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## Proceedings Geothermal Program Review XIV

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### Keeping Geothermal Energy Competitive in Foreign and Domestic Markets

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# National Advanced Drilling and Excavation Technologies Program and Institute

## Abstract

The National Advanced Drilling and Excavation Technologies (NADET) program has been established to facilitate cooperative, substantial, R&D programs necessary for the competitive survival of many basic industries dependent upon these technologies. Geothermal power generation is one such industry, where drilling costs must be substantially reduced. The Geothermal Energy Division of DOE has provided seed money to begin operations, but a broad support base from other sources must be established for the NADET program to continue. The NADET Institute at MIT has been established to administer the program. A series of workshops is underway to introduce the NADET program to industry and to gather information on needs and opportunities. An RFP has been issued seeking advanced drilling concepts applicable to geothermal drilling, with first round funding expected in July, 1996. A national facility for drilling and excavation research and demonstration has been established at the Nevada Test Site, with drilling and excavation R&D activities to be managed by NADET Institute. Work continues to secure broad support for a multi-industry program.

## Background

As noted in the invitation to this Program Review XIV, significant reductions in geothermal power costs are needed to bring about a resurgence in geothermal power projects within the U.S. Prominent among the costs are those associated with drilling. The National Advanced Drilling and Excavation Technologies (NADET) program has been established to provide a means to undertake the sustained programs that will be necessary to bring about significant reductions in drilling costs. The geothermal power industry, on its own, is not sufficient at this time to support such a program. The same is true of other industries dependent upon drilling and excavation technologies hence the need for collaborative action. The NADET Institute at the Massachusetts Institute of Technology will administer the program, while coordinating a host of separately funded projects that can benefit, and benefit from, broadly cooperative and integrated development of advanced technologies. Since July, 1995, the NADET Institute has been engaged in a variety of efforts, including the first round of support for research programs.

## Request for Proposals

NADET Institute issued its first Request for Proposals on March 1, 1996, seeking proposals for broadly defined advances in geothermal drilling technologies. The request was publicized in the Commerce Business Daily, by direct mail to the NADET mailing list and via press release to 140 media outlets.

A copy of the RFP is attached as Appendix A. The request is deliberately broad at this stage in order to stimulate a wide sampling of new ideas. In keeping with this initially wide search, a two-stage proposal procedure has been adopted. The initial response, due April 8, 1996, is limited to a 5-page prospectus or "pre-proposal," briefly defining the proposed project. From there a coherent initial program in keeping with available funding will be defined, and formal proposals will be invited from those within that program. With roughly one million dollars available for research, formal proposals will be invited for two to three times the number of projects that can be supported.

From the proposer's viewpoint, the limited pre-proposal format avoids the necessity of preparing an elaborate proposal until the proposed project is found to be relevant. From the NADET viewpoint, this approach should bring in a wide range of ideas which, if not relevant at this early stage, may be relevant in future projects as the NADET program grows in both scope and budget. This two-step format has been very favorably received by all who have called to inquire about the relevance of their ideas within the general RFP statement.

This first RFP is of course directed to projects which will be of benefit to geothermal drilling. But it is the basic premise of the NADET program that, with proper coordination, these will be of interest for many other applications. Preliminary indications point to a very broad range of interests among prospective proposers. NADET Institute expects a wide range of innovation, from concepts clearly of little significant promise to others offering the prospect of truly revolutionary advance.

Final definition of the RFP was preceded by a meeting with geothermal industry representatives in San Francisco on January 19, 1996. With ten industry members in attendance, this meeting substantially influenced the scope and sense of the NADET RFP. Starting with a NADET-proposed dual interest in advanced (i.e. lower cost) drilling technology and "smart drilling" systems, this group suggested, in view of the limited available funding, that the initial program focus only on advanced drilling. Further, the group converged on a statement of purpose for this initial program. Both key suggestions were incorporated in the final RFP. At the conclusion of its effort the group endorsed the concept of a permanent geothermal industry advisory committee to serve future NADET Institute planning. Those present volunteered to serve on such a committee and other members will be sought. It seems appropriate that other such advisory committees be formed to represent other industries as the NADET program grows.

Final selection of projects warranting formal proposals will be made at a meeting of all proposal reviewers in San Francisco on May 3. With a rapid turnaround of pre-proposals, final selection of funded projects is expected in July.

### **Startup Activities**

The NADET Institute structure is headed by an Operating Committee made up largely of industry members, and is lead by an industry chairman. The committee has met twice and is scheduled to meet four times each year. Presently composed of sixteen members, additional members in several key areas will be added.

Startup has also involved a continuing series of workshops to introduce the NADET program to industry and to solicit advice and guidance in program planning. The first, on Advanced Mining Technology, was held at the Colorado School of Mines on October 5-6, 1995. It was attended by thirty-two participants from industry, academia, and government agencies. In the face of the recent demise of the Bureau of Mines, a speaker from that organization summed up the conclusion of the workshop: Development of new, lower cost, environmentally friendly mining methods must continue.

The second workshop focused on geothermal drilling. It was held in Reno on October 10 and 12, 1995 in conjunction with the Annual Meeting of the Geothermal Resources Council. A preliminary introduction to NADET was held on the evening of the 10th, while a day-long technical workshop was held on the 12th. The workshop was attended by forty participants, mostly from industry. The discussions contributed significantly to the definition of research goals and opportunities in geothermal drilling and significantly shaped the current RFP.

At present, three more workshops are scheduled as follows:

April 25, 1996: Tunneling Workshop, covering both large and micro tunneling, held in Washington, D.C. in cooperation with the North American Tunneling '96 Conference, April 21-24.

May 1-2, 1996: Sensing Workshop, covering a wide range of position and other sensing needs and opportunities, held in Keystone, Colorado in cooperation with the Symposium on the Application of Geophysics to Engineering and Environmental Problems of the Environmental and Engineering Geophysical Society on April 28-May 1.

May 15, 1996: Oil and Gas Drilling Workshop, held in Houston preceding a Drilling Engineering Association meeting on May 16.

In addition, an Environmental Drilling Workshop is tentatively scheduled for late Spring.

As may be seen, workshops are often coordinated with other closely related meetings for the convenience of those who may wish to attend both. In addition to NADET's own mailing list, cooperating agencies provide assistance in assembling additional mailing lists of those directly interested in the subject of the workshop. For example, 400 additional names have been provided for direct mail invitations to the tunneling workshop.

## **Outreach**

NADET Institute has prepared a new brochure describing both the broad NADET program and the role of the Institute within that program. It has been distributed to the NADET mailing list, and to those who call for information, and it is distributed at various meetings. A media package containing a greater sampling of NADET information and activities is in preparation. The NADET mailing list has tripled in the last year and now includes about 940 individuals and organizations.

NADET Institute has assumed editorial responsibilities for the NADET News and the next issue is nearing completion and will be published in late April, with a newly-designed format. Articles are now in preparation for future issues and additional suggestions or contributions are welcomed.

## **National Drilling and Excavation Test Site - NeTI**

Researchers and developers in the drilling and excavation field, ranging from theoretical rock mechanics to massive equipment design, have long sought a national test site to facilitate research, testing, and demonstration. Such a facility is now being created at the Nevada Test Site (NTS). NTS is now managed by Bechtel-Nevada, with the mission to maintain a nuclear bomb test capability in the event the nation finds it necessary to return to such testing in the future. To help defray the costs of maintaining the facilities, equipment and work force, the Nevada Testing Institute (NeTI) has been established. NeTI is a not for profit corporation, providing commercial access to a comprehensive research, development, and demonstration facility for researchers and developers around the world. Facilities and personnel for drilling and excavation work and for explosive research (including explosive simulation of earthquakes) will be provided.

Drilling and excavation work at NeTI will be managed by NADET Institute, while explosive research will be managed by Stanford Research Institute. In keeping with the basic NADET concept, the test site will offer opportunities for cooperative testing and for "piggy-backing" of projects not otherwise possible. Participation in the management of this operation will add significantly to the credibility of the NADET Institute.

Formal announcement of the Nevada Testing Institute took place in a Las Vegas press conference on March 18. Early indications of world-wide interest in the facility are encouraging.

## Conclusion

It is necessary, even from the single-industry viewpoint of geothermal power, that the NADET Institute support base be broadened, both for the additional funding that is clearly necessary, and for the technological benefits that will accrue from cooperative, inter-industry sharing of thinking and opportunities. At the recent ASME Energy Week program and exposition in Houston, an oil industry spokesman outlined the industry's R&D direction in terms of three new views:

- New technology is more critical than it has been to survive in world competition.
- The oil and gas industry must look outside this industry for new ideas and talent.
- The industry must look to collaborative research in support of the industry as a whole rather than to independent research in support of separate proprietary advantage.

These comments clearly support the format and intent of the NADET program. The NADET program is indeed industry driven. It should ultimately be largely industry supported, but the present status of industry -supported advanced research (to say nothing of inter-industry collaborative R&D) is such that government support will be required to establish the feasibility of collaboration, and to sustain core projects necessary for substantial advances. Securing significant new federal support for inter-agency cooperative R&D is, however, rather difficult in the face of greatly reduced federal research budgets. NADET Institute will vigorously seek a broader funding base, but it seems clear that some demonstration of technical merit, and some industry support of the cooperative format will be necessary before significant inter-agency funding can be expected. Broad R&D support from a variety of sources is as essential to the geothermal energy industry's future in this country as it is to the NADET Institute's survival.

## NADET INSTITUTE REQUEST FOR PROPOSALS

The National Advanced Drilling and Excavation Technologies (NADET) Institute announces solicitation of prospectuses for advanced drilling technologies with primary interest in concepts relevant to geothermal drilling. NADET Institute is a research and development consortium supported by government and private funds that is administered by the Massachusetts Institute of Technology (MIT). Initial funding for NADET research has been provided by the Geothermal Energy Division of the U.S. Department of Energy. In order to exploit abundant geothermal energy resources, it will be necessary to reduce substantially geothermal well drilling costs.

The ultimate goal of this advanced drilling program is to reduce all drilling and excavation costs by 50 percent or more. That very ambitious goal cannot be achieved in a short time or by a narrowly focused program. While this solicitation focuses on relevance to geothermal drilling, clearly, advances in this area will be of benefit to many other drilling activities. This solicitation is intended to be the opening round in a multifaceted and sustained effort that, with funding from a wide variety of sources, can indeed achieve its goal of reduced drilling and excavation costs.

Present geothermal practices typically employ holes ranging in diameter from about 26 inches at the surface to 6 inches at depth, with depths from 5,000 to 10,000 feet. Hard rock (relative to oil-bearing formations) is typical, and fractured rock is often encountered. Bottom-hole temperatures typically range from 150°C to 350°C. Future operations may go to much greater depths and exploit higher temperatures, if enabling technologies can be developed.

Although geothermal drilling now uses drilling technologies and equipment adapted from the oil and gas drilling industry, at least six factors distinguish geothermal drilling and contribute to its higher cost. They are:

- harder rock or interbedded hard and soft rock,
- higher temperatures,
- more frequent lost circulation,
- increased corrosion and erosion of components,
- larger hole diameters, and
- remote, inaccessible drill sites

Drilling cost reduction within the range typical of geothermal drilling conditions is a function of many variables in addition to the instantaneous rate of penetration as determined by the drilling element. Thus, responses may address any or all of the above listed factors, singly or in combination. In any case, however, proposed work must be viewed within the context of a complete drilling system.

This solicitation seeks innovative, even revolutionary, approaches to the reduction of drilling costs. With limited initial funding and with the objective of identifying innovative approaches, a two-stage proposal response will be used. This announcement solicits brief, five-page (double-spaced, 12 pt. font) *prospectuses* consistent with the ultimate goal of drilling cost reduction. These prospectuses will be promptly evaluated by a review panel of technical experts, and a lesser number of full proposals will be invited in keeping with available funds and the development of an effective initial program. Approximately \$1 million dollars is expected to be available for first year programs and, depending upon proposal quality, six to ten grants are anticipated.

This announcement solicits prospectuses from individuals, universities, corporations, government, national, and private laboratories and other qualified entities. Prospectuses must be received at the NADET Institute by 5:00 pm EST, on Monday, April 8. They will be promptly screened and invitations to submit full proposals will be issued to those projects that appear best suited to program goals. We will notify all submitters as to the status of their prospectus when the review process is complete. However, no review comments will be made available. Grants are expected to be awarded in July, 1996.

Both short- and long-range projects may be proposed, but the availability of funding beyond the initial grant cannot be guaranteed at this time. Joint proposals and cost-shared projects are encouraged, but a single principal investigator should be identified for overall contractual responsibility.

Each prospectus should include, within the five-page double-spaced limitation, the following material:

- title and description of the proposed work,
- a brief description of the total system within which the proposed concept will function, although it is not necessary to propose work on an entire drilling system,
- an estimate of the project budget on an annual basis, including any cost sharing from other sources,
- an indication of the potential cost/benefit of a successful concept,
- the name, address, telephone, fax and e-mail of a contact person, and
- very brief credentials of the proposed principal investigator and any other key personnel

In addition to the availability of funding, continuation of projects beyond the first year will depend upon first-year progress of each project. Reimbursement for cost overruns will not be available.

First-year deliverables include a complete technical report and participation in an advanced drilling symposium scheduled for July, 1997. The report should include a

thorough evaluation of the concept's potential, an outline of the remaining program and cost to bring it to commercial fruition, and an indication of additional parties, if any, interested in participating in commercial development.

Information and descriptions contained in the prospectuses will remain confidential.

For further information, please contact the NADET office by phone at (617) 253-5782, by e-mail at [nadet@mit.edu](mailto:nadet@mit.edu) or by mail at the address below. Please be advised that only procedural questions can be answered by the NADET office. No additional technical information beyond this solicitation will be made available.

To submit a prospectus, please send five copies to:

US Mail: The NADET Institute  
MIT E40-481  
77 Massachusetts Avenue  
Cambridge, MA 02139

Overnight: The NADET Institute  
MIT Energy Lab, E40-481  
One Amherst Street  
Cambridge, MA 02139

Submittal by fax or e-mail is not allowed.

