

The diverse organizations involved in developing New Mexico's first geothermal power plant are a utility, an oil company and the government.

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The Baca Project: high mountain geothermal

As New Mexico electric generating facilities go, the Baca Geothermal Demonstration project is peanuts. The recently fired-up third unit at the San Juan Generating Station near Farmington will deliver about 480 megawatts of power to customers of Public Service Company of New Mexico and Tucson Gas and Electric. The four units at San Juan will provide more than 1,500 megawatts when the project is complete, compared to the Baca project's initial 50 megawatts with expansion possible to 400 megawatts. And the Baca project's cost, an estimated \$125 million, shrivels next to the estimated \$1.1 billion required for the four San Juan units.

Even the Baca's conversion of geothermal energy—the heat of the earth's core—into electricity is not unique. Union Geothermal Company of New Mexico, a partner with PNM in the Baca project, is a subsidiary of Union Oil of California, which operates The Geysers, the world's largest geothermal project. And the hot water beneath the Valles Caldera, site of the power plant, contains relatively few minerals, which means that the technology of delivering the steam to PNM for power generation remains straightforward. Though The Geysers' geothermal resource is steam, rather than water, Union's experience with a water resource consists of nine years of drilling on the Baca location and the development of a very similar water resource in the Philippines.

The project's uniqueness is a function of location—few power plants are built at an 8,800-foot elevation in high mountains with cold, snowy winters—and from the third partner—the Department of Energy which is providing 45% of the project's \$125 million cost. Union is contributing

34% and PNM 21%. The organizations are different, with different, sometimes conflicting approaches to their jobs and with different goals.

The project's site is at the edge of one of New Mexico's most beautiful spots, the Valles Caldera. The Valle Grande, the Caldera's largest grassy meadow, lies about 12 miles due west of Los Alamos. The Valles Caldera is on the original Baca Location No. 1 Land Grant that is today 96% owned by The Baca Land and Cattle Company and Dunigan Enterprises, private companies controlled by the late Pat Dunigan, who died in February 1980. The Valles Caldera was created with the explosion of a large volcano. Essentially, the top of the mountain blew off.

The power plant's location will be in Redondo Canyon, in the Caldera's southwest quadrant, and will be hidden from public view by forest-covered mountains including 11,254-foot Redondo Peak. The operation of the project requires drilling for the hot water, gathering the flow from several wells to satellite separators where the water will be "flashed" (rapidly converted) into saturated steam which will be sent to the power plant and then used to turn turbines, producing electricity. The end product, the electricity, will be sent to a substation in Los Alamos and plugged into the PNM system. Most of the electricity will be used in Los Alamos.

By the time this article appears, the



DOE's Wilbur and Union's Engebretsen:

"... proud of our status as the number one geothermal producer...."



PNM's Maddox:
 "... add fuel source diversity ..."

project may have approval from the Department of Energy. The project needs a "Record of Decision" from DOE, an explicit statement to proceed. The earliest possible issuance of the decision was February 19, 30 days after the first availability of the Environmental Impact Statement (EIS). A decision was hoped for by the end of March. The delay results from DOE's need to consider the project's "unquantifiable infringement" on the religious freedom of Pueblo Indians in the area. (Documents supplementing the EIS show vehement Pueblo opposition to the project.) The best guess of those involved in the project

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was that DOE would approve the project by the end of March.

The "wrinkle" of the Native American Religious Freedom Act became somewhat more jumbled in mid-March. Paul Tafoya, governor of Santa Clara Pueblo, 12 miles from the project, said his people would appeal to the New Mexico Legislature and, if necessary, to the courts, to block the project. "It's survival of our people," Tafoya said. "We have to have something for our grandchildren and great-grandchildren."

Because of the different nature of the three organizations involved in the



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project, the **Business Journal** asked representatives of each to talk about each organization's project objectives, why each got involved and how well their original assumptions have worked to date.

Simply stated, PNM serves as the overall project manager and will build the power plant and produce the electricity. Union's role is to take the hot water from the ground and sell it to PNM. DOE's role is financial and informational. Data gathered from the project will be available to developers of other potential geothermal resources.

Jack Maddox, the overall project manager, represented PNM. Dick Engebretsen, area manager, represented Union Geothermal and Art Wilbur, DOE's project manager, represented the government. All three are engineers. Maddox worked with private industrial companies before joining PNM five years ago. Wilbur also had industrial experience before joining NASA and DOE. Engebretsen's experience lies in the private sector.

To **Business Journal** editor Harold Morgan, it was evident the three men knew each other very well. The conversation took place February 27 in the conference room of Union's office in Rio Rancho.

BJ: Please describe the role your organization plays in this project and

please touch upon any organizational philosophies that might be unique to your company.

Maddox/PNM: Public Service Company of New Mexico's role in the project is to construct a power plant and transmission facilities for the generation of electricity. In addition, PNM has the role of project manager on the project.

PNM's organizational philosophy on the project is what is called a matrix project organization. We have key task

"We're very proud of our status as the number one geothermal producer in the world. We are a private enterprise and a furnisher of fuels to a consumer."

managers—we call them project personnel—assigned to the project. We rely upon them to identify the resources that are needed and then to draw upon the resources of departments and companies within PNM and Union to accomplish the project. These key people report only functionally to the project, but not administratively, as with, for instance, personnel matters.

As a public utility you have to work with the various state and federal agencies. That involves certain amounts of delay and a certain amount of time and effort to

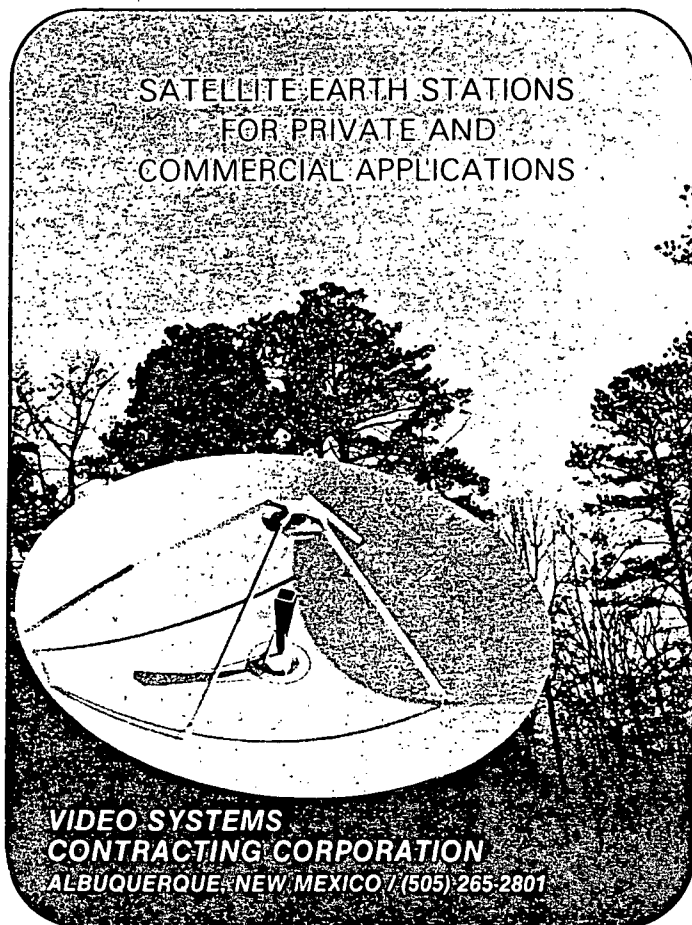
prepare special reports and to follow all the regulations by the letter. I don't think you have nearly as much of that in the purely private company such as Union. The difference (between a utility and a private company), I've noted, is that it takes a lot more effort to get the same job done. There are permits and requirements the utility has to go through, where the strictly private company can take most actions independently.

I have noted a considerable difference between certain investor-owned utilities and PNM. I think the main difference is that PNM is still young and has a lot of drive, a lot of enthusiasm for doing the job better than anyone else does it. Particularly, I've noticed utilities on the East Coast seem to have given up to a certain extent in the battle.

Engebretsen/Union: Union's prime function is to produce dry steam by contract to the utility company. To do so we need to take the resource from storage in the reservoir by the drilling of wells, then into the production pipeline system, the injection system and separation system to the power plant.

We're very proud of our status as the number one geothermal producer in the world. We are a private enterprise and we are a furnisher of fuels to a consumer.

Wilbur/DOE: The DOE objective is to



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help stimulate geothermal development in this country. It is a resource that has a very large potential but has not seen development in accordance with that potential largely because of economic factors or apparent economic factors.

Our objective is to help someone get started at (development of a hot water geothermal resource) and to use the information that comes from this project to show economic viability and get any answers to technical problems. We are in a cooperative agreement, a cost-shared arrangement. The DOE participation is largely financial. The output for us is to get some power on line and to get information we can spread among the community that may wish to participate in geothermal energy development.

We function in a matrix mode similar to

PNM. Administratively I report to the San Francisco operations office. All of the contracting is done from there. The negotiation of the cooperative agreement was handled from that office. Any assistance I need in personnel or procurement or finance or any of the usual administrative functions comes from that office.

“Our opinion is that the unknowns are engineering problems and not technological or scientific problems.”

One other reporting channel is to headquarters in Washington, D.C., to the Division of Geothermal Energy. That is the point of inception for projects such as

this. I must keep them satisfied that the content of the program is what they were expecting from it.

BJ: What were the reasons and motivations leading your organizations to become involved in this project and then to become involved together?

Maddox/PNM: I think the motivation was to add fuel source diversity to the system and to assure long term resources for the company. Our involvement really didn't start until about 1974 although our first study of geothermal was done in 1969. We did a study of statewide geothermal resources and identified the Baca resource as the resource that appeared the more promising in the state for development. Our recommendation

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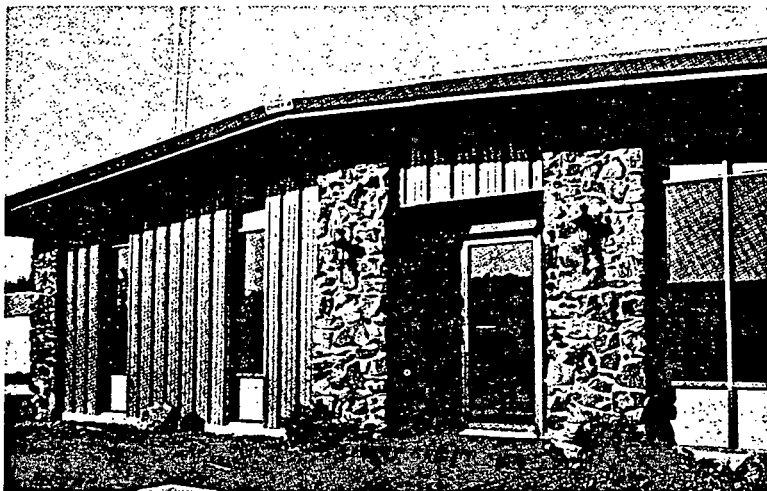
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to management was to continue to follow the Baca development and to pursue it at some later date.

Engebretsen/Union: Mr. Dunigan chose to develop the steam resource and he drilled four wells before Union became involved. I think he then began to realize the enormous expense and the length of time that money had to be tied up before it could become a commercial endeavor.

Union is not a utility company nor do we want to become one. Therefore, if you have a resource that can be used as a fuel, you look for an outlet for your fuel. In this case, PNM is a major power outlet for the state and we chose to begin negotiations with them.

Maddox/PNM: In 1974 we started discussions with Union on future development of the Baca resource. We held initial meetings to discuss how the first unit should be constructed and what the ultimate potential of the resource was.

BJ: We understand that DOE's involvement began with a Request for an Expression of Interest in this sort of project. Then a Program Opportunity Notice (PON) was issued in September 1977. Why did you respond to the PON?

Maddox/PNM: We had been exploring at that time development of the first 50 megawatt unit. Our objectives for this unit appeared consistent with DOE's as far as the size and timing of the unit.

Engebretsen/Union: We've got a large resource and we're the pioneer in developing it. It was advantageous (to pursue DOE involvement) because we had a considerable amount of money invested. You're going to get no return on investment unless you produce. DOE bridged the gap between what PNM could afford to pay for the steam as a fuel and what Union could afford to sell it for as a fuel. There was at that time a gap.

Wilbur/DOE: If the money were not needed, I think they would not have responded to the PON. I don't think any private industry with companies as competitive and independent as these two companies likes to have the government participating because government participation means doing a lot of things that companies would not normally do.

BJ: The benefit of DOE's involvement is financial support for the project. What are the costs?

Maddox/PNM: There is one (DOE) objective that is not consistent. That is the federal government's primary interest in stimulating geothermal development throughout the United States.

Engbretsen/Union: I would not say it's inconsistent—it's just not a common objective. Because our interest is profit motivated, as a separate company we would not try to supply our competition with everything we know. But you've got to weigh the good and the bad. There are certain basics that even by providing knowledge to the public and other industries, we're not hurting ourselves. If we had our choosing, we would choose not to. But in this case, it's to the benefit of the whole and one of the requirements of getting DOE involved.

BJ: And this requirement to make public information about the project is something you all completely understood going in?

Engbretsen/Union: Oh, yes! Our initial thoughts were that it was probably going to be an uncomfortable situation because it is contrary to the way Union operates within itself. In the contract negotiations, PNM, Union and DOE tried to ease that discomfort as much as possible and still meet the needs of DOE. It's all been compromise.

There are certain requirements that many levels of DOE would love to have seen. We were fortunate we could eliminate those. We have had to get more deeply involved than really we would want, but still less than the government would like. There have been tradeoffs.

BJ: Have there been any technological surprises?

Engbretsen/Union: No. Absolutely none as far as I'm concerned. One thing to keep in mind is that the only reason it is a demonstration project is because of federal involvement. If the fuel pricing gap did not exist and we did not have the DOE involved, it would be a standard commercial project.

“Union is not a utility company nor do we want to become one. Therefore, if you have a resource that can be used as a fuel, you look for an outlet for your fuel.”

In producing the resource, there is nothing real magic. From a geothermal standpoint our fluid is very clean and relatively easy to work with. We don't anticipate any problems from the resource handling standpoint in supplying steam to the turbine.

Maddox/PNM: I wouldn't consider this a research project at all. We're using existing technology. The fact that we're using equipment that has not been used before on this particular resource means there are some unknowns that may crop up. But our opinion is that the unknowns are engineering problems and not

technological or scientific problems.

BJ: I deduce that you approach engineering problems as being soluble.

Maddox/PNM: Yes, absolutely!

BJ: Have any special problems developed from the project's location in high mountains with heavy winter snows?

Maddox/PNM: Certainly. When we did our initial design, we didn't find any data on the maximum snow loads in the area. So we used some data that was existing in Los Alamos (19 miles from the project site).

Later we found the maximum snow loads to be three times what we projected which required us to considerably change the design of the building. Instead of the standard flat-roofed industrial building, which is much cheaper, we've gone to a pitched roof.

Engbretsen/Union: Our (weather) problems are a lot less than in Casper, Wyoming. You may learn that your conditions are a little different from what has been assumed in the past. But once you find out what your conditions are, you can design around them. There's nothing insurmountable about it.

BJ: Has there been a need to rethink or renegotiate the non-technical—the



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financial or organizational—portions of this three-way partnership?

Engbreetsen/Union: I feel you've got the whole life of the program for continued renegotiation of all portions of the contract to ease any real problem areas that occur between all three of us. The avenues are always open.

There has been some renegotiation of the contract as far as costs are concerned, but not as far as management philosophies are concerned.

Wilbur/DOE: There has been one modification to the cooperative agreement brought on by circumstances the DOE caused with its delay in the Environmental Impact Statement (EIS). The cooperative agreement set out a date by which the EIS would be done. It was not done on that date; it was several months later.

This caused some schedule complications particularly for PNM in some long procurement terms. By modifying the cooperative agreement, DOE has temporarily assumed the costs of those long procurements until PNM has the permit it needs from the Public Service Commission. At that point the costs revert to PNM.

Maddox/PNM: We were in a serious bind because of the long lead procurement actions necessary for the

power plant. You just don't go out and build a turbine generator the size of this office. You've got to order it and it has to be fabricated which takes well over one year.

We were running into serious problems maintaining the schedule because we could not continue that (procurement) program with the uncertainties of whether DOE was going to approve the project. DOE has assumed the financial risk.

Wilbur/DOE: I think we're going to have to do another one of those modifications to cover increased costs due to the schedule problems DOE's EIS lateness has caused. That is to be negotiated. The cooperative agreement calls for negotiations in good faith on such matters. That we will do.

BJ: We've seen some media coverage concerning the project's environmental impacts. Have these problems been resolved?

Maddox/PNM: There has been a lot of press coverage concerning the problems. To a certain extent that was reasonable because everyone thought of geothermal as a resource that is renewable and has no environmental impact. There was quite a bit of concern during the EIS development and a lot that was publicized about the environmental

impacts.

Anything that almost anyone does has environmental impact associated with it. It's just different people's perception of what is important and what environmental impacts they view from their perspective as being of great concern to them.

"The difference (between a public utility and a private company), I've noted, is that it takes a lot more effort to get the same job done. There are permits and requirements the utility has to go through, where the private company can take most actions independently."

Geothermal as an energy option is relatively benign. It definitely has less environmental impact associated with it than most other fuel sources. It surprised many people that we ran into so many problems.

I think it would also surprise a lot of people if they knew how many permits and how many agencies we had to deal with to build a 50 Mw geothermal power plant. (Maddox then named five federal agencies and six state agencies.) There are a number of others in the state. And of

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course there are all the environmental groups that take interest in developments of this nature. Nineteen separate Indian Pueblos surround the project in the North Central mountains of New Mexico. The individuals that live in the various communities have interest and are concerned about any kind of industrial development.

The only point I'm trying to make is that people were surprised we ran into so many problems. But I think if you put it into perspective, you cannot develop any project without this type of problem—since you have to deal with so many different agencies and governments and communities with different interests and different concerns.

BJ: The target date for the project to produce commercial power is April 1, 1982. Even with all the delays, are you on schedule?

Maddox/PNM: At this point I can say that from our and from Union's standpoint in developing the resource, we can still meet the commercial date. But rapidly our testing time and float time is being gobbled up by government delays. I don't blame that on Art Wilbur. It is Washington, D.C.

BJ: Is this cost-shared project relatively unusual for DOE?

Wilbur/DOE: It comes close to it. What we're doing here is more of an economic demonstration than anything else. It is, in that sense, probably unique.

The role of DOE in this is quite different than in a normal DOE-sponsored, DOE-paid project. In the usual kind of project, one places a great deal of control and organization on top of whomever is doing the work to assure that the objectives are met within cost and schedule. One of the remarkable things about this project is that the profit motive will help keep the project on schedule and within cost. The DOE contribution has a ceiling to it. We are relying on the private sector to do the job they know how to do best. It's one of the best business arrangements the government could have—one I'd like to see promoted further.

In consequence our organization is quite small. For a project of this size, it is quite remarkable to have a project office that consists of three professionals and a secretary. But I think that is all that is needed to accomplish the DOE objective.

I have been impressed with the way it has been possible for these three organizations to work together productively. The organization that has been set up between Union and PNM and DOE is such that if we do run into problems we have a mechanism for working them out. I anticipate the project will be successful:



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