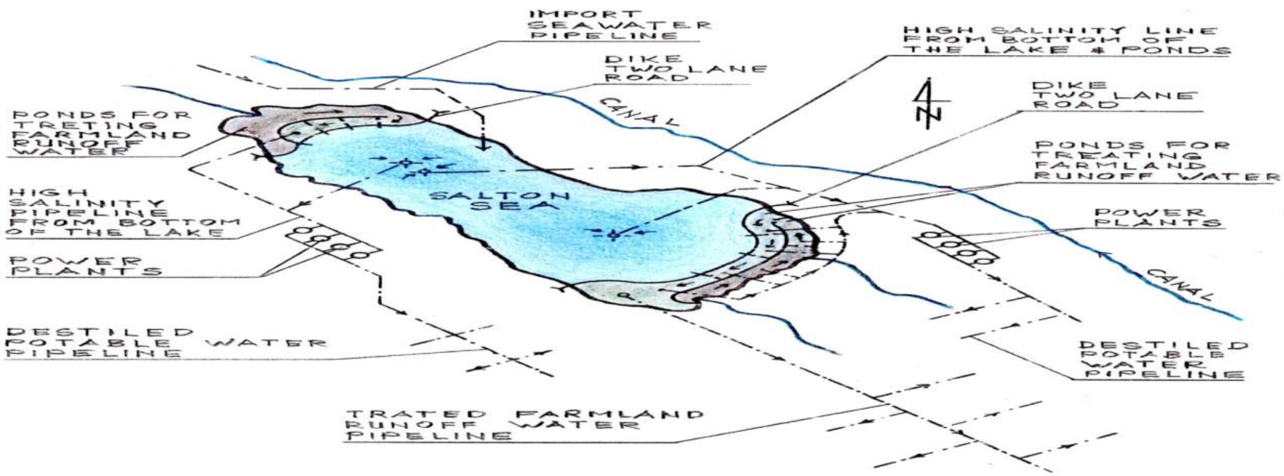
Harnessing Energy and Water in a Terminal Lake - the Salton Sea

– Power Point Presentation –

National Association of Environmental Professionals Conference, NAEP, in Durham, NC, - March 27-30, 2017



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EXECUTIVE SUMMARY:

OVERVIEW OF THE SALTON SEA SITUATION (I)

- **The Salton Sea is California's largest lake and is presently 25 % saltier than the Ocean. The Salton Sea is a "terminal lake," meaning that it has no outlets. Water flows into it from several limited sources but the only way water leaves the sea is by evaporation.**

- **The lake is shrinking exposing the lake bed and precipitating higher salinity levels and environmental issues as well as a serious threat to its multi- billion-dollar tourist trade.**

- **Under the terms of the Quantification Settlement Agreement (QSA) the lakes decline is set to accelerate starting in 2018. About the 1/3 of inflow water from the canal will be diverted to San Diego and Coachella Valley.**

- **Runoff water from nearby agricultural fields which contains fertilizers, pesticides and other pollutants from Mexicali contaminate Salton Sea and make it an undesirable tourist destination especially for beach goers.**

OVERVIEW OF THE SALTON SEA SITUATION (II)

- **The lake is 35 miles long, 15 miles wide, and is located south of Palm Springs in a basin 230 feet below sea level.**

- **The Earth's crust at the south end of the Salton Sea is relatively thin. Temperature in the Salton Sea Geothermal Field can reach 680 ºF (360 ºC) less than a mile below the surface.**

- **There have been many complains and studies about consequences for our community if a solution for the Salton Sea is not found .**

- **There have been several proposals involving importing seawater, but they failed to address the salinity balance and feasibility of the project.** It was wishful conventional thinking – implying canals, tunnels, pipelines without addressing the practicality of its implementation and how to pay for it.

- **This proposal is quite different - it incorporates in final comprehensive design, several patented technologies –** that have not been accessible to the authors of previous proposals.

OBJECTIVES OF THE ENCLOSED PROPOSAL FOR RESTORATION OF THE SALTON SEA

1. **Raising and stabilizing the lake's waterline level;**

2. **Preventing further pollution of the lake and treating farmland's runoff waters with natural and plant-based filtration systems** – mangrove tree and alike;

3. **Providing wildlife sanctuary**;

4. **Equalizing salinity of the salty terminal lake (Salton Sea) water with salinity of the Ocean.**

5. **Providing conditions for tourism and making Salton Sea a renewed recreational destination;**

6. **Harnessing prevalent geothermal source of the Salton Sea Geothermal Field (SSGF) for generation of electricity;** and as a byproducts

7. **Production of potable water and lithium;**

<u>PROJECT DESCRIPTION</u>

This proposal has an architectural element which harmoniously incorporates several patented technologies in a functional self-sustaining organism.

- **<u>Phase I</u>** - **Connecting the Salton Sea with the Ocean** (preferably San Diego / Carlsbad / Oceanside area) with a pipeline 48” (5 pipelines on uphill route and 1 pipeline on downhill route);
- **<u>Phase II</u>** - **Building two main dikes** - One in northern and one in southern part of the Salton Sea and several secondary dikes for forming ponds (wetland) for treatment of farmland’s runoff waters.
- **<u>Phase III</u>** - **Building one power plant** using (SCI-GHE) system at one of selected sector;
- **<u>Phase IV</u>** - **Building several more power plants** using (SCI-GHE) system - one in each selected sector; and
- **<u>Phase V</u>** - **Continued buildup** of additional power plants using (SCI-GHE) system at each selected sector;

DISALINIZATION OF THE SALTON SEA (I):

- **The desalinization of the Salton Sea and salt balance are the primary issues of this proposal.**

- **In order to compensate for evaporation of about 1.25 million acres/feet per year it has to be inflow at least 1.25 million acres/feet per year.**

- **By separating the lake into three sections with two main dikes we can treat existing inflow and reuse it for farmland,** which otherwise would be useless for farmland as it merge with the salty water of the lake**.**

- **By separating farmland's runoff waters from the central part of the lake, we can fill the central part of the lake with seawater and gradually reduce salinity by extracting higher salinity water from bottom of the lake.**

- **High salinity water (brine) has higher density and has tendency to accumulate at the lowest point(s) at the bottom of the lake where we can access it, pump it up and used in a new design of geothermal power plants for generation of electricity, and as byproducts produce potable water and lithium.**

DISALINIZATION OF THE SALTON SEA (II):

- High salinity water (brine) can be use for forming new geothermal reservoirs in the areas where new geothermal power plants (Scientific Geothermal Technology) are proposed for better conduction of the heat from hot rocks to first heat exchanger.

- Optionally, high salinity brine can be use for filing existing geothermal reservoirs;

- As an option - We could pump out high salinity water from bottom of the lake with pipeline 24" diameter and disperse it into vast Ocean: A few miles offshore near Carlsbad there is a trench called "Carlsbad Canyon" through which high salinity water would slide slowly into depth of the Ocean and find its way to join existing currents in the vast ocean without negative effect on marine life.

- Optionally, we can oxygenate brine on the way to the "Carlsbad Canyon" by injecting air into pipeline in several locations, by compressors.

- Hyper saline water – brine - is in sync with natural occurrence in oceans and together with temperature difference the main engine in currents circulation in Oceans - called "deep ocean currents" or thermohaline circulation.

Southern part of California - the Salton Sea – Pacific Ocean – Gulf of California (Sea of Cortez) - Google map

EXHIBIT “ A “

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Dimensions of the Salton Sea - Google map

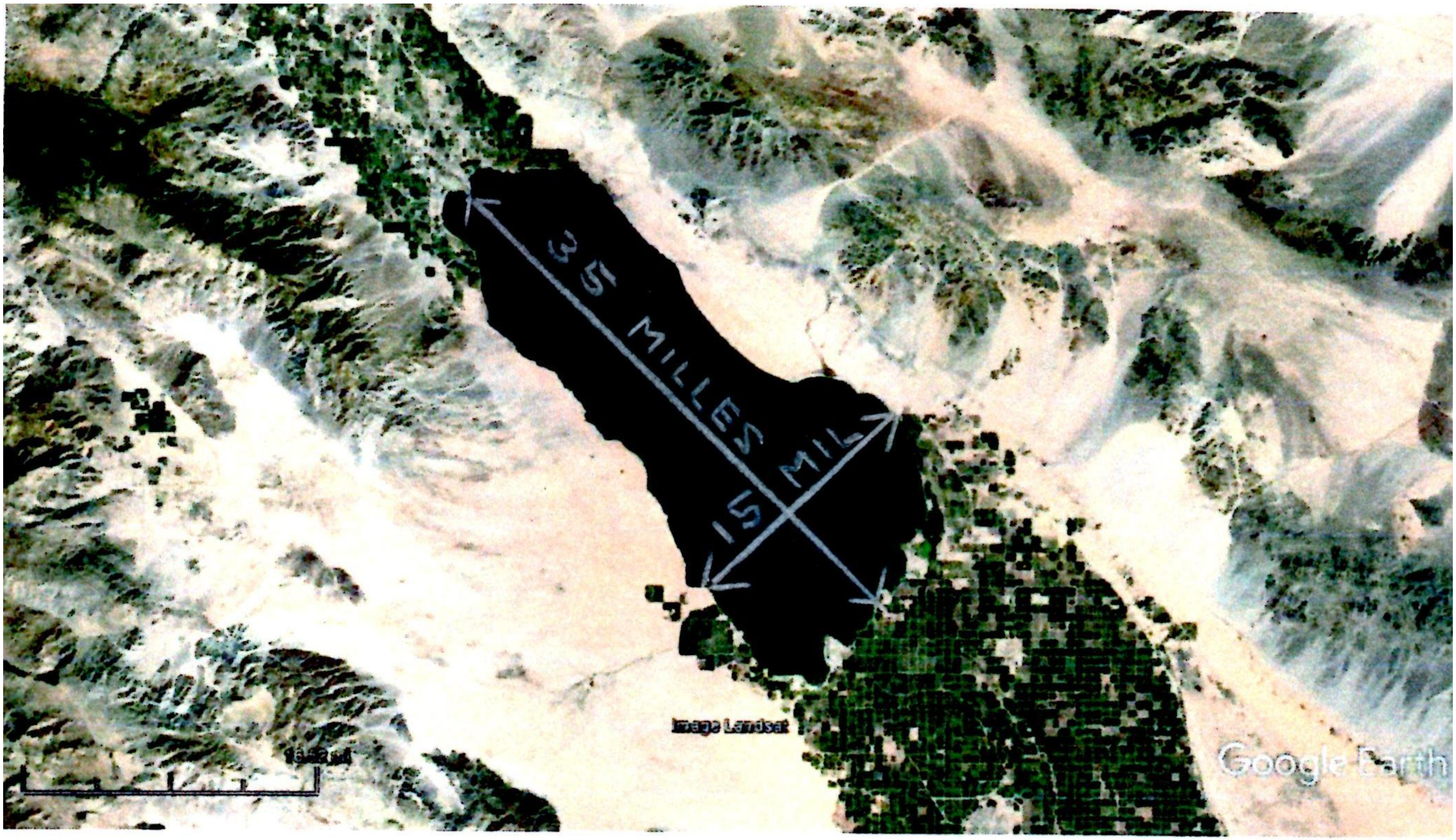

EXHIBIT " B "

GEOTHERMAL WORLDWIDE, INC.

Geothermal Map – USA – Temperatures at dept of 3.5 km

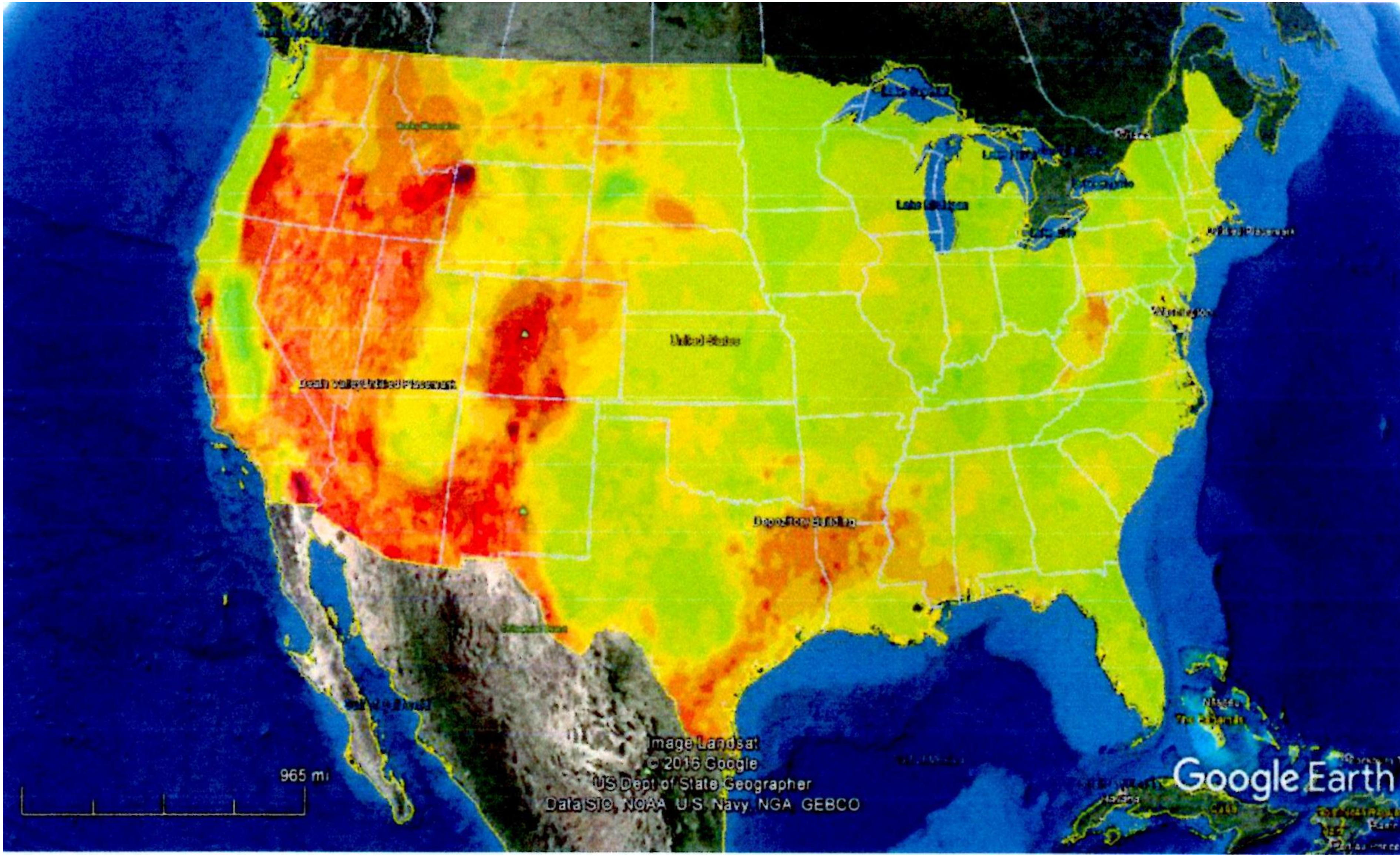

EXHIBIT “ C “

GEOTHERMAL WORLDWIDE, INC.

Geothermal Map – Southern California - Temperatures at dept of 3.5 km

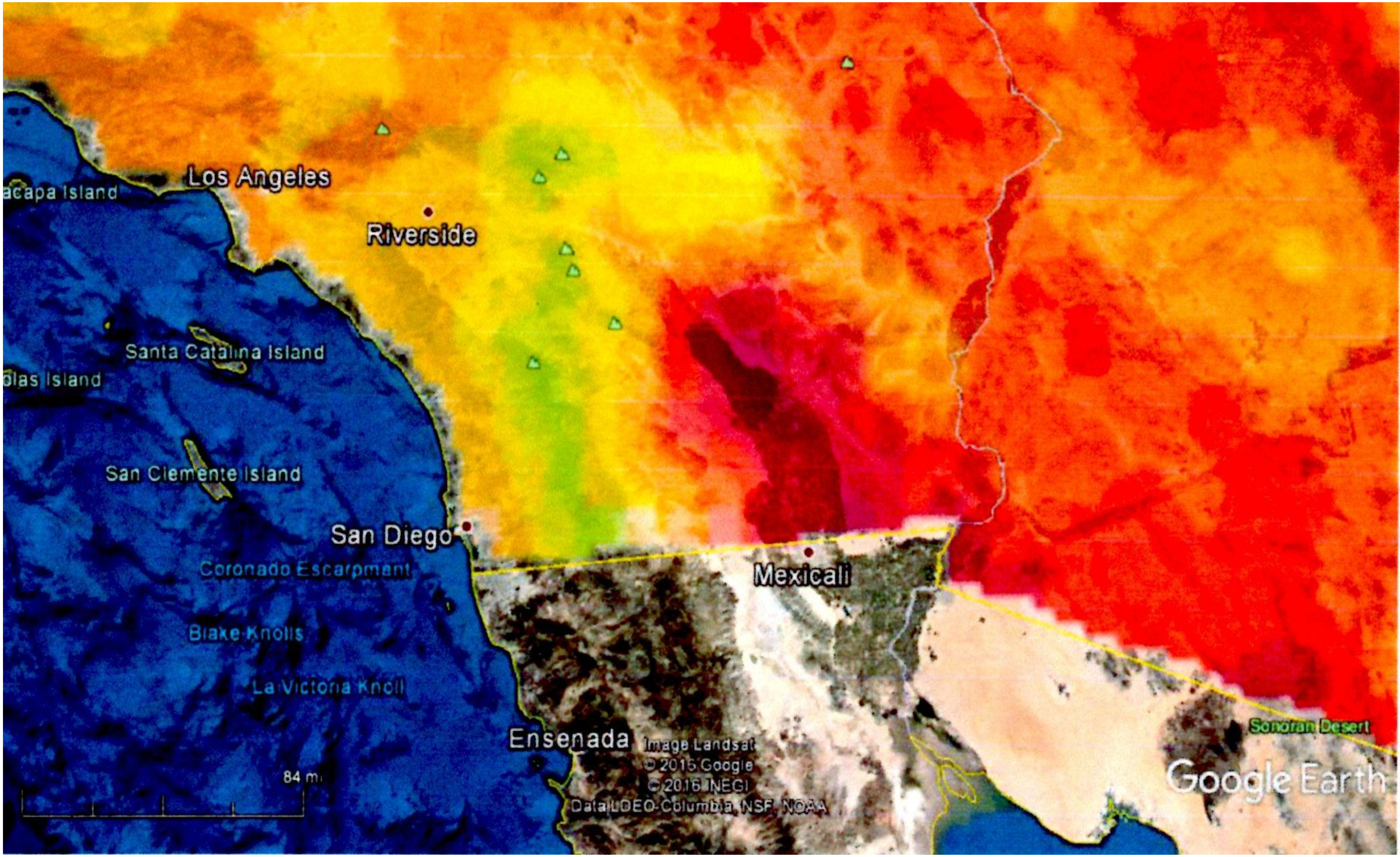

EXHIBIT " D "

GEOTHERMAL WORLDWIDE, INC.

Geothermal Map – Salton Sea area - Temperatures at dept of 3.5 km

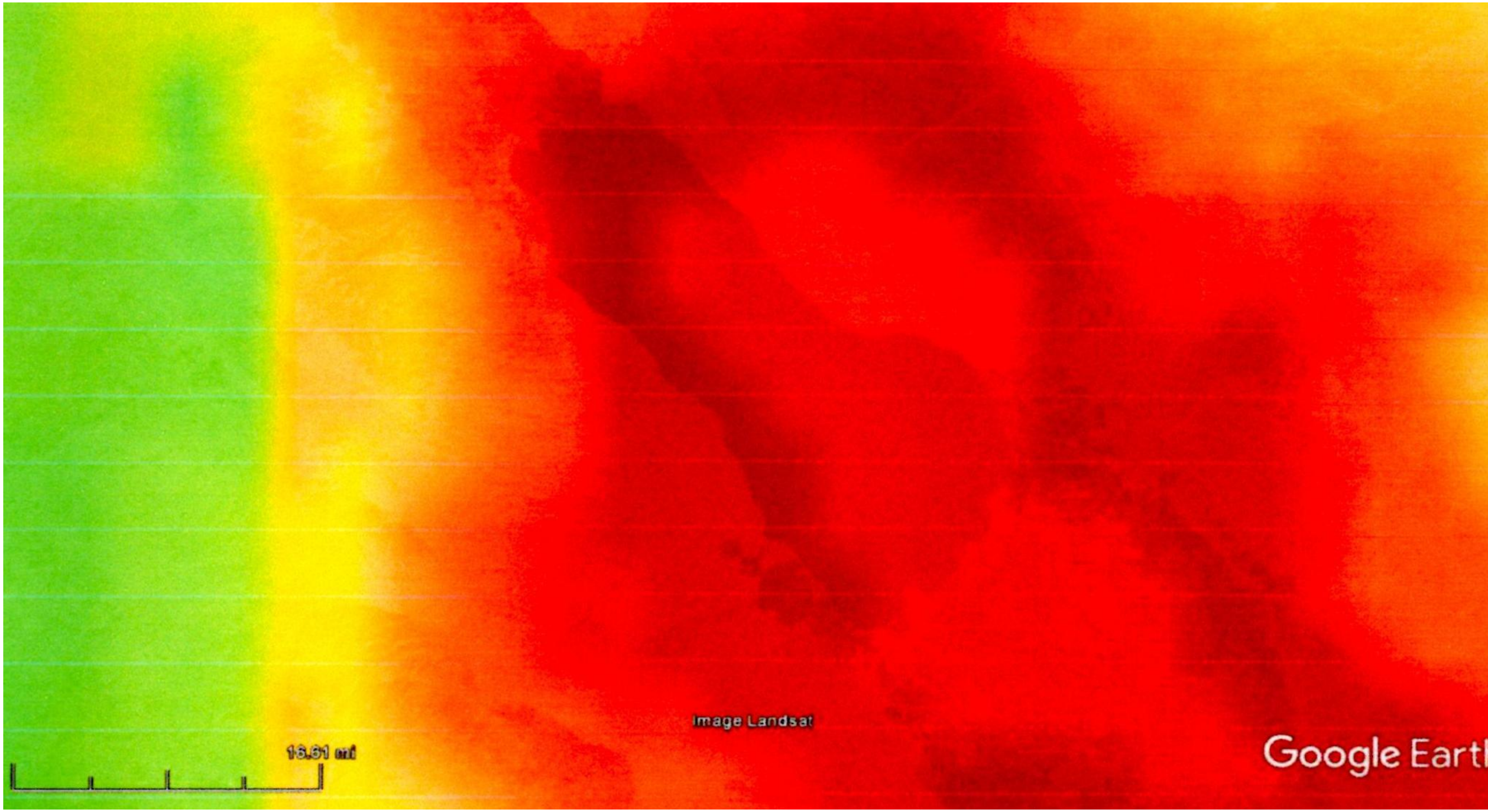

EXHIBIT " E "

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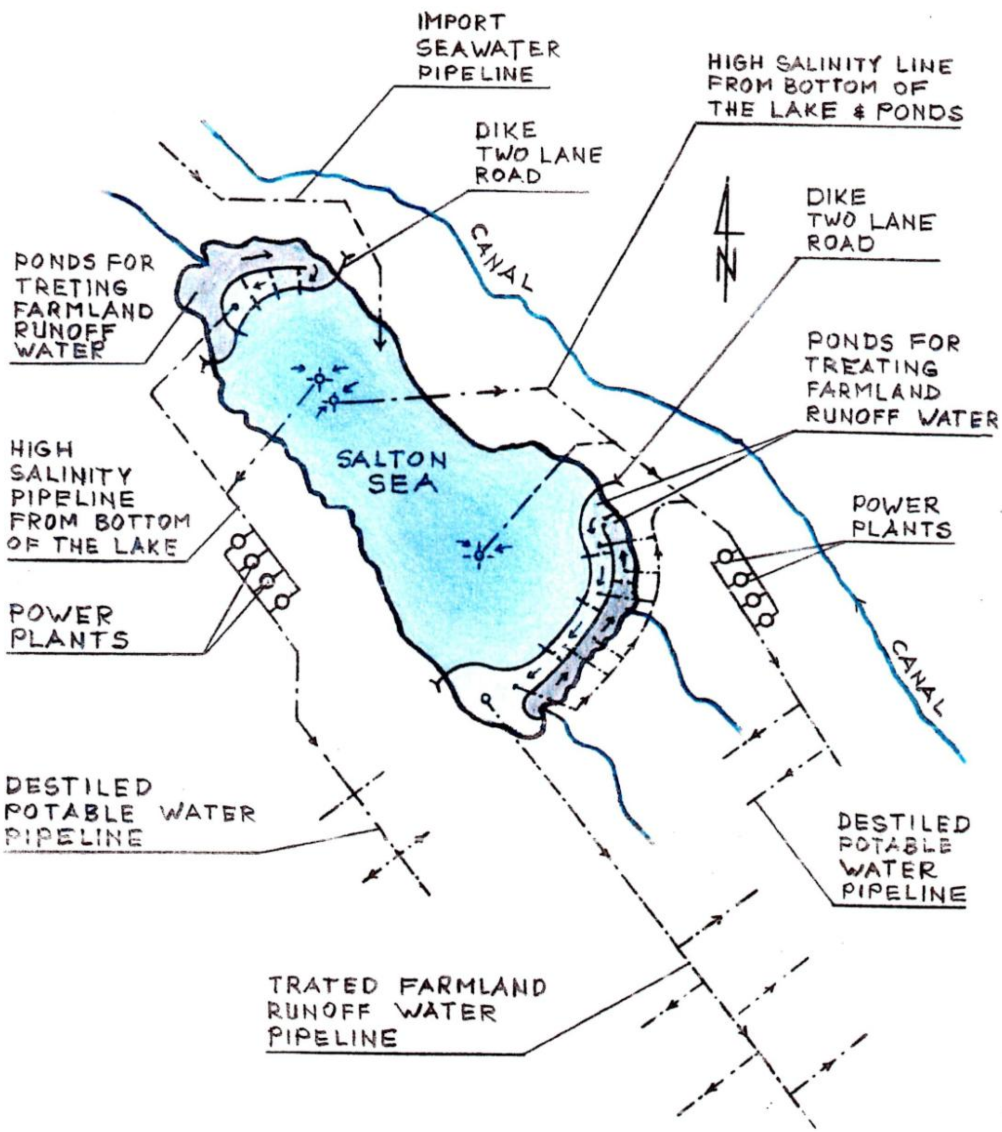
Summary of the Proposal for Restoration of the Salton Sea – (Phases I-V)



- <u>**Phase I**</u>: **Connecting the Salton Sea with Pacific Ocean** with pipelines for controlling waterline level of the lake; and **providing conditions for tourism.**
- <u>**Phase II**</u>**: Production of two sets of dikes –** one in northern and one in southern part of the Salton Sea - forming ponds for **treatment of farmland's runoff water and providing wildlife sanctuary; and separating (now) seawater in the central part of the lake and preventing its pollution.**
- <u>**Phase III**</u>**: Production of the first Power Plant using the SCI-GHE system for harnessing geothermal sources for production of electricity and potable water.**
- <u>**Phase IV**</u>**: Production of two additional power plants on two additional sectors.**
- <u>**Phase V**</u>**: Continued buildup of subsequent Power Plants at each sector.**

<u>EXHIBIT “ F “</u>

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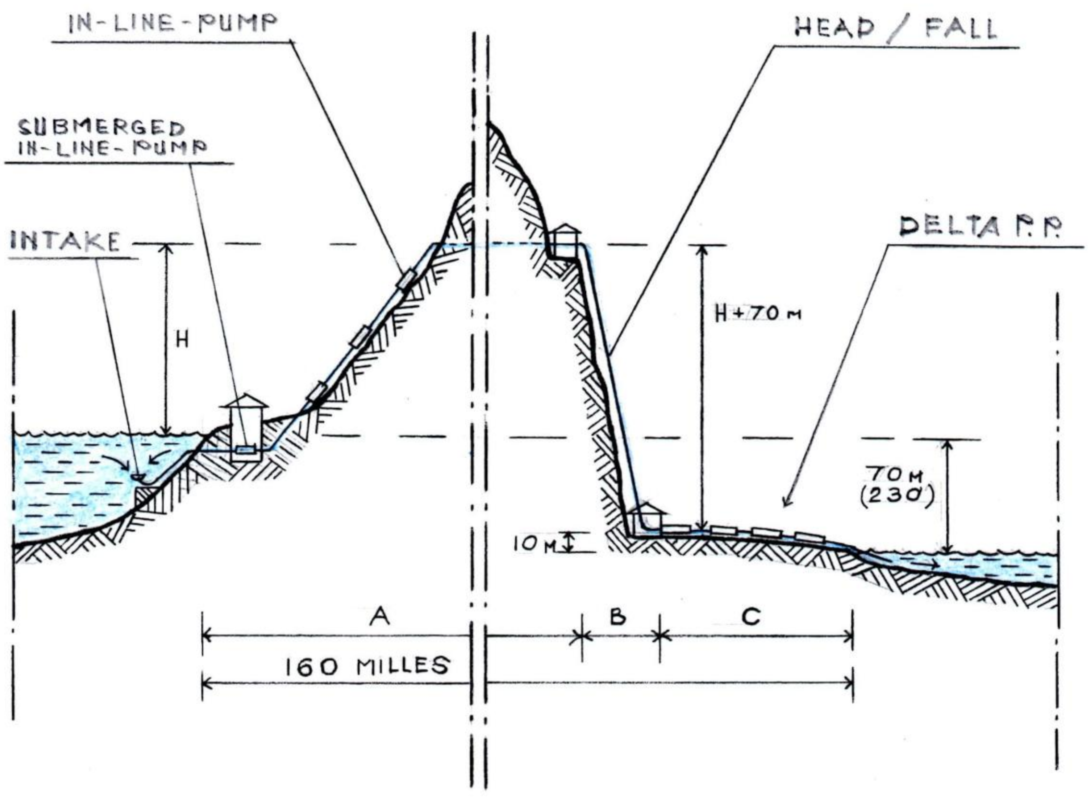
Typical Cross-section view of Elevation of the Ocean and the Salton Sea

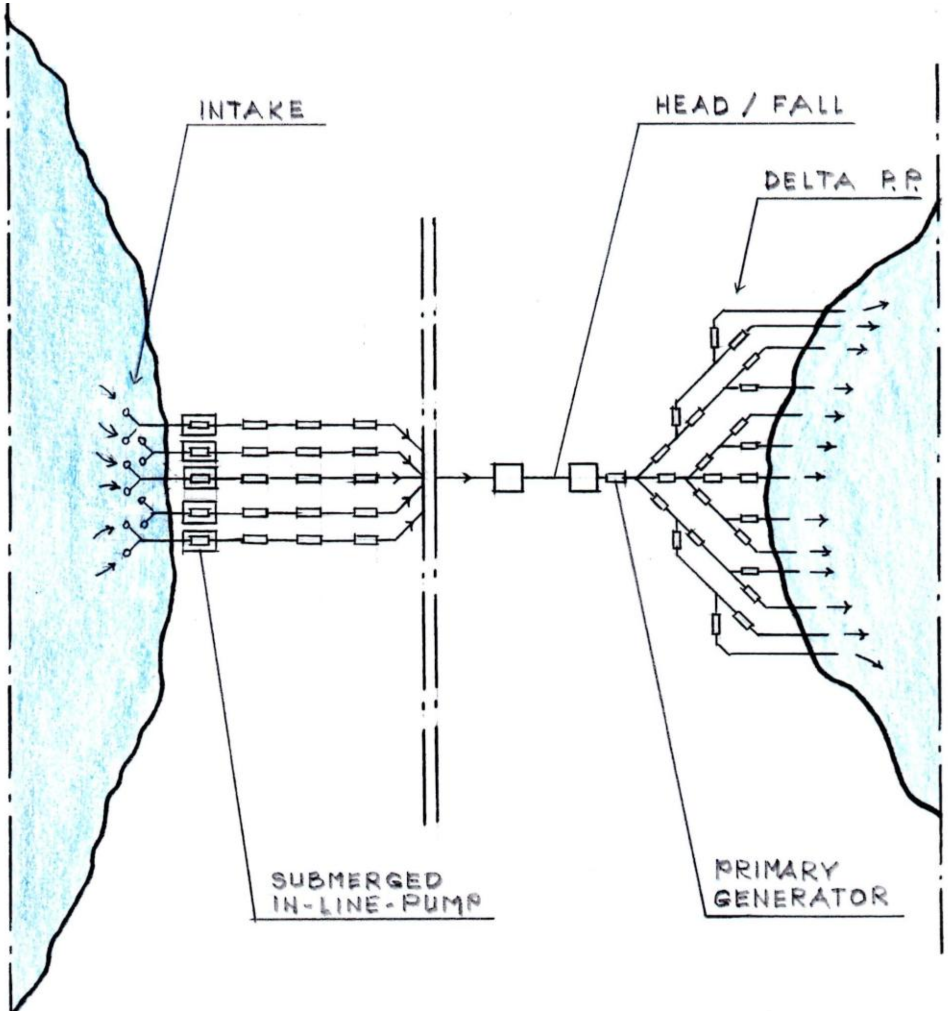


- **Salton Sea's water surface is 230' (70 meters) below the surface of the Ocean.**

EXHIBIT " G "

GEOTHERMAL WORLDWIDE, INC.

Typical Cross-section plain view of the proposed pipeline system connecting the Ocean with the Salton Sea



- Salton Sea's water surface is 230' (70 meters) below the surface of the Ocean.
- The first "In-line Pump" is submerged in the Ocean.
- Numerous repetitive segments of the "In-line Pump" are installed in the section "A".
- Numerous segments of the "In-Line-Generators" (Delta Power Plan) are installed in the section "C";

EXHIBIT " H "

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Route # 1 – Map - Importing seawater from the Ocean to the Salton Sea

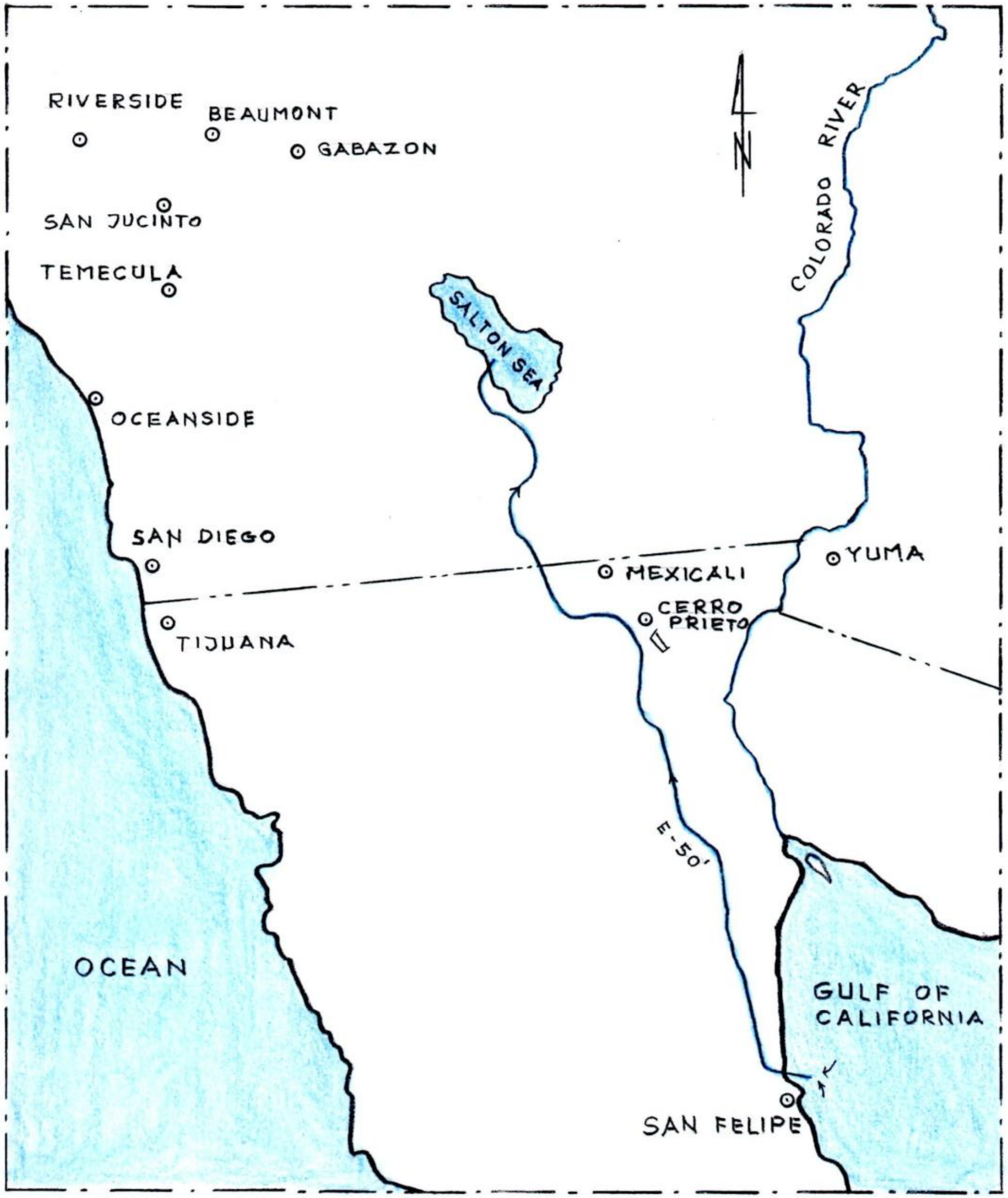

EXHIBIT "I"

Route # 1

- Importing seawater from the Gulf of California – corridor: **San Felipe** through **Mexicali**, Mexico, to the **Salton Sea**.
- Elevation to overcome is **35' (10 m).**
- Pipeline distance is about **150 miles**.
- Cost estimate for pipeline: **$1.7 B**
- This route produces power: **27.3 MWh.**
- This route also deals with the **"Other Country Issues"** – treaty – purchase of seawater – risk involved, etc.

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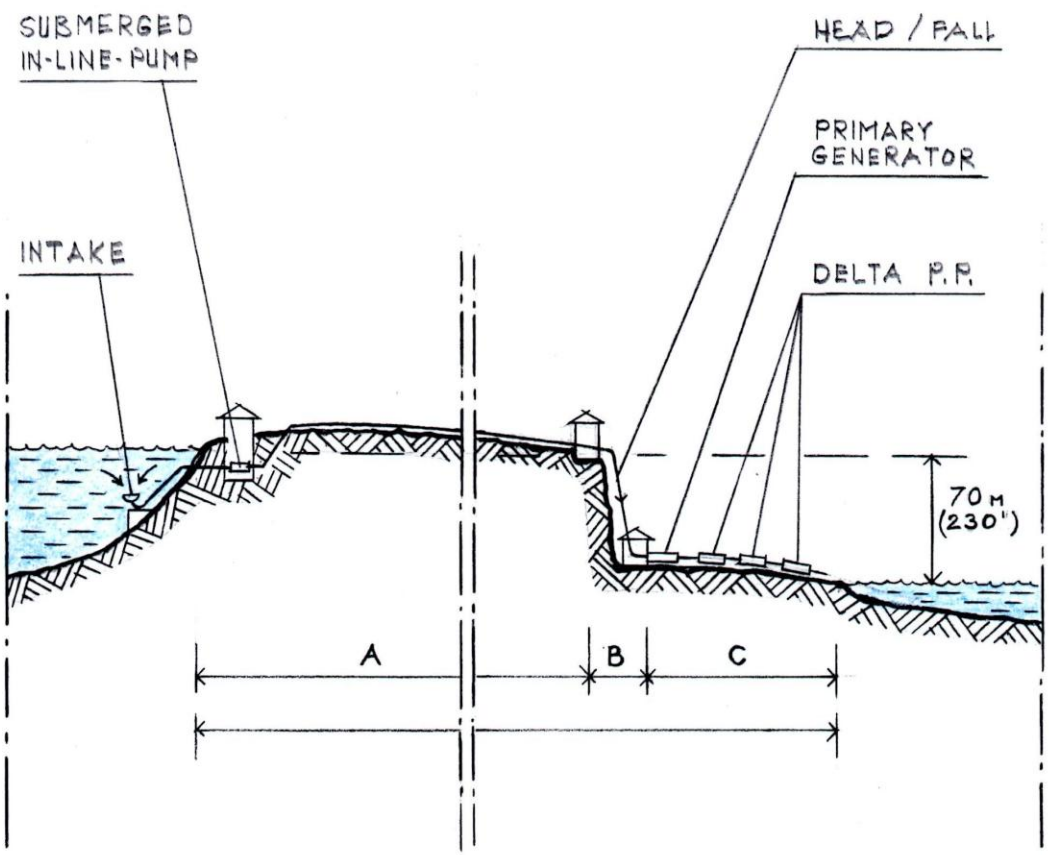
Route # 1 – Cross-sectional view



- Terrain of the Route #1 (corridor: Salton Sea - Gulf of California) is suitable and would be the **least expensive** option.
- There is the "**Other Country Issue**";
- Even if treaty with Mexico are reached and route established , I would recommend implementation of one of the USA corridors.
- It would **reduce dependency** and risk associated with the "other countries issues".
- It would be relatively **small investment** in comparison to the **revenue and benefits** that whole project would generate in the future.

EXHIBIT " J "

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Route # 1 – Plain view

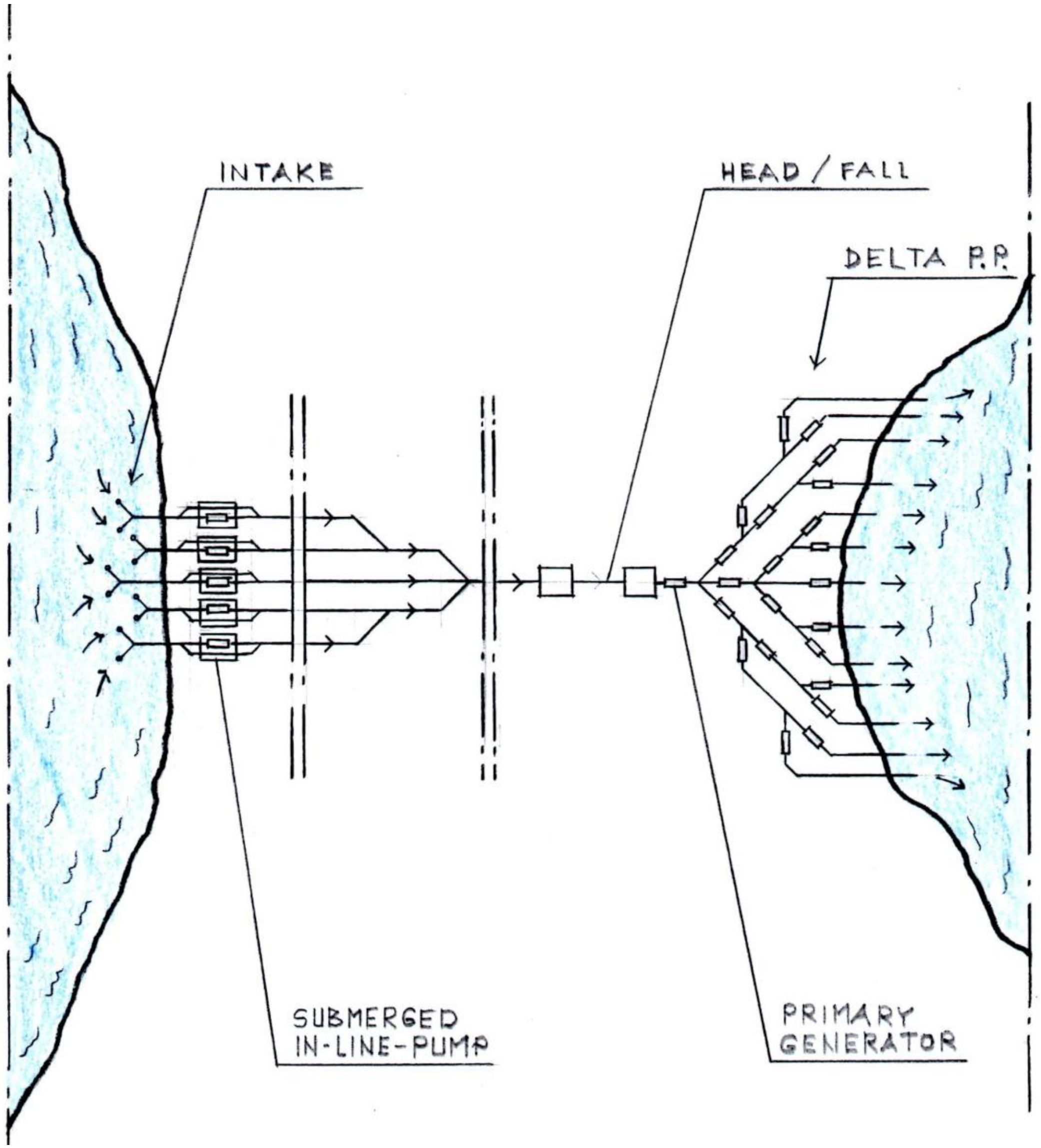
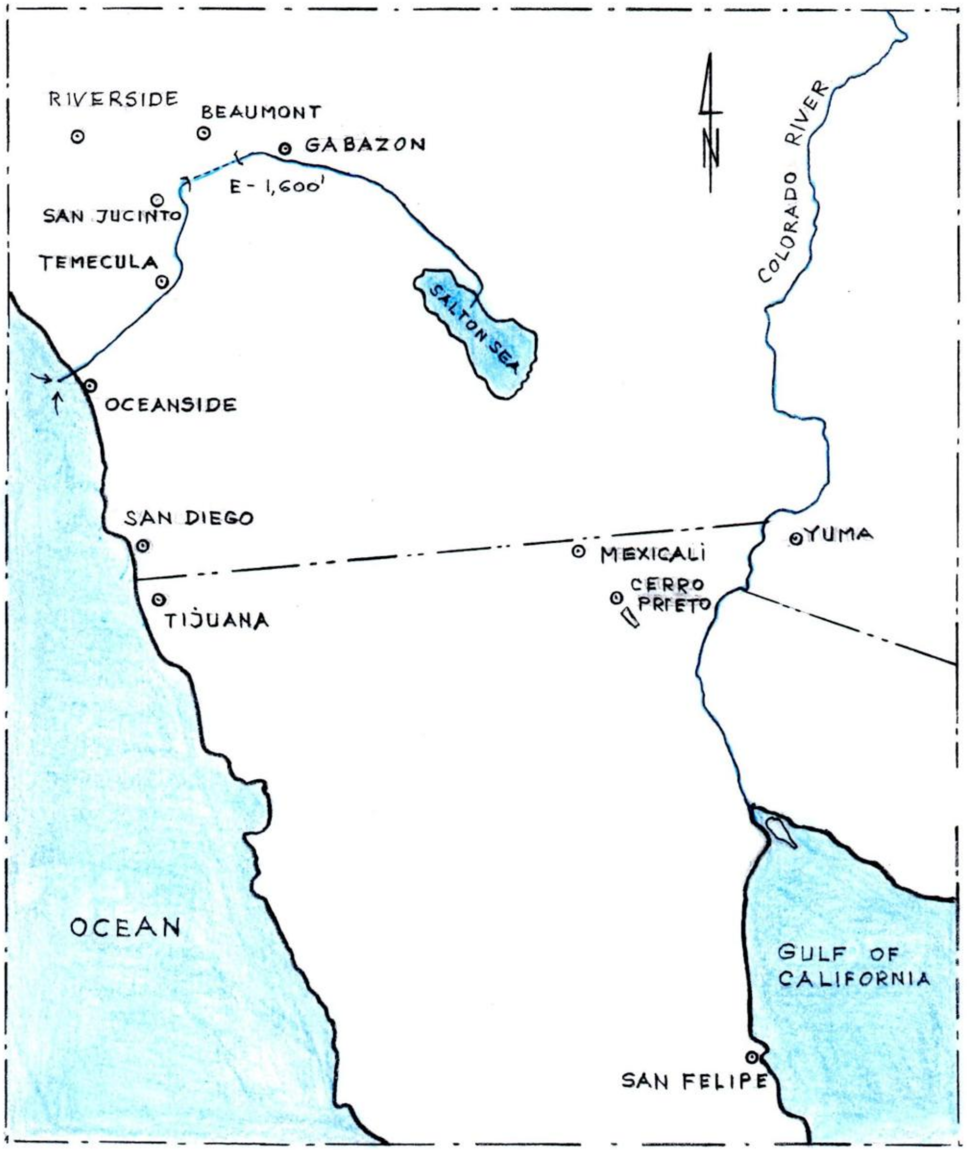


EXHIBIT " K "

Route # 1

- Route #1 – corridor: Salton Sea - San Felipe (Gulf of California);
- The Route # 1 has distance of about 150 miles with preferred topography which has an advantage in pipeline cost.
- Assumption $600 per linear foot. One mile 5,280 ' x $600 = $3,168,000; => $3,168,000 x 450 miles relatively flat terrain (50 miles x 5 pipelines + 50 miles x 3 pipelines + 50 miles 1 pipeline) = **$1,425,600,000**;
- The final cost might increase 20% to about **$1.7 billion.**
- If implemented a single outflow pipeline 24" the final cost might increase 30%.

Route # 2 – Map - Importing seawater from the Ocean to the Salton Sea



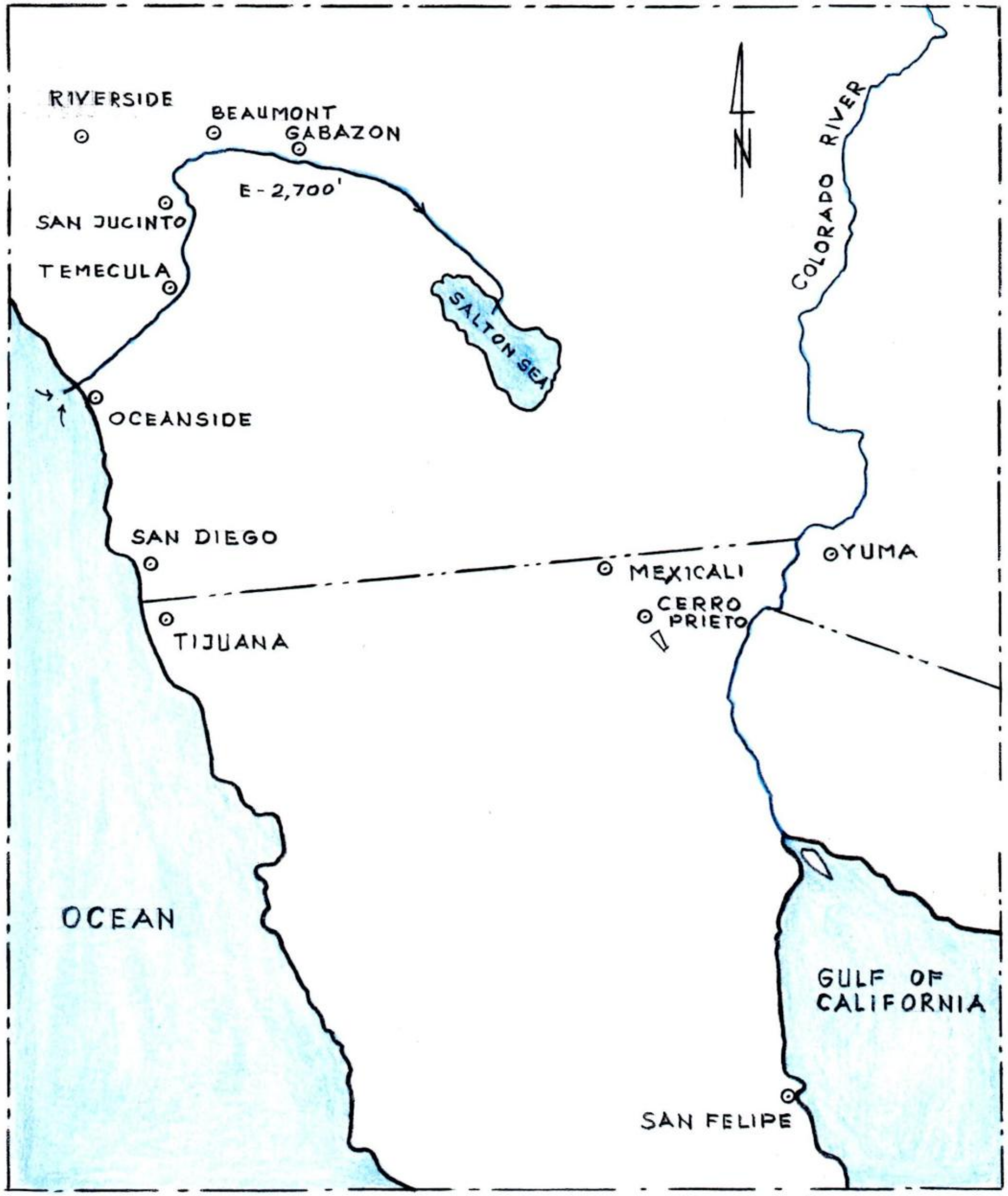
Route # 2

- Importing seawater from the Ocean - corridor - Cabazon (existing tunnel) – San Jacinto – Temecula – Oceanside;
- Elevation to overcome is **1,600‘ (488 m);**
- 2 cascades each with 279 m drop and 6 uphill pumping stations.
- Pipeline distance is about 160 miles.
- Cost estimate for pipeline: **$3.32 billion**.
- Energy needed for operation of the pipeline: **134.5 MWh**.
- For this route could be designate two (2) out of many planed geothermal power plants to generate power for importing seawater.

EXHIBIT “ L “

GEOTHERMAL WORLDWIDE, INC.

Route # 3 – Map - Importing seawater from the Ocean to the Salton Sea



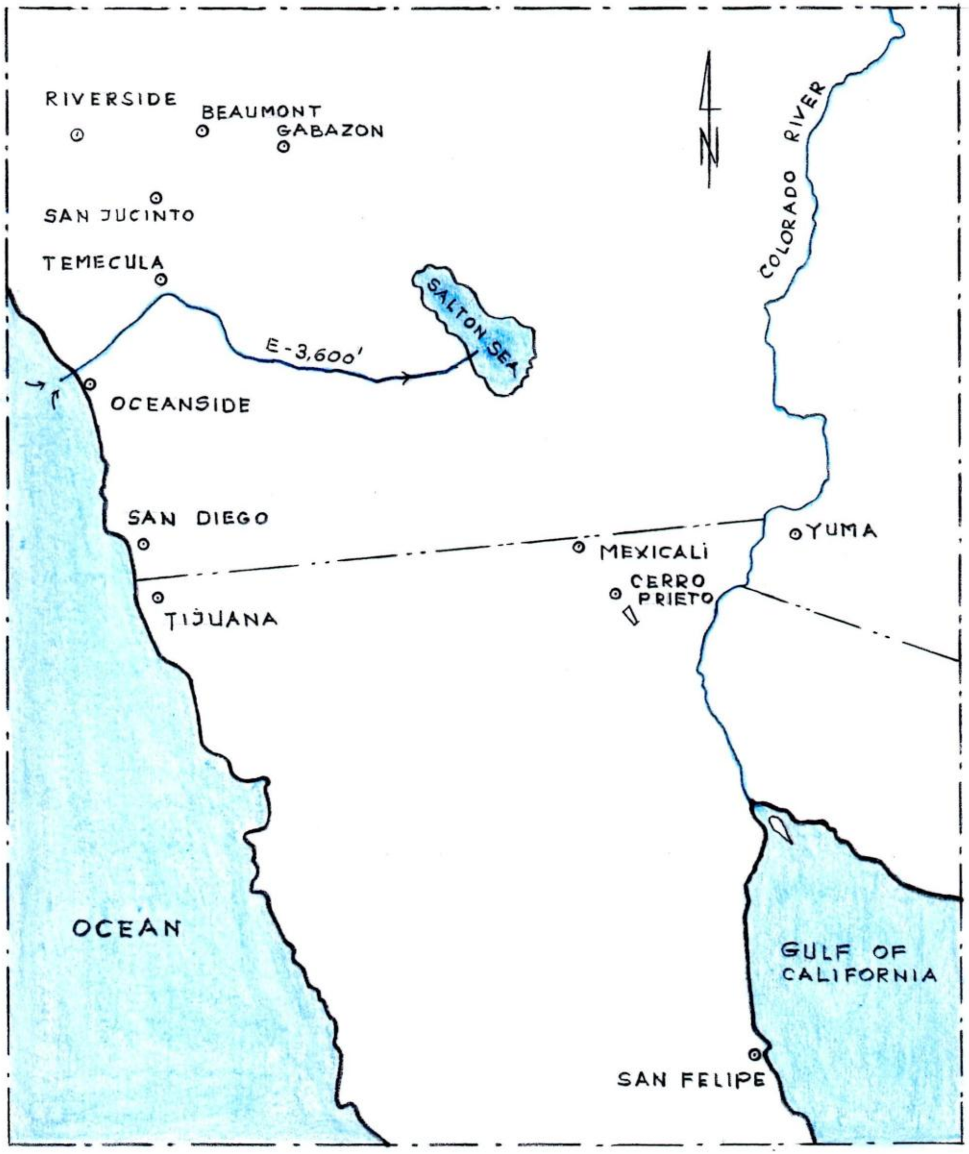
Route # 3

- Importing seawater from the Ocean - corridor Beaumont – San Jacinto – Temecula – Oceanside.
- Elevation to overcome: 2,700‘ (823 m). 3 cascades each with 297 m drop and 9 uphill pumping stations.
- Pipeline distance: about 170 miles;
- Cost estimate for pipeline: **$3.5 billion;**
- Energy needed for operation of the pipeline: **275.7 MWh**.
- For this route could be designate three (3) out of many planed geothermal power plants to generate power for importing seawater.

EXHIBIT “ M “

GEOTHERMAL WORLDWIDE, INC.

Route # 4 – Map - Importing seawater from the Ocean to the Salton Sea



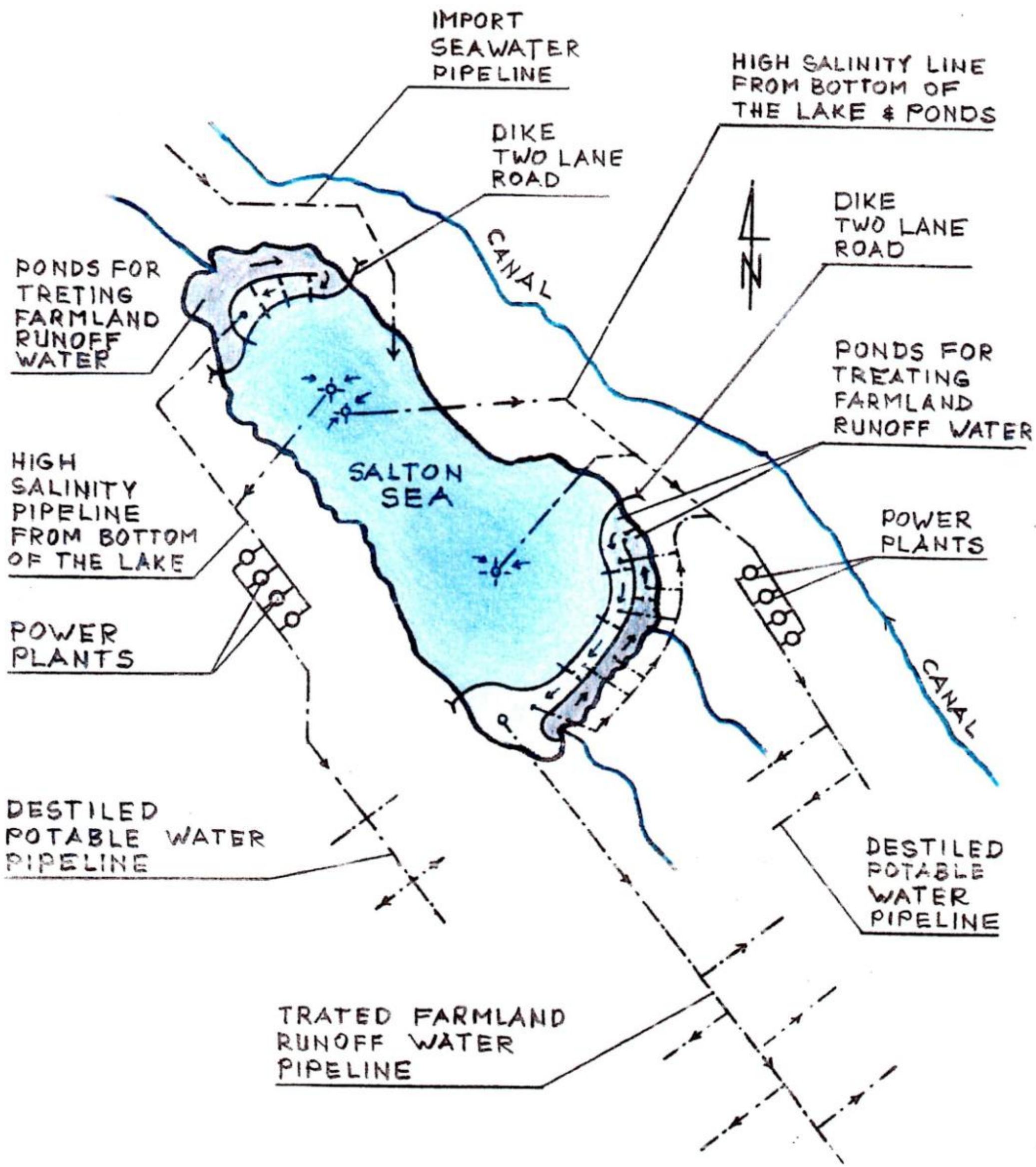
Route # 4

- Importing seawater from the Ocean – corridor Borrego Springs – Oceanside.
- Elevation to overcome is 3,600‘ (1,097 m).
- 4 cascades each with 292 m drop and 11 uphill pumping stations;
- Pipeline distance: about 100 miles.
- Cost estimate for pipeline: **$2.2 2 b;**
- Energy needed for operation of the pipeline: **380 MWh;**
- For this route could be designate four (4) out of many planed geothermal power plants to generate power for importing seawater.

EXHIBIT “ N “

GEOTHERMAL WORLDWIDE, INC.

Summary of the Proposal for the Restoration of the Salton Sean

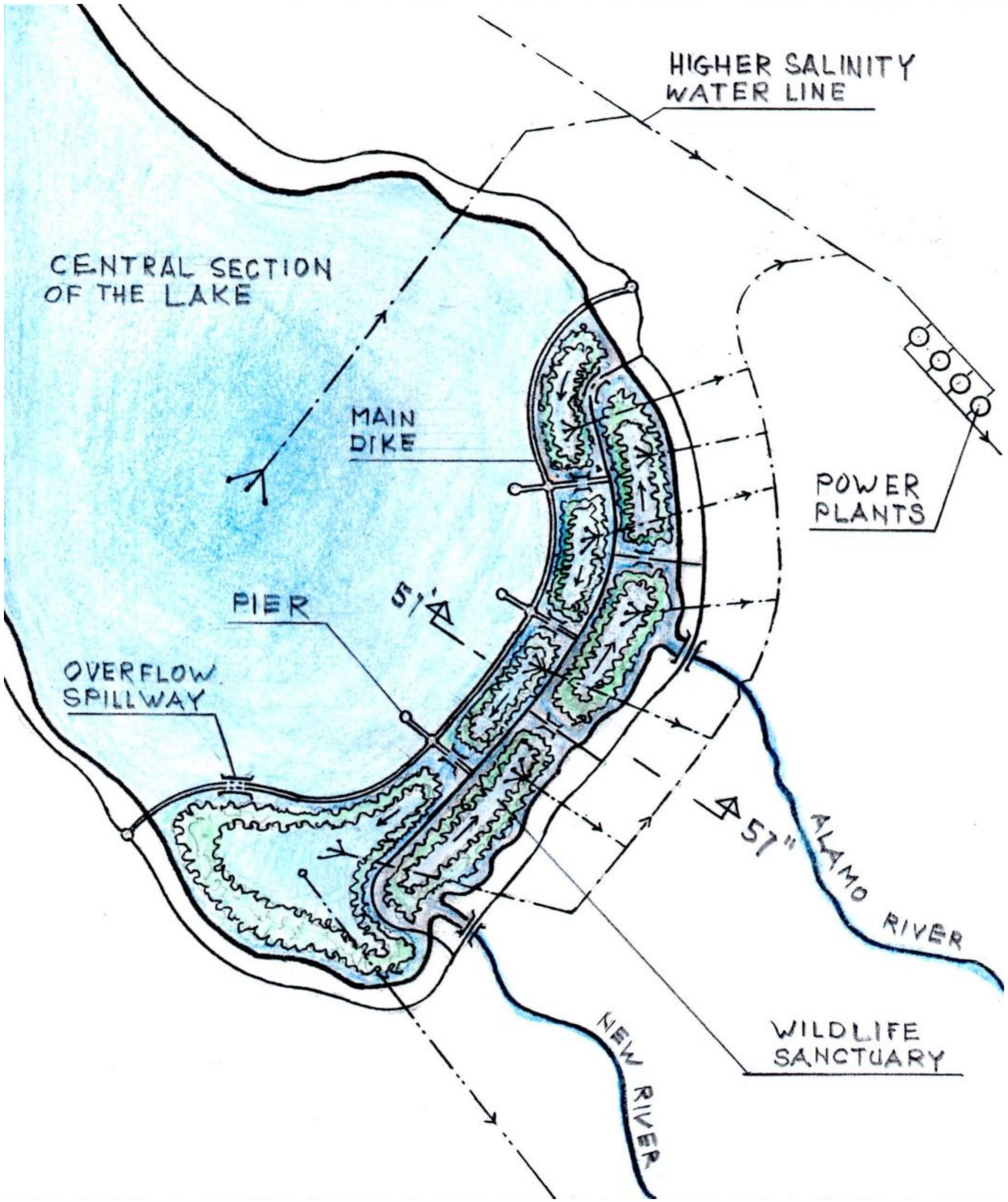


- **Two main dikes** (two lane roads) divides lake in **three** sections – **northern – southern -** and **central -** preventing pollution of the central section of the lake and **providing conditions for tourism** (hotels, motels, beaches, resorts, etc.,) ;
- **Secondary dikes** forms ponds for collecting and treating **farmland's** runoff water and providing **wildlife sanctuary – wetland;**
- **Inflow pipeline** bringing **seawater** from the **Pacific Ocean** (preferably San Diego area) to the **Salton Sea;**
- **Power Plants –** generates **electricity** from prevalent geothermal sources and produces **potable water** and **lithium** as a byproducts.

EXHIBIT " O "

GEOTHERMAL WORLDWIDE, INC.

Enlarged southern part of the Salton Sea – wildlife sanctuary



- **The main dikes** (two lane roads) divides lake into **three sections** – **preventing pollution** of the central section of the lake and **providing** conditions for **tourism;**
- **Secondary dikes** forms **ponds** for collecting and **treating farmland's** runoff water and providing **wildlife sanctuary** – wetland;
- **Wetlands** are planted with **mangrove trees** or alike for **natural filtration** of water;
- **Ponds** are dig in **"V"** shape to provide **slope** and **deep points** for **segregation** of **higher density** water which is pumped out and used in the power plants;

EXHIBIT " P "

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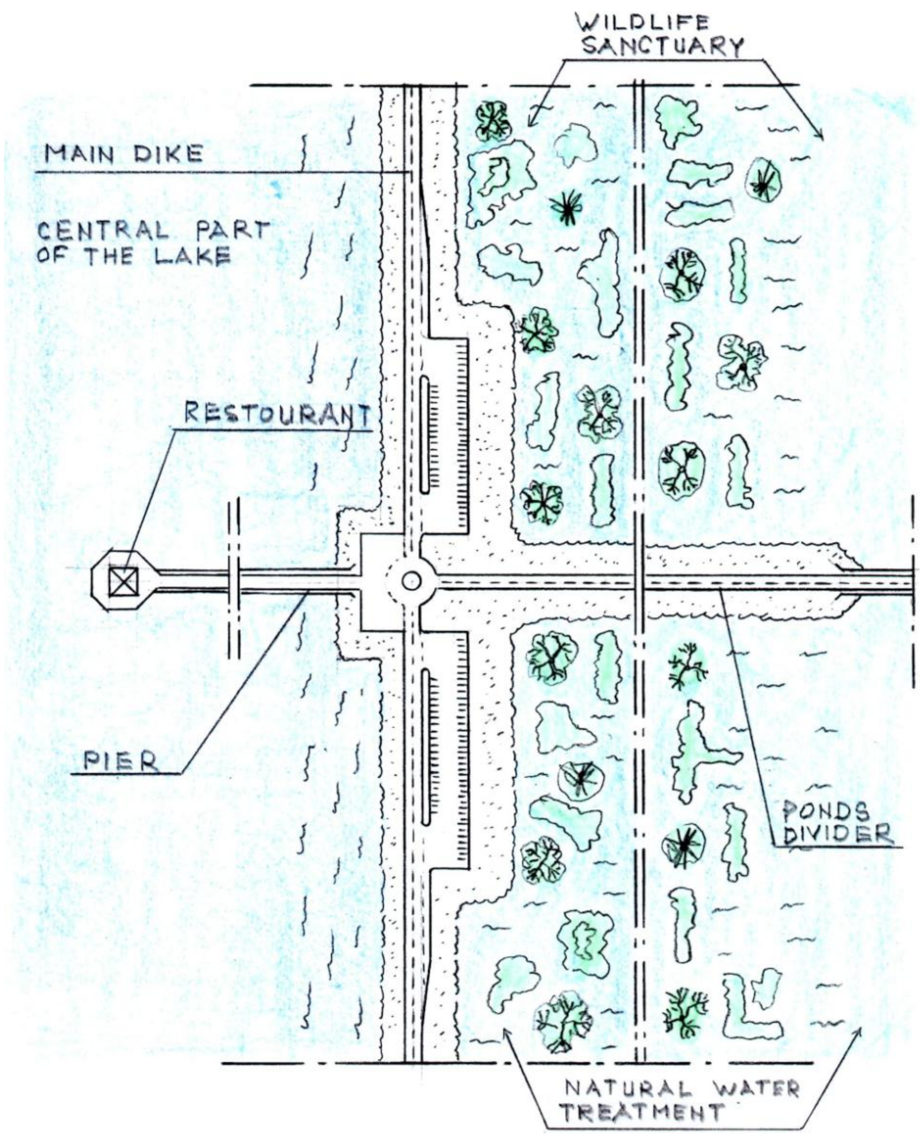
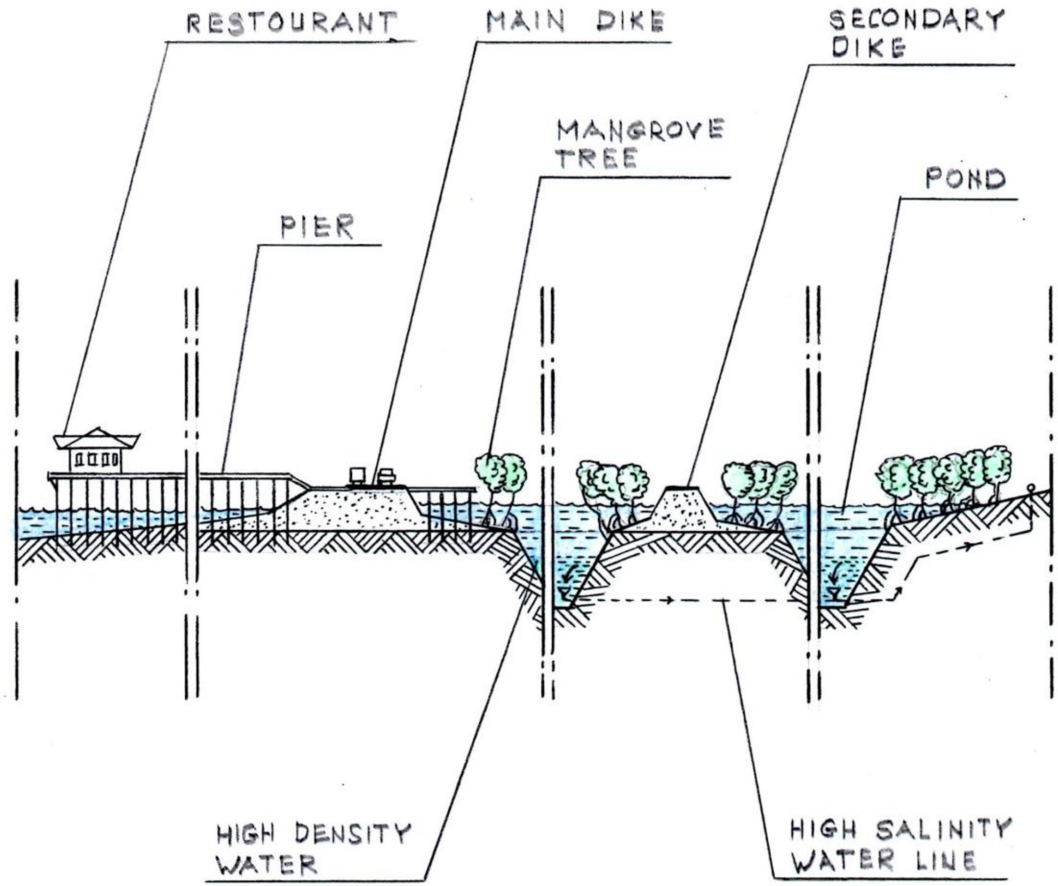
Plan view of a typical dike-pier intersection



- **The main dikes** (two lane roads) **divides** lake into **three sections** – **preventing pollution** of the central section of the lake **providing** conditions for **tourism;**
- **Secondary dikes** forms **ponds** for collecting and **treating** farmland's runoff water and providing **wildlife sanctuary** – wetland;
- **Wetlands** are planted with **mangrove trees** or alike for **natural filtration** of water;
- **Ponds** are dig in **"V"** shape to provide **slope** and **deep points** for **segregation** of **higher density** water which is pumped out and used in the power plants;
- There is a **restaurant** on the **pier** and parking places for visitors;

EXHIBIT " Q "

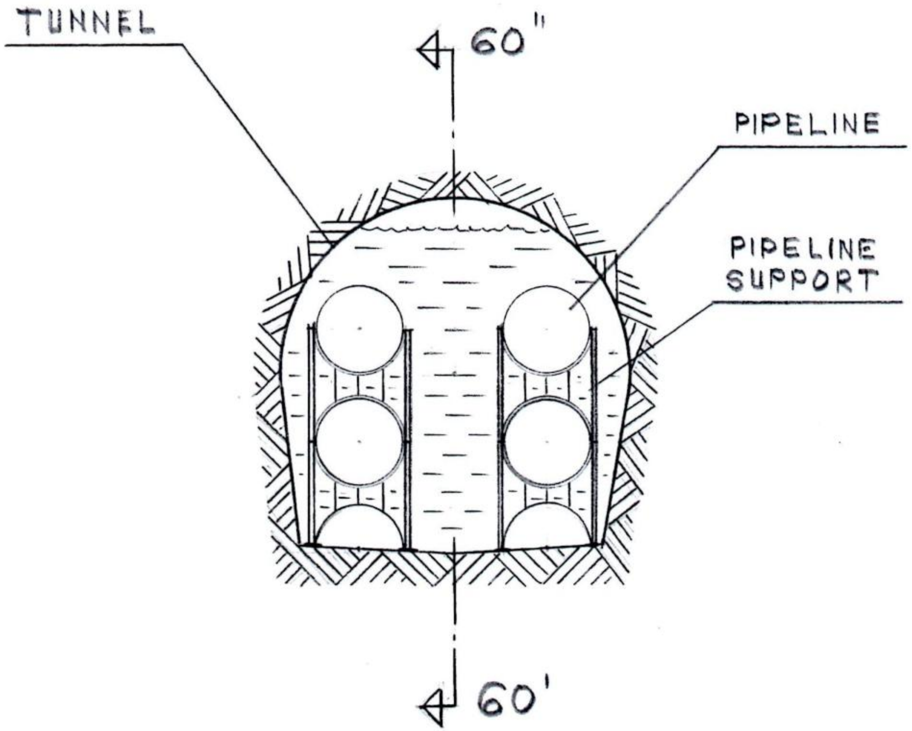
Cross-sectional view taken near a typical dike-pier intersection and through ponds treatment plant



- The **main dikes** (two lane roads) **divides** lake into **three** sections – **preventing pollution** of the central section of the lake and **providing conditions** for **tourism;**
- **Secondary dike** forms **ponds for collecting** and **treating** farmland's runoff water and **providing wildlife sanctuary** – wetland;
- **Wetlands** are planted with **mangrove trees** or alike for **natural filtration** of water;
- **Ponds** are dig in **"V"** shape to provide **slope** and **deep points** for **segregation** of **higher density** water which is pumped out and used in the power plants;
- There is a **restaurant** on the **pier;**

EXHIBIT " R "

Cross-sectional frontal view of an existing tunnel



- **Existing tunnel** from **Cabazon** to **San Jacinto;**
- **12 miles** long;
- **Elevation 1,600‘ (488 m”);**
- **16 feet** high and **16 feet** wide.
- Tunnel is used for delivering water from Colorado river to costal cities;
- Tunnel can be also used for **pipelines transporting seawater** from the **Ocean** to the **Salton Sea** according to the presented proposal.

EXHIBIT “ S “

Cross-sectional longitudinal view of an existing tunnel

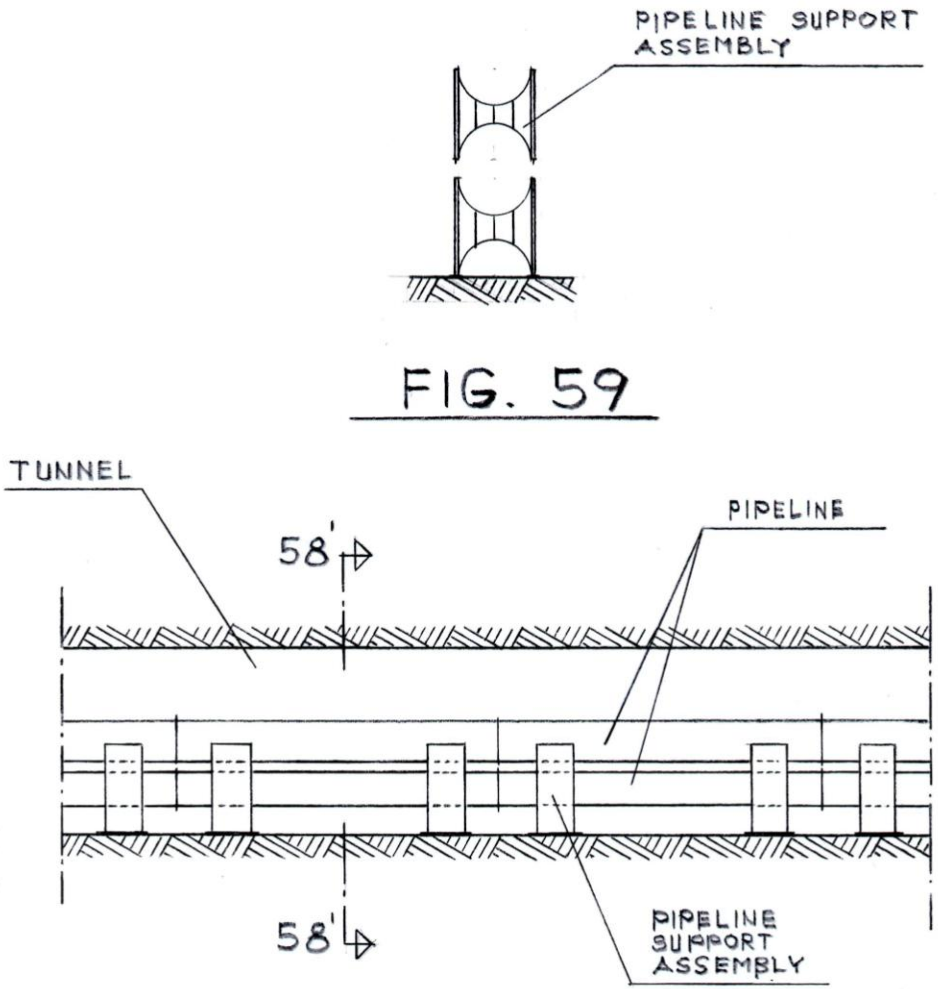


EXHIBIT " T "

- **Existing tunnel** from **Cabazon** to **San Jacinto;**
- **12 miles** long;
- **Elevation 1,600' (488 m");**
- **16 feet** high and **16 feet** wide.
- Tunnel is used for delivering water from Colorado river to costal cities;
- Tunnel can be also used for **pipelines transporting seawater** from the **Ocean** to the **Salton Sea** according to the presented proposal.
- **Pipeline support assembly;**

Typical cross-section view of the mid section of the pipeline connecting the Ocean with the Salton Sea

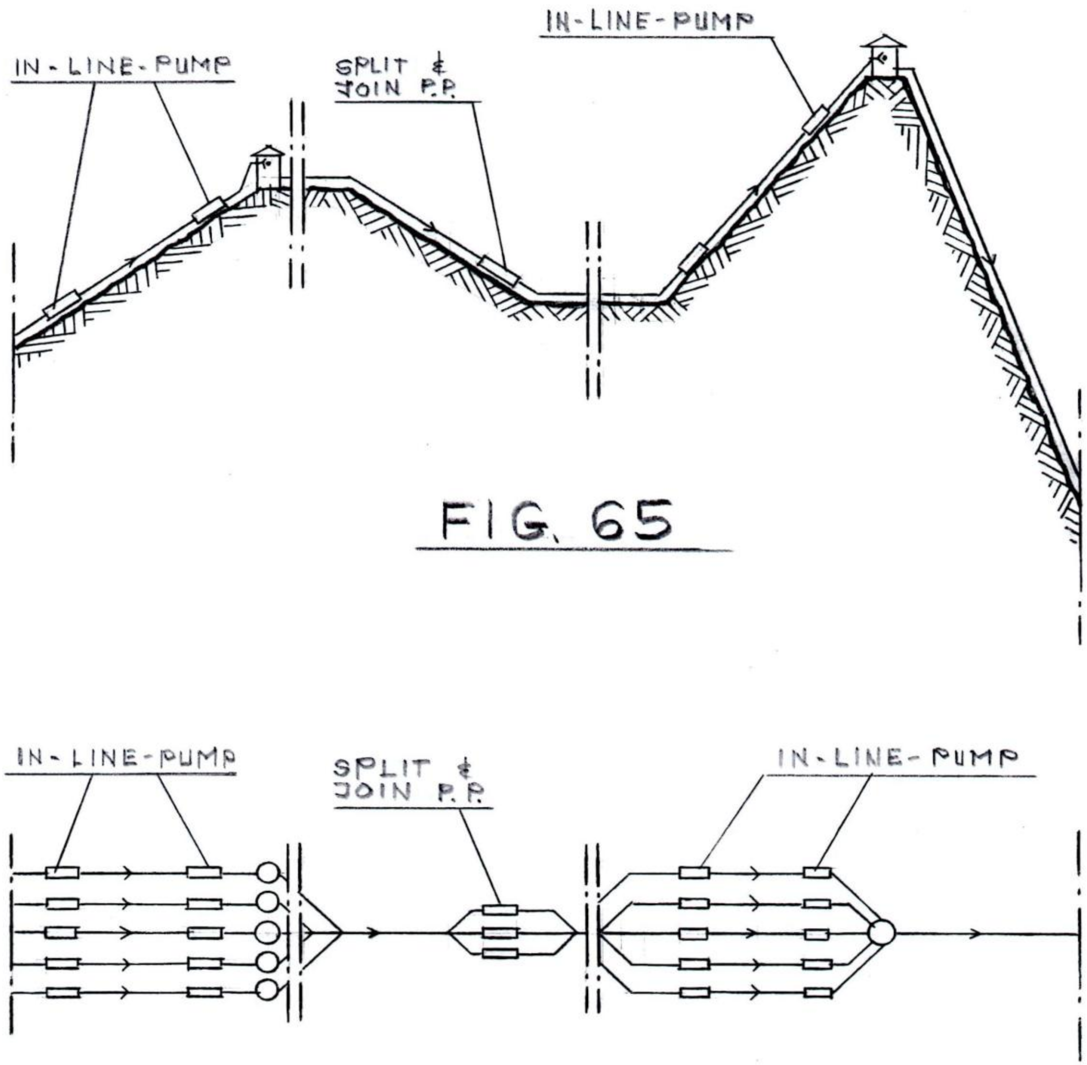


FIG. 65

- Numerous repetitive segments of the **"In-line Pump"** are installed in the **uphill** routes.
- Numerous segments of the **"In-Line-Generators" (Split & Join -** mini Power Plan**)** are installed in the **downhill** routes;
- **Split & Join** - mini Power Plants uses kinetic energy **after** fluid **exit** primary turbine.
- **It provides necessary volume** of fluid for multi-line uphill routes to **accommodate** necessary volume of fluid at the **final exit** section .

EXHIBIT " U "

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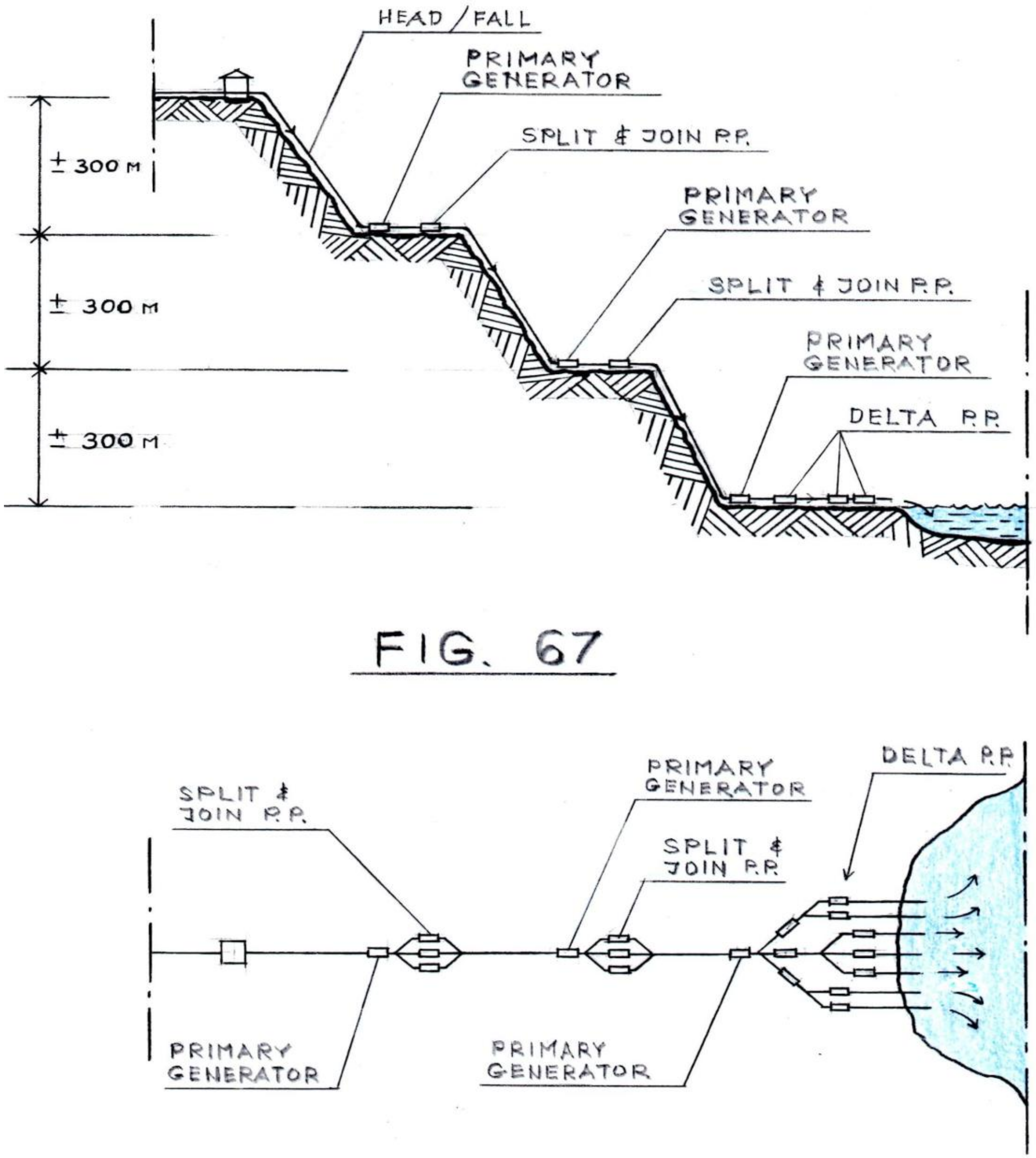
Typical cross-section view of the final downhill pipeline route.



- Downhill routes of pipeline can be built using several **cascades** with **"split and join"** mini hydropower plants to **avoid** buildup of **extreme pressure** in the pipeline especially in the last section of the final **downhill route** and to **harness more** kinetic energy and **minimize loses;**

- **"Delta" mini power plant splits fluid flow** into smaller branches with gradually **lesser fluid flow speed** in each subsequent branch, hence, increasing efficiency of harnessing kinetic energy and at the same time providing **the same volume** of seawater leaving the pipeline and **entering the lake** as is the volume of seawater entering the pipeline from the Ocean.

EXHIBIT " V "

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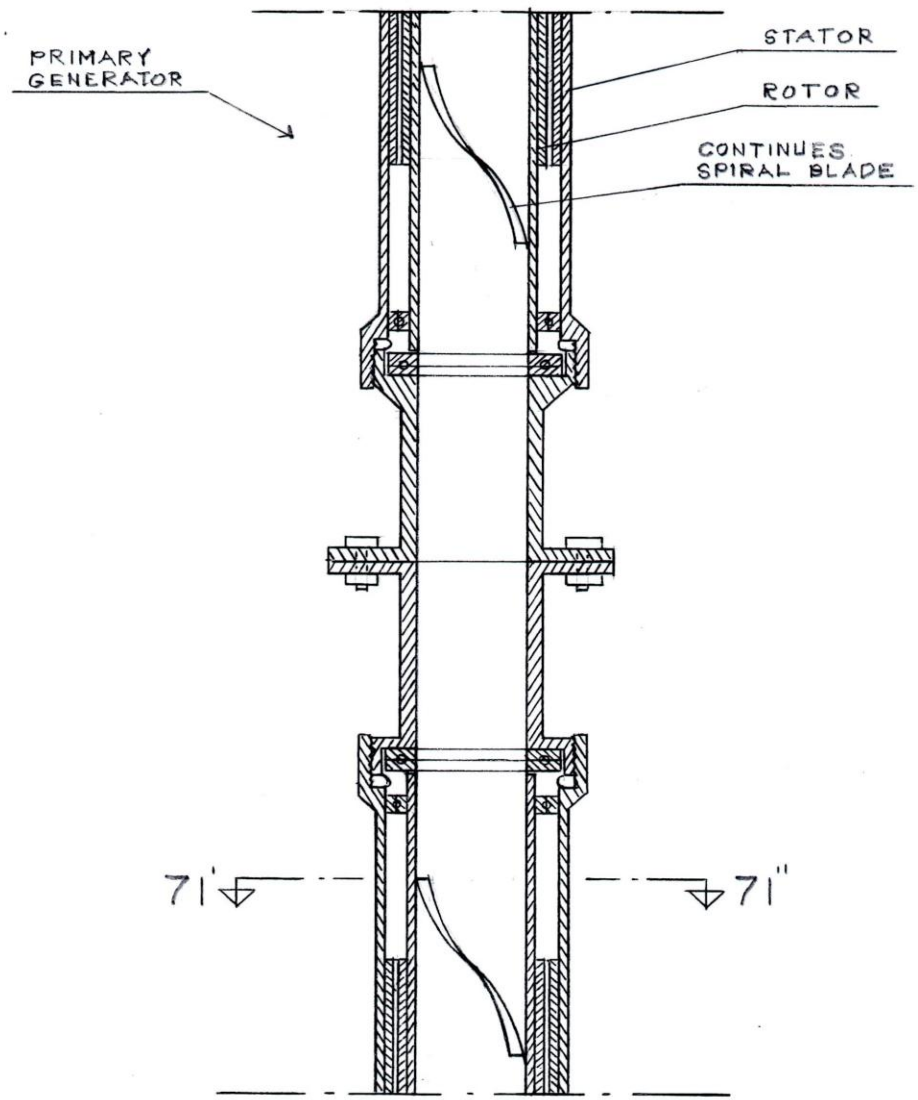
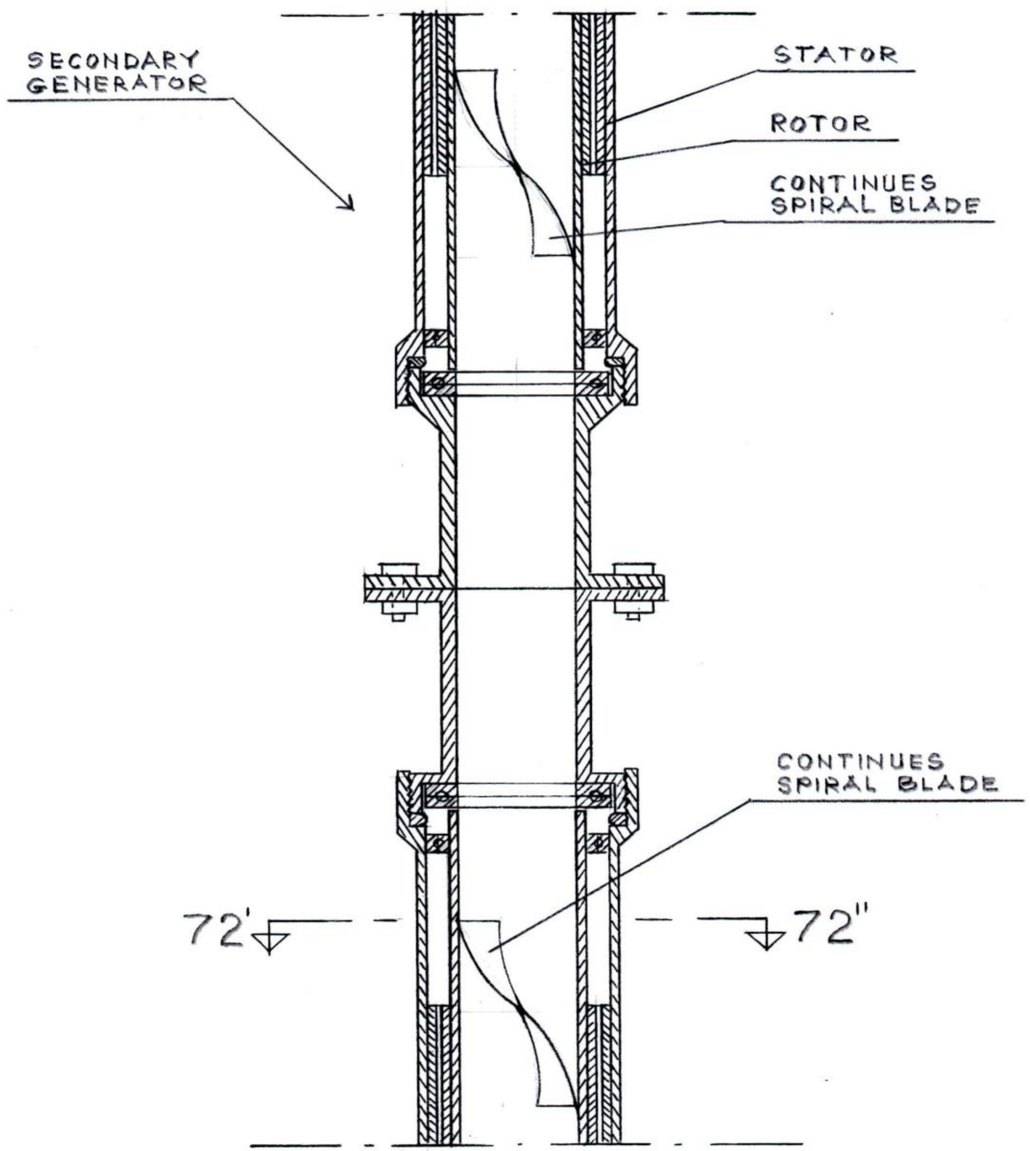
Cross-sectional longitudinal view of the Primary In-Line-Generator



- **The In-Line-Pump / Generator is an electromotor cylindrical shape and is inserted as a repetitive segment in the pipeline.**
- **As a shaft of the rotor it has a hollow cylinder with continues spiral blades inside hollow cylinder / shaft.**
- **In order to harness maximum energy from the fall, the primary generator at the bottom of the fall, have continuous spiral blades, inside the hollow cylinder, less exposed with bigger openings for the fluid to flow through the middle of the cylinder /shaft.**
- **It yields a maximum flow rate with limited diameter.**

EXHIBIT " W "

Cross-sectional longitudinal view of the Secondary In-Line-Generator



- The In-Line-Pump / Generator is an electromotor cylindrical shape and is inserted as a repetitive segment in the pipeline.
- As a shaft of the rotor it has a hollow cylinder with continues spiral blades inside hollow cylinder / shaft.
- The Secondary In-Line-Pump / Generators are a subsequent segments in the "Split & Join" and "Delta" mini Power Plants having gradually more exposed continuous spiral blade with smaller openings in the middle of the cylinder as speed of fluid gradually decreases.
- It yields a maximum flow rate with limited diameter.

EXHIBIT " X "

GEOTHERMAL WORLDWIDE, INC.

Cross-sectional frontal view of the Primary and Secondary In-Line-Pump / Generator

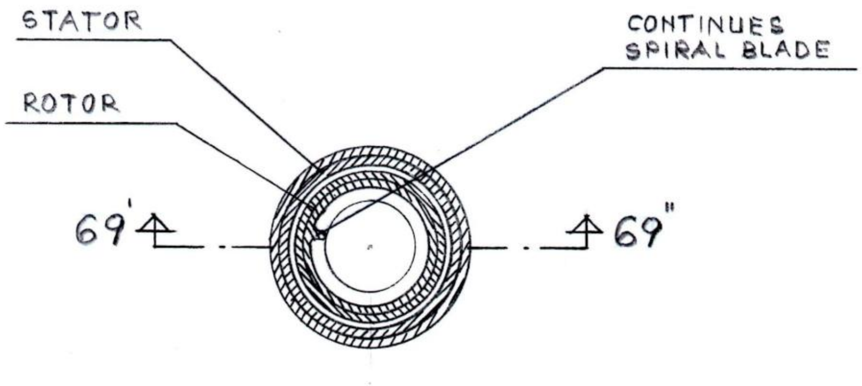
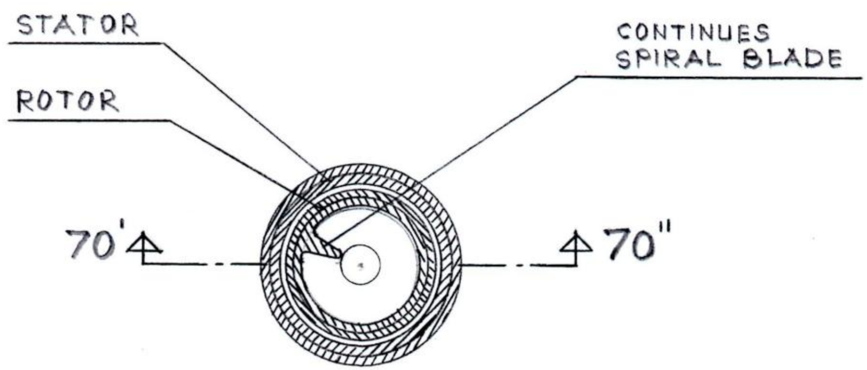


FIG. 71

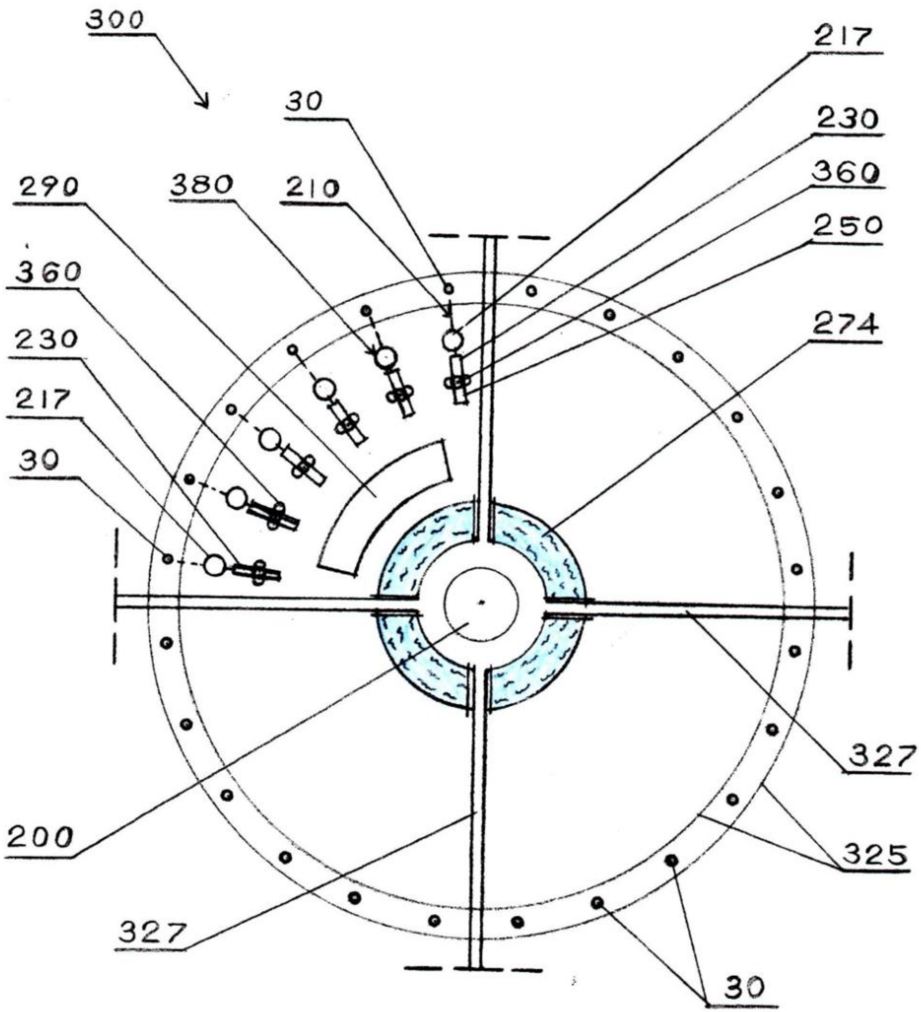


- **In order to harness maximum energy from the fall, the Primary Generator at the bottom of the fall, have continuous spiral blades, inside the hollow shaft, less exposed with bigger openings in the middle of the cylinder / shaft.**

- **The subsequent segments - the In-Line-Generators - in the section “C” (Delta Power Plant) have gradually more exposed continuous spiral blades with smaller openings in the middle of the cylinder / shaft as speed of fluid gradually decreases.**

EXHIBIT “ Y “

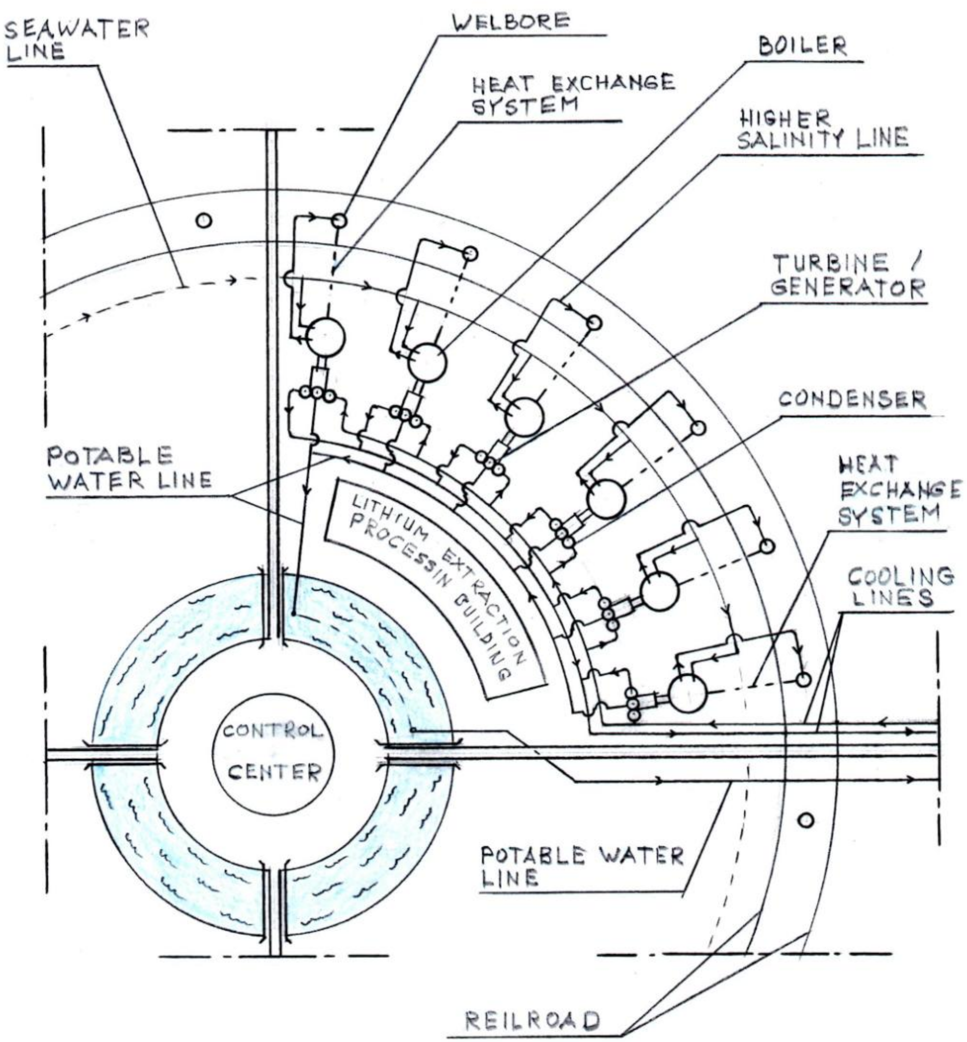
Plain view of a typical Power Plant



- **300 – Power Plant** about 500 meters diameter**;**
- **30 – Wells;**
- **380 – Power Units;**
- **200 – Control Center;**
- **290 – Processing Building;**
- **274 – Potable water pond;**
- **210 – Heat Exchange system;**
- **325 – Railroad track;**

EXHIBIT " Z "

Plain view of a quarter of Power Plant – Modular Unite



➢ The Power Plant uses completely closed loop system;

➢ Sea water is distributed to the boilers of the Power Unites;

➢ Steam passes through turbine / generator and condenser and condenses as a potable water;

➢ Remaining water in the boiler is now more saltier and is injected into wellbore to form geothermal reservoir for better conduction of heat from hot rocks to the first heat exchanger;

➢ After wellbore is filled the (now) saturated brine it is periodically excavated and distributed to the processing building for the extraction of lithium;

EXHIBIT " AA"

GEOTHERMAL WORLDWIDE, INC.

Schematic Cross-Sectional Diagram of an Universal Heat Exchange System 210

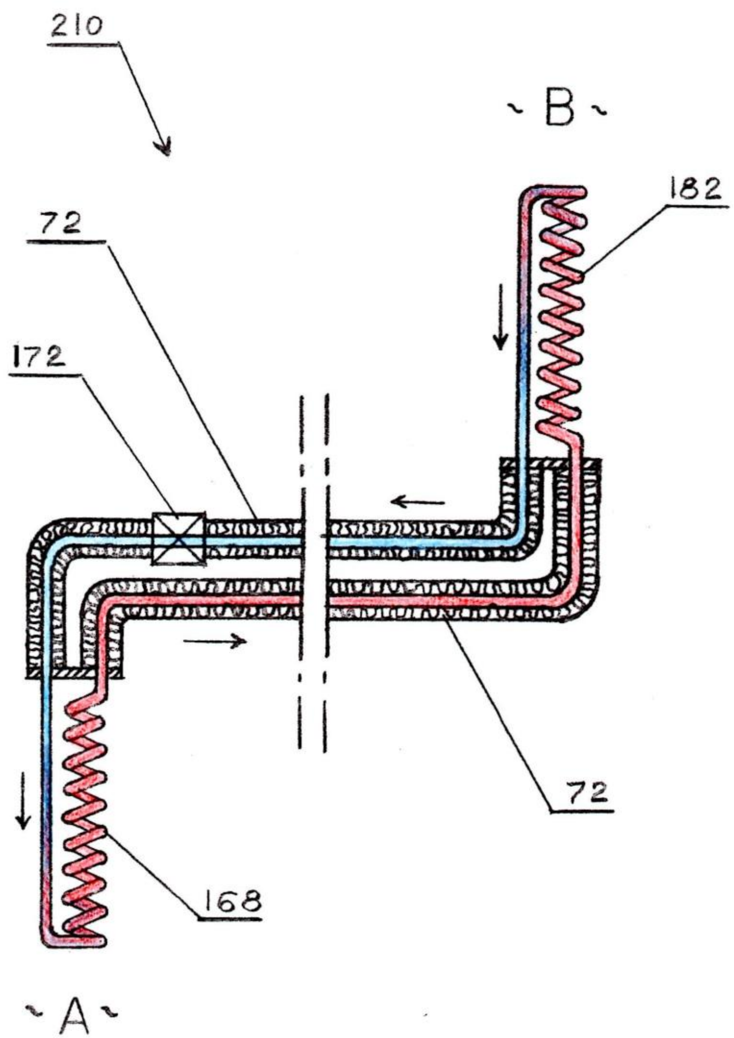


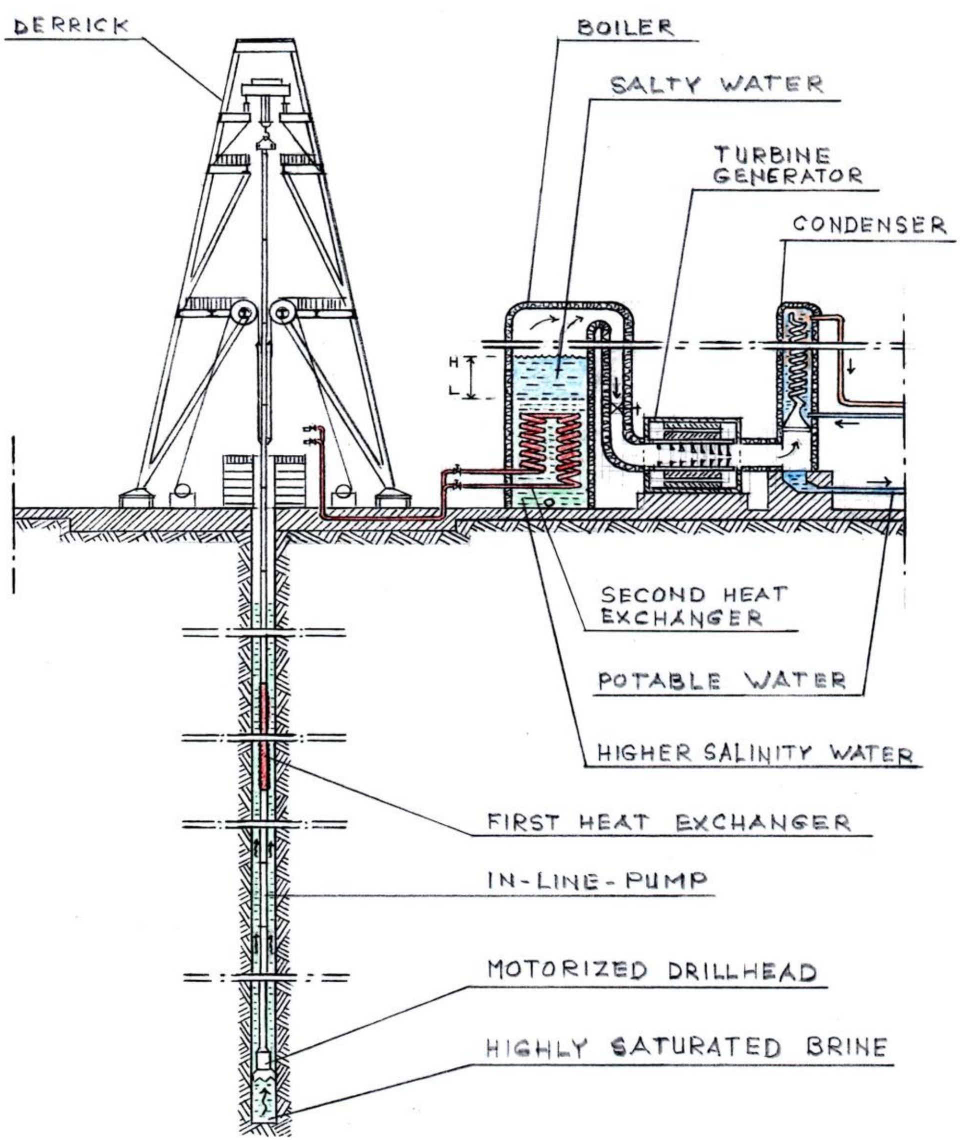
EXHIBIT "BB"

GEOTHERMAL WORLDWIDE, INC.

A schematic cross sectional diagram of an universal heat exchange system 210 with main segments including:

- **A thermally insulated close loop line 72 with an in-line pump 172;**
- **A first heat exchanger 168 positioned in heat source environment "A"; and**
- **A second heat exchanger 182 positioned in preferred environment "B";**
- **Heat is extracted from heat source through the first heat exchanger 168 and transferred through thermally insulated line 72 to the second heat exchanger 182 for external use including production of electricity.**
- **The universal heat exchange system 210 is a portable unite and can be used in many applications.**

Schematic cross-sectional view of a Power Unite

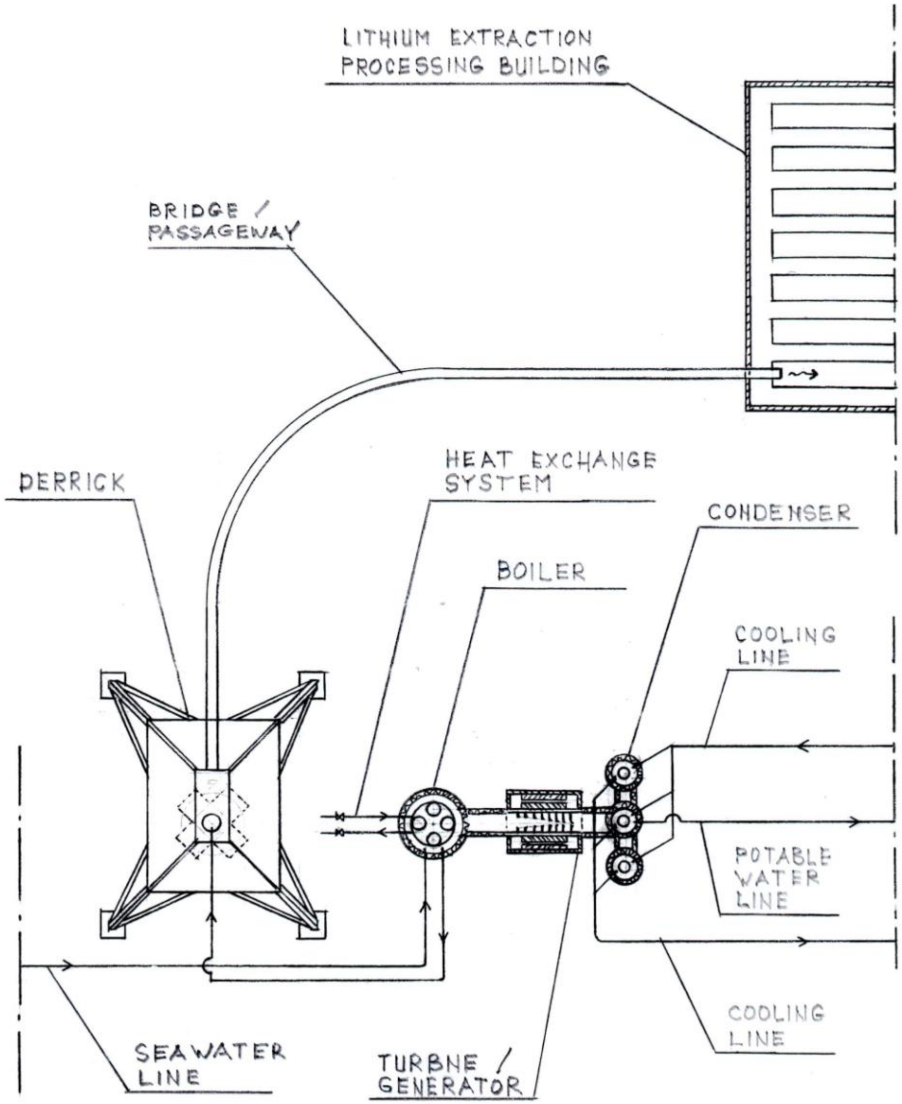


- A method for harnessing geothermal energy for generation of electricity by using complete closed loop heat exchange systems combined with on-board drilling apparatus.
- The first heat exchanger of the closed loop system is lowered at heat source and second heat exchanger is coupled into boiler / evaporator of the Power Unite.
- Salty water from the Salton Sea is injected into boiler / evaporator to the level “H”.
- Salty water is heated by heat exchanger and steam is produced which spins turbine and generator, which generates electricity.
- The power unit has a condenser which is cooled with additional closed loop system.
- Geothermal fluid and/or saturated brine is circulated around first heat exchanger with an on-board in-line-pump to minimize heat flux.
- Drilling can continue as needed in search for hot rocks until equilibrium is reached.

EXHIBIT “ CC”

GEOTHERMAL WORLDWIDE, INC.

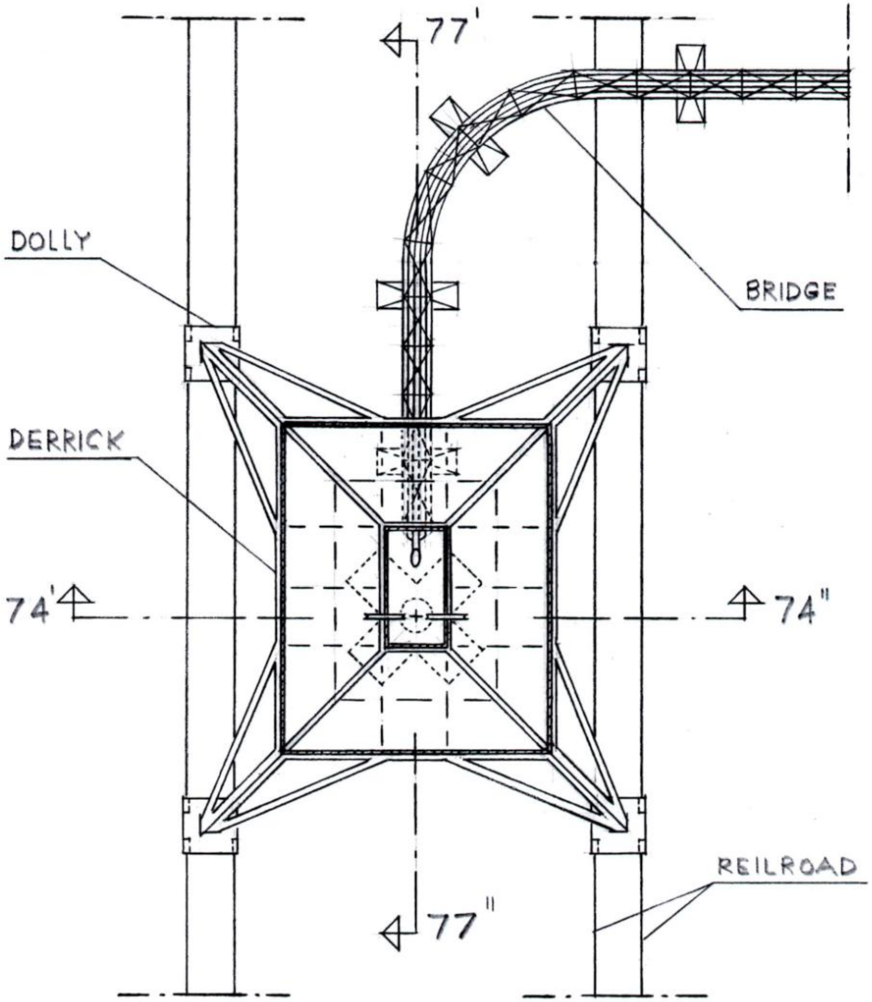
Schematic Plan View of a Power Unite



- Remaining salty water, level "L", from distiller is injected into wellbore to form geothermal reservoir for better conduction of heat from hot rocks to the first heat exchanger;
- After wellbore is filled with saturated brine it is periodically excavated and distributed to the processing building for extraction of the lithium;
- This system enable drilling deeper and wider wellbores with constant diameter.
- Presented system for drilling faster, deeper and wider wellbore consist of motorized drill head; separate excavation line; separate fluid delivery line; and separate closed loop cooling line engaged with Power Unit on the ground surface.

EXHIBIT " DD "

Schematic Cross-sectional Plain view of a Derrick

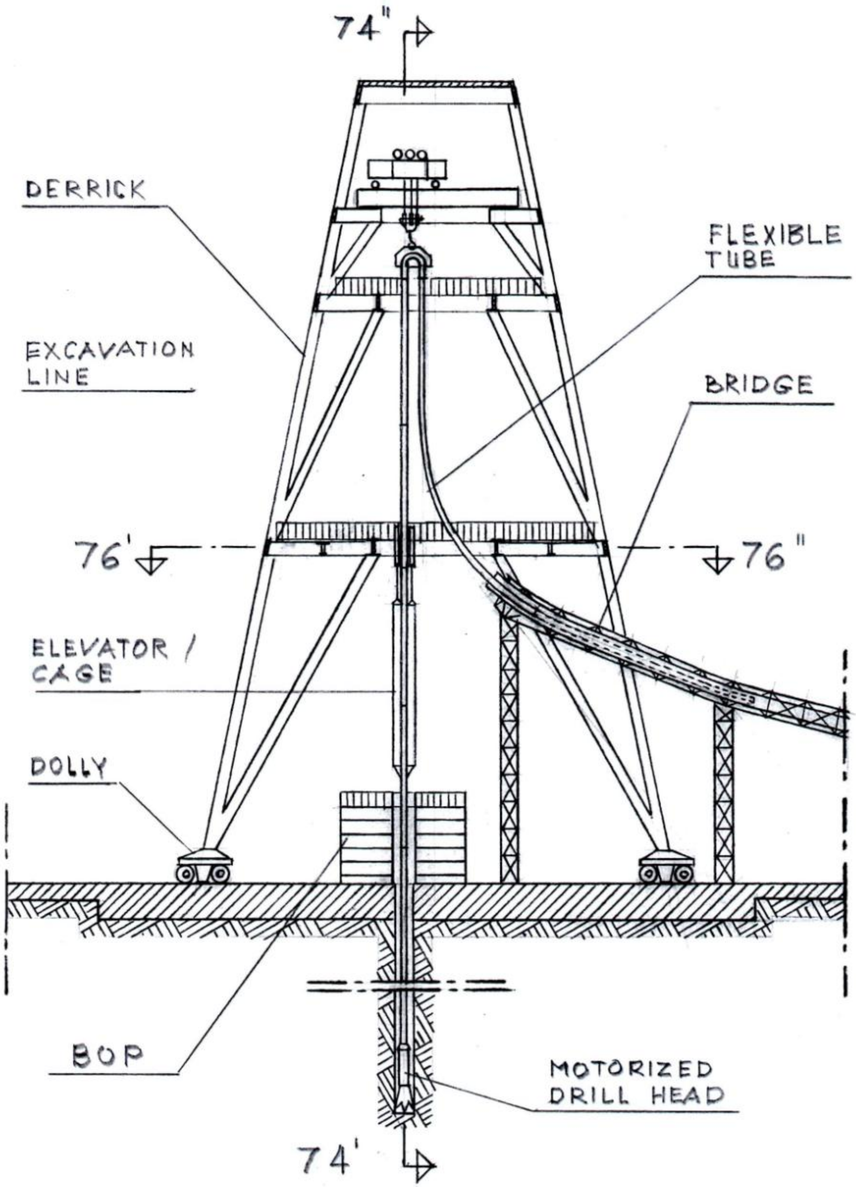


- The casing of the wellbore can be build during the drilling process.

EXHIBIT “ EE “

GEOTHERMAL WORLDWIDE, INC.

Schematic Cross-sectional Side view of a Derrick



- **A system for drilling faster, deeper and wider wellbore consist of motorized drill head; separate excavation line; separate fluid delivery line; and separate closed loop cooling line engaged with Power Unit on the ground surface.**
- **Presented drilling apparatus has retractable bits on the motorized drill head.**
- **The apparatus also incorporates an elevator system (cage) sliding over the drilling / excavation / heat exchange apparatus , delivering and installing casing sheets and concrete. The casing of the wellbore can be build during the drilling process.**
- **The diameter of the excavation line and rate of flow of mud and cuttings through it and the diameter of the fluid delivery line and rate of fluid flow through it are in balance requiring only limited fluid column at the bottom of the well bore.**
- **The excavation process continues regardless of the diameter of the drill head (wellbore); therefore this method eliminates well known drilling limitations relative to the depth and diameter of the wellbore.**

EXHIBIT “ FF “

GEOTHERMAL WORLDWIDE, INC.

Proposal for Restoration of the Salton Sean – An alternative option with inflow and outflow pipelines

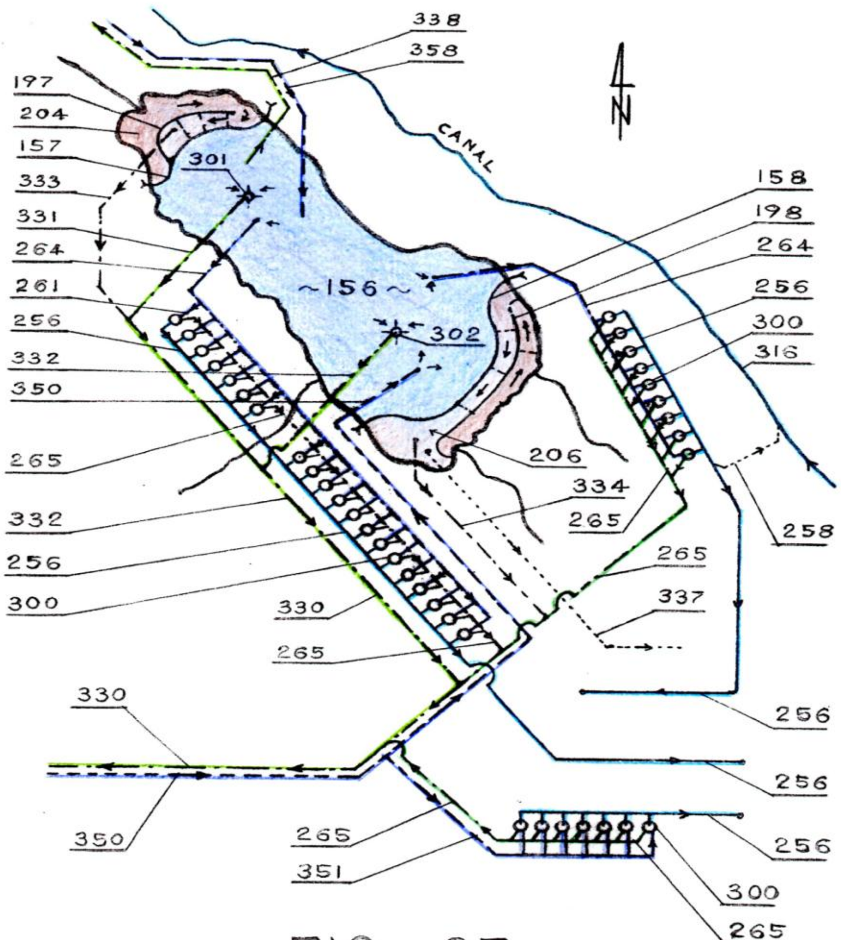


FIG. 37

- 156 – Salton Sea.
- 157 & 158 – Dikes forming ponds 204 & 206 – for collecting and treating farmland's runoff water and providing wildlife sanctuary (wetland).
- 330 – Outflow pipeline pumping out high salinity water from the Salton Sea and dispersing it into a vast Ocean.
- 350 – Inflow pipeline bringing water from the Pacific Ocean (preferably San Diego area) to the Salton Sea.
- 300 – Power Plants.
- 256 – Potable water line.

EXHIBIT " GG "

GEOTHERMAL WORLDWIDE, INC.

Proposal for Restoration of the Salton Sea
- Alternative cooling System -

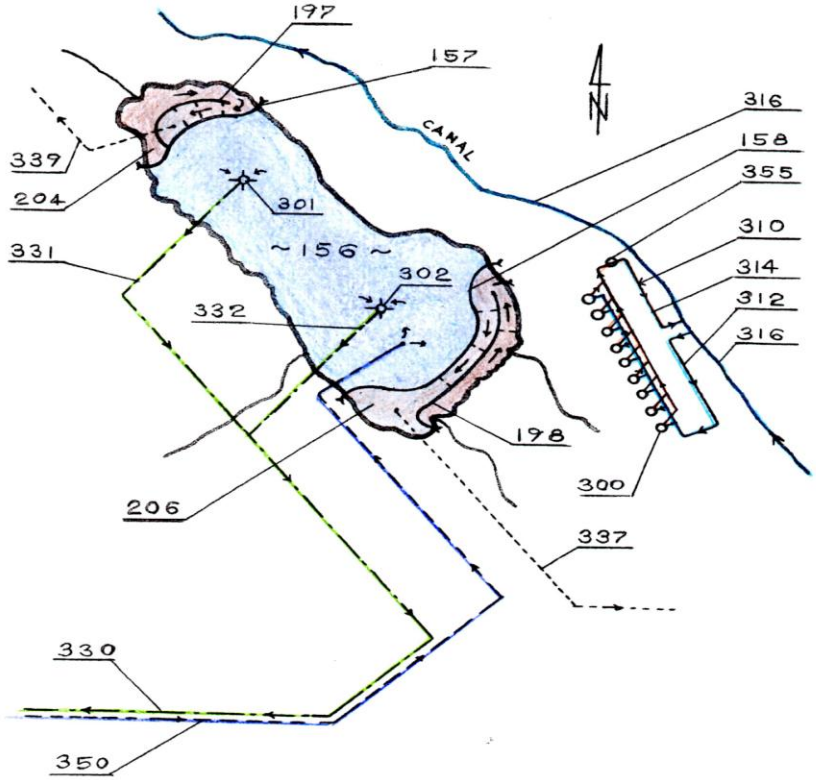


FIG. 38

- **156** – Salton Sea.
- **300 –** Power Plants.
- **316 –** Canal.
- **310 – Closed loop cooling system using water from canal.**
- **312 –** Inflow cooling line.
- **314 –** Outflow cooling line.

EXHIBIT "HH "

GEOTHERMAL WORLDWIDE, INC.

Proposal for Restoration of the Salton Sea
Power Plants Southeastern Sector

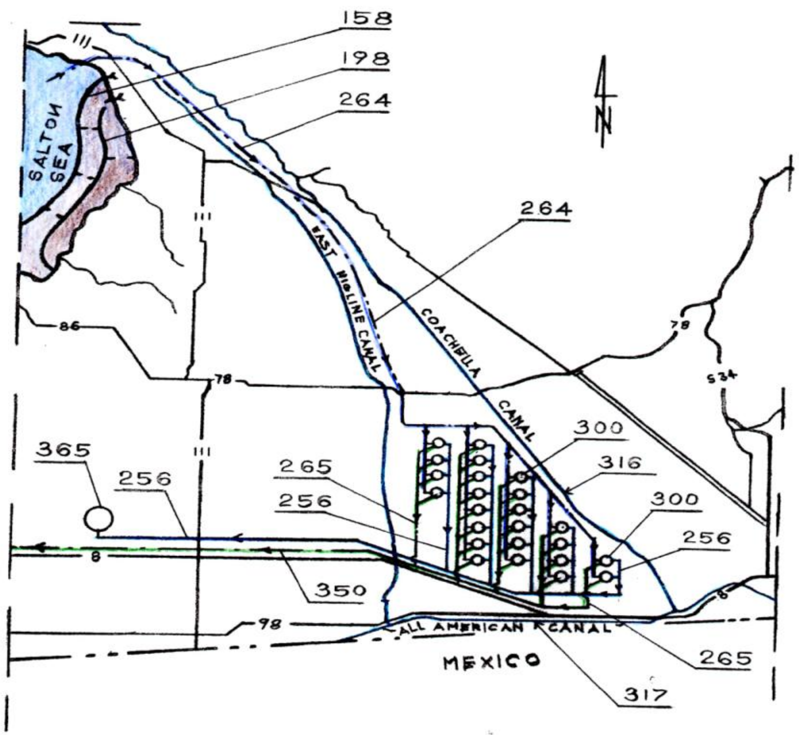


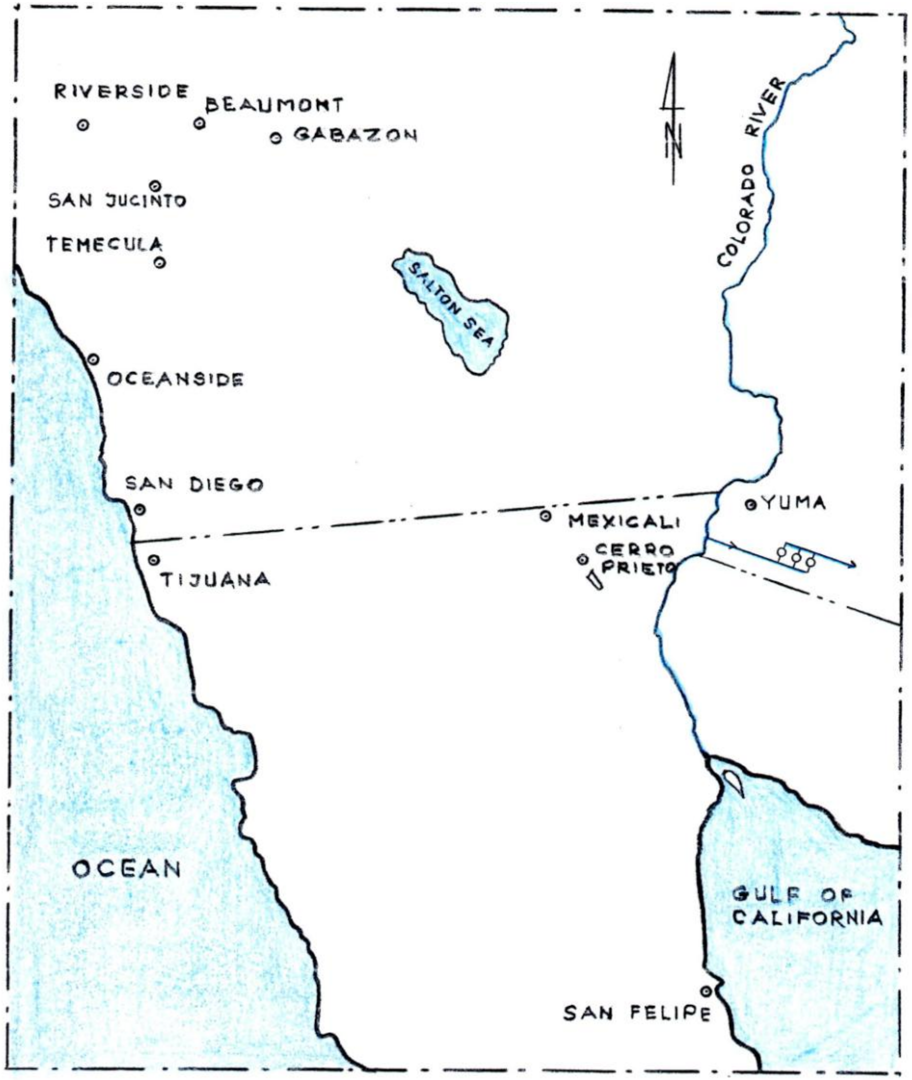
FIG. 39

- **156 – Salton Sea**
- **158 & 198 – Dikes forming ponds for collecting and treating farmland's runoff water and providing wildlife sanctuary.**
- **264 – Seawater from the lake.**
- **300 – Power Plants Southeast Sector.**
- **265 – High salinity line.**
- **256 – Potable water line.**

EXHIBIT " II "

GEOTHERMAL WORLDWIDE, INC.

Plain view map – Yuma, Arizona

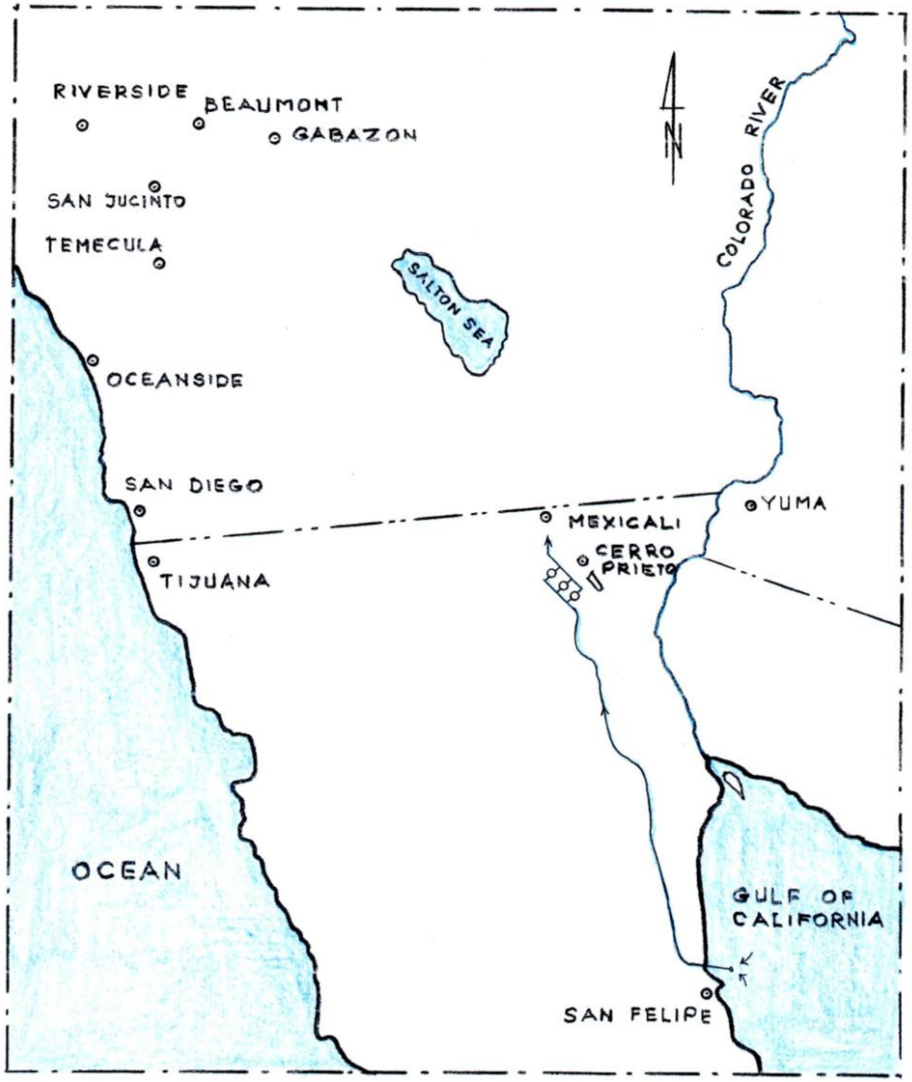


- This map illustrates proposed location for power plants near Yuma, Arizona, which has prevalent geothermal sources;
- Power Plants using disclosed "Scientific Geothermal Technology" in this location would be profitable venture;
- It would generate needed electricity and distilled water as a byproduct using water from nearby Colorado river;
- Optionally, if water use from Colorado river is limited or prohibited then the distilled water could be returned into the Colorado river.

EXHIBIT " JJ "

GEOTHERMAL WORLDWIDE, INC.

Plain view map – Cerro Prieto, Mexico

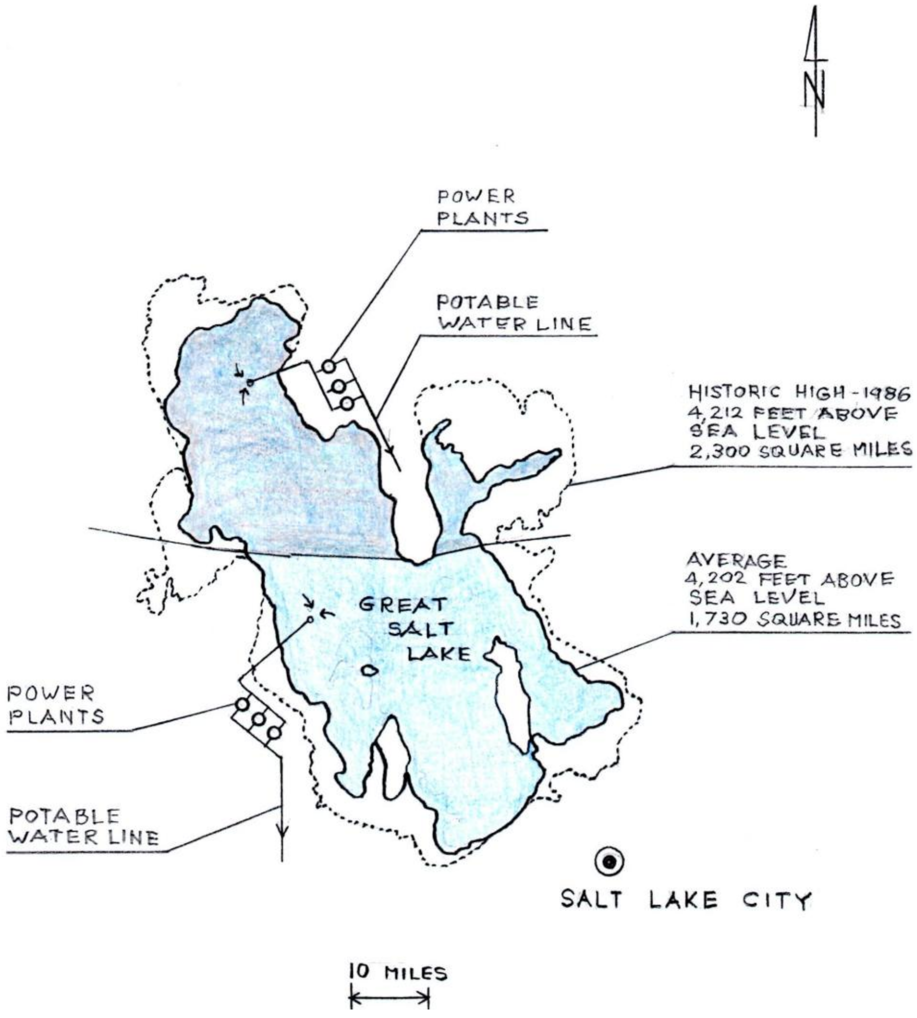


- This map illustrates proposed location for power plants near Cerro Prieto, Mexico, which has prevalent geothermal sources;
- Power Plants using disclosed the "Scientific Geothermal Technology" in this location would be profitable venture;
- It would generate needed electricity by harnessing geothermal sources using seawater from nearby Gulf of California (Sea of Cortez);
- Distilled water produced as a byproduct could be distributed to the nearby city Mexicali which desperately need potable water;
- Production of lithium would be profitable venture too.

EXHIBIT " KK "

GEOTHERMAL WORLDWIDE, INC.

Plain view map – Salt Lake City, Utah



- **This map illustrates proposed locations for power plants near Salt Lake City, Utah which has prevalent geothermal sources;**
- **Power Plants using disclosed "Scientific Geothermal Technology" in this location would be profitable venture;**
- **It would generate needed electricity by harnessing geothermal sources using salty water from nearby the Great Salt Lake;**
- **Distilled water produced as a byproduct could be distributed to the nearby city or returned into lake;**
- **Production of lithium would be profitable venture too.**

EXHIBIT " LL "

GEOTHERMAL WORLDWIDE, INC.

SPECIFIC BENEFIT TO THE SALTON SEA

- **This proposal is a long-term solution for the Salton Sea and it can be considered as a "Project of the Century" in California;**
- **It would employ many people during construction and after construction;**
- **It would cost less than $10 billion (preferably $7 billion), with the final result of "really" saving the Salton Sea and maintaining its water level of 50s and 60s.**
- **Preventing further pollution of the lake by dividing lake in three sections;**
- **Importing seawater, and providing conditions for tourism - Beaches, Resorts, Hotels, Motels, Front water properties, etc.**
- **Providing wildlife sanctuary. Birds can chose which section to inhabit;**
- **Harnessing prevalent geothermal energy with a "Scientific Geothermal Technology" using a complete closed loop system (not conventional geothermal technologies);**
- **Producing potable water as a byproduct without aditional expenses for it;**
- **Generating hundred billion dollars in a few decades for our economy and it will continue so in the future.**

PRELIMINARY COST ESTIMATE FOR PHASE I (Route # 1)

- The range of cost today of installed pressure pipe of 48-inch diameter in various terrains is about $600 – $1,000 per linear foot.
- **The Route # 1** has distance of about 150 miles with preferred topography which has an advantage in pipeline cost. Elevation to overcome: 35’ (10 m); Let’s assume $600 per linear foot.
- One mile 5,280 ‘ x $600 = $3,168,000;
- $3,168,000 x 450 miles relatively flat terrain (50 miles x 5 pipelines) + (50 miles x 3 pipelines) + (50 miles 1 pipeline) = $1,425,600,000.
- Because of a new product development + several pumping stations which will work temporally + final “delta” power plant on the final route + adding several freeway underpasses, right-of-way permits – the final cost might increase 20% to about **$1.7 billion.**
- Production of electricity: 27.3 MWh
- If the option - to pump out high salinity water from bottom of the lake with left over after extraction of lithium and to disperse it into Ocean - is going to be implemented a single pipeline of 24” diameter would be adequate. It is reasonable to expect that cost of each route would increase for about 1/3 of original estimate. If needed an additional pipeline of 24” diameter could be installed.
- Energy needed to transport the same amount of water through uphill pipeline section(s) which in this case (Route # 1 to overcome 262‘ (80 m) is: 3.2 MWh:
- Energy Net for Route # 1: 27.3 MWh – 3.2 MWh = **24 MWh**;

GEOTHERMAL WORLDWIDE, INC.

PRELIMINARY COST ESTIMATE FOR PHASE I (Route # 2)

- **Route # 2** - Importing seawater from the Ocean - corridor : **Oceanside** - **Temecula** – **San Jacinto** (existing tunnel) — **Cabazon – Salton Sea**; Pipeline distance is about **150 miles; Elevation** to overcome is about: **1,600' (488 m);**

- The range of cost today of installed pressure pipe of 48-inch diameter in various terrains is about $600 – $1,000 per linear foot. Here is used most conservative option $1,000 per linear foot.

- A mile = 5,280' x $1,000 = $5,280,000;

- Free Fall values at 488 meters + (70 meters Ocean to Lake difference) = 558 meters
  On this route can be used 2 cascades each with 279 m drop and 6 uphill pumping stations

- $5,280,000 x 375 miles (75 miles uphill x 5 pipelines) = $1,980,000,000; $5,280,000 x 75 miles (75 miles downhill x 1 pipeline) = $396,000,000.

- Connecting the Salton Sea with Pacific Ocean (San Diego area) distance about 150 miles – (75 miles uphill x 5 pipelines) + (75 miles downhill x 1 pipeline) it ends up to about $2.376 billion.

- Because of mountain terrain + development of a new product + several pumping stations + several tanks on uphill route + several "split and join" power plants + final "delta" power plant on the final route + adding several freeway underpasses, right-of-way permits - the final cost might increase about 40% to about **$3.32 billion.**

- The benefit of this route is using existing tunnel 13 miles long from Cabazon to San Jacinto.

- Cost estimate for pipeline for Route # 2: **$3.32 billion**; Energy needed for operation of the pipeline: **134.5 MWh.**

- For this route could be designate two (2) out of many planed geothermal power plants to generate power for importing water.

- If the option - to pump out high salinity water from bottom of the lake with left over after extraction of lithium and to disperse it into vast Ocean - is going to be implemented a single pipeline of 24" diameter would be adequate. It is reasonable to expect that cost of each route would increase for about 1/3 of original estimate. If needed an additional pipeline of 24" diameter could be installed.

GEOTHERMAL WORLDWIDE, INC.

PRELIMINARY COST ESTIMATE FOR PHASE I (Route # 3)

- **Route # 3** - Importing seawater from the Ocean - corridor : **Oceanside - Temecula – San Jacinto – Beaumont – Salton Sea;** Pipeline distance is about **160** miles**; Elevation** to overcome is about : **2,700' (823 m);**

- The range of cost today of installed pressure pipe of 48-inch diameter in various terrains is about $600 – $1,000 per linear foot. Here is used most conservative option $1,000 per linear foot.

- A mile = 5,280' x $1,000 = $5,280,000;

- Free Fall values at 823 meters + (70 meters Ocean to Lake difference) = 893 meters
  On this route can be used 3 cascades each with 297 m drop and 9 uphill pumping stations.

- $5,280,000 x 400 miles (80 miles uphill x 5 pipelines) = $2,112,000,000; $5,280,000 x 80 miles (80 miles downhill x 1 pipeline) = $422,400,000.

- Connecting the Salton Sea with Pacific Ocean (San Diego area) distance about 160 miles - 80 miles uphill (5 pipelines) + 80 miles downhill (1 pipeline) it ends up to about $2.534 billion.

- Because of mountain terrain + development of a new product + several pumping stations + several tanks on uphill route + several "split and join" power plants + final "delta" power plant on the final route + adding several freeway underpasses, right-of-way permits - the final cost might increase 40% to about **$3.5 billion.**

- The benefit of this route is using existing tunnel 13 miles long from Cabazon to San Jacinto.

- Cost estimate for pipeline for Route # 3: **$3.5 billion;** Energy needed for operation of the pipeline: **275.7 MWh.**

- For this route could be designate three (3) out of many planed geothermal power plants to generate power for importing water.

- If the option - to pump out high salinity water from bottom of the lake with left over after extraction of lithium and to disperse it into Ocean - is going to be implemented a single pipeline of 24" diameter would be adequate. It is reasonable to expect that cost of each route would increase for about 1/3 of original estimate. If needed an additional pipeline of 24" diameter could be installed.

GEOTHERMAL WORLDWIDE, INC.

Summary of the Preliminary Analyzes of Route 1 & 2:

Route # 1 - Importing seawater from the Gulf of California – corridor San Felipe through Mexicali, Mexico, to the Salton Sea.
Elevation to overcome is 35 ‘ (10 m).
Pipeline distance is about 150 miles.
Cost estimate for pipeline: $1.7 billion
The route produces power: 27.3 MWh

Route # 2 - Importing seawater from the Ocean - corridor Cabazon (existing tunnel) – San Jacinto – Temecula – Oceanside.
Elevation to overcome is 1,600‘ (488 m).
2 cascades each with 279 m drop and 6 uphill pumping stations
Pipeline distance is about 160 miles.
Cost estimate for pipeline: $3.32 billion.

Energy needed for operation of the pipeline: 134.5 MWh.
For this route could be designate two (2) out of many planed geothermal power plants to generate power for importing water.

Summary of the Preliminary Analyzes of Routes 3 & 4:

Route # 3 - Importing seawater from the Ocean - corridor Beaumont – San Jacinto – Temecula – Oceanside.
Elevation to overcome: 2,700‘ (823 m).
3 cascades each with 297 m drop and 9 uphill pumping stations.
Pipeline distance: about 170 miles.
Cost estimate for pipeline: $3.5 billion.

Energy needed for operation of the pipeline: 275.7 MWh.
For this route could be designate three (3) out of many planed geothermal power plants to generate power for importing water.

Route # 4 - Importing seawater from the Ocean - corridor Borrego Springs – Oceanside.
Elevation to overcome is 3,600‘ (1,097 m).
4 cascades each with 292 m drop and 11 uphill pumping stations.
Pipeline distance: about 100 miles.
Cost estimate for pipeline: $2.2 2 billion.

Energy needed for operation of the pipeline: 380 MWh.
For this route could be designate four (4) out of many planed geothermal power plants to generate power for importing water.

PRELIMINARY COST ESTIMATE FOR PHASE III & IV (continue)

- **The new drilling system is more expensive at this earlier stage because of development cost, but in the long term it would be better and less expensive solution.**

- **Those several power plants on several sectors around the Salton Sea would be able to finance subsequent power plants.**

- **More power plants we build with initial budget the faster we will proceed with subsequent power plants and whole project which final result will be more clean electricity and more potable water.**

- **The Phases I – IV, would cost less than <u>$10 billion dollars</u>, preferably $7.5 billion dollars** (about 3.5 billion dollars for pipelines; about $3 billion for dikes and wetlands – wildlife sanctuary; and about $1 billion for three Power Plants – one for each sector). **) with the final result of "really" saving the Salton Sea and providing condition for tourism, clean energy, potable water, and prosper economy.**

CONSTRUCTION TIME SHEDULE ESTIMATE

- **Preliminary and exploratory work on all three necessary phases (I, II and III) could start right away;**

- **Soon after necessary permits are obtained, construction of first three phases (I, II and III) could start at the relatively same time and preferably finished in about two years.**

- **Phase IV could start soon after and preferably finished in two years.**

- **Phase V could start during construction of Phase IV and will be continues process in the future.**

ESTIMATED PRODUCTION CAPACITY OF ONE PROPOSED GEOTHERMAL POWER PLANT

- Proposed Geothermal Power Plant(s) the "Scientific Geothermal Technology" consist of 24 well-bores and 24 Binary Power Units;
- 24 Binary Power Units x 4 MW = 96 MWh; ~ 100 MWh;
- Assumed price of $60 per MWh;
- $60 x 96 MWh = $5,760 per hour;
- $5,760 x 24h = $138,240 per day;
- $138,240 x 365 days = $50,457,600 per year;

ENERGY OVERVIEW IN GENERAL

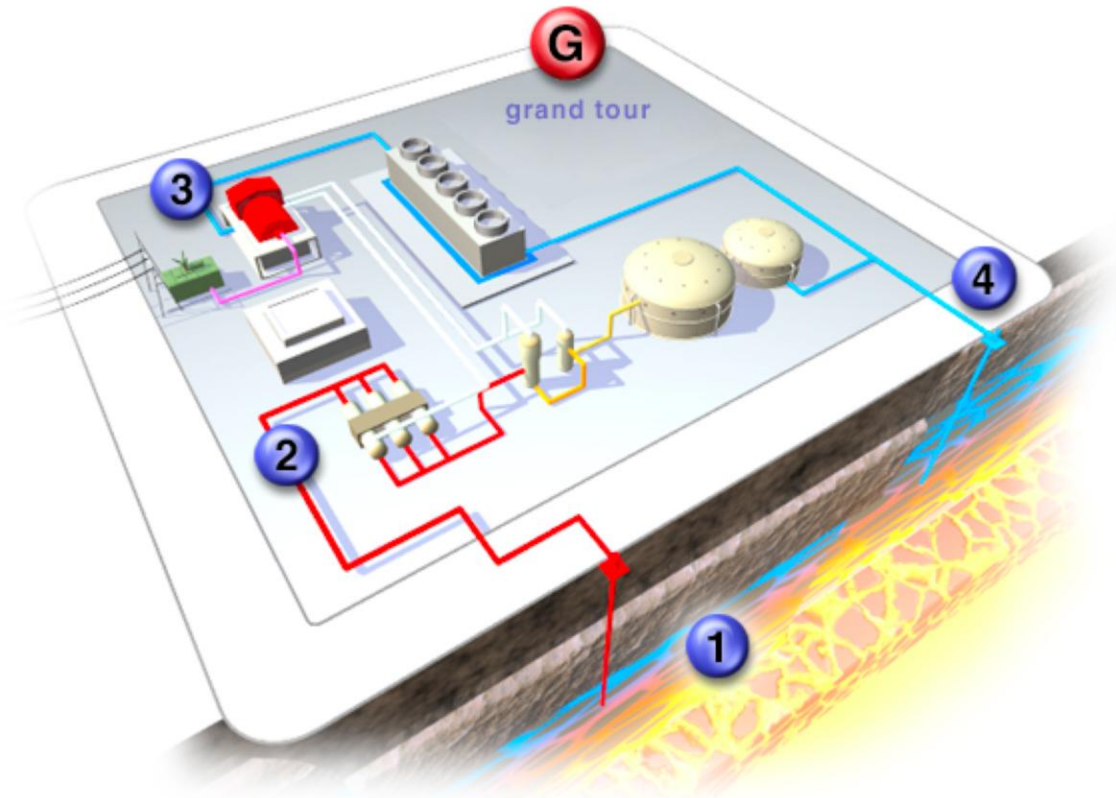
- **As population on our planet increases** there is constantly **increasing demand for electricity**.

- **Nuclear, Oil** and **Coal** burning Power Plants with their **waste material** are **pollutant** with **serious consequences** for our environment and our existence.

- Most of renewable energy technologies including **solar and wind** have serious **limitations** such as weather conditions.

- **In summary** – It is well know that **enormous energy** is below our feet – whether it is a few miles **underground** or on the **surface** in locations such as **Hawaii,** the **Erta Ale** volcano, the **East African Rift,** etc**.** The question was, until now, how to **harness it expediently and efficiently**?

Schematic View of an Conventional Geothermal Plant



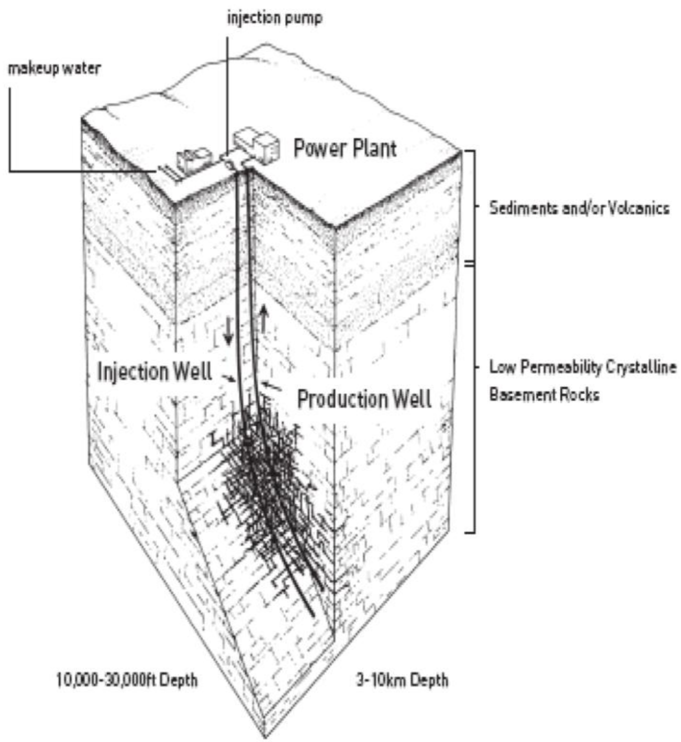
- **Location Limitations.**
- **Requires Hydrothermal reservoir.**
- **Maintenance issues with brine concentration, scaling and corrosion of equipment.**

Courtesy of CalEnergy – This illustration represents an existing geothermal power plant operation.

EXHIBIT “MM “

GEOTHERMAL WORLDWIDE, INC.

Schematic View of an Enhanced Geothermal System (EGS)

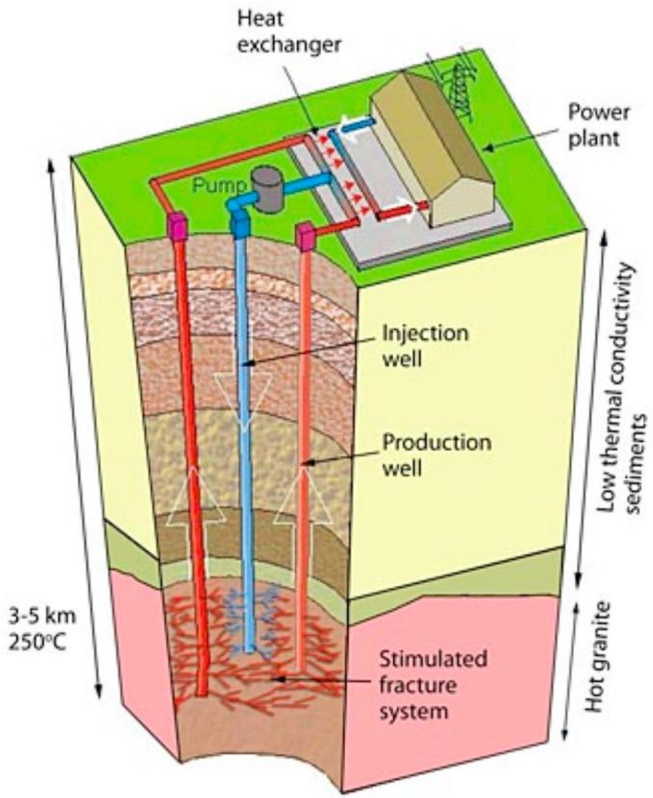


Requires:

- **Permeability of hot rocks**
- **Horizontal rock formation**
- **Substantial amount of water to be injected and maintained**

This Illustration is a Schematic of a conceptual two-wells Enhanced Geothermal System in hot rock in a low permeability crystalline basement formation.
(Courtesy of: DOE - Energy Efficiency & Renewable Energy)

Schematic View of an Enhanced Geothermal System (EGS))



Requires:

- ➢ **Permeability of hot rocks**
- ➢ **Horizontal rock formation**
- ➢ **Substantial amount of water to be injected and maintained**

This illustration is a schematic of another conceptual three-wells Enhanced Geothermal System in hot rock. 3D cutaway - diagram modified from ANU Hot Rock Energy website .
(Courtesy of: http://hotrock.anu.edu.au)

EXHIBIT “ OO “

GEOTHERMAL WORLDWIDE, INC.

The "Self Contained In-Ground Geothermal Generator" (SCI-GGG) system

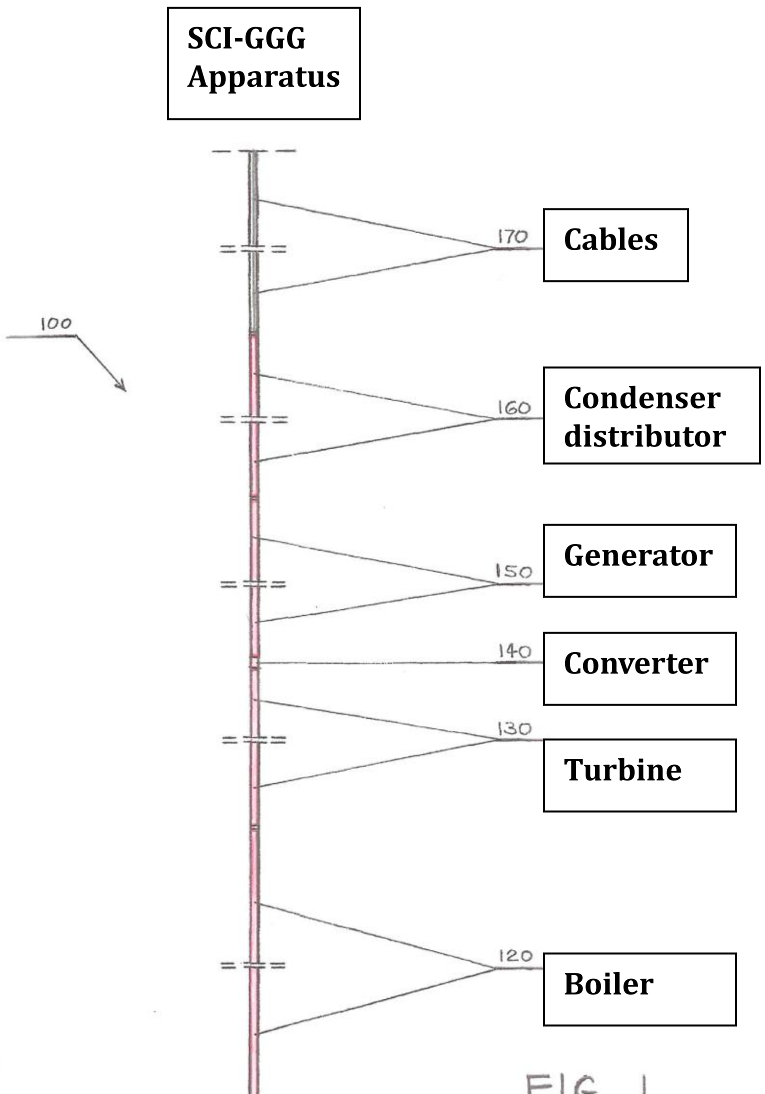


FIG. 1

The SCI-GGG system uses several completely closed loop systems and generates electricity down at the heat source and transmits it up to the ground level by means of electrical cables.

The SCI-GGG system consist of:

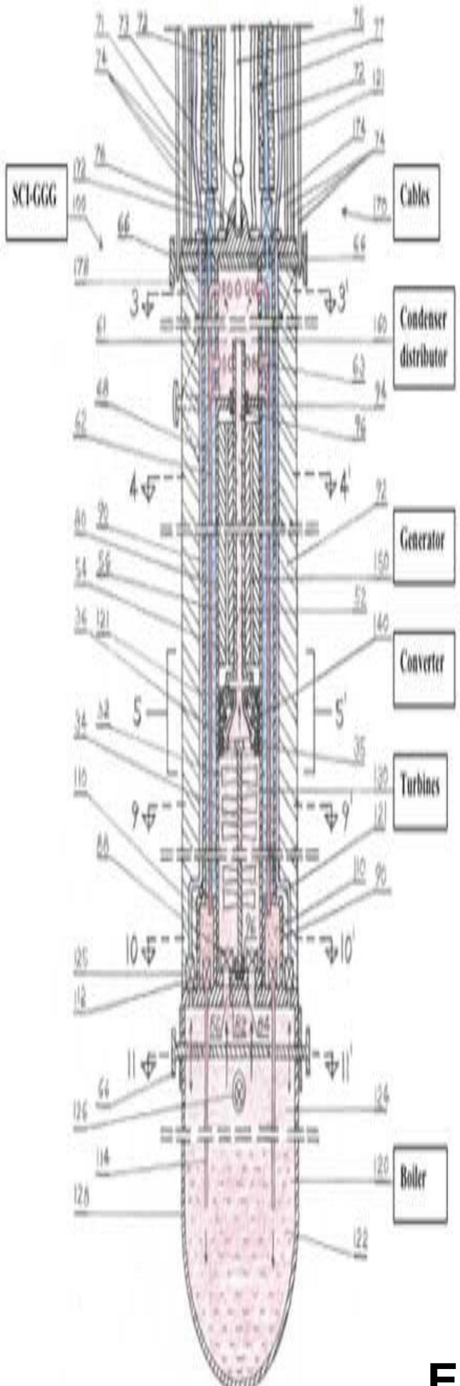
- **A BOILER;**
- **A TURBINE;**
- **A CONVERTER;**
- **A GENERATOR;**
- **A CONDENSER DISTRIBUTOR;**
- **CONDENSER** and COOLING system (not illustrated here); and
- **CABLES**

EXHIBIT " PP "

GEOTHERMAL WORLDWIDE, INC.

SCI-GGG System

2 of 17



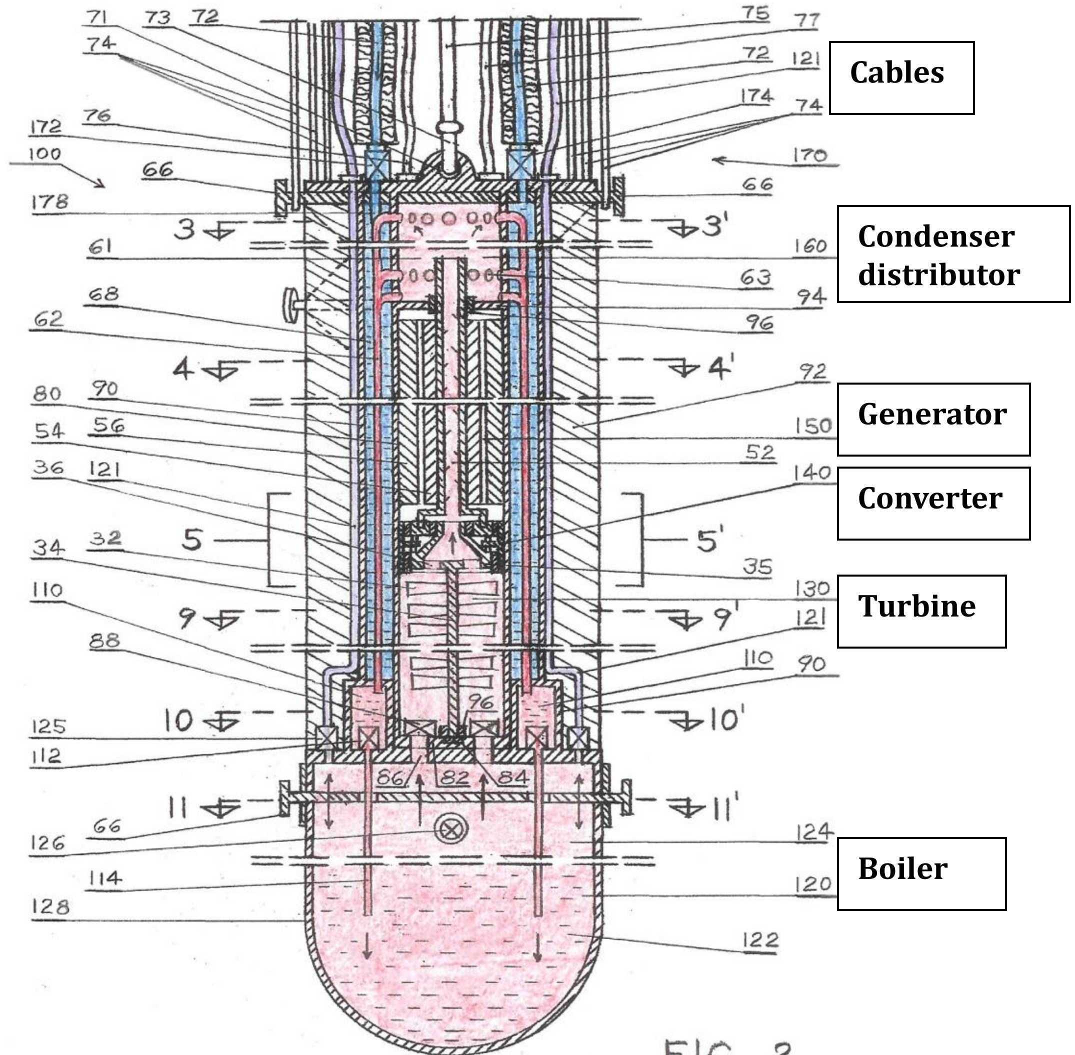


FIG. 2

EXHIBIT " QQ "

GEOTHERMAL WORLDWIDE, INC.

Self Contained In-Ground Geothermal Generator (SCI-GGG)

2 of 17

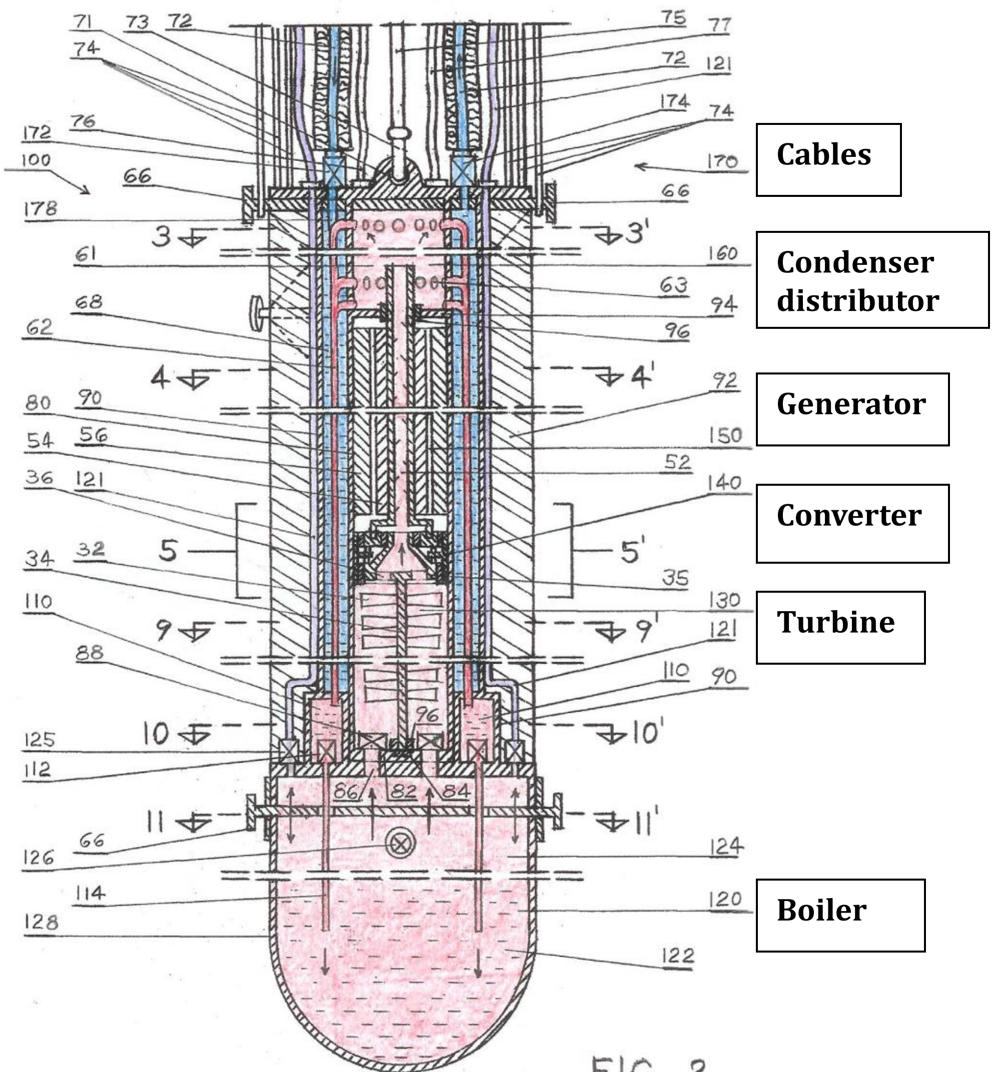


FIG. 2

The (SCI-GGG) method for harnessing geothermal energy for production of electricity consists of:

- Lowering a (SCI-GGG) apparatus into pre-drilled well bore at the source of heat;
- The (SCI-GGG) apparatus consists of: a boiler; a turbines; a converter; a generator; a condenser distributor; and a condenser that are arranged to function in confined spaces such as in a well bore.
- The SCI-GGGG absorbs heat from source of heat (hot rocks or reservoir) and generates electricity which is transmitted by cable to the ground surface to electrical grids for use in houses and industry.
- In the process of cooling the engine compartments with a separate closed loop system "Self Contained In-Ground Heat Exchanger" (SCI-GHE system), additional electricity is generated on the site.

EXHIBIT " RR "

GEOTHERMAL WORLDWIDE, INC.

Self Contained In-Ground Geothermal Generator (SCI-GGG system)

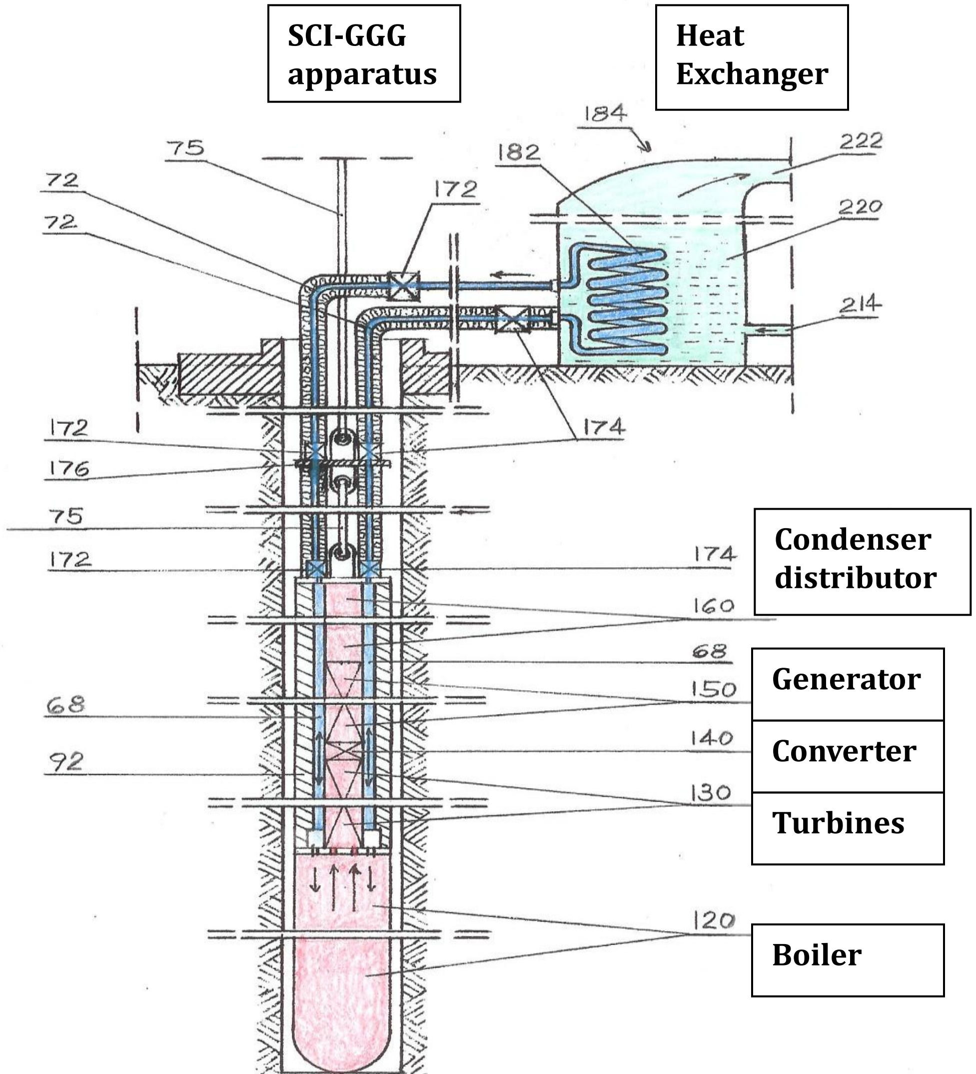


FIG. 12

- The SCI-GGG apparatus uses three (3) closed loop systems:
- A first closed loop systems (rosy color) circulates working fluid through a Boiler, Turbine, Generator, Condenser, and back through Boiler.
- A second closed loop systems (blue color) “the Self Contained In-Ground Heat Exchanger (SCI-GHE system)” circulates fluid through the condenser; thermally insulated hoses; and a Heat Exchanger coupled to the binary power unit on the ground surface.
- The “Self Contained In-Ground Heat Exchange” (SCI-GHE system) is an integral part of the SCI-GGG system and can be used separately as an independent Heat Exchanger.
- A third closed loop systems (greenish color) circulates working fluid through a binary power unit on the ground surface and generates additional electricity.

EXHIBIT “SS “

GEOTHERMAL WORLDWIDE, INC.

The "Self Contained In-Ground Heat Exchanger" (SCI-GHE system)

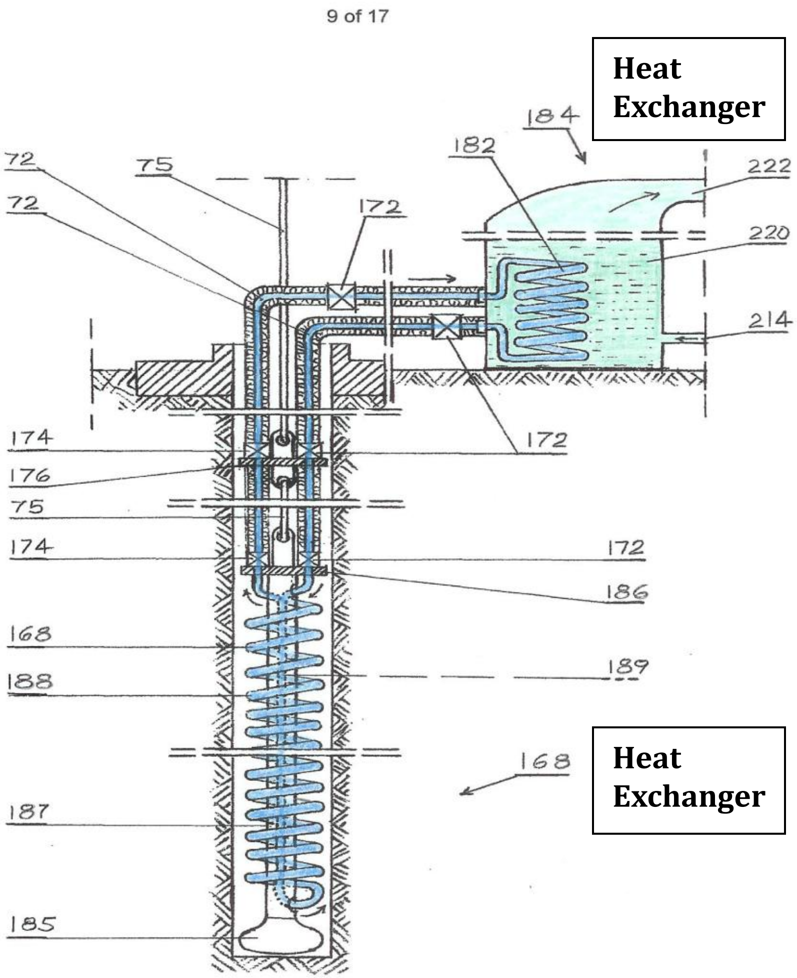


FIG. 13

EXHIBIT "TT"

- **The (SCI-GHE) apparatus is an integral part of the "Self Contained In-Ground Geothermal Generator" (SCI-GGG system) and is used separately as an independent Heat Exchanger apparatus.**
- **The (SCI-GHE) apparatus consist of: two coils (Heat Exchangers); a closed loop of thermally insulated pipes/hoses 72; at least one In-Line Pump 172; and a Binary Power Unit 184.**
- **The first coil (Heat Exchanger) 168 of the first closed loop systems is located at heat source and the second coil (Heat Exchanger) 182 is coupled into boiler of the Binary Power Unit on the ground surface which operates as a second closed loop system - the Organic Rankine Cycle (ORC) – which generates electricity.**
- **Alternatively, the (SCI-GHE) and/or (SCI-GHE) apparatus can be scaled to be used for extracting heat from abandon and marginal wells.**
- **The first coil (HE) at the bottom of well bore has vertical pipe and is structurally sound to support its weight.**

Scientific Geothermal Technology
SCI-GGG and SCI-GHE systems - side by side

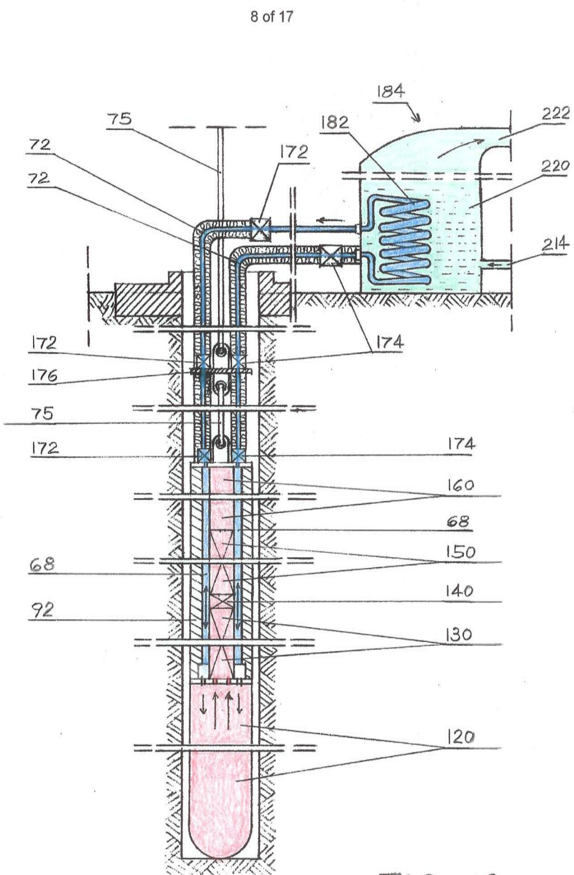


FIG. 12

SCI-GGG system

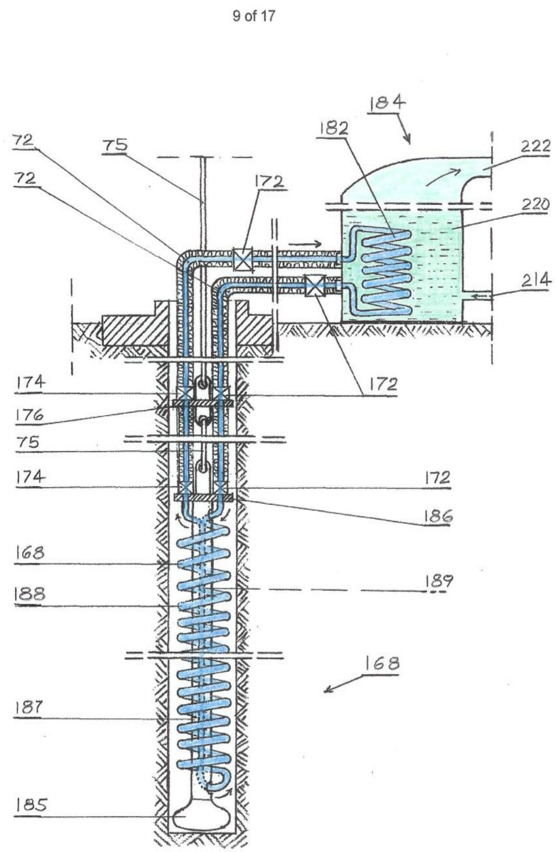


FIG. 13

SCI-GHE system

- **The SCIG-GGG system generates electricity down at the heat source and transmits it up to the ground level by means of electrical cables.**
- **The SCIG-GGG system generate additional electricity on the ground surface.**
- **The (SCI-GHE) system is an integral part of the (SCI-GGG) system and can be used separately as an independent Heat Exchange Apparatus.**
- **The (SCI-GHE) system has, the less production capacity than (SCI-GGG) system but it is easier to build and maintain.**
- **The Scientific Geothermal Technology doesn't require hydrothermal reservoirs, although is not limited to dry hot rocks.**

EXHIBIT " UU "

GEOTHERMAL WORLDWIDE, INC.

A Proposal for Temporary Cooling Dysfunctional Reactor at Fucushima Daiichi Nuclear Power Complex by using SCI-GHE System

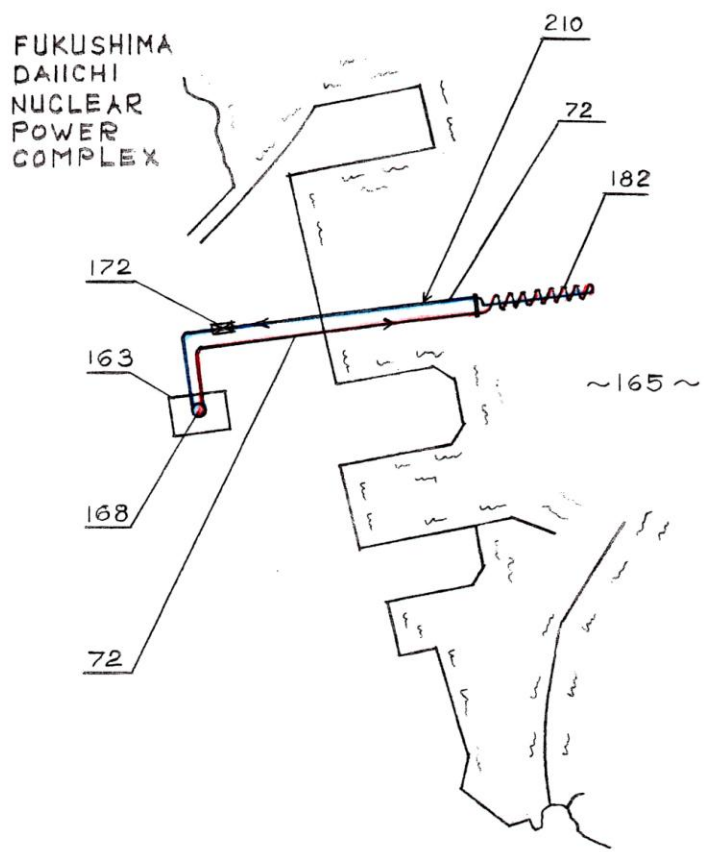


FIG. 25

- **FIG. 25 illustrate dysfunctional nuclear reactor 163, Ocean 165 and universal closed loop heat exchanger system 210.**
- **The first heat exchanger 168 is lowered into dysfunctional nuclear reactor 163 and the second heat exchanger 182 is submerged into nearby Ocean 165.**
- **Heat is extracted from dysfunctional overheating nuclear reactor 163 through the first heat exchanger 168 and transferred through closed loop line 72, to the second heat exchanger 182, and dispersed safely into the Ocean 165.**
- **Heat exchange fluid in closed loop system 210 is not in direct contact with radioactive material in dysfunctional nuclear reactor 163 or the Ocean 165.**
- **Multiple units of the closed loop system 210 can be deployed.**
- **Although a temporally solution, if needed, Portable Binary Power Unit, can be inserted into closed loop system 210.**

EXHIBIT "VV "

Schematic Plan View of a Power Plant for Production of Electricity in locations such as Hawaii by using SCI-GHE System

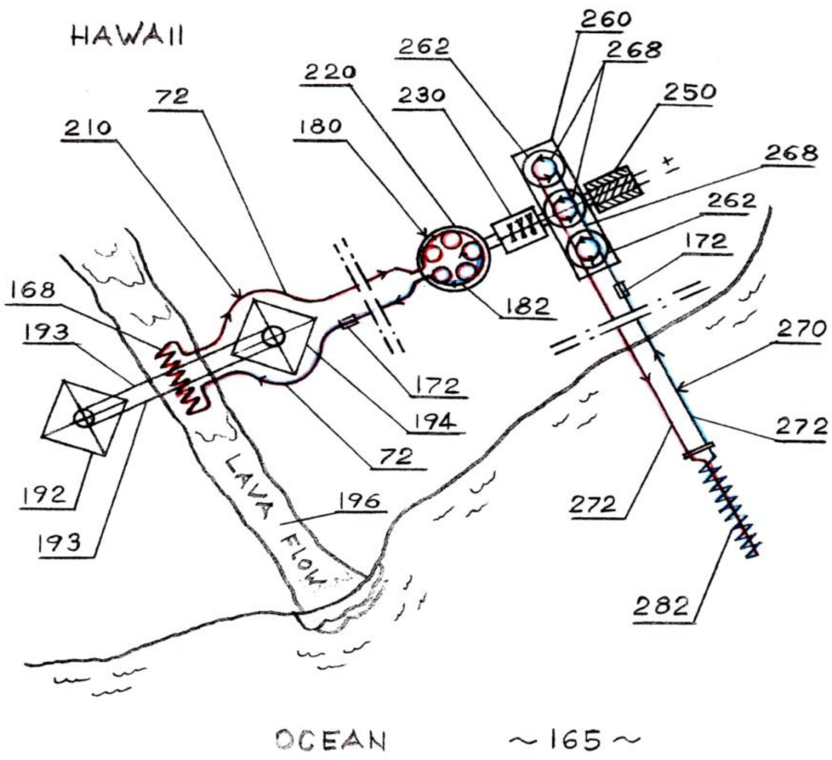


FIG. 26

- Two posts/towers 192 and 194 erected on either side of established lava flow/tube 196 with cable 193 suspended between them.
- The first heat exchanger 168 is lowered at safe distance, close to lava flow 196, and the second heat exchanger 182 is coupled into boiler/evaporator 220 of the binary power unit 180.
- Heat exchangers 168 and 182 are connected with thermally insulated closed loop system 210.
- Power unit 180 consist of a boiler 220 a turbine 230, a generator 250, and a condenser 260.
- Cooling system for the condenser 260 consisting of additional closed loop system 270 with heat exchanger 282 submerged into Ocean 165.

EXHIBIT "WW"

Cross-sectional view of a Power Plant for Production of Electricity from heat source such as Oil Well Flare Stacks by using SCI-GHE System

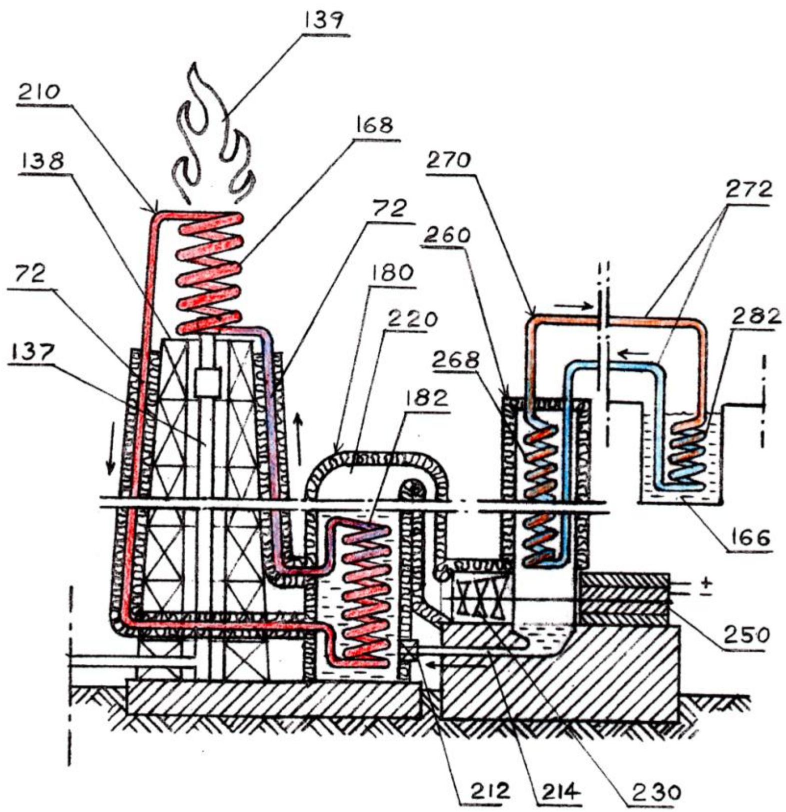
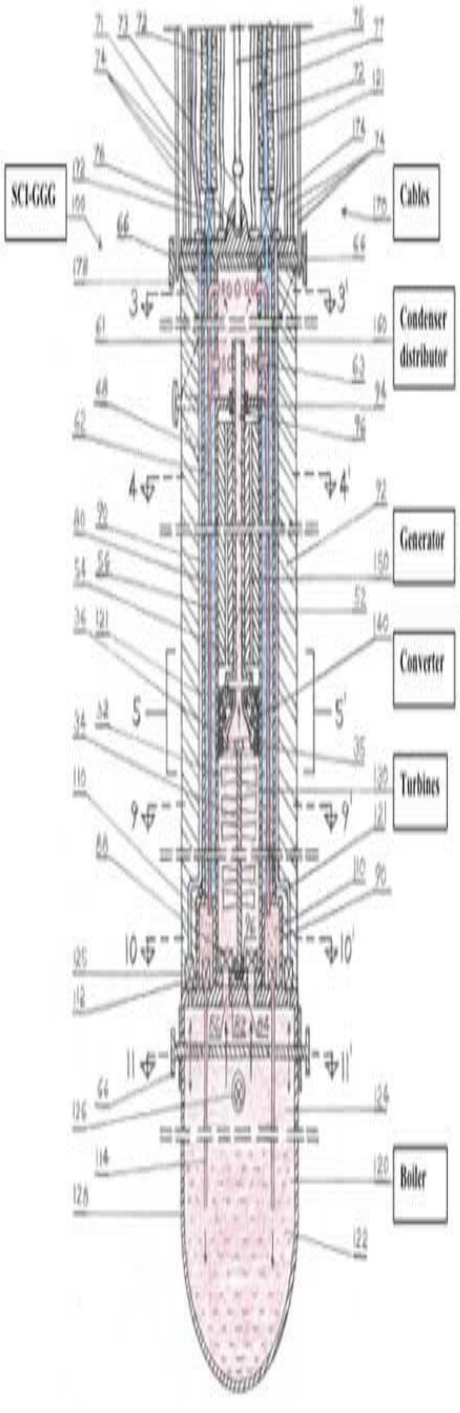


FIG. 27

- **Flare stack 137 has support structure 138.**
- **The heat exchange system 210 with the first heat exchanger 168 positioned on top of the supporting structure 138 and the second heat exchanger 182 coupled into boiler/evaporator 220 of the binary power unit 180.**
- **Heat from flame 139 is extracted through the first heat exchanger 168 and transferred through thermally insulated line 72 to the second heat exchanger 182.**
- **Binary power unit 180, has a boiler 220, turbines 230, a generator 250, and condenser 260.**
- **Condenser 260 is cooled with additional closed loop system 270 consisting of the first heat exchanger 268, closed loop line 272 and the second heat exchanger 282 which can be submerged into nearby source of cold water.**

EXHIBIT " XX "



Maintenance of the SCI-GGG system

- Basic maintenance of the apparatus – monitoring temperature, managing levels of fluids and lubrication, can be managed from the ground surface through service lines.
- Extensive maintenance – such as replacement of bearings, turbine, generator or fixing leak(s) – requires removal of apparatus, refurbishment or replacement and then reinsertion into the wellbore.

Advantages of the "Scientific Geothermal Technology“ the (SCI-GGG) & (SCI-GHE) systems (I):

1. **Generates electricity constantly 24 hours per** day regardless of weather condition on the ground surface.

2. **Needs a single well** bore to function and doesn’t need a hydrothermal reservoir although it is not limited to dry hot rocks.

3. **The (SCI-GHE) and/or (SCI-GHE) apparatus** can be **scaled** to be used for **extracting heat from abandon** and marginal **wells.**

4. Uses **several closed loop systems** and at no time is there any contact with the environment by the working fluid or the heat exchange fluid therefore it **doesn’t pollute the environment.**

5. **Eliminates** any concern of **”fracking”** (Hydraulic Fracturing).

6. **Eliminates** the issues of injection water.

7. **Eliminates** the issues of concentration of brine, **filtration, separation,** equipment **corrosion, scaling,** and ground **water pollution.**

Advantages of the "Scientific Geothermal Technology“ the (SCI-GGG) & (SCI-GHE) systems (II):

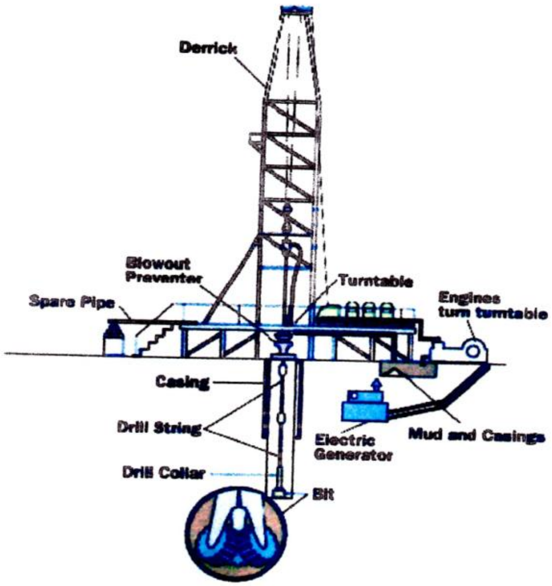
8. **Modular implementation** of the **"Scientific Geothermal Technology"** systems create immediate revenues and allowed continuation of buildups of additional modular units.

9. When eventually cooling of the rocks happen then **additional drilling** could be performed, **periodically** or **at once,** until **equilibrium** of heat absorption and heat replenishment is **achieved** rather than start drilling at a new location nearby. The **extended depth** will result **in hotter rock** formations and **higher heat flux.** Eventually, a point will be reached where heat extraction and heat replenishment will be in **balance - equilibrium.**

10. Necessary heat can be reached and used from any location and **every country has the potential** to access that limitless heat source and **produce electricity** by implementing the **"Scientific Geothermal Technology"** systems.

11. By implementing **"Scientific Geothermal Technology “** systems, we can **stop polluting** our planet with nuclear, coal and oil burning power plants and their toxic waste **and start producing electricity** from abundant **self sustaining geothermal source** for energy needs for our **current** and **future generations.**

Schematic view of an Contemporary Oil Rig Drilling System



Here are illustrated major systems of a land oil rig:

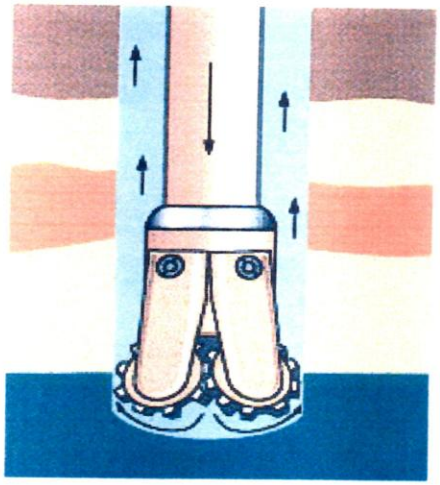
- **Power System** – Large diesel engines
- **Mechanical system** – driven by electric motors; hosting system; turntable;
- **Rotating equipment** – Swivel; kelly; turntable or rotary table; Drill string; drill bit(s);
- **Casing;**
- **Circulation system;**
- **Derrick;**
- **Blow Out Preventer;**

(Photo courtesy of the Energy Institute.)

EXHIBIT "YY"

GEOTHERMAL WORLDWIDE, INC.

Schematic view of an Contemporary Oil Rig Drilling System



Here is illustrated a drill bit:

- **Mad circulation system;**
- **Mad is injected through pipe and through several orifices at drill bit circulates up between pipe and wall of the well bore providing necessary stream for cutting to be excavated;**
- **By increasing size of the drill bit (well bore) and / or by increasing dept of the well bore it requires tremendous increase of pressure inside pipe and corresponding stream up;**
- **Contemporary drilling system have limitations how wide and deep wellbore can be drilled;**

EXHIBIT “ZZ “

(Photo courtesy of the Energy Institute).

GEOTHERMAL WORLDWIDE, INC.

Schematic view of an Apparatus for Drilling Faster, Deeper, and Wider Well Bore

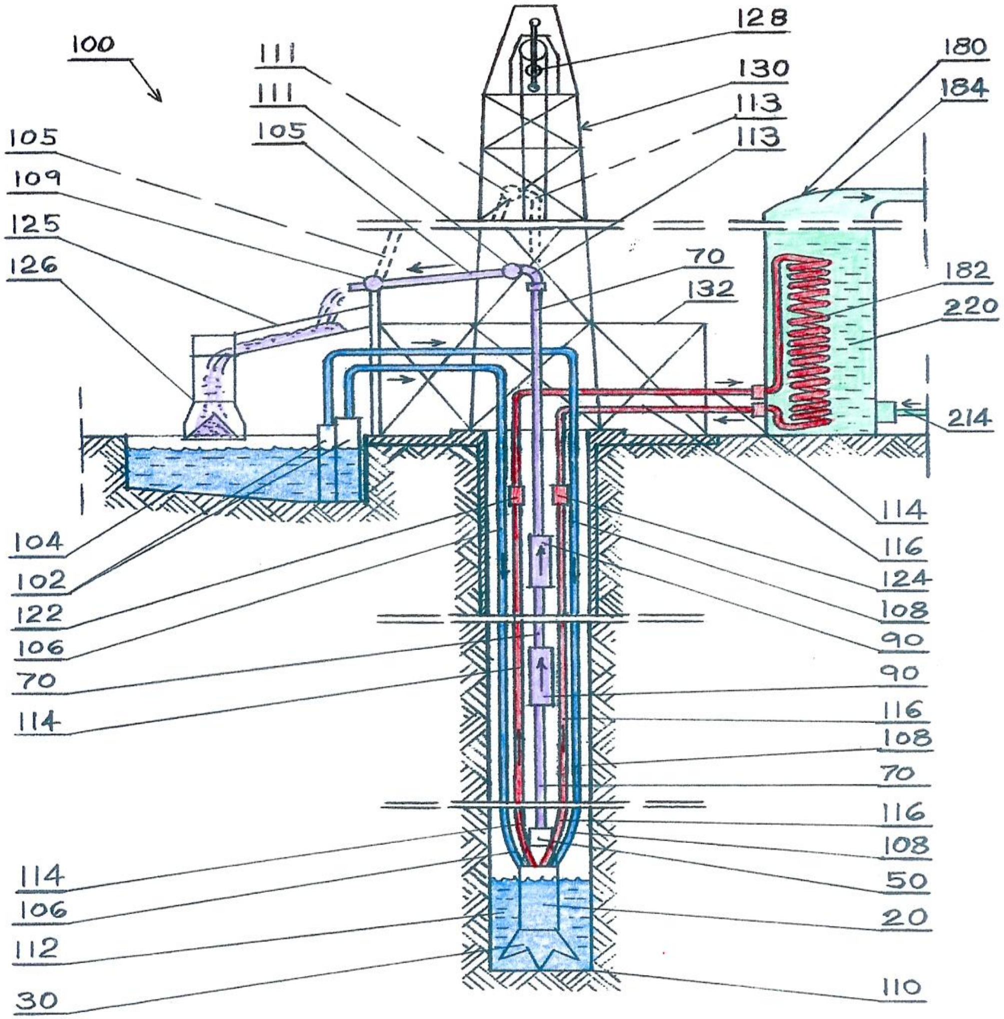


FIG. 1

EXHIBIT "AAA"

The apparatus and method for drilling deeper and wider well bores consist of:

- **A Motorized Drill Head for cutting and shredding ground material;**
- **A separate excavation line;**
- **A separate fluid delivery line;**
- **A separate close loop engine cooling line;**
- **The excavation line consists of multiple connected stationary segments of the main excavation pipe with periodical segments of an In-Line excavation pump;**
- **Optionally, whole excavation pipeline can consist of multiple segments of an In-Line excavation pump;**

GEOTHERMAL WORLDWIDE, INC.

Schematic view of an Motorized Drill Head of an Apparatus for Drilling Faster, Deeper, and Wider Well Bore

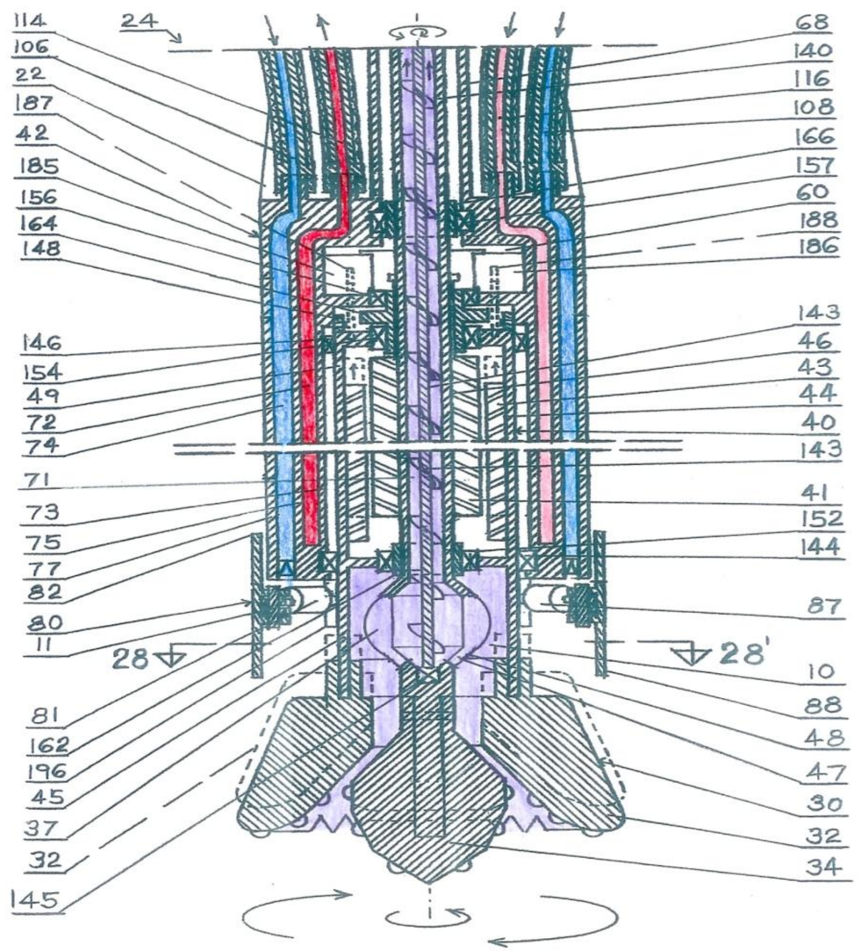


FIG. 27

- **The diameter of the excavation line and rate of flow of mud and cuttings through it and the diameter of the fluid delivery line and rate of fluid flow through it are in balance requiring only limited fluid column at the bottom of the well bore.**
- **Fluid column may exist through whole well bore to sustain it during drilling process, but not for excavation reasons.**
- **The excavation process continues regardless of the diameter of the drill head (wellbore);**
- **Therefore this method eliminates well known drilling limitations relative to the depth and diameter of the wellbore.**

EXHIBIT "BBB"

GEOTHERMAL WORLDWIDE, INC.

MISSION STATEMENT:

- **Our mission at Geothermal Worldwide, Inc., is to license our IP – and support the integration of its processes:**

- **"Self Contained In-Ground Geothermal Generator (SCI-GGG);**

- **"Self Contained In-Ground Heat Exchanger" (SCI-GHE);**

- **“In-Line-Pump/Generator”;**

- **“Apparatus for drilling deeper and wider well-bores” to the interested and capable parties worldwide and support the integration of its processes;**

US007849690B1

(12) **United States Patent**
Lakic

(10) **Patent No.: US 7,849,690 B1**
(45) **Date of Patent: Dec. 14, 2010**

(54) **SELF CONTAINED IN-GROUND GEOTHERMAL GENERATOR**

(76) Inventor: **Nikola Lakic**, 45-191 Elm St., Indio, CA (US) 92201

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 818 days.

(21) Appl. No.: **11/770,543**

(22) Filed: **Jun. 28, 2007**

Related U.S. Application Data

(60) Provisional application No. 60/922,440, filed on Apr. 7, 2007, provisional application No. 60/927,336, filed on May 2, 2007.

(51) **Int. Cl.**
F03G 7/00 (2006.01)

(52) **U.S. Cl.** .... **60/641.2**; 290/1 A; 290/2

(58) **Field of Classification Search** ..... 60/641.2, 641.4; 290/1 A, 2
See application file for complete search history.

(56) **References Cited**

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5,058,386 A * 10/1991 Senanayake 60/692
6,259,165 B1 * 7/2001 Brewington .... 290/1 A

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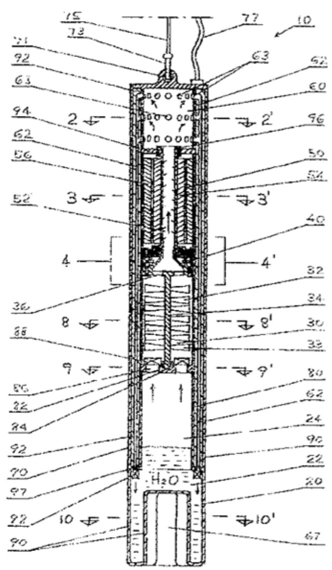
Primary Examiner—Hoang M Nguyen
(74) *Attorney, Agent, or Firm*—Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

A method of using geothermal energy to produce electricity by lowering a geothermal generator deep into pre-drilled holes below the Earth's surface. A geothermal generator includes a boiler, a turbine compartment, an electric generator, a condenser and an electric cable. The geothermal generator also includes an internal cylinder, an external cylinder and a plurality of tubes disposed between the internal cylinder and the external cylinder. The plurality of tubes is part of the condenser. In a method of using the geothermal generator, water contained within the boiler is converted to high-pressure, super heated steam due to heat contained within a pre-drilled well below the earth's surface. The steam is used to produce electric energy, which is transported to the ground surface by the electric cable.

22 Claims, 14 Drawing Sheets



- **US Patent Issued on: December 14, 2010;**
- **Title: Self Contained In-Ground Geothermal Generator;**

GEOTHERMAL WORLDWIDE, INC.

US008281591B2

(12) **United States Patent**
Lakic

(10) **Patent No.:** **US 8,281,591 B2**
(45) **Date of Patent:** **Oct. 9, 2012**

(54) **SELF CONTAINED IN-GROUND GEOTHERMAL GENERATOR**

(76) Inventor: **Nikola Lakic**, Indio, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 1035 days.

(21) Appl. No.: **12/197,073**

(22) Filed: **Aug. 22, 2008**

(65) **Prior Publication Data**

US 2011/0169274 A1 Jul. 14, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. 11/770,543, filed on Jun. 28, 2007, now Pat. No. 7,849,690.

(51) **Int. Cl.**
F01K 27/00 (2006.01)
F03G 7/00 (2006.01)

(52) **U.S. Cl.** **60/641.2**; 60/641.1; 60/641.4

(58) **Field of Classification Search** 60/641.1–641.5
See application file for complete search history.

(56) **References Cited**

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4,099,381	A	7/1978	Rappoport	
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4,407,126	A	10/1983	Aplenc	
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5,058,386	A	10/1991	Senanayake	
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Lakic, Self Contained In-Ground Geothermal Generator, U.S. Appl. No. 11/770,543, filed Jun. 28, 2007, Amendment, dated Sep. 8, 2010.
Lakic, Self Contained In-Ground Geothermal Generator, International Application No. PCT/US2009/054656, Priority date Aug. 22, 2008, Written Opinion of the International Searching Authority, dated Oct. 8, 2009.

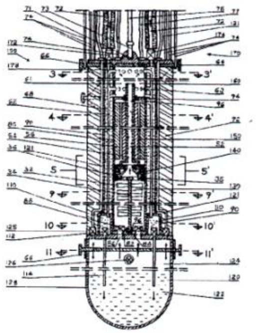
* cited by examiner

Primary Examiner — Thomas Denion
Assistant Examiner — Christopher Jetton
(74) *Attorney, Agent, or Firm* — Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

A self contained geothermal generator includes a boiler, a turbine compartment, an electricity generator, a condenser and an electric cable. The condenser includes a distributor chamber, a peripheral chamber and plurality of tubes disposed between the chambers. The peripheral chamber of the condenser surrounds and cools turbine, elective generator and selector of the condenser departments. The condenser cools and converts exhausted steam back in liquid state and returns it back into boiler for reheating. In a method of using the geothermal generator, water contained within the boiler is converted to high-pressure, super heated steam due to heat from hot rocks contained within a pre-drilled well below the Earth's surface. The steam is used to produce electric energy which is transported up to the ground surface by the electric cable. A plurality of geothermal generators may be used in a "binary" power plant through system of several heat exchangers.

13 Claims, 15 Drawing Sheets



- **US Patent Issued on: October. 9, 2012;**
- **Title: Self Contained In-Ground Geothermal Generator; and**
- **Several Patent Pending Applications**

GEOTHERMAL WORLDWIDE, INC

US008713940B2

(12) **United States Patent**
Lakic

(10) **Patent No.: US 8,713,940 B2**
(45) **Date of Patent: May 6, 2014**

(54) **SELF-CONTAINED IN-GROUND GEOTHERMAL GENERATOR**

(76) Inventor: **Nikola Lakic**, Indio, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 262 days.

(21) Appl. No.: **13/053,029**

(22) Filed: **Mar. 21, 2011**

(65) **Prior Publication Data**

US 2011/0167819 A1 Jul. 14, 2011

Related U.S. Application Data

(63) Continuation-in-part of application No. 12/197,073, filed on Aug. 22, 2008, now Pat. No. 8,281,591, and a continuation-in-part of application No. 11/770,543, filed on Jun. 28, 2007, now Pat. No. 7,849,690.

(51) **Int. Cl.**
F03G 7/00 (2006.01)

(52) **U.S. Cl.**
USPC **60/641.2**; 60/641.1; 60/641.4

(58) **Field of Classification Search**
USPC 60/641.1–641.5
See application file for complete search history.

(56) **References Cited**

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3,986,362	A *	10/1976	Baciu	60/641.2	
4,343,999	A *	8/1982	Wolf	290/2	
4,407,126	A *	10/1983	Aplenc	60/641.4	
4,776,169	A *	10/1988	Coles, Jr.	60/641.2	
5,058,386	A *	10/1991	Senanayake	60/692	
6,073,448	A *	6/2000	Lozada	60/641.2	
6,259,165	B1 *	7/2001	Brewington	290/1 A	
7,013,645	B2 *	3/2006	Brewington	60/641.2	
7,185,493	B1 *	3/2007	Connelly	60/641.15	
7,472,549	B2 *	1/2009	Brewington	60/641.2	
7,849,690	B1 *	12/2010	Lakic	60/641.2	
8,281,591	B2 *	10/2012	Lakic	60/641.2	

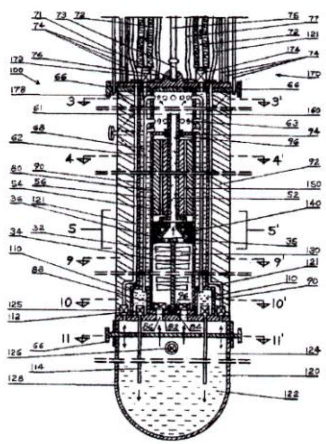
* cited by examiner

Primary Examiner — Thomas Denion
Assistant Examiner — Kelsey Stanek
(74) *Attorney, Agent, or Firm* — Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

A method of using geothermal energy to produce electricity by lowering a geothermal generator deep into a pre-drilled well bore below the Earth's surface. A self contained geothermal generator includes a boiler, a turbine compartment, an electricity generator, a condenser and an electric cable. The condenser includes a distributor chamber, a peripheral chamber and plurality of tubes disposed within the peripheral chamber. The peripheral chamber of the condenser surrounds the turbine, electric generator and distributor chamber departments and is cooled with a separate closed loop system. The condenser cools and converts exhausted steam back in liquid state and returns it back into the boiler for reheating. Water contained within the boiler is converted to high-pressure, super heated steam due to heat from hot rocks contained within a pre-drilled well bore. The steam is used to produce electric energy which is transported up to the ground surface by the electric cable.

7 Claims, 17 Drawing Sheets



- **US Patent Issued on: May 6, 2014;**
- **Title: Self Contained In-Ground Geothermal Generator;**
- **Several Patent Pending Applications;**

GEOTHERMAL WORLDWIDE, INC

US009206650B2

(12) **United States Patent**
Lakic

(10) **Patent No.: US 9,206,650 B2**
(45) **Date of Patent: Dec. 8, 2015**

(54) **APPARATUS FOR DRILLING FASTER, DEEPER AND WIDER WELL BORE**

(76) Inventor: **Nikola Lakic**, Indio, CA (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 779 days.

(21) Appl. No.: **13/424,184**

(22) Filed: **Mar. 19, 2012**

(65) **Prior Publication Data**

US 2012/0292112 A1 Nov. 22, 2012

Related U.S. Application Data

(63) Continuation-in-part of application No. PCT/US2010/049532, filed on Sep. 20, 2010.

(60) Provisional application No. 61/276,967, filed on Sep. 19, 2009, provisional application No. 61/395,235, filed on May 10, 2010, provisional application No. 61/397,109, filed on Jun. 7, 2010.

(51) **Int. Cl.**

E21B 4/00	(2006.01)
E21B 7/00	(2006.01)
E21B 10/26	(2006.01)
E21B 17/18	(2006.01)
E21B 21/01	(2006.01)
E21B 21/12	(2006.01)

(52) **U.S. Cl.**
CPC ***E21B 10/26*** (2013.01); ***E21B 7/002*** (2013.01); ***E21B 7/005*** (2013.01); ***E21B 17/18*** (2013.01); ***E21B 21/01*** (2013.01); ***E21B 21/12*** (2013.01)

(58) **Field of Classification Search**
CPC E21B 21/08; E21B 21/12; E21B 21/00; E21B 17/18; E21B 10/18; E21B 10/38; E21B 17/203; E21B 4/02; E21B 7/068; B08B 9/035
USPC 175/215, 25, 339, 320, 102, 324
See application file for complete search history.

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6,095,261	A *	8/2000	Trevino, Jr.	....	175/57

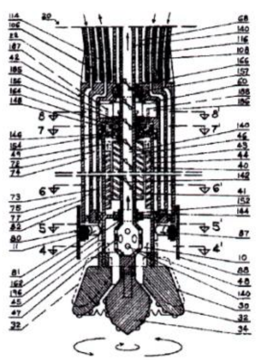
(Continued)

Primary Examiner — Daniel P Stephenson
(74) *Attorney, Agent, or Firm* — Schmeiser, Olsen & Watts LLP

(57) **ABSTRACT**

An apparatus and method for drilling deeper and wider well bores is provided. The apparatus includes a motorized drill head for cutting and shredding ground material; a separate excavation line; a separate fluid delivery line; and a separate close loop engine cooling line. The excavation line consists of multiple connected stationary segments of the main pipe with periodical segments of an in-line excavation pump. Alternatively, in another embodiment, excavation line consists of multiple connected segments of the main stationary pipe with rotating continues screw inside. The close loop cooling line consists of one heat exchanger in the motorized drill head and one on the ground surface in the binary unit where fluid is cooled and in process electricity produced which can be used as a supplement for powering drill head, pumps, equipment, etc.

29 Claims, 39 Drawing Sheets



- **US Patent Issued on: December 8, 2015;**
- **Title: APPAEATUS FOR DRILLING FASTER, DEEPER AND WIDER WELL BORE;**
- **Several Patent Pending Applications;**

GEOTHERMAL WORLDWIDE, INC

RELEVANT QUOTES

➢ **"We cannot solve our problems with the same thinking we used when we created them".**

~ Albert Einstein (1879-1955) ~

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➢ **"All truth passes through three stages:**

- **First, it is ridiculed;**
- **Second, it is violently opposed; and**
- **Third, it is accepted as self-evident".**

~ Arthur Schopenhauer (1788-1860) ~