


**TIER-1 APPLICATION TO THE NEW MEXICO INTERSTATE STREAM COMMISSION
FOR NEW MEXICO UNIT OR WATER UTILIZATION ALTERNATIVE
UNDER THE ARIZONA WATER SETTLEMENTS ACT**

APPLICANT INFORMATION

DATE June 28, 2011

<p>1. Legal Names: ¹Mark Person, ¹Fred Phillips, ¹Andrewe Campbell, ²James Witcher, ³Carl Gable</p>	<p>2. Organization: ¹New Mexico Tech, Dept. Earth & Envir. Sci., Hydrology Program, ²James Witcher & Assoc., ³Los Alamos National Laboratory</p>										
<p>3. Address (street, city, county, state, and zip code):</p> <p>Dept. Earth & Environmental Sciences, MSEC 208 801 Leroy Place Socorro, NM 87801</p>	<p>4. Name, email, and phone number of contract person:</p> <p>Mark Person mperson@nmt.edu 575-835-6505 (office) 812-345-3973 (cell)</p>										
<p>5. TYPE OF APPLICATION (check one): <input checked="" type="checkbox"/> Final <input type="checkbox"/> Preliminary for review <input type="checkbox"/> Revised</p>	<p>6. TYPE OF APPLICANT (CHECK BOX):</p> <p><input type="checkbox"/> local governments or municipalities</p> <p><input type="checkbox"/> soil and water conservation districts, irrigation districts or commissions, acequias, or other political subdivision of the State of New Mexico</p> <p><input checked="" type="checkbox"/> institutions of higher education or a consortium of such institutions</p> <p><input type="checkbox"/> non-profit organizations or associations</p> <p><input type="checkbox"/> private individual/s</p> <p><input type="checkbox"/> federal agency (ies)</p> <p><input type="checkbox"/> Other (specify)</p>										
<p>7. BRIEF PROJECT DESCRIPTION: In phase I, we propose to determine the feasibility of installing a 10 MW geothermal power plant and geothermal greenhouses along the San Francisco River. We conduct fieldwork, shallow drilling (2000 feet), aquifer test analysis, and hydrothermal modeling. During Phase II we would team with a private geothermal operator (ORMAT) to install the plant.</p>											
<p>8. AREAS AFFECTED (describe by county, municipality, township, etc. as applicable): Our focus would be on the Lower Frisco Hot Springs in Catron County near the City of Glenwood and the Gila Hot springs in Grant County about 16 miles north of the City of Grant.</p>											
<p>9. TOTAL FUNDING REQUESTED (in \$1,000):</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 20%;">2012: \$310</td> <td style="width: 20%;">2013: \$650</td> <td style="width: 20%;">2012:</td> <td style="width: 20%;">2013:</td> <td style="width: 20%;">2013:</td> </tr> <tr> <td>2012:</td> <td>2013:</td> <td>2012:</td> <td>2013:</td> <td>2012:</td> </tr> </table>		2012: \$310	2013: \$650	2012:	2013:	2013:	2012:	2013:	2012:	2013:	2012:
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<p>10a. TO THE BEST OF MY KNOWLEDGE AND BELIEF, ALL DATA IN THIS APPLICATION ARE TRUE AND CORRECT, THE DOCUMENT HAS BEEN DULY AUTHORIZED BY THE GOVERNING BODY OF THE APPLICANT AND THE APPLICANT WILL COMPLY WITH THE ATTACHED REQUIREMENTS AND ASSURANCES IF THE PROPOSAL IS ACCEPTED.</p>											
<p>10b. TYPED OR PRINTED NAME OF AUTHORIZED REPRESENTATIVE: Mark Person</p>	<p>11. TITLE: Professor</p>										
<p>12. PHONE NUMBER: 575-835-6506</p>											
<p>13. SIGNATURE: </p>	<p>DATE: June 28, 2011</p>										

14. Evaluation criteria.

A. *State whether the proposal is for the “New Mexico Unit,” a “water utilization alternative,” or both.*

Our proposed geothermal power plant is a *water utilization alternative* application. We proposed to install a 10 MWe air-cooled, geothermal binary plant that would utilize relatively small quantities of water. The geothermal fluids would be pumped from a deep (at least 1000 feet depth) hydrothermal reservoir along the San Francisco River. We will be utilizing deep, unappropriated groundwater. The reservoir is not in good hydrologic connection with the surface water system.

B. *Describe how the proposal will meet a “water supply demand” in the Southwest New Mexico Water Planning Region, comprised of Catron, Grant, Hidalgo and Luna Counties.*

A typical 10 MWe binary geothermal power plant uses about consumes between about 1500-5000 acre-feet per year (Clark et al. 2011). Most of the produced water would be reinjected with estimated water losses between 60-230 acre-feet per year. A geothermal power plant uses far less water than conventional power plants. A typical coal-power plant uses about 0.85 gal/kWh. A binary geothermal power plant uses only 0.2 gal/kWh (four time less water; Clark et al. 2011). Thus, our proposed geothermal power plant could offset water use in other regions of the state.

Reference

Clark, C.E, Harto, C. B., Sullivan, J. L, and M. Q. Wang, 2011, Water use in the development and operation of geothermal power plants, Argonne National Lab Report ANL/EVS/R-105, 74 p.

C. Describe how the proposal considers the Gila environment and describe how any negative impacts might be mitigated.

A geothermal power plant could have a negative impact on hot spring activities in the immediate vicinity (4 km²) of its location. This is hard to say without drilling and conducting a pumping test. Drilling and producing from a deeper (2-3 km) reservoir could potentially mitigate negative impacts of shallow geothermal production. Because the hot springs along the San Francisco River have moderate salinity, geothermal power plants may reduce the salt load to the river.

D. Describe how the proposal considers the historic uses of and future demands for water in the Southwest New Mexico Water Planning Region and the traditions, cultures and customs affecting those uses.

The main use of waters of the San Francisco River in New Mexico has been recreational. The river supports fishing, wildlife that provide a basis for economic activities associated with hunting (guiding and outfitting), birding, hiking and backpacking. There is also limited agricultural use. This is consistent with the longtime economic emphasis in the region on natural resource exploitation and outdoor recreation. Future economic development that does not endanger these resources is desirable and would be consistent with the local traditions. A geothermal power plant falls within this category. Water use would be minimal and the footprint of the plant small. It would not interfere with ecosystem functioning. The power generated is in demand and could be exported to areas where it is needed for economic development of the state as a whole. The plant would provide local jobs and income at minimal levels of water consumption.

FORM 14A

USE THIS FORM TO COMPLETE ANSWERS TO CRITERIA 1 THROUGH 4. NUMBER EACH ADDITIONAL RESPONSE WITH THE CORRESPONDING CRITERIA NUMBER AND SUB-CRITERIA. USE AS MANY PAGES AS NEEDED.

Our proposal is focused on water utilization associated with geothermal power generation along the San Francisco River Watershed in New Mexico. There are numerous hot springs along the San Francisco River. We plan to focus on the Frisco hot springs area where geochemical geothermometers and hot spring discharges suggest reservoir temperatures between 120-160 °C. These hot springs are in close proximity to electrical transmission lines to Arizona making this project feasible. The hot springs are located on a mix of private, BLM and US Forest Service lands. We propose to work with ORMAT to install a 10MW binary power plant, which use small amounts of water. Before a power plant can be installed, a feasibility study must be performed to “prove the resource”. This would represent Phase I of the project. This will involve field work in which we will conduct surface geophysical surveys (resistivity, SP, DTS) and collect geochemical based geothermometry from all hot springs in the area to estimate deep reservoir temperatures.

Ultimately, several deep test wells will have to be drilled to demonstrate that an aquifer exists with sufficient flow rates and temperatures to justify the significant investment of installing a power plant. Our proposal calls for drilling one test well to and to conduct a 7-day aquifer test. We have assembled a team of some of the most qualified experts in geothermal energy in the State/Nation. Jim Witcher is a leading authority of geothermal energy in New Mexico. He has drilled dozens of geothermal wells and has published numerous articles on geothermal energy in New Mexico. Fred Phillips, Andy Campbell and I are currently conducting a state wide geothermal assessment for the New Mexico Energy, Minerals & Natural Resources Department. I have worked on geothermal systems and hydrothermal modeling with Carl Gable at Los Alamos National Labs for a number of years (see reference list). We have developed a powerful, single-phase geothermal simulation model (PGEOFE) with unique grid generation capabilities using the program LaGrit. ORMAT is one of the most viable geothermal company in existence today (<http://www.ormat.com>). They have pioneered the development of binary geothermal power plants. They have designed and installed geothermal power plants all over the world. One of my former doctoral students (Lara Owens) works at ORMAT in Reno Nevada.

Geothermal energy production would help New Mexico be more energy independent. Currently, New Mexico is expected to derive 20 percent of its power generation from renewables by 2020. A geothermal power plant in either Catron or Grant counties would provide jobs and badly needed tax revenues. According to the non-profit Geo-Energy a 10 MW of geothermal power could provide 42 full time jobs and \$150 million economic output over a 30 year period. Geothermal activities supply 25% of the county tax base in the rural town of Imperial County, California, producing over \$12 million in tax revenue. In a town with a high rate of unemployment, the geothermal sector provides stable, well-paying jobs. For example, CalEnergy, the largest geothermal company in the California, is the single largest taxpayer in Imperial County. Geo-Energy goes on to indicate that since enactment of the 2005 Geothermal Steam Act Amendments, California state and local governments have received substantial revenues from geothermal leasing and production. Six states—California, Idaho, Nevada, New Mexico, Oregon, and Utah—collectively received \$27 million for FY 2007 and FY 2008 and 31 counties in those states received an additional \$4.3 million in 2007 and \$9.1 million in 2008. Greenhouses could also be

developed next to the power plant to use the spent geothermal fluids for agricultural production. According to Witcher (2002) geothermal greenhouses provide more than \$4 million, and gross receipts exceeding \$12 million in New Mexico. Greenhouse sales are among the top 10 agriculture sectors in the state. For example, the Burgett Geothermal Greenhouse near Cotton City is the largest employer and business in Hidalgo County.

References

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