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GEOTHERMAL DISTRICT HEATING - BASICS TO SUCCESS

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ABSTRACT

A district heating system using geothermal energy is a viable and economic option in many locations. A successful system, however, is dependent upon a variety of factors, and it is the purpose of this presentation to accent those items that are proving to have significant impact upon the successful operation of geothermal district heating systems. (These lessons can also apply to other sources of energy.) The six major basics to success that are discussed in this paper are economic viability, an adequate geothermal resource, simplicity of design, a closed loop system, a local champion, and good public relations.

BACKGROUND

The United States Department of Energy (DOE) through its Program Opportunity Notice (PON) program, has provided for cost sharing between the private sector and the federal government in demonstrating the technical and economic feasibility of moderate temperature geothermal systems. The Idaho National Engineering Laboratory, working under the direction of the Idaho Operations Office of DOE, has administered thirteen of these projects, nine of which led to operating systems. District heating systems comprise five of these, with four currently operating. The operating systems are located in Boise, Idaho, Elko Nevada, Pagosa Springs, Colorado, and Philip, South Dakota. One district heating project in Rexburg, Idaho could not be completed because of inadequate geothermal fluid flow. PON activities began in 1978, and final close-out of the remaining projects is expected to occur this fiscal year.

Many lessons were learned from the PON and other geothermal projects, and this presentation is a brief summation of the most significant factors affecting successful operation of these geothermal district heating systems.

SUCCESS FACTORS

Considerable time and effort has, and is, being spent in the development and use of components for geothermal systems, such as improved well drilling and reservoir confirmation techniques, treatment of geothermal brines, system component improvements, and other items. However, overall success of a geothermal district heating system hinges upon fulfillment of certain basic considerations. Just as artists have to occasionally stand back from their work to view the overall product, so is it necessary to do the same for a geothermal system. Failure to give attention to one segment of a project, while concentrating on another, could result in economic loss and even total system failure. The five district heating projects administered at the INEL have provided much information about project development. In the opinion of the author, the major basics to success are:

1) Economic viability,
2) An adequate geothermal resource,
3) Simplicity of design,
4) A closed loop system,
5) A local champion, and
6) Good public relations.

The listing is not necessarily prioritized because failure in one area can negate successes in the others. There are many other factors that have impact on overall project success, but this writing is primarily directed to the aforementioned six basics.

ECONOMIC VIABILITY

The basic "bottom line" to any project is its economic viability. Cost sharing on the PON projects was often necessary for a profitable endeavor. However, the industry then was in its formative stage. Efforts by the Department of Energy and others has since resulted in the development of an effective and knowledgeable infracture of geothermal system developers (engineers, consultants, builders, etc.). Reliance on in-house capabilities, especially in smaller cities and communities, to "save-a-buck" can prove to be disastrous.

DISCLAIMER

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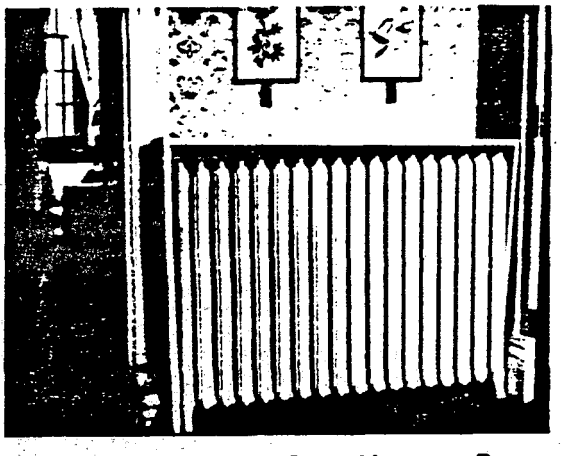
Geothermal utilization is a complex entity that requires the application of many different skills to ensure a successful project, and it is mandatory that the services of a knowledgeable developer be obtained. Contacting the Department of Energy, state energy offices, and other system developers can lead a potential user to qualified developers.

AN ADEQUATE GEOTHERMAL RESOURCE

Geothermal resources are found in many locations throughout the Western United States, but they must be close at hand if they are to be economically used. Surface manifistations, such as hot springs or fumaroles, are indicators of a potential resource. However these indicators are a major step removed from a producing well with tested capacity. Qualified resource developers are necessary for determining the feasibility of a project, for drilling and developing the resource, and designing and constructing a district heating system. Verification of the availability and capacity of a geothermal reservoir should be accomplished in stages in order to expend the least amount of funds. The drilling and development of a reservoir is a somewhat risky venture, which requires relatively large outlays of capital very early in the project development stage. Therefore, every reasonable effort should be made to determine the feasibility of a project prior to actual drilling of a production well. Designing, building, and installing system components before well drilling and analysis are complete is tantamount to financial suicide because of the risks involved.

SIMPLICITY OF DESIGN

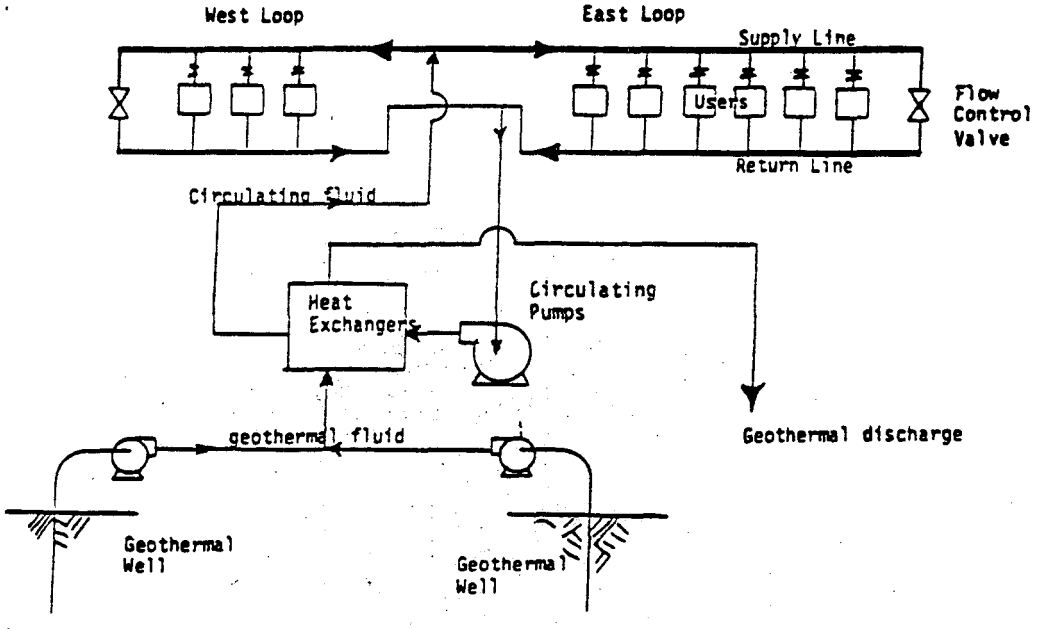
Most small cities and communities are not blessed with having highly trained technical persons to perform system maintenance and operation. Complex systems can easily die on the vine because the people available to service them lack the required expertise. To the trained design/engineer, the addition of more control valves here and there, more monitoring measurements, and "desired" operational features are a relatively simple effort. but to the community maintenance man, they can be a nightmare that leads to rejection. Critical to the success of a geothermal system is the KIS principle - Keep It Simple; don't forget who has to operate the system! Design simplicity also leads to lower system costs, both initially and for the long term.



Typical Radiator Used for Space Heating in Boise Warm Springs Homes

CLOSED LOOP SYSTEM

District heating systems are of two general types; the geothermal waters are circulated directly to the user or a separate potable water system heated through a heat exchanger separates the geothermal fluids from the customer. In those situations where the geothermal fluids contain enough deleterious ingredients, the heat exchange route is chosen early. But some geothermal waters are relatively "clean," and in the interest of saving dollars during the developing stage of a geothermal project, the decision can be made to supply the geothermal water directly to its end use. Time generally takes care of any financial benefits received - the geothermal water may not be as pure as assumed and corrosion or scale build-up occurs as a result of compounding conditions. Maintenance and other problems can occur and result in the ultimate addition of heat exchangers. Potential customers are much more agreeable to having clean "drinking water" circulated through their heating systems; fear of the known and unknown commodities that lurk within the geothermal waters that ascend from the lower regions can result in negative responses and financial failure. The attitude of the individual user also enters in - "it's the city's system, so call them about every (real or imagined) problem". Isolation of the geothermal fluids is one definite measure that can be taken to gain user participation and encourage them to assume their individual responsibili- ties, thus reducing service calls. Following is a simplified schematic of a district heating system, such as the one installed at Pagosa Springs, Colorado, which isolates the geothermal fluids from the "clean" heated water circulated to the individual users.



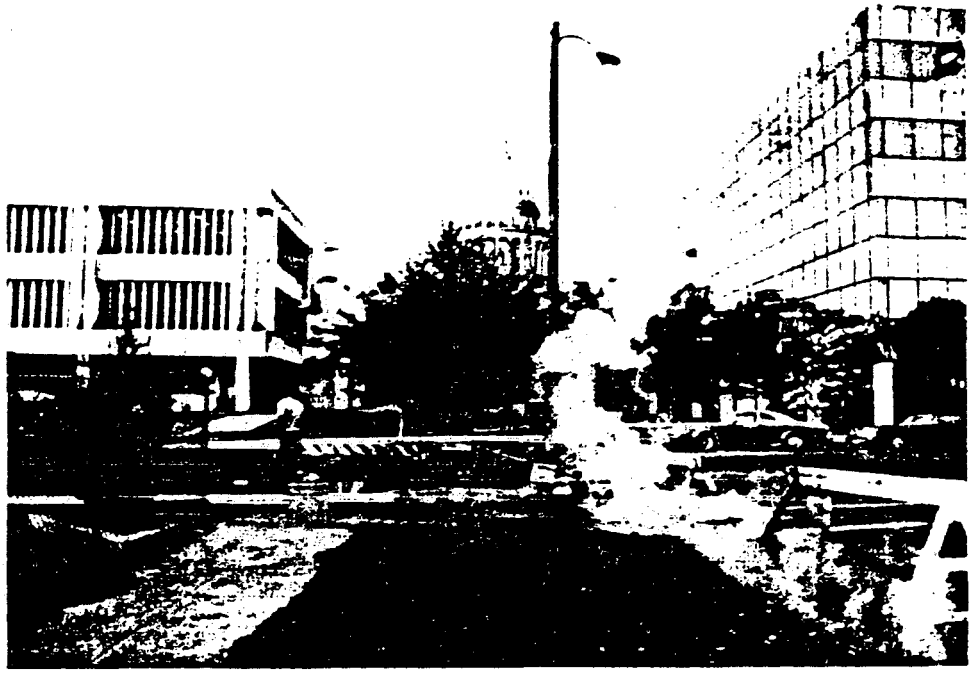
System Flow Schematic

A LOCAL CHAMPION

Perhaps one of the greatest keys to a successful project, yet too often ignored, is to have a person associated with the development and use of a geothermal system who is its strong promoter and supporter. Strong technical expertise is not normally available in the smaller communities or cities where the opportunity for development of a district heating system may exist. Therefore, the basic skills needed to operate a geothermal system have to be developed. Generally, the burden to oversee the development activities resides with someone selected from the community's utility organization. To this person, a geothermal system is the "new kid on the the block," and can be feared, ignored and rejected until enough knowledge is gained to overcome these natural responses. Positive motivation is needed to sell this person on the worth and value of the system so that he will, in turn, sell it to others. Frequent contacts need to be made by the local champion with other city personnel, and other affected agencies and organizations to help them gain an understanding of how the system operates and what impact it has in other related areas, such as water rights. The City of Pagosa Springs, Colorado, is an excellent example of a community of less than 3000 persons that has a district heating system that is primarily successful because of its local champion, Joe Dan Martinez. Joe Dan, a city utility group supervisor, who had no prior geothermal system expertise, endeavored to learn the basics about their geothermal system and developed into a strong supporter and promoter. Pagosa Springs is a community where numerous individual geothermal heating systems exist. The fear of losing flow from privately owned wells, because of the development of the City system, was overcome. Frequent visitations by Joe Dan helped assure the well owners that their systems were not being affected negatively, which helped prevent a highly emotional water rights battle from erupting. If resolution of water rights had been forced to occur without allowing time to "sell" the city system, the project would probably have been killed. The local champion is also needed to assure the city council members, who are concerned about immediate revenues, of the need to allow adequate time to obtain system acceptance and to develop the system to best meet the overall needs of the community. Although geothermal system maintenance is not complex, it is necessary that basic knowledge about the system is communicated to those in the maintenance department - another key to success that is accomplished by the local champion. Whereas the Pagosa Springs project has been blessed with a strong supporter and a subsequent profitable system with longevity, another current PON geothermal heating project may experience failure because of the indifference and apparent lack of acceptance on the part of the project's maintenance personnel.

GOOD PUBLIC RELATIONS

The worth of a product is in the eyes of the beholder - if a geothermal system is conceived to be good, it generally is. Conversely, lack of good public relations will leave potential developers and users in the dark without any desire to get involved in a geothermal district heating system. Citing the Pagosa Springs project, good public relations were primarily developed through their local champion and the city manager. Frequent contacts were made with the system users and their neighbors. There were often complaints about the system but in almost all cases, the problems were related to the users' equipment and not to the city's geothermal system. Continuing interface reduced the complaint frequency and developed a warm feeling on the part of the users. The same frequent interface helped relieve the fear of water right infringement, and the owners of existing wells are now interested in exchanging their water rights for connections to the district system as their individual systems approach the replacement stage. Good public relations are needed to assuage the concerns of the local governing organizations so that detrimental requirements are not imposed upon the development and operation of the system. Continued communications with these interested persons and groups, making them part of the project and maintaining an honest, upfront approach will overcome many dragons of destruction.



A LAST WORD

Geothermal district heating systems can be an environmentally safe, effective, and economic approach for a community to become more self reliant. Successful development and use depends on meeting the basic requirements for success. Economic viability is a must. Without a good geothermal resource, there is no project, and because of the high costs associated with drilling and developing geothermal wells, a phased approach is suggested to minimize the risk of expending large amounts of funds on an uneconomic project. A local champion is needed to promote the system, and effort needs to be directed to developing that local champion. Public relations, another key to success, can mean the difference between no project, an unsuccessful one, or a successful undertaking. Simplicity of system design is essential to effective maintenance and operation, especially in smaller communities. Isolating geothermal fluids from the end user can lead to greater acceptance and more customers. There are many other factors that lead to a successful project, and it is not the intent of the author to downgrade their importance, but rather to stress the basics and encourage the economic use of geothermal energy in district heating systems and in other applications.