

NOTICE CONCERNING COPYRIGHT RESTRICTIONS

This document may contain copyrighted materials. These materials have been made available for use in research, teaching, and private study, but may not be used for any commercial purpose. Users may not otherwise copy, reproduce, retransmit, distribute, publish, commercially exploit or otherwise transfer any material.

The copyright law of the United States (Title 17, United States Code) governs the making of photocopies or other reproductions of copyrighted material.

Under certain conditions specified in the law, libraries and archives are authorized to furnish a photocopy or other reproduction. One of these specific conditions is that the photocopy or reproduction is not to be "used for any purpose other than private study, scholarship, or research." If a user makes a request for, or later uses, a photocopy or reproduction for purposes in excess of "fair use," that user may be liable for copyright infringement.

This institution reserves the right to refuse to accept a copying order if, in its judgment, fulfillment of the order would involve violation of copyright law.

How the Department of Energy Loan Guaranty Program Paved the Way for the Growth of the Geothermal Industries

by Daniel N. Schochet, Ormat Inc., 980 Greg Street, Sparks, Nevada 89431-6039
and Dr. John E. Mock, U.S. Department of Energy, 1000 Independence Avenue, SW Washington, D.C. 20585

Abstract

The United States Department of Energy Loan Guaranty Program was created in 1974 with the objective of encouraging and assisting both the public and private sectors in overcoming the financing risk barriers to the development and operation of projects which would utilize the then newly emerging geothermal technologies. The program was to accomplish its objectives by providing for the full faith and credit of the United States government to guaranty the repayment of loans for project costs of up to \$100 million per project (representing up to 75 percent of project costs for the private sector and 90 percent for the public sector), for qualified projects and sponsors. One of the most notable successes of this visionary program was the Ormat East Mesa Project, where the \$50 million guaranteed loan was prepaid in full approximately 1 year after this loan was funded. This project was subsequently expanded, with private sector third party institutional financing, from its initial 24 MW in 1986 to 60 MW by 1989. The successful execution of the East Mesa project established the technical and economic feasibility of larger scale modular binary power plants, and paved the way for the growth of the geothermal industry.

Introduction

In 1977, Republic Geothermal Inc., an industry pioneer, obtained the first loan guaranty issued by the DOE, for \$9 million, and used these funds in part to successfully explore and define the East Mesa Geothermal Field. After acquiring the development rights from Republic in 1984, Ormat, utilizing a \$50 million loan guaranty as the cornerstone of the project's financing, also risked a major portion of its corporate assets to provide equity funding from internal and other sources and went on to successfully complete the development of the 24 MW nameplate Ormesa I Project. With its December 1986 grid synchronization and subsequent continued operation, the Ormesa I project established the technical feasibility of larger scale commercial modular binary power plants.

In March of 1989, approximately 1 year after the execution of the 20 year guaranteed loan agreement, the guaranteed loan was fully paid off, some 19 years early, by a refinancing of the Ormesa I Project with a 20 year term loan, non-recourse to the project sponsors, from an institutional lender. This application of the DOE loan guaranty program, combined with Ormat's modular binary tech-

nology, paved the way for the acceptance of the viability of liquid-dominated geothermal projects by the financial community. This resulted in the subsequent availability of over \$2 billion of institutional project asset based financing.

In the period from 1986 on, Ormat participated in the expansion of the East Mesa projects to a total of 50 MW and went on to install some 300 MW of geothermal capacity worldwide including the U.S.A. The non-Geysers geothermal projects in the U.S.A. grew from less than 30 MW on-line in 1984 to nearly 1,000 MW of reliable operating projects in 1993 (see Table 1).

The Department of Energy Loan Guaranty Program

The Geothermal Loan Guaranty Program was created by Public Law 93-410 in 1974, and amended by Public Laws 95-238 and 96-294. The basic objective of the program was to encourage and assist the public and private sectors to develop, construct and operate facilities relying on geothermal energy by allowing the Department of Energy to

Table 1. Operational U.S. Geothermal Projects (excluding Geysers)

PROJECT(s) NAME	SIZE (MW)	LOCATION COUNTY/STATE	TECHNOLOGY	ESTIMATED COST (\$000)	ON-LINE DATE
Desert Peak	9	Churchill/Nevada	Flash	\$18,000	85
Beowawe	10	Eureka/Nevada	Flash	\$30,000	86
Soda Lake (2)	14	Churchill/Nevada	Binary	\$45,000	87-91
Stillwater	12	Churchill/Nevada	Binary	\$37,000	90
Empire	3	Washoe/Nevada	Binary	\$12,000	87
Dixie Valley	57	Churchill/Nevada	Flash	\$140,000	87
Steamboat Springs (4)	30	Washoe/Nevada	Binary	\$70,000	87-91
Brady	24	Churchill/Nevada	Flash	\$65,000	92
Steamboat Hills	12	Washoe/Nevada	Flash	\$30,000	88
TADS	2	Lyon/Nevada	Binary	\$2,000	85
Cove Fort I	3	Beaver/Utah	Binary	\$6,000	86
Cove Fort II	7	Beaver/Utah	Flash Type	\$14,000	89
Roosevelt Hot Springs	25	Beaver/Utah	Flash	\$60,000	86
COSO (4)	250	Inyo/California	Flash	\$700,000	87-90
Ormesa (4)	60	Imperial/California	Binary	\$210,000	87-90
GEO East Mesa	12	Imperial/California	Binary	\$20,000	85
GEO East Mesa (2)	45	Imperial/California	Flash	\$120,000	90
Heber GEO	47	Imperial/California	Flash	\$110,000	86
Salton Sea (7)	240	Imperial/California	Flash	\$600,000	86-90
Mammoth Pacific (3)	34	Mammoth/California	Binary	\$105,000	86-91
Amadee	2	Lassen/California	Binary	\$6,000	89
SIGC/Heber	33	Imperial/California	Binary	\$100,000	93
Puna	25	Hawaii/Hawaii	Combined	\$100,000+	93
TOTAL	975 MW			\$2,600,000	

NOTE: This table was compiled by the authors from various industry sources.

guaranty loans made for this purpose. Loan guaranties were to be entered into for the purpose of:

1. Determination and evaluation of the commercial potential of geothermal resources.
2. Research and development with respect to geothermal extraction and utilization technology.
3. Acquisition of rights in geothermal resources.
4. Development, construction and operation of facilities for the demonstration or commercial production of electricity through the use of geothermal resources.
5. Construction and operation of a new commercial, agricultural or industrial facility or modification and operation of such a facility where geothermal hot water or steam was to be used within.

Key ingredients of the program provided for: the full faith and credit of the U.S. government; a maximum guaranty per project of \$100 million (\$200 million per borrower); the Department of Energy to guarantee up to 75 percent of the total project costs (except for municipalities and REA's — 90 percent); a maximum loan term of 30 years; collateral generally limited to project related asset; and the cumulative amount of all guaranties issued under the program not to exceed \$500 million.

The program was suspended in 1982, with no applications for new projects accepted after 1 March of that year.

The \$9.03 million loan for the Republic East Mesa field development project was the first loan guaranty issued by the Department of Energy in May 1977. Subsequently, eight more loan guaranties were approved bringing the total amount of committed loan guaranty authority to \$289.4 million.

The total loan proceeds disbursed were \$136,668,000, of which \$99,536,000 in principal was prepaid by the projects, with the balance of the loans defaulted and paid off by the DOE.

In addition to the Ormesa success story, the other very notable success of the loan guaranty program was the Northern California Power Agency. NCPA's 110 MW geothermal power plant at The Geysers in northern California, partially financed by a \$45 million DOE-guaranteed loan, was so successful that it repaid the guaranteed loan after only 2 years. This minimal operating period provided convincing proof of the plant's geothermal steam technology, and the agency was able not only to refinance the project with an entirely private bond issue, but also to build a second plant of the same size without any federal assistance. Early repayment of the 26 year loan saved DOE about \$40 million in interest support payments. NCPA plants were significant milestones in the development of The Geysers, the world's largest geothermal steam field.

1984 and the Geothermal Industry

In 1984, there were a number of non-Geysers geothermal projects under development, but, except for the 600 kW Ormat modular power plant at TAD's Enterprises in Wabuska, Nevada, none were operating commercially. At the time Ormat had been involved for 20 years in pioneering research and development, as well as manufacturing, of organic rankine cycle modular power plants. These plants, known as Ormat Energy Converters (OECs), were used for generating electricity from:

- Solar energy from flat plate collectors
- Locally available fuel sources for remote power applications
- Industrial unused process heat
- Low temperature brine from solar ponds
- Geothermal brine

A number of independent developers were seeking third party financing for projects, while several larger companies, such as Chevron and Phillips, were developing projects utilizing internal corporate funds. There were a number of potential institutional equity investors interested in geothermal projects; however, the real problem was how to secure long-term debt financing in view of the lack of geothermal project operating histories.

The Ormesa Project

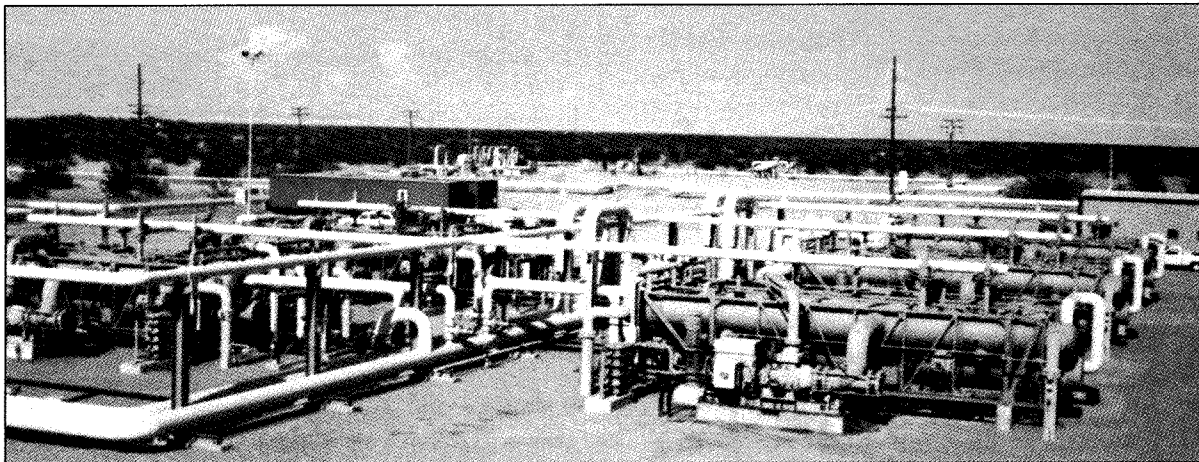
By late 1984, Republic had drilled and tested a significant number of wells and proven the existence of a major resource in the East Mesa area, and had executed two SO4 power sales agreements with Southern California Edison. In addition, Republic's loan guaranty commitment of up to \$50 million was potentially transferrable with the project if the new project sponsor could qualify.

Ormat, through its Ormat Systems Inc. subsidiary, purchased the East Mesa development rights from Republic, along with the assignment of the power sales agreements. By mid-1985 Ormat qualified for the DOE loan guaranty and was deeply involved in the development of the 24 MW Ormesa I Project, utilizing its own corporate credit as well as internal funds.

The project was to utilize 26 modular Ormat Energy Converters, with a gross capacity of 30 MW. The project resource temperature of 305°F was well suited for the Ormat binary technology. The total number of production wells was to be based on the temperatures and wellfield productivity, to be established by further drilling and testing. Production pumps were to be set at depths of 1,200 to 1,400 feet (then the limit of the state-of-the-art).



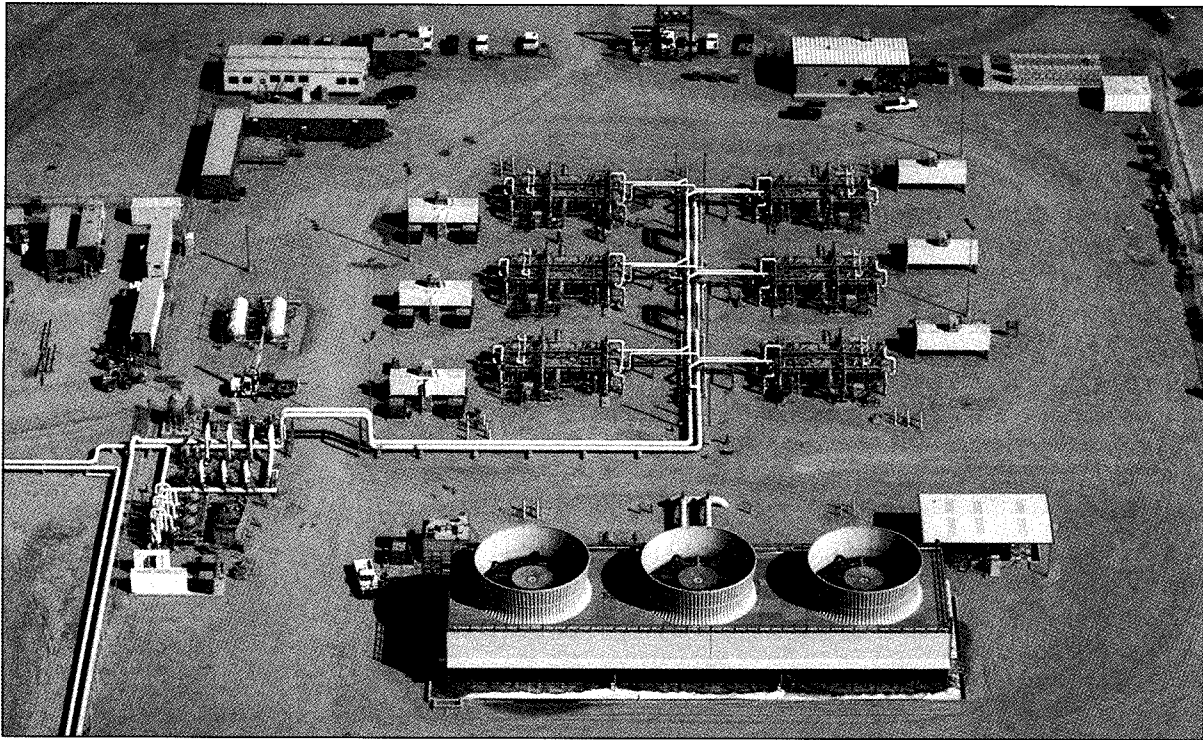
ORMESA I Power Plant comprised of 26 modular Ormat Energy Converters with 30 MW nameplate capacity, synchronized to the IID grid in December 1986.



ORMESA IE Expansion Plant comprised of 10 modular Ormat Energy Converters with 10 MW nameplate capacity, synchronized to the IID grid in December 1988.



ORMESA II Power Plant comprised of 20 modular Ormat Energy Converters with 20 MW nameplate capacity, synchronized to the IID grid in December 1987.



ORMESA IH Expansion Plant comprised of 12 modular Ormat Energy Converters with 13.2 MW nameplate capacity, synchronized to the IID grid in December 1989.



ORMESA II Power Plant comprised of 20 modular Ormat Energy Converters with 20 MW nameplate capacity, synchronized to the IID grid in December 1987.

The project was well conceived and was reviewed and recommended for approval by DOE's consultants. Based on the DOE loan guaranty as well as equity investment commitments by LFC Financial Corporation and Ormat's own bankers and corporate investors, a 100 percent construction loan was arranged through Bankers Trust Corporation, and subsequently was closed in mid-1986.

During the financing discussions the project was presented in detail many times to various financing entities as well as to DOE management and staff. It was clear that the financial community was prepared to fund debt for the purchase of familiar products such as commercial aircraft, computer installations and machine tools. However, the DOE loan guaranty was the needed catalyst for the lenders to step into new projects which could "generate electricity from hot water."

In December 1986, the 24 MW Ormesa I Project, with a total of 12 production and 6 injection wells, was completed and synchronized to the Imperial Irrigation District Grid for transmission of power to Southern California Edison. By December 1989 the Ormesa Project complex had been expanded in three more stages to 60 MW (see photos). The guaranteed Ormesa I long-term loan which was disbursed in March of 1988, was fully repaid by an institutional refinancing in March 1989. The large-scale technical and commercial viability of binary power plants had now been established.

In fact the Ormesa Projects and DOE's support paved the way for the successful binary development of the Heber geothermal resource. In 1993 the resource area, which was originally dedicated to the decommissioned San Diego Gas and Electric Heber Binary Project, was utilized to support the 33 MW net SIGC binary project. Utilizing Ormat modular binary power plant equipment,

this plant was constructed in the first 6 months of 1993 from ground breaking to utility Firm Operation. The flexibility of the modular concept allowed the project to utilize a distributed wellfield development with the modular binary power plant matched to the actual geothermal resource condition. DOE, by supporting both the successful modular Ormat binary Ormesa I Project as well as the single turbine SDG&E Binary project approach, was instrumental in establishing the overall viability of the vast moderate temperature geothermal resources of the U.S. for commercial electrical generation.

The Geothermal Industry Today

In the past several years we have witnessed a diminishment of development opportunities in the U.S. geothermal industry. So much has been discussed that any further mention now would be superfluous. However, since 1986 the utilization of liquid-dominated resources to support electrical generation has grown from 30 MW to nearly 1,000 MW of reliable power. The level of investment exceeds \$2.5 billion.

Power plants have been developed profitably to sell power for less than 6¢/kWh as the average all-inclusive price in 1994 dollars, the equivalent of 4.3¢/kWh in 1984 dollars.

When national policy fully values the environmental and fuel-risk-reduction attributes of geothermal energy, and the low priced natural gas glut eventually disappears, as it most certainly will, the geothermal industry will experience a resurgence which should dwarf the 1984-1994 period. Especially since in 1984 there was no track record, while in 1994 we can look at 1,000 MW of historical data — thanks to the U.S. Department of Energy and the pioneering risk takers of the geothermal industry.