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Geothermal Energy in Alaska: Site Data Base and Development Status

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in cooperation with

State of Alaska

Division of Energy and Power Development

PILGRIM HOT SPRINGS

Pilgrim Hot Springs is located on the Seward Peninsula approximately 42 miles (68 km) northeast of Nome. Access is by air to a small landing strip or by track vehicle. The Nome-Taylor road is 7 miles (11 km) east of Pilgrim.

Pilgrim Springs is in the wide flat valley of the Pilgrim river 1/3 miles (1/2 km) south of its banks.

The Valley is mantled by alluvial fill. The larger springs and associated seeps emerge from channel sands and silts in an abandoned loop of the Pilgrim river. However, other seeps and patches of warm ground occur in the adjacent area (perhaps old meanders).

This spring system is the site of a proposed exploration effort being conducted by the State of Alaska, Division of Energy and Power Development. The 1978 Legislature appropriated \$245,000 for this effort. D.E.P.D. has requested additional funding from the Federal Department of Energy to complete an exploratory effort and develop a demonstration project at the spring site.

The project will be conducted on ground owned by the Catholic Church and leased to Pilgrim Hot Springs Limited. The project will follow the following outline.

PILGRIM SPRINGS GEOTHERMAL PROJECT

Proposed Project Outline (Prepared by R.B. Forbes)

1. Aerial photography and infra-red imagery:

Recurrent low level (1,000 ft.(305 m)) color aerial photographs of snow melt patterns following onset of winter snowfall, and spring breakup. Melt patterns to be used as a guide for temperature survey grid. Request to be forwarded to Air Force for infra-red imagery of Pilgrim Springs area.

2. Thermal grid survey:

Downhole temperature survey, utilizing augers. Holes to be drilled at pre-determined grid survey locations. Temperature gradient data to be supplemented by water table measurements and soil and water sampling. Temperature data to be plotted on isothermal maps of the area.

3. Magnetometer survey:

Airborne magnetometer survey at elevations of 500 and 1,000 feet (152 and 305 m) above terrain, supplemented by surface survey. Survey to be based on flight and traverse lines with 250 feet separation.

4. Water temperature and chemistry:

Spring water temperatures to be determined at points of upwelling and in subsurface aquifers with thermal probes. Water samples to be obtained from subsurface and surface, and comparative chemistry used for determining mixing ratios with local groundwater table and revised deep reservoir temperatures based on geothermometry.

5. Seismic survey:

Seismic refraction and reflection profiling to supplement previous work. Emphasis on selection of deep drilling sites.

6. Test holes:

Three relatively shallow production test holes (about 150 feet (46 m)) to be drilled at sites selected on the basis of geophysical data. These holes would be drilled with aim of determining depth and thickness of hot water aquifers, plus flow rates and temperature of saline water in subsurface channel sands.

7. Resistivity survey:

Resistivity survey to determine subsurface geometry of sand and gravel aquifers containing saline spring water.

DEVELOPMENT PROJECT

The specific purpose for doing a demonstration project is to determine and develop a commercial production potential for vegetable and fruits in remote sites using geothermally-heated soils.

The intent is to establish an experimental station in the Arctic utilizing geothermal heat for food production. Ten acres (4 hectares) would be leased in the Pilgrim Hot Springs area. A 4,000 square foot (372 m²) greenhouse would be constructed. Development of food fodder and ornamental plots would be undertaken.

The models would be to develop a totally integrated horticultural production system and to determine the production costs of such a system for the Arctic area. This involves projection from seedlings to greenhouse production, the use of the greenhouse to provide seedling plants for outdoor production, soil heating in the outdoors, the use of row covers and plastic mulches, and normal field production integrating the new technologies that have been developed and experimentation with new techniques.

A non-profit agricultural experimental corporation could be set up that could generate as much as \$100,000 of the annual operating budget after the first year from crops produces here according to agricultural experts.

SITE DATA SUMMARY

SITE: PILGRIM HOT SPRINGS

..Physical Reservoir Data

..Temperature °C

Water: 17° to 45°C
Bottom: 27° to 80°C (Forbes, 1975)
Subsurface:

Measured 80°C, but probably higher - up to 150°C (White)

..Estimated Non-Electric Energy Potential (MBtuh* 30 years):

6×10^{15} cal./year

..Type of Overlying Rock: See Below

..Estimated Depth to Top of Reservoir (meters):

608' (185 m) CAP rock top 205' (59 m) (Forbes, 1975)

..Site Land Status

..Total Acres: 22,400

Federal Acres: 22,080
State Acres: 319.96

..Total Acres Leased: 0

..Geothermal Development Status:

None to date. No leasing planned on Federal or Indian lands at this time.

..Local and State Attitude Toward Geothermal Development:

C.J. Phillips, lessee and manager of the Pilgrim Hot Springs is authentically interested in development. He has said he would like to promote electrical production as well as the cascading usages of geothermal waters. He envisions a town here. Local legislators are enthusiastic as are Nome residents to the electrical development. Natives appear interested in agricultural development. Drilling money appropriated

..Land Use and Population:

There are no year-round residents.

SITE LOCATION AND PHYSICAL DESCRIPTION

SITE: PILGRIM HOT SPRINGS

..Latitude: 65° 06'N

..Longitude: 164° 55'W

..Rectilinear" Beldeleben, Quad A-6, T4S, R31W, Sect. 36

..County: Unorganized Borough

..Adjacent Counties:

..Topography:

Springs located on an abandoned meander of the Pilgrim River. Pilgrim Valley is mantled by alluvial fill. PC mountains exposed 4 miles north. CR intrusive 3 miles to south and east. Marshy with some subsidence to north toward springs. (Sapping)

..Present Land Use:

Used for recreation and summer gardening.

..Future Land Use Plans:

The State appropriated monies for an exploration effort at Pilgrim. DOE is considering a bill to establish an agricultural station at the springs. This will be under the direction of the University of Alaska. There has been interest in the development of a fish hatchery, along with a reindeer research center. More recreating facilities are planned. When technology comes on line the Nome Power facility has shown considerable interest in electric power.

..Aesthetics:

Very attractive, no permafrost, wilderness setting.

..Historical/Archaeological Significance:

Eskimo Name: Kruzgamepa. Gold mining resort for Nome gold stampede. Vegetables grown. Catholic mission school for natives closed 1942. It was an orphanage. Used for space heating. 107 orphans. (Phillips - personal contact).

..Comments and Critical Issues:

Proposed wildlife refuge on (d)(2) lands to North. It is located in an undeveloped area which is always a critical issue to environmentalists within the State of Alaska. Land status not very clear as the Natives have overselected and have not received the patent to any land yet. Bering Straits Native Corporation has not signed easement agreement WITH DOI, and are in litigation over proposed easements. BLM will not transfer lands until a decision is made. This should be late 1980.

Status of Church vs. Phillips vs. States Rights to be determined before well is drilled.

GEOLOGICAL/GEOPHYSICAL DESCRIPTION

SITE: PILGRIM HOT SPRINGS

..Geologic Description:

Quaternary alluvium covers much of the valley of the Pilgrim River. In the Kilgluaik Mountains to the south and Hen and Chickens Mountains to the north of the area, bedrock consists of various metamorphic rocks of Precambrian age. Medium to fine gravel biotite granite of cretaceous age is intruded locally into the metamorphic rocks. The Kigluaik Fault, down thrown to the north, trends east near the northern edge of the mountains. Numerous north trending faults are mapped, one of which is projected under the Valley fill 1.5 miles (2.4 km) east of the Hot Springs (McFadden, 1971).

The hot waters of the spring system appear to be contained in several abandoned stream sand channels in the vicinity. Temperatures of 70°C and 3 foot (2.7 m) depths have been recorded here.

..Geophysical Summary:

Steffano and Associates of Anchorage have conducted cursory resistivity in the area. Forbes of the U. of A. has conducted a seismic refraction and geomagnetic profile, across the spring site. (Forbes, 1975) A work plan including air borne magnetometer of seismic, gravity and resistivity is now being considered to aid in determining the best site for drilling an exploratory well in the area.

..Geologic Hazards:

The saturated sands could harbor foundation problems. There is a 25 square mile (65 km²) area free of permafrost but other lands in the area do have permafrost problems.

RESERVOIR CHARACTERISTICS

SITE: PILGRIM HOT SPRINGS

..Reservoir Temperature: 150°C might be greater (White, 1975).

..Subsurface: 150°C

..Geochemical:

SiO₂: 137 100 (White, 1975)
Na-K-Ca: 146

..Total Dissolved Solids:

Greater than recorded. Estimate by factor of 1/3 due to ground water mixing.

..Fluid Chemistry:

SiO ₂	100
Al ²	0.04
Fe	---
Ca	530
Mg	1.4
Na	1450
K	61
Li	4.0
NH ₃	---
HCO ₃	30.1
CO ₃	---
SO ₃	24
Cl ⁴	3346
F	4.7
Br	---
B	2.4
pH	6.75
Temp. °C	55

..Estimated Non-Electric Energy Potential (MBtuh 30 years):

.6 x 10¹⁸ cal. (White, 1975)

..Subsurface Area of Reservoir:

1.5 km²
Volume: 2.75 km³

LAND OWNERSHIP AND LEASING

SITE: PILGRIM HOT SPRINGS

..Land Ownership

..Total Acres: 24,400

Federal Acres: 22,080

State: 0

Private: 319.96

..Land Leased

Total Acres: 24,400

Federal: 22,080

State: 0

Private: 319.96

..Tentative Lease Sale Dates: None Planned. Private: 10 acres, 7/78.

..Summary of Leasing Status and Needs:

None at this time. Not likely to be any lease until land is patented by Natives.

GEOHERMAL DEVELOPMENT STATUS

SITE: PILGRIM HOT SPRINGS

..Present Development Status:

Used as private resort and garden.

..Projected or Planned Development:

Battelle NW has shown interest in initiating a reindeer research center using the geothermal water for the benefit of the calving season and protection against the elements. Native Corporation has recently shown interest in the development of their selected lands for agricultural development. \$245,000 was appropriated by the State Legislature to complete an exploratory drilling operation at the spring during FY, 1978. Matching money has been requested of the Federal Department of Energy to develop an agricultural experiment station. The experiment station will operate over a 15 year period and will be a show case for Northern Geothermal Technology.

INSTITUTIONAL CONSIDERATIONS

SITE: PILGRIM HOT SPRINGS

..Institutional Requirements:

The 319 acres (129 hectares) held by C.J. Phillips has no requirements on land itself as he has rights to the geothermal springs. Federal Lands: In order for any lease to be let a statement of concensus must be submitted by village or regional corporation depending on who is to receive title of the now federal lands. Part 3200, Geothermal Resource Leasing, CFR Title 43.

..Agency and Public Attitudes:

Designated by BLM as area of ecological concern in their (d)(1) Classification.

Native Corporations are profit making entities by definition. Accordingly, they have been receptive to development. C.J. Phillips, proprietor of springs, is very excited over the prospect of development. This is active participation by the BIA.

..Status of Requirements (i.e., EIA/EIS Requirements):

It is probable that surrounding lands will be Native. At this time, no EIS have been filed, but the lands have been assessed under the (d)(1) study by the Federal-State Land Use Commission.

State funds have been approved. Initial studies have been started on a work plan. Federal assistance has been requested.

ENVIRONMENTAL FACTORS

SITE: PILGRIM HOT SPRINGS

..CLIMATE (From Teller - Approx.)

..Prevailing Winds: East

..Precipitation (Annual):

14.5" (36.8 cm), including 50" (127 cm) snow.

..Average Temperature:

Minimum: -9 to 10°F (-23 to -12°C) in winter

Maximum: 37 to 57°F (2.8 to 13.8°C) in summer (Selkregg)

..Degree Days (Annual): 15,000

..AIR QUALITY: No known pollutants

..WATER QUALITY: No known pollutants in area

Mean annual runoff: 2 cubic ft./per./sec. per square mile.

..NOISE: No human induced;

..BIOLOGICAL

..Dominant Flora:

Moist tundra, cottonwood, berries, lowland hardwood forests.

..Dominant Fauna: Moose, grizzly bear

TRANSPORTATION AND UTILITIES

SITE: PILGRIM HOT SPRINGS

..Utility or Energy Transmission Corridors and Facilities:

Nome City power lines. Distance from the site is approximately 65 miles (105 km).

..Transportation Corridors or Facilities:

Nome to Taylor road. Distance from the site is approximately 7 miles (11 km). Access to right-of-way easement (subject to litigation) has been approved. Senate Bill #384 is now being debated to appropriate monies to build spur and upgrade road to Nome.

POPULATION

SITE: PILGRIM HOT SPRINGS

..General Description of Population:

There are presently no year round residents at Pilgrim Hot Springs. The greater Nome area (50 miles (80 km) to the south) has a population of 7,000 people. With 2,535 people within the city limits. The labor force of Nome and nearby rural villages ranging from Stebbins to Shishmaref include a large supply of skilled, semi-skilled and unskilled people available for work. (Nome Profile)

..Present Land Use:

The Pilgrim area is presently used for agriculture on a small scale commercial basis during the summer. The market is Nome.

Nome's economy is mainly that of a government/transportation center. The mining industry is still active in the area however.

..Future Land Use:

Possible development of the offshore oil potential should take place in the next decade. Mineral production seems likely as metal prices skyrocket.

Renewable resources such as agriculture are being considered for future development, especially in the Pilgrim Springs area.