

The “shore” way to clean energy

A combined heat and power generating plant in Władysławowo, Poland

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Many production processes have traditionally been geared towards a single end-product. Any by-products were primarily considered waste, and if a use could be found for them at all, this was usually coincidental and not by design. Increasing environmental awareness and rising energy costs are sparking a re-think, but rarely can a by-product that was previously discarded be put to not one but four good uses.

A drilling platform off the Polish coast used to flare off the gas that was produced with the oil. Meanwhile, the coastal resort of Władysławowo was heated by a multitude of coal and oil-fired plants that had detrimental effects on the local air quality. What better use for the waste gas than to replace these units by a combined power and district-heating plant? ABB was entrusted with supervising the construction and also with delivering the control system and much of the electrical equipment. Besides providing electricity and heat and improving air quality, the new plant on the beach supplies LPG (liquefied propane gas) and gasoline to other users. Not bad for a product that would otherwise be going to waste!

Ingenuity and energy

The idea of constructing a combined heat and power generating plant right on the beach in a tourist town on the shore of the Baltic Sea emerged in 1997. A thorough technical and financial analysis was performed demonstrating the economical and ecological viability of the investment. The results of this study were so convincing that the proposal easily attracted the financial support required.

The project's cost exceeded \$ 56 million. It was funded by shareholders' loans and loans from participating institutions that finance ecological projects such as the Ecofund Foundation, the National Fund for Environmental Protection and Water Management, and the Bank for Environmental Protection.

The construction of Władysławowo's combined heat and power generating plant finally resulted in:

- elimination of about 120 local coal- or oil-fired boilers and boiler houses
- reduction of discharged pollutants (dust) by 134,000 tons per year
- decrease of solid waste as a result of replacing solid fuel (coal) with gas
- reduction of sulfur dioxides, carbon dioxides and nitrogen oxides

How it all came about

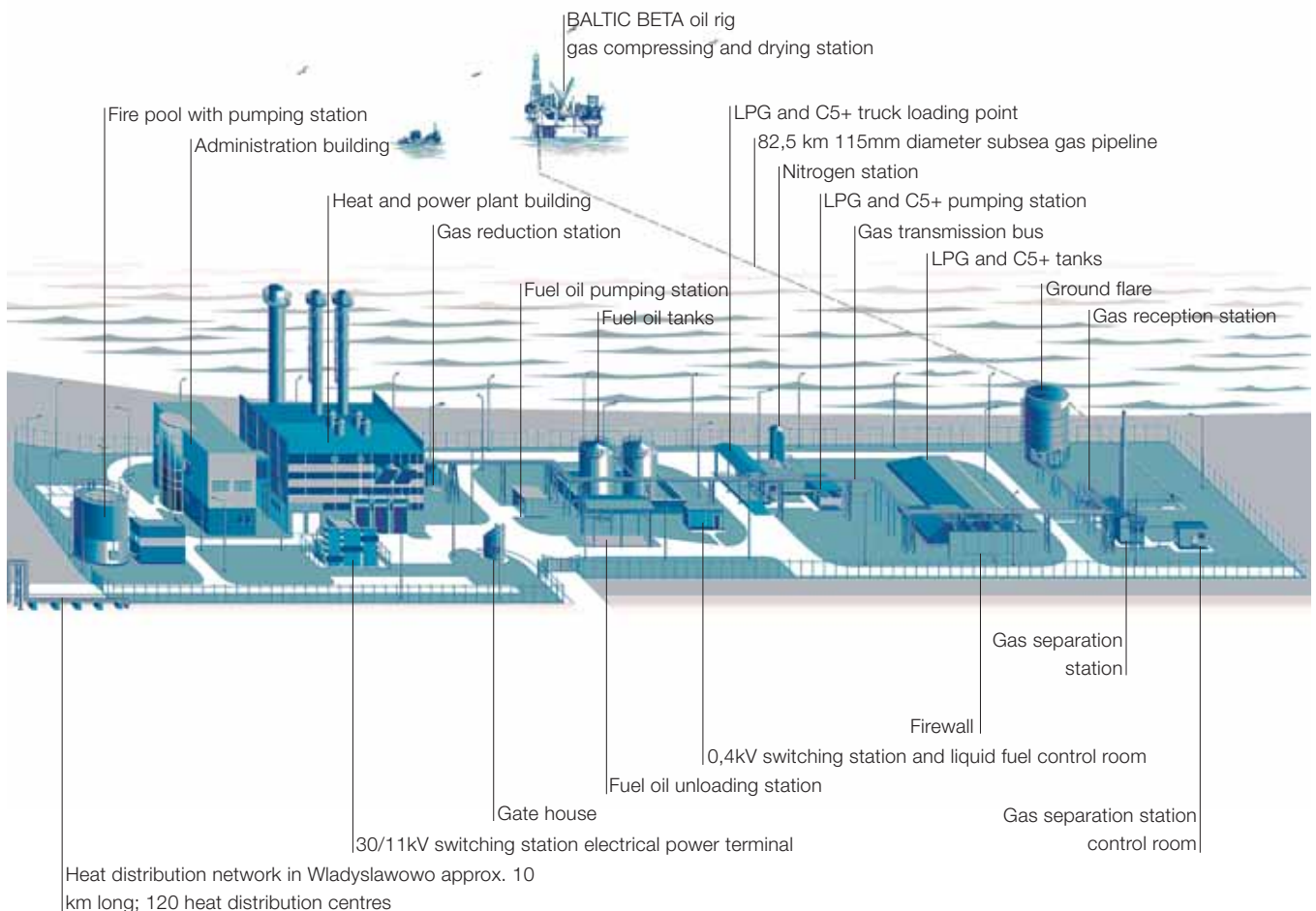
The main idea of the project was to utilize 100,000 m³ of gas that was unproductively flared every day at the drilling rig in the Baltic Sea – a waste with negative environmental consequences. Only a small part of this (10 percent) was used for the power requirements of the rig. The heat and power generating plant in Władysławowo turned out to be a unique enterprise in the national or even European region. It utilizes the natural gas associated with the extraction of crude oil. At present, about

100,000 m³ of natural gas per day are supplied via a newly laid submarine pipeline.

In 2001 Energobaltic, the company that was established to carry out that investment, was looking for a contractor to manage the project. The selected company would have to supervise the construction of an installation combining three different technological processes. These processes are the transport of gas from the drilling rig to the shore, gas treatment on the shore and safe and reliable production of heat and power for local requirements.

Following negotiations with several international companies of renown, Energobaltic conferred responsibility for the project's supervision and execution on ABB Zamech Gazpetro in February 2002. For more than a year a team of engineers and experts was

1 A single plant providing electricity, district-heating, LPG and gasoline – from gas otherwise wasted



engaged in the coordination of all project activities. These included the process of appointing suppliers and contractors through tendering, verification of technical documentation on a current basis, supervision and coordination of work at the construction site, supervision of start-up and commissioning of the sites and the settlement and financial controlling of the project.

All technological processes in the complex are connected to a central control system built on elements of ABB's Advant process control architecture.

The project was divided into two main phases. The first included construction of the heat-generating plant and district-heating system. The target was to start up the heating system no later than mid-September 2002 so that heat could be available for the Winter of 2002/03 heating season. Despite the very short period allowed for construction (only seven months) the deadline was met and heat supplies to the town officially commenced on the 18th of September 2002.

The second implementation phase included the construction of the gas supply from the offshore drilling-rig to the mainland. It also included the realization of the on-shore gas treatment and storage facility and of the gas turbines with waste-heat boiler.

The whole project was complete and went into full operation on the 30th June 2003.

Working to protect a sensitive location

The heat and power generating plant is situated in the industrial and harbor area of Władysławowo.

Władysławowo is located at the foot of the Hel Peninsula, near the Nadmorski Coastal Landscape Park. The facility has been constructed on the site of a disused coal-fired boiler and sewage treatment plant. Particular consideration was given to the aesthetic design to ensure that it blended well with the local environment. The town of about 12,000 inhabitants is a health resort. In the summer season, the number of inhabitants increases five-fold.

The waste-gas that was previously flared at the rig turned out to have an interesting chemical composition. It included only 45 percent methane but was very rich in heavy hydrocarbons – over 20 percent propane and butane, and its calorific value amounted to 54 MJ/Nm³. Therefore the heat and power generating plant was extended by a gas refining facility, where liquid fractions propane-butane and chemical gasoline are separated from the so called “wet gas”. This represents an important element of the project in terms of income. CHP Władysławowo therefore now manufactures four products: electricity, heat, LPG and gasoline (C5+). After separation of LPG and C5+, a light gas (a mixture of methane and ethane) is

transferred to feed gas turbines and water boilers. Liquefied propane-butane and C5+ is stored and sold.

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Because of its atypical chemical composition, the waste gas associated with the production of crude oil had to undergo an initial treatment on the offshore “Baltic-Beta” drilling rig ² in the Baltic Sea (ca. 75 km from the shoreline). Due to the presence of significant quantities of propane and butane the gas is considered to be a “wet” gas – it is transferred under very high pressure. After drying the gas and compressing it to up to 130 bar (so called “dense phase”), the gas is transferred by undersea pipeline to the gas separation station in the heat and power generating plant in Władysławowo.

The most interesting element of the project is the system of gas supply to the shore. The gas flows through a pipeline laid under the sea bed. The line measures 82.5 km in length and 115 mm in diameter and reflects state-of-the-art technology. Flexible steel pipes with polyethylene coating were unreeled from a multi-purpose vessel

² Initial treatment of the gas on board the “Baltic-Beta” drilling-rig – previously this gas was wastefully flared off



³ The gas pipeline was reeled out in 11 km sections



Ingenuity and energy

3 (similarly to electrical energy cables) in ca. 11 km sections. They were joined and positioned with the help of precise marine navigation systems. The pipeline was then buried using special marine equipment.

All technological processes in the complex are connected to a central control system 4 built on elements of ABB’s Advant process control architecture. It connects to all local control systems as well as the safety system that ensures the secure operation of the whole installation. The heat and power generating plant on the shore and the off-shore drilling rig are connected by satellite, providing personnel at both sites with continuous access to all necessary information. In fact, the control system supervises all process stages, both on- and off-shore, with the exception of the oil-drilling stage itself.

ABB also provided numerous electrical devices 5 for Władysławowo. These include drives for the automation system, medium voltage switchgear and power transformers for the drilling rig and the electric motor for the compressor on the drilling rig.

Winning by not wasting

The operation of CHP Władysławowo enabled the utilization of 100,000 m³ of gas per day – gas that was previously flared unproductively. This eliminates the use of ca. 750,000 tons of coal per year.

The investment has made it possible to shut down about 120 coal/oil-fired

boilers and boiler houses with a total power of 18 MWt, and to supply ca. 76,000 MWh of electricity to the national power grid annually. Of the boiler houses closed, ca. 90 percent were coal-fired. Others were oil-fired units whose operating costs were much too high for their owners. Their replacement required the construction of a district-heating system. This was built with the latest pre-lagged technology.

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Besides a significant improvement in air quality, the intended ecological effect consists of limiting the use of coal, eliminating the inconvenience connected with rail and road transport of coal and its handling and storage, while also reducing the amount of solid waste produced by its combustion.

The implemented solution aligns with the latest trends in world power engineering solutions. It is also in accordance with the Polish power engineering law, which itself takes into account recommendations of the European Economic Commission, the Second Sulphur Protocol and the Framework Convention of United Nations (concerning climatic change).

The gas turbines have a joint generating capacity of ca. 11 MWe and heat

to a total capacity of 18 MWt. Two waste-heat boilers, each with a capacity of 8.85 MWt, use hot waste combustion gases from the turbines to heat water, which in turn is used to transfer heat to the district heating system. Control systems regulate the boilers to meet the demand of Władysławowo accurately.

Three emergency back-up water boilers with a capacity of 5 MWt each are maintained as reserve in case of any stoppage of the gas separation plant or gas turbines. This helps ensure that the inhabitants of Władysławowo always have a secure source of heat.

The ABB experience

The execution of this complex investment extended the knowledge and competence of ABB Zamech Gazpetro’s engineers. It required the application of much technical know-how and creativity to combine the various sophisticated technological processes and achieve the fully automated and safe operation of the whole installation.

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4 The control system is based on ABB’s Advant architecture



5 Metering technology from ABB – a small but important component

