GEOTHERMIE
District heating scheme

SOUTHAMPTON
United Kingdom

Geothermal energy takes a rather subordinate position among renewable energy sources. Nevertheless, geothermal energy is available in many places and independent of the different seasons of the year, even if some regions do have a higher potential than others. In Southampton after a district heating and cooling scheme based on geothermie has proved its reliability and economical viability in more than ten years of operation.

THE CITY

The Southampton covers an area of 50 square kilometres and has a population of 212,000 people. It is situated centrally on the south coast of England.

The city is the biggest centre for shopping and business on the south coast and also regional centre of employment, learning and leisure serving South Hampshire. Southampton's car and train links are well established as its air and sea connections to the rest of Europe. It may be known through its parks which make Southampton the greenest city in the UK.

Climatic data:

Degree days (Basis 15.5 °C):	2247
Annual mean temperature:	10.8 °C

CONTEXT

Southampton, member of Energie-Cités, aspires to be one of the finest cities in the U.K. It wishes to offer a high quality of life to all its people including the opportunity to live now and in the future in a sustainable way. One vital area in which the Council is leading by example is in the use of energy. It seeks to reduce harmful emissions and greenhouse gases from energy production, conserve precious stocks of fossil fuels and maximize energy efficiency. The City's energy scheme contributes to all these aims at a competitive price for businesses and an affordable price for householders. The Council believes that it must not only advocate sustainable development, but demonstrate its commitment.

Therefore Southampton has led the way in the development of the first geothermal energy and combined heat & power (CHP) district heating and chilling scheme in UK. Its geothermal credentials were first established in the 1980's when United Kingdom Department of Energy undertook a research and development programme to examine the potential of geothermal aquifers in the UK. However after initial successful drilling a well in the Wessex Basin in 1981 the well in the centre of Southampton was deemed too small to develop the planned large scale district heating scheme. For this reason the project was abandoned by the Department of Energy. The City Council refused to let the project fall and, after considerable effort, found Utilicom Ltd, energy management company, as a partner with whom to develop a scheme.

EXPERIENCE OF SOUTHAMPTON

The Well

The Department of Energy working with Southampton City Council and the Energy Technology Support Unit drilled a well in the centre of Southampton itself. The water was found at a depth of nearly 1 800 meters and at temperature of 76 °C and it rises naturally in the well to within 100 meters of the surface. It is then pumped to the heat station. The temperature of the water on surface is 74 °C. Hot brine from the geothermal well today provides 18% of the total district heating mix. Fuel oil with 10% and natural gas with 70% account for the remainder.

The Scheme and Features

Construction of the project commenced in July 1987. Soon after scheme started, the Council realised that once the heating mains infrastructure went in place, it was possible to link in any other low grade heat. The Council and Utilicom therefore decided to initially add a small-scale Combined Heat & Power Generator (CHP) and absorption heat pumps. From those small beginnings the CHP element has grown considerably. District chilling was added in 1994 and since then there has been a rapidly growing demand for chilled water for air conditioning.

Picture 1. Mains being laid alongside the Civic Centre

The district heating scheme in Southampton closely resembles a huge domestic central heating system. Hot, treated water circulates underground from the heat station to customers in the city centre and it then returned for re-heating. A closed loop of high-tech pipes distributes heat from all Southampton's energy sources around the city centre. For each user, a pair of pipes, with isolating valves and a heat meter, replace a conventional boiler. The chilling system circulates cooled water from the heat station through additional insulated mains.

Picture 2. The Heat Station

At the heat station, heat transfers from the brine to the hot water heat distribution system. The heat exchanger, through which the hot brine is passed, is working in conjunction with an absorption heat pump. It transfers the heat to clean water. The cooled brine, at about 28 °C, runs out in the sea. Power for circulation pumps and plant is generated at the heat station by CHP, which is recent 5.7 MW high efficiency, multifuelled generator. The station houses the heat exchanger, brine and water filters, heat distribution pumps, a CHP generator to meet the system's electricity demand, plus control and data monitoring equipment. Surplus power is sold to the National Grid. The waste heat from the CHP generators is utilised by the absorption heat pump technology, in the winter, with geothermal

well and in the summer to supply the district chilling system. During periods of exceptionally high demand, extra heat can be provided by back-up boilers.

The Project Partners

The *Council* made available very valuable city centre land for the well, wellhead equipment and sizeable heat station building. It granted licences and wayleaves for laying distribution mains, and assisted with the planning processes. It established a multi-disciplinary project team, with representatives from engineering, planning, legal & finance officers to assist in development, and made bids to the European Union for financial support in developing the scheme. *Utilicom's* obligation was to finance, construct and operate the scheme's initial development, and it had a reciprocal obligation to co-operate wit the Council in later, wider development.

The Customers

At the time of initial investment the company had only one customer, the City Council, with whom they had signed a contract. The list of city customers is now extensive and varied, includes four hotels, one of them is five-star De Vere Grand Harbour Hotel which takes hot water for heating and chilled water for air conditioning, the BBC's regional radio and television studios, a food superstore, a large college campus, numerous office complexes, a vast swimming & diving complex, a major city centre hospital and one of the largest shopping malls in the U.K.

Picture 3. The West Quay shopping centre under development

The Statistical and Technical Data

The district scheme after ten years of operation delivers more than 30,000 MWh of heat each year alongside 4,000 MWh of electricity sold from the generating plant plus 1,200 MWh of power providing chilled water on tap. The CHP engine is saving over 10,000 tonnes per year of CO_2 emissions in the process. The scheme serves 20 major consumers in Southampton city centre. Circulating water is pumped around the city through 11 km of insulated service pipes, within a 2 km radius of the heat station and just 0.5 °C/km in temperature loss.

The Finances

Investment in the project has been made by private finance (IDEX 4M euros[1]), bank loans (6.07M euros) and from consumer connection charges (2.4M euros). In addition to this, four grants have been awarded, details as follows:

- Two EC Thermie grants for the geothermal well development and surface exploration, totalling 1 111 000 Euros.
- An EC Thermie grant of 115 000 Euros for the demonstration of an absorption heat pump working in conjunction with the geothermal well.
- An EC Thermie grant of 1 111 000 Euros for the demonstration of a new form of high efficiency gas diesel engine in the scheme.

This scheme offers substantial capital and operating cost saving to all consumers.

[1] Exchange rate is 1£=1.59785 Euros

EVALUATION AND OUTLOOK

After ten years of operation the district heating and cooling scheme in Southampton has proved it's reliability and economical viability. It is now clearly apparent that co-operation was a main factor which contributed to the success of the Southampton scheme. Co-operation between the public and private sector, between the City council and its development partner Utilicom and co-operation with European Union and the U.K. Department of Energy.

Encourage by the success of the geothermal project Southampton City Council and Utilicom have developed new projects:

- An innovative ice storage system will be added to meet peak loads from development. The ice store will be filled with ice at night using electricity from CHP and cooling drawn off during the day.
- Utilicom and Southampton City Council have secured a Government Single Regeneration Budget grant to develop a major new district heating scheme to the North West of the city (the Single Regeneration Budget is a major Government initiative to improve deprived communities). This scheme is to be powered by a large 48 MW CHP, gas turbine engine. The scheme will deliver low cost heat supplies to businesses schools and over 3,000 council homes. This scheme meets almost one third of the City's target for CO_2 reductions at a stroke, saving an estimated 80,000 tonnes of carbon emissions a year.
- An anaerobic Digestion plant is planned for the third millennium. This advanced 'green' technology processes household waste to produce a bio-gas that can be burned in further CHP generators, providing environmentally friendly heat and power to the city.

FOR FURTHER INFORMATION

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