Project Title: Geothermal Workforce Education Development and Retention

May 19, 2010

Principal Investigator: ?

Presenter Name: Jim Scott

Organization: Great Basin Center for Geothermal Energy, Univ. of Nevada, Reno

Track Name: Analysis, Data System and Education

- Timeline
  - Project start date: 1/15/10 , project end date: 2014,
- Budget
  - Total project funding: $9M, FY10: $995,000
- Barriers
  - Courses' importance to industry; sufficient enrollment.
- Partners
  - The University of Nevada, Reno (PI - ?) – Host organization
  - The University of Utah (PIs - Joe Moore and Pete Rose)
  - Stanford University (PI - Roland Horne)
  - Cornell University (PI - Jeff Tester)
  - Oregon Institute of Technology (PIs - John Lund and Toni Boyd)
  - Southern Methodist University (PI - David Blackwell)

Overview

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National Geothermal Institute (NGI) Project Objectives and Location.

- Establish an NGI.
  - Institute will provide instructional programs to educate and train the next generation of U.S. scientists, engineers, plant operators, technicians and policy makers.
  - A consortium of institutions is required to provide necessary depth of expertise in geothermal energy.

- University of Nevada, Reno (UNR) is the host organization.
  - Reno is the home location for many geothermal energy companies.
  - UNR's Redfield campus is located next to Ormat's operating geothermal plants that are a resource for hands-on learning.

Project Objectives and Location

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Track Name: Analysis, Data System and Education

Redfield Campus, U. Nevada, Reno

Principal Investigator: ?

Presenter Name: Jim Scott

Organization: Great Basin Center for Geothermal Energy, Univ. of Nevada, Reno

Track Name: Analysis, Data System and Education

Seeking Industry Feedback

- Course development at NGI will be based on the needs of the geothermal energy industry.
  - The target client for our courses is either:
    - a university student,
    - employed, seeking knowledge of the most advanced techniques,
    - seeking employment in the geothermal industry,
    - considering investing in the industry.

- A list for curriculum review composed of 113 people directly involved in the industry was compiled, including email addresses.
  - The individuals selected are likely to have the best insights into educational needs.

Seeking Industry Feedback

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- A preliminary "straw man" curriculum was prepared to stimulate comment.

- Eight proposed courses cover important aspects of geothermal energy :
  1. Introduction to Geothermal Energy Utilization;
  2. Geothermal Business Principles;
  3. Public Policy, Permitting and Environmental Issues;
  4. Exploration I;
  5. Exploration II;
  6. Reservoir Engineering and Management;
  7. Power Plant Design and Construction;
  8. Direct Use;

  Also included: Field Trips and an Individual Project.

Preliminary Curriculum

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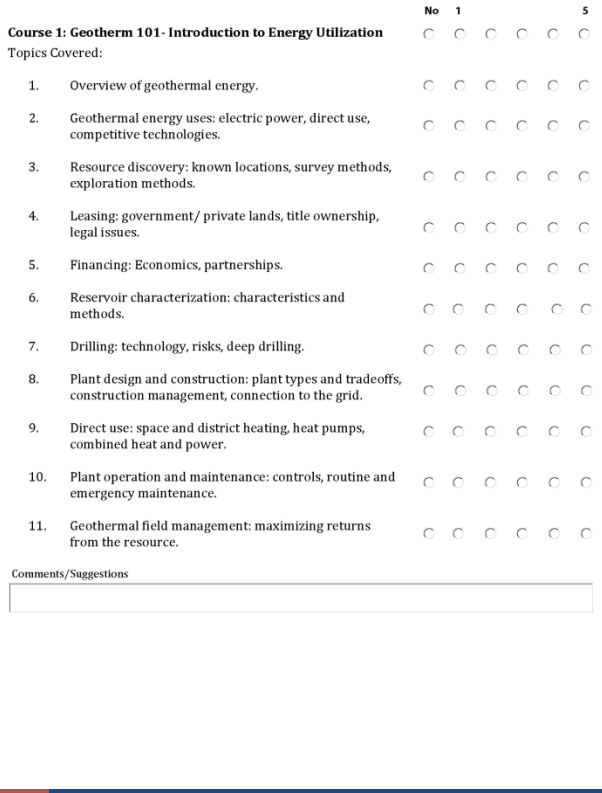
- Questionnaire was sent as a PDF with active "radio" buttons.
- Course and individual topics are scored 1-5
  - A "No" column for "No opinion".
  - Scoring: 1 = little importance, 5 = most Important.
- A comment/suggestion field allows recipients to communicate their thoughts on each course.



		No	1				5
Course 1: Geotherm 101- Introduction to Energy Utilization		○	○	○	○	○	○
Topics Covered:							
1.	Overview of geothermal energy.	○	○	○	○	○	○
2.	Geothermal energy uses: electric power, direct use, competitive technologies.	○	○	○	○	○	○
3.	Resource discovery: known locations, survey methods, exploration methods.	○	○	○	○	○	○
4.	Leasing: government/ private lands, title ownership, legal issues.	○	○	○	○	○	○
5.	Financing: Economics, partnerships.	○	○	○	○	○	○
6.	Reservoir characterization: characteristics and methods.	○	○	○	○	○	○
7.	Drilling: technology, risks, deep drilling.	○	○	○	○	○	○
8.	Plant design and construction: plant types and tradeoffs, construction management, connection to the grid.	○	○	○	○	○	○
9.	Direct use: space and district heating, heat pumps, combined heat and power.	○	○	○	○	○	○
10.	Plant operation and maintenance: controls, routine and emergency maintenance.	○	○	○	○	○	○
11.	Geothermal field management: maximizing returns from the resource.	○	○	○	○	○	○

Comments/Suggestions

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Questionnaire Page

Principal Investigator: ?

Presenter Name: Jim Scott

Organization: Great Basin Center for Geothermal Energy, Univ. of Nevada, Reno

Track Name: Analysis, Data System and Education

Questionnaires were emailed to 113 individuals.

- 21 responses received and tabulated.
- Response rate 21/113 = 19%

Questionnaire Responses

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Course	Average Value	Standard Deviation
1: Introduction to Geothermal Energy Utilization	4.32	1.11
2: Geothermal Business Principles	3.60	0.94
3:Public Policy, Permitting and Environmental Issues	3.80	0.89
4: Exploration I	4.30	0.98
5: Exploration II	4.26	0.93
6: Reservoir Engineering and Management	4.39	0.78
7: Power Plant Design and Construction	3.78	1.26
8: Direct Use	3.26	1.19
Field Trips and Individual Projects	4.55	0.60
Power Plant Operations - a technician course offered through Truckee Meadows Community College	3.84	1.38

Questionnaire Results

Statistical Values

Principal Investigator: ?

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Preliminary course topics were revised to reflect questionnaire comments.

- Example follows for Reservoir Engineering course.
- Original 7 topics expanded to 11.
- Lower emphasis on seismic methods.

Questionnaire Analysis

Principal Investigator: ?
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Course 6: **Geotherm 204- Reservoir Engineering and Management**

This is an upper-division college course covering the basic principles of reservoir engineering and management. Reservoir characterization methods are presented as well as the elements of managing the resource.

Topics covered:

1. Reservoir/Resource Characterization.
2. Seismic attributes of geothermal reservoirs.
3. Seismic analysis of geothermal reservoirs.
4. Tracing flowpaths with MEQs.
5. Reservoir management.
6. Injection well strategies.
7. Scaling prediction and control.

Questionnaire Version

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Course 6: **Geotherm 204- Reservoir Engineering and Management**

This is an upper-division college course covering the basic principles of reservoir engineering and management. Reservoir characterization methods are presented as well as the elements of managing the resource.

Topics covered:

1. Reservoir / resource characterization overview.
2. Reservoir modeling, thermodynamics.
3. Reservoir decline analysis, calculating reserves.
4. Well testing, tracer testing and interpretation.
5. Production logging (long-term temperature and pressure monitoring and interpretation; data storage and retrieval).
6. Injection management.
7. Natural recharge / cooling.
8. Corrosive fluids, scaling prediction and control.
9. Subsidence monitoring (gravity, InSAR, GPS).
10. EGS.
11. Seismic analysis of geothermal reservoirs.

Revised Course Topics

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Curriculum Development Workshop

- A one- or two-day workshop will be convened in Reno;
- Agenda:
  - Questionnaire results and "straw man" curriculum discussion,
  - Consortium partners will make presentations in their areas of expertise,
  - Input from industry representatives will be integrated,
  - Curriculum development assignments will be made,
  - A report summarizing results and conclusions will be prepared.

Curriculum Development Workshop

Principal Investigator: ?
Presenter Name: Jim Scott
Organization: Great Basin Center for Geothermal Energy, Univ. of Nevada, Reno

Track Name: Analysis, Data System and Education

Workshop Participants - Co-PIs

The University of Nevada, Reno (PI - ?; Workshop Organizer – Jim Scott) – Host organization

The University of Utah (PI - Joe Moore)

Stanford University (PI - Roland Horne)

Cornell University (PI - Jeff Tester)

Oregon Institute of Technology (PIs - John Lund and Toni Boyd)

Southern Methodist University (PI - David Blackwell)

Workshop Participants - Co-PIs

Principal Investigator: ?

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Track Name: Analysis, Data System and Education

Workshop Participants - DOE representative and Industry Collaborators

DOE - Nicole Reed
Ram Power - Christy Morris
Ormat - Charlene Wardlow
Enel - Andrew Rael
Nevada Geothermal Power - Kim Niggemann
Vulcan Power Co. - Jim Combs
SAIC - Sabodh Garg
Magma Energy, Reno - Walter (Dick) Benoit (not available in June)

Workshop Participants - Industry Collaborators

Principal Investigator: ?
Presenter Name: Jim Scott
Organization: Great Basin Center for Geothermal Energy, Univ. of Nevada, Reno

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Significant Meetings

Meetings were held to:

1. Explore possible NGI cooperation with U.S. Dept. of Labor training/placement programs;
2. Determine requirements for obtaining UNR credits and certificates for NGI courses;
3. Logistical and administrative services available for NGI at the Redfield campus;
4. Discuss a proposed Geothermal Plant Operator Course from TMCC;
5. Teleconference with our consortium members on a proposed curriculum;
6. Discuss the relationship of NGI to UNR's Alternative Energy Minor;
7. Discuss collaboration with the University of Auckland in New Zealand.

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Meetings – NevadaWorks – 2/2/10

- NevadaWorks is an organization funded by the U.S. Dept. of Labor to train and place clients in the local workforce.
  - JOINT = Job Opportunities in Nevada.
- We (NGI) presented our plan to provide courses and certification.
- NevadaWorks represents a possible NGI cooperative effort.
- Expecting a U.S. Dept. of Labor model RFP in April.

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Meetings – UNR Continuing Education 02/03/10

Scott and Shevenell met with 5 representatives of UNR Continuing Education to:

1.Determine requirements for obtaining UNR credits and certificates for NGI courses:
- Certificates can be awarded with minimal difficulty; UNR credits somewhat more.

2.Discover the logistical and administrative services available for NGI at the Redfield campus:
- Services such as transport, lodging, certification, tuition collection & disbursement are available at negotiable cost.

Meetings – UNR Continuing Education 02/03/10

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Meetings – TMCC Geothermal Plant Operator Course Advisory Committee 02/04/10

- Community college training for geothermal plant operators.
- Committee members from industry (4) and academia (7) guide curriculum development.
  - Shevenell and Scott are committee members.
- Course complements NGI curriculum.
  - Redfield campus serves both TMCC and NGI.

Meetings – TMCC Geothermal Plant Operator Course Advisory Committee 02/04/10

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Consortium Teleconference 2/12/10

•Call used teleconference application allowing on-line viewing and editing of documents.

- Summary of recent meetings was presented:
  1. NevadaWorks 02/02/10
  2. UNR Continuing Education 02/03/10
  3. TMCC Geothermal Plant Operator Course Advisory Committee 02/04/10

•Proposed list of geothermal course topics and possible instructors:

- Proposed curriculum edited during meeting.

•List of industry contacts with email addresses/websites: List approved

Consortium Teleconference 2/12/10

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Meetings – Advisory Committee for UNR Alternative Energy Minor 1/29/10

- An Alternative Energy Certificate is being prepared for the UNR curriculum.
- Minor requires 15 upper-division credits.
- NGI curriculum to provide credits.

Meetings – Advisory Committee for Alternative Energy Minor

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Meetings – University of Auckland, New Zealand

- Meeting during GRC - October, 2009.
- Met with representatives from New Zealand's Institute of Earth Science and Engineering (IESE), Univ. of Auckland; and Auckland UniServices Ltd.
- Draft Letter of Agreement received offering to share expertise in geothermal education and geothermal research and development.

Meetings – University of Auckland, New Zealand

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GBCGE Educational Mission

- Graduate Student Education
- Interdisciplinary Renewable Energy Minor
- Graduate Certificate in Renewable Energy
- Technician Training – Truckee Meadows Community College (TMCC)
- National Geothermal Training Institute – Redfield Campus

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