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Third Party Financing of Central Receiver Repowering Projects

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THIRD-PARTY FINANCING OF CENTRAL-RECEIVER
REPOWERING PROJECTS

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FOREWORD

This report presents a preliminary analysis of innovative Third Party financing of central receiver repowering projects. This work was done on Contract No. DE-AC03-81SF-11514 under the general direction of Dr. Keith Rose, Program Manager, and under the overall cognizance of Mr. Robert Hughey, Director of Solar Energy Division, San Francisco Operations Office, DOE/SAN.

This report was prepared by Dr. Prem Munjal with assistance from JoAnn Walter in carrying out the required computer runs. The study was conducted under the direction Dr. Prem Mathur who is also the Principal Investigator for this contract.

1.0 INTRODUCTION

DOE is developing solar thermal technology for utility and industrial applications that can significantly reduce the nation's dependence on imported oil. Progress has been made in solar central receiver system development that shows the potential technical viability and economic attractiveness of solar thermal energy systems. These studies and additional feedback from industry also show that, like any other new technology, the cost of a one-of-a-kind first plant is high and effective technology transfer to utility and industry will not take place without additional DOE efforts. This study investigates an innovative third party financing approach for the first solar thermal repowering plants that may reduce the need for direct DOE cost sharing during the critical early application of central receiver technology by industry.

2.0 THIRD PARTY FINANCING APPROACH

Third party refers to a corporation, partnership, or a joint venture that can take advantage of existing financial incentives. As owner of a solar thermal system, a utility itself cannot use the federal solar tax credit. In addition, the Tax Act of 1981 has assigned a longer depreciation class life for a utility property as compared to an equivalent business and industrial property. Also, unlike a utility owned project, a third party venture does not have the drawbacks of direct regulation. As long as the utility ownership is less than 50%, an initial repowering project can take advantage of various tax credits, accelerated depreciation and other benefits of an independent unregulated power producer. A utility may supply a portion of the required capital as equity money to a majority share partner or can offer a large loan for a leverage lease arrangement. A utility may also do the necessary operation and maintenance (O&M) of the central receiver and provide the project site. Similarly, a system supplier, e.g., heliostat manufacturer, may provide the necessary loan, may

become a partner with the third party, or both. A third party business may be established for the sole purpose of producing central receiver generated electricity. A third party can be a joint venture between: (a) investors group, service company, and/or utility; (b) system manufacturer, end user, and/or contractor; (c) profit-making business, utility, and/or developer; and (d) any combination of the above, where one of the parties can take full advantage of the various state and federal tax benefits that are offered by a central receiver project. The primary requirement of a successful third party structure is that it must have an adequate tax liability, which makes full use of various state and federal tax benefits. Figure 1 presents one of the many possible structures of a third party venture.

3.0 AVAILABLE FINANCIAL INCENTIVES

The recent changes in various state and federal laws are aimed at promoting the renewable energy sources, such as solar thermal central receiver technology. A utility is now required to purchase central receiver generated electricity at avoided cost rates. In addition, there are substantial tax credits and depreciation allowances provided by many state and federal laws to offset high pre-mass production heliostat costs. These tax benefits can make an initial repowering project an attractive investment in today's market. As the manufacturing of heliostats moves into mass production, there should be substantial reductions in the central receiver plant costs. These reductions will make the future production of central receiver electricity and industrial process heat economically attractive without the help of various financial incentives. Some of the available incentives applicable to a first repowering project are summarized below.

FIGURE 1. POSSIBLE STRUCTURE OF A THIRD PARTY CENTRAL RECEIVER (CR) VENTURE

3.1 GUARANTEED MARKET

Section 210 of the Public Utility Regulatory Policy Act (PURPA), is aimed at encouraging development of alternate energy sources. It gives the Federal Energy Regulatory Commission (FERC) certain powers to encourage the growth of small power production and cogeneration to displace conventional electric power generation. Solar thermal central receiver technology is one of the alternate energy sources contemplated by Congress in enacting PURPA. The protections and incentives offered by PURPA apply to the central receiver qualifying facilities, called QF's that are under 80 MWe (no limit for cogeneration). Utilities must purchase all usable electric energy made available by a QF at a rate that reflects the utilities "incremental costs".

Thus, QF's will receive maximum benefits without causing increases in electric rates for other consumers, at least increases that they would not otherwise experience. When generating electricity, a utility brings its least expensive source on-line first, and its most expensive source last (frequently an older oil-fired plant). The incremental cost of bringing the last, most expensive source on-line is called the "marginal" or "avoided" cost. A utility is required to pay for central receiver electricity at an "avoided cost" rate that will rise with increases in the cost of oil. For example, Pacific Gas and Electric currently (1981) assigns a price for purchasing renewable energy at 81 mills/kWh on-peak and 67 mills/kWh off-peak. The price paid for solar electricity varies with the utility so that it may be advantageous for a third party to sell electricity to a utility some distance from the plant site at a higher price. In this case, the QF is paid the avoided costs of the second utility less any transmission or "wheeling" expenses the first utility incurs.

A QF is also exempt from filing utility reports with the Federal Securities and Exchange Commission and is free from state and federal regulation as utilities.

3.2 FEDERAL TAX BENEFITS

Many federal tax benefits are also available to third party investors of central receiver technology. These tax benefits include the 10% federal investment tax credit and an additional 15% Solar Energy Tax Credit provided by the Windfall Profits Tax Act of 1980. This energy credit applies to all solar hardware except for the new transmission lines that may be required to interconnect with the utility grid. This credit has no limit, but is scheduled to expire December 31, 1985. Utility ownership of a central receiver technology is not eligible for this energy tax credit. Investment tax credit can be carried backwards and forwards. The Economic Recovery Tax Act of 1981 has increased the carry forward period from 7 to 15 years.

In addition to these tax credits, the new Tax Act of 1981 establishes a new depreciation system, known as the Accelerated Cost Recovery System (ACRS). Third party ownership of solar central receiver property would be qualified for a 5-year class property for depreciation. Compared to this, a utility ownership is allowed to depreciate the same plant in 10 to 15 years.

Recognizing that some businesses and utilities may not be able to completely use the above mentioned tax credits and depreciation, the Act provides for their transfer to corporations that could use them. To facilitate the transfer of these benefits, the new Tax Act establishes safe harbor rules that, if met, characterize a transaction as a lease for allowing the various tax credits and deductions to the nominal lessor. The qualifying requirement for this leveraged lease arrangement is that the property must be leased within three months after its acquisition and at all times during the term of the lease the lessor must have a minimum, "at-risk" investment of not less than 10% of the adjusted basis of the property. There is no requirement that the lessor derive a before-tax profit or have a positive cash flow, or that the property be usable by someone other than the lessee.

3.3 STATE TAX BENEFITS

Many states also provide additional state tax credits and depreciation benefits to renewable energy sources. Some states also exempt both property and sales taxes. In California, a central receiver project is eligible for a 25% state energy tax credit in addition to the federal tax credits. This credit has no limit and is not reduced by any federal tax credit. These credits apply to all components of the solar energy collection system, energy storage and power conditioning equipment. However, the tax savings produced by the state credit are reduced since these are treated as federal taxable income. Even so, the state tax credit is a valuable incentive which may be carried forward to future years. Again, California State law permits depreciation in 1, 3 or 5 years in lieu of the 25% state tax credits. Another option is to claim the state credit and depreciate the remaining cost above the amount of the credit within three years using the double declining balance.

In Arizona, the state tax credit is 35% of the cost of the solar energy system through 1983. Thereafter, the percentage decreases 5% per year until the credit expires on December 31, 1989. Excess credit may be carried forward for not more than 3 years. In lieu of claiming a credit, one can amortize solar equipments over a period of 3 years. In addition, the state exempts solar energy devices from property taxation through December 31, 1989. Also the solar system is exempt from the Business Sales and Excise Taxes. However, there are a few states that do not offer attractive credits for solar devices.

4.0 THIRD PARTY ECONOMICS OF FIRST CENTRAL RECEIVER REPOWERING PLANT

Like most new technologies, investment in a first central receiver repowering plant may not yield the desired returns that are commensurate with its associated possible risks. However, economic assessments of utility and industrial applications of central receiver technology show potential future economic viability of these systems. While solar system costs should decline through mass production, fuel costs will increase with time.

The central receiver strategy to transfer technology to industry include reducing technical and financial risks through operation of the Barstow plant to permit industrial scale-up and operation by repowering or solar retrofit of existing utility and industrial oil or gas fired plants. Site specific conceptual designs conducted by DOE through user-supplier industry participation show that the technology is acceptable to industry but additional technical and cost sharing will be required for the initial repowering plants in order to transfer central receiver technology to utility and industry. Once manufacturers have sufficiently developed their product to provide fixed price quotes within an acceptable price range and performance warranty, then normal private ownership of central receiver plants should become possible.

Figure 2 represents a simplified account of various cash flows into and out of the central receiver investments, shown by appropriate arrows. The future revenues from the sale of electric power are net of O&M expenses and have a present value representing X% of investment cost when discounted at the project's return rate. Similarly, benefits from various tax credits and depreciation, and costs of state and federal income tax payments on sales of electric power are given with their respective present values of Y% and Z% of investment cost. For the first and near term central receiver plants, the percent of cost covered defined as $(X+Y-Z)$ is less than 100%.

FIGURE 2. CASHFLOWS OF THIRD PARTY OWNERSHIP

The central receiver technology R&D activities can increase the electric value benefit through improved plant designs and subsystem efficiencies, increased system operating life, and reduced O&M and system costs. These activities and the mass production of heliostats should eventually bring the electric revenue benefit (X) to equal the investment cost.

This would also result in increased income tax payments (Z), which should eventually approach or exceed the tax benefits (Y). Thus, the government will begin to receive payoff from its renewable solar energy development programs as revenues from income tax payments (Z) increase over solar tax benefits (Y). In addition, an investment in solar development would have a significant impact on displacing critical fuels to reduce the nation's dependence on imported oil and American business would be less vulnerable to any interruption in foreign oil supplies.

4.1 CASE HISTORY OF A TYPICAL UTILITY REPOWERING PLANT

The Arizona Public Service (APS) Utility Saguaro Plant No. 1 is a candidate for central receiver repowering project for which specific conceptual designs have been developed. This plant site is located 41 miles north of Tucson, Arizona. APS in association with Martin Marietta Corporation completed its conceptual design using molten salt as the receiver heat transport fluid (Figure 3). Four hours of thermal storage are provided by an internally-insulated hot salt tank and an externally-insulated cold salt tank. When solar energy is available, salt is pumped from the cold salt tank at 530°F to the solar receiver where it is heated to about 1050°F. The heated salt returns to the hot salt tank where it is pumped to the heat exchanger string to generate superheated steam for the turbine operation at 1000°F, 1450 psia resulting in a net solar electric power output of 253,000 MWh/year. APS costs for this central receiver repowering project were estimated in (1985\$) for a plant start in 1985. The

FIGURE 3. APS SUGUARO SOLAR REPOWERING PROJECT

total cost estimated for the system was $\$273.7 \times 10^6$. The capital cost was $\$238.1 \times 10^6$ with a heliostat (10,500 @ 49 m^2 each) cost of $\$330/\text{m}^2$ (which is $\$230/\text{m}^2$ in 1981\$). Expenses due to annual O&M totaled $\$1.76 \times 10^6$. A 10-year operating plant life was conservatively assumed to account for the risk of a "first-of-a-kind" plant.

Using Arizona and federal corporate tax laws and assuming an electric sale price of 75 mills/kWh with a net escalation rate of 5% and a general inflation rate of 7%, the economics of this initial plant was evaluated using a 20% rate of return. Figure 4 shows the effect of heliostat cost reduction on the percent cost covered under the above mentioned assumptions. The base case with a heliostat cost of $\$330/\text{m}^2$ only recovers about 93% of investment cost (X,Y,Z in Figure 2 are respectively 44, 71, and 22 percent). In order to breakeven, that is 100% cost covered, a $\$190/\text{m}^2$ cost would be required. This indicates that additional technical and financial help to the third party would be required for the initial repowering plants. However, a 25% government cost share in capital equipments reduces the otherwise available tax benefits (Y) by 25%. Thus, government cost sharing would be more effective if applied to engineering and other non-capital items that tend to reduce the technical risks and uncertainties. An increase in the electric price to a 100 mills/kWh electric sales price will also result in a breakeven economics. Another possible approach to alleviate the problem of high cost of initial repowering plants, and to reduce government cost sharing is to employ innovative financing in the third party approach as discussed in the next section.

The above analysis assumed the availability of both federal and state solar energy tax credits. After the expiration of these tax credits, the remaining tax benefit (Y) would be reduced to 46% (versus 71% with energy credits), which must be recovered through the increased value of net after-tax electric benefits (X-Z) as mentioned earlier in Figure 2. The breakeven economics for this future scenario would require a 135 mills/kWh electric

FIGURE 4. EFFECT OF HELIOSTAT COST REDUCTION ON PERCENT COST COVERED FOR AN UNLEVERAGED THIRD PARTY VENTURE

price and a \$200/m² heliostat cost (1985\$). In this case the income tax payments (Z = 53%) to government exceed the derived tax benefits (Y = 46%) resulting in a net government payoff of about 7% of the system investment. Since these figures are based upon a discount rate of 20% and income tax payments are more heavily influenced by the discount rate than the tax benefits, the undiscounted payoff to government would be about 80% of system cost.

5.0 INNOVATIVE THIRD PARTY FINANCING

As discussed earlier, the major benefits from an initial central receiver third party ownership are the advantages of various tax benefits. The primary requirement of a successful central receiver third party financing is that it must have adequate tax liability to derive the necessary full benefits of various tax credits and deductions. The magnitude of these benefits can be further increased if the investment is leveraged by borrowing a substantial fraction of the required capital whose after-tax debt cost is lower than the after-tax rate of return expected by the third party. Arrangements of this sort were anticipated in the drafting of Economic Recovery Act of 1981 and PURPA and are encouraged by these Acts.

Figure 5 illustrates the structure of one possible third-party financing arrangement for the example case that could be an attractive investment in the construction of a repowering project, at current high system costs. The central element of the structure is the source of the equity funding -- a corporation or group of corporations, a partnership of individual investors, or some combination of these, with substantial tax liabilities and a concomitant need for increased tax credits and deductions that have become possible with leveraging. In the example considered here, an optimum leverage was obtained by 50% of plant cost loan and with 55% investor's equity which includes a 5% reserve fund. Cash from this reserve account is released, as required, in order to eliminate the negative before-tax cash flows that would otherwise occur during the early years of plant operation, before the revenue stream from electrical power sales has grown large enough to cover the costs of amortizing the loan.

It is assumed in the example that the interest charged on the debt portion of the investment is 12% and that the reserve funds earn interest at this rate while they remain on deposit. This interest rate may appear somewhat low in the light of current (1981) pathologically high rates, but it is expected that conditions will have stabilized (general inflation

FIGURE 5. LEVERAGING TO MAXIMIZE BENEFITS FOR A THIRD PARTY VENTURE

assumed at 7%) by the time such a plant would be constructed. Even if this does not occur, it is considered likely that debt financing at a reasonable interest rate may be provided by an organization with a strong vested interest in the central receiver technology, e.g., one of the large aerospace companies that have investments in the industry. Thus, to a heliostat supplier's parent corporation that has most to gain from the third party venture, a moderate interest loan may well appear to be a relatively low-cost way of ensuring itself a favorable market position. Such arrangements are not uncommon in the private sector (e.g., automobile industry) when access to a large market is desired by a major supplier. Also, since institutional lenders are not risk takers, the project size is important and the return these lenders receive on their debt funds depends on the credit backing and guarantees of these parties arranging the third party venture. Small companies are unlikely to offer this credit support. Large companies who have a direct stake in the central receiver venture and who have a basis for believing that their product is incorrectly perceived may take a risk position in various forms of extended warranties, debt and equity contributions to a third party venture. Again, the risks and uncertainties associated with the application of national security related new technology for projects of the magnitude of central receiver are often shared with the government.

Once the capital has been committed, construction funds are released to the A&E from a systems company responsible for the plant design, to the general contractor responsible for construction, and through him, to the subcontractors and suppliers of components and subsystems. After the system has been constructed and is in operation, the electric power output is delivered to the utility system serving the region in accordance with a long-term purchase agreement. In this example, all the other assumptions including plant costs, its operating life and costs, and electric price and its escalation rate are the same as given earlier. As described before in Figure 2, the arrows in Figure 5 show cash flows into or out of the investment. The percentages calculated indicate the present values in

percent of investment equity. Sale of electric power and reserve account came, respectively, to the revenues of 57.3% and 7.1% of investment equity. Credits and depreciation from Internal Revenue Service and Arizona tax board added to 105.6%. The benefits of the three tax credits can be realized in the year in which money is expended. Benefits derived from depreciation and other tax deductions, on the other hand, are spread over a number of years. Income tax payments on electric power revenues are 28.2%. Similarly, after-tax interest and principal repayments for the loan add up to about 41.5%. Both the income tax and the loan payments are negative cash flows (out of the system), and thus the arrows point away and a parenthesis is around the 28.1% and 41.5%. By adding the percentages of each component, noting the appropriate sign, 100% of the investment is recovered with an after-tax rate of return of 29.8%. Thus, the combined effect of all these sources of income and costs is to produce a net after-tax return on equity of 29.8%, -- a sufficiently handsome rate of return to justify a moderate degree of risk. The analysis, therefore, suggests that if the risk can indeed be kept moderate, early private-sector construction of the first utility-scale central receiver plant is a real possibility, even at system prices that are currently estimated by design contractors.

The above concept of third party financing is currently being pursued by LUZ International Ltd. for solar thermal process steam to textile companies and by Wind Farms and U.S. Wind Power for wind generated electric power to various utilities. Figure 6 shows the cumulative cash flow plots of before-tax, after-tax, and after-tax net present values as a function of time when the plant becomes operational, where cash flows are presented in terms of fraction of investment equity. The after-tax curve shows that approximately 90% of the investment equity is recovered in the first year with an early payback period of about 1.5 years. After 10 years, 140% of the investment is recovered and this yields a 29.8% return on equity as shown on the net present value curve. The before-tax cash flow recovers only 50% of equity, indicating that tax benefits play a major role in the recovery of investment for the initial central receiver plant. It should

FIGURE 6. CUMULATIVE CASH FLOW VS. TIME

also be noted that through proper leverage, negative cash flows were avoided for both before and after-tax situations by using The Aerospace Corporation third party simulation model. Also, the above analysis assumed the availability and full use of both state and federal solar energy tax credits. Without these tax credits, even an innovative financing of third party ownership will not yield the necessary return on investment and both higher (~105 mills/kWh, 1985\$) electric price and lower (~\$200/m², 1985\$) heliostat cost would be needed to approach the above mentioned return rate.

5.1 SENSITIVITY ANALYSIS

The above return rates are based upon the various assumptions and conditions that may be considered somewhat ideal by some companies and investors of solar central receiver, consequently, a sensitivity analysis on the above mentioned base case was performed and is shown in Figure 7. As mentioned earlier, this base case assumed no direct government cost sharing. This analysis was carried out to quantify the various risks and uncertainties of incurring higher system costs, O&M, loan rates and zero electric escalation. Also, benefits due to longer system life and higher electric price were analyzed. In addition, the effect of a New Mexico plant location where other parameters are kept unchanged, showed a significant lower return that is primarily due to the absence of any state energy credit. This indicates that third party financing for the present example of first plant cannot work without adequate state tax credits. The effect of a California location did not appreciably lower the rate of return, since California also offers very attractive state energy tax credit. The analysis also showed significantly lower returns if only 75% of tax credits could be utilized, indicating that tax benefits are not helpful unless the third party has an adequate tax liability.

<u>SCENARIO</u>	<u>RETURN ON INVESTMENT</u>
BASE CASE	29.8%
DOUBLE O&M	26.8%
LIFE 15 VS. 10 YEARS	42.4%
LIFE 20 VS. 10 YEARS	48.7%
LOAN RATE 15% VS. 12%	26.0%
NEW MEXICO VS. ARIZONA LOCATION	8.4%
CALIFORNIA VS. ARIZONA LOCATION	26.8%
75% USE OF TAX CREDITS VS. 100%	14.7%
ZERO ELECTRIC POWER ESCALATION VS. 5%	22.9%
25% INCREASE IN SYSTEM COST	19.9%
ELECTRIC POWER SALES PRICE 100 VS. 75 MILLS/kWh	41.7%

FIGURE 7. SENSITIVITY ANALYSIS OF BASE CASE ASSUMPTIONS

6.0 GENERAL OBSERVATIONS

Third party ownership with proper leverage financing represents a possible solution approach for the initial repowering plants for which pre-mass production heliostat costs are high. As shown by a case example, a substantial portion of investment equity can be recovered in the first few years of plant operation through various existing tax benefits. Also, good future years cash flows appear possible due to the requirement that utility purchase central receiver generated electricity at the high avoided cost rates. However, success of third party financing is highly dependent on its ability to take full advantage of various federal and state tax benefits. To do this, a third party group must have an adequate federal and state tax liability. Also, to cover the negative cash flow in the early years, a cash reserve may be required. Furthermore, in order to attract equity and necessary loan from the private sector for the early central receiver ventures, both a loan guarantee and an equipment performance warranty will probably be required.

Thus, third party financing of a repowering project with appropriate government risk sharing can play a significant role in bringing heliostat manufacturing to the mass production phase before state and federal energy credits are phased out.

In general, third party financing appears to be capable in helping stimulate mass production of heliostats and a rapid transfer of central receiver technology to utility and industry. The lower costs of solar plants through mass production and the higher prices that a utility or industry will pay for critical fossil fuels in the future are powerful incentives to encourage investments in the central receiver technology.