) when such data are available. It is estimated that this support will require three quarters man year in FY86, one half man year in FY87 and FY88.

th  
first time mentioned  
should heat flow be  
included above?  
resistivity?

*seems high for just attending meetings relative to time for actually doing the work as under Tasks 1 and 2*

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Task 3 Task three requires attendance at conferences, meetings and site visits as required. It is estimated that this support will require one quarter man year in FY86, one quarter man year in FY87, and one half man year in FY88.

#### Task Assignment Ceilings:

A target cost ceiling (level of effort) will be placed in each task assignment for performance of work under the contract. Such a target ceiling may be increased by the Project Officer (PO) at his/her discretion from time to time by notice to the performing organization in writing. The performing organization shall promptly notify the PO in writing whenever he believes that the then pertinent ceiling for any task assignment is insufficient. When and if the amount(s) paid and payable to the performing organization shall equal the then pertinent ceiling, the performing organization shall not be expected to perform further unless the PO increases such a ceiling in amount sufficient to cover additional work thereunder. The NRC shall not be obligated to pay the performing organization an amount in excess of such a ceiling. If and to the extent that such a ceiling has been increased, any cost incurred by the performing organization in performance in excess of the ceiling prior to its increase shall be allowable to the same extent as if such costs has been incurred after such increase in the ceiling.

#### 3.0 REPORTING REQUIREMENTS:

3.1 Scheduled dates indicate the latest acceptable date. However, these reports and dates are subject to change in accordance with changes in DOE schedules.

1. Monthly letter Status Reports: These reports shall be due by the 15th of each month.
2. Reports of Meetings and Field Trips: Due 10 days after completion of meeting or field trip.
3. Letter Reports/Topical Reports: Due at the conclusion of each subtask assignment.

#### 3.2 Monthly Letter Status Report:

Each month, the performing organization shall submit a letter report which summarizes by task:

1. The work performed during the previous month and findings important to the NRC program.

2. Milestones reached, update of subcontractor (if any) activities, meetings attended (list personnel, data, place, purpose and summary of meeting, summary of conclusions or agreements reached with other attendees);
3. Potential or actual contractual problem areas and their impacts (if the schedule has slipped or if the budget will be exceeded, this shall be stated and the reasons explained);
4. The personnel time expenditures during the previous month with the performing organization and subcontractor time expenditure listed separately; and
5. Costs and uncoded obligations, listed separately (a) during the previous month, (b) cumulative to date (fiscal year and total), and (c) projection by month for the current fiscal year. The first monthly report shall provide the initial projections, and subsequent reports shall either indicate revised projections or indicate "no change in the cost and uncoded obligation projection."
6. Monthly reports shall include a listing of subcontractor reports received that month and abstracts for and/or papers prepared by project personnel.

The reports shall be due by the 15th of each month.

### 3.3 Reports of Meetings and Field Trips:

A letter report of meetings and field trips shall be provided by the performing organization to be received by the NRC PO within 10 working days of completion of the meeting or field trip. These reports shall serve as a record of the trip or meeting and shall, as a minimum, identify the purpose, participants, itinerary, cost break-out, and significant findings.

### 3.4 Letter Reports/Topical Reports

The performing organization shall prepare draft and final letter or topical reports at the conclusion of each task or subtask assignment. Reports should include an Executive Summary that summarizes ~~the~~ results in the context of their impact on licensing and licensing needs and recommendations with regard to the project objectives as defined in the Statement of Work. Changes of reporting schedules shall be made by the NRC Project Officer and performing organization jointly. Draft and final reports shall be prepared in accordance with NRC manual chapter 1102 "Formal Contractor Documents" and the NRC Style Guide and Supplements. The

draft shall meet the format requirements of the formal report, shall have been edited and reviewed by the performing organization and, with the possible exception of few minor editing corrections, shall be ready to be published as a formal report if NRC has no comments.

The performing organization shall submit ten (10) copies of draft reports to the NRC Project Manager in accordance with the completion schedule. Within the 15 working days following submission of the draft report, the NRC Project Officer will comment in writing on these reports. The performing organization shall respond to these comments in writing within 15 days following receipt of NRC comments. Comments shall be mutually resolved by the NRC Project Manager and the performing organization. The final report shall be submitted within 20 working days after receipt of NRC comments and shall address a resolution of all NRC review comments.

### 3.5 Reporting Requirements

The following summarizes the required report distribution under this contract:

<u>Distribution</u>	<u>Meeting and Trips</u>	<u>Monthly Letter Status Reports: Progress</u>	<u>Letter Draft</u>	<u>Reports: Final</u>
Project Officer	1	1	6	6
Office of the Dir., NMSS (Attn: Program Support Branch)	1	1	1	1
Div. of Waste Mgmt. (Attn: Div. Dir.)	1	2	2	2
Contracting Officer	1	1	1	1
High-Level Waste Tech. Dev. Branch (Attn: Branch Chief)	1	1	1	1
Officer of Research	1	1	1	1
Documents Control	1	1	0	1

### 4.0 Meetings and Travel:

The performing organization shall attend planning or review meetings generally of one day or two days at NRC in Silver Spring, Maryland, as specified by the Project officer.

The performing organization shall attend field trips, technical meetings or site visits as specified by the Project Officer.

All domestic travel shall be approved in advance by the NRC Project Officer.

### 5.0 Presentations and Technical Papers:



A copy of all written and oral presentations given at professional meetings and technical papers submitted for publication in technical journals which are associated with this project shall be transmitted to the NRC technical Project Officer for review and approval in advance of the presentation or publication unless the paper or data is based on formal final reports already approved by NRC.

#### 6.0 Microfiche:

Microfiche is required of all reports to be published as NUREG or NUREG/CR documents. The specifications for the microfiche are listed in attachment (4) and distribution is as follows:

Document Management Branch  
Division of Technical Information  
and Document Control, 1 master

Document Control Center  
Division of Waste Management  
Office of Nuclear Materials Safety and Safeguards

#### 7.0 Quality Assurance Procedures:

For all draft and final technical reports delivered under this contract, the performing organization shall assure that an independent review and verification of a numerical computations and mathematical equations and derivations are performed by qualified personnel other than the original author(s) of the reports. If the performing organization proposes to verify/check less than 100 percent of all computations and mathematical equations and derivations in the report(s) (such as might be the case when there is a large number of routine, repetitive calculations), the performing organization must first obtain written approval from the NRC Project Manager. Computer-generated calculations will not require verification where the computer program has already been verified.

In addition, for all reports, including those which do not contain numerical analyses, a management review shall be conducted by the performing organizations' project management prior to submission to the NRC. All reports shall be annotated to indicate that the review and verification has been accomplished prior to their submission to the NRC. (This may be accomplished by use of cover letter accompanying the report if preferable.)

#### 8.0 NRC Furnished Material:

At the initiation of the contract the NRC will provide the performing organization with a copy of the procedural and technical portions of 10 CFR Part 60, the NRC

Standard Formant and Content Guide for the Site Characterization Report, a copy of the schedule of major events in the DOE's selection, design, and construction of the geologic repository, Site Characterization Review Plan, and a selected bibliography of reports and publications that have been developed for each site.

#### 9.0 Period of Performance:

Performance on this contract will commence on \_\_\_\_\_, 1986 and shall continue until September 30, 1988. Extension of the contract for another year can be made at the direction of the contracting officer.

#### 10.0 Technical Direction:

The NRC Project Officer for this work will be:

Dr. A.K. Ibrahim  
Geotechnical Branch  
Division of Waste Management  
Mail Stop 623-SS  
Washington, DC 20555  
Telephone No. (301) 427-4211

Dr. Ibrahim is designated as the NRC Project Officer for the purpose of assuring that the services required under this SOW are delivered as stated herein. All technical instructions to the Contractor shall be issued through the NRC/PM. As used here, technical instructions are instructions to the Contractor which provide details or suggest lines of inquiry for completion of the work set forth in this SOW. Technical instructions shall not constitute new assignment of work or changes of such a nature as to justify and adjustment in costs or period of performance.

#### Disposal of Property:

Upon completion of the project, a reconciled report will be developed jointly by the performing organization and NRC to record available equipment and/or material purchased with NRC funds. This report should be developed as soon as possible after the project is completed, or a termination decision has been made, but not later than sixty (60) days after the work termination date. The report should be submitted to the Property and Supply Branch, NRC.

## Evaluation Criteria

CriteriaTotal 100%

1. Is the contractor multi-disciplined? 50%  
Does he have in-house expertise (senior professionals on the payroll) in at least 3 of the 5 basic geophysical exploration methodologies (seismic, gravity, magnetics, electrical, borehole)? - supported by a good, on successful, record of performance.
2. Does the contractor have practical (in the field) operational expertise in both data acquisition and data interpretation? 40%  
supported by a good record of performance - reputation.
3. Does the contractor have in-house digital data processing capability? 10%

4. Management ability

5. <sup>Good</sup> Quality Control

NOV 18 1985

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Enclosure:  
Mark-up of SOW

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NOV 18 1985

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Division of Waste Management, NMSS

FROM: Frank A. Costanzi, Chief  
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SUBJECT: REVIEW OF WORK PLAN FOR FIN D1003

We have reviewed the statement of work (SOW) for this project and have the following general comments:

1. Subtasks 1.1 and 1.2 appear to be a repetition of earlier research projects by the University of Arizona<sup>1</sup> and Ertec Western, Inc.<sup>2</sup> A similar compendium of exploration methods is contained in an LLNL report<sup>3</sup> on work performed for the DOE.
2. The contractor should be required to use subcontractors or consultants on an as-needed basis to provide expertise that they do not have in house.

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NAME: EZurflueh	: AMurphy	: LBeratan	: FCostanzi	:	:	:
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PROJECT DESCRIPTIVE SUMMARY

DATE: August 14, 1985

PPSAS NO: 3112

PRIORITY: 1

OFFICE: NMSS

PROJECT TITLE: Technical Assistance in Geophysical Methods for Site Characterization

FIN NO: TBD

TYPE OF CONTRACT: RFP

CONTRACTOR:

ESTIMATED PERIOD OF PERFORMANCE:

PROJECT OFFICER: A. K. Ibrahim

FY BUDGET (\$K):	FY84	FY85	FY86	FY87	FY88
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PRIOR:	281.9	0			
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OPERATING:			125	200	150
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FOLLOW-ON:					
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3) *Meetings*  
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USER NEED:

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*It is also vital that expertise in state-of-the-art geophysical techniques be applied to the review by NRC of DOE investigations of waste repository sites*  
It is vital that the NRC staff be kept informed of, and assessments be made of, new technology and of improvements in geophysical survey methods such as instrumentation, data acquisition and processing as they apply to repository siting and design. This contract will assure that the NRC staff will have up-to-date information on geophysical technology on a continuing basis and be able to apply it to site surveying and characterization evaluations.

PRODUCTS:

The contractor will provide the staff with reports of meetings and field trips; letter reports, and topical reports *and a final report summarizing the contractor's evaluation of DOE's repository site reports.*

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Geophysical survey techniques are tools used in characterizing such structural deformation in the near and far field of a high level nuclear waste repository.

Geophysical survey methods are also applied to resolve concerns in siting a repository, such as, fluid flow, constructability, and subsurface characteristics of the host rock.

Geophysical surveys may be performed at the surface, in boreholes, and underground in a test facility or in the repository during construction and operation. On a regional scale, geophysical survey techniques are capable of pinpointing structures such as faults, monoclines, anticlines and synclines. On a smaller scale geophysical surveys can extend knowledge of the fracture and physical characteristics of the rock outward from a borehole or drift (such as an underground testing facility) a few inches to many tens of feet depending on the physical properties of the rock.

In the near field, geophysical surveying methods are capable of defining fracture sets and faults, and variations in rock properties such as density and electrical conductivity, that may impact on determination of fracture flow and constructability. Fractures and faults that connect the repository with aquifers, if encountered during construction, could be the means of flooding the repository. Over the long term, they can be paths for rapid transport of released nuclides. Geophysical surveying techniques are the only investigative methods that can characterize large volumes of rock quickly and inexpensively. Such techniques are the only investigative methods that can characterize large volumes of rock quickly and inexpensively. Such techniques include seismic reflection and refraction, gravity, magnetics, magnetotellurics, resistivity and special applications such as geotomography. It is imperative that the NRC staff be informed of the latest geophysical survey and interpretive techniques and the ways that standard techniques can be adapted to the special needs of high-level waste repository characterization.

The products resulting from this contract will be used to assess the capabilities and limitations of geophysical methods and data analysis techniques used by DOE to demonstrate waste isolation. The products will also be used to evaluate whether or not each of the favorable and potentially adverse conditions, present, have been adequately characterized, and the extent to which each contributes to or detracts from isolation.

## 2.0 WORK REQUIRED:

The performing organization shall conduct a survey of <sup>airborne</sup> currently available geophysical surveying methods and data analysis techniques applicable to site screening and site characterization investigations (surface, borehole and underground) in the geologic media under consideration by DOE.

The performing organization shall provide technical assistance in the review and assessment of the geophysical program of investigation and interpretation conducted by DOE during the site screening of a proposed high level waste (HLW) repository and of plans for the use of geophysical techniques during site characterization.

In doing this work, the performing organization must document, in topical or letter reports to the NRC, its findings concerning the various geophysical surveying methods and data analysis techniques identified as potentially useful in characterizing the site. The reports shall include assessments of the strengths and weaknesses of the methods and techniques discussed and the limits of the corresponding data and interpretations, and recommend applications of each method or technique in site screening or site characterization.

For each site screening and site characterization document containing a description of a geophysical program completed or proposed by DOE, and furnished by the NRC Project Officer the performing organization shall provide the NRC a report detailing its review of the completeness and adequacy of the geophysical program described ~~and soundness of decisions made~~.

The purpose of this work is to help assure the NRC staff that adequate information is available to assess the geophysical investigation programs conducted by DOE and DOE contractors in site screening and site characterization. Specific products include 1) topical or letter reports discussing specific geophysical methods, 2) technical document reviews and 3) letter reports on attendance at workshops and technical meetings and conferences. These products will be used to help develop Site Characterization Plan (SCP) reviews, Site Issue Analyses and appendices to the NRC Site Characterization Analyses (SCA), and guidance to DOE.

### 2.1 Task 1:

The performing organization shall conduct a survey of currently available geophysical surveying methods and data analysis techniques.

Specific elements of this task are:

Subtask 1.1 The performing organization shall identify proven geophysical surveying methods and data analysis techniques applicable to the site



screening and site characterization programs. The topical report will state which of the methods and techniques identified are state-of-the-art (a method of proven technology but still developmental in field application; geotomography is such a method).

Subtask 1.2 The performing organization will identify the strengths and weaknesses of each method, the limits and uncertainties of corresponding data and interpretations, particularly as they pertain to each medium and site.

Subtask 1.3 The performing organization will identify and discuss reasonable modifications to the methods and techniques identified in Subtask 1.1 that would render that method or technique more useful in site characterization. An example might be the modification of the acoustic emission technique by establishing a three dimensional geophone array so that the exact location of fractures causing micro-seismic events could be computed.

Subtask 1.4 The performing organization shall analyze the cost benefit of each geophysical method identified compared to non-geophysical methods designed to obtain the same data, if a suitable non-geophysical technique exists. An example might be drilling a borehole or series of boreholes compared to a seismic refraction survey to evaluate the limits of a geologic unit.

*is why is this necessary?  
Should be up to DOE*

Work in each subtask is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according on the reporting requirements specified in this SOW.

## 2.2 Task 2:

The performing organization shall provide technical assistance in the review and assessment of geophysical programs, and surveys and interpretations performed by DOE contractors in support of site screening and site characterization investigations. The review will assess the appropriateness of the data acquisition and data reduction techniques employed by DOE contractors and the adequacy of their interpretation of the data.

Specific elements of this task are:

Subtask 2.1 The performing organization shall review DOE and DOE contractor publications concerning geophysical investigations and interpretations.

Subtask 2.2 The performing organization shall review publications, other than those produced by DOE or DOE contractors, that concern geophysical investigations at the site.

Subtask 2.3 The performing organization shall review geophysical data and prepare alternative interpretations, as needed. Types of data would include seismic (reflection, refraction), gravity, magnetic, magnetotelluric and resistivity. Borehole geophysical techniques are included.

Of particular importance under this task is the review of the geophysical portions of site characterization documents.

The NRC Project Officer will supply the performing organization with all documents to be reviewed.

Work on this task is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according to the reporting requirements specified in this SOW.

### 2.3 Task 3:

The performing organization shall provide direct technical assistance in the form of attendance and participation as needed at conferences, the writing of technical positions and such other documents as needed, meetings and site visits and ancillary preparatory and follow-up meetings and consultations. These conferences, meetings and site visits will relate directly to tasks 1 and 2.

Work on this task is to commence only at the direction of the Contracting Officer. Work completed under this task will be reported to the Project Officer according to the reporting requirements specified in this SOW.

### 2.4 Estimated Requirements

Task 1 Task one consists of the identification and assessment of industry standard and state-of-the-art geophysical survey methods and techniques and their applicability to the geologic screening and characterization of sites in media proposed by the DOE. It is estimated that this support will require one half man year in FY86 and one half man year in FY87.

Task 2 Task two consists of the technical review of appropriate sections of the site characterization documents such as the SCR. This task also requires a technical review of the results of these geophysical surveys performed for site screening (seismic, gravity, magnetic, magnetotelluric and heat flow) when such data are available. It is estimated that this support will require three quarters man year in FY86, one half man year in FY87 and FY88.

*first time mentioned  
should heat flow be  
included above?  
resistivity?*

*seems high for just attending meetings relative to time for acct. doing the work as under Tasks 1 and 2*

- 5 -

Task 3 Task three requires attendance at conferences, meetings and site visits as required. It is estimated that this support will require one quarter man year in FY86, one quarter man year in FY87, and one half man year in FY88.

#### Task Assignment Ceilings:

A target cost ceiling (level of effort) will be placed in each task assignment for performance of work under the contract. Such a target ceiling may be increased by the Project Officer (PO) at his/her discretion from time to time by notice to the performing organization in writing. The performing organization shall promptly notify the PO in writing whenever he believes that the then pertinent ceiling for any task assignment is insufficient. When and if the amount(s) paid and payable to the performing organization shall equal the then pertinent ceiling, the performing organization shall not be expected to perform further unless the PO increases such a ceiling in amount sufficient to cover additional work thereunder. The NRC shall not be obligated to pay the performing organization an amount in excess of such a ceiling. If and to the extent that such a ceiling has been increased, any cost incurred by the performing organization in performance in excess of the ceiling prior to its increase shall be allowable to the same extent as if such costs has been incurred after such increase in the ceiling.

#### 3.0 REPORTING REQUIREMENTS:

3.1 Scheduled dates indicate the latest acceptable date. However, these reports and dates are subject to change in accordance with changes in DOE schedules.

1. Monthly letter Status Reports: These reports shall be due by the 15th of each month.
2. Reports of Meetings and Field Trips: Due 10 days after completion of meeting or field trip.
3. Letter Reports/Topical Reports: Due at the conclusion of each subtask assignment.

#### 3.2 Monthly Letter Status Report:

Each month, the performing organization shall submit a letter report which summarizes by task:

1. The work performed during the previous month and findings important to the NRC program.

2. Milestones reached, update of subcontractor (if any) activities, meetings attended (list personnel, data, place, purpose and summary of meeting, summary of conclusions or agreements reached with other attendees);
3. Potential or actual contractual problem areas and their impacts (if the schedule has slipped or if the budget will be exceeded, this shall be stated and the reasons explained);
4. The personnel time expenditures during the previous month with the performing organization and subcontractor time expenditure listed separately; and
5. Costs and uncosted obligations, listed separately (a) during the previous month, (b) cumulative to date (fiscal year and total), and (c) projection by month for the current fiscal year. The first monthly report shall provide the initial projections, and subsequent reports shall either indicate revised projections or indicate "no change in the cost and uncosted obligation projection."
6. Monthly reports shall include a listing of subcontractor reports received that month and abstracts for and/or papers prepared by project personnel.

The reports shall be due by the 15th of each month.

### 3.3 Reports of Meetings and Field Trips:

A letter report of meetings and field trips shall be provided by the performing organization to be received by the NRC PO within 10 working days of completion of the meeting or field trip. These reports shall serve as a record of the trip or meeting and shall, as a minimum, identify the purpose, participants, itinerary, cost break-out, and significant findings.

### 3.4 Letter Reports/Topical Reports

The performing organization shall prepare draft and final letter or topical reports at the conclusion of each task or subtask assignment. Reports should include an Executive Summary that summarizes ~~the~~ results in the context of their impact on licensing and licensing needs and recommendations with regard to the project objectives as defined in the Statement of Work. Changes of reporting schedules shall be made by the NRC Project Officer and performing organization jointly. Draft and final reports shall be prepared in accordance with NRC manual chapter 1102 "Formal Contractor Documents" and the NRC Style Guide and Supplements. The

draft shall meet the format requirements of the formal report, shall have been edited and reviewed by the performing organization and, with the possible exception of few minor editing corrections, shall be ready to be published as a formal report if NRC has no comments.

The performing organization shall submit ten (10) copies of draft reports to the NRC Project Manager in accordance with the completion schedule. Within the 15 working days following submission of the draft report, the NRC Project Officer will comment in writing on these reports. The performing organization shall respond to these comments in writing within 15 days following receipt of NRC comments. Comments shall be mutually resolved by the NRC Project Manager and the performing organization. The final report shall be submitted within 20 working days after receipt of NRC comments and shall address a resolution of all NRC review comments.



### 3.5 Reporting Requirements

The following summarizes the required report distribution under this contract:

<u>Distribution</u>	<u>Meeting and Trips</u>	<u>Monthly Letter Status Reports: Progress</u>	<u>Letter Draft</u>	<u>Reports: Final</u>
Project Officer	1	1	6	6
Office of the Dir., NMSS (Attn: Program Support Branch)	1	1	1	1
Div. of Waste Mgmt. (Attn: Div. Dir.)	1	2	2	2
Contracting Officer	1	1	1	1
High-Level Waste Tech. Dev. Branch (Attn: Branch Chief)	1	1	1	1
Officer of Research	1	1	1	1
Documents Control	1	1	0	1

### 4.0 Meetings and Travel:

The performing organization shall attend planning or review meetings generally of one day or two days at NRC in Silver Spring, Maryland, as specified by the Project officer.

The performing organization shall attend field trips, technical meetings or site visits as specified by the Project Officer.

All domestic travel shall be approved in advance by the NRC Project Officer.

### 5.0 Presentations and Technical Papers:

A copy of all written and oral presentations given at professional meetings and technical papers submitted for publication in technical journals which are associated with this project shall be transmitted to the NRC technical Project Officer for review and approval in advance of the presentation or publication unless the paper or data is based on formal final reports already approved by NRC.

#### 6.0 Microfiche:

Microfiche is required of all reports to be published as NUREG or NUREG/CR documents. The specifications for the microfiche are listed in attachment (4) and distribution is as follows:

Document Management Branch  
Division of Technical Information  
and Document Control, 1 master

Document Control Center  
Division of Waste Management  
Office of Nuclear Materials Safety and Safeguards

#### 7.0 Quality Assurance Procedures:

For all draft and final technical reports delivered under this contract, the performing organization shall assure that an independent review and verification of a numerical computations and mathematical equations and derivations are performed by qualified personnel other than the original author(s) of the reports. If the performing organization proposes to verify/check less than 100 percent of all computations and mathematical equations and derivations in the report(s) (such as might be the case when there is a large number of routine, repetitive calculations), the performing organization must first obtain written approval from the NRC Project Manager. Computer-generated calculations will not require verification where the computer program has already been verified.

In addition, for all reports, including those which do not contain numerical analyses, a management review shall be conducted by the performing organizations' project management prior to submission to the NRC. All reports shall be annotated to indicate that the review and verification has been accomplished prior to their submission to the NRC. (This may be accomplished by use of cover letter accompanying the report if preferable.)

#### 8.0 NRC Furnished Material:

At the initiation of the contract the NRC will provide the performing organization with a copy of the procedural and technical portions of 10 CFR Part 60, the NRC

Standard Formant and Content Guide for the Site Characterization Report, a copy of the schedule of major events in the DOE's selection, design, and construction of the geologic repository, Site Characterization Review Plan, and a selected bibliography of reports and publications that have been developed for each site.

#### 9.0 Period of Performance:

Performance on this contract will commence on \_\_\_\_\_, 1986 and shall continue until September 30, 1988. Extension of the contract for another year can be made at the direction of the contracting officer.

#### 10.0 Technical Direction:

The NRC Project Officer for this work will be:

Dr. A.K. Ibrahim  
Geotechnical Branch  
Division of Waste Management  
Mail Stop 623-SS  
Washington, DC 20555  
Telephone No. (301) 427-4211

Dr. Ibrahim is designated as the NRC Project Officer for the purpose of assuring that the services required under this SOW are delivered as stated herein. All technical instructions to the Contractor shall be issued through the NRC/PM. As used here, technical instructions are instructions to the Contractor which provide details or suggest lines of inquiry for completion of the work set forth in this SOW. Technical instructions shall not constitute new assignment of work or changes of such a nature as to justify and adjustment in costs or period of performance.

#### Disposal of Property:

Upon completion of the project, a reconciled report will be developed jointly by the performing organization and NRC to record available equipment and/or material purchased with NRC funds. This report should be developed as soon as possible after the project is completed, or a termination decision has been made, but not later than sixty (60) days after the work termination date. The report should be submitted to the Property and Supply Branch, NRC.

## Evaluation Criteria

CriteriaTotal 100%

1. Is the contractor multi-disciplined? 50%  
Does he have in-house expertise (senior professionals on the payroll) in at least 3 of the 5 basic geophysical exploration methodologies (seismic, gravity, magnetics, electrical, borehole)? *- supported by a good, on successful, record of performance.*
2. Does the contractor have practical (in the field) operational expertise in both data acquisition and data interpretation? 40%  
*supported by a good record of performance - reputation.*
3. Does the contractor have in-house digital data processing capability? 10%

4. *Management ability*

5. *Good Quality Control*