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NEW MEXICO'S PIONEERING STEPS IN COMMERCIALIZING SOLAR POWER

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ABSTRACT

Over the past two years, New Mexico has been engaged in a significant new approach to implement large purchases of solar power. This effort followed a regulatory process that treated solar power generation similar to conventional generation obtained by an investor-owned utility under the regulation of a public utility commission.

In 1997, Public Service Company of New Mexico (PNM) gained approval to purchase power from a 100-MW combustion turbine facility that would be owned and operated by a wholesale generator. At the same time it issued the approval, and following discussions with the utility, the New Mexico Public Utility Commission (NMPUC) also required PNM to issue a request for proposal for a 5-MW central station solar facility, a major step for solar technologies in the state, in what would be the world's largest of its technology type. In cooperation with the staff of the NMPUC, PNM reviewed the proposals received, and Applied Power Corporation was selected for the photovoltaic portion of the proposed plant, retaining ownership of the plant, assuming the risks connected with the technology, and operating the plant in exchange for a power purchase agreement in a first-of-its-kind contract for photovoltaics.

During the NMPUC hearings, various parties raised significant opposition to the cost-recovery mechanism

that was proposed and voiced issues about the type of solar plant, its size, cost, and the funding approaches to building it. Because of these issues, alternative proposals were put forth that reduced the size and costs of the plant and had implied changes in ownership and risks.

The order issued by the NMPUC on October 21, 1998, requires PNM to impose a charge of 0.5 percent on its retail electric customers' monthly bills to be used to acquire the solar facilities, but also to obtain other renewable electric power resources, both on a pay-as-you-go basis.

This paper identifies the issues and their resolution that similar projects are expected to encounter.

1. BACKGROUND

In 1997, PNM sought NMPUC approval of a 100-MW combustion turbine peaking unit. As the matter was under review, the NMPUC staff raised the possibility of adding a solar component to the plant, and after negotiations, an agreement was made stipulating that a request for proposal (RFP) for a 5-MW solar plant would go forward in combination with the 100-MW gas-turbine project. The NMPUC agreed to a stipulation that PNM would have full cost recovery for the solar plant and such full cost recovery would not place PNM at a competitive disadvantage.

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New Mexico's solar initiative was based on the NMPUC staff's assumption that solar energy could be reasonably competitive with peaking power costs under certain conditions, and that customers would be willing to pay the additional incremental cost of such solar generation. The project was initiated by state actions, and was not dependent upon Federal incentives. However, it came about in a climate of regional regulatory and legislative activity to promote renewables and/or solar energy in other southwestern states, notably Arizona, California, Nevada, and Texas.

2. THE 100-MW GAS TURBINE PLANT

The 100-MW (later sized at 132 MW utilizing a gas turbine guaranteed to meet NOX emission requirements of 15 parts per million) natural-gas-fired combustion turbine project was approved as an exempt wholesale generator with an exclusive long-term power sales contract to PNM. The wholesale generator has a 20-year power purchase agreement with PNM, and the unit is scheduled to be on-line sometime before the summer of 2000, when PNM's system is projected to need additional capacity for peak demand and for reliability. There is no dispute that this need exists, and the selected site is strategically located within the major PNM load center.

PNM will pay approximately \$7 million per year plus energy costs over the 20-year life of the power purchase agreement. The plant is supposed to be dispatchable at PNM's order--there are penalties for failure to dispatch. The duty factor of this plant is estimated to be in the range of 5% to 10% (58 to 115 million kWh/yr), although it will be capable of capacity factors greater than that. The \$45 million plant will provide peaking capacity for PNM, and in some ways it is improper to characterize its costs in terms of energy, but as will be shown, the solar plant also has characteristics of both capacity and energy, so a comparison is none-the-less provided. Under expected ranges of operation, the energy cost of the combustion turbine ranges from 10 to 16 cents per kilowatt-hour. Figure 1 demonstrates the energy cost from the gas turbine, based on various fuel costs and capacity factors.

3. THE PHOTOVOLTAIC PROPOSAL

In a somewhat unusual circumstance, but in accordance with the authorizing order, PNM and the NMPUC staff worked in cooperation on the solar project. The initial plan was to treat the procurement of solar energy similar to energy from the combustion turbine; that is, with expectations of a power purchase agreement and long-term contracted energy purchases. Under this

approach, the solar vendors would undertake the performance risks just as the combustion turbine operator undertook risks of performance. This purchasing approach may be a first, inasmuch as it has not been used for photovoltaic energy bought by a utility.

The requirements were defined in an request for proposal (RFP) solicitation. One unique aspect of that RFP was the requirement that the solar plant be rated for power (on an alternating current basis on the high side of the step-up transformer) at 3:00 p.m. on the day of the summer solstice, June 21 (with assumed clear sky conditions), a time chosen so the solar plant could be rated at a time somewhat representative of PNM's summer peaking needs. The specification (one of many for photovoltaics) resulted from PNM's need for firm power ratings.

Five bids to build a photovoltaic plant and two to use solar thermal power were received. The finalist for photovoltaics was Applied Power Corporation, with a plant consisting of 18,900 ASE Americas 300-W modules on a single-axis tracking system with power conditioning by Trace Technologies Corporation. Encompassing 30 acres, it would provide approximately 12 million kWh annually with a power output of 4.2 MW at the specified RFP conditions. As proposed, it would be the largest installation of photovoltaics in the world with a contracted energy price under 30 cents/kWh. The solar energy was to be purchased by PNM under a 20-year power purchase agreement. The proposed site was at the Mesa del Sol land development south of Albuquerque, a location within the major load center of PNM's system, and generation here could provide a small incremental contribution to meeting the peaking needs of Albuquerque.

4. TECHNICAL ASSISTANCE

One of the reasons for Sandia's involvement was to reduce technical risks for the involved parties of the New Mexico project, and for future projects of a similar nature. Sandia provided technical assistance to both PNM and to the NMPUC staff throughout the development of the RFP and subsequent review of the proposals, as these parties were relatively unfamiliar with the solar technology. One specific item of assistance was an assessment of the capacity contribution of a representative photovoltaic system. A correlation was made between the top twenty 1997 PNM system peaks and the coincident solar conditions at those times. An estimate of what a representative photovoltaic plant would provide for each of those times was then calculated. A load carrying capacity of about 80% is illustrated in Figure 2.

During the period of hearings by the Commission, Sandia transmitted a letter indicating research and development benefits that could be derived from a large solar plant, including development of performance rating and validation procedures, instrumentation to provide instantaneous performance data, potential testing of large inverters, and development of operation and maintenance procedures.

5. MAJOR ISSUES, RESOLUTIONS OF ISSUES, AND KEY FINDINGS

5.1 Society's Willingness to Pay

Society's willingness to pay was assumed going into the project, but was tested. In parallel with the contract negotiations, six renewable energy focus groups were conducted with PNM residential customers to ascertain public acceptance of the proposed solar plant. Due to the limited number of the customers involved in the focus groups however, the results were not considered statistically valid and only provided general guidance to PNM. The company learned that a majority of the participants knew what renewable energy was, but that green power and green pricing meant little to consumers. A majority of the participants supported the idea of an involuntary fee, because of the solar plant's worthwhile nature and because of the feeling that a purely voluntary system would not raise enough money. By a margin of 4 to 1, participants supported the idea of a renewables surcharge of \$1.40/month. "Energy for Tomorrow" was the most popular name tested.

However, the magnitude of the cost to build the solar plant was a concern, even when blended into aggregated billings. All parties were cognizant that PNM's customers naturally will desire the lowest possible energy prices. The parties involved in the NMPUC hearings might not be completely representative of the interests of New Mexico residents, but none of them appealed the final order.

Interestingly, although many statements outlining the economic and other benefits of the solar project were made in testimony filed with the NMPUC, no formal cost/benefit study was made throughout this process.

5.2 Strandable Costs

Strandable costs (costs that are higher-than-market value) that might be disallowed in a future regulatory action were a concern; even if a prior regulatory authority had approved them. The issue of strandable costs was initially addressed by means specified in a stipulated agreement of

the NMPUC staff, PNM, and the New Mexico Attorney General. Faced with opposition to this agreement and the issues raised in the hearings, the NMPUC ultimately removed the risks of strandable costs by ordering a pay-as-you-go funding and procurement approach, thus removing the dependence of future payment streams from the structure of the project.

5.3 Industry Objections

The type of plant was challenged. The New Mexico Solar Energy Industry Association raised objections to multiple features of the project even though other New Mexico and national solar energy groups supported the project. One concern was of a utility entering the solar business--possibly as unfair competition. Another point was that solar generation such as the photovoltaic plant could provide advantages to PNM over other companies in the event of a restructured utility industry. Advocates of rooftop or other types of systems asserted that the central plant project ignored the system benefits of small-scale, dispersed distributed solar generation resources. This was in spite of the economies of scale offered by a central plant and the approximately 20% increased generation (compared to optimum tilt of a fixed system) provided by tracking systems.

The issues raised were perhaps counter-intuitive to those involved in the project. Communication of plans and incorporation of ideas might have prevented issues being raised at a late point in the regulatory process. However, the local solar industry's issues were partially met by the NMPUC order to appoint a board of advisors and allot half of the funding to other types of solar and renewable systems to be overseen by the board. This process will involve a large segment of the New Mexico stakeholders.

6. THE FINAL ORDER

On February 2, 1999, the New Mexico Public Regulation Commission (the successor agency to the NMPUC) allowed the final order of the NMPUC made on December, 21, 1998, which was to proceed on a pay-as-you go approach. A rate rider of ½% will create a funding stream of about \$2.5 million per year to fund two separate renewable tracks. The first track is funded by one-half of the proceeds (¼%), and covers the large solar project--but incrementally, so that it will take decades to reach the 5-MW originally requested. It is expected that under this track PNM would purchase plant rather than energy. The remaining ¼% will be used to create a renewables fund that will be directed by a public input process by an advisory committee consisting of representatives from PNM, various classes of PNM

customers, schools and research institutes, and other interested parties, thereby bringing a wide range of experience to developing renewable resources in the state. The requirements are to be determined, but it is expected that the committee would guide a process of solicitations open to solar or other renewable electric systems through a periodic RFP administered by PNM. Again, PNM will likely purchase systems rather than energy.

7. CONCLUSIONS

In retrospect, the relatively high capital cost of a photovoltaic plant and associated risks derived from that cost drove decisions. It is expected that a pay-as-you-go approach where finance costs can be minimized or eliminated for projects funded either by customer rates or through direct voluntary customer contributions will prevail over long-term financed approaches. Like a home mortgage, a large fraction of the long-term payment stream needed to amortize capital costs will be the finance costs (as was the case for the original photovoltaic proposal). Due to the nature of photovoltaics, a modular technology, the power blocks can be relatively small, unlike many central generating plants, and economies of scale can be obtained for plant purchases at lower power ratings than through long-term contracted energy purchases. It should be noted that while a solar plant is subject to the variability of the solar resource and will need ongoing operating funds for maintenance and component replacements, it will not be subject to increases in fuel prices.

Using pay-as-you-go procurements eliminates finance charges. Under 100% equity financing, simple payback of a PV plant could be around 20 cents/kWh, including operation and maintenance costs, and at this price provides an interesting comparison with the costs associated with the gas turbine plant, which could escalate. However, this comparison only works if a decision is made not to consider the opportunity cost of capital and to make the solar investment a matter of policy for purposes of public benefit.

Whether solar energy is reasonably competitive with energy from conventional peaking generation plants under certain conditions may be debatable, but the assumption that customers (or institutions representing customers) would be willing to finance such solar generation was met in New Mexico. In the words of the NMPUC as stated in the approving order of October 27, 1998, "We have before us an extraordinary opportunity to provide a sustainable process that provides not only economic development for the solar and renewable industries in

New Mexico and elsewhere, but provides competitive, alternate opportunities for the ratepayers in this state."

8. ACKNOWLEDGEMENTS

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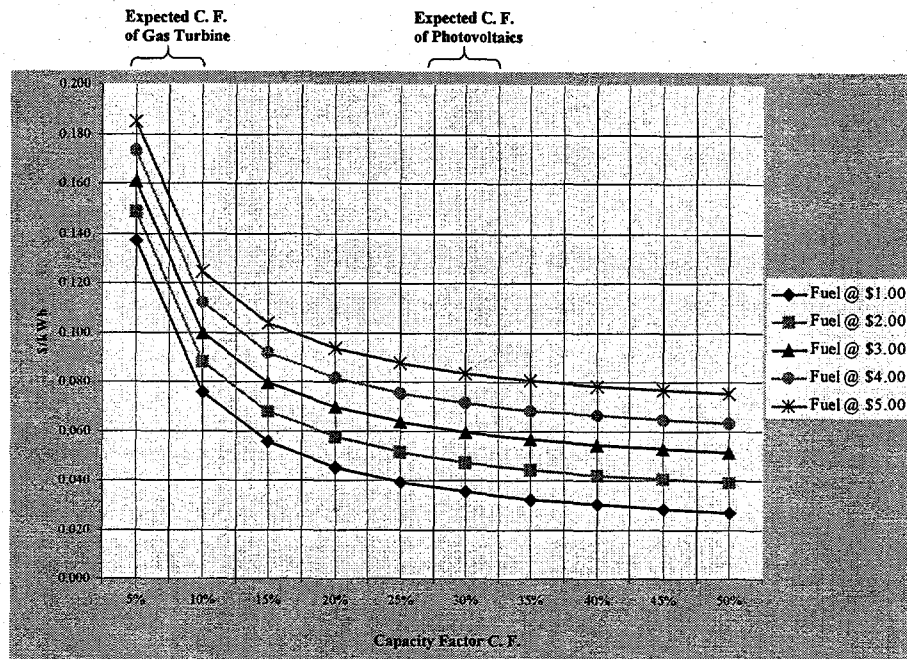


Fig. 1: Cost of Energy (1995 \$) From PNM Gas Turbine

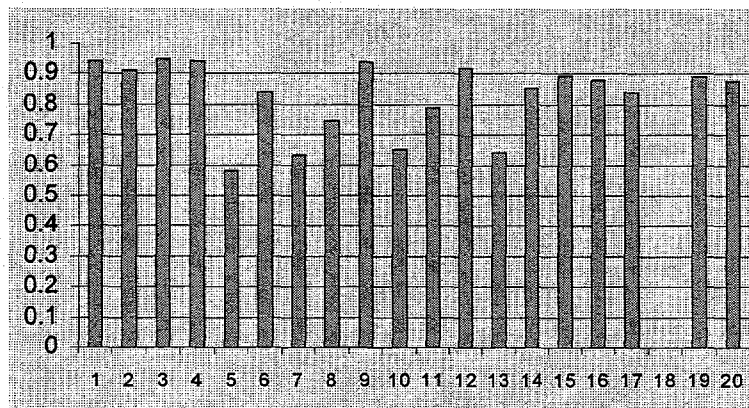


Fig. 2: Load Carrying Capacity of PV Plant

Fraction of "specified" PV Power Available for PNM
 Top 20 Peak Load Events Shown Chronologically
 Through June, July, August of 1997
 (event #18 occurred after sunset)