



# ESTRELLA DEL MAR II POWER BARGE FIRST DUAL FUEL GAS COMBINED CYCLE PLANT

Armando Rodriguez

Wartsila LNG Symposium – Trinidad – April 19, 2012

# Seaboard Power - Dominican Republic

- Established as first IPP in DR in 1989, started operating in 1990.
- Installed Capacity 112MW:
  - Estrella del Norte (EDN = 40MW) started operations in 1990.
  - Estrella del Mar (EDM = 72MW) started operations in 2000
- In 2001 become merchant plant.
- From 2001 to 2011, sold mostly to Spot Market and Independent Large Users, as well as to the Power Distribution & Generation Companies, through short term contracts.
- In 2009, signed agreement to sell both power barges.
- In 2010, ordered from Wartsila new dual fuel power barge (NG/HFO)
- In 2011, EDN & EDM barges were delivered to buyer. The EDM barge was leased back and continue to operate.

## SEABOARD'S THIRD POWER BARGE PROJECT WITH WARTSILA



Estrella del Norte (40MW) built in New Orleans 1989 and operated from 1990 to 2011



Estrella del Mar (72MW) built in Singapore 1999-2000 and in service since 2000

# Seaboard 110MW Power Barge

- After signing an MOU, Seaboard and Wartsila worked on the design, costing and shipyard pre-selection, with the EPC contract being signed on August 2010.
- Project Name: Estrella del Mar II Power Barge
- Project financed through Standard Chartered Bank.
- Project classified as a project of Clean Development Mechanism under the United Nations framework on Climate Change, duly supported by the National Council for Climate Change and Clean Development Mechanism of the Dominican Republic.



# Estrella Del Mar II



Efficiency is important, as power plants in the Dominican Republic are ranked on the basis of their efficiency and dispatched accordingly.

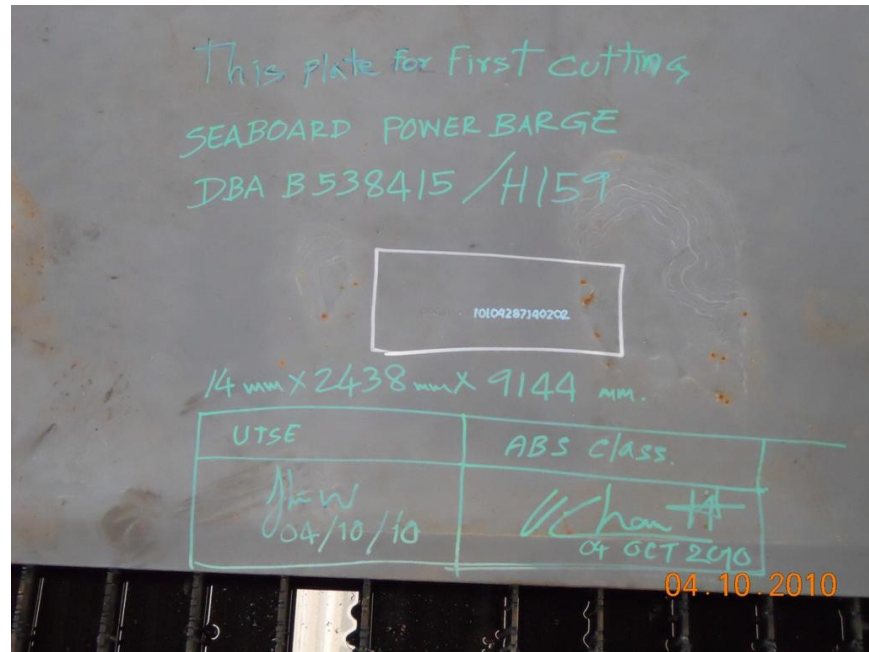
#### Characteristics:

- Started operations in late March 2012
- Six 18 cylinder Wartsila 50DF tri-fuel engines in V configuration (Wartsila 18V50DF) with full heat recovery and steam turbine generator.
- Dual fuel power barge (NG/HFO)
- Output:
  - 108 MW with HFO
  - 106 MW with NatGas
  - Of which, 8.8MW from Combined Cycle Steam Turbine
- Efficiency 47.8% (contractual)
- Heat Rate (actual)
  - 7,139 BTU/kWh on NatGas
  - 7,310 BTU/kWh on HFO

When running the engine in gas mode, the pilot fuel (LFO) amounts to less than 1 percent of full-load fuel consumption. The amount of pilot fuel is controlled by the engine control system.

Built by Wartsila at the Unithai Shipyard & Engineering, Ltd., in Thailand.





First steel for EDM II was cut on October 4, 2010





Construction of Barge Hull - April 7, 2011

104.4 m long x 32 m wide x 5.5 m draft

Fuel day tanks, lubricating oil and (fire) water tanks are located in the hull.





Construction of Power Plant Housing Structure - May 27, 2011  
The structure can withstand wind speeds of up to 120 mph for one minute





Auxiliary equipment on the deck & positioned on engine room #2 – end of May 2011





Cranes and containers full of equipment - June 17, 2011





Steam container – 6/17/2011

The Estrella del Mar II was launched on June 30, 2011.





Mobilizing the barge prior to Launch – End of June, 2011





Ready for Launch – June 30, 2011



Engines and generators lifted in July 2011 using a mobile 1800 ton crane.



After launch, on the water.





Note that two engines are already in place.





Steam condenser – 7/16/2011



Exhaust gas boiler installation (1 of 6)  
7/16/2011



Steam turbine and generator - 7/16/2011



Gen-set on main deck – 7/16/2011





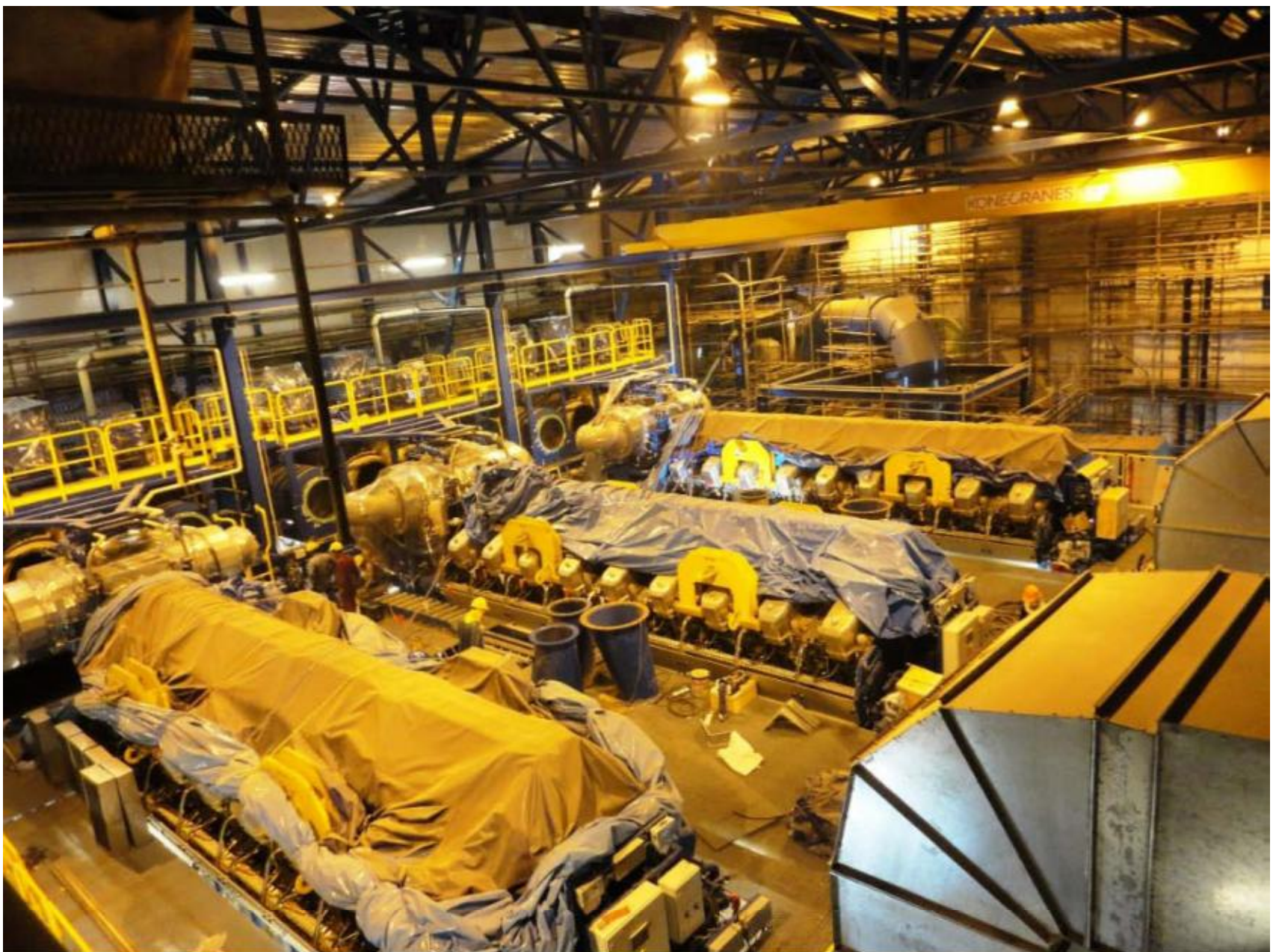
View Starboard Side – Initial work on exhaust ducts from each engine for heat recovery system, which cannot be directed out as usual, but have to be turned inward, with the boiler and the stack area located in the center.





View of Heat Recovery system & boiler area – September 10, 2011





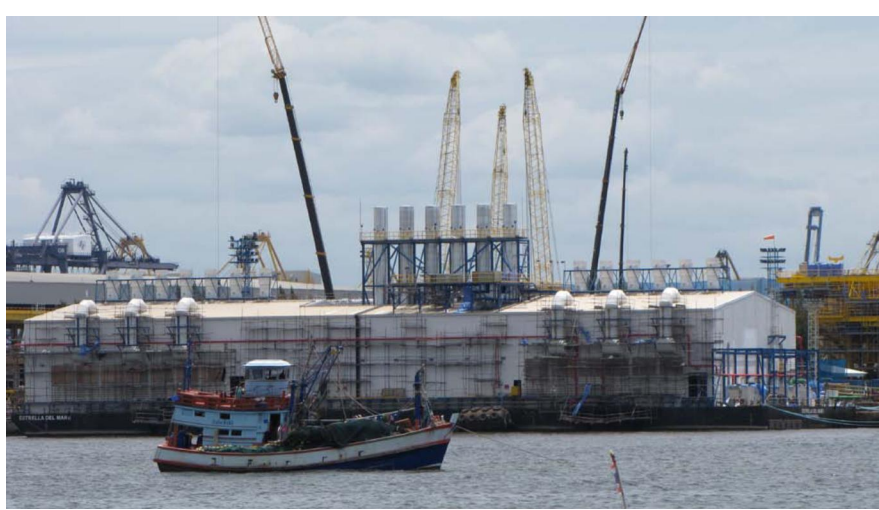
Engine room #1 – September 15, 2011





Roof of Engine Room #2  
Exhaust Stacks  
September 15, 2011





Port Side View - September 17, 2011



Stern – September 21, 2011



View Starboard Side (Without scaffoldings) - Note finished exhaust ducts & HR system.





1. Barge



2. HFO separators



3. Control room



4. Switchgear room

September 2011





Port Side View – October 12, 2011



October 19, 2011



Power Barge was carried on a semi-submersible vessel on November 30, 2011 from Thailand to Dominican Republic via Cape of Good Hope.



Barge being tugged early in the morning – November 30, 2011





Barge loaded on submersible vessel - November 30, 2011  
During transport, all internal equipment and components were fastened.

Power Barge arrived in DR after 43 days, on January 12, 2012  
and was put afloat on January 14, 2012





Barge being put afloat – January 14, 2012





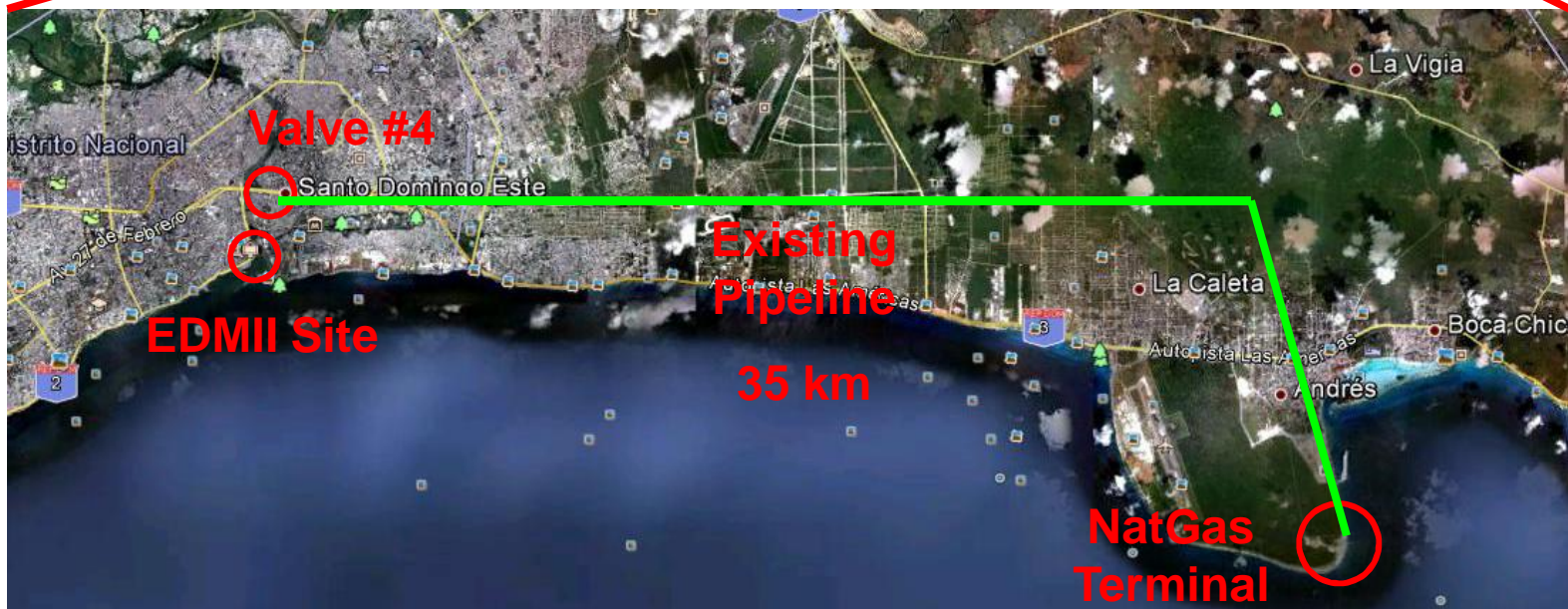
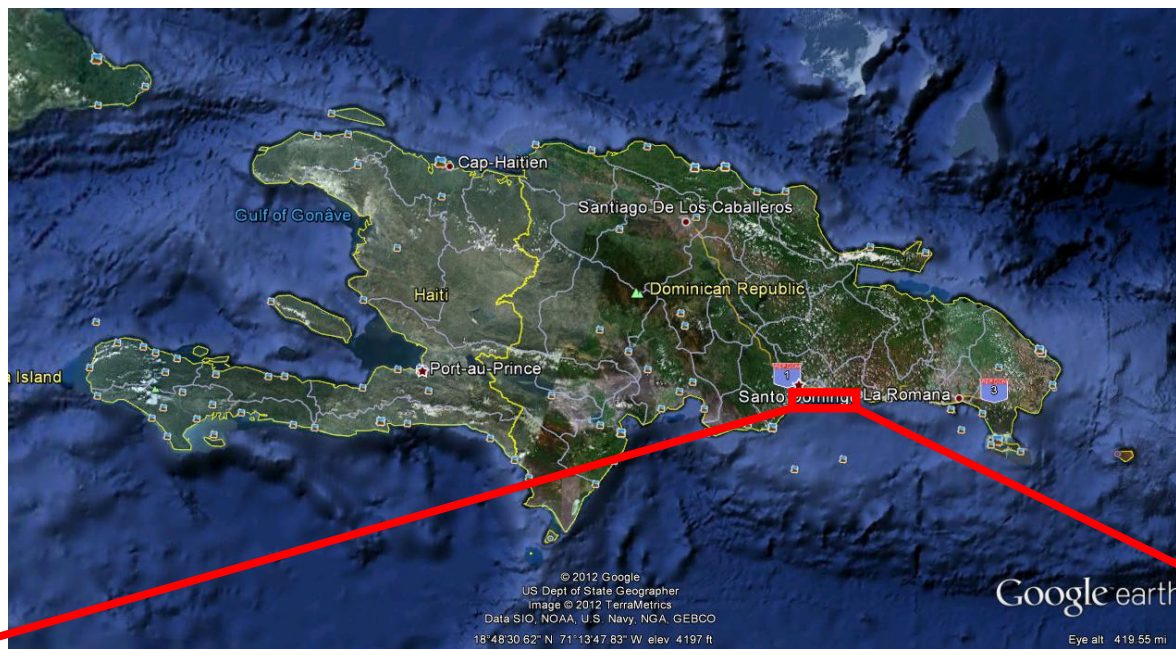
Barge tugged in to Ozama River & Port of Santo Domingo – January 14, 2012



Additional Power Barge Work in Dominican Republic

Gas Pipeline for Power Barge





Natural Gas supplied through Pipeline from terminal in Andres, Boca Chica 35 km away. Interconnection to existing pipeline at Valve #4 is at 3 km distance from site.

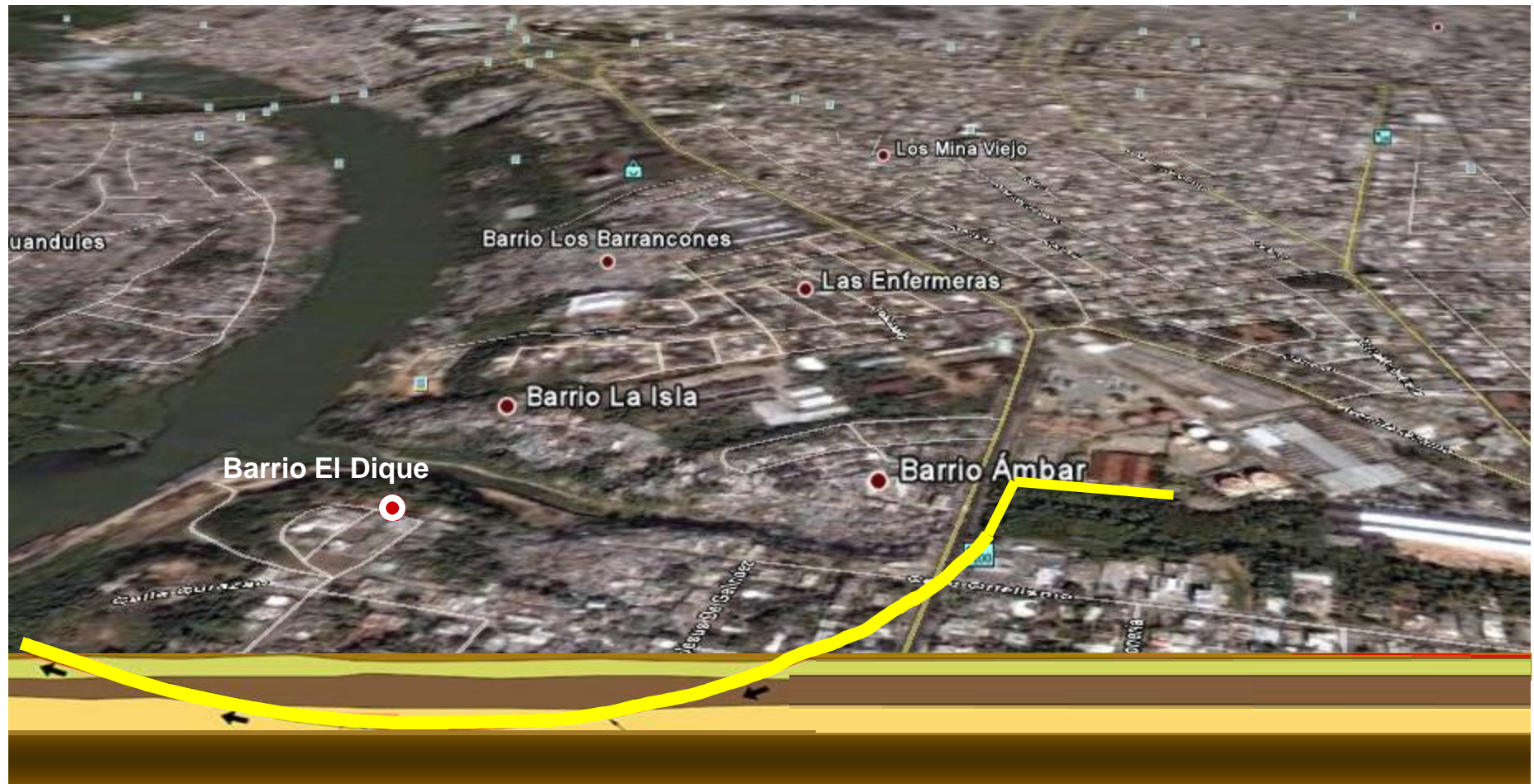


# HDD Pipeline Route



Interconnection to existing pipeline at Valve #4 was done using Horizontal Directional Drilling. Pipeline is almost 3 km long, first part under high density population area and second part under the river bed.





**The first stage of HDD work was almost 1 km length at depths of 30 to 40 meters.**





**The second stage of the HDD work was 2 km in length at 10 to 15 meters below the Ozama River bed and comes out next to power barge site.**

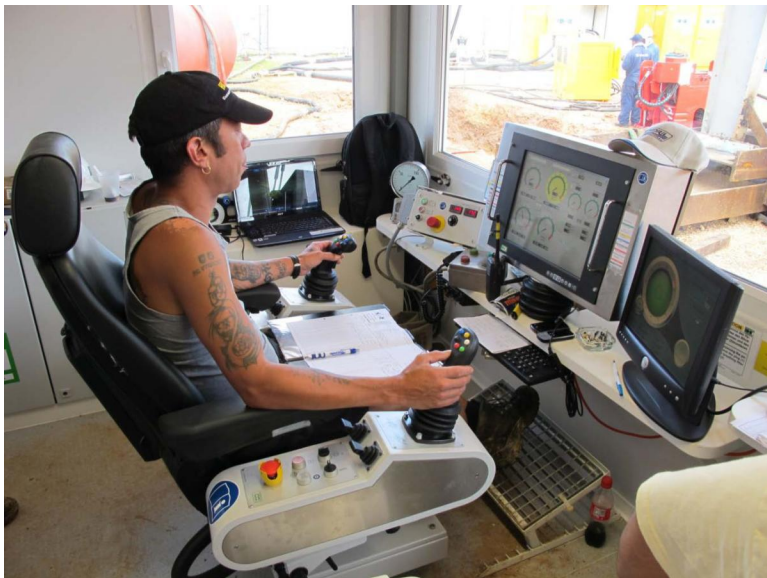




Drill rig and camp site



Drill rig with drill pipes



Drill operator with instrumentation & controls.



Pit in front of drill rig – entry point





Pipes (5 mm polymer), hoses & pumps



Different drill heads



Different reaming heads



Drill Site Camp Office





Drill coming out next to Ozama River



Reamer to increase from 8" to 20" diameter



Pipeline insertion.



Drums keeping pipe afloat





## Pipe lifted (to provide angle) and on rollers



Swivel connected to gas pipe



## Rig ready for pulling



Finished Drilling on October 3, 2011



## Electrical Work for Power Barge



Foundations for Towers & Transformers





Step-up transformer base and oil collecting pit

Substation tower





Substation, transformers and tower



Connector Tray





Mooring Work for Power Barge



80' long piles were used to reinforce the existing moorings





Connecting piles with steel beams and casted concrete (yellow gas pipeline)









From concept to reality.



Thank you.