

# **BIZKAIA WASTE TO ENERGY PLANT PROJECT**

**CONTRACT N° BM 80/96 ES-PO**



**SUMMARY REPORT**  
February 2005

## **1. PROJECT NUMBER**

BM 80/96 ES-PO / Renewable Energy Sources from biomass and waste

## **2. TITLE OF THE PROJECT**

CONSTRUCT A WASTE TO ENERGY PLANT WITH GREATER AVAILABILITY, ENERGY SAVING WITH HIGHER EFFICIENCY, AND REDUCED ENVIRONMENTAL IMPACT RESULTING IN A LOWER FEE FOR MSW DISPOSAL.

## **3. CONTRACTOR**

*Constructions Industrielles de la Méditerranée (CNIM)* as expert in Municipal Solid Waste (MSW) with energy recovery construction and operation, and *SENER Ingeniería y Sistemas, S.A.* as Engineering Company for the designing and engineering development of the project.

## **4. AIM OF THE PROJECT**

Build a WTE plant with increased availability, improved electrical output and generation efficiency, and with higher efficiency in energy recovery from biomass and waste, thereby making possible a lower fee for MSW disposal.

All those objectives were to be met with a lower environmental impact while obtaining a reasonable economic result.

## **5. PROJECT LOCATION**

The plant is located in Basque Country (Spain). The plant has been erected in Bilbao Metropolitan Area in the province of Bizkaia.

## **6. PROJECT DESCRIPTION**

The project incorporates a new concept for generation of electricity from MSW which allows efficient power generation, efficient waste disposal and low environmental impact.

### **Main equipment includes:**

- a) 1 Refuse feeding system to the furnace.
- b) 1 Refuse furnace with boiler and saturated steam generation at 100 bar.
- c) 1 Flue gas cleaning system with addition of ammonia, lime and active carbon.
- d) 1 Gas turbine generator with 43 MW power output.
- e) 1 Heat recovery steam generator at 100 bars.

- f) 1 Steam turbine generator with 56,5 MW power output.
- g) 1 Main condenser and 1 auxiliary condenser.
- h) Auxiliaries for the thermal cycle such as cooling towers, feedwater, etc.
- i) 1 Distributed control system (DCS).

### **Technical details:**

#### MSW furnace and boiler steam:

- a) 30 tons/hour of waste disposal capacity.
- b) Saturated steam (315 °C, 100 bars).
- c) All exposed furnace tubes are coated with inconel 625 to reduce corrosion rates.
- d) 2 Auxiliary burners installed using natural gas or gas oil to maintain temperature above 850° for 2 seconds in all conditions.

#### Flue gas treatment from the furnace and Control of emissions

- a) NOx reduction with ammonia solution injected at 2 levels in the furnace.
- b) SOx reduction with lime slurry injection in the scrubbers.
- c) Dioxins, furans, and mercury reduction by injection of active carbon.
- d) Particles and dust reduction in bag house filter system.
- e) Redundant control emission monitoring system directly connected to the Environmental Department of the Basque Government.

#### Heat Recovery Steam Generator

- a) Thermal power exhaust gases from the gas turbine.
- b) Superheated steam (538 °C 100 bar) to the steam turbine.
- c) Natural gas burners using fresh air to replace thermal energy in case of a gas turbine failure.

#### Gas turbine

- a) General Electric LM-6000 PD gas turbine generator of 43 MW.
- b) Low NOx emissions.
- c) Air inlet chilling system to fix air inlet temperature at 6-8 °C.
- d) 11 kV Brush generator.

#### Steam turbine

- a) General Electric-Nuovo Pignone steam generator of 56,5 MW.
- b) Two stage single reheat to improve efficiency.
- c) 11 kV Jeumont generator.

#### Control system and Electrical Net work

- a) Distribution Control System (DCS) supplied by General Electric.
- b) 11kV to 132 kV electrical park for connection to the grid.
- c) Underground connection to the grid 1200 m with 4 cables 1 in reserve.

#### Power and efficiency of the plant (expected)

- a) Gross power output: 99,5 MW
- b) Net power output: 94,0 MW
- c) Total electrical gross efficiency: 44,7 %
- d) MSW electrical gross efficiency: 44,4 %

Energy saving (expected)

- a) The design achieves an additional electrical output of 12 MW over similar combined cycle and waste incineration plants
- b) Equivalent energy saving of 25.000 t/year of fuel.
- c) Total energy saving of 57.000 t/year of fuel considering biomass thermal energy of the wastes.

**7. PROJECT RESULTS**

Results obtained during continuous operation, taken at the same time are as follows:

Waste data

- a. Low Heat Value (LHV): 8.000 kJ/Kg
- b. Consumption of wastes: 33,08 tons/h
- c. Thermal energy from wastes: 73,52 MWh

Consumption natural gas in the Gas Turbine plus Heat Recovery Boiler

- a. Consumption of natural gas (GT+HRB): 13.870 Nm<sup>3</sup>/h
- b. LHV of natural gas: 38.992 kJ/Nm<sup>3</sup>
- c. Specific consumption of gas per KW generated: 1,309 ter/kWh

Energy generation

- a. Gross energy: 99,176 MWh
- b. Net energy to the grid: 94,431 MWh
- c. Internal consumption read: 4,745 MWh (5,200 MWh with externals)
- d. Net power (grid connection)Gas turbine read: 40,111 MW
- e. Net power (grid connection)Steam Turbine read: 54,320 MW

Efficiency of the plant:

- a. Total Electrical Gross Efficiency: 44, 31 %
- b. Fossil fuel energy saving: 47,75 % (thermal plant combined cycle with natural gas comparison).

Energy saving:

- a. Total Energy Saving of 93.000 ton fuel oil per year.

**8. INVESTMENT AND FINANCING**

Zabalgarbi chose to build the project using the "Project Finance" model. This implies:

- A high debt to investment ratio.
- Financing and debt payment agreed prior to start of construction.
- No parent company guarantees from the shareholders of Zabalgarbi.

- Contracts in place between the parties prior to signing Zabalgardi arranged a line of credit for 129 million euros to be drawn in three parts during construction and repaid over the following 18 years.

The shareholders made the capital investments and along with subsidies available a total of 55 million euros available to start the project. The European Union by way of the Thermie program added another 2.4 million euros. A further 0.6 million euros will be provided by Thermie following project completion and final report.

The absence of parent company guarantees from the shareholders made necessary firm contracts between the parties regarding construction, operation and life cycle costs. Studies were made to ensure that the project was economically and technically viable for the time required to repay the financing.

These studies were undertaken as part of "Due Diligence" process by the banks and carried out by a team of experts familiar with similar projects to ensure viability.

## **9. ENVIRONMENTAL IMPACT**

Bizkaia WTE plant was designed using as a guideline the German environmental standard B1SchV/90 and to comply with the proposed EU Directive regarding waste incineration (EU 2000/76). The plant currently complies with the conditions applied by the current directive, Real Decreto 653/2003 (Directive 200/76/CE).

Emissions values measured during the startup until present comply with the European Directive, due to:

- NO<sub>x</sub> reduction with ammonia solution injected at 2 levels in the furnace.
- SO<sub>x</sub> reduction with lime slurry in the scrubbers.
- Dioxins and furans reduction by injection of active carbon.
- Particles and dust reduction in bag house filter system.

Following an environmental impact study and based on the Environmental Protection Program for the plant, Zabalgardi takes samples in order to estimate immissions in the surroundings. Samples are taken every three months for air, superficial water, soil and vegetation. Comparing results from the period 2002 until mid 2004, with those taken following start up no impact of the plant operation has been noted.

As stated in the Project, CO<sub>2</sub> emission per KW generated will be indeed, 204.500 t/year less than the emission of a conventional energy generation plant.

## 10. POTENCIAL AND CURRENT USERS

Currently 95 municipalities with 650.000 inhabitants in Bizkaia province use the facility. This represents almost full capacity of MSW in the plant.

The entry of several other municipalities in the province to the plant, currently in negotiation, will complete the capacity for the plant.

It's foreseen to receive rejected wastes part coming from some other waste recovery plants (paper, plastics...).

Other wastes from commercial and industrial areas classified as non hazardous wastes could be received if they comply with the specific procedure for waste reception in the plant. This procedure has been approved by the Environmental Department of the Basque Government.

It's been estimated that the energy produced represents 30% of the household consumption in Bizkaia province.

## 12. PAYBACK TIME OF THE PROJECT

Based on the data thus far collected we are able to demonstrate we will comply with the financial model proposed, have a TIR greater than 8.5%, and a payback time of 11 years.

## 13. MANUFACTURERS AND SUPPLIERS

SUPPLIER	SUPPLY	SUPPLIER	SUPPLY
ABB POWER TECH.	Transformer swithyard 132kv	METALDEZA	Metallic structure
ACIEROID	Metallic pannel	MIGUEL CARRERA Y CIA	Compressed air
AEROMECÁNICA STRANICH	Bag filter	MONCOBRA	Piping
AMAL	Scrubber; Lime slurry; ash silo	NUOVO PIGNONE	Steam turbine
AXIMA	Regulation metering station	ONDEO	Water traitment plant
BALCKE BALTOGAR	Fan; refrigeration tower	SIEMENS	Electric control system
BUREAU VERITAS (Es)		SIEMSA NORTE	Electrical erection
CNIM	Waste boiler	UTE ARMULAZA	Civil work
FERBECK & VICENT	Chimeney		
GE Energy (Norway)	Gas turbine		
GIROPES	Weighbridge		
JASO	Grane		
JEMA	SAI		
LOINTEK	Heat recovery boiler		

**BASIC SCHEME OF THE PLANT**

