Statement of Paul A. Thomsen

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Submitted to the U.S. House Energy and Environment Subcommittee

House Energy and Environment Committee

May 17, 2007

Mr. Chairman, members of the committee, it is my honor to testify today on behalf of not only ORMAT Technologies, but also on behalf of the Geothermal Energy Association whose testimony has been reviewed and approved by the entire Board of Directors and will be submitted along with my testimony into the record.

By way of introduction ORMAT Technologies, is a New York Stock Exchange registered company (symbol "ORA"). ORMAT technologies develops, owns, and operates geothermal and recovered energy facilities throughout the world. ORMAT has supplied 900 MWs of geothermal power plants in 21 countries. Here in the United States ORMAT owns and operates Approx 300 MWs of geothermal power plants in the states of California, Hawaii, Nevada, and we are pleased to be providing US Geothermal Company with the technology needed to bring Idaho's first geothermal power plant online.

We applaud Rep. McNerney for introducing HR 2304 which would direct the Secretary of Energy to conduct a program of research, development, demonstration and commercial applications for geothermal energy. This legislation would authorize a program that will help develop the science and technology needed to utilize the vast untapped geothermal resources of our nation.

Ormat believes a vast potential exists that could help meet the country's growing electricity needs, spur economic growth and help reduce emissions of greenhouse gases. The Geothermal Task Force of the Western Governors Association's Clean and Diversified Energy Advisory Group identified 5,600 MW of geothermal power that could be developed with existing incentives, and another 13,000 MW that could be tapped with additional time, higher prices, or both. Of course, these estimates assume today's level of technology, which is a major variable that could change these results.

HR 2304 would authorize and direct DOE to undertake a research program that would develop the tools and technology needed to find and successfully develop the hydrothermal resource base. Without the support of the federal government as proposed in HR 2304 it is our view that most of the hydrothermal resource base will not be developed under current conditions. HR 2304 would also direct the Department to take the steps towards developing full scale enhanced geothermal systems (EGS) technology. From Ormat's experience every MW of clean, baseload, geothermal energy we bring on line represents a 3 million capital investment by our company.

HR 2304 also would establish centers of geothermal technology transfer. Information is important to improve exploration, application of technology, and improved performance of

geothermal development and production efforts. Ormat feels that the proposal to establish such centers would be an important aid in efforts to tap our nation's geothermal resources.

Ormat recognizes that HR 2304 does list both coproduction and geopressured resources as items to be addressed by the Secretary of Energy in a required report to Congress on advanced uses of geothermal energy. If additional provisions are not included in the bill, we would hope that the Department would take this opportunity to re-examine its views of these, and all geothermal technologies, to develop programs that would effectively tap this enormous, undeveloped domestic energy supply.

Ormat believes cost-sharing is an appropriate and necessary component of a near-market partnership between the government and a for-profit entity. For an example of what can come from this type of collaboration I turn to the fact that ORMAT has signed a cost-shared Cooperative Research and Development Agreement (CRADA) with DOE to validate the feasibility of a proven technology already used in geothermal and Recovered Energy Generation (REG).

The project will be conducted at the DOE Rocky Mountain Oil Test Center (RMOTC), near Casper Wyoming, and will use an Ormat Organic Rankine Cycle (ORC) power generation system to produce commercial electricity. Ormat will supply the ORC power unit at its own expense while the DOE will install and operate the facility for a 12- month period. Ormat and the DOE will share the total cost of the test and the study, with Ormat bearing approximately two thirds of the less than $1M total investment.

Presently there are two large unutilized sources of hot water at the RMOTC Naval Petroleum Reserve No. 3, which produces water in excess of 190 degrees Fahrenheit and at flow rates sufficient for generation of approximately 200 kW. This project will consist of the installation, testing and evaluation of a binary geothermal power unit in the field near these hot water sources. The ORC power unit will be interconnected into the field electrical system and the energy produced will be used by RMOTC and monitored for reliability quality.

The information gathered from this project may have implications to the some 8,000 similar type wells have been identified in Texas, by Prof Richard Erdlac of the University of Texas of the Permian Basin, and the US DOE Geothermal Research Project Office. Lyle Johnson senior engineer at the RMOTC stated "The introduction of geothermal energy production in the oil field will increase the life of the fields and bridge the gap from fossil energy to renewable energy." Why are we zeroing out a research budget that provides such potential for this country.

Ormat believes that the full geothermal potential of the western United States can be brought online in the near term with the assistance of legislation as proposed by Rep. McNeary.

On behalf of Ormat, I want to applaud this committee for its interest in the secure domestic baseload energy supply that **is** geothermal energy. We humbly realize that the decisions made by this committee impact our nations energy security. This concludes my prepared comments I am happy to respond to any questions the committee might have.

Statement of the Geothermal Energy Association
May 17, 2007
House Committee on Science
Subcommittee on Energy and Environment

Mr. Chairman and Members of the Subcommittee, we applaud the Subcommittee for holding this hearing entitled "Developing Untapped Potential: Geothermal and Ocean Power Technologies." We submit this statement on behalf of the Board of Directors of the Geothermal Energy Association.

While only a small fraction of the geothermal resource base is utilized today, geothermal energy provides significant energy for our nation. The United States is the world's largest producer of geothermal electricity. The 2,800 MW existing power capacity generates an average of 16 billion kilowatt hours of energy per year.

According to a GEA survey released last week, seventy-four new geothermal energy projects are under development in the US that will provide an additional 2,900 megawatts of electric power capacity. This new capacity will represent an investment of roughly $6 billion, create 10,000 new full-time jobs, and stimulate over 40,000 person-years of construction and manufacturing employment across the nation.

While this new development is impressive, much more potential exists that could help meet the country's growing electricity needs, spur economic growth, and help reduce emissions of greenhouse gases. The Geothermal Task Force of the Western Governors' Association's Clean and Diversified Energy Advisory Group identified 5,600 MW of geothermal power that could be developed with existing incentives, and another 13,000 MW that could be tapped with additional time, higher prices, or both. Of course, these estimates assume today's level of technology, which is a major variable that could change these results.

Yet, even if these resources were developed, they would represent only a fraction of the hydrothermal resource base. The U.S. Geological Survey (USGS), in its Circular 790, estimates a hydrothermal resource base of between 95,000 and 150,000 MW, of which 25,000 are known resources. Most of the resources identified in the WGA study were known resources in 1979 when the USGS completed its report. In 1979 we lacked the technology to find and characterize most of the hydrothermal resource base, and unfortunately today we still lack that technical capability.

In addition to significant electric power generation, direct uses of geothermal resources by businesses, farms, and communities have substantial additional potential for energy, economic, and environmental benefits. While geothermal resources have been used in communities and homes for decades -- for example Boise, Idaho has been using geothermal resources for space heating for over 100 years -- the extensive potential for direct use has been largely ignored and underutilized. Direct use resources span the entire country -- from New York to Hawaii – and their expanded use could displace fossil fuels.

Beyond the conventional hydrothermal resources powering our existing generating plants and providing process heat, new types of geothermal resources are emerging. Recent estimates indicate a substantial potential for geothermal production from hot water co-produced in oil and gas fields, and there is renewed interest in geopressured resources in Texas, Louisiana and the Gulf. These hold significant future energy potential. Finally, development of the techniques for engineering geothermal systems (EGS) holds the promise of expanding economic production from known geothermal systems and someday allowing production from EGS power systems virtually anywhere in the US.

The benefits of expanding new geothermal production will be substantial. Geothermal power can be a major contributor to the power infrastructure and economic well-being of the United States. Geothermal power is a reliable, 24/7 baseload energy source that typically operates 90 to 98 percent of the time. Insulated from fuel market price volatility, geothermal power supports energy price stability and boosts energy security because it is a domestic resource. Geothermal power can help diversify the nation's energy supply and is a clean, renewable energy source.

The surge in geothermal development portrayed in GEA's new survey has been stimulated by the federal production tax credit (PTC), which was first extended to geothermal power facilities in 2005. The PTC provides the incentive needed to encourage investment in new projects, and state renewable portfolio standards (RPSs) ensure that there is a market for geothermal power. In the near-term, both are essential to sustain the momentum we are witnessing in new project development, but to develop the full potential of the resource advances in technology will be essential.

There are substantial needs for improvements in technology, resource information, and efficiencies for which federal research is vital. The range of near-term needs is broad. Our knowledge of the geothermal resource base is limited and largely outdated. The technology available today to identify and characterize the resource is too unreliable to mitigate the high risk of development. Drilling in harsh geothermal environments is difficult and expensive. In locations where the resource cannot presently support commercial production, we need to be able to apply EGS techniques to achieve power generation at competitive prices.

The geothermal industry supports a continued geothermal research program to address the near-term need to expand domestic energy production and the longer-term need to find the breakthroughs in technology that could revolutionize geothermal power production. This includes an ongoing R&D program focused on further expanding the hydrothermal resource base, developing the technology needed to make the EGS concept commercially viable, and taking advantage of the substantial deep thermal resources associated with the petroleum formations along the Gulf Coast. These programs are critical if we are to maintain our national status in cutting-edge geothermal technology, which is increasingly in jeopardy.

The January 2006 report of the WGA Geothermal Task Force Report also supports the need for federal research efforts. The Task Force Report recommends: "a strong, continuing geothermal research effort at the Department of Energy that addresses the full range of technical problems encountered in achieving full production from the identified and undiscovered resources in the West." The report also supports "…continuation of advanced technology programs and outreach

through GeoPowering the West." In addition, the report urges DOE to expand its program in critical areas "particularly the identification and development of new resources" and "support for exploration and exploratory drilling." Finally, it asks the Department of Energy (DOE) to "examine whether existing federal loan guarantee authority in law can be used to supplement these activities to reduce risk and encourage development of new resource areas." (http://www.westgov.org/wga/initiatives/cdeac/geothermal.htm.)

We applaud Rep. McNerney for introducing HR 23-4 which would direct the Secretary of Energy to conduct a program of research, development, demonstration and commercial applications for geothermal energy. This legislation would authorize a program that will help develop the science and technology needed to utilize the vast untapped geothermal resources of our nation.

One of the best overviews of that potential is presented in the National Renewable Energy Laboratory's (NREL) Technical Report published in November 2006, *Geothermal –The Energy Under Our Feet.* The report examines what it terms the "enormous potential of geothermal resources." It estimates what the full range of geothermal energy technologies could contribute by 2015, 2025 and 2050. *(Geothermal—The Energy Under Our Feet* is available at http://www.nrel.gov/docs/fy07osti/40665.pdf.) The following chart shows NREL's estimate of this potential:

Table 1 – Findings by Resource Category

			Estimated Developable Resources		
	Estimated Accessible Resource (MWe)	**2006 (Actual MWe)**	**2015 (MWe)**	**2025 (MWe)**	**2050 (MWe)**
Shallow Hydrothermal[1] (Identified) **>90°C/194°F**	30,000	2,800	10,000	20,000	30,000
Shallow Hydrothermal[1] (Unidentified) >150°C/302°F	120,000		TBD	TBD	TBD
Co-Prod & Geo-Press[2]	>100,000	2[3]	10,000 to 15,000	70,000	>100,000
Deep Geothermal[4]	1,300,000 to 13,000,000	0	1000	10,000	130,000
Thermal Uses	**(MWt)**	**(MWt)**	**(MWt)**	**(MWt)**	
Direct Use[5]	>60,000	620	1600	4,200	45,000
GHP[6]	>1,000,000	7,385	18,400	66,400	>1,000,000
GHP[6] Avoided Power	120,000	880	2,100	8,000	120,000

The NREL report points to at least three areas where geothermal resources might contribute 100,000 MW of more to domestic energy supplies: first, the hydrothermal resource base; second, oil and gas co-production and geopressured resources; and, third, development of "deep

geothermal" (or EGS) production. HR 2304 defines specific research efforts to address at least two of these three energy opportunities.

HR 2304 would authorize and direct DOE to undertake a research program that would develop the tools and technology needed to find and successfully develop the hydrothermal resource base. While tax incentives and state support may be able to double or triple current geothermal production, that would still be far short of tapping the nation's hydrothermal potential. Developing 10,000 or even 20,000 MW of geothermal energy would be only a fraction of the estimated hydrothermal resource. But, without the support of the federal government as proposed in HR 2304, it is our view that most of the hydrothermal resource base will not be developed under current conditions.

HR 2304 would also direct the Department to take the steps towards developing full scale EGS technology. A Massachusetts Institute of Technology (MIT)-led study released in January 2007 found "that mining the huge amounts of heat that reside as stored thermal energy in the Earth's hard rock crust could supply a substantial portion of the electricity the United States will need in the future, probably at competitive prices and with minimal environmental impact." (An Executive Summary and the full MIT report, The Future of Geothermal Energy, are available at: http://www1.eere.energy.gov/geothermal/future_geothermal.html).

We understand that Professor Jeff Tester of MIT will testify before the Subcommittee, so we will defer a lengthy discussion of EGS technology and its potential. However, GEA supports development of EGS technology as a critical element of DOE's long-term research strategy.

HR 2304 also would establish centers of geothermal technology transfer. Access to information can help improve exploration, application of technology, and improved performance of geothermal development and production efforts. The proposal to establish such centers would be an important aid in efforts to tap our nation's geothermal resources.

The one major area of potential identified by NREL that HR 2304 does not address with specific authorizing direction is oil and gas field co-production and geopressured resources. These resources hold substantial energy potential, but serious uncertainties that keep the market from moving forward must be addressed by federal efforts.

For co-production, there are uncertainties about the resource information as well as the best fit for power technology. Until there is better and more detailed information about the resource potential, and companies have experience using small scale power technology in these applications, it is unlikely that there will be rapid commercialization of geothermal technology in oilfield settings. Near-term cost-shared demonstrations at several sites would be the best approach to resolving these issues and accelerating development of the energy potential from co-production. We suggest the Committee consider adding this directly to the legislation rather than waiting for the report from the Secretary of Energy required by Section 10.

The potential of geopressured resources is impressive. They contain enormous quantities of hot water and gas. The recoverable gas from geopressured reservoirs has been estimated to be several hundred years supply for the entire nation. Geopressured resources are to natural gas

what oil shale resources are to liquid fuels – a potentially enormous source of energy. Unfortunately, the one demonstration conducted by DOE twenty years ago was terminated after a short period of operation, it did not seek to optimize for gas production, and it was based upon what is now somewhat dated technology. Today, we have begun to import greater quantities of natural gas, and projections show the US becoming much more dependent upon natural gas imports in the future.

Developing the technology to produce gas from geopressured geothermal resources could curtail our growing dependence on imports, but the cost and extreme risk of geopressured development will not be undertaken by industry alone. It requires a partnership with the government. Given the enormous resource potential, such an effort is justified and in the national interest.

We recognize that HR 2304 lists both co-production and geopressured resources as items to be addressed by the Secretary of Energy in a required report to Congress on advanced uses of geothermal energy. If additional provisions are not included in the bill, we hope the Department will take this opportunity to re-examine its views of these, and all geothermal technologies, to develop programs that would effectively tap this enormous, undeveloped domestic energy supply.

The cost-sharing requirements of HR 2304 raise a number of questions. While in principle, GEA believes cost-sharing is an appropriate and necessary component of a near-market partnership between the government and a for-profit entity, it's not clear that the provisions of the legislation recognize appropriately the role of contractors and researchers who lack the resources and profit-potential motivation to enter into a significant cost-share. In addition, we suggest that the Subcommittee consider making all cost-share requirements ranges rather than single proposed percentages and including in the measure some of the basic criteria DOE should use to determine when a cost share is appropriate and at what percentage. This might provide better results while maintaining the principle which we believe the legislation seeks to affirm.

Finally, we encourage the Committee to examine whether the update of the national geothermal resource assessment being conducted by the US Geologic Survey will be adequate and complete. This will be the first assessment in over 25 years, and it is critical to the future progress in geothermal energy production. Policy makers at all levels need accurate and reliable information about the potential contribution of geothermal resources. To be adequate and complete, the USGS assessment should examine the full range of geothermal resources identified in the NREL Report and include field verification as necessary.

We have attached to this statement a letter from Leland Roy Mink, the former Manager of the DOE Geothermal Research Program, who expresses his support for the legislation and the Subcommittee's initiative.

We thank the Subcommittee for considering our views, and encourage all Members of the Subcommittee to support HR 2304. This legislation is urgently needed to ensure that federal energy programs work to tap the tremendous potential of our nation's geothermal energy resources.

Attachment

Honorable Congressman Lampson, Chairman
Subcommittee on Energy and Environment
Committee on Science and Technology
US House of Representatives
Washington, DC 20515

Dear Mr. Chairman,

I wish to express strong endorsement for draft legislation the Subcommittee is considering for support of DOE Geothermal Research and Development. This legislation is critical for continued development of the tremendous geothermal energy potential the US possesses and the leadership role the US has established in geothermal technology.

I am writing because of deep concern about the DOE decision to terminate the geothermal technology program. I have been active in geothermal and other energy development throughout the US and internationally for over 35 years and recently retired as the manager of the US DOE Geothermal Technologies Program. I feel it is definitely not in the best interest of the nation to terminate a viable, domestic, renewable, non-polluting energy resource at this time. You, as the Subcommittee, have an opportunity now to make a significant contribution to the US energy portfolio.

Geothermal energy could play a significant role in addressing the US need for a clean renewable energy source. Historically electrical generation from geothermal has led both wind and solar and supplied significant power to several Western states. Geothermal heat pumps for heating and cooling of homes, schools and businesses has sizable potential throughout the US. Recent studies by the Massachusetts Institute of Technology and the National Renewable Energy Laboratory show significant electrical potential not only in the Western states, but indicate a strong potential throughout the US.

The DOE Geothermal Program support has resulted in significant technology breakthrough in areas of exploration, drilling, energy conversion and Enhanced Geothermal Systems (EGS), which has resulted in the US being a leader in development of geothermal energy. Cost shared programs with industry have stimulated development of this important and valuable domestic resource and without this support, industry will not be able to maintain its technological lead. DOE support to our national laboratories and universities has resulted in the advances in technology and the training of scientists and professionals for the future. Support to state energy office also has resulted in effective technology transfer to stimulate and expedite geothermal development.

In conclusion, the Subcommittee is at a critical stage in deciding the nation's energy future and I feel geothermal energy can play an important role in addressing the needs of the US energy future. We need all of the domestic possibilities for the US and geothermal is one of the only base load, non-polluting, renewable energy sources we have available to us. It could play a significant role in reducing our dependence on fossil fuel and the addressing the issue of climate change as a result of CO2 emissions.

I urge you to support legislation to direct DOE to conduct the best possible geothermal research program to tap the potential of this resource. Our nation needs it. It would also be a tragedy to see the US lose its status as a world leader in geothermal technology development and the resultant decline in the US Geothermal industry.

Respectfully submitted,

Leland Roy Mink
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