PAGOSA SPRINGS COLORADO

AGENDA BRIEF

MEETING: Town Council - 07 Jul 2020
FROM: Martin Schmidt, Public Works Director

PROJECT: Geothermal Report

ACTION: Council information

PURPOSE/BACKGROUND:

The Town of Pagosa Springs has owned and operated a geothermal heating system since December 1982 to provide geothermal heating during the colder months to customers in Town. The Town's geothermal heating system was funded by the Department of Energy (DOE) with additional funds provided by Archuleta County and the Town. The total cost to complete the system was over 1.4 million dollars (3.96 million in 2020). Currently, the system has 32 customers of varying sizes and is fully operational (shutdown for summer). The heating season for our geothermal system is typically October through April. The weather dictates the startup and shutdown of the system.

The attached report summarizes a review of the system completed by Plummer on behalf of the Town. The review includes an assessment of existing conditions of the major infrastructure, the existing demands and capacity for system expansion, and potential new ways to expand both the heat distribution utility and the geothermal resource; In each section there are recommended improvements. Manufacturer quotes and capital planning level cost estimates are included in the appendices for each recommended improvement, maintenance item, or major expansion opportunity for Town staff to make informed decisions about improvements.

Existing Conditions

Of the three wells owned by the Town, only two are used for the generation of heat for geothermal customers. The third well is leased to the Overlook Hot Springs. The geothermal water right of 450 gallons per minute that is used for heating is pulled from the #5 well. All of these wells are in good condition for their age and only require periodic maintenance. This water flows to the geothermal building where the heat is exchanged to a distribution loop. The heat exchanger has not had maintenance other than periodic cleaning since it was put into service. It is nearing limit of its continued service and needs attention by the manufacturer soon.

The optimal operation of the heat exchanger with current water rights, would produce 20% more saleable heat per day.

There are 3.4 miles of distribution and return lines under downtown Pagosa Springs. This pipe is Transite, a concrete-asbestos composite that was widely used for water delivery in the past. The expected lifespan of Transite is 50 years, putting Pagosa's piping near the end of its service life. The Transite system also limits the capability of the distribution loop because of the leaking that occurs when the pressures rise. Repairs to the system have been done with HDPE pipe, but because of the heat tolerance limitations it is not recommended to use this material in the future. Customer taps and piping have not been a large issue but have been made with a hodgepodge of materials and need to be done exclusively with PEX in the future.

Plummer has several recommendations for the current system. They recommend that the Town develop a plan to replace the Transite pipe completely. This replacement should be done with insulated pipe to significantly increase saleable heat. They also recommend that the heat exchanger go through extensive manufacturer maintenance in order to head off any failures of this critical part of the system. There is also a private well that threatens to fail and put all geothermal resources at risk for all users, Plummer suggests that the Town take a leadership role in coordinating the repair of this well or mitigating the risk.

System Capacity

System Capacity is the ability of our system to produce heat, lose heat during distribution and building heating, and still provide the amount of heat that our customers require to heat their homes. Plummer used historical data to determine that approximately 75% of transferred heat is lost and not sold to customers. This loss is related to the lack of pipe insulation and the natural limitations of a distribution system of this size. Major limitations to the capacity of the system are the gallons per minute flow of raw geothermal water, the gallons per minute flow of the distribution loop and the amount of heat the aquifer supplies (about 144 degrees). Modelling the current system, Plummer approximates that the geo system is delivering about 32,800 kBtu/day to current customers. By pushing the limits of our system and increasing the distribution loop GPM, the Town could increase its saleable heat by about 20%. The age and condition of the piping in the distribution loop make this unwise at this time.

By increasing the Town's water rights the number of customers could be increased further, but an attempt to increase the water rights was attempted in the early 1990's and was met with resistance. By using the 100 GPM that the Rumbaugh well has available for heating, the system could be expanded, but piping from this well head to the geothermal building would need to be installed. The best time for this connection would be during additional pipe replacements in the system. Staff asked Plummer to look into the possibility of a reinjection system or a closed loop system to determine if this could increase the amount of saleable energy, and the cost of drilling new wells and the technological challenges of this kind of reinjection make this a costly endevor with few benefits. Plummer does not recommend moving in this direction. Insulation in the existing system is not complete and adding insulated pipe could increase the system capacity by about 10 customers. This is in ongoing benefit without ongoing costs and seen a good option to pursue for the Town.

Expansion Opportunities

Staff requested that Plummer investigate the opportunities for expansion of the use of the Town's geothermal resource. This section looked at three main areas for expansion. The first was an option that would have allowed the geothermal system to run year-round. The summer cooling option would have used river water to supply cooling to the heat exchangers of geothermal customers in the summer. Unfortunately, the average summer river temperature is too high to provide effective cooling. Plummer stopped investigating this option at this point.

The second opportunity for expansion centered around increased traditional use (heating). The school district had asked the Town to look into connecting the high school to geothermal heat, but it was quickly determined that the geothermal utility does not have enough available heat to support the high school. Plummer recommends that the Town focus on new building heat connections on a smaller scale. While snowmelt and sidewalk heat are interesting options for geothermal heat, their heat usage is inconsistent and taxing to the system when used. In order to provide consistent heat service, this should not be a primary usage.

The third option that Plummer explored was the generation of electricity on a small scale. They included Information about a Thermal Electric Storage System from Novacab. This unit would use the outflow of our raw geothermal water, strip about 10 additional degrees from the water, and produce up to 1,634 MWh per year. This electricity could be used by the Town to offset the cost of running the geothermal pumps or sold back to LPEA. While the rate may be different for generation of this scale, the current wholesale rate of 4.2 cents per hour was used to estimate a potential annual revenue of $68,600 from the Novacab units. They have a substantial upfront cost of about $800,000, so the return on investment would be in about 12 years based on Plummer's estimations. One benefit to this energy generation would be that the geothermal utility would generate revenue in the summer, when it has traditionally not been operated.

The options presented by Plummer all have associated costs, some are within the geothermal utility's ability to budget for, and others like the TESS units and the full replacement of piping, would require outside assistance. Staff is looking for possible funding options at the state and federal levels. There may be funding for small scale energy generation through the state, and the Department of Energy may allow current DOE energy conservation funding to be used on previous DOE projects. Staff will present any funding options as they become available.

To summarize the Plummer report, the current system is generally working well and is sustainable for approximately another 10 years before major replacement work will need to occur through the entire distribution system. There is availability to increase the number of customers by a reasonable amount, and other uses of the geothermal resource should be explored. This report has given staff the information to pursue informed options for the geothermal system that can be used to insure the continued operation of this Utility.

Recommended Actions with Associated Costs

1. Pipe Replacement with PE-RT Insulated Pipe – $3.9 million
2. Heat Exchanger Maintenance - $35,180.00
3. Private Well Maintenance/Mitigation – $ Unknown; Protects Resource
4. Expansion of up to 13 customers – Connection fee + monthly rate
5. PEX for all future connections/repairs for customers – Increased saleable heat
6. Meter Heat Use for Billing Data/Rate Study - $1600 per new meter
7. TESS Unit Installation - $800,000
8. Minimal Sidewalk/Intersection Heating in the future - $ Unknown

ATTACHMENTS:
Plummer - Pagosa Geothermal Assessment

TOWN COUNCIL GOALS & OBJECTIVES:
3E: Develop a geothermal heating plan/assessment

TECHNICAL MEMORANDUM

Geothermal System Assessment

Town of Pagosa Springs
Pagosa Springs, Colorado

Prepared For	Pagosa Springs Sanitation General Improvements District
Prepared By	Steve Omer, P.E.
DATE	June 30, 2020
VERSION	1
PROJECT NO.	4092-008-01

PLUMMER

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1 INTRODUCTION

The Town of Pagosa Springs (Town) has been operating a geothermal heat distribution utility since 1981. The system uses a heat exchanger and closed loop distribution system to convey heat to nearby businesses and residences. Since the original installation, only general maintenance and the addition of flow meters has been completed and there has been no expansion of the service area. The existing equipment continues to perform as designed and provide an economical heat source to utility customers.

This technical memorandum (TM) provides a summarized review of the system completed by Plummer on behalf of the Town. The review includes an assessment of existing conditions of the major infrastructure, the existing demands and capacity for system expansion, and potential new ways to expand both the heat distribution utility and the geothermal resource for uses other than heat delivery; each section includes recommended improvements. Manufacturer quotes and capital planning level cost estimates are included in the appendices for each recommended improvement, maintenance item, or major expansion opportunity.

2 EXISTING CONDITIONS

The existing geothermal wells, heat exchanger, and distribution piping network have been in service since 1981. Minimal changes have been to the system since the original development was completed. The original piping at the well heads and within the geothermal building is steel, the distribution piping is Transite, and some of the pipe connections at the heat exchanger building have been replaced with HDPE. The following sections discuss each major component of the system.

2.1 GEOTHERMAL WELLS

The Town owns three geothermal wells, two of which are in active use. They are locally designated as the Rumbaugh Well, Well 3 and Well 5. Production from the Rumbaugh Well is not directly used by the Town but is leased to the Overlook Hot Springs. Well 3 has not been in operation in recent years and Well 5 is currently used to supply geothermal water to the heat exchanger.

Wells 3 and 5 share a single water right that is limited to 450 gallons per minute (gpm); the Town is able to consistently draw the full water right through Well 5, and Well 3 has not been operated in recent years. The Rumbaugh Well has a seasonably variable water right of 150 gpm during the heating season and 35 gpm during the non-heating season; 35 gpm is currently leased to the Overlook Hot Springs on an annual basis. Figure 1 shows the current condition of Well 5; the coating appears to be in good condition with some scale showing due to discharges from the air relief valve (this scale is not harming the coating or impacting the coatings rust preventive ability for the metal piping).

Figure 1. Well 5

2.2 HEAT EXCHANGER AND GEOTHERMAL BUILDING

Water from the geothermal supply well enters the geothermal building and passes through a plate and frame heat exchanger unit that transfers heat into the water in the distribution loop. The distribution loop water is supplied by a connection to the Pagosa Area Water and Sanitation District (PAWSD) potable water supply. Geothermal water leaving the heat exchanger is used by the nearby greenhouse project and then transferred to the Springs Resort for use in their geothermal pool and hot tubs. However, the geothermal water may also be discharged into the San Juan River if the Springs Resort lease should ever terminate. Flow from the well through the heat exchanger is artesian (there is no pump used to convey the geothermal water). The heat distribution system operates as a closed loop and a pump in the geothermal building moves water though the heat exchanger and distribution piping.

The piping and equipment in the geothermal building is in good repair. The temperature sensors were replaced in 2019 and the pipe coating is in good condition overall. Figure 2 (below) shows the heat exchanger and connecting piping. The yellow piping is the hot geothermal water from the well, the red piping is the geothermal water leaving the heat exchanger, orange piping is heated water for distribution, and green piping is the return from the distribution loop.

The plate and frame heat exchanger is a Tranter Supercharger Model with 326 plates that provide a total exchange surface area of 2650.5 square feet. This unit is relatively small within the Tranter product line, with similar units being able to provide up to 22,000 square feet of surface area. Operators occasionally tighten the heat exchanger plate pack to control leakage. The heat exchanger has a plate pack length tolerance range of 51.64 to 54.88 inches, and the current plate pack measurement is 51.81 inches. As the gaskets reach maximum compression, the torque required to tighten and seal the exchanger begins to rise exponentially.

Figure 2. Heat Exchanger

Table 1 summarizes the results of heat exchanger performance modeling completed by Tranter (Appendix A). Geothermal water enters the exchanger at 140 degrees F; all other temperatures at the exchanger are dependent on system performance and user demands. The Existing Conditions model scenario represents recent system performance, while the Max Distribution scenario shows the maximum performance that could be achieved with the existing system. The Theoretical Condition evaluates performance potentials that could be achieved with additional water rights; this condition is only presented as an example and increasing water rights is not a recommendation of this study.

Table 1. Modeled Heat Exchanger Performance

Description	Geothermal Flow Rate	Distribution Flow Rate	Heat Exchanged (kBtu/day)
Existing Conditions	450	375	131, 077
Max Distribution	450	700	158,908
Theoretical Condition[1]	700	700	225,311

1) This Theoretical Condition would require additional water rights

2.3 DISTRIBUTION SYSTEM

The distribution system delivers heated water to customer taps through two loops of buried pipe and occasional air release and flow control valves. One loop serves customers to the North of Hwy 160 along the Highway and Lewis Street, while the second loop serves customers along Durango, San Juan, and 8th Streets. There are several air release valve vaults to help release accumulated air from the system. At the far end of each loop of the distribution system, there is a flow control valve that provides some restriction where the system transitions from the feed to the return piping. The distribution system consists of approximately 1,480 feet of 6-inch, 14,304 feet of 8-inch, and 2,313 feet of 10-inch piping; there is a total of 18,100 feet or 3.4 miles of pipe in the system. A map of the system is provided in Appendix B.

At the time of original construction, Transite was a preferred piping material due to its relatively low weight and low friction loss. Transite is an asbestos-reinforced concrete material and due to modern regulations on asbestos exposure, it is no longer a desirable material. Potable water systems are actively abandoning Transite piping and there are federal regulations that apply to working with and disposing of Transite.

Limited sections of buried piping, where the distribution pipes enter the geothermal building, have previously been replaced with HDPE piping. HDPE has a maximum service temperature of 140 degrees F in pressurized applications, so further use of this material is not recommended.

The existing distribution pump can convey up to 700 gpm but is typically operated at a flow rate of 375 gpm. Staff have reported increased pipe failures when the system is operated at higher flow rates. The ability to increase flow in the distribution system may be a limitation to system expansion.

Customer connections are made with tapping saddles on the feed piping; many were installed during the original system construction and capped with a galvanized plug. The service piping varies by age of installation and materials, which currently includes galvanized steel, HDPE, and PEX. Staff have not reported significant issues with customer service connections.

2.4 RECOMMENDED IMPROVEMENTS

The overall geothermal system was constructed of durable materials and needs minimal preventative maintenance except for the distribution piping, which should be considered for replacement (see discussion in 2.4.3 below). However, there is an unused well head near the Town's wells that is heavily deteriorated; while it is not Town property, coordinated repair efforts may be worthwhile. The aging distribution piping represents the largest need for system improvements. The heat exchanger should also be considered for preventive maintenance as the stack length is close to the lower limit of tolerance and further tightening to control leaks will require continually increased force as the gaskets reach maximum compression.

2.4.1 Wells

The Town owned wells and the coatings appear to be in good condition. There is an unused well head adjacent to the Town's Well 5 that has a severely corroded shutoff valve. If this were to completely fail, it would have a negative impact on the geothermal resource and could impact all existing geothermal well owners. Plummer recommends a coordinated repair effort between the Town and well owner to protect the geothermal resource. Considering the poor condition of the existing valve, the repair may require a new valve hot tapped into the well casing below the existing valve. Also, any metal piping or valves that remain exposed should be coated in a 2-part epoxy paint system, such as Tnemec 1095, to prevent future corrosion.

Figure 3. Corroded Well Head

2.4.2 Heat Exchanger

While the heat exchanger continues to perform per its original design; it has never had gasket replacement, and the plate stack is nearing the minimum tolerance. Communications with the heat exchanger manufacturer have identified a recommended maintenance protocol. Due to the age of the unit, and the relatively compressed stack length, Tranter recommends a factory cleaning and inspection of the entire plate stack. Factory representatives are available to disassemble the heat exchanger, service the plates and gaskets, and reassemble the unit. Alternatively, Town staff may do the local work and ship the plates to Tranter for service at their facility. Tranter provided a quote of $35,032 (Appendix C) to perform the maintenance work and included the potential cost of a replacement plate at $148 per plate. The plate replacement cost is simply representative as they cannot predict if, or how many, plates may need replacement due to leaks found during the factory inspection process. Plummer recommends this preventive maintenance be completed to preserve operation of this critical piece of equipment.

2.4.3 Distribution System

Newer piping materials are available that do not contain hazardous asbestos and are designed for hot service temperatures of the geothermal system. Due to the relatively large 8-inch piping, only two manufacturers were identified as capable of supplying replacement pipe; a third manufacturer of high temperature thermoplastic piping was contacted but they do not provide sizes larger than 6-inch. Both materials identified can be installed and tapped in an identical manner to HDPE. Polypropylene and Polyethylene are leading thermoplastic materials for piping, the most common variants are known as PP and HDPE; both are available in special formulations for high temperature usage.

Polypropylene Random Copolymer (PPR) piping is the high temperature version of PP piping and PE-RT (Polyethylene of Raised Temperature) is the HDPE variant that is appropriate for geothermal service. Both can be purchased pre-insulated. Table 2 presents the budgetary cost of each material as bare pipe and with 2-inches of pre-installed insulation.

Table 2. Replacement Piping Material Cost

Description	Uninsulated ($/ft)	Insulated ($/ft)
6” PE-RT	22.5	39
8” PE-RT	38	56
10” PE-RT	64	94
6” PPR	53	88
8” PPR	60	96

The existing distribution system is insulated on the feed piping (going towards geothermal customers) and uninsulated on the return piping. Staff have reported the heat loss keeps the surrounding soil thawed to within a foot of the surface; while earth is a reasonable insulator, this loss is limiting the amount of heat that can be delivered to utility customers. Selection of pre-insulated piping is recommended for both feed and return piping to maximize utilization of the geothermal resource. Table 3 below presents the potential heat savings for insulated piping.

Table 3. Distribution Heat Loss

Description	Heat Loss (Btu/Hr-Ft)
8” Uninsulated PPR	145
8” Insulated PPR	22.7
Potential Heat Conservation	145 – 22.7 = 122.3

1) 400 feet length used correlates to the planned replacement piping in the CDOT McCabe Creek realignment project.

If the information from Table 3 is extrapolated to the whole system, the energy savings could be very significant. It becomes difficult to approximate the actual impact because of varying temperatures and velocities throughout the system. There is approximately 9,000 feet of return piping in the system and if the impact was 75 percent of that calculated above, the total heat savings is estimated to be 19,800 kBtu/day,

Due to asbestos regulations, replacement of Transite piping should not be achieved through a pipe bursting replacement method and requires specialized contractors and landfill facilities for disposal. Slip lining was also investigated as a potential repair mechanism; slip lining projects require access openings at intervals similar to sewer manholes, meaning the existing pipe would be cut at regular intervals further weakening the overall pipe system. Slip lining also has a similar installation cost to open trench pipe installation (without pavement repair costs).

The original distribution piping has been in use for almost 40 years and Transite was intended to have a 50 year service life. Plummer recommends the Transite piping be replaced with high temperature rated thermoplastic piping (PPR or PE-RT) when replacing the distribution piping. Considering the age of the Transite piping, complete distribution piping replacement should be included in capital planning; a Class IV Cost Estimate is included in Appendix D.

Insulated feed and return piping replacements are also recommended for future replacement projects.

The upgrade to all insulated piping could enable the Town to deliver heat to more customers and increase the potential revenue from the utility.

2.4.4 Service Connections and Metering

As discussed above in Section 2.3, there are a variety of materials in use at customer service connections, including galvanized steel, HDPE, and PEX. Plummer recommends standardizing to PEX for future service connections and any required service repairs.

Most existing customers have working meters to record the therms of heat capacity consumed. In recent years, the Town decided to bill customers on past usage averages and not continue with meter readings. This billing method creates potential loss due to changes in customer demand and impacts ability to access financial solvency of the geothermal utility. Plummer recommends meter reading be resumed (if only on a periodic basis) to track usage and develop a data set that could support a future financial assessment of the utility.

3 SYSTEM CAPACITY

A 2007 study found a mid-winter heat transfer rate of 98,300 kBtu/Day, with metered usage of approximately 26,900 kBtu/day. This historical data can be used to compare heat transfer to metered usage indicating that roughly 75 percent of heat transferred is lost in the distribution system and not sold to customers. Some background heat loss is inherent to this type of system and reducing those losses can be achieved by replacement with insulated piping; the total reduction is a function of technology selection and feet of pipe replaced. There were 21 metered customers in 2007, 32 customers in 2013 and leases to 2 hot springs companies, and 3 new customers since that time bringing the total to 35. The heat exchanger is typically operated with the full geothermal flow of 450 gpm, with the distribution loop running at 375 gpm.

3.1 CURRENT GEOTHERMAL DEMANDS

User demands have not been actively metered since 2013. A flat rate based on 8 year averages was adopted and implemented in 2014, and meter readings and meter maintenance have been largely discontinued since that time. A model of current heat exchanger performance shows a rate of 131,100 kBtu/Day. Assuming 75 percent distribution loss, this leads to an approximation of 32,800 kBtu/day delivered to current customers.

3.2 EXISTING GEOTHERMAL CAPACITY

The system is currently operated at the full permittable water right of the geothermal well, so no further expansion is considered for that side of the system. The distribution loop is currently run at less than the maximum capacity of the existing equipment. The pump that controls flow in the loop is able to provide flow up to 700 gpm; however, it is currently operated at 375 gpm. Model results indicate that increasing the flow is calculated to increase the potential heat transfer rate up to 158,900 kBtu/day, as compared to the model estimated 131,100 kBtu/day for operation at 375 gpm; however, geothermal staff report increased pipe breaks when running the pump at higher speeds and expanding capacity by increasing the pump flow rate could lead to the need for significant pipe repair.

Another important consideration is the impact of changes to existing customers. During the 2019/2020 operating season, changes made at the Springs Resort temporarily limited flow through the heat exchanger which caused the distribution loop temperature to drop as low as 110 degrees F (the long term average is 122 degrees F). While no customers complained about service issues, one reported their exchange system ran longer than usual. Due to this situation, the heat exchanger modeling was completed to review the amount of energy that can be exchanged without the return temperature dropping below 110F.

3.3 REMAINING GEOTHERMAL CAPACITY

The remaining capacity of the existing system is estimated to be the difference between current amount of heat transfer, 131,100 kBtu/day and the maximum rate of 158,900 kBtu/day; the resulting available capacity is estimated to be 27,800 kBtu/day. Based on previous meter readings, the average customer uses 3,150 kBtu/day; if the data excludes the largest consumers and focuses on residential customers, the average reduces to 2,100 kBtu/day. There is potential to add up to 9 new average customers or 13 average residential customers.

If the distribution piping were replaced with insulated materials, the system loss could be significantly reduced while increasing availability of sellable energy. Section 2.4.3 shows a potential heat savings of up to 19,800 kBtu/day. This could allow an additional 6 to 10 customers to be added to the system.

3.4 POTENTIAL FOR CAPACITY EXPANSION

There are several theoretical ways to increase system capacity. These approaches include:

1) increases to flow rate on either the geothermal or distribution loop would increase the amount of heat transferred assuming additional demand is added.
2) adding demand can lead to a higher temperature difference which increases the heat transfer to a limited degree but could have a negative impact on existing customers. The following paragraphs discuss options that have been reviewed.

3.4.1 Geothermal Water Right Increase

An increase to the geothermal water right for Wells 3 and 5 was attempted in 1990 and refused by the Colorado Division of Water Resources; an increase in geothermal flow would provide additional capacity to expand the geothermal utility. The unleased portion of the Rumbaugh well right could also be run to the existing geothermal building.

3.4.2 Closed Loop Geothermal Approach

A review of reinjection well expenses indicates that a closed loop geothermal approach should be removed from further consideration. Injection wells can cost millions of dollars to construct and the operating expense (reinjection pump electrical cost) can be very significant. Also, this unique approach might have permitting issues with the Division of Water Resources.

3.4.3 Increased Flow Rate

The most viable way to increase capacity of the existing system is by increasing the flow rate within the distribution loop. This would increase the heat transfer potential at the exchanger while maintaining the service level expected by existing customers. This approach may require replacement or repair of the distribution system piping.

4 EXPANSION OPPORTUNITIES

The following sections discuss several options for potential expanded usage of the geothermal system. Options considered include added traditional use for heating and snowmelt, cooling, and electrical power generation.

4.1 SUMMER COOLING OPTION

The Town has the ability (and water rights) to pump water from the river and could potentially run this through the heat exchanger during summer months. The potential to use existing infrastructure to offer cooling to existing geothermal customers was reviewed based on river temperature data collected by the USGS near the Hot Springs Boulevard bridge. During the review period of 1958 through 2013, the average river temperature between June and September was 63.4 degrees F. Thus, the minimal difference between the available source temperature and the desired temperature of most homes and businesses makes summer cooling an impractical use of the system.

4.2 INCREASED TRADITIONAL USAGE

There is remaining capacity for traditional heating and snowmelt usage. Building heat provides a more predictable impact to system loading than snowmelt, and a preference for those types of connections is recommended. Snowmelt related demands can vary greatly with weather and outdoor temperatures; whereas buildings are insulated, and interior heating provides a more predictable load for the geothermal system to support. While the ability to accommodate many new customers is currently limited by the condition of the distribution system, this remains a viable way to expand use of the geothermal utility.

The local High School was considered as a potential addition to the system. They currently have three 3-million Btu/day boilers and can run two of them simultaneously to keep up with typical winter heating demands. The geothermal system is not capable of transferring enough heat to support this load without additional water rights and other significant upgrades.

4.3 POWER GENERATION

There is a potential to generate electrical power with the latent heat in the geothermal water. Novacab has a thermal electric storage system (TESS) that is primarily marketed to help industrial users reduce peak electrical charges by storing energy during low cost periods and releasing it during the peak charge period. This technology could be used to generate electricity that the Town could then sell to the La Plata

Electric Association (LPEA). The manufacturer estimates up to 1,634 MWh could be produced annually. LPEA uses negotiated rates for power generators which could be as low as $0.042/kWh; this rate would lead to a potential annual revenue of $68,600. The revenue estimate is dependent on LPEA accepting the generated electricity and paying the rate of 4.2 cents per kWh; the actual rate may be negotiated higher than the minimum presented in this report. Using this conceptual-level information, a theoretical payback period of 12 years is calculated for the equipment cost of $805,000. Information presented in this section for the Novacab technology is based on a promotional-level proposal from Novacab is included as Appendix E.

The Novacab units would be installed down stream of utility customers during heating season with piping designed to bypass the distribution loop during summer months. Figure B (in Appendix E) presents a flow diagram of the existing system and potential piping connections for the electrical generation equipment. Novacab estimates the temperature drop across their system will be approximately 10 degrees F, so the existing system should be capable of supporting both the existing utility customers and the new load provided the geothermal flow is maintained at 450 gpm. The Novacab controller unit would best be housed inside the existing geothermal building, while the two reactor units are provided in shipping containers that can withstand outdoor installation.

5 CONCLUSIONS

The geothermal resources and heat distribution utility owned by the Town provide a unique and cost-effective source for winter heating and snowmelt for existing customers. The system continues to perform within design intentions after nearly 40 years of seasonal service. With appropriate maintenance, the system can continue to be a reliable utility resource for the local community.

The Town's wells are in good condition; however, it may be worthwhile coordinating repair of abandoned well heads. Maintenance is recommended for the existing heat exchanger, which will restore the plate pack to a factory new condition. Replacing the gaskets and cleaning the plates will enable the heat exchange to continue operation for many years into the future.

The distribution piping is also recommended for planned replacement. The existing Transite piping is approaching the end of the intended service life, and the tendency for pipe breaks is a limiting factor for system expansion. Complete distribution replacement would be an expensive single project but would provide the most economical solution. Pipe replacement should be planned and completed either incrementally or all at once depending on funding capabilities.

Expansion of current uses to include electrical power generation has the potential to provide a dependable revenue source for the Town, while allowing for the continued traditional usage of providing heating and snowmelt to utility customers. If geothermal power generation is developed, it could help provide funding for distribution replacement and other system maintenance needs.