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**FY 1991
ENVIRONMENTAL RESEARCH PROGRAMS
FOR THE DOE FIELD OFFICE, NEVADA**

WORK PLAN AND QUARTERLY REPORTS

**DESERT RESEARCH INSTITUTE
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FOURTH QUARTER REPORT

by

**Desert Research Institute
University of Nevada System**

Submitted to

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Richard D. McArthur

Richard D. McArthur

Desert Research Institute

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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, site mitigation plans, compliance activities, and historical research; 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, laboratory, field, and administrative activities.

In addition to these, archaeological site characterization, flood hazards for rail transportation, and paleofaunal investigations 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, review and classification of DRI documents, and preparation of any special reports, e.g., quarterly reports, not included in the requirements of the individual projects.

A new set of programs funded by the Office of Technology Development will be in place by the third quarter of FY 1991. These projects will address environmental restoration and waste management concerns, among other related topics.

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

This document contains the Work Plan, including project descriptions, tasks, deliverables and quarterly progress reports on each project for FY 1991.

NEVADA TEST SITE ARCHAEOLOGICAL PROGRAM

INTRODUCTION

The Nevada Test Site Archaeological Program is a continuing program which assists DOE in its compliance with various stipulations and regulations of the National Historic Preservation Act (NHPA), the American Indian Religious Freedom Act (AIRFA) and cultural resource components of the National Environmental Policy Act (NEPA). This assistance is provided through four ongoing and three newly proposed projects. The first ongoing project, Environmental Compliance for Ground-Disturbing Activities, addresses the identification, evaluation and mitigation of potential effects of DOE activities on historic and prehistoric archaeological resources throughout the NTS area. The second, Pahute and Rainier Mesas Long-Range Study Plan, proposes a comprehensive data recovery project focused at the mitigation of potential adverse impacts from weapons testing on archaeological resources on Pahute and Rainier Mesas (NTS Areas 12, 19, and 20) as specified in a Programmatic Agreement between DOE, the Nevada Division of Historic Preservation and Archaeology (NDHPA) and the Advisory Council on Historic Preservation (ACHP). The third is a multi-phase program to consult with Native American groups to assist DOE in complying with the AIRFA and assess the effects of DOE activities on Native Americans. The final ongoing project, administered through DOE's Yucca Mountain Project Office (YMPO), will assist DOE in complying with the stipulations specified in the PA between DOE and the ACHP concerning the characterization of Yucca Mountain as the Nation's first high-level nuclear waste repository.

The three additional newly proposed projects are: 1) the development of a Cultural Resources Management Plan; 2) the upgrading of the NTS Cultural Resource Archives (both projects are necessary for DOE to comply with Federal regulations); and 3) History of Nevada Nuclear Research, Development and Testing, which focuses on inventorying cultural resources associated with the nuclear testing program on the NTS and evaluating these resources for their eligibility to the National Register of Historic Places (NRHP).

ENVIRONMENTAL COMPLIANCE FOR GROUND-DISTURBING ACTIVITIES

Contact: Lonnie C. Pippin/Colleen M. Beck

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 and that the project will not have adverse effects on cultural resources and then allows the project to proceed. However, if cultural resources occur in the zone of potential adverse impact by a scheduled activity, each resource is evaluated for its scientific or historic worth and plans are devised to mitigate any adverse impacts on the archaeological sites held eligible for inclusion in the NRHP. Most

archaeological sites can be avoided by DOE projects on the NTS, 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. Field activities generate records associated with both archaeological site surveys and artifact collections from data recovery projects. Managing the site records involve two major activities: 1) data entry into the site record database maintained for the NTS; and 2) preparing records for and obtaining permanent site numbers from the Nevada State Museum or its delegate. These activities also generate archaeological collections, which require inventory, analysis and archiving of the collected materials, and managing of the records associated with these collections and analyses. These data recovery studies are funded by the responsible National Laboratory or Defense Agency and must be approved by both the NDHPA and the ACHP.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Conduct on-call preconstruction surveys prior to ground-disturbing activities.
- Task 2. Conduct limited test excavations at selected archaeological sites to fully evaluate their scientific significance and establish suitable plans for data recovery.
- Task 3. Prepare data recovery plans for those cultural resources which cannot be avoided when ground-disturbing activities are necessary.
- Task 4. Conduct data recovery at archaeological sites scheduled for disturbance by DOE activities.
- Task 5. Maintain and update cultural resources inventory files and site record maps.
- Task 6. Maintain archaeological collections using appropriate technology and materials for archival storage.
- Task 7. Assist DOE in the management of cultural resources on the NTS and in the preparation of management objectives and reports.
- Task 8. Assist DOE in public relations and communications concerning the NTS archaeology program.

DELIVERABLES

- 1. Cultural resources reconnaissance short reports, as required, for the above preconstruction surveys which evaluate the significance of all identified cultural resources and the potential effect on those resources and provide recommendations for the mitigation of any potential adverse effects.
- 2. Formal proposals for and final reports covering limited test excavations at selected archaeological sites as required.

3. Formal data recovery plans, as required, for consultations with the NDHPA and the ACHP.
4. Formal reports covering data recovery studies, as required.
5. Updated maps of areas surveyed and identified cultural resources, as needed.
6. Accessioning, labeling and inventory of collected materials from field activities, as required.
7. Written recommendations and associated documentation concerning the management of cultural resources, as necessary.
8. Activities and materials for explaining the NTS archaeology program, as requested.

Funding for the Environmental Compliance for Ground-Disturbing Activities will support these components: 1) survey and testing activities on the NTS, provided by DRI; and 2) data recovery efforts on the NTS, which are provided by the National Laboratory or Defense Agency responsible for the particular activity involved.

PROPOSED BUDGET: \$200,000

NTS BECAMP COMPONENT:		\$ 100,000
LABORATORY AND/OR AGENCY FUNDING:	LANL	\$ 50,000
	LLNL	\$ 50,000

PROGRESS ON TASKS

Task 1. Conduct on-call preconstruction surveys prior to ground-disturbing activities.

First Quarter (October - December 1990):

Preconstruction surveys were conducted for Characterization Well sites CW4B, CW5, CW7, CW8 and CW10 and their access roads.

Second Quarter (January - March 1991):

Two preconstruction projects were conducted, one for the On-Site Housing in Area 25, and one for the Nevada Bell communication line from the Specter Repeater to the CP Hill. One record search, for the CP Hill Trenches, was also conducted.

Third Quarter (April - June 1991):

Preconstruction surveys were conducted for three projects: 1) the Overhead KY Transmission Line which begins at Substation 5-2 and ends at 5-2-4160-2-1 (Well 2-RNMS) near Frenchman Flat in Area 5; 2) the location for a CCTV van in Area 7 near Yucca Flat; and 3) two study plots for the Land Surface Cleanup Project - one at the south end of Plutonium Valley in Area 3 and the other at the south end of Kawich Valley in Area 19.

Other construction projects occurred within disturbed zones in Yucca Flat, in areas previously identified by archaeological surveys. No field work was required on these projects.

Fourth Quarter (July - September 1991):

DRI conducted one survey for archaeological resources and two surveys of historic structures. The archaeological survey was conducted in Area 5 near the Radioactive Waste Management Site and was a reconnaissance of three primary and three alternate well locations, trench locations, and associated access roads. The two historic structure surveys were in Areas 5 and 25. The Underground Parking Garage in Frenchman Flat (Area 5) was examined by an architectural historian to complete a building inventory of the structure and to assess the impact of proposed renovations. In Area 25 the Bren Tower and its environs were examined with the same goal. This is the first time that an architectural historian has evaluated buildings on the NTS for compliance with Section 106 of the National Historic Preservation Act. Both of these structures were associated with the above-ground nuclear testing program in the 1960s and are considered eligible to the National Register of Historic Places for their association with a major event in the history of the United States.

DRI reviewed other projects which did not require a survey because they were outside the sample units on Pahute and Rainier Mesas or were in the exclusion area in Yucca Flat.

Task 2. Conduct limited test excavations at selected archaeological sites to fully evaluate their scientific significance and establish suitable plans for data recovery.

First Quarter:

No work was done on this task.

Second Quarter:

The potentially significant archaeological sites recorded during the Second Quarter did not need to be tested because either the land-disturbing activities were moved to avoid the sites or the project did not proceed as expected. As a result, no test excavation activities were required.

Third Quarter:

Five archaeological sites were recorded during the cultural resources surveys. All were isolated surface artifacts and were not associated with subsurface deposits. Therefore, test excavations were not required.

Fourth Quarter:

One archaeological site was recorded during the cultural resources survey. Test excavations were not required because the site was not associated with subsurface deposits.

Task 3. Prepare data recovery plans for those cultural resources which cannot be avoided by proposed ground-disturbing activities.

First Quarter:

No work was done on this task.

Second Quarter:

All land-disturbing projects at the NTS were able to avoid significant archaeological sites by modifying their construction plans. Because the significant sites were preserved, DRI did not prepare cultural resources data recovery plans.

Third Quarter:

The five archaeological sites were recorded completely in the field. Because these sites were considered ineligible for the National Register of Historic Places, it was recommended that the projects proceed as planned and data recovery was not necessary prior to the start of work.

Fourth Quarter:

The one site that was discovered was considered ineligible to the National Register of Historic Places, so it was not necessary to prepare a cultural resources data recovery plan.

Task 4. Conduct data recovery at archaeological sites scheduled for disturbance by DOE activities.

First Quarter:

Inventory and laboratory analysis of collections from U19ba, U19ao, U19an(bp) and U19bg were conducted.

Second Quarter:

No field work was conducted. Laboratory analysis and write up was begun on collections from U19bg, U19ba, U20bc, U19an borrow pit and U19az. In addition, final versions of the reports on U19ay, U19af and U19au were completed to be forwarded to the DOE Technical Information Officer for review.

Third Quarter:

No data recovery projects were begun because no significant archaeological sites were located within the proposed areas of DOE projects. However, work did continue on the laboratory analysis of artifacts from the data recovery project at U19bc. Laboratory analysis was completed on the artifacts from U19an-borrow pit, U19az, U19ba, and U19bg. These data recovery projects were conducted prior to the Programmatic Agreement for Pahute and Rainier Mesas.

Fourth Quarter:

Data recovery projects were not required because no significant archaeological sites were located within the proposed areas of DOE projects. However, work was completed on the laboratory analysis of the artifacts from the data recovery project at U19bc. This project was conducted prior to the Programmatic Agreement for Pahute and Rainier Mesas.

Task 5. Maintain and update cultural resources inventory files and site record maps.

First Quarter:

Ten sites were added to the cultural resources inventory files and site record maps as a result of the preconstruction surveys.

Second Quarter:

Thirty-five sites were added to the cultural resources inventory files from preconstruction projects conducted in this quarter, and those projects continued over from last quarter (Characterization Wells).

Third Quarter:

Five sites were added to the cultural resources inventory files and site record maps in the Reno and Las Vegas laboratories.

Fourth Quarter:

One site was added to the cultural resources inventory files and site record maps in the Reno and Las Vegas laboratories.

Task 6. Maintain archaeological collections using appropriate technology and materials for archival storage.

First Quarter:

No work was done on this task.

Second Quarter:

All artifacts collected from the NTS were processed and stored at DRI in Reno.

Third Quarter:

The archaeological collections continued to be inventoried and maintained at the DRI facilities in Reno. Construction work continued on upgrading the existing archival facilities, with completion expected prior to the end of the fiscal year.

Fourth Quarter:

Although no artifacts were added to the archaeological collections in Reno, the remodeling of the archival facilities continued and is near completion.

Task 7. Assist DOE in the management of cultural resources on the NTS and in the preparation of management objectives and reports.

First Quarter:

No work was done on this task.

Second Quarter:

Management of the cultural resources on the NTS continued on a case-by-case basis with DRI making recommendations for the resources at the Area 25 On-Site Housing, Characterization Wells, and Nevada Bell Projects.

Third Quarter:

DRI prepared the draft of the Programmatic Agreement between DOE, the State Historic Preservation Officer and the Advisory Council on Historic Preservation for the cultural resources of the NTS not covered by the Programmatic Agreements for Pahute and Rainier Mesas and Yucca Mountain. Also, DRI consulted with DOE over management policy regarding the collection of artifacts, the recordation and evaluation of historic structures, and

a site monitoring program. In addition, DRI made recommendations to DOE concerning the five archaeological sites recorded during this quarter. Due to the ineligibility of these five surface finds for the National Register of Historic Places, DRI recommended that construction proceed as planned for the associated projects.

Fourth Quarter:

DRI consulted with DOE concerning the management of the cultural resources on a case-by-case basis. The initiation of the historic structure inventory and assessment work required the development of a new program.

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

First Quarter:

No work was done on this task.

Second Quarter:

The purpose and results of the NTS archaeology program were presented in public lectures sponsored by the local chapters of the Nevada Archaeological Association. Activities included a tour of the Nevada Test Site archaeology for the Archaeo-Nevada society members.

Third Quarter:

In April, five DRI archaeologists who work at the NTS attended the annual meeting of the Society for American Archaeology in New Orleans and presented papers on the archaeology of the NTS. In May, DRI conducted a tour of the prehistoric rock art at the NTS for the American Rock Art Association, which held its annual meeting in Las Vegas.

Fourth Quarter:

DRI conducted a tour of the NTS for the Southwest Museum Directors Association. DRI archaeologists continued their participation in the activities of the Nevada Archaeological Association.

STATUS OF DELIVERABLES

1. SR032691-1: "A Class III Cultural Resources Reconnaissance of the Nevada Bell Fiber Optic Cable Route from Specter Mountain Repeater Station to CP 18 Radio Facilities, Nevada Test Site, Nye County, Nevada."	Completed
2. SR040991-1: "A Class III Cultural Resources Reconnaissance of a Proposed Overhead Transmission	Completed

Line from Substation 5-2 to 5-2-4160-2-1 (Well 2-RNMS), Nevada Test Site, Nye County, Nevada.”

3. SR010991-1: “A Class III Cultural Resources Reconnaissance of the On-Site Housing Area in Area 25, Nevada Test Site, Nye County, Nevada.”	Completed
4. SR041991-1: “A Class III Cultural Resources Survey of Two Study Plots for the Land Surface Cleanup Project.”	Completed
5. SR052291-1: “A Class III Cultural Resources Survey of a 15 by 20 m Square for the Placement of a Closed Circuit TV Van in Area 7 near Yucca Flat.”	Completed
6. “Archaeological Data Recovery at Drill Pad U19ay, Nye County, Nevada,” Technical Report #62.	Completed
7. “Data Recovery at Prehistoric Localities at U19af, Pahute Mesa, Nye County, Nevada,” Technical Report #63.	Completed
8. “Archaeological Data Recovery at Drill Pad U19au, Nye County, Nevada,” Technical Report #55.	Completed
9. “Inter- and Intrasite Analysis of Cultural Materials from U20aw, Nye County, Nevada,” Technical Report #66.	Submitted
10. “Archaeological Data Recovery at Drill Pad U19ax, Nye County, Nevada,” Technical Report #65.	Submitted
11. Draft Programmatic Agreement for all areas of the NTS not covered by the Programmatic Agreements for Pahute and Rainier Mesas and Yucca Mountain.	Submitted
12. SR092091-1: “A Class III Cultural Resources Reconnaissance of Three Primary Well Locations, Three Alternate Well Locations, One Trench Location, and Access Roads Around the RWMS, Area 5, Nevada Test Site, Nye County, Nevada.”	On Schedule
13. “Historic Inventory and Assessment of Impact for the Underground Parking Garage, Area 5, Nevada Test Site, Nye County, Nevada.”	On Schedule
14. “Historic Inventory and Assessment of Impact for the Bren Tower, Area 25, Nevada Test Site, Nye County, Nevada.”	On Schedule
15. “Archaeological Data Recovery Related to the U20at Project, Nye County, Nevada,” Technical Report #64.	On Schedule

16. "The Structure of a Temporary Camp at Drill Hole U19aq on Pahute Mesa, Nye County, Nevada," Technical Report #50.	On Schedule
17. "A Class III Archaeological Survey for Drill Hole U19az, Nye County, Nevada," Technical Report #68.	On Schedule
18. "Archaeological Studies at Drill Hole U20az, Pahute Mesa, Nye County, Nevada," Technical Report #67.	Completed
19. "Archaeological Investigations on the Buckboard Mesa Road Project: A Look at Small Obsidian Nodule Procurement in Upper Forty-Mile Wash, Southern Nye County, Nevada," Technical Report #69.	Completed

PROBLEMS ENCOUNTERED

First and Second Quarters: No specific problems were encountered.

Third Quarter: The BECAMP component of the budget is almost entirely expended. However, some charges were incorrectly placed on this account number and the situation will be rectified as soon as possible.

Fourth Quarter: No specific problems were encountered.

FY 1991 BUDGET SUMMARY NTS ARCHAEOLOGY

PAHUTE AND RAINIER MESAS LONG-RANGE STUDY PLAN

Contact: Lonnie C. Pippin/Colleen M. Beck

PROJECT DESCRIPTION

Pahute and Rainier Mesas (NTS Areas 12, 19, and 20) are used by DOE and the U.S. Department of Defense for nuclear weapons testing. Construction activities which accompany underground nuclear tests have resulted in extensive surface disturbance. Due to the density of cultural resources on Pahute and Rainier Mesas and the frequency of nuclear testing activities that have a potential to adversely affect those cultural resources, DOE has initiated a Programmatic Agreement (PA) between DOE, the Nevada Division of Historic Preservation and Archaeology (NDHPA) and the Advisory Council on Historic Preservation (ACHP) that specifies a long-range (10 year) plan for the mitigation of these potential adverse effects through a comprehensive data recovery program. That program has been outlined in the "Long-Range Study Plan for Negating Potential Adverse Affects to Cultural Resources on Pahute and Rainier Mesas, Nevada Test Site, Nevada," submitted to and approved by DOE in FY 1990. That document specifies the conditions under which data recovery will be undertaken and establishes procedures for consultations and coordination with all affected and/or interested agencies.

The ultimate objective of the long-range 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 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 the 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 NDHPA and ACHP concerning the fulfillment of this data recovery 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 located outside the proposed sample. Field activities will generate records associated with both archaeological site surveys and artifact collections from data recovery projects. Managing the site records involves entering data into the site record database maintained for the NTS and preparing records for and obtaining permanent site numbers from the Nevada State Museum or its delegate. These activities will also generate archaeological collections, which will require inventorying, analysis and archiving of the collected materials, as well as managing the records associated with these collections and analyses. Once the sample of cultural resources has been studied through data recovery programs and the NDHPA and ACHP have concurred with this sample, DOE will have fulfilled its obligations for the mitigation of potential adverse impacts to cultural resources on Pahute and Rainier Mesas. As scheduled in the Long-Range Study

Plan, this program is envisioned as a 10-year study, with the work effort and funding divided evenly over the life of the study. However, this schedule may be modified as necessary through consultation with the NDHPA.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Initiate investigations at drill holes and sample units (Area 20 Survey, U20ak, U20ao, U20at, U19ar, U19ar-P4, U19ad Power Line, U19ay, UNLV 148 and UNLV 152) 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 concerning the implementation of the Long-Range Study Plan for Pahute and Rainier Mesas.
- Task 4. Provide technical assistance to DOE in consulting with the NDHPA and ACHP as described in the plan.
- Task 5. Maintain an interpretive display in Mercury.
- Task 6. Maintain and update cultural resources inventory files and site.
- Task 7. Maintain archaeological collections using appropriate technology and materials for archival storage.

DELIVERABLES

- 1. Letter reports specifying the schedule, work effort, proposed modifications in the conduct and anticipated completion date of field work at individual sample units will be submitted prior to the initiation of those field investigations. Separate letter reports will be submitted following the completion of field investigations at each sample unit.
- 2. Quarterly letter reports describing the status of laboratory analyses and curation.
- 3. Interim technical reports and other supporting documentation (site records, published articles, etc.) will be submitted within 160 to 220 working days following the completion of data recovery efforts at each sample unit, or group of closely-related sample units.
- 4. Information and reports supporting DOE's consultation with the NDHPA and ACHP.
- 5. Exhibits in Mercury.
- 6. Updated maps of areas surveyed and identified cultural resources, as needed.
- 7. Accessioning, labeling and inventory of collected materials from field activities.

PROPOSED BUDGET: \$300,000

LANL \$150,000

LLNL \$150,000

PROGRESS ON TASKS

Task 1. Initiate investigations at drill holes and sample units (Area 20 Survey, U20ak, U20ao, U20at, U19ar, U19ar-P4, U19ad Power Line, U19ay, UNLV 148 and UNLV 152) specified for year 1 in the Long-Range Study Plan.

First Quarter (October – December 1990):

At this time, a final schedule of sample units to be investigated has yet to be determined. While no field work has been conducted, information concerning the locations of the sample units has been provided to the DOE so that it may be incorporated into their planning maps.

Second Quarter (January – March 1991):

A preliminary schedule of sample units was provided to DRI at the end of the quarter. No field work has commenced yet.

Third Quarter (April – June 1991):

A final schedule of sample units was provided to DRI on June 24. The final list for Year 1 of the Long-Range Study Plan retains only three sample units from the original list. The final sample units are U19ad-PL, U19ao, U19an, U19ax, U19aq, UNLV 122, U19at, UNLV 132, UNLV 58, DNA-1, and Rainier Bypass. DRI began the field work at U19ad-PL in April. A survey was conducted and a data recovery program was undertaken which included the excavation of an aboriginal structure. The data recovery was finished in June. Survey and data recovery began in sample unit U19ax in June and are expected to be completed in July. Excavations are in progress at a prehistoric rock shelter with survey and data recovery required in another portion of the sample unit.

Fourth Quarter (July – September 1991):

Investigations were initiated at sample units U19an, U19aq, U19ao, and UNLV 122. Field work was completed at U19ax, U19an, and U19aq. Work will be conducted at sample unit U19ao until the end of October. Except for two aboriginal brush structures at UNLV 122, all the field work at the sites in UNLV 122 was finished. A data recovery plan for the two structures will be prepared in FY 1992 because they need to be excavated. In addition, DRI conducted a survey in Sample Unit DNA-2 in Area 12 at the request of DOE.

Work on Tasks 2 through 7 did not begin until funding was received in the third quarter.

Task 2. Conduct laboratory analyses of data recovered from Task 1 field investigations and curate these data.

Third Quarter:

The artifacts and field samples from sample unit U19ad-PL are being inventoried and catalogued in preparation for analysis.

Fourth Quarter:

The laboratory has completed the artifact inventory, data entry, and labeling of tools from sample units U19ad-PL, U19ax, and U19aq.

Task 3. Prepare interim reports and other supporting documentation concerning the implementation of the Long-Range Study Plan for Pahute and Rainier Mesas.

Third Quarter:

No interim reports were prepared because the field work was begun in this quarter.

Fourth Quarter:

Monthly reports to DOE have detailed the initiation and progress of work at each of the sample units.

Task 4. Provide technical assistance to DOE in consulting with the NDHPA and ACHP as described in the plan.

Third Quarter:

Consultation did not occur because of the late start of the field work.

Fourth Quarter:

This task was not completed in FY 1991. The consultation will occur in early FY 1992.

Task 5. Maintain an interpretive display in Mercury.

Third and Fourth Quarters:

DRI is maintaining the interpretive display in Mercury and is currently designing a new display to be installed during the next fiscal year.

Task 6. Maintain and update cultural resources inventory files and site records.

Third Quarter:

The results of the field work within sample unit U19ad-PL were added to the cultural resources inventory files and site records.

Fourth Quarter:

The sites found during the field work at the sample units are being added to the files.

Task 7. Maintain archaeological collections using appropriate technology and materials for archival storage.

Third Quarter:

The U19ad-PL materials are being maintained at the DRI curation facilities in Reno.

Fourth Quarter:

The materials from all the sample units are in laboratory analysis at DRI in Reno. Upon completion of the analysis, the artifacts will be maintained at the same facility.

STATUS OF DELIVERABLES

A schedule for the initiation and completion of tasks at the specific sample units was established. Monthly reports submitted to DOE detailed the progress on the field work at each sample unit and the laboratory analysis.

PROBLEMS ENCOUNTERED

First and Second Quarters: No specific problems were encountered.

Third Quarter: Field work did not begin as early as expected on U19ad-PL due to late snows on the mesas. Field work in the other units was delayed until receipt of the final list of sample units.

Fourth Quarter: Although field work was conducted at six of the sample units, work was not initiated at five units due to the time constraints and the extensive archaeological materials in the other units.

FY 1991 BUDGET SUMMARY MESA LONG-RANGE STUDY

NTS AMERICAN INDIAN RELIGIOUS FREEDOM ACT COMPLIANCE PROGRAM

Contact: Lonnie C. 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 sites, use and possession of sacred objects, and freedom to worship through ceremonials and traditional rites. In 1987 DOE/YMPO initiated a program to consider Native American concerns in regard to its Nevada Nuclear Waste Storage Investigations (NNWSI) at Yucca Mountain. However, that program was focused only on DOE's activities associated with the Yucca Mountain Project and did not include consideration of other activities on the Nevada Test Site. The NTS AIRFA Compliance Program is designed to assist DOE in expanding its compliance with AIRFA to incorporate weapons testing activities on the Nevada Test Site. 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 around a phased approach that includes 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. In total, the program is expected to encompass approximately three years. The activities for FY 1991, the second year of study, will include only Phase 3 and the initiation of Phase 4.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Finalization of the baseline document and study design: The study design will outline 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. Following receipt of comments from DOE and the NDHPA, the plan will be updated, finalized and implemented.
- Task 2. Initiate consultation: Phase 4 activities during FY 1991 will evolve the initiation of consultation with Native American groups identified in Phase 3. This consultation will be conducted in accordance with the above approved study design and 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 36 CFR Part 800.

DELIVERABLES

1. Draft and final Baseline Document and Study Design (first quarter).
2. Quarterly progress reports on consultation activities.

PROPOSED BUDGET: \$90,000

PROGRESS ON TASKS

Task 1. Finalization of the baseline document and study design.

First Quarter (October – December 1990):

A draft baseline document and study design are completed and all editorial comments on the baseline document from project participants have been addressed by DRI. The study design, however, is still in the editorial process. Subcontracts with the University of Nevada, Reno, and the University of Michigan were not able to be initiated during the quarter. Although both institutions provided editorial comments during this period, ratification for that work has been requested by DOE. It is anticipated that additional work will not be initiated until these subcontracts are approved and in place. Both the baseline document and study design are scheduled to be presented to DOE during the second quarter pending approval of subcontracts.

Second Quarter (January – March 1991):

The baseline document has been completed and will be submitted with the study design in the third quarter.

Third Quarter (April – June 1991):

The baseline document was submitted to DOE for review and comments.

Fourth Quarter (July – September 1991):

The baseline document is still at DOE for review and approval to publish.

Task 2. Initiate consultation.

First Quarter:

The study design, yet unapproved by DOE, outlines a nine-step consultation process including initial tribal council contact, Official Tribal Contact Representative (OTCR) training, tribal leadership orientation, initial cultural expert interviews, additional investigative research, two on-site visits, mail survey, amassing of mitigation recommendations, and tribal review of the report on consultation. At the currently funded level (\$72K), it is anticipated that only the initial tribal council contact, OTCR training and tribal leadership orientation can be conducted during FY 1991.

Second Quarter:

The draft of the study design was revised to incorporate all internal editorial comments and will be delivered for DOE review in the third quarter.

Third Quarter:

The draft of the study design was delivered to DOE for review and comments.

Fourth Quarter:

The initial meetings with the Indian tribal councils began in August. By the end of this quarter, meetings had been conducted with 15 of the 17 tribes.

STATUS OF DELIVERABLES

1. "NTS American Indian Religious Freedom Act Compliance Program: Complying with AIRFA: A Literature Review and Evaluation" (12/31/90). Submitted
2. The report on consultation activities is delayed until the activities are completed in FY 1992.

PROBLEMS ENCOUNTERED

First Quarter: No specific problems were encountered. The Project Description, Tasks and Deliverables, however, were slightly modified to reflect changes in program activities and funding levels.

Second through Fourth Quarters: No specific problems were encountered.

**FY 1991 BUDGET SUMMARY
AIRFA COMPLIANCE**

HISTORY OF NTS NUCLEAR RESEARCH, DEVELOPMENT, AND TESTING

Contact: Lonnie C. Pippin

PROJECT DESCRIPTION

Research, development, and nuclear testing activities on the NTS have produced a number of cultural resources that are unique in nature and reflect events, people, and architectural and technological achievements that are significant in our Nation's history. These resources represent probably one of the most significant cultural events ever to occur in the State of Nevada and our Nation, the development and testing of nuclear weapons. In accordance with 36 CFR Part 800.10 (criteria a-c), districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling and association, and that are associated with events, people, or architectural (artistic) achievements that have made a significant contribution to the broad patterns of our history, are eligible for nomination to the National Register of Historic Places (NRHP). Under the National Historic Preservation Act, it is DOE's responsibility to identify these resources and develop plans for their protection and preservation. The History of Nevada Nuclear Research, Development and Testing project is a newly proposed, multi-phase program focused at assisting DOE in inventorying and interpreting cultural resources associated with the nuclear testing program in Nevada and evaluating these resources for their eligibility to the NRHP.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Identify and procure the assistance of an architectural historic preservation consultant.
- Task 2. Develop a historical and thematic overview of nuclear research, development and testing in Nevada. This task will build on the existing overview developed by the NDHPA in their Comprehensive Preservation Plan.
- Task 3. Develop a draft study plan outlining the proposed scope, survey methodology, and schedule for the identification, inventory, and evaluation of cultural resources associated with nuclear research, development and testing in Nevada.
- Task 4. Prepare a draft Programmatic Agreement concerning the treatment of cultural resources associated with nuclear research, development and testing in Nevada for consultation with the NDHPA and ACHP.

DELIVERABLES

- 1. A letter report and subcontract documentation procuring the assistance of an architectural historic preservation consultant (fourth quarter).
- 2. A historical and thematic overview of nuclear research, development, and testing in Nevada (fourth quarter).

3. A draft study plan outlining the proposed scope, survey methodology, and schedule for the identification, inventory and evaluation of cultural resources associated with nuclear research, development, and testing in Nevada (fourth quarter).
4. A draft Programmatic Agreement concerning the treatment of cultural resources associated with nuclear research, development and testing in Nevada for consultation with the NDHPA and ACHP (fourth quarter).

PROPOSED BUDGET: \$40,000

Funding was not allocated for this project.

NTS CULTURAL RESOURCES MANAGEMENT PLAN

Contact: Lonnie C. Pippin

PROJECT DESCRIPTION

Since 1978, the DOE Nevada Operations Office has been involved in the evaluation and management of cultural resources on the NTS. In these 12 years, DOE has initiated various programs for managing the cultural resources on the lands that it administers, including: 1) a systematic process for scheduling archaeological reconnaissance and other studies prior to ground-disturbing activities; 2) a sample reconnaissance and management plan for Yucca Flat; 3) extensive reconnaissance and testing, a programmatic agreement and research design for the Yucca Mountain region; 4) a long-range study plan and programmatic agreement for Pahute Mesa; 5) a program for complying with provisions of the American Indian Religious Freedom Act for both Yucca Mountain and the rest of the NTS; and 6) the evaluation of the actual history of nuclear research, development and testing. While many of these programs have been in place for years, an integrated plan describing the history, applicability, and interrelationships of these different programs, as well as policies and procedures, has not been developed. It is in DOE's interest that an integrative management plan be developed to provide continuity for the program, and that a concise description of their resource management program be drafted, which they can provide to interested parties. Developing an integrated management plan for the NTS is a newly proposed program which would involve two phases, the development of a draft plan for DOE's review and the production of a final plan incorporating review comments.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Prepare and submit a draft Cultural Resources Management Plan for the NTS to DOE for review.
- Task 2. Respond to review comments on the draft Cultural Resources Management Plan and prepare a final document.

DELIVERABLES

- 1. A draft cultural resources management plan (third quarter).
- 2. The final cultural resources management plan (fourth quarter).

PROPOSED BUDGET: \$30,000

Funding was not allocated for this project.

UPGRADING INVENTORY AND STORAGE OF EXISTING ARCHAEOLOGICAL COLLECTIONS TO NEW ARCHIVAL REQUIREMENTS

Contact: Lonnie C. Pippin/Colleen M. Beck

PROJECT DESCRIPTION

Federal regulations mandate that pre-existing archaeological collections, such as those which have been collected by DRI at the NTS over the last 11 years, be curated as described in 36 CFR Part 79.9. These regulations specify, in general terms: 1) requirements for handling and preserving the collections and records; 2) specifics of the physical plant which holds the collections; and 3) qualifications of individuals charged with the responsibilities of maintaining the collection. This project addresses deficiencies in the first of these three requirements, handling and preserving the collections.

While recording and collection procedures that DRI has used while acquiring this pre-existing collection meet many of the requirements of 36 CFR Part 79.9, there are two major deficiencies. The first is that with the exceptions of some perishable artifacts, materials are not stored in containers of archival quality (i.e., acid free boxes). Second, a systematic inventory and inspection of the materials has not been conducted. This project would conduct such an inventory and inspection of all pre-existing archaeological materials collected and stored at DRI prior to October 1, 1990, and in the process, store them using archival quality materials. Deliverables from this project would be a verified inventory of all archaeological materials recovered from the NTS (excluding material collected as a result of the NNWSI or YMP Projects) consistent with 36 CFR Part 79.11.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Inspect and inventory all artifacts collected by DRI from the NTS from 1978 to October 1, 1990.
- Task 2. Transfer all collections to archival quality storage materials.

DELIVERABLES

- 1. By the end of the fiscal year, provide an inventory of all artifacts collected by DRI from the NTS from 1978 to October 1, 1990.

PROPOSED BUDGET: \$30,000

Funding was not allocated for this project.

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 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: Nate Cooper

PROJECT DESCRIPTION

At the beginning of the eleventh year of this program, the major objective still is to increase the understanding by the residents of the areas surrounding the NTS of the DOE-sponsored activities that occur or have occurred at the NTS. Augmenting and enhancing the collection of airborne radiation data in the long-established EPA offsite monitoring network out of concern for the health and safety of those residents is also a major goal. The overriding consideration of all efforts in this program is the protection of that population from any radiation hazards that could occur as a result of weapons testing activities.

The major task in this program is to improve communication by maximizing the participation of the residents of the offsite area. Local residents have been hired to manage monitoring stations in 19 communities (18 of these stations are under the sponsorship of this program) 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 public meetings directed to carefully targeted audiences in selected locations in

Utah and Nevada, and with more emphasis placed on reaching students in school assemblies or classrooms and service clubs; 3) disseminating information on radiation monitoring and related subjects; 4) developing and maintaining contacts and communication with local citizens and officials; and 5) verifying selected data collected and analyzed by EPA at representative monitoring stations.

Conducting the research required to target specific audiences, including local schools, and organizing presentations tailored to those audiences will be a major activity in the early part of FY 1991. Public meetings are planned for later in the year when research and planning have been completed. Funding for these efforts is included in the proposed budget for FY 1991.

A plan for "Station Manager Emeritus" status has been developed to address the opportunity to replace some of our Station Managers and Alternates who have retired from their regular jobs and are, therefore, not in as good a position to act as program representatives, but still retain them as a trained and valuable resource in their communities. This plan has been presented in another document, and will be selectively implemented during FY 1991. The very nominal cost is identified in the proposed budget.

Additional attention should be given to moving existing monitoring stations to better locations near where they are now situated. Five such relocations have been suggested by Station Managers. Another effort that has the possibility of benefitting both the program and others involved with testing and other scientific endeavors is the addition of meteorological data collection equipment to a few selected monitoring stations, at basically no cost to the program. These two items should be discussed in detail before implementation. No funding is included in the proposed budget for FY 1991 for either of these tasks.

Another area of potential benefit is the opportunity to advise other DOE facilities that may be interested in implementing similar programs as a part of their operation. It is believed that the 10 years of experience gained by DRI staff could contribute significantly, in both efficiency and cost reduction, to such efforts. Funding for work on this concept is not included in the estimative budget for FY 1991.

Invitations to additional teachers to attend the annual summer training sessions are also envisioned, but funding for this effort is also not included in the budget.

TASKS TO BE ACCOMPLISHED IN FY 1991

Task 1. Schedule, coordinate and participate in six public meetings, to be held in:

- a. St. George, Utah (2)
- b. Cedar City, Utah (1)
- c. Beatty, Nevada (1)
- d. Tonopah, Nevada (2)

(Note: Locations and number of meetings are subject to change, pending determination of appropriate target audiences. This task includes the research required to properly identify those audiences.)

- Task 2. Schedule, coordinate and participate in (as appropriate) 10 school presentations or service club luncheons/meetings.
- Task 3. Assist in organizing and presenting two Station Manager training sessions (December 1990 and July/August 1991).
- 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 significant program activities within two weeks of occurrence.
- Task 8. Continue program coordination activities as required.

DELIVERABLES

- 1. Highlights and attendance summary of each public meeting or program presentation (letter report after each event).
- 2. Transcripts of pertinent portions of each Station Manager training session (January and September 1991).
- 3. A report on results of research to identify target audiences for public meetings (draft, February 1991).
- 4. An annual report of Community Monitoring program activities for FY 1991 (draft, December 1991).

PROPOSED BUDGET: \$362,000

PROGRESS ON TASKS

Task 1. Schedule, coordinate and participate in six public meetings.

First Quarter (October - December 1990):

No public meetings were held or scheduled. Initial contacts have been made in the research effort to identify target audiences. Public meetings are anticipated for scheduling early in the third quarter.

Second Quarter (January - March 1991):

A public meeting was held in Beatty, Nevada, on the evening of March 19, 1991. The targeted audience was comprised of local volunteer firemen, emergency medical technicians and health care professionals from that area. Nick Aquilina and Robert Taft made a presentation on "Nevada Test Site - Past, Present and Future" and Asa Robinson spoke on the Yucca Mountain Project. Twenty-nine local residents warmly received this information, with excellent questions and sincere interest in the material that was presented, which was chosen by the audience.

Research is being done to identify other audiences in Beatty and Tonopah, Nevada, and in St. George and Cedar City, Utah, for future meetings. Time and staff limitations have restricted progress on this task.

Third Quarter (April - June 1991)

The redirection of the outreach efforts toward schools and the goal of identifying target audiences has shifted this task to the research part to determine the existence and interests of people to whom our message should be communicated. This is being accomplished as part of the quarterly TLD trips, with emphasis on Tonopah, St. George and Cedar City.

The outreach efforts for this period are detailed in the report for Task 2.

Fourth Quarter (July - September 1991):

One "public" meeting was held. On September 20th, a presentation was given at the American Legion annual banquet in Delta, Utah, by Charles McWilliams, DOE/TOD, on the "U.S. and Russia Joint Verification Testing" to an audience of 114 adults.

The research and identification of target audiences has continued, but is limited to the quarterly TLD trips.

Most of the outreach efforts for this period are detailed in the report for Task 2.

Task 2. Schedule, coordinate and participate in (as appropriate) 10 school presentations or service club luncheons/meetings.

First Quarter:

A workshop, in cooperation with the Clark County School District, was held on October 25, 1990. Twenty-six junior and senior high school science teachers attended the 3½-hour

session, and heard four presentations of the type offered to teachers for their classes. The workshop and subsequent information dissemination have led to presenters being requested to speak to 19 classes at four junior and senior high schools in the area during January and February, covering 10 of the 16 subjects being offered. Arrangements have been completed for 15 of those presentations.

Nothing has been done in the service club area, but this is on the schedule to begin in the second quarter.

Second Quarter:

Nine presentations were made to 424 junior and senior high school students representing 18 classes in five local schools. Teachers in the following schools selected the topics and the presenters:

January 25 – Burkholder Junior High School, Henderson
7th & 8th grades – 4 classes – 100 students

January 25 – William Orr Junior High School, Las Vegas
9th grade – 1 class – 26 students

January 30 – Moapa Valley High School, Overton
12th grade – 4 classes – 78 students

February 1 – William Orr Junior High School, Las Vegas
9th grade – 1 class – 25 students

February 1 – William Orr Junior High School, Las Vegas
7th grade – 1 class – 19 students

February 15 – Washington Junior High School, Las Vegas
7th grade – 2 classes – 25 students

February 15 – Washington Junior High School, Las Vegas
8th grade – 2 classes – 28 students

February 20 – Moapa Valley High School, Overton
12th grade – 4 classes – 78 students

March 19 – Beatty High School, Beatty
10th, 11th, 12th grades – 2 classes – 45 students

Additional school presentations and at least one tour of the NTS are planned for the third quarter.

This task is believed to have been highly successful.

Third Quarter:

Two presentations were made to 131 students in five classes at two area schools:

April 29 – Kenny Guinn Jr. High School, Las Vegas
8th grade (accelerated) – 2 classes – 60 students

May 28 – Indian Springs Jr. & Sr. High Schools
6th, 8th, 11th and 12th grades – 3 classes – 71 students

On April 10, a bus tour of the NTS was given to 51 students (most of the senior class) plus four teachers from Moapa Valley High School. This was handled by DOE with assistance from DRI.

On April 25, a person from the DOE Personnel Office and a person from REEC participated in the annual Beatty High School Career Day. Approximately 150 students from the 7th through 12th grades were involved in the well-received effort.

A presentation to the White Pine Chamber of Commerce has been arranged for August 20 in Ely. Information on speaker availability has been sent to nine other service clubs in the area, with no responses received at this time.

Fourth Quarter:

On August 20, a presentation was given at the White Pine Chamber of Commerce luncheon meeting in Ely, Nevada. The topics were "Downwind Radiation Effects on the Population of Ely" by David Wheeler, DOE/NV, and "Offsite Radiation Monitoring" by Daryl Thome', EPA/EMSL. There were 27 adults present.

Two presentations were made to high school students:

September 16 – Indian Springs High School – 3 classes – 45 students. The topic was "History of Nuclear Weapons Testing" presented by Bob Taft.

September 19 – Indian Springs High School – 3 classes – 45 students. Response was given by Bob Taft to questions generated by September 16th presentation.

Presentations have been arranged for October 3, 1991, and April 14, 1992, at the Caliente and Panaca elementary, junior high, and senior high schools.

The Moapa Valley Rotary Club has requested six presentations between November 1991 and April 1992.

Task 3. Assist in organizing and presenting two Station Manager training sessions (December 1990 and July/August 1991).

First Quarter:

The winter training session was held at the Palace Station Hotel in Las Vegas, December 27 and 28. Twenty-two Station Managers and Alternates attended, with the

highlight being the half-day tour of the new EG&G facility at Nellis Air Force Base. It was a successful effort, as judged by the participants. Susan Moore, of the Nevada Office of Emergency Preparedness, was one of the distinguished attendees at the session.

Discussions and decisions will be made on the time and place for the summer training early in the second quarter.

Second Quarter:

The summer training session will be held at the Brian Head Royale Hotel, Brian Head, Utah, August 5-9, 1991. Preliminary arrangements have been made at the hotel, and a tentative agenda has been prepared by Dr. Gary Sandquist for the meeting.

Third Quarter:

Details of arrangements for the summer training session are on schedule. The agenda is almost complete, hotel and condominium arrangements are set, and the list of Managers and Alternates who will attend indicates that, at least thus far, only two cannot be there.

Fourth Quarter:

The five-day Summer Training Session was held at the Brian Head Royale Hotel in Brian Head, Utah, from August 5 through 9, 1991. Twenty-eight of the Station Managers and Alternates attended, with seven unable to attend. The training agenda was well received, with significant contributions made by EPA and speakers from Hanford, Rocky Flats, and INEL. Dr. Sandquist, assisted by Dr. Slaughter, provided a well organized session. Mary Lehman, of the Nevada Desert Experience, spoke on "Opposition to Continued Nuclear Testing" and Bruce Church responded on the "U.S. Nuclear Testing Program." Based on Station Manager evaluations, general comments, and personal observation, this may have been ^{the} our most successful session. *Speed out*

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:

Elected officials, community leaders and other citizens in the offsite areas were contacted as a part of the routine visits to 18 of the 19 stations in the Community Monitoring network. Telephone conversations and correspondence with some of these people and others occurred as deemed appropriate.

Second Quarter:

On a limited basis, contacts were made with community leaders, elected officials and other citizens in the offsite area as a part of the quarterly TLD run. Personnel and time limitations have precluded executing this task as it should be done.

Third Quarter:

Personal visits and telephone conversations were held with officials and citizens in the offsite area as a part of the routine TLD runs, visits to the stations, and the hiring effort. These contacts are deemed valuable, and will be expanded as time allows.

Fourth Quarter:

Personal visits and telephone conversations were held with officials and citizens in the offsite area as a part of the routine trips on the TLD run, visits to the stations, and the hiring efforts.

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

First Quarter:

The six sets of TLDs that were installed early in July 1990 were picked up and passed on to REEC Co for analysis. This is the last batch to be done at REEC Co. Five sets of TLDs, obtained from the Radiation Measurements Facility at Arizona State University (ASU), were installed at other locations during the early October trip.

Second Quarter:

Six sets of TLDs that were installed at randomly selected stations for the second quarter were collected and shipped to ASU for analysis. This is one more set than was indicated in the last quarter report. An additional six sets were installed for the third quarter monitoring effort.

Third Quarter:

TLDs were collected from the six stations where they were installed last quarter, and six new sets were put out at other stations. The relationship with and service from ASU seems to be working smoothly and satisfactorily.

Fourth Quarter:

TLDs were collected from the six stations where they were installed last quarter, and six new sets were put out at other stations. There is concern that ASU will not be able to provide the service as in the past. This will be negotiated when their reorganization is completed.

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

First Quarter:

Dr. Hiram Hunt was made Alternate Manager in Las Vegas and was replaced as Manager by Roy Reeder, a science teacher at Valley High School, who was hired in early

December. Recommendations have been requested from St. George officials for the vacant Alternate Manager position, and a trip to Ely for recruiting for both positions there is scheduled during the second quarter. The "Station Manager Emeritus" program was discussed and finalized and, pending budget confirmation, will be implemented as soon as possible.

Second Quarter:

An award ceremony was held in Mr. Aquilina's office in early January to commemorate the retirement of Dr. Hiram and Lois Hunt.

Discussions were held with Dr. David McLaren, Principal of White Pine High School, regarding replacements for the Co-Managers at Ely, resulting in four people being suggested for those positions. Two of those people will be hired in the third quarter. The present Ely Co-Managers will leave the program at the end of April.

Alternate Managers are being sought for the vacant positions in St. George and Las Vegas, with plans to hire them in time to attend the summer training session in August.

Third Quarter:

Station Managers and Alternates, who have in the past been considered consultants to DRI, were signed on as part-time DRI employees effective April 1. This action is a result of IRS regulations, and the transition is complete with very little problem involved.

The Co-Managers at Ely left the program at the end of May, and Rebecca Murdock was hired effective June 1 as Station Manager. Ms. Murdock teaches science at both junior and senior high school levels. Three other teachers were interviewed for the Alternate slot, but none has been hired to date.

The vacant Alternate position in St. George has been filled by Kelly Bringhurst, who teaches science and geology at Dixie College. This appointment was effective June 15.

Every effort is being made to hire two more Alternates in time for them to attend the training session in August.

Fourth Quarter:

The vacant Alternate position in Ely has been filled by Gloria Mullen effective July 15. Ms. Mullen teaches science at the White Pine Middle School.

The vacant Alternate position in Las Vegas was filled by Don Curry, a Valley High School science teacher, effective August 1.

Donald Newman, a science teacher at the Cedar City High School, was hired effective August 1 as the Cedar City Alternate. Glade Sorensen was promoted to Station Manager,

effective September 1. Melvin Baldwin retired as Station Manager in September and was appointed to Emeritus status.

All of the vacant positions are now filled. The new Station Managers and Alternates all attended the summer training session in August.

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

First Quarter:

A summary of the Clark County School District workshop was prepared and distributed. Preliminary scheduling of school presentations was drafted and forwarded to DOE program personnel. A draft of the FY 1990 Annual Report is nearing completion and will be out for review late in the second quarter.

Second Quarter:

A summary report of school presentations at the five schools visited was prepared and distributed. The FY 1990 Annual Report is still in the revising/editing mode, and will be forwarded for review in the third quarter.

Third Quarter:

Updated reports of the outreach presentations at the schools have been prepared and submitted to program personnel. Final data reduction and comparison for the FY 1990 Annual Report are being prepared, and the report will be reviewed and printed for distribution at the training session.

Fourth Quarter:

Updated reports of the outreach presentations at the schools have been prepared and submitted to program personnel. The FY 1990 Annual Report was approved for publication on September 27.

Task 8. Continue program coordination activities as required.

First Quarter:

Several meetings occurred involving DOE, EPA and DRI staff to discuss the program in general, with particular emphasis on the proposed modifications to the outreach efforts. The videos made of the Vincent Covello presentations were edited and re-edited by DOE and DRI staff with the goal being a shortened (about one hour) version that can be beneficially used by all involved in the program. That version will be ready for use during the second quarter. The periodic news clipping and article copying service was continued, and Station Managers/Alternates were notified of all announced nuclear tests.

The DRI contribution to the required move of the Indian Springs monitoring station was completed in December. In addition to three visits to the location, DRI staff identified and paid contractors for the pad installation and the electric service.

Second Quarter:

The Covello video was finalized, and several copies were made for distribution, particularly to those who make presentations at our public outreach functions. Station Managers and Alternates were notified of all announced nuclear tests, and the periodic news clipping service was continued. Meetings and discussions occurred as necessary with the DOE program manager and others involved in the effort.

Third Quarter:

Meetings were held as required with the DOE program manager, and we met with a representative from the Savannah River operation who is interested in setting up a similar program there. Dialog continues with EPA staff concerning the many things that come up regarding routine station operation. The periodic news clipping service was continued, which involves mailings to approximately 50 people, including a representative of Governor Miller.

Fourth Quarter:

Meetings were held as required with the DOE program manager and other program participants. There is continuing dialog with EPA staff concerning the many things that come up regarding routine station operation. Discussions were held with DOE and contractor representatives from Hanford, Rocky Flats, and INEL regarding our experiences with the program. The periodic news clipping service was continued, and nuclear test notifications were made to all locations.

STATUS OF DELIVERABLES

1. Annual report for FY 1990 (12/31/90)	Completed
2. Transcript of 1990 December training session (1/31/91)	Completed
3. Transcript of August 1991 training session (9/30/91) A draft is in preparation.	Delayed
4. Draft report on audience identification research (2/28/91) This report has been postponed indefinitely.	Delayed
5. Letter reports on school presentations and public meetings have been submitted regularly.	

PROBLEMS ENCOUNTERED

First Quarter: Due to the staff reduction on the program at DRI and the budget uncertainties that exist, some of the tasks have not been given the attention necessary to keep the program fully functional in all the desired areas.

Second Quarter: Staff shortages at DRI have still somewhat curtailed the full execution of all desired tasks, particularly the completion of the Annual Report. This will be remedied in the third quarter.

Third Quarter: Through shifts in assignments and responsibilities, the DRI staff problems have been addressed, and it is believed that activities will be accomplished in a more timely fashion in the future. The needed budget augmentation has not yet shown on a contract modification.

Fourth Quarter: No specific problems were encountered.

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 alleviate 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); the Safe Drinking Water Act (SDWA); and the Underground Injection Control Program. 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 composed of projects that are directed at providing DOE with the support necessary to comply with the various environmental protection policies. The NTS Groundwater Characterization Program (GCP) will be focused on anticipating problems, and the Tunnel Ponds Assessment, Generic Environmental Assessment for the NTS Monitoring and Characterization Program, and Offsite Hydrologic Evaluation projects will focus on assessing and correcting existing problems.

NTS GROUNDWATER CHARACTERIZATION PROGRAM

Contact: Charles Russell

PROJECT DESCRIPTION

DOE/Nevada Operations Office, in compliance with CERCLA, SARA, and DOE Order 5400.1, is in the process of establishing and implementing a GCP to support the Remedial Investigation and Feasibility Studies (RI/FS) required by CERCLA. Specifically, the GCP will generate documentable, high quality hydrologic and chemical data that will be needed to:

- a. delineate the boundaries, rates, directions and depths of regional and local groundwater flow systems on the NTS;
- b. determine the extent of groundwater contamination from underground nuclear testing and delineate possible transport pathways and rates of transport;
- c. identify and evaluate possible remedial strategies for groundwater contamination created by underground nuclear detonations;
- d. conduct environmental and human health risk assessments that will be used in the evaluation and implementation of the appropriate remedial strategy; and

- e. guide the implementation of the EPA-approved remedial strategy for groundwater contamination.

The data to be generated by the GCP and used by the RI/FS consist of: 1) subsurface stratigraphic, lithologic and structural data supplied by geologic cores, cuttings, and downhole geophysics; 2) potentiometric head data supplied by depth-discrete pressure transducers; 3) permeability, transmissivity and estimates of storativity derived from hydraulic pump tests, tracer tests and, where possible, geophysical logs; and 4) groundwater flow paths and contaminant transit times derived from aqueous geochemistry, trace metals, stable and radioactive isotopes, and the previously mentioned potentiometric and hydraulic parameters. All of the above data will be correlated to source-term data determined from LLNL, LANL, and Sandia (if possible) and plume data derived from specially designed characterization wells. All data will be used to develop conceptual hydrologic models for Yucca Flat, Frenchman Flat, Pahute Mesa and Rainier Mesa. The conceptual models will be used to develop a numerical flow model and a transport model for the NTS. Both models will provide the required support to all phases of the RI/FS process, including site characterization, baseline risk assessment, and the development, evaluation and implementation of remedial strategies.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Work with DOE to finalize and implement the GCP Quality Assurance and Quality Control Program. Assist DOE in the acquisition of all field equipment and personnel necessary to achieve program objectives.
- Task 2. Advise NTSO and NTS contractors on what materials and techniques should be used to construct the boreholes, and on what personnel would be required to achieve hydrologic objectives.
- Task 3. Supply each drilling operation with drilling engineers and hydrogeologists and conduct or assist hydrologic and chemical tests as required by the program.
- Task 4. Establish and maintain a data base of all data collected by the program and accepted by DOE/Quality Assurance Division.
- Task 5. Publish well reports containing all data derived from individual boreholes and reports required to answer program objectives as data become available.
- Task 6. Refine program objectives in conjunction with other program participants. Initiate development of conceptual model of the groundwater flow systems of Yucca Flat, Frenchman Flat, Rainier Mesa, and Pahute Mesa.

DELIVERABLES

1. GCP quality assurance program (second quarter).
2. Well completion reports, as required.
3. Reports that will present hydrologic data to satisfy program objectives and to supply information necessary to develop a conceptual NTS groundwater flow model, as required.
4. Refined program objectives (fourth quarter).
5. Drilling plans for FY 1992 characterization wells (third quarter).

PROPOSED BUDGET: \$1,590,000

PROGRESS ON TASKS

Task 1. Work with DOE to finalize and implement the GCP Quality Assurance and Quality Control Program. Assist DOE in the acquisition of all field equipment and personnel necessary to achieve program objectives.

First Quarter (October – December 1990):

The DRI Quality Assurance Plan and Sampling Analysis Plans are in draft form. Standard Operating Procedures are being formalized. Review drafts of all documents will be sent to DOE during the second quarter. Logistical support for this project is proceeding with DRI providing technical support to Raytheon Services of Nevada (RSN) and REEC Co for field equipment acquisition. Current levels of personnel within DRI are adequate to cover project commitments.

Second Quarter (January – March 1991):

Several documents related to quality assurance and control were compiled for the Groundwater Characterization Project: the Sample and Analysis Plan, Quality Assurance Plan, Data Management Plan, Standard Operating Procedures, and Configuration Management Plan. They will be submitted to DOE during the third quarter. The Environmental Assessment, the NTS Archaeology Programmatic Agreement and the RI/FS Scoping Plan were completed and submitted to DOE.

Development of a geophysical logging suite for the GCP, a hydraulic test program, and a geochemical sample suite continued. Assistance was given to RSN in evaluating a low pH annulus sealant and in setting up tests of the sliding sleeves.

Third Quarter (April – June 1991):

The Quality Assurance Plan (QAP) was submitted to DOE for review. Some opinions voiced within DOE seem to indicate that an EPA-style quality assurance document is unnecessary and that a Quality Implementation Plan and supporting procedures are required instead. An official decision from DOE is necessary to resolve the format question of the QAP before it can be finalized. Drafts of the Sample and Analysis Plan, Data Management Plan, Standard Operating Procedures, and Configuration Management Plan are awaiting resolution of questions regarding the format of the QAP before submission to DOE. Regardless of form, all required plans and procedures exist in written format to conduct and document GCP drilling. DRI assisted the GCP Working Group in developing a set of 16 wells to be drilled by the GCP over the next two years.

DRI continued to advise DOE and its subcontractors on various aspects of well drilling, siting, development, testing, completion, and sampling.

Fourth Quarter (July – September 1991):

The Quality Assurance Plan, Sample and Analysis Plan, Data Management Plan, Standard Operating Procedures, and Configuration Management Plan are in draft form and

have been submitted to DOE for review. Their status will remain the same until questions regarding the format and final disposition of the documents are determined.

Task 2. Advise NTSO and NTS contractors on materials and techniques used to construct the boreholes and personnel required to achieve hydrologic objectives.

First through Fourth Quarters:

DRI has been deeply involved in all aspects of well design. This support will continue for the duration of the project.

Task 3. Supply each drilling operation with drilling engineers and hydrogeologists and conduct or assist hydrologic and chemical tests as required by the program.

First and Second Quarters:

Progress will not be made on this task until drilling begins in the third quarter. Personnel to conduct and analyze chemical sampling and hydrologic tests are in place. Procedures to acquire geochemical samples and conduct hydraulic tests are currently being developed.

Third Quarter:

Progress will not be made on this task until drilling begins in the fourth quarter.

Fourth Quarter:

Drilling of the first GCP well began on July 17. Drilling engineers, geochemists, and hydrogeologists were available and at the rig as required to drill and sample this well.

Task 4. Establish and maintain a data base of all data collected by the program and accepted by DOE/Quality Assurance Division.

First Quarter:

It was determined that two data bases will be needed to contain all data collected by the project. One data base is the INFO data base that is part of the project's Geographic Information System (GIS). This data base is currently under development. The second data base is being constructed on DRI's Sun File-Server using the Unify Database. This data base will be completed during the second quarter.

Second Quarter:

The construction of two data bases was started last quarter. The INFO data base is still under development, while the second, using the Unity Database, is nearly complete; standard operating procedures are being written for data acquisition, evaluation, storage and retrieval.

Third Quarter:

The INFO data base is still under development. The UNIFY data base is essentially complete, and standard operating procedures are currently under development for data acquisition, evaluation, storage, and retrieval.

Fourth Quarter:

The two data bases to be used by the program are complete and ready to receive data. Standard operating procedures that guide data entry, storage, and retrieval are in preparation.

Task 5. Publish well reports containing all data derived from individual boreholes and reports required to answer program objectives as data become available.

No progress was made on this task in FY 1991.

Task 6. Refine program objectives in conjunction with other program participants. Initiate development of conceptual model of the groundwater flow systems of Yucca Flat, Frenchman Flat, Rainier Mesa, and Pahute Mesa.

First and Second Quarters:

Program objectives are in the process of being evaluated and prioritized. Input from other project participants has not been received, but is expected to start in the third quarter. Development of the conceptual models of the groundwater-flow system will not be attempted until new data become available in the third quarter.

Third Quarter:

Program objectives have been defined by DOE and project participants, and are currently being written into the GCP Work Plan. Sixteen drill sites have been chosen and prioritized by the GCP Working Group based on these objectives.

The DOE has tasked the USGS Water Resources Division to update the conceptual model of the groundwater flow system of the NTS. This task will not be further refined by DRI until information from the GCP wells becomes available. To facilitate this objective, the GCP Working Group has begun generating pre-drilling reports for each area. These reports compile existing hydrogeologic information into one report to assist drilling and testing the boreholes and provide a framework within which to update the hydrogeologic flow model as data from the GCP wells become available.

Fourth Quarter:

The draft GCP work plan is in internal review. The conceptual model being formulated by the USGS is still being completed. DRI will review the model upon its completion.

STATUS OF DELIVERABLES

1. Quality assurance program (3/31/91)	Submitted
2. Drilling plans for FY 1992 (6/30/91)	Delayed

PROBLEMS ENCOUNTERED

First, Second, and Third Quarters: No specific problems were encountered.

Fourth Quarter: Significant problems were encountered during the drilling of the first GCP well. Designs for the drill string proved inadequate to meet performance specifications. Drilling with dual-tube reverse-rotary was discontinued owing to the inability of the drill string to remove cuttings. Drilling was continued with a tri-cone reverse circulation. The estimated drilling time of one month actually took three months.

Poor core recovery, equipment failures, drilling fluid loss, and the conversion to mud as a drilling fluid all adversely affected the quality of the first borehole. DRI recommends a thorough redesign of the drill string to meet program needs.

TUNNEL PONDS ASSESSMENT PROJECT

Contact: 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 outside the tunnels. There, 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, T, and E tunnel complexes will be monitored on a continuous basis for flow rates and various chemical and physical properties. Fluid samples will be collected manually. 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 well for 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 additional water samples, if desired. 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.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Install effluent monitoring systems at U12n, U12e, and U12t tunnels, and collect samples and data from these installations.
- Task 2. Coordinate with REECo and DNA to design a sample grid for each of the three tunnel complex muck piles.

DELIVERABLES

- 1. A report detailing the results of the first phase of effluent monitoring (fourth quarter).
- 2. A report detailing potential grid patterns for sampling muck piles (fourth quarter).

PROPOSED BUDGET: \$125,000

PROGRESS ON TASKS

Task 1. Install effluent monitoring systems at U12n, U12e, and U12t tunnels, and collect samples and data from these installations.

First Quarter (October – December 1990):

DNA and REEC Co completed the tunnel effluent monitoring stations at U12e, U12n, and U12t tunnels in December. DRI will install instruments at these sites during January. Collection of samples and data is expected to begin upon completion of site instrumentation.

Second Quarter (January – March 1991):

The sample stations at U12e, U12n and U12t tunnels were fully instrumented and calibrated. Baseline monitoring of pH, electrical conductivity, discharge, temperature and turbidity began to debug the systems. Characterization monitoring and environmental sampling will be initiated during the third quarter.

Third Quarter (April – June 1991):

Baseline monitoring continued to establish parameters required for programming automated samplers and indicating periods when additional sampling may be warranted. Environmental sampling was initiated. The samples were analyzed for volatile organics, acid and base/neutral semivolatile organics, PCBs, metals, and anions.

Fourth Quarter (July – September 1991):

Baseline monitoring of pH, electrical conductivity, discharge, temperature, and turbidity continued to establish baseline conditions. Environmental sampling also continued.

Task 2. Coordinate with REEC Co and DNA to design a sample grid for each of the three tunnel complex muck piles.

First Quarter:

DRI is waiting for information from DNA that specifies periods when mine-back operations occurred at each of the tunnel muck piles. Mine-backs conducted during the 1960s and 1970s deposited low-level radioactive contamination into the muck piles. Once this information has been received, maps of the muck piles can be drafted that show zones of potential contamination. These maps will be used as the base for developing sample grids.

Second Quarter:

A draft report recommending a sampling plan for U12n tunnel muck pile was compiled. The report is in internal review and should be submitted to DOE during the third quarter. Reports for U12e and U12t tunnels are pending the release of information from DNA.

Third Quarter:

The draft sampling plan for U12n tunnel muck pile was informally released to DNA for comment. Information on the muck piles at U12g, U12e, U12t, and U12p has been received from DNA. Work is on hold until DNA comments on the U12n muck pile report are received.

Fourth Quarter:

Comments on the draft sampling plan for U12n tunnel muck pile have not been received. Comments from Dave Bedsun of DNA to Chuck Russell of DRI indicated that DNA is interested in an alternative method using a subcontractor to develop the sampling grid for the muck piles. If this is true, the scope of work for the project will need to be changed.

STATUS OF DELIVERABLES

1. Report on first phase of monitoring (9/30/91)	Delayed
2. Report on muck pile sampling (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

First, Second and Third Quarters: No specific problems were encountered.

Fourth Quarter: If DNA has decided to use an outside contractor to plan the tunnel muck pile sampling, then DNA must officially notify DOE to alter the scope of the project.

FY 1991 BUDGET SUMMARY TUNNEL PONDS

ENVIRONMENTAL ASSESSMENT FOR THE NTS GROUNDWATER MONITORING AND CHARACTERIZATION PROGRAM

Contact: Gilbert F. Cochran

PROJECT DESCRIPTION

This environmental assessment (EA) will evaluate the alternatives and associated impacts related to construction of monitoring wells for the DOE Hydrologic Monitoring and Characterization Program on the NTS. The intent of the EA is to evaluate the impacts associated with construction of all future wells on the NTS by examining the specific impacts associated with four representative wells.

Of the 12 currently proposed well sites, four representative sites will be selected for evaluation. Selection of the representative sites will be based on different physiographic, biogeographic, and geomorphic characteristics representative of all proposed and potential well construction sites. The information generated during the assessment of the representative well sites will be used to draw generalized conclusions about the effects of well construction at future sites exhibiting similar characteristics.

The EA will be organized in a standard format and will address the proposed actions and alternatives, affected environment, environmental consequences, and suggested mitigation measures. Important issues of concern include the effects of construction on the endangered desert tortoise as well as sensitive plant populations and habitat. Another issue of concern that will be addressed is the occupational risk associated with drilling, including the possibility of encountering radioactively contaminated fluids.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Assess the alternatives and associated impacts related to the construction of monitoring wells.
- Task 2. Prepare and submit draft EA to DOE/NV for review.
- Task 3. Respond to review comments and prepare final EA.
- Task 4. Respond to DOE/NV assessment and review requests as appropriate.

DELIVERABLES

- 1. A draft final EA, as requested.
- 2. A final EA, as requested.

PROPOSED BUDGET: \$36,000

PROGRESS ON TASKS

Task 1. Assess the alternatives and associated impacts related to the construction of monitoring wells.

First Quarter (October – December 1990):

Four of the 12 identified drill sites were selected as the basis for evaluating the environmental consequence of the 90-well program. Major potential areas of consequence were focused upon sensitive species, cultural resources, air quality, and hydrology. The major effect identified is the disruption of approximately 30 hectares for drill pads and approximately 580 km of roadway (6 m wide).

Alternatives to the proposed activities are quite limited in their ability to produce the needed information. Fewer wells could be drilled to the scale of effects, but with a comparable loss of needed information. Surface geophysical techniques cannot provide the information.

This task is complete.

Task 2. Prepare and submit draft EA to DOE/NV for review.

First Quarter:

A review draft of the EA was prepared and submitted to DOE/NV for comment. Reviewer comments were received in late December 1990.

This task is complete.

Task 3. Respond to review comments and prepare final EA.

First Quarter:

Response to the review comments was initiated in December.

Second Quarter (January – March 1991):

A revised draft was prepared and informally submitted by DOE/NV to DOE/HQ. HQ review comments are expected in April.

Third Quarter (April – June 1991):

The revised draft is still in review at DOE/HQ. No further progress can be made until comments are received.

Fourth Quarter (July – September 1991):

Efforts focused on responding to comments made both by DOE/HQ in Washington and by State of Nevada agencies. Following the DOE/HQ review, the EA was revised and copies

sent to the Nevada Clearing House for comments. Comment letters were received from only five state agencies: State Clearing House, Department of Wildlife, Division of Environmental Protection, Division of Historic Preservation and Archaeology, and Division of Water Resources. Draft responses to comments were prepared and submitted to DOE/NV for consideration in mid-September.

Task 4. Respond to DOE/NV assessment and review requests as appropriate.

No further requests have been received.

STATUS OF DELIVERABLES

1. Environmental assessment	Submitted

PROBLEMS ENCOUNTERED

No specific problems were encountered.

Budget: All expenditures have been charged to NTS Groundwater Characterization Project. No funding was allocated by DOE for this project.

OFFSITE HYDROLOGIC EVALUATION PROJECT

Contact: Jenny Chapman

PROJECT DESCRIPTION

In FY 1990, a report was prepared evaluating the groundwater monitoring programs at the eight underground nuclear test sites distant from the NTS. Deficiencies were found in all eight groundwater monitoring programs and recommendations for improvements were presented. Reportedly, remediation feasibility studies are scheduled to begin this year at Tatum Dome and the Gnome Site under the direction of other organizations. DRI anticipates providing scientific support for work at these sites, potentially including review of pertinent documents and plans, aid in selecting well locations, and some analysis of test results. The time budgeted for such activities assumes a supportive function for DRI in these site investigations. Despite the relatively small number of man-hours devoted, it is believed that DRI can make significant contributions to understanding the groundwater transport of radionuclides at Gnome and Tatum Dome due to DRI's background with the Offsite Hydrology Project. Budget modification will be necessary if a larger role for DRI is desired in work at these sites.

Feasibility studies of most of the other sites will require more planning to optimize results from expensive drilling activities. In particular, future work at Shoal, Faultless, and Amchitka would benefit from preparatory study (the gas-stimulation test sites are not recommended for additional work at this time, due to their low-risk situations). For FY 1991, work is proposed at the Shoal and Faultless sites in Nevada.

Shoal: Large fundamental uncertainties remain about the groundwater flow system at Shoal. The detonation was in a fractured granite and much of the uncertainty stems from extrapolating from a few data points in a highly anisotropic system. This has left even the most basic flow directions undetermined. In particular, the position of the groundwater divide, is unknown. The stable isotopic ratios of hydrogen and oxygen are very good tracers of a water's history and can be used to determine source areas for groundwater. Though isotopic studies cannot replace hydrologic data, the sampling and analysis are straightforward and inexpensive relative to drilling costs. It is planned that during FY 1991 all existing wells and springs in the Shoal area will be sampled for stable isotopic analysis and gross chemical parameters. By determining the isotopic and chemical signature of groundwater in the Sand Springs Range (from springs issuing from the granite) and defining the character of groundwater in the adjacent valleys, a determination of likely flow direction may be possible. This information can then be used to direct remedial investigation/feasibility study (RI/FS) activities in the more likely downgradient flow direction.

Faultless: Hydrologic issues at Faultless relate to the interaction of the cavity with the regional hydrologic system and the magnitude and direction of vertical flow. The water infilling behavior of the Faultless chimney was anomalous, with the development of a perched

water table in the cavity. Once the chimney began to fill above this perched layer, early estimates of great lengths of time to pre-shot conditions were revised and a new estimate was calculated that predicted that the pre-event water level would be reached between 1993 and 2018. Once that level is reached, the possibility of lateral transport of contaminants is greatly increased. Unfortunately, no monitoring of the Faultless chimney has been performed since 1983. There is interest within several organizations for a check on the status of the Faultless chimney. The water level in re-entry hole UC-1-P-2SR should be measured, temperature logging should be performed, and samples collected for radiologic analysis by LLNL. Water level measurements and sampling may also be performed in wells HTH-1 and HTH-2, located within a mile of the event. The budget will allow DRI personnel to participate in planning and carrying out the proposed field work, as well as provide gross chemical and isotopic analysis of any nonradiologic samples collected. Support for the sampling vehicle and radiologic analyses, as well as personnel time from other organizations, is not included.

Due to perceived funding constraints, no other major pieces of work are proposed for FY 1991. However, DRI has the interest and ability to contribute to initial scientific studies at the other offsite areas, or expanded investigations at the sites discussed above.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Provide scientific support as required for offsite activities under the direction of other organizations, particularly those at Tatum Dome and Gnome.
- Task 2. Plan and implement well and spring sampling in the vicinity of the Shoal site and interpret the results in the context of remedial investigation planning.
- Task 3. Participate in planning and implementing a field investigation of the status of Faultless chimney infilling.

DELIVERABLES

- 1. A letter report interpreting the results of field sampling at Shoal and Faultless (fourth quarter).
- 2. Preparation of reviews and analyses for Task 1, as required.

PROPOSED BUDGET: \$50,000

PROGRESS ON TASKS

Task 1. Provide scientific support as required for offsite activities under the direction of other organizations, particularly those at Tatum Dome and Gnome.

First and Second Quarters (October 1990 – March 1991):

No support was requested.

Third Quarter (April – June 1991):

The principal investigator attended a meeting on June 25 to discuss the proposed drilling of an exploratory oil/gas well adjacent to Tatum Dome.

Fourth Quarter (July – September 1991):

Section II.7B of the DOE/NV Environmental Monitoring Plan was reviewed at DOE's request. This section describes the monitoring plan for the Long-Term Hydrologic Monitoring Program (LTHMP) sites off the NTS. Comments were sent to DOE along with copies of the Offsite Evaluation report prepared last fiscal year.

Task 2. Plan and implement well and spring sampling in the vicinity of the Shoal site and interpret the results in the context of remedial investigation planning.

First Quarter:

No work was done on this task.

Second Quarter:

Well inventories from 1961–1963 have been examined and promising sampling locations have been identified. The EPA has provided descriptions of the LTHMP sampling locations, all of which will be included in DRI's hydrogeochemical sampling. Water chemistry results from the early 1960s have been analyzed using the geochemical computer code WATEQ, and the results are currently being interpreted. It is hoped that some clear chemical indicator parameters can be identified to aid in flow system analysis.

Third Quarter:

DRI conducted water sampling at the Shoal site on June 12 and 13. Samples were collected from several LTHMP locations: Hunt's Station (sample from storage tank, pump inoperative), Smith-James Spring, and Flowing Well. Other LTHMP sites (Spring Windmill and Well HS-1) could not be sampled due to missing or locked pumps. Additional sites that were sampled at the time of the Shoal test, but not included in the LTHMP, were also sampled on this trip. All water samples will be analyzed for major anions and cations, stable isotopes, and tritium.

Fourth Quarter:

Analytical results for the major ions and stable isotopes were received from the laboratories. Major ion results were compared to historical data and found to generally agree. Isotopic data were evaluated in the context of previous data collection in the Stillwater Range north of Shoal. A conceptual flow model was constructed and the probable chemical evolutionary paths compared to the actual water analyses. The analytical results and interpretations are being compiled into a letter report.

Task 3. Participate in planning and implementing a field investigation of the status of Faultless chimney infilling.

No work was performed on this task in FY 1991 because no trips to Faultless were scheduled by other organizations (e.g., LLNL or USGS).

STATUS OF DELIVERABLES

1. Report: "Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas", DOE/NV/10845-07 (delayed from FY 1990).	Completed
2. Letter report on field sampling (9/30/91) This report should be ready by 10/31/91.	Delayed
3. Review of the DOE Offsite Monitoring Plan. Sent to DOE on 9/18/91.	Completed

PROBLEMS ENCOUNTERED

First Quarter: No specific problems were encountered.

Second Quarter: No specific problems were encountered.

Third Quarter: The inability to sample several of the Shoal LTHMP locations was unexpected because EPA was consulted prior to the sampling trip and apparently they had no difficulty collecting samples in February 1991. DRI is considering whether to obtain a 3-phase generator to run two of the pumps, and whether any way to unlock the pump at HS-1 can be found. Depending on the chemical analyses from the samples collected, a decision will be made next quarter as to whether to try to sample those stations.

Fourth Quarter: Another researcher unknowingly submitted samples for tritium enrichment that contained relatively high activities of tritium. These samples contaminated the Shoal samples being processed in the same batch. This has necessitated the re-enrichment of the Shoal samples (archived splits) and will delay the results for several more months.

FY 1991 BUDGET SUMMARY OFFSITE HYDROLOGY

CONTAINMENT EVALUATION PANEL

Contact: Roger L. Jacobson

PROJECT DESCRIPTION

The Containment Evaluation Panel (CEP) is composed of experts in such areas as geology, hydrology, physics, engineering, nuclear weapons testing activities, and related scientific fields. The mission of this panel is to advise DOE on the overall effectiveness of the containment design of each proposed underground nuclear test and to identify any areas of concern prior to testing.

DRI's primary activity for the CEP continues to be the assessment of hydrologic implications of each test, as well as other aspects of the containment design. Each proposed underground test possesses unique features, which may require different analyses. These analyses will include an in-depth review of the information prepared for each event, and may include computer analyses of the data from past tests, analyses of the geology and material properties in and around the site of the proposed event, comparison of these parameters with those of past events, and examination of all hydrologic conditions at the test location.

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

All security activities related to CEP are provided under this task. In addition, during FY 1991, DRI will co-host the CEP Symposium with special security requirements and other related symposium activities to be accomplished by security personnel.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Assess the prospects for containment – all tests.
- Task 2. Attend all special meetings.
- Task 3. Accomplish all security-related activities for CEP and the 1991 Symposium.

DELIVERABLES

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

PROPOSED BUDGET: \$75,000

PROGRESS ON TASKS

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

First Quarter (October - December 1990):

The two Containment Evaluation Panel meetings were attended by the DRI representative to the CEP panel and other DRI personnel.

Second Quarter (January - March 1991):

The two Containment Evaluation Panel meetings, February 6 and 7 and March 5, were attended by the DRI representative to the Panel and other DRI personnel.

Third Quarter (April - June 1991):

The Containment Evaluation Panel meeting on May 22 was attended by the DRI panel member, Dr. Paul Fenske, and the alternate, Dr. Roger Jacobson.

Review work was carried out for upcoming events.

Fourth Quarter (July - September 1991):

DRI representatives attended two CEP meetings and categorized the tests presented. Before the meetings, materials developed by the appropriate laboratory were carefully reviewed and analyzed. Several tests were also observed to familiarize DRI personnel with testing activities.

The analysis of the spatial correlation of the water saturation data indicated that the water saturation data are not correlated at the range of the minimum spacing of data of 1,000 ft. The water saturation data may be correlated at smaller ranges but data do not exist at these ranges. A letter report on the analysis is in preparation and should be completed in October.

Task 2. Attend all special meetings.

First Quarter:

There were no special meetings.

Second Quarter:

The DOE Test Technology Branch tour of the NTS tunnels on February 5, 1991, was attended by the DRI Panel member, Dr. Paul Fenske.

Third and Fourth Quarters:

There were no special meetings.

Task 3. Accomplish all security-related activities for CEP and the 1991 Symposium.

First Quarter:

Final arrangements were made for the meeting location, lodging, and other accommodations for the 6th Containment Symposium scheduled for September 1991. Security approval for the meeting place was received from the DOE/NV, and the preliminary meetings held to set up security and write a security plan were attended by the DRI representative on the 6th Containment Symposium organizing committee.

Second Quarter:

Work is continuing on all arrangements for the 1991 Containment Symposium to be held in Reno, Nevada. A preliminary security survey has been completed and written up by DOE/NV and DRI has started writing a special plan to cover the activities of the symposium. All other security concerns related to the CEP were carried out as usual.

Third Quarter:

In April, a complete inventory of all classified documents at DRI was performed and a report sent to DOE/NV. Information was also provided to DOE/NV on the types of classified documents at DRI.

In May, the annual security inspection required for facilities housing classified information was conducted at DRI.

A draft copy of the security plan for the CEP Symposium was completed and submitted to the DOE/NV Security and Safeguards Division for review and approval. A DRI representative to the Symposium Organizing Committee attended a security meeting in Las Vegas and final revisions were made to the plan. The DRI will prepare the final document for DOE approval.

Other routine security concerns related to the CEP were carried out.

Fourth Quarter:

DRI was the host of the 6th Symposium on Containment of Underground Nuclear Explosions held on September 24-27 on the University of Nevada, Reno campus. As part of hosting this event, DRI provided audiovisual support, wrote a conference security plan, provided a secure facility, and provided other services generally required at a conference of this type.

PROBLEMS ENCOUNTERED

No specific problems were encountered.

FY 1991 BUDGET SUMMARY CEP

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM

INTRODUCTION

The major focus of the Hydrology/Radionuclide Migration Program (HRMP) is to attain a better understanding of the NTS hydrology and how or if groundwater may transport radionuclides. Specific studies are designed to better understand the radionuclide sources, the specific radionuclide transport mechanisms, and the hydrologic conditions near the underground tests, as well as the regional hydrology. This program is integrated with similar programs from the USGS, LANL, and LLNL.

HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM SUPPORT

Contact: Roger L. Jacobson

PROJECT DESCRIPTION

The HRMP is conducted to assess hydrogeological conditions and migration of hazardous materials released in the subsurface by nuclear tests. HRMP Support is designed to assist with the many different types of HRMP activities that are not directly related to individual projects in the work plan. Some of the nonspecific tasks that fall under this program are developing work plans, writing, editing, and reviewing proposals and project reports, conducting security briefings and radiation safety training, and participating in planning, review and coordination meetings. General field and laboratory support will also be provided.

TASKS TO BE ACCOMPLISHED IN FY 1991

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

DELIVERABLES

- 1. Monthly, quarterly and annual reports, as required.

PROPOSED BUDGET: \$190,000

PROGRESS ON TASKS

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

First Quarter (October – December 1990):

General administrative, laboratory and field support, and planning and budget control for HRMP activities were provided.

Second Quarter (January – March 1991):

Budgetary and programmatic support for the HRMP activities was provided, and several contract modifications were requested and received.

Third Quarter (April – June 1991):

Administrative and budget assistance, which involves contract modifications, was provided.

Fourth Quarter (July – September 1991):

General administrative and budget assistance was provided for all HRMP activities. Assistance was given to LLNL in a risk assessment project related to groundwater impact on offsite areas.

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

First Quarter:

The Program Manager attended numerous ad hoc meetings, including an October 18 and 19 HRMP meeting. General focus of the meeting was on program planning and groundwater protection.

Second Quarter:

Numerous meetings related to drilling an HRMP well during FY 1991 were attended by the Program Manager. In addition, a quarterly HRMP meeting on February 5 and 6 at LANL and various meetings related to environmental impacts on groundwater related to underground testing were attended.

Third Quarter:

Regular meetings (approximately each week) to help coordinate the HRMP and Groundwater Characterization Project were attended. This coordination is related particularly to drilling and testing protocols and procedures. A regular quarterly HRMP meeting in Las Vegas on May 22 and 23, where research results and future research were discussed, was also attended.

Fourth Quarter:

The Program Manager attended numerous HRMP meetings to discuss programmatic and budget issues and other meetings to help decide how the HRMP well will be drilled, tested, and completed.

Task 3. Write, edit, and review numerous reports, work plans and proposals, as necessary.

First Quarter:

Numerous technical reports (approximately five) and letter reports were completed and submitted to DOE for review. Several work plans and miscellaneous documents were also prepared for DOE review.

Second Quarter:

Work plans were written late in the quarter for eight new projects funded under the Office of Technology Development. The project descriptions, tasks and deliverables are included in this quarterly report, however, there will be no summaries of work accomplished to date until the end of the third quarter.

Several draft technical reports were prepared and submitted to DOE/IMD for review. Several technical reports underwent internal DRI peer review prior to submittal to DOE. The following HRMP-related reports were published during this reporting period:

1. Report of Drilling and Radionuclide Migration Investigations at UE20n#1, Pahute Mesa, Nevada Test Site, 1987, by S. Erikson, Report No. DOE/NV/10384-35.
2. Tritium Variations in Groundwater on the Nevada Test Site, by B. Lyles, Report No. DOE/NV/10384-32.
3. Time-Series Analysis of Ion and Isotope Geochemistry of Selected Springs of the Nevada Test Site, Nye County, Nevada, by B. Lyles et al., Report No. DOE/NV/10384-27.

Two letter reports were also prepared and submitted to DOE/ERWM. They are: 1) NTS Mesa Recharge Study-FY 1990, by B. Lyles and T. Mihevc; and 2) Radionuclide Distribution for Selected Wells on the NTS, by B. Lyles.

Third Quarter:

The following reports and plans were submitted to DOE for review:

1. "Quality Assurance Plan for the Nevada Test Site Groundwater Characterization Project" (April 16);
2. "A Comparative Analysis of Well Completion Structures for the U.S. Department of Energy's Nevada Test Site Groundwater Characterization Project," by Cullen and Donithan (May 1); and

3. "Hydrogeologic Characterization of Wells HTH-1, UE18r, UE6e, and HTH-3, Nevada Test Site," by Lyles, McKay, Chapman, and Tyler (June 21), DOE/NV/10845-08, DRI Publication #45087. This report fulfills the deliverable for FY 1990 under the project Well Validation Program.

Another report, "The Hydrology of Underground Nuclear Tests: The Effects of Collapse-Chimney Formation," by Brikowski, previously approved by DOE for submittal to the journal *Water Resources Research*, was readied for publication as a DRI report.

The following abstracts and manuscript received DOE approval for presentation:

1. "Hydrologic Transport of Radionuclides from Underground Tests: Constraints Derived from Analytic Models," by Brikowski, May 1991, submitted for presentation at the DOE 6th Containment Symposium in September in Reno;
2. "Completion Structures and Stemming Techniques for Very Deep Monitoring Wells," by Cullen, May 1991, submitted for presentation at the "Innovative Ground Water Technologies for the '90s" meeting of the Association of Groundwater Scientists and Engineers; and
3. "Assessment of Soil Moisture Movement in Nuclear Subsidence Craters," by Tyler, McKay, and Mihevc, submitted for publication in the journal *Hydrology*.

Fourth Quarter:

The following draft document was submitted to DOE for review:

1. "Characterization of Colloids Found in Various Groundwater Environments in Central and Southern Nevada," by W.L. Kingston and M. Whitbeck, July 1991, DOE/NV/10384-36, DRI Publication #45083. This report fulfills the deliverable for FY 1989 for the project Colloidal Transport of Radionuclides.

DRI principal investigators prepared individual project descriptions, tasks, deliverables, and budgets proposed for the FY 1992 Work Plan, a draft of which was submitted to DOE for review in late September.

Task 4. Provide administrative support to all WRC classified security-related activities under the HRMP, such as processing security badge requests, writing plans and regulations and conducting security briefings, as required.

First Quarter:

Various security-related documents were prepared and activities conducted relating to radiation safety, computer security, security briefings and similar activities.

Second Quarter:

DRI completed a new Facility Security Plan and a revised Operations Security (OPSEC) Plan. Yearly classified and OPSEC briefings were prepared. Security clearance requests were prepared for four individuals and briefings for health, safety, and security on the NTS were

carried out. A major effort was made on preparing the DRI Unclassified Computer Security Plan. All materials have been reviewed and writing begun.

Third Quarter:

A new DRI Facility Security Plan and the DRI OPSEC Plan were approved by DOE/NV and copies were made available to DRI personnel.

The required yearly security briefings were completed in April and records updated to reflect all new information. Security clearance requests were processed for four DRI employees and several more are in final preparation. Badging and other security related operations were carried out.

The unclassified computer security program has been developed and is ready for internal review. Computer security briefings for new personnel have been established.

Final work was completed on establishing files containing a complete radiation history for DRI employees working on the DOE contract. In June, a start was made on placing all this information into an ongoing data system for the DRI.

Fourth Quarter:

Meetings and symposiums were attended at DOE/NV including the OPSEC Quarterly Meeting, a Security Education Program Committee meeting, an educational meeting on the new security questionnaire forms and the current processing system for these forms, and a two-day symposium for derivative classifiers.

Work was started on an updated Threat Statement for the DRI Reno facility. Groundwork was laid for a new format to meet DOE criteria on program classification criteria and tracking systems. Work continued on the DRI unclassified computer security program with a continuing survey of the entire DRI program and the introduction of changes and new items into this program to keep DRI in compliance with new DOE regulations.

Applications for security clearance and other routine classified and unclassified business was carried out, as well as briefings for radiation health and safety. A format is being developed to place general information from the DRI briefings for security and health and safety information on the computer.

PROBLEMS ENCOUNTERED

No specific problems were encountered.

FY 1991 BUDGET SUMMARY
PROGRAM SUPPORT

HISTORY OF THE HYDROLOGY/RADIONUCLIDE MIGRATION PROGRAM AT THE NEVADA TEST SITE

Contact: Marjory A. Jones/Paul R. Fenske/Roger L. Jacobson

PROJECT DESCRIPTION

Scientific research has been conducted on the effects of underground nuclear testing on the subsurface environment of the NTS for the past 28 years. With the advent of underground testing at the NTS in 1962, groundwater contamination concerns became a focus for a series of studies administered by the Energy Research and Development Administration (ERDA), now DOE. Today, NTS operations are through the auspices of the DOE, and the groundwater studies continue as part of the Hydrology/Radionuclide Migration Program (HRMP).

This project will research the HRMP, previously the Radionuclide Migration (RNM) Program, from its beginnings to its present-day activities, document the events and people that led it to its creation and continuation, and provide highlights of significant activities. A concentrated effort will be placed on permanently recording accounts of these activities through literature searches and personal interviews with early researchers and program associates.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Conduct literature searches and interviews for applicable information on early nuclear testing activities on the NTS, and to gain information on events important to the foundation and continuation of the RNM and HRMP effort.

DELIVERABLES

1. A progress report on history of the RNM/HRMP (fourth quarter).

PROPOSED BUDGET: \$50,000

PROGRESS ON TASKS

Task 1. Conduct literature searches and interviews for applicable information on early nuclear testing activities on the NTS, and to gain information on events important to the foundation and continuation of the RNM and HRMP effort.

First Quarter (October – December 1990):

A transcript of an oral history, given by Dr. Paul Fenske, former DRI Water Resources Center Executive Director, on the early days of the RNM/HRMP was entered onto the DRI SUN electronic publishing system. The first draft of the history of the RNM/HRMP will incorporate this and other information collected from interviews and literature searches.

Second Quarter (January – March 1991):

A planning and informational meeting was held with Dr. P.R. Fenske at the DRI Reno office to discuss possible candidates for interviews and to go over the kinds of questions needed for these interviews. Each interview will be tape recorded and supplemented by hand-written notations, then transcribed and stored in computer files. The first of a series of personal interviews is anticipated to begin during the fourth quarter.

Information on the early days of the Radionuclide Migration Program continues to be collected. DRI work plans and proposals for research conducted on the NTS during that period, as well as reports and documentation from other DOE contractor agencies, are being looked at for related information.

Third Quarter (April – June 1991):

The search continues for pertinent information related to the early groundwater contamination studies conducted on the NTS. Activity to date has consisted of searching through contractor reports and other documentation for references to hydrologic and geologic studies conducted on the NTS in the late 1950s and early 1960s. Background information is being sought to supplement the oral histories and to aid in customizing the interview questions. A list of researchers, program managers, project directors, and others involved with these first groundwater studies is being compiled.

Fourth Quarter (July – September 1991):

Work on structuring a basic outline of major activities of the groundwater studies at the NTS over the last 30 years or so continued. This outline will be a chronological listing of general programs, e.g., radionuclide migration studies at the Cambric site, and the agencies and individuals involved in them. Further research will produce information to fill in the gaps between the general programs and the more specific projects. To aid in structuring this outline, a chronological list was made of a partial bibliography on radionuclide migration obtained from the DOE/NV library.

Two trips were made to Las Vegas to collect information from DOE/NV on the hydrologic studies at the NTS. A comprehensive listing of hydrology/radionuclide migration related documents available at the CIC was obtained. It is anticipated that the level of effort will pick up considerably in October.

STATUS OF DELIVERABLES

1. Progress report (9/30/91) Delayed
This report is in preparation.

PROBLEMS ENCOUNTERED

First and Second Quarters: No specific problems were encountered.

Third Quarter: No significant problems have been encountered so far, however, it is anticipated that there may be some difficulty locating some of the selected interviewees.

Fourth Quarter: A snag was encountered in one attempt to obtain unclassified data from the DOE/NV Completion Reports (the annual report on the weapons testing program). This problem should be remedied by the beginning of October. Another attempt will be made at that time to collect this information.

FY 1991 BUDGET SUMMARY

HRMP HISTORY

SITE-SPECIFIC STUDIES

Contact: Tom Brikowski

PROJECT DESCRIPTION

The purpose of this program is to investigate site-specific problems at the NTS, including issues of pre-test hydrology and post-test hydrologic response and radionuclide migration. The specific pre-test hydrologic issue to be addressed this year is the origin of apparently perched water encountered in two emplacement holes (Houston and Bexar) on Pahute Mesa. Studies of post-test hydrologic response at the Bullion Site will continue, with redrilling of the post-shot hole and installation of pressure-temperature monitors. A downgradient monitoring well may be designed and drilled, and periodic chemical sampling will be carried out in this and the post-shot hole. Chemical sampling at the Cheshire site may continue, in both the post-shot and downgradient monitoring holes. Studies of fluid overpressure and radionuclide migration in Yucca Flat will continue, with ongoing monitoring near the Aleman site and reporting of results from the previous fiscal year's efforts.

Ongoing research at the Cambric site will also be completed during FY 1991. Reports will summarize the results of modeling water infiltration from the ditch and also water and radionuclide movement away from the ditch.

Efforts will continue to develop conceptual and numerical models to describe water and radionuclide movement around 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 hydrologic system. Studies of this type are limited by the lack of hydrologic and radionuclide data, and therefore, numerical models are being developed to help explain water and radionuclide movement. If models can be calibrated at several sites, then the model results will be more acceptable when applied to water and radionuclide movement at other underground tests. This modeling effort will result in large cost savings by reducing the need for drilling and other field activities at the approximately 150 shots that may have placed radionuclides in the groundwater at the NTS.

Constraints on probable radionuclide migration can be developed using analytic models (exact mathematical solutions). These are useful as "first cut" predictions and when few hydrologic data are available. Analytic models developed during FY 1990 will be refined and extended this fiscal year, and will be applied at various HRMP sites.

Three-dimensional numerical models of post-shot hydrologic response at the Cheshire and Bullion sites should be completed during FY 1991. These models consider the effects of thermal and permeability changes at the two sites.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Complete the report on modeling water leakage from the Cambric ditch.
- Task 2. If possible, continue sampling at Cheshire. Routine sampling was stopped because of water disposal problems.
- Task 3. Assist in developing a "cradle to grave" hydrologic and radionuclide study at the Bullion site.
- Task 4. Sample, monitor and report on wells UE3e#4 and U4t.
- Task 5. Sample, analyze and report on the origin of the groundwater and hydrologic conditions at Houston and Bexar.
- Task 6. Continue to develop a numerical model to describe water movement around underground nuclear tests.
- Task 7. Continue to develop and apply analytic solutions to determine constraints on groundwater flow and transport near underground nuclear tests.

DELIVERABLES

- 1. A report on the results of numerical modeling at Cambric Ditch (third quarter). *(W. Ross - S. Whetters)*
- 2. A letter report on the characterization and probable origin of suspected perched water at the Bexar and Houston sites (third quarter). *(Jenny, Sam & Tom)* *Polite Mesa*
- 3. A letter report describing FY 1990-1991 activities at UE3e#4 and U4t (fourth quarter), if further work is required. *No further work was done.*
- 4. A manuscript on application of analytic models to derive flow and transport constraints (fourth quarter). *(manuscript written for 6th Contain. Symposium)*
- 5. A manuscript on numerical model results related to water movement near cavities (fourth quarter). *"Estimating Movement of Groundwater from a Pond as Large Radius Conduit"*
(in DOE review 4-2-92)

PROPOSED BUDGET: \$185,000

PROGRESS ON TASKS

Task 1. Complete the report on modeling water leakage from the Cambria ditch.

First Quarter (October – December 1990):

A report has been written and internally reviewed. After final internal review, it will be submitted to DOE for review and approval to publish.

Second through Fourth Quarters (January – September 1991)

No further progress was made on this task.

Task 2. If possible, continue sampling at Cheshire. Routine sampling was stopped because of water disposal problems.

First Quarter:

A general plan for disposal of pumped water during HRMP activities is being prepared. If this plan is approved by NTSO and the State of Nevada, sampling can continue at Cheshire.

Second Quarter:

Sampling of contaminated water will be impossible until a disposal plan has been accepted by the State of Nevada. This will require a year or more; therefore, this task cannot be completed.

Task 3. Assist in developing a "cradle to grave" hydrologic and radionuclide study at the Bullion site.

First Quarter:

A DRI report has been prepared entitled "Constraints on Potential Radionuclide Migration at the Bullion Site." This report has been internally reviewed, and awaits final revision, which has been delayed while analytic constraints are developed for general situations (see Task 7). Application of streamline determination and plume-front approximation techniques will significantly enhance this predictive report.

Further work on the Bullion site has been delayed while the reason for loss of access to the post-shot monitoring hole is evaluated. A small-diameter down-hole camera is being acquired, and the obstruction in this hole will be examined using this device.

Second and Third Quarters:

No further progress was made on this task.

Fourth Quarter:

No further progress was made at the Bullion site. A similar effort has begun at UE20bh under the Drilling and Testing Support project.

Task 4. Sample, monitor and report on wells UE3e#4 and U4t.

No work was done at these sites in FY 1991.

Task 5. Sample, analyze and report on the origin of the groundwater and hydrologic conditions at Houston and Bexar.

First Quarter:

A borehole-dilution test was initiated at the Bexar site. Fluorescence dye and lithium-bromide tracers were instilled into standing water in the emplacement hole. This fluid was monitored for changes in concentration for three months using wireline logging equipment supplemented by laboratory analysis of bailed samples. Indications are that the concentration has decreased about 25 percent. Assuming uniform horizontal flow around and through the emplacement hole, this rate of decrease implies groundwater velocities similar to those at Cheshire. This result was quite unexpected, and further analysis is underway. An improved conceptual model for local hydrologic flow is needed; some clues to the nature of this flow may be provided by the satellite holes near Bexar. It is thought that at least one of the drill holes at the site is draining a perched or semi-perched lens of water. This water is unlikely to be introduced drilling fluid since water levels have remained relatively constant while concentrations decreased during this investigation.

One lesson from this site is that drilling fluids should be tagged, if possible, and holes with standing water should be blown dry again to see if subsequent water levels are stable at pre-purging levels. If the water levels are stable, there is a much stronger possibility of regional, rather than local (possibly drilling-related), control on apparently perched water levels.

Second Quarter:

A final letter report summarizing the results of chemical sampling at Houston has been prepared and is in internal review (Chapman and Hokett, "Water Sampling at U19az: Results and Interpretation"). Samples taken from the Houston emplacement hole showed elevated SO_4 and total dissolved solids relative to Area 19-20 water wells (the probable sources of drilling fluids). Tritium in the samples was below detection limit. These geochemical changes could reflect interaction of injected water with salts deposited in the unsaturated zone, or the composition of naturally perched water. These two hypotheses cannot be distinguished by the current experiment.

Several presentations were made at HRMP planning meetings related to the "perched" water encountered at the Houston site, and ultimately to the proposed Area 19 hydrologic drill hole. Memoranda outlining DRI's proposed experiments for this hole were prepared and delivered to DOE/Environmental Restoration and Waste Management Division.

Third Quarter:

A tracer experiment was started to investigate the origin of anticipated perched water in hole U19bh (1500 ft northwest of U19az, where apparent perched water was encountered previously). Initial results suggest that fluids lost to the formation during drilling of the last 300 ft of the hole have not returned to the hole. An observed rise in the water level may be caused by the return of fluids injected before tracer was added or by the inflow of pristine (perched) formation water. A decline in the amount of tracer in the hole between 7/3/91 and 7/8/91 suggests that some outflow is occurring, while the increasing water level indicates inflow exceeds outflow.

Fourth Quarter:

Studies at the Houston and Bexar sites were completed in the second quarter. A report summarizing the results is in preparation.

Efforts continued to monitor water levels and composition at U19bh. The USGS monitors the water level and obtains samples approximately every month. DRI analyzes the samples for LiBr, pH, and electrical conductivity. Water levels have continued to rise, while the total tracer content remains constant, indicating that the dominant influx to the hole is unlabeled water. The lack of change in total Br indicates no net outflow of Br, so either there is little outflow of water from the hole or the influx of Br is at the same rate as the efflux.

Task 6. Continue to develop a numerical model to describe water movement around underground nuclear tests.

First Quarter:

Constraints provided by isothermal analytic models of this setting indicated that three-dimensional modeling was required (two-dimensional approximations were too inaccurate). The public-domain USGS code HST3D was obtained and installed for use in this task. Preliminary calibration runs have been completed, which strongly indicated the need for easy graphical output. The three-dimensional nature of this output required the use of advanced computing platforms and visualization software available in our Reno office. Much time was spent installing and learning to use these software packages. Translation of data output into formats required by these packages took much effort, but is largely complete.

Animation and three-dimensional representation of earlier two-dimensional results is not possible. This kind of presentation is an effective means of analyzing model results and demonstrating their significance. At this time, DRI does not have adequate video recording hardware; hopefully, by the end of the next quarter, preliminary animations can be created and presented.

Second Quarter:

Initial runs of HST3D for a Cheshire-like setting were made. Visualization of the results has been a problem, and continued effort was made to output the results in a form

suitable for plotting on the Silicon Graphics workstation in Reno. This involves some modification of the code. Development of computer tools for this process has begun, but is incomplete.

Third Quarter:

Additional progress was made in generating "genplot" format output from the USGS heat-solute-fluid flow simulator HST3D. A filter was written to translate this format to the input format required by the scientific visualization software "apE." An updated version of apE was obtained and installed on the Las Vegas computer. This software is required to present the voluminous output of HST3D in an interpretable form.

Fourth Quarter:

No further progress was made on this task.

Task 7. Continue to develop and apply analytic solutions to determine constraints on groundwater flow and transport near underground nuclear tests.

First Quarter:

A paper entitled "The Hydrology of Underground Nuclear Tests: The Effect of Collapse-Chimney Formation," was submitted to Water Resources Research in November. This paper describes isothermal, steady-state analytic models of the near-field environment, concentrating on the effect of test-induced permeability changes (i.e., chimney formation).

The description of flow in the near-field setting provides the basis for a companion paper, tentatively titled "The Hydrology of Underground Nuclear Tests: Constraints on Potential Radionuclide Migration from Analytic Models." Given descriptions of groundwater flux in the near-field environment, streamlines of flow and approximate boundaries of contaminant plumes can be derived. This approach is developed in the second manuscript (not quite complete), and will be applied at various HRMP sites, such as Bullion.

Second Quarter:

Work continued on deriving transport constraints (really first order estimates of transport) given analytic models of flow in chimney-aquifer systems. The development follows that of Bear and Jacobs (1965) where expressions for potential in the system are derived, and from these expressions for stream function are obtained. Given these, expressions for groundwater travel time can be derived. In this case, closed expressions for travel-time can only be derived for paths trending directly up or down the regional gradient. In addition, an equation for the "water divide" delimiting water in the aquifer that has passed through the chimney (and is potentially contaminated) can be obtained from the stream function. A manuscript is in preparation describing these results. Additional work is required to derive similar constraints in the case of a reduced-permeability chimney (i.e., bulk of

groundwater flow is horizontal across the chimney, rather than vertically through it). An abstract describing this work was submitted to the Containment Symposium to be held in September.

Third Quarter:

Formulas describing constraints on possible contaminant migration in the case of a permeable chimney connecting two aquifers were completed, and are described in a manuscript in preparation. Solutions for the case of a disk of differing permeability in a single aquifer (the case when the chimney has areas of limited average vertical permeability) will be generated next quarter.

Fourth Quarter:

Considerable progress was made on this task, culminating in the presentation of results at the Containment Symposium in Reno. A manuscript summarizing formulas for estimating tritium plume size and downstream times of arrival in simple chimney-aquifer systems was prepared for the symposium proceedings. Example calculations were included for the Cheshire and Bullion sites. These formulas are based on a highly simplified view of chimney-aquifer systems, and they require hydrogeologic inputs that are poorly known for the NTS, so they give only first-order estimates of potential transport rather than accurate predictions. The approach was kept simple in an effort to make the results usable by non-specialists. Preprints of the manuscript are available from DRI.

STATUS OF DELIVERABLES

1. Report: "Post-Shot Monitoring of the Near-Field Environment: Data Needs" (6/89). Draft written, needs better figures.	Delayed
2. Report: "The Hydrology of Underground Nuclear Tests: The Effect of Collapse Chimney Formation, " DRI Publication #45090 (9/89).	Completed
3. Manuscript: (tentative title) "Long-Term Hydrologic Response to Underground Nuclear Testing: Conceptual Model" (9/88) Mostly written.	Delayed
4. Report: "Constraints on Potential Radionuclide Migration at the Bullion Site" (9/90). Draft written and in internal review.	Delayed
5. Report on Cambric Ditch modeling (6/30/91)	Delayed
6. Letter report on perched water (6/30/91)	Delayed
7. Letter report on UE3e#4 and U4t (9/30/91)	Delayed

8. Manuscript: "Estimation of Hydrologic Transport of Radionuclides from Below Water Table Tests Using Analytic Models" delivered to the editor of the Containment Symposium Proceedings.	Completed
9. Manuscript on water movement near cavities (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

First Quarter: The move to three-dimensional modeling has necessitated access to more sophisticated graphics hardware and software. Currently, the best solution to this problem is to work in our Reno office. Similar hardware is available on the UNLV campus (the NSCEE Supercomputer Center), but software is lacking. In addition, locally-produced software has been required to translate between model output and graphics program input. Our new programmer in Las Vegas has been quite helpful in this area.

Compilation of hydrologic data is still difficult. Short-notice efforts such as those being carried out at Houston and Bexar would benefit from having some kind of hydrologic summary available. Hydrogeologic information has often been anecdotal and uncertain in these cases. If a site is to be singled out for HRMP scrutiny, the process of identifying study sites should include a written summary of available hydrologic information. As it stands now, we often initiate the study before becoming fully informed about the setting.

Second through Fourth Quarters: No specific problems were encountered.

FY 1991 BUDGET SUMMARY SITE-SPECIFIC STUDIES

SOURCE-TERM ANALYSIS

Contact: Bradley F. Lyles

PROJECT DESCRIPTION

During FY 1990, DRI accompanied EPA and collected parallel samples from wells in the Long-Term Hydrologic Monitoring Program. Samples were analyzed for tritium and major cations and anions for comparison with earlier samples. The parallel sampling was for interlaboratory comparison and as a quality assurance check. Results have not been received from EPA, but results from the DRI laboratories compare favorably with previous analyses. A direct comparison of the split samples will be made as soon as the EPA results become available. DRI will accompany EPA again on at least two sampling trips in FY 1991; samples will be collected at each site, but only selected samples will be analyzed.

Water samples were collected from Well TW1 to help further understand the potential sources for the slightly elevated tritium levels. Other wells on Yucca Flat have also shown slightly elevated tritium levels. An inventory of tritium data from NTS groundwater will be compiled and a map will be generated from those data showing regions of elevated tritium.

Several large-diameter open holes have been identified on the NTS that may be downgradient from potential sources of tritium; however, in most cases, these holes are not pumped to remove drilling fluids. To avoid potential contamination problems, techniques must be developed to ensure that sufficient time has passed since drilling was completed, prior to collecting tritium samples. Experiments will be conducted during FY 1991 to develop techniques that can be used in large-diameter bore holes.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Conduct parallel sampling with EPA, and independent analyses.
- Task 2. Develop tritium distribution map.
- Task 3. Design experiments that will yield techniques for sampling representative fluid from large-diameter bore holes.

DELIVERABLES

- 1. A letter report on the tritium analyses results (third quarter).
- 2. A report outlining the distribution of tritium (third quarter).
- 3. A letter report on techniques for sampling large-diameter bore holes (fourth quarter).

PROPOSED BUDGET: \$60,000

PROGRESS ON TASKS

Task 1. Conduct parallel sampling with EPA, and independent analyses.

First Quarter (October – December 1990):

No work was done on this task.

Second Quarter (January – March 1991):

Sampling with EPA is planned for early May.

Third Quarter (April – June 1991):

DRI personnel accompanied EPA investigators to four wells on May 8. Water was collected from and temperature, EC, and pH were measured at Well C, UE16d, UE19c, and Well 8. Water samples were submitted to the DRI enriched tritium laboratory for analysis, but the analyses will not be complete until the first quarter of FY 1992.

Fourth Quarter (July – September 1991):

No tritium analyses have been received from the enriched tritium laboratory for the samples collected in May. Plans are being made to conduct parallel sampling with the EPA in October 1991.

Task 2. Develop tritium distribution map.

First Quarter:

No work was done on this task.

Second Quarter:

Sources of tritium data were contacted to find out the extent of their data bases. Preliminary indications are that only a limited amount of data is available.

Third Quarter:

To develop the necessary data base to produce a tritium distribution map, inquiries have been made to DOE, LLNL, LANL, REECo, and EPA. Few data have been found from these sources thus far, though about 30 samples from emplacement holes have been found at EPA. If no other data are found, it may not be possible to develop a tritium distribution map.

Fourth Quarter:

Computer data base dumps have been received from EPA and REECo. Few data are available from emplacement holes, and none of the tritium values are above the current atmospheric levels. Therefore, the available data will be discussed in a data report, but it does not appear that there are enough data to produce a map.

Task 3. Design experiments that will yield techniques for sampling representative fluid from large-diameter bore holes.

These experiments are being done in conjunction with other studies at the Bexar site. See Task 5 under Site-Specific Studies.

STATUS OF DELIVERABLES

1. Letter report on tritium results (6/30/91) Analyses will not be complete until FY 1992.	Delayed
2. Report on tritium distribution (6/30/91) This report should be completed in December 1991.	Delayed
3. Letter report on sampling techniques (9/30/91) A draft of the report is in preparation.	Delayed

PROBLEMS ENCOUNTERED

No specific problems were encountered.

OPERATIONAL SUPPORT

Contact: Bradley F. Lyles

PROJECT DESCRIPTION

In FY 1990, DRI compiled available data for several unpumped wells on the NTS and outlined preliminary testing procedures for four wells based on those data. Temperature, electrical conductivity (EC), caliper, and thermal flowmeter data were recorded for three wells (TW1, UE18r, and UE6e), while only temperature and EC data and chemical samples were collected from HTH-3. Preliminary interpretations of thermal flowmeter data were found to be very useful in identifying zones of vertical flow in wells TW1 and UE18r. An additional three to four wells will be included for Phase I testing in FY 1991, with a list of possible wells including HTH-3, TWB, UE14b, and UE5f.

Based on the results from last year's study on wells, further research and development is warranted. Again, the primary objective will be to delineate well-bore flow zones. These data are important to better understand the local hydrology, as well as to determine the best sampling depth for monitoring purposes. To help accomplish this task, some technology development will be necessary on chemical tracers and flowmeters.

Another activity for FY 1991 will be to calculate the importance of stemming below the working point on wells that are drilled below the water table. This potential radionuclide pathway needs to be examined, and will be measured by point-source-dilution tracer tests.

Additional research will be conducted in emplacement holes to examine the potential use of in-situ optical techniques to measure free versus bound water along the well bore. The technique would be accurate, inexpensive, and would be very useful for well characterization.

A preliminary report has been completed for the FY 1990 Well Validation project. No further information has been received from the USGS, but sufficient information was available from DRI field notes to formulate preliminary conclusions about vertical gradients in the wells studied. The thermal flowmeter was found to be valuable in the wells studied in FY 1990 and should be incorporated in additional wells this year. The report further includes conclusions and recommendations about further studies for each well: HTH-1; run thermal flowmeter below 2,430 feet, investigate establishing access to the carbonate aquifer, and collect discrete samples with wire-line packer-sampler; UE18r; collect samples from four flow-zones outlined by thermal flowmeter, collect samples from two zones as part of the long-term hydrologic monitoring program, and set a packer at 1,380 feet to measure the shut-in pressure; UE6e; clean out hole from 2,090 to 4,209 and seal-off volcanic aquifers from the carbonate aquifer, and sample the carbonate aquifer as part of the long-term hydrologic monitoring program; HTH-3; remove the tubing from the well so that further testing can be conducted, evaluate drilling out the back-shoe and clean-out the hole below 1,517 feet, perform a long-term aquifer test to measure aquifer hydraulic properties and to collect water samples, and maintain a locked cap on the well and negotiate easier access to the

site with the Air Force to allow adding the well to the long-term hydrologic monitoring program as an up-gradient hole.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Identify and test several wells to determine water inlet and outlet zones, and establish a well validation program.
- Task 2. Develop the necessary equipment or technique to test wells identified in Task 1.
- Task 3. Calculate water movement below the working point in several typical overdrilled wells.
- Task 4. Examine the use of downhole optical techniques to measure in-situ free versus bound water.

DELIVERABLES

- 1. A well validation report detailing the physical and chemical conditions of the wells tested (fourth quarter).
- 2. A letter report on water movement below the working point (third quarter).
- 3. A letter report detailing the possibility and costs of using downhole optical techniques to determine free versus bound water (fourth quarter).

PROPOSED BUDGET: \$140,000

PROGRESS ON TASKS

Task 1. Identify and test several wells to determine water inlet and outlet zones. Establish a well validation program.

First Quarter (October – December 1990):

Open holes on the NTS are being reviewed for their location, completion history, and hydrologic significance; once a list has been developed, a meeting between DRI and the USGS will be organized to form a list of three to six wells that will be tested to validate the hydrogeology of each well.

Second Quarter (January – March 1991):

A meeting was held in Las Vegas in February and was attended by four DRI personnel. Approximately 20 wells were discussed; four wells were chosen for further evaluation this year, based on their location, lithology, and hydrologic setting (UE5n, HTH-E, UE14b and UE25p#1). After background data review is completed, testing procedures will be established.

Third Quarter (April – June 1991):

Background data have been reviewed for wells UE14b, HTH-E, UE1q, and Test Well B. Phase I testing will be conducted on each of these wells in July and Phase II testing will be conducted on wells HTH-1 and UE18r. Each well will be logged for temperature and EC variations; water samples will be collected from various depths as warranted by the temperature and EC logging results.

Fourth Quarter (July – September 1991):

Phase I testing was conducted at wells UE14b, TWB, HTH-E and UE1q in June and July. Temperature and EC were measured in each well and water samples were collected at specific depths based on the logging results. Phase II testing was conducted at wells HTH-1 and UE18r.

Task 2. Develop the necessary equipment or technique to test wells identified in Task 1.

First Quarter:

Based on experience gained from last year's well validation program, slight modifications have been made to the well logging equipment to increase the accuracy of the temperature and EC logging tool.

Second Quarter:

Steps are being taken to build a thermal flowmeter; it is anticipated that the tool will be available this summer for testing.

Third Quarter:

Further modifications have been made to the EC portion of the chemistry tool to refine the EC measurement resolution. Calibration and testing are to be completed in early July prior to logging.

Fourth Quarter:

A new temperature and EC tool was built in June and was used successfully in the field in June and July. Further modifications are being made to the EC portion of the old chemistry tool. The thermal pulse flow meter is being fabricated, and it should be ready by October. Testing and calibration should be completed by the end of December.

Task 3. Calculate water movement below the working point in several typical overdrilled wells.

No work was done on this task in FY 1991.

Task 4. Examine the use of downhole optical techniques to measure in-situ free versus bound water.

First Quarter:

No work was done on this task.

Second Quarter:

A test sample was obtained from the NTS core library for conducting the preliminary investigations. The sample obtained is identified as UE-7f at coordinates: N 259,845, E 207,318.9 m; (N 852,551, E 680,213 ft); elevation: 1,256.9 m (4,123.8 ft).

The core sample was taken from between 544.7 to 544.9 m (1,787.2 to 1,787.8 ft), tunnel formation unit 4K. The lithographic description lists zeolites, pumice, quartz, feldspar phenocrysts and biotite as constituents.

Small pockets of zeolite in the core sample were scraped to provide samples for analysis. Both powder-diffraction X-ray analysis and Fourier transform infrared spectral analyses were conducted. The zeolite was identified as clinoptilolite.

The infrared spectra clearly show both mineral hydroxyl stretching frequencies and the stretching and bending frequencies of molecular water associated with the zeolite framework.

Third Quarter:

Instrument cables have been purchased to conduct preliminary laboratory experiments.

Fourth Quarter:

Preliminary measurements in the laboratory have shown that it is possible to measure free versus bound water with the FTIR. However, more experiments will have to be run to determine if the amounts of each type of water can be quantified.

STATUS OF DELIVERABLES

1. Well validation report (9/30/91)	Submitted
2. Letter report on water movement (6/30/91) Work has not begun on this task, so the report is delayed indefinitely.	Delayed
3. Letter report on optical techniques (9/30/91)	Delayed
4. Report on FY 1990 findings Draft completed, still waiting for analysis of sites by the USGS.	Delayed

PROBLEMS ENCOUNTERED

First Quarter: The USGS analysis to complete FY 1990 well validation has not been received.

Second Quarter: Awaiting USGS analysis of FY 1990 well validation sites.

Third and Fourth Quarters: No specific problems were encountered.

FY 1991 BUDGET SUMMARY OPERATIONS SUPPORT

RADIONUCLIDE TRANSPORT INVESTIGATIONS

Contact: Jenny Chapman/Michael Whitbeck

PROJECT DESCRIPTION

Contaminant transport through groundwater is a function of the groundwater-flow properties and the physical and chemical characteristics of the water and the contaminant. The flow properties themselves can often be inferred from chemical and isotopic data as the isotopic signature traces a water's source and the chemical constituents are a record of where a water has been along its flowpath.

Given the dual importance of groundwater chemistry to contaminant transport studies, this project will assemble and begin interpreting chemical data collected at the NTS during the past 20 years. The last NTS-wide synthesis of groundwater chemistry and flow-system analysis was performed by Winograd and Thordarson in 1975 using data collected before 1970. Since then, many more samples have been collected and analyzed, but as part of specific, focused projects that were not directed at transport issues for the NTS as a whole. Interpreting these data in terms of flowpaths and the chemical environment along certain flowpaths will help determine what type and in what form various radionuclides may be transported and which pathways are most conducive to such transport.

Specifically, this project will form a usable data base of all chemical and physical characteristics of NTS groundwater pertinent to radionuclide transport. New data will be compared with the pre-1970 dataset using statistical and graphical techniques to build on the aquifer designations and flow relationships established by Winograd and Thordarson on the basis of hydrochemical facies. Factors of particular importance to radionuclide transport (e.g., pH, oxidation/reduction potential, temperature, total dissolved solids, organics, and colloids) will be emphasized and combined with flowpath information derived from chemistry and discrete-state compartment models to identify critical radionuclide transport pathways.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Assemble water chemistry analyses performed on samples collected from the NTS during the period 1970 to 1990. Particular emphasis will be placed on including parameters to which radionuclide transport is most sensitive.
- Task 2. Compare the new geochemical data with the pre-1970 data using statistical techniques and graphical geochemical techniques (e.g., Piper and Stiff diagrams).
- Task 3. Integrate the pre- and post-1970 chemistry data in the form of hydrochemical facies maps and possibly cross-sections. Compare these maps with potentiometric contour maps, discrete state compartment models, and other flow data to identify critical transport pathways.
- Task 4. Examine the potential for radionuclide transport by colloids.

DELIVERABLES

1. A report containing the synthesized geochemical data with a comparison of the pre- and post-1970 data, and interpretation in terms of radionuclide transport. Though the data base will be as complete as possible, the interpretations will be considered preliminary and will emphasize critical sources of uncertainty (fourth quarter).
2. A report on colloid investigations completed during FY 1990 (second quarter).

PROPOSED BUDGET: \$100,000

PROGRESS ON TASKS

Task 1. Assemble water chemistry analyses performed on samples collected from the NTS during the period 1970 to 1990. Particular emphasis will be placed on including parameters to which radionuclide transport is most sensitive.

First Quarter (October – December 1990):

No work was done on this task.

Second Quarter (January – March 1991):

Computer records of NTS samples analyzed since 1987 are being screened for inclusion into the Hydrologic Database. 1984 to 1986 analyses are already in the database. Samples analyzed in 1983 and before are recorded on paper records and laboratory personnel are sorting through those records, identifying the ones that are appropriate for DOE. A chemistry-oriented database is being designed to receive all pertinent data from the primary Hydrologic Database and allow for easy data manipulation.

Third Quarter (April – June 1991):

All chemistry analyses performed by DRI on samples for DOE between 1984 and 1990 have been checked and loaded into the primary DOE Hydrologic Database. The data have also been loaded into the chemistry-oriented database. The effort to assemble the pre-1984 paper records has been suspended due to lack of time left in the fiscal year. This task is now considered complete.

Task 2. Compare the new geochemical data with the pre-1970 data, using statistical techniques and graphical geochemical techniques (e.g., Piper and Stiff diagrams).

First Quarter:

No work was done on this task.

Second Quarter:

The pre-1970 data set was assembled using USGS reports and the data locations identified on NTS-area maps.

Third Quarter:

Work on this task will begin in earnest in the fourth quarter. Decisions have been made as to which statistical techniques to employ for the time-series analysis of the data, and computer software has been identified for use.

Fourth Quarter:

Data records were sorted to identify those with sufficient samples to warrant time-series analysis. Those with three or more samples through time were analyzed to obtain

a mean and standard deviation, but time-series plots have not been completed. Sites with two samples were simply averaged. The goal is to reduce the data so that one representative analysis remains from each well for comparison with the pre-1970 data.

Task 3. Integrate the pre- and post-1970 chemistry data in the form of hydrochemical facies maps and possibly cross-sections.

No work was performed on this task in FY 1991 because Task 2 was not completed.

Task 4. Examine the potential for radionuclide transport by colloids.

First Quarter:

A review of the literature on multi-site ligand/adsorption models was undertaken and is complete. These models will next be evaluated in conjunction with the known geochemistry at the NTS to address colloidal transport.

Second Quarter:

A report is being prepared. A meeting of scientists from LANL, LLNL and DRI was convened to discuss progress, problems and to set priorities for research in the colloidal transport of radionuclides. It was concluded that improved methodology for sampling was needed.

Third and Fourth Quarters:

No work was reported on this task.

STATUS OF DELIVERABLES

1. Report on geochemical data set (9/30/91)	Delayed
Checking and loading the data took longer than expected. It is hoped that the work will be completed in FY 1992.	
2. The report "Characterization of Colloids Found in Various Groundwater Environments in Central and Southern Nevada" by W.L. Kingston and M. Whitbeck (DOE/NV/10384-36, DRI #45083)	Submitted
has been submitted for DOE review and approval to publish.	

PROBLEMS ENCOUNTERED

No specific problems were encountered.

FY 1991 BUDGET SUMMARY RADIONUCLIDE TRANSPORT

LONG-RANGE HYDROLOGIC STUDIES

Contact: Neil Ingraham/Richard French/Carol Thompson

PROJECT DESCRIPTION

One of the questions regarding the NTS groundwater-flow system is under what conditions and where does groundwater recharge occur on the NTS? Previous studies have outlined several potential areas: 1) infiltration along washes; 2) infiltration through exposed bedrock; or 3) infiltration through coarse fan deposits. In this study, recharge associated with wash environments and high elevation will be addressed.

Over the past several years, recharge processes in the high elevation areas of Pahute and Rainier Mesas have been monitored. Four sites have been monitored on the mesas since FY 1989: Camp20, at Area 20 Camp; North20, at the north end of Area 20; Dead Horse, at Dead Horse Flat in Area 19; and Rainier, at the highest point of Rainier Mesa in Area 12. Basic meteorologic data (precipitation, air temperature, relative humidity) are collected at each site, as well as soil temperature at various depths, relative soil moisture (with soil-moisture blocks), and volumetric moisture content (North20 and Dead Horse sites only). Two time-domain reflectometers (TDRs) were installed in FY 1990 to measure the volumetric moisture content of the soils at the North20 and Dead Horse sites. Three additional monitoring stations will be installed in FY 1991 to collect data on recharge and runoff occurring away from the influence of the mesa environment.

The final report of the latest DSC model using deuterium as the tracer is currently being written. The results of this latest model provide new insights into the large-scale groundwater-flow regime on the NTS and should be further explored. Understanding the effect of climate change on the stable isotopic ratios of meteoric water is critical for complete interpretation of any large-scale groundwater-flow system.

Additional studies of the large-scale groundwater-flow system will involve previous numerical modeling of the hydraulic connections at the NTS. This effort will establish the foundations, obtain the code and investigate the setup and design of previous hydrologic models used on and around the NTS. A basic groundwater model will be developed to test sensitivities to various input parameters and to determine geographically sensitive areas on the NTS. This model will also help evaluate the importance of recharge in certain areas, groundwater barriers, areas of vertical flow, groundwater stagnation zones and similar hydrologic conditions.

An additional function of this project is the continued development of the Hydrological Data Base (HDB), a centralized repository for DRI's hydrologic and related data from the NTS. The HDB was set up in 1987, but little work was done because of changes in computer systems and the demands of other projects. In FY 1990, a review of the data base structure was made for compatibility with future data requirements and work on the conversion to the new

structure and a data base software upgrade began. Most of the effort in FY 1991 will involve making the data base operational and setting up procedures to add current data as available.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Conduct continuous monitoring at existing sites for precipitation, air temperature, relative humidity, soil temperature, and soil moisture.
- Task 2. Install three additional recharge monitoring stations.
- Task 3. Coordinate with the National Weather Service to conduct airborne snow surveys, if appropriate.
- Task 4. Continue to collect isotopic data and compare the isotope DSC model to a classic hydrologic model.
- Task 5. Complete the report on the DSC model results.
- Task 6. Establish the foundation for a basic groundwater flow model for the NTS.
- Task 7. Implement the HDB with selected user-application retrievals and prepare procedures for the management of the data base.
- Task 8. Prepare a user's manual and other documentation.
- Task 9. Implement procedures for adding current and historical data as they become available.
- Task 10. Evaluate NTS hydrometeorological data.

DELIVERABLES

- 1. A letter report summarizing the data collected with significant findings from the recharge stations described (fourth quarter).
- 2. A report on the DSC model (fourth quarter).
- 3. A letter report on progress toward establishing a hydrologic model for the NTS (fourth quarter).
- 4. A user's manual for the Hydrologic Data Base (fourth quarter).
- 5. A letter report on data added to the Hydrologic Data Base (fourth quarter).
- 6. A report on NTS hydrometeorological data (fourth quarter).

PROPOSED BUDGET: \$200,000

PROGRESS ON TASKS

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

First Quarter (October – December 1990):

A letter report reviewing data collected in FY 1990 has been completed and submitted to DOE for review. Recharge monitoring station data have been collected. One datalogger at Rainier Mesa was struck by lightning and is only partially operational.

Second Quarter (January – March 1991):

Recharge monitoring station data have been collected. Only 50 percent of the data was collected at the Rainier Mesa Site. The partially operational data logger will be up and running by the third quarter.

Third and Fourth Quarters (April – September 1991):

The four recharge monitoring sites were in full operation throughout this period.

Task 2. Install three additional recharge monitoring stations.

First Quarter:

Potential sites have been identified for the installation of the recharge monitoring stations.

Second Quarter:

Preliminary sites have been selected and field reconnaissance has been made to three sites: Big Burn Basin, Mid Valley, and Shaker Plant Wash.

Third Quarter:

Most of the equipment needed to install the stations has just been received. It will be installed during the fourth quarter.

Fourth Quarter:

Installation of the stations has been delayed due to other field activities. Plans are being made to install the equipment in October 1991.

Task 3. Coordinate with the National Weather Service to conduct airborne snow surveys, if appropriate.

No work was done on this task in FY 1991 because other tasks had higher priority.

Task 4. Continue to collect isotopic data and compare the isotope DSC model to a classic hydrologic model.

First Quarter:

No work was done on this task.

Second and Third Quarters:

The DSC model has been conceptually compared to classic hydrologic models on the NTS. Analysis of the results is in progress.

Fourth Quarter:

No work was done on this task.

Task 5. Complete the report on the DSC model results.

First Quarter:

The first draft of the DSC model report has been completed and reviewed by all principal investigators. The research is now being reviewed and assessed for possible publication in a refereed journal.

Second Quarter:

The draft DSC model report is being prepared for internal review.

Third Quarter:

The final draft of the DSC model report is nearly complete. Only minor changes are required before internal review begins.

Fourth Quarter:

No work was done on this task.

Task 6. Establish the foundation for a basic groundwater flow model for the NTS.

First Quarter:

No work was done on this task.

Second and Third Quarters:

Portions of the DSC model are currently being used to conceptually understand smaller flow regions on the NTS. This understanding is being compared to previous notions concerning the groundwater flow system on the NTS.

Fourth Quarter:

A letter report comparing the results of the DSC model to the results of other modeling studies is being prepared. The comparison will focus on the conceptual understanding of the groundwater flow system at the NTS. The letter report should be completed in October.

Task 7. Implement the HDB with selected user-application retrievals and prepare procedures for the management of the data base.

First Quarter:

Work continued on refining the design of and users' needs for access to the HDB before it is converted to the new version of the data base software. The data base design is in its last round of review before the conversion of the data currently in the data base takes place.

Second Quarter:

A final review of the design of the data base took place and some adjustments were made. Work began to implement the design with the data base management software.

Third Quarter:

Work continued to prepare the diagram and structure documentation of the revised data base design. This last version has been given to the primary researchers for confirmation.

Fourth Quarter:

The new structure for the data base was implemented. That structure and the data from the current data base were moved into the new version of the data base software. Checks, via retrievals, were made on the new system to make sure that the data had been transferred as planned. Retrievals from the current data base were made as requested by DRI researchers.

Task 8. Prepare a user's manual and other documentation.

No progress was made on the user's manual or the formal documentation in FY 1991. Documentation related to the new structure and the transfer of the data was kept as these functions were developed.

Task 9. Implement procedures for adding current and historical data as they become available.

First Quarter:

No progress was made on this task.

Second Quarter:

DRI chemical data from the period 1987 through 1990 were begun to be loaded into the data base. This process entailed writing a new program to read the data files, adding missing information (such as well locations), and checking the quality of the data.

Third Quarter:

The results of NTS water samples analyzed by DRI's Water Laboratory from 1987 to 1990 were added to the HDB. All the results from 1984 through 1990 are now available. A file of this information was created for the Radionuclide Transport Investigations project.

Fourth Quarter:

No progress was made on this task.

Task 10. Evaluate NTS hydrometeorological data.

First Quarter:

No progress was made on this task.

Second Quarter:

"Target-of-opportunity" planning is underway to study recharge in a dry wash during a pump test in Area 14. The planning horizon is two months. Comparison of snow data collected by heated tipping buckets and weighing buckets is 80 percent complete. The results will be contained in a letter report.

Third Quarter:

Work continues on the wash recharge aspect. Coordination with REEC Co over conducting this experiment continues. Comparison of snow data is complete.

Fourth Quarter:

Work on the wash recharge aspect has been delayed because of delays in REEC Co's schedule. REEC Co now anticipates that the pump test will occur in January 1992, which will not be an ideal time to study wash recharge since it is likely the ground will be frozen. Coordination with REEC Co regarding this experiment continues.

The comparison of snow data demonstrated that during small events the heated tipping bucket gauges underestimated the depth of precipitation relative to the weighing bucket gauges. A letter report regarding this is being prepared. The necessary electronic equipment was ordered to convert the weighing bucket gauges to a digital format that is compatible with the other equipment at the recharge monitoring stations.

The daily precipitation database has been updated through the end of 1990.

STATUS OF DELIVERABLES

1. Letter report on recharge station data (9/30/91)	Delayed
This report should be ready by 11/30/91.	

2. Report on DSC model (9/30/91)	Delayed
3. Letter report on hydrologic model (9/30/91)	Delayed
4. User's manual for data base (9/30/91)	Delayed
5. Letter report on data base (9/30/91)	Delayed
6. Report on hydrometeorological data (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

First and Second Quarters: No specific problems were encountered.

Third Quarter: Although the water chemistry results for Task 9 were in computerized format, much of the sample information had to be checked by hand. This increased the amount of time needed to complete the task.

Fourth Quarter: The installation of three additional sites has been delayed due to conflicting field activity schedules.

DRILLING AND TESTING SUPPORT

Contact: Roger Jacobson

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.

The major activity of this program will be the 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.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Choose a location for the FY 1991 HRMP drilling site, develop a drilling, sampling, and testing plan, and assist with testing and sampling during and after construction of the well.

DELIVERABLES

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

PROPOSED BUDGET: \$40,000

PROGRESS ON TASKS

Task 1. Choose a location for the FY 1991 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 1990):

No work was or will be done on this task, as no HRMP well will be drilled in FY 1991.

Second Quarter (January – March 1991):

Contrary to what was reported last quarter, plans now call for an HRMP well to be drilled during the fourth quarter of FY 1991. It will be in the south-central part of Area 20 and will be the first of a set of wells surrounding a future nuclear test.

Third Quarter (April – June 1991):

Site selection and planning for the Area 19 HRMP Hole were carried out. Initial plans were generated after a January HRMP meeting to investigate the environmental consequences of apparently perched water at the Houston site. Eventually the mission of this year's effort was expanded to environmental evaluation of Area 19, and a second set of proposed hydrologic investigations was developed and presented in April. In that meeting, a proposal emerged to carry out a "cradle to grave" hydrologic evaluation of a testing area, where the current well would be used to make hydrologic observations in an area before any weapons testing occurred. LLNL eventually proposed the site of the UE20bh well, and DRI was delegated responsibility for developing and supervising a hydrologic testing plan. This plan was submitted to LLNL in mid-June, and a final version of the plan will be submitted to NTS contractors by mid-July.

Fourth Quarter (July – September 1991):

After a number of planning meetings and revisions, a final Completion Plan was submitted to RSN for budgeting and contracting. The hydrologic testing will be divided into multiple phases that DRI will supervise. First will be delineation of flow zones using several flowmeter-type logs. Results from various methods will be compared. A long-term aquifer test will then be performed to develop the well and to determine a transmissivity for the full thickness of aquifer penetrated by the well. Drill stem tests will follow using a variable-speed pump. This should allow characterization of all anticipated ranges of permeable zones. Finally, the well will be cased and screened, then tested once more to determine well efficiency.

FY 1991 BUDGET SUMMARY
DRILLING & TESTING

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 1991 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: Carol Thompson

PROJECT DESCRIPTION

Currently, the BECAMP data base remains in the development phase. Work in FY 1991 will include completing the written procedures for managing the data base, completing the development of the data base, and adding archival data as they become available.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Complete the detailed procedures for implementation and management of the data base, data and document archival, and quality assurance.
- Task 2. Complete the implementation of the data base with the NAEG and RIDP data.
- Task 3. Prepare a user's manual for the data base.

- Task 4. Add BECAMP research data to the data base as they become available.
- Task 5. Submit documents pertinent to the BECAMP to Center for Information Control (CIC) for archival as they become available.
- Task 6. Add the DRI archaeology data to the data base.
- Task 7. Assist BECAMP researchers in using the data base.
- Task 8. Prepare a year-end summary report of FY 1991 progress.

DELIVERABLES

- 1. A draft quality assurance plan and management procedures for the data base (third quarter).
- 2. A final quality assurance plan and management procedures for the data base (fourth quarter).
- 3. A user's manual for the data base (fourth quarter).
- 4. A status report on addition of data to the data base (fourth quarter).

PROPOSED BUDGET: \$136,000

PROGRESS ON TASKS

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

No progress was made on this task in FY 1991.

Task 2. Complete the implementation of the data base with the NAEG and RIDP data.

First Quarter:

Work began to get the NAEG data in shape (assumptions on key missing data and missing records) for input to the data base management software.

Second Quarter:

Work progressed on correcting the information on the collection records, especially to determine the top and bottom depth for each soil sample, filling in collection dates, and correcting some of the location information. Problems in these areas were reviewed with LANL and REECOs Soils Laboratory personnel.

Third Quarter:

Work continued in correcting the information in the NAEG soils data that would affect their entry into the data base. This included writing a program to check and annotate such problems for review and correction. The review of these data began and help from REECOs Soils Laboratory to check on questions is being coordinated.

The review of the NAEG data base has been assigned to another staff member to facilitate better progress. The main programmer will begin work on the data base structure in the next quarter.

Fourth Quarter:

Work continued on correcting the information in the NAEG soils data that would affect their entry into the data base. Adjustments were made to the checking program after the first data set was reviewed to enhance the capabilities for checking and annotation. The help of staff from REECOs Soils Lab was enlisted to review the major questions since most of the information on the records originated there.

The programmer assigned to work on the data base implementation began learning the nuances of ORACLE, the data base management software. A set of current manuals was ordered and the programmer began learning how to use some of the features required for the data base, including security. Some improvements were made to the 1988 data base design.

Task 3. Prepare a user's manual for the data base.

Task 4. Add BECAMP research data to the data base as they become available.

Work on Tasks 3 and 4 cannot begin until Tasks 1 and 2 are completed.

Task 5. Submit documents pertinent to the BECAMP to CIC for archival as they become available.

Fourth Quarter:

The CIC made copies of the NAEG/RIDP/BECAMP information stored in the file cabinets as part of the archival function. Additional information still needs to be copied.

Task 6. Add the DRI archaeology data to the data base.

First and Second Quarters:

No progress was made on this task.

Third Quarter:

A teacher from a summer DRI-DOE program began work with the archaeology staff to define the elements of DRI's archaeology that would go into the data base.

Fourth Quarter:

Work on the structure for the archaeology part of the data base was completed by the teacher from the summer DRI-DOE program. Documentation for this structure was provided to the principal investigator.

Task 7. Assist BECAMP researchers in using the data base.

Task 8. Prepare a year-end summary report of FY 1991 progress.

No work was done on Tasks 7 and 8 in FY 1991.

STATUS OF DELIVERABLES

1. Draft QA plan (6/30/91)	Delayed
2. Final QA plan (9/30/91)	Delayed
3. User's manual for data base (9/30/91)	Delayed
4. Status report on data base (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

First Quarter: Two programmers have been identified to handle the tasks of this project. Not enough time was available from the main programmer and the principal investigator, due to other project commitments, to have allowed more progress on Tasks 1 and 2. The other tasks are dependent on Tasks 1 and 2 for completion.

Other Support: Assistance was given to the Quality Assurance Principal Investigator from LANL in assessing the sensitivity of the BECAMP data base.

Second Quarter: Not enough time was available from the main programmer and the principal investigator, due to other project commitments, to have allowed more progress on Tasks 1 and 2. Some delegation of duties is being made to relieve this problem.

Third Quarter: No specific problems were encountered.

Fourth Quarter: It was not until September that we were able to coordinate with the staff from the REECO Soils Lab to help review some of the data questions. More progress on the data base implementation was not made because of other project commitments which will be moving away.

FY 1991 BUDGET SUMMARY BECAMP DATA BASE

\$5,000 was given to the REECO CIC for the copying of the information at the REECO Soils Lab in preparation for archival. \$5,000 was given to REECO for use in the Desert Tortoise Program. \$10,000 was given to REECO for the time of the staff in the Soils Lab to help with the data questions.

BECAMP PROJECT DESIGN SUPPORT

Contact: Richard McArthur

PROJECT DESCRIPTION

The primary goal of this project is to help provide statistical support to the BECAMP. In FY 1991, this work is expected to include designing sampling plans and protocols, analyzing data and interpreting results, and reviewing reports and manuscripts. Some effort will also be devoted to preparing journal articles in conjunction with other BECAMP scientists.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Assist in preparing a journal article on the inventory and distribution of residual radionuclides on and near the NTS.
- Task 2. Assist the BECAMP scientists studying the flora and fauna of the NTS with the design of their studies and the analysis of their data.
- Task 3. Provide other support to BECAMP researchers as needed.

DELIVERABLES

None

PROPOSED BUDGET: \$33,000

PROGRESS ON TASKS

Task 1. Assist in preparing a journal article on the inventory and distribution of residual radionuclides on and near the NTS.

First Quarter (October – December 1990):

Approval to publish the summary report for the Radionuclide Inventory and Distribution Program (RIDP) was received in October. However, the program's Scientific Director requested some changes, one of which may require significant additional work. The report, which is part of the basis for the journal article, will be published as soon as this final problem (described below) is resolved.

Second Quarter (January – March 1991):

No response has been received from the Scientific Director of the Radionuclide Inventory and Distribution Program (RIDP) concerning the problem with the Little Feller II data. The RIDP summary report, which is part of the basis for the journal article, will be published as soon as this problem is resolved.

Third Quarter (April – June 1991):

The BECAMP Scientific Director has resolved the problem with the Little Feller II data from the RIDP. Work on the RIDP summary report will proceed next quarter.

Fourth Quarter (July – September 1991):

The RIDP summary report was completed and distributed to all BECAMP participants.

Task 2. Assist the BECAMP scientists studying the flora and fauna of the NTS with the design of their studies and the analysis of their data.

First Quarter:

A meeting was held with the researchers at REECo on November 15 to discuss various statistical aspects of their work. Most of the discussion focused on the lizard and small mammal studies, especially the method used to estimate densities and how to present the results. Other topics included the design of an experiment to study the competitive effect of introduced grasses on native plants and the analysis of small mammal data from the Liquified Gaseous Fuels Spill Test facility.

Also, the Detailed Procedure for wildlife observations on the NTS was reviewed and approved.

Second Quarter:

A draft of the report "Status of Perennial Plants on the Nevada Test Site in 1988" was received and comments sent to the author.

Third and Fourth Quarters:

No work was done on this task.

Task 3. Provide other support to BECAMP researchers as needed.

First Quarter:

The principal investigator attended a meeting on November 8 to discuss BECAMP goals and activities related to the designation of the NTS as a National Environmental Research Park.

In addition, the approximate locations of the plutonium-contaminated areas on the NTS and bombing range were determined (from previously published maps). This information will be used by EG&G to prepare a map showing the size and location of environmental restoration sites.

Second Quarter:

A draft manuscript on the use of uncertainty analyses with the Area 13 cattle data and a draft book that summarizes the work of the Nevada Applied Ecology Group were reviewed.

Third Quarter:

The principal investigator attended the BECAMP meeting in Las Vegas on June 25.

Fourth Quarter:

No support was requested.

STATUS OF DELIVERABLES

1. RIDP summary report, "Radionuclides in Surface Soil at the Nevada Test Site," August 1991, DOE/NV/10845-02, DRI Publication #45077.	Completed

PROBLEMS ENCOUNTERED

First Quarter: During a check of the calculations for the RIDP summary report, it was found that some of the parameter values used in analyzing the Little Feller II data were probably incorrect. The Scientific Director has been asked to verify this and to offer advice on what to do about it.

Second Quarter: The summary report is delayed due to the unresolved problem with the Little Feller II data (see Task 1).

Third and Fourth Quarters: No specific problems were encountered.

FY 1991 BUDGET SUMMARY
BECAMP PROJECT DESIGN

OFFSITE RADIATION EXPOSURE REVIEW PROJECT (ORERP)

Contact: Carol Thompson

PROJECT DESCRIPTION

DRI's current responsibilities for the ORERP emphasize quality assessment of the ORERP data bases and the creation and operation of the Individual Dose Assessment (IDA) Model. Work in FY 1991 will include completing two reports on previous tasks (Town Data Base and Lifestyle Survey), assessing the quality of several ORERP data bases, and developing an operational version of the IDA model.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Document and archive the computer programs and data relating to the Town Data Base.
- Task 2. Prepare a report on the Town Data Base.
- Task 3. Prepare a report on the Lifestyles Survey.
- Task 4. Continue development of the IDA model as segments become available from other task groups.
- Task 5. Continue assessing the quality of ORERP data bases.
- Task 6. Complete the transfer of Enewetak soil data to LLNL.
- Task 7. Provide other support as requested.

DELIVERABLES

- 1. A status report on the archive of the Town Data Base materials (third quarter).
- 2. A draft of the report on the Town Data Base (third quarter).
- 3. A draft of the report on the Lifestyles Survey (fourth quarter).
- 4. A status report on the transfer of Enewetak soil data to LLNL (third quarter).

PROPOSED BUDGET: \$154,000

PROGRESS ON TASKS

Task 1. Document and archive the computer programs and data relating to the Town Data Base.

First Quarter (October – December 1990):

Much time has been devoted to documenting the computer programs, procedures and data relating to the Town Data Base and the majority of the effort has been completed. Additional time is needed now to do this work because past DOE priorities have been to complete the data analysis and to make the actual data base available to ORERP. The documentation of the programs and procedures that were developed before 1985 are taking longer to work through because of the nondetailed nature of that documentation.

Second and Third Quarters (January – June 1991):

Work continued on the documentation of the computer programs and data files for the Town Data Base. The work was about 85 percent complete at the end of the third quarter.

Fourth Quarter (July – September 1991):

Documenting and placing the files on magnetic tape is about 98 percent completed. In some cases the amount of effort expended had to be balanced against the potential usefulness of some of the files. This meant making judgments about how much cleanup to perform on the older files or the extent of the documentation to be added to the newer programs to get this completed.

Task 2. Prepare a report on the Town Data Base.

First Quarter:

A first draft of the Town Data Base Report for DRI internal review has been completed.

Second Quarter:

No progress was made on this task.

Third Quarter:

Some work was performed toward the production of a second internal draft.

Fourth Quarter:

No progress was made on this task.

No work was done on Tasks 3 through 5 during the first two quarters.

Task 3. Prepare a report on the Lifestyles Survey.

Third Quarter:

The work to create the table and graphs for this report was reviewed. The computer at UNLV on which all of the analyses for this survey were run was shut down at the end of June. Time was spent sorting through and transferring those files to be used on DRI's computers.

Fourth Quarter:

Work progressed to define the table and histogram formats for the summaries from the survey. Most of the tables and histograms have been run once and are ready for review.

Task 4. Continue development of the IDA model as segments become available from other task groups.

Third Quarter:

At the April ORERP meeting, it was decided that this task would not begin until FY 1992 when CSU had their portion of the model completed.

Fourth Quarter:

No work was performed because the model from CSU was not available. DOE has been rethinking the form the IDA model will take because of the current cost-benefit.

Task 5. Continue assessing the quality of ORERP data bases.

Third Quarter:

Several reviews of the last event, KIWI B-4EV, in the Survey Meter Data Base were made.

Fourth Quarter:

All of the events from the SMDB have passed the quality check. Final changes to the report were made. DOE has asked that this version be reviewed once more before printing.

Task 6. Complete the transfer of Enewetak soil data to LLNL.

No work was done on this task during the first three quarters.

Fourth Quarter:

In beginning work on this task, it was found that the tape with the data from the original computer system had been scrapped in the move from DOE's Cyber to the DOE VAX system.

A backup file was found with most of the information that was on the tape. The following will be sent to LLNL to complete this task: plots of the islands showing the 50- and 100-km sampling points found in the published report and in the backup file; the values for Am-241 and Cs-137 imposed on these plots for the top and bottom depths of each profile; a tape that contains the result and sampling locations for all of the islands except Janet (transferred before); and documentation of what is being passed on and the possible problems that may need to be reviewed by LLNL.

Task 7. Provide other support as requested.

First Quarter:

No work was done on this task.

Second Quarter:

A draft of the report on the County Data Base was reviewed and returned to the author with comments.

Third and Fourth Quarters:

No work was done on this task.

STATUS OF DELIVERABLES

1. Status report on TDB archiving (6/30/91)	Delayed
2. Draft of TDB report (6/30/91)	Delayed
3. Draft of Lifestyles Survey report (9/30/91)	Delayed
4. Status report on Enewetak data (6/30/91)	Delayed

PROBLEMS ENCOUNTERED

First Quarter: No specific problems were encountered.

Second Quarter: The main programmer was pulled temporarily for assignment to another DOE project, but will be able to continue this work in the third quarter.

Third Quarter: Documentation of the estimates from the Town Data Base will not be completed this fiscal year because time from the principal investigator will not be available. Work on Task 1 has been slower than expected because the programmer has been pulled to other tasks. A decision has also been made to limit the documentation for some of the programs created before 1985 that relate to the creation of the 10-km Grid Data Base. The original documentation for these programs and data sets was not kept up as well as for those

created after 1985 and the cost of creating perfect documentation is too high given the potential benefit or use.

Fourth Quarter: No specific problems were encountered.

FY 1991 BUDGET SUMMARY OFFSITE

YUCCA MOUNTAIN PROJECT

INTRODUCTION

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 DOE, the Advisory Council on Historic Preservation (ACHP), and the Nevada Division of Historic Preservation and Archaeology (NDHPA), 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 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: Lonnie C. Pippin/David E. Rhode

PROJECT DESCRIPTION

General tasks identified in the EFAP, to be conducted during the site characterization phase of the Yucca Mountain Project (YMP), 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 1991 are listed below.

TASKS TO BE ACCOMPLISHED IN FY 1991

- 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. Complete the Research Design and Long-Range Data Recovery Plan for concurrence with DOE and ACHP.
- Task 4. Prepare and implement site-specific data recovery plans for archaeological data recovery of selected cultural resources in the YMP area, as specified in the Research Design and PA. In FY 1991, data recovery efforts will focus on those cultural resources located in the Midway Valley area.
- Task 5. Implement and maintain appropriate quality assurance procedures for archaeological field work, artifact analysis, and curation.
- Task 6. Maintain and update cultural resources inventory and analysis files, artifact storage and site records as necessary.
- Task 7. Provide escort to archaeological resources as necessary.
- Task 8. Undertake activities relevant to the public relations and worker education programs as specified in the EFAP.
- Task 9. Assist the DOE in preparation of cultural resources management objectives and reports, and coordination of cultural resources 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 YMP, as necessary.
- 2. Letter reports and short reports describing the status of preactivity cultural resource surveys, evaluations of cultural resource significance and potential adverse impacts, and recommendations regarding alternative means for the mitigation of those impacts, as necessary.
- 3. Data recovery plans, progress reports and summary documents describing data recovery activities conducted for the YMP, as needed.
- 4. Documentation of quality assurance procedures for field and laboratory activities, and preparation of forms describing compliance with those procedures, as needed.
- 5. Activities (e.g., teaching programs, interpretive displays, video programs, presentations) relevant to the public relations and worker education programs specified in the EFAP, as requested.

PROPOSED BUDGET: \$540,000

PROGRESS ON TASKS

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.

First Quarter (October – December 1990):

The general YMP research design and data recovery plan, prepared by DRI in the previous quarter, was submitted by the DOE to the ACHP. This document detailed the strategy of data recovery in monitoring compliance with the PA. The ACHP formally approved the research design and data recovery plan in December 1990.

The site monitoring program was conducted at several historical properties in the Yucca Mountain Project Area. At one site, 26Ny2970, monitoring revealed site disturbance resulting from off-road vehicle use. This was reported to the DOE at the end of December 1990. Mitigative actions will be discussed with the DOE early in the second quarter.

DRI also continued to coordinate with the Bureau of Land Management (BLM), National Park Service (NPS), U.S. Geological Survey (USGS), and Fish and Wildlife Service (FWS) concerning compliance with cultural resources regulations in support of DOE on several preactivity surveys for YMP activities located throughout southern Nevada and southeastern California (see Task 2).

Second Quarter (January – March 1991):

The Yucca Mountain Project research design and data recovery plan, reviewed by the ACHP during the previous quarter, was formally approved by the DOE. This document details the general strategy of data recovery in monitoring compliance with the PA. Additionally, DRI prepared sections of the Annual Report on compliance with the Programmatic Agreement, submitted to the ACHP in March. DRI also continued to coordinate with the BLM, USGS, and other agencies concerning compliance with cultural resources regulations in support of DOE on several preactivity surveys for YMP activities located throughout southern Nevada and southeastern California (see Task 2). Finally, DRI has consulted with the ACHP on numerous occasions concerning activity-specific plans for mitigative data recovery at specific sites in the Yucca Mountain Project region.

Third Quarter (April – June 1991):

DRI prepared site-specific data recovery plans for work required at archaeological sites on Alice Hill and in Midway Valley. These plans were submitted to DOE for review, and the Alice Hill plan was submitted to the ACHP and the SHPO for their comment. The ACHP responded to the Alice Hill plan, and work is expected to start on this project during the next quarter. ACHP comment on the Midway Valley data recovery plan is expected during the next quarter also, and work will commence shortly thereafter. DRI also continued to coordinate

with the BLM, USGS, and other agencies concerning compliance with cultural resources regulations in support of DOE on several preactivity surveys for YMP activities located throughout southern Nevada and southeastern California (see Task 2).

Fourth Quarter (July - September 1991):

The site-specific data recovery plan for work required at archaeological site 26Ny4759 in Midway Valley was submitted to the ACHP and the SHPO for review and comment. In August, the ACHP accepted the plan with a request for clarification on some points, and DRI prepared responses to their concerns. Work on this data recovery project commenced in September (see Task 4, below). DRI also continued to coordinate with the BLM, USGS, and other agencies concerning compliance with cultural resources regulations in support of DOE on several preactivity surveys for YMP activities in southern Nevada (see Task 2). Finally, DRI assisted SAIC personnel in compiling the Environmental Monitoring and Mitigation Plan Progress Report for 1991.

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

First Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for eight preactivity surveys. These projects include additional survey work near Trench A in the Midway Valley area, radiological monitoring plots, a light-duty vehicle staging area in Area 25 camp, Ecological Study Plot LLG7T, seismometer array plots, and locations of several surface water gauges and a water gauge simulation area. Additionally, work continued on surveys of existing seismic stations and proposed seismic stations and uplinks. Short reports were prepared describing the results of archaeological survey at seismic uplink stations (SR120390-1). Short reports for other preactivity survey projects are currently in preparation and will be submitted early in the second quarter of FY 1991.

Second Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for several preactivity surveys. These projects include additional survey work near Trench 14 in the Midway Valley area, along Alice Hill Road, and in the Cima volcanic area of southern California. Additionally, preactivity survey requests not requiring field work were processed for four proposed activities: telephone cable repair, spotted bat field studies, and Area 25 camp water system modifications, and EG&G trailer installation. Short reports detailing results of surveys were submitted for the Trench 14 survey, the Alice Hill Road repair survey, radiological monitoring plots, a light-duty vehicle staging area in Area 25 camp, Ecological Study Plot LLG7T, seismometer array plots, locations of several surface water gages and water gaging simulation area, and on existing and proposed seismic station locations. Short reports for the Cima volcanism project are currently in preparation and will be submitted early in the next quarter.

Third Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for several preactivity surveys. These projects include USGS flood-chasing activities, seismic station installation on Shoshone Peak, layout of flight panels for aerial photographic missions, installation of nine radiological monitoring stations, and soil test pits near the Lathrop Wells cinder cone. Short reports detailing results of surveys were submitted for the Cima Volcanic area (work was conducted last quarter) and the Lathrop Wells cinder cone. Short reports for the Shoshone Peak seismic station, flight panels, and the radiological monitoring stations are in preparation and will be submitted early in the next quarter. Survey for the USGS flood-chasing activities will also continue in the next quarter.

Fourth Quarter:

DRI personnel conducted records searches or archaeological field reconnaissance for several preactivity surveys. These projects include USGS flood-chasing activities, layout of flight panels for aerial photographic missions, placing streamflow gauges, expanding small mammal trapping grids, drilling of neutron boreholes, the JF-3 Well, and the prototype borehole, installing radiological monitoring stations, soil test pits and trenches in Midway Valley, installing a seismic station on Shoshone Peak, and establishing a reclamation trials site.

Survey or site reconnaissance was conducted for all but two of these projects. Work on the seismic station consisted of additional consultation with the USGS concerning options to avoid a known archaeological site in the proposed project area. The reclamation trial site was restricted to an area of existing disturbance, and did not require survey. Letters describing survey results and recommendations for further work have been submitted for all projects except the flood-chasing activities (which will continue in FY 1992) and the gauge placement. Short reports describing the results will be prepared during FY 1992.

In addition, one unit of the Southern Yucca Mountain sample survey was completed.

Task 3. Complete the Research Design and Long-Range Data Recovery Plan for concurrence with DOE and ACHP.

First Quarter:

As noted in Task 1, the Research Design and Data Recovery Plan for Yucca Mountain Project Archaeology Program was approved by the ACHP, and this task is now completed. The substance of this document will be incorporated into Environmental Field Activity Plans (EFAPs) in the near future.

This task is complete.

Fourth Quarter:

A draft revision of the Environmental Field Activity Plan for Archaeology, incorporating the substance of the research design and data recovery plan, was submitted to SAIC and DOE for review.

Task 4. Prepare and implement site-specific data recovery plans for archaeological data recovery of selected cultural resources in the Yucca Mountain Project area, as specified in the Research Design and PA.

First Quarter:

Specific data recovery plans for trenching operations in Midway Valley and for thermoluminescent dosimeter placement at site 26Ny5731 are currently being prepared. These sites were visited in the last quarter, and specific recommendations for data recovery strategies at the sites was devised. Data recovery plans describing those mitigative measures are in preparation, and will be submitted to the DOE upon request.

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

Second Quarter:

Two site-specific mitigative data recovery plans, for the Midway Valley Quarry site (26Ny4759) and for sites along Alice Hill Road, are currently in preparation and will be submitted for DOE and ACHP review in the next quarter.

Work is continuing to identify and map depositional and geomorphic units important for archaeological interpretation in the Yucca Mountain Project 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.

Third Quarter:

Site-specific mitigative data recovery plans for the Midway Valley Quarry site and for sites along Alice Hill Road were submitted for DOE and ACHP review.

Work is continuing to identify and map depositional and geomorphic units important for archaeological interpretation in the Yucca Mountain Project 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.

The first year's data on effective hydration temperature regimes in the Yucca Mountain region were collected. These data will provide a basis for calibrating obsidian hydration measurements on artifacts to provide chronological information.

Several ceramic samples from archaeological sites in the Yucca Mountain region were submitted for age determination using the thermoluminescence method.

Fourth Quarter:

At the Midway Valley Quarry site (26Ny4759), archaeological data recovery field work commenced on September 4 and continued through September. It is expected that field data recovery will continue through mid-October on this site.

Data recovery was completed at three sites along Alice Hill Road in July. All three sites were small surface lithic scatters, each with fewer than 50 artifacts. These small sites are representative of a large number of sites in the Yucca Mountain area, making up most of the archaeological record in this region. DOE requested that DRI determine whether enough of these small sites have been studied that continued data recovery at these small sites is no longer necessary. This study will be conducted during FY 1992.

Work continued on creating a multi-level Geographic Information System (GIS) for the archaeological resources in the project area.

Additional effective hydration temperature (EHT) probes were placed in selected locations in the Yucca Mountain area to measure surface EHT, to complement the subsurface information currently being collected. This information is needed to calibrate obsidian hydration measurements on artifacts to provide chronological information.

Several ceramic samples from archaeological sites in the Yucca Mountain region were submitted for age determination using the thermoluminescence method. Results from one sample were obtained, providing a date of approximately 500 years ago for the Dune Wash Rockshelter site (26Ny3042).

Task 5. Implement and maintain appropriate quality assurance procedures for archaeological field work, artifact analysis, and curation.

First Quarter:

DRI formally entered into an agreement with the DOE to operate under the Technical and Management Support Services (T&MSS) Quality Assurance (QA) program. This action included development and submittal of grading packages to determine the quality criteria important to DRI activities, preparation of training documentation for all DRI personnel participating in the YMP Archaeology Program, and QA training for DRI personnel. Work instructions have been prepared and submitted for QA review.

Second Quarter:

As part of the T&MSS QA program, DRI archaeological activities were re-examined and placed on the Projects Requirements list, indicating their position as not quality-affecting

activities. Several new DRI personnel working on the YMP were provided required QA training. Work instructions for particular activities have been prepared and submitted for QA review.

Third Quarter:

As part of the T&MSS QA program, DRI archaeological work instructions for particular activities were submitted for internal QA review.

Several new DRI employees working on the YMP were provided required QA training.

Fourth Quarter:

DRI archaeological work instructions for particular activities (archaeological survey, site recording, surface artifact collection, and excavation) were given internal QA review. Comments from the review were incorporated into the documents, and these work instructions and accompanying forms were returned to T&MSS personnel for final processing.

Several new DRI employees working on the YMP were provided required QA training.

Task 6. Maintain and update cultural resources inventory and analysis files, artifact storage and site records as necessary.

First, Second, and Third Quarters:

Cultural resources inventory files and site records have been updated to incorporate all new archaeological properties located as part of YMP activities. In addition, a complete inventory and organization of all artifacts collected for the YMP is continuing.

Fourth Quarter:

Cultural resource inventory files and site records have been updated to incorporate all new archaeological properties located as part of YMP activities. In addition, a complete inventory and organization of all artifacts collected for the YMP has been completed. Corrections to the archaeological databases will be made as necessary during FY 1992.

Task 7. Provide escort to archaeological resources as necessary.

First, Second, and Third Quarters:

No escort to archaeological sites was required.

Fourth Quarter:

DRI personnel escorted personnel from DOE and Pan Am World Services to obtain photographs of archaeological sites for use in technical and public presentations and other

purposes. In addition, DRI archaeologists escorted SAIC personnel to one archaeological site as part of the USGS flood-chasing preactivity survey project.

Task 8. Undertake activities relevant to the public relations and worker education programs as specified in the EFAP.

First Quarter:

The training program developed by DRI for worker education about environmental regulations and duties pertaining to archaeological resources was presented to YMP participants. This program constitutes a major component of the worker education.

In addition, DRI personnel submitted a paper for the April 1991 American Nuclear Society Symposium on high-level radioactive waste management. This paper presents general information on the Yucca Mountain Project Archaeological Program.

Second Quarter:

The training program developed by DRI for worker education about environmental regulations and duties pertaining to archaeological resources was presented to YMP participants. This program constitutes a major component of the worker education program required by the PA (see Task 1).

Third Quarter:

The training program developed by DRI for worker education about environmental regulations and duties pertaining to archaeological resources was presented to YMP participants. This program constitutes a major component of the worker education program required by the PA (see Task 1). Additionally, a display on the archaeological program was developed and presented at public tours of the Yucca Mountain Site Office in Area 25. Finally, photographs and slides of Native Americans and archaeological artifacts were submitted to Yucca Mountain Project Office personnel and to SAIC staff for inclusion in public talks and displays.

Fourth Quarter:

The training program developed by DRI was presented to YMP participants. In addition, the display on the archaeological program was presented at several public tours of the Yucca Mountain Site Office. Finally, DRI assisted DOE in obtaining photographs of archaeological sites in the Yucca Mountain region for inclusion in public talks and displays.

Task 9. Assist the DOE in preparation of cultural resources management objectives and reports, and coordination of cultural resources management plans with appropriate agencies as required in the PA.

First Quarter:

DRI assisted the 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 the DOE in support of the preactivity surveys described in Task 2, above. Coordination of cultural resource management plans includes interactions with the USGS, BLM (Las Vegas District, Stateline and Caliente Resource Areas; Battle Mountain District, Tonopah Resource Area; Ely District; Desert District, Barstow Resource area; and Bakersfield District, Bishop Resource area), the NPS (Death Valley National Monument and the Lake Mead National Recreation Area), and the FWS (Desert Bighorn Range, Pahrnagat National Wildlife Refuge), as well as UNLV Museum of Natural History, for preactivity surveys on lands under various jurisdictions. Coordination of cultural resource management efforts were also conducted in support of the activities described in Task 7.

Second Quarter:

DRI provided short reports and clearance letters to the DOE in support of the preactivity surveys described in Task 2, above. DRI also assisted in preparation of the Annual Report on the Programmatic Agreement, and an evaluation of the Environmental Assessment. Coordination of cultural resource management plans include interactions with the ACHP, USGS, BLM, UNLV Environmental Research Center, and several California State Archaeological Information Centers, for preactivity surveys on lands under various jurisdictions.

Third Quarter:

DRI provided short reports and clearance letters to the DOE in support of the preactivity surveys described in Task 2, above. DRI also provided information for inclusion in the Early Site Suitability Evaluation, and is currently revising the EFAP for archaeological studies. Coordination of cultural resource management plans includes interactions with the ACHP, USGS, BLM, UNLV Environmental Research Center, and several California State Archaeological Information Centers, for preactivity surveys on lands under various jurisdictions.

Fourth Quarter:

DRI provided short reports and clearance letters to DOE in support of the preactivity surveys described in Task 2. DRI also submitted a revision of the EFAP for archaeological studies, and assisted in preparation of a DOE policy paper on resolving Native American concerns, and assisted with revisions to the Early Site Suitability Evaluation, the Environmental Training Program, and the Environmental Monitoring and Mitigation Plan Progress Report. Coordination of cultural resource management plans included interactions with the ACHP, USGS, BLM, UNLV Environmental Research Center, and the Eastern California State Archaeological Information Center.

STATUS OF DELIVERABLES

1. Data Recovery Plan – Alice Hill

Complete

2. Data Recovery Plan – Midway Valley	Complete
3. Short Report – Cima Volcanic area	Complete
4. Short Report – Lathrop Wells cinder cone	Complete
5. Draft revised EFAP	Submitted
6. Work instructions	Complete

PROBLEMS ENCOUNTERED

No specific problems were encountered.

FY 1991 BUDGET SUMMARY YUCCA MOUNTAIN ARCHAEOLOGY

CHARACTERIZATION OF SOUTHERN NEVADA PALEOFAUNAS

Contact: Stephanie Livingston

PROJECT DESCRIPTION

The goal of this study is to construct a history of Great Basin faunas, particularly mammalian taxa, that will provide empirical evidence of past environmental and climatic conditions within the area of internal drainage. These data will be organized for characterizing the fauna of the Great Basin during the last 10,000 to 12,000 years and for monitoring faunal changes that co-occur with changes in vegetation and other environmental indicators. Taxonomic composition of archaeological and paleontological faunas from various areas within the Great Basin and morphological changes within individual mammalian taxa at specific localities are being investigated to monitor faunal response to changing environmental conditions. Data are being obtained from published records, modern museum specimens, and raptor pellets to provide a modern control to which the paleofaunas can be compared. This study will provide an independent set of surrogate data for use in modeling future climate and its effect on the hydrology of the Yucca Mountain area.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Data collection from existing paleofaunal and modern faunal collections.
- Task 2. Field recovery of modern, archaeological, and/or paleontological faunal materials to fill in data gaps.
- Task 3. Dating and other special analyses.
- Task 4. Preliminary compilation of available data.

DELIVERABLES

- 1. A report of the location and content of existing paleofaunal records and collections (fourth quarter).
- 2. A report on the literature review of existing applications of faunal data to climatic modeling (fourth quarter).
- 3. A report on the morphological variability among populations of modern Great Basin species useful for monitoring environmental changes (fourth quarter).

PROPOSED BUDGET: \$101,000

PROGRESS ON TASKS

Task 1. Data collection from existing paleofaunal and modern faunal collections.

First Quarter (October – December 1990):

Analysis of the Floating Island archaeological fauna, including that being done under subcontract to the Antiquities Section, State of Utah, is progressing on schedule. Morphological data for woodrat and kangaroo rat populations are being compiled.

Second Quarter (January – March 1991):

Analysis of the Floating Island archaeological fauna is progressing on schedule. Subcontract to the Antiquities Section, State of Utah, is completed and all materials have been received per agreement. Morphological data for prehistoric leporid, kangaroo rat, and woodrat populations are being compiled.

Third Quarter (April – June 1991):

Analyses of the Floating Island, Serendipity Cave, and Handprint Cave archaeological faunas are progressing. Morphological data for prehistoric leporid, kangaroo rat, and woodrat populations are being compiled.

Fourth Quarter (July – September 1991):

Work continued on the analysis of archaeological faunas and the compilation of morphological data for prehistoric leporid, kangaroo rat, and woodrat populations.

Task 2. Field recovery of modern, archaeological, and/or paleontological faunal materials to fill in data gaps.

First Quarter:

No work was done on this task.

Second and Third Quarters:

A number of potential sites have been selected. Field work will begin when adequate funding is available.

Fourth Quarter:

No field work was done this season. If adequate funding is available and new assistants can be hired, work will begin during the next field season in 1992.

Task 3. Dating and other special analyses.

No work was done on this task in FY 1991 due to lack of funding.

Task 4. Preliminary compilation of available data.

First Quarter:

A data base of faunal data for the Great Basin has been initiated.

Second Quarter:

A data base of faunal data for the Great Basin has been initiated, and data are now in the process of being entered into a format amenable to distribution mapping.

Third and Fourth Quarters:

No work was done on this task.

STATUS OF DELIVERABLES

1. Report on existing collections (9/30/91)	Delayed
2. Report on literature review (9/30/91)	Delayed
3. Report on morphological variability (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

First Quarter: No specific problems were encountered.

Second Quarter: No specific problems were encountered. Uncertainty regarding the current year's funding has caused delays in planning for work.

Third Quarter: Uncertainty about funding delayed planning and executing of the work described in the research design. All field work, travel to collections, collections requests from museums, special analyses, and work requiring additional personnel have been suspended pending additional funding. Carry-over funding from FY 1990 is being used to complete tasks already in progress.

Fourth Quarter: Only about 60 percent of the requested funding for FY 1991 was provided, and it was not received until after the field season. Consequently, the tasks involving travel and field work could not be completed. Absence of funding also precluded employment of a graduate student to assist with laboratory and analysis tasks. Special samples for analyses such as radiocarbon dates have not been submitted.

Also, numerous requests by DRI for specifics on quality assurance requirements for this project are only now being addressed in a manner that will allow work to proceed in compliance with DOE requirements.

FY 1991 BUDGET SUMMARY YMPO PALEOFAUNAS

**DEVELOPMENT AND APPLICATION OF METHODOLOGIES FOR THE
IDENTIFICATION OF FLOOD HAZARD ZONES ALONG POTENTIAL
RAIL ACCESS CORRIDORS TO THE YUCCA MOUNTAIN SITE**

Contact: 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 to 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 at risk: 1) preliminary analysis of the lengths identified in the initial screening; and 2) 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 1991

- Task 1. Complete the report on the generic screening process for the identification of corridor lengths that will require additional evaluation from the viewpoint of flood hazard.
- Task 2. Meet with Union Pacific Railroad to discuss its drainage mitigation criteria.
- Task 3. Identify lengths of the Caliente route corridors with a high flood potential.
- Task 4. Develop a preliminary analysis methodology and search historical records for information on regional flood characteristics.
- Task 5. Conduct a literature review to determine if there are models available for the detailed analysis component of the project.

DELIVERABLES

- 1. A report on the screening process results (second quarter).
- 2. A report on the implementation of the screening process on a GIS system, if appropriate (fourth quarter).
- 3. A report on the literature review of the available models (fourth quarter).

PROPOSED BUDGET: \$110,000

PROGRESS ON TASKS

Task 1. Complete the report on the generic screening process for the identification of corridor lengths that will require additional evaluation from the viewpoint of flood hazard.

First Quarter (October – December 1990):

The report is approximately 90 percent complete. In addition to the report, two articles for publication in the peer-reviewed literature are being prepared.

Second Quarter (January – March 1991):

The annotated bibliography was completed and published (DOE Report No. DOE/NV/10845-04). One peer-reviewed paper was completed and submitted for publication. A second peer-reviewed paper is 90 percent complete.

Third Quarter (April – June 1991):

A paper titled "Design of Flood Protection for Transportation Alignments on Alluvial Fans" has been tentatively accepted for publication by ASCE's *Journal of the Irrigation and Drainage Division*.

A paper titled "Preferred Direction of Flow on Alluvial Fans" has been submitted to ASCE's *Journal of Hydraulic Engineering*.

Fourth Quarter (July – September 1991):

The paper "Design of Flood Protection for Transportation Alignments on Alluvial Fans" was accepted for publication (tentative date: April 1992).

Task 2. Meet with Union Pacific Railroad to discuss its drainage mitigation criteria.

First Quarter:

No progress was made on this task.

Second Quarter:

A report on meetings with transportation agencies was completed and submitted to DOE.

Third Quarter:

Contact has been established with Union Pacific Railroad and approximately 20 potential sites for verification investigations identified.

Fourth Quarter:

See Task 4.

Task 3. Identify lengths of the Caliente route corridors with a high flood potential.

First Quarter:

No progress was made on this task.

Second Quarter:

Work has begun on this task.

Third Quarter:

Work is progressing on this task.

Fourth Quarter:

Work on this task has been delayed because other tasks have a higher priority.

Task 4. Develop a preliminary analysis methodology and search historical records for information on regional flood characteristics.

First Quarter:

No progress was made on this task.

Second Quarter:

A preliminary method has been developed and formatted for submission to a refereed journal. Work on extending the method is in progress.

Third Quarter:

Contact has been established with Union Pacific Railroad and approximately 20 potential sites for verification investigations identified.

Fourth Quarter:

Twenty potential sites for verification investigations have been identified. Reconnaissance level investigations using topographic maps, aerial photographs, and field visits have been initiated. Contact to obtain historical information has been established with the Union Pacific Railroad, Southern Pacific Railroad, Coachella Valley Water District, and the U.S. Army at Hawthorne, Nevada. Further support in accomplishing this task has been supplied by the Nevada Air National Guard (aerial photography in the Hawthorne area) and the U.S. Marine Corps (support regarding access to withdrawn lands in southern California).

Task 5. Conduct a literature review to determine if there are models available for the detailed analysis component of the project.

First Quarter:

No progress was made on this task.

Second Quarter:

The literature review was conducted and is included in the report for Task 1.

STATUS OF DELIVERABLES

1. Report: "Development of Methodologies for the Identification of Flood Hazard Zones Along Potential Rail Access Corridors to the Yucca Mountain Site: Annotated Bibliography," DOE/NV/10845-04. Completed

PROBLEMS ENCOUNTERED

First Quarter: No specific problems were encountered.

Second Quarter: Delays in the review process at DOE affected the submission of reports and journal articles.

Third Quarter: The requested FY 1991 funds have not been received from DOE, and all carry-over monies from FY 1990 have been spent. It is anticipated that a contract modification will be received from DOE so that research might continue as planned.

Fourth Quarter: No specific problems were encountered.

FY 1991 BUDGET SUMMARY
YMPO FLOOD HAZARD

ENHANCEMENT OF REGIONAL CLIMATE MODELING WITH A CLOUD COVER CLIMATOLOGY

Contact: Melanie A. Wetzel

PROJECT DESCRIPTION

A climatological data base of cloud cover information obtained from meteorological satellites will be developed for specific time periods coincident with the Yucca Mountain Project regional climate model simulations and used in validating and augmenting the climate model results.

Satellite-derived cloud cover data sets provide a spatially continuous and temporally consistent information source for the validation of climate simulation models. In these models, clouds and their resultant precipitation are formulated as simple functions of the relative humidity and vertical motion predicted by the models, and testing of these methods with observational data has not been extensive. The National Center for Atmospheric Research (NCAR) Community Climate Model-NCAR/Penn State Mesoscale Model (CCM-MM4) is being used in the Yucca Mountain research program to simulate regional climate conditions which may affect the site. With a 60 km spatial resolution, this model represents many features of orographic cloudiness and precipitation which are also observable in satellite imagery. A satellite cloud climatology data base will be developed for this study, using data which have been archived as part of the International Satellite Cloud Climatology Project (ISCCP). These data will be applied to validating and possibly improving the climate model cloud formation methodology.

Analysis of cloud cover distributions will include a quantitative summary of differences in the areal cloud coverage determined from the climate model and the satellite data, and a qualitative description of the geographic distributions of cloud cover and the synoptic and model conditions under which significant differences occur. The time periods of intercomparison will be those in which both CCM-MM4 model simulations and satellite observations are available. The diurnal and longer-term cloud variability will be characterized. Systematic discrepancies in the model production of cloud cover (and coincident precipitation, as derived from observations) will be identified if they occur, and these can be used to suggest improvements to the model parameterizations of cloud and resultant precipitation.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Purchase satellite image data from the ISCCP archive at the National Environmental Satellite, Data and Information Service (NESDIS) and other sources.
- Task 2. Obtain NCAR regional climate model results and produce data fields at model time step of total air column cloud cover, for times which overlap the satellite data.

- Task 3. Develop methodology to process, graphically display, and statistically summarize both the satellite-derived cloud cover fields and the climate model results, using the DRI Sun computer workstations.
- Task 4. Develop procedures for intercomparison of the cloud cover and precipitation fields for specific time periods, and evaluate the observed variability and differences in these data sets.
- Task 5. Identify location- or meteorology-dependent conditions which may create routine bias or error in the generation of cloud cover and precipitation by the regional climate model.

DELIVERABLES

- 1. A report on the availability of satellite climatology data bases and supporting auxiliary information useful in validating model predicted cloudiness (1/31/92).
- 2. A report on the intercomparison of satellite-derived cloud cover and model-generated cloud fields within the time periods used for the Yucca Mountain regional climate model simulations at NCAR (5/31/92).
- 3. Recommendations on the possible modification of the cloud parameterizations in the climate model to more accurately represent the distribution of clouds, precipitation and atmospheric radiation budget variables (5/31/92).

PROPOSED BUDGET: \$59,913

PROGRESS ON TASKS

Funding for this project was not received until the third quarter.

Task 1. Acquire satellite cloud climatology data.

Third Quarter (April - June 1991):

Satellite radiance data for October 1988 have been ordered from the ISCCP product archive to begin the development of cloud cover distributions for time periods matching the climate simulations. The NCAR climate model results are available for 1982, 1983, 1988 and January-April 1989, with improvements in the model formulations in use beginning mid-year in 1988. The satellite cloud climatology data are available beginning the latter half of 1983, but the focus will be on late 1988 and early 1989 to take advantage of the model code improvements. Project funds were used to visit the Cooperative Institute for Research in the Atmosphere (CIRA) in Fort Collins, Colorado, for discussions with Don Reinke on the availability of a 2.5-km cloud cover data base to supplement the planned use of the ISCCP cloud climatology.

Fourth Quarter (July - September 1991):

Satellite radiance data for October 1988 have been received from the ISCCP archive. In addition, clear-sky land albedo composites for months and image times matching the ISCCP data have been obtained for use in identifying cloud cover in the ISCCP radiance data.

Task 2. Prepare cloud parameters from climate model results.

Third Quarter:

Project funds were expended for travel to NCAR to work with Starley Thompson, Gary Bates, and Filippo Giorgi on the use of the NCAR CCM-MM4 regional climate model simulation results. The NCAR scientists provided every possible assistance in making the model results available. Research papers recently published by the NCAR group concerning the regional model simulations are providing information on the overall design and conclusions of the modeling effort. Technical documents on the climate model are also being reviewed. The NCAR CRAY computer system is being used to extract the model cloud cover fields from the simulation results.

Fourth Quarter:

Cloud cover values produced by the NCAR regional climate model simulations for YMPO are being extracted from the NCAR computer archive. These will be used to create data arrays of cloud cover which can be numerically processed for statistical analysis and displayed in image format on the SUN computers.

Task 3. Develop analysis methodology.

Development of the analysis methodology for the data sets has begun. Software is being written for display and use of the data files. The applicability of Geographic Information System (GIS) software to assist in the processing is also being evaluated.

PROBLEMS ENCOUNTERED

Third and Fourth Quarters: No specific problems were encountered.

SPECIAL RESEARCH PROGRAMS

INTRODUCTION

A provision of the reauthorized Clean Air Act of 1990 describes the research activities to be carried out at the Liquified Gaseous Fuels Spill Test Facility (LGFSTF) at the NTS. This legislation states that at least 10 chemicals shall be analyzed, and two chemicals shall be field-tested each year. The Act further authorizes the Secretary of Energy to enter into contracts and cooperative agreements with, and make grants to, non-profit entities affiliated with the University of Nevada and the University of Wyoming to carry out the provisions of the Act, and authorizes \$3,000,000 for these activities in FY 1991. DRI and The Western Research Institute (WRI) are coordinating the program.

RESEARCH OF TOXIC SUBSTANCES AT THE LIQUIFIED GASEOUS FUELS SPILL TEST FACILITY

Contact: Richard Egami

PROJECT DESCRIPTION

The work will consist of experimental and analytical research of toxic air contaminants at the LGFSTF, including conducting controlled releases, evaluating dispersion models, chemical transformations, mitigation, emergency response, and monitoring methods, and disseminating results. DRI and WRI will work with LGFSTF staff and contractors to do these tasks. The two entities will cooperate in this program, and will employ other experts as needed to complete the research. Detailed task statements will be prepared once the conceptual tasks have been reviewed, modified, and agreed upon.

The funding for this effort has been authorized, but not yet appropriated to DOE.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Conduct controlled release of toxic substance experiments.
- Task 2. Evaluate toxic dispersion models.
- Task 3. Investigate chemical transformation phenomena.
- Task 4. Evaluate emergency response and mitigation methods.
- Task 5. Develop improved monitoring methods.
- Task 6. Disseminate results to scientific and user communities.

DELIVERABLES

(To be determined, based on budget and time allocations.)

PROPOSED BUDGET: **\$3,000,000** total, **\$1,500,000** to DRI

Funding was not allocated for this project.

OFFICE OF TECHNOLOGY DEVELOPMENT PROGRAMS

INTRODUCTION

The Office of Technology Development (OTD) of the Department of Energy's (DOE) Office of Environmental Restoration (ER) and Waste Management (WM) is responsible for the development of techniques, procedures and equipment to efficiently and effectively operate its ER/WM programs. Within this function is the responsibility for determining DOE's ER/WM human resource requirements and developing and implementing programs for acquiring and maintaining a skilled ER/WM work force.

The management and administration of the DRI/OTD program initiatives and approved tasks will be conducted through Technical Program Officer/Manager Support. DRI will oversee the implementation of the Science and Technology Education Program (STEP) programs which include the development of curricula to train ER/WM professionals.

The projects for plutonium soil cleanup will address aspects of soil analysis and the development of a data base prototype. The Soil Analyses and Sampling Protocols Project encompasses the development of standardized soil analysis protocols, identification of methods and procedures to collect representative soil samples, and the presentation of a test protocol to evaluate equipment which will simultaneously minimize the amount of plutonium in the tailings and minimize the volume of the concentrate. The Soil Characterization project will investigate the physical and chemical reasons why a particular plutonium removal process works or does not work, and the Data Base Development for Plutonium Soil Cleanup project will develop the data base prototype that will be used in the evaluation to identify the process with the best potential to remove plutonium from various types of soil. In another project, a new method for estimating data curves and surfaces will be tested on problems of interest to DOE. The method, Robust Bicubic Surface Estimation (RBSE), is believed to have significant advantages over kriging or spline estimation as a way to model environmental contamination.

The Development of Methods for Optimum Well Placement project involves the identification of current techniques for siting of groundwater monitoring wells and the development of an integrated approach to determining optimum well locations to reduce uncertainty about the groundwater characterization or plume interception.

The Hyperspectral Remote Sensing project will investigate the feasibility and utility of high-resolution scanning of land surfaces to help identify hazardous waste materials.

Some development of the OTD programs was done in the first two quarters of FY 1991 using carry-over funding from FY 1990. Quarterly progress reports for the OTD programs will begin with the third quarter of FY 1991.

**TECHNICAL PROGRAM OFFICER/TECHNICAL PROJECT MANAGER
(TPO/TPM) SUPPORT**

Contact: Roger L. Jacobson

PROJECT DESCRIPTION

To ensure continuous, efficient management and administration of the DRI program initiatives and approved tasks for the Office of Technology Development (OTD), provisions are made for reporting, monitoring, and managing responsibilities under Technical Program Officer (TPO) and Technical Program Manager (TPM) Support. The development of technical task plans (TTPs) as needed, attendance at required meetings, submittal of information to OTD, implementation of technical workshops, and response to OTD support needs are included in these responsibilities. Also included are the review of documents and coordination support for task administration on OTD projects.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Provide coordination of the DRI/OTD programs.
- Task 2. Attend program planning, review, and coordination meetings.
- Task 3. Provide reports and information to OTD, as requested.

DELIVERABLES

- 1. Monthly reports on all OTD functions.

PROPOSED BUDGET: \$130,000

PROGRESS ON TASKS

Task 1. Provide coordination of the DRI/OTD programs.

Third Quarter (April – June 1991):

Coordination of the program activities pertaining to STEP program development (program selection, institutional sign-off, contract negotiation and preparation), 1991/1992 technical task plans (TTPs), program review presentation materials, and contractor responsibilities was continued during this quarter.

Fourth Quarter (July – September 1991):

Coordination of program activities pertaining to STEP (completion of contract approval process, accounting and reporting) and 1991/1992 TTPs continued.

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

Third Quarter:

Program review planning meetings for the DRI/OTD programs were attended as requested.

Materials were developed for presentations made to the DOE/OTD Educational Outreach Advisory Panel.

STEP budget review and program development meetings were held with the approved prospective award recipients. STEP presentation materials were developed for the DOE/OTD educational outreach program review held in Washington, D.C. Two representatives attended the meetings on June 10 to 12.

Fourth Quarter:

TPM meetings were attended locally and at Oak Ridge and INEL. TTP budget and planning meetings were also attended.

Materials were developed for a STEP Advisory Board presentation. Other STEP activities, the Environmental Studies Program inauguration and a mathematics teacher training session for the Students Understanding Mathematics and Science (SUMS) project, were also attended. Accounting and reporting procedures for the STEP project were developed.

Task 3. Provide reports and information to OTD, as requested.

Third Quarter:

Three new 1991 TTPs for educational outreach activities were prepared and submitted for the DOE program review. Two 1992 TTPs, Optimum Well Placement and STEP, were prepared and submitted for the June program review.

Five STEP contracts were finalized and submitted to DOE in early June for approval.

Monthly reports for currently funded OTD DRI programs were prepared and submitted.

Fourth Quarter:

Monthly reports for the OTD/DRI programs were prepared and submitted. Preparation of the OTD/DRI work plan began. Information for and review of 1992 TTPs was provided.

PROBLEMS ENCOUNTERED

Third Quarter: Only partial funding has been received to date for all the DRI OTD programs.

Fourth Quarter: After the contract issues were resolved, DRI was advised that continued involvement in the OTD educational outreach efforts will be discontinued for 1992. Program coordination efforts will continue through the completion of the FY 1991 STEP projects in July 1992.

FY 1991 BUDGET SUMMARY TEAM SUPPORT

SCIENCE AND TECHNOLOGY EDUCATION PROGRAM (STEP)

Contact: Diana Hovey-Spencer

PROJECT DESCRIPTION

Through the OTD, the DOE has implemented the Science and Technology Education Program (STEP). This program is designed to support the development of educational programs for training career professionals in Environmental Restoration (ER) and Waste Management (WM). Assuring the long-term availability of adequate numbers of skilled technicians, engineers, and scientists qualified to work on the DOE ER/WM programs is critical to DOE's capability to efficiently and effectively operate its facilities in compliance with the nation's environmental laws and regulations.

For FY 1991, program support has been provided in three categories: vertically integrated ER/WM career development programs, programs of educational enrichment for educators and students, and programs designed to recruit and retain, in the science, engineering and related disciplines, a larger number of academically disadvantaged students, including women, minorities, and persons with disabilities.

DRI will be responsible for the coordination, monthly reporting, and general management of the FY 1991 STEP programs.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Distribute funds to assigned programs.
- Task 2. Coordinate program implementation and reporting.

DELIVERABLES

- 1. Monthly status reports.
- 2. Final project reports (fourth quarter).

PROPOSED BUDGET: \$250,000

PROGRESS ON TASKS

Task 1. Distribute funds to assigned programs.

Third Quarter (April – June 1991):

Program funds were disbursed from DOE for the EG&G portion of the STEP program. No additional work was done on this task because the remaining five program contracts have not been approved by DOE.

Fourth Quarter (July – September 1991):

Invoices for program expenditures, as provided for in the approved contracts, are being processed as received each month.

Task 2. Coordinate program implementation and reporting.

Third Quarter:

No work was done on this task because the submitted contracts have not been approved. No funds can be disbursed until the contracts have been approved. (See also TPO/TBM Support.)

Fourth Quarter:

The approval process for the remaining five STEP programs was completed. Program development and activity continued on all six STEP programs. Accounting and reporting procedures were developed for each program.

STATUS OF DELIVERABLES

1. Final project reports (9/30/91) Delayed
The reports will be completed by July 31, 1992.

PROBLEMS ENCOUNTERED

Third Quarter: The program review and selection process was prolonged due to the requirement for institutional sign-off from each DOE-approved program prior to funding. In addition, the DOE contract sign-off process is being delayed due to continued legal reviews.

Fourth Quarter: Because the program review and selection process was delayed, project activity will extend through June 1992. The final project reports will be completed in July 1992.

BUDGET

Funding for this project was received in July. However, none of the money was spent because no invoices were received during the quarter.

SOIL ANALYSES AND SAMPLING PROTOCOLS

Contact: Forest L. Miller, Jr.

PROJECT DESCRIPTION

This project is designed to develop standardized soil analysis protocols, identify methods and procedures to collect representative soil samples, and present a test protocol for evaluating equipment that will simultaneously minimize the amount of plutonium in the tailings and minimize the volume of the concentrate. Task groups will be formed to develop the requisite sets of protocols.

A consistent set of protocols and procedures will be developed for use in characterizing the soils from five sites: NTS, Hanford, Idaho National Engineering Laboratory, Fernald, and Rocky Flats. If consistent protocols and procedures are used, the soils from the sites can be compared and the characterization data can be used as covariates in the comparisons between the competing pieces of equipment. The data will also be useful in the study of soil-method combinations which yield either unusually good or unusually bad results.

The soils to be used in evaluating the competing equipment/methods must be consistent from site to site in their characteristics. A task group will develop a consistent set of protocols and procedures for sample collection at the sites, and/or preparation of the collected soil samples at the NTS, to provide this feed for the test methods.

A task group will develop and standardize the procedures to be used in comparing the competing methods. Each method will be judged against an objective set of criteria that has been specified prior to testing.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Organize the various tasks or working groups.
- Task 2. Develop a consensus among the soil scientists at the five sites about the methods to be used to characterize the soils at the sites. A document will be created containing these protocols and procedures.
- Task 3. Develop a consensus among the soil scientists at the five sites about the methods to be used to sample the soils. The decisions, any alternatives, and explanation of the methods chosen will be determined.
- Task 4. Specify the methods and procedures to be used to compare the competing cleanup methods.
- Task 5. Review the methods for soil characterization and sampling, soil preprocessing plans, and the methods which will be used to compare the candidate cleanup devices with the organizations proposing the soil cleanup methods. Solicit their

comments concerning the adequacy of the soil preprocessing and the fairness and validity of the proposed analyses.

- Task 6. Revise the analytical techniques considering the comments received. Prepare a report documenting the soil characterization, soil preprocessing, and the analytical methods used to compare the candidate treatment methods.

DELIVERABLES

1. A soil characterization strategy document which is applicable to the soils at the five sites and which has been reviewed by a group of outside peer authorities (fourth quarter).
2. A report on documented strategy and a proposed device to create a consistent feed for the candidate cleanup methods from the soils collected at the five sites (fourth quarter).

PROPOSED BUDGET: \$100,000

PROGRESS ON TASKS

Task 1. Organize the various tasks or working groups.

Third Quarter (April – June 1991):

This task has been accomplished. The working group to accomplish Tasks 2 and 3 will meet in Las Vegas on July 29 and 30.

Task 2. Develop a consensus among the soil scientists at the five sites about the methods to be used to characterize the soils at the sites.

Fourth Quarter (July – September 1991):

A set of soil characterization protocols has been developed or taken from the literature and sent out for review. The committee will meet on November 7 and 8 to finalize the protocols.

Task 3. Develop a consensus among the soil scientists at the five sites about the methods to be used to sample the soils.

Fourth Quarter:

Sampling methods were discussed at the July meeting and will be decided upon at the November meeting. Although concepts such as collecting a sample representative of a larger population will be common to each site, the actual methods used at each site may differ because the areas to be sampled vary.

Task 4. Specify the methods and procedures to be used to compare the competing cleanup methods.

No progress was made on this task in FY 1991.

Task 5. Review the methods for soil characterization and sampling, soil preprocessing plans, and the methods which will be used to compare the candidate cleanup devices with the organizations proposing the soil cleanup methods.

This task cannot be completed until Tasks 1 through 4 have been completed and the candidate remediation method firms have been chosen.

STATUS OF DELIVERABLES

1. Strategy document (9/30/91)	Delayed
2. Report on strategy and proposed device (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

Third Quarter: No problems have been found to date, but the amount of time needed to have the soil scientists named was underestimated. Some of the time can be made up by careful planning for the July 29 meeting.

Fourth Quarter: No problems were encountered.

FY 1991 BUDGET SUMMARY SOIL QA

SOIL CHARACTERIZATION
Contact: John W. Hess/Michael Whitbeck

PROJECT DESCRIPTION

This project will examine the physical and chemical reasons why particular processes for removing plutonium from soils work or do not work. Plutonium removal processes are being developed for use in cleaning up contaminated soils at several DOE sites around the country.

Information is needed on how soil cleanup processes may be developed and/or modified to be more effective at removing plutonium or other heavy metals from soil. It will be important to understand the plutonium forms in both the concentrate (fraction which should have higher plutonium values) and the tailings (fraction which should be relatively plutonium free).

Cleanup success or failure can be attributed to soil-grain size distribution, chemical form of the contaminant, location of the contaminant within the grain, and/or mineralogical composition of the soil. Understanding the reasons for the successes and failures will help ensure that the correct removal procedures are used at each cleanup site.

The project will consist of a literature review, computer and laboratory experiments, and analyses. Particular attention will be given to developing rapid and easy-to-use techniques to identify the plutonium form in different soil aliquots.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Investigate chemical thermodynamic and K_d data for plutonium.
- Task 2. Develop procedures to identify the form and bonding of plutonium in soil samples.
- Task 3. Conduct laboratory experiments using surrogate materials.

DELIVERABLES

- 1. Letter report on Task 1 and 2 (fourth quarter).
- 2. Report on Task 3 (fourth quarter).

PROPOSED BUDGET: \$100,000

PROGRESS ON TASKS

Task 1. Investigate chemical thermodynamic and K_d data for plutonium.

Third Quarter (April – June 1991):

The literature was reviewed concerning sequential leaching techniques as a means of evaluating the effectiveness of plutonium contaminated soil remediation protocols and as a means of qualitatively addressing the chemical forms in which finely divided plutonium might be present in the soils under evaluation.

Fourth Quarter (July – September 1991):

A small computer program was written to calculate the solubility of plutonium in "pure" water. The numbers obtained were in agreement with published data. However, computed values for "soil solutions" were lower by a factor of about a million.

Task 2. Develop procedures to identify the form and bonding of plutonium in soil samples.

Third Quarter:

M. Whitbeck met with Dr. R. Silva at LLNL and discussed the current status of the chemistry of plutonium in the environment. Several methods were discussed for using selective column experiments in conjunction with detailed chemical models. The results of these discussions were formulated into a more detailed proposal to conduct experiments and model development to facilitate the analysis of remediation trials.

A sample of the geochemical model "hydraql" was obtained from LLNL for modification to run on the SUN computers.

Two proposals were reviewed relevant to this work; both employed sequential leaching as part of their protocols.

Fourth Quarter:

No work was done on this task.

Task 3. Conduct laboratory experiments using surrogate materials.

No work was done on this task in FY 1991.

STATUS OF DELIVERABLES

1. Letter report on plutonium studies (9/30/91)	Delayed
2. Report on laboratory experiments (9/30/91)	Delayed

PROBLEMS ENCOUNTERED

Third quarter: No specific problems were encountered.

Fourth Quarter: In preparation for performing soil column experiments, the University Radiation Safety Officer (RSO) was asked to investigate the requirements for DRI to receive soil samples containing trace amounts of americium and plutonium. According to the RSO, the University's license does not permit any transuranics. The state health department will be contacted directly to find out specifically what is needed to modify our license. Receiving soil samples containing Am and Pu isotopes may require that the samples be pre-analyzed to some degree before they are sent from the NTS to the DRI laboratory in Reno.

FY 1991 BUDGET SUMMARY SOIL CHARACTERIZATION

DATA BASE DEVELOPMENT FOR PLUTONIUM SOIL CLEANUP

Contact: Carol Thompson

PROJECT DESCRIPTION

The purpose of this project is to develop a data base to store the information obtained from testing various types of equipment to separate plutonium from the soil collected at approximately five different DOE sites. The data base will be developed to include data on many types of soil analyses, grain-size determination, radiation counts, volumes, and similar types of information. The data base development will be coordinated with data available on soils from all the involved sites.

Evaluations to identify the process with the best potential to remove plutonium from various soil types will be made utilizing the information generated on this project .

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Develop a list of all potential data bases.
- Task 2. Meet with representatives from all sites and develop a system that will meet the various site requirements.
- Task 3. Develop a prototype data base working with one representative from each site involved in the technology testing.

DELIVERABLES

- 1. Documentation for the development of the data base.

PROPOSED BUDGET: \$50,000

PROGRESS ON TASKS

Task 1. Develop a list of all potential data bases.

Fourth Quarter (July – September 1991):

Work included learning about the project and defining some general approaches to the needs of the project.

Task 2. Meet with representatives from all sites and develop a system that will meet the various site requirements.

Task 3. Develop a prototype data base working with one representative from each site involved in the technology testing.

No work was performed on Tasks 2 and 3 in FY 1991.

PROBLEMS ENCOUNTERED

Fourth Quarter: Funding for this project was not allocated until the end of July. By that time, personnel were pretty much committed to other tasks.

ROBUST BICUBIC SURFACE ESTIMATION
Contact: Forest L. Miller, Jr./Evangelos A. Yfantis

PROJECT DESCRIPTION

A new method for estimation of curves and surfaces has been developed. The method, called Robust Bicubic Surface Estimation (RBSE), has significant advantages over both bicubic spline estimation and kriging as a way to model environmental contamination because it is not necessary to make the restrictive assumptions needed for the use of these methods to provide valid analyses.

The purposes of this project are to further the development of RBSE and to demonstrate its usefulness in a stand-alone mode, in comparison with kriging and spline estimation, and by applying the method to problems of interest to the DOE.

Project responsibilities will be divided between DRI and the University of Nevada, Las Vegas (UNLV). The responsibility for the technical aspects of the project will be primarily with UNLV. Other project responsibilities will be assigned based partially upon the strengths of the graduate students involved in the project.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Complete theoretical development of deterministic RBSE and prepare a careful exposition of the method.
- Task 2. Develop software for RBSE, including graphics, to facilitate its comparison with splines.
- Task 3. Run and compare Galileo ground zero (GZ) data.
- Task 4. Transfer a copy of the Galileo ground zero area radiological contamination data to UNLV.
- Task 5. Verify and analyze the quality of the transferred data set.
- Task 6. Develop graphical representations of aspects of the data set.

DELIVERABLES

- 1. An exposition on the method of deterministic RBSE.

PROPOSED BUDGET: \$100,000

PROGRESS ON TASKS

Task 1. Complete theoretical development of deterministic RBSE and prepare a careful exposition of the method.

Third Quarter (April – June 1991):

This task has been completed, and a manuscript has been submitted for publication.

Task 2. Develop software for RBSE, including graphics, to facilitate its comparison with splines.

Third Quarter:

A software package has been designed to implement RBSE. The package includes representation of points in three-dimensional space, rotation of the points around any axis in real time, projection of the points on an arbitrary plane, estimation of the surface using RBSE and the data points, rotation of the surface in real time, hidden line elimination, isopleth generation, and mean square error estimation.

Programming of the package driver has begun. The individual parts of the package will be written by the students. Two students start work on the project on July 1.

Fourth Quarter (July – September 1991):

An algorithm for data compression is being created to enable display of several screen images in a short period of time, thus creating animation.

Task 3. Run and compare Galileo ground zero (GZ) data.

Third Quarter:

Work on Task 3 cannot begin until Task 2 is completed.

Fourth Quarter:

Work is in progress on analyzing the Galileo data with both RBSE and bicubic splines and comparing the results.

Task 4. Transfer a copy of the Galileo ground zero area radiological contamination data to UNLV.

Third Quarter:

This task was completed in April.

Task 5. Verify and analyze the quality of the transferred data set.

Third Quarter:

This task was completed in May.

Task 6. Develop graphical representations of aspects of the data set.

Work on Task 6 cannot begin until Task 2 is completed.

STATUS OF DELIVERABLES

1. Exposition of the RSBE method

Completed

A manuscript, "A new quadratic and biquadratic algorithm for curve and surface estimation," by E.A. Yfantis, has been accepted by *Computer Aided Geometric Design*.

PROBLEMS ENCOUNTERED

Third and Fourth Quarters: No problems have been encountered.

**FY 1991 BUDGET SUMMARY
SURFACE ESTIMATION**

DEVELOPMENT OF METHODS FOR OPTIMUM WELL PLACEMENT

Contact: Elizabeth A. Jacobson

PROJECT DESCRIPTION

The development of methods for optimum siting of groundwater characterization and monitoring wells are just in the formative stage, especially for groundwater sites where no contaminant plume has been observed and hydrologic data are sparse. The goal of this research is to develop an integrated approach for optimum siting of groundwater characterization and monitoring wells and also for evaluating the benefit of certain locations. The approach should consider all available information from geologic, hydrologic, groundwater chemistry, and isotopic data. Classic "forward" groundwater models calculate hydraulic heads based on transmissivity, recharge rates, and boundary conditions. In many field sites, there are insufficient measurements of aquifer parameters and too limited knowledge of recharge rates and boundary conditions to model the groundwater flow system. The inverse method (also known as parameter estimation) estimates aquifer characteristics based on hydraulic heads using a numerical model. The integrated approach will involve developing statistical inverse methods (that include all the available data and their associated statistics if available) and uncertainty analysis methods. The statistical inverse method, together with an uncertainty analysis, can be used to indicate the optimum location of wells to reduce uncertainty about the groundwater characterization or the plume interception.

In FY 1991, the project will involve identifying the current techniques for siting of groundwater monitoring wells and comparing similar types of techniques to the proposed integrated approach. In addition, the development of the theory for the integrated approach will be started.

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Complete the proceedings of the DOE/EPA Workshop on Methods for Siting Groundwater Monitoring Wells. The proceedings of the workshop will contain information from the workshop presentations that represents the current techniques for siting groundwater monitoring wells.
- Task 2. Compare similar types of techniques to the proposed integrated approach to evaluate strengths and weaknesses.
- Task 3. Start developing the theory of the integrated approach.

DELIVERABLES

- 1. Proceedings of the Workshop on Methods for Siting Groundwater Monitoring Wells (draft, third quarter; completion, fourth quarter).
- 2. Letter report comparing similar methods to proposed approach (fourth quarter).

PROPOSED BUDGET: \$75,000

PROGRESS ON TASKS

Task 1. Complete the proceedings of the DOE/EPA Workshop on Methods for Siting Groundwater Monitoring Wells. The proceedings of the workshop will contain information from the workshop presentations that represents the current techniques for siting groundwater monitoring wells.

Third Quarter (April – June 1991):

A draft copy of the proceedings was submitted to DOE's Technology Development Branch in May. The proceedings were incomplete because some abstracts and viewgraphs had not been received. Preparation of the proceedings continued in June with the receipt of material from several presentations. Abstracts and viewgraphs have yet to be received from six presenters.

Fourth Quarter (July – September 1991):

The proceedings of the workshop are being finalized and should be submitted in October. Abstracts and viewgraphs from several presentations have not been received, so the proceedings will be completed with the material currently available.

Task 2. Compare similar types of techniques to the proposed integrated approach to evaluate strengths and weaknesses.

Third Quarter:

Several methods have been identified that may have similarities to the proposed research. These methods are being investigated and will be compared to the proposed research, if appropriate.

Fourth Quarter:

In July, several journal articles were located that describe approaches for network design. These articles are being reviewed as potential complementary approaches and are being compared to the proposed approach. In addition, several new journal articles have been located and have been added to the group included for comparison.

Task 3. Start developing the theory of the integrated approach.

Third Quarter:

Preliminary discussions about methods for siting groundwater wells have been conducted with researchers from Stanford University, Pacific Northwest Laboratories and University of Washington. These discussions will aid in developing an integrated approach, as well as in identifying complementary approaches that can be included in other projects. In late May and June, several sets of viewgraphs detailing this project were prepared for DOE review

meetings. The interim 1992 TTP was also prepared in June. Recently, material was received from Golder Associates concerning their approach for siting monitoring wells. This information may aid in developing the integrated approach or indicate a potential complementary approach.

Fourth Quarter:

A portion of the work on developing the theory of the integrated approach will include the information obtained from the comparisons in Task 2. Work on Task 3 will continue when Task 2 is completed.

STATUS OF DELIVERABLES

1. Draft Workshop proceedings (6/30/91) Delayed
2. Letter report on methods (9/30/91) Delayed
 This report is delayed due to the late start of the project.
 It should be completed before March 1992.

PROBLEMS ENCOUNTERED

Third Quarter: The schedule for publication of the workshop proceedings may be impacted due to the delay in receiving material from some presenters.

Fourth Quarter: No specific problems were encountered.

FY 1991 BUDGET SUMMARY WELL PLACEMENT

HYPERSPECTRAL REMOTE SENSING

Contact: David A. Mouat

PROJECT DESCRIPTION

This project is designed to assist EG&G/EM in its efforts to characterize hazardous waste activities at various DOE facilities. Specifically, it is designed to establish the feasibility and utility of hyperspectral remote sensing in the direct and geobotanical discrimination of hazardous waste materials.

Activities to be performed include: 1) a survey and evaluation of operational hyperspectral resolution airborne and satellite sensors; 2) an examination of spectral characteristics of hazardous wastes (both organic and inorganic); 3) a survey of geobotanical responses to hazardous wastes; and 4) a ground and laboratory spectral characterization of hazardous wastes (as specified by DOE - EG&G/EM).

TASKS TO BE ACCOMPLISHED IN FY 1991

- Task 1. Perform literature review.
- Task 2. Examine spectral characteristics of selected hazardous waste materials.
- Task 3. Survey geobotanical responses to hazardous wastes.

DELIVERABLES

- 1. Monthly and annual progress reports on all tasks.
- 2. Report on Task 1.

PROPOSED BUDGET: \$50,000

PROGRESS ON TASKS

Task 1. Perform literature review.

Third Quarter:

The project began in early May. Since that time, over 2,000 abstracts on hyperspectral imaging systems, spectral properties of hazardous wastes, and the spectral properties of hazardous waste-affected vegetation have been archived. These documents are being examined for suitability. The technical report summarizing these documents has been started. The ground and laboratory characterization of known hazardous materials has not begun.

Fourth Quarter:

A report has been compiled on airborne and satellite high resolution systems which have a potential for use by DOE for hazardous waste examination, analysis, and monitoring. This report is currently in review.

Task 2. Examine spectral characteristics of selected hazardous waste materials.

Third Quarter:

DRI team members went to the Jet Propulsion Laboratory to participate in the Airborne Visible and Infrared Imaging Spectrometer and Thermal Infrared Multispectral Scanner workshops in May.

EEG/EM acquired a PS-II (personal spectrometer) in June to aid in the ground spectral measurements.

Fourth Quarter:

The project has acquired an Advanced Spectral Devices Personal Spectrometer-II (PS-II). This highly portable, high spectral resolution instrument has a very rapid integration time and will allow us to characterize direct *in situ* spectral properties of hazardous waste materials and indirect effects on associated vegetation and soils. It is particularly appropriate for the former activity in that vegetation response to anomalous environmental chemistry has been hypothesized to exhibit unique spectral effects in the part of the spectrum sensed by the PS-II. In addition, the PS-II is an ideal ground verification and calibration instrument for simultaneous airborne or satellite examination of hazardous waste activities.

Task 3. Survey geobotanical responses to hazardous wastes.

Fourth Quarter:

On July 14, a potentially toxic railroad spill occurred in the upper Sacramento River in northern California. DRI suggested the affected portions of the Sacramento River to be

considered as a test site. This was approved. DRI field crews, aided by the California Department of Fish and Game, analyzed affected vegetation with the PS-II. Preliminary findings resulted in DOE authorizing a Compact Airborne Spectrographic Imager flight on August 21 and 22. Data from that flight have recently been shipped to EGG/EM and will soon be sent to DRI.

STATUS OF DELIVERABLES

1. Report on literature review (9/30/91)

Delayed

FY 1991 BUDGET SUMMARY REMOTE SENSING