Science Plan

Frank H. Rogers Center for Environmental Remediation and Monitoring (CERM)
Desert Research Institute, Nevada System of Higher Education

History of CERM

The Center for Environmental Remediation and Monitoring (CERM) was established in July 2003 as part of a gift by Jim Rogers, now Chancellor of the Nevada System of Higher Education (NSHE), in honor of his father, Frank H. Rogers, the first director of the Nevada Test Site (NTS). The private gift, the largest in the history of the Desert Research Institute (DRI), was made as a contribution to what is now the Frank H. Rogers Science and Technology Building at the Southern Nevada Science Center of DRI in Las Vegas. As part of the gift toward the building construction, the donor asked that a program be established that would complement the facilities and resources of the building. A series of short proposals was developed and the one for CERM was selected.

The CERM proposal focused on furthering the types of research that DRI has conducted for the U.S. Department of Energy (DOE), including environmental remediation and monitoring, which had been a major focus of DRI research for the agency over the last 10 years. However, it was recognized that there were opportunities and a need to extend DRI research successes with DOE to other sponsors. Also incorporated were previous National Science Advisory Committee (NSAC) recommendations, as well as those of an evaluation by Battelle in 2000 on technology development strategies for the State, for DRI to develop research in human exposure and risk assessment, and on the development of remediation strategies, techniques, and technologies. Management of DRI's Technical Research, Engineering and Development Services (TREDS) contract for the DOE, National Nuclear Security Administration Nevada Site Office continues to be one of the major activities of CERM.

CERM Mission

The following mission statement was established when the creation of CERM was approved by the Board of Regents of the NSHE:

> "Through basic and applied research and other types of scientific and engineering-based support, the Frank H. Rogers Center for Environmental Remediation and Monitoring (CERM) at the Desert Research Institute (DRI) will seek solutions to environmental contamination created by military, industrial, and municipal activities, and develop and provide means of protecting human health and the environment from contaminants for a variety of research sponsors. CERM will build upon DRI's success in environmental remediation, monitoring, and public health protection for the Department of Energy to address related issues and needs in Nevada, the United States, and elsewhere in the world."

CERM Focus Areas

While CERM will continue to respond to unanticipated opportunities, the following are five research focus areas for the Center. In the first four areas, DRI has gained research experience and has had accomplishments with DOE through its TREDS contract, although in all cases, there are additional opportunities. The fifth focus area is one of increasing research importance with the DOE National Nuclear Security Administration Office of Nonproliferation Research and Development (NA-20) and Office of Emergency Response (NA-40), although other sponsors (e.g., U.S. Environmental Protection Agency, U.S. Department of Homeland Security) could provide related opportunities.

Focus Area 1. Addressing potential risk and human health impacts associated with environmental contaminants, constituents, and conditions.

While CERM and other programs will seek to maintain and build DRI's expertise in groundwater, surface, vadose zone, and air modeling and contaminant transport, considerable interdisciplinary depth can be built by tying contaminant transport outcomes to human and ecologic exposure and risk. In many cases, this is the answer to the "so what?" question about the relevance of the research. With DOE in recent years, through collaborations with national laboratories, and more recently with health physics expertise of its own, DRI has had the opportunity to address human risk in its groundwater modeling of radionuclide contaminants at the "Off-Site Test Areas." In addition, with relatively new faculty in fields such as aquatic ecology, DRI has also had the opportunity to address hydrologic risk as it pertains to ecology. Addressing human and ecologic risk would also be a means by which DRI could contribute to and benefit from the NSHE focus on strengthening statewide programs, research, and facilities in health sciences.

Implementation and Research Opportunities

A decision beyond DRI's control is that DOE's management of the Offsite Test Areas is being transferred to the DOE Office of Legacy Management (OLM) at the beginning of federal fiscal year (FY) 2007. DRI has met with personnel of the OLM Grand Junction, Colorado, office and hopes to establish some type of mechanism for it to continue its research on subsurface contamination at these sites. The Offsite Test Areas are eight sites in five states where underground nuclear tests were conducted off the NTS. DRI's research at these sites has led to opportunities to develop risk-based compliance boundaries for contaminant transport as well as contribute to long-term stewardship (LTS—see Focus Area 2) for risk management at these sites. Other opportunities exist in Las Vegas with the U.S. Environmental Protection Agency (EPA) Laboratory for Indoor Air and Radiation, and Risk Evaluation Laboratory in Las Vegas. DRI recently developed an MOU with EPA. In addition, there are potential research collaborations with the Health Physics and Radiochemistry laboratories at the University of Nevada, Las Vegas (UNLV), to address contaminant transport and risk associated with radionuclides.

Many of the environmental legacies of the Cold War production of nuclear weapons in the U.S. are being addressed through the DOE Environmental Management (EM) program. Although DRI should continue to seek research opportunities with EM, this program is declining in size as remediation of sites is completed. Similar environmental remediation efforts were beginning in

Russia and former states of the Soviet Union in the mid-1990s. However, after the events of September 11, 2001, many of the resources originally planned for environmental cleanup were redirected to recovering and securing special nuclear materials. Considerable progress has been made in safeguarding these materials and opportunities to address the still existing environmental contamination and human health concerns may develop again.

Focus Area 2. Long-term stewardship (LTS) or legacy management of waste storage or disposal sites, or where contamination is left in place or is infeasible to remove.

In this context, long-term stewardship (LTS) and legacy management refer to the management of contaminants left in place and their associated risks. In some cases, a decision has been made to leave contaminants in place because there are no known means of removing them from the environmental media. Such is the case with most radionuclides found in groundwater at nuclear test sites. In other cases, the associated costs and environmental impacts that would occur with cleanup have led decision makers to leave contaminants in place. This is the case with surface soils contaminated with plutonium at the NTS and Nellis Air Force Range, and with depleted uranium (DU) at U.S. Department of Defense (DoD) facilities such as Yuma Proving Ground.

Decisions to leave contaminants in place should be predicated on a careful evaluation of future land or resource use, and risk scenarios. However, these can change rapidly. The current drought in the western U.S. and increasing demands on water resources are creating risk scenarios associated with groundwater contamination from underground nuclear test sites in the U.S. that were not even considered reasonable a few years ago. In addition, natural climate variability as well as human-induced environmental change (e.g., invasive plant species and changing fire regimes in the western U.S.) are creating factors that have not been addressed in LTS planning in many cases. DRI research can help in understanding these changes and help to develop decision support processes that take these factors into account.

A third LTS strategy that DRI has been successful in implementing is using its expertise in cultural resources and historic preservation to document what activities took place and what remains in place at particular locations. For the DOE Nevada Site Office, “historic evaluations” by DRI cultural resource scientists have frequently been the first step in characterizing contaminated sites by shedding light on past activities and potentially associated contaminants. DRI’s current program of documenting the history and environmental liabilities of sites that were considered for nuclear experiments with the Plowshare Program came about because of costly, and largely unnecessary, cleanup actions that had to take place because of loss of institutional knowledge of this program.

Implementation and Research Opportunities

In some cases, the impacts of changing environmental factors are not understood. For example, there have been large fires on DOE and DoD facilities in recent years, and research (such as that conducted at the Nevada Desert FACE Facility) shows that the frequency of fires will continue to increase in the western U.S. because of invasive plant species and climate change. A research

opportunity that CERM hopes to develop is to evaluate the impact of more frequent fires on the mobility of surface contaminants from wind suspension and water transport. In addition, there may be regional impacts on air quality and water recharge by changes in fire regimes over large regions such as the Great Basin.

Also, DRI has developed innovative decision support models for management of contaminated groundwater sites. A contract with the DOE OLM would allow it to continue this research for the Offsite Test Areas. In addition, because of delays in the submittal of a license for the proposed Yucca Mountain repository, DRI has refocused some of the research under its Yucca Mountain Environmental Monitoring Initiative to document baseline conditions and processes on areas of the land withdrawal that would be managed for the repository. Finally, CERM hopes to extend the type of research DRI has conducted for the Plowshare Program to other agencies, such as the U.S. Army Corps of Engineers Formerly Utilized Defense Sites program.

Focus Area 3. Developing and implementing novel methods and strategies for environmental monitoring, remediation, and reclamation.

Past independent reviews of DRI, including the NSAC Review in 2001, have recommended that DRI extend its environmental contaminant research beyond characterization to the development and testing of strategies for remediation. In particular, for passive remediation techniques (e.g., bioremediation or enhanced bioremediation), there are opportunities for DRI to implement comprehensive strategies that involve human and environmental risk management, LTS, and remediation. The risk management and LTS come into place when contaminants and health risks are likely to remain in place longer and require management while remediation processes are taking place. In addition, passive remediation strategies may also require monitoring of processes or constituents not normally measured, providing an opportunity for technology development to meet such needs.

Another opportunity in this area would be the development of remediation or restoration strategies that build upon or enhance natural processes. For example, DRI research on how alternative landfill covers may change over time in arid regions (“coupled environmental processes”) has shed light on the processes of environmental change as well as techniques by which arid and semi-arid regions may be restored. This has benefits far beyond management of alternative covers and includes habitat restoration and methods of addressing desertification issues.

CERM hopes to continue to collaborate with private industry on technology development and testing for environmental remediation and monitoring. A particular success has been DRI’s five-year effort with AEA Technologies, Plc., in which pumping technologies from the nuclear power plant industry have been modified to environmental needs such as deep well sampling.

Implementation and Research Opportunities

Recently hired faculty at DRI, both in the Division of Hydrologic Sciences and the Division of Earth and Ecosystem Sciences, can help the Institute to better address reactive transport processes in ground and surface water, and solute transport in the vadose zone. The results of major DRI

federal initiatives such as Desert Terrain have application to military activities in arid regions, but also to remediation and reclamation activities in arid regions.

Collaboration with, or strategic hires in, resource economics may help to identify opportunities where remediation and risk management strategies can also be evaluated with a life-cycle cost perspective. Many closure-in-place decisions have involved little evaluation of the life-cycle costs of maintaining the closure, or of environmental change that can affect the remedial strategy with time. In some cases where remedial decisions have been hastily made, there may be chances for DRI to conduct research in a reasonable time-frame on a more permanent remedy. New contracts with DOE and OLM could provide opportunities for this, as would early DRI involvement in the next round of the Base Realignment and Closure (BRAC) program. A meeting is planned with the U.S. Army Environmental Services program to explore research opportunities for the BRAC program.

Other research opportunities may exist in focusing on particular constituents of concern. For example, higher-than-normal levels of tungsten have been suggested as possible causes of leukemia clusters in Fallon, Nevada, and other health-related clusters in places such as Yuma, Arizona, may be linked to selenium. However, the evidence at places such as Fallon is probably best described as correlative since comparatively little is known about how humans may come into contact with tungsten or how tungsten moves through different environmental media.

Although managing environmental monitoring programs requires a continuous commitment of DRI personnel (see Focus Area 4), these programs can provide a cost-effective platform for testing new technologies or techniques, and provide access to environmental media (e.g., groundwater wells) or media (e.g., air samples) that make basic research proposals more cost effective to pursue. Last, they provide a means of testing new technologies. For example, DRI is currently testing passive radon monitoring instruments for its Yucca Mountain Environmental Monitoring Initiative on Community Environmental Monitoring Program (CEMP) stations (see Focus Area 4 for more discussion of the CEMP). Possible new platform monitoring programs that would also benefit from the credibility of an organization such as DRI could include 1) design and operation of air and water monitoring programs for Yucca Mountain; 2) groundwater monitoring for regulatory closures of areas of underground nuclear testing on the NTS; or 3) monitoring for impacts and for model validation should, as proposed, future municipal water needs for Las Vegas be met by large-scale water development and diversion projects from eastern Nevada or from areas to the northwest of the city. Originally, DRI envisioned that it could grow into this type of role should Yucca Mountain be licensed as a repository. However, significant delays in the program (a license application is not scheduled to be submitted now until FY 2008) make this less likely as a near-term goal.

Focus Area 4. Involving stakeholders in environmental monitoring, other data collection, and decision making.

Largely as a result of DRI's success with the CEMP in off-site monitoring around the NTS, CERM proposes a focus area that builds upon stakeholder involvement in environmental monitoring or other data collection. Several objectives can be met: 1) involvement of stakeholders can be an effective means of science education, one in which sometimes abstract science concepts can be

overcome by having citizens actually involved in the scientific process; 2) where data are needed over large areas, stakeholder participation in the operation of monitoring equipment may be a practical and cost-effective way of collecting information; and 3) where the results of the data collection efforts will be used for decision making that could affect stakeholders' lives, their involvement in the process may build greater consent for decisions.

The CEMP, managed and operated by DRI for the DOE Nevada Site Office, is a network of 28 radiation and meteorological monitoring stations in Nevada, western Utah, and eastern California. At most of the stations, DRI employs local citizens - Community Environmental Monitors (CEMs) - to help with maintenance of the stations, collection of particulate air filter samples, and dissemination of results to members of their community. Because the CEMs are hourly employees of DRI, there is an expectation that they will perform their responsibilities in accordance with procedures and participate in annual training. DRI also maintains a public web site where data from most of the sensors at the stations are updated hourly. Many of the CEMs are also school teachers who involve students in the operation of their stations, further increasing the educational benefits of the program.

Implementation and Research Opportunities

It is unlikely that DRI would have the means or desire to manage many programs that involve stakeholders for an extended period of time because of the large commitment of DRI personnel. Rather, it is envisioned that the DRI research opportunities would be in the form of "technology transfer" by working with other organizations to help design programs to meet particular data quality objectives. An advantage of DRI continuing to manage some programs such as the CEMP is that these programs can serve as "test beds" for new technologies and new education programs linked to the monitoring. An example of the latter is the proposed collaboration between the CEMP and DRI GreenPower program. Objectives of this collaboration would be to have solar deployments in rural parts of the state, but to also highlight the niche role that solar provides by, for example, allowing operation of scientific equipment (such as many of the instruments on current CEMP stations) off of power grids. A GreenPower federal initiative has been proposed to the U.S. Department of Education.

Another area that DRI is pursuing is CEMP-type programs as one type of "nuclear openness initiative," a strategy proposed for nonproliferation in which nongovernmental personnel in one country demonstrate to another that nuclear testing is not occurring. An opportunity that DRI is in the early stages of pursuing is a monitoring program near the Chernobyl impact zone. Twenty years after the accident, it remains a major stigma for the Ukraine. The CEMP would be a means to involve lay persons in a program that would allow Ukraine to play a greater role in the recovery of the Chernobyl impact zone.

In addition, DRI collaborations with Desert Knowledge Australia and the Cold and Arid Regions Engineering and Environmental Laboratory of the Chinese Academy of Science may require the collection of data over large regions that might only feasibly be done by involving the local populace. DRI has been invited to participate in the 2006 Annual Workshop of Desert Knowledge Australia to explore this type of strategy. In some cases, what data quality objectives can be achieved may depend on what types of instruments can feasibly be operated or maintained by

stakeholders. A factor that makes the development of stakeholder-based programs an interdisciplinary endeavor for DRI is that one cannot expect that techniques that work for one culture be immediately applied to another. Questions such as what is monitored, who does the monitoring, and even to what degree instruments are "black boxes" versus instruments that are easily deconvoluted will need to be answered to make a program successful. For applications of community monitoring to data collection efforts in sparsely populated arid regions, CERM has discussed teaming with the DRI Center for Arid Lands Environmental Management.

Focus Area 5. Using DRI expertise in environmental measurement, monitoring, and modeling to address issues and needs in nonproliferation, emergency response, and national security.

With a new TREDS contract, many opportunities exist for DRI to grow its research in nonproliferation, emergency response, and national security. DRI areas of expertise, and several existing programs, could contribute to research growth in: 1) monitoring for radionuclides as part of environmental remediation and compliance; 2) investigating properties and processes by which dust and fine aerosols are created and transported, and methods of determining their composition; 3) modeling aerosol plume behavior, including in complex terrain; and 4) the Western Regional Climate Center that DRI manages for the National Oceanic and Atmospheric Administration.

Implementation and Research Opportunities

Focusing on needs for arid regions may be a good strategy for DRI to develop research opportunities in this area. For example, the Nevada Test Site's Nonproliferation Test and Evaluation Complex (NPTEC) (previously known as the spill test facility) allows for permitted releases of agents not possible elsewhere. Although there are significant natural security issues associated with arid regions of the world right now, many models for atmospheric behavior with regard to aerosols and sensors for nonproliferation and homeland security were developed in more mesic climates. Currently, the DOE Atmospheric Radiation Monitoring (ARM) program lacks a focus on arid regions. Although the principle objective of the ARM program is on climate change, an ARM site in Nevada could address needs in climate change that would enhance ongoing DRI research in environmental change (e.g., the Nevada Desert Climate Change Facility on the NTS, and the Lysimeter Research Facility in Boulder City, Nevada) as well as address nonproliferation and security needs for arid regions. Due to this rapidly evolving field in terms of roles and responsibilities for different agencies, CERM is planning to fund DRI participation in forums and conferences to stay abreast of developments.

Summary of CERM Goals and Activities

Two tables are provided that summarize goals (Table I) and proposed activities (Table II) for CERM. Although opportunities may arise outside of the five focus areas previously discussed, the goals and activities are organized around the five areas of research discussed above. Further, for each of the five focus areas, goals and activities are grouped into "Established," "Near-term," and "Long-term." "Established" includes ongoing and recently completed research that can lead to further research. "Near-term" goals and activities are those of highest priority to pursue in the next

one to two years, while "Long-term" goals include those that may take three or more years to develop. Nevertheless, for out-year goals, there are near-term activities necessary to achieve those goals.

Activities include each of the following types:

- Strategic Hires through the Divisions: One example is to hire a second faculty member with expertise in risk assessment and/or health physics (Focus Areas 1 and 5).

- Collaborations: In some cases, these might take the place of strategic hires, or they could be for larger research programs that DRI alone could not do. Implementation of research through the recently developed MOU with the EPA laboratories in Las Vegas is an example.

- Involvement in New Forums or Organizations: The objective would be to better understand opportunities in new research areas, meet key agency personnel, and contribute to strategic planning for programs. An example is the proposal for DRI personnel to regularly attend meetings of the National Academy of Sciences Nuclear and Radiation Studies Board (Focus Area 5).

- Visits to Potential Sponsors or Field Sites: One example is the invitation for DRI to meet with the U.S. Army Environmental Services Center in Denver (Focus Area 3).

- Full Proposals and White Papers: White papers can function as *de facto* pre-proposals in meetings with or visits by research sponsors. One currently under development is an investigation of the effects of fires on the stability of soil contaminants (Focus Area 2).

- Articles and Other Forms of External Communication: This could include support for peer-reviewed journals, as well as coordination with DRI Institutional Advancement for DRI newsletter articles and features on CERM-sponsored research on the DRI web site. To cite an example, DRI has been invited to submit a manuscript on the CEMP for the *Journal of Risk Analysis* (Focus Area 4).

- What Has Worked and What Has Not: While not glamorous, documenting or otherwise communicating to DRI personnel what has not worked can save someone from inadvertently taking the same road.

  CERM Management Products: This is ongoing. An activity proposed for FY 2007 is to develop a more comprehensive internal web site for training, safety and health, and other information for DRI faculty who manage projects and programs for DOE.

Table I--Goals

CERM Science Plan

Research Focus Areas	Current Goals	Near Term Goals	Long-Term Goals
1. Contaminant transport and human and ecologic risk.	1. Address human and ecologic risk in association with groundwater flow and transport modeling. 2. Contribute to Nevada System of Higher Education emphasis on health related research.	1. Reactive transport modeling to evaluate effectiveness of passive remediation (see 3.) 2. Build collaborative efforts between DRI and EPA Lab for Indoor Air and Radiation, and EPA Exposure Research Lab.	1. Address contamination at international sites where the current focus is securing vulnerable special nuclear materials from the Cold War.
2. Long-term Stewardship (LTS) and Legacy Management	1. Effective management of institutional knowledge for LTS. 2. Establishment of baseline conditions and criteria for monitoring media if Yucca Mountain is used as high level radioactive waste repository.	1. Evaluate impacts of environmental change and incorporate into decisions on management of legacy contaminants (e.g., changing fire regime, natural climate variability, climate change). 2. Contribute to Legacy Management strategies for DOE and DOD facilities.	
3. Methods and strategies for environmental monitoring, remediation, and reclamation.	1. Greater use of cultural & and historic preservation expertise for understanding anthropomorphic cause and effect. 2. Technology development for high priority DOE NSO needs.	1. Develop niche areas of research for passive or passive-enhanced remediation of water/soils (e.g., with bioremediation). 2. Linking DRI technology development to support DRI designed monitoring programs.	1. Research on constituent transformation for contaminant or constituents of concerns as it moved through different environmental media (air, soils, surface water, and groundwater). 2. Management of vulnerable freshwater resources (e.g., freshwater coastal lenses).
4. Stakeholder involvement in environmental monitoring and decision making.	1. Continued effective management of Community Environmental Monitoring Program (CEMP) for the Nevada Test Site (NTS).	1. Design & implementation of other programs which involve stakeholders. 2. Increase science education effectiveness of CEMP-type programs, especially for K-12 education.	1. Addressing data collection needs with stakeholder involvement where such collection would otherwise be impractical. 2. Establishment of a program for another culture which must consider social values and practices different than most in the US
5. Nonproliferation, emergency management and national security.	1. Research to address current needs for radiation monitoring for existing DRI programs. 2. Use new DRI contract for DOE NSO as a mechanisms for growing DRI research in this area.	1. Apply DRI expertise in environmental radiological monitoring and air monitoring to nonproliferation, emergency management, national security. 2. Atmospheric monitoring and characterization for arid regions—many international security concerns are in arid regions.	1. Use of stakeholder monitoring programs as part of nuclear openness initiatives for nonproliferation.

Table II--Activities

CERM Science Plan

Research Focus Areas	Established	Near Term	Long Term
1. Contaminant transport with human and ecologic risk.	1. Proof of concept/model validation for gw flow & transport modeling at Offsite Test Areas. 2. Climax Mine modeling at the Nevada Test Site. 3. Groundwater modeling upgradient of Yucca Mountain. 4. Radiation exposure risk from low level radioactive waste truck transport.	1. Contract for DOE Office of Legacy Management (OLM) which begins managing the Offsites in FY07. 2. New contract with DOE NSO. 3. QA Plan for DOE NSO Contract—applications to groundwater models being used to established groundwater use restrictions. 4. Hire second risk/health physics faculty (see also Focus Area 5).	1. Fate and transport of tungsten—linked to health issues in Fallon, NV. 2. Long-term issues associated with cyanide leach mining of gold. 3. Establishing IPA Program with EPA-LV Laboratories.
2. Long-term Stewardship (LTS) and Legacy Management	1. Establishment of baseline conditions for the land withdrawal for Yucca Mountain. 2. Documentation & evaluation of environmental liabilities associated with DOE Plowshare sites. 3. Water yield assessments of basins on and around NTS; impacts of groundwater development on contaminant distribution.	1. DRI contract with DOE Office of Legacy Management. 2. Full-field deployment and testing of *in situ* detector for tritium in groundwater. 3. DOE NSO: Impacts of fires on areas of surface soil contamination on DOE and DOD facilities in the western U.S. 4. Proposal to NEH for Plowshare Program Colloquium in association with NTS Atomic Testing Museum. 5. GIS-Decision Support Models for managing contaminated soil sites on NTS and Nellis Air Force Range. 6. Meet with Nye County on collaborations on groundwater monitoring for Yucca Mountain.	1. Research on gw monitoring & performance validation for Yucca Mountain Repository. 2. Proposal to DOE Office of Science on impacts of changing fire regime on LTS of surface closures and contaminants in place in western US. 3. Impacts of regional fire regime change on air quality (dust) and recharge. 3. Proposal for investigation of DOD liabilities associated with Plowshare and Formerly Utilized Defense Site Program. 4. Decision support models for resource management of operating facilities (NTS and Tonopah Test Range) with legacy contamination. 5. Courses/guest lectures with UNLV Environmental Sciences Program in School of Urban Planning.

3. Methods and strategies for environmental monitoring, remediation, and reclamation.	1. Deep well sampling and tritium membrane research with AEA Technologies, Plc. 2. Modeling subsidence of alternative landfill covers at Edwards Air Force Base. 3. DRI studies on organic emulsions for stabilizing metal contaminants in surface soils.	1. Use of new remote imagery and processing techniques for post-closure monitoring of environmental remediation sites. 2. DRI visit/presentation to US Army Environmental Center, Denver. 3. DRI visit/presentation to Naval Facilities Service Center, California. 4. Meeting with EPA on Radon Program.	1. Coupled environmental processes research for arid regions—comparison between regions, and application of results to environmental remediation and reclamation. 2. Joint UNR/DRI proposals on use of remote imagery for environmental management.
4. Stakeholder involvement in environmental monitoring and decision making.	1. Continued effective management of the Community Environmental Monitoring Program (CEMP) for the NTS.	1. Establishment of CEMP station at Duckwater Indian Reservation—first tribal nation involvement in program. 2. Peer review publication on CEMP. 3. Collaboration between DRI GreenPower program and CEMP for solar power projects and science ed. in rural Nevada. 3. Hiring science education specialist for GreenPower & CEMP Programs. 4. Develop a CEMP Science Box. 5. Invitation to participate in Desert Knowledge Australia 2006 Workshop.	1. Proposal for establishing at CEMP-type program around the Chernobyl impact zone in The Ukraine. 2. Data collection over large, sparsely populated areas (e.g., dust emission sources in China; weather in arid regions of Australia). Possible collaborations with CALEM.
5. Nonproliferation, emergency management, and national security.	1. Independent monitoring for DOD DTRA Divine Strake Test. 2. 133Xe atmospheric monitoring in Las Vegas. 3. Testing & evaluation of monitoring technologies for noble gases, radon, and spectral gamma analysis.	1. Proposal for fine resolution modeling for aerosol testing for the NTS Test & Evaluation Program. 2. Hire second risk assessment/health physics specialist. 3. Hire additional technician to assist with radiological monitoring technologies and techniques. 4. MOU with Northrop-Grumman for Nonproliferation & Homeland Security Research with DOE NSO. 5. DRI attendance at National Academy of Science Nuclear and Radiation Studies Board meetings.	1. Proposal for a dual-purpose Desert ARM site in Nevada—for climate change and nonproliferation research. 2. Implementation of Nevada Science and Security Program. 3. Proposals for atmospheric simulations for short-time frames, particularly for urban areas (focus on urban areas in arid regions, such as SW USA). 4. DRI taught courses in Health Physics Program at UNLV. 5. Evaluate potential for an International Security and Environmental Resources program for DRI, particularly with a focus on water.

DRI Center for Environmental Remediation and Monitoring (CERM)
Selected Activities and Accomplishments

State Fiscal Year 2004

- Three-year contract with U.S. Navy Engineering Service Center/Encapco, Inc. to study the effectiveness of organic emulsions for stabilization of plutonium and depleted uranium on western DOD facilities and DOE; total funding $750K.
- Three-year project from DOE Nevada Site Office to model subbasin groundwater flow & contaminant transport for the Climax Mine, Nevada Test Site; $1.2M.
- Year 1 of DRI collaboration with AEA Technologies, Plc. on technology development for deep groundwater well sampling and in situ tritium monitoring; @ $400K to date.
- State of Nevada Applied Research Initiative Grant to test prototype low-pressure gamma ion chamber on the Community Environmental Monitoring Program (CEMP) station network; $115K.
- Year 1, Yucca Mountain Environmental Monitoring federal initiative; $5.75M of funding over three years.

State Fiscal Year 2005

- For Nonproliferation Sensor Testing and Evaluation Program at the Nevada Test Site: Atmospheric Profiling for Sensor Testing; $75K over two years.
- University of Nevada, Reno (UNR) and DRI Grant for Development and Deployment of In-Situ Tritium Detector in Groundwater: $200K to DRI for laboratory testing of detector. Funding from the DOE Advance Monitoring Sensor Initiative.
- US Air Force, Edwards Air Force Base; Development of Design Criteria for Alternative Landfill Covers; $125K.

State Fiscal Year 2006

- Subcontract with Pacific Northwest National Lab (PNNL). Phase I of Developing RadioXenon Baseline for U.S. Nuclear Test Sites for Compliance with the Comprehensive Test Ban Treaty; $95K
- Modeling Subsidence of Alternative Landfill Waste Covers at Edwards Air Force Base; Air Force Center for Environmental Excellence; $185K
- Independent Monitoring for Divine Strake Test—DOD, Defense Threat Reduction Agency; $85K
- Submitted proposal for new, five-year Technical Research, Engineering, and Development Services Contract for the Department of Energy, Nevada Site Office; approximately $40M
- Developed Quality Assurance Plan (QAP) for the EPA Nevada Rivers Water Quality Initiative; developed draft QAP for DRI.