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Heat Mains: Europe's Longest Sea Crossing

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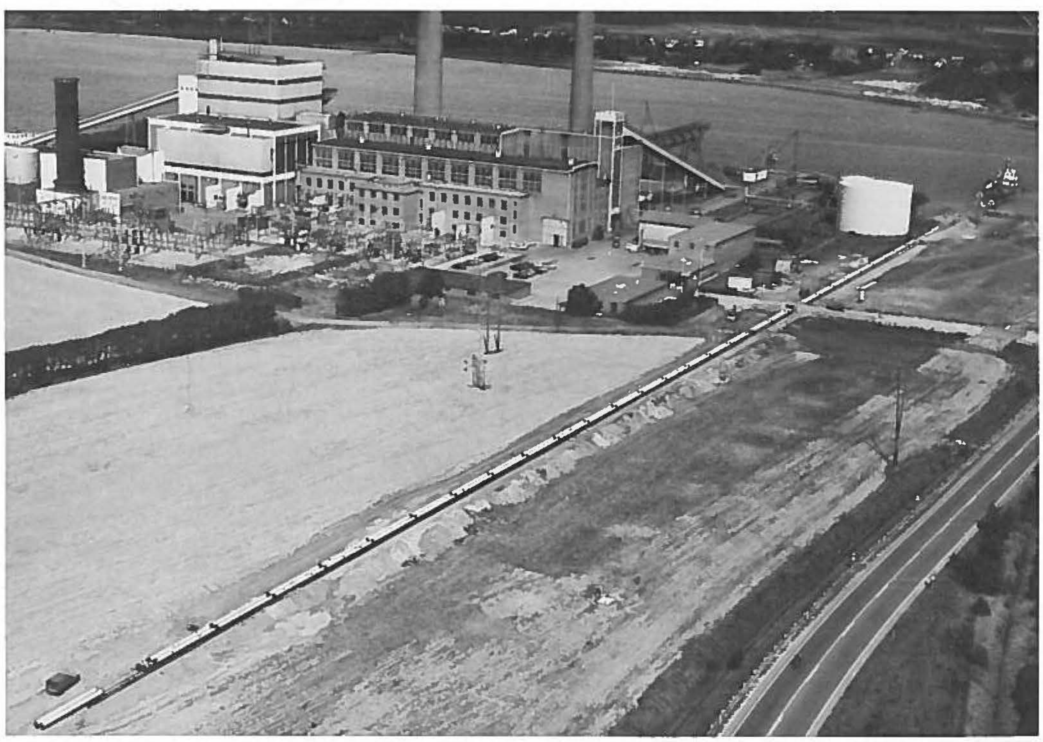
The most urgent part of many national energy conservation campaigns since 1973 is to use, wherever possible, the heat otherwise wasted from electricity generating stations, refuse incinerators and industry, instead of burning fuels. This has already resulted in a substantial increase in the scope and number of long distance hot water mains installations. There are well over 50 large-diameter, cross-country heat mains in use in the world as well as hundreds of miles of insulated systems in tunnels under rivers, estuaries, harbours and canals such as in Stockholm (Sweden) and Hamburg (Germany).

Heat mains laid under the sea have also become necessary in some cases so that "waste" heat, especially from conventional and nuclear power stations, can be distributed as piped hot water throughout a wide region to obviate the consumption of fuels for heating. It is claimed that the longest submarine heat mains installation is in Denmark, between a power station on the island of Masnedo and the mainland town of Vordingborg and outlying building complexes which include a hospital and industries. The substantial quantities of reject heat from the turbo-generator sets are now put to good use instead of being pumped into the sea. The station has been retrofitted for combined heat and power (CHP) production instead of generating electricity only, a comparatively simple, quick and inexpensive conversion that more than doubles the thermal efficiency. Vordingborg is already district heated, as are virtually all Danish towns and cities, so waste heat will replace that previously supplied by the three fuel-burning heat-only boiler plants. It is common practice to retain the thermal stations as substations after the changeover to CHP supplies, but often they also serve as stand-by plant and for peak-load operation. This technique obviates the high extra cost of oversized mains that otherwise would be necessary to cope with occasional short duration heat demands.

This pattern of development over the years, from local heat stations to an ultimate CHP station and peak-load plants, is typical of the step-by-step growth of "district" heating until whole conurbations use only residual heat. The designed maximum operating temperature is 110 C, but the usual flow temperature will be nearer 90 C.

The submarine sections of the twin heat transmission pipelines from Masnedo to Vordingborg are of the pipe-in-pipe air-gap type with steel casing. They are buried in a two-metre deep trench in the sea bed to be protected from shipping activities. The total length of pipes installed, excluding distribution and connections, is 7 km. *(Continued on 37)*



Combined heat and power station on the island of Masnedo, Denmark, showing the sea-crossing section of heat mains being prefabricated and assembled prior to installation under the sea.

(Continued from 34)

The long sections of the twin pipelines on the island and mainland are a plastic-cased pipe-in-pipe system without air gap. The service pipes are steel, insulated concentrically with rigid urethane foam within a thick, high-density polyethylene casing. It is a standard ICM (Mollerpipe) prefabricated system with mechanically strong and positive steel joint closures sinter-coated with polyethylene and cathodically protected. The appropriate British Standard is 4508 Parts 3 and 4.

The 360-metre long sea crossing system was developed by Kabel-und-Metalwerke of Hannover (Germany), better known for their Flexwell flexible heat cables. The dimensions are as follows: the steel service pipes are 324 mm bore with 7 mm thick walls and the concentric steel casing for each one is 457 mm bore, 10 mm thick with a substantial bitumen-glass coating and cathodic protection. The insulation thickness is 40 mm. It is a system closely similar to the one specified in BS 4508 Part 1.

The contractors with overall responsibility were the well-known district heating engineers, Bruun & Sorensen, who have had over half a century of district heating design and installation experience in Denmark and other countries.

All three firms are directly or indirectly members of the U.K. District Heating Association.

The decision by the Vordingborg Town Council to provide cheap heat for all by installing a heat mains pipeline across the sea to the power station was taken in the summer of 1977, and the project was completed in January 1979. This speed of decision-making, design and installation will be astonishing and enviable to those frustrated people in the few countries, such as Britain, with climates similar to Denmark, but still without that greatest of energy saving measures, CHP, in spite of—or because of—very many years of talking and paper work.

The Danish Government's policy, since 1973, to give highest priority to combined heat and power production and the use of other residual heat sources, is probably a main reason for this and many other similar projects being completed or in progress. Twenty-five per cent of the cost of such schemes is met by the Government which receives repayment in about four years, by savings in the cost of fuel imports. New legislation will make it mandatory in the future for waste heat supplies to be used, wherever available, for all heating and hot water supplies. There are the additional benefits, that this labour-intensive work of district heating/CHP and refuse incineration helps substantially to give nation-wide employment in several industries, and creates a much needed demand for steel products.

The method used to lay the sea crossing section of the mains is interesting. The twin pipelines were completely prefabricated, with the final assembly being carried out on the island's railway sidings as shown in the photograph. Three ships were spaced out along the sea route between the island and the mainland, and anchored at the required positions to locate the pipeline. The complete submarine sections, after the fixing of oil drum pontoons, were transported on low-loader railway trucks over the foreshore and then pulled into the sea by winches on the mainland. The flotation effect of the pontoons kept the pipelines half a metre below the water surface. The twin pipelines, after phased removal of the pontoons, were then lowered into the sea bed trench by means of cranes on the ships.

The total cost voted by Vordingborg Town Council was 25m. kr towards which they received a Government subsidy of 4.5m. kr.

Acknowledgements

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SUCCESSFUL INCINERATION PLANT

The municipal refuse-burning plant which generates process steam for sale in Braintree, Mass., a suburb of Boston, is now operating seven days a week—and in full compliance with environmental standards, verified by tests which were observed by the Environmental Protection Agency and the Massachusetts Department of Environmental Quality Engineering.

The refuse comes from the town's population of 35,000 people, and some private trash haulers who pay a $10 fee for dumping privileges; and additional sources are being sought for more burnable waste.

The plant's capacity is now nearly double what it was originally, and the increased capability was achieved without any major capital investment. Modification of original equipment resulted in an estimated saving of 94 per cent of what a new plant would have cost. A Boston consulting engineering firm, Metcalf & Eddy; and the company which supplied the boilers, Riley Stoker of Worcester, Mass.; worked together to reduce particulate emission to meet prescribed air quality standards.

The plant's two boilers were designed, when installed in 1971, to burn 120 tons of refuse per day; but have since burned as many as 192 tons per day each, during capacity testing. Each boiler can generate up to 30,000 lb/hr of saturated process steam for distribution to an industrial plant in the area.

Braintree is now contemplating several different plans for expansion of its successful facility—a phenomenon among municipal incinerators which have shut down because of failure to meet environmental standards.