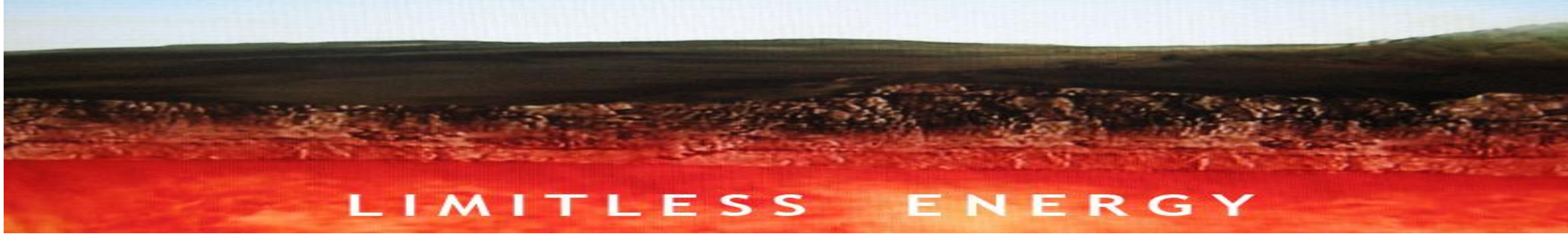
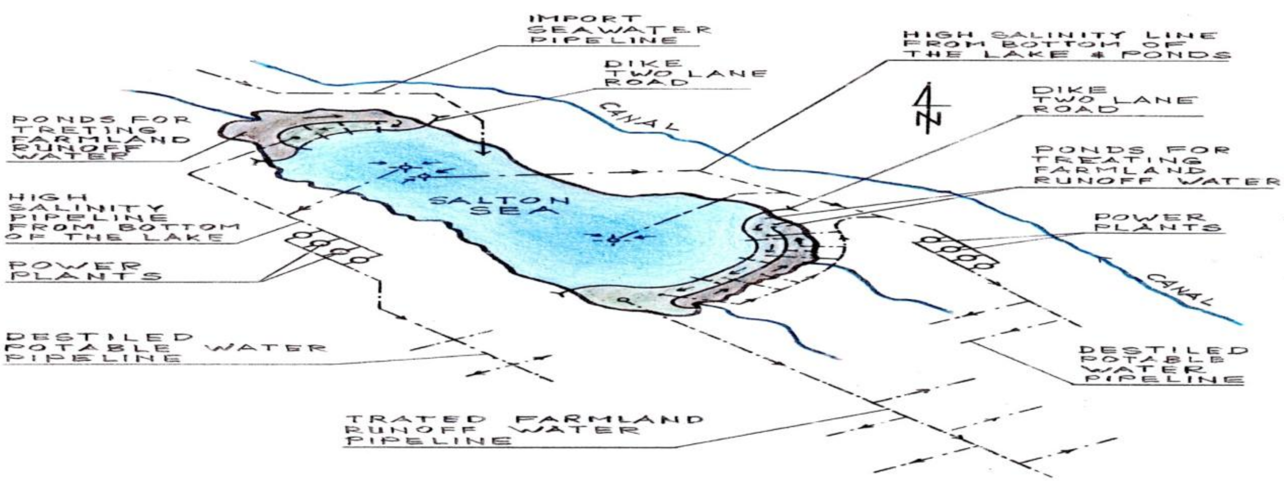


Papers for the

"Request for Information (RFI) for Salton Sea Water Importation Projects"

by California Natural Resource Agency

- PowerPoint Presentation - March 9, 2018, Indio, CA



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EXECUTIVE SUMMARY:

OVERVIEW OF THE SALTON SEA SITUATION (I)

- The Salton Sea is California's largest lake and is presently 50 % 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;**

PROJECT DESCRIPTION

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

- **Phase I** - **Connecting the Salton Sea with the Ocean** (presented are 5 Routs - corridors) with a pipeline 48” (5 pipelines on uphill route and 1 pipeline on downhill route);
- **Phase II** - **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.
- **Phase III** - **Building one power plant** using (SCI-GHE) system at one of selected sector;
- **Phase IV** - **Building several more power plants** using (SCI-GHE) system - one in three selected sector; and
- **Phase V** - **Continued buildup** of additional power plants using (SCI-GHE) system at each selected sector;

DESALINIZATION 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.**

Dimensions of the Salton Sea - Google map

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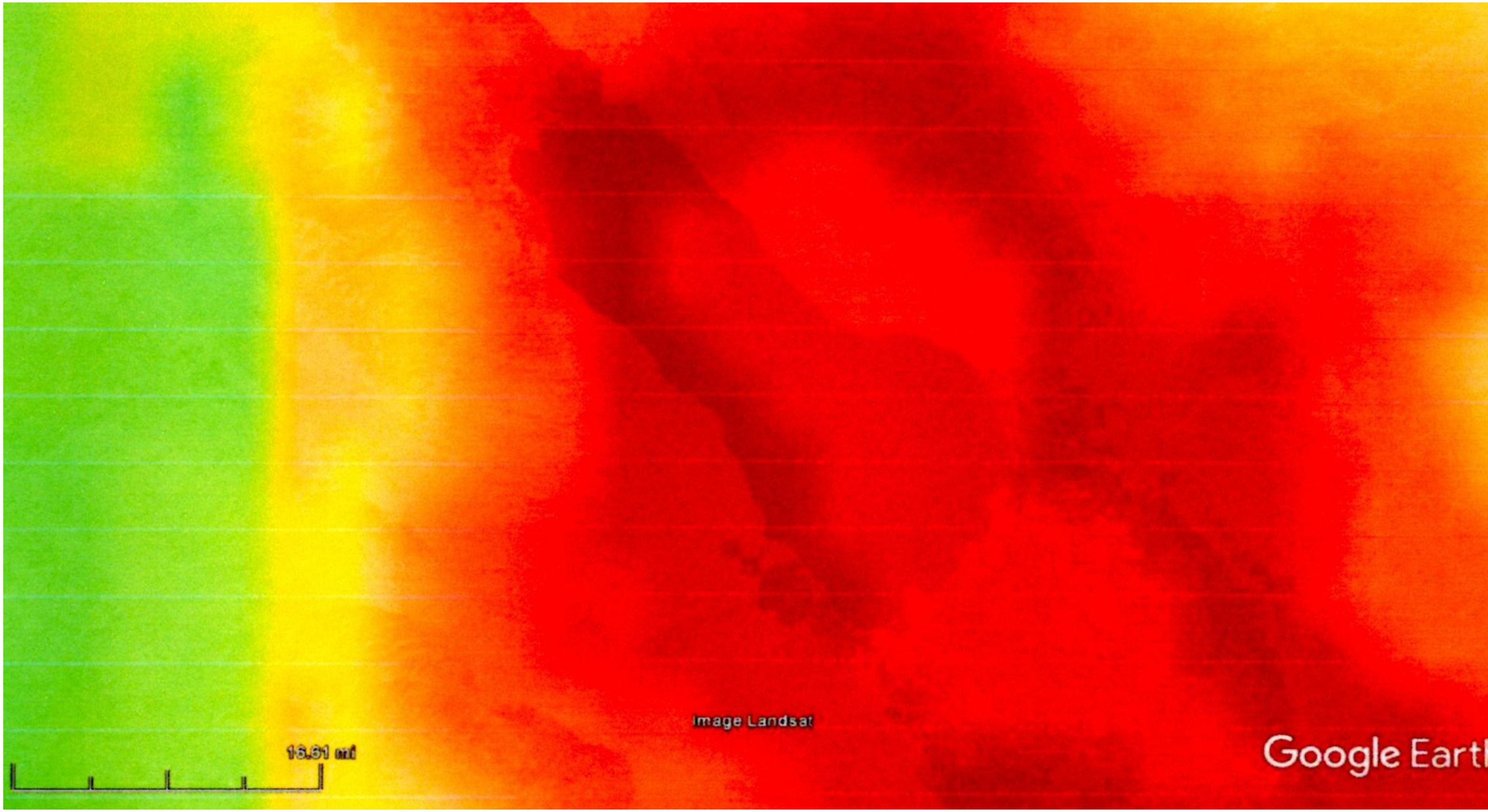
Geothermal Map – Salton Sea area - Temperatures at dept of 3.5 km



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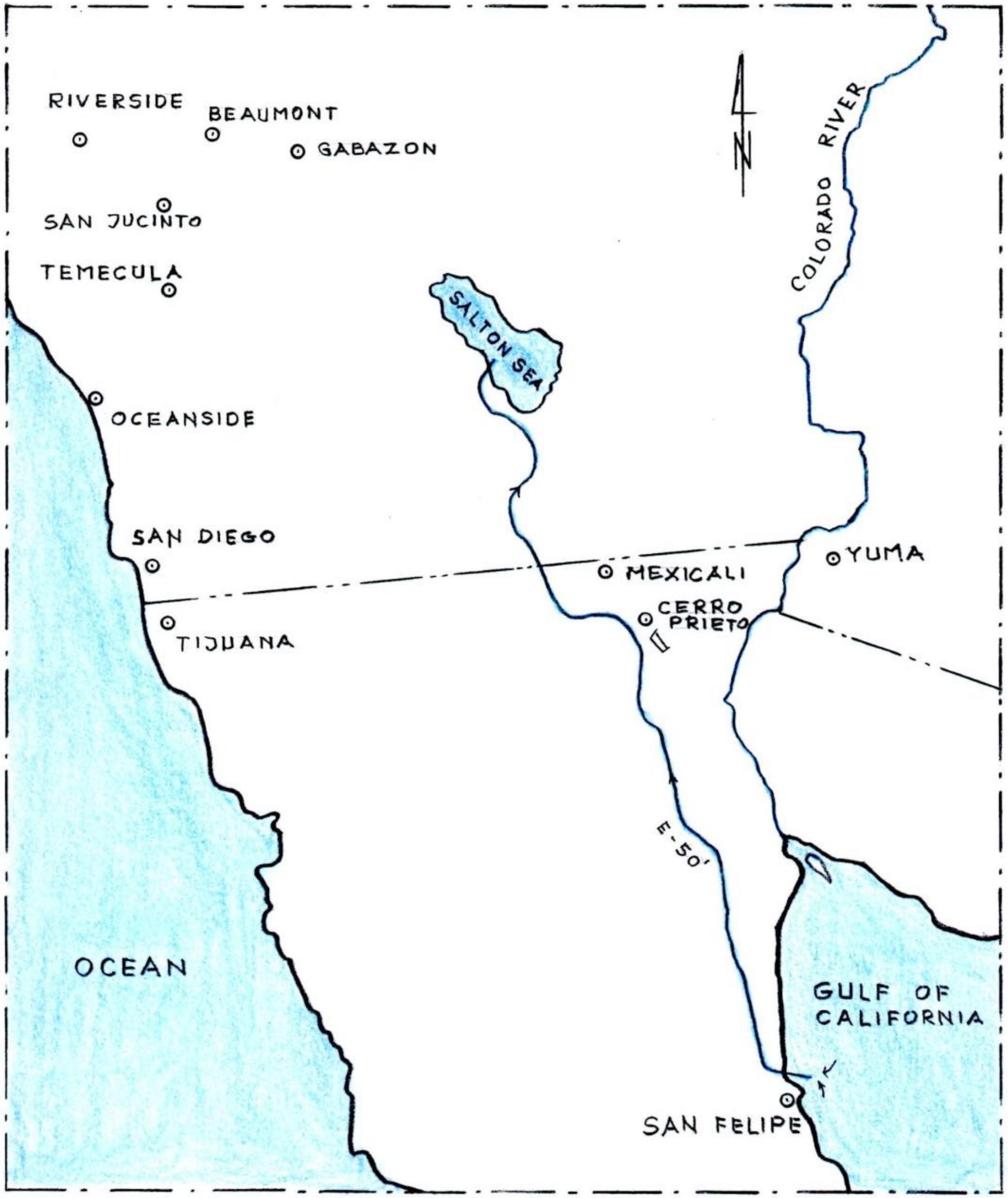
Route # 1 – Map - Importing seawater from the Ocean to the Salton Sea



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 mile;**
- Cost estimate for pipeline: **$1.7 B;**
- Cost estimates for TOS: **$184.8 M;**
- Generated hydro power: **27.3 MWh;**
- Generated solar power: **1,058 MWh**;
- Revenue from TOS: **$114,349,320;**
- Revenue from hydro: **$13,759,200;**
- Revenue total: **$128,108,520;**

- This route also deals with the **“Other Country Issues”** – treaty – purchase of seawater – risk involved, etc.

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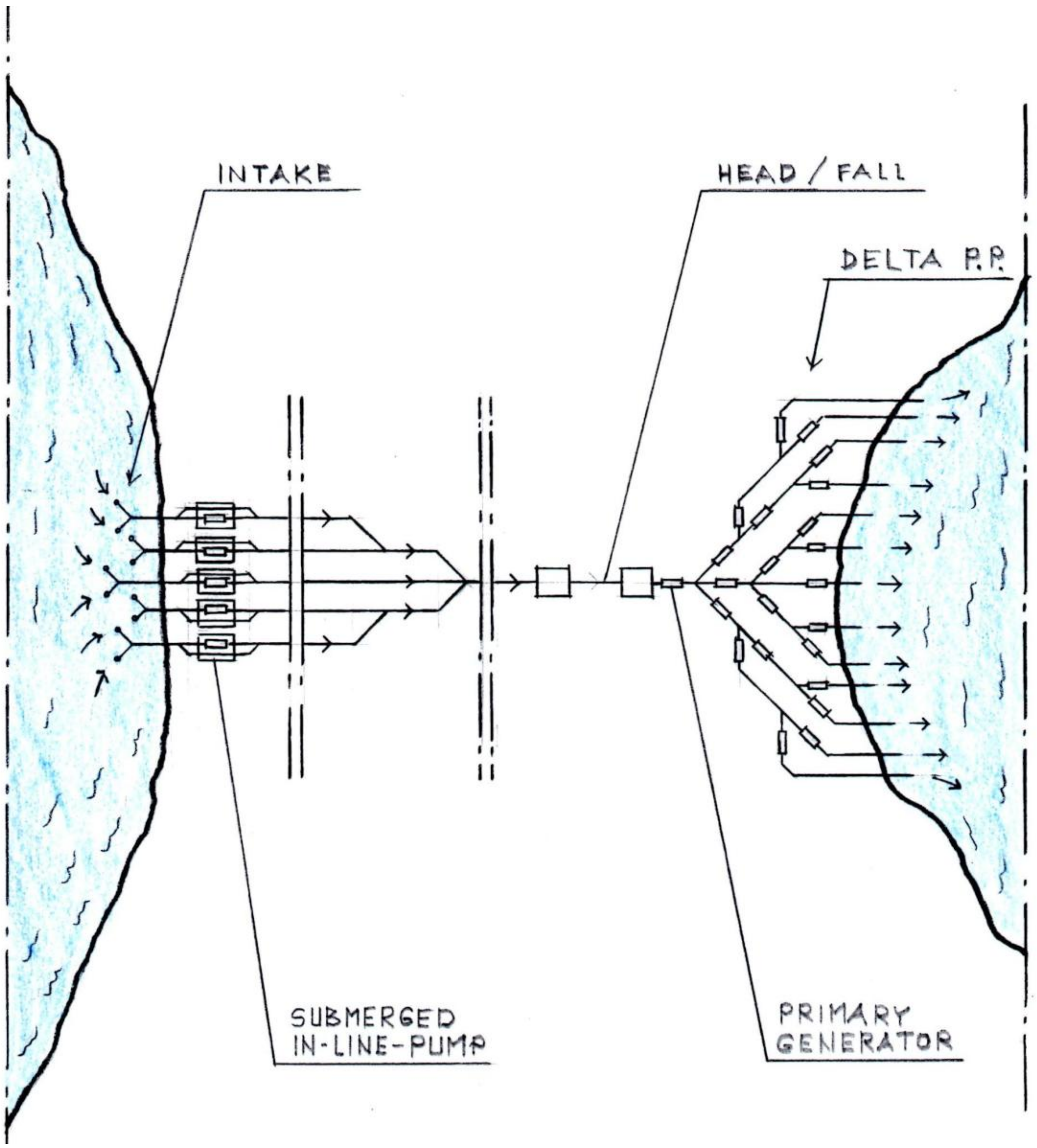
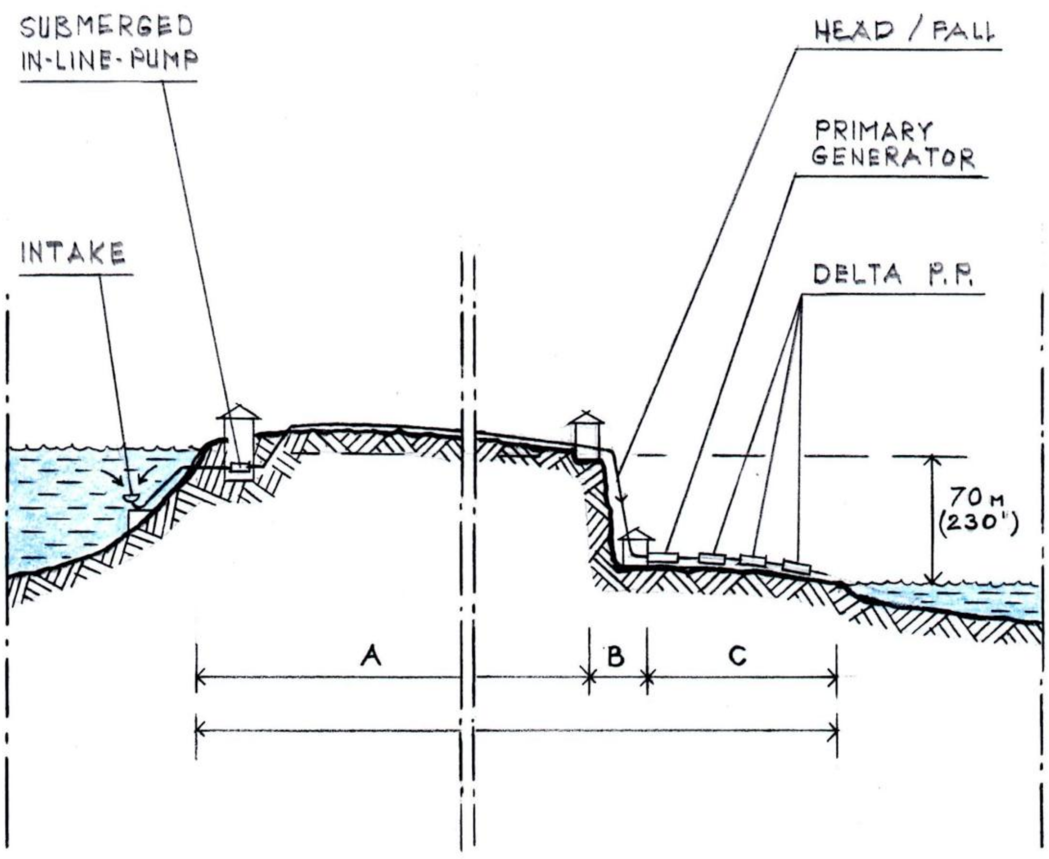
Route # 1 – Plain view



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 # 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 corridor too.
- 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.

Plain view of a schematic diagram of an alternative pipeline route connecting Salton Sea with Gulf of California, Mexico

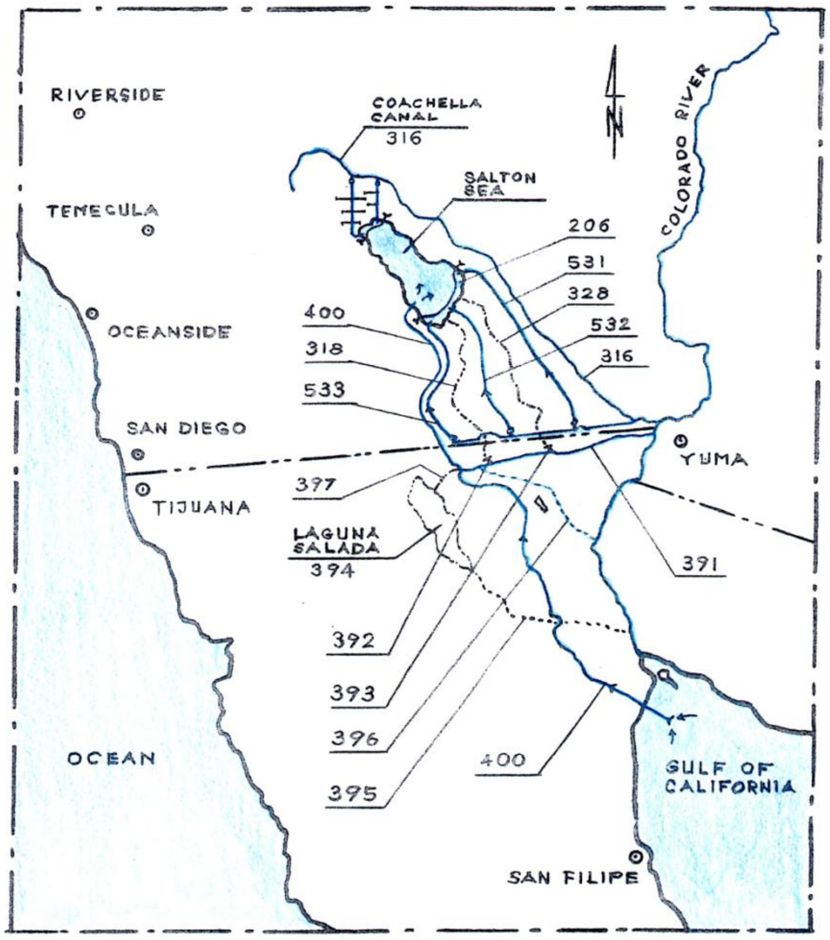


FIG. 86

- Redirection of the New River **318** and Alamo River **328** on Mexican side of the border with two gates **392** and **393** to flow towards Laguna Salada **394;**
- Requires relatively inexpensive earth work (a few miles cut) **397** west of Mexicali, Mexico. ;
- Optional route **396** bypassing Laguna Salada **394** on the way to the Ocean**;**
- the amount of water for the farmland from All-American Canal can be controlled with valves **536** to be used only as necessary with sprinkler system preventing formation of the runoffs water from farmlands entering the Salton Sea;
- This option requires treaty with Mexico to secure long-term interest of both countries.

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Alternative pipeline system associated with route connecting Salton Sea with Gulf of California, Mexico

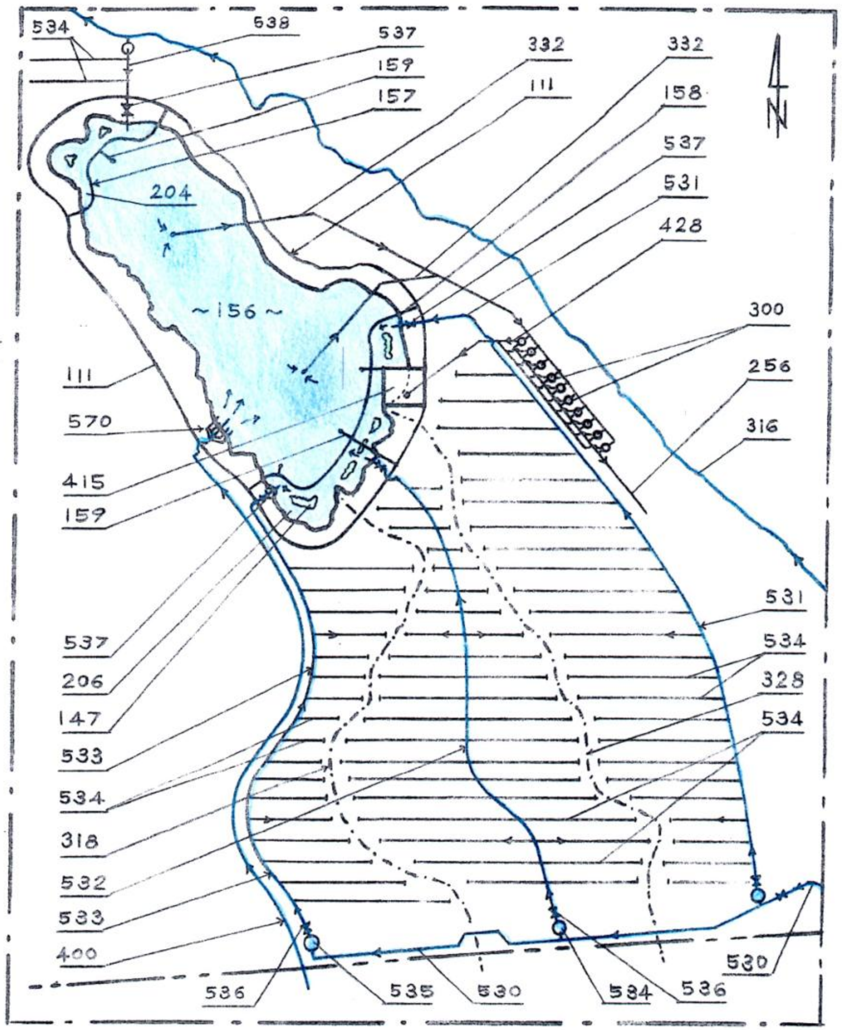

FIG. 87

- System designed for more efficient water conservation to accommodate water restriction and supply to southern section **206** – the wildlife sanctuary;
- The amount of water for the farmland from All-American Canal can be controlled with valves **536** to be used only as necessary with sprinkler system preventing formation of the runoffs water from farmlands entering the Salton Sea;
- Three main pipelines; eastern branch **531**; central branch **532**; and western branch **533**; and secondary pipelines **534** extending from each of three main branches;
- Control valves **536** on beginning and control valves **537** on their ends.

Enlarged southern part of the Salton Sea – wildlife sanctuary

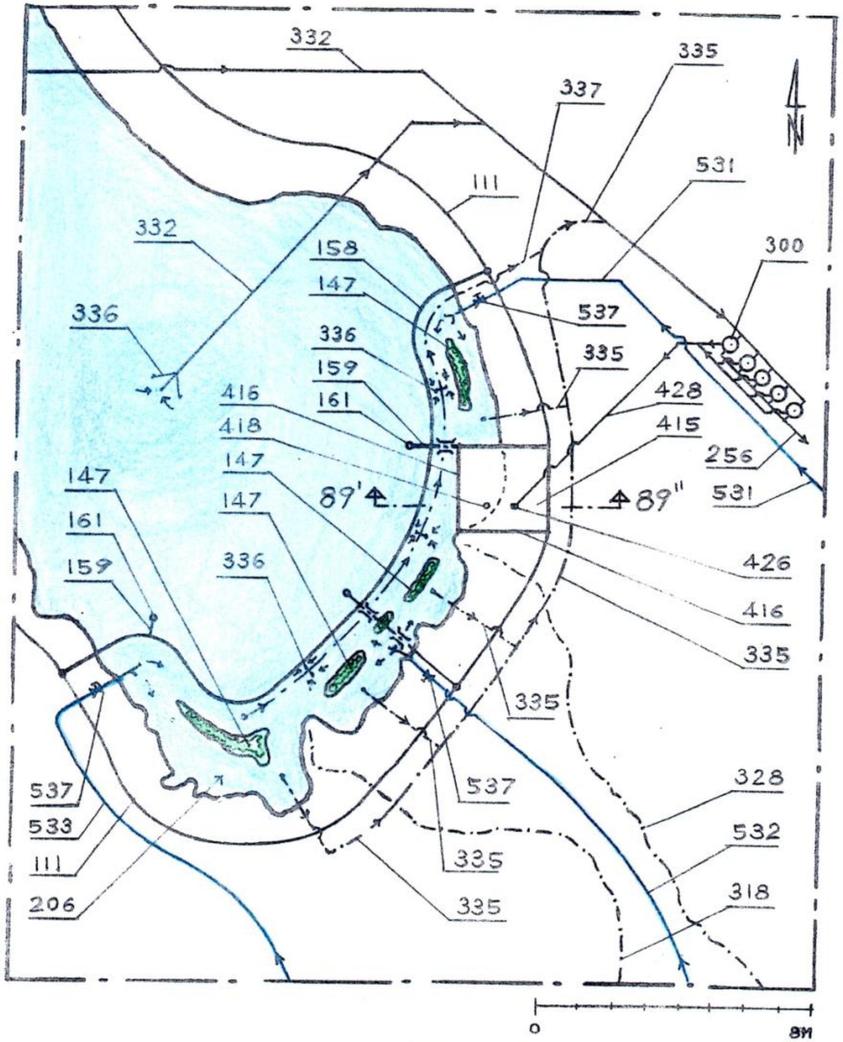

FIG. 88

- The southern section of the lake **206** (wild life sanctuary) with an area **415** surrounded with a levy (dike) - two lain road **416**, to form dry land **415** and secure development of a conventional geothermal power plant **427** at the area of known geothermal reservoir;
- If needed, the waste material from power plant **300** can be diluted with water from pipelines **332**, **335** or **337** before being injected into geothermal reservoirs.
- Three main pipelines **531, 532** and **533** with control valves **537** for providing and circulating water in the southern section of the lake **206** (the wild life sanctuary).
- There is a **restaurant** on the **pier;**
- There are islands for birds **147**;

Plan view of a typical dike-pier intersection

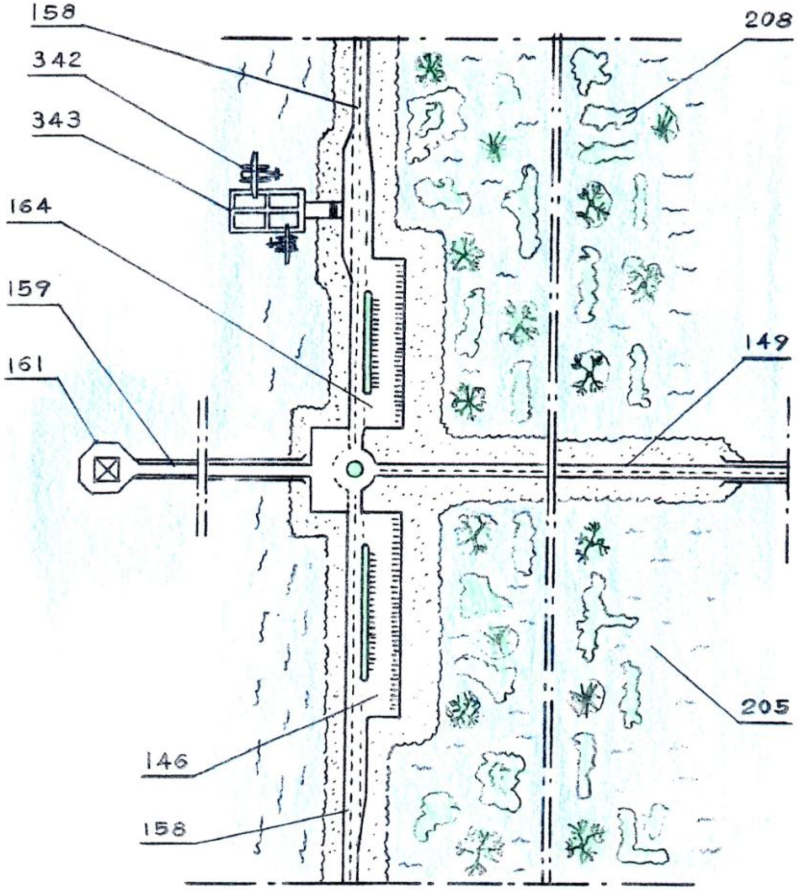

FIG. 57

- **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;

- **Ponds** are dig in **"V"** shape to provide **slope** and **deep points** for **segregation** of **higher density** water which is selectively pumped out and used in the power plants;

- There is a **restaurant** on the **pier** and parking places for visitors;

- There is airport for amphibian airplans;

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Cross-sectional view 89'-89" taken near a typical dike-pier intersection

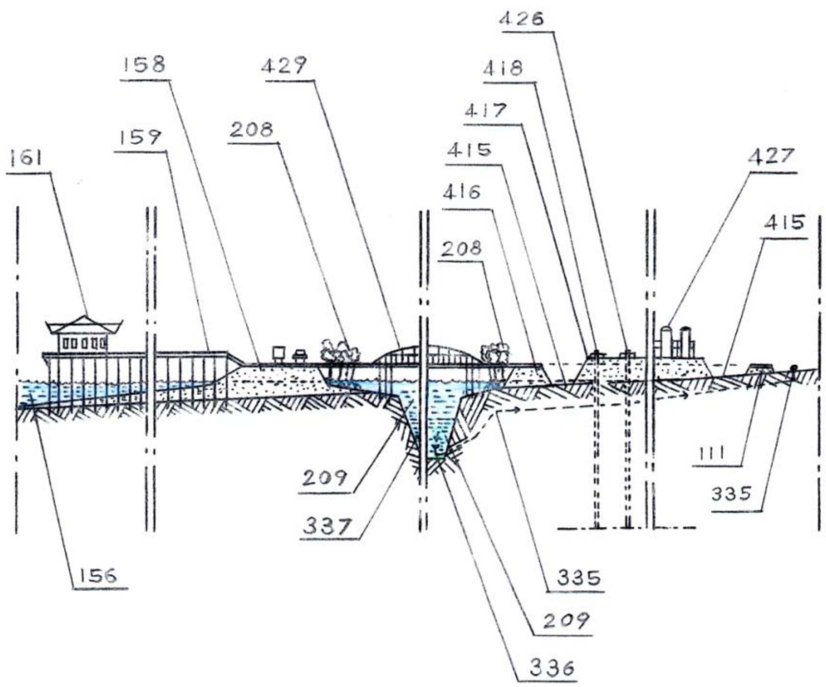

FIG. 89

- 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;**
- **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;
- The injection well **426** can be used for depositing waste material from power plant **300** with high salinity water through pipeline **428** into depleting geothermal reservoir**.**
- There is a **restaurant** on the **pier;**

Enlarged northern part of the Salton Sea – wildlife sanctuary

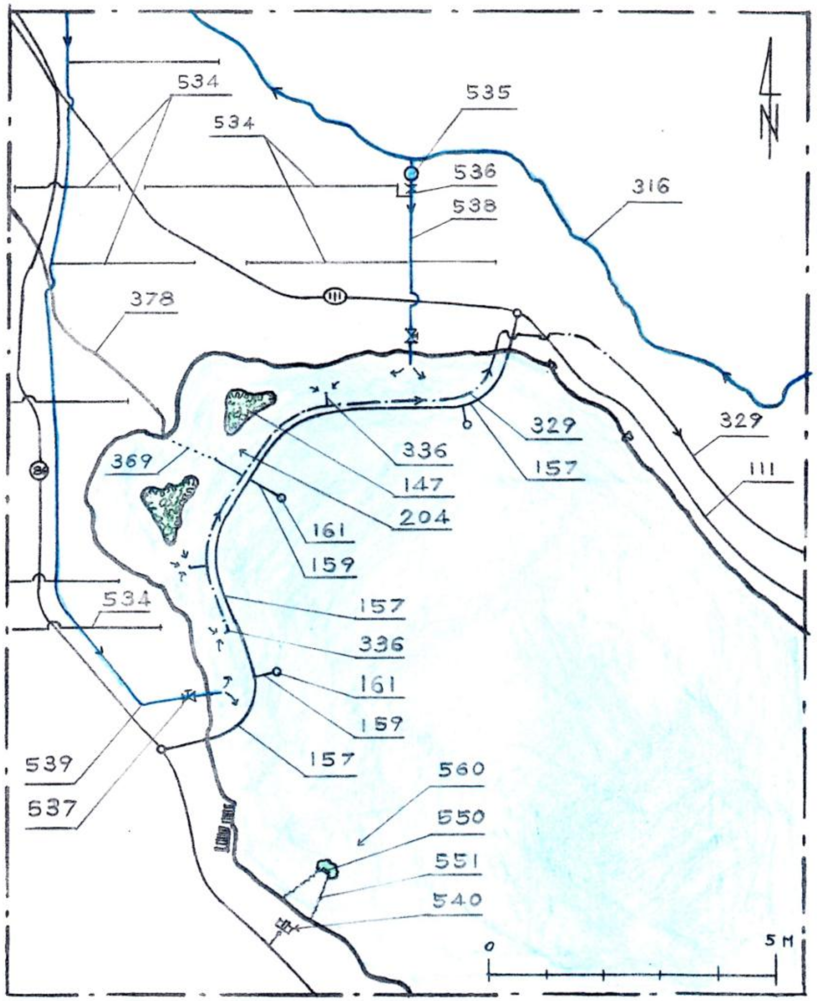

FIG. 90

- 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;**
- Pipelines **538** and **539** distributing water to secondary pipelines **534** using sprinkler system for final distribution of water to farmland.
- The amount of water for the farmland can be controlled with valves **536** and **537** to be used only as necessary;
- There is a **restaurant** on the **pier;**
- Possible location of a Hotel Resort **540** with a section in the Salton Sea with the tower **550** to be built on manmade island **560** which contain a mechanism for generation of waves for surfing;

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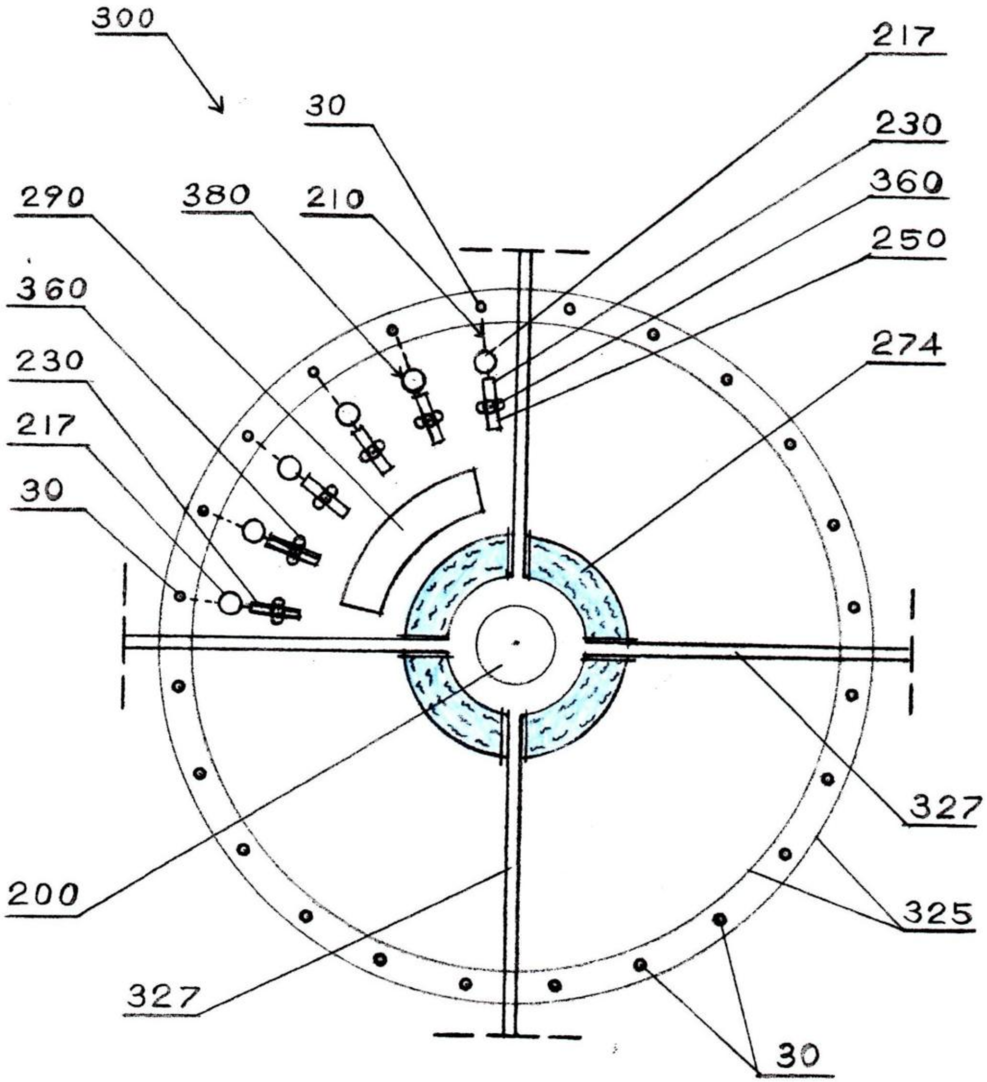
Plain view of a typical Power Plant



- **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;**

Schematic cross-sectional view of a Power Unite

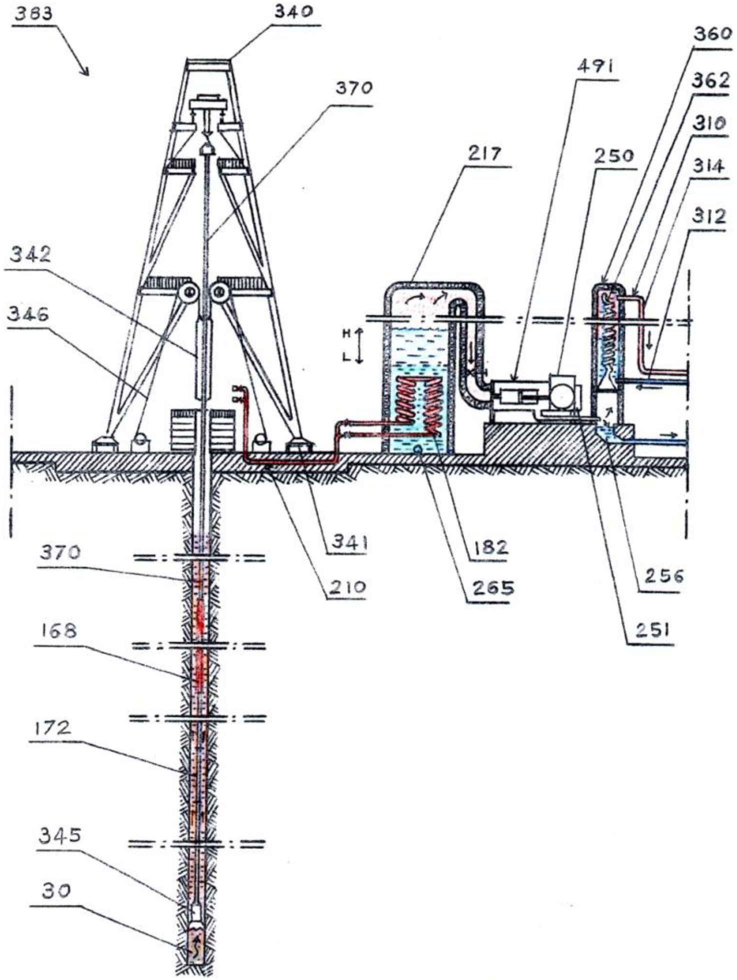


FIG. 79

- 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 enters pistons 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.

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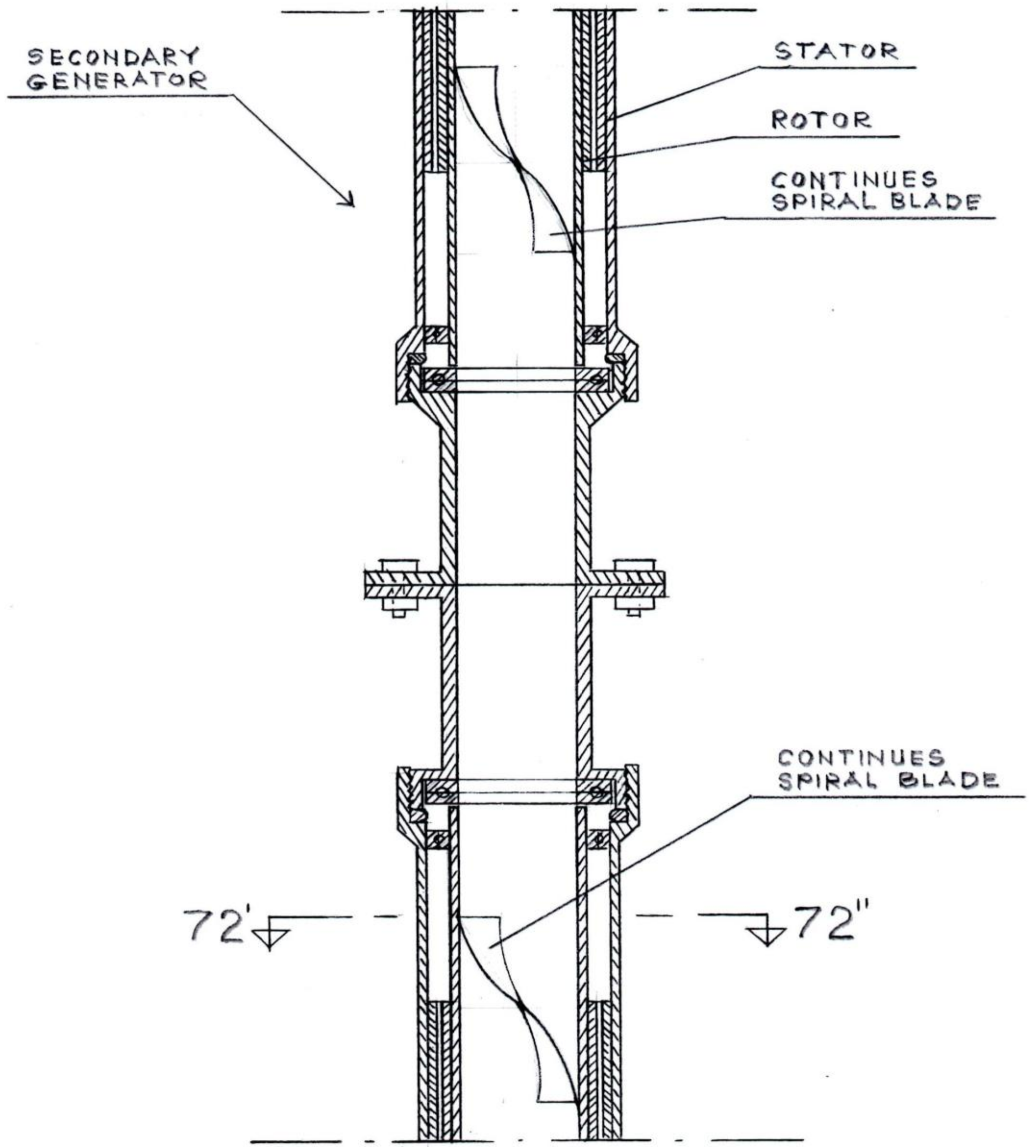
Cross-sectional longitudinal view of the Secondary In-Line-Pump / Generator



- **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 providing smaller openings in the middle of the cylinder as speed of fluid gradually decreases.**
- **It yields a maximum flow rate with limited diameter.**

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

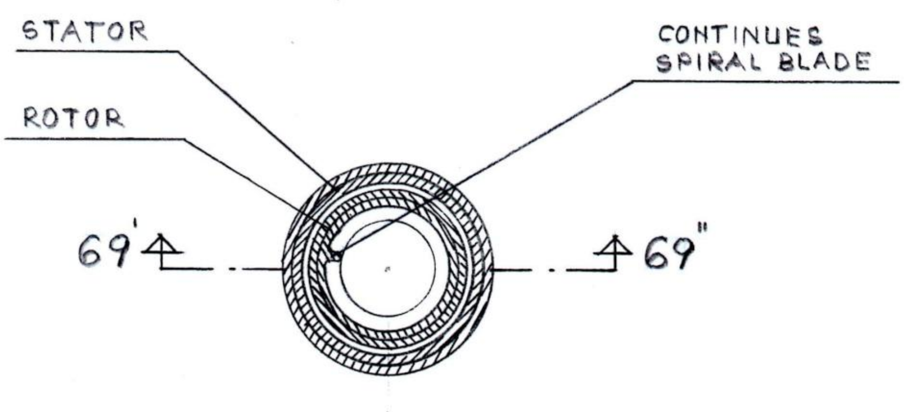
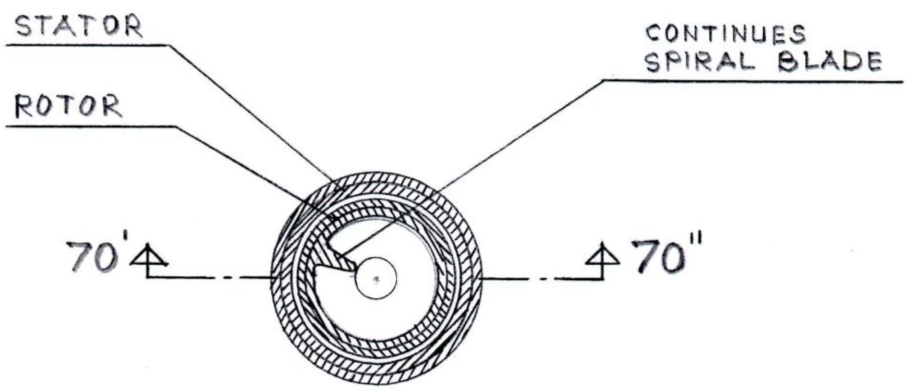


FIG. 71



- 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.

Schematic cross-sectional view of a Power Unite

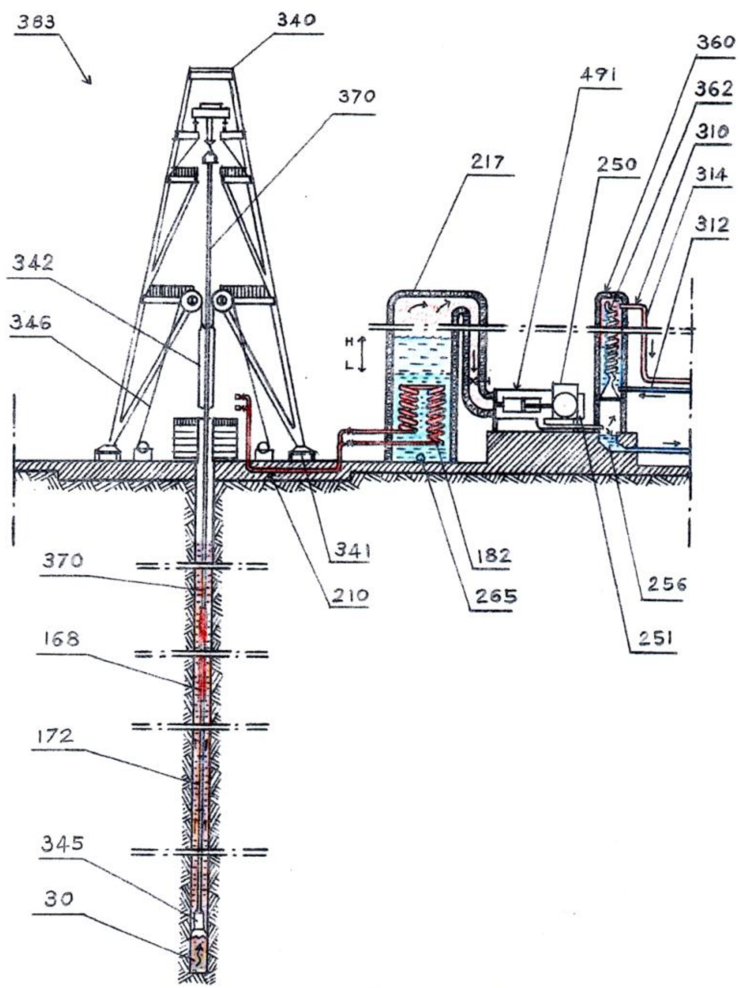


FIG. 79

- 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 enters pistons 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.

Cross-sectional view of a solar panel assembly

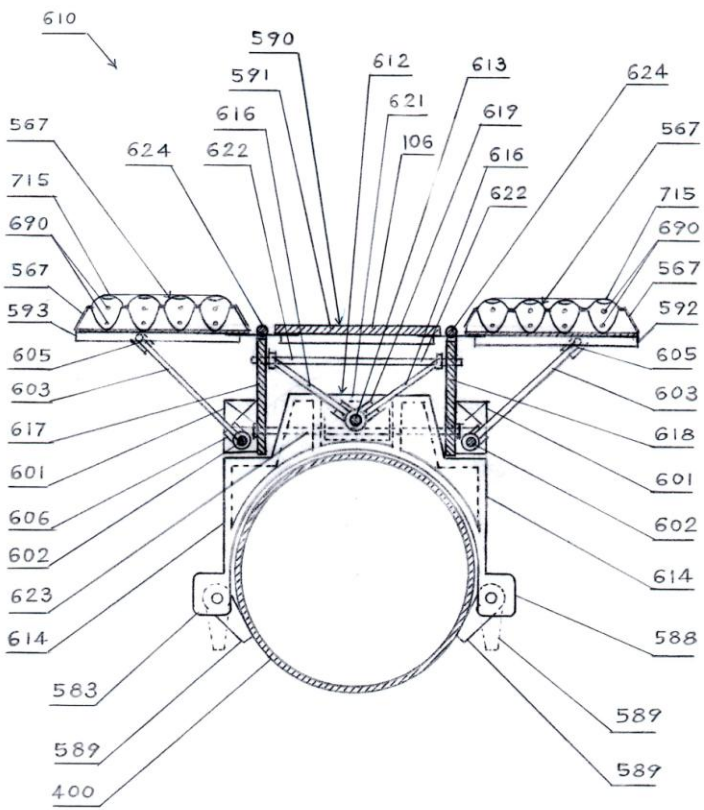


FIG. 100

- A Thermo Optical Solar (TOS) panel assembly **610** and its attachment system to the pipeline **400.**

A side view of the solar panel assembly and its attachment system to the pipeline

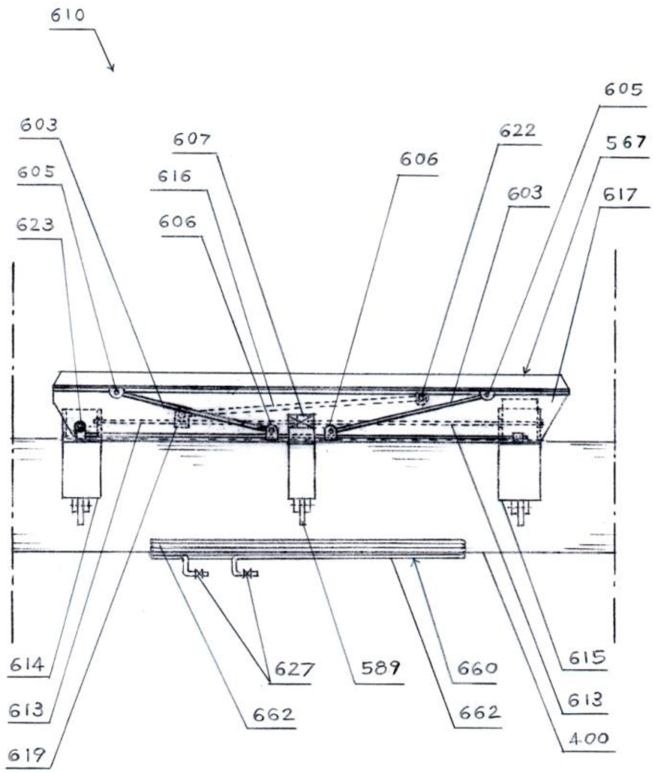


FIG. 103

- A side view of the solar panel assembly **610** and its attachment system to the pipeline **400** and its lifting mechanism **612** in horizontal position;
- The condenser **660** consist of bended metal pipeline **662** and connectors **627** which connect closed loop line of the thermo optical solar system **567** and **700**;

A perspective view of a pipeline with solar panel assemblies attached to the pipeline in combination with a line of alternative solar system aside pipeline

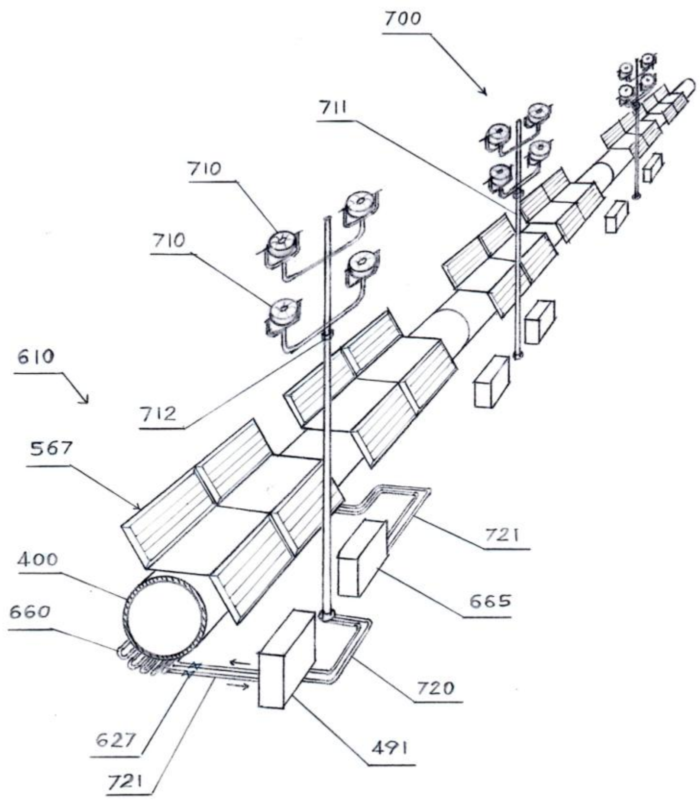


FIG. 106

- Perspective view of a pipeline with solar panel assemblies **610** attached to the pipeline in combination with a line of an alternative “thermo optical solar system” **700** aside pipeline.

Summary of the Preliminary Analyzes of Route #1

- **Route #1** --- Corridor: San Felipe - Mexicali, Mexico, - Salton Sea.
- Elevation to overcome is 35 ‘ (10 m);
- Pipeline distance is about 150 miles;

- Cost estimate for pipeline: $1.7 billion;

- Cost estimate for TOS: $184.8 million;

- Route #1 would generate hydropower: 27.3 MWh;

- The Thermo Optical Solar System installed on pipeline would generate 1,058.79 MWh;

- Revenue generated from the Thermo Optical Solar (TOS) System installed on pipeline Route #1 would be at least $114,349,320 per year;

- Revenue generated from the “Delta” hydro power plant would be $13,759,200 per year;
- Revenue total: **$128,108,520** per year;

<u>Summary of the Preliminary Analyzes of Route #2</u>

- **<u>Route #2</u>** Corridor: Oceanside - Temecula – San Jacinto (existing tunnel) – Cabazon - Salton Sea;

- Elevation to overcome is 1,600‘ (488 m);
  2 cascades each with 279 m drop and 6uphill pumping stations;

- Pipeline distance is about 160 miles;
- Cost estimate for pipeline: <u>$3.32 billion;</u>
- Cost estimate for TOS: <u>$200 million;</u>
- Energy needed for operation of the pipeline: 134.5 MWh;
- The Thermo Optical Solar System installed on pipeline would generate <u>1,058.79 MWh</u>;

- Remaining 924.30 MWh can be sold to the grid;

- Revenue generated from the Thermo Optical Solar (TOS) System installed on pipeline Route #2 would be at least **<u>$99,824,400</u>** per year;

Summary of the Preliminary Analyzes of Route #3

- **Route #3** Corridor: Oceanside - Temecula - San Jacinto - Beaumont – Salton Sea.

- 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;
- Cost estimate for TOS: $209.440 million
- Energy needed for operation of the pipeline: 275.7 MWh;
- The Thermo Optical Solar System(TOS) installed on the Route #3 pipeline can generate 1,124.97 MWh;
- Remaining 849.27 MWh can be sold to the grid;
- Revenue generated from the Thermo Optical Solar (TOS) System installed on pipeline Route #3 would be at least **$91,721,160** per year;

Summary of the Preliminary Analyzes of Route #4

- **Route #4** Corridor: Oceanside - Temecula - Borrego - Springs –.Salton Sea.

- 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: $2.220 billion;
- Cost estimate for TOS: $123.200 million;
- Energy needed for operation of the pipeline: 380 MWh;
- The Thermo Optical Solar System installed on route #4 pipeline can generate 661,7 MWh;
- Remaining 281.7 MWh can be sold to the grid;
- Revenue generated from the Thermo Optical Solar (TOS) System installed on pipeline Route #4 would be at least **$30,423,600** per year.

Summary of the Preliminary Analyzes of Route #5

- **Route #5** Corridor: Long Beach – Whitewater - Springs – Salton Sea.

- Elevation to overcome: 2,700‘ (823 m);
  3 cascades each with 297 m drop and 9 uphill pumping stations;
- Pipeline distance: about 200 miles;
- Cost estimate for pipeline: $4.118 billion;
- Cost estimate for TOS: $246.400 million;
- Energy needed for operation of the pipeline: 275.7 MWh;
- The Thermo Optical Solar System installed on route #5 pipeline can generate1,323.49 MWh;
- Remaining **1,047.80 MWh** can be sold to the grid;
- Revenue generated from the Thermo Optical Solar (TOS) System installed on pipeline Route #5 would be at least **$113,162,400** per year