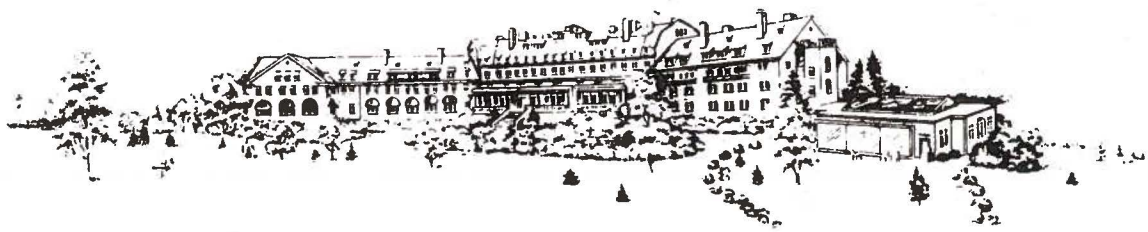
DISTRICT HEATING

JANUARY—FEBRUARY—MARCH 1975



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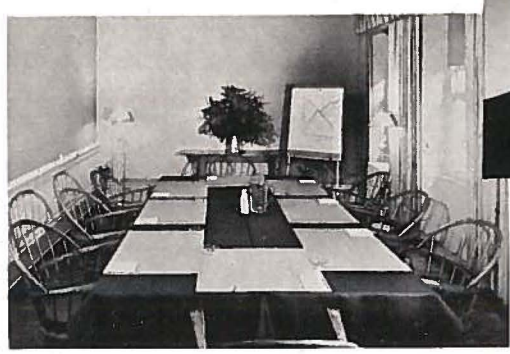

on June 23-25
at Skytop, Pennsylvania

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District Heating and Cooling in Japan

by **Senya Akagi**, Manager of Environmental Systems Design Department
and
Yoshio Kitao, Senior Member of Environmental Systems Design Department
Hitachi Shipbuilding & Engineering Company

Climate in Japan

The Japan Islands, which consist of four large and many other small islands, extend between 25 and 45 degrees north latitude, at the western end of the Pacific. In spite of their location in the temperate zone, the climate is not completely mild. In summer, as they border on the Pacific, it is hot and humid in the southwestern parts. In winter, affected by the cold wind from Siberia, it is very cold in the northeastern parts.

For example, in Tokyo it is hot and sultry in July and August, but the temperature falls to nearly zero C (32 F) in January and February. The climate in Hokkaido, the northernmost prefecture, resembles that of North Germany. In Sapporo, the capital city of Hokkaido, an average temperature of below Zero C lasts four months, from December to March. In those districts, heating is indispensable for daily life. On the other hand, in the cities such as Fukuoka in the southwestern part, cooling in summer is required, as well as heating in winter. Accordingly, the prospect for district heating and cooling systems is encouraging. Fig. 1 shows climate diagrams of typical cities in Japan, and also of New York and Berlin in comparison.

History of District Heating and Cooling in Japan

Although actual construction of district heating and cooling systems has existed only since 1966, the necessity of district heating had been proposed from old times. After the Kanto Earthquake in 1923, it was proposed by a group of leading authorities to introduce district heating into reconstruction of the central zone of Tokyo, from a fire-prevention point of view. Also in 1949-1955, in reconstruction of the bombed cities after World War II, district heating was proposed as one of the modern city facilities, and as a way of calamity prevention, but it did not materialize.

Meanwhile, buildings in the same area, such as hospital or campus buildings, were heated by centralized heating systems. The occupation forces constructed district heating systems for their barracks and family villages in Japan, and this stimulated interest in district heating. Since 1960, the industrial production and Gross National Product of Japan have been increasing, and the economic background is becoming stabilized. But at the same time, as industrial activity grew, public nuisance such as air pollution had become a serious problem. Under such circumstances, there was a growing tendency to construct district heating systems for the purpose of public nuisance prevention and improvement of the living environment.

In 1966, construction of the first hot water district heating system was begun at the Maruyama Kitamachi housing site in Sapporo, and was completed in September 1967. This project included only six buildings and 180 houses and although it was a small installation, the most important matter was that the first commercial district heating system which served the average citizen of Japan was realized by this project.

In 1968, the authorities of Sapporo City decided to build a large district heating system in the central zone of the city, to prevent air pollution caused by individual heating in winter. This project began operation in 1971, and further expansion is scheduled (Fig. 2).

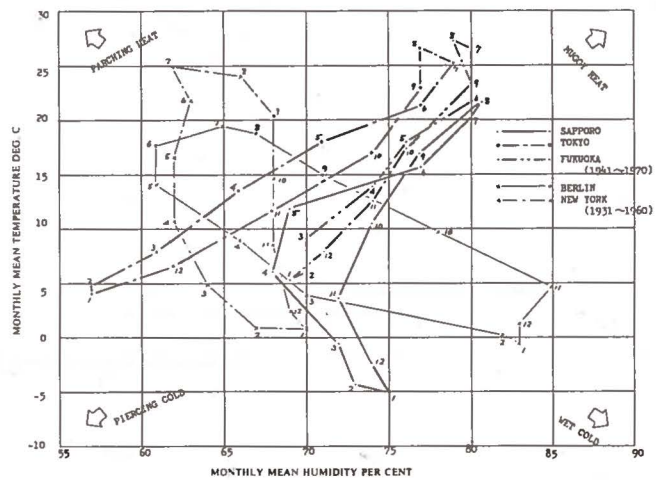

Fig. 1—Climate diagram. Figures 1 through 12 on diagram refer to the months of the year: 1 = January; 2 = February, etc.

TABLE I

DISTRICT HEATING AND COOLIN(

LOCATION	UNDERTAKING	CUSTOMERS							DISTRICT AREA ha
		APARTMENTS	OFFICE BUILDINGS	HOTELS	STORES	RESIDENCES	AIRPORT TERMINAL	OTHERS	
1 Maruyama Kitamachi Housing Site, Sapporo	Hokkaido Housing Corp.	X							1.6
2 Wholesale Center, Sapporo	Sapporo Wholesale Center				X				
3 Wholesale Center, Sendai	Sendai Wholesale Center				X				50
4 Central Zone, Sapporo	Hokkaido Heat Supply Corp.		X	X	X			X	100
5 Shinjuku New City Center, Tokyo	Tokyo Gas Co.		X	X					16.4
6 Senri New Town Central Area, Osaka	Osaka Gas Co.	X	X	X	X				31.5
7 Senpoku New Town Izumigaoka, Osaka	Osaka Gas Co.	X			X			X	44
8 Senpoku New Town Toga, Osaka	Osaka Gas Co.		X		X				8.5
9 Makomanai Housing Site, Sapporo	Hokkaido District Heating Co.	X	X		X				20.6
10 Shimonopporo Housing Site, Sapporo	Hokkaido District Heating Co.	X						X	272
11 Itoi Housing Site, Tomakomai	Tomakomai Heat Service Co.	X	X						118
12 Kita Hiroshima Housing Site, Hokkaido	Japan Heat Energy Co.	X	X			X		X	350
13 Hon Machi Area, Okazaki	Okazaki Energy Supply Co.		X		X				7.3
14 Marunouchi Area, Tokyo	Mitsubishi Jisho Co.		X						
15 Tsurugaya Housing Site, Sendai	Sendai City		X		X	X			
16 Commodity Distribution Center, Fukuoka	Fukuoka Heat Supply Co.				X				40
17 Kakeyu Hot Spring, Nagano Pref.	Kakeyu Hot Spring Supply Co.			X					6.4
18 Narita New Town, Chiba Pref.	Tokyo Gas Co.	X	X		X				30.5
19 Wholesale Site, Fukushima	Fukushima Wholesale Assoc.				X				
20 Kosei Redevelopment Area, Sapporo	Hokkaido Heat Supply Corp.	X	X		X				11
21 Iwate Commodity Distribution Center	Iwate Development Corp.		X			X			
22 Hakodate Wholesale Center	Hakodate Heat Supply Co.				X				14.9
23 Bannaguro Housing Site, Hokkaido	Ishikari Service Co.	X				X			73
24 Tokyo International Airport, Narita	New Airport Public Corp.		X				X		150
25 Saitama Kita Commodity Distribution Center	Saitama Kita C.D. Assoc.				X				37
26 Senpoku New Town Komyoike, Osaka	Osaka Gas Co.	X	X		X				29.5
27 Central Area, Tomakomai	Tomakomai Energy Corp.	X			X				74.7
28 Otemachi Area, Tokyo			X						
29 Katayamazu Hot Spring, Ishikawa Pref.	Katayamazu Hot Spring Assoc.			X					
30 Tama New Town Nagayama, Tokyo		X				X			
31 Morinomiya Housing Site, Osaka	Osaka Gas Co.	X							
32 Sea Side New Town Kemigawa, Chiba Pref.									
33 Ikebukuro City Sub-Center, Tokyo	Ikebukuro District H&C Co.		X	X	X				

*R.I.P. denotes Refuse Incineration Plant.

PROJECTS IN JAPAN OCTOBER 1974

TABLE I

TOTAL FLOOR AREA m^2	CAPACITY		THERMAL MEDIUM					FUEL				PIPE SYSTEM	H/C CHANGEOVER	OPERATION START	COMPLETION
	HEATING G cal/h	COOLING USRT	HOT WATER	STEAM	°C Kg/cm²	CHILLED WATER	°C	BUNKER OIL	KEROSENE	TOWN GAS	OTHER FUEL				
8,700	0.8		X		120/80			B				2		'67	'67
	4.8		X		150/120			X				2		'66	'66
66,000	10		X		150/80			B				2		'69	'70
1,018,000	170		X		215/120				X		COAL	2		'71	'74
1,477,500	125	37,000		X	10	X	4/12		X	X		4		'71	
470,000	62	17,000	X		180/120	X	5/13		X	X		4		'70	'74
288,000	27.5	5,500	X		80/70	X	6/13		X	X		2		'71	'78
54,500	7.7	2,500												'73	'82
	10.6		X		150/80			A				2		'71	'73
745,600	66		X		150/12			C	*R.I.P. WASTE HEAT			2		'71	'81
97,200	12.7		X		150/80			C				2		'72	'76
	59.9		X									2		'72	'80
112,000	8.6	2,500		X	8	X	6/14		X	X		4		'72	'73
	226	66,000		X						X				'73	'73
24,100	4	280	X		130/80	X	7/14	A						'71	'72
106,000	19.4	4,950	X		120/50	X	7/14		X			4		'73	'74
			X		150/100							2		'73	'73
167,000	9.8	3,310	X		70/50	X	7/13	NATURAL GAS				2	X	'73	'77
23,800	3.6		X		115/70				X			2		'73	'73
195,000	24		X		160/90				X			2		'74	'75
	15													'73	'73
45,000	6.4		X		120/70			A	X			2		'74	'75
320,700	27.9		X		150/130			A	X			2		'75	'80
360,000	54	11,000	X		150/80	X	5/12					4			
26,800	4.5	1,490	X		66/555	X	7/13			X		2	X		
248,700															
	29.1									X	LPG	2		'75	'83
														'76	'78
														'74	'85
								*R.I.P. WASTE HEAT						'75	'76
														'74	'80

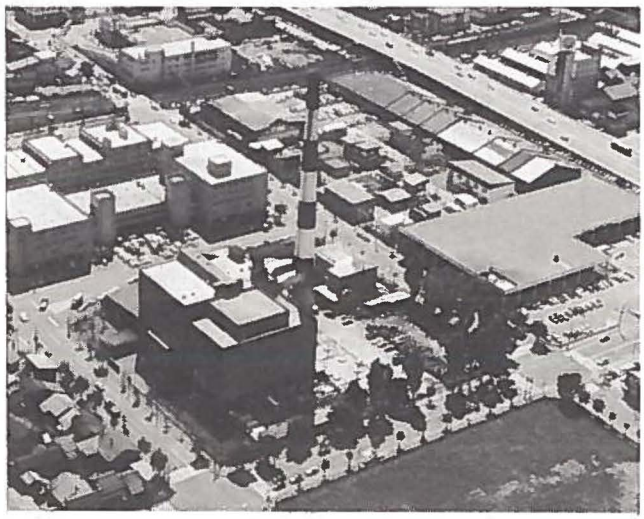

Fig. 2—Boiler plant and customers' buildings in Sapporo central zone.

The summer is very hot and humid in the southwestern parts of Japan, including Tokyo, and almost all offices and buildings in those parts have their own individual cooling equipment. In 1970, the international exposition—Expo '70—was held at Osaka from March to September, through summer, and a large district cooling system with a capacity reaching 37,000 RT was constructed to serve that area.

Senri, a new town near Osaka, and Shinjuku (Fig. 3), a new city center in Tokyo, both of which had their inception in 1969, were furnished with district cooling as well as heating. In these projects, steam boilers are operated in all seasons for heating and cooling. District heating and cooling in Japan are considered to have come in real earnest with the construction of the Sapporo central zone, Senri new town, and Shinjuku new city center.

Present Situation of District Heating and Cooling

As mentioned above, the industrial production activities in Japan which increased rapidly in the 1960's, are carried out mostly in the cities located on the Pacific coast. Therefore, those cities are suffering from public nuisance and excessive concentration of population. To avoid such undesirable conditions, large housing sites were constructed, old heavily populated areas were redeveloped, and commodity distribution centers were built. These construction projects included the installation of district heating and cooling systems to reduce air pollution and improve the environment.

Table I and Fig. 4 show the district heating and cooling plants either in operation or under construction. Table I shows that there were many, and therefore the Japanese Government enacted a law for heat supplying enterprises on June 22, 1972. By this law, heat supplying enterprises which supply energy for district heating and cooling in the form of hot water, steam or chilled water,

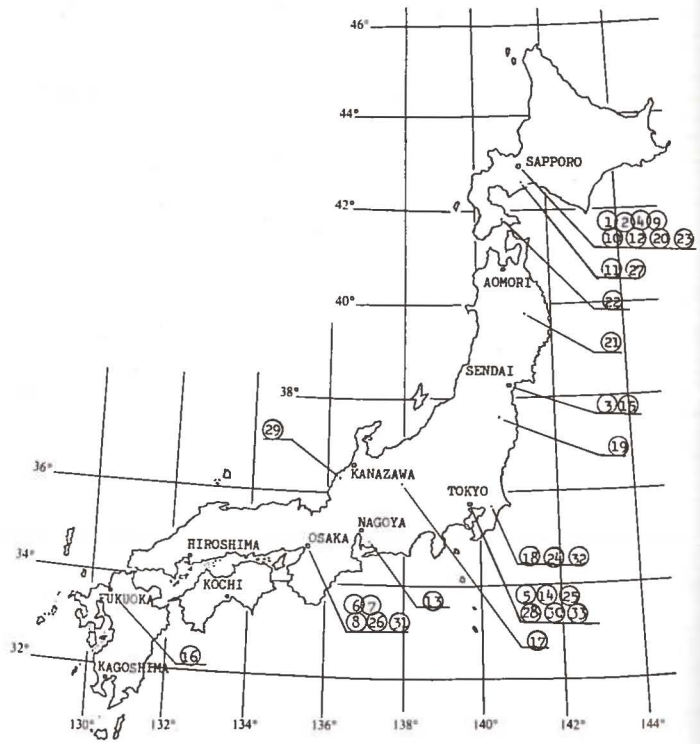

Fig. 4—Location of district heating and cooling projects in Japan. The circled numbers correspond to the location numbers in Table I.

are regulated and encouraged as a public utility. At the same time, the beneficiaries are protected, because a heat supplying enterprise has a character of exclusiveness in the area, and its heat distribution piping has to be buried mainly under public roadways. To hold enterprises responsible for supplying stable heat supply and safety, the law regulates necessary technical requirements, and also controls heat service rates. The Government aims to promote a sound growth of the heat energy business through this law.

The "heating is essential for our daily life" way of thinking is not so popular in Japan, except in northern parts. Heat supplying enterprises, which are managed by the local governments are very few. Most of them are operated by a newly established, semi-official company,

Fig. 3—Shinjuku new city center, Tokyo.

which is called the third sector, consisting of an energy supply company such as a gas company, the facility maker itself, or its newly established subsidiary company. Table I shows those undertakings also.

As fuel for district heating and cooling systems, kerosene and town gas are mainly used because they cause less air pollution. According to special local conditions, coal or natural gas is used in some places. Since the oil panic in 1973, district heating and cooling which had been developed as one of the effective means of preventing air pollution, has been reevaluated as an available method for energy saving. And at the same time, power stations combined with heat supply have been studied by the people concerned. Almost all steam power stations in Japan are located on the seaside, for the convenience of getting fuel oil and cooling water. But unfortunately, they are far from the central zone of the city, and no combined station is realized. In the future, gas turbine peak load stations located in the city may be combined with heat supply.

Utilization of waste heat from refuse incineration plants for district heating and cooling has been studied, and now two projects are under construction; one is the Morinomiya housing site in Osaka, and another the Shimonopporo housing site in Sapporo. Refuse incineration plants will be promoted further in new housing projects near big cities.

As mentioned before, buildings in hot and sultry parts of Japan have been provided with cooling equipment, and even in northern parts, modern buildings have to be cooled because of their high heat release on the inside. Under such circumstances, district cooling has been planned and constructed, as well as district heating. But district cooling systems which supply chilled water require more machinery, larger distribution piping, and higher service rates than those of district heating. So, it is rather difficult to implement district cooling, except under special conditions.

District heating and cooling in Japan, which started only in 1966, has been developed rapidly as shown in Table I, and from now on, based on the experiences of these plants, steady progress can be expected.

With the technical cooperation of American Hydrotherm Overseas Corporation, we constructed the first project, Maruyama Kitamachi housing site; and the biggest project, Sapporo central zone; and now we have installed a total of eight projects in Japan and two in Korea. We would like to promote district heating and cooling systems in the form most adaptable to Japan, based on the knowledge gained through actual experience. ✹