NATO-CCMS PROGRAMME - GEOTHERMAL ENERGY

HOT WATER FROM SEDIMENTARY BASINS

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HOT WATER FROM SEDIMENTARY BASINS

On the 9-10 June 1976, I attended a meeting in Paris on the subject of the uses of hot geothermal water from sedimentary basins. The meeting was arranged by the French Government as part of the NATO-CCMS Programme on Geothermal Energy. The meeting was of a different format from previous meetings in this series, since it consisted entirely of a technical presentation by French personnel, both industrial and governmental. There was no discussion of any possible cooperative programmes, nor was there any provision for the description of current work by any other country.

The first day and a half consisted of presentations in the conference room and the last afternoon was occupied by a visit to two geothermal installations in the outskirts of Paris. Delegates were presented with copies of two reports, first a major publication under the title "Potentiel Géothermique du Bassin Parisien" containing a document of over 100 pages and a series of maps showing reservoir thickness, depth, temperature, porosity, permeability, etc. The second is entitled "La géothermie-chauffage de logements", and is more of a public relations document. In order that these reports might be discussed with personnel from the oil industry in Canada, I have asked for translations to be made.

M. Sangnier of the Délégation Générale à la Recherche Scientifique et Technique opened the meeting and acted as Chairman throughout. Mr. Willis of U.S. ERDA also made a few comments on behalf of the U.S.A. as pilot nation of the Geothermal Programme

and on behalf of all guests. The points recorded here are in the order in which they were presented at the meeting, and no attempt has been made to sort them into any more logical order. M. Sangnier opened the meeting by outlining the four major problems of the use of Geothermal Water from Sedimentary Basins and he listed these as; (1) the finding of the resources, (2) the analysis of the nature of the water including the salinity and the means of disposal, (3) the legislation that governs the use of hot water from the ground, since current legislation in France covers the use of fresh water but not heat from the earth and (4) the promotion of the techniques and the encouragement of industrial agencies to become involved. Mr. Willis commented in his opening remarks that ERDA is preparing a plan to guarantee loans by banks to fund geothermal projects. It is expected that the amount of money involved will be M$200 per year, and the object of this is to attract capital to geothermal development and to establish investor confidence.

M. Maget described the geological Setting of the sedimentary basins and the methods used in the early stages to obtain information. He also pointed out that there are several areas of France where geothermal resources are being sought, but the three major ones are the Paris Basin, the Aquitaine Basin and the Alsace - Rhinegraben area.

Temperature and other data was recovered from existing records of oil and gas drilling. Temperature data had been obtained by three methods: measurement during drilling, measurement of flowing

water, and borehole logging after the end of drilling. An attempt was made to relate mud return temperature to hole temperature, but the differences were from 12°C to 18°C, and the results were not encouraging. Geothermal gradients were calculated where possible.

M. Olivet stated that it was necessary to produce 8-9 Mcal/hr from each pair of wells for economic operation. He stressed that use of these geothermal systems is very new and that there is no background of experience on which to draw. No aspects of the operation are yet clearcut and he expects a continuous process of learning for the next several years. Later on in the meeting he gave some cost figures for a specific development. Research is needed particularly into the effect of reinjection, the rate of depletion of heat in reservoirs, and the optimization of the spacing of wells.

Mr. Vuillaume briefly described some computer models of space-heating systems. For use with geothermal waters a heating floor panel using water from 40°C reducing to 25°C is preferable, since conventional radiators need water starting at 90°C and reducing to 70°C. Mr. Aureille described the technicalities of heat pumps. Heat pumps are brought into action when climatic conditions reach a certain point and the normal heat exchangers become incapable of maintaining the necessary heat to the buildings.

Mr. Gringarten described some of the technicalities of producing wells. The water in use contains 10,000 - 15,000 ppm of salt, with traces of hydrogen sulphide. The reinjection of the used water creates a cold region around the reinjection wells, which grows until it includes eventually the production well. This system has the

advantage that the cooled water will take up the heat in the rock itself whereas a single well with surface disposal of water would only produce the heat contained in the water. The spacing of wells has been chosen to provide production for 30 years. This was an arbitrary choice since it had to be a compromise between calculations of lifetime of equipment, amortization rate, etc. Unfortunately it will take 30 years to find out whether their spacing is correct. An experiment is going on in a shallow bed, working on a much smaller time scale, and it is hoped that this operation will confirm their calculations.

Mr. Goguel described briefly the legislation now before the National Assembly, and which is expected to be voted on this month. If the legislative process is not completed this month the bill will probably have to wait for one or two years. The bill is designed to create amendments to the Code of Mines of 1810 to cover the use of hot water. The present mining legislation is based on a list of substances to be recovered. Other substances are free to the owner of the surface rights. The French obviously consider it important that the heat from the earth should be specifically included in the legislation, probably because it is not a tangible substance like other minerals and cannot rely on precedent.

Mr. Chenevier gave some figures on production costs. A pair of production wells costs approximately 6,000,000 francs. There is a state scheme to bear the risk of failure in exploration wells for hot water. This plan was set up to encourage a development of geothermal resources since there is clearly more risk involved in the drilling of small numbers of wells for a new source than

there is in the drilling of large numbers of wells for a well-established resource. This scheme has operated for one year. He stated that the sum involved was 7 million francs in 1975, which will grow to 16 million francs in 1976 and probably to 25 million francs in 1977. It was not clear from his presentation whether these figures were the risk accepted or the payments made, and it was not possible to establish this. Six operations were begun in 1975 and the number of dwellings involved is 13,500. They hope to be able to provide heating eventually for 400,000 dwellings, many of which will be in the form of apartment blocks. Mr. Willis pointed out that the French assistance scheme amounts to an interest free loan that is repaid on success of a drilling venture, whereas the American system consists only of an indemnification of a bank against default by the borrower.

On the second day we heard detailed descriptions of the two installations that we were to visit. Mr. Beaudouin described the installation at Creil. The drilling programme was finished on the 6 May 1976. The original geological study was based on oil well data. Pumps are used in the production wells although there is some artesian flow, and complete reinjection is used to ensure pressure maintenance, to provide disposal, and to replenish the heat carrier. The spacing of the wells at Creil is calculated to provide heat for 40 years before cold water arrives at the production wells. There are two pairs of wells, each having a spacing of 1 km, and with a spacing of 1.8 km between the pairs. The temperature of the water is about 60^{O}C. Mr. Olivet stated that it was planned to heat 4000 apartments by geothermal water, 2000 of which are already built with heating pipes in the floors

using water at 52°C reducing to 41°C. The required supply is 200 m^3/hr. Common low temperatures in the area are 2°C. The minimum air temperature is -7°C, and peak leads are covered by supplementary power. Of the heat used 41% is provided by conventional heat exchanges, 26.4% by the heat pumps, 6.6% by the compressors of the heat pumps and 26% by supplementary sources. The excess cost of the geothermal installation over a conventional installation was given as 16,000,000 francs. Amortization of various components has been summarized to be less than 15 years, and the net saving after amortization was quoted as 0.84 million francs per year.

Mr. Lessieur described the operation at Villeneuve la Garenne. The heating of a very large apartment block containing 1700 units was originally achieved by heavy fuel oil. The first contact with the owner was in December 1974, the work of drilling and changes of installation ended in January 1976, and heating by geothermal resources began in March 1976. At this site the single pair of wells is drilled from the same platform. The collars are 10m apart, but directional drilling ensures that the two wells are 1000m apart in the producing formation. Much of the well casing used is of fibreglass. The production well flows by artesian action at 25 m^3/hr but by pumping 185 m^3/hr is achieved at a temperature of 55°C. It is estimated that the geothermal heat results in a saving of 2,250 tons per year of conventional fuel, but more electricity is used, resulting in a net saving of 54% of energy sources other than geothermal.

Brief descriptions were given of other projects in various states of planning and development, but not in the same detail as the two described above.

Contact with O.E.C.D. delegation in Paris. During the afternoon before NATO-CCMS meeting I visited the offices of the Canadian Delegation to OECD and spoke with Mr. Boxer on the subject of the IEA geothermal programme. There had been a meeting in Paris the previous week of the group concerned with small power plants. At this meeting it was stated by the Japanese that they were able to supply all requirements for small (5 megawatt) power plants for experimental use in areas under geothermal development. I have not yet been able to obtain any of the Japanese promotional literature but I will attempt to find out more about this because of the obvious benefits to possible CIDA programmes.

CONCLUSIONS

This meeting in Paris was particularly interesting in the light of the preliminary survey of temperature and permeability data in Canadian reservoirs performed during the last winter for this Department by Sproule Associates in Calgary. Within the tight limits of the project the Calgary consultant examined the temperature data and developed cross sections of some of the hotter parts of sedimentary reservoirs in western Canada. Highest temperatures in the sedimentary basins reach 180^{o}C, well above the temperatures found in the Paris basin, but unfortunately these high temperatures are found at great depth beneath areas of low population density.

The French experience is that the use of water at 60°C is economically attractive. It seems probable that similar developments could be undertaken in Canada but further study is required based on the French experience and the results of the contract to Sproule Associates. It is my intention to study the Sproule report in detail, in order to determine the appropriate direction in which to proceed with another contract.