Rapid introduction of ATES into Flanders (Belgium) through exchanges of experience with the Neterlands

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RAPID INTRODUCTION OF ATES INTO FLANDERS (BELGIUM) THROUGH EXCHANGE OF EXPERIENCE AND EXPERTISE WITH THE NETHERLANDS

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ABSTRACT

In the autumn of 1996, the first Aquifer Thermal Energy Storage System was put into effect in Flanders (the northern region of Belgium). The project is a cold/heat storage system in an aquifer to serve the CERA Bank headquarters in Leuven. The project is the first concrete proof of the intensive marketing efforts that VITO has been making on behalf of the Flemish government based on know-how built up in the Netherlands.

In 1994, the marketing activities were launched with a study on the potential for underground thermal energy storage. The conclusion of the study was that cold/heat storage in aquifers would be the most convenient technology for thermal energy storage applications in Flanders.

After the study, marketing activities have resulted in two projects, a number of feasibility studies and a broader awareness and knowledge of ATES in the Flanders region.

The development of ATES in Belgium has demonstrated that an intensive exchange of knowledge and experience with other countries, especially the Netherlands, can speed up the acceptance of a new technology and its introduction onto the market.

1. BELGIUM MARKET DEVELOPMENT OF ATES

The introduction of ATES in Belgium started in 1994 with a study on the feasibility of ATES in Flanders (Northern Region of Belgium) at the request of the Ministry of Economic Affairs of Flanders (Dirven, 1995). This study included a survey of energy storage systems and related activities in Europe (Germany, Switzerland, Sweden and the

Netherlands). The purpose was to determine which system would be the most convenient for the Flanders region in considering of the geological situation, climate and economics. The collection of data was made possible through the participation of Belgium in the Annex 8 experts' working group on the IEA Implementing Agreement Energy Conservation through Energy Storage and in particular through the bilateral co-operation between Belgium and the Netherlands.

The conclusion of the study (Dirven, 1995) was that cold/heat storage in aquifers would be the most convenient technology for thermal energy storage applications. This conclusion was largely based on know-how built up in the Netherlands where the climate and, to some extent, the geological situation are comparable with those in Flanders. Besides a hydrogeological analysis of the Flanders region demonstrated that 65 % of the underground will be suitable for ATES.

In the Netherlands, ATES has been in use since the mid-80s, but it was not until 1990 that commercial applications began to expand. Now more than 40 projects are operational. In addition to use in the building sector, there is growing interest from industry.

2. COLD/HEAT STORAGE IN AQUIFER

There are three potential categories of users of ATES: industry, agriculture and large buildings (offices, hospitals, ...). A market analysis (IF Technology, 1995) shows that the biggest and most profitable application of this technology is cold storage in large buildings, where it can replace chillers running on electricity. Not only can electricity be saved but also fuel by pre-heating of the ventilation air.

In large buildings the air-conditioning is controlled by air-handling units. The cold is usually produced by chillers and cooling towers; fossil fuel burners deliver the heat. The cold/heat storage system used cold groundwater. In summer, when cooling is needed, groundwater is withdrawn from the cold well to cool the water system of the building through a heat exchanger. This groundwater will heat up and is injected into the other well, called the warm well. The building water system cools the incoming air in the air-handling units. In winter the system acts in reverse. Groundwater is withdrawn from the warm well, heating up the water system of the building for pre-heating of the cold ventilation air in the air-handling units. The cooled groundwater is then injected into the cold well for later use during summertime. This double action means the system has no need for an additional cold source like a chiller or a cooling tower: in the summer it uses winter cold to cool, and in the winter it saves on heating of the building by using summer heat. Furthermore, cold/heat storage in aquifer is a flexible system, it can be integrated into an existing air-conditioning installation to optimise the working conditions of the chillers.

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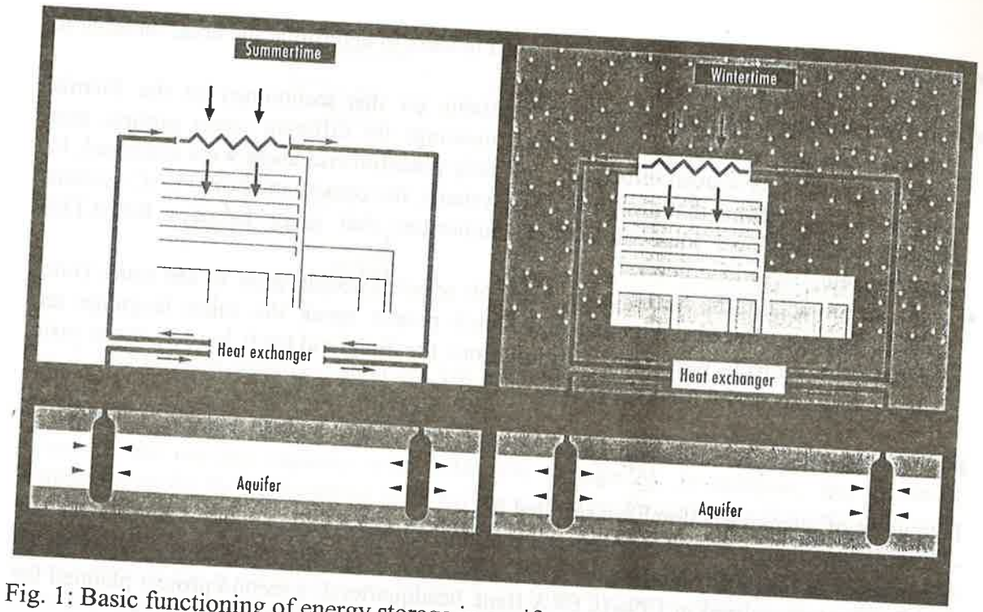

Fig. 1: Basic functioning of energy storage in aquifers

3. ECONOMIC PROSPECTS

Table 1 illustrates how cold/heat storage has its most profitable application in industry, offices and buildings. On average, a pay back period between 3 to 8 years can be expected in the Netherlands. The other applications are less profitable, but could become more interesting if fuel and electricity prices were to increase (IF Technology, 1995).

Table 1: Economic prospects

SECTOR	ECONOMIC PROSPECTS
Industry	cost-effective at short notice (< 5 years)
Offices and buildings	in many cases already cost-effective
Agriculture	Very variable depending on sub-sector

4. IMPLEMENTATION OF ATES IN BELGIUM

4.1 Marketing strategy in Belgium

The marketing strategy of VITO for the implementation of the technology of cold/heat storage in aquifers is based on the following items:

- the gathering of available knowledge and practical experience from the Netherlands;

- the production of a hydrogeological map of Flanders to determine the areas suitable for cold/heat storage in aquifers;
- the dissemination of the information available on this technology to the Flemish market. Through workshops and selected meetings for different target groups, more than 400 people have been informed. Not only potential end-users were informed, but also consultancy firms that design HVAC-systems, the constructors of HVAC-systems, branch organisations, local authorities, authorities that grant licences for ATES-systems, etc.
- visits to projects in the Netherlands. Over 60 selected people went to see some Dutch ATES projects. Because Flemish and Dutch people speak the same language and because the projects were only 100 km from the Belgian/Dutch border, these visits were a very successful marketing tool.

4.2 Results of the marketing action

Two years of intensive action have resulted in:
- a wide knowledge of ATES within the Belgium market;
- a number of feasibility studies;
- a first project realised in 1996 (CERA Bank headquarters), a second project planned for 1997 (KLINA Hospital);
- five other potential projects open for discussion.

The two first projects were supported by the Ministry of Economic Affairs of the Flemish Government with a subsidy of 35 % of the total investment for the ATES system.

The market prognosis is that 15 projects will have been realised by the year 2000. This number of projects depends heavily on the success of the first projects. If these are unsuccessful for whatever reason, the market will be destroyed for the next ten years. There is only one chance to effect a good market introduction (Bakema, 1995).

5. ATES PROJECTS IN BELGIUM

5.1 CERA Bank headquarters

The CERA Bank headquarters building in Leuven was constructed in 1991. More than 1800 persons work there. After five years, this relatively new building already needs additional cooling because the working population has increased and more computers are being used. This has elevated the amount of internal heat production. The original system consisted of ice buffers and chillers (Figure 2). The condensers of the chillers are cooled with water from a pond in front of the building. The pond was found to be too small, so the temperature increased. This resulted in the condensers running at too high a temperature and subsequently the chillers dropping out.

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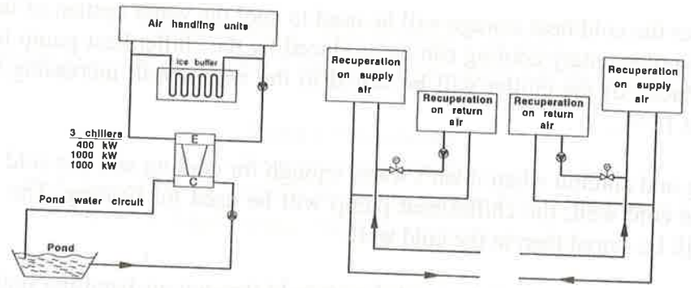

Fig. 2: The original cooling system of CERA Bank before ATES

A cold/heat storage system has been integrated into the existing infrastructure and increased the cooling capacity with 1000 kW (Figure 3). In summer, the incoming ventilation air for the air-handling units will be cooled by groundwater from the cold well, and secondly it cools the pond water flowing to the chiller condensers. During wintertime, the cold well is loaded with cold from the ventilation air (pre-heating) and when the temperature of the pond water goes below 6 °C from the pond. Installation of the ATES system produced a substantial energy saving because the chillers will be used less and will run with a higher COP, plus a reduction of the heating costs of the building during winter through pre-heating of the ventilation air. The total cost for adding this ATES system to the cooling system amounts to US $ 0.65 million. During the winter of 1996-97 this system will be operational and it will be the first building in the world to have a cooling system that integrates ATES with a cooling system based on chillers and ice buffers.

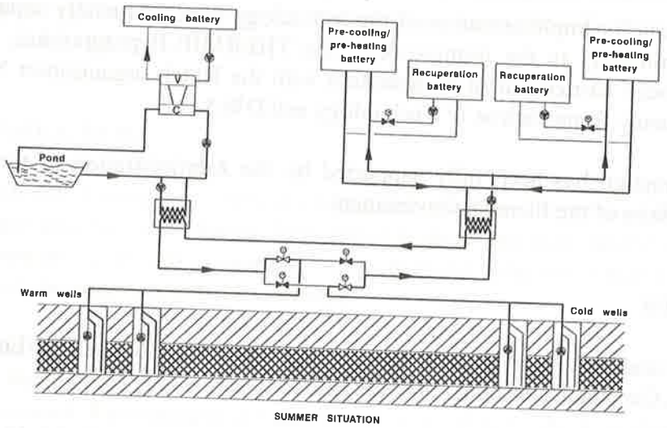

Fig. 3: Integrated ATES system of CERA Bank

5.2 KLINA Hospital

In 1997 activities related to the installation of an ATES system will start in the brand-new KLINA Hospital with a capacity of 440 beds. The ATES system will be coupled to a chiller/heat pump installation.

During summer the cold/heat storage will be used to cool the water system of the hospital, if necessary supplementary cooling can be produced by the chiller/heat pump installation. The heat produced of the chiller will be stored in the warm well, increasing the aquifer temperature to 18 °C.

During spring and autumn when it isn't warm enough for cooling and not cold enough for loading of the cold well, the chiller/heat pump will be used for heating. The cold of the evaporator will be stored then in the cold well.

During winter the cold well will be loaded with cold through air-handling units when the outside temperature will be below 6°C. The mean withdrawal temperature of the cold well is 9°C.

6 CONCLUSIONS

The fast market introduction of ATES in Belgium has been realised through an intensive exchange of knowledge and experience with other countries through the participation of Belgium in Annex 8 (Implementing Underground Thermal Energy Storage System) of the IEA Implementing Agreement of Energy Conservation through Energy Storage and through the bilateral co-operation between Belgium and the Netherlands within the framework of the EC THERMIE-B programme.

ACKNOWLEDGEMENTS

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