Northwest CHP Application Center

Combined Heat and Power for the states of
Alaska, Idaho, Montana, Oregon and Washington
in cooperation with the U.S. Department of Energy

Case Study: Valley Medical Center, Renton, WA

Combined Heat and Power - 3.6 MWc

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Cooperating agencies: Washington State University Extension Energy Program, U.S. Department of Energy, Alaska Energy Authority, Idaho Department of Water Resources Energy Division, Montana Department of Environmental Quality Energy Program and Oregon Department of Energy

Valley Medical Center

3.6 MW Gas Fired, Reciprocating Engines, Cogeneration Plant

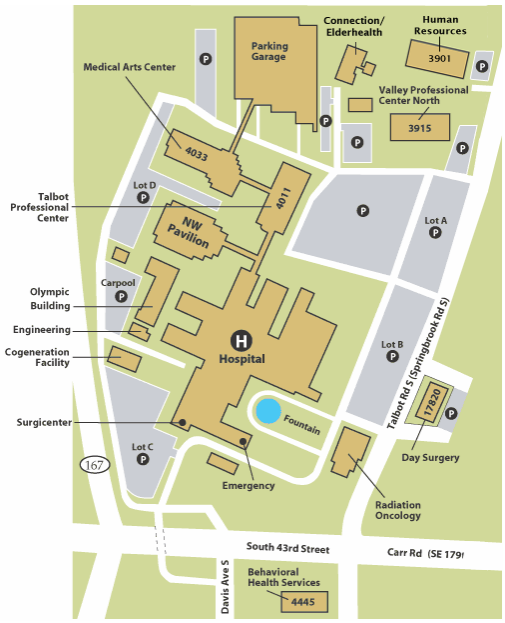

Figure 1. Valley Medical Center Campus Layout

Site Description

The Valley Medical Center (VMC) is the largest nonprofit health provider between Seattle and Tacoma, Washington. The Center provides a wide variety of medical services to the community including surgical, and 24-hour emergency care. Valley serves as a regional center, providing specialized treatment in cardiology, oncology, high-risk obstetrics, orthopedics, neurology, and pediatrics. The hospital is licensed for 302 beds.

The hospital campus was dedicated on October 4, 1969 at its current site. Over the years the Hospital expanded, added and changed. From 1977 to 1983, $23 million was spent adding on a new Emergency Treatment Center, Surgicenter and Children's wing. More beds were added and other departments expanded. VMC quadrupled in size from 254,000 to 1.3 million square feet between 1969 and 1997.

Faced with a history of growth and uncertain future energy prices, the VMC elected to build a 3.6 MW cogeneration plant in 1997. They invested $6 million in the project and selected four 900 kW gas-fired, spark-ignited reciprocating engines as prime movers, because their electric-to-thermal output ratio was the best fit for the campus energy profile. The plant was sized to displace electricity purchased by VMC. The project objectives did not include exportation of any power to the grid. Three cogeneration units were intended to satisfy electrical demand on the campus, with the additional unit as standby. A key factor in the project planning was to establish a firm 10-year natural gas contract, which expires in 2007. The current firm price is about 25 percent of the current market price for natural gas. Due to maximum consumption limitations in the gas contract, the VMC cogeneration plant is currently limited to using an average of 5,300 therms per day or about 159,000 therms (159 kTherms or 15,000 million BTU's) per month; this limited the CHP plant in 2004 to producing about 58 percent of the total electricity consumed by VMC (see Table 2).

The plant became fully operational in 1998.

Figure 2. Cogeneration Plant at Valley Medical Center

Plant Configuration

The cogeneration plant consists of four 20-cylinder Jenbacker Energiesysteme Ltd (Austria) spark-ignited V—block-rpm engines geared to1800-rpm generators to produce 898 kW each (see Figures 3 and 4). There are four waste-heat recovery boilers attached to each cogeneration unit. Three Cleaver Brooks steam boilers are piped in parallel with the heat recovery boilers to provide supplemental energy to the steam network. In addition, water cooling the engine jackets produces about 139 gal/min of 185F water under design conditions. Due to the limitations in available gas to the VMC and the cogeneration plant, most of the thermal energy is produced by the steam boilers (See Table 1 and Figure 5). The Jenbacker engines are designed with lean-burn low emission controls that maintain an air/fuel ratio of 1.6 to 1.7. The technology achieves low emissions (NO_x=1.00 grams/hp-hr, CO = 2.00 grams/hp-hr, and VOC = 0.31 grams/hp-hr) and does not require down stream exhaust cleanup. In general, the operation of the plant has met project expectations during the past six years of service.

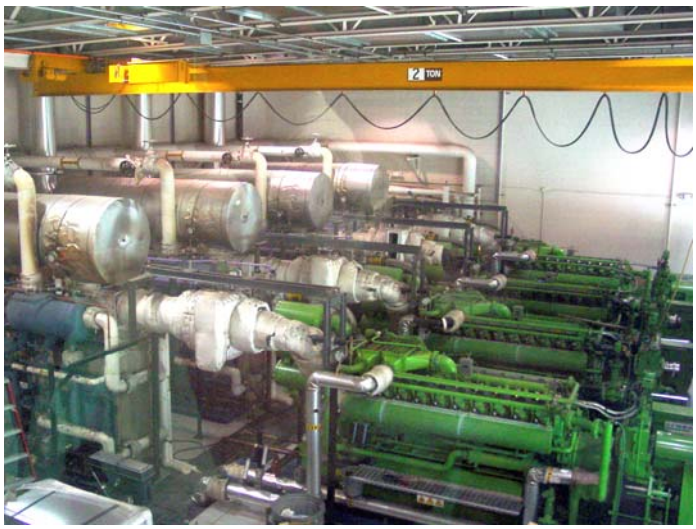

Figure 3. Engines and Waste Heat Boilers

Figure 4. Engines and Generations

Table 1: Annual Total Fuel Usage

Date	Natural Gas Used, 1000 Therms				Thermal Energy Produced, lbs of Steam		
	Boilers	CHP	Total		From Boilers	From CHP	Total
Jan '04	66	101	167		3,644,818	1,489,500	5,134,318
Feb '04	63	91	154		3,127,078	1,353,000	4,480,078
Mar '04	62	102	164		2,951,328	1,447,500	4,398,828
Apr '04	33	129	162		2,194,904	1,578,000	3,772,904
May '04	21	145	166		1,620,041	1,746,000	3,366,041
Jun '04	12	139	151		1,219,183	1,675,500	2,894,683
Jul '04	4	136	140		1,142,214	1,633,500	2,775,714
Aug '04	9	129	138		1,634,785	1,417,500	3,052,285
Sep '04	13	128	141		2,852,467	915,000	3,767,467
Oct '04	80	85	165		4,242,463	1,161,000	5,403,463
Nov '04	103	59	162		5,315,400	1,473,000	6,788,400
Dec '03	38	128	166		2,983,912	1,630,500	4,614,412
TOTAL	505	1,372	1,877		32,928,593	17,520,000	50,448,593
UNITS	1,000 Therms				# of Steam	# of Steam	# of Steam

Table 2. Annual Electric Generation and Use in MWhr

2004	Generated On-Site	Sold Back to the Utility	Purchased from the Utility	Total Delivered to Campus	Peak Electric Power Demand (kW)
Jan	993	none	646	1,639	n/a
Feb	902	none	606	1,508	n/a
Mar	965	none	663	1,628	n/a
Apr	1,052	none	588	1,640	n/a
May	1,164	none	626	1,790	n/a
Jun	1,117	none	793	1,910	n/a
Jul	1,089	none	1,120	2,209	n/a
Aug	945	none	1,143	2,088	n/a
Sep	610	none	911	1,521	n/a
Oct	774	none	648	1,422	n/a
Nov	982	none	532	1,514	n/a
Dec '03	1,087	none	159	1,246	n/a
Total	11,680	none	8,435	20,115	n/a

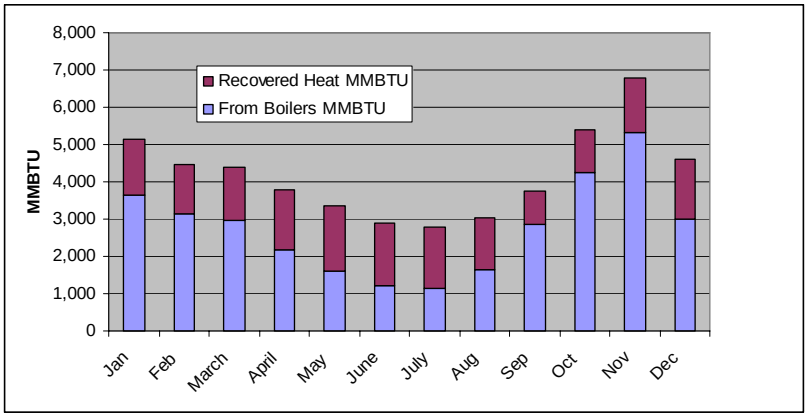

Figure 5. Annual Thermal Energy Provided

Financial Statistics

The cost of gas under the existing contract, which expires in 2007, is about $0.24 per therm delivered to the plant. Therefore, the *operating* cost of electrical generation (excluding labor and maintenance), based upon the existing contract fuel cost, is about $0.028 per kWh.

Energy/Financial Analysis Overview

The Valley Medical Center determined in early 2005 that the plant would be permanently shut down May 1, 2005, and all the cogeneration assets in the plant would be liquidated. The decision was based upon the fact that the very favorably priced gas contract could not be renewed beyond expiration in August 2007, and it would be more economical for the Medical Center to re-sell the gas available to them under the existing gas contract than to continue operating the cogeneration plant.

Additional Considerations

The primary lessons learned by the Valley Medical Center cogeneration project are:

1. It can be very difficult to project future energy costs for cogeneration projects.
2. Changing economic factors occurring during the life of the project may obviate all assumptions made at the time a project is being planned and developed.