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District Heating and Cooling at Mission Bay

November 1989 Briefing Paper

The City of San Francisco, in cooperation with the Pacific Gas and Electric Company, and with the assistance and support of the U.S. Department of Energy, is in the process of analyzing the technical and economic feasibility of a District Heating and Cooling System for the Mission Bay redevelopment area in San Francisco. The following gives an overview of district heating and cooling technology and describes the origins and current status of the project.

District Heating and Cooling Technology

District Heating and Cooling (DHC) is the centralized generation of thermal energy for distribution and use in individual buildings. DHC is a proven and reliable technology with systems ranging in size from small institutional systems which generally serve only one user (e.g. a college campus), to large, city wide networks. The most common applications of DHC systems in the United States are university and industrial complexes, central business corridors, and apartment building complexes. Many major cities in the United States have steam systems dating back to the early part of the twentieth century. Since the second World War, cities in many European countries have developed extensive networks of modern district heating systems. San Francisco has two district steam systems. PG&E operates a system in the heart of San Francisco's financial district and its adjoining areas serving over 200 commercial buildings including customers such as the Crocker Center, the Transamerica Building, and the Hilton Hotel. The City and County owns and operates a second system that serves municipal buildings in the Civic Center area. Following the energy crises of the 1970's, DHC has experienced a major resurgence in the U.S. as communities have begun to recognize the need to develop inexpensive and reliable energy sources.

The benefits of DHC arise from the fact that thermal energy can be produced more efficiently in a centralized facility. Low cost thermal sources such as power plant waste heat, cogenerated heat, industrial waste heat, heat pumps, or properly sized fossil fuel or electric equipment are widely used. The thermal energy is distributed in the form of hot or chilled water or steam through a network of piping to individual buildings. Buildings then use the thermal energy in

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their own space conditioning systems. As a result, building tenants and owners receive substantial savings in initial heating and cooling equipment costs as well as long term energy cost savings.

In addition to the initial savings and energy cost savings, users of DHC systems benefit from lower maintenance and insurance costs. Building developers also have more flexibility in their building design and more rentable space within buildings because of reduced space requirements for boilers and other equipment. For the community, DHC offers improved air quality and increased self-sufficiency due to the flexibility in choice of fuels and the resulting stable energy prices.

District Heating and Cooling at Mission Bay

The new development at Mission Bay offers a unique opportunity to incorporate a modern DHC system. Mission Bay is currently one of the largest urban redevelopment projects in the nation. In the planning stages for over six years, the 300 acre site will ultimately support a new, high density, mixed use community containing as many as 8000 new housing units and 7.6 million square feet of office, 2.6 million square feet of research and development, a luxury hotel, and large and small scale retail. The project is in its final plannings stages. The development plan is nearing completion, and the principal landowner, Santa Fe Pacific Realty Corporation, is currently negotiating the development agreement with the City. Mission Bay will be built over the next twenty to thirty years in phases each including a variety of land uses. Current expectations are that initial ground breaking will occur in 1991 or early 1992.

DHC can provide an economic and efficient supply of energy to the new commercial and residential growth that will take place in Mission Bay. Using an efficient heat source and economies of scale, it can offer thermal energy to buildings at reduced prices. DHC at Mission Bay can reduce initial capital investment costs to building developers, as well as costs for annual energy and building operation and maintenance. DHC, therefore, can make a very real contribution to the affordability of housing and commercial space.

The Mission Bay development has a number of characteristics ideal for DHC system development. First, San Francisco's coastal climate provides a DHC system with a constant thermal heat load demand throughout the year and thus, a stable revenue stream for the DHC system. In addition, Mission Bay's high

building density is attractive for DHC, since a relatively minimal amount of piping can be installed to serve a relatively large load. This reduces transmission and distribution costs, while also lowering thermal losses.

The mixed use development at Mission Bay is also an advantage in that this diversity will provide a more constant daily thermal load to the DHC system (commercial space with daytime demand, residential with evening demand) and hence a more stable daily revenue stream. (Much like a power plant, the operating efficiency of a DHC system is greatly increased when the demand is constant and near capacity. Wide swings in demand are not efficient). Finally, since the installation of the thermal network infrastructure can "piggy-back" on that of other utilities, the usual initial costs for a district heating system can be reduced.

In 1987, the PUC Bureau of Energy Conservation prepared recommendations for the Mission Bay project. These recommendations became known as the Energy Plan for Mission Bay. One of the recommendations was that district heating and cooling be carefully examined as a potential source of thermal energy for the development area, both for its energy efficiency and environmental benefits, and for its beneficial impacts on the economic development of the new Mission Bay Community.

Preliminary studies of DHC at Mission Bay were then conducted by the San Francisco Public Utilities Commission, Bureau of Energy Conservation and its consultants: John Nimmons & Associates including Gordon Bloomquist, PhD and Monica Westerlund of Westerlund Communications; and by Pacific Gas and Electric Company, the local gas and electric utility, and owners and operators of San Francisco's district steam system serving the downtown area. PG&E's initial work led to a report in December 1987, "District Heating and Cooling for Mission Bay, Preliminary Feasibility Study". The report concluded that the project was worthy of further study and that district cooling, especially, had excellent economic potential.

In 1988 the Bureau of Energy Conservation received a U.S. Department of Energy Grant to investigate the technical and economic feasibility of a DHC system for the Mission Bay redevelopment project. In furtherance of these efforts, the Pacific Gas and Electric Company provided additional technical and financial support to the study. In May 1989, the City of San Francisco and Pacific Gas and Electric Company requested qualifications from firms qualified in District Heating and Cooling to provide engineering services to assess the economic and technical feasibility of DHC at Mission Bay. VBB Pacific Planners/Engineers/Economists was selected to perform the work.

The Consultant team, headed up by VBB Pacific, is as follows:

VBB Pacific Planners/Engineers/Economists	DHC specialists
B. Hojlund Rasmussen Engineers/Planners	DHC specialists
Raymond Brooks Engineers	Local mechanical engineering specialist
EDAW Architects/Planners/Engineers	Mission Bay planners

VBB Pacific specializes in DHC development, having provided planning, design, and operational advisory services on over 40 DHC projects since 1978. VBB Pacific's parent firm, the VBB Group, is one of the world's largest DHC engineering consultants, having designed and managed the construction of over 1,200 MWt of capacity in over 110 DHC systems worldwide since 1950.

B. Hojlund Rasmussen is a Danish engineering firm that specializes in large-scale energy systems, particularly DHC. Since 1953, BHR has designed and managed the construction of over 4,800 MWt of capacity in over 40 DHC systems worldwide. BHR investigated the feasibility of district heating expansion in San Francisco for the City and PG&E in 1984-85.

Raymond Brooks Engineering is a Bay Area mechanical engineering firm with extensive experience in energy conservation, district heating (San Francisco State University), HVAC systems, and piping networks. It has performed numerous projects in the vicinity of Mission Bay, including several assignments for the City of San Francisco.

EDAW is one of the nation's largest consulting firms in urban design, site engineering, and environmental analysis. Based in San Francisco, EDAW recently oversaw completion of the Mission Bay master plan for the City.

Current Status of the Project

VBB Pacific began work in September 1989 with the Mission Bay DHC Study kick-off meeting on September 26th. The next meeting is scheduled for January 16th where VBB Pacific will be presenting an interim progress report on the project. A draft of the final report is tentatively due in April 1990.

Project team members include representatives from Pacific Gas and Electric Company, the San Francisco PUC/Bureau of Energy Conservation, the San Francisco Department of City Planning, the San Francisco Department of Public Works, Santa Fe Pacific Realty Corp, as well as the engineering consultant team. A complete list of project team members is attached. Fore more information on this project, you may contact John Deakin, the Director of the PUC/Bureau of Energy Conservaton or Christine Vance at 864-6915.

Mission Bay DHC Study Project Team

San Francisco PUC/Bureau of Energy Conservation

John F. Deakin	Director of the Bureau
Christine Vance	Project Manager

Pacific Gas and Electric Company

Dirk Van Ulden	Manager, San Francisco Division Marketing
Gwenn Hardin	San Francisco Division Marketing
Doug Herman	Mechanical Engineering Department
Rich Mayer	Manager, Steam Department

Consultants to the PUC/Bureau of Energy Conservation

John Nimmons	John Nimmons & Associates
Gordon Bloomquist	Washington State Energy Office
Monica Westerlund	Westerlund Communications

San Francisco Department of City Planning

Alec Bash	Mission Bay Project Director
Lilia Medina	Associate Planner on Mission Bay

Santa Fe Pacific Realty Company

Don Marini	Mission Bay Project Manager
Kerstin Fraser Magary	Mission Bay Project Manager

San Francisco Department of Public Works

Joe chueng	Project Manager Division of Project Management

VBB Consultant Team Key Staff Assignments

VBB Pacific

Eliot Allen, AICP	Principal-in-Charge/Project Manager
Jeffrey Ponsness, PE	Senior Project Engineer/Economist
Bjorn Ulfvin, PE	Project Engineer
Richard Ogle, PE	Project Engineer
Anders Hill, PE	Project Engineer

BHR

Knud Schousboe Christensen	Head, Energy Department
Jan Elleriis	Senior Engineer
Peter Randlov	Senior Engineer

Raymond Brooks Engineering

Raymond Brooks	Principal Engineer

EDAW

Larry Dodge	Senior Consultant

Mission Bay DHC Assessment Work Group Invitees

The following is a list of invitees to serve on the Assessment Work Group for the Mission Bay DHC project organized by area of interest or expertise.

Community Economic Development Interests

Jim Queen	-	Community Development Council
Gail Goldman	-	Mayor's Office of Business and Economic Development
Roberto Barragan	-	Mission Economic Development Assoc.

Utility Interests

Ronald Wendland	Electric Power Research Institute (EPRI)

Technical Review/Energy Users Interests

Joe Torres	-	Bechtel Enterprises
Tom McKewan	-	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)

Environmental Interests

Ira Kurlander	-	San Francisco Tomorrow

Financing Expertise

Domenic Falcone	-	Domenic Falcone Associates Inc. (A Financial Services Corp.)