Appendix D
Technology Description and Diagrams

E.G.L. RESOURCES, INC.

Location: COLORADO **Installation:** SEC.20-T2S-R98W E.G.L. RESOURCES, INC. PILOT PRODUCTION SCHEMATIC

Field: RIO BLANCO COUNTY

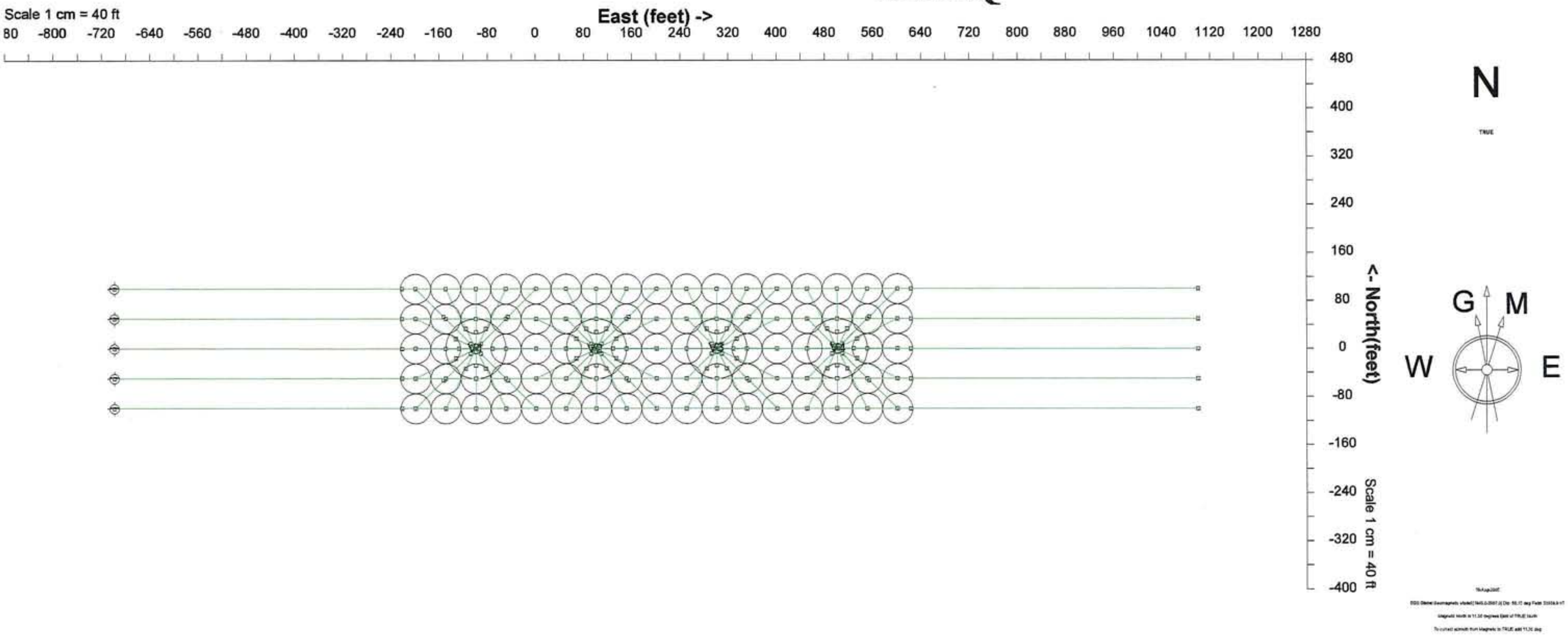


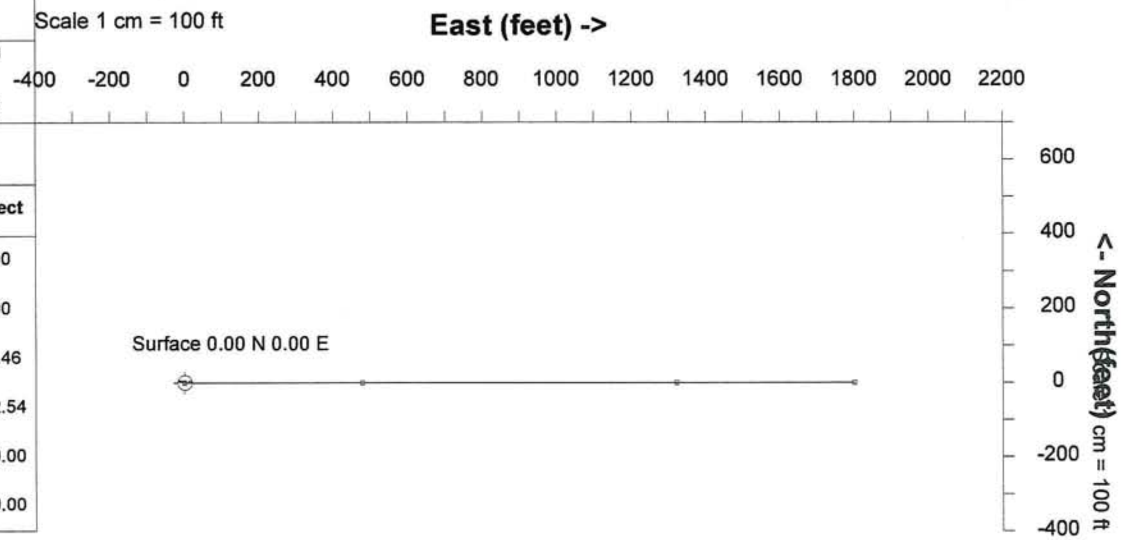
FIGURE 1

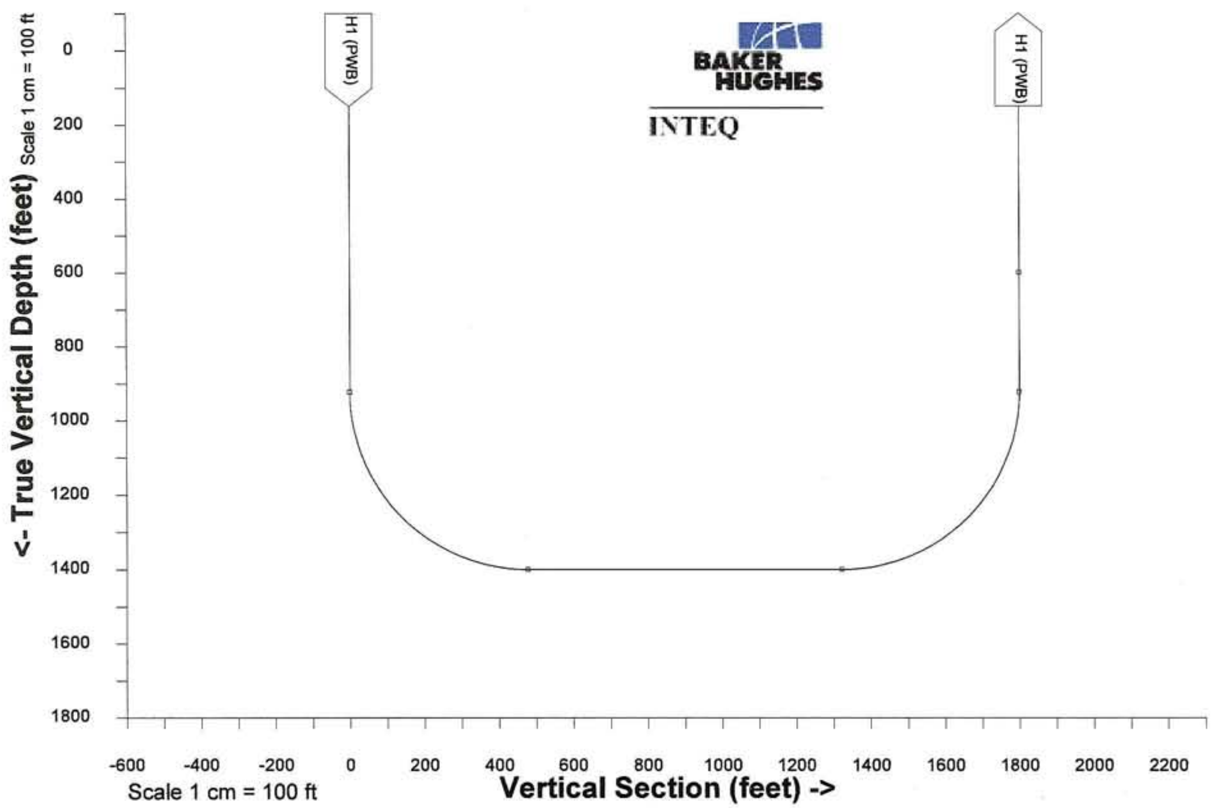
E.G.L. RESOURCES, INC.

Location: COLORADO **Slot:** Slot #1 H1
Field: RIO BLANCO COUNTY **Well:** H1
Installation: SEC.20-T2S-R98W E.G.L. RESOURCES, INC. PILOT PRODUCTION SCHEMATIC **Wellbore:** H1 (PWB)

WELL PROFILE DATA

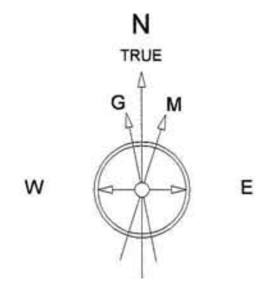
Point	MD	Inc	Azi	TVD	North	East	deg/100ft	V. Sect
Tie on	0.00	0.00	90.00	0.00	0.00	0.00	0.00	0.00
KOP	922.54	0.00	90.00	922.54	0.00	0.00	0.00	0.00
End of Build	1672.54	90.00	90.00	1400.00	0.00	477.46	12.00	477.46
Target	2517.61	90.00	90.00	1400.00	0.00	1322.54	0.00	1322.54
End of Build/Turn	3267.61	180.00	270.00	922.53	0.00	1800.00	12.00	1800.00
T.D. & Target	4190.15	180.00	270.00	0.00	0.00	1800.00	0.00	1800.00





BAKER HUGHES
INTEQ

Azimuth 90.00 with reference 0.00 N, 0.00 E from Slot #1 H1



10-Aug-2005
BGS Global Geomagnetic Model [1945,0-2007,0] Dip: 66,15 deg Field: 53039,9 nT
Magnetic North is 11.36 degrees East of TRUE North
To correct azimuth from Magnetic to TRUE add 11.36 deg

Created by : Planner
Date plotted : 23-Aug-2005

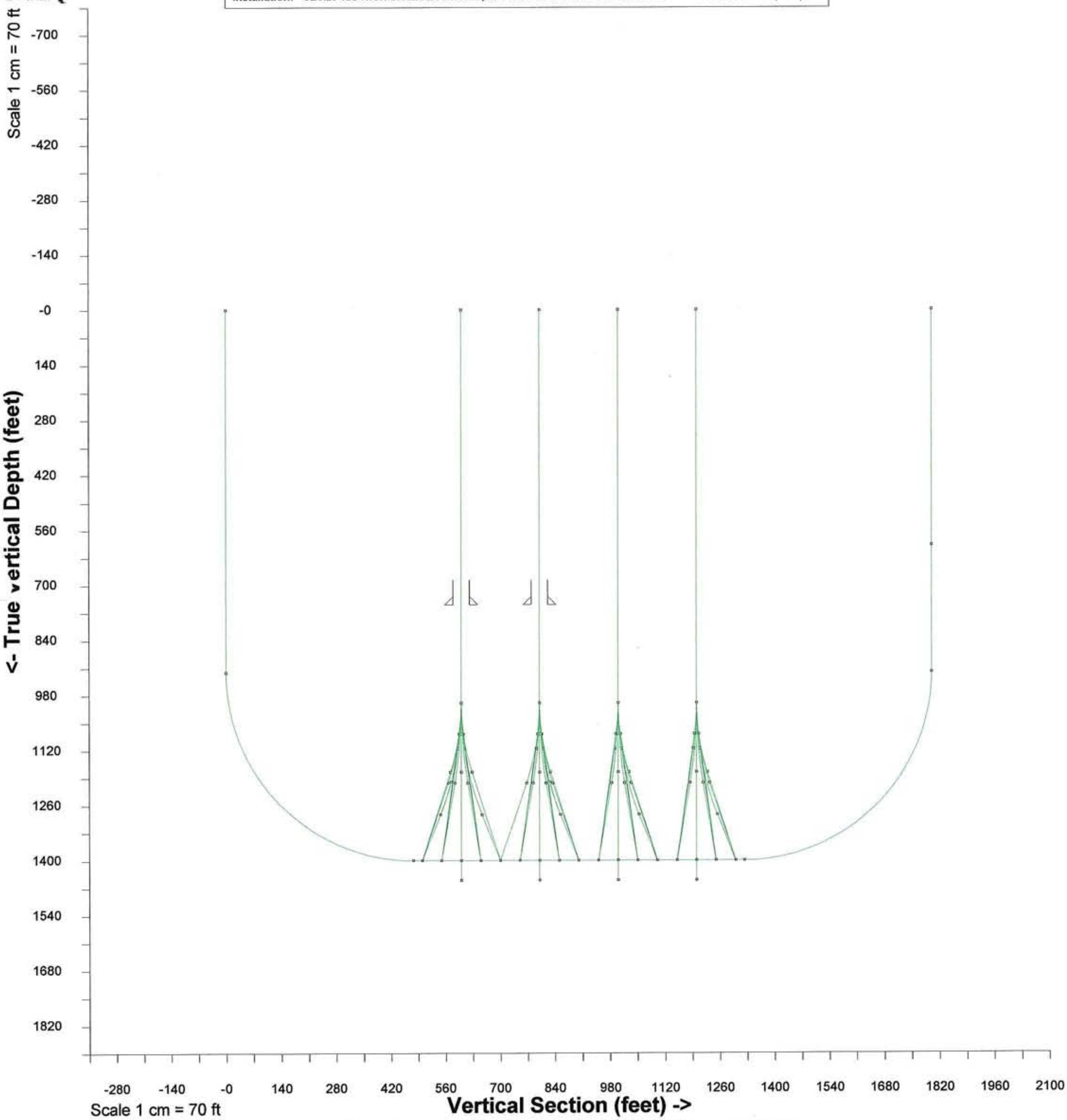
Plot reference is H1 (PWB).
Ref wellpath is "SPIDER" HOLES.
Coordinates are in feet reference Slot #1 H1.
True Vertical Depths are reference Rig Datum.
Measured Depths are reference Rig Datum.
Rig Datum: Datum #1
Rig Datum to Mean Sea Level: 0.00 ft.
Plot North is aligned to TRUE North.

FIGURE 2

E.G.L. RESOURCES, INC.

BAKER HUGHES INTEQ

Location:	COLORADO	Slot:	Slot #1 H1
Field:	RIO BLANCO COUNTY	Well:	H1
Installation:	SEC.20-T2S-R98W E.G.L. RESOURCES, INC. PILOT PRODUCTION SCHEMATIC	Wellbore:	H1 (PWB)



Azimuth 90.00 with reference 0.00 N, 0.00 E from Slot #1 H1

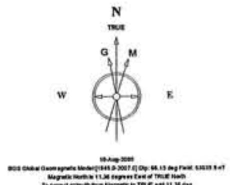


FIGURE 3

Created by : Planner
Date plotted : 23-Aug-2005
Plot reference is H1 (PWB).
Ref wellpath is "SPIDER" HOLES.
Coordinates are in feet reference Slot #1 H1.
True Vertical Depths are reference Rig Datum.
Measured Depths are reference Rig Datum.
Rig Datum: Datum #1
Rig Datum to Mean Sea Level: 0.00 ft.
Plot North is aligned to TRUE North.

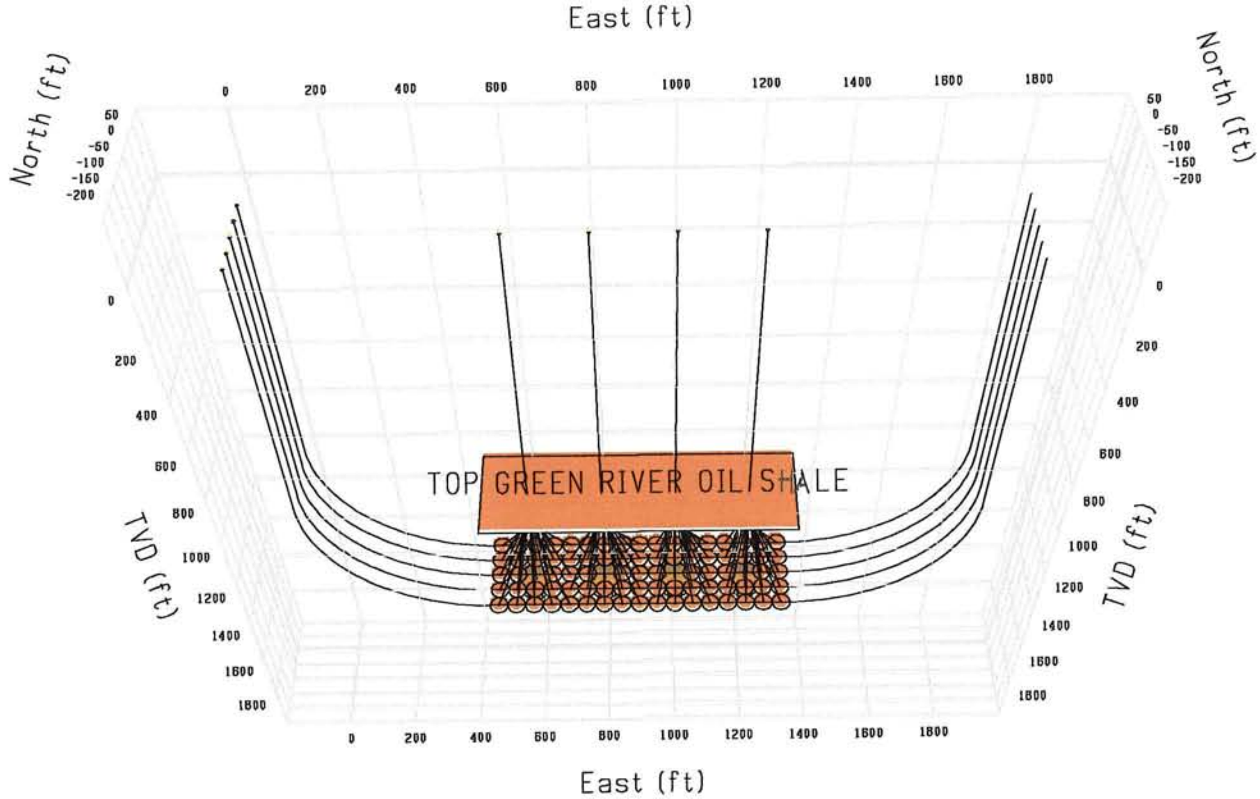

East (ft)
North (ft)
0
200
400
600
800
1000
1200
1400
1600
1800
50
0
-50
-100
-150
-200
TVD (ft)
TOP GREEN RIVER OIL SHALE
East (ft)

Figure 4

1. EGL Oil Shale Process

EGL has developed an innovative technology for insitu processing oil shale deposits to produce hydrocarbons. The EGL Oil Shale Process involves a systems approach to application of modern oil and gas methodology to insitu oil shale processing. This unique technology is based partially on the extraordinary progress made over the last twenty-five years in exploiting petroleum reserves, including advances in geology and geophysics, drilling and measurement while drilling (MWD), hydraulic fracturing and other means of stimulation of very low permeability and low porosity reservoirs, and new completion technology and production techniques. Advances in technology such as these have resulted in exploitation of entirely new types and classes of oil and gas reservoirs, and their application will enable efficient and economic development of oil shale deposits. Such oil and gas exploration and exploitation technology was not available during the late 1970's and early 1980's, the last period of intense interest in oil shale.

EGL will apply this innovative petroleum technology in a new way to exploit the vast oil shale deposits of Colorado, Utah and Wyoming. The EGL Oil Shale Process will be further developed and refined in a field demonstration project as outlined in this document. EGL will work with leading experts and universities in petroleum technology and oil shale, including the University of Wyoming and the Colorado School of Mines, as well as appropriate government agencies, in mounting the field demonstration project.

The EGL Oil Shale Process provides a unique systems approach focused in six areas: (1) resource characterization, (2) energy delivery systems, (3) product recovery systems, (4) reservoir hydraulic fracturing and/or other means of stimulation, (5) systems for optimization of energy recovery, and (6) operations, environmental protection, and reclamation. This technology will be applied initially to the very thick, competent oil shale strata of the Piceance Basin, although modifications of EGL technology can be employed in a variety of other geologic and depositional settings for oil shale. EGL's approach to each of these five areas will be discussed in turn.

Resource Characterization

One of the areas of most rapid recent advance in oil and gas exploration and exploitation has been in reservoir characterization. Over the last two decades, the petroleum industry has universally recognized the need to understand more fully and precisely the geology of petroleum reservoirs, particularly in terms of the subtle ways in which heterogeneities affect exploitation. It is common current practice to utilize a multidisciplinary team approach in putting together a plan for reservoir exploitation, and to assemble a team of geologists, geophysicists, drilling engineers, completion and stimulation specialists, production engineers and project economists who are involved in the project from the outset. EGL has employed this approach in this oil shale development plan, and will continue to use this approach through subsequent phases of development.

In selection of the lease nomination site, EGL has reviewed available geological and hydrological information. As the site plan continues to be developed, EGL will continue to employ the team approach for reservoir characterization and resource delineation, and will obtain and employ additional information as needed, such as 3-D seismic and down-hole seismic data.

One of the most important areas of resource characterization is hydrology, and identification and description of ground water sources. As described in the following sections, the *EGL Oil Shale Process* is designed to minimize problems with subsurface water. The wells for energy delivery will be cased off and insulated against thermal transfer to all overburden and any aquifers within the overburden strata.

The initial field demonstration site was selected to minimize potential problems with hydrology. As the field demonstration project is expanded, any aquifers and/or water conductive fractures and/or leach zones in the shale itself will be identified, and water movement into the thermal zone will be prevented by boundary wells to pump off any mobile water.

Energy Delivery System

A key feature of EGL's technology is the energy delivery system. Energy delivery will be via indirect heat transfer from a closed system. This system will minimize potential contamination and environmental problems for both the site's surface as well as subsurface hydrology, and will minimize loss of expensive fluid heat transfer media. The energy system involves multiple, deviated wells drilled from the surface to the oil shale zone, and then returning to the surface. The wells will be cased, and partially cemented, and will form part of a closed system through which a heat transfer medium will be circulated. Heat will be supplied by combusting natural gas or propane for the testing phase, and retort gas when it becomes available and if suitable. Commercially, retort gas will be the primary source of heat, but boilers will be capable of combusting liquid or gaseous fuels. If electric heating is employed the electricity will be supplied from the grid for the testing phase, but may be produced from the combustion of retort gases in the commercial phase. Earlier studies and plants in Israel and China indicate that electric power may also be produced from the direct combustion of oil shale, and could be employed if oil shale mining operations evolve in the future. The advantage of combusting oil shale is that sulfur emissions are essentially nil, because the natural components in Colorado oil shales absorb the sulfur compounds. The repeating pattern, size and layout will be optimized during the final design.

A schematic diagram of the energy delivery (and recovery) system is shown in Figure 1. In this illustration, it is assumed that the overburden is about 1000-feet thick, the oil shale deposit to be heated in the field test is approximately 300 ft thick (Mahogany plus R6), and this initial phase of the field demonstration project is based on a 2.5-acre surface area. Expansion of this technology to commercial scale will likely increase the number of heating and recovery wells. And based upon economic and other factors in the future it may also exploit the remainder of the oil shale zone (some 1000 feet of oil shale). The oil shales below the Mahogany plus R-6 zone is much leaner (less that an average of 25 gallons per ton). For the test program EGL believes it can get the necessary data for scale-up without exploiting the entire oil shale section.

EGL technology involves drilling and cementing a large diameter conduit pipe from the surface to near the top of the oil shale deposit. As shown in Figure 1, this conduit is placed in the middle of the right side of the pattern (assumed to be the East side). The cement will provide thermal insulation for the large diameter conduit pipe. EGL then employs modern coiled tubing drilling technology to place a number of smaller diameter wells through the conduit pipe that vertically penetrate nearly the full length of the oil shale deposit. The number of wells to be drilled will depend on the desired production schedule, and the concomitant required heat input. The exact number of required wells will be established during detailed engineering design for the final project, but for the initial 2.5-acre plot, it is anticipated that approximately 5 wells will be employed. After vertical penetration to near the bottom of the oil shale zone, the wells will be drilled horizontally for a distance of about 1000 ft to the left (or West) side of the pattern. The wells will then be directed vertically upward and will vertically penetrate the oil shale and overburden through to the surface.

The cased wells entering the conduit well will be joined together by a common injection manifold system, and the returned wells will also be connected to a collection manifold. In this fashion, the wells will form part of a closed system, through which a heating fluid can be circulated. The injection section of the wells will be cemented into the conduit pipe with high temperature insulating cement to reduce heat loss into the overburden.

A heating fluid will be pumped to sufficient pressure for circulation through the entire system, heated to the necessary final retorting temperature by surface heat transfer equipment, injected into the wells entering the conduit, and will flow through the multiple wells to provide heat to the oil shale deposit. The heating fluid will be returned at the surface to the heat transfer equipment for recycle. A number of heating fluids can be used, and the system is designed for sequential use of heating fluids during different phases of the project, if required. It is expected that steam will be used during the initial heating phase of the development. Steam has the advantages of high heat transfer coefficients in the interior of the pipe, excellent carrying capacity of energy due to its high latent heat of vaporization, and the ready availability and low cost of package steam boilers. This technology has been developed and applied in ongoing steam-flood oil recovery projects in California and around the world for the past 50 years. In addition to steam, during the later stages of processing it may be desirable to use a high temperature hot oil heat transfer medium, such as Dowtherm, Syltherm and/or Paratherm. The system is designed to accommodate this and other fluid heat transfer media.

In addition to use of a circulating, high temperature heat transfer fluid, the system will also be designed such that electrical heaters can be lowered into the heating wells. Operated in this fashion, the oil shale formation can be heated inexpensively to several hundred degrees F with steam or another fluid, and final heating can be done with electrical resistance heaters.

The advantages of this energy delivery system are several-fold. First, as noted above, the heat transfer system is closed, and will minimize potential contamination and environmental problems, and possible loss of expensive heat transfer media. Secondly, the EGL energy delivery system is designed to leave a very small surface footprint, with minimal surface disruption. The injection side of the wells will be drilled by deviated drilling technology through a single conduit pipe from a single drill pad, minimizing surface impact. Likewise, the collection side of the wells will be designed to penetrate the surface upwardly and vertically over a very small area, with the same result. Finally, the closed energy delivery system provides for maximum flexibility in use of different modes of heating, by circulation of one or more heating fluids or with electrical resistance heaters.

Challenges for the energy delivery system derive primarily from the fact that over the life of the project, temperatures in excess of 700°F are expected. Problems with differential expansion of the tubular goods must be addressed, as well as forces on the pipe due to swelling of the oil shale during processing. In addition, it is critical that the heat delivery system be well designed from the outset, since it will not be possible to drill additional wells after the formation temperature exceeds a threshold limit. However, these challenges can be met by careful, detailed final engineering.

Product Recovery System

Another key to the EGL Oil Shale Process is the hydrocarbon product recovery system. This system is designed to efficiently collect and maximize recovery of hydrocarbon products. As with the energy delivery system, production wells will be drilled via coiled tubing drilling system through a large diameter, insulated conduit pipe. As with the heat delivery system, this will minimize the surface footprint and reduce environmental impact of the recovery system. The product recovery system is also shown in Figure 1. A number and placement of the recovery wells will depend on detailed reservoir characterization studies. For the field test program our such wells will be employed that will be drilled to and then extend from near the top of the oil shale zone to near the horizontal portion of the energy delivery wells.

Mechanisms for oil generation and recovery are expected to multiple and complex. For example, the principal means of oil generation will be through kerogen decomposition in the high temperature zone that is developed by the multiple pipe energy delivery system. Initially temperatures will be highest at the point at which the multiple injection pipe system leaves the large vertical conduit pipe. These high temperatures will be sustained as the process continues, but will move downward along the injection pipe system, and then horizontally as reservoir heating proceeds. As kerogen decomposition proceeds, oil, gas and water will be generated. The light ends from the oil fraction will be distilled out of the heavy ends, and will migrate through any fractures present in the oil shale. The light ends and water vapor will tend to move upward, heating the oil shale during the process. Any water initially present in the formation, or that which is produced during shale oil generation, will also be vaporized and will migrate along with gas, oil distillate, and oil. As oil vapor and water vapor reach cooler portions of the reservoir, condensation will occur, with heat liberation due to the latent heat of vaporization of these materials. This refluxing process is expected to be an important mechanism for heat transfer from hot to cold zones. Because of the presence of multiple fluid phases, flow patterns in the leached or fracture system will be very complex. Nonetheless, flow will occur, and fluids will migrate toward the recovery zones. As hydrocarbon gas, distillate and oil move into the reservoir regions which contain the product recovery systems, they will be collected in recovery zones and pumped or transported by pressure differential to the surface. Most of the hydrocarbons are however expected to be recovered at the surface as vapors.

The design of the product recovery system will depend to a large degree on the resource characterization studies. For example, if Nahcolite or Dawsonite zones or lenses are present, they may be leached or partially leached and incorporated into the product delivery system. Alternatively, the product recovery wells can be under-reamed or highly fractured in the near vicinity of the bottom of the wells, in order to provide collection zones of very high permeability and porosity within the reservoir.

<u>Reservoir Stimulation</u>

The final element in product heating and recovery involves stimulating the oil shale deposit by hydraulic fracturing. This will provide an extensive fracture system to allow flow of fluids from the point of generation near the energy delivery system toward the product recovery zones.

Well completions and stimulation, including hydraulic fracturing, is another area in which oil and gas technology has advanced dramatically over the past two decades. The applicability of hydraulic fracturing jobs has progressed dramatically over this time frame. Reservoirs which were much too tight to develop during the 1970's and 1980's (including reservoirs with micro-Darcy permeability) currently are routinely fracture treated to yield very productive and profitable oil and gas wells. In addition, the size of fracture jobs has grown extraordinarily as well. Equipment, personnel, procedures and modeling techniques are available to implement, control and predict a wide range of fracture procedures. Fracture size, fracture orientation, the effects of foams, the use of propants, and a host of other features can be provided by firms that provide well completion, stimulation, and fracture treatments.

Energy Recovery

Because of the extraordinary energy demands of oil shale processing, efficient energy management is one of the most important aspects of production of oil from oil shale deposits, and is a major area in which projects may founder.

The EGL Oil Shale Process provides unique methods of energy management, conservation, and efficiency. First of all, the EGL process employs indirect heat transfer, in which the heating fluid is segregated from the oil shale deposits by an energy delivery system comprised of a number of wells. This greatly simplifies energy management.

While some energy is consumed in the thermal decomposition of kerogen, these reactions are only slightly endothermic. The vast majority of the energy requirements come simply from heating the huge quantities of rock -- oil shale, overburden, and underburden. It is essential to recover energy from this source. It should be noted that vaporizing excessive amounts of water that may exist in the natural environment will reduce energy efficiency. Thus selecting the optimum thickness/depth of oil shale to retort in connection with identifying natural aquifers, via the characterization program, is an important feature of the program to optimize energy efficiency and reduce environmental impacts.

During the early stages of retorting of a vertical column of oil shale, the energy input will be completely utilized in heating the deposit. However, as the project proceeds, the heating fluid leaving the energy delivery wells may reach high enough temperatures that direct reuse will pose operational problems. During this mid-stage of operations, the exit heating fluid can be directed to an adjacent pattern in which operations are just beginning, so that heat is efficiently used for initial reservoir heating of this adjacent pattern, while the heat transfer medium is cooled to easily manageable temperatures.

Equally importantly, as oil recovery from a pattern nears completion, it will be possible to recover a substantial fraction of the energy in the formation, by preheating the heat transfer medium in this spent pattern. In this fashion, overall energy recovery will be dramatically enhanced. It is apparent that with careful engineering, overall energy efficiency of the *EGL Oil Shale Process* will be very high, compared to other oil shale processes.

During field demonstration tests, it will be important to keep track of energy requirements and usage, and to develop a complete energy budget for the EGL Oil Shale Process. To facilitate this work, the first phases of the field demonstration project will be highly instrumented, and heating fluid flow rates, temperatures, and other properties will be closely monitored, as well as reservoir temperatures and pressures during production, and quantities of produced fluids. Such instrumentation will be key to process control, and to minimizing peak temperatures to avoid carbonates decomposition. Carbonates decomposition is highly endothermic, and can represent a significant heat sink for the overall process if not controlled properly.

Day-to-Day Operations, Environmental Protection, and Reclamation

The final areas in which the EGL Oil Shale Process offers benefits is in day-to-day operations, environmental protection, and site reclamation.

Because of the unique features of the EGL Oil Shale Process, the following advantages are afforded in day-to-day operations. First, because of the use of indirect heat transfer, it will be possible to closely control the process, and keep the temperature levels and timing of thermal decomposition of kerogen at optimum levels to maximize production of oil and gas. At the same time, such control will enable minimization of decomposition of mineral carbonates and thus reduce production of CO_2 and other undesirable by-products. Secondly, the design of the EGL Oil Shale Process assures that any produced vapors will be collected at the lowest possible pressure, and thereby will avoid moving any products off lease or to the surface other than through the production/collection facilities.

The *EGL* Oil Shale Process also offers unique advantages for minimizing environmental disturbance. First, the process is a true insitu process, in which oil and gas are produced in place -- the process thus requires no mining operations with attendant site disturbance. The process is designed to give the smallest possible footprint through the use of centrally located drilling conductor pipes to provide for introduction of multiple deviated wells for energy delivery and for product collection. Produced gas and light ends can be employed on-site for energy generation, and scrubbers will be installed on boilers/condensers, etc. to minimize undesirable emissions.

Finally, following exploitation of the oil shale resource, the EGL Oil Shale Process, because of its true insitu nature, small drilling footprint, and energy recovery systems, will enable efficient reclamation and site remediation, which will be handled according to applicable federal, state and local regulations, and appropriate industry practice.

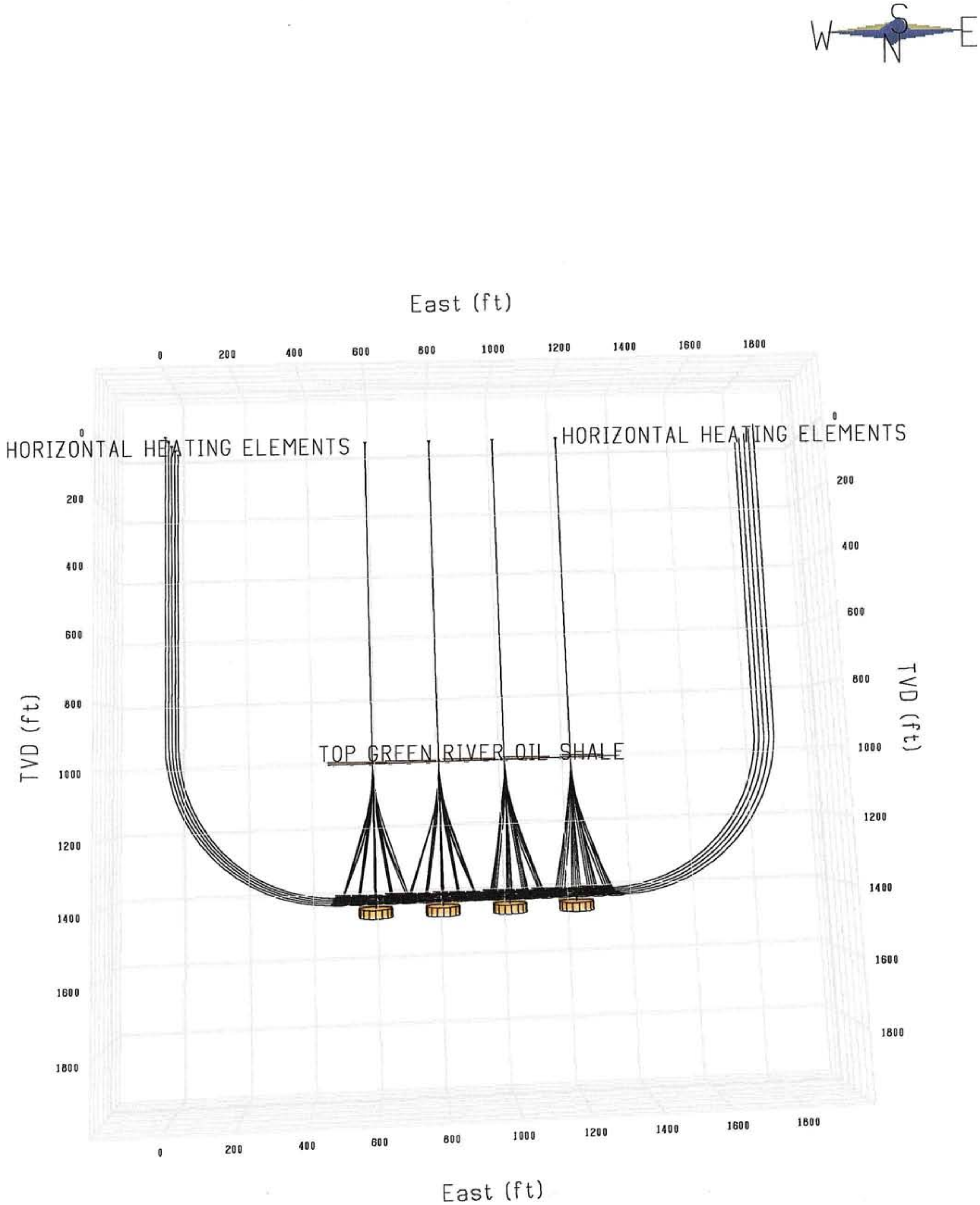


Figure 1 – EGL Oil Shale Process Schematic – Field Test Scale