



# Weston Geophysical CORPORATION

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June 4, 1985  
WGC - R531

'85 JUN -7 P 1:32

U.S. NUCLEAR REGULATORY COMMISSION  
Division of Waste Management - NMSS  
Washington DC 20555

Attn: Dr. Abou-Bakr Ibrahim, SS-623

Subject: Trip Report May 23, 1985  
Basal Waste Isolation Project [BWIP]  
DOE/NRC Meeting on seismic survey and other  
geophysical work, Silver Spring, MD

WM-RES  
WM Docket File  
D-1003  
WESTON

WM Project 10, 11, 16  
Docket No. \_\_\_\_\_  
PDR   
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Gentlemen:

In accordance with the provisions of contract NRC-02-84-001, we hereby enclose the findings and comments by Mr. Edward N. Levine, Sr. Staff Geophysicist, resulting from his participation in the subject meeting. This meeting provided an overview of the DOE/Rockwell approach to the reflection profiling program, its purpose and scope, as well as general information on other geophysical programs.

In accordance with the contract requirements, Mr. Levine has provided the NRC with technical assistance in the review and assessment of the geophysical programs completed, in progress and planned for the BWIP project. It would be most helpful to the NRC and their reviewers if they could monitor the progress of the test and production reflection survey programs during this summer.

The cost breakdown for participation in subject workshop was provided by telephone to Mr. Barry Bromberg of the NRC on May 22, 1985.

We wish to thank the commission for the opportunity to participate in this meeting and in the review of this important project.

Very truly yours,

WESTON GEOPHYSICAL CORPORATION

Edward N. Levine  
For Vincent J. Murphy  
Principal/Manager

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BASALT WASTE ISOLATION PROJECT [BWIP]  
Hanford, WA  
COMMENTS ON DOE/NRC MEETING ON SEISMIC SURVEY  
&  
OTHER GEOPHYSICAL DATA  
SILVER SPRING, MD - MAY 23, 1985

Meeting took place in accordance with attached agenda. Principal participants:

Bill Justus, NRC  
Dr. Abou-Bakr Ibrahim, NRC  
Kristin Westbrook, NRC  
Bob Wright, NRC  
E. Levine, WGC, Consultant to NRC  
Dick Berry, consultant to NRC

Dave Dallen, Richland Project Office, DOE  
Bruce Hurley, Geologist, DOE  
Ernest Berkman, Emerald Exploration, Consultant to DOE

Ann Talman, Rockwell Hanford  
Tom Mitchell, Rockwell Hanford

A. Introduction

Ann Talman described previous seismic reflection investigations on the Hanford reservation and the reprocessing of those seismic sections closest to the RRL along Lines 3, 5 and 8.

B. Seismic Survey

The planned seismic reflection survey program for the summer of 1985 is described in the statement of work for seismic reflection surveys. The basic program is to consist of a seismic reflection field experimentation along a two mile profile parallel to and approximately 1,000 foot west of Line 5. This experimentation program will use a variety of energy sources and data recording and processing parameters to arrive at the optimum parameters for conducting a production survey. A statement of work was prepared by Rockwell with consultation from Mr. Ernest Berkman of Emerald Exploration who performed the reprocessing of the 1979/1980 data. The data acquisition and processing contract has been awarded to Walker Geophysical Company of Essex, Iowa, apparently on the basis of low bid although comments by DOE/Rockwell indicate that they have an expertise in high resolution seismic reflection survey work. The interpretation of the seismic reflection data will be performed under Rockwell's direction with Tom Mitchell performing the lead role assisted by Joe Kunk of Rockwell and Ernest Berkman of Emerald Exploration.

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The field testing parameters, Task 1, including the energy source requirements were discussed in detail. The energy sources described in the RFP and the Statement of Work include primacord, air gun or equivalent, and explosives. It was decided to use these types of impulse energy sources rather than vibroseis or other type of vibrator in order to obtain good refraction data in conjunction with the reflection survey. It is now planned to drill the explosives detonation holes to a depth of 25 feet, a depth limit imposed by some unspecified considerations at the Hanford site. E. Levine suggested the use of water in these shotholes in order to greatly improve energy generation and coupling. Other proposals included a variety of energy sources including the PEA shooter proposed by CGG.

Rockwell is apparently designing a test program which includes a number of variations in such parameters as the configuration of the geophone array [probably using arrays perpendicular to the line], the size of explosives charges and types, filter settings and frequency cutoffs, number of geophones, number of folds, and length of recording time. It was suggested that Rockwell utilize a matrix type system in order to ensure and document that all combinations of parameter variations have been addressed through the field testing program.

In response to questioning it was determined that the parameters to be used are consistent with a reflection survey to include the upper part of the basalt at a depth range of several hundred to 1,000 feet. Phil Justus summarized the three principal objectives of the survey as follows:

1. To determine the character of the suprabasalt sediments, their structure and stratigraphic continuity;
2. the structure of the younger basalts, that is the upper basalt flows;
3. to investigate Yakima Geophysical Anomaly and the Upper Cold Creek Syncline hydrologic barrier which may or may not be the same feature.

This survey is not designed to investigate the repository depth of approximately 3,000 feet. Suggestions to the data acquisitions program by the NRC and their consultants were mainly geared for the acquisition of data which could later be processed to investigate deeper targets, mainly recording possibly as much as two seconds of data although only one half second of data may be processed at the present time, and utilizing a lower frequency cut off of 20 or 30 hz rather than the 40 hz as noted in the specifications. Berkman noted that the low frequency cutoff would be based on the noise test and implied that it would be extremely difficult to filter out low frequency noise in the data processing. The representative of the Yakima Indian nation noted their interest in the basement structure of the Hanford reservation area.

Data processing will be conducted by Walker Geophysical in accordance with instructions from Rockwell. It was emphasized by E. Levine that datum corrections and refraction statics must be input before other processing steps. Ernest Berkman noted that the order of processing is not specified at the present time. In view of the problems with the reprocessed data, it is likely that the datum corrections and refraction statics will be input

at an early stage. Ibrahim expressed considerable concern about residual datum and NMO corrections to adjust for misalignment of reflecting horizons between CDP gathers. In response to a question from E. Levine, the vertical seismic profiling data or vertical velocity information will be used where available. According to Tom Mitchell some VSP data is available in three old wells, however beneath the upper layers of the basalt there are no reflective horizons in the next .2 seconds of the basalt. Some VSP data will be obtained in bore holes located in the option II area. Ann Talman noted that all original field tapes will be saved.

The location of the test program and the Option I and Option II profiling were discussed. The test program is located across the center part of the RRL in order to take advantage of borehole data as well as to verify the capabilities of the reflection technique across a topographic change. According to Ann Talman, if the test program is successful, production survey will begin at Option II [the Cold Creek Barrier area] before work is initiated in the Option I area. Option II consists of three, east-west lines located across the north south trending Cold Creek feature. Option I consists of a northeasterly trending line perpendicular to the structural grain and a northwesterly trending line parallel with the structural grain, intersecting at RRL - 2 in the center of the repository area. E. Levine noted the possibility of poor reflection data in the Option II area which is over 100 foot higher in elevation than the test and Option I areas. This increased thickness of dry material may hinder the quality of the reflection data. It is suggested that if the reflection data is not successful in the Option II area, then consideration be given to a program of seismic refraction to investigate the top of the basalt topography similar to the refraction programs previously accomplished by Weston Geophysical in the vicinity of the WPPSS I, II, and IV sites and the Skagit-at-Hanford site, especially while all of the seismic equipment is available on the Hanford Reservation. A possible scenario would involve completion of the Option I reflection program while preparations consisting of deep shot hole drilling are underway for refraction investigations in the Option II area.

#### C. Previous Seismic Survey

The re-interpretation of the seismic reflection data along Line 3, 5 and 8 were largely based on the use of synthetic seismograms generated at each well located along the reflection line. In response to Ibrahim's questioning, Ernest Berkman referred to the description of the interpretation procedure as contained on page 57 of SD-177. When further questioned by Ibrahim concerning continuity of reflectors, Berkman was rather defensive and noted that the interpretation is shown on the interpreted depth section plates, plates 26, 27, and 28 of SD-177. According to Berkman the interpreted depth sections incorporate all data; boring data, gravity data, magnetic data, and seismic reflection data in developing the structural interpretation shown on those plates. Subsequently the interpretation is then shown by solid lines on the basic stack plates, 7A, 8A and 9A, to show just how good and/or how bad the seismic data is. In other words, the interpretation relies upon the boring to boring correlation with the interpretation of the area between borings modified on the basis of the geophysical data.

The relatively continuous reflectors at approximately .5 seconds on the original reflection profiles are not continuous on the reprocessed data according to Berkman. The reason that it shows up on the original processed section is that there is a dead zone created by AGC [trace equalization] below the strong reflectors of the basalt surface. Once the trace equalization diminishes with increasing time then the reflectors show up at their normal amplitude level such as appears at .5 seconds. An example of the dead zone at .5 seconds appears on the re-interpreted section for Line 5 between shot points 870 and 890.

Berkman views the rise in the subbasalt refractors on Line 5 in the vicinity of topographic change as an artifact in the processing and not a true representation of the basalt layering. The interpretation presented for the south end of Line 5 shows three fault features in the profile. E. Levine hypothesized an interpretation of no-faulting with the borings connected in a general straight line manner describing a rise in the basalt surface to the south. Berkman stated that the only data that would preclude such a straight line interpretation is the detailed gravity data at the south end of Line 5. This gravity data is contained in-house at Rockwell and has not been presented to the NRC. E. Levine emphasized the problems with using solid lines for the interpretation on plates 7A, 8A and 9A where there is a decided uncertainty in the data. Berkman utilized the interval velocity data, plates 22, 23 and 24 to validate his technique for interpreting structure, particularly along the southern end of Line 5.

#### D. Plans for Other Geophysical Work at BWIP

The following is an update of recent, current and planned geophysical activity at BWIP. Collection of gravity and magnetic data on a 500 foot station basis continues to the west and the northwest and southwest of the RRL. Some modeling of anomalies in the site area is in progress, particularly gravity analysis for nearsurface information. To investigate deep structure, 22 MT stations have been acquired across RAW. They expect to acquire more MT data over the next two or three years, during the next fiscal year in the site area and Snively basin and Yakima ridge areas. A generalized report on the interpretation of the MT data is due in FY86. In terms of recent activities only the MT data has been analyzed in 1985. This MT data shows the subbasalts sediments thickening to the southwest. The deep northeast-southwest refraction profile completed across the Hanford reservation in 1984 by the U.S.G.S. is still under analysis. In order to improve their crustal model, Rockwell had portable seismograph stations established to the south and east in the vicinity of the Blue Mountains and the University of Washington also had some portable stations established. These data have not been interpreted; Washington data may have some timing problems. There have been no small scale surveys to investigate any specific structural features conducted since the last workshop of March 84. Rockwell plans to input their data base into a computer system, allowing for map printouts in overlay form at various common scales.

A tectonic workshop is scheduled for the November/December time frame of 1985.

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## SUPPLEMENTARY COMMENTS

1. According to the U.S. Geophysical News, the model air gun to be used at the Hanford site, the Bolt LSS-3B could provide 100 hertz data, the type of hi-frequency data required for good, shallow refraction profiling. Other energy systems should also be considered including the Hydropulse which can provide 12,000 foot pounds of energy, probably in the mid frequency range.
2. The primacord will be plowed in to a depth of three feet, the area should also be watered in order to provide more efficient energy generation and coupling.
3. The spread geometry with a far trace offset of 1,225 feet is more than sufficient length to obtain good refraction data to the depth of 8,000-10,000 foot per second horizon associated with the Ringold formation.
4. According to the U.S. Geophysical News, Walker Geophysical has one crew operating, their crew number one, in Iowa conducting a spec shoot using dynamite and a DFS-5. The crew is under the direction of Cameron Walker.
5. At the meeting, it was stated that there is no VSP data below a depth of 600 feet on the reservation. However on page 52 of SD-177 it is noted that a sonic log for RRL2 was utilized in the depths zone of 1,500 to 3,922 feet. There is an apparent data gap in any vertical velocity information between a depth of 600 and 1,500 feet. The synthetic seismogram constructed from these data is shown on Figure 21 and indicates a number of fairly strong reflectors in time interval of approximately .48 to .62 seconds. This synthetic seismogram would tend to validate the .5 seconds reflector as real data.
6. It would be most helpful to the NRC and their reviewers if they had the opportunity to review the progress of this summer's reflection profiling program and could comment in such a manner as occurred in the morning session of the May 23 meeting. A field visit by NRC staff and their consultants after completion of the test program and during data acquisition in the option 2 area, might help to increase the NRC's confidence level and help satisfy the NRC that everything is being done to acquire the best reflection data possible. On the other hand the NRC may not wish to have any of their actions construed as being participatory or approving of DOE's programs.
7. After the 5/23 meeting, I reviewed the interpretation section of SD-177. There is a strong implication in SD-177 that the structural interpretation is based on the seismic reflection data rather than Berkman's assertion that the structural interpretation is based on the correlation between borings as modified by geophysical data between borings. This major inconsistency would require extensive amplification and would lead to considerable revisions to the reprocessing report if it were officially

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reviewed by the NRC as part of a licensing action. Also for licensing activities, it is strongly recommended that DOE and Rockwell use appropriate qualifiers such as dashed lines where seismic interpretation is questionable versus solid lines where they feel confident of the interpretation. A presentation such as plates 7A, 8A and 9A without explanation is totally unacceptable in a licensing action.

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MAY 22 1985

REVISED AGENDA FOR DOE-NRC MEETING

MEETING LOCATION: U.S. Nuclear Regulatory Commission  
Silver Spring, MD, Room 130

DATE: May 23, 1985

TIME: 9:00 a.m. to 3:00 p.m.

PURPOSE: To exchange views on plans for the seismic survey and other  
geophysical work at BWIP.

A. INTRODUCTION

B. SEISMIC SURVEY

1. Planned seismic survey - background, purpose, and objectives
2. Discussion of the statement of work.
3. Usefulness of the survey to the BWIP

C. PREVIOUS SEISMIC SURVEY  
(If time allows)

1. Status of interpretations of seismic reflection  
Lines 3, 5, and 8
2. Short discussion on bases for the interpretations and supporting  
material used

D. PLANS FOR OTHER GEOPHYSICAL WORK AT BWIP

E. CLOSING REMARKS BY DOE, NRC, STATE OF WASHINGTON, AFFECTED INDIAN TRIBES,  
THE PUBLIC