

“We Speak, Eat, and Breathe Geothermal”

– Jennifer M. Livermore
Geophysicist, Schlumberger
Graduate, National Geothermal Academy

by Susan Fox Hodgson

August 11 was graduation day for students attending the National Geothermal Academy (NGA) on the Reno campus of the University of Nevada. After the ceremony, I talked with Jennifer Livermore at the reception—her quote is the title. We had met a few weeks earlier at the NGA module on geothermal power plants and she attended every other module, as well, calling her time at the NGA “... a complete whirlwind, an immersion in geothermal. I learned the terminology and know so much more about geothermal and drilling. The eight weeks were quite intense. I will be contacting the professors and my fellow students—and some are my friends for life. Everyone got along. It was just amazing.”

Fifty-four students (28% female), from 10 countries, were enrolled in the program, which began on June 20. Twenty-seven students—exactly one half—took all nine modules. The rest came and went, attending some modules and not others. But everyone had a strong academic background. In fact 21 of the NGA students are graduate students and 4

are undergraduates, 17 are working in industry, 7 in academia, and 5 in government.

Dr. Joe Moore, a co-instructor with Dr. Dave Blackwell on resource assessment and evaluation, returned to Reno on graduation day, when I asked about his 35 students. He said their questions had been great. His course included a field trip day and two evening sessions with microscopes. About half of the students were geologists and



Power-plant class co-presenter, Dr. Brian Anderson, clarifies a perplexing point for Sema Tekin of Turkey (photo left), and Timea Grego of Hungary. Sema is a geothermal drilling rig engineer for Turkish Petroleum International Company Ltd. Recently she watched over nine wells as they were drilled successfully in Turkey's Germencik Geothermal Field. Timea is beginning a doctorate on energy systems and sustainability at the University of Nevada, Reno.

PHOTOS BY S. HODGSON.

Education

half engineers, and in his class the geologists and engineers worked together in small groups to help each other solve problems.

On the theory that power plants are an important topic not widely understood, I attended the first two days of the geothermal power plant course offered by Drs. Ronald DiPippo and Brian Anderson. On July 25 at 8:30 am, the professors



Dr. Ronald DiPippo, power-plant class co-presenter, talks with NGA student Paul Schwering. Paul is a graduate student studying geophysics at the University of Nevada, Reno.

were poised to start and 30 students and I were seated, waiting to learn. The students opened 30 computers and I opened a composition book with a marbled black and white cover. We were ready.

Dr. DiPippo said he hoped everyone would learn from the course what he or she needed. Some may be looking for an overview and some design and optimization details. Exploring, testing, drilling, producing, and generating electricity from geothermal resources is really challenging, he said, and nobody has expertise in every area. He called geothermal development a highly multidisciplinary subject and said the people in geothermal need to communicate

with their colleagues on every geothermal topic. "Smart geothermal decisions," he said, "are made when everyone talks together."

Dr. DiPippo mentioned a crucial point about geothermal power plants. He said, "Nothing is more dangerous in geothermal than prematurely ordering the energy-conversion system." He said a mentor at Brown University, Dr. Joseph Kestin, told him this 30 years ago and the maxim still holds true today—and still sometimes is ignored. For surprisingly, the inner workings of a geothermal power plant are very delicate—not as they may appear—and designed entirely around the geothermal fluids meant to run them.

Well fluid types, temperatures, pressures, and flow rates all determine the internal structure of the plant. Whenever power plants are designed and built without complete fluid data, and if it turns out the actual fluid data do not match the specifications used by the manufacturer, the results can range from disappointing to catastrophic. To generate electricity economically and efficiently, a geothermal power plant needs to have the fluids it was designed for.

Toni Boyd, an instructor from the GeoHeat Center at the Oregon Institute of Technology (OIT), came to Reno personally to take the NGA students to Klamath Falls to learn about low-temperature geothermal development. She

said her OIT classes covered the whole gamut of direct use: heat pumps, greenhouses, agriculture, space heating, and district heating. At the Reno graduation ceremony, the students presented Toni with an NGA-engraved beer mug in appreciation of her efforts.

I spoke with Dr. Wendy Calvin, the NGA program director, on graduation day. She was happy but still facing a few weeks of wrap-up activities. Dr. Calvin said, "The NGA went really well. The students are beginning to appreciate the unique nature of their experiences. Now that they've survived—they are saying: yes, it actually was really good. The final student project has

Education

made them focus on the geothermal areas they are heading toward. They all have stories to tell, and I hope we can do this again. Because we had such a tight timeline this first session, we didn't have enough time for publicizing the program. I hope the applications can be sent out earlier next year," she said.

Stanford professor Dr. Roland Horne taught the NGA reservoir engineering module and returned to Reno for the graduation ceremony. Asked to characterize the NGA, he said, "It is a brilliant success. The kids are totally engaged and really worked for the whole eight weeks. Many students are already significantly along a geothermal path and they all have established

a geothermal foundation. The NGA should be continued as long as a demand exists for hiring the students.

"The strength of the program is that it is comprehensive, and this makes it unique in the US. The course materials in the NGA program are something no single professor or university could have presented, because every person and institution has different skill sets.

"It is important to note, as well, that half of the students came for separate pieces of the program. I wish something like the NGA had been available to me when I was 25 or even 45 years old. Clearly, the program itself wouldn't be here without support from the US Department of Energy (DOE), and I believe the NGA needs a few more years of momentum to become self-sustaining," he concluded.

A DOE grant of \$995,000 was awarded to the University of Nevada, Reno, in March 2010 for



Students and instructors from the NGA Power Plant Design and Construction class pose during the field trip to Ormat Technologies, Inc.'s, Steamboat Geothermal Power Plant Complex in Reno, Nevada.

Education



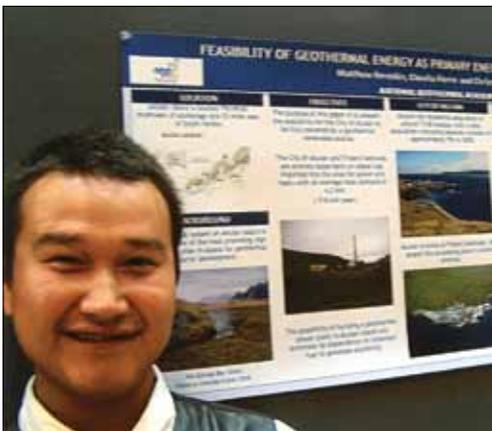
At Ormat Technologies, Inc.'s, Steamboat Geothermal Power Plant Complex, students listen to Dr. DiPippo, back row at right. The colorful logo on an NGA tee shirt takes center stage.

developing and operating the NGA. The NGA, basically, is a consortium of leading geothermal schools, including Cornell University, the Oregon Institute of Technology, Southern Methodist University, Stanford University, the University of Utah, and others. The focus on geothermal science and technology was designed to bring students, professors, and industry professionals from around the country to Reno to learn about geothermal energy.

Throughout the sessions, students talked with industry representatives. These included Steve Hirsch from Geothermal Development Associates;



Dr. Xiuhua Zheng, an NGA student from China, meets Charlene Wardlow at the graduation reception sponsored by Ormat Technologies, Inc. Dr. Zheng is a professor at China University of Geosciences in Beijing and has a doctorate in geological engineering. She has worked extensively to engineer and drill geothermal wells, including wells in Tibet. She plans to teach what she has learned at the NGA to professors in her university. Charlene Wardlow is Director of Business Development for Ormat Technologies, Inc.



Matthew Bereskin is a city council member and water treatment plant operator for the city of Akutan, Alaska. The city is on Akutan Island, part of the Fox Island group in the eastern Aleutians. To support the Akutan Geothermal Development Project, Matthew attended the NGA, foregoing a summer income from commercial fishing. Matthew said, "I came to the NGA to get a good background in geothermal and it worked. I'll work on a Master's Degree in geothermal in the future."

Students attending all NGA modules had to create a Final Project. Matthew undertook his project with Christopher Reyes (see front cover) and Claudia Fierro, Imperial Irrigation District engineers from El Centro, California. The trio titled their work, Feasibility of Geothermal Energy as Primary Energy Source in Akutan City. In the photo, Matthew stands next to their poster.

The goal of the Akutan project is to build and operate a 10 to 12 MWe geothermal power plant. With monies from the State of Alaska and the school district (whose funding comes from a fish tax paid by Trident Seafoods), the city of Akutan has drilled two geothermal temperature-gradient wells—one at 833 feet, registering 336 °F and one at 1,400 feet, registering 326 °F. Matthew himself ran the well logs and in 2012 hopes to drill two additional temperature-gradient wells and find higher temperatures. Drilling will occur in Hot Springs Bay Valley, near an inlet north of the city. Articles about the Akutan project can be found in GRC Bulletin issues.

Education

Jagadeeswara R. Kodali from Kodali Inc.; Dick Benoit, Jim Echols, Monte Morison, and Tracey Van Gundy from Magma Energy Corporation; Heidi Bethel, Dan Fleischmann, Brigette Martini, Josh Nordquist, Rahm Orenstein, Paul Thomsen, Patrick Walsh, and Charlene Wardlow from Ormat Technologies, Inc.; Shuman Moore from Oski Energy LLC; Dan Schochet from Ram Power, Corporation; and Gary Johnson from the US Bureau of Land Management, Nevada.

“Industry collaboration ensures the inclusion of specific areas of geothermal expertise,” said Gina Tempel, Associate Dean for the College of Science at the University of Nevada, Reno. “We are training a US national-energy infrastructure to develop the country’s geothermal resources,” she concluded. ■



Dr. Wendy Calvin is in charge of the National Geothermal Academy. She is a Professor of Geophysics & Remote Sensing and the Director of the Great Basin Center for Geothermal Energy at the University of Nevada, Reno.

National Geothermal Academy Classes & Instructors

June 20 – August 11, 2011

- **Introduction to Geothermal Energy Utilization**
Jefferson Tester, Cornell University
- **Environmental Policy and Permitting**
Mark DeMuth, WCRM, Inc.
- **Resource Assessment & Exploration**
Dave Blackwell, Southern Methodist University & Joe Moore, EGI/University of Utah
- **Drilling Engineering**
Bill Livesay, Livesay Consultants and Louis Capuano, Jr. & Louis Capuano III, Thermasource, Inc.
- **Reservoir Engineering**
Roland Horne, Stanford
- **Power Plant Design and Construction**
Ronald DiPippo, Renewable Energy Consultant & Brian Anderson, West Virginia University
- **Direct Use and Heat Pumps**
Tonya Boyd, Geo-Heat Center, Oregon Institute of Technology & John W. Lund, Low-Temperature Geothermal Program, NREL
- **Geothermal Business Principles and Development**
John McKinsey, Stoel-Rives LLP
- **Independent and Team Projects**
Wendy Calvin, Great Basin Center for Geothermal Energy, University of Nevada, Reno



On the last day of the NGA direct-use class in Klamath Falls, Oregon, the students visited Crater Lake, a volcanic national park. Here they pose at a vista point overlooking Crater Lake. PHOTO BY T. BOYD.