

ENERGY  
CONSERVATION  
SYMPOSIUM

A presentation of experience in  
geothermal district heating, resource  
recovery systems and co-generation.

San Francisco, the 1st of May 1979.



**DANISH BOARD OF  
DISTRICT HEATING**

in conjunction with The Federation of Danish  
Industries, The Royal Danish Ministry of  
Foreign Affairs and The Royal Danish Consulate  
in San Francisco assisted by The U.S. Department  
of Energy and E.G. and G. Idaho, Inc.

## FOREWORD

Energy problems have assumed a central position of importance in the whole of the western world. The immediate causes of this are the later years' evaluations of oil production in the future. The latest move has been made by IEA (the International Energy Agency) who have informed every member country that it must reduce its oil consumption by 5%.

It is therefore obvious that on this basis interest must be concentrated on energy savings and new forms of energy sources.

In this connection, District Heating has assumed a leading role.

In Denmark, it has done so since the thirties. Approximately 30% of the country's dwelling heating is thus catered for by District Heating and the plans for the future aim at a considerable expansion of this facility. The knowledge that has been acquired in the District Heating sector is extensive and, in an international context, perhaps even unique.

It is my belief, that over and above using this know-how in the domestic market, there are numerous possibilities for export. I know that Danish firms are both interested and capable of taking up the challenge.

There is therefore every reason to recognize and appreciate the initiative taken in this field which, from any point of view, must be considered as essential.

*Copenhagen, March 1979*



**ARNE CHRISTIANSEN**  
*Minister of Industry, Commerce and Energy*

## IN DENMARK WE GET TOGETHER WITH DISTRICT HEATING

For a long time we have used District Heating in the kingdom as an intensive form of energy saving. In Denmark we have, as pioneers in this field, vast experience. The most distinguished companies in the District Heating sector have therefore in 1978, formed the Danish Board of District Heating (DBDH) for the purpose of providing export of Danish engineering and Danish technology. The total turnover of the companies involved is approaching one thousand million Danish crowns.

The Danish Board of District Heating is prepared to offer you the benefits of proven techniques for your convenience and we hope that Danish know-how will have a key role to play in the war on energy waste, also in your country. The Danish Board of District Heating spearhead the way to full exploitation of all energy forms.



## DANISH BOARD OF DISTRICT HEATING

Rugaardsvej 274  
DK-5210 Odense NV  
Tel.: (09) 16 16 88

## **THE DEVELOPMENT OF DISTRICT HEATING IN DENMARK**

**Summary of paper by Lennart Larson, Alderman of Odense, Chairman of the Danish District Heating Association, President of NORDVARME (the presidium of Nordic District Heating Associations).**

The paper provides an overall picture of District Heating in Denmark with information relating to the past development and present day applications that have made Denmark the world leader in the use of District Heating. The described plans for the future underline the role District Heating has to continue to play in the safeguarding of the future wellbeing of the Danes.

All subject matters are treated in a separate but not unrelated form. Over and above the 3 abovementioned general topics Danish methods, attitudes and purposes are reflected in sections dealing with the 3 main »components« of a District Heating scheme, i.e., heat production, distribution and consumer installations. Other sections go into the various adopted methods of metering and billing, their advantages and disadvantages. Finally, problems of energy supply, alternative fuels, consumption, legislation and future policies are described together with estimates illustrating trends and targets.

## **ENERGY SOURCES FOR DISTRICT HEATING SCHEMES**

**Summary of paper by Gunnar Kjær, President, Vølund USA Ltd.**

District heating is a system by which heat from the most economical source available is piped as hot water (or steam) to houses, residential and commercial buildings to provide a service of heating, air conditioning and hot water for domestic and process purposes.

The introduction of low temperature hot water as a heat transfer medium has simplified many consumer installations, cheapened distribution systems, and has made available new energy sources for exploitation.

The paper discusses the experience gained from the use of conventional as well as untraditional energy sources for district heating.

## **UTILIZATION OF REFUSE-HEAT**

**Summary of paper by Knud Larsen, B. Sc. (Mech. Eng.), Head of Department, Rambøll & Hannemann, Odense.**

All the methods used for refuse disposal and dumping involve environmental problems. Although this naturally also applies to incineration, this still offers best solution when combined with re-use of paper, glass, etc. - and energy utilization through district heating for example.

The report illustrates an actual Danish example, Vestforbrænding in Copenhagen, which receives and processes solid waste from about 600,000 inhabitants of Copenhagen and some of its suburbs. The heat content of the solid waste is utilized as district heating, serving apartment houses, office buildings, factories, schools and a hospital in one of the suburbs.

## **PLANNING OF DISTRIBUTION NETWORK TO NEW DISTRICT HEATING PLANTS.**

**Summary of paper by Chief Engineer Walther Mikkelsen, Bruun & Sørensen A/S, Aarhus.**

The paper describes the distribution system and states the advantages of using low-temperature hot-water systems in order to save energy and provide sound schemes even to areas with detached single-family houses. Experience is a key word when designing district heating network, and the paper discusses the results achieved during 50 years of experience in Denmark.

Another important aspect of a reliable system is the house connections, which have to be designed to the specific conditions of each plant. This will be discussed in connection with the principles of metering and settlement of consumption.

Finally, maintenance and precautions against corrosion as well as codes of practice and public approach to district heating will be discussed.

## **FUNDAMENTALS AND ECONOMIC PRINCIPLES IN DISTRICT HEATING PLANNING**

**Summary of paper by  
Mogens Larsen, Consulting Engineer P.E.,  
Harry & Mogens Larsen I-S, Odense.**

The whole future of the industrialized world depends on the efficient use of our diminishing resources of hydro-carbon fuels.

As a considerable percentage of our energy is used for domestic purposes, this is the most logical area in which savings can be made. In Denmark we have reached an advanced stage in this technology.

By using District Heating systems with low temperature hot water, we have proved the system's reliability, efficiency and low cost. Furthermore, the added possibility of combining electricity generation and district heating gives impressive improvements in thermal efficiency, as can be seen in the accompanying illustrations, which serve as an implement in the evaluation of the many aspects of district heating.

With regard to the establishment of district heating it is worth remembering the importance of population densities, the higher the population density, the lower the costs. Another important aspect in establishing District Heating is that it is not necessary to establish the entire city initially. Temporary heat plant can be used until the main transmission line can be established.

These and other fundamentals and economic principles in District Heating planning given in the lecture are based on our Danish experience. We have reached certain conclusions which we hope can be a basis for a wider debate, which can be beneficial to the implementation of District Heating.

## **HOW DO PUBLIC UTILITIES LOOK UPON COGENERATION OF POWER AND HEAT?**

**Summary of paper by Technical Director Torben Rieber, Vestkraft, Esbjerg.**

The paper describes the technical aspects of combined generation as well as the characteristics of combined power and heat generation in Danish utilities, and the practical limits to the combined production compared with a given power system are described. Vestkraft in Esbjerg, which has been in operation for many years, is given as an example of a combined power and heat supply plant, and a back-pressure plant under construction at the Central-Jutland town Herning is described.

## **BRUUN & SØRENSEN A/S**

Aaboulevarden 22  
DK-8000 Århus C  
Tel. (06) 12 42 33  
Telex: 17707

The B&S concern was founded in 1893 and now consists of 7 individual divisions which have a total of 1300 employed. In 1978 the turnover amounted to 100 million US\$. The main activity is district heating which is handled by the division B&S Rørteknik. B&S has worked more than 70 years with district heating. Already in 1907, B&S established a district heating plant in Vienna. In the twenties B&S established the first plants in Denmark utilizing waste heat from power stations. Today they are still operating.

The B&S activities include preparation of technical and economical studies for: distribution systems, co-generation, all kinds of waste heat utilization, transmission systems, as well as detail projecting of the systems. On the homemarket a special department within the division takes care of construction and maintenance.

Another activity is preparation of heat plans outlining energy saving extensions.

Total solutions for refuse treatment is offered by the B&S Environmental Engineering Division. More than 70 incinerators utilizing the waste heat have been erected in Europe and Japan.

## **B&W DAMP**

### **Steam Power Engineering**

Teknikerbyen 23  
DK-2830 Virum  
Tel. (02) 85 71 00  
Telex: 37451 bwdamp ak

B&W Damp is a division of Burmeister & Wain A/S. Today the division employs about 600 persons, and the business turnover in 1978 was about US\$ 34 mio.

B&W Damp develops and delivers high and low pressure steam-boiler plants to power stations and to industry. As main contractors we deliver turn-key energy supply plants to industry and to district heating.

B&W Damp undertakes complete projects, involving management of total engineering, manufacturing and purchasing of all materials and components for complete boiler plants. B&W Damp carries out analysis of total energy solutions, based on co-operation between industry and communities. In special, we emphasize on the use of waste materials as fuel, extraction of waste heat from air or water by use of heat exchangers, exhaust gas boilers, heat pumps etc.

In this way B&W Damp has specialized in big energy systems and in the use of untraditional resources allowing extensive fuel savings. To this end, we have developed profound computerprograms, to carry out both technical and economical analysis of total energy systems.

B&W Damp has also focused on flexibility in fuel consumption. The division is currently involved in projects, converting boilers from oil firing to combustion of solid fuels (coal, waste wood etc.).

To obtain total flexibility with respect to fuels, B&W Damp has developed a fluidized bed boiler, which is now being applied to the Danish district heating system. This completes our boiler program, which covers all types of boilers for power and district heating generation.

## **ISS CLORIUS INTERNATIONAL A/S**

Literbuen 16  
DK-2740 Skovlunde  
Tel. (02) 91 17 77

For more than 75 years the ISS CLORIUS INTERNATIONAL a.s. has manufactured heat-regulating and -measuring equipment. The experience, so far acquired in this field, is today utilized in a thorough knowledge about the measuring of heat consumption, as well as the accounting of costs in order to allocate these according to the consumption. Today more than 30 million heat meters control the heating expenses in Europe. All these heat meters work according to the evaporation principle. Concurrently with the technological progress a new BTU-meter without moving parts has been developed. With this meter the measuring can be absolute instead of comparative. The BTU-meter can be used alone or together with evaporation meters according to requirement or technical installations. Therefore, the Clorius heat accounting service is run according to the most modern principles. The new BTU-meter will be publicly introduced for the first time at the coming symposium. ISS CLORIUS INTERNATIONAL a.s. is a subsidiary of ISS-INTERNATIONAL SERVICE SYSTEM - the largest service organization in Europe.

## **DANSK OLIE- & STOKERFYRING**

Sct. Jørgensgade 108-110  
DK-5000 Odense C  
Tel. (09) 13 70 49  
Telex: 59 749

Dansk Olie- & Stokerfyring was founded in 1974, and is today an exporter to various European countries of rotary oil burners, oil units for heating of FO-4 oil for burners, water addition units for FO-4 oil and oxygen and viscosity control for burners.

Impartial authorities have judged the rotary oil burners as ranging between the most advanced, offering, exceptionally good economy.

The units for heating FO-4 oil are compact units safeguarded against performance stops. The water in oil units are manufactured as combined units which both pre-heat the oil and add water to the oil, or are supplied in connection with existing oil pre-heaters. Their specific features are that the water/oil percentage can be changed by pushing 2 electronic impulses and that the oil/water consumption is registered on electronic counters via built-in water/oil gauges. They are further equipped with double pump and filter sets securing a solid matter reduction of 85-95%.

## DÜROTAN RØR A/S

Brovadvej Erritsø  
DK-7000 Fredericia  
Tel. (05) 94 23 33  
Telex: 51167 durtan dk

During the last 25 years Dürotan Ltd. has specialised in insulation of district heating mains and has carried out many large contracts in more than 120 towns in Denmark alone.

After the introduction of polyurethane foam it was found possible to use this new insulation material in conjunction with a waterproof protection covering of polyethylene for a prefabricated pipe system for underground district heating systems which are manufactured in our factories in Fredericia, Denmark in three systems:

STANDARD - UNIVERSAL - and EXTRA - system.

The standard system is a »bonded« preinsulated pipe, which can be used with a maximum operating temperature of  $130^{\circ}\text{C} = 260^{\circ}\text{F}$ .

The Universal system is a »stress-less« pipe system, where the steel pipe is protected by bituthene and can be used with a maximum operating temperature of  $130^{\circ}\text{C} = 260^{\circ}\text{F}$ .

The Extra system is a »stress less« pipe system for maximum working temperature of  $170^{\circ}\text{C} = 338^{\circ}\text{F}$ .

All bends, tee-pieces, anchors, bellows etc. are premanufactured with a polyethylene outer casing.

The Dürotan pipe-in-pipe system has been found to be a low cost and efficient means of installing underground pipes for a large number of purposes and the system is therefore being increasingly recommended and specified.

## JYDSK VARMEKEDELFABRIK A/S

Edwin Rahrsvej 32  
DK-8220 Brabrand  
Tel. (06) 25 26 55

Jydsk Varmekedelfabrik A/S was established in 1948 and manufactures products for the heating sector under the trade mark EURO-THERM. Jydsk Varmekedelfabrik cooperates with M.A.N., West Germany and Parkinson Gowan G.W.B., England. Jydsk Varmekedelfabrik has app. 100 employees.

The production program includes boilers, rotary oil burners, oil preheaters, water dosage plants, portable heating stations and electronic fuel control systems.

The boilers can utilize oil, gas, coal, wood and refuse combustion with outputs from 0.1 - 25 MW for steam, hot water and air. They are of HEO type with 20 years operation time and automatic cleaning of smoke tubes.

The rotary oil burners are made with an output of 200 - 1800 kg oil/n, whereas the oil preheaters using either steam, hot water or electricity has outputs ranging from 500 - 6000 kg/h.

The water dosage plants reduces the oil coke up to 96% when burning heavy oil.

The portable heating stations are delivered as turn key plants with outputs of 0.25 - 4.0 MW.

The electronic fuel control plants are registering and sensing the actual amounts and qualities of the fuel, and compensate for inevitable fluctuations of viscosity, pressure, temperature, etc. thereby reducing the oil consumption with 3.5 - 8% in general.



### **KAMSTRUP-METRO A/S**

Jacob Knudsensvej 12  
DK-8230 Aabyhøj  
Tel. (06) 15 76 11  
Telex: 64502

KAMSTRUP-METRO A/S was established in 1946 and is today considered one of the leading producers of Scandinavia within Measuring and Control Equipment for temperature, pressure, level and flow.

The products, the technological basic elements of which are fine mechanical, electronic, electromechanical and pneumatic, are developed, constructed and produced in accordance with the demands of quality and operation made within the marine engine industry, the food industry, the building industry, the petrochemical industry, the drug industry etc.

The sale distributes itself on the home market as well as the export market, a.o. Norway, Sweden, Finland, German Federal Republic, Netherlands, Belgium, Spain, Poland, Yugoslavia.

The company has as its disposal about 4,000 m<sup>2</sup> of production area and employes 130 men, the engineering and technical background of whom ensures development of the own product programme of the company as well as technical consultative assistance for solution and special problems within our know-how field.

### **HARRY & MOGENS LARSEN I-S**

Consulting Engineers  
Skolevej 8  
DK-5270 Odense N  
Tel. (09) 18 18 04

Member of the Association of Consulting Engineers in Denmark (FRI).  
Member of the International Federation of Consulting Engineers (FIDIC).

Harry & Mogens Larsen I-S consulting engineers was established in 1954. The company offers a broad range of engineering services including preliminary surveys and report, project design, project management and field supervision.

The company designs complete heating facilities including boiler plants and distribution networks.

Currently installed boiler capacity is in excess of 600 mill. Btu/h. (175 MW) serving over 15000 users through 250 miles (400 km) of dual-pipe distribution networks have been designed and commissioned.

Harry & Mogens Larsen I-S is ready to offer their services and know-how based on 25 years of experience in the design and development of co-generation facilities and district heating systems.

The company has been involved in other major projects such as commercial and public buildings, shopping centers, stores and warehouses, nursing homes, multi-family residences, public swimming pools and municipal water treatment plants.

## LØGSTØR RØRINDUSTRI A/S

Danmarksvej  
DK-9670 Løgstør  
Tel. (08) 67 18 66  
Telex: 60765

LØGSTØR RØRINDUSTRI was founded in 1963 by the coppersmith, Mr. Ege Andersen who invented the pre-fabricated district heating pipe.

Today LØGSTØR PIPES are manufactured in an up-to-date plant with a total production area of 20,000 square meters. LØGSTØR RØRINDUSTRI attaches great importance to an advanced production method, thus a vertical boring and turning machine is used for making insulating pieces for wedge couplings. Poly-ethylene pipes are made in a newly built extrusion plant, where it is possible to make pipes ranging from 90 to 315 mm. Due to a concentrated production progress LØGSTØR RØRINDUSTRI is able to manufacture by far the largest part of component parts for the district heating system.

Apart from the traditional production of pre-fabricated district heating pipes the following components are manufactured:

LR/PEX is used for district heating, central heating, cold and hot utility water, max. temperature 95 degrees Celcius. Dimensions of inner tubes: 22 x 3 mm, of jacket pipes: 63 x 4 mm. Can be supplied in coils of 50 meters.

The wedge coupling: a fast, easy and safe assembling of LØGSTØR PIPES.

Pre-fabricated district heating pipes are supplied in dimensions up to 1200 mm.

i.c.møller a/s  
tredevej 191  
dk-7000 fredericia  
tel. (05) 92 62 11

i.c.møller a/s has its headquarters in Fredericia, Denmark, and employs over 300 persons. Due to dynamic development it is now Europe's largest manufacturer of prefabricated pipe-in-pipe systems for district heating. i.c.møller is a subsidiary of the Brown Boveri Company.

i.c.møller's rapid growth has taken place concurrently with the spread of district heating, and increasing exports are the result of technical know-how and experience, gained in a long and close relationship with district heating system operators throughout Europe. The i.c.møller system comprises of pre-insulated pipe-in-pipe, together with all necessary pressure tight fittings, to provide a complete system.

It is also available with an integral electronic alarm system, which indicates digitally when and where a fault has occurred in the pipe network.

The system is marketed in 12 countries in Europe. It has been developed in close collaboration with official Danish scientific institutes, and it is based on a large number of inventions and patents at home and abroad. i.c.møller has been working with buried pipe systems since 1952, and installed the first prefabricated steel-in-plastic pipe at the Carlsberg Breweries as early as 1956, and since then it has supplied pipes to more than 1000 district heating projects all over Europe.

## **RAMBØLL & HANNEMANN**

Lavsensvænget 8  
DK-5200 Odense V  
Tel. (09) 11 10 10  
Telex 59938 ramhan dk

Rambøll & Hannemann offers international consulting services in planning, engineering and associated fields. Member of FIDIC.

The firm has more than 30 years experience on project execution.

Rambøll & Hannemann was established in 1945 and it has a staff of almost 400 and drawing offices in 11 Danish towns and in Norway, Germany and Tunisia and they are thus one of Denmark's biggest consulting engineering firms with a turnover in 1978 of approx. 12 mill. dollars.

Rambøll & Hannemann offers its services in three main fields:

*Research and studies, master planning:*

Research site surveys feasibility studies, cost benefit analyses, planning and programme development.

*Design:* Studies, surveys, preliminary design, detailed design, invitation for tenders.

*Construction supervision:* Contract negotiations, project administration, supervision of construction and installations, quality control to ensure compliance with specifications.

For district heating systems, the company offers all-inclusive services:

Energy and heat supply plans, distribution plans, connection principles.

Feasibility studies, transport analysis for strategic siting, refuse incineration, alternative energy sources.

Buildings, pipe systems for production, distribution and service connections.

Operation and maintenance plans for buildings and pipe installations.

Technical and financial consulting services and planning are also in a large number of other fields.

## **SCAN-TECHNIC**

Industrial Agencies Limited  
Egegårdsvej 59-61  
DK-2610 Rødovre  
Tel. (01) 70 87 77  
Telex 15864

SCAN-TECHNIC is an engineering and trading agency founded in 1945. The sphere covers production and sale of many mechanical engineering products, all of which are practically used in the control and distribution of energy.

The greatest importance is attached to the two following important areas of production within district heating equipment:

*1. SCAN-COMP compensators for district heating pipes.*

Up to now the bellows compensators have been made in dimensions of max. 1200 mm. They were formed on the basis of Teddington bellows and have now been produced for about 10 years.

*2. A wide programme of welded valves for district heating system.*

The valves are made with a view to complete exemption from maintenance and are ball valves which have been developed through close co-operation with the Japanese firm KTM. The valves cover all general pipe dimensions and have by now been produced up to 400 mm inclusive. Among other things they include a series which is adjusted to individual conditions, such as a spindle height proportioned to a safe operation from street level.

SCAN-TECHNIC is an expert on these important areas and based on experience a current development takes place.

Assisting us in this aim is our close co-operation with our customers and consulting engineers before, during, and after installation.



## ENERGY CONSERVATION SYMPOSIUM - USA

Plaza Airport Inn, San Francisco

Chairman: Mr. Jens Peder Jensen, Industrial Attachee,  
Danish Consulate General in New York.

### Programme:

- 08.00-09.00 Registration.
- 09.00-09.20 **Welcome** by Mr. Børge Lund, Consul of Denmark, San Francisco and Mr. Eric Peterson, Program Manager, Division of Geothermal Resource Management, Department of Energy, Washington DC.
- 09.20-09.40 **Presentation and Overview of Geothermal Energy in the U.S.:**  
R. J. Schultz, Manager, Hydrothermal Energy Commercialisation, Div. of E.G. and G. Idaho, Inc.
- 09.40-10.10 **The Development of District Heating in Denmark:**  
Lennart Larson, Alderman of Odense, Chairman of the Danish District Heating Association, President of NORDVARME.
- 10.10-10.30 **Question Time.**
- 10.30-11.00 **Coffee Break.**
- 11.00-11.15 **Presentation of Participants:**  
Mr. Jens Peder Jensen.
- 11.15-11.45 **Energy Sources for District Heating Schemes:**  
Gunnar Kjær, President, Vølund USA Ltd.
- 11.45-12.00 **Question Time.**
- 12.00-13.30 **Lunch.**
- 13.30-14.00 **Planning of Distribution Network to New District Heating Plants:**  
Flemming Hammer-Sørensen, B. Sc. (Mech. Eng.), Bruun & Sørensen A/S.
- 14.00-14.30 **Fundamentals and Economic Principles in District Heating Planning:**  
Mogens Larsen, Consulting Engineer P.E., Harry & Mogens Larsen I-S.
- 14.30-15.30 **Question Time/Panel Discussion.**
- 15.30-15.45 **Closing Remarks** by Jens Peder Jensen.
- 15.45- **Workshop and Social Event.**

Temporary address of the participants: Plaza Airport Inn, San Francisco.  
Further information also available from: The Royal Danish Consulate,  
Three Embarcadero Center, Suite 2060, San Francisco, California 94111.