Mike Wright

STATE OF UTAH

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF WATER RIGHTS

JUN 7 1978

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RECEIVED
R. J. SCHULTZ
MAY 23 1978

	ACTION	INFO
WPJ		
LED	✓	
WDG		
RCS		
JAH		
DT		

File 18.3

May 22, 1978

Bob Schultz
Box 1625
Idaho Falls, ID 83401

Dear Bob:

These are copies of the rough cut on aggregated power on-line for both electrical and non-electrical uses in Utah. In the past few weeks I have done a lot of work to refine and verify the electrical scenario, but I was not able to gather useful information on non-electric uses until I talked to you last week. As a result, I'll have to make major changes in the non-electric schedule. Because time is quite short, I'll send you these first cuts and let you look them over. I'll probably have to go ahead with a second rough cut before being able to consult with you, but we might still be able to refine it somewhat before the final report. I have included two copies so that you and Lloyd can both review them.

I appreciate your help very much. I only regret that I didn't get in touch with you much sooner. If we can assist you or work with you in any way, we will be more than happy to do so. Thanks again.

Yours truly,

Ward Wagstaff

Ward Wagstaff

jpw

5/23/78 gave LED his copy
ut

	tot. MWe	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01	02
Roosevelt Prospect	400			50		50		100		100		100												
Cove Fort Sulphurdale	400					50	50		50	50	100		100											
West Cove Fort	200						50		50		50	50												
North Cove Fort	200						50		50		50	50												
Thermo	100							50		50														
Other Areas (Sevier Lake, Black Rock Desert Delta Area).	200								50		50		50	50										
TOTAL FOR YEAR				50		100	150	150	200	200	250	200	150	50										
CUMULATIVE TOTAL				50		150	300	450	650	850	1100	1300	1450	1500										

Assumptions used in Scenarios
April 1978

Roosevelt Hot Springs Prospect

1. Reservoir capacity--assumed to be 400 MWe. This figure is averaged between Phillips, (1) and UP&L (2) estimates of 300 MWe, and Dr. Ward's admittedly optimistic guess of 500 MWe. (3) In this respect 400 MWt is an optimistic and fairly realistic estimate.

2. According to Phillips and UP&L (1,2), the plants are planned to come on-line in 55 MWe units two years apart. The following assumptions were based on this information:

   A. The plants were assumed to come on-line two years apart.
   B. The later plants were assumed to be 100 MWe plants. This presumes
      (1) adequate reservoir capacity and
      (2) development by a single operator (unitization). It is possible that later plants might be 55 MWe plants on-line each year.

Cove Fort

1. Several factors will tend to retard development at Cove Fort. (Sulphurdale)

   A. Drilling has been very difficult. It has taken a long time and considerable problems were encountered from a geological standpoint.
   B. Because of these problems with drilling, the wells drilled by Union have been very expensive.
   C. The presence of a viable reservoir has not yet been satisfactorily verified.

2. In spite of these setbacks, several ventures are proceeding. (4) For purposes of the long-range scenario, the following separate ventures were assumed.

   A. Sulphurdale--Union could have two areas here. One North of the freeway, one south. Because Union still appears to be progressing, one plant was assumed to come on-line in 1984, and another in 1985, at the other site. The sites are left unspecified. This is an optimistic forecast, particularly in light of the difficulties mentioned above.
   B. North Cove Fort (Dog Valley)--Hunt Oil Co. is currently drilling on private lands several miles north of the Sulphurdale area. An optimistic forecast would put them on-line about 1985, although they may try to come on-line about 1984. Of course, they could encounter problems and develop later or not at all.
   C. West Cove Fort Area--several groups are conducting intensive exploratory activities in this area, although no deep wells have been drilled. The main developers in this area are AMAX, Hunt, Chevron, Phillips, and others. An optimistic estimate could place at least one of these prospects on-line in 1985. (4) Because several developers are involved, the plants could come on line in bunches; the assumption for the scenario was about a plant each year.

Continued

3. Reservoir Quantities: Based roughly on Dr. Ward's estimates of 500 MW for Cove Fort and 2000 MWe for the whole area,(3) the following quantities were estimated:

   Sulphurdale 400 MWe.
   North Cove Fort 200 MWe.
   West Cove Fort 200 MWe.

   These are quite arbitrary estimates; Sulphurdale was allotted 400 MWe because it seems at this time to be the most likely area. The amount for the whole area was estimated to be 800 MWe because it included parts of areas which were originally estimated at 500 MWe with the area generally unspecified. (3) North Cove Fort and West Cove Fort were guessed to have 200 MWe each, merely because that seemed like a reasonable alloment. Again, these capacities are arbitrary and are useful only for purposes of estimating development patterns.

4. Federal Programs and other incentives/assistance: It was assumed that optimistics estimates would be partially justified by the development of federal initiatives to accelerate and assist development in Cove Fort areas. It was also assumed that optimistic estimates were justified by the need for such estimates in planning operations.

   Note: Cascading and multiple use systems will very likely be developed for some of these areas, most particularly in the Sulphurdale area where exhaust from the power plant may be used in sulphur mining or other industrial operations.(4)

Thermo Prospect

1. Reservoir capacity was assumed to be 100 MWe. This is more optimistic than the Core Team estimate of 50 MWe, but much less than some previous estimates. The rationale for this figure would be that the area involved might be larger than the 1.5 km^2 estimated by USGS Circular 726, although at this time there is little evidence to support this hypothesis.

2. Earlier scenarios estimated drilling to begin at Thermo in 1980.(6) Republic Geothermal drilled a deep well in late 1977. This would seem to indicate that development at Thermo could be advanced by as much as two years. Also, federal programs could make an earlier production date feasible, not only for Thermo, but also for some of the Cove Fort areas. On the other hand, preliminary information from the Republic Well at Thermo does not seem to justify boundless optimism; hence the first plant was estimated to produce power on-line about 1986, with another 50 MWe plant following two years later.

References

1. Phillips Petroleum Co., Verbal and written communications, February and March, 1978.

2. Dr. Val Finlayson, Director of Research and Development, Utah Power and Light Company, Salt Lake City, Utah. Personal Communication, March 28, 1978.

3. Dr. Stanley H. Ward, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah. Personal Communication, March 28, 1978.

4. Kenneth Bull, U.S. Geological Survey, District Geothermal Supervisor, Salt Lake City, Utah. Personal Communication, April 4, 1978.

5. State and Federal Geothermal Leases, compiled by the Utah State Team, February, 1978.

6. MITRE Corporation, METREK Division, "Site Specific Analysis of Geothermal Development--Data Files of Prospective Sites." October, 1977

	tot MWt	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	0
Monroe/Red Hill/ Johnson	85		1	2	3	4	6	8	10	10	10	10	10	6	5										
Crystal H.S.	43		1	2	3	4	6	10	8	6	3														
Wasatch/Beck's/ Hobo	65			1	3	5	10	10	10	10	10	4	2												
Midway	11			1	2	4	4																		
Ogden/Hooper/ Utah/ Hill AFB	95			2	3	5	10	20	20	15	10	10													
Meadow/Hatton	45						2	2	4	6	8	8	6	6	3										
Jospeh H.S.	45						2	4	8	10	6	5	5	3	2										
New Castle	40*					2	2	4	6	10	10	6													
Cove Fort (Sulphurdale)	400*							10	10	20	40	40	40	40	40		40		40		40		40		
Thermo	200*										2	4	4	10	20	40		40		40		40			
Tintic	100*					2	6	12	20	20	15	10	10	5											
Beryl	100*					4	10	20	15	15	15	15	6												
Abraham	100*							2	2	6	10	15	15	15	15	15	5								
West Cove Fort	100*								2	2	6	10	15	15	15	15	10	10							
Black Rock Desert	100*								2	2	6	10	15	15	15	15	10	10							
Veyo	10			1		2	2	3	2																
LaVerkin	10				1			2	2	3	2														

	tot MWt	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01
Crystal (Madsen's) H.S	27					2	2	2	4	6	6	3	2												
Other Areas	200*						2	2	4	4	4	6	8	10	10	10	10	10	10	10	10	10	10	10	
Continuation																02	03	04	05	06	07	08	09	10	11
of Other Areas																10	10	10	10	10					
Total for Year			2	9	15	34	64	111	129	145	163	156	138	125	125	95	75	70	50	50	50	50	50	10	10
Cumulative Tot.			2	11	26	60	124	235	364	509	672	828	966	1091	1216	1311	1386	1456	1506	1556	1606	1656	1706	1716	17.

Low Temperature Geothermal Uses: General Assumptions:

1. The reservoir energy potentials for most of the sites (the spring areas) were taken from the Core Team estimates of reservoir thermal potential. These estimates are based on the following assumptions:

   A. Reservoir temperatures were taken from chemical or physical data in USGS Circular 726 (8) and as provided by Dr. Swanberg. (1)

   B. A standard reservoir volume was assumed, as used in USGS Circular 726, of 2.25 km^3 (8)

   C. Stored heat and thermal potential are calculated from these values with weighting factors from USGS Circular 726. This factor is the recovery factor, 0.06, found on p.116. (8)

2. Any postulated development is, of course, dependent on the presence of suitable resources. Development in most cases was assumed to be gradual at first. Rates of development and relative magnitudes of energy use were estimated from the following factors:

   A. Known plans for development, as ascertained through literature or verbal communications (see references);

   B. Probable or potential uses, such as greenhouses, mining, etc.;

   C. Proximity to areas of potential use, or conversely, relative isolation;

   D. General potential of the prospect, including such factors as temperature, heat content, flow, dissolved solids, etc.

   The potential MWt (for 30 years) was opportioned over a seemingly reasonable period based on the above factors.

3. As an approximate quideline, rates and magnitudes of development were based loosely on an estimate of about 1 MWt for a greenhouse of 2050 m^2. (2)

4. Some areas which were not included in the Core Team Report were assigned a reservoir potential on a purely arbitrary basis. These capacities are noted with an asterisk (*) on the scenarios and other places.

5. The most probable sites were treated individually. The potential for the rest of the state, incuding less likely known sites and currently unknown sites, were assigned an arbitrary value (see the assumptions for this prospect).

6. Estimates are admittedly optimistic. Neither individual magnitudes nor rates can be considered to be reflections of the real situation. The scenarios usually reflect more what could be rather than what will be, even according to present plans.

Continued

7. Individual scenarios are not intended to be accurate reflections of real development as much as a basis for the aggregated scenarios. Thus, the aggregated scenarios are probably of more worth than the individual scenarios.

8. The estimated development times have been estimated without regard to development lag times or institutional factors, for the following reasons:

   A. Institutional factors are still very vague and vary greatly. Time will not permit extensive scenarios for each individual site at this point in the study.

   B. Even if average lag times were known for the specific steps required at each site, the procedure for developing scenarios would involve estimating a date for development and then working backwards. At this point, the basic results would be the same.

   C. It is to be hoped that the "semi-continuous" approach to the scenarios makes up for some of the specific inaccuracies in the time schedules.

9. It was assumed for all cases that development will be reasonably feasible from economic and technical standpoints.

10. Dissolved solids data are averages of the samples cited in WRB-13 (Reference 6)

Prospect: Monroe Hot Springs
(also Red Hill, Johnson Hot Spring)

Resource Characteristics:

Surface Fluid Temperature: Monroe 76°C, Red Hill 77°C, Johnson's 25°C (6)

Subsurface Fluid Temperature: Monroe 120°C, Red Hill 135°C (1)

Total Dissolved Solids: Monroe 2750 ppm, Red Hill 2630 ppm, Johnson 428 ppm. (6)

Estimated Energy Potential: Monroe 38 MWt, Red Hill 43 MWt, Johnson 4 MWt for 30 years Total: 85 MWt (1)

Type of Overlying Rocks: Springs issue from tufa mounds along the base of the mountain, (6) grading west into alluvium in the valley.

Location of Prospect: Just east of Monroe, Utah; T25S, R3W, Sec. 11, 15, and 27. (6)

Description: Series of hot springs issuing from hillside immediately east of Monroe City, at the base of a large mountain. The springs are along a north-south trending fault. (6)

Land Ownership: Mostly Private. (2) Some BLM and National Forest Lands east of the prospect. (11)

Land Use: Municipal, agricultural, range land, and forest land nearby.

Leasing: Some leasing in area. Limited leasing because most of the land is private. (12)

Activity:

The Springs are presently being used by a spa for heating a swimming pool, showers, etc. The owners have expressed plans for eventually heating greenhouses and a motel complex.

The City of Monroe has received conditional approval on a proposal for a space heating system for the city. The first phase of this project would involve the heating of the South Sevier District High School; later the system would be expanded to heat homes in the city as well as several larger buildings in the city, a number of greenhouses, and several multiple unit complexes (motels and apartments).

Assumptions:

1. Geothermal Resources are at this time being used to heat a spa and resort. The Monroe City development will probably drill a well late in 1978 or early in 1979. Use of the water will begin shortly thereafter to heat the school.

2. The development outlined in the Monroe proposal was assumed to utilize about 6 MWt, and will be developed up to about 1981.

3. Development beyond 1981 will likely continue. Some of the development will be in houses and homes, but it will probably include more greenhouses and other agricultural/light industrial uses.

4. Development will probably depend a lot on reservoir characteristics, which will not be accurately determined until development actually begins. Thus, the development will probably proceed step-wise over a number of years.

Prospect: Crystal Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 58^{o}C (6)

Subsurface Fluid Temperature: 135^{o}C (1)

Total Dissolved Solids: 1520 ppm (6)

Estimated Energy Potential: 43 MWt for 30 years. (1)

Type of Overlying Rocks: Unconsolidated valley fill. Bedrock at fairly shallow depths. Volcanic rocks underlie the fill. (6)

Location of Prospect: South end of Salt lake Valley, near "Point of the Mountain". Area near T4S, R1W, Sec, 12, NW¼ (6)

Description: Series of Hot Springs discharging into clear pools and ponds.

Land Ownership: Some private (Mr. Dunion) (3); also, the state owns some land in the immediate vicinity, including the State Prison Complex.

Land Use: Some agricultural, few greenhouses, fish culture, State Prison; Div. of Forestry has some land just south of the prison, which maybe used for silviculture. (3)

Leasing: No state or federal leases. (No sate or federal lands) (12)

Activity: Some discharge from the springs is used by Mr. Dunion, for use in raising tropical fish. (3)

During January and February, 1978, the Utah Geological and Mineral Survey drilled a series of temperature gradient wells near the site under the State Cooperative Program.

In connection with the temperature gradient holes, the Utah Division of Forestry plans to drill a test well near the prison which, if producible, could be used to heat greenhouses. Eventual uses in the area could include more green houses, heating for housing developments, and space heating for the State Prison.

Assumptions:

1. It is assumed that development will begin slowly as the reservoir parameters are explored. If the reservoir proves adequate, more greenhouses will be added and the prison will consider space heating. Because construction of houses or retrofitting of the prison will take some time, the peak of the development will probably be spread over several years. After the main peak of utilization has passed, additional development will probably occur as the limits of the reservoir are explored.

2. No pretense has been made to represent accurately the magnitudes of heat necessary for heating the prison. The estimated available energy has merely been apportioned over a reasonable interval.

3. The estimated development times have been estimated without regard to development times or institutional factors, for the following reasons:

   A. Institutional factors are still very vague and vary greatly. Time will not permit extensive scenarios for each individual site.

   B. Even if average lag times were known for the specific steps required at each site, the procedure for developing scenarios would involve estimating a date for development and then working backwards. At this point, the basic results would be the same.

   C. It is to be hoped that the "semi-continuous" approach to the scenarios makes up for some of the specific inaccuracies in the time schedules.

Prospect: Wasatch Hot Springs/Beck's Hot Springs/Hobo Hot Springs (3)

Resource Characteristics:

Surface Fluid Temperature: Wasatch 42°C, Beck's 56°C (6)

Subsurface Fluid Temperature: Wasatch 120°C (1), Beck's 90°C (1)

Total Dissolved Solids: Beck's 13,400 ppm, Wasatch 7220 ppm (6)

Estimated Energy Potential: Wasatch 38 MWt/30 years, Beck's 27 MWt/30 years (1)

Type of Overlying Rocks: Both springs issue near the contact between Quaternary Valley fill and Paleozioc limestones. (6)

Location of Prospect: Salt Lake Valley near the north end of Salt Lake City. T1N, R1W; Beck's, Sec. 14, SW¼SE¼. Wasatch, Sec. 25, NW¼SE¼. (6)

Description: Hot Springs along Wasatch Fault, along east edge of Salt Lake Valley between Salt Lake City and Bountiful City.

Land Ownership: Mostly private (within city). (11)

Land Use: Grades from residential and commercial near Wasatch Springs to light and heavy industry north from Beck's Springs.

Leasing: No federal or state lands in the vicinity of the springs.

Activity:

At one time, Wasatch H.S. and Beck's H.S. were used for spas. However, neither is presently being used, and Beck's is discharging large amounts of hot water to a canal leading to Great Salt Lake. Some warm waters in the area are used for washing gravel by gravel companies in the area.

Assumptions:

1. Although the hot springs discharge is not being used at this time, the proximity of the springs to the city center and industrial areas makes them prime targets for development. Several parties have inquired about the use of warm water in the area for space heating. For these reasons, development is expected to begin within the next

few years, and to continue thereafter as interest grows. At least two buildings in Salt Lake City area are using heat pump applications in connection with heating and cooling. (The buildings are the LDS Church Office Building in the downtown area and the International Center near the Salt Lake Airport.) (3) Because of the general area of the springs much of the development was assumed to be primarily light industrial or large space heating uses.

2. Development rates, times, and magnitudes are arbitrary but reasonable estimates.

Prospect: Midway Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 45°C (1,6)

Subsurface Fluid Temperature:

Total Dissolved Solids: 1770 ppm (6)

Estimated Energy Potential: 11 MWt (based on surface Temp.) (1)

Type of Overlying Rocks: The springs issue from calcerous tufa about 70 ft. thick, underlain by alluvium (6)

Location of Prospect: In the area of T3S, R4E, Sec. 26, 27,34,35, in the Northwest corner of the Heber Valley. (6)

Description: Numerous Hot springs with tufa mounds. The springs drain into Snake Creek above Midway.

Land Ownership: Mostly state and private lands (11).

Land Use: Mostly agricultural, also residential, recreational (Wasatch Mountain State Park, etc.).

Leasing: Some State and/or Federal leasing in Heber Valley, but not in the vicinity of the springs. (12)

Activity:

One of the large springs has been used for several years as water for a swimming pool and resort.

The Utah Geological and Mineral Survey is scheduled to drill temperature gradient holes near the springs in mid-April, under the DOE State Cooperative Program.

There have been a few inquiries regarding the use of geothermal fluids for space heating; however, nothing is definite or specifically planned at this time.

Assumptions:

1. Midway H.S. are near the small town of Midway, but there are at this time only a school and town hall which could be major users of geothermal heat. Development would probably take the form of greenhouses and/or housing developments such as apartments or condominiums. There is a fish hatchery near Midway but it is several miles from the hot springs area. Development was estimated to begin about 1980 on a small scale and to extend over several years.

2. Development rates, times, and magnitudes arbitrary but reasonable estimates.

Prospect: Ogden Area: Ogden H.S., Utah H.S., Hooper H.S., Hill AFB

Resource Characteristics:

Surface Fluid Temperature: Ogden H.S. 58°C, Hooper H.S. 60°C, Utah 58°C. (6)

Subsurface Fluid Temperature: Ogden H.S. 110°C, Hooper H.S. 105°C, Utah H.S. 95°C. (1)

Total Dissolved Solids: Ogden H.S. 8700 ppm, Hooper 8800 ppm., Utah 18,600 ppm. (6)

Estimated Energy Potential: Ogden H.S. 34 MWt/30 yr., Hooper H.S. 32 MWt/30 yr., Utah H.S. 29 MWt/30 yr. Total 95 MWt/30 yr. (1)

Type of Overlying Rocks: Ogden H.S. rise along a fault in Precambrian rocks; Hooper H.S. rise from Quaternary Valley fill; Utah H.S. issue in an area of complex faulting in Cambrian rocks. (6)

Location of Prospect: Ogden H.S. T6N, R1W, Sec. 23, SW¼SW¼; Hooper H.S. T5N, R3W, Sec. 27, SW¼; Utah H.S. T7N, R2W, Sec.14, SW¼SE¼. Generally east, west, and north of Ogden respectively. (6)

Description: Various hot springs; Utah H.S. is used for greenhouses, Ogden is a diffuse spring area, Hooper is not used at the present time. (3,6)

Land Ownership: Mostly private. Hooper H.S. is near the wildlife refuge. (11) Hill AFB is federal reserve land. (7)

Land Use: Mostly municipal. The actual spring areas are away from the city. Hooper is in an agricultural area, and Utah H.S. is in an agricultural and light industrial area.

Leasing: No federal or state leases in this area. (12) (No federal or or state lands) (11)

Activity: Utah H.S. is currently being used to heat greenhouses by by the Allen Plant Co. and another company.(3) There is a lot of iron in the water. (3,6) There appear to be plans for further development.

Ogden H.S. was used as a resort, now is being discharged as runoff. The water is hot, but the source is diffuse, posing possible tapping problems. Water is quite mineralized. (3)

Hooper water is hot, but the spring is some distance from population areas and is currently not being used. (3)

Hill AFB at Ogden contracted to EG&G to do a study on the possibility of heating buildings on the base with geothermal fluids. (7) No particular geothermal resources are known to be beneath the base, but a major fault does run through the base area and might possibly provide a conduit for hot fluids beneath the base.

Assumptions:

1. The magnitude of the resource was assumed to be equal to the sum of the estimated potential for the three spring areas. This assumption is obviously not accurate since the estimate was applied over the whole area, including Hill AFB. However, no other data is available. Again, magnitudes, times, and growth rates are only rough guesses.

2. Development was assumed to start small, with existing uses (resorts and greenhouses), and to begin in the early 80's as the feasibility of geothermal uses are proven. Development of geothermal heating for Hill AFB was assumed to be possible and feasible, so that development there would begin about 1982 to 1984, an optimistic estimate. Because most of the buildings would require retrofitting, etc., development at the air base was assumed to proceed step-wise over a number of years.

Prospect Meadow/Hatton Hot Springs

Resource Characteristics:

Surface Fluid Temperature: Hatton H.S. 38°C, (1,6) Meadow 41°C (6)

Subsurface Fluid Temperature: Meadow H.S. 105°C (1)

Total Dissolved Solids: Meadow 4800 ppm, Hatton 4760 ppm (6)

Estimated Energy Potential: Meadow 37 MWt/30 yr., Hatton 8 MWt/30 yr. (1)

Type of Overlying Rocks: The springs are in valley fill of Tertiary or Quaternary age; There are Quaternary basalt flows within a few miles of the Springs. (6)

Location of Prospect: Near Meadow and Hatton in Beaver Co.
Meadow H.S. T22S, R6W, Sec. 26, SW¼SW¼;
Hatton, T22S, R6W, Sec. 35, SE¼SE¼. (6)

Description: The spring areas are west of Hatton in a semi-arid range area. Hatton spring no longer flows. (6)

Land Ownership: Mostly private, some federal lands in area. (11)

Land Use: Agricultural, range, desert.

Leasing: State and federal leasing in area. (12)

Activity: Meadow Hot Springs is a relatively new spring, now being used for stock watering. (3)

Hatton Hot Springs no longer flows. (6)

Assumptions:

1. Meadow and Hatton Hot Springs are some distance from the towns of Meadow and Hatton. (3,6) Because of this slight isolation, development of the spring areas per se will probably not occur until the early or mid 1980's, and probably will start out with a few greenhouses or similar agricultural or light industry.

2. Immediate area of the springs is of questionable geothermal potential because of the relatively low temperature of the spring water, the low silica content, and the similarity in chemical quality to the ground water in a fairly large surrounding area. (6)

However, the springs are in an area of late Tertiary and Quaternary volcanic flows. Some lands in the area have been leased for Geothermal development. It is likely therefore that the geothermal potential of the area is not confined to the springs area. This leads to the possibility that geothermal development could occur much nearer to the cities of Meadow, Hatton, and Kanosh, and perhaps over a larger area. However, because this type of development would require drilling and is somewhat more risky, it would probably be delayed until the middle or late 1980's and may be related to attempts to locate resources suitable for electrical production.

3. The estimates of magnitude of recoverable energy for the area is the sum of the estimates for the springs, even though the potential extends beyond the spring area. Development rates, times, and relative magnitudes are arbitrary but reasonable estimates.

Prospect: Joseph Hot Springs

<u>Resource Characteristics</u>:

Surface Fluid Temperature: 64°C (6)

Subsurface Fluid Temperature: 162°C (1)

Total Dissolved Solids: 5100 ppm (6)

Estimated Energy Potential: 45 MWt/30 yr. (1)

Type of Overlying Rocks: Joseph H.S. issues from a tufa mound over the Dry Wash fault. Immediately east of the fault there are extensive volcanic outcroppings of late Tertiary age. On the other side of the fault are unconsolidated Quaternary deposits. (6,13)

Location of Prospect: T25S, R4W, Sec, 23. South east of the town of Joseph in Sevier County, Utah. (6)

Description:

Land Ownership: Mostly private in the valley, surrounded by BLM land east of the main valley. (11)

Land Use: Agricultural, range land, rural residential.

Leasing: Leasing has occured in the immediate area of the springs and of the town of Joseph. (13)

Activity: Spring Area, very low discharge. No known development activity.

Assumptions:

1. Joseph Hot Spring has a relatively low discharge. On the one hand, this may indicate a lower recharge rate (suggested by Ref. 3); on the other hand, it may be due to sealing action by precipitates and may be a pressurized system (suggested by Ref. 5). Although the evident recharge area is not as large as that of Monroe Hot Springs a few miles away, the Joseph's Springs are located on a long fault, which may extend up along the Sevier River. (6) It is quite apparent that the magnitude of the resource will only be determined by exploratory drilling. For the purposes of the scenario, the estimated magnitude of the resource as determined by USGS Circular 726 was used. (1,8) Development rates, times, and magnitudes are reasonable estimates only.

Continued

2. The hot springs area is about a mile from Joseph. In order to make a community space heating system feasible, it would pretty much be necessary for larger heat loads to be located at the far end of a distribution line. This would put the load about 1½ miles from the spring area. Three factors might change this situation:

   A. Wells might be drilled away from the springs area. However, this would involve more geophysical exploration and because of the greater risk, might not be feasible at all.

   B. Greenhouses or other similar industry might be located between the springs and the town. Although this would be more feasible, it would not provide the loads in the city which would make space heating for residences feasible.

   C. It may become feasible to transport the heat longer distances.

   In any of these cases, development would probably not gain very much momentum before the mid-1980's.

Prospect: New Castle

<u>Resource Characteristics</u>:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids: Relatively low. (3,4,5,9)

Estimated Energy Potential: Not known, arbitrary estimate of 40 MWt/30yr.

Type of Overlying Rocks: Most of the valley is overlain by Quaternary alluvium; within a few miles of New Castle there are outcroppings of late Tertiary volcanic rocks and Tertiary granites.

Location of Prospect: About T36S, R15W. (11)

Description: Agricultural area, with water wells which have hot water at shallow depths.

Land Ownership: Large block of state land to the east of New Castle, federal lands to the south and southwest, private lands to the west. (11)

Land Use: Agricultural, range land, rural residential.

Leasing: Some leasing has occurred on state and federal lands in the vicinity of New Castle. (12)

Activity: A well which was drilled to provide water for irrigation hit hot water at shallow depths. The water is presently cooled and used for irrigation.

Assumptions:

1. The New Castle area is at present a moderate priority for temperature gradient exploration under the State Cooperative Program. (3,4) There are few dwellings in the area, but possibilities for light industry exist (greenhouses, crop drying, extending growing season). The water is very low in dissolved solids. Because one well has already been drilled and other exploratory work is planned, development may come in the early 1980's. The primary drawback would be the isolation of the area.

Prospect: Cove Fort (Sulphurdale)

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not Known, arbitrary estimate for comparison purposes 400 MWt/30 yr.

Type of Overlying Rocks:

Location of Prospect: West Central Utah near Cove Fort, about T25S, R6&7W. Commonly known as The Cove Fort or the Cove Fort Sulphurdale area.

Description:

Land Ownership: Some private, BLM, and National Forest.

Land Use:

Leasing: Extensive leasing of state and federal lands. (12)

Activity: Union has drilled two wells in this area, one of them caved in. There is at this time the possibility that the area will not yield resources which would be suitable for electrical generation. Whether or not electrical generation is possible there is a good potential for direct utilization at the prospect.

A. Inquiries have been made and plans may be underway to use a cascading system. Potential uses would be greenhouses or other industrial uses. (5)

B. A specific use may be at the sulphur mining operations at Sulphurdale, where heat is required for the sulphur extraction process. (5)

Continued

Assumptions:

1. Although there may be some institutional restraints (part of the probable geothermal field is on Forest Land) (5), the possibility of industrial use of geothermal heat appears good. The industrial use will probably coincide with the production of electrical power. (5)

2. The magnitude of the power in use will depend primarily on the resource. The estimate of 400 MWt for 30 years is an arbitrary estimate based on estimates of the electrical potential for the area. (9)

3. It is assumed that once the geothermal resource has been proven that industrial use will be added in fairly large increments on a fairly regular basis.

Prospect: Thermo

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known, Arbitrary Estimate of 200 MWt/30 yr.

Type of Overlying Rocks:

Location of Prospect: West and south of Minersville, about T30&31S, R12&13W. (11)

Description:

Land Ownership: Mostly BLM, some state and federal land. (12)

Land Use:

Leasing: State and federal lands have been leased extensively. (12)

Activity: Republic Geothermal Inc. has drilled a deep geothermal well in the area which is still being tested. Geophysical and temperature gradient exploration has also taken place quite extensively.

Assumptions:

1. Although there have been no specific plans expressed for either cascading systems or purely industrial use, it is very likely that the resource will be suitable to direct utilization. This development will probably not occur until the mid or late 1980's for the following reasons:

   A. The general development of the Thermo area is several years behind the development for The Roosevelt and Cove Fort areas this would put development at about the mid-1980's

   B. The Thermo area is quite isolated and this fact would probably account for some retardation of development.

2. The magnitude of the heat potential for this prospect is an arbitrary but reasonable estimate, as are the development times, rates, and magn

Prospect: Tintic

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known; arbitrary estimate of 100 MWt/30 yr. for scenario purposes.

Type of Overlying Rocks: Alluvium, tertiary pyroclastics. (13)

Location of Prospect: T10&11S, R2&3W. South of Utah Valley in the center part of the state.

Description: Hot water issues from the Burgin Mine and is discharged to a stream. It runs several miles down the canyon and is ponded in an evaporation pond.

Land Ownership: Private, BLM, and some state lands. (11)

Land Use: Some mining; agriculture in the valley area.

Leasing: Some state and federal lands leased. (12)

Activity: The Burgin Mine discharges hot water down from the Tintic mountains to an evaporation pond. No use is presently made of the heat from the water. Some interest in the area has been expressed by exploration companies and some leasing (state and federal) has taken place.

Assumptions:

1. Even though Kennecott, which owns the Burgin Mine, has at present no specific plans for utilization of the geothermal fluids which are discharged from the mine, it was assumed that Kennecott would become interested in development of the resource, or that they would cooperate with a second party which could develop the resource. The water discharged from the mine could be either put through heat exchangers for industrial use near the mine or piped out of the mountains to sites where the terrain is more suitable to construction. There are no towns or housing areas near the mining area, but the presence of Goshen Warm Springs may indicate a general distribution of the resource through the valley.

2. The magnitude of the heat potential for this prospect is an arbitrary but reasonable estimate, as are development time, rates, and magnitude.

Prospect: Beryl

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known, arbitrary estimate of 100 MWt/30 yr. for scenario purposes.

Type of Overlying Rocks: Mostly Quaternary alluvium and lake bed sediments. (13)

Location of Prospect: Southern Utah. South and west of Thermo Hot Springs; T33&34S, R16W, and surrounding area. (11)

Description:

Land Ownership: Mostly private, some state and federal lands. (11)

Land Use: Farming, rural, residential.

Leasing: State and federal lands in the area have been leased. (12)

Activity: Utah and Power and Light, in conjunction with McCulloch Oil and Geothermal Kinetics, drilled three deep exploratory wells in the general vicinity of Beryl. Although the wells were not suitable for electrical production, they were very suitable for low temperature uses. (5,9,10) Interest in the Beryl area has also been expressed by other parties. (4)

Assumptions:

1. The Beryl area is quite isolated, a factor which would tend to retard development. Development, when it occurs, will almost certainly be industrial, since there are so few buildings in the area which could be heated. On the other hand, three wells have already been drilled, and the companies involved are considering low temperature use. (10) For these reasons, development was estimated to begin in the early 1980's. Because industrial use is most likely, development was estimated to come on-line in relatively large increments.

2. The magnitude of heat content used for the scenario is an arbitrary but reasonable estimate, as are development times, rates, and magnitude

Prospect: Abraham Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 82°C (6)

Subsurface Fluid Temperature: 125°C (1)

Total Dissolved Solids: 3500 ppm (6)

Estimated Energy Potential: 39 MWt/30 yrs. (1)
Arbitrary estimate of springs and surrounding area, for comparison purposes: 100 MWt/30 yrs.

Type of Overlying Rocks: The springs issue from a tufa mound near a Quaternary basalt flow. (6)

Location of Prospect: The springs are located at T14S, R8W, Sec. 10 and 15; (6) the surrounding area is all potentially a resource one.

Description: Abraham Hot Springs issues from a tufa mound near Fumarole Butte, an old volcanic vent (Quaternary basalt). (6) Most of the water discharges to a slough area in the desert bottom.

Land Ownership: Mostly BLM, some state and private. (11)

Land Use: Mostly desert, some range, etc.

Leasing: KGRA area. Extensive leasing on federal and state lands. (12)

Activity: Leasing, geophysical exploration, and temperature gradient exploration has taken place in the area of the Abraham Hot Springs. Some of the discharge from the Springs is used for a spa-type resort. The heat content of the resource may be less than is now apparent (absence of boiling temperatures, relatively low silica content, large water discharge); (6) drilling will probably be necessary to define the resource potential.

Assumptions:

1. The Abraham Springs area is quite isolated. However, the discharge from the springs themselves is copious and hot. Beyond use for bathing, development at the springs and in the surrounding area will probably be primarily light industrial. Development is estimated to begin in the mid-1980's and to gain momentum as more uses become feasible, technical and economical.

Prospect: West Cove Fort Area

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Arbitrary, but reasonable estimate for comparison purposes: 100 MWt/30 yr.

Type of Overlying Rocks: Alluvium, late Tertiary basalt and basaltic andesite flows. (13)

Location of Prospect: North of the Roosevelt Prospect. West of the Cove Fort area. About T24&25S, R7&8W. (11,12)

Description:

Land Ownership: Mostly BLM, some state and private. (11)

Land Use: Some agriculture; mostly range and desert.

Leasing: Extensive leasing on state and federal lands. (12)

Activity: Extensive leasing, with geophysical and temperature gradient exploration. (12,14)

Assumptions:

1. It appears that there are several possible areas for electrical production in Utah and the area near Black Rock or the "West Cove Fort Area" is a possible prospect. If water can be found at depth, the area could be a potential low-temperature geothermal prospect whether or not the resource is suitable for electrical production. The scenario is based on the assumption that hot water can be located in sufficient quantities to make development feasible.

2. The estimate of a resource potential of 100 MWt/30 yr. is an arbitrary but reasonable estimate as are development times, rates, and magnitudes

Prospect: Black Rock Desert.

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known; arbitrary estimate for scenario purposes: 100 MWt/30 yr.

Type of Overlying Rocks: Lake bed sediments, Quaternary basalt, and late Tertiary basalt and basaltic andesite flows. (13)

Location of Prospect: West of Cove Fort area, about T23&24S, R7&8W. (12)

Description:

Land Ownership: Mostly BLM, some state and private lands. (11)

Land Use:

Leasing: Extensive leasing on state and federal lands. (12)

Activity: Extensive leasing, with geophysical and temperature gradient Exploration. (12,14)

Assumptions:

1. It appears that there are several possible areas for electrical production in Utah, and the area near Black Rock or the "West Cove Fort Area" is a possible prospect. If water can be found at depth, the area could be a potential low-temperature geothermal prospect whether or not the resource is suitable for electrical production. The scenario is based on the assumption that hot water can be located in sufficient quantities to make development feasible.

2. The estimate of a resource potential of 100 MWt/30 yr. is an arbitrary but reasonable estimate, as are development times, rates, and magnitudes.

Prospect: Veyo, LaVerki

Resource Characteristics

Surface Fluid Temperature: Veyo 42°C, LaVerkin 42°C (1,6)

Subsurface Fluid Temperature:

Total Dissolved Solids: Veyo 396 ppm., LaVerkin 9580 ppm (6)

Estimated Energy Potential: Veyo 10 MWt/30 yr., LaVerkin 10 MWt/30 yr. (1)

Type of Overlying Rocks: Veyo, Quarternary basalts. LaVerkin, Paleozoic limestone, along Hurricane fault. (6)

Location of Prospect: Veyo, the springs are at T40S, R16W, Sec. 6, NW¼SE¼SW¼, about 18 miles north-northwest of St. George in southern Utah. LaVerkin springs are at T41S, R13S, Sec. 25, about 18 miles east-northeast of St. George. (6)

Description:

Land Ownership: Veyo: private land immediately around Veyo; some state lands nearby, BLM controls most of the surrounding area. (11)
LaVerkin: Also mostly private, BLM lands nearby. (11)

Land Use:

Leasing: Some leasing in the Veyo area. (12)

Activity: Veyo Hot Springs is currently used as a swimming pool and spa. LaVerkin (Dixie) Hot Springs issue from the bed and banks of the Virgin River near LaVerkin.

Assumptions:

1. Veyo: It would be reasonable to expect that some further development will occur at Veyo even though the magnitude of the resource available appears to be limited. Interest has been expressed in including the area as part of the temperature gradient survey under the State Cooperativ Program. (9) Development would probably not be of great magnitude; but it could come in the mid-1980's. Use will probably be space heating or light industrial (greenhouses, etc.). Development rates, times and magnitudes are arbitrary but reasonable estimates.

Continued

LaVerkin: These springs discharge directly into the Virgin River, and recovery and collection might be difficult. It would certainly require exploration and probably test wells to determine if the reservoir has potential. In any case, development probably will not come until mid or late 1980's. Development times, rates, and magnitudes are arbitrary but reasonable estimates.

Prospect: Crystal (Madsen's, Honeyville)

Resource Characteristics:

Surface Fluid Temperature: 56°C (6)

Subsurface Fluid Temperature: 90°C (1)

Total Dissolved Solids: 42,100 ppm (6)

Estimated Energy Potential: 27 MWt/30 yr. (1)

Type of Overlying Rocks: The springs issue from Paleozioc rocks along the Wasatch fault zone, (6) in Quaternary alluvium. (13)

Location of Prospect: The springs are located at about T11N, R2W, Sec. 29, NE¼SE¼, in Box Elder Co., about 10 miles north of Brigham City. (6).

Description: Hot springs, used for spa, along the Wasatch fault on the West face of the Wasatch Mountains. The flow from the springs flows in Salt Creek, which flows through an agricultural area. (6)

Land Ownership: Mostly private. Forest lands in the area to the east in the mountains.

Land Use: Mostly agricultural. The town of Honeyville is a few miles south of the spring area. (6)

Leasing: No leasing of state or federal lands in area. (12)

Activity: Crystal Hot Springs is presently used for a swimming pool, and the possibility exists for space heating. (3)

Assumptions:

1. It was assumed that interest in the geothermal potential will grow, and it seems reasonable that development will start in the early or mid-1980's.

2. It was assumed that the resource is adequate for space heating or light industry; development time, rates, and magnitudes are arbitrary but reasonable estimates.

Prospect: Other Areas (Indludes other springs and other potentials areas).

Assumption: The main assumption was that the other areas are generally remote and/or of small magnitude. Development at most of these areas will probably be after the mid-1980's, and will probably come in small increments. Again, the magnitudes used for the scenario are only a reasonable estimate.

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Mineralized Springs in Utah and Their Effect on Manageable Water Supplies

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Report WG23-6

Utah Water Research Laboratory
Utah State University

In cooperation with the
Utah Water and Power Board

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Table 1. CHEMICAL ANALYSES AND QUALITY OF MINERALIZED SPRINGS IN UTAH

Location Coordinate	Name of spring	Date of sampling	Temp. F° (°C)	Flow cfs	Sodium ppm	Sodium epm	Potassium ppm	Potassium epm	Calcium ppm	Calcium epm	Magnesium ppm	Magnesium epm	Li ppm
Hydrologic Unit	**No. 1 — Great Salt Lake Desert**												
		1964											
(C-2-6)	Grantsville Warm Springs	7-29	86°	0.2	13,500	587.2	258	6.6					
(C-1-7)9	Big Spring nr. Timpie	7-29	72°	7.6	2,300	100.0	170	4.3	390	19.5	320	26.3	3.60
(C-1-7)9	Big Spring nr. Timpie	8-17	72°	7.6	3,450	150.0	135	3.4	160	8.0	300	24.7	3.05
(B-13-5)	Blue Springs nr. Howell	9-10	80°	7.6	540	23.5	32.5	0.8	83	4.1	24	2.0	0.84
(C-3-8)	Deseret Springs--Skull Valley	8-17	74°	2.0	2,300	100.0	95	2.4	140	7.0	125	14.4	2.20
	Fish Springs Group												
(C-11-14)26	North Springs	8-19	75°	2.6	700	30.4	68	1.7	88	4.4	105	8.6	1.50
(C-11-14)26	Middle & Thomas	8-19	72-78°	25.0	440	19.1	60	1.5	76	3.8	15	1.2	1.20
(C-11-14)3	Wilson's Hot Springs	8-19	95-140°	0.75	11,500	500.2	420	10.7					
(C-15-19)31C	Candy Warm Springs	8-19	80°	21.0	25	1.1	4.3	0.1	26	1.3	10	0.8	0.44
Hydrologic Unit	**No. 2 — Bear River**												
(Idaho)	Vincent Hot Springs	7-30	180° 82°	0.4	4,200	182.7	910	23.2	445	22.2	335	27.6	11.20
(Idaho)	Battle Creek Hot Springs	7-30	173°	2.0	3,550	154.4	660	16.9	310	15.5	305	25.1	8.20
(B-11-2)29	Honeyville Crystal (Mixed)	9-11	90°	9.0	6,988	304.0	305	7.8	383	19.1	85	7.0	
(B-11-2)29dac	Honeyville Crystal (Cold)	9-11	63°	5.5	425	18.5	31	0.8	76	3.8	46	3.8	
(B-11-2)29dab	Honeyville Crystal (Hot)	9-11	130°	3.5	15,931	693.0	762	19.5	862	43.0	194	16.0	
(B-13-3)	South Udy's Hot Springs	7-17	110°	0.8	2,050	89.2	180	4.6	355	17.7	335	27.6	4.40
(B-13-3)	South Udy's Hot Springs	9-11	104°	0.8	3,356	146	141	3.6	202	10.1	74	6.1	
(B-13-3)	Udy's Hot Spring	7-17	93°	2.2	2,750	119.6	155	3.9	260	13.0	320	26.3	3.40
(B-13-3)	Udy's Hot Spring	9-11	93°	2.2	2,804	122	121	3.1	158	7.9	64	5.3	
(B-13-2)27d	Cutler Springs	7-17	76°	0.7	1,850	80.5	83	2.1	205	10.2	305	25.1	2.10
(B-11-4)	Bothwell Salt Creek Springs	7-17	69°	17.0	600	26.1	37	0.9	86	4.3	190	15.6	0.75
(B-11-4)	Bothwell Salt Creek Springs	9-10	69°	16.0	425	18.5	325	8.3	82	4.1	24	2.0	0.75
(Idaho)	Prices Hot Springs	8-11	92°	6.0	2,200	95.7	180	4.6	200	10.0	200	16.4	3.90
(Idaho)	Prices Hot Springs	9-11	92°	6.0	1,000	43.5	105	2.7	170	8.5	135	11.1	2.60
Hydrologic Unit	**No. 3 — Weber River**												
(B-7-2)4dc	Utah Hot Springs	8-4	136°	1.5	7,200	313.2	1,100	28.1	1,550	77.3	470	38.6	24.0
(B-7-2)4dc	Utah Hot Springs	9-2	135°	1.5	11,500	500.2	1,310	33.5					
(A-4-2) 36b	Como Hot Springs, Morgan	8-27	82°	3.1	34	1.5	7.4	0.2	86	4.3	2.5	0.2	0.36
Hydrologic Unit	**No. 4 — Jordan**												
(B-1-1)25	Wasatch Hot Springs	7-29	110°	0.7	1,950	84.8	118	3.0	500	25.0	240	19.7	4.0
(B-1-1)25	Wasatch Spring at Tunnel	8-18	110°	0.6	2,100	91.4	110	2.8	320	16.0	215	17.7	3.45
(B-1-1)25	Wasatch Spring at Resort	9-2	102°	0.6	1,950	84.8	168	4.3	300	15.0	190	15.6	3.65
(D-13-2)	South Salt Creek at Nephi	9-1	54°	0.01	820	35.7	10.4	0.3	86	4.3	86	1	0.90
(D-12-3)	No. Salt Creek Spring nr. Nephi	9-1	60°	0.002	16,500	717.8	71	1.8					
(C-5-1)	Saratoga at Pool	8-5	118°	0.4	220	9.6	31.5	0.8	93	4.6	10	0.8	1.80
(C-5-1)	Saratoga North Spring	8-5	106°	0.01	210	9.1	31.0	0.8	96	4.8	15	1.2	1.80
(D-8-1)	Lincoln Point Spring	8-5	92°	0.17	940	40.9	185	4.7	330	16.5	210	17.3	3.90
(D-9-3)	Castilla Hot Spring	8-4	108°	0.08	1,600	69.6	160	4.1	430	21.4	190	15.6	4.60
(D-9-3)	Castilla Hot Spring Pt # 2	9-2	78°	0.01	2,150	93.5	200	5.1	300	15.0	305	25.1	0.12
(D-3-4)	Schneitter's Hot Pots Homestead	8-25	100°	0.4	132	5.7	34	0.8	182	9.1	51	4.2	1.45
(D-3-4)	Ken Johnson Hot Springs	7-23	114°	2.5	200	8.7	40	1.0	265	13.2	210	17.3	1.50
(C-4-1)	Crystal Spring Pt. of Mtn.	8-18	72°	0.13	230	10.0	58	1.5	88	4.4	6	0.5	1.65
(D-10-1)	Goshen Warm Spring North	8-5	74°	3.90	330	14.4	25.5	0.6	52	2.6	45	3.7	0.76
(D-10-1)	Goshen Warm Spring North	9-2	74°	3.90	380	16.5	25.0	0.6	29	1.4	29	2.4	0.64
(D-10-1)	Goshen Warm Spring South	8-5	74°	4.10	320	13.9	28.5	0.7	52	2.6	6	0.5	0.90
(D-10-1)	Goshen Warm Spring South	9-2	74°	4.10	360	15.7	24.0	0.6	37	1.8	37	3.0	0.63
((D-8-5))	Diamond Fork Warm Spring	9-3	69°	0.75	150	6.5	11.0	0.3	68	3.4	32	2.6	0.62
Hydrologic Unit	**No. 5 — Sevier**												
(C-25-3)11dbb	Monroe Hot Spring	8-7	140°	0.06	480	20.9	79	2.0	225	11.2	24	2.0	2.10
(C-25-3)11d	Monroe Hot Spring	7-15	112°	0.06	450	19.6	82	2.1	175	8.7	125	10.3	2.20
(C-21-1)11	Redmond Lake	8-6	72°	18.0	190	8.3	65	1.7	83	4.1	25	2.0	2.15
(C-25-4)23	Joseph Hot Springs	7-15	140-145°	0.02	960	41.8	85	2.2	265	13.2	230	18.9	4.15
(C-25-3)11	Red Hill Hot Spring	7-15	168°	0.17	420	18.3	86	2.2	205	10.2	150	12.3	2.10
(C-14-8)15	Abraham Hot Springs	9-1	150-175°	3.0	590	25.7	81.5	2.1	230	11.5	105	8.6	2.75
(C-14-8)15	Abraham Hot Spring at Bath	9-1	150°	0.2	820	35.7	78	2.0	210	10.5	175	14.4	2.50
Hydrologic Unit	**No. 6 — Cedar**												
(C-30-12)28	Thermo Hot Springs	8-7	164°	0.05	440	19.1	6.4	0.2	54	2.7	12	0.1	0.27
(C-30-12)28	Thermo Hot Springs North	8-20	175°	0.01	440	19.1	60	1.5	76	3.8	15	1.2	1.20
Hydrologic Unit	**No. 7 — Uintah** UTAH												
(D-4-24)	Split Mtn. Warm Springs	8-27	88°	20	145	6.3	17.5	0.4	87	4.3	6.0	0.5	0.54
U(C-4-7)	Strawberry Springs	8-28	58°	0.11	3,550	154.4	20.5	0.5	78.0	3.9	160	13.2	1.20
Hydrologic Unit	**No. 9 — South and East Colorado**												
(C-41-13)24	LaVerkin Hot Spring	8-21	108°	11.6	2,400	104.4	230	5.9	510	25.4	310	25.5	0.32

Lithium ppm	Lithium epm	Strontium ppm	Strontium epm	Cesium ppm	Iron ppm	Boron ppm	Chloride ppm	Chloride epm	Sulfate ppm	Sulfate epm	Carbonate ppm	Carbonate epm	Bicarbonate ppm	Bicarbonate epm	Total dissolved solids by evaporation at 105°C ppm	Total dissolved solids by sum of constit. ppm	EC (micromhos at 25°C)	Total hardness as $CaCO_3$	pH	Tons per day salt
					0.26	1.5	10,142	286.0	443	9.22	4.5	0.15	185	3.03	20,130	24,534	22,500		7.5	10.87
3.60	0.52	6.8	0.16	2	0.29	0.9	4,539	128.0	360	7.49	3.6	0.12	188	3.09	8,960	8,335	12,900	2,291	7.6	183.86
3.05	0.44	8.2	0.19	1	0.14	0.7	2,386	67.3	49.5	1.03	4.5	0.15	248	4.06	4,570	6,768	13,820	1,634	7.9	93.78
0.84	0.12	4.6	0.10	Trace	0.28	0.2	886	25.0	67.7	1.41	8.7	0.29	268	4.40	2,030	1,923	3,580	306	8.0	41.66
2.20	0.32	6.4	0.15	0.6	0.31	0.6	3,454	97.4	206	4.78	0.0	0.00	166	2.72	5,620	6,563	9,440	864	2.8	30.35
1.50	0.22	4.6	0.10	Trace	0.25	1.0	1,284	36.2	345	7.18	5.4	0.18	251	4.11	2,880	2,861	4,460	652	7.9	20.22
1.20	0.17	4.0	0.09	0	0.45	0.8	617	17.4	383	7.97	3.6	0.12	207	3.39	2,060	1,813	2,990	251	7.9	139.05
					0.28	2.7	11,560	326.0	146	3.05	3.6	0.12	130	2.13	24,200	23,762	32,100	—	7.5	49.00
0.44	0.06	3.3	0.08	0	0.13	0.4	30.1	0.85	17.3	0.36	4.5	0.15	171	2.81	420	292	469	106	7.9	23.81
11.20	1.61	10.5	0.24	3	0.18	3.1	6880	194.0	38.9	0.81	0.0	0.00	372	6.10	13,190	13,200	18,500	2,490	7.3	14.24
8.20	1.18	7.6	0.17	0	0.32	2.8	4,681	132.0	30.2	0.63	5.4	0.18	410	6.72	9,010	9,974	12,300	2,029	7.7	48.65
				0	1.27	2.2	10,000	282.0	221	4.61	0.0	0.00	194	3.18	18,820	18,183	11,900	1,306	7.3	457.33
				0	1.07	0.2	656	18.5	56.7	1.18	0.0	0.00	253	4.14	1,920	1,550	2,330	379	7.5	26.51
				Trace	1.86	4.2	23,617	666.0	438	9.12	0.0	0.00	165	2.70	43,790	41,985	43,300	2,951	7.0	413.82
4.40	0.63	8.6	0.20	2	0.38	0.9	4,823	136.0	110	2.30	1.8	0.06	154	2.53	9,070	8,075	12,900	2,265	7.4	19.59
				3	1.06	1.0	4,752	134	93.2	1.94	0.0	0.00	224	3.67	9,190	8,847	6,210		7.2	19.85
3.40	0.49	9.2	0.21	2	0.27	0.7	4,326	122.0	81.6	1.70	2.7	0.09	144	2.36	7,420	7,909	9,540	1,966	7.4	44.07
				3	0.86	0.8	3,865	109	80.7	1.68	2.7	0.09	164	2.69	7,780	7,264	5,690		7.4	46.21
2.10	0.30	4.6	0.10	1	0.26	0.4	2,511	70.8	68.2	1.42	2.7	0.09	159	2.60	4,960	5,220	7,220	1,767	7.2	9.37
0.75	0.11	2.45	0.05	0.5	0.28	0.3	748	21.1	79.7	1.66	5.4	0.18	289	4.74	1,590	2,050	2,990	997	7.7	72.98
0.75	0.11	4.6	0.10	Trace	0.29	0.2	734	20.7	66.8	1.39	5.4	0.18	267	4.38	1,800	1,941	3,180	304	7.9	77.76
3.90	0.56	7.5	0.17	1	0.31	0.6	2,961	83.5	60.0	1.25	0.9	0.03	170	2.78	5,810	6,024	8,855	1,322	7.4	94.12
2.60	0.37	6.8	0.16	0.6	0.23	0.9	4,504	127.0	317	6.61	5.4	0.18	192	3.14	8,680	6,453	7,940	980	7.7	140.62
24.0	3.46	22.5	0.51	10	0.29	4.6	12,270	346.0	197	4.11	0.0	0.0	104	1.71	29,400	23,058	24,700	5,804	7.3	119.07
					0.21	4.5	12,695	358.0	194	4.03	0.0	0.0	107	1.75	23,060	25,810	33,400	—	7.3	93.39
0.36	0.05	3.5	0.08	0	0.32	0.6	39.0	1.10	204	4.25	0.0	0.0	169	2.77	690	547	852	225	7.8	5.78
4.0	0.58	8.0	0.18	1.5	0.32	1.1	3,149	88.8	850	17.7	2.7	0.09	192	3.14	7,380	7,055	10,100	2,236	7.4	13.95
3.45	0.50	8.0	0.18	0.75	0.32	1.1	3,294	92.9	855	17.8	0.0	0.00	140	2.30	7,060	7,069	10,500	1,684	7.7	11.44
3.65	0.52	6.4	0.15	1.1	0.22	1.3	3,213	90.6	840	17.5	0.0	0.00	143	2.34	7,230	6,673	9,950	1,531	7.6	11.71
0.90	0.13	5.5	0.13	Trace	0.08	0.2	1,145	32.3	393	8.19	2.7	0.09	131	2.14	2,690	2,688	3,280	569	7.6	0.07
					0.75	0.5	26,986	761.0	2,992	62.3	2.7	0.09	140	2.30	52,440	46,693	64,200	—	7.4	0.28
1.80	0.26	4.6	0.10	Trace	0.19	0.8	331	9.33	409	8.52	1.8	0.06	117	1.91	1,400	1,127	1,950	273	7.5	1.51
1.80	0.26	2.1	0.05	0	0.18	0.9	310	8.75	422	8.79	0.0	0.00	126	2.07	1,410	1,221	1,860	301	7.6	0.04
3.90	0.56	4.7	0.11	0.7	0.26	1.9	2,429	68.5	879	18.3	0.0	0.00	159	2.60	6,230	5,163	9,300	1,688	7.4	2.86
4.60	0.66	4.7	0.11	0.75	0.23	2.0	2,426	68.4	1,575	32.8	0.0	0.00	164	2.68	7,040	6,579	10,100	1,856	7.5	1.52
0.12	0.02	9.8	0.22	1.2	0.08	1.5	3,195	90.1	2,036	42.4	1.8	0.06	933	1.53	8,900	8,326	13,300	2,004	7.3	0.24
1.45	0.21	2.3	0.05	0	0.26	0.9	122	3.45	764	15.9	3.6	0.12	173	2.83	1,690	1,468	2,060	664	7.5	1.82
1.50	0.22	2.8	0.06	Trace	0.29	1.2	152	4.3	778	16.2	1.8	0.06	159	2.60	1,680	1,825	2,070	1,526	7.4	11.34
1.65	0.24	4.0	0.09	0	0.31	0.8	560	15.8	53.3	1.11	2.7	0.09	140	2.30	1,410	1,149	2,370	244	7.6	0.49
0.76	0.12	3.5	0.08	Trace	0.17	0.3	486	13.7	91.2	1.90	3.9	0.13	182	2.99	1,290	1,231	2,100	315	7.7	13.58
0.64	0.09	4.6	0.10	0	0.30	0.2	511	14.4	87.9	1.83	0.0	0.00	251	4.11	1,370	1,322	2,210	192	7.8	14.43
0.90	0.13	1.75	0.04	0	0.20	0.4	538	15.1	79.2	1.65	3.6	0.12	184	3.02	1,430	1,217	2,410	154	7.7	15.83
0.63	0.09	5.0	0.11	Trace	0.08	0.2	542	15.3	70.6	1.47	2.7	0.09	206	3.38	1,450	1,274	2,320	245	7.8	16.05
0.62	0.09	3.3	0.08	Trace	0.23	0.5	44	1.23	386	8.04	1.8	0.06	161	2.64	910	858	1160	302	7.8	1.84
2.10	0.30	3.0	0.07	Trace	0.07	2.8	599	16.9	884	18.4	0.0	0.00	269	4.41	2,630	2,581	3,620	660	7.4	0.43
2.20	0.32	4.6	0.10	1.5	0.36	2.7	592	16.7	898	18.7	3.6	0.12	112	1.83	2,810	2,487	3,650	951	7.7	0.46
2.15	0.31	2.3	0.05	2.4	0.22	1.2	209	5.90	447	9.3	9.0	0.30	302	4.95	1,530	1,388	1,910	310	8.0	74.36
4.15	0.60	3.6	0.09	0.75	0.25	3.6	1,585	44.7	1,239	25.8	3.6	0.12	118	1.94	5,210	3,520	6,630	1,608	7.6	0.28
2.10	0.30	10.8	0.25	0.5	0.32	3.6	620	17.5	893	18.6	2.7	0.09	90.9	1.49	2,780	2,500	3,620	1,129	7.5	1.28
2.75	0.40	5.8	0.13	Trace	0.31	0.9	1,386	39.1	692	14.4	1.8	0.06	115	1.88	4,070	3,223	5,740	1,006	7.6	32.97
2.50	0.36	6.8	0.16	Trace	0.17	0.9	1,390	39.2	975	20.3	0.0	0.00	123	2.01	4,000	3,796	5,580	1,244	7.6	2.16
0.27	0.04	2.3	0.05	Trace	0.26	0.4	180	5.08	87.8	1.87	7.2	0.24	148	2.43	570	943	969	139	7.9	0.07
1.20	0.17	4.0	0.09	0	0.26	1.0	205	5.77	434	9.03	2.7	0.09	276	4.53	1,600	1,521	2,020	251	7.9	0.04
0.54	0.08	3.6	0.08	0	0.31	0.3	288	8.11	194	4.03	2.7	0.09	140	2.3	1,080	888	1,560	464	7.8	58.32
1.20	0.17	7.6	0.17	0.8	0.13	12.0	660	18.6	159	3.32	1203	40.1	4,417	72.4	7,130	10,292	9,410	853	9.5	2.12
0.32	0.05	10.5	0.24	1.2	0.07	4.2	3,379	95.3	1,393	29.0	0.0	0.00	214	3.5	9,930	8,483	14,200	2,549	7.2	311.01

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AGGREGATED SCENARIO--DIRECT UTILIZATION OF GEOTHERMAL RESOURCES IN UTAH

26 May update

	Tot. MWt	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99
Monroe/Red Hill/Johnson	85		1	1	1	2	2	3	4	2	2	1	1	1	1		1		1		1		1
Crystal H. S.	43	1	1	2	4	2	2	1	1	1	1	1		1		1		1		1		1	
Wasatch/Beck's/Hobo	65			1	3	5	10	15	5	5	5	2	2	1	1	1	1		1		1		1
Midway	11			1	2	1	1	1		1		1		1		1		1					
Ogden/Hooper/Utah/Hill AFB	95			2	3	5	10	10	10	7	5	5	3	2	2	2	2	2	1	1	1	1	
Meadow/Hatton	45						1	2	4	10	10	3	2	2	1	1	1	1		1		1	
Joseph H. S.	45						1	2	4	4	2	2	1	1	1	1	1		1		1		1
New Castle	45*					1	1	2	4	7	10	8	4	2	1	1		1		1		1	
Cove Fort (Sulphurdale)	400*							2	4	7	10	10	10	5	5	3	3	3	3	3	3	2	2
Thermo	200*										1	2	4	10	10	10	5	5	3	3	3	3	2
Tintic	100*					2	2	2	4	4	5	5	4	3	3	3	3	3	3	3	3	2	2
Beryl	100*					2	4	10	15	10	5	5	5	4	3	3	3	3	2	2	2	2	2
Abraham	100*						1	1	2	6	10	10	5	4	4	3	3	3	3	3	2	2	2
West Cove Fort	100*								2	2	6	10	10	10	5	3	3	2	2	2	2	2	2
Black Rock Desert	100*								2	2	6	10	10	10	5	3	3	2	2	2	2	2	2
Veyo	10			1	1	2	2	1	1	1	1												
LaVerkin	10				1	1	2	2	1	1	1	1											
Crystal (Madsen's) H. S.	27					1	1	2	4	2	2	1	1		1		1		1		1		1
Other Areas	200*						1	2	4	4	4	6	6	4	4	2	2	2	2	2	2	2	2
Total for Year		1	2	8	15	24	41	58	71	76	86	83	68	61	47	38	32	29	25	24	24	21	20
Cumulative Total		1	3	11	26	50	91	149	220	296	382	465	533	594	641	679	711	740	765	789	813	834	854

Continued

	Tot. MWt	2000	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20
Monroe/Red Hill/Johnson	85		1		1		1		1		1		1		1		1		1		1	
Crystal H. S.	43	1		1		1		1		1		1		1		1		1		1		1
Wasatch/Beck's/Hobo	65		1		1		1		1													
Midway	11																					
Ogden/Hooper/Utah/Hill AFB	95	1		1		1		1		1		1		1		1		1		1		1
Meadow/Hatton	45	1		1		1		1		1												
Joseph H. S.	45		1		1		1		1		1		1		1		1		1		1	
New Castle	45*	1																				
Cove Fort (Sulphurdale)	400*	2	2	2	1	1	1	1	1	1	1	1		1		1		1		1		
Thermo	200*	2	1	1	1	1	1		1		1		1		1		1		1		1	
Tintic	100*	2	1	1	1	1		1		1		1		1		1		1		1		1
Beryl	100*	1	1	1	1	1	1	1	1		1		1		1		1		1		1	
Abraham	100*	2	2	1	1	1	1	1		1		1		1		1		1		1		1
West Cove Fort	100*	2	2	1	1	1	1	1	1		1		1		1		1		1		1	
Black Rock Desert	100*	2	2	1	1	1	1	1		1		1		1		1		1		1		1
Veyo	10																					
LaVerkin	10																					
Crystal (Madsen's) H. S.	27		1		1		1		1		1		1		1		1					
Other Areas	200*	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2
Total for Year		19	17	13	13	12	12	11	10	9	9	8	8	8	8	8	8	8	7	8	7	8
Cumulative Total		873	890	903	916	928	940	951	961	970	979	987	995	1003	1011	1019	1027	1035	1042	1050	1057	1065

Assumptions used in Scenarios
April 1978

Roosevelt Hot Springs Prospect

1. Reservoir capacity--assumed to be 400 MWe. This figure is averaged between Phillips, (1) and UP&L (2) estimates of 300 MWe, and Dr. Ward's admittedly optimistic guess of 500 MWe. (3) In this respect 400 MWt is an optimistic and fairly realistic estimate.

2. According to Phillips and UP&L (1,2), the plants are planned to come on-line in 55 MWe units two years apart. The following assumptions were based on this information:

   A. The plants were assumed to come on-line two years apart.
   B. The later plants were assumed to be 100 MWe plants. This presumes
      (1) adequate reservoir capacity and
      (2) development by a single operator (unitization). It is possible that later plants might be 55 MWe plants on-line each year.

Cove Fort

1. Several factors will tend to retard development at Cove Fort. (Sulphurdale)

   A. Drilling has been very difficult. It has taken a long time and considerable problems were encountered from a geological standpoint.
   B. Because of these problems with drilling, the wells drilled by Union have been very expensive.
   C. The presence of a viable reservoir has not yet been satisfactorily verified.

2. In spite of these setbacks, several ventures are proceeding. (4) For purposes of the long-range scenario, the following separate ventures were assumed.

   A. Sulphurdale--Union could have two areas here. One North of the freeway, one south. Because Union still appears to be progressing, one plant was assumed to come on-line in 1984, and another in 1985, at the other site. The sites are left unspecified. This is an optimistic forecast, particularly in light of the difficulties mentioned above.
   B. North Cove Fort (Dog Valley)--Hunt Oil Co. is currently drilling on private lands several miles north of the Sulphurdale area. An optimistic forecast would put them on-line about 1985, although they may try to come on-line about 1984. Of course, they could encounter problems and develop later or not at all.
   C. West Cove Fort Area--several groups are conducting intensive exploratory activities in this area, although no deep wells have been drilled. The main developers in this area are AMAX, Hunt, Chevron, Phillips, and others. An optimistic estimate could place at least one of these prospects on-line in 1985. (4) Because several developers are involved, the plants could come on line in bunches; the assumption for the scenario was about a plant each year.

Continued

3. Reservoir Quantities: Based roughly on Dr. Ward's estimates of 500 MW for Cove Fort and 2000 MWe for the whole area,(3) the following quantities were estimated:

   Sulphurdale 400 MWe.
   North Cove Fort 200 MWe.
   West Cove Fort 200 MWe.

   These are quite arbitrary estimates; Sulphurdale was allotted 400 MWe because it seems at this time to be the most likely area. The amount for the whole area was estimated to be 800 MWe because it included parts of areas which were originally estimated at 500 MWe with the area generally unspecified. (3) North Cove Fort and West Cove Fort were guessed to have 200 MWe each, merely because that seemed like a reasonable allotment. Again, these capacities are arbitrary and are useful only for purposes of estimating development patterns.

4. Federal Programs and other incentives/assistance: It was assumed that optimistics estimates would be partially justified by the development of federal initiatives to accelerate and assist development in Cove Fort areas. It was also assumed that optimistic estimates were justified by the need for such estimates in planning operations.

   Note: Cascading and multiple use systems will very likely be developed for some of these areas, most particularly in the Sulphurdale area where exhaust from the power plant may be used in sulphur mining or other industrial operations.(4)

Thermo Prospect

1. Reservoir capacity was assumed to be 100 MWe. This is more optimistic than the Core Team estimate of 50 MWe, but much less than some previous estimates. The rationale for this figure would be that the area involved might be larger than the 1.5 km^2 estimated by USGS Circular 726, although at this time there is little evidence to support this hypothesis.

2. Earlier scenarios estimated drilling to begin at Thermo in 1980.(6) Republic Geothermal drilled a deep well in late 1977. This would seem to indicate that development at Thermo could be advanced by as much as two years. Also, federal programs could make an earlier production date feasible, not only for Thermo, but also for some of the Cove Fort areas. On the other hand, preliminary information from the Republic Well at Thermo does not seem to justify boundless optimism; hence the first plant was estimated to produce power on-line about 1986, with another 50 MWe plant following two years later.

References

1. Phillips Petroleum Co., Verbal and written communications, February and March, 1978.

2. Dr. Val Finlayson, Director of Research and Development, Utah Power and Light Company, Salt Lake City, Utah. Personal Communication, March 28, 1978.

3. Dr. Stanley H. Ward, Chairman, Department of Geology and Geophysics, University of Utah, Salt Lake City, Utah. Personal Communication, March 28, 1978.

4. Kenneth Bull, U.S. Geological Survey, District Geothermal Supervisor, Salt Lake City, Utah. Personal Communication, April 4, 1978.

5. State and Federal Geothermal Leases, compiled by the Utah State Team, February, 1978.

6. MITRE Corporation, METREK Division, "Site Specific Analysis of Geothermal Development--Data Files of Prospective Sites." October, 1977

Aggregated Scenario--Electrical Production from Geothermal Resources in Utah

	tot. MWe	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01	02	03
osevelt Prospect	400			50		50		100		100		100													
ve Fort Sulphurdale	400					50	50		50	50	100		100												
st Cove Fort	200						50		50		50	50													
rth Cove Fort	200						50		50		50	50													
ermo	100							50		50															
her Areas evier Lake, ack Rock Desert lta Area).	200								50		50		50	50											
TAL FOR YEAR				50		100	150	150	200	200	250	200	150	50											
MULATIVE TOTAL				50		150	300	450	650	850	1100	1300	1450	1500											

Aggregated Scenario--Direct Utilization of Geothermal Resources in Utah

	tot MWt	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01
Monroe/Red Hill/ Johnson	85		1	2	3	4	6	8	10	10	10	10	10	6	5										
Crystal H.S.	43		1	2	3	4	6	10	8	6	3														
Wasatch/Beck's/ Hobo	65			1	3	5	10	10	10	10	10	4	2												
Midway	11			1	2	4	4																		
Ogden/Hooper/ Utah/ Hill AFB	95			2	3	5	10	20	20	15	10	10													
Meadow/Hatton	45						2	2	4	6	8	8	6	6	3										
Jospeh H.S.	45						2	4	8	10	6	5	5	3	2										
New Castle	40*					2	2	4	6	10	10	6													
Cove Fort (Sulphurdale)	400*							10	10	20	40	40	40	40	40		40		40		40		40		
Thermo	200*										2	4	4	10	20	40		40		40		40			
Tintic	100*					2	6	12	20	20	15	10	10	5											
Beryl	100*					4	10	20	15	15	15	15	6												
Abraham	100*							2	2	6	10	15	15	15	15	15	5								
West Cove Fort	100*								2	2	6	10	15	15	15	15	10	10							
Black Rock Desert	100*								2	2	6	10	15	15	15	15	10	10							
Veyo	10			1		2	2	3	2																
LaVerkin	10				1			2	2	3	2														

Continued

	tot MWt	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	2000	01
Crystal (Madsen's) H.S.	27					2	2	2	4	6	6	3	2												
Other Areas	200*						2	2	4	4	4	6	8	10	10	10	10	10	10	10	10	10	10	10	10
Continuation																02	03	04	05	06	07	08	09	10	11
of Other Areas																10	10	10	10	10					
Total for Year			2	9	15	34	64	111	129	145	163	156	138	125	125	95	75	70	50	50	50	50	50	10	10
Cumulative Tot.			2	11	26	60	124	235	364	509	672	828	966	1091	1216	1311	1386	1456	1506	1556	1606	1656	1706	1716	1726

Low Temperature Geothermal Uses: General Assumptions:

1. The reservoir energy potentials for most of the sites (the spring areas) were taken from the Core Team estimates of reservoir thermal potential. These estimates are based on the following assumptions:

   A. Reservoir temperatures were taken from chemical or physical data in USGS Circular 726 (8) and as provided by Dr. Swanberg. (1)

   B. A standard reservoir volume was assumed, as used in USGS Circular 726, of 2.25 km^3 (8)

   C. Stored heat and thermal potential are calculated from these values with weighting factors from USGS Circular 726. This factor is the recovery factor, 0.06, found on p.116. (8)

2. Any postulated development is, of course, dependent on the presence of suitable resources. Development in most cases was assumed to be gradual at first. Rates of development and relative magnitudes of energy use were estimated from the following factors:

   A. Known plans for development, as ascertained through literature or verbal communications (see references);

   B. Probable or potential uses, such as greenhouses, mining, etc.;

   C. Proximity to areas of potential use, or conversely, relative isolation;

   D. General potential of the prospect, including such factors as temperature, heat content, flow, dissolved solids, etc.

   The potential MWt (for 30 years) was opportioned over a seemingly reasonable period based on the above factors.

3. As an approximate quideline, rates and magnitudes of development were based loosely on an estimate of about 1 MWt for a greenhouse of 2050 m^2. (2)

4. Some areas which were not included in the Core Team Report were assigned a reservoir potential on a purely arbitrary basis. These capacities are noted with an asterisk (*) on the scenarios and other places.

5. The most probable sites were treated individually. The potential for the rest of the state, incuding less likely known sites and currently unknown sites, were assigned an arbitrary value (see the assumptions for this prospect).

6. Estimates are admittedly optimistic. Neither individual magnitudes nor rates can be considered to be reflections of the real situation. The scenarios usually reflect more what <u>could</u> be rather than what <u>will</u> be, even according to present plans.

Continued

7. Individual scenarios are not intended to be accurate reflections of real development as much as a basis for the aggregated scenarios. Thus, the aggregated scenarios are probably of more worth than the individual scenarios.

8. The estimated development times have been estimated without regard to development lag times or institutional factors, for the following reasons:

   A. Institutional factors are still very vague and vary greatly. Time will not permit extensive scenarios for each individual site at this point in the study.

   B. Even if average lag times were known for the specific steps required at each site, the procedure for developing scenarios would involve estimating a date for development and then working backwards. At this point, the basic results would be the same.

   C. It is to be hoped that the "semi-continuous" approach to the scenarios makes up for some of the specific inaccuracies in the time schedules.

9. It was assumed for all cases that development will be reasonably feasible from economic and technical standpoints.

10. Dissolved solids data are averages of the samples cited in WRB-13 (Reference 6)

Prospect: Monroe Hot Springs
(also Red Hill, Johnson Hot Spring)

Resource Characteristics:

Surface Fluid Temperature: Monroe 76°C, Red Hill 77°C, Johnson's 25°C (6)

Subsurface Fluid Temperature: Monroe 120°C, Red Hill 135°C (1) – indicate thermometer used (cmtple, & choise

Total Dissolved Solids: Monroe 2750 ppm, Red Hill 2630 ppm, Johnson 428 ppm. (6)

Estimated Energy Potential: Monroe 38 MWt, Red Hill 43 MWt, Johnson 4 MWt for 30 years Total: 85 MWt (1)

Type of Overlying Rocks: Springs issue from tufa mounds along the base of the mountain, (6) grading west into alluvium in the valley.

Location of Prospect: Just east of Monroe, Utah; T25S, R3W, Sec. 11, 15, and 27. (6)

Description: Series of hot springs issuing from hillside immediately east of Monroe City, at the base of a large mountain. The springs are along a north-south trending fault. (6)

Land Ownership: Mostly Private. (2) Some BLM and National Forest Lands east of the prospect. (11)

Land Use: Municipal, agricultural, range land, and forest land nearby.

Leasing: Some leasing in area. Limited leasing because most of the land is private. (12)

Activity:

The Springs are presently being used by a spa for heating a swimming pool, showers, etc. The owners have expressed plans for eventually heating greenhouses and a motel complex.

The City of Monroe has received conditional approval on a proposal for a space heating system for the city. The first phase of this project would involve the heating of the South Sevier District High School; later the system would be expanded to heat homes in the city as well as several larger buildings in the city, a number of greenhouses, and several multiple unit complexes (motels and apartments).

Assumptions:

1. Geothermal Resources are at this time being used to heat a spa and resort. The Monroe City development will probably drill a well late in 1978 or early in 1979. Use of the water will begin shortly thereafter to heat the school.

2. The development outlined in the Monroe proposal was assumed to utilize about 6 MWt, and will be developed up to about 1981.

3. Development beyond 1981 will likely continue. Some of the development will be in houses and homes, but it will probably include more greenhouses and other agricultural/light industrial uses.

4. Development will probably depend a lot on reservoir characteristics, which will not be accurately determined until development actually begins. Thus, the development will probably proceed step-wise over a number of years.

Prospect: Crystal Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 58°C (6)

Subsurface Fluid Temperature: 135°C (1) 77°C measured @ 280'

Total Dissolved Solids: 1520 ppm (6)

Estimated Energy Potential: 43 MWt for 30 years. (1)

Type of Overlying Rocks: Unconsolidated valley fill. Bedrock at fairly shallow depths. Volcanic rocks underlie the fill. (6)

Location of Prospect: South end of Salt lake Valley, near "Point of the Mountain". Area near T4S, R1W, Sec, 12, NW¼ (6)

Description: Series of Hot Springs discharging into clear pools and ponds.

Land Ownership: Some private (Mr. Dunion) (3); also, the state owns some land in the immediate vicinity, including the State Prison Complex.

Land Use: Some agricultural, few greenhouses, fish culture, State Prison; Div. of Forestry has some land just south of the prison, which maybe used for silviculture. (3)

Leasing: No state or federal leases. (No sate or federal lands) (12)

Activity: Some discharge from the springs is used by Mr. Dunion, for use in raising tropical fish. (3)

During January and February, 1978, the Utah Geological and Mineral Survey drilled a series of temperature gradient wells near the site under the State Cooperative Program.

In connection with the temperature gradient holes, the Utah Division of Forestry plans to drill a test well near the prison which, if producible, could be used to heat greenhouses. Eventual uses in the area could include more green houses, heating for housing developments, and space heating for the State Prison.

Upda

Assumptions:

1. It is assumed that development will begin slowly as the reservoir parameters are explored. If the reservoir proves adequate, more greenhouses will be added and the prison will consider space heating. Because construction of houses or retrofitting of the prison will take some time, the peak of the development will probably be spread over several years. After the main peak of utilization has passed, additional development will probably occur as the limits of the reservoir are explored.

poss., but unlikely? (don't tell Warden, include now

2. No pretense has been made to represent accurately the magnitudes of heat necessary for heating the prison. The estimated available energy has merely been apportioned over a reasonable interval.

3. The estimated development times have been estimated without regard to development times or institutional factors, for the following reasons:

   A. Institutional factors are still very vague and vary greatly. Time will not permit extensive scenarios for each individual site.

   B. Even if average lag times were known for the specific steps required at each site, the procedure for developing scenarios would involve estimating a date for development and then working backwards. At this point, the basic results would be the same.

   C. It is to be hoped that the "semi-continuous" approach to the scenarios makes up for some of the specific inaccuracies in the time schedules.

Prospect: Wasatch Hot Springs/Beck's Hot Springs/Hobo Hot Springs (3)

Resource Characteristics:

Surface Fluid Temperature: Wasatch 42°C, Beck's 56°C (6)

Subsurface Fluid Temperature: Wasatch 120°C (1), Beck's 90°C (1) } any UGMS update?

Total Dissolved Solids: Beck's 13,400 ppm, Wasatch 7220 ppm (6)

Estimated Energy Potential: Wasatch 38 MWt/30 years, Beck's 27 MWt/30 years (1)

Type of Overlying Rocks: Both springs issue near the contact between Quaternary Valley fill and Paleozioc limestones. (6)

Location of Prospect: Salt Lake Valley near the north end of Salt Lake City. T1N, R1W; Beck's, Sec. 14, SW¼SE¼. Wasatch, Sec. 25, NW¼SE¼. (6)

Description: Hot Springs along Wasatch Fault, along east edge of Salt Lake Valley between Salt Lake City and Bountiful City.

Land Ownership: Mostly private (within city). (11)

Land Use: Grades from residential and commercial near Wasatch Springs to light and heavy industry north from Beck's Springs.

Leasing: No federal or state lands in the vicinity of the springs.

Activity:

At one time, Wasatch H.S. and Beck's H.S. were used for spas. However, neither is presently being used, and Beck's is discharging large amounts of hot water to a canal leading to Great Salt Lake. Some warm waters in the area are used for washing gravel by gravel companies in the area.

Assumptions:

1. Although the hot springs discharge is not being used at this time, the proximity of the springs to the city center and industrial areas makes them prime targets for development. Several parties have inquired about the use of warm water in the area for space heating. For these reasons, development is expected to begin within the next

few years, and to continue thereafter as interest grows. At least two buildings in Salt Lake City area are using heat pump applications in connection with heating and cooling. (The buildings are the LDS Church Office Building in the downtown area and the International Center near the Salt Lake Airport.) (3) Because of the general area of the springs much of the development was assumed to be primarily light industrial or large space heating uses.

2. Development rates, times, and magnitudes are arbitrary but reasonable estimates.

Prospect: Midway Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 45°C (1,6)

Subsurface Fluid Temperature:

Total Dissolved Solids: 1770 ppm (6)

Estimated Energy Potential: 11 MWt (based on surface Temp.) (1)

Type of Overlying Rocks: The springs issue from calcerous tufa about 70 ft. thick, underlain by alluvium (6)

Location of Prospect: In the area of T3S, R4E, Sec. 26, 27,34,35, in the Northwest corner of the Heber Valley. (6)

Description: Numerous Hot springs with tufa mounds. The springs drain into Snake Creek above Midway.

Land Ownership: Mostly state and private lands (11).

Land Use: Mostly agricultural, also residential, recreational (Wasatch Mountain State Park, etc.).

Leasing: Some State and/or Federal leasing in Heber Valley, but not in the vicinity of the springs. (12)

Activity:

One of the large springs has been used for several years as water for a swimming pool and resort.

The Utah Geological and Mineral Survey is scheduled to drill temperature gradient holes near the springs in mid-April, under the DOE State Cooperative Program. results include

There have been a few inquiries regarding the use of geothermal fluids for space heating; however, nothing is definite or specifically planned at this time.

Assumptions:

1. Midway H.S. are near the small town of Midway, but there are at this time only a school and town hall which could be major users of geothermal heat. Development would probably take the form of greenhouses and/or housing developments such as apartments or condominiums. There is a fish hatchery near Midway but it is several miles from the hot springs area. Development was estimated to begin about 1980 on a small scale and to extend over several years.

2. Development rates, times, and magnitudes arbitrary but reasonable estimates.

Prospect: Ogden Area: Ogden H.S., Utah H.S., Hooper H.S., Hill AFB

Resource Characteristics:

Surface Fluid Temperature: Ogden H.S. 58°C, Hooper H.S. 60°C, Utah 58°C. (6)

Subsurface Fluid Temperature: Ogden H.S. 110°C, Hooper H.S. 105°C, Utah H.S. 95°C. (1)

Total Dissolved Solids: Ogden H.S. 8700 ppm, Hooper 8800 ppm., Utah 18,600 ppm. (6)

Estimated Energy Potential: Ogden H.S. 34 MWt/30 yr., Hooper H.S. 32 MWt/30 yr., Utah H.S. 29 MWt/30 yr. Total 95 MWt/30 yr. (1)

Type of Overlying Rocks: Ogden H.S. rise along a fault in Precambrian rocks; Hooper H.S. rise from Quaternary Valley fill; Utah H.S. issue in an area of complex faulting in Cambrian rocks. (6)

Location of Prospect: Ogden H.S. T6N, R1W, Sec. 23, SW¼SW¼; Hooper H.S. T5N, R3W, Sec. 27, SW¼; Utah H.S. T7N, R2W, Sec. 14, SW¼SE¼. Generally east, west, and north of Ogden respectively. (6)

Description: Various hot springs; Utah H.S. is used for greenhouses, Ogden is a diffuse spring area, Hooper is not used at the present time. (3,6)

Land Ownership: Mostly private. Hooper H.S. is near the wildlife refuge. (11) Hill AFB is federal reserve land. (7)

Land Use: Mostly municipal. The actual spring areas are away from the city. Hooper is in an agricultural area, and Utah H.S. is in an agricultural and light industrial area.

Leasing: No federal or state leases in this area. (12) (No federal or or state lands) (11)

Activity: Utah H.S. is currently being used to heat greenhouses by by the Allen Plant Co. and another company. (3) There is a lot of iron in the water. (3,6) There appear to be plans for further development.

Ogden H.S. was used as a resort, now is being discharged as runoff. The water is hot, but the source is diffuse, posing possible tapping problems. Water is quite mineralized. (3)

Continued

Hooper water is hot, but the spring is some distance from population areas and is currently not being used. (3)

Hill AFB at Ogden contracted to EG&G to do a study on the possibility of heating buildings on the base with geothermal fluids. (7) No particular geothermal resources are known to be beneath the base, but a major fault does run through the base area and might possibly provide a conduit for hot fluids beneath the base.

Assumptions:

1. The magnitude of the resource was assumed to be equal to the sum of the estimated potential for the three spring areas. This assumption is obviously not accurate since the estimate was applied over the whole area, including Hill AFB. However, no other data is available. Again, magnitudes, times, and growth rates are only rough guesses.

2. Development was assumed to start small, with existing uses (resorts and greenhouses), and to begin in the early 80's as the feasibility of geothermal uses are proven. Development of geothermal heating for Hill AFB was assumed to be possible and feasible, so that development there would begin about 1982 to 1984, an optimistic estimate. Because most of the buildings would require retrofitting, etc., development at the air base was assumed to proceed step-wise over a number of years.

Prospect Meadow/Hatton Hot Springs

Resource Characteristics:

Surface Fluid Temperature: Hatton H.S. 38°C, (1,6) Meadow 41°C (6)

Subsurface Fluid Temperature: Meadow H.S. 105°C (1)

Total Dissolved Solids: Meadow 4800 ppm, Hatton 4760 ppm (6)

Estimated Energy Potential: Meadow 37 MWt/30 yr., Hatton 8 MWt/30 yr. (1)

Type of Overlying Rocks: The springs are in valley fill of Tertiary or Quaternary age; There are Quaternary basalt flows within a few miles of the Springs. (6)

Location of Prospect: Near Meadow and Hatton in Beaver Co.
Meadow H.S. T22S, R6W, Sec. 26, SW¼SW¼;
Hatton, T22S, R6W, Sec. 35, SE¼SE¼. (6)

Description: The spring areas are west of Hatton in a semi-arid range area. Hatton spring no longer flows. (6)

Land Ownership: Mostly private, some federal lands in area. (11)

Land Use: Agricultural, range, desert.

Leasing: State and federal leasing in area. (12)

Activity: Meadow Hot Springs is a relatively new spring, now being used for stock watering. (3)

Hatton Hot Springs no longer flows. (6)

Assumptions:

1. Meadow and Hatton Hot Springs are some distance from the towns of Meadow and Hatton. (3,6) Because of this slight isolation, development of the spring areas per se will probably not occur until the early or mid 1980's, and probably will start out with a few greenhouses or similar agricultural or light industry.

2. Immediate area of the springs is of questionable geothermal potential because of the relatively low temperature of the spring water, the low silica content, and the similarity in chemical quality to the ground water in a fairly large surrounding area. (6)

However, the springs are in an area of late Tertiary and Quaternary volcanic flows. Some lands in the area have been leased for Geothermal development. It is likely therefore that the geothermal potential of the area is not confined to the springs area. This leads to the possibility that geothermal development could occur much nearer to the cities of Meadow, Hatton, and Kanosh, and perhaps over a larger area. However, because this type of development would require drilling and is somewhat more risky, it would probably be delayed until the middle or late 1980's and may be related to attempts to locate resources suitable for electrical production.

3. The estimates of magnitude of recoverable energy for the area is the sum of the estimates for the springs, even though the potential extends beyond the spring area. Development rates, times, and relative magnitudes are arbitrary but reasonable estimates.

Prospect: Joseph Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 64°C (6)

Subsurface Fluid Temperature: 162°C (1)

Total Dissolved Solids: 5100 ppm (6)

Estimated Energy Potential: 45 MWt/30 yr. (1)

Type of Overlying Rocks: Joseph H.S. issues from a tufa mound over the Dry Wash fault. Immediately east of the fault there are extensive volcanic outcroppings of late Tertiary age. On the other side of the fault are unconsolidated Quaternary deposits. (6,13)

Location of Prospect: T25S, R4W, Sec, 23. South east of the town of Joseph in Sevier County, Utah. (6)

call UUG Chapman

Description:

Land Ownership: Mostly private in the valley, surrounded by BLM land east of the main valley. (11)

Land Use: Agricultural, range land, rural residential.

Leasing: Leasing has occured in the immediate area of the springs and of the town of Joseph. (13)

Activity: Spring Area, very low discharge. No known development activity.

Assumptions:

1. Joseph Hot Spring has a relatively low discharge. On the one hand, this may indicate a lower recharge rate (suggested by Ref. 3); on the other hand, it may be due to sealing action by precipitates and may be a pressurized system (suggested by Ref. 5). Although the evident recharge area is not as large as that of Monroe Hot Springs a few miles away, the Joseph's Springs are located on a long fault, which may extend up along the Sevier River. (6) It is quite apparent that the magnitude of the resource will only be determined by exploratory drilling. For the purposes of the scenario, the estimated magnitude of the resource as determined by USGS Circular 726 was used. (1,8) Development rates, times, and magnitudes are reasonable estimates only.

Continued

2. The hot springs area is about a mile from Joseph. In order to make a community space heating system feasible, it would pretty much be necessary for larger heat loads to be located at the far end of a distribution line. This would put the load about 1½ miles from the spring area. Three factors might change this situation:

   A. Wells might be drilled away from the springs area. However, this would involve more geophysical exploration and because of the greater risk, might not be feasible at all.

   B. Greenhouses or other similar industry might be located between the springs and the town. Although this would be more feasible, it would not provide the loads in the city which would make space heating for residences feasible.

   C. It may become feasible to transport the heat longer distances.

   In any of these cases, development would probably not gain very much momentum before the mid-1980's.

Prospect: New Castle

Resource Characteristics:

Surface Fluid Temperature: ~ 100°C

Subsurface Fluid Temperature: n.d

Total Dissolved Solids: Relatively low. (3,4,5,9)

Estimated Energy Potential: Not known, arbitrary estimate of 40 MWt/30yr.

Type of Overlying Rocks: Most of the valley is overlain by Quaternary alluvium; within a few miles of New Castle there are outcroppings of late Tertiary volcanic rocks and Tertiary granites.

Location of Prospect: About T36S, R15W. (11)

Description: Agricultural area, with water wells which have hot water at shallow depths.

Land Ownership: Large block of state land to the east of New Castle, federal lands to the south and southwest, private lands to the west. (11)

Land Use: Agricultural, range land, rural residential.

Leasing: Some leasing has occurred on state and federal lands in the vicinity of New Castle. (12)

Activity: A well which was drilled to provide water for irrigation hit hot water at shallow depths. The water is presently cooled and used for irrigation.

Assumptions:

1. The New Castle area is at present a moderate priority for temperature gradient exploration under the State Cooperative Program. (3,4) There are few dwellings in the area, but possibilities for light industry exist (greenhouses, crop drying, extending growing season). The water is very low in dissolved solids. Because one well has already been drilled and other exploratory work is planned, development may come in the early 1980's. The primary drawback would be the isolation of the area.

Prospect: Cove Fort (Sulphurdale)

Resource Characteristics:

Surface Fluid Temperature: rumored 80°F in spring

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not Known, arbitrary estimate for comparison purposes 400 MWt/30 yr.

Type of Overlying Rocks: Mesozoic and Cenozoic sediments, Cenozoic volcanics

Location of Prospect: West Central Utah near Cove Fort, about T25S, R6&7W. Commonly known as The Cove Fort or the Cove Fort-Sulphurdale area.

Description:

Land Ownership: Some private, BLM, and National Forest.

Land Use: Mining - S of

Leasing: Extensive leasing of state and federal lands. (12)

Activity: Union has drilled two wells in this area, one of them caved in. There is at this time the possibility that the area will not yield resources which would be suitable for electrical generation. Whether or not electrical generation is possible there is a good potential for direct utilization at the prospect.

A. Inquiries have been made and plans may be underway to use a cascading system. Potential uses would be greenhouses or other industrial uses. (5)

B. A specific use may be at the sulphur mining operations at Sulphurdale, where heat is required for the sulphur extraction process. (5)

Continued

Assumptions:

1. Although there may be some institutional restraints (part of the probable geothermal field is on Forest Land) (5), the possibility of industrial use of geothermal heat appears good. The industrial use will probably coincide with the production of electrical power. (5)

2. The magnitude of the power in use will depend primarily on the resource. The estimate of 400 MWt for 30 years is an arbitrary estimate based on estimates of the electrical potential for the area. (9)

3. It is assumed that once the geothermal resource has been proven that industrial use will be added in fairly large increments on a fairly regular basis.

Prospect: Thermo

<u>Resource Characteristics</u>:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known, Arbitrary Estimate of 200 MWt/30 yr.

Type of Overlying Rocks:

Location of Prospect: West and south of Minersville, about T30&31S, R12&13W. (11)

Description:

Land Ownership: Mostly BLM, some state and federal land. (12)

Land Use:

Leasing: State and federal lands have been leased extensively. (12)

Activity: Republic Geothermal Inc. has drilled a deep geothermal well in the area which is still being tested. Geophysical and temperature gradient exploration has also taken place quite extensively.

Assumptions:

1. Although there have been no specific plans expressed for either cascading systems or purely industrial use, it is very likely that the resource will be suitable to direct utilization. This development will probably not occur until the mid or late 1980's for the following reasons:

   A. The general development of the Thermo area is several years behind the development for The Roosevelt and Cove Fort areas this would put development at about the mid-1980's

   B. The Thermo area is quite isolated and this fact would probably account for some retardation of development.

2. The magnitude of the heat potential for this prospect is an arbitrary but reasonable estimate, as are the development times, rates, and magnitudes.

Prospect: Tintic

Resource Characteristics:

Surface Fluid Temperature: should be a mine H_2O temp somewhere in USGS prof. papers

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known; arbitrary estimate of 100 MWt/30 yr. for scenario purposes.

Type of Overlying Rocks: Alluvium, tertiary pyroclastics. (13)

Location of Prospect: T10&11S, R2&3W. South of Utah Valley in the center part of the state.

Description: Hot water issues from the Burgin Mine and is discharged to a stream. It runs several miles down the canyon and is ponded in an evaporation pond.

Land Ownership: Private, BLM, and some state lands. (11)

Land Use: Some mining; agriculture in the valley area.

Leasing: Some state and federal lands leased. (12)

Activity: The Burgin Mine discharges hot water down from the Tintic mountains to an evaporation pond. No use is presently made of the heat from the water. Some interest in the area has been expressed by exploration companies and some leasing (state and federal) has taken place.

Assumptions:

1. Even though Kennecott, which owns the Burgin Mine, has at present no specific plans for utilization of the geothermal fluids which are discharged from the mine, it was assumed that Kennecott would become interested in development of the resource, or that they would cooperate with a second party which could develop the resource. The water discharged from the mine could be either put through heat exchangers for industrial use near the mine or piped out of the mountains to sites where the terrain is more suitable to construction. There are no towns or housing areas near the mining area, but the presence of Goshen Warm Springs may indicate a general distribution of the resource through the valley.

2. The magnitude of the heat potential for this prospect is an arbitrary but reasonable estimate, as are development time, rates, and magnitudes.

Prospect: Beryl

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known, arbitrary estimate of 100 MWt/30 yr. for scenario purposes.

Type of Overlying Rocks: Mostly Quaternary alluvium and lake bed sediments. (13)

Location of Prospect: Southern Utah. South and west of Thermo Hot Springs; T33&34S, R16W, and surrounding area. (11)

Description:

Land Ownership: Mostly private, some state and federal lands. (11)

Land Use: Farming, rural, residential.

Leasing: State and federal lands in the area have been leased. (12)

Activity: Utah and Power and Light, in conjunction with McCulloch Oil and Geothermal Kinetics, drilled three deep exploratory wells in the general vicinity of Beryl. Although the wells were not suitable for electrical production, they were very suitable for low temperature uses. (5,9,10) Interest in the Beryl area has also been expressed by other parties. (4)

Assumptions:

1. The Beryl area is quite isolated, a factor which would tend to retard development. Development, when it occurs, will almost certainly be industrial, since there are so few buildings in the area which could be heated. On the other hand, three wells have already been drilled, and the companies involved are considering low temperature use. (10) For these reasons, development was estimated to begin in the early 1980's. Because industrial use is most likely, development was estimated to come on-line in relatively large increments.

2. The magnitude of heat content used for the scenario is an arbitrary but reasonable estimate, as are development times, rates, and magnitudes.

Prospect: Abraham Hot Springs

Resource Characteristics:

Surface Fluid Temperature: 82°C (6)

Subsurface Fluid Temperature: 125°C (1)

Total Dissolved Solids: 3500 ppm (6)

Estimated Energy Potential: 39 MWt/30 yrs. (1)
Arbitrary estimate of springs and surrounding area, for comparison purposes: 100 MWt/30 yrs.

Type of Overlying Rocks: The springs issue from a tufa mound near a Quaternary basalt flow. (6)

Location of Prospect: The springs are located at T14S, R8W, Sec. 10 and 15; (6) the surrounding area is all potentially a resource one.

Description: Abraham Hot Springs issues from a tufa mound near Fumarole Butte, an old volcanic vent (Quaternary basalt). (6) Most of the water discharges to a slough area in the desert bottom.

Land Ownership: Mostly BLM, some state and private. (11)

Land Use: Mostly desert, some range, etc.

Leasing: KGRA area. Extensive leasing on federal and state lands. (12)

Activity: Leasing, geophysical exploration, and temperature gradient exploration has taken place in the area of the Abraham Hot Springs. Some of the discharge from the Springs is used for a spa-type resort. The heat content of the resource may be less than is now apparent (absence of boiling temperatures, relatively low silica content, large water discharge); (6) drilling will probably be necessary to define the resource potential.

Assumptions:

1. The Abraham Springs area is quite isolated. However, the discharge from the springs themselves is copious and hot. Beyond use for bathing, development at the springs and in the surrounding area will probably be primarily light industrial. Development is estimated to begin in the mid-1980's and to gain momentum as more uses become feasible, technical and economical.

Prospect: West Cove Fort Area

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Arbitrary, but reasonable estimate for comparison purposes: 100 MWt/30 yr.

Type of Overlying Rocks: Alluvium, late Tertiary basalt and basaltic andesite flows. (13)

Location of Prospect: North of the Roosevelt Prospect. West of the Cove Fort area. About T24&25S, R7&8W. (11,12)

Description:

Land Ownership: Mostly BLM, some state and private. (11)

Land Use: Some agriculture; mostly range and desert.

Leasing: Extensive leasing on state and federal lands. (12)

Activity: Extensive leasing, with geophysical and temperature gradient exploration. (12,14)

Assumptions:

1. It appears that there are several possible areas for electrical production in Utah and the area near Black Rock or the "West Cove Fort Area" is a possible prospect. If water can be found at depth, the area could be a potential low-temperature geothermal prospect whether or not the resource is suitable for electrical production. The scenario is based on the assumption that hot water can be located in sufficient quantities to make development feasible.

2. The estimate of a resource potential of 100 MWt/30 yr. is an arbitrary but reasonable estimate as are development times, rates, and magnitudes.

Prospect: Black Rock Desert.

Resource Characteristics:

Surface Fluid Temperature:

Subsurface Fluid Temperature:

Total Dissolved Solids:

Estimated Energy Potential: Not known; arbitrary estimate for scenario purposes: 100 MWt/30 yr.

Type of Overlying Rocks: Lake bed sediments, Quaternary basalt, and late Tertiary basalt and basaltic andesite flows. (13)

Location of Prospect: West of Cove Fort area, about T23&24S, R7&8W. (12)

Description:

Land Ownership: Mostly BLM, some state and private lands. (11)

Land Use:

Leasing: Extensive leasing on state and federal lands. (12)

Activity: Extensive leasing, with geophysical and temperature gradient Exploration. (12,14)

Assumptions:

1. It appears that there are several possible areas for electrical production in Utah, and the area near Black Rock or the "West Cove Fort Area" is a possible prospect. If water can be found at depth, the area could be a potential low-temperature geothermal prospect whether or not the resource is suitable for electrical production. The scenario is based on the assumption that hot water can be located in sufficient quantities to make development feasible.

2. The estimate of a resource potential of 100 MWt/30 yr. is an arbitrary but reasonable estimate, as are development times, rates, and magnitudes.

Prospect: Veyo, LaVerkin

Resource Characteristics

Surface Fluid Temperature: Veyo 42°C, LaVerkin 42°C (1,6)

Subsurface Fluid Temperature:

Total Dissolved Solids: Veyo 396 ppm., LaVerkin 9580 ppm (6)

Estimated Energy Potential: Veyo 10 MWt/30 yr., LaVerkin 10 MWt/30 yr. (1)

Type of Overlying Rocks: Veyo, Quarternary basalts. LaVerkin, Paleozoic limestone, along Hurricane fault. (6)

Location of Prospect: Veyo, the springs are at T40S, R16W, Sec. 6, NW¼SE¼SW¼, about 18 miles north-northwest of St. George in southern Utah. LaVerkin springs are at T41S, R13S, Sec. 25, about 18 miles east-northeast of St. George. (6)

Description:

Land Ownership: Veyo: private land immediately around Veyo; some state lands nearby, BLM controls most of the surrounding area. (11)
LaVerkin: Also mostly private, BLM lands nearby. (11)

Land Use:

Leasing: Some leasing in the Veyo area. (12)

Activity: Veyo Hot Springs is currently used as a swimming pool and spa. LaVerkin (Dixie) Hot Springs issue from the bed and banks of the Virgin River near LaVerkin.

Assumptions:

1. Veyo: It would be reasonable to expect that some further development will occur at Veyo even though the magnitude of the resource available appears to be limited. Interest has been expressed in including the area as part of the temperature gradient survey under the State Cooperative Program. (9) Development would probably not be of great magnitude; but it could come in the mid-1980's. Use will probably be space heating or light industrial (greenhouses, etc.). Development rates, times and magnitudes are arbitrary but reasonable estimates.

Continued

LaVerkin: These springs discharge directly into the Virgin River, and recovery and collection might be difficult. It would certainly require exploration and probably test wells to determine if the reservoir has potential. In any case, development probably will not come until mid or late 1980's. Development times, rates, and magnitudes are arbitrary but reasonable estimates.

Prospect: Crystal (Madsen's, Honeyville)

Resource Characteristics:

Surface Fluid Temperature: 56°C (6)

Subsurface Fluid Temperature: 90°C (1)

Total Dissolved Solids: 42,100 ppm (6)

Estimated Energy Potential: 27 MWt/30 yr. (1)

Type of Overlying Rocks: The springs issue from Paleozioc rocks along the Wasatch fault zone, (6) in Quaternary alluvium. (13)

Location of Prospect: The springs are located at about T11N, R2W, Sec. 29, NE¼SE¼, in Box Elder Co., about 10 miles north of Brigham City. (6).

Description: Hot springs, used for spa, along the Wasatch fault on the West face of the Wasatch Mountains. The flow from the springs flows in Salt Creek, which flows through an agricultural area. (6)

Land Ownership: Mostly private. Forest lands in the area to the east in the mountains.

Land Use: Mostly agricultural. The town of Honeyville is a few miles south of the spring area. (6)

Leasing: No leasing of state or federal lands in area. (12)

Activity: Crystal Hot Springs is presently used for a swimming pool, and the possibility exists for space heating. (3)

Assumptions:

1. It was assumed that interest in the geothermal potential will grow, and it seems reasonable that development will start in the early or mid-1980's.

2. It was assumed that the resource is adequate for space heating or light industry; development time, rates, and magnitudes are arbitrary but reasonable estimates.

Prospect: Other Areas (Indludes other springs and other potentials areas).

Assumption: The main assumption was that the other areas are generally remote and/or of small magnitude. Development at most of these areas will probably be after the mid-1980's, and will probably come in small increments. Again, the magnitudes used for the scenario are only a reasonable estimate.

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WORK SCOPE OUTLINE FOR "OPERATIONS RESEARCH" (OR) CONTRACTOR
IN SOUTHWESTERN STATES
(UTAH, COLORADO, ARIZONA, NEVADA, NEW MEXICO)

Mission

To perform operations research and outreach activities in support of DOE/DGE's geothermal planning, research, and development goals for Region 2, and to coordinate certain state activities with other DGE programmatic efforts in the region.

Objectives

1. Prepare and Maintain State Geothermal Development Profiles (Scenarios): Assess the present status of geothermal development and resource potential, and prepare profiles for the development of the geothermal resources in the region. Particularly, potential user groups, as well as specific enterprises, should be identified. These profiles should indicate the probable effects of public policies and of various levels of government participation and stimulative programs on the development of a regional geothermal industry. The state profiles should also indicate likely changes in the rate of resource development and utilization as a result of changing economic and technical conditions.

2. Outreach: Through the principal OR operative in each state, conduct a program of information dissemination, coordinate regional and Laboratory technical assistance capabilities, and work with appropriate state regulatory and legislative offices and committees in order to increase the public awareness of geothermal development possibilities in each of the states.

Regional Coordination

The activities of the OR contractor in the Southwestern States must be coordinated with other organizations and regional activities, as noted below, in order to ensure complementary and non-duplicative efforts:

1. Operations Research Contractor in the Northern Rocky Mountain and Plains States: It is proposed that New Mexico Energy Institute, in its present role as the Operations Research Contractor in the five southwestern states of Region 2, assume data analysis responsibility for the entire ten-state area of Region 2 (data collection, state coordination, and outreach activities will be the responsibility of another contractor). In order to have consistency in data analysis and display for the entire region, therefore, it will be necessary to ensure that data development work in each state follows a format compatible with that already being developed. This will apply to all aspects of data acquisition such as:

   a. the geothermal resource base (location, quality, quantity, ownership, leasing status)

   b. utilization data (trends in demography, industrial, and community development)

   c. legal and institutional factors

   d. economics of resource exploitation

   e. technology development

   f. water resources

   Mutual coordination by both operations research contractors is a prerequisite to a successful regional program.

2. State-Coupled Resource Assessment Program: It will be essential that the OR contractor work with and rely upon the resource assessment program already established in each of the states for the resource aspects of the profile development. State OR teams will be primarily concerned with utilization analyses, rather than resource or geophysical research. Particularly, more attention needs to be given to industrial process possibilities.

3. National Conference of State Legislatures (NCSL): The state working groups of the NCSL will be a valuable resource for the profile development work. The OR work, in turn, will be a resource for the NCSL in its mission of conducting a policy review of statutes and regulations in each of the states to develop recommendations on changes that would favorably impact the rate of geothermal project development. It is essential that the state OR work relate effectively to both the NCSL and state-coupled resource assessment programs.

General Guidelines

1. The RPPM computer software development work should continue, with its principal focus as earlier described in objective (1). All profile development work peripheral to this objective should be eliminated. All WBS elements described in current NMEI draft proposal (such as socioeconomic, energy-water interface, etc.) should be explicit in how they support objective (1).

2. Matching funds for the program should continue to be sought from the states and from the regional development commissions.

3. Advisory bodies composed of key government and private enterprise representatives should be maintained to review and critique the profile development and supporting studies and activities.

4. Approximate allocation of time might be as follows:

a.	operations research and supporting activity	40%
b.	outreach	35%
c.	assistance to state	15%
d.	travel and regional meetings	10%

4-21-82

UTAH STATE PRISON GEOTHERMAL PROJECT

Chemical Monitoring of Test Well USP/TH-1

PROGRAM II: EPA REQUIREMENTS AND PROPOSED GEOTHERMAL RESERVOIR ASSESSMENT

Chemical monitoring of fluids from wells and springs can play an important role in design of geothermal field management policies by allowing prediction and documentation of the changes that are likely to occur during exploitation. Changes in chemistry of the fluids produced during aquifer tests can be used to detect physical changes occurring in the system at different depths as a result of major fluid withdrawal. For example, gas may be created to fill a void in the aquifer, or there may be vertical or lateral inflow to the production levels.

The chemical monitoring program outlined by the EPA, and required during the 30 day flow test of the Utah State Prison well (USP/TH-1) by the Utah Division of Facilities Construction and Management, is adequate to assess the environmental considerations of the waters but falls far short of the geochemical program needed to adequately support the well test program and to evaluate the effects of exploitation on the geothermal field. More frequent sampling is recommended, with initial samples collected on the first day during each production step of the well-test program, followed by daily collection until stable production conditions are attained. Also, additional analyses of chemical constituents most effected by the thermal activity are required. These include temperature, pH, Na, K, Ca, Mg, SiO_2, Cl, HCO_3, SO_4, B, F, Li, hydrogen isotopes and oxygen isotope in the liquid, and gases such as CO_2 and H_2S in the exsolved phase.

Before the flow test, water and gas samples should be collected and analysed for the above constituents from other wells and springs in the area to document initial conditions, including the three local hot springs, the State Forestry well (SF-1) and thermal gradient well A, which both have artesian flow, Utah Roses thermal well, and four local water wells. In addition, during the flow test the Utah Roses well should be sampled once a week, if accessible, to determine the effects of pumping on the thermal fluids in this well. These additional chemical data will allow determination of the variation with time of solute concentrations in discharge from the Utah State Prison well and to a lesser extent from the Utah Roses well.

These changes can be related to the long-term productivity of the system and the prediction of future thermal fluid supplies. For example, the percentage of nonthermal ground water infiltration as a result of exploitation can be estimated. Isotope analyses can be used to fingerprint the recharge area of the thermal fluids and thereby document changes in fluid sources and thus nonthermal ground water infiltration. Chemical geothermometers can be calculated to predict the possible effects of pumping on maximum reservoir temperatures.

Earth Science Laboratory scientists are familiar with the geochemistry of fluids discharging from geothermal wells and springs. Their monitoring of the geochemistry of thermal springs and wells in low-to moderate-temperature geothermal systems along the Wasatch Front and in southeastern Idaho, systems similar to the resource tapped by the Utah State Prison well, has been used to document flow paths, sources of thermal fluids, and reservoir temperatures (Glenn and others, 1980; Cole, 1981, 1982; Capuano, 1981). Studies of these systems have been part of an ongoing geothermal resource evaluation program which has existed at the Earth Science Laboratory for the last five years.

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STATEMENT OF WORK

I) Temperature will be measured and a visual estimate of oil and grease in the fluid will be determined once per day

II) Once per week (4 times during the 30 day test) fluid samples from well USP/TH-1 will be collected and analysed using approved EPA techniques* for:

Total Suspended Solids
Total Dissolved Solids
Dissolved Oxygen
Oil and Grease
Chlorides
Sulfates
Sulfides
Total Boron
Total Arsenic
Total Copper
Total Iron
Total Lead
Total Mercury
Total Nickel
Total Cadmium
Gross Alpha Radiation
Dissolved Radium 226, 228 Combined
Total Radium 226, 228 Combined

EPA Requirements

III) Twice per month (2 times during the 30 day test)

A) Water samples from well USP/TH-1 will be collected and analysed using approved EPA techniques* for:

Chemical oxygen demand

Total Kjeldahl Nitrogen

Total Uranium

B) Water quality of the Jordan River will be determined at:

1) a point upstream from the point of entry of the geothermal produced waters

2) a point just downstream from the point of entry of the geothermal produced waters (after reasonably complete mixing occurs)

Parameters to be determined using approved EPA techniques* include:

Temperature

Total Boron

Alpha, gross

Beta, gross

Dissolved Radium 226, 228 Combined

Total Uranium,

Estimated Flow

C) The temperature of the discharged geothermal water will be measured at the point just prior to entry of the flow into the Jordan River.

EPA Requirement

IV. Geothermal System evaluation

A) For each liquid sample collected the following parameters should be determined:

Temperature

pH

Sodium

Potassium

Calcium

Magnesium

Silica

Chloride

Bicarbonate

Sulfate

Boron

Fluoride

Lithium

Total Dissolved Solids

B) If gas sampling apparatus is available a gas sample should be collected with each water sample from Utah State Prison well USP/TH-1, and should be analysed for:

CO_2

H_2S

CH_4

At the same time the gas is collected the fluid temperature should be recorded.

C) Sampling Schedule

1) Prior to the flow test the following wells and springs should be sampled

a) Three local hot springs (CR-1, CR-2, CR-3)

b) Utah Roses thermal well

c) State Forestry well (SF-1)

d) Thermal gradient well A

e) Four local water wells

2) During flow test

a) Utah State Prison well, USP/TH-1 (gas and liquid samples)

1) First day (at each production step)

a) at 100 gpm

b) at 200 gpm

c) at 325 gpm

2) Daily samples, days 2 through 8 of flow

3) Samples every 3rd day till end of production (from days 11 through 30)

b) Utah Roses thermal well (if not accessible sample SF-1). Sample weekly (4 times during the 30 days)

D) Oxygen and hydrogen isotopes should be determined for the following water sampled

1) All waters sampled prior to production

2) The following water taken from well USP/TH-1 during production. One every week (4 samples for the 30 days)

*Although all laboratory measurements made at the Earth Science Laboratory will apply approved EPA techniques, the Earth Science Laboratory is not an EPA certified laboratory at the present time.