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**ENVIRONMENTAL RESEARCH PROGRAMS
FOR THE NEVADA OPERATIONS OFFICE**

WORK PLAN AND QUARTERLY REPORTS

**DESERT RESEARCH INSTITUTE
Contract Number DE-AC08-90NV10845**

FIRST THROUGH FOURTH QUARTER REPORTS

by
**Desert Research Institute
University of Nevada System**

submitted to
**Nevada Operations Office
U.S. Department of Energy
Las Vegas, Nevada**

MASTER

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NOVEMBER 1990

WATER RESOURCES CENTER

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Las Vegas, Nevada**

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NOVEMBER 1990

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INTRODUCTION

The work carried out on behalf of the U.S. Department of Energy (DOE) by the Desert Research Institute (DRI) includes a wide range of research and support activities associated with the Weapons Testing Program conducted at the Nevada Test Site (NTS). Ongoing and new environmental research programs to be conducted by DRI over the period of this contract include archaeological studies and site mitigation plans; offsite community radiation monitoring support; environmental compliance activities related to state and federal regulations; hydrologic assessment of containment of underground nuclear detonations; hydrology/radionuclide investigations designed to better understand and predict the possible subsurface movement of radionuclides at the NTS; and support of various statistical and data management and design activities.

In addition to these, archaeological and other activities will be carried out in support of the Yucca Mountain Project. Other areas of the overall program which require DRI support are classified security activities, radiation safety and training, quality assurance and control, computer protection and historical data management, derivative classification of DRI documents, and preparation of any special reports, e.g., quarterly reports, not included in the requirements of the individual projects.

In accordance with specific contract requirements for each year of effort, DRI will produce summary, status and final reports and, in some cases, journal articles which will present the results of specific research efforts.

The following sections describe the details of the ongoing and new work, followed by a quarterly report for each project.

NEVADA TEST SITE ARCHAEOLOGICAL PROGRAM

INTRODUCTION

The NTS Archaeological Program is designed to conduct archaeological studies prior to all ground-disturbing activities on the NTS. In doing so, DRI fulfills DOE's obligation to comply with the regulations of the National Environmental Policy Act (NEPA) and the National Historic Preservation Act (NHPA). Three programs address these activities. The first, Environmental Compliance for Ground-Disturbing Activities, includes site mitigation plans should these ground-disturbing activities adversely impact cultural resources. The second, Pahute and Rainier Mesas Long-Range Study Plan, proposes a comprehensive data recovery program as part of the mitigation of all potential adverse impacts on these areas, however, it has not been included in FY 1990 funding. The third program is a multi-phase program to consult with Native American Groups to assist DOE in complying with the American Indian Religious Freedom Act (AIRFA). The three programs are described in the following sections.

ENVIRONMENTAL COMPLIANCE FOR GROUND-DISTURBING ACTIVITIES

Contact: Dr. Lonnie Pippin

PROJECT DESCRIPTION

To comply with the NEPA and NHPA, archaeological studies must precede all ground-disturbing activities on the NTS. If cultural resources are not present at a site, DOE documents that a study was conducted, usually through DRI's cultural resources reconnaissance short report, and allows the project to proceed. However, if cultural resources occur in the zone of adverse impact by a scheduled activity, then each cultural resource must be evaluated for its scientific or historic worth and plans must be devised to mitigate any adverse impacts on the archaeological sites held eligible for inclusion in the National Register of Historic Places. Most archaeological sites on the NTS can be avoided by DOE projects, but occasionally significant cultural resources occur within the zone of proposed direct impact. In those cases, DOE mitigates any adverse impacts to the site through a scientific study of the site prior to the scheduled disturbance. These data recovery studies are funded by the responsible National Laboratory or Defense Agency and must be approved by both the Nevada Division of Historic Preservation and Archeology and the President's Advisory Council on Historic Preservation (ACHP).

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Conduct preconstruction surveys prior to ground-disturbing activities as required.
- Task 2. Complete reports from previous data recovery projects.
- Task 3. Conduct limited test excavations at selected archaeological sites to fully evaluate their scientific significance and establish suitable plans for data recovery.

- Task 4. Prepare data recovery plans for those cultural resources which cannot be avoided by proposed ground-disturbing activities.
- Task 5. Conduct data recovery studies at archaeological sites scheduled for disturbance.
- Task 6. Maintain and update cultural resources inventory files and site record maps as necessary.
- Task 7. Assist DOE in managing cultural resources on the NTS and preparing management objectives and reports.
- Task 8. Assist DOE in public relations and communication concerning the NTS archaeology program.

DELIVERABLES

- 1. Cultural resources reconnaissance reports as required.
- 2. Reports for U20aw, U20az, U19az, Buckboard Mesa and other data recovery activities conducted in FY 1989.
- 3. Reports covering limited test excavations as required.
- 4. Data recovery plans as required.
- 5. Reports covering data recovery studies as required.
- 6. Updated inventory files and maps of surveyed areas as needed.
- 7. Recommendations concerning the management of cultural resources as necessary.
- 8. Activities and materials for explaining the NTS archaeology program as requested.

BUDGET - ENVIRONMENTAL COMPLIANCE FOR GROUND-DISTURBING

ACTIVITIES: \$70,000

LABORATORY FUNDING: \$200,000

TOTAL BUDGET - NTS ARCHAEOLOGICAL PROGRAM: \$270,000

PROGRESS ON TASKS

Task 1. Conduct preconstruction surveys prior to ground-disturbing activities as required.

First Quarter (October – December 1989):

Five preconstruction surveys were conducted: Canyon Substation, U19az Ground Motion Study, U19az Boundary Survey, U20bd Shoofly Road, and Well 4A Survey.

Second Quarter (January – March 1990):

One preconstruction survey near Camp Desert Rock was conducted.

Third Quarter (April – June 1990):

Preconstruction surveys included the inspection of eight characterization wells at various locations around the NTS.

Fourth Quarter (July – September 1990):

Preconstruction surveys were conducted for three additional characterization well sites, as well as relocations of four of the original groups in the survey. An additional preconstruction survey was conducted for a power line between Areas 2 and 12.

Task 2. Complete reports from previous data recovery projects.

First Quarter:

Work continued on the three remaining reports from previous projects: U20az, U20aw and Buckboard Mesa. A review draft of U20az should be transmitted to DOE in the first week of January, a review draft of U20aw by the end of January, and a review draft of Buckboard Mesa by the end of February.

Second Quarter:

Review drafts of three reports, U20az, U20aw and Buckboard Mesa, were completed, which fulfills the requirement of completing old reports that do not have field work yet to be done. Two reports, U19az and U19ao, await completion of field work before final drafts can be prepared.

Third Quarter:

Field work on U19az was completed, and analysis of the collection was initiated. Field work for U19ao remains on hold.

Fourth Quarter:

Work on old reports was limited to the cataloging and analysis of artifacts recovered from fieldwork at U19az.

Task 3. Conduct limited test excavations at selected archaeological sites to fully evaluate their scientific significance and establish suitable plans for data recovery.

First through Fourth Quarters:

No test excavations were conducted.

Task 4. Prepare data recovery plans for those cultural resources which cannot be avoided by ground-disturbing activities.

First Quarter:

Five data recovery plans (four combined in a single document) were developed. The single plan involved data recovery at 26Ny5774 on Rainier Mesa (Ue12T#9). The combined report contained data recovery strategies for drill sites U19az, U19ba, U19bf and U19bg (U19ar).

Second through Fourth Quarters:

No new data recovery plans were submitted.

Task 5. Conduct data recovery studies at archaeological sites scheduled for disturbance.

First Quarter:

No data recovery was initiated.

Second Quarter:

No new data recovery plans were implemented.

Third Quarter:

In addition to the field work at U19az, field work was completed for U19ba, U19bg and U20bd. Cataloging and analysis of these collections were initiated.

Fourth Quarter:

Data recovery was completed for U19ba and U19an borrow pits. Cataloging of these collections was initiated. Mapping and artifact collection were also conducted at Cliff Springs.

Task 6. Maintain and update cultural resources inventory files and site record maps as necessary.

First Quarter:

Four archaeological sites were recorded and added as a result of preconstruction surveys conducted in support of the Weapons program. Cataloging and data entry were

conducted for artifact collections at U19ao, and analysis was done for the U20aw and Buckboard Mesa reports.

Second Quarter:

One archaeological site was added to the inventory files.

Third Quarter:

Thirty-nine archaeological sites were added to the site inventory files and maps.

Fourth Quarter:

Sixteen archaeological sites were added to the site records. In addition, work was begun to set up a computer network and dedicated archival computer for data from the NTS programs.

Task 7. Assist DOE in managing cultural resources on the NTS and preparing management objectives and reports.

First Quarter:

The Programmatic Agreement between DOE, the ACHP and the Nevada State Historic Preservation Office (SHPO) was reviewed.

Second Quarter:

DRI held discussions with SHPO and the ACHP concerning the Long-Range Study Plan for Pahute and Rainier Mesas. Agreement was reached concerning this data recovery plan, and DRI is preparing a revised draft incorporating the comments of these two agencies.

DRI has also prepared and submitted to DOE a draft archival agreement for the collections obtained during the ongoing cultural resources studies.

Third Quarter:

DRI submitted a revised draft of the Long-Range Study Plan for Pahute and Rainier Mesas, which was accepted by the appropriate agencies as part of a Programmatic Agreement for these areas. DRI personnel participated in a DOE meeting to help explain the effects of implementing the Programmatic Agreement on the DOE archaeological program.

Fourth Quarter:

In preparation for implementing the long-range study plan of Pahute and Rainier Mesas, all of the proposed sample units were inspected for suitability. Alternatives were proposed for those which no longer possessed suitable integrity. The coordinate data from these units were digitized and forwarded to Holmes and Narver for mapping purposes.

Task 8. Assist DOE in public relations and communication concerning the NTS archaeology program.

First Quarter:

No activity occurred in this area.

Second Quarter:

DRI staff helped prepare a museum exhibit for the Nevada State Museum in Las Vegas.

Third Quarter:

Dr. Pippin conducted a field tour of NTS archaeological sites for archaeologists attending the Society of American Archaeology's annual meeting in Las Vegas.

Fourth Quarter:

DRI staff did not participate in any public relations projects.

First Quarter Summary:

Problems encountered: Writing the old reports has consistently taken more time than originally estimated, because of the difficulties in estimating analysis efforts, personnel turnover, and interruptions by other tasks which have a higher priority. The benefits of bringing in additional people to do the analysis and write these old reports are questionable; with new authors, additional explanations of the procedures used during the data recovery and analysis techniques are required.

Budget: Approximately 59 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 77 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Due to increased field and laboratory activity, the straight-line projection has been exceeded. Approximately 100 percent of the budget has been expended, but additional funding is expected early in the fourth quarter.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Early in the fourth quarter, the DRI program received an additional \$146,000. LLNL and LANL received an additional \$50,000 and \$70,000, respectively. Approximately 75 percent of the budget has been expended.

PAHUTE AND RAINIER MESAS LONG-RANGE STUDY PLAN

Contact: Dr. Lonnie Pippin

PROJECT DESCRIPTION

Pahute and Rainier Mesas are used by the DOE and the U.S. Department of Defense/Defense Nuclear Agency (DOD/DNA) for nuclear weapons testing. Due to the density of cultural resources on Pahute and Rainier Mesas and the frequency of nuclear testing activities that can adversely affect those resources, the established procedures for mitigating adverse impacts have become redundant and unwieldy. A single program is needed that will result in the mitigation of all potential adverse impacts on Pahute and Rainier Mesas through a comprehensive data recovery program. DRI has proposed to implement such a data recovery program in its "Long Range Study Plan For Negating Potential Adverse Affects to Cultural Resources on Pahute and Rainier Mesas, Nevada Test Site, Nevada" submitted to DOE in June 1988.

The ultimate objective of the proposed data recovery program is to study, based on modifications to the existing sample of surveyed areas, a geographically representative 11 percent sample of all cultural resources on Pahute and Rainier Mesas. This long-term goal will be achieved through the accumulation of information from data recovery programs at drill holes previously scheduled for nuclear events and from selected sample units that are representative of all geographic areas on Pahute and Rainier Mesas. Interim reports will be prepared for each data recovery effort at selected drill holes and upon the completion of studies at each geographic sample unit. A final integrative report will be prepared upon the attainment of the ultimate geographically representative sample of all cultural resources. Consultation with the Nevada Division of Historic Preservation and Archeology and President's Advisory Council concerning the fulfillment of this plan will be held annually, prior to modifying any sample recovery programs and upon the completion of each interim or final report. However, consultations no longer will be required prior to ground-disturbing activities at individual drill holes that are located outside of the proposed sample. Once the sample of cultural resources has been studied through data recovery programs and the Nevada Division of Historic Preservation and Archeology and the Advisory Council have concurred with the results of this sample, the DOE will have fulfilled its obligations for the mitigation of potential adverse impacts to cultural resources on Pahute and Rainier Mesas. This program is envisioned as a 10-year study, with the work effort divided evenly over the life of the study.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Initiate investigations at drill holes and sample units specified for year 1 in the long-range study plan.
- Task 2. Conduct laboratory analyses of data recovered from Task 1 field investigations and curate these data.

- Task 3. Prepare interim reports and other supporting documentation.
- Task 4. Provide technical assistance to DOE in consulting with the Nevada Division of Historic Preservation and Archeology and the Advisory Council on Historic Preservation.
- Task 5. Maintain an interpretive display in Mercury.

DELIVERABLES

- 1. Letter reports specifying the schedule, work effort, proposed modifications, and anticipated completion date of field work at individual sample units, to be submitted prior to the initiation of those field investigations.
- 2. Letter reports describing the status of laboratory analyses and curation procedures as necessary.
- 3. Interim reports and other supporting documentation (site records, published articles, etc.) concerning the implementation of the long-range study plan for Pahute and Rainier Mesas.
- 4. Background information and reports supporting DOE's consultation with the Nevada Division of Historic Preservation and Archeology and the Advisory Council on Historic Preservation.
- 5. Exhibits in Mercury.

BUDGET - No funding was allocated for this program during FY 1990.

**NTS AMERICAN INDIAN RELIGIOUS FREEDOM ACT
COMPLIANCE PROGRAM
Contact: Dr. Lonnie Pippin**

PROJECT DESCRIPTION

Section 2 of the American Indian Religious Freedom Act (AIRFA) of 1978 (P.L. 95-341) directs federal agencies to consult with Native Americans to determine appropriate procedures to protect the inherent rights of Native Americans to believe, express, and exercise their traditional religions including, but not limited to, access to site, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites. In 1987, DOE's Yucca Mountain Project Office initiated a program to consider Native American concerns in regard to its Yucca Mountain Project (YMP). However, that program was focused only on DOE's activities associated with the YMP and did not include consideration of other activities on the NTS. The NTS AIRFA Compliance Program is designed to assist DOE in expanding its compliance with AIRFA to incorporate all activities on the NTS. It is directed at the development and implementation of a consultation plan designed to solicit, on behalf of DOE, Native American comments regarding the effects of DOE activities on historic properties of Native American origin and the expression and exercise of traditional Native American religions.

The NTS AIRFA Compliance Program has been developed in seven phases: 1) literature review and evaluation; 2) preparation of a baseline document; 3) preparation of a study design; 4) consultation with Native Americans; 5) preparation of a preliminary draft report; 6) preparation of a final draft report; and 7) preparation of a final report. The total length of the program is expected to be approximately 25 months. The activities for FY 1990, as described below, will include all of Phases 1 through 3 and a portion of Phase 4.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Literature Review and Evaluation: This task will include the review and evaluation of all related literature developed in association with the project, literature documenting the identification of cultural resources on the NTS, federal regulations and guidelines regarding Native American consultations, DOE policy documents, and consultations with Native Americans regarding the disposition of the burial site at Drill Hole U20aw.
- Task 2. Preparation of a Baseline Document: This task will consist of the development of a baseline document that summarizes the results of previous consultations with Native Americans concerning the YMP and Drill Hole U20aw projects and relates that work to the NTS. In addition, this document will identify key issues that should be addressed through further consultations and recommendations concerning methods and procedures to be used in those consultations.

- Task 3. Preparation of Study Design: The baseline document prepared during Phase 2 activities will be used to prepare a detailed plan of study for Native American consultations for the entire NTS. That plan will be designed to build on previous consultations and will include the identification of Native American groups to be included in consultations, methods to be used in consultation, assignment of tasks, identification of key personnel responsible for each task, and scheduling of work efforts.
- Task 4. Consultation: Phase 4 activities during FY 1990 will involve the actual consultation with Native American groups identified in Phase 3. This consultation will include initial contacts with concerned Native American groups, off-site interviews with key cultural experts, and one of two planned site visits. Although the entire NTS will be encompassed by these consultations, emphasis will be placed on those areas in which DOE's activities have been or will be focused (i.e., Pahute-Rainier Mesas, Yucca Flat, Frenchman Flat, Mid Valley, Mercury Valley, and Jackass Flat). Consultation will be conducted in accordance with the most recent version of Traditional Cultural Properties Guidelines for Evaluation (P.L. Parker and T.F. King, U.S. Department of Interior, National Park Service, Interagency Resources Division) and 36CFR800.

DELIVERABLES

1. Baseline document to be submitted to DOE (first quarter).
2. Study design to be submitted to DOE (first quarter).
3. Progress report to be submitted to DOE (fourth quarter).

BUDGET - NTS AIRFA COMPLIANCE PROGRAM: \$70,000

PROGRESS ON TASKS

Task 1. Literature review and evaluation.

First Quarter (October – December 1989):

Getting the necessary contracts and subcontracts in place has taken more time than originally anticipated, causing a delay in meeting the original schedule. A revised schedule will be determined early in the second quarter.

Second Quarter (January – March 1990):

After completing contracts with the University of Michigan and the University of Nevada, Reno, literature review was initiated, beginning with a review of legal cases related to AIRFA and a synopsis of projects in Nevada where AIRFA compliance was attempted.

Third Quarter (April – June 1990):

The review and evaluation of the existing literature and all previous consultations and interactions with Native Americans on and around the NTS are completed. This review includes a summary of all Federal legislation and regulations pertinent to AIRFA compliance, the identification of key issues that might be addressed through further consultations, and an appraisal of how this existing information pertains to and can be used in the development of the AIRFA Compliance Program for the NTS.

Fourth Quarter (July – September 1990):

The progress report on this task was not received for inclusion in this report. It will be submitted separately at a later date.

Task 2. Preparation of a baseline document.

First Quarter:

The preparation of a baseline document is anticipated to be completed in the second quarter.

Second Quarter:

A meeting between the two subcontractors concerning the responsibilities for the baseline document and preparation of the baseline document and study design will occur early next quarter due to delay in getting contracts processed.

Third Quarter:

Significant progress has been made in the preparation of a baseline document incorporating the above literature review and evaluation (Task 1) and supporting the preparation of a

Study Design (Task 3). Currently, it is planned that this baseline document will be included as a portion of the Study Design and will be submitted to DOE with the Study Design during the fourth quarter.

Fourth Quarter:

The progress report on this task was not received for inclusion in this report. It will be submitted separately at a later date.

Task 3. Preparation of a study design.

First Quarter:

Work on the study design is awaiting completion of the baseline document.

Second Quarter:

In subsequent quarterly reports, Task 3 will be included with Task 2, above.

Third Quarter:

Work has been initiated on the preparation of a detailed study plan that will be based on information summarized in the baseline document and will be followed during subsequent phases of the NTS AIRFA Compliance Program.

Fourth Quarter:

The progress report on this task was not received for inclusion in this report. It will be submitted separately at a later date.

Task 4. Consultation.

First Quarter:

No consultations have been conducted.

Second Quarter:

No consultations have been conducted.

Third Quarter:

No work was done on this task, although the above tasks have included the identification of Native Americans who will be involved in the consultation process.

Fourth Quarter:

The progress report on this task was not received for inclusion in this report. It will be submitted separately at a later date.

First Quarter Summary:

Problems encountered: See Task 1 above.

Budget: Approximately 6 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: See Task 1 above.

Budget: Approximately 10 percent of the budget has been expended.

Third Quarter Summary:

Due to difficulties in obtaining DOE permission to initiate subcontracts with the University of Nevada and the University of Michigan, the AIRFA Compliance Program is behind schedule. Nevertheless, as planned, the Study Design will be submitted to DOE in FY 1990.

Budget: Approximately 26 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: The progress report on this task was not received for inclusion in this report. It will be submitted separately at a later date.

Budget: Approximately 87 percent of the budget has been expended.

OFFSITE RADIATION SAFETY

INTRODUCTION

Since the inception of nuclear testing at the NTS, a major commitment has been made by DOE and its predecessor agencies to protect the health and safety of the residents in the area surrounding the NTS. Radiation monitoring has been done by various groups and agencies since the days of the earliest testing, with that responsibility resting with the U.S. Environmental Protection Agency (EPA) since 1970.

Radiation monitoring has evolved from early measurements taken with hand-held instruments to today's equipment for continuous and real-time collecting and reporting of data. Water and milk samples are currently monitored routinely for radiation, and whole-body radiation measurements are made on selected residents from the offsite area on a periodic basis. Air samples are collected continuously at more than 30 locations and analyzed for radiation, and there exists a standby network of air monitors in every contiguous state west of the Mississippi River. Real-time radiation levels are reported continuously and automatically through a satellite link between the pressurized ion chambers (PICs), located at each Community Monitoring station and several remote EPA sites, and the Las Vegas EPA laboratory.

COMMUNITY RADIATION MONITORING PROGRAM

Contact: Mr. Nate Cooper

PROJECT DESCRIPTION

At the beginning of the tenth year of this program, the objectives still include enhancing and augmenting the collection of airborne radiation data at selected locations in the long-established EPA monitoring network, plus increasing the understanding of this effort and other DOE-sponsored activities at the NTS by the residents of the surrounding area. The overriding consideration in the program is the protection of the health and safety of that population from any radiation hazards that could occur as a result of weapons testing activities.

Improving communication by involving in as many ways as possible the residents of the offsite area is the major task in this program. Local residents have been hired to manage monitoring stations in 19 communities (18 of these stations are under the sponsorship of this effort) and have been afforded extensive training and information as program representatives in their communities. The work done by DRI, which is accomplished through close cooperation with staff of DOE, EPA, and the University of Utah, includes: 1) hiring and managing the Station Managers and Alternates; 2) presenting public education forums, including town meetings, which may in coming years receive less emphasis, while more effort is placed on reaching school assemblies and service clubs; 3) disseminating information on radiation monitoring and related subjects; 4) developing and maintaining contacts and communication with local officials; and 5) verifying the data collected and analyzed by EPA at selected monitoring stations.

TASKS TO BE ACCOMPLISHED IN FY 1990

Task 1. Schedule, coordinate, and participate in nine town meetings, tentatively scheduled as follows:

- a. November 1989 – St. George and Cedar City, Utah
- b. January 1990 – Pahrump, Nevada
- c. March 1990 – Alamo and Rachel, Nevada
- d. April 1990 – Bishop, California
- e. May 1990 – Mesquite and Bunkerville, Nevada
- f. September 1990 – Dolan Springs, Arizona

(Note: Both dates and locations are subject to change as events and conditions dictate.)

Task 2. Assist in organizing and presenting two training sessions (December 1989 and July/August 1990).

Task 3. Schedule, coordinate, and participate in five or more school assembly programs or service club luncheons/meetings as appropriate, in conjunction with town meetings if feasible.

Task 4. Maintain contacts and communication with community leaders and others in the region through personal visits, correspondence, tours, telephone conversations and other means.

Task 5. Continue the DRI external data verification program to independently verify and evaluate data collected by EPA.

Task 6. Hire and/or terminate and continue supervision of and assistance to Station Managers and Alternates as required.

Task 7. Prepare and distribute to interested parties a summary report of program activities within two weeks of occurrence.

Task 8. Continue program coordination activities as required.

DELIVERABLES

1. An attendance summary and highlights of each town meeting or program presentation (after each meeting/presentation).
2. A transcript of pertinent portions of both training sessions (January and August 1990).
3. An annual report of Community Monitoring activities for FY 1989 (December 1989).

BUDGET – COMMUNITY RADIATION MONITORING PROGRAM: \$324,000

PROGRESS ON TASKS

Task 1. Schedule, coordinate, and participate in nine town meetings.

First Quarter (October - December 1989):

Town meetings scheduled for December 5 and 6, 1989, in Cedar City and St. George, Utah, were postponed until later this year. It was decided in a meeting with EPA and DOE that additional time to obtain pertinent reports and studies and to otherwise prepare for these important and visible town meetings would be the best course of action. Following is the revised schedule of town meetings for this fiscal year:

- a. February 1990 - Pahrump, Nevada, and Bishop, California
- b. March 1990 - Alamo and Rachel, Nevada
- c. April 1990 - Dolan Springs, Arizona
- d. June 1990 - Mesquite and Bunkerville, Nevada
- e. September 1990 - St. George and Cedar City, Utah

Second Quarter (January - March 1990):

Two meetings were held in February 1990. The first was in Pahrump, Nevada, on Friday, February 9, and was attended by 29 people. The second meeting was held in Bishop, California, on Thursday, February 15, and was attended by 64 people, about half of whom were loudly anti-nuclear.

Meetings tentatively scheduled for Rachel and Alamo, Nevada, for March were moved to April 16 and 17 so that the DOE/NV Manager could attend.

Third Quarter (April - June 1990):

A revised and reformatted town meeting agenda was instituted beginning this quarter, including a changed, updated, and shortened format.

Five town meetings were held with varying success. The Rachel, Nevada, meeting was held on Monday, April 16, at the Rachel Bar and Grill. After a community-hosted spaghetti dinner, Nick Aquilina and the official party made the presentation to 50 people. The meeting was deemed very successful.

The next night, April 17, the same material was presented to 27 people in Alamo, Nevada. This meeting was also well received.

The third meeting was held in Dolan Springs, Arizona, on May 24. Forty-one people attended, and indicated appreciation of efforts. Among other things, a tour of the Nevada Test Site was discussed.

On June 27, six local citizens appeared at the meeting in Bunkerville, Nevada, and the next night, June 28, three people attended the meeting at Mesquite, Nevada. Between sum-

mer farming activities (both places) and an unscheduled and conflicting City Council meeting (Mesquite), a review of the times and places of town meetings is scheduled in an attempt to enhance attendance.

The final two meetings of the year are tentatively scheduled for St. George and Cedar City, Utah, in September.

Fourth Quarter (July – September 1990):

No town meetings were held. The two that were tentatively scheduled, St. George and Cedar City, Utah, were postponed until research is done on targeted audiences and specific meeting formats are established.

Task 2. Assist in organizing and presenting two training sessions (December 1989 and July/August 1990).

First Quarter:

The Winter Training Session was held at the Palace Station Hotel and Casino in Las Vegas, December 27 and 28. Twenty-seven Managers and Alternates attended the session that was highlighted by presentations by the Nuclear Emergency Search Team.

Second Quarter:

Polling of Managers, Alternates and others involved with the program resulted in scheduling the summer training session for July 30 – August 3, 1990, in Brian Head, Utah.

Third Quarter:

Hotel reservations have been made at the Brian Head Royale Hotel in Brian Head, Utah, for the summer training session to be held July 30 – August 3, 1990. Other assistance in arrangements, including the agenda, speakers and general activities, has been rendered. This session will, in part, be concurrent with a meeting of the DOE Offsite Radiation Exposure Review Project task group leaders, plus a significant number of DOE officials.

Fourth Quarter:

The five-day Summer Training Session was held at the Brian Head Royale Hotel in Brian Head, Utah, from July 30 through August 3, 1990. Twenty-five of the Station Managers and Alternates attended, with seven unable to attend for various reasons. An excellent program was offered, highlighted by Dr. Vincent Covello's presentation on "Risk Communication." The training agenda was well received, with significant contributions made by EPA and several "outside" speakers. Dr. Sandquist did his usual great job of organizing and lecturing.

Task 3. Schedule, coordinate, and participate in five or more school assembly programs or service club luncheons/meetings as appropriate, in conjunction with town meetings.

First Quarter:

As a result of postponing the town meetings, no service club or school assembly presentations were made.

Second Quarter:

A total of four school and two service club presentations were made in conjunction with the two February town meetings. Presentations were made on February 9 to the Pahrump Valley Senior Citizens' Center and two science classes at Pahrump Valley High School; approximately 184 people attended. On February 15, presentations were made to 17 people at the Bishop Chamber of Commerce and to 43 students and their teachers at Bishop Union High School.

Third Quarter:

No school assembly or service club presentations were made. At least one of each is planned for the fourth quarter.

Fourth Quarter:

A presentation was made to the St. George, Utah, Chamber of Commerce members at their luncheon meeting on September 26, 1990. The subject, chosen by them, was "Fallout in St. George: Past and Present," addressed by David Wheeler (DOE-NV), with assistance from Station Manager Jack Heppler and Bob Lucas from DRI. The 56 people who attended were mostly interested and appreciative, with some hostility in evidence. Overall, it was a worthwhile effort, which resulted in an invitation to return and speak to the group again in the near future on related subjects.

Task 4. Maintain contacts and communication with community leaders and others in the region through personal visits, correspondence, tours, telephone conversations and other means.

First Quarter:

Except for Salt Lake City, every station was visited at least once. Elected and other officials were visited when possible, including several newly elected community leaders who had not been met previously.

Second Quarter:

Every station except Salt Lake City was visited. Elected officials were invited to the Pahrump and Bishop town meetings, as is the case with all town meetings, and several attended.

Third Quarter:

Visits to stations, program personnel, and others were continued as a part of the routine interaction with local residents.

Fourth Quarter:

Visits to stations, program personnel, and others were continued as a part of the routine interaction with local residents. Almost all stations were visited at least once.

Task 5. Continue the DRI external data verification program to independently verify and evaluate data collected by EPA.

First Quarter:

Six TLDs, set out the previous quarter, were picked up for analysis; six new TLDs were installed at other stations on the same trip.

Second Quarter:

Six TLDs, set out in six locations at the beginning of the quarter, were picked up and sent to REECo for analysis. Twelve TLDs were installed, two each at six new locations.

Two out-of-state suppliers were contacted in an effort to obtain TLDs and analyses from a source independent of DOE contractors. To date, a new vendor has not been selected.

Third Quarter:

Thermoluminescent dosimeters were picked up from six stations and sent for analysis for last quarter. Six new sets of TLDs were installed at other stations. A very reasonable bid from a new supplier/analyzer for TLDs for next year has been received and is being evaluated.

Fourth Quarter:

TLDs installed this quarter will be picked up and sent for analysis in early October. New sets will be installed at other locations at the same time. The new TLDs are from a different source (the Radiation Measurements Facility at Arizona State University), where we have made arrangements for FY 1991 supply and analysis service.

Task 6. Hire and/or terminate and continue supervision of and assistance to Station Managers and Alternates as required.

First Quarter:

There were no personnel changes. It is anticipated that new Alternates will be hired for the currently vacant Austin and Las Vegas positions. The matter of retired school teachers was discussed by agency participants at the Winter Training Session.

Weekly reports from the EPA route personnel have kept DRI informed on which Station Managers are visiting their stations, and which are not. Several times when a problem seemed evident, a telephone call to the Manager was sufficient to resolve the problem. This will be continued.

Second Quarter:

Efforts to find Alternate Managers for the Austin and Las Vegas stations were unsuccessful. There were no other changes.

Letters were sent early in the quarter to those Managers who, for whatever reason, had demonstrated a tendency not to document visits to their stations. Substantial improvement was noted in the weeks following.

Third Quarter:

No personnel changes occurred during this period, although several were discussed and will be implemented prior to October 1.

The matter of retired people continuing to serve as Station Managers or Alternates has been addressed, and changes are anticipated during the fourth quarter. Those changes will be reported as appropriate.

Fourth Quarter:

One new Alternate Manager, Tom Brannan, principal of the Austin High School, has been hired to assist Bill Cox at the Austin station. Two people have been interviewed for the Las Vegas positions. At Alamo, Alternate Rick Hardy has been appointed Station Manager, with Dell Sullivan changing status to Alternate there. Recruiting and hiring will be accomplished for positions in Ely and Goldfield, Nevada, and St. George, Utah, early in FY 1991.

Task 7. Prepare and distribute to interested parties a summary report of program activities within two weeks of occurrence.

First Quarter:

The postponement of the December meetings largely prevented any work on this task.

Second Quarter:

Post-meeting memoranda were distributed. Completion of the annual report was delayed by problems in resolving TLD comparisons; a draft should be ready in April.

Third Quarter:

Short analyses and summaries of the town meetings held during this quarter were prepared and distributed.

The FY 1989 Annual Report was completed, reviewed and approved for printing and distribution, which will occur in early July.

Fourth Quarter:

The FY 1989 Annual Report was printed and distributed in July. The transcript of the Station Manager's Reports from the Summer Training Session was prepared and distributed in September. A summary and analysis of the St. George Chamber of Commerce luncheon meeting presentation was written and distributed. Work has begun on the FY 1990 Annual Report.

Task 8. Continue program coordination activities as required.

First Quarter:

The Winter Training Session caused, as usual, interaction and communication to increase. Telephone calls made before and after underground nuclear tests have continued, as have distribution of news clippings and other aspects of the program. More time is being spent visiting with Managers and others while on trips around the network, with the intention of better serving station needs.

Second Quarter:

Program coordination activities have continued. Agency participants, at the request of DOE management, made some changes in the town meeting presentation. The new presentation will be made in the April meetings in Rachel and Alamo.

Third Quarter:

Several meetings were held relating to changing the town meeting agenda and other program-related activities. Discussions with DOE program personnel regarding program goals for next year were initiated.

Station Managers and Alternates were notified of all announced nuclear tests, and the periodic news clipping service was continued.

Fourth Quarter:

Discussions with DOE program personnel continued in several meetings regarding extensive changes in meeting format and audience selection, as well as program guidelines for FY 1991. One meeting was held with Gene Butler, science curriculum coordinator for the Clark County School District, on the subject of presentations to Clark County teachers and students, which should lead to rather significant opportunities in FY 1991.

Bob Lucas resigned effective September 30. Nate Cooper and Juana Blackburn will be transferred to DRI's Water Resources Center in October, which will allow more time and attention to be devoted to the program in the future.

The periodic news clippings service was continued with copies to people on our mailing list, and Station Managers/Alternates were notified of all announced nuclear tests.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 18 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 42 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 62 percent of the budget has been expended, with a jump in costs anticipated near year-end because of the summer training session.

Fourth Quarter Summary:

Problems encountered: Several opportunities have been identified that will improve the program, i.e., low-cost retention of retired Station Managers, assisting other DOE facilities in initiating community monitoring programs, involving more educators in the program, collecting continuous meteorologic data at selected stations. Efforts are under way to implement those that can be funded.

Budget: Approximately 100 percent of the budget has been expended.

ENVIRONMENTAL COMPLIANCE PROGRAM

INTRODUCTION

DOE has made the policy commitment in Order 5400.1 to conduct its operations in compliance with both the letter and spirit of applicable environmental statutes, regulations and standards. Two important aspects of this policy commitment are to correct existing environmental problems and to anticipate and address potential environmental concerns before they become a threat to environmental quality or public health.

Significant federal legislation to which this policy is responsive includes the National Environmental Policy Act of 1969 (NEPA); the Federal Water Pollution Control Act as amended to the Clean Water Act (CWA); the Resource Conservation Recovery Act (RCRA); the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) as amended by the Superfund Amendment and Reauthorization Act (SARA); and the Safe Drinking Water Act (SDWA). These federal statutes have resulted in related state and local laws, and derivative federal, state and local regulations implementing those laws.

The DRI Environmental Compliance Program is directed at providing DOE with necessary support to comply with the environmental protection policy. This program contains elements focused on anticipating problems (Characterization Well Project, Geophysical Water-Level Estimation); assessing and correcting existing problems (Tunnel Ponds Assessment Project, Environmental Assessment and Review, Offsite Hydrologic Evaluation Project, RIDP Summary Report); and providing a data base for environmental studies (Environmental Data Base).

NTS CHARACTERIZATION WELL PROJECT

Contact: Mr. Charles Russell

PROJECT DESCRIPTION

To comply with RCRA and CERCLA requirements, DOE needs to implement an effective groundwater monitoring system for radionuclide transport at the NTS. This system will necessitate wells being installed in several aquifers and basins to adequately monitor radionuclides injected into or near the saturated zone by underground testing. The system must complement the existing testing program and be compatible with future testing.

This six-phase program is a refinement of the tasks outlined in the FY 1989 work plan. The six phases are: 1) assessment of the current monitoring system, 2) compilation and analysis of the available NTS groundwater data (in an iterative process) to identify data gaps that should be addressed by the site characterization, 3) design of the exploratory drilling and testing program to satisfy perceived data gaps, 4) exploratory drilling and testing and collation of existing data to design a comprehensive groundwater monitoring system for the NTS, 5) drilling, construction, and development of the monitoring wells, and 6) development and implementation of a groundwater sampling and statistical analysis plan for the monitoring network.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Continue data compilation.
- Task 2. Conduct initial analysis of data and identify data gaps.
- Task 3. Organize drilling teams and responsibilities for the characterization phase.
- Task 4. Design initial characterization wells (and associated drilling plans) to be drilled during FY 1991.

DELIVERABLES

- 1. A report outlining initial data gaps. Similar reports may be issued as the characterization phase proceeds (first quarter).
- 2. A letter report containing preliminary location, design, and drilling plans for initial characterization wells (second quarter).

BUDGET - NTS CHARACTERIZATION WELL PROJECT: \$150,000

PROGRESS ON TASKS

Task 1. Continue data compilation.

First Quarter (October – December 1989):

Groundwater data collected from LLNL, USGS, F&S, EPA, DRI, Earth Tech, and REECO during FY 1989 are being compiled into a data base. These data will aid in the design of FY 1991 characterization wells. Many discrepancies and errors have been found in the data, which may limit their usefulness to the project.

Second Quarter (January – March 1990):

Data collection is complete and compilation should be complete by the fourth quarter.

Third Quarter (April – June 1990):

Data compilation continued.

Fourth Quarter (July – September 1990):

This task has been completed.

Task 2. Conduct initial analysis of data and identify data gaps.

First Quarter:

The NTS hydrologic models and supporting data bases have been analyzed by DRI staff. Potential objectives were identified for the NTS Groundwater Characterization Program. A report summarizing these objectives is in internal review and is anticipated to be delivered during the second quarter.

Second Quarter:

The report summarizing the objectives of the NTS Groundwater Characterization Program was submitted to DOE for review. It is anticipated that the review will be completed in the third quarter, after which the document will be sent to LANL, LLNL, and the USGS for additional comments. This document is a working draft and will not be final until the entire Groundwater Characterization Program is completed.

Third Quarter:

The Groundwater Characterization Program Objectives Hierarchy has been released by DOE to the USGS, LLNL, and LANL. Their comments are expected to be delivered and addressed by the end of the fourth quarter.

Fourth Quarter:

Review comments on the Groundwater Characterization Program Objectives Hierarchy have not been received, owing to a restructuring of the program's direction. Beginning in

FY 1992, a Remedial Investigation/Feasibility Study Contractor will assume formal control for the program's future. Data gaps identified by DRI will guide only the emplacement of FY 1991 wells. Future wells will address the specific needs of a Human and Environmental Risk Assessment as identified by the contractor in consultation with DRI. No further progress is anticipated and the task is considered complete.

Task 3. Organize drilling teams and responsibilities for the characterization phase.

First Quarter:

A project organization plan was presented to DOE. Refinement of the plan and hiring of essential personnel are in progress.

Second Quarter:

Refinement of the organizational responsibilities and the drilling teams continued. A drilling engineer was hired and applications were received for four additional hydrogeologist positions.

Third Quarter:

Refinement of the organizational responsibilities and the drilling teams continued. Two hydrogeologists were hired and applications were received for the final two hydrogeologist positions. DRI helped DOE formulate organizational responsibilities and budgets for the program. Staffing of drilling teams will be completed by the first quarter of FY 1991.

Fourth Quarter:

Drill teams are 80 percent complete with only minor roles still remaining to be assigned. Owing to the restructuring of the program's direction, however, further hiring is not anticipated.

Task 4. Design initial characterization wells (and associated drilling plans) to be drilled during FY 1991.

First Quarter:

Initial objectives, location, and depths have been identified for the first 12 characterization wells and presented to DOE. Refinement of the well designs will occur throughout FY 1990. A progress report has been issued to DOE that cites the location and objectives of the wells. Similar progress reports will be issued as the project and well designs proceed.

Second Quarter:

The first two drilling plans have been submitted to DOE/NTSO. The others are in preparation and should be completed early in the third quarter. A generic drilling plan has been

developed by NTSO and is currently being refined. All nine onsite locations have been visited by DRI staff, Fenix and Scisson of Nevada (FSN) surveyors, and NTSO personnel. Five of the wells have been staked for biological and archaeological surveys. This work will continue through the fourth quarter.

Third Quarter:

All 10 well sites have been staked and located, and hole objectives delineated and tied into program objectives. Two wells have been dropped until the second year (CW12 and CW9). All drilling plans will be delivered to NTSO early in the fourth quarter. Half of the drill sites have been surveyed for archaeology and threatened and endangered species. The remainder of the sites will be surveyed during the fourth quarter. Discussions on whether REECO or an offsite driller will conduct the program have moved to DOE and REECO. Resolution of the matter should occur during the fourth quarter. Draft quality assurance documents have been created and will be completed by the fourth quarter, as have hydrologic and geochemical testing protocols. Borehole design and completion methodologies have been finalized.

Fourth Quarter:

All wells have been or are currently being surveyed for cultural resources and threatened or endangered species. The Environmental Assessment is 75 percent complete. Negotiations with the USAF are underway for access to all offsite wells. Drilling plans are essentially complete with research into the grouting and stemming materials being conducted by DRI, FSN, and LLNL. The Quality Implementation Plan has been sent to Earth Technologies for review. The Quality Assurance Program is in preparation and outlines for the Data Quality Objectives Report, the Data Management Report, and the Sampling and Analysis Plan are in preparation.

First Quarter Summary:

Problems encountered: Two problems have occurred: 1) acquisition of the remaining LANL data base has been slow, and 2) there are a large number of inaccuracies, errors, and omissions in the acquired data bases.

Budget: Approximately 17 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems were encountered.

Budget: Approximately 67 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems were encountered. The budget received an additional \$133,000 to support staffing requirements for the program.

Budget: Forty percent of the revised \$283,000 budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems were encountered.

Budget: The program received an additional \$363,500 to support FY 1991 requirements. Forty-eight percent of the revised \$646,500 budget has been expended. The unspent funds will carry over to FY 1991.

GEOPHYSICAL WATER-LEVEL ESTIMATION

Contact: Dr. Kendrick Taylor

PROJECT DESCRIPTION

A major difficulty in groundwater studies is that depth-to-water data are generally limited to relatively few discrete points (wells) distributed over a large, continuous but variable system. This circumstance requires extrapolation over large areas, which introduces major uncertainties in the interpretation of groundwater movement. Validation of extrapolated depths to water can only be done by drilling wells, which is both expensive and time-consuming. However, surface geophysical techniques may offer a way to remove much depth-to-water uncertainty in a timely and cost-effective manner.

Because the pore fluid in a geological formation conducts electrical current, most formations have a greater electrical conductivity when saturated than when unsaturated. Surface geophysical methods can be used to measure the electrical conductivity of the earth as a function of depth, and thus to indicate the depth to the saturated zone.

To accomplish this, two electrical methods, transient electromagnetics and d.c. resistivity, will be utilized. The interpretation of both methods is based upon representation of the earth as a one-dimensional, layered earth model, with the thickness and conductivity of each layer being determined from field data. The two methods will be used in conjunction to avoid the problem of equivalence, which can result in non-unique interpretations.

An effort will be made to evaluate the utility of the methods by using existing data and computer modeling. Existing well logs will be used to develop geoelectrical models that are representative of the areas where the use of geophysics may be appropriate. Existing numerical models will be used to calculate the field measurements that will be obtained in these areas. By slightly altering the parameters in the geoelectrical models, it will be possible to determine the sensitivity of the combination of transient and d.c. methods to determine the depth to saturation. Based on the modeling results, it will be possible to determine what geologic conditions are required for the surface geophysical methods to be of use.

If the results of the model suggest that the geophysical methods are appropriate for this problem, field work will be conducted in FY 1991. The focus of the field work will be to determine optimal field parameters and to verify the method in areas where there is adequate well control.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Develop geoelectric models to evaluate the appropriateness of using surface geophysics to estimate depth to saturation.

DELIVERABLES

1. A letter report on Task 1 (fourth quarter).

BUDGET - GEOPHYSICAL WATER-LEVEL ESTIMATION: \$20,000

PROGRESS ON TASKS

Task 1. Develop geoelectric models to evaluate the appropriateness of using surface geophysics to estimate depth to saturation.

First Quarter (October – December 1989):

No work was done on this task.

Second Quarter (January – March 1990):

To start work on this task, initial study areas on the NTS were identified and wells from each of the different areas were chosen. To obtain electrical conductivity data for these wells, it is necessary to have access to geophysical well logs. A formal request has been made to DOE for this access and a response is expected early in the third quarter.

Third Quarter (April – June 1990):

Work continued with DOE on obtaining induction logs from wells in the study areas. LLNL provided a list of wells where induction logs were run, which has been useful.

On May 30, 1990, Ms. Regina Bochicchio went to Reno to discuss the project with Dr. Ken Taylor, who demonstrated the software that will be used.

Fourth Quarter (July – September 1990):

Induction well logs arrived from DOE in mid-June. Seven well logs were chosen as suitable for the water level estimation study and were digitized. The digitized logs were used as the basis for computer simulation models of transient electromagnetic (TEM) soundings, using the commercial program TEMIX. The computer modeling and analysis took approximately one and a half months to complete. The results of the analysis were compiled into a report, which is in the final stages of processing.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: No money has been spent.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 2 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 16 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: The letter report on the results of Task 1 has been prepared and is anticipated to be submitted to DOE during the first quarter of FY 1991.

Budget: Actual spending on this project has slightly exceeded the straight-line projection at 104 percent.

TUNNEL PONDS ASSESSMENT PROJECT

Contact: Mr. Charles Russell

PROJECT DESCRIPTION

Detonations of nuclear devices and the associated mining activities in the Area 12 tunnel complex have produced radioactive and hazardous materials which are transported by water from the tunnels to ponds located outside the tunnels. Here, the water slowly infiltrates into the underlying carbonate rocks. The rock mined from the tunnels, some of which contains radioactive materials, is deposited in muck piles near the tunnel entrances.

The contamination in the tunnel ponds, the effluent water, and the muck piles needs to be studied in a systematic fashion. A careful assessment of the past and present situation related to effluent volumes, effluent radionuclide conditions, and types of materials in the muck piles will be conducted.

The effluent from N and T tunnels and two separate adits at the E tunnel complex will be monitored on a continuous basis for flow rates and various chemical and physical properties. Fluid samples will also be collected by automated equipment. A datalogger will be the controlling element of the system and will collect and transmit data. The discharge will be measured with a three-inch Parshall Flume equipped with a stilling well. A pressure transducer will be installed in the stilling wells for the automated flow measurements. The necessary sensors for measuring water temperature, electric conductivity and turbidity will be included in the monitoring system. A portable discrete sampler will be used to collect the water samples. The sampler can be programmed to collect samples at specified times or collect samples when activated by the datalogger. Each tunnel that is monitored will have one of these systems, although minor differences for each tunnel may exist.

The erosion and dispersal downstream of the muck piles and associated contaminants can occur in two ways. First, precipitation in the upstream watersheds that results in flash floods will result in erosion of muck piles if they are located within the floodplain. A single flood could erode a significant amount of material and disperse it downstream. The potential for transport by such events can be evaluated with standard watershed and sediment transport models. Second, precipitation directly on the muck piles will result in overland flow and sediment transport. While the amount of material transported during a single flow event may be small, the cumulative effect of many such events may be significant. Furthermore, this process may move the muck pile material to locations where it is more susceptible to transport by flow from the upstream watersheds.

The primary source of the effluent water is recharge from the mesas above the tunnel complex. Travel times of recharged water can be relatively long or short, depending on the dryness or wetness of the fractured rock material. The data obtained by examining the fractal nature of fractures in the mesa top and tunnel rocks will help in determining travel times and flow rates for a given amount of recharge.

ment shelter awaiting installation. The monitoring station at U12n has not been installed. DRI has drafted a quality assurance program for the sampling effort. This report is currently in internal review. REECO Laboratories in Mercury, Nevada, have been identified as the primary analytical laboratory for this project.

Task 3. Coordinate with REECO to design a sample grid for each of the three tunnel complex muck piles.

First Quarter:

No progress was made on this task; however, it is anticipated work will begin during the second quarter.

Second Quarter:

Recent and historical photographs obtained from EG&G and additional DNA data from tunnel complex muck piles will be correlated with mine-back activities to assist in the sampling of contaminated areas of the U12n, U12e, and U12t muck piles. Upon acquisition of these data, this task will be complete.

Third Quarter:

No progress was made on this task, as DNA has not supplied the relevant data. This task will be completed once the data are received.

Fourth Quarter:

A coordination meeting was conducted between DRI and DNA. It was decided that DNA will compile historical records concerned with placement of mine-back waste within U12n, U12e, and U12t muck piles. DRI will map the growth of the muck piles over time and utilize the information from DNA to identify those areas most likely to contain buried waste. DRI has completed its task and is waiting for the information from DNA to complete the project.

Task 4. Delineate the upstream watersheds and subcatchment areas and estimate the upstream hydrologic characteristics.

First Quarter:

Delineation of the upstream watersheds and subcatchment areas and estimation of hydrologic characteristics was initiated and should be completed during the second quarter. This task is being accomplished utilizing USGS 7-1/2 minute topographic maps and recent airphotos of the tunnel complexes.

Second Quarter:

This task has been completed.

Task 5. Conduct watershed modeling, estimate flood event hyetographs, and conduct sediment transport analysis.

First Quarter:

A U.S. Army Corps of Engineers' watershed model was obtained and is being calibrated. Initial analysis of the watersheds, estimation of flood potential, and sediment transport analysis will be conducted during the second and third quarters.

Second Quarter:

Calibration of the U.S. Army Corp of Engineers' watershed model continues; initial analysis of the watersheds, estimation of flood potential, and sediment transport analysis were started and will continue through the third and fourth quarters.

Third Quarter:

The U.S. Army Corps of Engineers' watershed model has been calibrated and all watershed modeling completed. One-hundred-year flood hydrographs for all tunnels of concern were estimated. Samples of the materials in the muck piles have been obtained where possible and size analyses have been performed. Preparation of a draft report has been initiated.

Fourth Quarter:

This task is completed and a draft report has been issued to DNA and DOE.

First Quarter Summary:

Problems encountered: No final decisions have been made on budgetary responsibilities, delaying the installation of the monitoring stations.

Reports: Due to the delay in installation of monitoring stations, Deliverable 1 will be moved to the second quarter of FY 1991. Deliverable 2 is on schedule for the fourth quarter of FY 1990.

Budget: Approximately 14 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: Delays in installation of the monitoring stations continue.

Reports: Deliverable 1 will not be completed until the third quarter of FY 1991 due to delays in installation of the monitoring stations. Deliverable 2 is on schedule for the fourth quarter of FY 1990.

Budget: Approximately 25 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: Delays in installation of the monitoring stations have continued through the third quarter owing to the multi-agency nature of the project and the lack of

DRI's ability to enforce timetables on other organizations. Delays on grid design for a muck pile sampling program continue from lack of data from DNA. Sediment transport analysis has been hampered in the immediate vicinity of the muck piles owing to limited topographic data.

Reports: Deliverable 1 will be delayed until the fourth quarter of FY 1991. The ramifications of limited topographic data will be discussed in Deliverable 2, which is on schedule for the fourth quarter of FY 1990.

Budget: Fifty-one percent of the \$150,000 budget has been spent.

Fourth Quarter Summary:

Problems encountered: Delays in installation of the monitoring stations have continued owing to the multi-agency nature of the project and the lack of DRI's ability to enforce timetables on other organizations.

Reports: Deliverable 1 will be delayed until the first quarter of FY 1992. Delays on grid design for a muck pile sampling program continue due to lack of data from DNA.

Budget: Approximately 74 percent of the budget has been spent. The unspent funds will be carried over to FY 1991.

ENVIRONMENTAL ASSESSMENT AND REVIEW

Contact: Dr. Gilbert Cochran

PROJECT DESCRIPTION

This project will support DOE requirements on the NTS to conduct activities to comply with various federal and state environmental regulations and statutes. A major focus will be on waste disposal. This project will involve data collection, analyses, document preparation, document review and program assessment. It is anticipated that activities subject to NEPA, RCRA and CERCLA provisions will continue to expand and diversify on the NTS and, therefore, the DRI involvement will continually change to meet these needs. This program will in large measure be driven by DOE's policy commitments in Order 5400.1.

In December 1987, DRI began preparation of an Environmental Assessment (EA) for the proposed mixed waste management unit (MWMU) at the Area 5 Radioactive Waste Management Site. Several delays were experienced in that program related to discussions among DOE/NV, EPA, and DOE/HQ. In January 1989, DRI completed a draft EA, which was sent by DOE/NV to DOE/HQ for review.

DOE/HQ review identified several areas of the EA where additional analysis is warranted and requested inclusion of transportation. Revision of the EA is on hold pending DOE/NV notice to proceed. Once authorization to proceed is received, the following tasks will be undertaken in FY 1990.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Carry out added analyses for the MWMU.
- Task 2. Revise the EA and incorporate new analyses.
- Task 3. Submit draft final EA to DOE/NV for review.
- Task 4. Respond to any additional review comments and prepare final EA.
- Task 5. Respond to DOE/NV assessment and review requests as appropriate.

DELIVERABLES

- 1. Draft final EA, as requested.
- 2. Final EA, as requested.

BUDGET - ENVIRONMENTAL ASSESSMENT AND REVIEW: \$30,000

PROGRESS ON TASKS

Task 1. Carry out added analyses for the MWMU.

First Quarter (October – December 1989):

Additional analyses were conducted on various aspects of the MWMU, including transportation.

Second Quarter (January – March 1990):

This task was completed in the first quarter.

Task 2. Revise the EA and incorporate new analyses.

First Quarter:

A draft of the EA was written including the results of the transportation study and other components.

Second Quarter:

This task was completed in the first quarter.

Task 3. Submit draft final EA to DOE/NV for review.

First Quarter:

The draft final EA is scheduled to be submitted to DOE in January 1990.

Second Quarter:

The draft final EA was submitted to DOE on January 15, 1990.

Third Quarter (April – June 1990):

No work was done on this task. DOE is still deliberating on their next actions.

Fourth Quarter (July – September 1990):

This task is complete.

Task 4. Respond to any additional review comments and prepare final EA.

First Quarter:

No work was done on this task.

Second Quarter:

Review comments were received from DOE/NV and appropriate changes made in the draft final EA. In February, DOE/NV submitted the draft final EA to DOE/HQ for review

and comments. HQ review resulted in delaying publication of the EA. HQ brought in outside reviewers to prepare a short version of the EA, which addresses only the Rocky Flats pond-crete. Final disposition of the draft final EA is pending further DOE/HQ decisions.

Third Quarter:

Final disposition of the draft final EA is pending further DOE/HQ decisions.

Fourth Quarter:

No further revisions were required on the draft final EA. This task is complete.

Task 5. Respond to DOE/NV assessment and review requests as appropriate.

First through Fourth Quarters:

No additional assessment or review requests were received.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 8 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 81 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 83 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 101 percent of the budget has been expended.

OFFSITE HYDROLOGIC EVALUATION PROJECT

Contact: Ms. Jenny Chapman

PROJECT DESCRIPTION

The purpose of this program is to identify monitoring objectives at the offsite test areas (Fallon Nuclear Test Site, Central Nevada Test Site, Gasbuggy, Rulison, Rio Blanco, Amchitka, Tatum Dome, and Gnome), review past sampling strategies, and prepare plans for future work to improve the Long-Term Hydrologic Monitoring Program (LTHMP) at these sites. This process was completed for four of the eight offsite test areas in FY 1989. The task for FY 1990 is to complete the recommendations for future work for all of the offsite areas. These recommendations may be general, applying to all of the offsite areas, or they may be highly site specific. One general recommendation will probably be that hydrologic release scenarios be developed for all of the sites to enable the validity of current sampling locations to be critically evaluated. An example of a site-specific recommendation is for water levels to be measured in shallow water wells near the Central Nevada Test Area to establish which wells are on possible flow paths from the test area. This could lead to the elimination of unnecessary well sampling. Some attention may also be given to developing a procedure for analyzing the radionuclide data generated by the offsite LTHMP.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Complete review of existing monitoring programs at the eight offsite areas and prepare a comprehensive list of recommended work.

DELIVERABLES

1. A report of recommended future work at each of the offsite test areas, based on current and past monitoring activities and knowledge of the hydrogeologic systems (fourth quarter).

BUDGET - OFFSITE HYDROLOGIC EVALUATION PROJECT: \$30,000

PROGRESS ON TASKS

Task 1. Complete review of existing monitoring programs at the eight offsite areas and prepare a comprehensive list of recommended work.

First Quarter (October - December 1989):

Four of the eight offsite testing areas were reviewed during FY 1989, and a preliminary report of the findings was provided to DOE. The review of the Gasbuggy Site was completed and analysis of Tatum Dome begun.

Second Quarter (January - March 1990):

Analyses of the Tatum Dome and the Gnome/Coach sites were completed. Evaluation of seven of the eight offsite test areas is now complete. Work on the final site, Amchitka, was begun and is approximately half completed.

Third Quarter (April - June 1990):

The analysis of groundwater monitoring at Amchitka was completed. The final project report was written and internally reviewed for technical content and derivative classification. The report was submitted to the DOE on June 18, 1990, completing work on this project.

Fourth Quarter (July - September 1990):

Work on this task was completed last quarter.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: A draft report of work in progress was sent to DOE in December after internal DRI review. The draft report will be revised and submitted as a final report upon completion of reviews of the final four offsite areas during FY 1990.

Budget: Approximately 55 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: It is anticipated that the final report will be completed during the third quarter.

Budget: Approximately 90 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: The project report, entitled "Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas" by Jenny B. Chapman and Sam L. Hokett, was submitted to Dr. Don Elle on June 18, 1990.

Budget: The project was completed slightly over budget, with a \$1,460 overrun. Approximately 106 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: The project report, submitted to DOE last quarter, is still in review.

Budget: Approximately 108 percent of the budget has been expended.

ENVIRONMENTAL DATA BASE

Contact: Ms. Carol Thompson

PROJECT DESCRIPTION

Several sets of NTS hydrological data have been obtained from other DOE contractors as part of the Characterization Well Project. To make these data sets more readily available for use in planning the characterization wells, they will be added to the existing Hydrological Data Base. This task probably will not be completed until late in FY 1990; in the meantime, programming assistance will be provided for retrieving and displaying data from the individual data sets on an as-needed basis.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Add data obtained for the Characterization Well Project to the Hydrological Data Base.
- Task 2. Assist with the retrieval and display of data from these data sets as needed.

DELIVERABLES

None.

BUDGET – ENVIRONMENTAL DATA BASE: \$40,000

PROGRESS ON TASKS

Task 1. Add data obtained for the Characterization Well Project to the Hydrological Data Base.

First Quarter (October – December 1989):

Methodologies were developed for coordinating and transforming most of the data received from PAI, USGS, F&S, LLNL, Sandia, and REEC Co for the Characterization Well Project into one data base design. Some work was done to locate and check historical DRI chemistry data for this data base.

Second Quarter (January – March 1990):

The data from FSN (formerly F&S), LLNL, and REEC Co were transformed and are ready for loading into the data base. Work on the USGS data is about 80 percent complete.

Third Quarter (April – June 1990):

The data from FSN, LLNL, REEC Co and the USGS have been transformed and loaded into the data base. Work on the data from Sandia is about 20 percent complete.

Fourth Quarter (July – September 1990):

The remaining data were transformed and all but one set was loaded into the data base. Additional information is required before the last set can be loaded.

Task 2. Assist with the retrieval and display of data from these data sets as needed.

First Quarter:

No work was done on this task as the data base is unavailable.

Second Quarter:

No work was done on this task as the data base is unavailable.

Third Quarter:

Informal instruction for accessing the data in the data base was given to one of the researchers.

Fourth Quarter:

The retrieval methodology was tested and some retrievals were performed for the researchers.

First Quarter Summary:

Problems encountered: It was decided to not include the PAI data in the data base because of the inconsistencies found in it.

Budget: Approximately 43 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: A great deal of time was spent trying to resolve inconsistencies in location information between and within the data sets and inconsistencies in the date and naming information, for example, within the data sets. Much time was also spent working with the unique and, in some cases, complicated data structures provided.

Budget: Approximately 75 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: The funding for this task was virtually depleted by the end of May. This was due primarily to the extra effort required to transform the uniquely formatted data sets into a single-formatted data base. Work on this data base will continue with funding from the Hydrological Data Base (under Hydrological Data Management), since the data may be used in conjunction with the GIS to be developed from that data base.

Budget: Approximately 100 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: Since the budget for this work was expended before the end of the previous quarter, work continued to be funded as noted in the above summary.

Budget: Approximately 100 percent of the budget has been expended.

RADIONUCLIDE INVENTORY AND DISTRIBUTION PROGRAM SUMMARY REPORT

Contact: Dr. Richard McArthur

PROJECT DESCRIPTION

Between 1981 and 1985, all of the known radioactively contaminated areas on the NTS were surveyed as part of the Radionuclide Inventory and Distribution Program (RIDP). The results of these surveys were published in five separate DRI reports covering different parts of the NTS. The RIDP summary report will be a more accessible and more useful document because it will bring together all the results to give an integrated picture of radionuclide distributions in the surface soil of the entire NTS.

The report will contain a review of methods, estimated radionuclide inventories for each NTS area, composite maps of radionuclide distributions, and a map of 5 mR/hr exposure rate isopleths. The data for shorter-lived radionuclides will be decay-corrected to 1 January 1990 to provide the most accurate information possible.

TASKS TO BE ACCOMPLISHED IN FY 1990

Task 1. Prepare the RIDP summary report

DELIVERABLES

1. The RIDP summary report (fourth quarter).

BUDGET - RIDP SUMMARY REPORT: \$27,000

PROGRESS ON TASKS

Task 1. Prepare the RIDP summary report.

First Quarter (October – December 1989):

Work focused on writing the program to calculate the exposure rate at each measurement location from the concentrations of 15 radionuclides. This required calculating the conversion factors for changing nCi/m^2 to mR/hr , preparing the 45 computer files containing the radionuclide concentration data, and writing subroutines to decay-correct the data and compute the exposure rate. The program has been completed and tested.

Second Quarter (January – March 1990):

All the calculations for the report (radionuclide inventories, exposure rates, and plutonium concentrations) were completed, as were the maps of radionuclide distributions. A draft of the text is about 75 percent complete.

Third Quarter (April – June 1990):

A draft of the report was completed and distributed for review.

Fourth Quarter (July – September 1990):

A final draft of the report was completed and sent to DOE for review and approval to publish.

First Quarter Summary:

Problems encountered: No problems have been encountered. However, some difficulty is anticipated in plotting all of the exposure rates after they are calculated (second quarter).

Budget: Approximately 22 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No problems have been encountered.

Budget: Approximately 98 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No problems have been encountered.

Budget: Approximately 100 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No problems have been encountered.

Budget: Approximately 103 percent of the budget has been expended.

CONTAINMENT EVALUATION PANEL

Contact: Dr. Roger Jacobson

PROJECT DESCRIPTION

The Containment Evaluation Panel (CEP) is comprised of individuals with expertise in such areas as geology, hydrology, physics, engineering, nuclear weapons testing and related fields. The function of this panel is to evaluate the containment design of each proposed underground nuclear test and to advise the DOE of the technical adequacy of such design. The objective of this effort is the successful containment of all nuclear tests considered by the panel.

DRI's primary activity for the CEP will continue to be the assessment of the hydrologic implications of each test, as well as other aspects of the containment design. Since each test possesses unique features, the activities that are carried out will vary from test to test and may include computer analyses of the data from past tests, analyses of the geology and materials properties in and around the site of the proposed event, and comparison of these parameters with those of past events. Hydrologic conditions at the test location are important for containment of underground nuclear tests, so it is important to examine the existing hydrologic data from areas where shots are to be conducted.

Attendance by the DRI member or alternate is required at regular and special CEP meetings. Travel to the sponsoring laboratories is occasionally required.

In addition, all security-related activities of DRI related to CEP are provided for under this task.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Assess the prospects for containment – all tests.
- Task 2. Attend all special meetings.
- Task 3. Examine hydrologic data relevant to containment.
- Task 4. Accomplish all security-related activities for CEP.

DELIVERABLES

- 1. Categorization statements for each event considered by the Panel.

BUDGET – CONTAINMENT EVALUATION PANEL: \$102,000

PROGRESS ON TASKS

Task 1. Assess the prospects for containment – all tests.

First Quarter (October – December 1989):

Two CEP meetings were attended by the DRI Panel member and alternate. These meetings were held on October 11 and December 13. In conjunction with the December meeting was a tour of the Mineral Quarry tunnel.

Second Quarter (January – March 1990):

DRI panelists attended one CEP meeting, held on February 14, 1990.

Third Quarter (April – June 1990):

DRI panel member, Dr. Paul Fenske, and guest, Dr. Gil Cochran (DRI), attended the May and June CEP meetings.

Fourth Quarter (July – September 1990):

Dr. Paul Fenske, Dr. Roger Jacobson, and guest, Dr. Gil Cochran, attended the 189th CEP meeting, held in September 1990.

Task 2. Attend all special meetings.

First Quarter:

No special meetings were called.

Second Quarter:

A special meeting was called for March 30, 1990, which Dr. Fenske attended.

Third Quarter:

No special meetings were called.

Fourth Quarter:

No special meetings were called. Dr. Paul Fenske spent several days reviewing information in preparation for the September meeting.

Task 3. Examine hydrologic data relevant to containment.

First Quarter:

No work was done on this task.

Second Quarter:

Spatial correlation in soil saturation was investigated for three elevations at Yucca Flat using semivariogram analysis. Approximately 24 data values were available for each horizon with separation between data locations of 1,000 feet to over three miles. Because the data were widely scattered in space and of limited number, the semivariograms gave no clear indication that the saturation values were spatially correlated. However, some suggestion of spatial correlation was observed. Additional data will have to be obtained and included in the analysis before the question of spatial correlation in the saturation data can be answered. Toward this end, LLNL was contacted concerning additional data from other boreholes at Yucca Flat. Information from 32 additional boreholes are available and will be included in further analyses when the data are received.

Third Quarter:

Site Characteristics Reports or preliminary reports were obtained from LLNL for 30 additional boreholes at Yucca Flat. However, less than half of the reports contained the necessary information of saturation ratio with depth needed for the analysis of spatial correlation.

The additional data have been included in the semivariogram analysis of the saturation ratio. A preliminary analysis suggests that at separation distances of 1,000 ft and 2,000 ft, no spatial correlation exists, and at shorter separation distances of 500 ft and 750 ft, insufficient data are available to make a determination of spatial correlation. Saturation ratio is a calculated variable not measured directly and thus is subject to errors. To investigate the spatial correlation of a measured property, an analysis using semivariograms of porosity data will be undertaken.

Fourth Quarter:

To investigate the special correlation of a measured property, an analysis of porosity data using semivariograms was started. The analysis is still in progress and should be completed the first quarter of FY 1991.

A letter report describing the results of the semivariogram analysis of the saturation data was started this quarter and will be completed early in the next quarter.

Task 4. Accomplish all security-related activities for CEP.

First Quarter:

All security-related activities for CEP were accomplished, as necessary.

Second Quarter:

All security-related activities for CEP, such as maintenance of safe-room files and classified documents control, were accomplished, as necessary.

Third Quarter:

An inventory of all classified documents in DRI custody was completed in April.

DRI received and passed the yearly classified security inspection.

OPSEC goals as they pertain to information pertinent to the CEP were identified, and will be included in the DRI OPSEC program.

General security-related work was carried out during this period.

Fourth Quarter:

Work was started on a revised version of the classified security plan. An inventory of classified documents on-hand was completed. Organizational work toward a CEP Symposium in 1991 was begun.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 22 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 40 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 65 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 98 percent of the budget has been expended.

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM

INTRODUCTION

To address the environmental and safety aspects of continued underground nuclear testing at the NTS, the major focus of the Hydrology/Radionuclide Migration Program (HRMP) is to gain a better understanding of groundwater flow directions and velocities and radionuclide migration on both a local and a regional level. This will be accomplished through a variety of research and support projects ranging from regional groundwater modeling and radionuclide chemistry studies to statistical and data management support for the large quantities of hydrologic and other data which have been and will continue to be collected, stored and retrieved. A large portion of the program will be integrated with the characterization well project.

REGIONAL GROUNDWATER INVESTIGATIONS

GEOCHEMICAL AND ISOTOPIC MODELS

Contact: Dr. Neil Ingraham

PROJECT DESCRIPTION

The first major activity will be to complete the comprehensive discrete-state compartment (DSC) model of the NTS groundwater system using deuterium as a tracer. The model has been constructed, the input parameters have been identified, and the model will soon be run. However, in areas with low density of data from wells the modeling results will be less definitive.

A second major activity will include comparing and contrasting the results from this DSC model and a previous model which used carbon-14. The results from the two models will be compared for their compatibility and evaluated in terms of recharge, groundwater flow, and discharge. Any discrepancy between the models will be investigated and, if necessary, the parameters of either model (deuterium and carbon-14 values, etc.) may be reevaluated.

A third major activity will be an investigation of groundwater recharge and flow using stable isotopic data. This study will apply previously collected stable isotopic data of rainfall and groundwater to evaluating the conditions of groundwater recharge. The results of the study should allow qualitative definition of the recharge characteristics of each of the hydrologic subbasins on the NTS. The end result will be a qualitative relationship between surface environment and a range of stable isotopic values on infiltrating water. This activity may require the collection of additional hydrologic, isotopic, and geochemical data from existing wells and springs which areally expand our current data base.

The final activity will be a feasibility study to test the viability of the stable isotopic ratios of soil vapor used to predict those of liquid water in the soil zone. The rate and extent of the

downward movement of water (or the upward movement of vapor from the deep groundwater system) in the soil zone are important factors, particularly in arid hydrologic systems, but are generally difficult to monitor, primarily because of the difficulty in collecting water samples. Sampling water vapor in the soil could allow a more detailed study of water movement through the soil, while eliminating some of the difficulties usually encountered.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Complete the DSC model using deuterium as a tracer.
- Task 2. Complete the carbon-14 correction and the DSC model using carbon-14 as a tracer, and evaluate the two DSC models in terms of compatibility.
- Task 3. Describe the stable isotopic compositions of recharge water and compare to groundwater.
- Task 4. Devise a vapor collection method and test for precision.

DELIVERABLES

- 1. A final report on the DSC model results using deuterium as a tracer (second quarter).
- 2. A final report on the DSC model results using carbon-14 as a tracer (second quarter).
- 3. A progress report describing the stable isotopic compositions of recharge water (first quarter).
- 4. A progress report describing the methods of collection, results, and interpretations of the soil vapor sampling (fourth quarter).

BUDGET - GEOCHEMICAL AND ISOTOPIC MODELS: \$70,000

PROGRESS ON TASKS

Task 1. Complete the DSC model using deuterium as a tracer.

First Quarter (October – December 1989):

The entire steady-state DSC model has been calibrated for deuterium. Discharge volumes and carbon-14 decay ages were used as an independent check on the results. In addition, two transient model scenarios were calibrated to attempt to mimic a cooler and wetter climate that prevailed during the Wisconsin glacial age. Recharge rates from the steady-state model were multiplied by five and the dD values were depleted by 5 per mil for one scenario and 10 per mil for another. These two scenarios were then calibrated in a similar manner as for the steady-state model.

Also, a short computer program was written to calculate the mean age of the water in each cell for the transient scenarios. Simple test simulations were run to ensure proper operation. These results will be useful for comparison.

Second Quarter (January – March 1990):

Mean ages were calculated for each cell of the two transient-model scenarios, which address the cooler and wetter climatic conditions that prevailed during the late Wisconsin glacial age, as well as for the steady-state scenario. In addition, a sensitivity analysis was performed on the steady-state scenario. The DSC model is completed and results are being written. To date, several sections of the final report have been written.

Third Quarter (April – June 1990):

The DSC model is completed and a first draft of the final report is nearly completed.

Fourth Quarter (July – September 1990):

The first draft of the DSC model report has been completed and has been reviewed by all principal investigators. Minor changes to the document are being made.

Task 2. Complete the carbon-14 correction and the DSC model using carbon-14 as a tracer, and evaluate the two DSC models in terms of compatibility.

First Quarter:

No work was done on this task.

Second Quarter:

No work was done on this task.

Third Quarter:

Graduate student Ms. Elizabeth Spencer completed her work on this project. The report will be submitted to DOE in the fourth quarter.

Fourth Quarter:

This task is essentially completed. The final report is in.

Task 3. Describe the stable isotopic compositions of recharge water and compare to groundwater.

First Quarter:

No work was done on this task.

Second Quarter:

All of the data necessary to perform comparisons of the stable isotopic ratios of recharge water and groundwater have been assembled.

Third Quarter:

This task is currently being performed in the context of the DSC model.

Fourth Quarter:

The data required to compare the stable isotopic ratios of recharge water and groundwater are available. Interpretations are currently being made.

Task 4. Devise a vapor collection method and test for precision.

First Quarter:

No work was done on this task.

Second Quarter:

Nearly a dozen soil vapor samples that had been equilibrated with soil water of known stable isotopic composition were analyzed. The stable isotopic results were not well understood, and the method of extracting water from the soil became suspect. It soon became clear that to understand the isotopic composition of soil vapor, a dependable method of extracting water from soil for stable isotopic analysis is necessary. Therefore, a procedure for testing various techniques of extracting water from soil for isotopic analysis was developed and the testing was begun.

Third Quarter:

Testing of various techniques of extracting water from soil for isotopic analysis has begun. The techniques are being explored for the extraction of water from soil for tritium, and chemical analysis as well. Two techniques are initially being explored: 1) azeotropic distillation using toluene, and 2) simple heating and vacuum distillation. The soil being used is a Hanford Loam, and the water used for hydration is from the Truckee River.

Fourth Quarter:

Testing of various techniques of extracting water from soil for isotopic analysis is continuing. The results obtained to date have demonstrated a necessity for continuing this research.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: The final report on the DSC model is being written.

Budget: Approximately 22 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: See task 4.

Budget: Approximately 40 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: To date, the expenditures are about on the straight-line projections. Approximately 76 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 117 percent of the budget has been expended.

LOCAL GROUNDWATER INVESTIGATIONS

YUCCA FLAT HYDROLOGY

Contact: Mr. Todd Mihevc

PROJECT DESCRIPTION

The high hydraulic pressure observed in Yucca Flat continues to be a problem with respect to nuclear testing, increasing the engineering and material cost and causing concern for radionuclide migration. At the present time, the cause of the high pressure and its vertical and spatial distribution are not well known. The long-term goal of this project is to collect the hydraulic information necessary to understand the high pressure zone (HPZ) at Yucca Flat. The information obtained will not only be useful in reducing the supplemental cost associated with the HPZ, but will also be useful to other hydrogeological studies conducted in Yucca Flat.

Because of the nature of the aquifer testing that is currently being conducted at Yucca Flat, specific hole designations for monitoring are difficult to make. This testing will be conducted in existing holes that become available where underground nuclear testing programs will not be affected. As an example, during FY 1989, the U.S. Geological Survey and DRI assisted Los Alamos National Laboratory in aquifer testing at UE4t. These tests included a four-week series of straddle packer tests followed by a long-term straddle packer test designed to determine the elevation of the natural water table at this location. During FY 1990, it is anticipated that straddle packer testing and continuous fluid level monitoring will continue as bore holes become available for hydrologic investigations. An additional method for obtaining hydraulic information within the high-pressure zone is to instrument exploratory holes. When suitable exploratory holes are identified, reliable instruments will be grouted in the hole. It will be necessary to work with the testing community to use suitable methods to ensure future containment in the plugged exploratory holes containing this equipment. The information obtained from the hydrologic monitoring will be useful for many related studies such as understanding the movement of groundwater in the vicinity of a nuclear test.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Monitor exploratory holes associated with the HPZ.
- Task 2. Instrument a satellite hole near an emplacement hole.

DELIVERABLES

1. A letter report including the type of monitoring, equipment used, and the formations monitored in each hole (fourth quarter).

BUDGET - YUCCA FLAT HYDROLOGY: \$25,000

PROGRESS ON TASKS

Task 1. Monitor exploratory holes associated with the HPZ.

First Quarter (October – December 1989):

Current fluid level monitoring at Yucca Flat is limited to the straddle packer test at UE4t, designed to determine the location of the water table in this high pressure zone. The packers were set at two depths, so three zones could be monitored. The transducer monitoring the upper zone failed. The pressure in the lowest zone went from 319 to 400 PSI over a period of five days in May 1989 and has steadily decreased since; it is now at about 294 PSI. The USGS is monitoring the center zone.

Second Quarter (January – March 1990):

Although monitoring at UE4t is currently being conducted, arrangements are being made to remove the packer assembly and monitoring equipment from this exploratory hole. Discussions on the installation of a permanent monitoring station are in progress. It is anticipated that this monitoring hole will be designed similar to UE3e#4, although pressure transducers may be permanently installed in the formations.

Third Quarter (April – June 1990):

The fluid-level monitoring at UE4t is still in progress. The pressure record from January 1 to March 9 is characterized by a steady decrease of pressure from 294 PSI to 290.3 PSI. Between March 9 and March 24, the pressure sharply rose from 290.3 PSI to 297 PSI. The remaining record shows a gradual decrease with minor deviations.

Removal of the packer assembly and installation of the piezometers and transducers is expected to occur when a crew becomes available for this work. Transducers are currently being calibrated for these purposes.

Fourth Quarter (July – September 1990):

The monitoring equipment has been removed from UE4t so that the reconstruction of this hole with piezometers could commence. The decision not to install transducers permanently in the gravel pack has been made for containment concerns.

Task 2. Instrument a satellite hole near an emplacement hole.

First through Fourth Quarters:

No work was done on this task.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 15 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 38 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 51 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 97 percent of the budget has been expended.

RECHARGE AND RUNOFF STUDIES

Contact: Mr. Todd Mihevc/Dr. Richard French

PROJECT DESCRIPTION

One of the fundamental questions concerning the groundwater system at the NTS relates to the conditions under which recharge occurs. The locations and conditions that have previously been discussed are: 1) through the bottom of washes and drainages during heavy summer thunderstorms; 2) through fractures in exposed bedrock from accumulated winter snow melt; or 3) through coarse fan deposits. In this study, the conditions of recharge will be investigated in the high-elevation and wash environments.

The high-elevation areas of interest are Pahute and Rainier Mesas, where four sites were chosen in FY 1989 for monitoring instrumentation. Recharge monitoring stations were installed at these sites, one each at Camp 20, the northwest portion of Area 20 (North 20), Deadhorse Flat, and near the communication facility on Rainier Mesa. Soil moisture is being monitored through the use of soil moisture blocks, and temperature measurements are taken with thermistors. By the end of FY 1989, two of the sites, Deadhorse Flat and North 20, will have been instrumented with time domain reflectometers (TDRs), instruments which are capable of determining the in situ water content of soil by measuring the dielectric constant of the soil, a soil characteristic almost totally dependent upon soil moisture.

To complement the recharge monitoring program, a cooperative study is being proposed with the National Weather Service (NWS), which has developed a program using an airborne natural gamma sensor for the determination of the integrated moisture content of the snow over a large area. This type of data will be very useful in determining the amount of water that is available for infiltration. It would also give valuable insight to the spatial variability of snowfall on Pahute Mesa. The NWS would like to extend their program to include the western United States where snow depths and moisture contents are greater than in the eastern and central parts of the nation. Although contact has been made with the NWS, details and arrangements for this cooperative study still need to be made.

The wash environments of interest on the NTS are Fortymile Wash, Thirsty Canyon Wash, Silent Canyon Wash, and Barren Wash. Currently, as part of the Yucca Mountain Project, the USGS is conducting an in-depth study of the Fortymile Wash area; therefore, it may not be necessary to study this area in as much detail. The remaining washes will be evaluated first at a reconnaissance level by visually observing runoff characteristics of the washes and then monitored with data loggers and various soil probes for their recharge potential. The techniques used in the mesa recharge part of this study will be employed here along with lysimeters buried in the washes to measure the mass of the recharging water.

This investigation of groundwater recharge at the NTS will be accomplished by continuous monitoring of the selected sites for precipitation, air temperature, relative humidity, soil temperature, soil moisture, and integrated soil moisture of snow. The results of the study

should allow a better definition of recharge characteristics of some of the hydrologic subbasins at the NTS and the conditions of recharge for groundwater found in those subbasins.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Conduct continuous monitoring of the sites for precipitation, air temperature, relative humidity, soil temperature, and soil moisture.
- Task 2. Conduct intense field data collection when conditions are conducive for infiltration.
- Task 3. Develop a program with the National Weather Service to use airborne sensors for snow surveys on Pahute Mesa.
- Task 4. Conduct a reconnaissance level survey of the washes at the NTS. The criteria for this survey will include 1) size of the watershed, 2) geologic character of the wash, 3) potential of the wash for offsite transport of contaminants, and 4) the suitability of the wash for the intended study.

DELIVERABLES

- 1. A letter report summarizing the data collected. Analysis of the data will be included to the extent of detailing the significant findings. Included in this report will be a summary of the TDR, with diagrams describing the electronics developed for the automated operations (fourth quarter).
- 2. A letter report detailing the plan for a cooperative study with the National Weather Service using airborne snow surveys on Pahute Mesa (fourth quarter).
- 3. A letter report identifying one or more washes for study and outlining a work plan for FY 1991 (fourth quarter).

BUDGET - RECHARGE AND RUNOFF STUDIES: \$50,000

PROGRESS ON TASKS

Task 1. Conduct continuous monitoring of the sites for precipitation, air temperature, relative humidity, soil temperature, and soil moisture.

First Quarter (October – December 1989):

The reconfiguration and installation of the TDR was completed early in the quarter. This instrument was installed at the North 20 site. The meteorologic and soil data have been collected at the specified intervals.

Second Quarter (January – March 1990):

Continuous monitoring of the sites has been conducted at each of the four sites on Pahute Mesa (North20, Camp20, Deadhorse, and Rainier). Several snow-fall events were recorded at each of the sites, and during most of the quarter the upper soil horizons were frozen, prohibiting infiltration. During the latter portion of the second quarter, soil-moisture increases were noticed at the North20 site; however, it is too early to determine if recharge is actually occurring.

Third Quarter (April – June 1990):

A TDR has been installed at the Deadhorse Flat site. This site has been reconfigured so this instrumentation can be accessed remotely. The meteorologic and soil data have been collected at the specified interval.

Fourth Quarter (July – September 1990):

The meteorological and soil parameters have been collected at the specified intervals. The TDR at the Deadhorse site, which was installed at the end of the third quarter, is working properly.

Task 2. Conduct intense field data collection when conditions are conducive for infiltration.

First Quarter:

Since there were no significant precipitation events during the quarter, intensive data collection has not been conducted.

Second Quarter:

No precipitation events have occurred to warrant intense field data collection. The only precipitation observed fell in the form of snow and subsequently melted over time. Intense data collection will be conducted during rainfall events, primarily those associated with thunderstorms.

Third Quarter:

Since there were no significant precipitation events, intense field data collection was not conducted..

Fourth Quarter:

A series of thunderstorms occurred on Pahute Mesa at the end of this quarter. The TDR recorded moisture moving into the soil zone; however, at the time of this report, it was too early to know the fate of this water.

Task 3. Develop a program with the National Weather Service to use airborne sensors for snow surveys on Pahute Mesa.

First Quarter:

No work was done on this task.

Second Quarter:

Preliminary discussions have been held with the National Weather Service.

Third Quarter:

Further discussions were held with National Weather Service with regard to remote sensing applications.

Fourth Quarter:

Discussions with National Weather Service have continued. The results of those discussions and recommendations to pursue these endeavors will be described in a letter report.

Task 4. Conduct a reconnaissance level survey of the washes at the NTS.

First Quarter:

No work was done on this task.

Second Quarter:

It is anticipated that reconnaissance of selected washes will be conducted in the third and fourth quarters during the intense data collection, as part of Task 2. Washes that have been outlined for field reconnaissance include Silent Canyon, Thirsty Canyon, the headwaters of Fortymile Wash, and several unnamed canyons around Pahute Mesa.

Third Quarter:

No work was done on this task.

Fourth Quarter:

The wash survey was conducted and Big Burn Valley has been selected for further studies. The information will be detailed in the letter report.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 31 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 72 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 91 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: The Camp20 datalogger experienced a failure where data was lost. The system has been repaired and is working properly.

Budget: Approximately 98 percent of the budget has been expended.

DRILLING AND TESTING SUPPORT

Contact: Mr. Karl Pohlmann

PROJECT DESCRIPTION

Drilling activities will be designed to gather the geologic, hydraulic, and water chemistry data required to better understand groundwater flow and potential contaminant transport at the NTS. The Drilling and Testing Support Project will choose drilling locations, design the drilling, sampling, and testing plan, supervise drilling activities, provide field and laboratory support, and analyze and report the results.

Two specific activities will be conducted in FY 1990. The first will be planning and implementation of the FY 1990 HRMP drilling project. The type of test well (hydrology or radionuclide transport) and its location will be determined by the HRMP committee, based on the needs of the program. In cooperation with the other contributing organizations, a drilling site will be chosen and a drilling, sampling, and testing plan developed. The plan will include the drilling method, depth and diameter of the borehole, lithologic sampling details, required borehole geophysical logs and surveys, design of the well installation, description of hydraulic testing, groundwater sampling plan, and responsibilities of the various organizations involved in the project. During development, the plan will be submitted to DOE and other participating agencies for comment. Upon commencement of drilling activities, DRI will provide supervision and decisions as required. Onsite responsibilities may include measuring water levels, determining intervals for sidewall coring, determining borehole logging requirements, measuring groundwater chemical parameters, obtaining groundwater samples, choosing intervals for hydraulic testing, supervising installation of well casing, and determining pump depth and discharge rate. Groundwater samples will be analyzed for major and trace constituents, environmental isotopes, and radionuclides. The progress and results of the project will be compiled with important findings reported to DOE.

The second activity will be to continue groundwater sampling at test well UE-20n#1, which began in the fourth quarter of FY 1989. This sampling, which will be carried out quarterly for one calendar year, will follow procedures similar to those utilized in the FY 1988 sampling. In addition, the DRI deep-well sampling rig will be used to collect samples from intervals which are important for hydrogeologic and radionuclide transport reasons. These data will be incorporated with data collected at UE-20n#1 since well construction was completed.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Choose a location for the FY 1990 HRMP drilling site, develop a drilling, sampling, and testing plan, and assist with testing and sampling during and after construction of the well.
- Task 2. Conduct quarterly groundwater sampling at UE-20n#1.

DELIVERABLES

1. Status reports and summaries, as requested by DOE.

BUDGET - DRILLING & TESTING SUPPORT: \$50,000

PROGRESS ON TASKS

Task 1. Choose a location for the FY 1990 HRMP drilling site, develop a drilling, sampling, and testing plan, and assist with testing and sampling during and after construction of the well.

First Quarter (October – December 1989):

The site selection process for the FY 1990 HRMP drilling project is currently being conducted by the HRMP committee. The drilling, sampling, and testing plan will be developed after the site is selected and the research program outlined.

Second Quarter (January – March 1990):

A site (UE3e#4) was selected by the HRMP committee, and drilling and construction of the well was completed, with drilling reaching a total depth of 2,372 feet and continuous coring in the interval between 2,100 and 2,220 feet. Tritium activity in the return fluid, the gamma-ray log, and gamma activity in the recovered core suggest possible pathways of radionuclide migration at depths of 1,775, 2,160, and 2,230 feet. Percussion and sidewall coring were attempted at the two lower depths, however, sidewall core could not be recovered from the 2,230-foot depth. Very slow water-level recovery rates in the borehole indicated that the adjacent formations were of low permeability and that hydraulic testing would be difficult and the results of questionable use. As a result, pumping tests and straddle packer tests were not conducted.

Prior to installation of the monitoring wells, the borehole composite water level had stabilized to approximately 1,545 feet below land surface. Three 2 ⁷/₈" O.D. monitoring wells were installed in the open borehole with their 20-foot screened intervals centered at depths of 1,630, 1,900, and 2,160 feet. Water levels measured in these wells suggest a strong, vertically upward hydraulic gradient at this location.

To date, monitoring wells have undergone one day of development by swabbing. Additional swabbing efforts are required to remove drilling- and construction-related contaminants from the gravel packs and monitoring wells and to ensure representative groundwater samples. Future hydraulic head measurements and groundwater sampling in these wells will assist in defining the flow system below Yucca Flat.

Third Quarter (April – June 1990):

Development of the three UE3e#4 monitoring wells by swabbing continued. Tritium values revealed a rapid differentiation between the three zones. As well #1 was developed, activities increased to a level of about 4000 pCi/mL. In the other two wells, tritium activities rapidly declined to below 800 pCi/mL as development progressed. These data support the theory that the tritium source is a fracture observed at 2,160 feet and also indicate that the monitoring intervals are well isolated.

In contrast to the tritium trends, both EC and pH levels have either increased or remained at levels much higher than would be expected for these types of aquifers. The pH values in all three wells have risen to about 12 and remained there throughout swabbing, while the EC values have all increased to above 7500 micromhos/cm. It appears that the high pH values have resulted from the presence of partially reacted cement in the water, a situation that may only be improved, if at all, by considerably more development. As a result of this cement contamination, groundwater samples have not been collected, as they would probably not represent aquifer conditions and could not be used for the purposes of hydrogeochemical interpretations. Further development may be carried out if groundwater geochemical information is deemed worthwhile at this location; otherwise, these wells will only be used for measurements of hydraulic parameters.

Fourth Quarter (July - September 1990):

The impending demobilization of the drilling rig from UE3e#4 led to a final attempt at further development of the three monitoring wells. Sand bailing of all three wells was conducted on July 23, followed by swabbing on July 24. Observations made during sand bailing suggest that, although volumes of suspended solids are being reduced slightly, water quality is not improving (pH values remain above 12 in all three wells). The high pH values have been attributed to the presence of partially reacted cement in the groundwater near the wells. In addition, trends of steady increases in hydraulic head and ^3H levels in well #2, observed prior to the July development activities, suggest the integrity of the seal between this well and well #1 below may have been lost.

No further research activities have been conducted at the site. As stated in the third quarter report, groundwater samples have not been collected, as they would probably not represent aquifer conditions and could not be used for hydrogeochemical interpretations.

Task 2. Conduct quarterly groundwater sampling at UE-20n#1.

First Quarter:

Quarterly sampling at UE-20n#1 is being delayed until the proper State permits have been acquired.

Second Quarter:

DRI quarterly sampling at UE-20n#1 is on hold pending receipt of the proper State permits.

Third Quarter:

Quarterly sampling at UE-20n#1 is being delayed until the proper State permits have been acquired and an investigative plan has been established.

Fourth Quarter:

As was reported in the third quarter, sampling at UE-20n#1 is being delayed until the proper State permits have been acquired and an investigative plan has been established.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 29 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered, with the exception of that stated under Task 2.

Budget: Approximately 76 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered other than those described under Tasks 1 and 2.

Budget: Approximately 94 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered other than those described under Tasks 1 and 2.

Budget: Approximately 97 percent of the budget has been expended.

WELL VALIDATION PROGRAM
Contact: Mr. Scott Tyler/Mr. Bradley Lyles

PROJECT DESCRIPTION

To quantify the movement of groundwater beneath the NTS and to help develop a monitoring strategy to detect the possible migration of hazardous and radioactive substances at the NTS, DRI plans to conduct detailed testing of existing and proposed monitoring wells on the NTS. To date, wells used for monitoring, especially those not used for water supply, are poorly characterized with regard to lithology, aquifers penetrated, vertical hydraulic gradients, and vertical variations in water quality.

One of the most critical parameters for monitoring is the knowledge of what aquifer or unit is being sampled when a sample is collected. In wells with large pumps installed, water samples represent a water quality weighted most heavily to the most productive (highest transmissivity) aquifer penetrated by the well. In general, pumped wells on the NTS have undergone some hydraulic testing, and it is likely that in most cases it will be possible to infer which zones are being sampled from existing data.

Of more concern are the wells which are not pumped. These wells are traditionally sampled by bailing a small quantity of water from some arbitrary depth below the water table. Bailed wells, or wells which are only slightly stressed (low volume pumps) and penetrate multiple transmissive zones, pose two serious problems. First, vertical hydraulic gradients may exist between the transmissive zones. Differences in head between aquifers or between transmissive zones will induce vertical flow within the borehole. Water will move into the borehole from the highest head zone and flow out of the borehole in those zones where the head is lower. As a result, water bailed from some arbitrary depth may not represent the water quality of the depth sampled, but instead may be a weighted average of water quality from several aquifers or transmissive zones. If contamination is detected, it will be impossible to define the zone or zones from which it came.

The second major difficulty in the use of bailed wells without detailed hydraulic data is the use of water level or head measurements based upon the static water level in a well. Vertical head variations found in the few wells tested to date suggest that transmissive zones within aquifers may be isolated from one another over some undetermined scale.

A detailed testing strategy for wells presently or proposed for use as monitoring wells will be developed. The first task of this project will be to review the available data archived by Fenix and Scisson and develop a monitoring well inventory and data base. Upon review of the existing data, a two-phase testing strategy will be implemented. Phase I will focus on borehole flowmeter logging, caliper logging, and water chemistry to assess the vertical variations in the borehole. Phase II testing will use Phase I data to prescribe packer testing and more detailed logging. In addition to flowmeter logging, techniques such as borehole diffusion tests

and trace-injector testing will be reviewed and further developed. Such tests may be run concurrently with flowmeter measurements.

After completion of the testing strategy, three wells will be chosen for Phase I examination. Existing data will be used to choose wells which are likely to show a wide range of response, i.e., wells in recharge zones where head gradients are downward, wells in horizontal flow zones where no vertical gradients are anticipated, and wells in discharge zones where upward gradients should exist. Phase I will consist of borehole logging where previous logging is inadequate, caliper logging, television logging to verify hole completion data and to map fracture zones, and borehole flowmeter testing to determine fluid velocity within the borehole under non-pumping conditions. These data can be used to infer the direction and the general magnitude of vertical hydraulic gradients between transmissive zones and will allow sampling plans to be developed for each well and indicate from what unit or units water samples are representative. At the present time, sensitive borehole flowmeter technology has been developed in the commercial and research sector. The project team plans to work closely with USGS staff in development and implementation of Phase I testing.

The work will be conducted in FY 1990 and reported as wells are tested. At the completion of this phase of work, plans will be developed to conduct Phase II testing at the three wells. Phase I testing will then begin on the remaining potential monitoring wells. It is anticipated that such testing will become routine procedure on all wells completed for NTS monitoring.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Assemble preliminary data for potential monitoring wells.
- Task 2. Develop Phase I testing procedures.
- Task 3. Complete Phase I testing on three wells.
- Task 4. Develop Phase II testing procedures.

DELIVERABLES

- 1. A report describing testing procedures developed in the first year of testing (fourth quarter).

BUDGET - WELL VALIDATION PROGRAM: \$150,000

PROGRESS ON TASKS

Task 1. Assemble preliminary data for potential monitoring wells.

First Quarter (October - December 1989):

Fenix and Scisson well completion and logging data were requested. These data contain information on well logs and drilling histories for the drill holes outlined in the draft monitoring well document. It is anticipated that during the second quarter, F&S data will be reviewed and three wells chosen for detailed flowmeter logging and sampling. Dr. Alfred Hess, of the USGS in Denver, will be contacted and asked to participate in the task, both at the operations permit and logging operation design stages. Dr. Hess has developed and tested several types of borehole flowmeters.

Second Quarter (January - March 1990):

Preliminary data have been received from FSN (formerly F&S) and reviewed. Detailed information has been requested from DOE for selected wells; upon review of this information, two to four wells will be chosen for further testing.

Third Quarter (April - June 1990):

Five wells were chosen for further testing. This task is now complete.

Fourth Quarter (July - September 1990):

This task was completed in the third quarter.

Task 2. Develop Phase I testing procedures.

First Quarter:

No work was done on this task.

Second Quarter:

Preliminary discussions have taken place within the working group.

Third Quarter:

The well validation program participants met with the USGS to plan field activities. These activities include well sampling, logging and borehole-flowmeter surveys. This task is now complete.

Fourth Quarter:

This task was completed in the third quarter.

Task 3. Complete Phase I testing on three wells.

First Quarter:

No work was done on this task.

Second Quarter:

No work was done on this task.

Third Quarter:

In June, this program was carried out with samples being collected at HTH-3, UE18r, and HTH-1. Detailed geophysical logs and borehole-flowmeter logs were made in conjunction with the USGS at UE18r and HTH-1. In each of these unpumped boreholes, natural vertical flow, induced by vertical hydraulic gradients, was detected. The implications of natural vertical flow under unpumped conditions are serious for both composite head measurements and bailed water sampling techniques often employed at the NTS. The presence of vertical flow suggests that depth to water measurements do not represent the actual hydraulic head present in any of the open intervals of the boreholes sampled. Upward flow suggests heads are greater at depth, while downward flow suggests a decrease in head with depth. In either case, such flow invalidates the assumption of horizontal flow traditionally used in estimating groundwater flow and contaminant transport potential. The results from this preliminary analysis show that the three-dimensional nature of the groundwater systems at the NTS needs to be evaluated if realistic models of groundwater flow are to be developed.

The existence of vertical flow in the two boreholes investigated also has implications for groundwater sampling and monitoring strategies. Bailed samples from near the surface of the water within a well casing does not necessarily represent the chemistry of water in the adjacent aquifer but may be more representative of groundwater from deeper in the formation if vertical head gradients are present within the borehole. Detailed flowmeter measurements such as those conducted at wells HTH-1 and UE18r are needed to determine where in the open boreholes the fluid originates.

Fourth Quarter:

Water samples were collected from seven discrete intervals in Well TW1 with DRI logging equipment on September 24-26; additionally, a temperature and EC log was run on September 26. The samples were submitted to the DRI laboratories for gross chemical and tritium analysis. Results from these samples may shed some light on the possible sources of elevated tritium observed during a previous sampling effort in 1989. Sample splits were also collected for outside laboratory analysis. These chemical analysis and temperature/EC logs will be compared to the results from the TAM sampling exercise. Detailed reports are currently being developed for Wells TW1, UE18r, and HTH-3. The report on TW1 is being used as a template for the other wells and has been reviewed and approved internally, and draft reports have been developed for UE18r and HTH-3. Detailed analysis of the thermal flow data is expected from the USGS in December.

Task 4. Develop Phase II testing procedures.

First Quarter:

No work was done on this task.

Second Quarter:

No work was done on this task.

Third Quarter:

Flow data were collected to determine flowing zones. Detailed plans/suggestions for packer testing and sampling will be completed in the fourth quarter.

During the fourth quarter, a more detailed analysis of the flowmeter and logging data will be conducted. In addition, groundwater sampling via bailer will be conducted at UE18r and HTH-1 using the flowmeter data to guide the depth at which samples are taken. Using these data, representative geochemical samples may be collected.

Fourth Quarter:

Based on our findings during FY 1990, testing procedures have been outlined for next year. A working group meeting will be held during the first quarter of FY 1991 to decide on options for the next phase of testing.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 7 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 29 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 79 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: We were unable to collect samples from Well UE18r due to entrance restrictions during the latter portion of September; attempts will be made to sample UE18r in the first quarter of FY 1991.

Budget: The straight-line projection has been slightly exceeded with approximately 108 percent of the budget having been expended.

RADIONUCLIDE TRANSPORT INVESTIGATIONS

NEAR-FIELD HYDROLOGIC STUDY

Contact: Dr. Tom Brikowski

PROJECT DESCRIPTION

The goal of this study is to provide a better understanding of the early stages (first 20 years) of groundwater movement and radionuclide migration near underground nuclear tests. The near-field hydrologic system is important because it controls the transfer of water and radionuclides from the shot cavity to the regional hydrologic system; therefore, it can strongly affect the environmental impact of underground tests. Unexpected rapid transport of radionuclides at locations such as UE-20n suggests this transfer can be quite efficient in many cases, and emphasizes that the transport process remains poorly understood.

A variety of factors influence the near-field hydrologic environment, which may interact in a complicated fashion. To date, this project has concentrated on evaluating the effects of each factor individually, with the eventual goal of producing a combined model that includes each factor and interactions between them. The influence of pre-existing hydrologic gradients and thermal input from tests have been evaluated. In FY 1990, the influence of test-induced changes in rock properties will be addressed. As a follow-up to the DRI report on crater infiltration, the consequences of enhanced infiltration in the unsaturated portion of the collapse chimney will also be examined.

As always, these studies are limited by the lack of hydrologic data from the near-field environment. To address this problem, implementation of the post-shot hydrologic monitoring plan will be attempted. Success will depend on the existence of and access to a suitable post-shot sampling hole. A string of two or three sets of pressure-temperature sensors in the drill-back hole of a saturated zone test will be installed. One of the sets would be located in the base of the cavity, one near the pre-test water table, and one in a likely outflow zone (if such a zone is encountered). Pressure-temperature conditions will then be monitored through time as the chimney refills with water and the test-induced fluid pressure anomaly dissipates.

Investigations will be conducted using numerical models of the saturated and unsaturated zones of the near-field environment of underground tests. When appropriate, mathematical (i.e., analytic) solutions will be developed or employed.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Assemble data pertaining to permeability change/fracturing and groundwater mounding in the near-field environment.
- Task 2. Locate one or more suitable sites for post-shot pressure-temperature monitoring and attempt to install sensors and begin monitoring program.

- Task 3. Investigate effect of test-induced permeability change on near-field hydrologic behavior using numerical models.
- Task 4. Investigate effect of test-induced groundwater mounding around underground tests on near-field hydrologic behavior using numerical models.

DELIVERABLES

1. A letter report describing installation and preliminary results of Task 2 if a suitable monitoring site is available (fourth quarter).
2. One or two manuscripts intended for publication describing the results of Tasks 3 and 4 (fourth quarter).

BUDGET - NEAR-FIELD HYDROLOGIC STUDIES: \$85,000

PROGRESS ON TASKS

Task 1. Assemble data pertaining to permeability change/fracturing and groundwater mounding in the near-field environment.

First Quarter (October – December 1989):

Few data appear to be available, beyond those provided in Boardman and Skrove (J. Pet. Tech. 18:619–623 (1966)). The search will continue.

Second Quarter (January – March 1990):

A data summary was included in the Post-Shot Monitoring Data Needs report discussed below.

Third Quarter (April – June 1990):

This task has been completed.

Task 2. Locate one or more suitable sites for post-shot pressure-temperature monitoring and attempt to install sensors and begin monitoring program.

First Quarter:

No work was done on this task.

Second Quarter:

A site has been located (Bullion), and general and site-specific plans have been written for this monitoring. In the process of writing the site-specific plan, it became clear that a more general document describing data needs was required (i.e., discussing the purpose, and not necessarily the details of proposed data gathering activities). This data-needs document represents the final form of an FY 1988–1989 deliverable for this project.

The specific plan calls for installing a pressure-temperature transducer in the drill-back hole at the base of the collapse chimney. Two or more temperature sensors will be installed higher in the chimney. The intent is to monitor the evolution of temperature with time in the chimney, and accurately monitor the in-filling process.

Third Quarter:

Site-specific plans for post-shot monitoring at Bullion were prepared and approved by LLNL. Development of this plan, coordination with other HRMP organizations and test safety personnel occupied much of the quarter. Plans call for a post-shot 60-day waiting period after which HRMP will have access to the hole.

DRI will purchase the wireline for this project, and is constructing a string of thermistors; a water-level indicator will be installed in the hole after the waiting period. The

string will be used to make periodic temperature logs of the hole until temperatures are less than approximately 100°C. Between logging sessions, the thermistor string will be withdrawn into the lubricator at the wellhead, allowing the wellbore to be sealed off with a ball valve to ensure that no gas leaks will occur between logging sessions.

After liquid water, or temperatures less than 100°C, are encountered, the thermistor string will be exchanged for a pressure-temperature and water-level indicator assembly, to be installed in the hole indefinitely. This string will be removed during periodic water sampling runs. DRI is currently constructing this assembly. The goal of this stage of the project is to obtain a continuous record of water level and temperature changes within the shot cavity.

At regular intervals after the cavity is about 50 percent full, a water sample will be taken and analyzed for radionuclide content. During sampling, the transducer string will be exchanged for the bailer assembly. DRI may provide all or part of the bailer, which will thereafter be dedicated to sampling heavily contaminated wells.

Initial estimates were that infilling of the Bullion chimney would require seven months to two years. Lack of high pressure and steam in the post-shot hole suggests that infilling may begin earlier than anticipated, and pressure monitoring and water sampling may begin soon after the waiting period.

Preliminary calculations based on analytical models of groundwater-flow flux through chimneys suggest that little movement of water out of the cavity is likely (a letter report is in preparation). The lower part of the cavity and fractures from it may intersect permeable rhyolite flows, but all units above these flows are highly zeolitized and are likely to be relatively impermeable. Thermal driving forces will be directed upward in the cavity, and tend to limit downward flow of water into the rhyolite flows. For this reason, the currently proposed down-gradient hole may never encounter radionuclides from Bullion. The Bullion site is a fine location for monitoring physical conditions and chemical variations in the cavity (the source term), but it is so situated that significant radionuclide migration from the cavity is unlikely to occur. Efforts have begun to evaluate the proposed Tenabo test as a candidate for down-gradient monitoring.

Fourth Quarter:

Construction of temperature and pressure probes for installation at the Bullion site was completed. Actual installation will take place in the first weeks of October. In addition, a downhole chemical sampler (bailer) was constructed from existing DRI parts, and will be used in the Bullion post-shot hole at a later date. Coordination of the construction allows all devices to be operated using a seven-conductor wireline purchased for this project. Wireline services will be provided by LLNL. All of these devices will be reusable. The wireline itself is expected to be heavily contaminated, and may or may not be usable in other (contaminated) holes.

The plan for the first HRMP entry at the Bullion post-shot hole calls for perforation of the bottom 20+ ft of hole by Atlas Wireline Services. At that time, temperature will be monitored, and if it is below 100°C, the pressure-temperature transducer tool will be installed at the bottom of the hole. Temperature and pressure will then be continuously monitored for at least several months. At some time, probably November, the transducer tool will be removed, and the bailer used to obtain water samples. The transducer will then be reinstalled. Behavior of the hole during gas sampling suggests that temperatures rapidly declined below 100°C, probably because of the presence of highly permeable rhyolite flows at the base of the cavity.

Two migration paths are predicted for radionuclide migration at Bullion. The base of the shot cavity/chimney intersects rhyolite flows that are probably highly permeable. Preliminary predictions of likely groundwater flow and transport at Bullion indicate that radionuclides produced in these units will migrate rapidly downgradient. Radionuclides lying higher in the chimney, where the walls are formed by low-permeability zeolitized tuffs, are likely to remain in place. A best guess for probable radionuclide migration is that approximately 25 percent of nonreactive species introduced at shot time will migrate to the proposed downgradient well (four cavity radii from ground zero) in 10 years. The remaining material will move upward in the chimney, and very slowly laterally through the zeolitized tuff, arriving at the downgradient well in 1,000 years. Radioactive decay of dissolved species is not considered in these predictions.

Task 3. Investigate effect of test-induced permeability change on near-field hydrologic behavior using numerical models.

First through Third Quarters:

No work was done on this task.

Fourth Quarter:

Efforts related to this task early in the fiscal year made it clear that mathematical (analytic) solutions were a more appropriate approach at this time. Lack of field data and poor understanding of even the basic hydrology in the near-field environment are the basis for this conclusion. Consequently, an extensive effort began to develop analytic solutions describing groundwater flow through collapse chimneys that connect permeable zones. The conceptual model for this was the setting at Cheshire. Solutions were developed for a vertical, filled cylindrical conduit connecting two tabular aquifers, and have been summarized in a manuscript now under review at DOE (see deliverables below). These solutions are especially useful where few data are available, because the solutions can be arranged to give the explicit dependence of flow in the chimney-aquifer system on any given parameter. Uncertainty in flow predictions resulting from uncertainty in field parameters can be demonstrated directly in this way. In numerical models, uncertainty of predictions is often difficult to determine.

These analytic solutions can also be manipulated to give constraints on radionuclide migration. A second report attempting to determine constraints at the Bullion site is in internal review at DRI. The results from this effort have been used to help locate the downgradient hole at Bullion, and are briefly discussed under Task 2.

Task 4. Investigate effect of test-induced groundwater mounding around underground tests on near-field hydrologic behavior using numerical models.

First through Fourth Quarters:

No work was done on this task (see Task 3).

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

General progress: Efforts in the first quarter of this project were generally directed at completing papers and making presentations concerning results from last year.

A poster session entitled "Hydrologic Phenomena Related to Underground Nuclear Tests in the Saturated Zone: Man-Made Hydrothermal Systems" was presented December 6th at the American Geophysical Union meeting in San Francisco. Comments about the poster suggested that near-field environment studies provide a useful field test of hydrothermal theory. A surprising amount of interest came from engineering/fluid-dynamics specialists. One interesting suggestion was that these sites could be used for large-scale investigations of porous-media fluid dynamics.

A manuscript, entitled "The Hydrology of Underground Nuclear Tests: 1. The Effect of Collapse Chimney Formation," was completed in December and circulated for internal (DRI) review. It is now being rewritten, and should be submitted to the journal *Water Resources Research* sometime this spring.

Budget: Approximately 24 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: The report entitled "Post-Shot Monitoring of the Near-Field Environment: Data Needs" is undergoing preliminary review. It fulfills the FY 1989 third quarter deliverable.

A manuscript, "The Hydrology of Underground Nuclear Tests: 1. The Effect of Collapse Chimney Formation," has completed preliminary internal review and is awaiting revisions. It fulfills the FY 1989 fourth quarter deliverable.

A manuscript, entitled "Long-Term Hydrologic Response to Underground Nuclear Testing: Conceptual Model," (tentative title), is nearly complete, and is intended to fulfill the FY 1987 and FY 1988 fourth quarter deliverables.

Budget: Approximately 43 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: The Bullion post-shot monitoring is a radical new experiment, and many difficulties were encountered in coordination with all involved parties. This was particularly true with the test safety personnel, and delays in safety discussions forced planning for the experiment to be hastily conducted (i.e., the go-ahead was not given until very late). This is unlikely to be a problem in the future, since many concerns have now been resolved.

In reality, the system worked as it should with safety concerns being paramount, but an unfortunate side-effect was to compress the detailed scientific planning into the short period available between safety approval and the detonation. Earlier detailed dialog between all concerned parties will help in the future.

Reports: The report entitled "Post-Shot Monitoring of the Near-Field Environment: Data Needs" is in final review. It fulfills the FY 1989 third quarter deliverable.

A report on preliminary predictions of chimney infilling and radionuclide migration is in preparation. A draft will be circulated in mid/late July to assist in planning for the HRMP FY 1991 drill hole.

Report(s) on results of Tasks 3 and 4. No progress.

A manuscript, "The Hydrology of Underground Nuclear Tests: The Effect of Collapse Chimney Formation," is in final internal review. This report fulfills the FY 1989 fourth quarter deliverable.

A manuscript, entitled "Long-Term Hydrologic Response to Underground Nuclear Testing: Conceptual Model," is nearly complete; it is intended to fulfill the FY 1987 and FY 1988 fourth quarter deliverable.

Budget: Approximately 74 percent of the budget has been expended. Project spending is below the straight-line projection.

Fourth Quarter Summary:

Problems encountered: Delays in gaining access to the Bullion post-shot hole probably mean that many of the dissipation test-related temperature and pressure anomalies will not be observed. There are two reasons for this. First, the experiment is new for the NTS, and careful and extensive safety review is required. This should be less time-consuming for future experiments now that many questions have been answered at the Bullion site. Second, the Bullion

chimney is likely to equilibrate quite rapidly, owing to the presence of high permeability rocks at the base of the cavity. Any post-shot monitoring experiment at this site was likely to miss much of the equilibration period, unless prudent safety limitations were disregarded.

A second problem was in the generation of presentation-quality graphics (figures). Copies of figures from other publications are acceptable for the review stage of a document, but not for the final version. The “..Data Needs” report listed below was completed in draft form in April, but extraction of data from earlier reports for use in figure regeneration has stalled this document since then. Additional staff may help solve this problem, but often the report author must do the time-consuming task of data extraction for replotting previously-published diagrams.

Reports: The report entitled “Post-Shot Monitoring of the Near-Field Environment: Data Needs,” has been written and needs publication-quality figures.

A manuscript, “The Hydrology of Underground Nuclear Tests: The Effect of Collapse Chimney Formation,” is in DOE review, to be submitted to *Water Resources Research*.

A report, entitled “Constraints on Potential Radionuclide Migration at the Bullion Site,” has been written and is in internal review.

There has been no progress on the report(s) on results of Tasks 3 and 4.

A manuscript, entitled “Long-Term Hydrologic Response to Underground Nuclear Testing: Conceptual Model,” is in preparation. It is envisioned as a lead article in a *Water Resources Research* special section on NTS Hydrology. Item 2 is the second article for this section.

Budget: Approximately 92 percent of the budget has been expended. Project spending is below the straight-line projection due to delay by safety reviews at the end of the quarter.

RADIONUCLIDE GEOCHEMISTRY STUDIES

Contact: Dr. Michael Whitbeck

PROJECT DESCRIPTION

The geochemical behavior of radionuclides in the subsurface is of environmental interest. Knowledge of this behavior is required for a better understanding of radionuclide migration.

In this study, model elements representing radionuclides of interest will be used to investigate adsorption and desorption isotherms. These isotherms will be critically evaluated with respect to the mechanism of adsorption. Potential adsorption sites considered include inorganic surfaces, such as colloidal silica and calcite, and organic colloidal material, such as dissolved organic carbon (DOC).

This study will use non-radioactive isotopes wherever possible for reasons of safety and cost. Where radioactive isotopes are required, cooperative arrangements will be sought with Lawrence Livermore National Laboratory (LLNL) or Los Alamos National Laboratory (LANL).

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Determine binding of various radionuclides and nonradionuclides to colloidal silica and calcite.
- Task 2. Study the competition of several different radionuclides for chelation sites on simple molecules (carbonate, oxalate, etc.).
- Task 3. Collect samples for examination of DOC in colloidal-size fraction.

DELIVERABLES

- 1. A report detailing the results of Tasks 1, 2 and 3 (fourth quarter).

BUDGET - RADIONUCLIDE GEOCHEMISTRY STUDIES: \$75,000

PROGRESS ON TASKS

Task 1. Determine binding of various radionuclides and nonradionuclides to colloidal silica and calcite.

First Quarter (October – December 1989):

Materials were ordered. No other work was performed.

Second Quarter (January – March 1990):

No work was conducted on this task. A suitable alternative to laser-induced fluorescence detection has not been found. Conventional wet chemical analysis would not yield the necessary speciation information at the low concentrations desired.

Third Quarter (April – June 1990):

No work was done on this task.

Fourth Quarter (July – September 1990):

The determination of binding using hypersensitive transitions of the lanthanide ions was not performed. Initial attempts to detect the hypersensitive transitions by laser induced fluorescence gave unsatisfactory results. Another attempt using the photoacoustic method now in use at LLNL should be tried.

Task 2. Study the competition of several different radionuclides for chelation sites on simple molecules (carbonate, oxalate, etc.).

First Quarter:

A literature review is in progress.

Second Quarter:

A few preliminary experiments were run using relatively high concentrations. The chemical speciation of lanthanides at trace levels is particularly difficult. Extraction of solvated lanthanides with crown ethers (e.g., 18-crown-6) is contemplated. Subsequent conventional analysis by atomic adsorption (AA) or inductively coupled plasma spectrometry (ICP) could follow, however, the organic phase would hinder the sensitivity — a critical issue to this application.

Third Quarter:

This quarter was spent recording spectra of acetate solutions to ascertain the best experimental method for use with lanthanides. Magnesium acetate was examined since it is well characterized in the literature. Three sampling methods were investigated: 1) direct transmis-

sion with zinc selenide cells and calcium fluoride cells; 2) attenuated total reflectance with a KRS-5 trapezoid; and 3) attenuated total reflectance with a "Circle-Cell" using a zinc selenide cylinder.

The direct transmission studies were of some utility, however, there is some difficulty with maintaining a sufficiently thin cell. The KRS-5 trapezoid did not give reproducible sample thickness and was etched by the acetate solutions. The Circle-Cell (TM Spectra-Tech) gave the best performance and shows no sign of etching. The magnesium acetate spectra (ca 0.5M) were in agreement with literature values for ion-pair formation; the first equilibrium constant was computed and was also in agreement with literature values.

To apply the above sampling and measurement to the lanthanides, consideration must be given to the cost (high for some lanthanides), tendency to hydrolyze, and formation of strong inner-complexes that would compete with the acetate ligand. Microsyntheses (mg) of carbonate precipitates were undertaken using samarium chloride as a prototype. The carbonate can readily be converted into perchlorates or acetates for the complexation studies. Good yield of the carbonate was attained with no evidence of hydrolysis. The samarium carbonate was collected over a 0.1 micrometer ultrafilter (vacuum) and washed repeatedly with DI water, then dried in a vacuum oven prior to recording the infrared spectra. On scaling to the gram level, considerable hydrolysis occurred and a mixed or basic carbonate was precipitated. This may preclude using the carbonate to gravimetrically prepare stock solutions, in which case ICP spectrometry will be used to quantify lanthanide concentrations.

Fourth Quarter:

The chelation of series of lanthanides was investigated. Infrared spectra of lanthanide acetate solutions were recorded using attenuated total reflectance. The preliminary results indicate the formation of a bidentate (chelate) complex even for dysprosium and heavier lanthanides contrary to theoretical predictions.

Task 3. Collect samples for examination of DOC in colloidal-size fraction.

First Quarter:

Dr. Whitbeck attended an HRMP meeting at the NTS to coordinate sampling activities with other organizations.

Second Quarter:

A sampling plan has been devised to collect water samples in conjunction with the well characterization sample collection activity.

Third Quarter:

Water samples were collected.

Fourth Quarter:

This task is essentially completed. Data analysis and reporting is awaiting laboratory analysis results.

First Quarter Summary:

Problems encountered: It was originally planned to use laser-induced fluorescence to study surface complexation (Task 1), however, there was insufficient funding to purchase some of the necessary equipment. Alternative plans are now being considered.

Budget: Approximately 10 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 22 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 58 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 100 percent of the budget has been expended.

NONRADIONUCLIDE GEOCHEMISTRY STUDIES

Contact: Dr. Michael Whitbeck

PROJECT DESCRIPTION

This project will survey selected groundwaters at the NTS to provide background information on the occurrence and distribution of metals and organic compounds. Water samples will be collected at selected water supply wells, tunnel discharges, and shot cavities. These samples will be sent to the DRI Water Resources Center laboratories and analyzed. Field measurements will be taken for temperature, pH, dissolved oxygen, Eh, EC, and HCO_3^- . In addition, samples will be analyzed for major dissolved species, including sodium, potassium, silicon, magnesium, calcium, chloride, sulfate, nitrate and silica, and minor species, including cesium, aluminum, lead, chromium, mercury, iron, manganese and strontium. These analyses will aid in predicting the geochemical behavior of contaminant metal ions in these waters.

All water samples will also be analyzed for total organic carbon (TOC), dissolved organic carbon (DOC), and environmental isotopes, such as deuterium, oxygen-18, carbon-13, carbon-14, and tritium. The values obtained will be compared with the average for clean formation waters (to be determined). Water with high values will be further analyzed to determine the nature and, if possible, the identity of the organic components. Consideration will be given to the most likely organic constituents for the water samples and compound-specific analyses will also be made.

These analyses will aid in estimating the potential for chelation of contaminant metal ions in these waters. This is of interest in predicting the geochemical behavior of contaminant metal ions with respect to adsorption and transport.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Refine field techniques to collect water samples.
- Task 2. Collect and analyze water samples for selected species.
- Task 3. Investigate mode of migration of species.
- Task 4. Conduct preliminary investigations to determine the relationship between radionuclides from the shot cavities and other species.

DELIVERABLES

- 1. A report detailing the results of this study (fourth quarter).

BUDGET - NONRADIONUCLIDE GEOCHEMISTRY STUDIES: \$67,000

PROGRESS ON TASKS

Task 1. Refine field techniques to collect water samples.

First Quarter (October – December 1989):

A preliminary evaluation of sodium azide as a water sample preservative was performed. Safety considerations may preclude its use in preserving field samples.

Second Quarter (January – March 1990):

Sodium azide solutions were found to be stable and will be used to preserve samples for DOC measurements. Separate samples will be collected and preserved by refrigeration alone for comparison.

Third Quarter (April – June 1990):

No work was done on this task.

Fourth Quarter (July – September 1990):

The collection of water samples at the NTS for TOC/DOC measurements may require some form of sample preservation to assure the integrity of the sample. The addition of a preservative for one analyte of interest may alter the water chemistry in an adverse way for other analytes and should not be undertaken lightly. Buddemeier (personal communication) has indicated no observed problems with bacterial growth on samples several months to a year old without preservation. This is not unreasonable for some wells, and with studies focused on the inorganic chemistry. However, with increasing evidence of bacterial populations at depth and possible surface contamination in sample handling, some further investigation is warranted. This task is intended to address whether preservation should be used for TOC/DOC samples.

Samples were collected from three wells for TOC/DOC analysis. One set of samples was preserved with dilute sodium azide solution added in the field and the other set was left untreated. The results are shown in Table 1. The higher organic carbon contents of untreated samples may indicate bacterial growth.

TABLE 1. TOC/DOC MEASUREMENTS WITH AND WITHOUT PRESERVATION.

Sample	TOC (mg/l)		DOC (mg/l)	
	treated	untreated	treated	untreated
Well C	0.1	0.5	0.1	0.2
UE16d	0.1	0.5	0.1	0.1
Well 8	<0.1	<0.1	<0.1	<0.1

Given this finding, some form of sample preservation is justified. Many potential methods have been suggested in the literature. Some of these methods, and their potential drawbacks, are:

preservative	- potential interferences and problems
addition of heavy metals	- interference with other analyses, precipitation, worker safety
addition of azide	- precipitation, safety
addition of acid	- may alter samples by precipitation
filtration through silver membrane	- labor intensive may alter chemicals

Task 2. Collect and analyze water samples for selected species.

First Quarter:

Dr. Whitbeck attended a HRMP meeting at the NTS to coordinate sampling activities with other organizations. It is anticipated that open-hole sampling may begin after March 1990 and continue into the summer months.

Second Quarter:

Sample collection is planned for this summer, in conjunction with the well characterization sampling activity.

Third Quarter:

Water samples were collected and soil samples were submitted for TOC analysis.

Fourth Quarter:

Data analysis and reporting is awaiting laboratory analysis results.

Task 3. Investigate mode of migration of species.

First Quarter:

A literature review is in progress.

Second Quarter:

Multiple (surface-) site binding and competitive chelation-ligation models are being studied.

Third Quarter:

No work was done on this task.

Fourth Quarter:

Speciation is a critical factor in determining the mode of migration of metals and radionuclides. To address speciation, the strengths and weaknesses of current models for multi-ligand binding and surface complexation were considered. Previous characterization of mineral and colloidal species at the NTS gives evidence for a variety of surfaces and ligands: 1) solid-crystalline silicates; 2) amorphous silicates; 3) specific minerals; and possibly 4) organics. It is doubtful that any one model will adequately describe all of these. The surface complexation model is suitable to surfaces 1 and 3, multi-ligand models may be applicable to 4, and the type 2 surface may be approximated by either model, but may be better modeled with a porous-surface complexation model.

Task 4. Conduct preliminary investigations to determine the relationship between radionuclides from the shot cavities and other species.

First Quarter:

No work was done on this task.

Second Quarter:

A cursory examination of neutron activation of emplacement material was undertaken to determine if this might yield information on the source of some colloidal species observed, particularly iron at the Cheshire site. It is estimated that much less than 0.1 percent of the emplacement iron might undergo a thermal neutron reaction, and thus would probably not be suitable as a means of identifying the source of the iron found in Cheshire water.

Third Quarter:

No work was done on this task.

Fourth Quarter:

The interaction of radionuclides from a shot cavity with other species was considered with respect to alteration of groundwater chemistry. The principal interactions include precipitation, complexation, and adsorption. Minor interaction may follow from ionizing radiation produced by the radionuclides.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 9 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 20 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 37 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 91 percent of the budget has been expended.

CAMBRIC DITCH STUDIES

Contact: Dr. Steve Mizell

PROJECT DESCRIPTION

This project will investigate radionuclide migration in the unsaturated zone at the Cambric Ditch in Area 5. Over the past 13 years, approximately two-thirds of the water entering the ditch has re-infiltrated into the subsurface, creating a steady-state infiltration source ideally suited for a field-scale radionuclide tracer experiment. Basic elements of this study include: 1) identifying appropriate tracers, 2) developing unsaturated zone water-sampling methods, 3) characterizing hydrogeologic and geochemical properties of the site, 4) installing instrumentation, 5) performing the experiment, and 6) modeling the experimental results.

A suite of tracers will be used, allowing investigation of a range of nuclide behavior characteristics. For example, the suite will include some nuclides that are strongly sorbed, some that are weakly sorbed, and some that lie in between. The tracers will be selected and appropriate quantities for injection will be determined within the guidelines of permitting requirements, safety considerations, detection at depths of interest, and representation of potential contaminants. Task 1 for FY 1990 will be to develop and evaluate a tracer injection method capable of delivering tracer fluids to the unsaturated zone below the level of most vegetation. The system must protect worker health and safety by minimizing the potential for contact with the tracer fluid.

Traditional unsaturated zone sampling equipment, constructed of ceramic and plastic, is known to adsorb many constituents from the soil water as it enters the sampler reservoir. Sampling devices not subject to adsorption problems would produce more representative samples and require less tracer at the injection point. Porous stainless steel samplers have been used in unsaturated zone laboratory work and may be appropriate for field applications. Task 2 will include development of a stainless steel sampling lysimeter and evaluation of the hydrologic and chemical characteristics of both the stainless steel lysimeter and the ceramic lysimeter. The dual evaluation will permit comparison of data obtained from ceramic lysimeters already in place at the Cambric Ditch.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Design and test a tracer injection methodology.
- Task 2. Develop and evaluate the sampling lysimeters.

DELIVERABLES

- 1. A technical report documenting and discussing the work completed (fourth quarter).

BUDGET - CAMBRIC DITCH STUDIES: \$50,000

PROGRESS ON TASKS

Task 1. Design and test a tracer injection methodology.

First Quarter (October – December 1989):

Analysis of subsurface hydrologic properties at the Cambric Ditch is continuing in preparation for conceptual and detailed design of an injection methodology for use in anticipated tracer migration studies at the ditch. Matric potential is being determined in laboratory experiments using core material retrieved from previous drilling activity at the ditch site. Results of an unsaturated zone modeling exercise, illustrating flow direction and potential, are also being prepared.

Second Quarter (January – March 1990):

Moisture content and matric potential have been determined on 19 cores collected during previous drilling at Cambric Ditch. Additional cores from the same borehole will be analyzed to determine moisture content and saturated hydraulic conductivity.

A report documenting the results of an unsaturated zone modeling experiment is in preparation. This experiment used available data to construct a numerical model of unsaturated zone water movement beneath the Cambric Ditch and illustrates flow direction and moisture content.

Third Quarter (April – June 1990):

A brief data report documenting collection, analysis, and results of moisture content and matric potential determinations completed on 19 cores selected from a 150-ft borehole drilled previously at the Cambric Ditch is being prepared. This data set may be expanded by analysis of additional cores from the same borehole to determine moisture content and saturated hydraulic conductivity.

A draft report describing results of an unsaturated zone modeling experiment has been prepared. The experiment documented in this report used available hydrologic data to construct a numerical model of unsaturated zone water movement beneath the Cambric Ditch and illustrates steady-state flow direction and moisture content.

Fourth Quarter (July – September 1990):

A short report of the history of research conducted at the Cambric Ditch Site was prepared. This report contains an annotated bibliography of relevant data sources as well as a summary of work accomplished.

A draft report describing results of an unsaturated zone modeling experiment and associated field data collection has been prepared. The experiment used available hydrologic data to construct a numerical model of unsaturated zone water movement beneath the Cambric

Ditch and illustrates steady-state flow direction and moisture content. This report is yet to be reviewed internally and so has not been distributed.

Task 2. Develop and evaluate the sampling lysimeters.

First Quarter:

It has been learned that other researchers, notably Dr. Birl Lowery, University of Wisconsin, are involved in the development of a stainless steel lysimeter. Current activities under this task are directed at coordinating efforts with some of these researchers to minimize duplication of effort.

Second Quarter:

Plans for evaluation of alternative unsaturated zone sampling lysimeters are being revised in order to coordinate with other researchers and minimize duplication of effort.

Third Quarter:

Plans for evaluation of alternative unsaturated zone sampling lysimeters constructed of stainless steel are being cancelled because the same general work is currently being performed by researchers at the University of Wisconsin. Progress at the University of Wisconsin is sufficiently advanced that it presently seems inappropriate to conduct similar work in Las Vegas. Opportunity may exist for a cooperative effort in field testing the new lysimeter designs in the future.

Fourth Quarter:

No work was done on this task. This task was cancelled during the third quarter because the same general work is currently being performed by researchers at the University of Wisconsin.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 20 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: LLNL plans to undertake geophysical investigations at the Cambic Ditch may require removal of casing in an existing borehole. If casing removal is necessary, there will be a diversion of funds from planned activities to instrument the borehole and oversee the casing removal.

Budget: Approximately 38 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered. There has been no further information concerning removal of steel casing from an existing borehole at the Cambric Ditch to facilitate LLNL's plans to undertake geophysical investigations at the site.

Budget: Approximately 47 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 73 percent of the budget has been expended.

RADIONUCLIDE DISTRIBUTION STUDIES

Contact: Mr. Bradley Lyles

PROJECT DESCRIPTION

A network of monitoring wells on the NTS suggests that spikes in tritium have occurred temporally. Tritium in these wells may have come from the atmosphere or nuclear explosions. A thorough understanding of the occurrence of these isotopes is imperative to estimate the occurrence or breakthrough of other potentially more harmful isotopes. Currently, the monitoring data base contains data from approximately 22 locations which are sampled by EPA and REECO on a varying time schedule depending on the site. Work on radionuclide distribution in FY 1990 will be broken into two tasks: 1) parallel sampling of selected wells currently in the monitoring program, and 2) tracking the sample collection of radionuclides during drilling of emplacement holes.

Several of the wells in the monitoring program have shown large variations in tritium over the past 5 to 10 years of sampling. The observed variations are not well understood, but they may be due to the rapid infiltration of surface water recharge, the breakthrough of tritiated water from the shot cavities, or sampling or analytical errors. To better understand these variations, a parallel sampling program will be established to measure the tritium concentration in selected wells monitored by EPA/REECO. Samples will be collected during or within a few days of the normal collection and analyzed by DRI for enriched tritium; these results will be compared to the results from the EPA/REECO samples. This comparison will help us understand how much variation may be due to error and how much may be due to normal variation. Samples will be collected from five monitoring wells at two different sample periods (once in the fall and once in the spring).

During the drilling of emplacement holes, there are commonly periods of down-time sufficient to collect water samples from the bore hole. Samples of this type may yield information from areas where few data are available and may give some indication of radionuclide migration in the testing areas. The main objective of this task is to monitor the drilling schedules and assist REECO in sampling these holes during periods of down-time. Additionally, the sample analyses would be reviewed and if tritium exists, REECO would be instructed to take additional samples for boil-down analysis at LLNL and LANL.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Conduct a parallel sampling program to evaluate variabilities in samples from monitoring wells on the NTS.
- Task 2. Monitor drilling schedules to establish sampling strategies for radionuclides when appropriate.

DELIVERABLES

1. A letter report on the tritium analysis results (fourth quarter). However, if abnormally high values are found, then the DOE will be notified immediately and resampling of the wells will be initiated.
2. A letter report comparing these results with the samples collected by EPA/REECo, once the data are received from the EPA/REECo laboratories (fourth quarter).

BUDGET - RADIONUCLIDE DISTRIBUTION STUDIES: \$40,000

PROGRESS ON TASKS

Task 1. Conduct a parallel sampling program to evaluate variabilities in samples from monitoring wells on the NTS.

First Quarter (October – December 1989):

No samples were collected.

Second Quarter (January – March 1990):

Information was received from EPA regarding the sites sampled as part of the long-term hydrological monitoring program, and arrangements were made to conduct parallel sampling on April 16.

Third Quarter (April – June 1990):

On April 16–17, 1990, a parallel sample effort was conducted with the EPA and samples were collected from nine wells (Well C, Well C-1, Well 8, Well 2, UE15d, Water Well 20, UE19c, T.W.B., and Army Well 1). Field measurements of temperature, pH, and electrical conductivity were made at the time of sample collection; water samples were submitted for major ion and tritium isotope analyses. Only partial analysis results have been received to date and were found to be similar to previous results. No analysis results have been received from the EPA laboratory.

Fourth Quarter (July – September 1990):

A parallel sample effort was conducted with the EPA and samples were collected from 11 wells (Well C, Well C-1, Well 8, UE15d, Water Well 20, UE19c, Well 5C, Well UE5c, Well J-13, Well J-12, and Army Well 1) on September 10–11, 1990. Field measurements of temperature, pH, and electrical conductivity were made at the time of sample collection; water samples were submitted for major ion and tritium isotope analyses. No analysis results have been received from DRI or EPA laboratories.

Task 2. Monitor drilling schedules to establish sampling strategies for radionuclides when appropriate.

First Quarter:

No work was done on this task.

Second Quarter:

Due to the small number of wells currently being drilled, plans have been expanded to include available open holes that have recently been completed. Open holes down-gradient from testing areas will be sampled for potential radionuclide contamination.

Third and Fourth Quarters:

No work was done on this task.

First Quarter Summary:

Problems encountered: No major problems were encountered.

Reports: The draft report from last fiscal year is currently undergoing internal review and revisions.

Budget: Approximately 16 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: Peer review comments on FY 1989's Tritium Distribution project report have been reviewed and addressed accordingly. Data related to a tracer test that was conducted at wells C and C-1, which may answer questions raised during peer review related to abnormal concentrations of tritium at that site, are forthcoming from the USGS. Once these data are received, the report will be completed and submitted to DOE.

Budget: Approximately 50 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: Final revisions have been made on FY 1989's Tritium Distribution Report and the report is undergoing derivative classification prior to submission to DOE.

Budget: Approximately 85 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: Final revisions have been made on FY 1989's draft Tritium Distribution Report. After the report is reviewed by a derivative classifier, it will be submitted to DOE.

Budget: Approximately 110 percent of the budget has been expended.

HYDROLOGIC DATA MANAGEMENT

Contact: Ms. Carol Thompson

PROJECT DESCRIPTION

This project has two primary components: the continued development of the Hydrologic Data Base (HDB) and the incorporation of NTS hydrologic and other environmental data into a Geographic Information System (GIS).

The HDB was set up in 1987 as a central repository for DRI's hydrologic and related data from the NTS. Because of changes in computer systems and the demands of other projects, little work has been done on the HDB in the last two years. Most of the effort in FY 1990 will involve the resumption of work on the HDB.

When it becomes operational, probably late in FY 1991, the GIS will be an important tool in helping DRI study environmental processes on the NTS and plan the direction of future research programs. Work in FY 1990 will focus on the initial planning of the design of the GIS, identifying and obtaining suitable GIS hardware and software, and beginning to learn how to use it.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Review the status of the HDB, including verifying what data have been added and identifying what data still need to be added.
- Task 2. Add data collected since 1987.
- Task 3. Prepare a user's manual and other documentation.
- Task 4. Add historical data as time permits.
- Task 5. Evaluate the needs of potential GIS users and develop a design for the GIS.
- Task 6. Investigate different GIS packages and decide which best suits our needs.

DELIVERABLES

None.

BUDGET - HYDROLOGIC DATA MANAGEMENT: \$100,000

PROGRESS ON TASKS

Task 1. Review the status of the HDB, including verifying what data have been added and identifying what data still need to be added.

First Quarter (October – December 1989):

Some of the data to be added to the data base were reviewed for accuracy and completeness. No further work on the data base was performed.

Second Quarter (January – March 1990):

A demonstration of screen and printed retrievals was prepared for review by some of the prospective DRI data base users. The demonstration, based on the current data base structure, was used as a vehicle for discussing the researchers' needs for information fields and methods of retrieval so that the structure of the data base could be finalized. Another meeting will be held in May with additional DRI researchers to pinpoint a current "final" list of requirements before additional work with the data base continues. Work to check the completeness and accuracy of the historical DRI water data continued. Some of the missing data were recalculated and will be added to the data base.

Third Quarter (April – June 1990):

Several meetings with DRI researchers were held to clarify future needs for information in the data base, the details of the sampling procedures, and the types of data collected. A final draft of the design is being developed for review by the researchers.

Fourth Quarter (July – September 1990):

Work began on the implementation of the changes in the data base structure that were developed in the previous quarter and to convert the data base to the new version of the data base management software. During this time, researchers from the well characterization program asked that some new records and fields be added to the data base structure to facilitate use of it with their data. These changes have been designed and require a final review before implementation.

Task 2. Add data collected since 1987.

First through Fourth Quarters:

No work was done on this task.

Task 3. Prepare a user's manual and other documentation.

First through Fourth Quarters:

No work was done on this task.

Task 4. Add historical data as time permits.

First through Fourth Quarters:

No work was done on this task.

Task 5. Evaluate the needs of potential GIS users and develop a design for the GIS.

First Quarter:

An initial review of the technology of the GIS and of users' needs for the GIS was made.

Second through Fourth Quarters:

No work was done on this task.

Task 6. Investigate different GIS packages and decide which best suits our needs.

First Quarter:

A review of the GIS packages used by EG&G, EPA, USGS, and University of California at Santa Barbara was made. A decision has been made to initially use ARC/INFO because of its many capabilities and its widespread use by organizations in southern Nevada with which DRI will need to collaborate.

Second Quarter:

The software and most of the hardware for the GIS have been ordered, however, selection of peripherals has not been made.

Third Quarter:

The software and most of the hardware ordered for the GIS has arrived and work has begun on installing the software.

Fourth Quarter:

No work was done on this task.

First Quarter Summary:

Problems encountered: Work on the data base did not progress very far because the programmer responsible for the data base was on leave for most of the quarter. We expect the work effort to pick up again in February.

Budget: Approximately 19 percent of the budget has been expended.

Other work: DRI staff helped coordinate the NV GIS Conference held in December 1989 for the benefit of the DOE family and other local organizations in southern Nevada. DRI's

cost for the binders and photocopied material was \$3230; staff support to coordinate the conference and prepare the binders was \$4400 (these are fully burdened costs).

Second Quarter Summary:

Problems encountered: What follows is more of a procedural decision than an actual problem. It has been several years since the original data base design was created and there are new studies in DRI's work plans. Thus, it seemed worthwhile to take the time now to perform another "needs assessment" before work on the data base continued. This would prevent possible major reconfigurations of this data base or possible duplication of the data in other data bases because the original data base was not viewed as a useful tool to the researchers.

Budget: Approximately 34 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: The level of work accomplished this quarter has been a function of the time available from the staff implementing the data base. Very good progress has been made on the design, especially with respect to the future needs of the researchers. Once the final design has been reviewed by the researchers and data base staff, conversion of the current data base to the new format will begin. Interviews are currently being conducted to staff the position responsible for the GIS.

Other work: Some retrievals from the old data base have been prepared as requested.

Budget: Approximately 62 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: The level of work accomplished this quarter has been a function of the time available from the staff implementing the data base. The design of the data base will now allow it to be more useful for the upcoming data collection activities, especially the well characterization program. Interviews were conducted to staff the position responsible for the GIS, but a candidate has not yet been hired.

Other work: Some retrievals from the old data base have been prepared as requested.

Budget: Approximately 88 percent of the budget has been expended.

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM SUPPORT

Contact: Dr. Roger Jacobson

PROJECT DESCRIPTION

Many of the activities of the HRMP are not directly related to individual projects in the work plan. These activities involve administrative and programmatic support to the HRMP participants as well as non-specific tasks, such as developing work plans, writing, editing, and reviewing progress reports and proposals, conducting security briefings and radiation safety training and participating in planning, review and coordination meetings. General field and laboratory support for these HRMP projects will also be provided.

The program planning and support funds will handle activities associated with the NTS which currently are unscheduled and cannot be anticipated.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Provide general administrative, programmatic, field and laboratory support to HRMP projects.
- Task 2. Attend program planning, review, and coordination meetings.
- Task 3. Write, edit, review, and conduct derivative classification on reports, work plans, and proposals, as necessary.
- Task 4. Provide administrative support to all WRC classified security-related activities under HRMP, such as processing security badge requests, writing plans and regulations, and conducting security briefings, as required.

DELIVERABLES

None.

BUDGET - HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM SUPPORT:

\$175,000

PROGRESS ON TASKS

Task 1. Provide general administrative, programmatic, field, and laboratory support to HRMP projects.

First Quarter (October – December 1989):

General program support was given in all areas, including review of the various QA/QC plans, and development of safety and field procedures for NTS activities.

Second Quarter (January – March 1990):

General budget, management, field and laboratory support continued to be given in all areas, including preparation of work plans, proposals, safety and field procedures for NTS activities, and QA/QC plans. Several new staff were hired to work on the DOE program; they will be located in the Las Vegas Water Resources Center office.

A DRI-generated proposal to study microbiology of the deep subsurface environment was granted by DOE/HQ, and plans were finalized.

Third Quarter (April – June 1990):

Support to HRMP projects continued, with special emphasis placed on conducting informal meetings with individual project personnel in both Reno and Las Vegas. Overall objectives for the current program were discussed, as well as those for FY 1991. Work on the various QA/QC plans and the development of safety and field procedures continued.

Fourth Quarter (July – September 1990):

All aspects of general support to the HRMP continued. Routine updates were conducted on the status of project investigations, problems, and important findings. These are reported in the individual project quarterly reports presented in this document. Basic laboratory, field and management support was also given.

Task 2. Attend program planning, review, and coordination meetings.

First Quarter:

Weekly meetings were held with Dr. Elle. An HRMP meeting was held on November 3 and 4 in Monterey, California. On November 14, Dr. Jacobson attended the DOE Tiger Team meeting, and on November 16, he attended a meeting with the USGS on well locations and general program activities. In addition, the DRI quarterly meeting of DOE program participants was held in Reno on December 18.

Second Quarter:

The Program Manager participated in the following:

1. A DOE meeting in Orlando, Florida, January 15-17, which focused on future research programs, particularly Deep Aquifer Microbiology.
2. Periodic meetings with DOE on the status of the HRMP.
3. A quarterly meeting with DRI Assistant Program Managers, held in Reno on March 29. Topics covered drilling program status, environmental assessments and compliance, reports and reporting guidelines, Operations Security, radiation and general safety requirements.
4. Research Development, Demonstration, Testing and Evaluation (RDDT&E) Program planning meetings, and the development of several Activity Data Sheets (ADS) for this program.

Third Quarter:

The DRI Program Manager attended the following meetings:

1. The annual ORSA/TIMS meeting in Las Vegas on May 7-9. Dr. Jacobson presented a paper related to scientific studies needed for general environmental restoration.
2. OPSEC and military threat briefings on May 14-16, to learn more about protection of non-classified information.
3. An HRMP meeting at LLNL on June 25 and 16, to discuss program goals and objectives.

Fourth Quarter:

In preparation for writing the FY 1991 Work Plan, the Program Manager participated in numerous meetings with DOE, where discussions of continuing and new topics of investigation were held. DRI principal investigators prepared individual project descriptions, tasks, deliverables and budgets for the proposed studies that will be included in the Work Plan.

Task 3. Write, edit, review, and conduct derivative classification on reports, work plans, and proposals, as necessary.

First Quarter:

Technical review and editing were performed for several draft reports. Revisions are in progress. These reports will be reviewed by a derivative classifier prior to being submitted to DOE.

Second Quarter:

Activity on this task has increased substantially. Many of the old deliverables from previous fiscal years have been edited, reviewed by a derivative classifier, and are complete or

nearly complete. There are several which are in internal review. The completed reports will be submitted to DOE after receiving DRI approval.

Third Quarter:

Peer review and editing of several draft technical reports, letter reports, and program plans were conducted. It is anticipated that this activity will increase during the next quarter, and the first quarter of FY 1991, when the FY 1991 Work Plan and several project reports will be completed.

Fourth Quarter:

Peer reviewers and editors were kept busy with a variety of draft letter and technical reports. Derivative classifiers reviewed several documents for submittal to DOE for review and approval to publish. The following technical reports have received DOE approval to publish:

1. Red Canyon Wash Infiltration Studies (T.L. Hurst et al., DOE/NV/10384-25).
2. Stable Isotopic Studies of Precipitation and Spring Discharge on the Nevada Test Site (N. Ingraham et al., DOE/NV/10845-03).

The following documents were given verbal approval by DOE, but are awaiting the required approval letter before being sent to press:

1. Radionuclides in Surface Soil at the NTS (R. McArthur).
2. The Hydrology of Underground Nuclear Tests: The Effect of Collapse-Chimney Formation (T. Brikowski).

Task 4. Provide administrative support to all WRC classified security-related activities under HRMP.

First Quarter:

The DRI security officer completed badge requests, clearance requests, and security, safe-room and secretarial tasks, as required.

Second Quarter:

Security-related activities included routine badge requests, clearance requests, and security, saferoom and secretarial tasks. The DRI Operations Security (OPSEC) Program plan for FY 1990 was drafted, as were the Threat Statement, and Critical and Sensitive Information (CSIL) and Essential Elements of Friendly Information (EEFI) lists, required by OPSEC, for this fiscal year. An OPSEC Working Group meeting was held on March 22, 1990, with discussions on various aspects of the security plan as it now exists.

A meeting of the DOE/NV OPSEC Working Group was also held in March, and was attended by the DRI OPSEC Coordinator.

Third Quarter:

A comprehensive briefing was completed for all DRI employees working on the DOE program.

The DOE/NV OPSEC Committee quarterly meeting was attended by a DRI representative.

Work is continuing on a restructured DRI security plan. Writing and meetings were completed on work toward the DRI OPSEC plan.

A general vulnerability assessment for the DRI was completed and OPSEC program guides for visitor access and foreign travel were implemented. DRI replacement security clearance applications were submitted to the DOE. Reinvestigation clearance applications were completed and submitted to the DOE. Other security requirements were continued on an ongoing basis.

Fourth Quarter:

Security, saferoom and secretarial tasks were completed, as necessary. Several reinvestigations of Q-cleared personnel were initiated, and revisions to the OPSEC plan were made. Restructuring of the DRI security plan also continued.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 43 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 78 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: The budget has been overexpended by about 10 percent; however, additional funding is expected early in the fourth quarter. The overexpenditure was due to increased efforts in processing old reports and various project-related activities.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: An additional \$37,000 was received early in the fourth quarter. Approximately 100 percent of the budget has been expended.

STATISTICS AND DATA MANAGEMENT

INTRODUCTION

The Statistics and Data Management Group was originally formed to manage and analyze the data from several radiological decontamination projects in the late 1970s. The group has since provided statistical and data management support to a number of DOE environmental assessment projects. Most of the work to be done in FY 1990 involves continued support of two ongoing programs, the Basic Environmental Compliance and Monitoring Program (BECAMP) and the Offsite Radiation Exposure Review Project (ORERP).

The goals of the BECAMP are to assess changes over time in radiological and ecological conditions at the NTS and to provide information needed to ensure that activities on the NTS comply with environmental regulations. The BECAMP, a revision and extension of the previous Nevada Applied Ecology Group (NAEG) and Radionuclide Inventory and Distribution Program (RIDP), involves several DOE contractors. DRI's roles in the BECAMP include managing the project data base and providing statistical and decision-making support to the project researchers and managers.

The ORERP was established to collect information about activities at the NTS during the period of atmospheric testing and to review the exposure to NTS fallout of people living near the NTS. DRI serves the ORERP as a statistics and quality control support group, as a data base manager, and as the coordinator for the final Individual Dose Assessment (IDA) model.

BASIC ENVIRONMENTAL COMPLIANCE AND MONITORING PROGRAM (BECAMP) DATA BASE

Contact: Ms. Carol Thompson

PROJECT DESCRIPTION

Currently, the BECAMP data base is in the development phase: the structure and operational procedures have been defined, the data base has been created, and some NAEG soil data have been entered. Work in FY 1990 will include completing the development of the data base, adding and archiving data as they become available, and adding as much existing NAEG and RIDP data as possible.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Complete the detailed procedures for data base management, data archival, and quality assurance.
- Task 2. Add any available current BECAMP research data to the data base.
- Task 3. Add the DRI archaeology data to the data base.

- Task 4. Add the RIDP data and NAEG large animal, small animal, and vegetation data to the data base.
- Task 5. Prepare a user's manual for the data base.
- Task 6. Assist BECAMP researchers in using the data base as needed.

DELIVERABLES

1. Final quality assurance plan and management procedures for the data base (third quarter).
2. User's manual for the data base (fourth quarter).
3. Status report on addition of data to the data base (fourth quarter).

BUDGET - BECAMP DATA BASE: \$132,000

PROGRESS ON TASKS

Task 1. Complete the detailed procedures for data base management, data archival, and quality assurance.

First Quarter (October – December 1989):

No work was done on this task.

Second Quarter (January – March 1990):

Some preliminary discussion took place with personnel from REEC's Coordination and Information Center (CIC) regarding the future archiving of BECAMP and NAEG materials.

Third Quarter (April – June 1990):

DRI and the CIC staff reviewed the NAEG/BECAMP files at the NTS to determine the level of effort required to archive the historical files. A presentation was made by CIC staff at the BECAMP meeting to describe and demonstrate the capabilities of the CIC to archive materials from this project. It is currently the responsibility of these two organizations to define the methodology for the archival function. A new person has been hired whose duties will include the preparation of procedures for the Quality Assurance plan and the detailed BECAMP data base.

Fourth Quarter (July – September 1990):

Work on the BECAMP QA plan began and an internal first draft was completed. Staff also participated in discussions relating to DOE Order 1360.2 (Computer Protection for Unclassified Sensitive Systems) to assess the direction in which BECAMP and its researchers would be required to operate.

Task 2. Add any available current BECAMP research data to the data base.

First through Fourth Quarters:

No work was done on this task.

Task 3. Add the DRI archaeology data to the data base.

First through Fourth Quarters:

No work was done on this task.

Task 4. Add the RIDP data and the NAEG large animal, small animal and vegetation data to the data base.

First through Fourth Quarters:

No work was done on this task.

Task 5. Prepare a user's manual for the data base.

First through Fourth Quarters:

No work was done on this task.

Task 6. Assist BECAMP researchers in using the data base as needed.

First through Fourth Quarters:

No work was done on this task.

First Quarter Summary:

Problems encountered: The search to replace the programmer for the data base did not begin until this quarter, with the verification of our new contract and BECAMP funding. Since the new programmer will not be starting until January 1990, no appreciable work was done on any of the tasks.

Budget: Approximately 5 percent of the budget was expended.

Second Quarter Summary:

Problems encountered: The new programmer began work in January and has been getting acquainted with the ORACLE data base management software and the structure of the NAEG data and the BECAMP data base. During this period, it was determined that some revisions in the data base structure would be required to account for fields that had been left out. Since this revision was necessary, an attempt was made to resolve, by the middle of May, a few of the more major problems that affected the usefulness of some NAEG information before the data were reloaded into the data base. This would save some of the headaches involved in correcting the problems after the data were loaded.

Other work: Richard Hunter requested DRI assistance in developing a data base with ORACLE on his IBM PC to catalog the herbarium materials. The work included developing the design, creating the data base structure, data entry form, and some capability for performing retrievals, and providing documentation on the data base. Some minor additions in the documentation will complete this task.

Budget: Approximately 26 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: Work on the data base has not progressed as well as expected. Some work required for transforming the NAEG data for use in the data base was accomplished. The programmer hired in January has left and a new one is being sought.

Other work: A retrieval was prepared for LANL relating to the plutonium data available from four areas of the NTS.

Budget: Approximately 50 percent of the budget has been expended. A sum of \$7,000 will be transferred to the CIC for them to begin archiving the NAEG/BECAMP materials.

Fourth Quarter Summary:

Problems encountered: A new programmer was hired in September, but it was decided to switch the responsibilities of this programmer with one of our programmers who is more experienced with data base management software. This latter programmer will begin working on the BECAMP data base in November after completing a current project.

Budget: Approximately 81 percent of the budget has been expended.

BECAMP PROJECT DESIGN SUPPORT

Contact: Dr. Richard McArthur

PROJECT DESCRIPTION

The primary goal of this project is to provide statistical support to the BECAMP. In FY 1990, this work may include designing sampling plans and protocols, analyzing data and interpreting results, and helping to integrate the results of the various research components of the program.

Work under this project may also include support to other projects under the DOE's Environmental Protection Division (EPD) which may need statistical or other technical assistance on a short-term or one-time, as-needed basis. Such support might include experimental design and analysis, quality assurance investigations, data analysis, review of measurement methods and sampling plans, design of data bases, and technical evaluation of proposals, reports, and other documents that involve the use of statistical methods.

TASKS TO BE ACCOMPLISHED IN FY 1990

Task 1. Provide support to BECAMP researchers as requested.

Task 2. Provide support to other EPD projects as requested.

DELIVERABLES

None.

BUDGET - BECAMP PROJECT DESIGN SUPPORT: \$32,000

PROGRESS ON TASKS

Task 1. Provide support to BECAMP researchers as requested.

First Quarter (October – December 1989):

On November 29, Dr. McArthur met with Richard Hunter and Phil Medica at Mercury to discuss some of the statistical aspects of their studies of the flora and fauna on the NTS. He was able to answer some of their questions, and brought back some data for further study.

Second Quarter (January – March 1990):

Further discussions were held with Richard Hunter and Phil Medica at the BECAMP meeting in January. As a result of these discussions, several changes to the detailed procedures for the lizard and tortoise studies were suggested. Drafts of several sections of the 1988 annual report on the plant and the animal monitoring were also reviewed.

In February, three sets of 1989 lizard data were received from Phil Medica. Alternative ways of analyzing these data are currently being explored.

Third Quarter (April – June 1990):

Work during the first part of the quarter focused on reviewing methods for estimating the size of animal populations and applying some of these methods to lizard data from the NTS. Following the BECAMP mid-year meeting in May, copies of the CAPTURE computer program and user's manual were obtained from REECo. Current efforts are being directed at learning how to use this program to analyze the data from capture/recapture studies on the NTS.

Fourth Quarter (July – September 1990):

The data for adult lizards on study plot YUF001 in 1989 were analyzed using the CAPTURE program to estimate population sizes under several different models. The results were sent to the principal investigator for the project at REECo.

A draft of the report "Status of Small Mammals on the NTS in 1988," by M. Saethre and P. Medica, was reviewed and returned to the authors with comments.

Task 2. Provide support to other EPD projects as requested.

First Quarter:

In October, Dr. McArthur presented a paper on the statistical aspects of estimating plutonium inventories in soil at the 28th Hanford Symposium on Health and the Environment, held in Richland, Washington.

Second through Fourth Quarters:

No support was requested.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 28 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 47 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 66 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems have been encountered.

Budget: Approximately 100 percent of the budget has been expended.

OFFSITE RADIATION EXPOSURE REVIEW PROJECT (ORERP)

Contact: Ms. Carol Thompson

PROJECT DESCRIPTION

DRI's current responsibilities for the ORERP emphasize data base management and the creation and operation of the Individual Dose Assessment (IDA) model. Work in FY 1990 will include completing two reports on previous tasks (Town Data Base and Lifestyles Survey), assessing the quality of several ORERP data bases, and developing an operational version of the IDA model.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Complete the report on the Town Data Base.
- Task 2. Revise the journal article on the Town Data Base.
- Task 3. Document and archive the computer programs and data relating to the Town Data Base.
- Task 4. Prepare a report on the Lifestyles Survey.
- Task 5. Continue development of the IDA model as segments become available from other task groups.
- Task 6. Complete the quality assessment of the Town Data Base.
- Task 7. Complete the quality assessment of the Survey Meter Data Base.
- Task 8. Complete the quality assessment of the Air Quality Data Base.
- Task 9. Prepare a report on the quality assessment of the ORERP data bases.
- Task 10. Distribute the report on the Phase II Soils project.
- Task 11. Provide other support as requested.

DELIVERABLES

- 1. *Draft report on the Town Data Base (third quarter).
- 2. *Revised journal article submitted to the Journal of Health Physics (second quarter).
- 3. *Status report on documentation and archival of Town Data Base (third quarter).
- 4. *Draft report on the Lifestyles Survey (fourth quarter).

BUDGET - OFFSITE RADIATION EXPOSURE REVIEW PROJECT: \$173,000

PROGRESS ON TASKS

Task 1. Complete the report on the Town Data Base.

First Quarter (October – December 1989):

The checking of the estimates for the Town Data Base was completed. A copy of these estimates was sent to the task groups as requested. No work was done on the report.

Second Quarter (January – March 1990):

A comparison of the exposure-rate estimates included in the Town Data Base with the contours on the fallout patterns was completed. Some corrections were made and a final version was sent to the task groups. A version of the County Data Base was received from LLNL and transformed into the format used for the Town Data Base. A copy of this reformatted data base was also sent to the task groups. No work was done on the report.

Third Quarter (April – June 1990):

No work was done on this task.

Fourth Quarter (July – September 1990):

About 15 records from the County Data Base were not included in the copies sent to the task groups. An updated version of the data base will be sent in October 1990. No work was done on the report.

Task 2. Revise the journal article on the Town Data Base.

First Quarter:

No work was done on this task.

Second Quarter:

Significant revisions were made to the journal article to clarify the description of the methodology and to account for major changes made in the methodology since the symposium was held. The revised paper will be returned to the publisher by mid-April.

Third Quarter:

The paper was resubmitted in mid-April and notice has been received that the revision was accepted for publication.

Fourth Quarter:

This task is complete.

Task 3. Document and archive the computer programs and data relating to the Town Data Base.

First Quarter:

Upon completion of the checking in Task 1, most of the data and program files were stored on magnetic tapes. This was done to save disk space charges until the files to be archived could be organized.

Second Quarter:

Files from the revision of the Town Data Base and the transformation of the County Data Base were stored on magnetic tapes until a final archival could be performed.

Third Quarter:

No work was done on this task.

Fourth Quarter:

Work was begun on the organization, cleanup, and final documentation of the files from the Town and County Data Base.

Task 4. Prepare a report on the Lifestyles Survey.

First through Fourth Quarters:

No work was done on this task.

Task 5. Continue development of the IDA model as segments become available from other task groups.

First Quarter:

No work was done on this task.

Second Quarter:

A copy of the IDA questionnaire presented to the DAAG in 1987 was given to H & N for work on the latest ORERP-related book. Some discussion with Colorado State University took place regarding the food consumption tables required for completing the dietary part of the questionnaire. A copy of the questionnaire was also given to REEC Co for use in the Prescott litigation. No other work was done on this task.

Third and Fourth Quarters:

No work was done on this task.

Task 6. *Complete the quality assessment of the Town Data Base.

First through Fourth Quarters:

No work was done on this task.

Task 7. *Complete the quality assessment of the Survey Meter Data Base.

First Quarter:

No additional quality assessment was done on the data base, but the report on the Survey Meter Data Base was extensively revised. The revised version has been sent out for review.

Second Quarter:

The report on the Survey Meter Data Base was revised several times. There are a few minor corrections to be made. The revised report will not be published until REEC Co incorporates the corrections from the review of the Town Data Base.

Third Quarter:

The corrections from the review of the Town Data Base were made to the Survey Meter Data Base and verified. The events requiring additional quality assessment were completed and all corrections were verified. About 10 additional documents are in the process of being coded for entry into the data base. The report will not be passed on to REEC Co for further publishing until these events have been entered and checked.

Fourth Quarter:

The additional documents have been coded, entered and checked according to the quality assurance procedures. Some small details need to be completed in the report before it is given to REEC Co for final preparation.

Task 8. *Complete the quality assessment of the Air Quality Data Base.

First through Fourth Quarters:

No work was done on this task.

Task 9. *Prepare a report on the quality assessment of the ORERP data bases.

First through Fourth Quarters:

No work was done on this task.

Task 10. *Distribute the report on the Phase II Soils project.

First Quarter:

The second printing of the report was defective; the original has been sent out to be printed a third time.

Second Quarter:

The printing of the report has not yet been completed.

Third Quarter:

The report was received from the printer in May. Copies have been sent to other ORERP participants, and distribution to the property owners and managers who helped with the project is about 50 percent complete.

Fourth Quarter:

Distribution of the report was completed with the mailing of approximately 250 copies.

Task 11. *Provide other statistical support as requested.

First Quarter:

No support was requested.

Second Quarter:

No support was requested.

Third Quarter:

Work began on writing the fallout verification chapters of the ORERP completion report. Four boxes of ORERP documents were retrieved from the DRI archives and examined. Extensive notes were taken from progress reports and minutes of the task group leaders' meetings and workshops, as well as the transcripts of the DAAG meetings. These notes will be used to prepare a summary of the work done for both Phase I and Phase II of the fallout verification task.

Fourth Quarter:

Two presentations about DRI work in ORERP were made at the Community Monitoring Program Station Manager's Meeting in August.

A draft of the Phase I fallout verification chapter of the ORERP completion report was completed and delivered at the ORERP meeting in August.

A draft of the book "Fireballs at Dawn" by H. Friesen was reviewed and returned to the author with comments.

First Quarter Summary:

Problems encountered: *Tasks 6 through 11 and the Deliverables have been changed to better reflect what can reasonably be done this fiscal year (given that the checking of the Town Data Base took longer than expected). There will be one technical report on the quality assessment of all the ORERP data bases; DOE will be provided with a status report as each is completed.

Budget: Approximately 19 percent of the budget has been expended.

Deliverables (changes):

1. Draft report on the Town Data Base (third quarter).
2. Revised journal article submitted to the Journal of Health Physics (second quarter).
3. Status report on documentation and archival of Town Data Base (third quarter).
4. Draft report on the Lifestyles Survey (fourth quarter).

Second Quarter Summary:

Problems encountered: Staff who have worked almost full-time on this project during its crunch periods have had to spend time catching up with work on other projects.

Budget: Approximately 35 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: Staff time was not available to a great extent because of the requirements of other projects. A review of what could yet be accomplished in this fiscal year was presented to DOE. The following tasks are to be accomplished: 1) finish the Survey Meter Data Base Report; 2) distribute the Phase II report; 3) prepare a draft of the Fallout Verification chapters of the ORERP Completion Report; 4) archive the Town Data Base information; 5) begin the Town Data Base report; and 6) retrieve the Enewetak soil data for LLNL.

Budget: Approximately 58 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: Staff time was not available to a great extent because of the requirements of other projects. Of the tasks listed in the above summary, Task 1 is nearly complete, Tasks 2 and 3 are complete and work on Task 4 has begun.

Budget: Approximately 90 percent of the budget has been expended.

YUCCA MOUNTAIN PROJECT

INTRODUCTION

In order to comply with the National Environmental Policy Act, National Historic Preservation Act, and Nuclear Waste Policy Act, and to fulfill the obligations specified in a Programmatic Agreement (PA) between the DOE, the Advisory Council on Historic Preservation (ACHP), and the Nevada Division of Historic Preservation and Archeology, the DOE is required to precede all site characterization activities with cultural resources investigations. The nature and extent of those studies for the Yucca Mountain Project Archaeological Program have been described in the Environmental Field Activity Plan (EFAP) supporting the Yucca Mountain Project (DOE Document DOE/NV-10576-16), and in the Research Design and Long Range Study Plan for Archaeological Data Recovery and Analysis at the Yucca Mountain Archaeological District, Nevada.

DRI will also support the Yucca Mountain Project Office with various scientific and other studies relevant to site characterization that are not related to archaeology. These activities may include both field and laboratory studies related to meteorology, engineering, biology, geology, and hydrology. An attempt will be made to conduct research in areas that are unrelated to the current State of Nevada funded program on Yucca Mountain. At the present time, funding has not been allocated for this work. Tasks and deliverables will be specified in the individual research proposals, as required.

YUCCA MOUNTAIN PROJECT ARCHAEOLOGICAL PROGRAM

Contact: Dr. Lonnie Pippin/Dr. David Rhode

PROJECT DESCRIPTION

General tasks identified in the EFAP, to be conducted during the site characterization phase of the Yucca Mountain Project, include: 1) identification and recording of cultural resources, 2) evaluation of cultural resources, 3) evaluation of potential adverse effects, 4) recommendations for mitigation of potential adverse effects, 5) monitoring of potential adverse effects, 6) data recovery programs, 7) escort to archaeological sites, and 8) public relations and worker education programs. Although any or all of these tasks may be required during any one particular fiscal year during the lifetime of the site characterization phase, specific tasks and deliverables scheduled for FY 1990 are listed below.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Assist the DOE in monitoring compliance with the PA between the ACHP and the DOE, including management of cultural resources and preparation of reports on implementation progress.

- Task 2. Conduct preactivity surveys and evaluations and provide recommendations as specified in the EFAP.
- Task 3. Initiate long-range data recovery plans at selected cultural resources in the Yucca Mountain Archaeological District, as specified in the Research Design. In FY 1990, data recovery efforts will focus on archaeological reconnaissance of areas in the Yucca Mountain Archaeological District that have not been adequately investigated in previous years.
- Task 4. Implement and maintain appropriate quality assurance procedures for data collection, cataloging, and archiving.
- Task 5. Maintain and update cultural resources inventory files and site records maps as necessary.
- Task 6. Provide escort to archaeological resources as necessary.
- Task 7. Undertake activities relevant to the public relations and worker education programs as specified in the EFAP.
- Task 8. Assist the DOE in preparation of cultural resources management objectives and reports, and coordination of cultural resource management plans with appropriate agencies as required in the PA.

DELIVERABLES

- 1. Documentation and forms for management of cultural resources and monitoring compliance with the PA on the Yucca Mountain Project, as necessary.
- 2. Letter reports and short reports, as necessary, describing the status of preactivity cultural resources surveys, evaluations of cultural resource significance and potential adverse impacts, and recommendations regarding alternative means for the mitigation of those impacts.
- 3. Progress reports and summary documents describing data recovery activities conducted under the long-range study plan, as necessary.
- 4. Documentation of field and laboratory activities as specified in the quality assurance procedures for archaeological studies in the Yucca Mountain Project area implemented by the DOE, as needed.
- 5. Activities (i.e., interpretive displays, video programs) relevant to the public relations and worker education programs specified in the EFAP, as requested.

BUDGET - YUCCA MOUNTAIN PROJECT ARCHAEOLOGICAL PROGRAM: \$610,000

PROGRESS ON TASKS

Task 1. Assist DOE in monitoring compliance with the PA between the ACHP and the DOE, including management of cultural resources and preparation of reports on implementation progress.

First Quarter (October – December 1989):

DRI assisted DOE in preparing the annual report to the ACHP, describing activities conducted in the management of archaeological resources in the Yucca Mountain Project area during the 1989 calendar year. This annual report is required in Stipulation 1 of the PA as a key component of monitoring compliance with the PA.

Second Quarter (January – March 1990):

DRI submitted responses to comments by the ACHP on the Research Design and Long-Range Study Plan, in support of Stipulations 2 and 3 of the Programmatic Agreement. In addition, DRI provided responses to DOE comments on the "Programmatic Agreement on Historic Preservation Annual Report," which describes activities conducted in the management of archaeological resources in the Yucca Mountain Project area during the 1989 calendar year in compliance with the Programmatic Agreement. This annual report is required in Stipulation 1 of the PA as a key component of monitoring compliance with the PA.

Third Quarter (April – June 1990):

DRI and DOE discussed modifications in the strategy of monitoring compliance with the PA in management of cultural resources, to better fit the DOE's overall project policies. These discussions resulted in the following compliance strategy:

- 1) avoidance of direct or indirect effects on cultural resources resulting from project activities should be achieved wherever feasible;
- 2) preactivity surveys will be conducted in advance of ground-disturbing activities to identify cultural resources in the proposed areas, to assess their historical, cultural, and scientific importance, and to recommend plans for avoidance or mitigation of potential adverse effects; limited subsurface examination may be required in some instances to assess the eligibility of a cultural resource;
- 3) known cultural resources will be regularly and periodically monitored to assess changes in the condition of those cultural resources;
- 4) any eligible cultural resources subject to adverse effects either from direct project-specific, ground-disturbing activities (including those cultural resources located within a safety buffer of the area that will be disturbed) or from indirect effects of the project as a whole, as revealed by monitoring, will be subject to archaeological data recovery efforts; and

- 5) the adequacy of the sample of cultural resources subject to data recovery will be assessed with respect to the information requirements to address the important research issues outlined in the Research Design and Long-Range Study Plan.

This strategy will be presented in the Research Design and Long-Range Study Plan, which will be submitted to DOE in the fourth quarter for review.

DRI also coordinated with the BLM, National Park Service (NPS), and Fish and Wildlife Service (FWS) concerning compliance with cultural resources regulations in support of DOE on an extensive preactivity survey for existing seismic stations located throughout southern Nevada and southeastern California (see Task 2).

Fourth Quarter (July - September 1990):

DRI prepared a comprehensive research design and data recovery plan to DOE for submittal to the ACHP. This document detailed the strategy of data recovery in monitoring compliance with the PA. Following comments by the Yucca Mountain Project Office, and in consultation with DOE personnel, a final draft of the research design was prepared for ACHP review. This research design will be submitted to ACHP early in the first quarter of FY 1991.

In addition, DRI developed an archaeological resources training module for an overall environmental training program, to be required of all workers on the Yucca Mountain Project (see Task 5). This is a major component of the worker education program required by the PA.

DRI also continued to coordinate with the BLM, NPS, USGS, and FWS concerning compliance with cultural resources regulations in support of DOE on an extensive preactivity survey for existing seismic stations located throughout southern Nevada and southeastern California, and in other preactivity tasks (see Task 2).

Task 2. Conduct preactivity surveys and evaluations and provide recommendations as specified in the EFAP.

First Quarter:

DRI personnel conducted archaeological field reconnaissance for two preactivity surveys of YMP activities. The first of these concerned placement of effective hydration temperature (EHT) probes near 16 weather stations on the NTS; no archaeological resources were found during this survey. The second, concerning areas chosen for rabbit-gamebird transects and predator scent stations, revealed two archaeological sites in the areas slated for project activities, but neither of these sites will be adversely affected by those activities. Short reports are being prepared for these reconnaissances. An additional preactivity survey request, to sample water from Well J-12, did not require additional field reconnaissance; a site records review of the area revealed several archaeological sites in the vicinity, but these will not be affected by the planned activities.

A short report describing the results of reconnaissances on Rattlesnake Ridge, conducted in the fourth quarter of FY 1989, was submitted to DOE in December 1989. DRI personnel received two additional preactivity survey requests from DOE, and fieldwork is scheduled to commence in the second quarter pending further instructions from DOE and its contractors.

Second Quarter:

DRI personnel conducted archaeological field reconnaissance for four preactivity surveys of YMP activities. The first of these concerned placement of 111 ground-control panels located over a large region surrounding the YMP area, in support of orthophoto mapping of the project area. A total of nine cultural resources were located during this survey, but none of them will be adversely affected by the project. A short report (SR011790-1) was prepared and submitted to DOE and to BLM on this activity. Reconnaissance of an additional rabbit-gamebird transect continued a preactivity survey begun last quarter. No archaeological sites were encountered in this last reconnaissance; a short report (SR121989-1) is currently being prepared. Survey of 16 deer-forage units, in support of the radiological monitoring program, was also conducted (SR022190-1); one archaeological site was located, but will not be affected by project activities. Finally, 10 ecological study plots located on Nellis AFB lands were surveyed, and a short report was prepared (SR022790-1). A single archaeological site was found, but it will also not be affected by proposed activities.

An additional preactivity survey request, to conduct soil tests in areas around the Exploratory Shaft Facility and prospective quarry areas, did not require additional field reconnaissance in Area 25; site records review of the area revealed several archaeological sites in the vicinity, which will probably be affected by the planned activities. One prospective quarry site in Area 1 will require a survey to be conducted during the third quarter pending DOE coordination with the activity planners.

Finally, two preactivity survey requests in support of radiological monitoring were received by DRI in late March, and will be conducted during the third quarter.

Third Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for five preactivity surveys of YMP activities. A site records search of 10 near-field radiological monitoring plots revealed archaeological sites at two of these plots (letter, Rhode to Kaiser 6/6/90), while a records search for improvements to radiological facilities in Area 25 Camp indicated no cultural resources (letter, Rhode to Kaiser, 5/15/90). Reconnaissance of three proposed Ecological Study Plots revealed no cultural resources (Short Report SR061290-1). Reconnaissance for existing and proposed seismic stations projects is continuing, and will be completed during the fourth quarter. Requests for preactivity surveys for surface-water monitoring stations and proposed seismic stations in Amargosa Desert will also be completed during the fourth quarter.

In addition, a short report describing reconnaissance of rabbit-gamebird transects and predator-scent stations, conducted during the second quarter, was completed (SR121989-1).

Finally, DRI personnel participated as expert advisors in two alternative design studies, one for Exploratory Shaft Facility (ESF) alternative plans and one for Calico Hills Formation geological testing. The ESF alternative plans evaluation included identification of the known cultural resources potentially affected by different alternative designs, fieldwork to identify cultural resources in potentially affected areas not previously surveyed, development of a scale for ranking different designs in terms of their effects to cultural resources, and ranking those different designs on the developed scale. The Calico Hills Formation study involved identification of known cultural resources potentially affected by different study designs and determination of the cost and time necessary to conduct preactivity surveys or data recovery efforts at those potentially affected cultural resources.

Fourth Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for five preactivity surveys. Work continued on the survey of existing seismic stations and proposed seismic stations and uplinks. Consultation with USGS and BLM personnel indicated that the monitoring activities planned for 37 existing seismic stations would have no adverse effect on cultural resources. A short report was prepared describing the results of archaeological survey at six other existing seismic stations (SR061290-2). Several other seismic stations have been surveyed, and a short report is being prepared for submittal early in the first quarter of FY 1991. Preactivity surveys of proposed seismic stations include six for which a short report has been prepared (SR061490-1), and six others for which a short report is currently in preparation. Three strong motion sensor sites have also been surveyed, and the results will be reported shortly. Additional proposed seismic stations locations will be surveyed as they are located in the field.

Field surveys were conducted at proposed trench locations in Areas A and B of the Midway Valley trenching project. Several isolated artifacts were recorded in one trench location, but the information potential will not be affected by trench activities. A second trench location lies within site 26Ny4759, a major aboriginal toolstone quarry area in Midway Valley. Data recovery will be necessary in this location, and a data recovery plan is currently in preparation.

Finally, field reconnaissance of a proposed temporary building site on the 60-m meteorological station in Midway Valley revealed no cultural resources.

Task 3. Initiate long-range data recovery plans at selected cultural resources in the Yucca Mountain Archaeological District, as specified in the Research Design; specifically, archaeological reconnaissance of areas not adequately investigated in previous years.

First Quarter:

The research design and long-range data recovery plan, submitted to DOE last quarter, was forwarded by them to the ACHP for review and comment. DRI personnel received these comments in mid-December and are currently responding to them. Additional archaeological reconnaissance of areas not adequately investigated during previous years has not been initiated, pending approval of the data recovery program and resolution of the desert tortoise situation in the YMP area.

Second Quarter:

DRI personnel concluded their response to ACHP comments on the research design and long-range data recovery plan, and submitted their comments to DOE in early March for review.

Additional archaeological reconnaissance of areas not adequately investigated during previous years has not been initiated during this quarter, pending approval of DOE. Sample units have been chosen for two areas of the YMP area: the lower Fortymile Wash area and the southwest Yucca Mountain area. Survey of these samples is expected to begin in the third quarter.

Third Quarter:

The research design and long-range data recovery program is currently under revision to accommodate changes in the strategy of compliance with the PA in managing cultural resources (see Task 1). A revised draft of this document will be submitted to DOE in the fourth quarter.

In addition, DRI requested that additional surveys be conducted in several portions of the YMP area, as stipulated in the PA. Sample units have been chosen for two areas of the YMP area: the Lower Fortymile Wash area and the southwest Yucca Mountain area. DOE is currently reviewing this request. Survey of these sample units is expected to begin in the fourth quarter.

Fieldwork was initiated with Dr. Irving Friedman of the USGS on a program to measure effective hydration temperatures in different environmental settings in the YMP area and vicinity. This involved burying a series of effective hydration temperature cells in several locations, to be retrieved in a year for measurement. This program will allow the obsidian hydration dating program to correct for differential temperatures resulting from artifact burial or differences in elevation.

Pottery samples from sites in the project area were also sent to the University of Washington's Thermoluminescence Laboratory to determine the feasibility of thermoluminescent dating of materials for the project.

Finally, work has been initiated to identify and map depositional and geomorphic units important for archaeological interpretation in the YMP area, and to prepare numerical data sets concerning site locations and areas surveyed for creation of a multi-level geographic information system (GIS) for the project area.

Fourth Quarter:

The research design and long-range data recovery program has been completed, submitted to DOE for review, and revised following that review (see Task 1). It is currently being prepared for submittal to the ACHP. In addition, a specific data recovery plan for trenching operations in Midway Valley is currently being prepared.

In addition, DRI received approval to conduct additional surveys in several portions of the Yucca Mountain Project area, as stipulated in the PA. Sample units have been chosen for two areas of the YMP area: the lower Fortymile Wash area and the southwest Yucca Mountain area. Survey of these samples is expected to begin in the first quarter of FY 1991.

Pottery samples from sites in the project area, sent to the University of Washington Thermoluminescence Laboratory to determine the feasibility of thermoluminescence dating of materials for the project, revealed that such a program will be very worthwhile for providing chronological information concerning archaeological pottery and settlements.

Finally, work is continuing to identify and map depositional and geomorphic units important for archaeological interpretation in the YMP area, and to prepare numerical data-sets concerning site locations and areas surveyed for creation of a multi-level Geographic Information System (GIS) for the project area.

Task 4. Implement and maintain appropriate quality assurance procedures for data collection, cataloging, and archiving.

First Quarter:

Quality assurance procedures for archaeological laboratory analyses and data management are being revised in response to DOE comments and modifications in quality assurance requirements. These revised procedures will be submitted to DOE next quarter.

Second Quarter:

Quality assurance procedures for archaeological laboratory analyses and data management have been formulated, and are awaiting implementation pending DOE approval of QA program requirements. Field procedures were submitted for review last fiscal year. Both lab

and field procedures will be submitted to DOE during the third quarter for final QA grading and implementation.

Third Quarter:

The QA program under which the archaeological program will operate was approved by DOE in late May. Procedures (work instructions) are currently being written according to the QA program requirements, and will be submitted for review early in the fourth quarter.

Fourth Quarter:

DRI personnel received QA training from the YMPO, negotiated to be a participant in the T&MSS QA program, and have prepared work instructions for archaeological activities conducted under the auspices of that QA program. In addition, DRI personnel prepared grading packages to determine the quality level of archaeological activities, per the YMP QA program. These grading packages are currently under review by T&MSS, for submittal to the Quality Review Board early in the first quarter of FY 1991.

Task 5. Maintain and update cultural resource inventory files and site record maps as necessary.

First Quarter:

Cultural resource inventory files and site records have been updated to incorporate all new archaeological properties located during this quarter as part of YMP activities.

Second Quarter:

Cultural resource inventory files and site records have been updated to incorporate all new archaeological properties located during this quarter as part of YMP activities.

Third Quarter:

Cultural resource inventory files and site records have been updated to incorporate all new archaeological properties located during this quarter as part of YMP activities.

Fourth Quarter:

Cultural resource inventory files and site records have been updated to incorporate all new archaeological properties located during this quarter as part of YMP activities. In addition, a complete inventory and organization of all artifacts collected for the Yucca Mountain Project has been initiated.

Task 6. Provide escort to archaeological resources as necessary.

First Quarter:

No escort to archaeological sites in the YMP area was required.

Second Quarter:

No escort to archaeological sites in the YMP area was required.

Third Quarter:

Escort to archaeological sites in the YMP area was provided to the Nuclear Waste Technical Review Board, Congressional and Administration staff, and DOE officials from the Yucca Mountain Project Office.

Fourth Quarter:

Escort to archaeological sites in the YMP area was provided to personnel from Sandia National Laboratories, the T&MSS QA program, the DOE Project Office, and associated contractors.

Task 7. Undertake activities relevant to the public relations and worker education programs as specified in the EFAP.

First Quarter:

DRI assisted DOE in plans for a display of artifacts and other materials pertinent to Native American concerns in the YMP area. This assistance will continue in the future as the display develops.

Second Quarter:

DRI assisted DOE in creating replicas of Native American artifacts for a DOE display of materials pertinent to Native American concerns in the Yucca Mountain Project area, in Las Vegas. In addition, DRI personnel supported development of a display on southern Nevada archaeology to be created at the Nevada State Museum in Las Vegas. Finally, DRI prepared presentation materials for the Nuclear Waste Technical Review Board, to be held in the third quarter in Las Vegas. Preparation of this technical presentation will continue into the next quarter.

Third Quarter:

DRI personnel supported development of a display of southern Nevada archaeology exhibited at the Nevada State Museum in Las Vegas. DRI personnel also organized and participated in a symposium concerning southern Great Basin archaeology at the national Society for American Archaeology meetings held in Las Vegas in April. A technical update of the archaeological program was also presented before the Nuclear Waste Technical Review Board, including a field trip to show the Board cultural resources in the YMP area. In addition, a field trip of the YMP area was conducted for a group of Congressional and Administration representatives (see task 6, above). Finally, materials have been prepared for an environmental training program to be given to all YMP workers. These materials, including

viewgraphs, a lesson plan, and handouts, will be completed in the fourth quarter and will be distributed shortly thereafter.

Fourth Quarter:

A training program was developed for worker education about environmental regulations and duties, to be presented to all workers on the YMP. This training program was presented to the Project Manager and his staff at the YMPO in Las Vegas, and to training coordinators from all major agencies involved in the project, at Sandia National Laboratories in Albuquerque. The training program is now being presented to all workers by these training coordinators and their staffs. This program constitutes a major component of the worker education program required by the PA (see Task 1).

In addition, DRI personnel submitted an abstract of a paper to be presented next April at the American Nuclear Society symposium on high-level radioactive waste management. This abstract has been accepted, and a draft of the paper is currently being prepared for DOE review in October.

Task 8. Assist the DOE in preparation of cultural resources management objectives and reports, and coordination of cultural resource management plans with appropriate agencies as required in the PA.

First Quarter:

DRI assisted DOE in preparing the Environmental Mitigation Management Plan and the Annual Report on PA Compliance for the ACHP. In addition, DRI is continuing to prepare the Research Design and Long-Range Data Recovery Plan, in response to comments by the ACHP, as noted above (Task 3).

Second Quarter:

DRI assisted the DOE in preparation of the Annual Report on PA compliance for the ACHP, as noted in Task 1, above. In addition, DRI prepared responses to comments by the ACHP on the Research Design and Long-Range Data Recovery Plan, described in Task 3. Coordination of cultural resource management plans included interaction with the BLM, Las Vegas District, and the Museum of Natural History at UNLV, for preactivity surveys on BLM lands. Coordination of cultural resource management efforts was also conducted in support of the activities described in Task 7.

Third Quarter:

DRI assisted DOE in preparation of the compliance strategy for management of archaeological resources at Yucca Mountain, as noted in Task 1, above. Two short reports and two clearance letters were submitted to DOE in support of the preactivity surveys described in Task 2, above. Coordination of cultural resource management plans includes interactions

with the Bureau of Land Management (Las Vegas District, Stateline and Caliente Resource Areas; Battle Mountain District, Tonopah Resource Area; Ely District; Desert District, Ridgecrest Resource area; and Bakersfield District, Bishop Resource area), the National Park Service (Death Valley National Monument and the Lake Mead National Recreation Area), and the Fish and Wildlife Service (Desert Bighorn Range, Pahrangat Wildlife Refuge), as well as the UNLV Museum of Natural History, for preactivity surveys on lands under various jurisdictions. Coordination of cultural resource management efforts was also conducted in support of the activities described in Task 7.

Fourth Quarter:

DRI assisted DOE in preparation of the compliance strategy for management of archaeological resources at Yucca Mountain, as noted in Task 1, above. Short reports and clearance letters were submitted to DOE in support of the preactivity surveys described in Task 2, above. Coordination of cultural resource management plans with the appropriate agencies (see third quarter report) was conducted.

First Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: Deliverable reports submitted include the Annual Report to the ACHP on compliance with the PA and short reports and letters on preactivity surveys.

Budget: Approximately 6 percent of the budget has been expended.

Second Quarter Summary:

Problems encountered: No specific problems have been encountered.

Reports: Deliverables submitted this quarter include the final draft of the Annual Report to the ACHP on compliance with the PA, the responses to comments by the ACHP on the Research Design and Long-Range Data Recovery Plan, and short reports and letters on preactivity surveys. Other deliverables include artifact replicas and presentation materials for public or technical presentations and displays.

Budget: Approximately 22 percent of the budget has been expended.

Third Quarter Summary:

Problems encountered: No specific problems were encountered.

Reports: Deliverable reports submitted include short reports and letters on preactivity surveys. Other deliverables include presentation or training materials for public or technical presentations, evaluations of alternative design plans, and field trips.

Budget: Approximately 41 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems were encountered.

Reports: Deliverable reports submitted include short reports and letters on preactivity surveys. Other deliverables include presentation or training materials for worker education, public or technical presentations, preparation of quality assurance documents and grading packages, and field trips.

Budget: Approximately 69 percent of the budget has been expended.

CHARACTERIZATION OF SOUTHERN NEVADA PALEOFAUNAS

Contact: Dr. Stephanie D. Livingston

PROJECT DESCRIPTION

The goal of this study is to construct a history of Great Basin faunas that will provide independent empirical evidence of past environmental and climatic conditions for use in modeling future climate and its effect on the hydrology of the Yucca Mountain area.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Literature search for applications of faunal data to climate studies.
- Task 2. Literature search of published and archival materials housed in agency and museum files for description of excavated faunas and modern biological surveys.
- Task 3. Search of existing paleofaunal collections for specimens amenable to morphometric analysis.
- Task 4. Collection of morphometric data from museum collections for description of variability amenable to environmental interpretation.

DELIVERABLES

- 1. Report of the location and content of existing paleofaunal records and collections.
- 2. Report on the literature review of existing applications of faunal data to climatic modeling.
- 3. Preliminary report on the morphological variability among populations of modern species for use in the model.

BUDGET - CHARACTERIZATION OF SOUTHERN NEVADA PALEOFAUNAS: \$73,668

PROGRESS ON TASKS

Task 1. Literature search for applications of faunal data to climate studies.

Third Quarter (April – June 1990):

Compilation of an annotated bibliography of relevant sources has been initiated.

Fourth Quarter (July – September 1990):

Compilation of an annotated bibliography of relevant sources is continuing.

Task 2. Literature search of published and archival materials housed in agency and museum files for descriptions of excavated faunas and modern biological surveys.

Third Quarter:

Compilation of an annotated bibliography of relevant sources has been initiated.

Fourth Quarter:

Compilation of an annotated bibliography of relevant sources is continuing.

Task 3. Search of existing paleofaunal collections for specimens amenable to morphometric analysis.

Third Quarter:

Materials are being pulled from the Floating Island archaeological collection.

Fourth Quarter:

A subcontract to the Antiquities Section, State of Utah, was written to expedite cost-effective recovery of stratified, radiocarbon-dated faunal materials from the archaeological collections from the Silver Island Range. These materials span the last 7,500 years, and contain well over four million specimens of bone, most of which are small mammals, birds, and reptiles. This collection will provide a faunal sequence from the northeastern Great Basin, the furthest possible source of water in a regional regime that could affect the Yucca Mountain area.

Similar prehistoric faunal collections that provide abundant appropriate materials in a similar state of analysis are rare. A collection that has been analyzed and reported for archaeological purposes has been identified for the central Great Basin, and procedures for obtaining access to the small mammals from this site are being initiated. An unexcavated southern Great Basin site with potential to yield a stratified faunal record also has been identified; further information, access and permission to excavate this site are being sought.

Task 4. Collection of morphometric data from museum collections for description of variability amenable to environmental interpretation.

Third Quarter:

No work was done on this task.

Fourth Quarter:

Variables that will reflect parameters of interest are being identified, and comparative materials with appropriate data from different environmental regimes are being collected.

Third Quarter Summary:

Problems encountered: The proposal for FY 1990 was written for the work to be conducted in a 12-month period, but logistics are allowing only four months in which to accomplish the tasks. Funding was not available until June.

Reports: Deliverable reports will be written during the fourth quarter.

Budget: Approximately 8 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: Due to the funding schedule (see Third Quarter Summary), all tasks identified for this fiscal year cannot be completed. Work has, however, been initiated on all tasks.

Reports: No tasks are sufficiently complete to provide an informative report.

Budget: Approximately 51 percent of the budget has been expended.

**DEVELOPMENT AND APPLICATION OF METHODOLOGIES
FOR THE IDENTIFICATION OF FLOOD HAZARD ZONES
ALONG POTENTIAL RAIL ACCESS CORRIDORS
TO THE YUCCA MOUNTAIN SITE**

Contact: Dr. Richard H. French

PROJECT DESCRIPTION

The potential hazards posed to the surface transport of radioactive waste by fluvial and mud and debris flooding on alluvial fans include: 1) damage and/or burial of the vehicles transporting the waste, and 2) the closure of major transportation systems during flooding events. The objective of this study is to identify the lengths of proposed rail transportation corridors in Nevada that are subject to flood hazard by 1) identification of those lengths of corridors at risk, 2) preliminary analysis of the lengths identified in the initial screening, and 3) detailed analysis of the lengths remaining after the preliminary analysis. It is anticipated that these data will be combined with a geographic information system, GIS, to facilitate the rapid evaluation of potential rail transportation corridors with respect to potential surface water hydrology problems and mitigation from the viewpoint of effectiveness and cost.

TASKS TO BE ACCOMPLISHED IN FY 1990

- Task 1. Meet with the Arizona, California, Nevada, New Mexico and Utah Departments of Transportation to determine their current design and drainage mitigation criteria for highways.
- Task 2. Meet with the relevant railroads to determine their current design and drainage mitigation criteria for railroads.
- Task 3. Develop a generic screening process for the identification of corridor lengths that will require additional evaluation from the viewpoint of flood hazard.
- Task 4. Assist DOE, as requested, in the analyses of the records of flooding in perennial river crossings.
- Task 5. Identify lengths of the Caliente route corridors with a high flood potential.

DELIVERABLES

- 1. Report on meetings with the transportation departments and railroads, including an annotated bibliography of reference materials.
- 2. Report describing the development of the initial screening process and documenting its use.
- 3. Report identifying the lengths of the Caliente route corridors with a high flood potential.

PROGRESS ON TASKS

Task 1. Meet with the Arizona, California, Nevada, New Mexico and Utah Departments of Transportation to determine their current design and drainage mitigation criteria for highways.

Third Quarter (April – June 1990):

Meetings have been held with the Nevada and California Departments of Transportation. Meetings with the U.S. Department of Transportation, Arizona Department of Transportation, and the California Department of Water Resources will be arranged in the immediate future. The annotated bibliography is approximately 30 percent complete.

Fourth Quarter (July – September 1990):

Meetings have now been held with the Arizona, California, and Nevada Departments of Transportation. Several teleconferences have been held with the U.S. Department of Transportation. While the meetings have been productive in identifying problems, they have not been productive in identifying solutions to the problems.

The annotated bibliography is complete and has been submitted to DOE in a draft form for review. We anticipate that as additional references are identified, they will be added to the bibliography and revised editions of the bibliography published as warranted.

Task 2. Meet with the relevant railroads to determine their current design and drainage mitigation criteria for railroads.

Third Quarter:

No meetings with railroads have been held.

Fourth Quarter:

Contact has been established with the Union Pacific Railroad (UPRR) and with its hydrology consultants. A meeting will be scheduled with the UPRR in the near future. We are in the process of targeting specific lengths of their line where we would like to examine their maintenance records.

Task 3. Develop a generic screening process for the identification of corridor lengths that will require additional evaluation from the viewpoint of flood hazard.

Third Quarter:

The generic screening process is being developed. It is anticipated that the application of this process to test corridors will occur late in the fourth quarter of FY 1990 or early in the first quarter of FY 1991. The Caliente route has been delineated on topographic sheets.

Fourth Quarter:

The report detailing the generic screening process that was developed is approximately 30 percent complete. This report will include example applications to both the Caliente route and existing UPRR alignments.

Task 4. Assist DOE, as requested, in the analyses of the records of flooding in perennial river crossings.

Third Quarter:

No work was done on this task.

Fourth Quarter:

Advice on drainage analysis was provided to both SAIC and Kennedy/Jenks/Chilton (Reno).

Task 5. Identify lengths of the Caliente route corridors with a high flood potential.

Third and Fourth Quarters:

No work was done on this task.

Third Quarter Summary:

Problems encountered: No specific problems were encountered. This project was initiated in April 1990 and has been funded for six months of FY 1990.

Budget: Approximately 24 percent of the budget has been expended.

Fourth Quarter Summary:

Problems encountered: No specific problems were encountered.

Budget: Approximately 74 percent of the budget has been expended.