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Black Rock Geothermal Project
(23-AFC-03)

Testimony, Declaration, and Resume Package

Submitted to
California Energy Commission

Prepared by
Black Rock Geothermal LLC

with technical assistance from

JACOBS®

May 2023

Project Description

I. Introduction

A. Names: Jon Trujillo and Jerry Salamy

B. Qualifications: The panel's qualifications are as noted in their resumes contained in Appendix B.

C. Prior Filings: In addition to the statements herein, this testimony incorporates by reference the following documents submitted in this proceeding:

- Black Rock Geothermal Project Application for Certification (TN # 249752), 4/18/2023
- Numerical Reservoir Simulation of the Salton Sea Geothermal Resource for Power Generation (TN#: 250040), 5/8/2023

The facts contained in this testimony (including all referenced documents) are true and correct to the best of our knowledge and belief. To the extent this testimony contains opinions, such opinions reflect our best professional judgment. We adopt this as our testimony, and we make these statements and render these opinions freely and under oath for the purpose of constituting sworn testimony in this proceeding.

II. Summary of Testimony

The Black Rock Geothermal Project ("BRGP") is an approximately 77 (net) megawatt geothermal power plant located within the Salton Sea Known Geothermal Resource Area in Imperial County, California. The BRGP has a planned operational life of 40 years. Reservoir modeling results demonstrate that the geothermal resource can support BRGP operations while supporting the existing geothermal projects and other geothermal developments proposed by affiliates of the Applicant, including the Elmore North Geothermal Project and the Morton Bay Geothermal Project. Because the BRGP is located on a site capable of providing geothermal resources in commercial quantities, the Applicant is requesting a 12-month certification process for the project.

Geothermal Resource

I. Introduction

A. Names: Hossein Shamshiri and James Lovekin

B. Qualifications: The panel's qualifications are as noted in their resumes contained in Appendix B.

C. Prior Filings: In addition to the statements herein, this testimony incorporates by reference the following document submitted in this proceeding:

- Numerical Reservoir Simulation of the Salton Sea Geothermal Resource for Power Generation (TN#: 250040), 5/8/2023

The facts contained in this testimony (including all referenced documents) are true and correct to the best of our knowledge and belief. To the extent this testimony contains opinions, such opinions reflect our best professional judgment. We adopt this as our testimony, and we make these statements and render these opinions freely and under oath for the purpose of constituting sworn testimony in this proceeding.

II. Summary of Testimony

The Black Rock Geothermal Project ("BRGP") is an approximately 77 (net) megawatt geothermal power plant located within the Salton Sea Known Geothermal Resource Area in Imperial County, California. The BRGP has a planned operational life of 40 years. Reservoir modeling results demonstrate that the Salton Sea Geothermal Field, which includes the geothermal reservoir underlying the Black Rock Geothermal Project, is capable of providing geothermal resources in commercial quantities that can support the power generation requirements of the BRGP, Elmore North Geothermal Project (approximately 140 net megawatts), and Morton Bay Geothermal Project (approximately 140 net megawatts), as well as existing geothermal facilities utilizing the same geothermal resource.

Appendix A

Black Rock Geothermal Project (23-AFC-03) Signed Declarations

DECLARATION OF JAMES LOVEKIN, PE

I, James Lovekin, declare as follows:

1. I am presently employed by GeothermEx, Inc. as Manager of Field Operations.

2. A copy of my professional qualifications and experience are attached hereto and incorporated herein by reference.

3. The prepared testimony on Geothermal Resources for the Black Rock Geothermal Project (23-AFC-03) – specifically, a report entitled "Numerical Reservoir Simulation of the Salton Sea Geothermal Resource for Power Generation," dated May 2023 (TN No. 250040) – was prepared either by me or under my supervision, and it is based on my independent analysis, data from reliable sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is true and correct with respect to the issue(s) addressed herein.

5. I am personally familiar with the facts and conclusions presented in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief.

DATED: 25 MAY 2023

SIGNED: James Lovekin

NAME: JAMES LOVEKIN

DECLARATION OF JERRY SALAMY

I, Jerry Salamy, declare as follows:

1. I am presently employed by Jacobs Engineering Inc. as Principal Project Manager.

2. A copy of my professional qualifications and experience are attached hereto and incorporated herein by reference.

3. The prepared testimony on Project Description for the Black Rock Geothermal Project (23-AFC-03) was prepared either by me or under my supervision, and is based on my independent analysis, data from reliable sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is true and correct with respect to the issue(s) addressed herein.

5. I am personally familiar with the facts and conclusions presented in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief.

DATED: May 25, 2023

SIGNED: 

NAME: Jerry Salamy

DECLARATION OF HOSSEIN SHAMSHIRI

I, Hossein Shamshiri, declare as follows:

1. I am presently employed by Geo Resource Management as Principal Reservoir Engineer and Project Manager.

2. A copy of my professional qualifications and experience are attached hereto and incorporated herein by reference.

3. The prepared testimony on Geothermal Resources for the Black Rock Geothermal Project (23-AFC-03) – specifically, a report entitled "Numerical Reservoir Simulation of the Salton Sea Geothermal Resource for Power Generation," dated May 2023 (TN No. 250040) was facilitated and evaluated by me. In my professional opinion, said report is based on independent analysis and utilizes data from reliable sources.

4. It is my professional opinion that the prepared testimony is true and correct with respect to the issue(s) addressed therein.

5. I am personally familiar with the facts and conclusions presented in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief.

DATED: 05/25/2023

SIGNED: hshamshiri

NAME: Hossein Shamshiri

DECLARATION OF JON TRUJILLO

I, Jon Trujillo declare as follows:

1. I am presently employed by BHE Renewables, LLC as General Manager of Geothermal Development.

2. A copy of my professional qualifications and experience are attached hereto and incorporated herein by reference.

3. The prepared testimony on Project Description for the Black Rock Geothermal Project (23-AFC-03) was prepared either by me or under my supervision, and is based on my independent analysis, data from reliable sources, and my professional experience and knowledge.

4. It is my professional opinion that the prepared testimony is true and correct with respect to the issue(s) addressed herein.

5. I am personally familiar with the facts and conclusions presented in the testimony and if called as a witness could testify competently thereto.

I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct to the best of my knowledge and belief.

DATED: May 26, 2023

SIGNED: 

NAME: Jon Trujillo

Appendix B

Black Rock Geothermal Project (23-AFC-03) Resumes

GeothermEx
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Email geothermexinfo@slb.com

JAMES LOVEKIN, PE

PRESENT POSITION

Manager of Field Operations

EXPERTISE

Mr. Lovekin has been actively involved in geothermal reservoir engineering and the economic evaluation of projects since 1985. His specialties include:

- Planning and execution of geothermal well tests
- Assessment of geothermal reserves and sustainable reservoir capacity
- Preparation and review of cash-flow models to evaluate project economics
- Budgeting and cost control for drilling and for monitoring reservoir performance
- Forecasting reservoir performance and estimating make-up drilling requirements
- Interpretation of well logs, pressure transient tests, tracer tests, and geochemical trends
- Design and supervision of well workovers
- Prevention of scale in geothermal wells and surface facilities
- Selection of optimal injection strategies for geothermal fields

EDUCATION

Engineer's Degree in Petroleum Engineering, Stanford University, 1987

B.S. in Geological Engineering, University of Nevada, Reno, 1980

B.A. in American Studies, Amherst College, Amherst, Massachusetts, 1977

Fluent in French; speaks and reads Spanish; and reads Russian

Mr. Lovekin is a Registered Professional Engineer in Petroleum Engineering in the State of California (Certificate Number 1594)

EXPERIENCE

Manager of Field Operations, GeothermEx, Inc., 1996 - present

As GeothermEx's Manager of Field Operations, Mr. Lovekin is responsible for:

- planning field development
- assessing well capacities
- monitoring reservoir performance
- evaluating cash-flow models and budgets for drilling and field operations

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Mr. Lovekin has undertaken these types of analyses at numerous geothermal fields in the United States, Indonesia, the Philippines, Kenya, and Central America.

Selected projects include:

- Resource assessment, economic model review, lenders' resource consultant services, well test analysis, and advice on development strategy for Supreme Energy (Muara Laboh and Rantau Dedap projects in Indonesia, 2012 to present.
- Project Manager of all GeothermEx projects undertaken for Ormat, including McGinness Hills, Tuscarora, Don Campbell, Tungsten Mountain, Bradys Hot Springs, Steamboat, Mammoth, East Mesa, North Valley, and Heber. This work has included resource assessment, review of financial models, reservoir management and optimization, injection management, due diligence for project financing, and specialized analyses to resolve specific operational issues. 2012 - present.
- Provision of technical analysis of geothermal development issues in Hawaii for the Department of Land and Natural Resources of the State of Hawaii, including advice on maintaining well integrity during the volcanic eruption of 2018 and plans to place the wells back in service, 2012 – present.
- Consulting services for resource assessment and well testing for several geothermal fields in Turkey, including the Yerka Mt. Ida project in Canakkale Province; the 3S Kale Incirliova project in Aydin Province; and the Sanko Caferbeyli project in Manisa province, 2016-present.
- Project manager for resource assessment and performance forecasting for the Roosevelt Hot Springs geothermal field. For PacifiCorp, 2013 - 2015.
- Assessment of business opportunities and recommendations for expansion of geothermal portfolio of a major U.S. electrical utility. For Black & Veatch Corporation, 2009 – 2010.
- Project Manager for resource assessment, economic review, well-test analysis, and due-diligence reporting for financing of the Hudson Ranch geothermal project in the Salton Sea. For EnergySource LLC, 2008-present.
- Evaluation of resource adequacy and business plans for geothermal projects in Nevada, in support of evaluations by regional electrical utility for formulation of power purchase agreements. For NV Energy, 2008 – 2011.
- Analysis of business plan, budget and revenue projections, and resource viability for the acquisition and expansion of the Stillwater geothermal project, Nevada. For Leucadia Corporation, 2001 – 2002.
- Development of ASTM standard definitions for geothermal reserves (1997-1998) and steam quality (2000-2001) as Chair of the Technical Standards Committee of the Geothermal Resources Council (now Geothermal Rising).

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- Assessment of power generation forecasts and of project financial projections for three geothermal projects operated by Calpine Corporation at The Geysers (Aidlin, Bear Canyon, and West Ford Flat), in support of refinancing for CIT Group/Newcourt Capital, 2000-2001.
- Analysis of the geothermal potential of the State of Hawaii, including economic evaluation of options for alternative uses of geothermal energy. For the Department of Business, Economic Development and Tourism of the State of Hawaii, 1999-2000.
- Assessment of sustainable capacity for electrical generation and mineral extraction at new plants in the Salton Sea geothermal field, including assessment of specialized operational requirements and analysis of budgets for drilling, operations and maintenance. For CalEnergy Company, 1999.
- Pre-feasibility studies for development of six geothermal projects in the Philippines. For US Geothermal Industries Corporation (USGIC) on behalf of US Department of Energy, 1998-1999.
- Evaluation and review of project economics, including assessment of drilling requirements and budgetary constraints, in four major Indonesian geothermal projects (Dieng, Patuha, Wayang Windu and Bali) totaling more than 300 MW. For Credit Suisse First Boston, 1996-1998.

CalEnergy Company, Inc., Ridgecrest, California, 1987 - 1996

As Director of Geothermal Resources (1991 - 1996), Mr. Lovekin:

- Managed reservoir engineering, geology, and drilling activities for CalEnergy's operating geothermal fields in the United States, listed with their MW ratings at the time: Coso (270 MW), Salton Sea (326 MW), Roosevelt Hot Springs (25 MW), and Desert Peak (9 MW).
- Supervised resource-related aspects of exploration, drilling, field assessment, and project economics for CalEnergy's geothermal projects under development, including Newberry Crater, Oregon; Glass Mountain (Medicine Lake), California; Dieng, Indonesia; and Patuha, Indonesia.
- Coordinated a program of relocating injection at Coso by drilling in-field wells to improve pressure support in the reservoir.
- Successfully negotiated an agreement between different partnership interests and royalty holders at Coso to permit exchanges of steam between lease areas, to provide greater flexibility in utilizing available steam and to minimize the drilling of make-up wells.

As District Reservoir Engineer of the Coso Geothermal Field (1987-1991), Mr. Lovekin:

- Directed reservoir engineering at the Coso Geothermal Field in Inyo County, California, during its first four years of commercial operations.
- Conducted flow tests of approximately 50 productive wells at Coso.

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- Established a reservoir monitoring program incorporating flow rate measurements, pressure and temperature surveys, geochemical sampling, and tracer studies.
- Made forecasts of make-up drilling requirements and participated in the site selection for new wells.
- Prepared reserve estimates and performed economic evaluations of Coso and other geothermal properties being considered for acquisition.

Production Engineer, Chevron USA, Inc., Ventura County, California, Summer 1986

- Estimated reserves for the Pliocene Gas Pool in the West Montalvo Field in Ventura County, California, and recommended a plan of depletion.

Engineering Assistant, Unocal Geothermal, Santa Rosa, California, Summer 1985

- Performed pressure-transient analysis and assisted in the construction of the annual isobaric map of The Geysers Geothermal Field.

Petroleum Engineer, Amoco Production Company, New Mexico and Texas, 1980 - 1984

- Worked with oil and gas fields in the Permian and Delaware basins, with the Bravo Dome Carbon Dioxide Gas Field in northeastern New Mexico, and with offshore oil operations in the Gulf of Suez.
- Evaluated water flooding projects for expansion, designed well simulations, analyzed well logs and pressure transient data, and estimated reserves.

Geologist, Amax Exploration, Inc., Colorado, Summer 1980

- Performed field work on a project to assess the geothermal potential of the Rio Grande Rift area of New Mexico.
- Measured geothermal gradient in water wells and took water samples from wells and hot springs.

MEMBERSHIPS AND ASSOCIATIONS

Geothermal Rising (formerly Geothermal Resources Council) - Member of the Board of Directors, 1993 – 2020

International Geothermal Association

Society of Petroleum Engineers

American Association of Petroleum Geologists

Association of Engineering Geologists

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PUBLICATIONS

Lovekin, J. W., Dagistan, O. F., Ari, C., Hoyt, T., and Romero, G., "Geothermal Applications of Electric Submersible Pumps (ESPs) in the USA and Turkey." World Geothermal Congress, Reykjavik, Iceland, May 2020 (publication deferred to 2021).

Lovekin, J. W., Görür, N., and Şile, H., "Case study of the 3S Kale Incirliova Geothermal Project, Aydın Province, Turkey." Geothermal Resources Council, Transactions, Vol. 43, pp. 133-138, 2019.

Hackett, L. B., Lovekin, J. W., and Aydın, M., "Exploration and Development of the Mt. Ida Geothermal Project, Çanakkale Province, Western Turkey." Geothermal Resources Council, Transactions, Vol. 42, pp. 881-887, 2018.

Lovekin, J. W., Morrison, M., Champneys, G., and Morrow, J. W., "Temperature recovery after long-term injection: case history from Soda Lake, Nevada." Geothermal Resources Council, Transactions, Vol. 41, pp. 2770-2779, 2017.

Lovekin, J. W., Delwiche, B., and Spielman, P., "McGinness Hills – case study of a successful expansion," Geothermal Resources Council, Transactions, Vol. 40, pp. 67-71, 2016.

Chabora, E. R., Lovekin, J. W., Spielman, P., and Krieger, Z., "Resource Performance at Ormat's Tuscarora Geothermal Project, Nevada USA," Proceedings, World Geothermal Congress, 8 pages, 2015.

Orenstein, R., Delwiche, B., and Lovekin, J. W., "The Don A. Campbell geothermal project – development of a low-temperature resource," Proceedings, World Geothermal Congress, 6 pages, 2015.

Lovekin, J. W., and Pletka, R., "Geothermal assessment as part of California's Renewable Energy Transmission Initiative (RETI)," Geothermal Resources Council, Transactions, Vol. 33, pp. 1,013-1,018, 2009.

Lovekin, J. W., Sanyal, S. K., Sener, A. C., Tiangco, T., and Gutiérrez-Santana, P., "Potential improvements to existing geothermal facilities in California," Geothermal Resources Council, Transactions, Vol. 30, pp. 885-890, 2006.

Lovekin, J. W., Henneberger, R. C., and Sanyal, S. K., "Energy reserves and costs of geothermal resources in Hawaii," Geothermal Resources Council, Transactions, Vol. 30, pp. 891-895, 2006.

Sanyal, S, K., Klein, C. W., Lovekin, J. W., and Henneberger, R. C., "National assessment of U.S. geothermal resources – a perspective," Geothermal Resources Council, Transactions, Vol. 28, pp. 355-362, 2004.

Klein, C. W., Lovekin, J. W., and Sanyal, S. K., "New geothermal site identification and qualification." Consultant report for California Energy Commission, Publication No. P500-04-051, April 2004. Report and accompanying PIER Geothermal Database available on the web at: http://www.energy.ca.gov/pier/final_project_reports/500-04-051.html.

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Sabin, A. E., Unruh, J. R., Walker, J. D., Monastero, F. W., Lovekin, J. W., Robertson-Tait, A., Ross, H., Sorensen, M., Leong, R., Holte, C. T., Amos, C., and Blackwell, D., "Geothermal energy resource assessment on military lands," Proceedings of the Twenty-ninth Workshop on Geothermal Reservoir Engineering, Stanford Geothermal Program, pp. 42-51, 2004.

Sanyal, S. K., Lovekin, J. W., Henneberger, R. C., Robertson-Tait, A., Brown, P. J., Morris, C. L., Schochet, D., "Injection testing for an enhanced geothermal system project at Desert Peak, Nevada", Geothermal Resources Council, Transactions, Vol. 27, pp. 885-891, 2003.

Butler, S. J., Sanyal, S. K., Robertson-Tait, A., Lovekin, J. W., and Benoit, D., "A case history of numerical modeling of a fault-controlled geothermal system at Beowawe, Nevada," Proceedings of the Twenty-sixth Workshop on Geothermal Reservoir Engineering, Stanford Geothermal Program, pp. 35-40, 2001.

Robertson-Tait, A. and Lovekin, J. W., "Potential sites and experiments for enhanced geothermal systems in the western United States," Geothermal Resources Council Transactions, Vol. 24, pp. 169-174, 2000.

Sanyal, S. K., Robertson-Tait, A., Klein, C. W., Butler, S. J., Lovekin, J. W., Brown, P. J., Sudarman, S., and Sulaiman, S., "Assessment of steam supply for the expansion of generation capacity from 140 to 200 MW, Kamojang Geothermal Field, West Java, Indonesia," Geothermal Resources Council Transactions, Vol. 24, pp. 571-578, 2000.

Lovekin, J. W., "The economics of sustainable geothermal development," Geothermal Resource Council Transactions, Vol. 24, pp. 113-118, 2000.

Lovekin, J. W., "Sustainable geothermal power: the life cycle of a geothermal field," Geothermal Resource Council Transactions, Vol. 22, pp. 515-519, 1998.

Hirtz, P., and Lovekin, J. W., "Tracer dilution measurements for two-phase geothermal production: comparative testing and operating experience," Geothermal Resource Council Transactions, Vol.19, pp. 563-568, 1995.

Hirtz, P., Lovekin, J. W., Copp, J. F., Buck, C., and Adams, M.C., "Enthalpy and mass flowrate measurements for two-phase geothermal production by tracer dilution techniques," Proceedings of the Eighteenth Workshop on Geothermal Reservoir Engineering, Stanford Geothermal Program, pp. 17-27, 1993.

Lovekin, J. W., "Control of calcium carbonate scale using concentric tubing at Coso geothermal field," Geothermal Resource Council Transactions, Vol.14, Part 2, pp. 1611-1617, 1990.

Lovekin, J. W., "Correlation of rig test and James tube tests in the Coso geothermal field," Proceedings of the Fifteenth Workshop on Geothermal Reservoir Engineering, Stanford Geothermal Program, pp. 167-172, 1990.

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Lovekin, J. W., and Horne, R. N., "Optimization of injection scheduling in geothermal fields," Geothermal Resources Council Transactions, Vol.11, pp. 607-614, 1987.

SELECTED COURSES PRESENTED

2012 Resource Management Techniques to Optimize Geothermal Power Projects. 4th African Rift Geothermal Conference (ARGEO), Nairobi, Kenya, 22 November 2012.

2011 Reservoir Engineering: Well Testing and Numerical Simulation. Geothermal Resources Council Workshop on Introduction to Geothermal Exploration, San Diego, California, 22 October 2011.

2010 Reservoir Engineering I: Well Testing. Geothermal Resources Council Workshop, Sacramento, California, 22 October 2010.

2009 Planning, Development and Operations. Geothermal Resource Council Workshop on "Getting More Geothermal Projects Online," 3 October 2009.

2009 Geothermal Exploration – Siting Wells for Production and Injection. Geothermal Resources Council "Geo 101" Workshop, Reno, Nevada, 2 October 2009.

2008 Reservoir Development Strategy: Siting Wells for Production and Injection. Geothermal Resources Council Workshop on Geothermal Reservoir Evaluation, Reno, Nevada, 4 October 2008.

2003 Reservoir Engineering. Geothermal Resources Council Workshop on Geothermal Project Development, Los Azufres, Mexico. 10 October 2003.

2003 Well Testing. Geothermal Resources Council Workshop on Geothermal Project Development, Los Azufres, Mexico. 9 October 2003.

HONORS AND AWARDS

2021 President's Aidlin Award for services to Geothermal Rising. Presented at the Geothermal Rising Conference (GRC), San Diego, California, 6 October 2021.

2017 Best Paper Award in the session on Reservoir Engineering / Reservoir Management / Modeling 2, Geothermal Resources Council Annual Meeting, 4 October 2017.

2009 Geothermal Special Achievement Award from the Geothermal Resources Council. "For outstanding achievements in the fields of geothermal reservoir evaluation and geothermal resource assessment."

CITIZENSHIP

United States

Jerry Salamy

Principal Project Manager

Education

B.A., Chemistry, Holy Names College, Oakland

Relevant Experience

Mr. Salamy has over 30 years of experience, including assignments as Project Manager for numerous Applications for Certification (AFC) before the California Energy Commission (CEC). Mr. Salamy has also been the Deputy Project Manager or Technical Lead on an additional AFCs. He has assisted clients in satisfying the CEC construction compliance requirements for numerous projects, has prepared over 30 petitions to amend CEC licenses, and has prepared and provided expert witness testimony in CEC hearings

Representative Projects

Geothermal Power Plants

Terra-Gen Power, Dixie Meadows and Coyote Canyon Exploration and Utilization Environmental Assessments, Churchill County, Nevada. Managed the preparation of technical studies to support the preparation of an exploration Environmental Assessment (EA) for Terra-Gen's Dixie Meadows and Coyote Canyon geothermal power plant geothermal exploration drilling efforts. Technical studies prepared by CH2M HILL included biological, cultural, paleontological, and wetlands. These studies formed the basis of the exploration EA CH2M HILL prepared and transmitted to Bureau of Land Management's Carson City Field Office for publication. In addition to the exploration EA, Mr. Salamy managed the preparation of a utilization EA to support the operation of the Coyote Canyon site. In addition to utilization EA, CH2M HILL also prepared a Churchill County Special Use Permit (SUP) Application for the operation of the Coyote Canyon Geothermal Power Plant. CH2M HILL also represented the project before the Churchill County Planning Commission in support of the SUP. CH2M HILL also prepared sections of the Utility Environmental Protection Act (UEPA) permit pertaining to environmental impacts of the project for submittal to the Nevada Public Utilities Commission.

Application for Certification, Salton Sea Unit 6 Geothermal Power Plant, Mid American Energy Holding Company, Imperial County, CA. Mr. Salamy managed the licensing of a 185-MW geothermal power plant in Imperial County, California. The power plant design was based on the flash geothermal power plant process, which produces both solid and liquid byproducts (brine cake and spent brine) that required disposal. The project site was located in a rural area of Imperial County, but was adjacent to a National Wildlife Refuge that supports significant populations of avian species. The licensing process involved the review of all environmental areas,

specifically focused on waste disposal, air quality, hazardous materials handling, and biological resources. Mr. Salamy managed preparation of over 500 data responses to requests submitted by the State and the public. The project was successfully completed, with a license issued by the California Energy Commission.

In addition to the power plant license, a Biological Assessment (BA) was submitted to United States Fish and Wildlife Service for the Section 7 consultation due to potential wildlife impacts. The primary wildlife species addressed in the BA were Yuma Clapper rails, Burrowing Owls, Mountain Plover, and California Brown Pelicans. Extensive Yuma Clapper rail protocol surveys were performed to support the BA development and subsequent compliance with the Biological Opinion.

Project components required the fill of a small portion of the Salton Sea and several ephemeral streams associated with the 31 mile transmission lines. These fill activities required the preparation of a Bureau of Land Management (BLM) Plan of Development and wetland delineations that were submitted to the Corp of Engineers in support of the Section 404 permit applications and California Department of Fish and Wildlife Section (CDFW) 1600 Lake and Streambed Alteration permit.

Mr. Salamy also prepared an amendment to the California Energy Commission license to allow for the generation of an additional 35 megawatts of electricity through increased geothermal fluid extraction combined with the use of an organic rankin cycle (ORC) system. The ORC was designed to use waste heat from the geothermal fluid after passing though the steam generation portion of the binary type geothermal process. The modification to the project required CH2M HILL to complete the reanalysis of the impacts to all environmental areas. The amendment was approved by the Energy Commission.

Calpine Geysers Application for Certification Amendment, Calpine Corp., Middleton, California. Managed the preparation of license amendments for six Geyser Power Plant projects to allow for the use of recycled water on the project sites. The license amendment included the analysis of air quality, biological, cultural, paleontological, land use, noise, visual resources, and traffic and transportation impacts. The project required the preparation of a Title 22 Engineer's Report and is being granted approval from two Regional Water Quality Control Boards and the State Department of Health Services.

Thermal Power Plants

Compliance Support, Colusa Generating Station, Pacific Gas and Electric Company, Maxwell, California. Mr. Salamy managed the licensing of the Colusa Generating Station, a 660 megawatt natural gas fired power plant, located adjacent to Pacific Gas and Electric Company's (PG&E) Delevan Compressor Station, in Colusa County. The project required the preparation of a California Energy Commission Application for Certification license application and numerous permit applications. Mr. Salamy also managed the preparation of a Biological Assessment supporting the Section 7

consultation for upland species impacts. In addition, the project required the preparation of a Corp of Engineers Section 404 and a CDFW Section 1600 lake and streambed alteration applications required due to the wetland impacts associated with the construction of a bridge.

Mr. Salamy also assisted PG&E in the development and implementation of construction compliance support documentation for biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an operational Storm Water Pollution Prevention Plan. Mr. Salamy continues to provide ongoing operational support for ongoing biological resources monitoring and hazardous materials management plan updates.

Compliance Support, Gateway Generating Station, Pacific Gas and Electric Company, Antioch, California. Managed the development and implementation of compliance support documentation for biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an operational Storm Water Pollution Prevention Plan.

Program Manager and Air Quality Lead; Application for Certification; Alamitos Energy Center; AES Southland Development LLC; Long Beach, CA. Planned and executed the preparation of an AFC for a 1,040-MW repower of the existing Alamitos Beach Generating Station located within the coastal zone of Long Beach, CA. The project required the preparation of numerous studies and a Prevention of Significant Deterioration (PSD) permit application submitted to the South Coast Air Quality Management District. The AFC was required to demonstrate conformance with the City of Long Beach's Local Coastal Program. The Coastal Commission has been consulted by the CEC and has indicated they are not expecting to comment of the CEC's license for the project. The CEC issued the final decision for the project in May 2017.

Program Manager and Air Quality Lead; Application for Certification; Redondo Beach Energy Project; AES Southland Development LLC; Redondo Beach, CA. Managed the preparation of the air quality section of an AFC for a 546-MW combined cycle repower of the existing Redondo Beach Generating Station. The project required the preparation of numerous studies and a Prevention of Significant Deterioration (PSD) permit application submitted to the South Coast Air Quality Management District. Air permitting required extensive document preparation to demonstrate the project was employing the Best Available Control Technology to control greenhouse gas emissions. The project was actively opposed by several public groups and the City of Redondo Beach. Project permitting was suspended until a Power Purchase Agreement can be secured from the electric utility through the Request for Offer process.

Program Manager and Air Quality Lead; Application for Certification; Huntington Beach Energy Project; AES Southland Development LLC; Huntington Beach, CA. Planned and executed the preparation of the AFC for a 840-MW repower of the existing Huntington Beach Generating Station located within the coastal zone of Huntington Beach, CA. The AFC was required to demonstrate conformance with the City of

Huntington Beach's Local Coastal Program (LCP). The Coastal Commission issued a report to the CEC defining areas where, in its opinion, the project did not conform to the LCP requirements. Mr. Salamy mobilized a team to prepare a rebuttal to the Coastal Commission's assertions, which was adopted by the CEC in its license.

The CEC issued the final decision for the project in May 2017.

Application for Certification for three Natural Gas-fired Energy Facilities, co-located at PG&E's San Mateo, Scott, and Martin substations, San Mateo, California. Managed the preparation of three Applications for Certification on expedited licensing schedule enacted by gubernatorial executive order. Mr. Salamy was responsible for proposal, costing, scheduling, team management and direction, as well as project execution within the three week AFC preparation timeline. Mr. Salamy authored the project description, air quality, and alternative sections of all three Applications for Certification. In addition, Mr. Salamy prepared three air permits for submittal to the Bay Area Air Quality Management District.

Construction Compliance Support, Canyon Power Plant, Southern California Public Power Authority, Anaheim, California. Managed the development and implementation of compliance support documentation for biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an operational Storm Water Pollution Prevention Plan. Developed a construction fugitive dust monitoring program to mitigate construction impacts to nearby businesses.

Application for Certification, South Bay Replacement Project, LS Power South Bay, LLC, Chula Vista, CA. Mr. Salamy was the deputy project manager for the development of an AFC to develop a natural-gas-fired, combined-cycle power plant located at Port of San Diego. The South Bay Replacement project will replace the existing South Bay Power Plant. The AFC included the demolition of the existing South Bay Power Plant and Mr. Salamy was responsible for soliciting bids and preparing a summary of the potential environmental impacts associated with the demolition of the existing power plant. The project was located in the coastal zone and would have normally required a Coastal Development Permit (CDP), but for the California Energy Commission's exclusive jurisdiction where they incorporate CDP conditions into the license. To support the CEC's development of CDP conditions, Mr. Salamy managed the preparation of an analysis demonstrating the project's conformance with the Coastal Act requirements.

Air Quality Lead, Application for Certification, Mariposa Energy Project, Diamond Generating Corporation, Tracy, CA. Managed the preparation of the air quality section of an AFC for a 200-MW peaking power plant near Tracy, CA. The project required the preparation of numerous other studies and a permit application submitted to the Bay Area Air Quality Management District. Air permitting required extensive document preparation to demonstrate the project was employing the Best Available Control Technology to control air emissions. The project was highly contested with a significant level of public involvement.

Application for Certification, Sutter Power Plant, Calpine Corp., Yuba City, California. Managed the preparation of the air quality section of the Sutter Power Plant AFC. The air quality analysis required the preparation of an environmental setting for the project site, a criteria and toxic pollutant emission inventory, a Best Available Control Technology analysis, and air dispersion modeling. These analyses were used to support the preparation of Prevention of Significant Deterioration and New Source Review permit applications. These applications were submitted to the U.S. EPA Region IX office and the Feather River Air Quality Management District for the issuance of a construction permits. The scope of work also required the identification of emission reduction credits (ERCs) to support the New Source Review permitting process. Mr. Salamy was instrumental in locating and negotiating for the purchase of the ERCs necessary for the siting of the Sutter Power Plant.

Application for Certification and Construction Compliance Support, Los Esteros Critical Energy Facility, Calpine C*Power, San Jose, California. Managed the preparation of the AFC for a 180-MW power plant in San Jose. The project required the preparation of numerous other studies/documents to satisfy CEC staff requests. These studies/documents included the preparation of a General Plan amendment and planned development zoning applications, archaeological and paleontological survey reports, and biological resource protection permits, including a CDFW Section 1600 lake and streambed Alteration application, a Corp of Engineers Section 404 application, and Regional Water Quality Control Board Section 401 application.

Mr. Salamy also managed the development and implementation of biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an electromagnetic force evaluation for project construction.

Application for Certification, East Altamont Energy Center, Calpine Corp., Tracy, California. Managed the preparation of the East Altamont Energy Center AFC for a 1,100-MW power plant in Tracy. Mr. Salamy also prepared the alternative site and generating technologies analyses, ammonia risk assessments, and provided general licensing support. This project included a 4 mile transmission line to interconnect the project to the Western Tracy Substation.

Application for Certification, Metcalf Energy Center, Calpine Corp., San Jose, California. Assisted in the management of the preparation of the Metcalf Energy Center AFC. Mr. Salamy was responsible for the development and tracking of data response submittals requested by the CEC. Mr. Salamy also authored data responses for hazardous materials management.

Application for Certification and Construction Compliance Support, Delta Energy Center, Calpine Corp., Pittsburg, California. Managed the preparation of the Delta Energy Center AFC for an 880-MW power plant in Pittsburg. The project included a 3-mile, 230 kilovolt (kV) transmission line (both above ground and underground), a 5-mile natural gas pipeline, and a short recycled water supply pipeline. The natural gas

pipeline traversed a wetland and required the preparation of a Biological Assessment supporting the Section 7 consultation, a Corp of Engineers Section 404, and a CDFW Section 1600 lake and streambed alteration applications.

Mr. Salamy also managed the development and implementation of biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an electromagnetic force evaluation for project construction. Portions of the natural gas pipeline required the use of horizontal directional drilling and Mr. Salamy managed the development of a Frack-Out Plan for incorporation into the Biological Resources Mitigation Implementation and Monitoring Plan. During construction of the gas pipeline, a frack-out occurred requiring the implementation of the Frack-Out Plan to avoid impacts to the wetlands and the endangered Saltwater harvest mouse.

Construction Compliance Support for Linear Facilities, Los Medanos Energy Center, Calpine Corp., Pittsburg, California. Managed the development and implementation of compliance support documentation for biological, cultural, and paleontological resource monitoring programs; risk management plan; traffic and transportation management plan; waste reduction program; and an electromagnetic force evaluation for the project construction.

Critical Issues Assessment for 5 Solar Sites in Western US, Iberdrola Renewables. Managed the preparation of critical issues reports for 5 sites located on federal lands managed by the Bureau of Land Management (BLM) in California, Nevada, Arizona and New Mexico. The purpose of the Critical Issues Assessment (CIA) was to identify fatal environmental flaws with the selected sites. The CIA entailed reviewing applicable plans, conducting literature searches and field reconnaissance visits, development of water supply strategies, and development of surface hydrology estimates. A CIA was developed for each of the 5 sites and provided recommendations for additional studies where applicable.

MID Electric Generation Station (MEGS), Modesto Irrigation District, Ripon, California. Assistant project manager for the SPPE to license a nominal 95-MW natural-gas-fired, simple-cycle generating facility consisting of two natural-gas-fired combustion turbines with approximately 0.25 mile of new 69-kV power line and fiber optic cable; 0.25 mile of new 8-inch diameter natural gas pipeline; and water supply and wastewater tap lines into City of Ripon lines in Stockton Avenue. The project would occupy 8 acres within a 12.25-acre parcel. This plant had noise and land use issues to resolve. Plant is nearing completion of construction.

San Joaquin Valley Energy Center, Calpine Corp, San Joaquin County, , California. Prepared the ammonia risk analysis in support of the licensing of a 1,060-MW combined-cycle merchant plant to be located in the city of San Joaquin.

Cosumnes Power Plant, SMUD, Wilton, California. Prepared the ammonia risk assessment and assisted in responding to numerous data request for a 1,000-MW combined-cycle power plant on buffer lands for the former Rancho Seco Nuclear Plant.

Also managed the identification of emission reduction credits in support of the facility licensing effort.

Walnut Energy Center, Turlock Irrigation District, Turlock, California. Assistant project manager for the licensing of this 250-MW combined-cycle generating facility configured using two natural-gas-fired combustion turbines and one steam turbine. Managed the ammonia risk assessment, preparing a detailed analysis showing the probability of and potential effects of an accidental release on nearby residential receptors. Also assisted in responding to numerous hazardous materials handling issues.

Highgrove Generating Station, AES Pacific, Highgrove, California. Prepared the air quality permits and Application for Certification for 300 megawatt (MW) peaking facility consisting of three natural-gas-fired turbines and associated equipment. The project will employ General Electric's LMS100 combustion turbine generators (CTG) that integrate new technology to increase the combustion turbine's efficiency above existing turbine technologies.

Vernon Power Plant, City of Vernon, California. Prepared the air quality permit and Application for Certification for 913 megawatt (MW) base load facility consisting of three natural-gas-fired turbines and heat recovery steam generators, one steam turbine, and associated equipment. The project will employ Siemen combustion turbine generators (CTG) that integrate new "fast start" technology to decrease the combustion turbine's start up duration and air emissions.

HOSSEIN SHAMSHIRI
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Hossein Shamshiri holds a master's degree in petroleum engineering from Texas A&M University and has 12 years of experience in reservoir engineering, with most of his experience in the Geothermal Industry. Mr. Shamshiri has a keen understanding of the challenges and opportunities in the geothermal industry and has developed an extensive set of personal and professional relationships at all levels within the industry. His areas of expertise include:

- Resource adequacy studies,
- Project management,
- Financial modeling of geothermal wellfield for project development and maintenance purposes
- Reservoir modeling and simulation,
- Wellbore modeling,
- Geothermal resource assessment,
- Wellfield maintenance planning and budgeting,
- Wellbore integrity assessment,

In addition to his strong reservoir engineering and project management background, Mr. Shamshiri has gained experience and knowledge in other aspects of geothermal projects including drilling and plant operations which has gained him a multi-disciplinary knowledge of the geothermal projects. Ms. Shamshiri is currently the president, principal reservoir engineering, and project manager at Geo Resource Management.

EDUCATION

Master of Science
Texas A&M University
Petroleum Engineering Department

Bachelor of Science
Petroleum University of Technology
Petroleum Engineering Department

PROFESSIONAL EXPERIENCE

2009-2011	Reservoir engineering research assistant – Texas A&M University
2012	Reservoir engineer – Occidental Petroleum Corporation

2012-2016 Senior reservoir engineer – Berkshire Hathaway Energy Geothermal

- Salton Sea Geothermal Field

2016-2017 Senior reservoir engineer – Terra-gen Operating Company

- Coso Geothermal Field
- Dixie Valley Geothermal Field
- Beowawe Geothermal Field

2017-Present Principal reservoir engineer, and project manager – Geo Resource Management

- Salton Sea Geothermal Field

SELECT GEOTHERMAL INDUSTRY-RELATED EXPERTISE

- Reservoir modeling and simulation
- Wellbore modeling
- Integrated reservoir modeling, wellbore modeling, and process modeling
- Financial modeling of geothermal wellfield for project development and maintenance purposes
- Wellfield monitoring and evaluation
- Project management, budgeting, and planning
- Resource assessment, feasibility studies, and project development
- Design and Evaluation of Diagnostic and Monitoring Surveys
- Wellbore Integrity Assessment

Reservoir Modeling and Simulation

Reservoir models integrate all the resource-related data for a geothermal field including geological data, operational data, and fluid properties. Therefore, a reservoir model is a robust tool for understanding the behavior of a geothermal resource and predicting its performance. This includes the performance of the reservoir as it relates to energy and mineral extraction. Mr. Shamshiri utilizes state-of-the-art reservoir simulation software and has developed robust tools and algorithms for reservoir modeling projects over the years. Some of the major tasks related to his reservoir modeling expertise are as follows:

- Developing Reservoir Models
- History Matching (Model Calibration)
  History matching is the process of improving the reservoir model to match the measured data. These data include reservoir pressure, enthalpy, and mineral concentrations. This is a critical task in reservoir modeling to ensure that the reservoir model is calibrated.
- Model Updating
  Model updating is required to improve the accuracy of simulation results and long-term

prediction of reservoir conditions. This is achieved by updating reservoir models with new injection and production data along with any updates to the conceptual model.

- Forecasting
  Once the reservoir model is calibrated, reservoir simulation is performed to predict reservoir conditions under various operating scenarios. The forecasting process is utilized to understand future reservoir conditions, assess the adequacy of the resource for different operational conditions, and to evaluate development projects.
- Resource Adequacy and Assessment
  Resource and well-related data together with advanced modeling techniques are utilized to assess the geothermal resource and determine the energy or mineral extraction level at which the project is economically sustainable.
- Mineral Extracting Modeling
  This is utilized to simulate and forecast the production of different types of minerals from geothermal brine.

Wellbore Modeling

Mr. Shamshiri has extensive experience in projects involving wellbore modeling. Wellbore modeling is an effective tool to simulate and evaluate the performance of injection and production wells. It integrates reservoir conditions, wellbore geometry, and injection and production data to simulate well performance. Wellbore modeling could be utilized to evaluate the past performance of the wells and the effectiveness of the workovers performed. It could also be utilized as a decision-making tool by modeling the well performance under different wellbore completion scenarios.

Integrated Reservoir, Wellbore and Process Modeling

A geothermal power generation system consists of the geothermal reservoir, the wells (injection and production), and the power plant facility. Integrated modeling of these components is necessary in order to accurately assess a geothermal project as a whole. Mr. Shamshiri has extensive experience in reservoir and wellbore modeling and integrating the results with process flow modeling.

Financial modeling of geothermal wellfield for project development and maintenance purposes

Developing a wellfield financial model starts with forecasting wellfield (injection and production) performance. The forecast wellfield performance will then be utilized to plan for various remedial well works to maintain the required injection and production capacities. The financial model will include the timing and cost associated with all the remedial works. Mr. Shamshiri has developed and maintained several financial models for wellfield development and maintenance including multiple projects at Salton Geothermal Field over the past 11 years.

Wellfield Monitoring and Evaluation

Various factors, such as wellbore scaling, can cause capacity decline in injection and production wells. Mr. Shamshiri utilizes innovative methodologies to evaluate, monitor and forecast the performance of the wells and design remedial works to retrieve their capacity.

Project Management, Budgeting and Planning

Wellfield and resource management of a geothermal project is a very critical task to ensure continuous and reliable power generation. Maintaining the wellfield is usually expensive due to the high cost of wellfield maintenance projects (drilling rig and non-drilling rig remedial works) and, therefore, requires effective planning and budgeting. Mr. Shamshiri has extensive experience in the evaluation of wellfield performance and preparing short-term and long-term plans for wellfield maintenance and project management with the goal to maintain wellfield performance at the demand level required for full power generation.

Resource Assessment, Feasibility Studies and Project Development

Mr. Shamshiri utilizes feasibility studies and what-if analysis to provide packaged results to the development teams. Evaluating the past performance of resource and wellfield, analyzing surveys, reservoir and wellbore modeling and economic evaluations are all performed as part of this task. He evaluates the productivity and strength of the geothermal resource and informs the development team of the risks and costs involved in developing a new project or expanding an existing one.

Design and Evaluation of Diagnostic and Monitoring Surveys

Surveys are effective tools for characterizing a geothermal reservoir and evaluation of well performance. Mr. Shamshiri provides expert advice on the design and analysis of these surveys. Below are some examples of these surveys:

- Reservoir Tracer Testing
  Reservoir tracer testing is utilized to evaluate the connectivity of the injection and production wells and to optimize the operation of the wellfield. The tracer test results are also utilized in the history-matching process of reservoir modeling.
- Pressure-Temperature Surveys
  These surveys are frequently utilized in the geothermal industry to characterize the wells and reservoir. Analyzing and interpreting the survey data are the key to gathering meaningful results.
- Nitrogen Pressure tests
  Pressure tests could be designed to investigate the casing integrity of injection and production wells. The pressure tests could show the severity and location of any casing failure.
- Caliper surveys
  These surveys are also utilized to investigate casing integrity, the remaining wall thickness

of the casing, and any flow restrictions in the cased portion of the wells.

- Radioactive Tracer Testing
  Radioactive tracer testing is utilized to investigate the integrity of the production casing in injection wells by injecting a radioactive tracer and logging the wellbore for high radiation (in excess of the background radiation) for possible casing holes or casing shoe damage.
- Spinner Survey
  Spinner surveys are widely utilized to:
  - Characterize the flow of injection and production wells
  - Detect casing damage or flow restrictions

Wellbore Integrity Assessment

Wells are a significant part of the cost of geothermal projects and a required asset to maintain operation and generation. The tangible well assets are the upper-cased portion of the wells. The cased and cemented portion of the well need to be protected from the corrosive geothermal fluids that pass through it. Pressure tests and casing evaluation logs are the only methods of evaluating the integrity of the down-hole casing. Mr. Shamshiri has extensive experience in designing and interpreting these tests and advising operators on risks and appropriate remedial work**.**

SOFTWARE SKILLS

TETRAD, PETRASIM, WELLSIM, ECLIPSE, MATLAB, RIMBASE, CMG, MICROSOFT PACKAGE, etc.

SELECTED PUBLICATIONS

Conference Papers

Shamshiri H., Jafarpour B. Optimization of Aquifer Storage Performance through Improved Sweep Efficiency in Geologic CO2-Storage Systems, SPE-139643, SPE International Conference on CO2 Capture, Storage, & Utilization, 10-12 November 2010, New Orleans, Louisiana

Journal Papers

Shamshiri, H., and B. Jafarpour (2012), Controlled CO2 injection into heterogeneous geologic formations for improved solubility and residual trapping, Water Resource. Res., 48, W02530, doi:10.1029/2011WR010455.

Jon W. Trujillo

General Manager, Geothermal Development

Jon has 19 years of professional experience developing, managing and exploring for geologic resources. His focus for has been on geothermal operations and development for the last 14 years, including the management of people, projects and finances.

Relevant Experience

BHE Renewables, LLC. **2021 – Present**

GM, Geothermal Development *Calipatria, CA*

Leading the design, development, permitting and energy marketing of three geothermal power facilities (401 MW) in the Salton Sea Geothermal Reservoir of Imperial Valley with the support of senior employees, subject matter experts, and consultants.

Geothermal Rising (GR) **2017 – Present**

Board President / Board Member / Board Advisor

GR is a non-profit international association for geothermal professionals with over 1,300 members. GR supports advancement of the global geothermal community through the transfer of knowledge and public advocacy.

BHE Renewables **2017 – 2021**

Geothermal Resource Manager *Calipatria, CA*

Managed drilling, resource and landfill operations for four geothermal facilities (345 MW), including 19 staff and budgets of $20-70m annually. The team focuses on safe drilling operations, compliance adherence, well performance and maintenance, resource management, and daily hauling of geothermal filter cake. Representative for tours and media.

BHE Renewables / CalEnergy Operating Corp. **2009 – 2017**

Senior Geoscientist & Geochemist *Calipatria, CA*

Resource management and optimization for geothermal operations. Targeted & directionally drilled 15 wells with a summed flow capacity of 76,000 gpm. Development support and resource estimation for a planned 235 MW geothermal expansion project. Regulatory liaison and developed a site specific GHG model that was approved by CARB. Discovered ore-grade silver within plant waste stream. Implemented a GIS server that merged 3D datasets and geochemical databases. Doubled the acquisition rate of the tracer flow testing program.

War Eagle Mining Company **2006 – 2009**

Project Geologist *Chihuahua, Mexico & Tucson, AZ*

Mineral exploration and development in rural Chihuahua, Mexico, including a two rig (9,000 meters) drilling program. Targeted a discovery hole and developed two additional mineralized zones. Supervised 19 staff. Provided technical support in board meetings and fund raising ($4.3m). Company representative in media campaign. Expedited drilling equipment from Mexican and U.S. suppliers. Brokered sale of $250k in equipment.

HydroGeophysics Inc. **2006**

Geologist *Denver, CO & Tucson, AZ*

Acquisition, coordination & interpretation of 2D and 3D geophysical surveys, including resistivity, induced polarization, electro-magnetics and gravity. Developed fluid migration monitoring system using resistivity for enhanced oil recovery reservoirs.

RockWare Inc. **2004 – 2005**

Geologist & Business Development Manager *Golden, CO*

Geologic, GIS and CAD software sales, consulting and client specific training. Increased GIS sales by 25%.

Education

Harvard University Extension School: graduate course work – Organizational Behavior (2015), Financial Accounting Principles (2014), Principles of Finance (2010)

Virginia Polytechnic Institute and State University: pursued a Master of Sciences in Geosciences (2002 – 2004) and managed a radiogenic isotope laboratory

University of Missouri – Rolla: Bachelor of Science in Geology & Geophysics (1998 – 2002)