Surprise Valley Electrification Corp.

Recovery Act: Rural Cooperative Geothermal Development Electric & Agriculture
DE-EE0003006

Final Scientific Report

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Executive Summary
In late 2008 the Colahan Ranch approached Surprise Valley Electrification Corp. (SVEC) about developing the geothermal resource on their ranch for power production. The Colahan's had discovered the resource in 1980 when drilling a well for supplemental irrigation water. The temperature of the water from this well is 235 degree F. For 30 years the Colahan Ranch has used the water for irrigation, first pumping it into a cooling pond, then out to their irrigation pivots for alfalfa hay production.

In 2008 the Ranch completed a USDA funded feasibility assessment on the resource, which found it suitable for power production. The geochemistry of the water indicated the source temperature to be in the 250-300 degree F range. SVEC funded and conducted a flow test of the resource in February 2009, which indicated the reservoir capable of producing 2000 gpm and could support a power plant of 2-3 megawatts.

Surprise Valley Electric Corp's (SVEC) vision for developing this resource was based on our wholesale power agreement with Bonneville Power Administration (BPA) and BPA's notification that they were going to a two TIER rate structure and that they could not meet future load growth at the lower TIER 1 rates. It made sense to develop a renewable resource to help meet the projected load growth of our system over the next ten years or more and protect the cooperative membership from high cost market rates.

Several years ago, when this project was in its inception, electricity purchased at the TIER 2/market rate was projected to be much higher than the TIER 1 rate. As a slow growing rural electric cooperative at the time, it would be several years before our load growth would put us into TIER 2 rates. Our vision was to develop this geothermal resource, sell the generated electricity at market rates for several years, using the profits from these sales to pay down debt. Then, when SVEC needed to purchase TIER 2 power, take this generation to load at a lower value than purchasing power at market rates.

This was a good vision which became a difficult reality due to dramatic changes in the energy market. In the spring and summer of 2012, whole sale electricity markets dropped to historic lows, and demand for additional electric loads, including renewable energy, had diminished. At this time SVEC had developed and constructed two wells and had just signed a $7 million agreement for the purchase of a TAS Energy power plant. During late 2012 and 2013 the projected generation from this plant was being unsuccessfully solicited around the region. A number of options were looked into and discussed, but there was always the understanding that the generation could be sold, as a last resort, as a QF PURPA sale to PacifiCorp.

Since August 2013, SVEC has been negotiating with PacifiCorp (PAC) on a PURPA Power Purchase Agreement (PPA). Several drafts have gone back and forth between the parties, but difficult stipulations in the drafts have kept one or both parties from executing a PPA. In June 2015 SVEC filed a complaint with the Oregon Public Utility Commission claiming concerns with the delays in executing an agreement.

The lesson learned here is to get the generation sold prior to initiating construction. This seems like the normal and proper decision, but when this project was in planning stages and proposals were made and accepted by US DOE for this grant and Oregon DOE for the BETC program, grant requirements and deadlines began to push and direct the project decision making.

We have had a very difficult time getting the generation sold in the current electric market environment. I believe the prior SVEC management believed renewable, green energy would sell itself and therefore, selling the generation was not a priority, but instead meeting grant and program requirements and deadlines pushed the development of the resource as the priority.

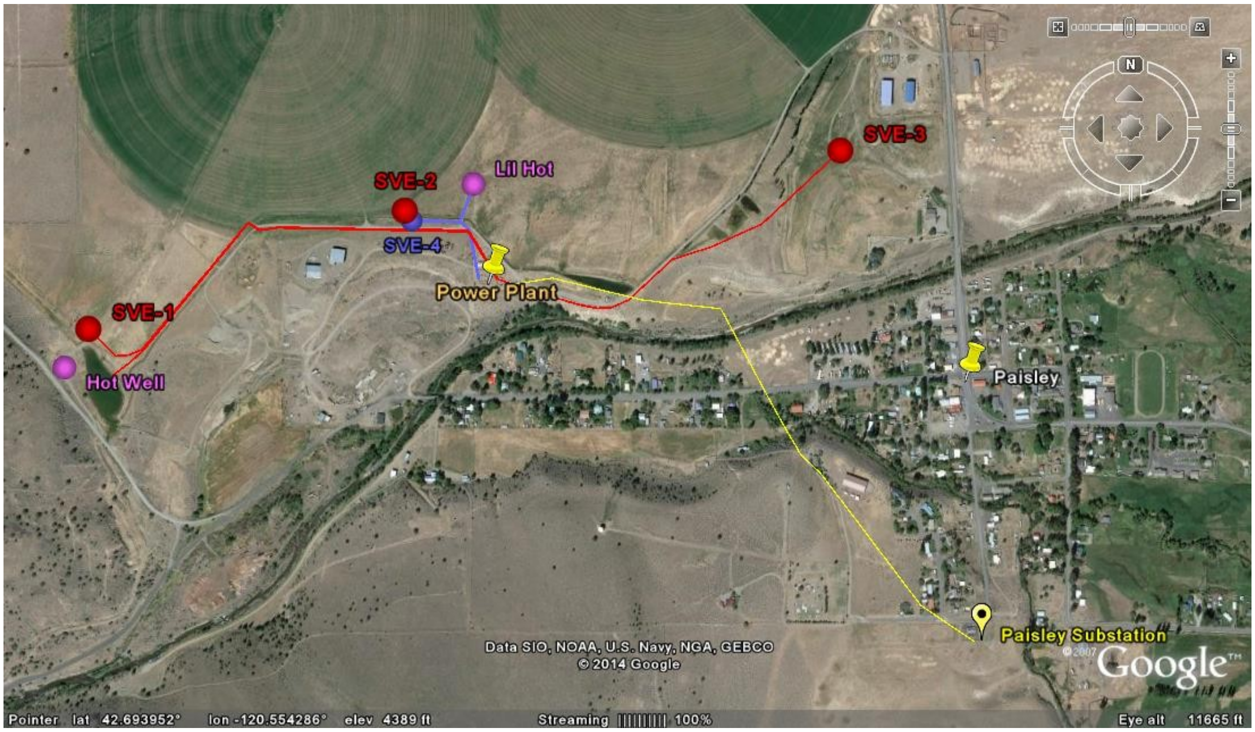
Therefore another lesson learned is to not allow grants and programs to obscure your decision making. Determine the projects number one priority; to sell the generation, and complete that task before other development is started, even if grants and tax incentive deadlines are missed and incentives lost. In the long run the financial position of the project will be much better off with a power purchase agreement in hand prior to costly development of resources, purchase of expensive generation plants and equipment and construction of wells and gathering system.

When financially planning, include the cost of experts and consultants. We took on this project believing we could understand and work through all the various issues encountered in developing this project. We did work through many situations and learned a lot along the way, but we also found out that our inexperience and unfamiliarity could be very costly in time, energy and money.

A small electric cooperative does not have the staff and expertise on board to deal with many of the issues associated with development of geothermal resources and generating plants, electric generation sales and interconnections, engineering and system design, grant management and project budgeting, contract negotiations and legal issues, water rights and water development, resource permitting requirements and land rights, among other issues. We relied heavily on professionals in these various fields to provide advice, layout course of action and provide plans and designs, so that we could make decisions and project progress.

Geothermal power has been marketed by the geothermal industry as base load power. As the electric market changes, geothermal resources need to be flexible to change. Base load may not be the most important or desirable load for the energy market. Many markets are looking for loads that meet a utilities peak or are fluid enough to ramp up and down. Geothermal can meet the requirements of these markets too and must be ready to explore how to fit into the changing industry.

In summary, we believe this is a valuable resource to the members of SVEC, whether we are able to sell the electricity produced on the market or take to serve our own load. As long as the resource lasts, we believe this project will provide sustainable and reliable power for the members of the cooperative for many years.



Overall Project View - Production wells:SVE 1, SVE 2; Injection well: SVE 3; Make up water wells: SVE 4 & Lil Hot; red line:geothermal brine pipeline; yellow:new 69kV transmission

Project Objectives

Following are the project objectives as described in the grant proposal and award:
SVEC seeks to develop the geothermal resource in Paisley for the benefit of its rural electric Cooperative members. The end state sought is a reliable source of sustainable base load power, not subject to fossil fuel price volatility, that promotes the creation of other businesses with the community and establishes a process other electric cooperatives can follow to develop small geothermal projects. Goals include:

1. **Sustainable and Reliable Competitively priced base load power.**
   We believe the geothermal resources available will provide many years of sustainable base load power. A number of geologists have worked on or reviewed the project. All have indicated the geology and modeling of the resource indicate more than 10mw of energy available. Our development of 3mw was intended to not over tax the resource to ensure longevity and sustainability of the resource.

   Geothermal energy is a base load resource that will supply a steady load of energy 24 hours a day, 365 days a year, regardless of wind or sunshine. We have developed this resource and have constructed a 3mw geothermal generating plant that will provide competitively priced, base load energy for the members of SVEC.

2. **To demonstrate that local resources (irrigation well drillers, local trades) can develop geothermal resources economically.**

Looking at the overall picture of the costs to develop this resource, whether local trades were used or professionals in the geothermal industries, the cost was well above the anticipated development costs.

We discovered through this process that there were not many local trades that could provide the service needed for development. We used a number of individuals and businesses locally, but also relied very heavily on contractors and professionals who had extensive experience in geothermal development or specific fields.

Local trades used in the development of the project were professional geologist for resource development and well monitoring, construction inspector, welding and fabrication, grading and road development, engineering services and surveying, pump installation, repair and flow testing and electrical installation at pumping plants.

We also used our own crews for a number of jobs, including construction of service taps to pumping plants, installation and removal of test piping and weed removal and treatment.

In house we built and used a 2 meter probe system and well monitoring equipment. We performed our own well flow testing, built well monitoring equipment and monitored wells.

The following geothermal and resource professionals were used: resource development engineer, well drilling engineer, design and construction engineers, geologists, geoscientists, well analysis professionals, environmental engineers, water rights professionals, permits and land use professional, geothermal project accountant, construction contractor and professional crane services and specialty equipment.

We demonstrated that local trades and resources can play a part in the development of geothermal resources, and possibly reduce some of the costs. But, overall professionals in the geothermal field are needed and depended on to complete these projects, especially with the lack of knowledge, staff and experience found at a small cooperative.

3. **To demonstrate that the Cooperative Business Develop Model (Non Profit) can develop the small geothermal resources within its service territory, that larger developers consider too small and not economic.**

   It is quite remarkable that a small electric cooperative, with limited staff and no previous experience or knowledge in large project development or knowledge about geothermal resource development or power plant construction and operation, has successfully completed this project. However, our success in developing this project was at a cost much higher than anticipated or budgeted.

   As one geothermal professional said, “you pay for your education.” We have found that statement to be true as we encountered numerous obstacles, paying both financially and in time, what was required to overcome the obstacle.

Total cost of this project was $22 million for a plant which produces 3.1 mw. The completed project is significantly larger than the original design and therefore the price tag is greater. The cost per megawatt is $7.1 million. This is in line with other small geothermal projects in the industry, but much greater than the value we believed we could develop it for. With grants and tax credits of nearly $5 million the project cost is $5.5 million per megawatt. Our budget during development proposed a cost of $2.5-$3 million per megawatt after grants and tax credits applied.

These costs were much greater than we budgeted or anticipated. When large developers are wary of a resource, we recommend engaging them and discussing why they see a resource as not economical. These developers have a lot of experience in the geothermal field and can provide insight to determine if a project is feasible. Look at all the reasons the large developer considers the project to not be economical and then determine if this is a project a small cooperative can be successful developing realizing that large developers have different priorities than cooperatives.

4. **To demonstrate the advantage of fully utilizing the Rural Cooperative electric transmission system, e.g. no large electrical upgrade is required for the smaller geothermal resources and the distributed resources will reduce transmission losses.**
   A substation and short transmission line were required to deliver the generated power from the generating plant to the existing Cooperative transmission system. The cost of this upgrade was about five percent of the project development cost.

   One aspect of the existing Cooperative transmission system was ignored during planning of the project. To deliver the generated power to an entity outside the Cooperative service area, the power must be delivered 44 miles on the cooperative ageing transmission line. This transmission line must be upgraded and/or replaced if it is to serve this resource for the next 20 to 30 years. This cost was not considered in the project plan.

   Reduction of transmission losses will only be realized if the generated energy is being used in the Cooperative's system. A calculated transmission loss, whether it is physically delivered or not, is included in the PPA, thereby offsetting any gain for putting load on the SVEC system at Paisley.

5. **To demonstrate to other cooperatives that developing geothermal is an advantage to their members.**
   The development of this project is for the long term. One of our directors has said that the benefit will be for our children and grandchildren. Short term difficulties can cause us to forget the long term goal and results of a project like this. I do not believe we can evaluate advantages at this early stage of the plant production.

During the planning stages of the project advantages to the cooperative members made more sense because market rates for electricity were high. Developing our own resource at a lower than market rate would then be attractive if the cooperative needed to purchase market rate power. Our vision at the beginning stages of this project was to sell the generated power on the market for several years to pay down the development costs. Then, when the cooperative needed additional power, instead of buying at market prices, we would take this generation to load. That is an advantage to the members.

Much has changed during the development of the project. First, wholesale electricity markets have dropped to very low rates, which are no better than the cost of generating the power, making sale of the generated power very difficult. Second, the energy markets in the northwest are flooded. No utilities are looking for power. The northwest economy is not growing and is not demanding more power, again making it very difficult to find a buyer for the power. Third, utilities in the northwest have met their RPS requirements and are not in need of renewable energy. Fourth, the California market in a generic sense is very attractive. But in a practical sense getting the power to California has proven very difficult and costly. In addition, California legislation greatly hinders out of state power to meet RPS requirements.

We believe this generating plant will be a benefit to the SVEC members over the long life of the plant. As we have seen during the development years, the energy market can change dramatically. At this point in time we cannot predict what the future energy markets will be. If the markets improve and the region is once again in need of renewable energy, we may be able to sell it for greater returns for the membership. If not, it will provide a steady supply of renewable energy for our membership.

6. **To demonstrate that geothermal development improves when geothermal uses are cascaded, e.g. both electrical and direct heat uses.**
   We have not been able to demonstrate this to date. We have made plans for the City of Paisley and/or for Paisley School to use energy from the spent fluid (at 150F) to do direct heating of community and school buildings. These projects will not lower the development cost for Surprise Valley Electric, but it positions the cooperative to be able to help the community by reducing community/school development and heating costs.

   The landowner is looking into aquaculture and greenhouse agriculture, but these have not been developed at this time. The cost of development for the landowner has been greatly reduced due to the infrastructure already in place.

7. **To demonstrate that geothermal development can be integrated with an operating ranch to make both applications better.**
   We have worked hard during development not to interfere or impact negatively the operation of the ranch. The rancher has participated with us on many of the decisions, including determination where to site the plant, where to run pipe lines

and has provided equipment and man power on a number of tasks. SVEC has improved the ranch roads, gates and cattle watering facilities.

The biggest benefit to the ranch has been the development of additional water that is available as supplemental irrigation water. SVEC has worked with the ranch to complete water transfers so that the ranch water rights are protected. The development of additional water has been very beneficial to the ranch. The original hot well, which was developed as a supplemental source of irrigation water, did not produce all of the ranch's water right. With the inclusion of the SVEC production wells, the ranch now has its full allotment of supplemental water. This has resulted in more hay produced and an additional pivot irrigation field being developed.

8. **To demonstrate the potential benefit to Bonneville Power Administration (BPA) when direct customers develop their own sources of power, this could make more power available to BPA and perhaps alleviate transmission bottlenecks.**
Paisley and SVEC's Oregon service territory is in the PAC (PacifiCorp) West balancing area and not under the transmission control of BPA. This small resource is hardly noticeable to the PACW power grid operators and nearly invisible on the northwest power grid.

If we choose to take this generation to serve our own load, it would offset the same amount (approximately 2.3MW) that BPA would deliver to us. This amount can then in turn be delivered elsewhere by BPA or BPA would not need to purchase this amount for us on the energy market. I cannot say if BPA considers this as a benefit or not.

9. **To demonstrate the uses of the 2 meter depth temperature survey to facilitate location of injection wells.**
SVEC built our own set of 2 meter equipment after meeting with Professor Mark Coolbaugh at University of Nevada, Reno who has used the system extensively in University research in Nevada. Professor Coolbaugh and associates typically use the 2 meter temperature survey on a much larger scale than we did, looking for anomalies and then focusing on those areas for further research. We tightened up the survey to a much smaller area, shrinking the grid to more closely zero in on temperature variations. Several surveys were made of the resource area along the fault line and extending east more than a mile. Maps were developed from the data collected showing the heat zones.

A Bouger gravity survey was also conducted along the fault line and extending east over a portion of the area surveyed by the 2 meter system. These overlapping surveys, along with geological field work, were used to determine where to locate the geothermal wells. See Paisley2MTempSurvey.pdf; Pais_complete_bouger.jpg.

10. **To demonstrate that the development of distributed small resources contributes to building a sustainable region.**

The development of this project has had a positive impact on this small community and on the surrounding communities by fostering business for the local economy through purchase of construction materials; retail sales for motels, restaurant, grocery and retail stores. We have contracted with local contractors for road and grading work, geological investigation and well monitoring, construction inspection, well development and pump/motor installation.

The Plant Operator is a resident of Paisley, as well as the assistant operators, which will be employed until a remote operating system can be activated.

It is difficult to determine at this time, with limited plant operations, if the development of distributed small resources has contributed to building a sustainable region. The project does provide SVEC with a renewable and sustainable generating source.

Summary of Project Activities

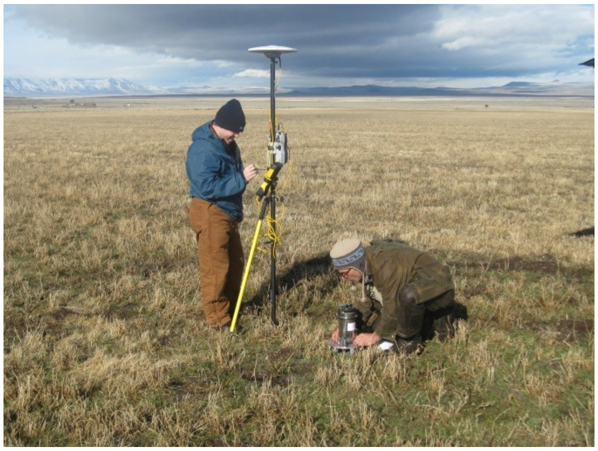
The original hypothesis of this project was to develop this small, low temperature geothermal resource on a cooperative member's ranch using our Rural Electric Cooperative position and relationships to be more economically feasible than a large developer and more "rancher" friendly. We believed the cooperative business model would serve us well as we engaged the services of local contractors rather than use more expensive geothermal industry contractors.

As a rural electric cooperative serving the Paisley area, we had a long and healthy relationship already established with the Colahan Ranch, and could be a trusted partner to them in the development of this resource. Having spent many years building power lines and reading meters on members' property we were sensitive to ranch operations and made it a priority not to adversely disturb the operation of the Colahan Ranch. Also, being in partnership with a member-owner of the electric cooperative, we welcomed the owner's involvement in the planning of the project and specifically included them in the siting of the plant and gathering system pipe lines. For example, gathering system expansion loops were built vertically, rather than horizontally, to take up less farmed acreage and to allow for passage of equipment and livestock.

Other local ranches have allowed us to monitor their wells in our investigation of the resource and have generously provided equipment and water during development.

We also were sensitive to the water rights and needs on the ranch and have worked with the State Water Resources to protect the ranch's water rights and even improve them. The ranch, on their part, has allowed SVEC the use of one of their wells for cooling water and access to the whole property for resource investigation and development.

Our approach to use local trades and resources to develop the geothermal resource for a sustainable energy source went well during the resource development stages. SVEC studied methods for investigating geothermal resources, such as well logging and measuring soil temperatures. We met with university professors and personnel who were using various methods, studied their procedures and equipment and made our own equipment to perform our studies, rather than contracting for these services. In turn, our equipment has been used by others in the area for geothermal investigation and we have also participated on some of these investigations. We contracted with local and regional geologists and developed procedures for investigating the resource. The University of Nevada, Reno developed the 2 Meter probe method for measuring temperatures in the upper two meters of surface. The attached document Paisley2MTempSurvey.pdf is the final product of these surveys and was instrumental, along with the gravity survey and geographical investigation, in the decision to determine well locations.



Local geologist, Silvio Pezzopane (adjusting the instrument) and Boise State geology masters student Kyle Makowsky, perform Bouger Gravity Survey.

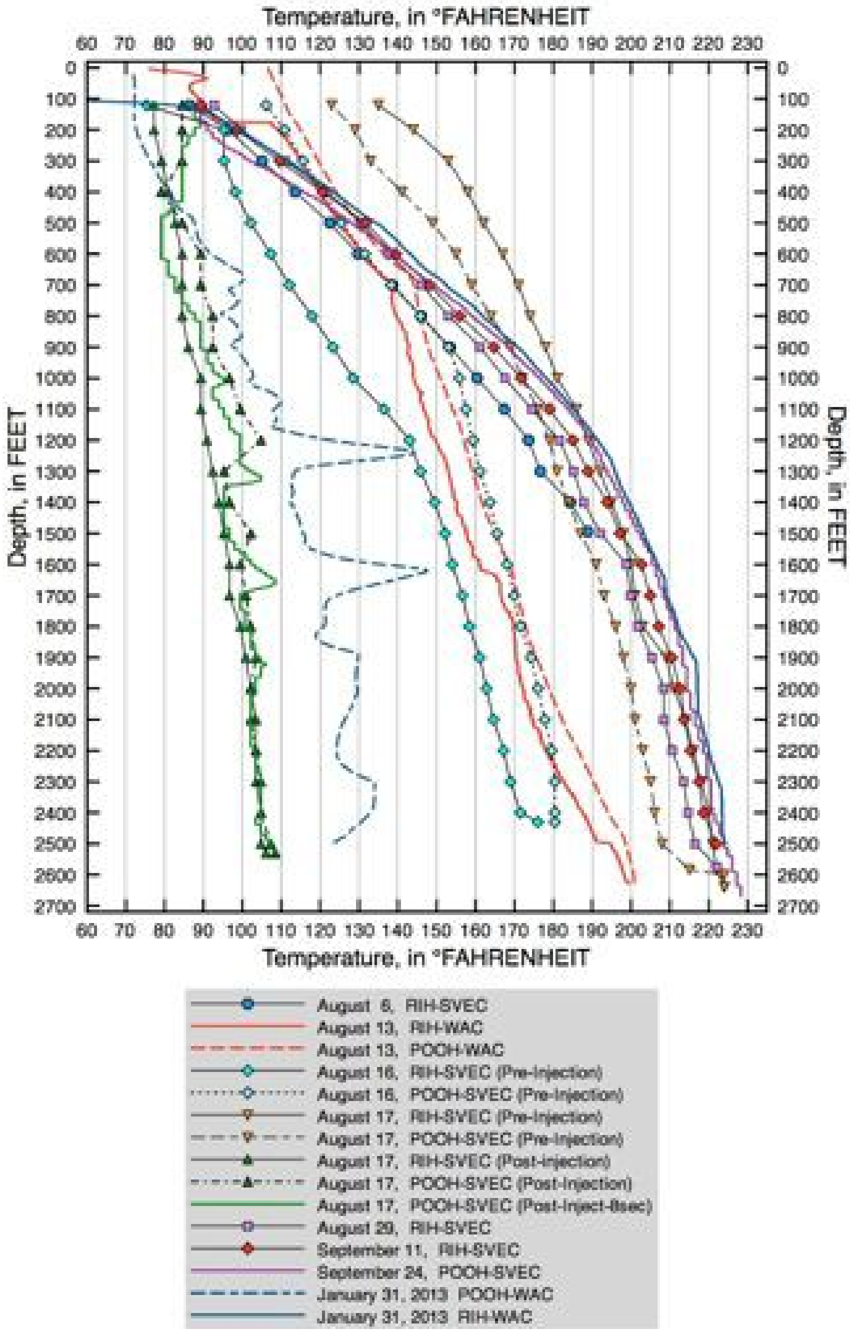
Engineer, Dan Hand, and SVEC's Lynn Culp drive 2 meter probe.

Next page left. Temperature being taken at 2 meter depth. Top of probes were insulated to reduce temperature transfer down the steel probe. Ambient temperature was also recorded.

Next page right. Pulling 2 meter probes with battery run wench and tool attached to pickup truck. This tool was designed and constructed locally, by Partridge Enterprises.

Well logging equipment was also built for monitoring temperature in wells to 3000 feet. An old reel off a fire truck was given to SVEC. The reel was cut down and modified to hold 3000 feet of cable. The reel was mounted to the tail gate of a pickup and an arm with a sprocket was extended from the pickup trailer receiver to guide the wire out, over and into the well. A weight was built with a chamber to hold the temperature data logger and a cable counter was mounted on the arm for measuring the cable as it entered the well. Processes and various techniques were developed and used for logging wells. SVE 3 Well Logs 2012-2013.pdf is one product of the many wells we monitored using the data to incorporate with other geological data to build our resource model and determine well locations.

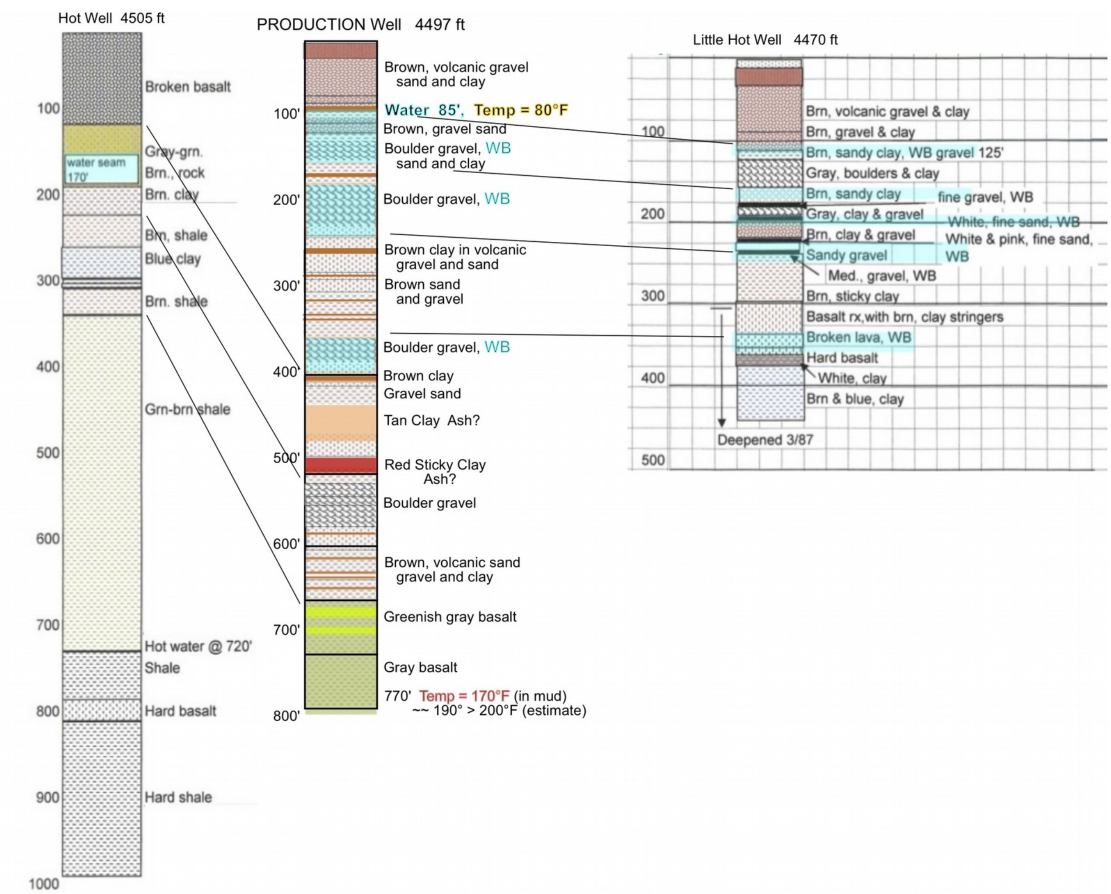
Well logging equipment built locally by Partridge Enterprises for SVEC to measure temperature in wells to 3000 feet.



Downhole temperatures in Well SVE-3 were monitored over several months from August 2012 to January 2013. Downhole temperatures were measured using a self-contained battery operated data logger that records the temperature as it is lowered and raised in the well via a wireline winch.
SVE 3 Well Logs 2012-2013.pdf

Drilling the three production/injection wells was a challenge. Our original plan was to reconstruct the existing hot well to geothermal standards. After meeting with several well drillers, it was determined that work on this well would be too risky financially in the capability to develop the well and in safety to construction personnel. A decision was made to drill a new production well and a new injection well. These wells became known as SVE 1 and SVE 2. The geologists and engineers projection after gathering and studying the resource data was that a production well could be drilled to 1500 feet with a production of 2000 gpm at 300F.

Following is a geologist's correlation between two previously drilled wells on the ranch and the newly drilled Production Well (SVE 1), which was not complete at the time of this graphic.



After months of drilling on both SVE 1 and SVE 2, the driller was unable to advance past approximately 1000 feet in SVE 1 and 500 feet in SVE 2. After enlisting professional drilling engineers, it was determined to dismiss the drilling company and hire another company that had the equipment and experience to complete the job. Western Well Drilling from Redmond, Oregon completed the drilling on both wells, installed the casing in both, but because of the poor drilling of the first company, was unable to get the casing to the bottom in SVE 2 leaving about 240 feet of casing up into the well. Western performed the initial air lift production test on SVE 1, which did not produce the projected results. After SVEC performed additional flow and temperature tests it was determined that SVE 1 would only produce 1200 gpm at 240F, well below the projected production. We decided at that juncture to perform a flow test on SVE 2. Western Well Drilling was hired back to remove the casing which was hung in the well and to perform an air lift test. SVEC performed additional flow and temperature tests and determined SVE 2 could produce at least 2000 gpm at 227F.

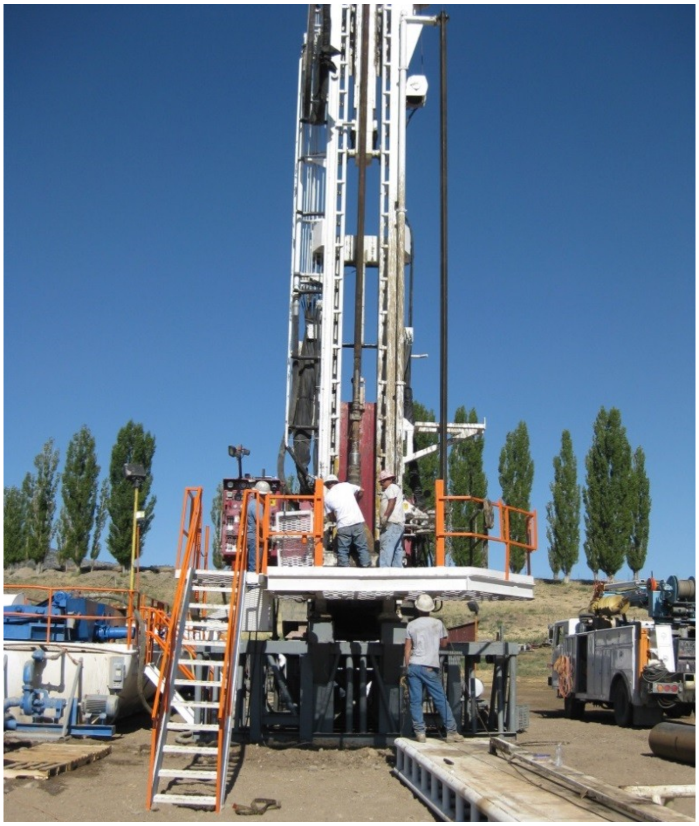
At this point we had to make a decision how to proceed. We determined there were three options to consider:

- Use as originally planned – SVE 1 as production well, SVE 2 as injection well; projected output 1.3MW
- Use SVE 2 as production well and SVE 1 as injection well; projected output 2.5MW
- Combine SVE 1 and SVE 2 as production wells at flow of 4000gpm and 232F, drill new injection well; projected output 4MW

The decision by the SVEC board of directors was to combine the two wells for production and drill a new well for injection. After additional consideration, the production level was lowered to 3000 gpm so that the resource would not be over taxed.

The injection zone in the new well (SVE 3) was projected to be encountered in the range of 1500 feet. When drilling this well no fractured zones were encountered in the first 1500 feet. A decision had to be made whether drilling would continue and what depth would be the limit to our drilling or should drilling stop and a more suitable well location be determined. At 1730 feet and still no fracture zones encountered, the board of directors decided that drilling should continue to a maximum depth of 3000 feet or three more days. Two days later, the drillers encountered first lost circulation at 2400 feet with total loss of circulation at 2650 feet. Bottom of drilled well is 2705 feet.

After flow tests on SVE 3, with results of 2000 gpm at 225F, it was determined to use SVE 1 and SVE 2 as production wells and SVE 3 as the injection well. These are the type of situations the cooperative board of directors made decisions on.



Welsco Well Drilling out of Fallon, NV begins drilling on SVE 3. Welsco was assisted by Capuano Engineering on engineering and drilling this well. Welsco completed the well, performed air lift test, and cleaned SVE 1 within one month of arrival on the site.

Geoscientist, Leland Davis of Geologica, records data from SVE 1 production well using ultrasonic flow meter and various gages and instruments.

Once the wells were developed a longer term injection test was performed. SVEC hired Geologica of Reno, Nevada to perform an assessment of the reservoir capacity. The results of the assessment were to provide SVEC with an evaluation to determine if the resource was sustainable at this Go-No Go decision point.

The Power Purchase Agreement (PPA) has been much more difficult to obtain than originally anticipated and planned for and has become a major issue in operating the plant for a margin that is valuable to the cooperative membership. During the planning of the project much was not understood about PPA's, generation plant operation within balancing authorities, Qualifying Facilities (QF), interconnection requirements, Renewable Energy Credits (RECs) and transmission and wheeling services and contracts.

A simplistic approach was taken to the sale of the generated power, believing that any renewable energy produced would be desired and easily sold within the northwest region or California. Rather than preparing for the sale of energy and taking the time to execute a PPA, the SVEC team began resource research and development, successfully obtaining this US DOE grant and an Oregon Business Energy Tax Credit, executing an agreement for the TAS Energy power plant and drilling and developing wells. While all this was commendable progress on the development of the project, it ignored the most important aspect of selling the power.

SVEC first began soliciting the proposed renewable energy around the northwest region, specifically with BPA utilities, after signing an agreement with TAS to build the power plant. After unsuccessfully obtaining a PPA, SVEC hired Bonneville Environmental Foundation (BEF) to research northwest and California markets, again, unsuccessfully finding an agreement, but learning of the cost to get the power into California. BEF and SVEC believed the power could be sold to PacifiCorp as a last resort QF PURPA sale, and in fact was informed by PAC staff that a PURPA sale could be drafted and executing within 60 to 90 days of initiating the agreement.

After nearly two and a half years of negotiating a PURPA PPA an agreement still has not been executed. In June 2015, SVEC filed a complaint with the Oregon PUC. This complaint may be viewed at http://edocs.puc.state.or.us/efdocs/HAA/haa162438.pdf.

Even though the complaint is scheduled on the OPUC calendar for a hearing, we are still negotiating with PAC trying to reach an agreement. We have hired two different law firms to help us negotiate the PPA and all the issues PAC has presented to us, as well as prepare the complaint and oversee the hearing process.

In the meantime we have worked with BPA to acquire a temporary agreement to take the generated energy to our system load for one year, beginning October 1, 2015, allowing us to continue PAC negotiations or move forward based on the outcome of the OPUC hearing.

We believe the difficulty we are having getting an agreement executed basically comes down to utilities not desiring to take any new load during these times of low markets and stagnant load growth. Most of the recent tariff changes made by utilities concerning PURPA agreements are for the most part a means of discouraging new projects from seeking a PURPA contracts with utilities.

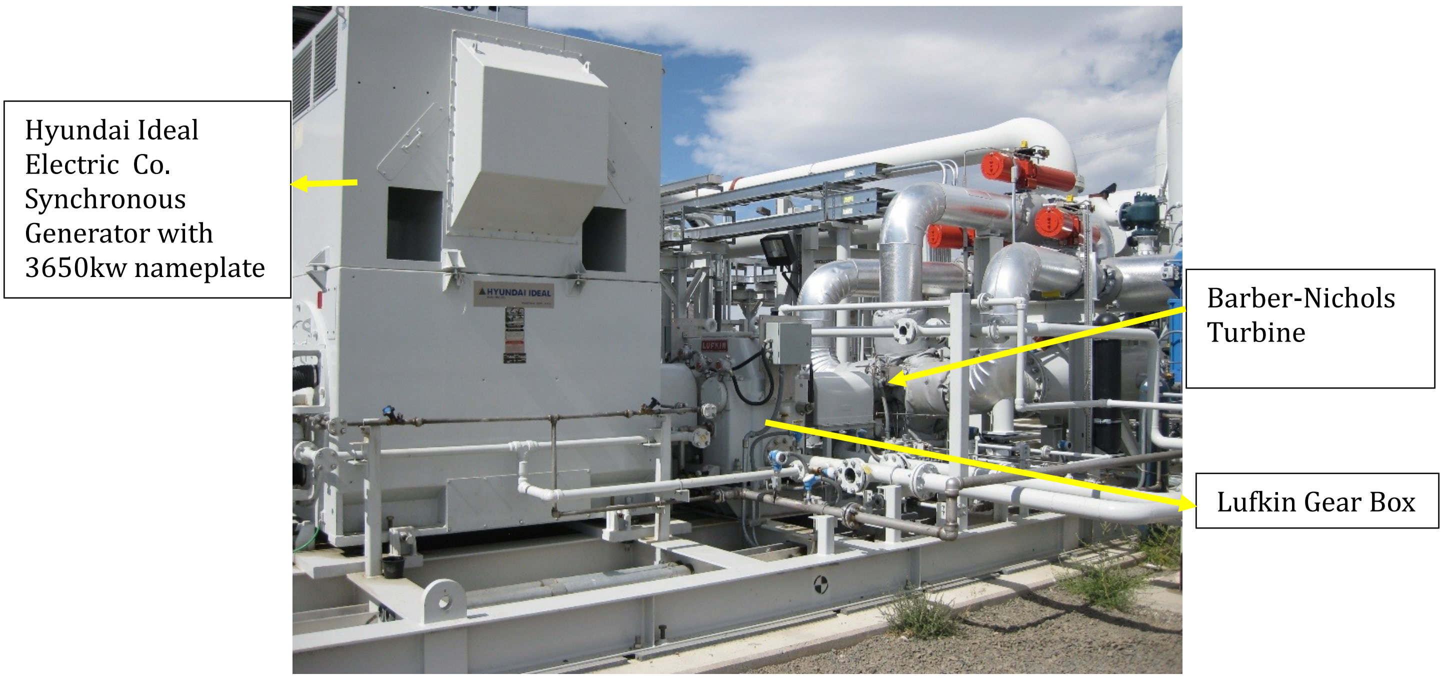
In planning and development of the project the SVEC team supposed they could understand and work through the State of Oregon Water Resource Department (WRD) requirements, regulations and laws. These water issues, including development of makeup and cooling water, and water transfers and water rights, have been perplexing to negotiate without the assistance of professional consultants. SVEC has hired GIS Water Solutions to prepare documentation, guide and advise through these issues, which will continue to progress over the next year or two.

A major decision point for the SVEC team, including the board of directors, was to determine if the project should proceed after receiving the bids for balance of plant (BOP) construction, which were more than three times the budgeted cost projection. At this point, SVEC had already contracted with TAS for the power plant, which was nearing completion at the TAS facility in Texas, and had developed three geothermal wells. More than $10 million had already been invested in the project by this time. After discussion of how to proceed, including selling the project, the board of directors decided to continue the development of the project for the members of the cooperative.

TAS Energy, the designer and builder of the modular power plant, has been extremely difficult to work with throughout plant construction, start-up and commissioning. An example of these difficulties is SVEC's request in the power plant bid for the plant to be monitored and evaluated daily, but also have remote monitoring and operation. TAS's first draft of a contract with SVEC included the plant being remotely operated, but unbeknownst to the SVEC team, the remote operation and monitoring option was removed from subsequent contract drafts, including the executed contract between the two parties.

At the first contract review and planning meeting with SVEC, POWER Engineers and TAS Energy, remote monitoring was discussed, with TAS promising a change order to address it.

This change order never was supplied, and in our ignorance and lack of contract administration experience, we did not realize that remote operation was not being designed into the plant until the plant was nearly built. When this was discovered TAS's response was to deny they ever knew of our remote monitoring/operation request, then TAS produced an excessively expensive change order to do a study on whether remote operation was feasible or not. SVEC decide not to address remote operation at this time, but instead to fully man the plant. The issue with this is that a 3mw plant cannot financially support a full staff to cover operations 24 hours a day, 365 days a year.



TAS Energy power generation module which holds the turbo-expander, gearhead and generator.

There have been many other issues with TAS including receiving plant documentation that includes information and data specific to other plants rather than this plant; not receiving Operation and Maintenance manuals; incomplete or missing design drawings and revisions. Plant start up over the past year was delayed by two major equipment malfunctions including high vibrations in the turbo expander and leaking condenser tubes at the condenser tube sheet. TAS also did not properly protect the condenser from cold weather last winter and froze a number of the condenser tubes, which had to be plugged and retired before the plant was ever ready for commercial operation.

We have been through a long commissioning process, and even though we have received a Certificate of Completion of Commissioning from TAS, stating that the plant is suitable for commercial operation, there still is a punch list to be completed, as well as, performing a second Capacity Test. The first Capacity Test was run on September 3, 2015. The performance of the plant during that test had a shortfall of 88kw below the TAS design guarantee. TAS determined that the vaporizer tubes were fouled and had them cleaned in

October. TAS has not scheduled the follow up capacity test to determine if the plant meets design output. SVEC began commercial operations of the plant beginning October 1, 2015, but the plant has been down as much or more than operational due to continued mechanical issues, which TAS and SVEC are addressing.

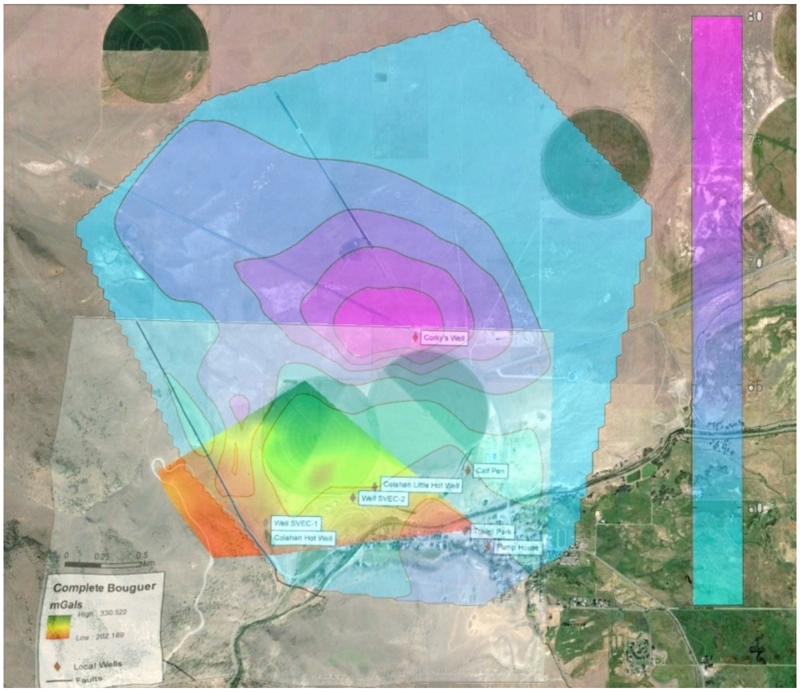
Products Developed

1. A productive low temperature geothermal power plant generating 3.1 mw of sustainable and renewable energy for the members of SVEC, including renewable energy credits to be sold or credited toward the Cooperative's renewable energy portfolio.
   a. Developed geothermal resource of 3000gpm at 233F brine.
   b. Three successful geothermal wells drilled and developed for production and injection of brine.
   c. Developed functioning gathering system, including two production pumps and more than 9,000 feet of pipeline.
   d. Constructed electrical substation and one mile of 69kVa transmission power line. To deliver the produced energy to SVEC system and/or purchasing party.

SVE 2 Production Well. Gathering system pipe line and valves have been insulated.

2. 2 Meter Temperature Survey used to determine well locations, develop resource model.
   a. Paisley2MTempSurvey.pdf
   b. 2 Meter survey equipment, including probes, temperature monitors, power hammer, removal equipment, and miscellaneous equipment for proper installation and removal.

3. Bouger Gravity Survey. See below 2 meter and Bouger survey overlay.



4. Added value to Colahan Ranch
    a. Royalty on sales of electric generation.
    b. Brine from geothermal wells provides additional supplemental irrigation water to ranch at lower temperature and no pumping cost to Ranch.
    c. Additional wells transferred to Ranch water rights, including both production wells, gives Ranch four points to draw water from, rather than just one.
    d. Improved ranch roads, gates and cattle watering facility.
    e. Ports have been installed on injection pipeline for Ranch to use spent brine for direct heating, mineral baths, or heating for greenhouse or aquaculture.

5. Added value to City of Paisley
   a. One full time position for Plant Operator and five part-time assistant plant operators.
   b. Contracted locally for geology work, road and plant yard grading, construction inspection, welding and repairs.
   c. Over 120 contractors and construction workers in town for many months at a time over several years frequenting restaurants, motel, grocery store, fuel stations.
   d. SVEC has agreed to provide spent brine and heat exchanger for Paisley School and/or City of Paisley direct heating.
   e. Collaborating with City concerning City water rights and assisting with certification of said rights.

6. Added value for Lake County and surrounding areas
   a. Increased revenue for restaurants, motels, grocery/retail stores, fuel distributors. Many of the contractors/workers have stayed in Lakeview, Summer Lake and surrounding areas.
   b. Contracted locally for engineering services, concrete and construction materials, pump purchase, installation and repairs, well drilling and construction.

7. Publications, conferences papers, public releases
   a. Publications. Ruralite magazine, Electric Co-op Today, RE Magazine
      i. The following articles are found on the Ruralite web site under archives http://www.ruralite.org/
         - PL pp 28-29 sept 2014_2014.pdf
         - VB p 25 color april 2013_2013.pdf
         - c-15 p 32 may_2012.pdf

- c-15 p 8 August_2015.pdf; c-15 p 25 August_2015.pdf
- c-15 pp 4-5 june_2013.pdf
- c-15 pp 04-5-8 oct 2011_2011.pdf

ii. http://www.ect.coop/power-supply/renewable-energy/co-op-tests-low-heat-geothermal/40202

iii. http://www.ect.coop/power-supply/renewable-energy/coming-soon-co-op-geothermal-plant-in-oregon/70458

b. Conference Papers

i. L; Snyder, W, October 2011. Characterizing Geothermal Systems Through Geologic, Geochemical, and Geophysical Techniques: A Case Study from Paisley, Oregon and Fairfield, Idaho; Geologic Society of America.

ii. Hand, D; Mink, L; Silveria, D; Culp, L, October 2011. Paisley Oregon Geothermal Project; Geothermal Resource Council, San Diego, CA.

iii. Mink, L. 2012. Rural Electric Development Model. Harvesting Clean Energy Conference, Billings, Montana, January 2012.

iv. Makowsky, Kyle; Snyder, Walt; Mink, Leland, September 2013. Characterization of a Basin and Range type Geothermal system in Southeast Oregon, the Paisley Geothermal System. Rocky Mt Section AAPG Meeting, Salt Lake City, UT.

v. Makowsky, Kyle; Snyder, Walt; Mink, Leland, September 2013. Characterization of a Basin and Range type Geothermal system in Southeast Oregon, the Paisley Geothermal System. Geothermal Resource Council Annual Meeting, Reno, NV.

vi. Mink, Leland L; Pezzopane, Silvio K; & Culp, E Lynn, 2014. Surprise Valley Electric Paisley, Oregon Geothermal Power Project, Geothermal Resource Council Annual Meeting, Portland, OR, 2014.

vii. Mink, L; Pezzopane, S; Culp, L, April 2015. Small Scale Geothermal Development – An Example of Cooperation Between Land Owner and Electrical Cooperative, World Geothermal Conference, Melbourne, Australia, 19-25 April, 2015.

c. Public Releases: News articles

i. http://www.opb.org/news/article/paisley-geothermal-plant-may-be-online-this-summer/

ii. http://www.ect.coop/power-supply/renewable-energy/coming-soon-co-op-geothermal-plant-in-oregon/70458

iii. http://lakecountyexam.com/paisley-geothermal-fixes-faults-in-step-towards-start/

iv. http://djcoregon.com/news/2009/11/04/tiny-town-takes-geothermal-lead/

v. http://lakecountyexam.com/20-million-geothermal-powerplant-set-to-arrive-on-nov-18/

vi. http://www.renewableenergyworld.com/articles/2014/05/global-geothermal-news-roundup-us-plants-near-completion-south-africa-closer-to-tapping-resource.html

vii. http://www.industcards.com/geo-usa.htm

viii. http://www.heraldandnews.com/news/local_news/business/paisley-geothermal-plant-still-not-operable/article_dd72c85d-e6ee-5d7d-9d5a-2d416eb1947f.html

ix. http://lakecountyexam.com/paisley-geothermal-site-tour/

8. Web Site.
   http://www.surprisevalleyelectric.org/content/paisley-geothermal-project

9. Networks/Collaborations Fostered.
   a. Resource Development: geologists Leland L. Mink, Silvio Pezzopane; Geologica; Anna Carter; Geothermal Energy Association, Geothermal Resource Council, US DOE Geothermal Technologies Office; Oregon Dept. of Geology and Minerals; Oregon Geothermal Working Group, Well Analysis Corp.
   b. Power Sales: BPA; Bonneville Environmental Foundation; Obsidian Renewables, LLC; Oregon Energy Trust.
   c. Engineers: POWER Engineers; Evergreen Engineering; Anderson Engineering; Daedalus Engineering; Brian Brown Engineering and Sustainable Engineering.

   d. Well development and pump work: Western Well Drilling; Welsco; Klamath Pump Company; Mitchell, Lewis & Staver; Capuano Engineering.

   e. Water Rights Issues: GSI Water Solutions; OWRD Staff and Water Master.

   f. Electrical Installation and Repairs: IME Electric; Carl Tracy Electric.

   g. Geothermal equipment/construction: TAS Energy, Colorado TBC, Industrial Builders.

10. Technologies/Techniques:
    a. 2 Meter survey: Paisley2mTempSurvey.pdf
    b. Gravity Survey: Gravity.Fig4.19.pdf
    c. Demonstrating feasible operation of low temperature generating plant.

11. Inventions/Patents – NA

12. Other Products
    a. Presentations. Documents/files are listed but are not included in the report.
        i. Small Scale Geothermal Resources presented at Northwest Public Power Association; Northwest Requirements Utilities; Oregon Rural Electric Cooperative Association and CORE (not sure who this group is).
            Small Scale Geothermal Resources for Public Power.pdf
            Small Scale Geothermal Resources for NRU.pdf
            Small Scale Geothermal Resources ORECA.pdf
            Small Scale Geothermal Resources for CORE.pdf
        ii. 2010 Geothermal Technologies Peer Review
            DOE2010PeerReview.pdf
        iii. 2011 Geothermal Technologies Peer Review
            DOE2011PeerReview.pdf
        iv. Lakeview Rotary
            Lakeview Rotary.pdf
        v. Oregon Geothermal Working Group
            OGWGroup 411.pdf
        vi. Presentation to Senator Walden and staff at Paisley Oregon
            Paisley Geo Walden 611.pdf
        vii. 2012 Geothermal Technologies Peer Review
            SVE DOE2012 Peer Review.pdf
        viii. Golden State Power Cooperative 2012 Annual Meeting
            GSPC 2012 Lynn.pdf
        ix. Oregon Geothermal Working Group
            OGWGroup712.pdf
        x. Southern Oregon Economic Development
            PaisleyRenewable0613.pdf
        xi. Oregon Geothermal Working Group
            PaisleyOGWG1113.pdf
        xii. Alturas Sunrise Rotary
            Rotary031214.pdf
        xiii. Lake County Commissioners
            PaisleyGeo0514.pdf
        xiv. Surprise Valley Electric Annual Meeting
            SVE AnnMtg14.pdf
        xv. 2014 Geothermal Resource Council
            GRC_Paisley_Plant14

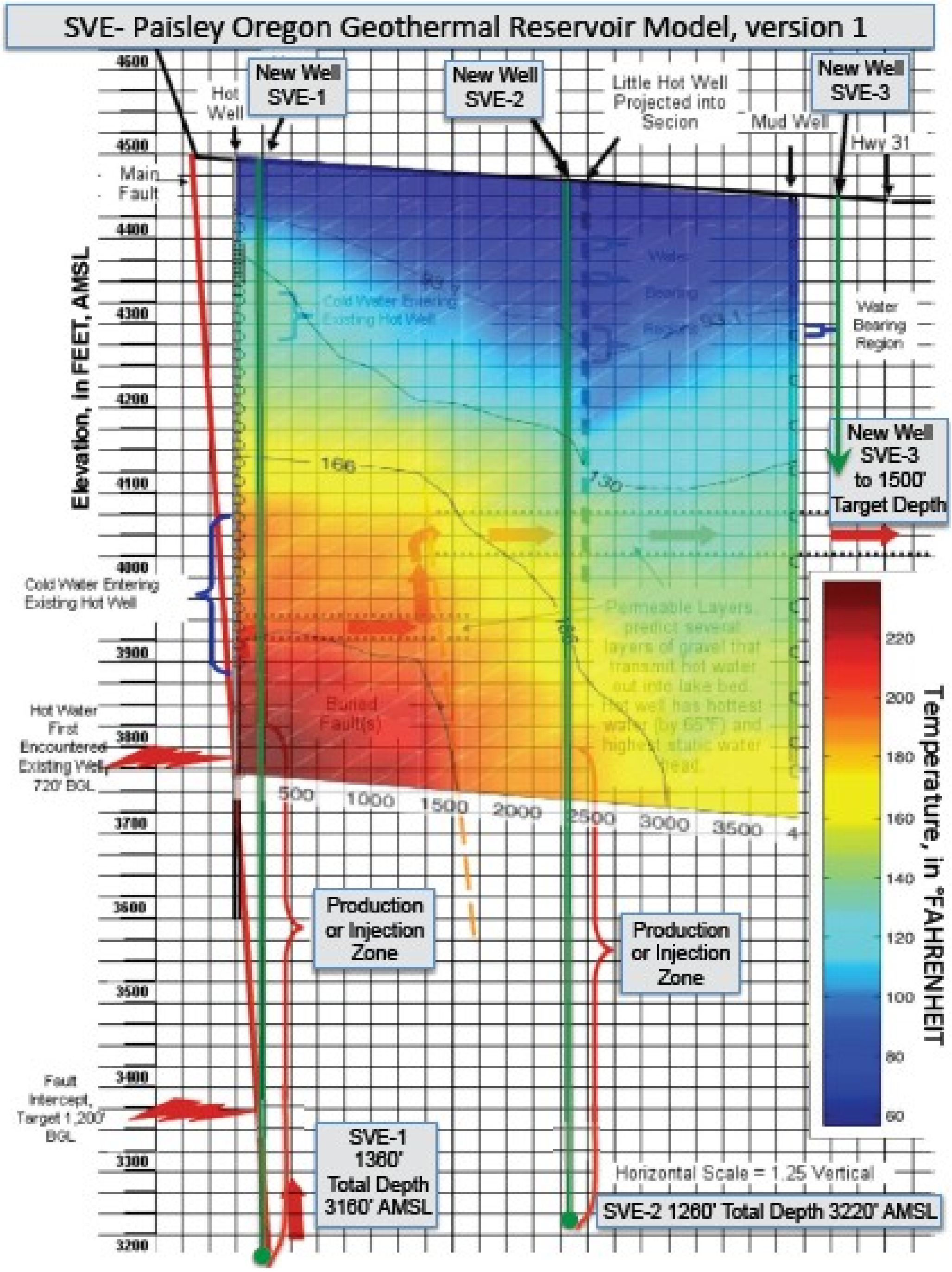
b. Physical Collections. See Appendix A.

i. Lithographic Description of SVE 1: LithologicDesc_SVE1.doc
ii. Lithographic Description of SVE 2: LithologicDescSVE2.pdf
iii. Lithographic Description of SVE 3: Well3 LithographicDescription.pdf
iv. Well Temperature Log SVE 1: SVE Well1 1128.pdf
v. Well Temperature Log SVE 2: SVE Well 2 Well Log 1128.pdf
vi. Well Temperature Log SVE 3: SVE 3 Well Logs 2012-2013.pdf
vii. Well Chemistry SVE 1: SVE 1 Chemistry 2-01-12.pdf
viii. Well Chemistry SVE 2: ChemTest SVE2.pdf
ix. Well Chemistry SVE 3: Well 3 chemistry.pdf
x. Wells Summary: SVEWellData_Summary.xlsx
xi. Injectivity of SVE 2: Injectivity of Well SVE2.pdf
xii. Injectivity of SVE 3: Injection_Test_SAIC_Report.pdf
xiii. DOGAMI Injection Permit Application: SVE_INJECTION_Permit_lr.pdf

First flow tests on SVE 1 using old tank as a steam separator.

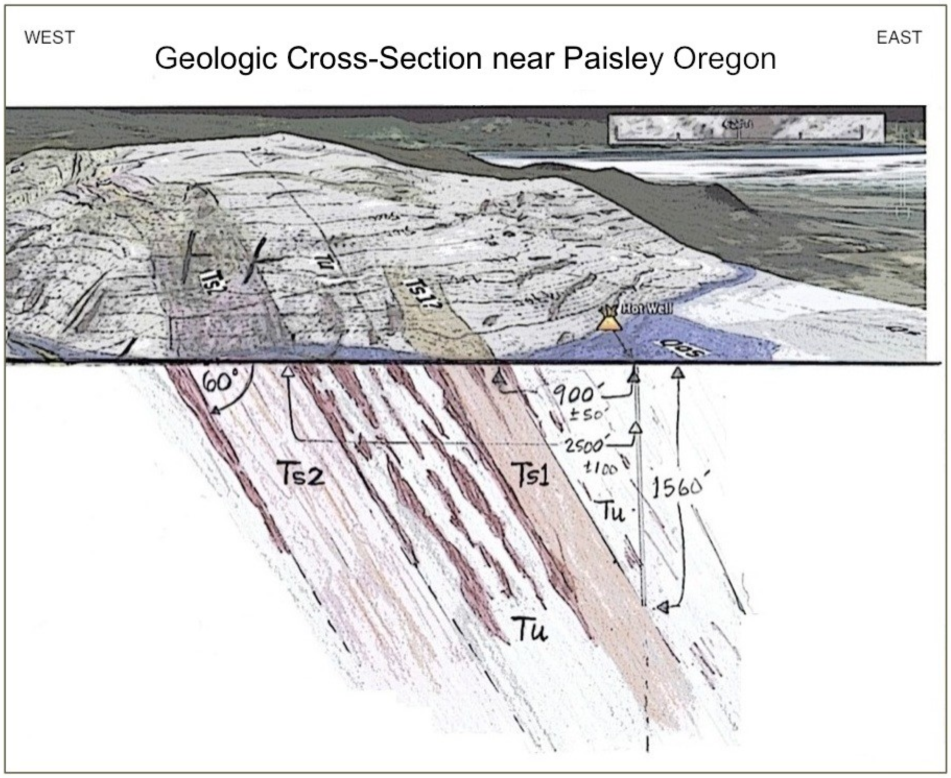
c. Res

xiv.

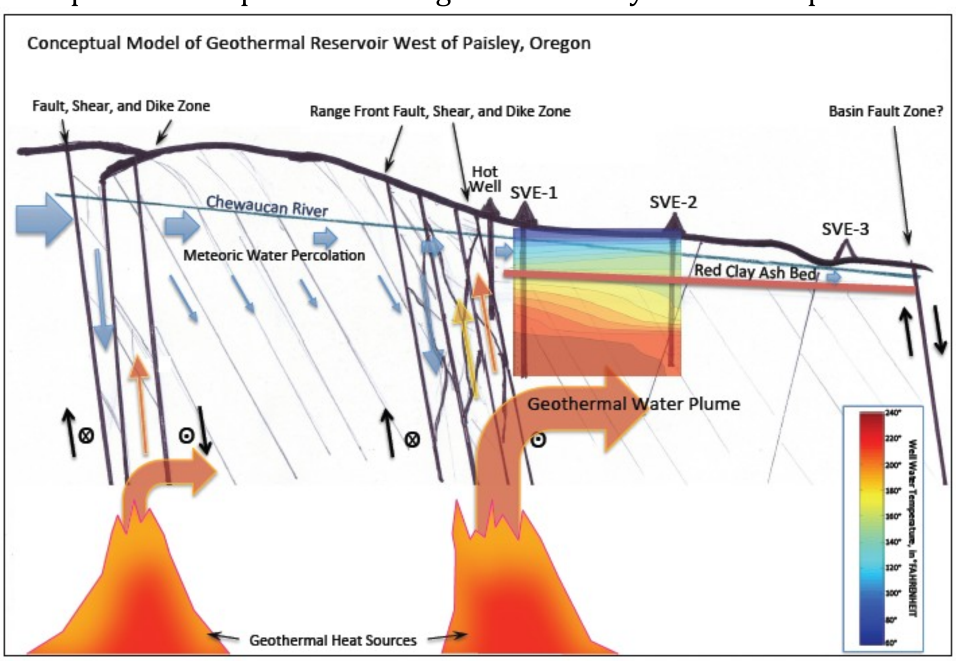


SVE- Paisley Oregon Geothermal Reservoir Model, version 1
New Well SVE-1
New Well SVE-2
Little Hot Well Projected into Secion
New Well SVE-3
Hot Well
Mud Well
Hwy 31
Main Fault
Elevation, in FEET, AMSL
Cold Water Entering Existing Hot Well
Water Bearing Region
New Well SVE-3 to 1500' Target Depth
Permeable Layers, predict several layers of gravel that transmit hot water out into lake bed. Hot well has hottest water (by 65°F) and highest static water head.
Buried Fault(s)
Hot Water First Encountered Existing Well, 720' BGL
Production or Injection Zone
Production or Injection Zone
Fault Intercept, Target 1,200' BGL
SVE-1 1360' Total Depth 3160' AMSL
SVE-2 1260' Total Depth 3220' AMSL
Horizontal Scale = 1.25 Vertical
Temperature, in °FAHRENHEIT

xv. Model of geologic formations following geologic mapping and investigation on and around project site. Figure_20_c.pdf

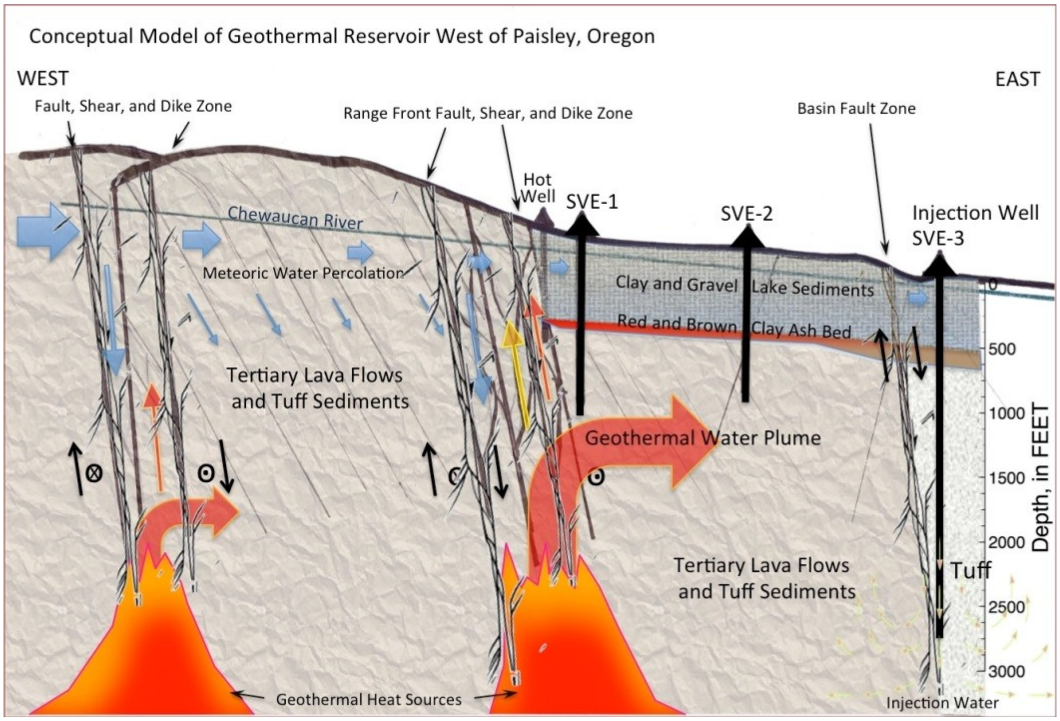


xvi. Conceptual Model prior to drilling SVE 3. PaisleyResMod1-3.pdf



xvii. Conceptual Model after drilling SVE 3. Note repositioning of Basin Fault Zone after well 3 drilled. The expected target zone of this well was 1500 feet. Fractured zones were not encountered until 2500 feet, indicating we had stepped across this fault zone.

Surprise Valley_08 15 12-final.pd



d. Educational Aid

i. Presentation at Paisley School Science Fair

Paisley School Science Fair 2012.pdf

ii. Paisley Elementary field trip of gathering system and plant

iii. Presentation at Surprise Valley 4H
Renewable Energy SV4H 1213.pdf

iv. Lakeview High School science class field trip of gathering system, geology and power plant.

13. Computer Modeling – NA

14. Equipment
2 meter and well logging, information provided in report.
Well monitoring with well level indicator tool with total dissolved solids meter.
Ultrasonic flow meter was used to measure flow from all drilled wells and for injection tests.
Used various transducers, thermo couples and data loggers for collecting and monitoring resource data.

SVEC's Lynn Culp measuring flow and brine temperature during production test on SVE 2.

Financial Challenges

There were many financial challenges for the staff of this small electric cooperative. The staff did not have any previous experience administering grants and had limited experience using a variety of lending sources. Managing the extra workload brought to the financial staff without adding any personnel was difficult.
Managing various sources of funding and working with a number of different financial sources took time and effort to learn, process and administer.

The first funding of the project was through SVEC's cash reserves for resource development and research. The majority of the project funds came from National Rural Utilities Cooperative Finance Corp. (CFC) loans. We had previous experience working with CFC, which provided SVEC with a line of credit, which was put in place while working on a new CREBs loan also with CFC. The line of credit was transferred to the nCREBs once the loan was approved.

There were two sources of grants/credits which benefited the project. This $2 million US DOE grant and an Oregon Business Energy Tax Credit at just under $3 million.

Financial Management Lessons Learned
It is difficult for a small cooperative staff to pick up the additional work load to administer grants, tax credits, loan documents and financial management of a project. Adding staff with grant administration experience may be beneficial to handle this additional workload and grant/funding requirements.

The staff would have benefitted from more guidance from DOE to coordinate cost share expenses, once this was understood accounting of the grant became more manageable. It would also have benefitted staff to understand the required documents for the DOE auditors to make their audit more efficient. An onsite training or webinar with DOE financial staff at the beginning of the project would have provided more guidance on the "how to's" of grant administration.

Expenses for project should have been kept separate from the day to day expenses of the Cooperative. A separate bank account for paying expenses would have allowed for better tracking of project costs.

All of the financial management personnel we worked with were very professional. We appreciate the help from DOE staff in the reconciliation of the completion of the grant reporting and various issues throughout the years.

Appendix A – Plant Operator, Mike Norris (standing), discusses plant operations with Assistant Operator, Dustin Withers.

12. Other Products

a. Physical Collections

i. Lithographic Description of SVE 1: LithologicDesc_SVE1.doc

LITHOGRAPHIC DESCRIPTION OF OIL OR GAS WELL

(Not required if a mud log is submitted)

STATE OF OREGON • DEPT OF GEOLOGY & MINERAL INDUSTRIES • 229 BROADALBIN ST SW • ALBANY OR 97321

(In compliance with rules and regulations pursuant to ORS 520.)

(1) Permittee Information

Name	Surprise Valley Electrification Corp.
Mailing Address	516 US Hwy 395 E
City/State/Zip	Alturas, CA 96101
Telephone	530.233.3511
Fax	530.233.2190
Email	lynnsvec@frontier.com
Prepared by	Lynn Culp, Silvio Pezzopane, Roy Mink, Kyle Makovsky

(2) Well Information

Well No.	SVE #1
DOGAMI ID No.	36-037-90009 Lake 448

Signature	Title	Date
	General Manager	5/29/2012

(3) Well Cuttings

Depth		Description
From	To	
0	40	Brown clay soil and gravelly sand
40	75	Brownish-grey rounded mixed volcanic (basalt, rhyolite, andesite, tuff, pumice) gravel, qtz-rich sand
75	105	Grey quartz-rich sand, with thin brown and grey clay beds, Water Bearing (WB)
105	150	Greyish-brown mixed volcanic gravel, qtz-sand, and clay, WB
150	165	Brown mixed volcanic (basalt, rhyolite, andesite) gravel, rounded sand and clay
165	175	Brown clayey sand and mixed gravels
175	225	Blackish grey basalt gravel, w/ sand and clay beds, WB
225	240	Blackish grey to brown basalt and andesite gravel, and sand
240	305	Varicolored mixed volcanic (basalt, rhyolite, andesite, tuff) gravel and sand, w/ brown clay beds
305	360	Brown gravelly sand and brown clay beds
360	390	Varicolored (grey, brown, black, red, green) basalt, rhyolite, andesite gravel, sand, and brown clay, WB
390	415	Brownish grey and red volcanic gravel, sand, and clay, WB
415	435	Varicolored mixed volcanic gravel (basalt, rhyolite, andesite, tuff), rounded, reddish brown sand and clay
435	490	Varicolored coarse volcanic gravel, rounded, red to brown sand, brown sticky clay beds
490	530	Varicolored volcanic pebble gravel, rounded, w/ sand and reddish brown sticky clay
530	540	White calcite, black and grey basalt andesite, red rhyolite, red and grey tuff w/ brownish red sticky clay
540	575	Red sticky clay ash, vesicular and fiberous pumice clasts, minor sand, grey pebbles
575	640	Red and grey tuffs w/ altered vesicles, minor grey to greenish to black basalt, andesite, rhyolite, WB?
640	675	Red rhyolite tuff and grey andesite w/ altered vesicles, greenish basalt, blades of calcite
675	715	Light grey basalt, reddish brown and green alteration stains, altered vesicles, pyrite, euhedral calcite and quartz
715	715	Light greyish green rhyolite, reddish brown to dark purple basalt?, altered vesicles, pyrite, calcite and quartz
715	795	Dark greenish grey andesite?, dark purplish brown basalt, minor light red and white tuff, rare euhedral quartz
795	870	Dark grey to brown basalt w/ white pumice chunks, rare red and white tuff cinders, rare euhedral quartz
870	905	Dark greenish grey to dark purplish brown basalt, few pumice, rare euhedral and calcite quartz
905	920	Grey to white calcite flakes, possible fracture zone? no rock data ~ lost circulation, samples floated up during trip out
920	950	Brown sticky slick clay ash, large (<2 cm dia.) euhedral calcite chunks, red cinders and pumice, dries hard
950	1000	Purple, grey, and brown lithic tuff, poorly-welded?, soft waxy, sticky ashy clay, small calcite and quartz crystals
1000	1050	Green, grey, and brown andesite, alteration stains, red lithic tuff, cinders?, large euhedral calcite and quartz crystals
1050	1080	Dark greenish grey andesite, reddish purple stains, hard, fine-grained, large euhedral calcite flakes (fractures?)
1080	1100	no data ~ no returns
1100	1100	Red, grey, white, and brown lithic tuff or volcaniclastic sediment (depth uncertain, samples floated up during cleaning)
1100	1120	no data ~ no returns ~ lost circulation
1120	1120	Dark greenish grey andesite, reddish purple clay? stains, hard, fine-grained, red lithic tuff w/ euhedral quartz crystals, (depth uncertain, sample picked out of the drill collar)
1120	1133	no data ~ no returns
1133	1133	Reddish brown, lithic tuff, poorly-welded?, sticky clay, dries hard, small calcite and quartz crystals (depth uncertain, sample stuck to the drill bit face)
1133	1235	no data ~ no returns
1235	1315	Dark greenish grey andesite, red lithic tuff, euhedral quartz crystals, (depth uncertain, sample stuck to the bailer)
1315	1360	no data ~ no returns
	1360	~ Total Depth

LIT
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LITHOGRAPHIC DESCRIPTION OF OIL OR GAS WELL

(Not required if a mud log is submitted)

STATE OF OREGON • DEPT OF GEOLOGY & MINERAL INDUSTRIES • 229 BROADALBIN ST SW • ALBANY OR 97321

(In compliance with rules and regulations pursuant to ORS 520.)

(1) Permittee Information

Name	Surprise Valley Electrification Corp.
Mailing Address	516 US Hwy 395 E.
City/State/Zip	Alturas, CA 96101
Telephone	530.233.3511
Fax	530.233.2190
Email	lynnsvec@frontier.com
Prepared by	Lynn Culp, Kyle Makovsky, Roy Mink, Silvio Pezzopane

(2) Well Information

Well No.	SVE #2
DOGAMI ID No.	36-037-90027 Lake 1628

	General Manager	5/29/2012
Signature	*Title*	*Date*

(3) Well Cuttings

Depth		Description
From	To	
0	40	Brown clay soil and gravelly sand
40	60	Light brown ash fragments, reddish rhyolite, black basalt, minor calcite/quartz
60	80	Light brown/grey ash, red rhyolite, black basalt, cinders, rounded grains, black and red cuttings magnetic
80	105	Light grey/brown ash, red rhyolite, black basalt, rounded grains, chert and obsidian magnetic
105	125	Light grey/brown ash, red rhyolite, black basalt, rounded grains, purple, orange alteration, green stone
125	155	Grey/brown ash, red rhyolite, black basalt, rounded grains, black and grey chips magnetic, light tan pumice fragments
155	185	Grey/brown ash, red rhyolite, black basalt, magnetic, white/grey pumice green stone, minor alteration stains
185	210	Grey/brown rhyolite, red rhyolite with alteration, black basalt, white/grey pumice
210	245	Grey/brown rhyolite, red rhyolite, black basalt, light brown pumice
245	300	Grey/brown rhyolite, red and brown rhyolite, black basalt, pumice, rounded grains
300	340	Brown/grey rhyolite, rounded w/ some alteration, light grey tuff, black basalt/rhyolite; light grey tuff, feldspar chips
340	360	Grey/light brown rhyolite, dark grey/black rhyolite, light red/yellow altered rhyolite, some chips rounded
360	410	Grey/brown rhyolite, dark grey/black basalt, light red/yellow altered rhyolite, grey/white pumice, rounded pebbles
410	420	Black basalt, light brown rhyolite, some alteration
425	430	no data - no returns
435	460	Black basalt, light brown/grey rhyolite, red altered rhyolite
460	465	Fine sand of light brown/grey rhyolite, black basalt/rhyolite; light brown/red altered rhyolite
465	475	Light brown/grey rhyolite, black basalt/rhyolite, yellow/red altered rhyolite
475	490	Large amount fine sand, smaller cuttings are same as above with white alteration/pumice
490	510	Altered tuff, light grey to reddish brown to dark brown, waxy texture, amorphous silica present
510	530	no data - no returns
530	565	Dark to light gray basalt, andesite, white and green alteration minerals
565	620	Porphyritic basalt and andesite, pink/dark green/white alteration, opaline quartz, amorphous silica, calcite rhombs
620	695	Dark gray, green, purple, and red basalt, amorphous silica, euhedral quartz, and calcite in vesicles
695	710	Porphyritic andesite, opaline quartz
710	790	Gray green and red basalt, altered, fibrous banded white mineral, calcite rhombs, crystalline and opaline quartz
790	800	Olivine rich basalt, little alteration
800	815	Porphyritic andesite and basalt rock, highly altered, clear crystalline quartz, banded alteration
815	845	Amygdaloidal basalt, amygdules are green, white banded, botryoidal texture, calcite grains
845	890	Gray basalt, little to no alteration
890	905	Vesicular/amygdaloidal basalt, high amount of crystalline quartz filling vesicles
905	920	Basalt with pyrite mineralization
920	930	Gray basaltic andesite
930	960	Gray/red/purple basalt, calcite rhombs, some amygdaloidal calcite
960	1010	Dark gray and green basalt, calcite rhombs
1010	1070	Highly altered vesicular/amygdaloidal basalt, pyrite mineralization, dark green/white/pink alteration minerals
1070	1260	no data - no returns
	1260	- Total Depth

LITHOLOGICDESC_SVE2
REV. 08/05/03

iii. Lithographic Description of SVE 3: Well3 LithographicDescription.pdf

LITHOGRAPHIC DESCRIPTION OF OIL OR GAS WELL

(Not required if a mud log is submitted)

STATE OF OREGON • DEPT OF GEOLOGY & MINERAL INDUSTRIES • 229 BROADALBIN ST SW • ALBANY OR 97321

(In compliance with rules and regulations pursuant to ORS 520.)

(1) Permittee Information

Name	Surprise Valley Electric
Mailing Address	516 U.S. Hwy. 395E
City/State/Zip	Alturas, California 96101
Telephone	866-843-2667 530-233-3511
Fax	
Email	
Prepared by	Lynn Culp, Roy Mink, Silvio Pezzopane

(2) Well Information

Well No.	SVE-3
DOGAMI ID No.	

Signature *Title* *Date*

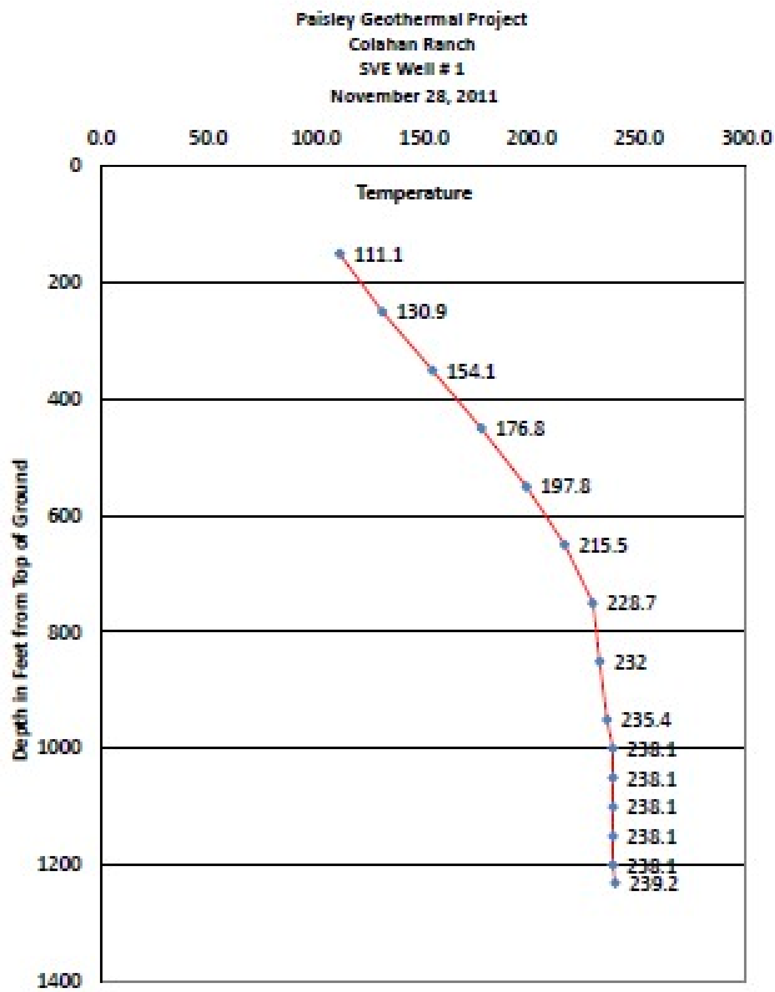
(3) Well Cuttings

Depth		Description
From	To	
0	10	Brown sandy soil and gravelly sand; mix of volcanic lithologies (basalt, rhyolite, andesite, tuff, pumice)
10	40	Brownish-gray rounded fine gravel; mixed volcanic (basalt, rhyolite, andesite, obsidian, tuff, pumice), qtz-rich sand
40	100	Brownish-gray rounded medium to coarse (cobble) gravel; mixed volcanic (as above)
100	180	Dark brownish-gray rounded sand and gravel; mixed volcanic (as above)
180	230	Light-dark brownish-gray rounded medium (pebble) gravel; mixed volcanic (as above)
230	310	Brownish-gray rounded sand and coarse gravel; mixed volcanic (as above), qtz and detrital sand, brown silt and clay
310	440	Dark brownish gray rounded basalt gravel; olivine? phenocrysts rusty yellowish green, minor varicolored tuff and cinders
440	460	Brownish-gray rounded sand and medium gravel; mixed volcanic (as above), qtz and detrital sand, brown clay
460	490	Light-dark brownish gray rounded basalt gravel; phenocrysts rusty yellowish green, minor varicolored tuff and cinders
490	560	Brownish-gray rounded medium (pebble) gravel; mixed volcanic lithologies (as above), sand, brown clay
560	600	Brown sticky clay ash; dark brownish gray basalt gravel; weakly cemented qtz sand and ash fragments
600	660	Brownish-gray rounded pebble gravel; mixed volcanic lithologies, sand, brown clay
660	720	Reddish brown sticky clay ash; lithics of varicolored tuff; rounded pebble gravel, white, red, and black cinders, qtz sand
720	820	Grayish brown clay ash; soft red, olive gray to brown tuff; rounded basalt pebble gravel, w/pumicite and obsidian
820	860	Light olive brown clay ash; chunks soft red and brown non-welded tuff; rounded basalt pebble gravel
860	880	Reddish brown clay ash; chunks olive, red, and brown non-welded tuff; rounded pebble gravel, olive green clay coatings
880	920	Light olive to grayish brown clay ash; waxy red, white, and brown tuff and ash fragments; rounded basalt pebble gravel
920	970	Reddish brown clay ash; waxy olive, red, and brown tuff; weakly cemented qtz sand and ash fragments
970	1040	Brown clay ash; white pumicite, qtz sand, rounded olive and red welded tuff granules, cinders and ash fragments
1040	1140	Reddish brown clay ash; chunks of waxy olive, red, and light gray tuff; weakly cemented qtz sand and ash fragments
1140	1240	Red sticky clay ash; lithics of cinders and qtz ash fragments; whitish, red and gray tuff, rounded obsidian/basalt pebbles
1240	1290	Dark olive brown clay ash; red and olive gray non-welded tuff; rounded qtz, obsidian grains
1290	1350	Dark gray clay and ash; red and gray tuff; rounded basalt pebbles; calcite/qtz (chalcedony?) coatings/fillings
1350	1490	Dark olive gray to black, partially-welded vitric lithic tuff; red and gray tuff; clay, calcite/qtz fillings/cement?
1490	1540	Dark olive gray to black, moderately-welded vitric tuff; varicolored tuff lithics; calcite/qtz fillings/cement
1540	1630	Black partially-welded lithic tuff (50%); brown clay ash (20%), varicolored tuff (30%); calcite/qtz blades/fillings/cement
1630	1730	Reddish brown clay ash (60%); black to olive and varicolored tuffs (40%); calcite/qtz euhedral, blades/coatings
1730	1840	Black to dark olive partially-welded lithic tuff (60%); brown and gray tuff (40%); calcite/qtz in blades/fillings/cement
1840	1910	Black to dark olive partially-welded lithic tuff (50%); brown and gray tuff (50%); calcite/qtz in blades/fillings/cement
1910	1920	Reddish brown clay ash (60%); olive to black, and varicolored tuff (30%); calcite/qtz blades, rounded pebbles
1920	1990	Dark gray to black partially-welded tuff (60%); brown and gray ash tuff (40%); calcite/qtz fillings/cement
1990	2090	Olive gray to black moderately-welded vitric tuff (80%); white, red and gray ash tuff (<20%); chalcedony, FeO stains?
2090	2210	Light gray to white ash tuff (90-20%); black to olive gray tuff (20-70%), brown, red, and gray tuff (2-15%); qtz
2210	2370	Dark reddish brown lithic non-welded (ash) tuff (70-90%); red, white, black, and olive gray tuff (10-30%); calcite/qtz
2370	2410	Light bluish to greenish gray ash tuff (90-20%); brown, red, black, white, olive tuff (20-70%); calcite/euhedral qtz
2410	2430	Dark reddish brown lithic ash tuff (50-70%); greenish gray tuff (20-30%), red, gray, and black tuff (10-20%); calcite/qtz
2430	2460	Light bluish to greenish gray ash tuff (90-20%); brown, black, and red lithic tuff (20-70%); euhedral calcite blades/qtz
2460	2580	Dark reddish brown lithic ash tuff (40-50%); greenish gray ash tuff (20-30%), varicolored tuff (10-30%); calcite

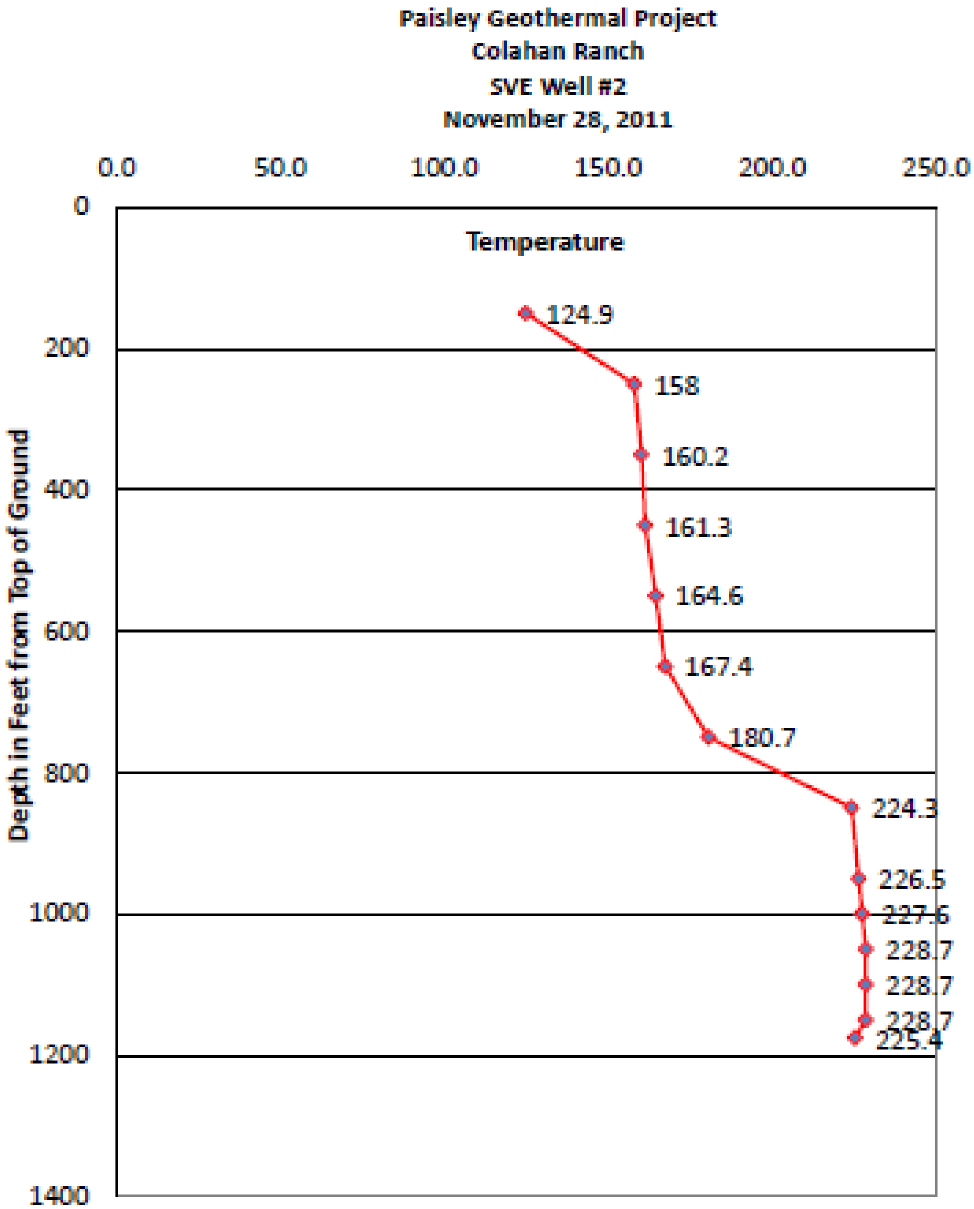
LITHOLOGICDESC_SVE3.DOC
REV. 08/05/03

2580	2610	Reddish brown tuff (30-40%); olive gray moderately-welded tuff (20-30%); varicolored lithics (20-30%), calcite blades
2610	2630	Reddish brown tuff (30-40%); olive gray densely-welded tuff (20-30%); varicolored lithics (20-30%), calcite blades
2630	2660	Reddish brown tuff (40-50%); olive gray partially-welded tuff (20-30%); varicolored lithics (10-20%), calcite/qtz crystals
2660	2705	no returns ~ no data
	2705	~ Total Vertical Depth (before cleaning)

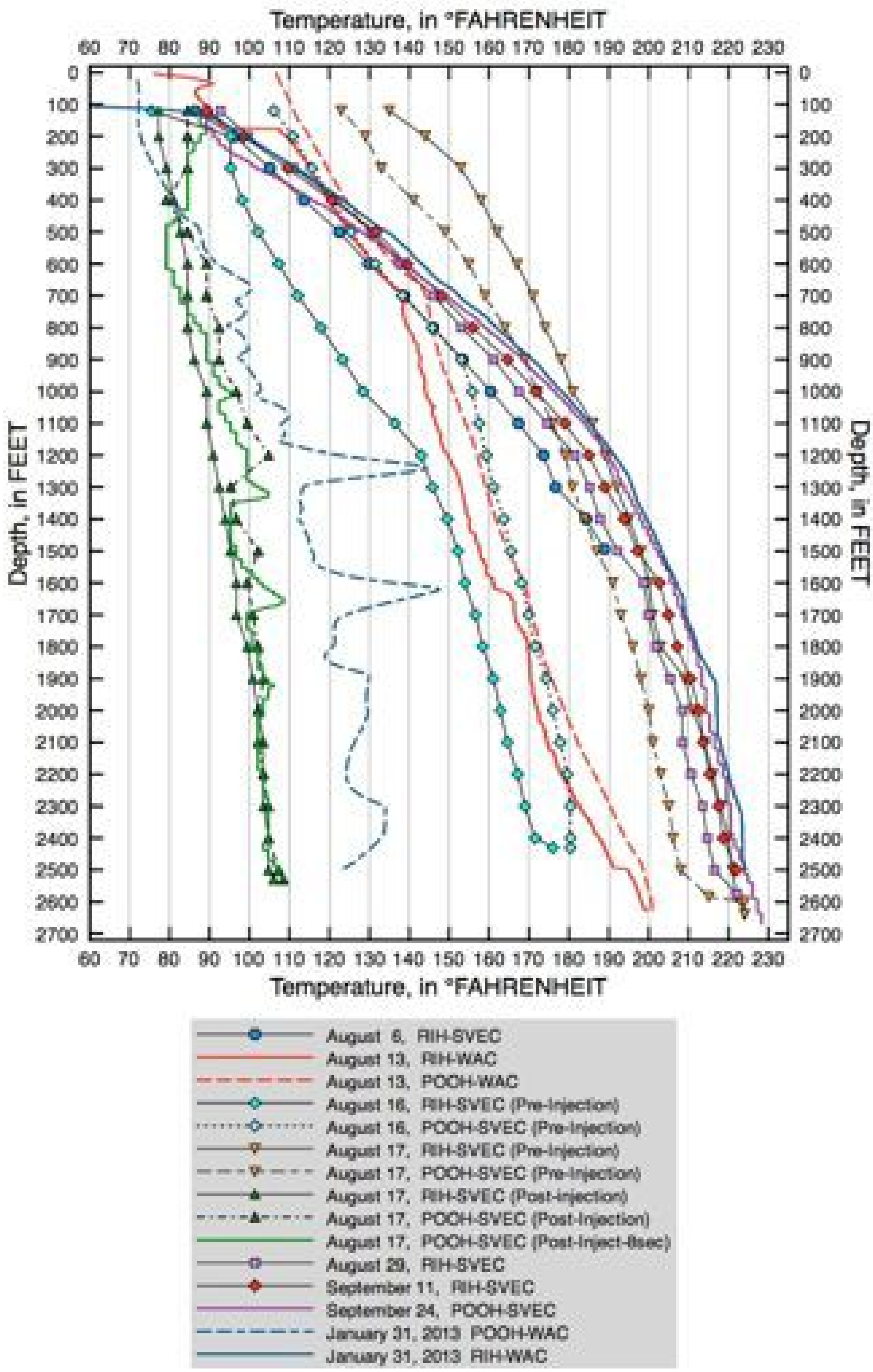
iv. Well Temperature Log SVE 1: SVE Well1 1128.pdf



v. Well Temperature Log SVE 2: SVE Well 2 Well Log 1128.pdf



vi. Well Temperature Log SVE 3: SVE 3 Well Logs 2012-2013.pdf



vii. Well Chemistry SVE 1: SVE 1 Chemistry 2-01-12.pdf

Analytical Laboratories, Inc.

1804 N. 33rd Street
Boise, Idaho 83703
Phone (208) 342-5515

Date Report Printed: 2/1/2012 2:38:07 P
http://www.analyticallaboratories.com

Laboratory Analysis Report

Sample Number: 1201437

Attn: DAN HAND
SUSTAINABLE ENGINEERING
13801 120TH ST E
PUYALLUP, WA 98374

Collected By:
Submitted By: UPS

Source of Sample:
PARSLEY PRODUCTION WELL

Time of Collection: 14:30
Date of Collection: 12/30/2011
Date Received: 1/16/2012
Report Date: 2/1/2012

PWS#:
PWS Name:

Field Temp: Temp Rcvd in Lab:

PH, NO3 ND PAST RECOMMENDED HOLDING TIME. DAN HAND SAID TO RUN ANYWAY.

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic Low	0.01	0.538	mg/L	0.003	EPA 200.8	1/23/2012	JH
Value greatly exceeds the Drinking water MCL of 0.010 mg/L.							
Boron, B		8.07	mg/L	0.10	EPA 200.7	1/19/2012	KC
Calcium, Ca	UR	29.5	mg/L	0.50	EPA 200.7	1/24/2012	KC
Iron, Fe	UR	0.26	mg/L	0.05	EPA 200.7	1/20/2012	KC
Magnesium, Mg	UR	<0.50	mg/L	0.50	EPA 200.7	1/24/2012	KC
Manganese, Mn	UR	<0.05	mg/L	0.05	EPA 200.7	1/20/2012	KC
Potassium, K	UR	10.9	mg/L	0.5	EPA 200.7	1/24/2012	KC
Silica	UR	142	mg/L	0.25	EPA 200.7	1/19/2012	KC
Sodium, Na	UR	311	mg/L	0.50	EPA 200.7	1/31/2012	KC
Nitrate (as N)		<0.2	mg/L	0.2	EPA 300.0	1/16/2012	KC
Carbon, Total Inorganic		12.5	mg/L	0.1	EPA 415.1	1/17/2012	MDM
Bicarbonate		76.8	mg/L		SM 2320	1/18/2012	SS
Carbonate		0.0	mg/L		SM 2320	1/18/2012	SS
Chloride, Cl	UR	232	mg/L	1	EPA 300.0	1/17/2012	KC
Conductivity	UR	1,750	umhos	2	SM 2510B	1/16/2012	KC
Fluoride, F	4.0	3.20	mg/L	0.10	EPA 300.0	1/16/2012	KC
pH	UR	8.5	S.U.		SM 4500-H B	1/16/2012	KC
Sulfate, SO4	UR	391	mg/L	1	EPA 300.0	1/17/2012	KC
Total Dissolved Solids	UR	1,130	mg/L	25	SM 2540C	1/20/2012	MG

CC: email to: [illegible]

MCL = Maximum Contamination Level
MDL = Method/Minimum Detection Limit
UR = Unregulated

Thank you for choosing Analytical Laboratories for your testing needs.
If you have any questions about this report, or any future analytical needs, please contact your client manager.
James Hibbs

viii. Well Chemistry SVE 2: ChemTest SVE2.pdf

Analytical Laboratories, Inc.

1804 N. 33rd Street
Boise, Idaho 83703
Phone (208) 342-5515

Date Report Printed: 11/18/2011 3:26:3
http://www.analyticallaboratories.com

Laboratory Analysis Report

Sample Number: 1133304

This is SVE 2, which was originally identified as the "injection well"

Attn: DAN HAND
SUSTAINABLE ENGINEERING
13801 120TH ST E
PUYALLUP, WA 98374

Collected By:
Submitted By: FED EX

Source of Sample:
PAISLEY, OR COLAHAN RANCH INJECTION WELL

Time of Collection: 15:51
Date of Collection: 10/30/2011
Date Received: 11/2/2011
Report Date: 11/18/2011

Field Temp: Temp Rcvd in Lab:

PWS#:
PWS Name:

NO3/PH RCVD PAST RECOMMENDED HOLDING TIME

Test Requested	MCL	Analysis Result	Units	MDL	Method	Date Completed	Analyst
Arsenic Low	0.01	0.450	mg/L	0.003	EPA 200.8	11/10/2011	JH
Boron, B		8.13	mg/L	0.10	EPA 200.7	11/15/2011	KC
Calcium, Ca	UR	36.3	mg/L	0.50	EPA 200.7	11/8/2011	KC
Iron, Fe	UR	37.6	mg/L	0.05	EPA 200.7	11/11/2011	KC
Magnesium, Mg	UR	6.78	mg/L	0.50	EPA 200.7	11/8/2011	KC
Manganese, Mn	UR	1.25	mg/L	0.05	EPA 200.7	11/9/2011	KC
Metals Digestion		*			EPA 200.9-11	11/3/2011	JMS
Potassium, K	UR	17.0	mg/L	0.5	EPA 200.7	11/8/2011	KC
Silica	UR	246	mg/L	0.25	EPA 200.7	11/17/2011	KC
Sodium, Na	UR	306	mg/L	0.50	EPA 200.7	11/15/2011	KC
Nitrate (as N)		<0.2	mg/L	0.2	EPA 300.0	11/2/2011	KC
Carbon, Total Inorganic		13.8	mg/L	0.1	EPA 415.1	11/15/2011	MDM
Bicarbonate		101	mg/L		SM 2320	11/10/2011	SS
Carbonate		0.0	mg/L		SM 2320	11/10/2011	SS
Chloride, Cl	UR	229	mg/L	1	EPA 300.0	11/8/2011	KC
Conductivity	UR	1,630	umhos	2	SM 2510B	11/2/2011	JK
Fluoride, F	4.0	2.98	mg/L	0.10	EPA 300.0	11/8/2011	KC
pH	UR	8.4	S.U.		SM 4500-H B	11/2/2011	JK
Sulfate, SO4	UR	387	mg/L	1	EPA 300.0	11/8/2011	KC
Total Dissolved Solids	UR	1,200	mg/L	25	SM 2540C	11/4/2011	DLR

MCL = Maximum Contamination Level
MDL = Method Minimum Detection Limit
UR = Unregulated

Thank you for choosing Analytical Laboratories for your testing needs.
If you have any questions about this report, or any future analytical needs, please contact your client manager.
James Hibbs

ix. Well Chemistry SVE 3: Well 3 chemistry.pdf

Alpha Analytical, Inc.

255 Glendale Ave. • Suite 21 • Sparks, Nevada 89431-5778
(775) 355-1044 • (775) 355-0406 FAX • 1-800-283-1183

ANALYTICAL REPORT

Geologica Inc.
639 Isbell Rd, Suite 380-H
Reno, NV 89509

Attn: Leland Davis
Phone: (775) 525-0019
Fax:
Date Received : 10/24/12

Job:

Anions by IC
EPA Method 300.0

		Parameter	Concentration	Reporting Limit	Date Extracted	Date Analyzed
Client ID: SVE-3a						
Lab ID :	GEL12102423-01A	Chloride	210	50 mg/L	10/30/12 08:11	10/30/12 12:41
Date Sampled	10/22/12 10:00	Sulfate (SO4)	350	75 mg/L	10/30/12 08:11	10/30/12 12:41
Client ID: Paisley City Well						
Lab ID :	GEL12102423-02A	Chloride	3.3	0.50 mg/L	10/30/12 08:11	10/30/12 13:00
Date Sampled	10/23/12 12:50	Sulfate (SO4)	7.3	0.50 mg/L	10/30/12 08:11	10/30/12 13:00
Client ID: SVE-3B						
Lab ID :	GEL12102423-03A	Chloride	210	50 mg/L	10/30/12 08:11	10/30/12 13:18
Date Sampled	10/23/12 13:10	Sulfate (SO4)	350	75 mg/L	10/30/12 08:11	10/30/12 13:18

Roger Scholl Randy Gardner Walter Hinchman

Roger L. Scholl, Ph.D., Laboratory Director • • Randy Gardner, Laboratory Manager • • Walter Hinchman, Quality Assurance Officer
Sacramento, CA • (916) 366-9089 / Las Vegas, NV • (702) 281-4848 / Carson, CA • (714) 386-2901 / info@alpha-analytical.com
Alpha Analytical, Inc. certifies that the test results meet all requirements of NELAC unless footnoted otherwise.

11/07/12
Report Date

x. Wells Summary: SVEWellData_Summary.xlsx

Well #	Drill Depth	Bottom Temp.	Test Flow/gpm	Flowing Temp.	Production Flow/gpm	Pumping Water Level	Static Level	
SVE Well #1	1360ft	239.2 F	1300	240 F	1000	440ft	140ft	production brine
SVE Well #2	1260ft	225.4 F	2500	227 F	2000	260ft	131ft	production brine
SVE Well #3	2705ft	225 F	2200	225F		159ft	106ft	for injection of spent brine
SVE Well #4	378ft		60	118 F	60	270ft	94ft	cooling water
Little Hot Well	270ft*		300	125 F	146	252ft	86ft	cooling water

*Drilled to 315ft in 1964, cased to 270ft. Deepened to 432ft 1987. Oct 2013 video showed well had filled to 270ft.

xi. Injectivity of SVE 2: Injectivity of Well SVE2.pdf

Injectivity of Well SVE#2

In October 2012, produced water from well SVE#3 was injected into well SVE#2 at a rate of ~2000 gpm. The wellhead pressure was about 3 to 4 psi. Although the temperature of the injected fluid was not recorded, it is estimated to be ~150 ^{o}F (Lynn Culp, E-mail dated January 10, 2013). The static water level in SVE#2 is about 130 ft below the wellhead. Assuming a liquid water pressure gradient of 0.43 psi/ft, the excess pressure (i.e. pressure over the stable reservoir pressure) is estimated to be

P (excess) = 3.5 + 0.43 (130) = 59.4 psi.

Thus a rough estimate of the injectivity of SVE#2 is given by:

II = 2000/59.4 = 34 gpm/psi

With an injectivity of 34 gpm/psi, the minimum injection rate to obtain a positive wellhead pressure is 0.43(130) (34) = 1900 gpm.

During the January 2013 injection test of SVE#2, injection rates ranged from 505 gpm to 1400 gpm. Not unsurprisingly, these injection rates were not accompanied by a positive wellhead pressure in SVE#2.

To conclude, available data indicate that SVE#2 has a very high injectivity of about 34 gpm/psi. For liquid feedzone wells such as SVE#2, to first order the productivity index equals the injectivity index. Pending future additional testing of SVE#2, a productivity index of 34 gpm/psi may be used for modeling the production behavior of this well.

xii. Injectivity of SVE 3: Injection_Test_SAIC_Report.pdf. Full report not included here.

Multi-rate Injection Test of Well SVE#3, January 30-31, 2013

A multi-rate injection test was performed in well SVE#3 on January 30-31, 2013. The total injection period was about 24 hours. The pressure and temperature data recorded by a downhole gauge at 2500 ft are displayed in Figure 1. Prior to injection, the temperature at 2500 ft was about 225 ^{o}F; it quickly declined to about ~78 ^{o}F after about 1 hour of injection and then more slowly to ~54 ^{o}F towards the end of the injection period. After stopping injection, the temperature at 2500 ft began to recover; by the end of the recording period (Figure 1), the temperature had increased to ~124 ^{o}F. The temperature of the injected water varied from ~70 ^{o}F at the start of injection to ~50 ^{o}F at the end of injection.

(several pages of test results and discussion come between these two statements)

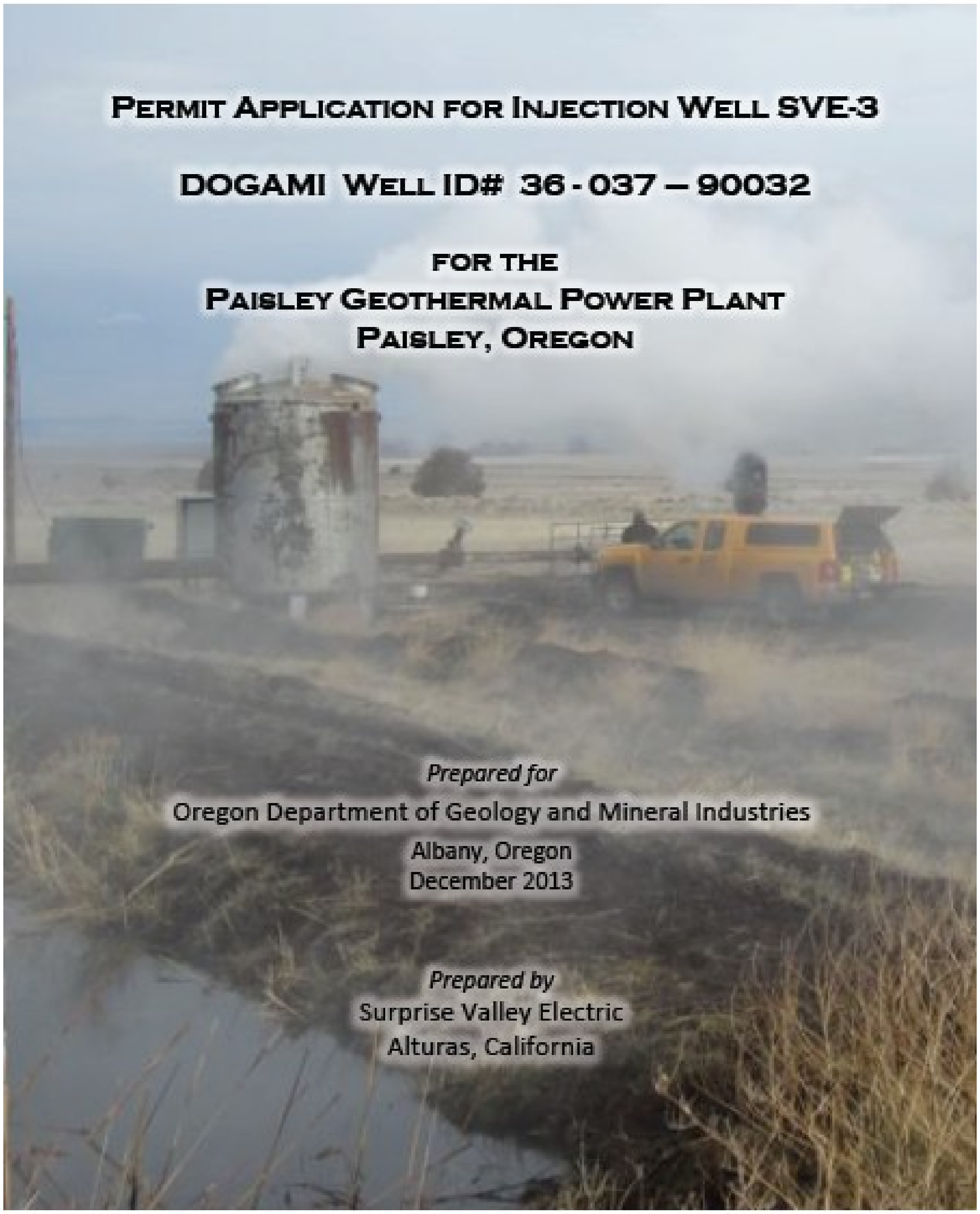
II = 913/ (1023.2-1017.1) = 150 gpm/psi

The above injectivity value is extremely high and is consistent with the very high permeability-thickness inferred from the fall-off data. It should be noted here that the pressure was still increasing at the end of the injection period; therefore, it is likely that the injectivity index derived from a long-term injectivity test will be lower than 150 gpm/psi.

In conclusion, it appears that the formation intercepted by well SVE#3 is extremely permeable, and that the well has a very high injectivity index. It will be prudent to confirm the inferred value of the injectivity index from the present very short (~24 hours) injectivity test with a much longer (at least one week) test. Injection into well SVE#3 should present minimum problems, and be achievable with none (or minimum) injection pumping loads.

xiii. DOGAMI Injection Permit Application: SVE_INJECTION_Permit_lr.pdf.

Complete report may be requested for review.



Appendix B – Project Costs

Total cost of this project was $22 million for a plant which produces 3.1 mw gross. The completed project is significantly larger than the original design and therefore the price tag is greater than initial grant application. The cost per megawatt is $7.1 million. With grants and tax credits of nearly $5 million the project cost is $5.5 million per megawatt. Our budget during development proposed a cost of $2.5-$3 million per megawatt after grants and tax credits applied.

The following tables provide an overview of the financial expenditures of the project. Line 6.d. listed as "Equipment" is broken down in the second table.

Line 6.f. "Contractual" includes:

a. $467,090 for resource development, which includes, building the resource model and monitoring and modeling wells production and injection tests.
b. $2,993,690 for drilling, materials, construction and development of production wells SVE 1 and SVE 2, injection well SVE 3 and make up water well SVE 4.
c. $913,634 for engineering of the gathering system and transmission power line and electrical substation.
d. $706,119 for materials and construction of .9 mile 69 kv transmission line from power plant substation to SVEC Paisley substation/transmission line.
e. $5,856,059 for the construction of the gathering system, including cost of materials and construction of pipe lines from the production wells to the plant and the pipe line from the plant to the injection well; construction of power plant foundations, materials and construction of electrical system and fences; assembly of power plant units and cooling tower.

Applicant Name: SURPRISE VALLEY ELECTRIFICATION CORP. Award Number: DE-EE0003006

Budget Information - Non Construction Programs

OMB Approval No. 0348-0044

Section A - Budget Summary		Estimated Unobligated Funds		New or Revised Budget		
Grant Program Function or Activity (a)	Catalog of Federal Domestic Assistance Number (b)	Federal (c)	Non-Federal (d)	Federal (e)	Non-Federal (f)	Total (g)
1. Budget Period 1 of 1	81.087			$2,000,000	$18,046,974	$20,046,974
2.						$0
3.						$0
4.						$0
5. Totals		$0	$0	$2,000,000	$18,046,974	$20,046,974

Section B - Budget Categories	Grant Program, Function or Activity				
6. Object Class Categories	(1)	(2)	(3)	(4)	Total (5)
a. Personnel	$177,084				$177,084
b. Fringe Benefits	$70,834				$70,834
c. Travel	$58,920				$58,920
d. Equipment	$8,995,258				$8,995,258
e. Supplies					$0
f. Contractual	$10,936,679				$10,936,679
g. Construction					$0
h. Other	$229,200				$229,200
i. Total Direct Charges (sum of 6a-6h)	$20,467,975	$0	$0	$0	$20,467,975
j. Indirect Charges					$0
k. **Totals** (sum of 6i-6j)	$20,467,975	$0	$0	$0	$20,467,975
7. Program Income					$0

Project Equipment Costs

Equipment Item	Qty	Unit Cost	Total Cost	Basis of Cost	Justification of need
			Budget Period 1		
EXAMPLE ONLY!!! Thermal shock chamber	2	$20,000	$40,000	Vendor Quote	Reliability testing of PV modules- Task 4.3
TURBINES	1	$7,709,940	$7,709,940	TAS ENERGY Invoice	TASK 2.1 PLANT
TURBINES/DELIVERY	1	$447,172	$447,172	TAS ENERGY Invoice	TASK 2.1 PLANT DELIVERY
PUMPS IN PLANT	1	$13,462	$13,462	GOULDS PUMPS INC. INVOICE	TASK 2.1 PUMPS IN PLANT
WELL PUMP	1	$151,750	$151,750	KLAMATH PUMP CENTER Invoice	TASK 2.3 PUMPS IN WELLS
INSTRUMENTATION/CONTROLS	1	$38,590	$38,590	SIEMANS INVOICE	TASK 2.4 ELECTRICAL UPGRADE-CIRCUIT BREAKER
GENERATOR	1	$101,551	$101,551	CUMMINS NORTHWEST LLC Invoice	TASK 2.6 ASSEMBLY/BACKUP GENERATOR
TRANSMISSION	1	$327,264	$327,264	ABB INC. Invoice	TASK 2.6 SUBSTATION TRANSFORMER
INSTRUMENTATION/CONTROLS	1	$42,481	$42,481	SAYLOR CUSTOM CONTROLS INC. INVOICE	TASK 2.6 ASSEMBLY/MONIORING-CONTROL PANELS
INSTRUMENTATION/CONTROLS	1	$108,520	$108,520	PCE PACIFIC INC. INVOICE	TASK 2.6 ASSEMBLY/MONITORING-CONTROL
INSTRUMENTATION/CONTROLS	1	$22,046	$22,046	INVENSYS SYSTEMS INC. INVOICE	TASK 2.6 ASSEMBLY/MONITORING-CONTROL GAUGE
INSTRUMENTATION/CONTROLS	1	$27,369	$27,369	RUST AUTHOMATION & CONTROLS INC. INVOICE	TASK 2.6 ASSEMBLY/MONITORING-CONTROL INSTRUMENTS
INSTRUMENTATION/CONTROLS	1	$5,113	$5,113	SELMON COMPANY INC. INVOICE	TASK 2.6 ASSEMBLY/MONITORING-CONTROL INSTRUMENTS
Budget Period 1 Total			$8,995,258		
			Budget Period 2		
			$0		
			$0		
Budget Period 2 Total			$0		
			Budget Period 3		
			$0		
			$0		
Budget Period 3 Total			$0		
PROJECT TOTAL			$8,995,258		

Additional Explanations/Comments (as necessary)

The above table is the cost for the equipment which makes up the power plant, electrical substation and gathering system. It does not include the cost of pipe line material and construction. Following are descriptions of the equipment in each of the categories listed above:

a. Turbines. This is the TAS Energy power plant including engineering costs for the plant design. This item includes the turbine, vaporizer, condenser, gear head, generator, cooling tower and fans, refrigerant pump out equipment, high pressure refrigerant pump, two cooling water pumps, control house, electrical switchgear, electrical control center, programming and controls, piping, sensors, valves, refrigerant and various other equipment to operate the power plant.
b. Pumps in Plant is the pump for the chemical blowdown system.
c. Well Pump. This is the cost for the two production pumps and two make up water pumps, including installation.
d. Instrumentation and Controls (6 items). These items are on the gathering system and include flow meters, pressure gauges, temperature gauges, electrical panels, control panels and various equipment to automate the control and monitoring of the gathering system.
e. Generator. This is the backup diesel generator that is used when the electrical supply to the plant is lost. This system operates to allow the plant to cool down and protect against pressure build up and loss of refrigerant.
f. Transmission. This is the cost for the 10mva transformer in the power plant substation.

SVEC's total cost of the project is $22 million. The cost allowed for the DOE cost-share is $20,467,975. The additional $1.5 million was for early project research, design and development, including personnel and travel costs.