Appendix T1 CP/HP Distict Heating and Cooling Description, Revised

August 20, 2009

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The following is a summary of information regarding the integration of central heating and cooling plants into Hunters Point and Candlestick Point. These systems are to be included in the EIR as options.

BAU Option – All heating and cooling is generated at the individual building level

District Energy Option – All heating and cooling energy is generated at the district level and distributed to individual buildings

General Site Description – District Heating and Cooling Option

District heating and cooling plants have been identified as an option for providing site wide heating and cooling energy. Two potential locations for these systems have been identified, one serving Hunters Point and a second serving Candlestick Point. The location identified for the district plant serving Hunter's Point is in the parking structure adjacent to the R&D facilities. The most probable location for the district plant serving Candlestick Point is in the parking structure adjacent to the regional retail center. Distribution infrastructure sill also be required. Each central plant facility will likely consist of two separate stories. The first story provides an enclosure for the boilers, chillers, pumps and other ancillary equipment. The upper story (or roof) provides a location for the heat rejection units and boiler flue exhaust both of which have to discharge externally. These emissions will have an impact on local environmental quality which is described below. Below is a figure that identifies the proposed central plant locations and pipe distribution network.

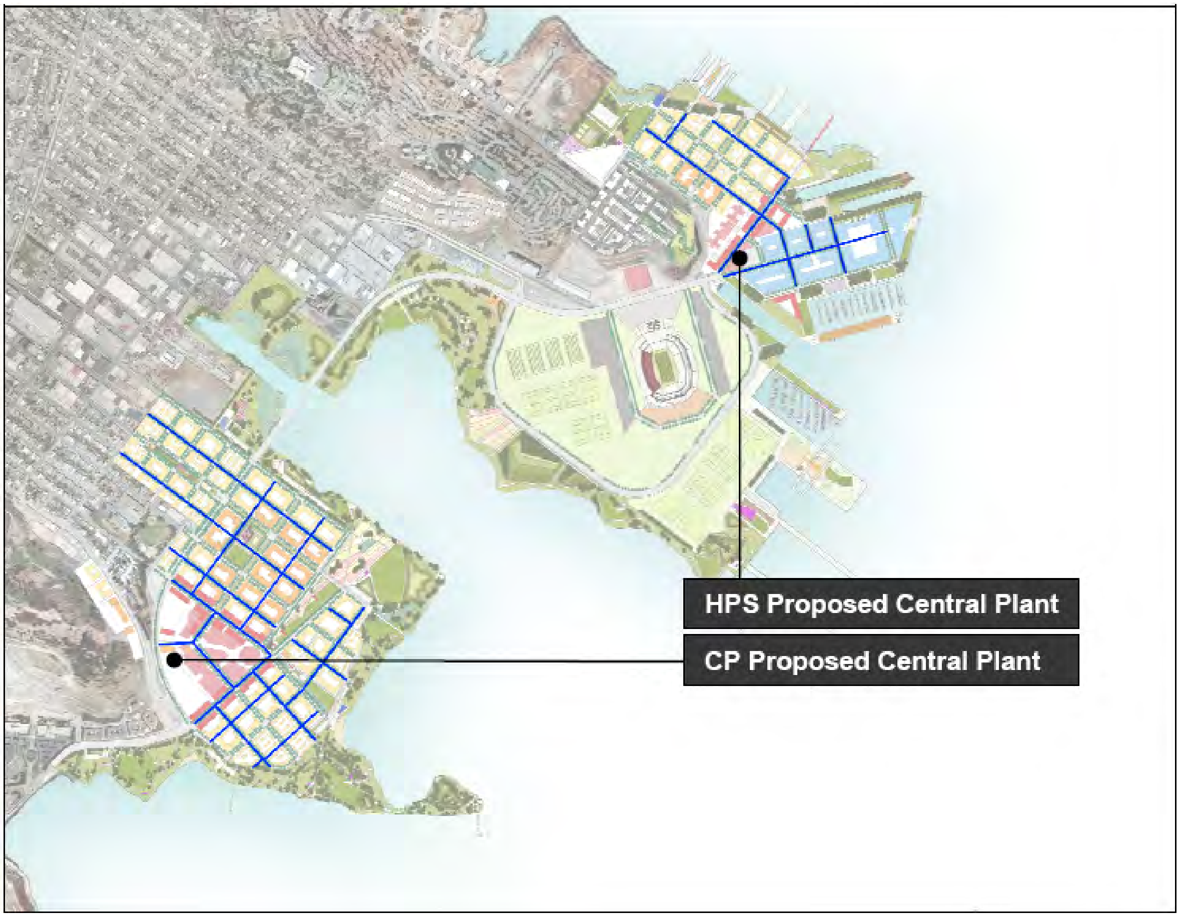


Figure – Proposed Central Plant Locations

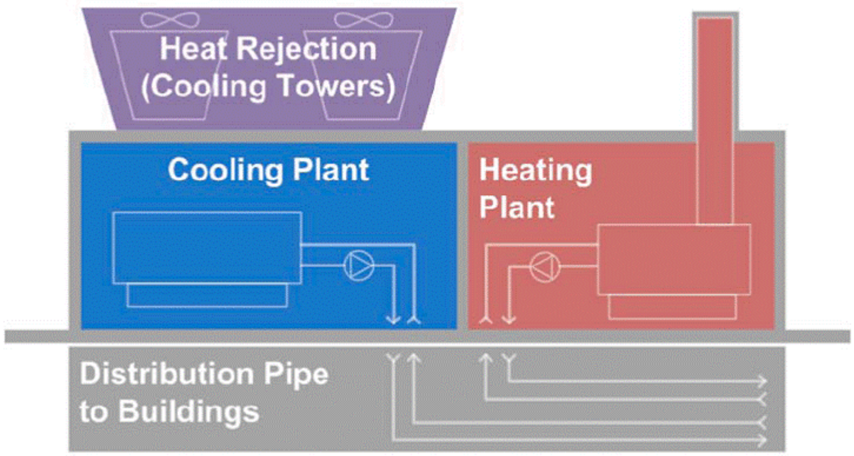
Major Plant Equipment for the District Heating and Cooling Option

Heating would be provided by natural gas boilers providing either steam or hot water. In addition to natural gas as the primary fuel source, electricity will be required for base of plant operation and distribution. The heat will then be distributed through underground piping networks to each building or customer. Steam is distributed through the backpressure created by the steam. Hot water is distributed through electrically driven pumping systems. The most likely medium for distribution will be low temperature hot water (<250 degrees Fahrenheit). Other base of plant equipment including expansion devices, air elimination, and water treatment will also be required for the heating plant.

Cooling may be generated by several sources including natural gas fired, steam fired, or electrically driven chillers. The most likely and energy efficient option would be the use of electrically driven chillers for chilled water generation and water cooled cooling towers for heat rejection. Several electric centrifugal chillers will be required to generate chilled water. The heat extracted from the waters is then transferred to the cooling towers where the heat is rejected to the ambient air through the evaporation process. Electrically driven pumping systems are used for transferring heat form the chillers to the cooling towers and for distributing the chilled water to the development. Other base of plant equipment including expansion devices, air separation devices, and water treatment equipment will be required for the cooling plant.

The configuration of the heating and cooling plant is most likely to be a 2-story stacked system to reduce the overall building footprint. The cooling plant and heating plant will be enclosed structures. The heating plant will requires ambient air for fuel combustion which may enter from an exterior wall or through the roof. The boiler will also have a flue where combustion exhaust is emitted to the ambient air. The best location for these flues are through the roof. A diagram of the stacked central plant system and major components has been included below. Cooling towers require significant volumes of ambient air for the heat rejection process. For this reason cooling towers are generally placed outdoors. Stacking the cooling towers on the roof will minimize the overall building footprint, but increase the structural requirements of the building due to the significant weight of the cooling towers.

Figure: Stacked Central Plant for Heating and Cooling Energy Generation



Based on preliminary heating and cooling load estimates for the entire site (and assuming minimum energy compliance scenario), the area for each plant will likely be 60,000 to 85,000 square feet each, depending on the specific equipment used. The heating and cooling plants will likely require a 15-20 feet story height to allow for equipment size and clearances. The cooling towers will have a similar height and will discharge vertically. The preliminary heating and cooling capacities used for these estimates have been identified in the table below.

Table: Preliminary Cooling and Heating Loads

Load Type	Hunters Point Shipyard	Candlestick Point	Totals*
Cooling Load (tons)	14,090	11,822	20,730
Heating Load (kBtu/hr)	91,511	184,213	220,579

*Diversity has been applied to the total development values.

Assuming a stacked configuration, the cooling towers would be located above the cooling plant reducing the building footprint to 40,000-65,000 square feet. This assumes the following breakdown for each of the major plant components:

- Cooling Towers: 15,000-25,000 square feet (8,000 to 12,000 tons cooling)
- Chiller Plant: 20,000-30,000 square feet (8,000 to 12,000 tons cooling)
- Boiler Plant: 20,000-35,000 square feet (75 Mbtu-150 Mbtu heating)

If dry cooling towers or combination wet/dry cooling towers are used (to eliminate or minimize visual plumes as described in the environmental impacts section below), an additional 30% of area is required for the cooling tower plant. Combination wet/dry cooling towers will also have an increase in height of about 30%

over typical. The total area required for the optional cooling towers will be 60,000-93,000 square feet, or a stacked building footprint of 40,000-78,000 square feet.

Distribution Infrastructure

Cooling and heating will be distributed through hydronic piping networks. These networks will be made up of supply and return, insulated piping located in utility trenches below grade. The location and depth of the pipe for this system is consistent with other low pressure water utility piping. Connections to buildings will include meters for accounting and billing purposes.

Heating energy will be distributed in the form of hot water via a pipe distribution network. The peak hot water flow capacity of the central plant will be about 10,000 and 5,000 gallons per minute for Hunter's Point and Candlestick point respectively. The main hot water pipe sizes will be approximately 18 and 12 inches in diameter.

Cooling energy will be distributed in the form of chilled water via a pipe distribution network. The peak chilled water flow capacity of the central plant will be about 30,000 and 25,000 gallons per minute for Hunter's Point and Candlestick point respectively. The main hot water pipe sizes will be approximately 36 and 30 inches in diameter.

Each building or customer would be provided with a point of connection to the distribution loop. This point of connection would include meters from which the energy consumption of each service (heating or cooling) will be determined. Metering devices and point of connection may happen just outside the building or just within the building. The point of connection would require access by the district energy system operators.

Environmental Impact

Air Quality

The major systems having potential impacts to air quality or the natural gas fired boilers used for generating hot water and the cooling towers used to reject heat to the atmosphere.

The emissions form the boiler systems include several criteria pollutants identified by the United States Environmental Protection Agency (US EPA). These criteria pollutants are regulated through National Ambient Air Quality Standards (NAAQS)[1], California Ambient Air Quality Standards (CAAQS)[2], and Bay Area Air Quality Management District (BAAQMD) Rules and Regulations[3]. The boilers and associated equipment will all be designed and operated in conformance with the most stringent requirements of each of these regulating bodies. The boilers used in the district energy system will be classified as large boilers (>2,000,000 BTU capacity). These boilers are regulated for both nitrogen oxides (NOx) and carbon monoxide (CO). In general, the emissions standards for large boilers are more stringent than those for small boilers.[4] By meeting and possibly exceeding these emissions standards through the use of more efficient boiler technologies and centralized control, the emissions from criteria pollutants will be less than the BAU Option. In addition, the boilers used in the District Energy Option would incorporate the best available control technology, which is currently estimated to be about 8 ppmv for nitrogen oxides.

Cooling tower emissions include water vapor, drift and blowdown. Of these three emission sources, drift has the most significant impact to air quality. Drift occurs when droplets of water are carried out of the cooling tower through the tower exhaust air. Evaporated water that provides for the heat dissipation process is a pure water source and not a regulated source emission, but drift contains the same concentration of impurities as the cooling tower water. These impurities include dissolved solids which are particulate matter <10 microns (PM10) a regulated emission. Drift eliminators are baffle-like devices that capture these water droplets and can reduce drift to below 0.1%. Drift eliminators and alternative cooling tower water treatment practices will be implemented so as to minimize drift and its potential impacts on air quality. In addition, the cooling towers will use the best modern practices in their operation.

In general, the overall energy demand of this centralized system will be approximately 2% lower than the BAU option of each building utilizing its own separate cooling and heating plant. This is primarily accomplished through efficient equipment and increased system diversity.

Water Quality

The cooling tower water blowdown may have potential water quality impacts. Blowdown is a process of dissolved solids control in which cooling tower water is discharged and replaced it with makeup water in order to dilute the dissolved solids. Increased concentrations of dissolved solids are produced as a result of the evaporation process. This is the most common method of dissolved solids control. The cooling tower installation will be designed, constructed, and operated based on local water quality regulations so as to minimize impact on water quality. The incorporation of alternative cooling tower water treatment practices will also aid in reducing the impact.

Noise

Having the plant in a central location will have large equipment that will have larger environmental noise. In the District Energy Option, this noise source will be generated in the parking structure adjacent to the urban center rather than at each building. Therefore, the District Energy plant will reduce widespread ambient environmental noise emissions over the BAU case and the central location will provide for greater ease in the acoustic treatment of these systems.

Noise from cooling towers is generally the most difficult to treat as this type of equipment must be located outdoors to allow for the intake and exhaust of ambient air. Noise from a cooling tower is generated by the impact of falling water, movement of air by fans, fan and motor vibrations caused within the structure and by motors, and fan accessories. This noise is typical for all cooling tower sizes. Since the size of the cooling towers is greater and the amount of air flowing through the towers is also larger, the local noise generated by these units will be higher in the District Energy Option. In the BAU case, cooling towers or similar heat rejection devices will be placed at each building. Although the noise generated by larger cooling towers is greater than that of a smaller tower, the ability to provide noise mitigation for multiple cooling tower locations is much more difficult for the building level BAU Option. In addition, the cooling tower location will be adjacent to the urban center rather than within, reducing overall ambient noise within the more densely occupied urban centers.

Noise generated from boilers, chillers and distribution equipment are more easily treated acoustically than cooling towers. The larger equipment will generate greater noise than smaller distributed equipment, but will be centrally located and acoustically treated. There will be no major acoustical impacts for this type of equipment in the District Energy Option as compared to the BAU Option.

Visual Impacts

Cooling towers are likely to have a visual plume. The plume, discharge air form the cooling tower, is made up of saturated air and warmer than ambient. When this warm saturated discharge air mixes with the ambient air, the air is cooled and water condenses forming a visual plume. These water droplets are pure water and free of pollutants or contaminants, contradictory to the perception of the general public that the plume is a hazardous pollutant being released into the atmosphere.

Ambient temperature conditions, discharge temperature conditions, volume of discharge air and velocity of discharge air are all factors that will determine the amount of condensation that occurs and the visibility of the plume. The plume can present a visual hazard if it interferes with roads or airports and may cause the formation of fog and even icing of roadways at low ambient temperatures.

Visual plumes will occur at this location some portion of the year without mitigation. Visual plume mitigation technologies, including combination wet/dry cooling towers, can be used if the visual plume is an issue. These towers may increase equipment cost by as much as 3 times and require slightly more energy use per unit of cooling; however, use of the dry cooling tower portion will reduce overall water consumption. Combination wet/dry cooling towers are generally larger than typical water only cooling towers.

Additional environmental benefits of the centralized vs distributed system include:

- Increased potential for incorporation of renewable energy systems leading to reduced GHG emissions for the developments.
- Smaller overall equipment sizes due to the diversified end uses being served.
- Simpler noise control – the noisiest equipment is removed from each building and noise can be treated in a single location within the parking garage.

Additional Benefits

All of the above benefits will be available to both the vertical and horizontal aspects of the developments. In addition, the following benefits can be attributed directly to vertical developers;

- Increase in usable floor area in buildings – it is estimated that this could be in the region of 3% for larger buildings due to the elimination of cooling and heating equipment.
- A district system can offer a plug and play path to help meet any sustainable goals that a vertical developer or future building owners / tenants may have – for example net zero energy.
- Better control over the aesthetics of buildings – no need to find routes or locations for boiler flues and heat rejection equipment on the exterior of the buildings.
- A reduction in building level maintenance.
- Has the potential to make roof spaces cleaner leading to improved views from adjacent buildings and the opportunity to incorporate renewable technologies or green roofs at a building level.

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[1] National Ambient Air Quality Standards (NAAQS) are defined by the United States Environmental Protection Agency.

[2] California Ambient Air Quality Standards (CAAQS) are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of regulations.

[3] Bay Area Air Quality Management District (BAAQMD) provides rules and regulations for air quality in 16 specific air quality zones in the Bay Area Region of Northern California. These rules and regulations are more stringent than CAAQS and NAAQS for large boiler installations.

[4] BAAQMD Regulation 9 Rule 7 governs emissions for Large Boilers (>2,000,000 Btu input energy) which are considered for the District Energy Option. The boilers are likely to be load following, more than 5,000,000 BTU/hr and less than 75,000,000. Therefore the maximum allowable emissions limit for oxides of nitrogen is 15 parts per million by volume (ppmv) and the maximum allowable emissions limit for carbon monoxide is 400 parts per million by volume (ppmv). BAAQMD Regulation 9 Rule 6 governs emissions for Small Boilers (>75,000 and <2,000,000 BTU input energy) which are likely to be provided in the BAU Option. The boilers are likely to have input energy ratings between 400,000 BTU/hr and 2,000,000 BTU/hr. Therefore, the maximum allowable emissions limit for oxides of nitrogen under this rule are 20 ppm after January 1, 2013. Carbon monoxide is not regulated under this rule.