

# **EMD's Geothermal Energy Committee Mid-Year 2011 Report**

**Richard J. Erdlac, Jr., Ph.D., P.G., Chair**

**November 7, 2011**

## **Vice-Chairs:**

- David Blackwell, Ph.D., (Vice-Chair: University), Southern Methodist University, TX
- Richard J. Erdlac, Jr., Ph.D., P.G., (Acting Vice-Chair: Industry), Calnetix, Inc.
- Tom Anderson, P.G., (Vice-Chair: Government)
- TBA, (Vice-Chair: Representative of DEG)
- TBA, (Vice-Chair: Representative of DPA)

## **Advisory Committee:**

- Paul Morgan, Ph.D., Colorado Geological Survey, Golden, CO
- Michael D. Campbell, P.G., P.H., I2M Associates, LLC, Houston, TX
- Steven Tischer, P.G. Arcadis, Midland, TX
- Cenk Yardimcilar, Ankara, Turkey

## **Special Consultant:**

- Joel Renner, Inver Grove Heights, MN

## **Committee Activities**

### **2012 AAPG Annual Meeting - Long Beach**

A request had been made to have a geothermal session at the 2012 AAPG annual meeting in Long Beach under Theme 7 - Alternative Energy. Emails were sent to those who had previously expressed interest in the geothermal committee. The Geothermal Resources Council (GRC) was contacted to place the call for papers in their news section on their website. The Geothermal Energy Association (GEA) ran a short description in their weekly online newsletter. Finally, certain individuals and groups known to be conducting work with geothermal energy production in sedimentary rock/basins were also contacted with the call for papers. A total of 20 responses were received for people interested in participating, Nine were listed as oral only while the remaining 11 were oral or poster presentation amenable.

Due to the scarcity of papers under alternative energy, only the geothermal and gas hydrates sub-categories had sufficient papers to make up Theme 7. The final tally for geothermal session was 9 oral presentations and 9 poster presentations. Two of the 11 submitted poster presentations were deleted from the program due to the need for combining the gas hydrates and geothermal papers in the time and space allotted.

## Geothermal Technology Program (GTP) Blue Ribbon Panel Recommendations

In March the DOE Office of Energy Efficiency and Renewable Energy (EERE) assembled a panel of geothermal experts in Albuquerque, NM for a guided discussion on the future of geothermal energy in the U.S. A total of 15 panelists were brought together to identify the obstacles to geothermal energy growth, discuss the appropriate role of DOE in enabling geothermal energy, and recommend priority research and development areas for the EERE GTP.

In June a draft copy of this discussion was made available for public comment. Upon hearing of this notice release, I forwarded the announcement to members of the committee for their review and determination as to whether they wished to respond to the draft discussion. I did choose to respond to the discussion, and the following is a complete statement as to my response:

Dear Sirs...Madams...

I am writing to provide comments prior to the July 29 cutoff about the released draft report on the GTP Blue Ribbon Panel Recommendations dated June 17, 2011. I will address my comments on a subject basis and reference the page numbers in the draft report that I see reflect that particular subject.

Resource Identification/Definition/Exploration/Risk – Pages 3, 4, 5, 8 – While the USGS and other agencies have done important broad-based gathering of information for the advancement of geothermal energy development, I do not see that it should be the continuing job of the federal government to be active in “locating these resources in the near term using rapid reconnaissance surveys, surface exploration, stress measurements, fracture mapping, temperature gradient drilling or even cost-shared exploration drilling”. This is the job of industry, a success story that has been demonstrated in the oil and gas industry for over 100 years.

Geothermal energy, like the O&G industry, is risky. The resource is, for the most part hidden under ground requiring the use of geophysical and geologic tools to explore for this resource and trained geoscientists to know how to obtain and use the data...often qualitatively...to make an educated guess. The O&G industry has generally not been successful making direct predictions as to the amount of resource available or ‘seeing’ the resource underground, with the single exception that I know of being the implementation of bright spot recognition within a sandstone gas reservoir. There are no guarantees and until the drill bit goes into the ground to either prove or disprove the existence of the resource, the presence of a resource in sufficient quantity for economic recovery is an unknown. There is risk involved and there always will be due to the nature of the business. Finding geothermal is not like building a wind farm, which is why it takes people with a different bent to be in this energy field. Learn to live with it; the oil industry has and it has thrived. I firmly believe the geothermal industry can too.

These statements also go for the drilling of wells. I agree with those individuals who stated on page 3 “that funding conventional drilling is not an appropriate use of government R&D funds, and that the government should not fund activities that could reduce fair competition in the market nor support drilling efforts just to help the industry stay alive”. Again, having to eventually drill a well to prove or disprove a resource is part of the necessity of this industry. If providing funding is only for the purpose of lowering the cost of drilling, then this will become a never ending process. The cost

for drilling a geothermal well is linked, whether you like it or not, to the demand for drilling by the O&G industry. Thus it will never really be possible to 'lower the cost' for drilling as there are only so many drilling companies and they will go where the demand exists. If more geothermal companies come into existence along with a natural growing need for drilling, then the drilling business will begin to shift its focus and see geothermal as an important part to their future as a drilling company. In the end each company involved with geothermal development should know and have their own business plan and cost estimates based upon individual company needs. Incentives from Congress for geothermal development are appropriate just as it has been done for other energy resources. It is not the DOE's job to reduce individual company risk in direct energy development.

Field Laboratory – Pages 6, 7 – To my way of thinking there already exists a field laboratory where developers and scientists can test ideas. It's called RMOTC! Just because it exists at an oil field does not make it unusable for geothermal testing. There is a deeper granite that could be used for testing EGS concepts and new drilling techniques. There is no reason for creating another such site until it can be shown that RMOTC cannot be used for needed geothermal testing. Thus the general statement on page 7 that "there is no such field location open to both developers and scientists" is invalid. And besides, there never can be a single site "for conducting rock physics experiments and flow tests, validating geophysical models, and testing tools and technologies for all geothermal resources" due to the variations that exist in the geologic environment! And if you are going to have multiple "small" satellite field sites, how many are you going to have? How many rock types and subsurface conditions are you going to test in? Some of this work should be supported by industry as applied R&D, something that I personally saw happening when I was more full time employed in the O&G industry. Again, this is the nature of this type of energy production business. If you don't like it, go build a wind farm that only operates at a 17-26% capacity factor.

Sedimentary/Education/Workforce – Pages 3, 9 – The statements regarding education and workforce development to the effect that "investment by DOE in geothermal education and workforce development is unnecessary" and "there is not a workforce shortage in the industry" are extremely short sighted. I agree with these statements only in the sense that the geothermal industry seems to be stagnant and has not expanded out of a very narrow approach to geothermal power development, thus making the need for an expanded workforce mute. The question that should be asked is why hasn't the industry expanded?

In 2009 a group called Emerging Energy Research (now an IHS company) published a report called 'Global Geothermal Markets and Strategies: 2009-2020'. One of the graphics in the document indicated the geographic presence of leading global geothermal developers. While several of these developers have been acquired by other companies since this publication appeared, a quick count indicated only 50-60 companies worldwide that were active in geothermal development. Only 16 of these companies were active in the U.S for geothermal development...16! This is in major contrast to the many hundreds of companies that operate in the U.S let alone in the world for oil and gas resources. It is time for a reality check!

The geothermal industry is a shadow of the O&G industry and a shadow of what it could be if companies would be willing to expand their business model to other geologic environments, such as sedimentary basins. Thus if the program should no longer "invest in research, development and demonstration of low temperature, coproduced, geopressured, or sedimentary resources due to the absence of any major technological challenges in those areas" (italics added) (page 3) then why are existing geothermal companies choosing not to expand from their existing comfort zone into the

development of geothermal in sedimentary basins, such as the geopressed geothermal Gulf Coast, where a resource is known to exist, where wells can potentially produce 1-3 MW per well (past comments by Dr. Sanyal at GRC and the DOE geopressed program), and where no major technical challenges exist? If geothermal companies are upset because of the length of time it takes in project development on various federal acreage sites, the why don't these same companies 'Come To Texas', or at least the Gulf Coast where there is a known resource, the delivery infrastructure is already in place, and the citizens are for the most part appreciative of industries that wrestle energy from the ground and understand the complexities involved because they work in the business? Why is the existing geothermal industry so entrenched in its present direction, and apparently uninterested in changing?

To me, this indicates that there is a drastic lack of broad geothermal E&P operations within existing companies that are willing to step out of a narrow comfort zone in the geologic environment into which they will look to develop geothermal. If this is true, then why should the DOE provide funding to support a status quo? If the DOE wants to truly expand geothermal power production, then there needs to be effort placed in an outreach expansion of communication to encompass industry-based groups like the GRC and GEA in geothermal with AAPG, SEG, SPE, and the PTTC in the O&G industry towards an integrated geothermal development. In this manner a more concerted effort at communication and 'education' as to the potential for expanding the geothermal areas of interest would bring more companies into the E&P arena with an increased need for trained personnel. To me, the fact that there is no need for geothermal personnel implies that the industry is stagnant and not expanding. And if the industry is not expanding, how can it ever hope to increase the MW output and be taken seriously by the energy industry and the public as a whole, let alone the politicians who decide upon the amount of funds available for needed activities? If geothermal energy production has the huge potential for development that is described by numerous professionals and agencies...a statement that I believe to be true...then a major goal of the DOE should be an effort to cross industry boundaries and harness the abilities of all subsurface energy professionals towards the acquisition of the oil and gas resources we still need now and the geothermal resources that can replace some of the fossil fuel use for the future.

Final General Comments – As Chair of the Geothermal Committee of the Energy and Minerals Division of the AAPG, I helped in the organizing of both a geothermal short course ('Geothermal 201') and a geothermal theme session at the most recent Annual AAPG conference with a focus on geothermal in sedimentary basins. The 1-day short course was attended by about 35 people mostly involved with O&G operations. In spite of the short closing of the government over that particular weekend, making it impossible for people like Tim Reinhardt to attend, the short course was well receive. In fact I anticipate being involved with a second major effort that will soon be underway for developing a larger geothermal theme session at the 2012 AAPG meeting to be held in Long Beach.

Since I first attended a GRC meeting in 2004 I have been impressed and welcomed by numerous individuals in the geothermal industry as a new researcher. I have met many professionals far more experienced with geothermal than I, but I have generally received a warm welcome by most everyone. I don't think anyone can say that I am not 100% behind the development of geothermal energy as I see this resource having great importance for future baseload electrical power generation, from an energy source that is nearly inexhaustible and exists everywhere within the earth.

But coming in as an outsider, meaning a previous O&G individual, the geothermal industry has become too entrenched in the geographic area of development and too dependent upon government funding for conducting the business of energy production. Too much of what I read in the panel recommendations are things that I have heard at past meetings that I have attended. It is time for companies to step out a little more on their own and look to develop geothermal elsewhere. To not do so would be as ridiculous as an O&G company saying 'I'm only going to look for oil and gas in this single basin and only in sandstone of a particular age.' They can do it, but they will be limited in how much they can produce. And they will miss many other resource opportunities with that narrow of a mindset. That is what I see ongoing in the geothermal industry, with maybe a couple of exceptions.

One final comment...

When I first started with Gulf Oil Exploration & Production Co. in Midland, our Division Geologist made an interesting statement regarding the entire aspect of exploration. He said that it is necessary for each new generation of geoscientists who come into the business to think that those who came before them missed energy resources along the way, and have an attitude that I can do better. Interestingly it is that attitude, and the willingness to try something new or to relook at the same area with newer eyes and ideas, that has allowed the O&G industry to become the world's most important source of energy. And guess what...more oil and gas has been found that way! A case in point is oil and gas from shale, which did not exist when I started in the business and never considered as a serious possibility at that time!

Similarly it is time to step in a truly new direction for geothermal energy production by industry and government, if we do not want to see the industry fade away.

All of these opinions are strictly my own and do not necessarily reflect those of the company for whom I work.

Best regards.

Richard J. Erdlac, Jr., Ph.D.

Director of Energy Exploration

Access Energy

### **New Geothermal Technology Program (GTP) Manager**

In September it was announced that Mr. Douglas Hollett had joined the Department of Energy as the new GTP Manager. Mr. Hollett has over 25 years of experience in oil and gas exploration. He has held leadership positions in research, exploration, and business development at Marathon Oil since 1981. Prior to working at Marathon, he was an exploration geologist at Union Oil Company. He was instrumental in the formation and growth of Canada's first integrated research agency for oil and gas related research. He has a Master's degree in geology from the University of Utah and a B.S. in geology from Williams College.

I was able to have a short discussion with Douglas while attending the 2011 GRC meeting in San Diego. Mr. Hollett does believe that there need to be a closer relation developed between geothermal and O&G industries. He sees organizations like GRC and AAPG being important in

improving this relationship, along with other organizations such as NAPE. His reason for mentioning NAPE had much to do with those interested in geothermal production being able to learn what O&G activity is ongoing, properties that may be available for acquisition especially if greater amounts of (hot) water are being produced. He believes that the story about geothermal in sedimentary basins, such as coproduction, needs to receive greater publicity, and is interested in how multiple wells being drilled from a single pad in a shale play may translate into future hot water production for geothermal. Unfortunately he did tend to agree with the DOE EERE Blue Ribbon committee report that the DOE should probably not invest more into geothermal production within sedimentary basins.

As a result of my being able to speak with the new GTP Manager, I would like to recommend the following:

- 1) That an ad-hoc committee should be explored between at least the AAPG/EMD and the GRC/GEA for the purpose of developing ways to more effectively share technology and ideas applicable within both the oil and gas and geothermal industries, and for developing ways to jointly work together towards subsurface energy production.
- 2) That one of the first objectives of such an ad-hoc committee be to address the need for a future joint AAPG/GRC technical meeting that can allow members of both or either society to meet each other and consider how geothermal production can be more viable within wells drilled originally for oil and gas production.

### **Geothermal Resources Council Meeting (GRC) San Diego Meeting**

Several of the committee including David Blackwell, Paul Morgan, and myself independently attended the recent GRC meeting in California. There were 13 papers/presentations that I saw listed that were involved with geothermal exploration, database development, and equipment advance that were related to geothermal energy production within sedimentary rock or sedimentary basins. Several of the presenters will also be giving their presentations at the 2012 AAPG meeting in the geothermal session. Blackwell and his colleagues gave presentations involving U.S. temperature maps and resource estimates, mapping in CO, WY, MO, and NE, and the National Geothermal Data System (NGDS). Morgan spoke on BHT data in the Piceance Basin of CO as a prospective sedimentary basin EGS (enhanced/engineered geothermal system) resource.

Will Gosnold and colleagues from UND gave presentations on geothermal system resources in Minnesota, affects of post-glacial warming for northern hemisphere heat flow, GIS analysis of thermal energy in selected reservoirs of the Williston Basin, and estimating BHT corrections in the Williston, Andarko, Arkoma, and Permian Basins. Roland Horne and colleagues discussed power production potential in the Los Angeles Basin. Two separate papers by Christine Ehlig-Economides (TAMU) and Chad Augustine (NREL) and associated colleagues independently discussed geothermal development potential from the Haynesville and the Wilcox/Frio Formations respectively. Finally, presentations given by GeoTek Energy, LLC and Blade Energy discussed their approach to subsurface heat exchange systems and gravity head fluid flow in hot water movement.

## **Public Resource Database**

A DOE-funded project is underway through Boise State University and in conjunction with the Arizona Geological Survey and all the remaining state geological surveys to develop a publically available geothermal database for industry use. Various surface and subsurface data, including O&G well BHT data, is being collected and correlated for eventual availability over the internet for both research and industrial use.

At the heart of the Geoscience Information network is a catalog system that enables data providers to publish metadata for data and services, and for data consumers to discover those resources. The catalog system is based on a federated system of metadata registries (databases that host and manage the metadata) that are accessible for search and harvest via public web services. Metadata records in this system are viewed as a public resource. Information within this catalog can be viewed at <http://catalog.usgin.org/geoportal/catalog/main/home.page>.

Independent of the catalog, Google has worked with the SMU Geothermal Laboratory to develop an online series of geothermal temperature maps that can be viewed as a first pass analysis of the geothermal potential in various areas of the U.S. The site can be reached at <http://www.google.org/egs/>.

## **Hilcorp / Cleco / Access Energy Coproduced Geothermal Energy**

Earlier in February/March of 2011, a coproduced geothermal project was initiated in Louisiana by Cleco Power LLC and Hilcorp Energy. A 125 kW ORC (organic Rankin cycle) binary turbine was provided my Access Energy to Cleco for this project. The project is purely commercial in nature and did not use state or federal funds, meaning this was not a demonstration project. A single gas well, producing around 5,000 of brine at an average temperature of 240°F was tapped to extract some of the heat to generate around 65 kW gross output, or about 50 kW net. Cleco is purchasing the power to meet part of their renewable porfolio requirements. More will be said about this project in future technical presentations.

## **National Science Foundation (NSF) Geothermal Workshop**

On November 7-11 a NSF workshop occurred in Salt Lake City with focus on an under-studied portion of the renewable energy portfolio - the geothermal energy of sedimentary basins. The title of the meeting was "Tracking An Energy Elephant - Challenges for Unlocking the Geothermal Potential of Sedimentary Basins." Paul Morgan, one of the members of the geothermal committee, was able to attend the meeting and was able to provide a summary of the activities that occurred at the meeting. I am grateful that Paul was able to attend and provide this update for EMD.

"For two and a half days over sixty attendees, aided by web participants, listened to and questioned formal presentations related to various aspects of the geothermal potential of sedimentary basins. They also discussed some of these topics in breakout sessions. A fundamental question that was posed to the group by John Holbrook of Texas Christian University was, "What are the basic science and engineering challenges to making

sedimentary geothermal a reality?" A second question that he posed was, "How do we keep people (with diverse skills and from different disciplines) together to go forward (after the meeting)?" After an overview of geothermal resources in the United State by David Blackwell from the Geothermal Lab at Southern Methodist University, and a more focused look at possible geothermal resources in the sedimentary basins of Utah by Rick Allis, Utah State Geologist, most of the meeting was used to discuss five 'breakout topics.' Each topic was introduced by a presentation and then discussed in smaller groups of about twenty participants drawn from mixed backgrounds. The breakout topics were: 1) *sedimentary basin architecture and thermal regimes*, 2) *permeability and fluid flow in sedimentary basins - geofluids in native and engineered conduits*, 3) *engineering challenges for geothermal resources of sedimentary basins*, 4) *imaging deep sedimentary basins*, and 5) *education and diversity related to research and careers*. An additional topic without a breakout session on *cyberinfrastructure for a multidisciplinary research and education* was presented by Walter Snyder of Boise State University. This topic was presented as essential for the future. The title for the final summary session was, "An NSF Initiative on Geothermal Energy of Sedimentary Basins." During this session questions were compiled addressing the fundamental questions that were asked at the beginning of the meeting.

Many good ideas arose in the presentations, discussions and questions associated with this workshop. The meeting was loosely structured with participants from a wide range of backgrounds to encourage collaboration, and this goal was in large part successful. At times, however, some of the 'challenges' that were discussed were not universally agreed to be challenges. For example, working at temperatures above 200°C and with fluids (brines) that are likely to be chemically active and/or prone to scaling were often suggested as new subjects for research. However, these are common working conditions in many existing high-temperature geothermal fields and are not specific to unlocking the geothermal potential of sedimentary basins. A more pertinent challenge that was suggested was access to field laboratories, particularly drill holes in sedimentary basins where data may be collected to calibrate thermal, permeability, chemical, engineering, and other models relevant to testing the geothermal potential of sedimentary basins. Expensive drilling projects are hard for NSF to fund, but perhaps through governmental interagency collaboration and/or private/government cost sharing, some drill holes may become field laboratories at least on a temporary basis. A report is in preparation from the meeting and all participants will have an opportunity to review and comment on this report. One of the international participants in the meeting, Ladislaus Rybach from GeoWatt AC, shared some of his very useful experience in the development of geothermal energy in Europe especially the development of the geothermal potential of sedimentary basins in Germany. He left a the URL of a useful data site of this work: <http://www.geotis.de/>. Germany is not the USA, but with the work of the organizers in convening this workshop, the compilation of questions that was the result of this workshop, and some research into the experiences of our international colleagues, the report from this meeting could provide a valuable document for NSF and other agencies to fund projects according to their mandates that will realize the geothermal potential of sedimentary basins in North America sooner rather than later."



## **Suggested O&G Incentive Addition**

Many political sound bites have been made by both the Republican and Democratic parties regarding existing oil and gas incentives, where to maintain them or to eliminate at least some of the existing incentives. As a result of attending the GRC meeting, along with reviewing the Blue Ribbon Committee recommendations, two incentive ideas came to mind that I believe the AAPG should adopt for helping to expand geothermal energy production by the O&G industry:

- 1) Incentives should be extended to oil and gas companies for coproduction of geothermal energy from water that is of sufficient volume and of an appropriate temperature for existing ORC and other heat-to-electric technology to produce electricity at or near the well head.
- 2) Incentives would exist for oil and gas companies to take a depleted oil or gas well that has been economically depleted and convert the well to a geothermal production well by opening hot water zones behind pipe.
- 3) These incentives would be cumulative in that a coproduced well could eventually become a full time geothermal energy production well, with the second incentive coming into effect as the first incentive drops off.
- 4) Incentive 2 should be of a higher economic value compared to Incentive 1 above for the purpose of an added bonus in converting a previous O&G well into a geothermal energy well.

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## **EMD's Geothermal Energy Committee Mid-Year 2011 Report - UPDATE**

Dr. Erdlac is no longer a full time employee of Calnetix/Access Energy. The low price of natural gas and the low industry interest in waste heat-to-electric resulted in the company cutting several positions.

### **Hilcorp / Cleco / Access Energy Coproduced Geothermal Energy**

The coproduced project came to an abrupt halt on August 30 when a leak that had developed in the heat exchanger allowed brine to enter the turbine and bring the rotor to a stop. After a detailed analysis the difficulties were identified and a new heat exchanger was in construction for replacement at the site.

### **ElectraTherm: Green Machine Completes Low-Temperature Geo Energy Oilfield Demonstration**

ElectraTherm's Green Machine completed a six-month demonstration in summer 2011 to prove its viability to generate geothermal power from oil and gas wells. Their equipment is a small-scale (<200 kWe) application to generate fuel-free, emission free power at an oil well, and was developed from a grant by the DOE's Research Partnership to Secure Energy for America

(RPSEA). The Green Machine is based on the Organic Rankin Cycle and uses preferred temperatures of between 190°F and 240°F. Among the partners involved with this project include Denbury Resources, Inc. (who supplied the well in Mississippi), Gulf Coast Green Energy (who is a distributor of the Green Machine), and SMU (who had conducted initial work at the site). Temperature at the well was 204°F, with 100 BOPD and 4,000 BHPD for an average output of 19 kWe per hour. The unit is designed for 30-65 kWe.