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Ratepayer Financing of Solar Thermal Electric Commercial Demonstration Projects

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INTRODUCTION

Commercialization of a new energy supply technology requires demonstration of its feasibility to potential customers at each stage of development. While small improvements of proven energy supply systems are usually privately pioneered, larger or more unique research projects are often delayed as economic and technical concerns are assuaged through public sector R&D funding. For solar thermal central receivers, even though their technical viability has been tested on a small scale, acceptance by utilities will require full-scale field experiments and commercial-sized demonstration plants.[1]

These facilities will not be inexpensive; cost estimates per project are over $100 million. This may tax the ability of the Department of Energy to cost-share more than a limited number of facilities due to budgetary constraints. Consequently, the utilities may be forced to finance solar plants through private sector capital markets. Those markets have not yet been tapped because the perceived technical risk and speculative project revenue generation of solar thermal electric systems has made private capital prohibitively expensive if available at all. If a utility could be guaranteed a fair return on all reasonably incurred project costs, those concerns would be alleviated and a new source of financing

[1]A survey of nine southwestern utilities concluded that large-scale operating and reliability data are prerequisites for utility commitment to the concept receiver systems. Fish, M.J., "Utility Views on Solar Thermal Central Receivers," Sandia Laboratories, Livermore, for the U.S. Department of Energy, April, 1980.

Recent empirical work in the market diffusion of photovoltaic energy systems suggests that the likelihood of product adoption in a given end-use sector is increased as the number of successful installations increase. Conversely, almost two-thirds of the market surveyed indicated that between one and ten demonstration projects were necessary before the system could be considered. Lilien, Gary L., "The Diffusion of Photovoltaics: Background, Modeling, and Initial Reaction of the Agricultural-Irrigation Sector," Energy Laboratory of the Massachusetts Institute of Technology, Cambridge, Mass., for the U.S. Department of Energy, March 1978.

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for solar thermal electric field experiments might be opened.

The Federal Energy Regulatory Commission[2] has recognized that utilities will play an important role in the development of alternative energy sources. While the Commission has not yet addressed utility use of solar energy supply sources, its regulatory philosophy has evolved from tentative support of financially speculative energy supply undertakings to approval of projects with considerable technical and financial risk. Evidence of the Commission's position came late last year when the Commission took the first major federal action facilitating the development of a commercial-sized synthetic fuels facility.[3] The Commission approved a rate structure which provided the requisite financial guarantees for the Great Plains Gasification Associates to construct a high-Btu coal gasification plant.[4] The Commission found that the project was essential to the development of a coal gas industry and required, among other provisions, that customers of the natural gas companies bear the costs of the project, regardless of its success in operation.

This report will suggest that the Commission's clear RD&D policy, as most recently articulated through its Great Plains opinion, provides an unexplored opportunity for the financing of solar thermal field experiments. Specifically, we will examine the Commission's regulations and rulings regarding alternative energy research and development efforts to demonstrate substantial precedent for RD&D support. With that background, we will assess the potential for financing a solar central receiver demonstration project for utility application through ratepayer surcharges and project guarantees.

[2]The terms, "Federal Energy Regulatory Commission" (FERC), "Federal Power Commission" (FPC), and "Commission" have been used interchangeably throughout this report. Jurisdiction over electric utility rate regulation had originally been conferred on the Federal Power Commission by the Federal Power Act, 16 USC 791a *et seq.* The FPC's authority with respect to electricity rates and charges was expressly transferred to FERC by the DOE Organization Act, Pub Law 95-91, §401(a), 91 Stat 565, 582. Relevant amendments to FERC jurisdiction occurred under the Public Utility Regulatory Policies Act of 1978 (PURPA), a part of the National Energy Act, Pub. Law 95-617, 92 Stat 3117 *et seq.* See especially 92 Stat at 3140.

[3]Great Plains Coal Gasification, successor in interest to ANR Gasification Properties Company and PGC Coal Gasification Company et al., Opinion No. 69, issued November 21, 1979, and Opinion No. 69-A, issued January 21, 1980. Opinion No. 69 is hereinafter cited as "Great Plains."

[4]The Great Plains Gasification Associates are a general partnership formed by five corporations that are affiliates of certain pipeline companies under the jurisdiction of the Commission. The partners are: Columbia Coal Gasification Corp., an affiliate of Columbia Gas Transmission Corp.; ANR Gasification Properties Co., an affiliate of Michigan Wisconsin Pipe Line Co.; PGC Coal Gasification Properties Co., an affiliate of Natural Gas Pipeline Company of America; Tenneco SNG Inc., an affiliate of Tennessee Gas Pipeline Co., a division of Tenneco Inc.; and Transco Coal Gas Co., an affiliate of Transcontinental as Pipe Line Co.

NATURE OF THE INVESTMENT RISK

Before examining the concept of rate surcharges for supporting large scale solar commercial demonstration plants, it is necessary to discuss in general terms the investment constraints faced by the utility. Due to the requirements of providing adequate service quality at reasonable rates with reasonable profits, the regulated industry has approached investment in capacity additions in a generally risk adverse manner. Generally, only established generating technologies were considered for capacity additions. Consequently, the technical risk problem has generally not been a strong influence on utility considerations of evolving energy supply technologies.[5] The financial risks encountered by a utility include any risk which will abuse the authorized rate of return by (1) not allowing the utility to recover its cost of capital, (2) not maintaining the financial integrity of the enterprise, or (3) failing to attract new capital.[6] Since modern generating plants are physically larger, cost more to construct, and take longer to get in the rate base, the traditional economic issues of utilities versus the regulatory bodies have returned to center stage during the last decade's high inflation. The concern of maintaining a rate of return close to the imbedded cost of capital has created financial difficulties in attracting new higher priced capital.[7] Since the ratepayers

[5]This has been true even for nuclear power where military experience (i.e., submarines) was gained even before the Shippingport commercial demonstration plant. Moreover, utilities have never really had to consider a radically new technology before as the solar technologies are now forcing them to do.

[6]The utility manager's investment decision is colored by his need to attract new financial capital. As a class, investors in utilities tend to be interested in secure, low-risk investment opportunities that will provide a steady, if comparatively reduced, current return. Management decision making is thus under heavy pressure to adopt only the most risk-free technologies, a practice which serves the utility and coincidently provides a reliable quality of service to customers. Such amplified risk aversion could also prolong solar commercialization. For a far-reaching discussion of potential investor influence in a utility's decisions regarding nuclear power, see Ferrar, Terry A., "Three Mile Island -- The Regulatory Challenge of 1979," Public Utilities Fortnightly, July 19, 1979, p. 15.

[7]For an excellent discussion of utility rate making procedures, see Garfield, Paul J. and Wallace F. Lovejoy, Public Utility Economics, (Englewood Cliffs, N.J.: Prentice-Hall, Inc., 1964). For a current discussion of rate reform see Aman, Alfred C., Jr., and Glen S. Howard, "Natural Gas and Utility Rate Reform: Taxation Through Rate Making," Hastings Law Journal, May 1977. Two measures to partially mitigating these risks are the Adjustment for Funds Used During Construction and Construction Work in Progress surcharges. Both are discussed further infra.

have historically only been asked to pay for investments included in the rate base once a plant is used and useful, the utility must be acutely sensitive to any financial risks.[8]

In addition to this risk adverse milieu, the utility manager contemplating a newer energy technology must consider various shades of technical risk. Some of these variations manifest themselves as financial risks as well. There are at least four types of technically related risks: 1) the project costs will be higher than expected; 2) the plant will generate less electricity (or natural gas) than had been expected; 3) the operations and maintenance (O&M) costs will be much higher than projected; or 4) the plant will fail entirely.

The risk that project costs will be higher than anticipated is familiar to utilities building bigger versions of conventional generating technologies; technical scaling-up problems frequently increase expenditures over the anticipated costs. The coal gasification plant proposed by the Great Plains Gasification Associates and the first commercial solar thermal electric facility will be larger than any similar project previously attempted. Since previous cost data is scarce, it would be extremely optimistic not to expect some overrun. Therefore, a manager attempting to make a reasonable and prudent end-product investment decision would need a guarantee that all costs he reasonably incurred would be included in the rate base.

The risks that the plant will generate less electricity than expected or will have excessive O&M costs can be considered together since they deal with operation at less than projected technical levels. Even a conventional plant may never produce at its designed capacity factor due to a variety of engineering, design, or construction problems. Consequently, there is a very real possibility that a plant employing first generation technology will be even more susceptible to these types of problems. In the case of the solar thermal electric plant, if less electricity is produced, the plant will be underutilized. If the plant is part of a repowering unit, the oil or gas side will be used more, increasing the total cost of the enterprise. For a fuel saver solar thermal electric plant, the realized economics will be damaged. Technical failure is a two-edged sword; it increases costs and decreases the return to a plant.

Costs may also increase through operation and maintenance problems (e.g., heliostat maintenance becomes a major activity). Again, this is a risk that may only be mitigated by practical experience.

Finally, the prospect of complete failure is particularly worrisome when dealing with a technology without a track record. Certainly, the loss of the plant will require substitution of

[8]Kirsten, Jack B., "The Incremental Costs of Capital and a Reasonable Rate of Return," Public Utilities Fortnightly, July 5, 1979.

another energy source, most likely the oil or gas that the repowering facility was displacing.[9] However, a more severe loss will be the cost of carrying the unused assets without earning a return.[10] This will hinder both internal and external funds generation if the unit cannot be returned to service. Although there may be some salvage value, the bulk of the principal and any accrued interest must be repaid.

Thus, the utility manager needs two additional guarantees: 1) as long as the plant produces any power, the entire plant will remain in the rate base; and 2) if the plant fails, the ratepayers will reimburse the utility of the capital investment loss within a reasonable period of time.[11]

FEDERAL REGULATORY SUPPORT

The history of federal regulatory support of the development of alternative energy supply sources has substantially paralleled the national energy supply requirements. The Commission's early reluctance to venture into an uncharted and, for the most part, unrecognized area of national energy supply requirements has progressed to financial and, recently, technical support of alternative energy sources.

Before the spur of the 1973 oil crisis, the Commission viewed its mandate to protect the consumer essentially

[9] A graphic illustration of the potential for disasterous economic consequences of project failure is provided by the Three Mile Island incident, where monthly replacement power costs were estimated to be $24 million (to be reduced to $10 million if Unit 1 resumed operation) and monthly capital costs to be $8 million. Testimony of W.E. Kuhns, Chairman of GPU Corp., Subcommittee on Nuclear Regulation of the Senate Committee on Environmental and Public Works (April 23, 1979).

[10] Actual withdrawal of a facility from the ratebase generally demands not only that the plant be currently unused but also that it not be useful during the period in which the rates are to be in effect. There is considerable latitude in which a utility can argue that a plant is experiencing an unscheduled outage and is includable in the ratebase, rather than withdrawn from service. The broad general standard is that the length of time which a facility may be out of service and not removed from the ratebase depends upon the nature of the plant, the degree to which the outage can be expected to occur during normal operation, and the certainty with which resumption of service can be predicted. Decision and Order of the Pennsylvania Public Utility Comn. Concerning TMI, Docket No. I-79040308, issued June 15, 1979. See also, Evansville v. Southern Indiana Gas & Electric Co., Ind. App. Ct., 339 NE2d 562 (1975). Such a withdrawal should be distinguished from rate treatment of casualty losses, which is usually done by amortizing the loss over some period of years rather than reflecting the costs in a single year's rates. See e.g., Pennsylvania Public Utility Comn. v. Pennsylvania Gas & Water Co. (Pa., 1975) 12 PUR 4th 165, (amortization of the costs of flood damage to utility plant as the result of Hurricane Agnes allowed).

[11] The request for regulatory guarantees conjures up another risk, that of the fickle nature of the regulatory body. The possibility of subsequent disapproval of a project is more distinct at the state level, particularly in those states with elected officials, than at the federal level. For a discussion of the constantly changing the rules of the game see, Lee, Charles H., and Thomas J. Healey, "Project Financing of Large Scale Energy Programs," Public Utilities Portnightly, April 14, 1977.

as to ensure the lowest cost energy to the ultimate consumer.[12] However, its support of increasingly more speculative energy technologies has changed markedly. The evolution of the Commission's perception of that mandate can be dramatically traced through the line of cases dealing with the importation of liquefied natural gas to its current culmination in the Great Plains coal gasification decision.

Liquified Natural Gas

Early in 1970, anticipating a future shortfall in domestic supplies, a conglomerate of public utilities[13] began searching for alternative sources of fuel. After considering a variety of supplemental sources,[14] the conglomerate contracted to import 1,000,000 Mcf of liquefied natural gas (LNG) per day from Algeria for a twenty-five year period beginning in 1976.[15] The gas was to be used only to service existing customers for the purpose of preventing curtailments of service.

Design of a proper rate schedule for the imported LNG was of critical importance to the Commission. LNG has unique factors that should arguably accord it special rate treatment. First, because of its extreme volatility, new transportation and storage facilities have had to be developed. Second, LNG costs more to produce than conventional natural gas and must be contracted for by its importers significantly in advance of its potential use. The advantages of LNG are that it is useful in alleviating short-term supply deficits, and, as

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12 - The clear intent of the Federal Power Act (16 USC §805 a) is to ensure that the Commission protects consumers against excessive prices, though those interests must be balanced against the legitimate investor concern with the financial integrity of the company, Federal Power Comn. v. Hope Natural Gas Co., 320 U.S. 591, 603 (1974).

13 The participants included: Columbia LNG Corp., a division of Columbia Gas System, Inc; Consolidated System LNG Corp., a division of Consolidated Natural Gas Co.; and Southern Energy Company, a division of Southern Natural Gas Company.

14 According to the findings of fact of the Administrative Law Judge, Algerian liquefied natural gas was a more desirable supplement than natural gas from Canada, Alaska, Mexico, Nigeria, Trinidad, Venezuela or other domestic sources, gasified coal, reformed naphtha, or other feedstocks such as methanol or oil shale, or nuclear stimulated gas for a number of reasons-- cost, supply, availability, etc. Footnote by the Court, Columbia LNG Corp. v. Federal Power Comn. 491 F.2d 651, 652, n.2,(5th Cir., 1974).

15 Actual contractual arrangements were made by the conglomerate with the El Paso Algeria Corp., a susidiary of El Paso Natural Gas Co., to have El Paso Algeria purchase and transport the required amount of LNG from Societe National Sonatarch, an Algerian state-owned company.

conventional fuel prices increase, it becomes economically more viable.[16]

The issue facing the Commission was to determine which of the conglomerate's customers would be required to pay for the LNG purchases. In previous opinions, the Commission had traditionally allowed the costs of newly discovered gas to be "rolled-in" with the existing gas. Under such a system, each customer pays for the higher-priced gas pro-rata, whether or not he actually uses the new gas or remains served by the old supply. In its initial decision rendered in 1972, the Commission did not allow rolled-in pricing but required the actual purchasers of the LNG to pay the incremental costs.[17] The Commission reasoned that the conglomerate and its shareholders should take the risk of finding customers for the higher-priced LNG, and should therefore be allowed a return sufficient to encourage such an experimental undertaking. The rate-payers, the Commission announced, should not have to sustain the burden of projects that are not economically viable.[18] As a matter of policy, the Commission determined that there was an incentive for the utility to keep costs at a minimum to encourage customer purchase of LNG if incremental pricing were employed.[19] The ultimate effect of the ruling was to chill the conglomerate's desire to import LNG until the incremental price difference between LNG and conventional gas had decreased.

Not unexpectedly, the conglomerate appealed. Four months later, the Commission agreed that developing separate LNG rate schedules would be administratively impracticable. It ordered that rolled-in pricing be allowed at the wholesale level, but that the various state public utility commissions could force the pipeline or retail distributors to employ incremental pricing.[20]

Commissioner Brooke, in a dissent that would become a harbinger for future Commission rulings, objected vigorously to the implementation of imcremental pricing at the pipeline level. He stated in pertinent part,

> It (LNG) is not an incremental supply in the sense that it will be used by customers incidental to those now attached but rather that it will constitute a badly needed augmentation of dwindling domestic supplies. It will not supplment domestic gas because there is no domestic alternative.... Evolution of pricing in the natural gas industry has followed the rolled-in or averaging concept because it

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[16] As such, LNG had been traditionally viewed as meeting peak load needs.

[17] In re. Columbia LNG Corp., et al. Pocket No. CP71-68, F.P.C. Opinion Number 622, 47 Federal Power Comn. Reports 1624, 1639-1640, issued June 28, 1972.

[18] Id. at 1640.

[19] Id, citing F.P.C. v. Louisiana Power & Light Co., 406 U.S. 621 at 631 (1972).

[20] In re. Columbia LNG Corp. et al., Docket No. CP71-68, F.P.C. Opinion No. 622-A, 48 Federal Power Comn. Reports 723, 729-730, issued October 5, 1972.

> benefits all customers of any given system by assuring "equal treatment for customers receiving equal service." (Battle Creek Gas Co. v. F.P.C., 281 F.2d 42 (CADC, 1960))…. Consumers, to be sure, will be required to pay somewhat higher prices for gas on a rolled-in basis, but rolled-in pricing will enable the recapture of incremental costs…. I can appreciate the arguments that incremental pricing merits attention from a purely theoretical economic point of view, but the practical circumstances of this case, as it has been structured to benefit consumers, certainly do not support any departure from accepted rolled-in pricing methodology….[21]

Once more the conglomerate appealed. The U.S. Court of Appeals for the Fifth Circuit found the Commission's decision to employ incremental pricing at the pipeline level unsupported by substantial evidence and, without reaching the merits of the rolled-in pricing issue, vacated the Commission's decision and remanded it back for their further consideration.[22]

The battle lines had thus been drawn on an issue that the Commission is only now beginning to resolve -- who should bear the technical and financial risks of a project designed to supply energy by nonconventional means? On one side lined traditional economists and the consumer forces. Their argument that risks should be shared by those who stand to profit from them has as its basis two substantial underpinnings. First, pricing at the margin was necessary to restrain the utilities from spending on overly risky projects. Second, in allocating benefits to costs, those who were the direct beneficiaries of the new supply source (*i.e.*, its actual purchasers) should pay the higher price. They concluded that the risks should be borne by the utility's shareholders, as the ultimate recipients of anticipated profit. The project sponsors opposed incremental pricing and argued that the ultimate beneficiaries were all of the ratepayers, for everyone would benefit from a secure energy supply.

The turn of events in the next two years took much of the wind from the sails of the proponents of incremental pricing. Gas prices increased, and LNG became no longer an exotic energy supply for low priority consumers, but a significant fraction of the conglomerate's gas reserves.[23] Suddenly LNG was closer to being economically competitive with conventional gas and a critical supply source for even the highest priority

[21] *Id* at 740.

[22] *Columbia LNG Corp. v. Federal Power Comn.* 491 F.2d651, (5th Cir, 1974).

[23] During the first year of operation, Columbia estimated that LNG would represent 9.7% of total supply, Consolidated estimated it as 18.3% of its supply, and Southern estimated it as 16.9% of its total supply. *Re. Columbia LNG Corp et al.*, Docket Nos. CP71-68 *et al.*, Opinion No. 786, 18 PUR 4th 359, 366, issued January 21, 1977.

consumers. In this light, the Commission decided that proper allocation of benefits to cost required rolled-in pricing at both the wholesale and pipeline level.[24]

At almost the same time, another group of Commissioners turned down the petition of the Trunkline LNG Co. to roll-in the prices on its LNG imports.[25] The Trunkline LNG Co. petitioned the Commission for a rehearing, stating that the decision was inconsistent with the Columbia LNG decision and contrary to the goal of encouraging all forms of supplemental supplies in times of energy shortages. The Commission reversed its initial ruling and accepted Trunkline's argument, stating that it would be inconsistent with their responsibility of consumer protection were it to, in effect, "kill the project by using incremental pricing."[26] Since that time, there has been little wavering in the Commission's readiness to supplement natural gas supply by the use of LNG.[27]

Federal Regulatory Support of Research and Development

Paralleling the Commission's recognition of the need to encourage the development of existing gas supplies was a more generic realization that the energy mix structure could face severe supply constraints in the mid- to long-term. During the last several years, the Commission has taken an increasingly progressive stance in encouraging companies within its jurisdiction to undertake projects which develop technological innovations or alternative energy supply sources. It has recognized that without some regulatory vehicle by which private research and development projects can be furthered, only the most risk-free technologies will be adopted.

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24 Id. The Commission's opinion cited both increased system reliability and consumer equity as reasons to employ rolled-in pricing. "[The] use of rolled-in pricing ensures that two otherwise similar customers will not pay radically different prices for commingled gas, merely because one happens to have been receiving the service longer than the other. Use of the rolled-in method thus serves the interest of equal treatment for customers receiving equal service." Id at 368, Citing Mr. Justice Reed in Battle Creek Gas Co. v. Federal Power Comn., 281 F.2d 42, 46.

25 In re. Trunkline LNG Co., Docket Nos. CP74-138 et al., Opinion No. 796, CCH Utilities Law Reports - Federal - New Matters at ¶11,942, issued April 29, 1977. The original Trunkline LNG hearing was terminated five weeks before the Columbia LNG petition was granted, but the Trunkline decision was handed down three months after Columbia.

26 In re Trunkline LNG Co., Docket Nos. CP75-138 et al., Opinion No. 796-A, CCH Utilities Law Reports - Federal - New Matters at ¶11,970.

27 See e.g. Re. Tennessee Natural Gas Lines, Inc., Docket No. RP76-99, FERC Opinion No. 8, 24 PUR 4th 381, issued February 21, 1978. (Rolled-in pricing granted utility on the basis that it permitted increased operating flexibility which allowed utility to safely authorize takes by direct customers when it might not otherwise be able to do so if the LNG facility were not available to provide protection to high priority customers).

The Commission's recognition of the need for significantly expanded national energy research and development has been enunciated in a series of regulations and administrative rulings.[28] Early Commission orders provided for changes in the uniform system of accounts for electric utility and natural gas companies by establishing a specific amount for R&D expenditures, allowed amortization of approved research and development expenditures over a period of up to five years, and allowed rate base treatment for unamortized balances.[29] Later assurance of advance rate treatment and continued tracking of R&D expenditures was approved.[30]

In 1976, the Commission proposed an important addition to its regulations. It recognized that while many energy technologies were known to be feasible on a laboratory scale, there was often considerable concern as to their economic feasibility at the commercial level. Because this uncertainty often precluded the financing for the construction of the first several commercial scale facilities, the Commission adopted a rule, Order No. 566, granting advance rate approval as RD&D expense to that portion of a unique demonstration project which would be precluded from complete financing as a normal business investment.[31]

Order No. 566 represents significant progress from previous Commission orders. The initial method of testing the reasonableness of RD&D projects was to examine the technical structure of each proposed project to determine whether it met a prescribed definition of research and development and had a reasonable chance of benefiting the ratepayer. The Commission recognized that such a procedure substituted the technical and research judgment of a limited Commission staff for that of the utility's technical personnel, with the potential for causing a long and costly delay.

The method adopted in Order No. 566 is to establish a set of criteria based on the planning process itself. In such an approach, an individual RD&D expenditure would be reasonable if it supported a comprehensive and integrated energy RD&D program meeting the ultimate purpose of the company to serve the ratepayers and the general public.

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[28] The most recent regulation on rate treatment of RD&D efforts propounded by the Commission announced that its regulatory philosophy was to ensure that its regulation prescribe the most direct and effective means to stimulate RD&D effort. Federal Power Comn., Notice of Proposed Rulemaking, Advanced Approval of Rate Treatment for Research and Development, issued June 23, 1976, 41 Federal Register 25914.

[29] Federal Power Comn. Order No. 408, issued August 26, 1970.

[30] Federal Power Comn. Order No. 483, "Research and Development, Accounting and Reporting," Docket No. R-462, 49 FPC 1054, issued April 30, 1973.

[31] Federal Power Comn. Order No. 566, "Order Prescribing Changes in Accounting and Rate Treatment for Research, Development, and Demonstration Expenditures," issued June 3, 1977, 42 F.R. 30150. In Order 566, the Commission expanded its definition of research and development (R&D) to include demonstration projects as well (RD&D).

Under the provisions of Order 566, the Commission will judge RD&D projects or programs by evidence of the following:

1. That the RD&D objectives of the company or research organization have been clearly established.
2. That the plan evolves from these RD&D objectives and adequately utilizes the viewpoints of scientific, engineering, industry, economic, consumer and environmental interests.
3. That an effective mechanism exists and is used for coordinating the proposed research and development plan with federal RD&D programs and with other relevant private efforts of national scope.
4. That the project is well conceived and has a reasonable chance of benefiting the ratepayer in a reasonable period of time, having due regard to the basic, exploratory or applied nature of each submitted RD&D project.
5. That whatever achievements may result, including knowledge gained or technology developed from the RD&D effort, if any, will accrue to the benefit of the sponsoring jurisdictional company(ies) and its/their customers.

The Commission expressed a strong preference in Order 566 that large scale demonstration projects applying for special ratebase treatment be funded by an RD&D organization jointly supported by companies having a large number of ratepayers so that the impact on individual consumers would be minimized.[32]

While the Commission has not yet addressed utility use of solar thermal central receivers, its policy towards the use of nonconventional energy sources has been articulated with respect to coal gasification and liquefied natural gas (LNG). However, the progression of the Commission's decisions is clear. Financial risks hindered LNG development but were approved. Financial risks coupled with technical uncertainty were encountered in the coal gasification decision. The technical risk of solar thermal as an untested supply source will cause similar financial constraints. Neither line of decisions is dispositive of how the Commission will rule on a proposed solar thermal facility. However, the similarities of the issues to be decided, and the Commission's clear policy of furthering nonconventional energy research and development strongly suggest that treatment of solar thermal demonstration projects will parallel that of coal gasification and LNG.

[32] Federal Power Comn., Order No. 566, 41 F.R. 25914, 25916.

Great Plains Coal Gasification Decision

The most dramatic exemplar of the Commission's RD&D policy is the Great Plains Coal Gasification case, where the Commission approved a project designed to demonstrate the technical and commercial feasibility of converting coal into pipeline quality gas. The importance of the Great Plains decision is that it fully demonstrates the Commission's eagerness to encourage the private development of alternative energy sources.[33] No other project had been granted the full range of financial incentives to further RD&D efforts that the Great Plains facility received. This section of the paper will first explore the Commission's reasoning in Great Plains that substantially granted the financing package requested by the sponsors, and second, lay the groundwork for applying similar standards for solar thermal field experiments.

The project sponsors, the Great Plains Coal Gasification Associates, sought to employ project financing for the facility. Project financing is defined as,

> "financing of a particular economic unit in which a lender is satisfied to look initially to the cash flows and earnings of that economic unit as the source of funds from which a loan will be repaid and to the assets of the economic unit as collateral for the loan."[34]

The opportunity to segregate the project's cash flows from the sponsor's other operations allows appraisal of the credit risk of lending directly to the project. This can often be accomplished with minimum impact to the sponsor's or owner's debt capability through indirect credit arrangements. This approach is quite common in the non-regulated industries specializing in mineral extractive operations. Only recently has the concept been proposed for regulated industry investments.[35]

However, since project financing is generally used only with proven and established technologies, the economic self-sufficiency of the project was at risk. It was essential to demonstrate to the potential investors a history of reliable performance based on use of the technology at the scale contemplated. Since that was not possible, Great

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[33] The Office of Consumer Counsel for the State of Ohio, the Public Service Commission for the State of New York, the State of Michigan and General Motors have filed an appeal of the Great Plains decision in the United States Court of Appeals for the D.C. Circuit. No decision on that appeal has been rendered. However, the Commission has denied the appellant's application for rehearing in Great Plains, FERC Opinion No. 69-A, Docket CP78-391 et al., issued January 21, 1980.

[34] Kevitt, Peter K., Project Financing, AMR International, California, 1978.

[35] Project financing, using non-traditional utility financing sources, also has the added benefit of accessing investors who may be able to use the tax creidts available for recent federal energy legislation which prohibits utilities from doing so.

Plains project needed a revenue assurance guarantee. In order to demonstrate the credit worthiness for a project financing, the sponsors sought to develop economic and legal linkage among the project financing entity, the sponsors themselves and the users of the project. Thus the sponsors sought to structure the Great Plains project so as to allow the Commission to exercise jurisdiction and then to persuade them to allow ratepayers to guarantee the investment.[36]

The Commission approved the major planks of the Great Plains proposal, which included a ratepayer guarantee of all debt services, rolled-in pricing, a tracking provision allowing automatic recovery of all project costs, and a charge to ratepayers covering debt financing of costs during the construction period (CWIP).[37] However, the Commission reduced the requested return on equity from 15 to 13 percent.

In reaching their decision the Commission demanded affirmative resolution of four conditions:

(1) Is it likely that a large-scale coal gasification industry will be needed in the near future?

(2) Are the demonstration benefits of the specific facility proposed worth the cost of the project?

(3) Are the specific finance and tariff proposals of the sponsors reasonable and in the public interest?

(4) Is it reasonable for ratepayers and customers of the sponsoring companies to pay for the cost of the project and provide financial guarantees to the investors in the project?[38]

Because similar questions will be asked when a proposal for a solar utility is advanced, the Commission's response in Great Plains will be analyzed in some detail below.

(1) Is it likely that a large-scale gasification industry will be needed in the near future?

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[36] Great Plains at Opinion p. 58.

[37] Great Plains at Opinion p. 58. With respect to the charge covering debt financing of costs during the construction period, the Commission departed from its standard practice of capitalizing such costs and adding them to the rate base, recovering them over the life of the project as "allowance for funds used during construction" or AFUDC. Under the AFUDC concept, the customers who receive the benefits of the gas supply project pay for the entire cost of the project, with benefits proportional to the amounts of gas consumed. However, because the Commission found that the information generated about the commercial, technical, institutional, and environmental feasibility of coal gasification would benefit both current and future ratepayers, a CWIP surcharge was allowed. CWIP also would have the advantage of spreading the costs of the project over a longer period of time to a greater number of ratepayers. Great Plains at Opinion pp. 68-69. For a discussion of the advantages of CWIP, see Comtois, Wilfred H., "Construction Work in Progress in the Rate Base: A Benefit to the Consumer," Public Utilities Fortnightly, May 8, 1980, p. 19. See also Johnson, Johnny R., "Construction Work in Progress: Planning for the Rate Case," Public Utilities Fortnightly, August 2, 1979, p. 15.

[38] Great Plains at Opinion pp. 18-19.

The Commission examined the current national energy situation in answering this question. It found that it was in the national interest "to shift from our extensive dependence on depleting oil and gas sources towards use of more abundant energy sources such as coal, waste and renewable resources ... (and) ... in the longer run ... (to) transit to a solar fuel based energy economy."[39] The Commission recognized that while the proposed project would obviously not solve all of our energy problems, its limited goal of evaluating the potential role, if any, of coal gasification in the improvement of our energy situation satisfied the Commission's standards for achieving RD&D status.

(2) Are the demonstration benefits of the specific facility worth the cost of the project?

(3) Are the specific finance and tariff proposals of the sponsors reasonable and in the public interest?

These two questions should be considered together, for a properly structured proposal which elicits a favorable response from the Commission to the second question will serve to provide a favorable answer to the third question. It will also create the setting for an affirmative response to the fourth question.[40]

The Commission grouped the demonstration benefits of the project into three categories. The first advantage to the Great Plains project is that it would allow the financial community, government planners, and the gas industry to better assess the economic and technical feasibility of producing high-Btu gas from coal. The Commission found that the uncertainties facing the development of a coal gasification industry, particularly construction costs and plant efficiency, could only be resolved through a commercialized demonstration project. It anticipated that at least three kinds of novel technical data would be obtained from the project: the various components of the plant were to be assembled in a particular sequence for the first time; the technology was to be used in a unique manner; and the sizes of some of the components were to be larger than had been used commerciall elsewhere.[41]

The Commission found that the second advantage to the project was that information about the regulatory and governmental approval processes on the federal, state, and local levels could be gleaned. Institutional barriers to commercialization would be identified for future sponsors, and a predicate for possible regulatory change would be established.[42]

Finally, the project was anticipated to provide a wealth of data on environmental and socioeconomic

[39] Great Plains at Opinion pp. 19-20.

[40] Similar analysis was used in Zipp, Joel F., "Impact of the Great Plains Coal Gasification Decision on a Coal Gas Industry," Public Utilities Fortnightly, May 8, 1980, p. 33.

[41] Great Plains at Opinion pp. 25-30.

[42] Great Plains at Opinion pp. 30-31.

impacts of coal gasification facilities, again clearing the way for future sponsors.[43] In sum, the Commission found that the primary benefit of the project was information, not simply additional amounts of energy. As such, the Commission concluded that the project qualified as a commercial demonstration facility under FERC Order 566.[44]

(4) Is it reasonable for the ratepayers and customers of the sponsoring companies to pay for the cost of the project and provide the requisite financial guarantees to the investors in the project?

The final question demands resolution of a more fundamental issue first: if an RD&D project is deemed necessary to fulfill certain national energy policy goals, should the ratepayers or the taxpayers finance the facility? The answer to that question is critical to the future of central receiver field experiments.

Both sides offered persuasive arguments. Consumer groups argued that it would be inequitable to have a minority of natural gas consumers pay all the costs of the project, while the benefits of learning the economic and technical feasibility of manufacturing and marketing coal gas or solar-generated electricity would inure to the nation as a whole. National benefits, they submitted, should be paid for from national coffers.

The Commission justified passing through the costs of the Great Plains project to the ratepayers by advocating two complementary philosophies. Neither group disputed the initial premise of the Commission, that the goal of regulatory pricing should be to achieve a matching of benefits to cost.[45] The Commission found that consumers receive distinct benefits from the facility that transcend the indirect benefits received by the nation as a whole: 1) the gas produced would go directly to the consumer, and 2) because the total quantity of gas available to the system is increased, system operating reliability is enhanced by allowing customer takes at times it might not otherwise be able to because of the need to protect the supplies of high-priority customers.[46] The Commission also reiterated its stance that more avenues of research are likely to be explored if research is decentralized and innovations undertaken by many firms.[47]

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[43] Great Plains at Opinion p. 31.

[44] Great Plains at Opinion p. 48.

[45] Great Plains at Opinion p. 41. Garfield and Lovejov, op. cit. That policy was derived in a major part from the Supreme Court's ruling in Federal Power Comn. v. Hope Natural Gas Co., 320 U.S. 591 (1944). An extensive discussion of similar policy questions relating to the Three Mile Island incident can be found in Avery, George A., "The Costs of Nuclear Accidents and Abandonments in Rate Making," Public Utilities Fortnightly, November 8, 1979, p. 17. See also Ferrar, Terry A., op. cit.

[46] Great Plains at Opinion p. 41.

[47] Great Plains at Opinion p. 44.

The specific question addressed by the Commission of whether it is reasonable to have the ratepayers and customers of the sponsoring companies pay for and guarantee an RD&D project can now be discussed. Rather than requiring an idealistic sort of equity by attempting to quantify the indirect benefits received by non-purchasers, the Commission established the following test for ratepayer financing of RD&D projects: is there a sufficient sharing of the risks and responsibilities that no single customer will be required to bear unreasonable costs or risks?[48] Although the Commission stated that wider sponsorship of the project would have been preferable, it approved the proposed allocation of costs among the customers of the five sponsors, a group which included consumers of approximately one-third of the nation's interstate gas. The increase in the cost of gas of 2.6 cents per Mcf (and as much as 6.0-8.5 cents per Mcf if the project failed immediately after its construction) was found not to lay an onerous burden on the individual consumer.[49]

Potential Application For Solar Thermal Field Experiments

While the previous discussion necessarily focused on Commission rulings on other sources of alternative energies, similar reasoning can be applied to the potential for rate restructuring to encourage solar thermal RD&D efforts. In this section we will pose redundant questions to those determining the Great Plains decision to analyze the potential of a similar approach for utility use of solar central receivers.

(1) Is it likely that a large-scale solar thermal industry will be needed in the near future?

The Domestic Policy Review of solar energy concluded that solar energy offers numerous important advantages over competing technologies, among them oil displacement and environmental compatibility.[50] Solar thermal applications were given the objective of supplying three quads of the national energy demand by the year 2000.[51] The critical nature of solar thermal energy to achieving the nation's energy objectives certainly meets the criteria suggested by the Commission for furthering proposed demonstration projects.

(2) Are the demonstration benefits of the specific facility worth the cost of the project?

(3) Are the specific finance and tariff proposals reasonable and in the public interest?

The need for a solar thermal demonstration project is critical to the future of the industry. A survey of

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[48] Great Plains at Opinion p. 18.

[49] Great Plains at Opinion pp. 46-47.

[50] Domestic Policy Review of Solar Energy, a Response Memorandum to the President of the United States, printed by U.S. Department of Energy, February 1979, p. iii.

[51] Solar thermal goals for the year 2000 are: 4 quads thermal electric and 2.6 quads for industrial process heat and agriculture. U.S. Department of Energy, Division of Central Solar Technology, Solar Thermal Branch, Solar Thermal Program Multiyear Plan, August 28, 1979, Washington, D.C.

utility views on the need for solar demonstration projects completed earlier this year concluded that large-scale operating and reliability data are necessary prerequisites for utility commitment to the solar central receiver concept as a viable alternative.[52] The study found that demonstration at 50 MWe or larger for two or four years would largely satisfy those needs. Moreover, the utilities felt that the demonstration projects ought to be utility operated rather than government controlled to insure project credibility.

The need for solar thermal field experiments having been demonstrated, similar analysis as to the reasonableness of the specific finance and tariff proposals can not be applied. Clearly, a customer group far larger than the actual customers of the plant benefits from its installation. Total electricity available and system reliability are increased, thereby providing benefits for all of the utility's customers. Such an allocation fits foursquare in the Commission's definition of allowable RD&D rate treatment.

(4) Is it reasonable for the ratepayers and customers of the sponsoring companies to pay for the cost of the project and provide the requisite financial guarantees to the investor in the solar thermal project?

Electric utility rates are structured under the same general philosophy as those for gas; that is, those who receive the benefits from the facility ought to bear its financial burden. The separate and distinct benefit received by the customers of the sponsoring utilities parallel those of the Great Plains customers: the power produced by the central receiver installation would go to the consumers and system reliability would consequently be increased.

To meet the Commission's test of having sufficient risk sharing such that no customer would bear unreasonable costs, a solar thermal field experiment would have to be broadly sponsored. A consortium of companies would probably require interconnect capability to the central receiver facility (either wheeled or direct) in order to

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[52] Fish, M.J., op. cit. The utilities viewed the successful operation of the Barstow pilot plant as essential to the development and acceptance of the solar central receiver concept. Extended delay or cancellation of the Barstow project was seen as very detrimental because: 1) the availability of design, performance, and operating information required for a utility to consider the technology would be postponed, and 2) more significantly, Barstow would become a highly visible example of the lack of a clear government commitment in developing renewables, and particularly solar, as a viable power production option.

demonstrate potential benefit to their customers.[53] Then, so long as no single customer bears an unreasonable burden and each receives some potential benefit, a project meeting the criteria addressed above is likely to be approved.[54]

Non-participating utilities with interconnect capability to the solar facility also receive some potential benefit. Such utilities would be able to draw from the solar plant during their down time, and pool reliability would thereby increase. In such a situation, it would not seem unreasonable to include some portion of the RD&D cost in contracted rates between participating and non-participating utilities. However, the Commission does not have jurisdiction to compel ratepayers of non-participating utilities to insure an RD&D project.[55]

We advance the suggestion made above for rate restructuring to aid the development of solar thermal field experiments not as the only potential alternative rate structures, b[illegible] as one possible for [illegible] ratepayer participation in solar RD&[illegible] efforts.

CONCLUSION

The barriers to the commercialization of solar thermal systems in the utility market are acute; the perceived risk in investing in an untested system is extraordinary. If solar thermal is to come of age, the technical and economic feasibility of the system must be demonstrated. The vehicle for privately financed field experiments is apparently available, at minimal risk to the utilities under FERC jurisdiction. With the Commission's commitment to allaying the financial and, apparently, the technical concerns of utilities wishing to employ alternative energy supply sources, full-scale government participation in solar thermal electric commercial demonstration projects becomes less imperative. In fact, the future of the technology may be in the hands of its eventual customers.

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[53] A discussion of electric utility coordination can be found in Resource Planning Associates, "The Florida Electric Power Coordinating Group: An Evolving Power Pool," for the U.S. Department of Energy, Economic Regulatory Administration, October 1979, and in the follow-up to that report, "Power Pooling: Issues and Approaches," DOE/ERA, January 1980. The degree of utility integration proposed here is substantially greater than exists in most pooling arrangements, though increasing coordination is becoming prevalent. The authors concur with the Resource Planning Associates that the state public utility commissions will play a critical role in stimulating coordination between the utilities.

[54] Great Plains at Opinion p. 42. The Commission in so ruling extended the holding of Public Service Comn. for the State of New York v. Federal Power Comn., 516 F2d 746 (C.A.D.C., 1975), on remand 417 US 964, 94 SCt 3167, 41 LEd2d 1136 (1974), with instructions, citing Mobil Oil Corp. v. Federal Power Comn. 417 US 287, 94 SCt 2378, 41 LED 2d 72 (1974). The New York Public Service Commission had objected to the FPC's extension of the rate base to include expenditures argued not to be used and useful in providing utility service. In rejecting the New York Public Service Commission's claim, the D.C. Court of Appeals held that "An increase in the base rate made in order to encourage exploration by producers in a time of extreme supply shortages may be valid, assuming the ultimate rate is within the zone of cost data, even though the amount of increased supply ascribable to the rate increase cannot be precisely quantified". 516 F.2d at 749.

[55] See Great Plains at Opinion pp. 41-45.