CITY OF PORTLAND, MAINE
DEPARTMENT OF AVIATION
AND TRANSPORTATION

VALE AIP Discretionary Grant Application for the Installation of a Geothermal System

Revised and Submitted: 15th April, 2010

Prepared by: Roy Williams PE LEED AP

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Section 1: Project information

Project Title: Vale grant for the Installation of a Geothermal System

Airport Code: PWM

Airport Name: Portland International Jetport

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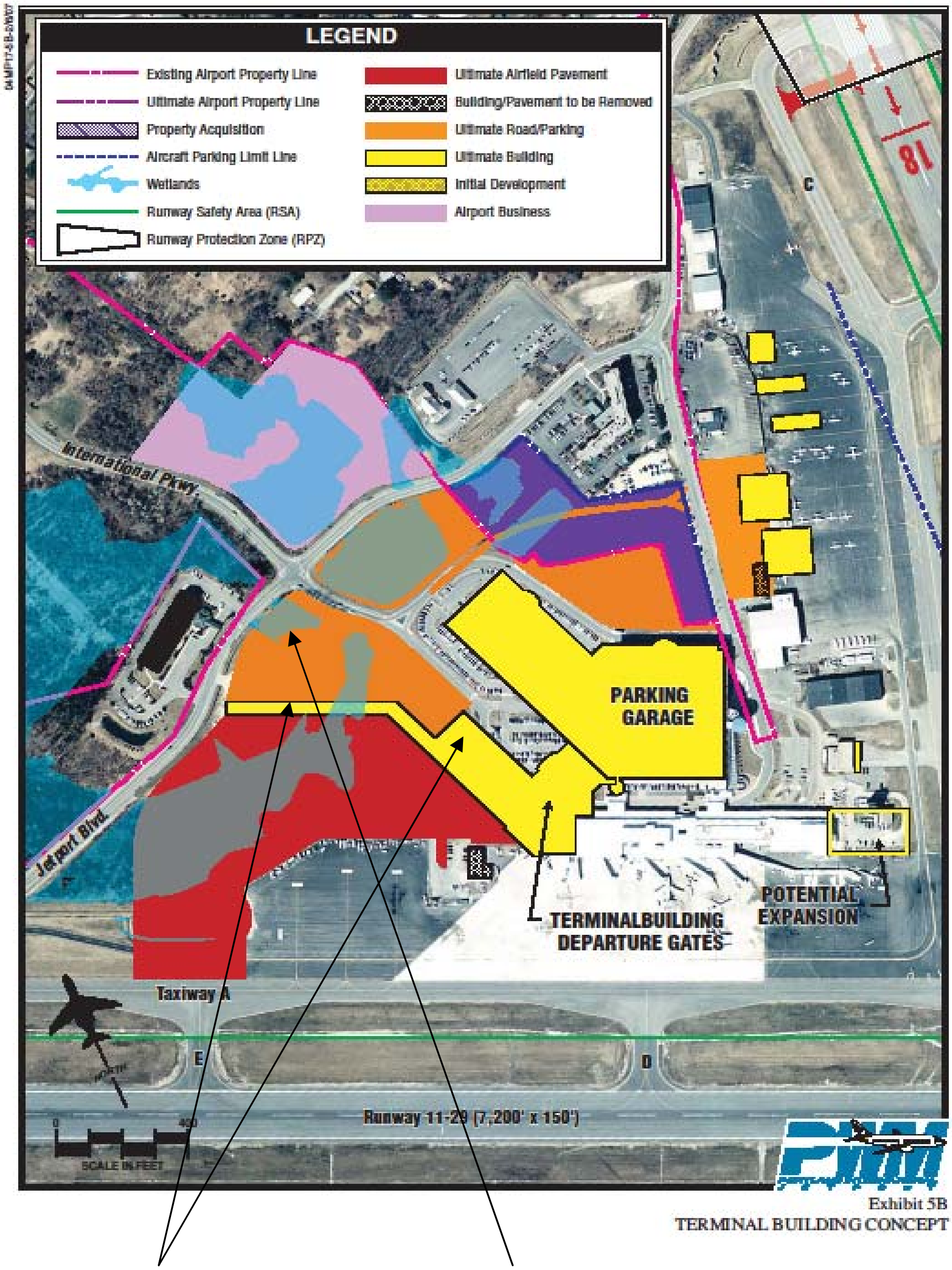
Section 2: Description of Proposed Emission Reduction Measures

The Portland International Jetport is owned and operated by the City of Portland and managed by the City's Department of Aviation and Transportation. The Portland International Jetport is currently engaged in a major construction terminal expansion that is scheduled to begin in April 2010. The Airport Director, Mr. Paul Bradbury and Mr. Roy Williams, the Airport Deputy Director of Engineering and Facilities, will be representing the City during the construction of the expansion and, if grant money is awarded, the installation and operation of the geothermal system. The Construction Manager is Turner Construction of Boston Mass and the Architect is Gensler whose office is also located in Boston Mass. The engineering designers are AMEC of Portland and the geothermal designers are Hayley and Aldridge of Boston.

The Jetport's principal air carriers are Air Tran, Continental, Delta, JetBlue, Air Wisconsin (aka United) and US Airways. Over the past year the airport has experienced larger than expected growth with a record passenger flows. The Portland International Jetport anticipates total passenger volume to continue to grow further and this growth, originating from the introduction of two new low cost airlines, has resulted in the need to expand the Portland Jetport's main terminal building. The existing passenger terminal building will be expanded in a north westerly direction (see Appendix D site plan). The terminal expansion is approximately 145,000 square feet and will include renovation of portions of the existing Jetport main terminal building. Scope of work shall include a relocated employee parking area and this shall be the site of the new geothermal system bore field. Much consideration was given to the location of the geothermal bore field as the projected life of the system is 40 years and the airports 30 year master plan shows growth in a westerly direction. Referring to Fig 1, it is clear that the optimal employee parking site has no conflict within the 30 year master plan.

It is confirmed that PWM is located in an area designated by the MeDEPAQ as a maintenance area for regulated pollutants and PWM is seeking AIP discretionary funding for the installation of a geothermal well system to reduce emitted pollutants from the planned terminal expansion base plan heating plant. In particular, if emission of Nox (Oxides of Nitrogen) and VOCs (Volatile Organic Compounds) can be reduced or avoided by reduction or elimination of No 2 fuel oil usage for heating purposes, it is obvious that the regional air quality will benefit. PWM is proposing to reduce emissions by producing heating from a geothermal plant with centralized heat pumps, supplemented by dual fuel (natural gas/ No 2 fuel oil) hot water boilers. The new geothermal plant will produce both heating and cooling, but since the focus is on heating plant emissions, the plant heat pump capacity will be optimized for heating and the cooling plant will be supplemented with a centrifugal chiller. The geothermal plant shall serve only the terminal addition.



Future Potential Expansions

Proposed Bore Field Site

Fig. 1 – 30 year Master Plan.

The geothermal plant arrangement is as follows: A modular water to water heat pump system located in the new terminal addition mechanical room shall generate heating water at 130 deg. F and chilled water at 42 deg F, depending on the season. The bore field capacity shall allow the heat pump system to produce up to 180 tons (1.6 million Btus) of cooling and 2265 Mbtus/hr of heating or a combination of both that does not exceed an energy rate of 2265Mbtus/hr to the bore field. The heat pump system heating and cooling source will be a bore field of multiple 400 or 500 foot deep drilled wells located to the north west of the terminal addition underneath a proposed employee parking lot (see Appendix D site plan). Supply and return lines will run from a closed 2" or 3" dia. closed loop in each well to a supply manifold in an underground vault near the bore field and then run approximately 750 feet as a pair of 8" supply and return lines underground to the terminal expansion mechanical room. See Fig. 2.

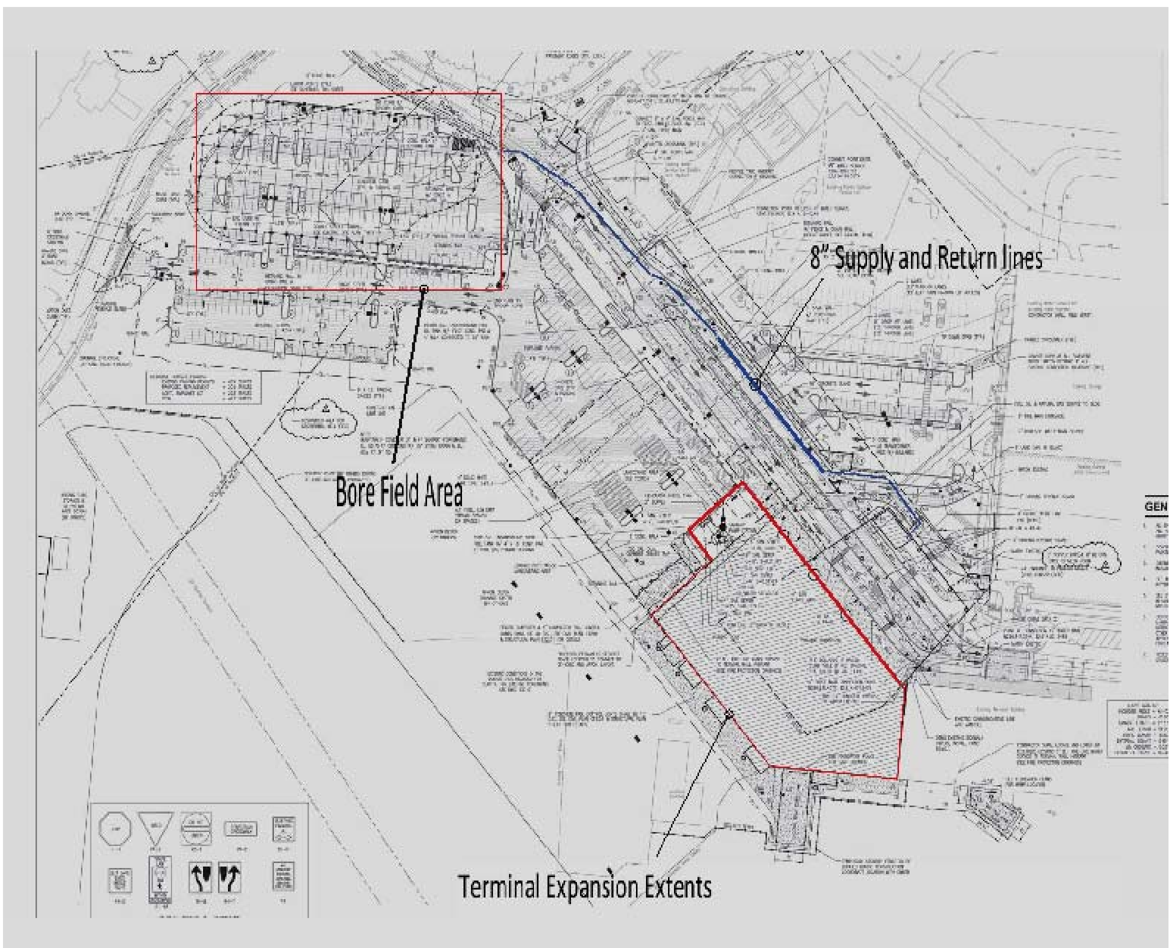
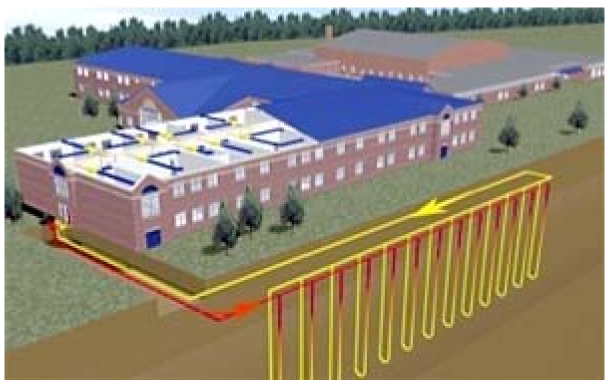


Fig 2.

A system pump and backup pump will circulate the heat source/heat sink loop fluid (15% propylene glycol/85% water) from the pumps in the terminal addition mechanical room to the bore field and back. From the heat pumps, 8" pipe manifolds will connect to the chilled water piping mains and the low temperature heating water mains. A system of low temperature (130 deg F supply/110 deg F return) 8” heating water mains will be routed to hot water coils in Air Handling Units (AHU) 1 and 2 in the terminal addition mechanical well on the roof. A system pump and backup pump with variable frequency drives (VFDs) will circulate hot water through the low temperature piping mains to the low temperature heating equipment. A cross connection to the high temperature heating water mains will allow the hot water boilers to supplement the heat pumps during normal heating season operation and provide heating water for freeze protection if an extended electrical outage occurs. A system of high temperature (180 deg F supply/160 deg F return) 3” heating water mains will be routed to finned radiation along building perimeter walls, the door heater and unit heaters in stairwells and baggage handling spaces. The hot water boilers will provide hot water and each boiler will be sized to provide freeze protection for the terminal addition. A circulator pump will be provided for each boiler and a system pump, with VFDs, will circulate hot water through high temperature piping mains to the high temperature heating equipment.



Graphic representation of a geothermal system

The chilled water mains will serve AHUs 1 and 2 in the mechanical well on the roof, plus fan coil units and blower coils on lower levels. A 475 ton centrifugal chiller will also be piped to the chilled water mains for supplemental cooling. A system pump and a backup pump will circulate chilled water to the heat pump, chiller and cooling equipment. A fluid cooler mounted in the terminal addition mechanical well on the roof will provide heat rejection for the chiller capacity and a condenser pump with a VFD dedicate to the chiller will circulate water to the fluid cooler.

It is important to note that the chilled water system emission reductions are zero at the PWM site as there will be no oil energy consumption conducted during this process. However, there are substantial emissions reductions back at the electricity power generating plant but are not valid for this grant application and therefore have not been included. I have highlighted this chilled water narrative within this application to show that there are additional environmental benefits, albeit not within the Jetport area, from emission reductions and an electricity usage perspective but has no bearing on this application.

Overview of the Total Cost of Project

A summary of hard and soft costs are shown in Table 1 below. A more detailed breakdown of these costs is reflected in the project application sheets in Appendix A. This summary reflects the selected bidder's costs for construction. Appendix D includes a spreadsheet that clearly shows the bid format with the lowest bidder breakdown. It is important to note that as this geothermal system supplements the Terminal Expansion, an early decision was made to "firewall" the mechanical room as the demarcation line where geothermal system starts and ends and no costs associated outside that firewall are included in this grant application other than the supply and return lines and bore field.

Overview of Project Costs

Description	**Project Total Cost**	**89% Eligible**	**11% Ineligible**	**AIP @95% Funding**	**State and Local Share**
Installation	$ 2,791,191	$2,484,160	$307,031	$2,359,952	$431,239
Design Costs	$ 204,396	$181,912	$ 22,484	$172,817	$31,579
Administration Expense	$ 2,000	$1,780	$220	$1,691	$309
Total	$2,997,587	$2,667,852	$ 329,735	$2,534,460	$ 463,127

Table 1 *Local matching funds are provided from PWM cash reserves.*

This application is requesting $2,534,460 for the geothermal project. As the VALE EDMS reports indicate, this project is estimated to save a total emissions reduction of 41 tons of NOx and 43 tons of Ozone over the 40 year life span of the geothermal system (See Section 3). This would equal to over 101,912 gallons of oil saved per year and a projected savings of over 4 million gallons of heating oil over the life of the system (See Savings and Pollutant reductions Sheet in Appendix B).
To summarize, this geothermal project application is proposed as an effort to reduce emissions by using substantially less fuel oil consumption during the heating season using a ground source geothermal energy system taking advantage of the earth's stable temperature underground, providing heat energy in the winter and a bonus of a heat sink in the summer.

Section 3: Emission Reduction Estimates

The EDMS Approach

This following documents the rationale in deducing the on-site emissions reductions from the Jetport boiler plants by reducing the boiler plant fuel oil consumption using the VALE EDMS reporting software.

A description of the existing and new terminal area heating plants follows:

Existing Terminal Boiler Plants

The existing 157,300 square foot Terminal space is served from two Boiler Plants in the East and West Wing Mechanical Penthouses. Each mechanical penthouse has two hot water boilers and each boiler is a maximum of 3 million Btuh input. The boilers in the East Penthouse Mechanical Room have dual-fuel capability and have both gas and oil supplies. The West Penthouse Mechanical Room boilers have only a fuel oil supply. The boilers generate hot water for air handling unit heating coils, unit heaters, finned radiation along the walls, radiant floor tubing and snow melt tubing buried in slabs outdoors.

New Expansion Boiler Plant

The proposed terminal expansion encloses an area of approximately 140,000 sf. Almost all of this space is provided with comfort heating to comply with ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy. The proposed heating system is a hydronic system with hot water generated by oil-fired boilers circulated to Air Handling Unit heating coils, Variable Air Volume (VAV) box heating coils, unit heaters, radiant floors, snow melting systems and finned radiation along perimeter walls. The Boilers will generate hot water at temperatures up to 180 degrees ˚F. The hottest water will be circulated to the Air Handler Units heating coils, VAV box heating coils for ventilation air and building heating; and to unit heaters and finned radiation for building heating. Lower temperature (below 120 degrees ˚F) water will be circulated to tubing embedded in the floor slabs for building heating and to snow melt tubing buried outside.

Method of Estimating Emitted Pollutants and Pollutant Reduction

It is PWM's understanding that the basis of the VALE grant is to reduce the amount of oxides of nitrogen (Nox) emissions by use of a geothermal heat pump system to eliminate the firing of distillate (No. 2 fuel) oil. To make this determination, the following steps are needed:

1. Configure the Terminal addition heating systems as oil-fired boilers (Base configuration) and a Geothermal alternate with supplemental gas-fired boilers. (GSHP configuration).
2. Model the new terminal building, including location, floor areas, wall areas, glass areas, and roof areas. Input the thermal performance characteristics of the building components.
3. Generate and input building use schedules including lighting, people and ventilation.
4. Calculate the heating and cooling loads.
5. Generate the projected energy use for the addition in terms of heating fuel energy used annually.

6. Determine the Jetport as a major or minor emissions source and determine the required Best Available Control Technology (BACT).
7. Tabulate the heating fuel usage and convert to the energy units required by the emissions software. No. 2 fuel oil heat content is figured at 140,000 btu/gallon.
8. Model the heating plant emissions using EDMS (Emissions and Dispersion Modeling System) software from the Federal Aviation Administration Office of Environment and Energy. Compare the NOx emissions from the Base configuration and GSHP configuration to generate annual tons of NOX reduced by means of the GSHP system.

Step 1: The heating systems were configured as follows: The Base configuration was a plant of two hot water boilers fired with 0.5% sulfur distillate fuel oil. The hot water would be generated at temperatures up to 180 deg ˚F and circulated to heating coils and finned radiation. The hot water would be mixed with cooler water for delivery to radiant floor and snow melt systems.

The GSHP configuration is a geothermal bore field of 500 foot +/- drilled wells circulating water to water–to-water heat pumps in the new Expansion Mechanical Room. The bore field will be used as a heat source for the heat pumps. Heating water will be generated by the heat pumps at temperatures up to 120 deg ˚F and circulated to radiant floors and snow melt systems. Heating coils for air handlers and fan coils are would be sized to provide adequate heat using lower temperature water from the heat pump system. A gas-fired condensing boiler plant would provide hot water for the unit heaters, the finned radiation along the exterior walls, and the domestic hot water system; heat pumps for domestic water heating will also be investigated. The hydronic heating system piping would be reconfigured with high-temperature and low temperature loops to the heating equipment.

Step 2: The terminal addition was modeled with Trace 700 load modeling software from the Trane Company. A copy of selected output reports is included in Appendix B. In the interest of providing the most accurate output, the systems were modeled with and without domestic water heating load and the results have been tabulated below. The net result of the domestic water load was an increase of 3% in fuel use.

Step 3: Schedules were generated for the lights, people and ventilation. These schedules are tabulated as percentages of the full occupancy and are shown in Appendix D. Two basic schedules; Ticketing and hold room, were generated and the occupied spaces were classified as one or the other. The projected total occupancy load was tabulated from the Architectural documents; a tabulation sheet with comments is included in the Appendix B.

Step 4: The Jetport heating and cooling loads were generated. Copies of the Base Configuration loads are included in the Appendix B. The total heating load was 5900 Mbtuh and the total cooling load was 639 tons.

Step 5: The heating energy use was modeled for the Base configuration and GSHP configuration and the results are tabulated below.

Jetport Expansion	Thousands of Btu/year	Gallons of No. 2 Fuel Oil/year	Kiloliters of No. 2 Fuel Oil/year
Oil Fired Boiler Plant No Domestic Hot Water	17,944,728	128,177	485.21
Oil Fired Boiler Plant Domestic Hot Water	18,413,576	131,525	497.88

Table 2 *The Trace Energy Consumption Summary is included in the Appendix D*

Step 6: Determination of Best Available Control Technology

The calculated boiler plant capacity has been projected at 6 million Btuh to meet the design heating load. As noted above, the existing boiler plants have an installed capacity of 12 million Btuh; hence the Jetport total heating plant capacity is 18 million Btuh which would seem to put the Jetport into the Minor Source category as defined by the State of Maine Department of Environmental Protection Chapter 115: Major and Minor Source Air Emission License Regulations. To corroborate this determination, a calculation for the Jetport plant emissions based on 2% sulfur No. 2 fuel oil and an annual projected fuel use per year was made. (No 2 fuel oil with a sulfur content of 2% or less is allowed by State of Maine Department of Environmental Protection Chapter 106 LOW SULFUR FUEL). According to the Jetport current air emission license, (See copy of page in Appendix B) the average annual boiler plant permitted fuel use is 98,000 gallons of No. 2 fuel oil per year. Assuming a domestic hot water load of 100Mbtuh during occupied periods, the building model projected a fuel use of 131,525 gallons of No. 2 fuel oil per year for the Terminal Expansion. The total fuel oil consumption for the existing and new boiler plants is estimated at 229,525 gallons per year.

According to the emissions factors contained in the US EPA Standard AP-42 COMPILATION OF AIR POLLUTANT EMISSION FACTORS Volume I: STATIONARY POINT AND AREA SOURCES, the following quantities of pollutants would be emitted during one year of plant operation, assuming 229,525 gallons of No. 2 fuel oil are burned: (See Table 1.3-1. in Appendix B)

CRITERIA POLLUTANT	THRESHOLD FOR A MAJOR SOURCE
SO2: 32.59 tons per year	100 tons per year per Maine DEP standards
S03: 0.46 tons per year	100 tons per year per Maine DEP standards
NOx: 2.30 tons per year	100 tons per year per Maine DEP standards
CO: 0.57 tons per year	100 tons per year per Maine DEP standards
PM: 0.23 tons per year	100 tons per year per Maine DEP standards

Table 3

Hence, it is clear the boiler plants fall under the Minor Source definition of the State of Maine Department of Environmental Protection Chapter 115 regulations. This is a minor source with small boilers.
Since it is a minor source and the boilers are small and simple commercial types rather than large industrial or power boiler types with more sophisticated control systems, the Best Available Control Technology (BACT) for such plants has been considered to be the firing of low-sulfur (0.5% sulfur) fuel oil rather than more elaborate technology such as scrubbers. Recent Maine DEP license applications reviews have accepted low sulfur fuel with material specifications that comply with ASTM D396-78 *Standard Specifications for Fuel Oil.* Low sulfur No. 2 Fuel Oil is hereby presented as BACT for the new boiler plant.

Step 7: The heating energy baselines used for the emissions modeling is shown in table 4.

Jetport Expansion Only 131,525 Gallons of No. 2 Fuel Oil/year 497.88 Kiloliters of No. 2 Fuel Oil/year Oil Fired Boiler Plant – With Domestic Hot Water

Table 4

Step 8: Eliminating the concept to have the geothermal system supplement the existing terminal due to high upfront costs, the emission reductions for the new plant using a geothermal system was modeled using the EDMS software. The results are tabulated below:

Jetport Addition alone	**Tons /year**
Baseline Boiler plant	1.285
Geothermal and Boiler Plant	0.263
Reduction in tons of NOx	-1.02
Reduction in tons of VOC	-0.055
Total reduction in tons of Ozone	**-1.075**

Table 5 *The Emission Reduction Reports are included in the Appendix A*

Geothermal Program Optimization Field Study Comparison

A Geothermal Program Optimization Field Study Comparison analysis has been conducted to find the most cost effective geothermal program size, designed to maximize benefits, maximizing reductions of up front capital costs. This study was conducted as a secondary source of data to compare the EDMS software emission reductions, confirming viability of this proposed geothermal system.

The Terminal Expansion Project currently includes conventional heating and cooling systems which can be used to assist a geothermal system. This allowed a geothermal program field study to be developed which captured the base load, not the peak loads, which is far more cost effective than an "all geothermal" system. Various geothermal scenarios were developed, ranging from designs providing 10% of the annual heating to load up to 100% of the annual heating load. Firstly, geothermal designs for both the "terminal expansion only" and the "expansion and existing terminal" were evaluated. The scenarios that were investigated targeted the effect on the value proposition for capturing more/less heating loads, to reduce fuel oil consumption and limit the amount of VALE grant funding that would be potentially available. Each design also opportunistically uses the geothermal system to provide some of the building cooling loads to obtain additional energy reduction benefits and to maintain long term well field temperature balance. For each scenario, the number of wells and the size of the VALE grant funding was estimated, based on the estimated NOx and VOC reduction provided by the system. After reviewing the preliminary results, the design team quickly concluded that the geothermal designs for the "expansion and including the existing terminal building" scenario required too much up front capital costs and would not be feasible. Therefore, the recommendation moving forward was to design for the new terminal expansion only.

After investigating a range of geothermal system sizes, it was determined that a geothermal system that provided between 75% and 95% of the annual building heating load yielded the optimal combination of delivered long term benefit and least net cost, considering Vale grant funding. Larger geothermal systems (>95% of the annual heating load) were found to have increasing high up front capital costs, compared to the incremental benefit delivered. Similarly, the opportunity to maximize emission reductions became diminished for systems smaller than ones that provide <75% of the annual heating load. On this basis geothermal design of 95% annual heating load and 75% annual heating load were further developed as Scenarios A and B respectively. These will be described in more following detail. In order to "ground truth" the optimization analysis, the field study was conducted. This program consisted of drilling a single, 400ft deep pilot test well within the proposed limits of the well field and was conducted to

- Provide data for contractor pricing
- Allow a thermal load test to be conducted on site, to obtain site specific parameters for design
- Serve as a production geothermal well such that these "up front" costs would not be lost if the project moved forward.

The thermal load test provided the following results.

Thermal Load Test Results

Measured Ambient Ground Temperatures – ˚F	49.5
Estimated Thermal Conductivity (BTU/hr*ft*˚F)	2.17
Estimated Thermal Diffusivity (ft^2/day)	1.37

Table 6 *Details of well installation, the thermal load test and the log for GTW-101are not included in Appendix D but can be provided on request*

Combining the results of the optimization work together with the validated ground characteristics from the field test program, the following scenarios are recommended.

- **Scenario A**: 95% of low temperature base load heating and opportunistic cooling for the new addition only. This geothermal system would require 60,000 linear feet of geothermal well

- **Scenario B**: 75% of low temperature base load heating and opportunistic cooling for the new addition only. This geothermal system would require 44,000 linear feet of geothermal well.

Given the available bore field space restrictions and other issues, it was recommended that each geothermal well be installed to depths of between 400 and 500feet below grade surface. Accordingly, the above scenarios would yield:

Number of wells per Scenario

Well depth	Scenario **A**	Scenario **B**
400ft	150	110
500ft	120	88

Table 7

The above program recommendations are based on the following:

- Multistack MS5oZ644 heat pumps
- 15% propylene glycol antifreeze
- Supply temperatures delivered from the field range from 40˚F and 90˚F
- Chilled water supply of 44˚F
- Hot water supply temperature of 130˚F
- 20ft center to center well spacing

- 1.25” diameter HDPE U tube
- 1.0 Btu/hr/ft-˚F thermal conductivity grout
- Geo-clips spaced on 10ft centers
- Wells with a 6” drilled borehole diameter.

Both systems will require assistance from the conventional systems. Generally, the geothermal system is designed to provide base load heating and cooling to the planned addition. The following supplemental heating and cooling assistance will be required to cover the balance of the heating and cooling loads not covered by the geothermal system.

Table 8 Supplemental heating and Cooling Required

	Annual		**Peak**	
Scenario	**Heating (MBtu)**	**Cooling (MBtu)**	**Heating (MBtu)**	**Cooling (MBtu)**
A	786,350	9,390,865	1,849	5,885
B	3,679,508	10,909,939	2,538	6,374

System benefits include reduced NOx and VOCs reductions. See table 9 below

Table 9 - Field determined Predicted Annual Ozone Emissions Reductions by Scenario

Scenario	**NOx and VOC (ton/yr)**
A	0.83
B	0.66

It is clear that Scenario A captures the most benefit. As outlined in Table 7, either option of 150 wells at 400 ft depth or 120 wells of 500 ft depth or any number in between those depths that would yield the required 60,000 lineal feet of well bores maximizing thermal transfer.

Conclusions:

The total emission reductions estimated for the 40 year life cycle of the project, is summarized in table 10 below. If a comparison is studied between the EDMS annual reductions of 1.02 tons/year for NOx and 0.055 tons per year for VOCs this would yield a total of **1.075** tons per year of Ozone reductions. The field study ozone reductions using a different modeling system has ozone reductions of **0.83** (see table 9) tons per year. This is considered an acceptable range of disparity and concludes that the EDMS software predicted quantity of ozone reduction is reliable and will be used in this application..

EDMS Total Emission Reductions

Annual Cycle

CO (tons)	*VOC* (tons)	*NOx* (tons)	*Sox* (tons)	*PM10* (tons)	*PM25* (tons)
-0.255	-0.055	-1.02	-0.368	-0.055	-0.042

Total Emission Reductions for Installation of Geothermal System 40 Year Life Cycle (EDMS)

CO (tons)	*VOC* (tons)	*NOx* (tons)	*Sox* (tons)	*PM10* (tons)	*PM25* (tons)
-10.204	-2.208	- 40.818	-14.711	- 2.194	-1.686

Table 10

Summary:
PWM is confident in stating that this proposed system can significantly reduce the carbon footprint of the new expansion by utilizing an on-site source of clean, renewable energy which falls in line with the VALE mission statement *"VALE is a national program to reduce airport ground emissions at commercial service airports located in designated air quality nonattainment and maintenance areas. The program was established to finance low emission vehicles, refueling and recharging stations, gate electrification, and **other airport air quality improvements**"*.

Section 4: Confirmation that Emission Reductions meet CAA Criteria

4.1 Quantifiable:
The emission reductions have been determined by using the EDMS software version 5.1.2. In addition to the EDMS modeling software, a PWM funded field study was performed (as described in section 3) to compare predicted emission reductions. Both of these methods can be verified.

4.2 Surplus:
This application is proposing a geothermal system that is entirely voluntary and any emission reductions associated with this system are not required by any Federal, State or Local regulatory control measures or have been allocated to any other emission reduction project. Although the geothermal system is a supporting infrastructure to the terminal expansion, the system proposed is in addition to the terminal expansion project and has no direct bearing on the Terminal Expansion Project funding mechanisms and stands alone as a project in its own right.

4.3 Federally Enforceable:
The emission reductions will be enforceable through FAA's grant assurance provisions and through the VALE Program special conditions. The jetport will maintain documentation on fuel usage, using fuel meters and calculated emission reductions on a monthly basis. These data sheets will be forwarded to the State air quality department to assure predicted reductions are met. The jetport will plan on displaying a dynamic display in the terminal and on their website that clearly shows to the public the emission reductions and the mechanics of the geothermal system as a learning tool on sustainability.

4.4 Permanent:
The geothermal system is a statically located piece of infrastructure with limited moving parts and, therefore, it is stated that it is permanent. It is predicted that the system shall continue to reduce emissions on a continual basis through the system's life cycle. It is very much in the interest of PWM to monitor usage of oil consumption, which is directly related to the emission reductions, so a methodology, a stated in 4.3, will be in place to track this system over its useful life.

4.4 Adequately Supported:
PWM is a regional airport that has seen significant passenger growth over the last 5 years. In quantitative terms, the Jetport has grown from 680,000 enplanements in 2004 to over 900,000 enplanements in 2009. CY 2010 and 2011 forecast show increased growth to above 950,000 enplanements. The longer Forecast for activity shows rapid growth tapering off by 2015 and continuing moderate growth beyond. PWM showed adequate profits of $3.4m in FY 2010 and it is predicted that PWM shall remain profitable in the foreseeable future. With a staff of over 45 people, that includes a large maintenance and engineering department, PWM is confident to state that they are adequately prepared to monitor and maintain the geothermal system once in operation.

Section 5: Relationship to State implementation plan

The Maine Department of Environment Protection Bureau of Air Quality has confirmed that there is no relationship with this applications predicted emission reductions and the State Implementation plan. If you require further confirmation on this matter, please contact Kathy Tarbuck at (207) 287 9931 or kathy.tarbuck@maine.gov

Section 6: Funding Sources

PWM is anticipating that 95% of the 89% allowable Project Total Cost for this geothermal project will come from AIP VALE funds. There will be no PFC funds allocated to this project. The required Local Share shall come from PWM cash reserve which is supported by other airport revenues.

Table 11 below summarizes the funding for the proposed project. As stated in Section 2, PWM is requesting the FAA to provide AIP VALE funds in the amount of $ 2,534,460 representing an 95% VALE portion of the 89 % eligible of Project Total Cost. This percentage cost is consistent with the FAA guidelines indicated in the AIP Handbook Section 601 for public use areas.

Overview of Project Costs

Description	**Project Total Cost**	**89% Eligible**	**11% Ineligible**	**AIP @ 95% Funding**	**State and Local Share**
Installation	$ 2,791,191	$2,484,160	$307,031	$2,359,952	$431,239
Design Costs	$ 204,396	$181,912	$ 22,484	$172,817	$31,579
Administration Expense	$ 2,000	$1,780	$220	$1,691	$309
Total	$2,997,587	$2,667,852	$ 329,735	$2,534,460	$ 463,127

Table 11

Section 7: Cost Effectiveness

Based on the average estimate of emission reductions as stated in section 3, the projected emission reduction of ozone, over the life cycle of the system, is 43.026 tons. Therefore, the cost effectiveness of Ozone reduction (NOx + VOC) is $69,669 per ton. See table 12 below. The cost effectiveness values of all pollutants are shown on this sheet also. The jetport concludes that because of the large investment in supporting infrastructure, there is a low cost effectiveness. It is this reason that because of the high dollar "up front" costs determining the low value effectiveness compared with the ranges shown in the VALE Technical report. The Jetport requests that due to the Jetport's size and reflecting on that the geothermal application is a new concept for VALE funding, that this cost effectiveness be considered acceptable and funding is granted.

It should also be noted that there is additional ozone reductions due to the cooling season that have been omitted in this application which would improve the cost effectiveness (See section 2)

Pollutant	Projected Emission Reductions over Useful Life of Project Vehicles and Equipment (tons)	Cost Effectiveness over Useful Life of Project Vehicles and Equipment ($/ton)
NOx	40.818	$73,437.87
VOC	2.208	$1,357,602.81
Ozone (NOx + VOC)	43.026	$69,669.20
CO	10.204	$293,765.88
PM_{10}	2.194	$1,366,265.72
$PM_{2.5}$	1.686	$1,777,928.23
SO_2	14.711	$203,765.01

Table 12

Section 8: Vehicle Commitments

This section is not applicable as the grant request is for infrastructure only.

Section 9: Schedule

Please the Project Schedule in Appendix D for an overall projected timeline. As an overview, the terminal expansion project is as follows:

- *VALE Grant approved – 1st May 2010*
- *Geothermal Contract Awarded – Early May 2010*
- *15th May 2010 – commencement of boring of wells*
- *Wells/trenching completed Oct 2010*
- *Building closed in 1st February 2011*
- *Mechanical Systems in place – commissioning – June 2011*
- *Geothermal on line and commissioned – Aug 1st 2011.*
- *Terminal occupied – Oct 1st 2011*

Appendix A

AERC REPORT AND VALE WORKSHEETS

Appendix B

EDMS INPUT SHEETS

Appendix C

STATE REVIEW

Appendix D

SUPPORTING TECH AND COST DATA

FAA Voluntary Airport Low Emission Program
PAGE 1. GENERAL INFORMATION

Airport Name:	Portland International Jetport	3-Letter Airport ID:	PWM
Contact Person:	Roy Williams PE LEED AP	Air Quality Proposal Date:	16th April 2010
Mailing Address:	001 Westbrook Street Portland Maine 0410:	Phone:	207 756 8026
Email Address:	rsw@portlandmaine.gov	Fax:	207 774 7740

What is the air quality status of the region?
(Place an "X" for all designations that apply)

	Pollutant		Status
x	Ozone (O_3) 8-hour standard		Nonattainment
		x	Maintenance
	Particulate Matter (PM)		
x	PM_{10}		Nonattainment
		x	Maintenance
x	$PM_{2.5}$		Nonattainment
		x	Maintenance
x	Carbon Monoxide (CO)		Nonattainment
		x	Maintenance
x	Nitrogen Dioxide (NO_2)		Nonattainment
		x	Maintenance
x	Sulfur Dioxide (SO_2)		Nonattainment
		x	Maintenance

Hub Designation (place "X" in one)[1]			
Large	Medium	Small	Non-hub
		x	

[1/] Per the criteria in FAA Order 5100.38B and subsequent updates.

AERC Option on Project Life

AERC Option: The sponsor may obtain AERCs up to 20 years for vehicles and equipment with shorter useful lives. The AERC Option requires a separate ER Report that includes the VALE-funded years plus the additional option years. (Note: FAA's evaluation of project cost effectiveness does not include emission reductions for the extra AERC Option years.)

(Check for AERC Option)

☐ AERC Option: Sponsor commits to replacing VALE-funded vehicles and equipment with equivalent or cleaner low-emission technology.

(Check below if AERC Option above does not include all project vehicles and equipment)

☐ AERC Option applies only to some VALE-funded vehicles and equipment (attach detailed explanation)

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PAGE 2. AIP-funded - INDIVIDUAL VEHICLE INFORMATION

(Repeat the completion of this sheet for each VALE vehicle type to be acquired using AIP funds)[1]

Air Quality Proposal Date: 16th April 2010

Vehicle Identification	Vehicle Class (check one)	Alternative Fuel Type (check one)	Replacement Conventional Fuel Type (check one)
Anticipated Vehicle(s) Deployment Date: ______	☐ Ground Support Equipment (GSE) (nonroad & unlicensed)	☐ Electric	☐ Diesel
Owner: ______	☐ Ground Access Vehicle (GAV) (licensed for onroad use)	☐ CNG (compressed natural gas)	☐ Gasoline
Model and Model Year: ______		☐ LNG (liquified natural gas)	☐ Other ______
Manufacturer: ______		☐ LPG (liquified petroleum gas/propane)	
		☐ Hybrid Technology	
		☐ Hydrogen (Fuel Cell)	
		☐ Ethanol 85	
		☐ Methanol 85	
		☐ Coal-derived liquid fuels	
		☐ Biodiesel (100%)	
		☐ Other ______	

Unit Cost Per Vehicle

Avg. Useful Life (years):[2]	______
Vehicle Base Cost ($):[3]	______
Incremental Cost ($):[4]	______
AIP Funding Share per Vehicle/Incremental Cost:	$0.00
Matching Funds Required:	$0.00
Use PFCs for matching funds (Y/N)?	

Airport Vehicle Type
(place number of proposed vehicles in box next to type - choose only one vehicle type per worksheet)

☐ Air Conditioning Unit	☐ Fuel Truck	☐ Passenger Car
☐ Baggage Tug	☐ Generator	☐ Passenger Van
☐ Belt Loader	☐ Ground Power Unit	☐ Service Van
☐ Cargo Loader	☐ Fire Truck	☐ Pickup Truck
☐ Cargo Tractor	☐ Lavatory Truck	☐ 22' Shuttle
☐ Catering Truck	☐ Pushback Tractor	☐ 30-35' Bus
☐ Deicer Truck	☐ Sweeper	☐ 40' Bus
☐ Fork Lift	☐ Sport Utility Vehicle (SUV)	☐ Other ______

If proposed VALE program includes the replacement of old vehicles, provide old vehicle info below:

	Make/Model/Vehicle ID	Model Year	Hp	Avg. miles/year or hours/year	Method of Disposal of old vehicle	RUL[5] (yr)
1						
2						
3						
4						
5						
6						
7						
8						
9						

Summary

Total Number of Proposed Vehicles:		0
Total Request for AIP Funding Share:		$0.00
Total PFC Matching Funds Requested:	+	$0.00
Total Other Matching Funds:	+	$0.00
Total Incremental Cost:	**=**	**$0.00**

Repeat this page as needed for each proposed vehicle type.

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1/ Multiple vehicles can be listed only if they're IDENTICAL vehicle types (i.e., same model, year etc.) Otherwise, a separate vehicle information sheet (this page) must be prepared.

2/ Refer to Table 4-1 in the VALE program Technical Report.

3/ "Vehicle Base Cost" is the purchase price of the same or equivalent new conventional-fuel (gas/diesel) vehicle. This is not eligible for AIP funding, except for emergency and safety vehicles (FAA Order 5100.38B).

4/ The "Incremental Cost" is the difference in total purchase price between the proposed VALE vehicle and the same, or closely similar, new conventionally fueled (gas/diesel) vehicle (Base Cost).

5/ RUL = Remaining Useful Life (see Technical Report, Chapter 4).

PAGE 3. PFC-funded - INDIVIDUAL VEHICLE INFORMATION

(Repeat the completion of this sheet for each VALE vehicle type to be acquired using PFC funds)[1]

Air Quality Proposal Date: 16th April 2010

Vehicle Identification	Vehicle Class (check one)	Alternative Fuel Type (check one)	Replacement Conventional Fuel Type (check one)
Anticipated Vehicle(s) Deployment Date: ______	☐ Ground Support Equipment (GSE) nonroad, unlicensed	☐ Electric	☐ Diesel
Owner: ______	☐ Ground Access Vehicle (GAV) licensed for onroad use	☐ CNG (compressed natural gas)	☐ Gasoline
Model and Model Year: ______		☐ LNG (liquified natural gas)	☐ Other ______
Manufacturer: ______		☐ LPG (liquified petroleum gas/propane)	
		☐ Hybrid Technology	
		☐ Hydrogen (Fuel Cell)	
		☐ Ethanol 85	
		☐ Methanol 85	
		☐ Coal-derived liquid fuels	
		☐ Biodiesel (100%)	
		☐ Retrofit/Rebuild	
		☐ Other ______	

Unit Cost Per Vehicle

Avg. Useful Life (years):[2] ______
Vehicle Base Cost ($):[3] ______
Incremental Cost ($):[4] ______

Incremental Funding/Vehicle: $0.00

Airport Vehicle Type
(place number of proposed vehicles in box next to type - choose only one vehicle type per worksheet)

☐ Air Conditioning Unit	☐ Fuel Truck	☐ Passenger Car
☐ Baggage Tug	☐ Generator	☐ Passenger Van
☐ Belt Loader	☐ Ground Power Unit	☐ Service Van
☐ Cargo Loader	☐ Fire Truck	☐ Pickup Truck
☐ Cargo Tractor	☐ Lavatory Truck	☐ 22' Shuttle
☐ Catering Truck	☐ Pushback Tractor	☐ 30-35' Bus
☐ Deicer Truck	☐ Sweeper	☐ 40' Bus
☐ Fork Lift	☐ Sport Utility Vehicle (SUV)	☐ Other ______

If proposed VALE program includes the replacement of old vehicles, provide old vehicle info below:

	Make/Model/Vehicle ID	Model Year	Hp	Avg. miles/year or hours/year	Method of Disposal of old vehicle	RUL[5] (yr)
1						
2						
3						
4						
5						
6						
7						
8						
9						

Summary

Total Number of Proposed Vehicles: 0

Total Requested PFC Funding for Incremental Cost: $0.00

Repeat this page as needed for each proposed vehicle type.

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1/ Multiple vehicles can be listed only if they're IDENTICAL vehicle types (i.e., same model, year etc.) Otherwise, a separate vehicle information sheet (this page) must be prepared.
2/ Refer to Table 4-1 in the VALE program Technical Report.
3/ "Vehicle Base Cost" is the purchase price of the same or equivalent new conventional-fuel (gas/diesel) vehicle. This is not eligible for AIP funding, except for emergency and safety vehicles (FAA Order 5100.38B).
4/ The "Incremental Cost" is the difference in total purchase price between the proposed VALE vehicle and the same, or closely similar, new conventionally fueled (gas/diesel) vehicle (Base Cost).
5/ RUL = Remaining Useful Life (see Technical Report, Chapter 4).

PAGE 4. VALE INFRASTRUCTURE SUMMARY SHEET

Air Quality Proposal Date: 16th April 2010

							Infrastructure Funding Options Box: [1]	**AIPOTH**
	Low Emissions Infrastructure Technololgy or Equipment Units							
	Description (including fuel type, size)	Start-up Date	Estimated Operating Life (years)	No. of Units	Total Cost[2]	AIP Eligible Cost Share	PFC Funds Required	Other Matching Funds Required
1	Wellfield Installation	May-10	40	110	$1,339,791.00	$1,132,793.29	NA	$206,997.71
2	Building mechanical Equipment	May-10	20	18	$1,451,400.00	$1,227,158.70	NA	$224,241.30
3	Administration Expense				$2,000.00	$1,691.00	NA	$309.00
4	Architectural Engineering basic fees				$204,396.00	$172,816.82	NA	$31,579.18
5								
6								
7								
8								
9								
10								
11								
12								
	Totals:				**$2,997,587.00**	**$2,534,459.81**	**$0.00**	**$463,127.19**

1/ Chose one of the following for funding low emissions infrastructure:

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AIPPFC = To designate the use of AIP funds for low emissions infrastructure with matching funds from PFCs.
AIPOTH = To designate the use of AIP funds for low emissions infrastructure with matching funds from another funding source.
PFC = To designate the use of PFC funds for low emissions infrastructure.

2/ Include all eligible costs such as design, equipment, and installation.

PAGE 5.
PROJECT FUNDING SUMMARY SHEET

Air Quality Proposal Date: 16th April 2010

VALE Capital Purchases	AIP Requested Funds	PFC Requested Funds	AIP Matching Funds	Other Local Funds*	Total Project Funds
Vehicles	$0.00	$0.00	$0.00	$0.00	$0.00
Infrastructure	$2,534,459.81	$0.00	$0.00	$463,127.19	$2,997,587.00
**Other Eligible Costs ** **	$0.00	$0.00	$0.00	$0.00	$0.00
Totals	$2,534,459.81	$0.00	$0.00	$463,127.19	$2,997,587.00

*Other committed local funding to project beyond required AIP matching funds (no vehicle base costs).

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** Include project formulation.

PAGE 6.
PROJECT COST EFFECTIVENESS SUMMARY SHEET

Air Quality Proposal Date: 16th April 2010

Pollutant	Projected Emission Reductions over Useful Life of Project Vehicles and Equipment (tons)	Cost Effectiveness over Useful Life of Project Vehicles and Equipment ($/ton)
NOx	40.818	$73,437.87
VOC	2.208	$1,357,602.81
Ozone (NOx + VOC)	43.026	$69,669.20
CO	10.204	$293,765.88
PM_{10}	2.194	$1,366,265.72
$PM_{2.5}$	1.686	$1,777,928.23
SO_2	14.711	$203,765.01

Report Date: Mon Feb 01 14:14:47 2010

Emissions Reduction Report for Cost Effectiveness

REPORT PROPERTIES:

SOURCE GROUP: All (categorized by pollutants)
UNITS: Short tons per year

Portland Intl Jetport

Year	Scenario	CO	THC	NMHC	VOC	TOG	NOx	SOx	PM-10	PM-2.5
2011	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2012	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2013	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2014	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2015	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2016	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2017	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2018	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2019	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2020	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
	Baseline									

	Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
2021	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2022	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2023	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2024	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2025	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2026	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2027	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2028	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2029	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2030	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2031	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2032	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2033	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*

2034	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2035	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2036	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2037	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2038	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2039	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2040	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2041	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2042	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2043	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2044	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2045	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2046	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011

	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2047	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2048	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2049	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
2050	Baseline Boiler Plant	0.321	N/A	0.036	0.069	0.069	1.284	0.463	0.069	0.053
	Geothermal and Boiler Plant	0.066	N/A	0.007	0.014	0.014	0.263	0.095	0.014	0.011
	Net Change	*-0.255*	*0*	*-0.028*	*-0.055*	*-0.055*	*-1.02*	*-0.368*	*-0.055*	*-0.042*
Cumulative Total	**Baseline Boiler Plant**	**12.836**	**N/A**	**1.425**	**2.777**	**2.777**	**51.346**	**18.506**	**2.76**	**2.121**
	Geothermal and Boiler Plant	**2.632**	**N/A**	**0.292**	**0.57**	**0.57**	**10.528**	**3.795**	**0.566**	**0.435**
	Net Change	***-10.204***	***0***	***-1.133***	***-2.208***	***-2.208***	***-40.818***	***-14.711***	***-2.194***	***-1.686***

New Portland Jetport Terminal Space Model – Calculated Occupancy Load

Departing Passengers	1050	(1)
Arriving Passengers	1050	(2)
Holdroom Passengers	393	(3)
Staff	100	(4)
Total	**2593**	**(5)**

Notes:

(1) Based on Gensler Terminal Addition and Renovations Basis of Design Narrative, May 2008 pg. 3.

(2) Based on Gensler Terminal Addition and Renovations Basis of Design Narrative, May 2008 pg. 4.

(3) Based on Gensler Terminal Addition and Renovations Basis of Design Narrative, May 2008 pg. 6.

(4) Based on TSA employees each for 5 screening rows; 6 TSA employees for private screening; 9 TSA employees for baggage screening; 6 police officers on duty, 12 baggage handlers, 6 airline ticketing agents, 6 airline staff support, 3 Jetport administrative personnel, 4 Jetport maintenance personnel, and 18 concessions personnel.

(5) Based on a person count schedule on Gensler architectural drawing A00.10, but assuming as a worst case that departing and arriving passengers peak at the same time. The Gensler people total is 2557 persons, or 98.6% of the Oest total.

Portland Jetport Terminal Expansion Space Occupancy Schedules

Time of Occupancy	Percent of Full Occupancy - Ticketing Hall Schedule	Percent of Full Occupancy - Holdroom Schedule
Midnight to 4 am	5	5
4 am to 5 am	50	35
5 am to 6 am	100	80
6 am to 7 am	80	100
7 am to 8 am	40	80
8 am to 9 am	40	70
9 am to 11 am	60	50
11 am to 1 pm	50	70
1 pm to 3 pm	50	50
3 pm to 6 pm	60	70
6 pm to 9 pm	40	40
9pm to Midnight	5	5

Location	Portland, Maine	
Building owner	City of Portland	
Program user	RHB	
Company	OEST Associates, Inc	
Comments	Building exceeds ASHRAE 90 1 requirements	
By	Amec Inc.	
Dataset name	S:\000_Trace 700 Projects\533.01.25 Portland Jetport\NOX RED BASE NO DHW.trc	
Calculation time	09:53 PM on 11/27/2009	
TRACE® 700 version	6.2.4	
Location	Portland PWM, Maine	
Latitude	43.7	deg
Longitude	70.3	deg
Time Zone	5	
Elevation	0	ft
Barometric pressure	30.2	in. Hg
Air density	0.0768	lb/cu ft
Air specific heat	0.2444	Btu/lb·°F
Density-specific heat product	1.1261	Btu/h·cfm·°F
Latent heat factor	4,957.0	Btu·min/h·cu ft
Enthalpy factor	4.6069	lb·min/hr·cu ft
Summer design dry bulb	87	°F
Summer design wet bulb	71	°F
Winter design dry bulb	-4	°F
Summer clearness number	1.03	
Winter clearness number	1.03	
Summer ground reflectance	0.20	
Winter ground reflectance	0.20	
Carbon Dioxide Level	400	ppm
Design simulation period	January - December	
Cooling load methodology	TETD-TA1	
Heating load methodology	UATD	

SYSTEM SUMMARY

DESIGN COOLING CAPACITIES

By Amec Inc.

Alternative 1

Building Airside Systems and Plant Capacities

		Peak Plant Loads								Block Plant Loads									
Plant	System	Main Coil ton	Aux Coil ton	Opt Vent Coil ton	Misc Load ton	Stg 1 Desic Cond ton	Stg 2 Desic Cond ton	Base Utility ton	Peak Total ton	Time Of Peak mo/hr	Main Coil ton	Aux Coil ton	Opt Vent Coil ton	Misc Load ton	Stg 1 Desic Cond ton	Stg 2 Desic Cond ton	Base Utility ton	Block Total ton
Cooling plant - 003		639.1	0.0	0.0	0.0	0.0	0.0	0.0	639.1	7/7	638.9	0.0	0.0	0.0	0.0	0.0	0.0	638.9
	AHU-1	340.1	0.0	0.0	0.0	0.0	0.0	0.0	340.1	7/7	340.1	0.0	0.0	0.0	0.0	0.0	0.0	340.1
	AHU-2	281.3	0.0	0.0	0.0	0.0	0.0	0.0	281.3	7/7	281.3	0.0	0.0	0.0	0.0	0.0	0.0	281.3
	AC UNITS	17.6	0.0	0.0	0.0	0.0	0.0	0.0	17.6	7/7	17.4	0.0	0.0	0.0	0.0	0.0	0.0	17.4
Building totals		639.1	0.0	0.0	0.0	0.0	0.0	0.0	639.1		638.9	0.0	0.0	0.0	0.0	0.0	0.0	638.9

Building peak load is 639.1 tons.

Building maximum block load of 638.9 tons occurs in July at hour 7 based on system simulation.

SYSTEM SUMMARY

DESIGN HEATING CAPACITIES

By Amec Inc.

Alternative 1

System Coil Capacities

System Description	System Type	Main System Btu/h	Aux System Btu/h	Preheat Btu/h	Reheat Btu/h	Humid. Btu/h	Optional Vent Btu/h	Stg 1 Desic Regen Btu/h	Stg 2 Desic Regen Btu/h	Stg 1 Frost Prevention Btu/h	Stg 2 Frost Prevention Btu/h	Heating Totals Btu/h
AHU-1	Bypass VAV with Reheat (30% Min Flow Default)	-1,725,867	0	0	-1,160,157	0	0	0	0	0	0	-1,725,867
AHU-2	Bypass VAV with Reheat (30% Min Flow Default)	-2,427,364	0	0	-1,764,304	0	0	0	0	0	0	-2,427,364
Unit Heater	Unit Heaters	-1,704,067	0	0	0	0	0	0	0	0	0	-1,704,067
AC UNITS	Packaged Terminal Air Conditioner	-4,915	0	0	0	0	0	0	0	0	0	-4,915
Totals		**-5,862,213**	**0**	**0**	**-2,924,460**	**0**	**0**	**0**	**0**	**0**	**0**	**-5,862,213**

Building Plant Capacities

		Peak Loads												
Plant	System	Main Coil MBh	Preheat Coil MBh	Reheat Coil MBh	Humid. Coil MBh	Aux Coil MBh	Opt Vent Coil MBh	Misc Load MBh	Stg 1 Desic. Regen. MBh	Stg 2 Desic. Regen. MBh	Stg 1 Frost Prev. MBh	Stg 2 Frost Prev. MBh	Base Utility MBh	Absorption Load MBh
Heating plant - 004		5,862	0	0	0	0	0	0	0	0	0	0	100	0
	AHU-1	1,726	0	0	0	0	0	0	0	0	0	0	0	0
	AHU-2	2,427	0	0	0	0	0	0	0	0	0	0	0	0
	Unit Heater	1,704	0	0	0	0	0	0	0	0	0	0	0	0
	AC UNITS	5	0	0	0	0	0	0	0	0	0	0	0	0
Heating plant - 005		0	0	0	0	0	0	0	0	0	0	0	0	0

Building peak load is 5,962.2 MBh.

PEAK COOLING LOADS

MAIN SYSTEM

By Amec Inc.

System Zone Room		Floor Area ft²	SPACE Peak Time Mo/Hr	SPACE OA Condition DB °F	SPACE OA Condition WB °F	SPACE Room Dry Bulb °F	SPACE Supply Dry Bulb °F	SPACE Space Air Flow cfm	SPACE Space Sensible Load Btu/h	SPACE Space Latent Load Btu/h	COIL Peak Time Mo/Hr	COIL OA Condition DB °F	COIL OA Condition WB °F	COIL Supply Dry Bulb °F	COIL Coil Airflow cfm	COIL Coil Sensible Load Btu/h	COIL Coil Latent Load Btu/h
Alternative 1																	
Level 2 - Electrical Closet	Peak	215	7 /17	85	70	78.0	55.0	305	7,907	287	7 /16	86	71	55.0	305	7,988	320
Level 2 - IT Closet	Peak	300	7 /17	85	70	78.0	55.0	1,019	26,391	428	7 /16	86	71	55.0	1,019	26,680	473
Level 3 - Elev Machine Room	Peak	69	7 /21	76	62	78.0	55.0	6,558	169,851	0	7 /21	76	62	55.0	6,558	171,799	0
Level 3 - Telcom Room	Peak	101	7 /17	85	70	78.0	55.0	144	3,742	135	7 /16	86	71	55.0	144	3,790	150
AC UNITS	**Peak**	**685**		**85**	**70**	**78.0**	**55.0**	**8,027**	**207,891**	**850**		**86**	**71**	**55.0**	**8,027**	**210,257**	**943**
AC UNITS	**Block**	**685**	**7 /17**	**85**	**70**	**78.0**	**55.0**	**8,027**	**207,875**	**850**	**7 /16**	**86**	**71**	**55.0**	**8,027**	**210,236**	**943**
Level 1 - Baggage EDS	Peak	16,140	7 /7	70	57	78.0	50.0	70,017	2,207,712	0	7 /7	70	57	50.0	70,017	2,700,201	71,398
Level 1 - Baggage ETD	Peak	2,640	7 /8	71	59	75.0	50.0	4,628	130,297	3,692	7 /8	71	59	50.0	4,628	163,201	9,458
Level 3 - Bridge	Peak	4,025	9 /11	73	61	75.0	50.0	4,391	123,613	8,962	9 /11	73	61	50.0	4,391	152,846	12,247
Level 3 - Office	Peak	2,375	7 /22	74	61	75.0	50.0	565	15,900	4,750	7 /17	85	70	50.0	565	30,012	6,781
Level 3 - Queue	Peak	13,235	6 /18	81	64	78.0	50.0	12,340	389,071	110,000	7 /18	83	68	50.0	12,340	666,014	149,303
Level 3 - Screening Rooms	Peak	142	7 /20	78	64	75.0	50.0	77	2,165	1,200	7 /16	86	71	50.0	77	4,303	1,498
Level 3 - Security	Peak	6,085	6 /18	81	64	75.0	50.0	7,945	223,674	14,600	7 /18	83	68	50.0	7,945	289,944	39,906
Level 3 - Security Exit	Peak	6,645	6 /18	81	64	78.0	50.0	3,222	101,597	24,000	7 /18	83	68	50.0	3,222	180,664	34,263
Level 3 - Security Operations	Peak	342	7 /20	78	64	75.0	50.0	78	2,200	478	7 /18	83	68	50.0	78	3,858	727
AHU-1	**Peak**	**51,629**		**68**	**54**	**77.5**	**50.0**	**103,263**	**3,196,228**	**167,682**		**85**	**70**	**50.0**	**103,263**	**4,551,838**	**325,581**
AHU-1	**Block**	**51,629**	**6 /7**	**68**	**54**	**77.5**	**50.0**	**103,263**	**3,233,706**	**165,811**	**7 /17**	**85**	**70**	**50.0**	**103,263**	**3,544,922**	**536,515**
Level 1 - BHS Manual Sortation	Peak	30	7 /15	87	71	75.0	50.0	23	654	432	7 /15	87	71	50.0	23	4,481	610
Level 1 - Curbside Check-in	Peak	450	7 /15	87	71	75.0	75.0	0	0	1,509	7 /15	87	71	75.0	0	0	0
Level 1 - Escalators/Elevators	Peak	5,120	7 /14	86	71	75.0	50.0	2,008	56,538	26,199	7 /15	87	71	50.0	2,008	79,362	38,911
Level 1 - IDF Closet	Peak	235	7 /21	76	62	78.0	50.0	819	25,823	0	7 /15	87	71	50.0	819	34,817	6,302
Level 1 - Ticketing Counters	Peak	2,200	7 /7	70	57	75.0	50.0	4,866	136,987	15,000	7 /16	86	71	50.0	4,866	154,447	50,976
Level 1 - Ticketing Hall NE	Peak	7,600	7 /14	86	71	75.0	50.0	4,334	122,024	59,348	7 /15	87	71	50.0	4,334	286,037	86,139
Level 1 - Ticketing Hall NW	Peak	4,215	6 /8	70	56	75.0	50.0	10,726	301,958	30,307	7 /9	74	61	50.0	10,726	360,590	33,752
Level 1 - Ticketing Offices	Peak	5,800	7 /21	76	62	75.0	50.0	1,759	49,532	15,000	7 /15	87	71	50.0	1,759	89,727	28,538
Level 2 - Circulation	Peak	6,282	7 /21	76	62	75.0	50.0	2,120	59,681	21,000	7 /15	87	71	50.0	2,120	135,526	37,312
Level 2 - Circulation & Atrium	Peak	4,971	9 /15	80	67	75.0	50.0	12,857	361,965	20,000	8 /16	85	69	50.0	12,857	465,702	102,004
Level 2 - Concessions Central	Peak	491	7 /21	76	62	75.0	50.0	136	3,840	982	7 /15	87	71	50.0	136	7,771	2,032
Level 2 - Concessions East	Peak	846	7 /21	76	62	75.0	50.0	515	14,502	8,000	7 /15	87	71	50.0	515	38,902	11,964
Level 2 - Concessions Storage	Peak	1,147	7 /22	74	61	79.0	50.0	248	8,102	1,051	7 /16	86	71	50.0	248	22,917	2,886
Level 2 - Concessions West	Peak	2,097	7 /21	76	62	75.0	50.0	1,018	28,660	12,000	7 /15	87	71	50.0	1,018	65,857	19,833
Level 2 - Concessions/Seating	Peak	2,860	7 /21	76	62	75.0	50.0	2,494	70,220	44,000	7 /15	87	71	50.0	2,494	198,545	63,192
Level 2 - Fixed Link (long)	Peak	1,500	7 /21	76	62	76.0	50.0	447	13,094	3,055	7 /16	86	71	50.0	447	19,054	5,869
Level 2 - Fixed Link (short)	Peak	565	7 /21	76	62	76.0	50.0	163	4,773	1,194	7 /16	86	71	50.0	163	6,941	2,513

System	Zone Room		Floor Area ft²	SPACE Peak Time Mo/Hr	OA Condition DB °F	OA Condition WB °F	Room Dry Bulb °F	Supply Dry Bulb °F	Space Air Flow cfm	Space Sensible Load Btu/h	Space Latent Load Btu/h	COIL Peak Time Mo/Hr	OA Condition DB °F	OA Condition WB °F	Supply Dry Bulb °F	Coil Airflow cfm	Coil Sensible Load Btu/h	Coil Latent Load Btu/h
	Level 2 - International Corridor	Peak	3,512	7/21	76	62	75.0	50.0	763	21,477	7,024	7 /15	87	71	50.0	763	53,619	12,894
	Level 2 - NW Holdrooms	Peak	1,833	7/16	86	71	75.0	50.0	426	12,000	2,184	7 /15	87	71	50.0	426	21,558	4,827
	Level 2 - S Holdrooms	Peak	5,033	10/13	63	57	75.0	50.0	4,667	131,374	20,074	8 /14	85	69	50.0	4,667	177,854	44,127
	Level 2 - Sterile Corridor	Peak	789	6/18	81	64	75.0	50.0	1,441	40,574	1,632	7 /18	83	68	50.0	1,441	53,242	7,690
	Level 2 - SW Holdrooms	Peak	8,535	9/16	80	66	75.0	50.0	7,878	221,782	59,119	7 /16	86	71	50.0	7,878	337,259	106,341
	Level 3 - Escalators/Elevators	Peak	2,365	10/11	58	54	75.0	50.0	4,555	128,223	10,000	9 /12	76	63	50.0	4,555	159,294	25,977
AHU-2		**Peak**	**68,476**		**80**	**66**	**75.1**	**50.0**	**64,265**	**1,813,785**	**359,110**		**86**	**71**	**50.0**	**64,265**	**2,931,830**	**694,688**
AHU-2		**Block**	**68,476**	**9/14**	**80**	**66**	**75.1**	**50.0**	**64,265**	**1,892,047**	**359,130**	**7 /16**	**86**	**71**	**50.0**	**64,265**	**2,582,623**	**793,415**
	Level 1 - Baggage Make-Up	Peak	0	0/0	0	0	0.0	0.0	0	0	0	0 /0	0	0	0.0	0	0	0
	Level 1 - Restrooms	Peak	0	0/0	0	0	0.0	0.0	0	0	0	0 /0	0	0	0.0	0	0	0
	Level 2 - Restrooms	Peak	0	0/0	0	0	0.0	0.0	0	0	0	0 /0	0	0	0.0	0	0	0
Unit Heater		**Peak**	**0**		**0**	**0**	**0.0**	**0.0**	**0**	**0**	**0**		**0**	**0**	**0.0**	**0**	**0**	**0**
Unit Heater		**Block**	**0**	**0/0**	**0**	**0**	**0.0**	**0.0**	**0**	**0**	**0**	**0 /0**	**0**	**0**	**0.0**	**0**	**0**	**0**

PEAK HEATING LOADS

MAIN SYSTEM

By Amec Inc.

	OA Condition DB °F	OA Condition WB °F
Peak Time		
Htg Design	-4	-6

System	Zone Room	Block or Peak	Floor Area ft²	SPACE Room Dry Bulb °F	SPACE Supply Dry Bulb °F	SPACE Space Air Flow cfm	SPACE Space Sensible Load Btu/h	COIL Supply Dry Bulb °F	COIL Coil Air Flow cfm	COIL Coil Sensible Load Btu/h
Alternative 1										
	Level 2 - Electrical Closet	Peak	215	74.0	78.8	305	-1,657	78.8	305	-1,657
	Level 2 - IT Closet	Peak	300	74.0	76.0	1,019	-2,312	76.0	1,019	-2,312
	Level 3 - Elev Machine Room	Peak	69	74.0	74.0	6,558	-168	74.0	6,558	-168
	Level 3 - Telcom Room	Peak	101	74.0	78.8	144	-778	78.8	144	-778
AC UNITS		**Peak**	**685**	**74.0**	**74.5**	**8,027**	**-4,915**	**74.5**	**8,027**	**-4,915**
AC UNITS		**Block**	**685**	**74.0**	**74.3**	**8,027**	**-2,802**	**74.5**	**8,027**	**-4,915**
	Level 1 - Baggage EDS	Peak	16,140	55.0	55.0	21,005	25,181	55.0	21,005	-246,440
	Level 1 - Baggage ETD	Peak	2,640	74.0	103.3	1,388	-45,746	103.3	1,388	-91,743
	Level 3 - Bridge	Peak	4,025	74.0	119.8	1,317	-67,991	119.8	1,317	-111,629
	Level 3 - Office	Peak	2,375	74.0	87.9	871	-13,616	87.9	871	-42,465
	Level 3 - Queue	Peak	13,235	74.0	86.8	16,397	-235,552	86.8	16,397	-778,756
	Level 3 - Screening Rooms	Peak	142	74.0	85.1	128	-1,600	85.1	128	-5,853
	Level 3 - Security	Peak	6,085	74.0	102.8	3,042	-98,686	102.8	3,042	-199,462
	Level 3 - Security Exit	Peak	6,645	74.0	94.2	4,329	-98,666	94.2	4,329	-242,078
	Level 3 - Security Operations	Peak	342	74.0	105.6	108	-3,853	105.6	108	-7,439
AHU-1		**Peak**	**51,629**	**65.8**	**76.1**	**48,586**	**-540,529**	**76.1**	**48,586**	**-1,725,866**
AHU-1		**Block**	**51,629**	**65.8**	**75.7**	**48,586**	**-540,529**	**75.7**	**48,586**	**-1,700,685**
	Level 1 - BHS Manual Sortation	Peak	30	60.0	61.3	150	-222	61.3	150	-2,787
	Level 1 - Curbside Check-in	Peak	450	50.0	25,432.5	0	-3,277	25,432.5	0	-95
	Level 1 - Escalators/Elevators	Peak	5,120	74.0	126.7	1,024	-60,827	126.7	1,024	-94,475
	Level 1 - IDF Closet	Peak	235	74.0	75.4	246	-379	75.4	246	-8,453
	Level 1 - Ticketing Counters	Peak	2,200	74.0	75.5	2,315	-3,866	75.5	2,315	-79,936
	Level 1 - Ticketing Hall NE	Peak	7,600	74.0	82.4	8,395	-79,151	82.4	8,395	-355,009
	Level 1 - Ticketing Hall NW	Peak	4,215	74.0	95.7	4,843	-118,441	95.7	4,843	-277,581
	Level 1 - Ticketing Offices	Peak	5,800	74.0	80.7	2,410	-18,235	80.7	2,410	-97,427
	Level 2 - Circulation	Peak	6,282	74.0	76.3	3,881	-10,141	76.3	3,881	-137,682
	Level 2 - Circulation & Atrium	Peak	4,971	74.0	113.2	3,857	-170,147	113.2	3,857	-296,893
	Level 2 - Concessions Central	Peak	491	74.0	77.2	221	-793	77.2	221	-8,053
	Level 2 - Concessions East	Peak	846	74.0	75.0	1,169	-1,366	75.0	1,169	-39,785
	Level 2 - Concessions Storage	Peak	1,147	74.0	77.8	554	-2,354	77.8	554	-20,571
	Level 2 - Concessions West	Peak	2,097	74.0	75.6	1,919	-3,385	75.6	1,919	-66,456
	Level 2 - Concessions/Seating	Peak	2,860	74.0	74.7	6,072	-4,617	74.7	6,072	-204,141
	Level 2 - Fixed Link (long)	Peak	1,500	70.0	119.9	134	-7,534	119.9	134	-11,338

	OA Condition	
	DB	WB
Peak Time	°F	°F
Htg Design	-4	-6

					SPACE				COIL		
System	Zone Room	Block or Peak	Floor Area ft²	Room Dry Bulb °F	Supply Dry Bulb °F	Space Air Flow cfm	Space Sensible Load Btu/h	Supply Dry Bulb °F	Coil Air Flow cfm	Coil Sensible Load Btu/h
	Level 2 - Fixed Link (short)	Peak	565	68.0	99.7	49	-1,745	99.7	49	-3,022
	Level 2 - International Corridor	Peak	3,512	74.0	77.2	1,580	-5,669	77.2	1,580	-57,601
	Level 2 - NW Holdrooms	Peak	1,833	74.0	82.4	567	-5,374	82.4	567	-23,992
	Level 2 - S Holdrooms	Peak	5,033	74.0	87.0	3,507	-51,206	87.0	3,507	-166,431
	Level 2 - Sterile Corridor	Peak	789	68.0	104.9	432	-17,991	104.9	432	-29,277
	Level 2 - SW Holdrooms	Peak	8,535	74.0	81.2	8,832	-71,359	81.2	8,832	-361,576
	Level 3 - Escalators/Elevators	Peak	2,365	74.0	86.9	1,723	-24,981	86.9	1,723	-81,598
AHU-2		**Peak**	**68,476**	**73.9**	**84.8**	**53,881**	**-663,060**	**84.8**	**53,881**	**-2,424,182**
AHU-2		**Block**	**68,476**	**73.9**	**84.8**	**53,881**	**-662,522**	**84.8**	**53,881**	**-2,426,826**
	Level 1 - Baggage Make-Up	Peak	16,000	50.0	51.6	24,000	-43,358	51.6	24,000	91,772
	Level 1 - Restrooms	Peak	910	74.0	80.7	830	-6,218	80.7	830	-23,977
	Level 2 - Restrooms	Peak	1,810	74.0	82.8	1,250	-12,368	82.8	1,250	-39,113
Unit Heater		**Peak**	**18,720**	**51.9**	**54.0**	**26,080**	**-61,944**	**54.0**	**26,080**	**28,683**
Unit Heater		**Block**	**18,720**	**51.9**	**54.0**	**26,080**	**-61,944**	**54.0**	**26,080**	**-1,586,594**

Load / Airflow Summary

By Amec Inc.

System	Zone Room **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	VAV Minimum %	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg
Alternative 1														
	Level 2 - Electrical Closet	Rm Peak	215	0.0	7,988	8,308	305	10.65	0	0	-1,657	305	4.2	4.2
	Level 2 - IT Closet	Rm Peak	300	0.0	26,680	27,153	1,019	25.47	0	0	-2,312	1,019	1.8	1.8
	Level 3 - Elev Machine Room	Rm Peak	69	0.0	171,799	171,799	6,558	178.20	0	0	-168	6,558	0.0	0.0
	Level 3 - Telcom Room	Rm Peak	101	0.0	3,790	3,940	144	3.30	0	0	-778	144	4.2	4.2
AC UNITS		**Sys Peak**	**685**	**0.0**	**210,257**	**211,200**	**8,027**				**-4,915**	**8,027**	**0.5**	**0.5**
AC UNITS		**Sys Block**	**685**	**0.0**	**210,236**	**211,179**	**8,027**				**-4,915**	**8,027**	**0.5**	**0.5**
	Level 1 - Baggage EDS	Rm Peak	16,140	0.0	2,700,201	2,771,599	70,017	32.54	21,005	30	-246,440	49,012	11.0	10.4
	Level 1 - Baggage ETD	Rm Peak	2,640	18.5	163,201	172,659	4,628	13.15	1,388	30	-91,743	3,240	11.0	10.4
	Level 3 - Bridge	Rm Peak	4,025	40.3	152,846	165,093	4,391	3.27	1,317	30	-111,629	3,074	11.0	10.4
	Level 3 - Office	Rm Peak	2,375	23.8	30,012	36,793	871	2.75	871	100	-42,465	0	11.0	16.1
	Level 3 - Queue	Rm Peak	13,235	550.0	666,014	815,317	16,397	2.89	16,397	100	-778,756	0	11.0	13.9
	Level 3 - Screening Rooms	Rm Peak	142	6.0	4,303	5,800	128	2.09	128	100	-5,853	0	11.0	17.4
	Level 3 - Security	Rm Peak	6,085	73.0	289,944	329,850	7,945	3.01	3,042	38	-199,462	4,903	11.0	10.4
	Level 3 - Security Exit	Rm Peak	6,645	120.0	180,664	214,927	4,329	1.50	4,329	100	-242,078	0	11.0	14.0
	Level 3 - Security Operations	Rm Peak	342	2.4	3,858	4,585	108	0.73	108	100	-7,439	0	11.0	14.5
AHU-1		**Sys Peak**	**51,629**	**833.9**	**4,551,838**	**4,877,419**	**103,263**				**-1,725,866**	**54,677**	**11.0**	**11.0**
AHU-1		**Sys Block**	**51,629**	**833.9**	**3,544,922**	**4,081,436**	**103,263**				**-1,700,685**	**54,677**	**11.0**	**11.0**
	Level 1 - BHS Manual Sortation	Rm Peak	30	2.0	4,481	5,091	150	40.00	150	100	-2,787	0	27.4	100.0
	Level 1 - Curbside Check-in	Rm Peak	450	0.0	0	0	0	0.00	0	30	-95	0	27.4	100.0
	Level 1 - Escalators/Elevators	Rm Peak	5,120	92.0	79,362	118,273	2,008	0.55	1,024	51	-94,475	984	27.4	22.5
	Level 1 - IDF Closet	Rm Peak	235	0.0	34,817	41,118	819	26.14	246	30	-8,453	573	27.4	22.5
	Level 1 - Ticketing Counters	Rm Peak	2,200	75.0	154,447	205,423	4,866	16.59	2,315	48	-79,936	2,551	27.4	22.5
	Level 1 - Ticketing Hall NE	Rm Peak	7,600	275.0	286,037	372,176	8,395	4.10	8,395	100	-355,009	0	27.4	43.6
	Level 1 - Ticketing Hall NW	Rm Peak	4,215	160.0	360,590	394,342	10,726	6.09	4,843	45	-277,581	5,883	27.4	22.5
	Level 1 - Ticketing Offices	Rm Peak	5,800	75.0	89,727	118,265	2,410	3.12	2,410	100	-97,427	0	27.4	30.8
	Level 2 - Circulation	Rm Peak	6,282	105.0	135,526	172,838	3,881	4.16	3,881	100	-137,682	0	27.4	41.2
	Level 2 - Circulation & Atrium	Rm Peak	4,971	100.0	465,702	567,706	12,857	3.88	3,857	30	-296,893	9,000	27.4	22.5
	Level 2 - Concessions Central	Rm Peak	491	4.9	7,771	9,802	221	3.38	221	100	-8,053	0	27.4	36.5
	Level 2 - Concessions East	Rm Peak	846	40.0	38,902	50,865	1,169	10.37	1,169	100	-39,785	0	27.4	51.1
	Level 2 - Concessions Storage	Rm Peak	1,147	3.8	22,917	25,802	554	3.63	554	100	-20,571	0	27.4	50.3
	Level 2 - Concessions West	Rm Peak	2,097	60.0	65,857	85,690	1,919	6.86	1,919	100	-66,456	0	27.4	42.4
	Level 2 - Concessions/Seating	Rm Peak	2,860	220.0	198,545	261,737	6,072	15.92	6,072	100	-204,141	0	27.4	54.8
	Level 2 - Fixed Link (long)	Rm Peak	1,500	15.0	19,054	24,922	447	2.56	134	30	-11,338	313	27.4	22.5
	Level 2 - Fixed Link (short)	Rm Peak	565	5.7	6,941	9,454	163	2.47	49	30	-3,022	114	27.4	22.5
	Level 2 - International Corridor	Rm Peak	3,512	35.1	53,619	66,513	1,580	3.38	1,580	100	-57,601	0	27.4	46.6

*** This report does not display heating only systems.**

System	Zone Room **		Floor Area ft²	People #	Coil Cooling Sensible Btu/h	Coil Cooling Total Btu/h	Space Design Max SA cfm	Air Changes ach/hr	VAV Minimum SA cfm	VAV Minimum %	Main Coil Heating Sensible Btu/h	Heating Fan Max SA cfm	Percent OA Clg	Percent OA Htg
	Level 2 - NW Holdrooms	Rm Peak	1,833	8.0	21,558	26,385	567	2.06	567	100	-23,992	0	27.4	29.9
	Level 2 - S Holdrooms	Rm Peak	5,033	100.0	177,854	221,980	4,667	4.91	3,507	75	-166,431	1,160	27.4	22.5
	Level 2 - Sterile Corridor	Rm Peak	789	7.9	53,242	60,932	1,441	12.18	432	30	-29,277	1,009	27.4	22.5
	Level 2 - SW Holdrooms	Rm Peak	8,535	285.0	337,259	443,600	8,832	5.48	8,832	100	-361,576	0	27.4	25.2
	Level 3 - Escalators/Elevators	Rm Peak	2,365	50.0	159,294	185,271	4,555	6.54	1,723	38	-81,598	2,832	27.4	22.5
AHU-2		**Sys Peak**	**68,476**	**1,719.4**	**2,931,830**	**3,626,518**	**64,265**				**-2,424,182**	**10,384**	**27.4**	**27.4**
AHU-2		**Sys Block**	**68,476**	**1,719.4**	**2,582,623**	**3,376,038**	**64,265**				**-2,426,826**	**10,384**	**27.4**	**27.4**

*** This report does not display heating only systems.**

BASELINE PLANT

ENERGY CONSUMPTION SUMMARY

By Amec Inc.

	Elect Cons. (kWh)	Oil Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating		17,944,728		30.6 %	17,944,728	18,889,188
Other Htg Accessories	115,262			0.7 %	393,390	1,180,288
Heating Subtotal	**115,262**	**17,944,728**		**31.3 %**	**18,338,118**	**20,069,476**
Primary cooling						
Cooling Compressor	781,113			4.6 %	2,665,940	7,998,620
Tower/Cond Fans	295,031		5,273	1.7 %	1,006,940	3,021,122
Condenser Pump	27,676			0.2 %	94,457	283,398
Other Clg Accessories	47,095			0.3 %	160,734	482,250
Cooling Subtotal....	**1,150,914**		**5,273**	**6.7 %**	**3,928,070**	**11,785,389**
Auxiliary						
Supply Fans	4,357,018			25.4 %	14,870,501	44,615,960
Pumps	59,019			0.3 %	201,433	604,361
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	4,416,037			25.7 %	15,071,934	45,220,324
Lighting						
Lighting	823,473			4.8 %	2,810,512	8,432,379
Receptacle						
Receptacles	5,399,403			31.5 %	18,428,161	55,290,008
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**11,905,088**	**17,944,728**	**5,273**	**100.0 %**	**58,576,793**	**140,797,568**

Equal to 128,177 GALLONS OF No. 2 FUEL OIL ANNUALLY ON SITE.

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

AP-42
FIFTH EDITION
JANUARY 1995

COMPILATION OF AIR POLLUTANT EMISSION FACTORS

VOLUME I: STATIONARY POINT AND AREA SOURCES

Office Of Air Quality Planning And Standards
Office Of Air And Radiation
U. S. Environmental Protection Agency
Research Triangle Park, NC 27711

January 1995

Table 1.3-1. (cont.)

Firing Configuration (SCC)[a]	SO_2[b]		SO_3[c]		NO_x[d]		CO[e]		Filterable PM[f]	
	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING	Emission Factor ($lb/10^3$ gal)	EMISSION FACTOR RATING
Boilers < 100 Million Btu/hr										
No. 6 oil fired (1-02-004-02/03) (1-03-004-02/03)	157S	A	2S	A	55	A	5	A	10	B
No. 5 oil fired (1-03-004-04)	157S	A	2S	A	55	A	5	A	9.19(S)+3.22	A
No. 4 oil fired (1-03-005-04)	150S	A	2S	A	20	A	5	A	7	B
Distillate oil fired (1-02-005-02/03) (1-03-005-02/03)	142S	A	2S	A	20	A	5	A	2	A
Residential furnace (A2104004/A2104011)	142S	A	2S	A	18	A	5	A	0.4[g]	B

[a] To convert from $lb/10^3$ gal to $kg/10^3$ L, multiply by 0.120. SCC = Source Classification Code.
[b] References 1-2,6-9,14,56-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.
[c] References 1-2,6-8,16,57-60. S indicates that the weight % of sulfur in the oil should be multiplied by the value given. For example, if the fuel is 1% sulfur, then S = 1.
[d] References 6-7,15,19,22,56-62. Expressed as NO_2. Test results indicate that at least 95% by weight of NO_x is NO for all boiler types except residential furnaces, where about 75% is NO. For utility vertical fired boilers use 105 $lb/10^3$ gal at full load and normal (>15%) excess air. Nitrogen oxides emissions from residual oil combustion in industrial and commercial boilers are related to fuel nitrogen content, estimated by the following empirical relationship: $lb\ NO_2/10^3\ gal = 20.54 + 104.39(N)$, where N is the weight % of nitrogen in the oil. For example, if the fuel is 1% nitrogen, then N = 1.
[e] References 6-8,14,17-19,56-61. CO emissions may increase by factors of 10 to 100 if the unit is improperly operated or not well maintained.
[f] References 6-8,10,13-15,56-60,62-63. Filterable PM is that particulate collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train. Particulate emission factors for residual oil combustion are, on average, a function of fuel oil sulfur content where S is the weight % of sulfur in oil. For example, if fuel oil is 1% sulfur, then S = 1.
[g] Based on data from new burner designs. Pre-1970's burner designs may emit filterable PM as high as 3.0 $lb/10^3$ gal.

GENERAL AIR EMISSION LICENSE INFORMATION

State of Maine
Department of Environmental Protection
Bureau of Air Quality

(Revised 4/97)

- **What is the purpose of an air emission license?**

The purpose of an air emission license is to compile all requirements, regulations and consents relating to air pollution for a facility in one document.

Maine has had an existing licensing program in place since the early 1970's for the licensing of major and minor sources of air pollution. In the Clean Air Act Amendments of 1990, licensing was mandated for major sources. Maine has been given the authority over this program in 38 M.R.S.A. Section 344 and 590.

- **Who must apply?**

Both Minor and Major sources must apply for air emission licenses. Please refer to Maine Regulations Chapter 115 (licensing for minor sources) and Chapter 140 (licensing for major sources) for a detailed applicability determination. The summaries stated below are not a comprehensive outline of what regulations the facility may be subject to, but rather a general guideline.

- *Under Chapter 115 - minor sources*

In general, sources subject to Chapter 115 include facilities with the Potential to Emit less than the following:

50 ton per year of VOC.
10 ton per year of a single Hazardous Air Pollutant.
25 ton per year of all Hazardous Air Pollutants combined.
100 ton per year of any other regulated pollutant (PM, PM_{10}, SO_2, NO_X, CO).

The following are exemptions to licensing - for a complete list of licensing exemptions, see Chapter 115, Section (1)(C):

A summary of the BACT analysis for Boilers #5, #6 and #7 is the following:

1. Chapter 106 regulates fuel sulfur content. However the use of natural gas or #2 fuel oil which meets the criteria in ASTM D396, is more stringent and shall be considered BACT.
2. Chapter 103 regulates PM emission limits. However, the PM limits of 0.05 lb/MMBtu when firing Natural Gas and 0.08 lb/MMBtu when firing #2 fuel oil are more stringent and shall be considered BACT.
3. SO_2 emission limits are based a mass balance when firing #2 fuel oil, and AP-42 data dated 07/98 when firing natural gas:
4. NO_x, CO and VOC emission limits are based on AP-42 data dated 09/98 and 7/98 for the combustion of fuel oil and natural gas respectively.
   NO_X - #2 Fuel Oil – 20 lb NO_X/1000 gal
   Natural Gas – 100 lb/MMscf
   CO - #2 Fuel Oil – 5 lb CO/1000 gal
   Natural Gas – 84 lb CO/MMscf
   VOC - #2 Fuel Oil – 0.556 lb VOC/1000 gal
   Natural Gas – 5.5 lb VOC/MMscf

5. When firing #2 fuel oil, visible emissions from the combined stack serving boilers #5, #6 and #7 shall not exceed 20% opacity on a six (6) minute block average.
6. When firing Natural Gas, visible emissions from the combined stack serving boilers #5, #6 and #7 shall not exceed 10% opacity on a six (6) minute block average.

D. Emergency Generator #4

Emergency generator #4 has a maximum rated capacity of 0.55 MMBtu/hr.

Emergency generators are only to be operated for maintenance purposes and for situations arising from sudden and reasonably unforeseeable events beyond the control of the source. Back-up generators are not to be used for prime power when reliable offsite power is available.

A summary of the BACT analysis for Emergency Generator #4 is the following:

1. Emergency generator #4 shall be limited to 500 hr/yr of operation based on a 12 month rolling total. Compliance shall be demonstrated by a written log of all generator operating hours.
2. 06-096 CMR 106 regulates fuel sulfur content. However, the use of natural gas is more stringent and shall be considered BACT.
3. A PM emission limit of 0.05 lb/MMBtu shall be considered BACT. The PM_{10} limits are derived from the PM limits.

GEOTHERMAL PLANT

ENERGY CONSUMPTION SUMMARY

By Amec Inc.

	Elect Cons. (kWh)	Oil Cons. (kBtu)	Water Cons. (1000 gals)	% of Total Building Energy	Total Building Energy (kBtu/yr)	Total Source Energy* (kBtu/yr)
Alternative 1						
Primary heating						
Primary heating	1,824,388	3,677,134		19.8 %	9,903,769	22,552,440
Other Htg Accessories	47,080			0.3 %	160,684	482,100
Heating Subtotal	**1,871,468**	**3,677,134**		**20.2 %**	**10,064,453**	**23,034,542**
Primary cooling						
Cooling Compressor	699,635			4.8 %	2,387,853	7,164,275
Tower/Cond Fans	57,771		625	0.4 %	197,171	591,573
Condenser Pump	82,316			0.6 %	280,945	842,919
Other Clg Accessories	61			0.0 %	207	622
Cooling Subtotal....	**839,782**		**625**	**5.7 %**	**2,866,176**	**8,599,388**
Auxiliary						
Supply Fans	4,259,777			29.1 %	14,538,619	43,620,216
Pumps	362,244			2.5 %	1,236,339	3,709,388
Stand-alone Base Utilities				0.0 %	0	0
Aux Subtotal....	4,622,021			31.6 %	15,774,958	47,329,604
Lighting						
Lighting	823,473			5.6 %	2,810,512	8,432,379
Receptacle						
Receptacles	5,399,403			36.9 %	18,428,161	55,290,008
Cogeneration						
Cogeneration				0.0 %	0	0
Totals						
Totals**	**13,556,146**	**3,677,134**	**625**	**100.0 %**	**49,944,260**	**142,685,920**

Equal to 26,265 GALLONS OF No. 2 FUEL OIL ANNUALLY ONSITE

* Note: Resource Utilization factors are included in the Total Source Energy value.
** Note: This report can display a maximum of 7 utilities. If additional utilities are used, they will be included in the total.

STATE OF MAINE
DEPARTMENT OF ENVIRONMENTAL PROTECTION

JOHN ELIAS BALDACCI
GOVERNOR

DAVID P. LITTELL
COMMISSIONER

February 17, 2010

LaVerne Reid
Federal Aviation Authority
New England Headquarters
12 New England Executive Park
Burlington, MA 01803

RE: Airport Emission Reduction Credits
City of Portland, Maine - Portland International Jetport

Dear LaVerne Reid:

The Maine Department of Environment Protection, Bureau of Air Quality (Department) has reviewed the application for the Airport Emission Reduction Credits (AERCS) received from the Portland International Jetport (PWM) on February 17, 2010. The Department has determined that the proposed low-emission project described in the Portland International Jetport's application meets the requirements of the Clean Air Act and is consistent with Vision 100 (P.L.108-176) as implemented by the Federal Aviation Administration (FAA) Voluntary Airport Low Emission (VALE) "Technical report" and associated U.S. Environmental protection Agency (EPA) "Guidance on Airport Emission reduction Credits for Early measures through Voluntary Airport Low Emission Programs".

The preliminary review of the Portland International Jetport's Vale project application indicates that the emission reduction estimates are reasonable and accurate. Based on this review, the Department accepts the Portland International Jetport's application and will make a timely future determination of AERCs based solely on VALE and AERC program guidance in relation to general conformity and new source review (NSR) regulations. Approved AERCs for general conformity will be granted by the Department on a one to one basis (project emission reductions to AERCs by pollutant), while AERCs for NSR will be granted, if eligible on a similar basis or according to Department and NSR regulations and procedures.

The Department will grant AERCs to Portland International Jetport following FAA project funding and receipt of updated Portland International Jetport emission reduction estimates. The AERCs for this project may only be used at the Portland International Jetport. Portland International Jetport is responsible for project tracking and record keeping and for making this information available to the Department and public as requested.

If you have any questions, please contact me at (207) 287-9931 or via email at kathy.tarbuck@maine.gov

Sincerely,

Kathy Tarbuck

Kathy Tarbuck
Licensing
MEDEP, Bureau of Air Quality

cc. Dr. Jake A. Plante
Office of Airport Planning
Federal Aviation Authority
800 Independence Avenue, SW
Washington, DC 20591

Mr. Bob Siris
Federal Aviation Authority
New England Headquarters
12 New England Executive Park
Burlington, MA 01803

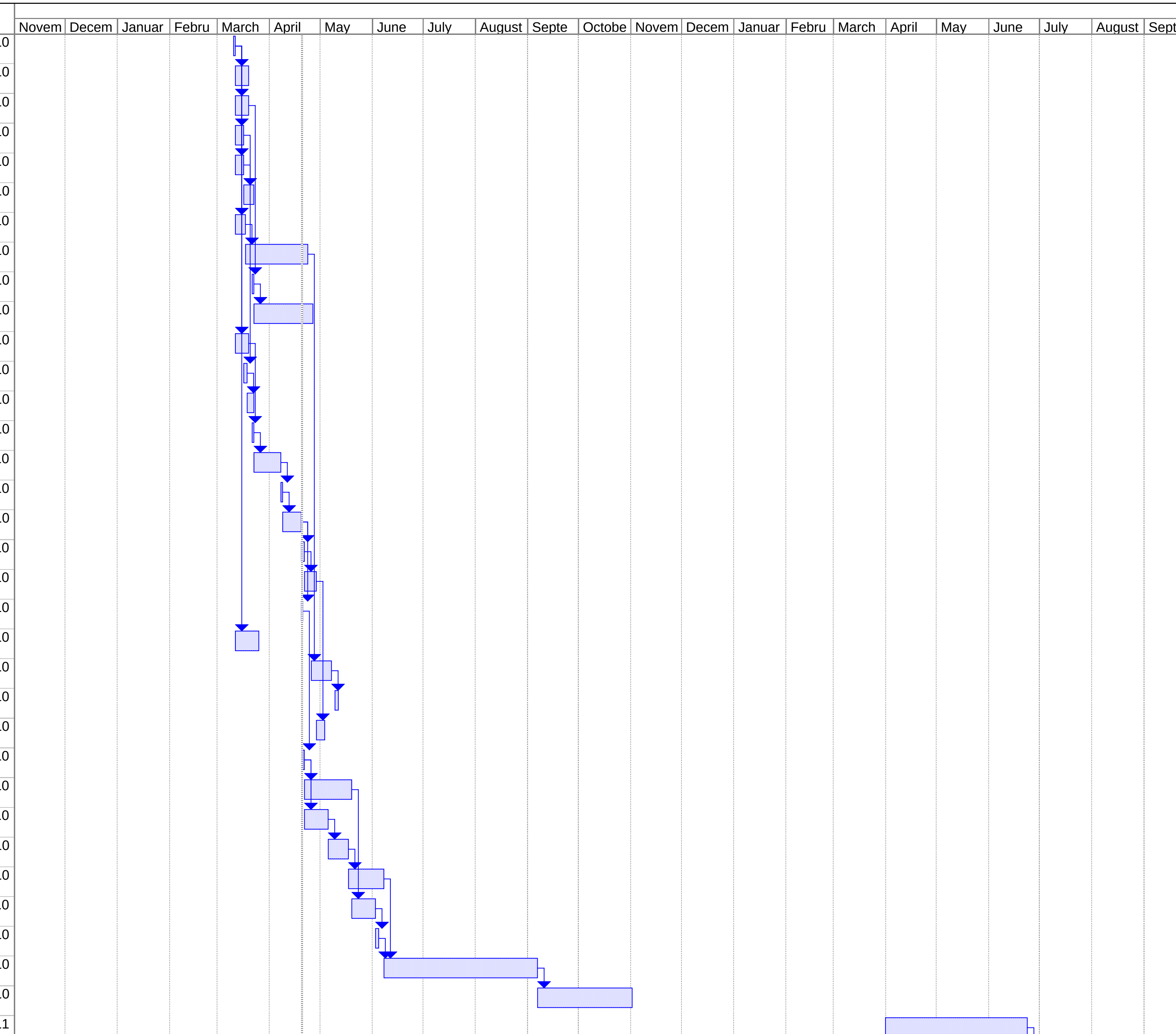
Mr. Roy Williams
Portland International Jetport
1001 Westbrook Street
Portland, ME 04901

Portland International Jetport

Geothermal Option - VALE Grant Schedule (updated Tue 4/20/10)

Turner Construction

ID	Task Name	Duration	Start	Finish
1	Jetport initiates Geothermal Recovery strategy	1 day	Thu 3/11/10	Thu 3/11/10
2	Complete Geotherm BID Package #1- wellfield,vaults, and mains to Building	6 days	Fri 3/12/10	Fri 3/19/10
3	Complete Mech. EQUIP Package #2- Selected Mech. Equip effected by Geot	6 days	Fri 3/12/10	Fri 3/19/10
4	Turner proposal to D-H	3 days	Fri 3/12/10	Tue 3/16/10
5	**Jetport requests Pre-Design Meeting with FAA in Burlington**	3 days	Fri 3/12/10	Tue 3/16/10
6	Jetport confirms proceed on Geothermal recovery-Authorizations	4 days	Wed 3/17/10	Mon 3/22/10
7	Oest completes Bid Spec for Mech-Equip #2	4 days	Fri 3/12/10	Wed 3/17/10
8	Oest Completes and issues Bulletin 4A Mechanical design	27 days	Thu 3/18/10	Fri 4/23/10
9	**Turner releases Mechanical Coordination to Third Party-Both options**	1 day	Mon 3/22/10	Mon 3/22/10
10	Mechanical coordination Process and submission-Phase 1 For HVAC Award	25 days	Tue 3/23/10	Mon 4/26/10
11	Turner completes bid scopes #1&2 with DH	6 days	Fri 3/12/10	Fri 3/19/10
12	DH drafts Advertisement for Jetport/Portland approval.	2 days	Wed 3/17/10	Thu 3/18/10
13	City of Portland Advertises	2 days	Fri 3/19/10	Mon 3/22/10
14	Bid packages at City Hall for bidder Pick up	1 day	Mon 3/22/10	Mon 3/22/10
15	Bid period	12 days	Tue 3/23/10	Wed 4/7/10
16	Bids due to be submitted	1 day	Thu 4/8/10	Thu 4/8/10
17	Reconcile/evalute Bids	7 days	Fri 4/9/10	Mon 4/19/10
18	Vale Grant reapplication	2 days	Tue 4/20/10	Wed 4/21/10
19	**AIP approval from FAA/Vale Grant**	5 days	Thu 4/22/10	Wed 4/28/10
20	Conditional Award#1&#2 - based of Vale/AIP reapplication	1 day	Tue 4/20/10	Tue 4/20/10
21	Plumbing and Electrical Awards	10 days	Fri 3/12/10	Thu 3/25/10
22	**Award HVAC**	10 days	Mon 4/26/10	Fri 5/7/10
23	Initiate HVAC sign-off of coordianted drawings.	2 days	Mon 5/10/10	Tue 5/11/10
24	**Critical Jetport release date for geoothermal OPTION**	3 days	Thu 4/29/10	Mon 5/3/10
25	Release partial authorization for geothermal well field submittals	1 day	Wed 4/21/10	Wed 4/21/10
26	Submitt Wellfield engineering	20 days	Thu 4/22/10	Wed 5/19/10
27	release 2000 lf of 8" mains for insatlation in inbound road	10 days	Thu 4/22/10	Wed 5/5/10
28	Deliver 2000lf Main to site	8 days	Thu 5/6/10	Mon 5/17/10
29	Install Mains Inbound road/test coord. With Utility installation	15 days	Tue 5/18/10	Mon 6/7/10
30	H&A Submission approval	10 days	Thu 5/20/10	Wed 6/2/10
31	Deliver Materials for wellfield installation	2 days	Thu 6/3/10	Fri 6/4/10
32	Install geothermal Wellfields	65 days	Tue 6/8/10	Mon 9/6/10
33	Complete west parking lot-Phase Two	40 days	Tue 9/7/10	Mon 11/1/10
34	start up and commission system	60 days	Fri 4/1/11	Thu 6/23/11



Project: Portland geothermal
Date: Tue 4/20/10

Task	Progress	Summary	External Tasks
Split	Milestone	Project Summary	External Milestone
Deadline			

ID		Task Name	Duration	Start	Finish	Novem	Decem	Januar	Febru	March	April	May	June	July	August	Septe	Octobe	Novem	Decem	Januar	Febru	March	April	May	June	July	August	Septe
35		Punchlist and Turnover	60 days	Fri 6/24/11	Thu 9/15/11																							

Project: Portland geothermal
Date: Tue 4/20/10

Task | Progress | Summary | External Tasks | Deadline
Split | Milestone | Project Summary | External Milestone

April 8, 2010

DESIGN AND INSTALLATION OF GROUND SOURCE HEAT SINK AT THE PORTLAND INTERNATIONAL JETPORT
Bid 6410

BIDDER	Addendum 1	Design Option #1 Base Bid – Basis of Award	Design Option #1 Mobilization and Demobilization Greater Than 200 gpm Water	Design Option #1 Additional Equipment, Materials, and Labor Greater Than 200 gpm Water	Provide Breakout Pricing for Wellfield Engineering Costs	Provide Breakout Pricing for Wellfield Supply Headers (8" mains) Material Costs (as indicated in part A of sketch GT-FS-2
GOODWIN WELL AND WATER	√	$1.330,791.00	$10,000.00	$5,000.00	$46,224.00	$33,100.00
NATIONAL GEOTHERMAL	√	$1,127,738.00	$6,500.00	$9,000.00	$114,900.00	$23,200.00

BUILDING MECHANICAL EQUIPMENT ASSOCIATED WITH THE GROUND SOURCE HEAT SINK AT THE PORTLAND INTERNATIONAL JETPORT - BID 6510			
Bidder		**Mechanical Equipment Items**	
Damon Mechanical Services	**Item No.**	**Item Description**	**Total Amount (Per Equipment Package)**
	236416-1	Centrifugal Water Chiller	$359,400.00
	238146-1	Water to Water Modular Heat Pumps	$603,500.00
	236500-1	Cooling Tower & Heat Exchanger	$284,400.00
	235223-1	Cast Iron Boilers	$119,800.00
	232123-1	Hydronic Pumps, Expansion Tank and Air Separator	$84,300.00
		TOTAL FOR BASE MECHANICAL EQUIPMENT ITEMS	**$1,451,400.00**
		Alternate Mechanical Equipment	
	236416-A1	Provide Two (2) 400 Ton Chillers in lieu of specified	$543,000.00
	236416-A2	Provide One (1) Additional Year of Chiller Full Service Contract	$5,200.00
	238146-A1	Provide One (1) Additional Year of Modular Heat Pump Full Service Contract	$12,150.00
	236500-A1	Provide Two (2) 1200 gpm Cooling Towers and no Heat Exchanger in lieu of the specified	$308,800.00
	236500-A2	Provide One (1) Year of Cooling Tower Full Service Contract	$11,500.00
	235223-A1	Provide Two (2) 4623 MBH Boilers in lieu of the specified	$163,600.00
	235223-A2	Extend Boiler Parts & Labor Warranty to Years 3, 4 & 5 after project substantial completion	$11,800.00
	235223-A3	Provide One (1) Additional Year of Boiler Full Service Contract	$11,500.00
	232123-A1	Provide Three (3) 1360 gpm, Two (2) 900 gpm, Two (2) 450 gpm pumps, no expansion trans and no air separator in lieu of the specified equipment	($22,000.00)
		TOTAL FOR ALTERNATE MECHANICAL EQUIPMENT ITEMS	**$1,045,550.00**

Haley & Aldrich, Inc.
75 Washington Avenue
Suite 203
Portland, ME 04101-2617

Tel: 207.482.4600
Fax: 207.775.7666
HaleyAldrich.com

HALEY & ALDRICH

16 April 2010
File No. 35024-110

Deluca Hoffman
778 Main Street
South Portland, Maine 04106

Attention: Dwight Anderson

Subject: Bidder Qualification Review, AIP 3-23-0038-70
Portland International Jetport (PWM)
Portland Maine

Ladies and Gentlemen:

We have completed our review of the bidders' proposals, received by our office on 15 April 2010. Our review was focused specifically on qualifications with respect to technical Specification Section 23 81 46.

We noted that the National Geothermal bid includes three drilling subcontractors, Plumbago Drilling, Adam Baker Well Drilling, and Maine Well and Pump. We have not been able to verify that these companies are licensed well drillers in the State of Maine. We have attempted to verify their status with the State in telephone communications on 15 April 2010. We understand that the City has also made inquiries to confirm their licensure status. These inquiries are on going.

Based on information included in the bids, we would consider the National Geothermal proposal non-qualifying and recommend that it be withdrawn from consideration. Specification Section 23 81 46, Article 1.06.A.1 states that the "Contractor that installs the wells be licensed in the State of Maine." This requirement was included in consideration of the best interest of the Owner. We consider a licensed driller as a minimum qualification for installation the wells. There are over 150 licensed well drillers in the State of Maine.

This project requirement was also included in anticipation that the State of Maine will soon adopt, potentially during the course of this project, regulations that will require, by law, licensed well drillers for geothermal projects. We believe that it is in the best interest of the Owner to avoid this potential non-compliance that could occur during well field construction. Hence, we made this potential future requirement part of the minimum qualifications for the project.

Sincerely yours,
HALEY & ALDRICH, INC.

Paul F. Ormond
Senior Engineer

Wayne A. Chadbourne, P.E.
Vice President

c: Gensler; Attn.:Jim Stanislaski
Turner Construction Company; Attn.: Philip Coleman
Portland International Jetport; Attn.: Roy Williams

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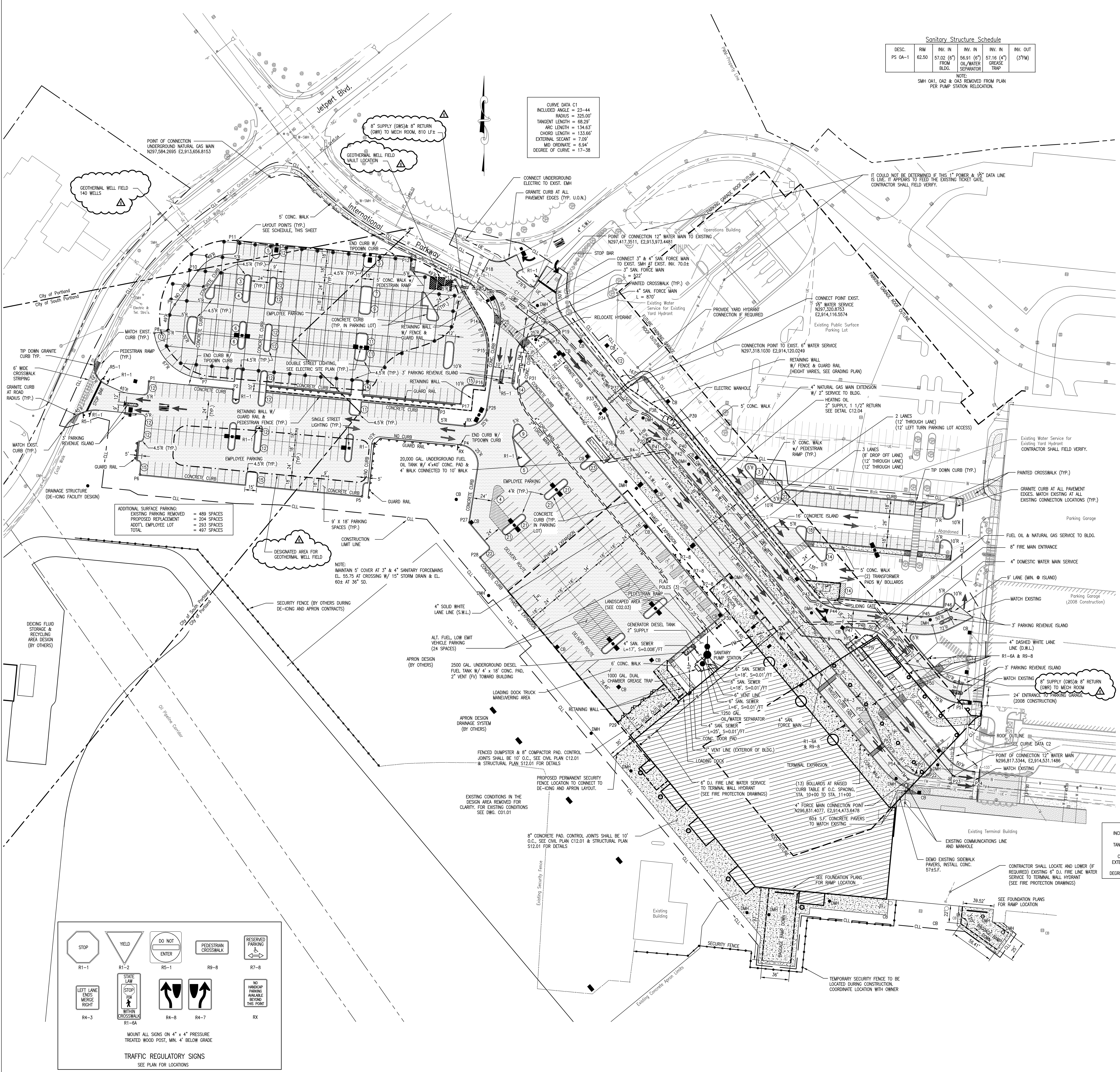


Sanitary Structure Schedule

DESC.	RIM	INV. IN	INV. IN	INV. IN	INV. OUT
PS OA-1	62.50	57.02 (6") FROM BLDG.	56.91 (6") OIL/WATER SEPARATOR	57.16 (4") GREASE TRAP	(3"FM)

NOTE:
SMH OA1, OA2 & OA3 REMOVED FROM PLAN PER PUMP STATION RELOCATION.

CURVE DATA C2
INCLUDED ANGLE = 45-03
RADIUS = 66.00'
TANGENT LENGTH = 27.37'
ARC LENGTH = 51.90'
CHORD LENGTH = 50.57'
EXTERNAL SECANT = 5.45'
MID ORDINATE = 5.03'
DEGREE OF CURVE = 86-49

SHEET NOTES

Layout Coordinate Schedule

Symbol	North	East
P1	297322.3702	2913503.1698
P2	297311.8659	2913610.6577
P3	297286.1889	2913873.4061
P4	297241.2754	2913901.1721
P5	297175.2196	2913775.1472
P6	297202.9391	2913491.4984
P7	297325.9201	2913569.6595
P8	297384.0274	2913509.7270
P9	297420.5302	2913535.9138
P10	297463.8152	2913565.9383
P11	297502.2427	2913616.0640
P12	297480.5402	2913838.1418
P13	297452.3289	2913894.3531
P14	297398.3532	2913925.8652
P15	297358.0563	2913934.6865
P16	297316.3831	2913930.6140
P17	297293.5155	2913901.2507
P18	297463.6708	2913930.1528
P19	297383.8682	2914027.7309
P20	297248.5682	2914139.4235
P21	296831.9845	2914483.3207
P22	296818.9077	2914497.8773
P23	296808.2946	2914528.0050
P24	296805.5936	2914556.5679
P25	297395.7746	2913951.9271
P26	297285.7935	2913934.8296
P27	297141.8447	2913912.4516
P28	297097.2439	2913926.2555
P29	296886.8167	2914102.0399
P30	297023.1290	2914235.7411
P31	297322.6601	2913985.5222
P32	297372.1345	2914016.6698
P33	297302.3998	2914074.2370
P34	297278.4116	2914088.9125
P35	297251.8844	2914100.3778
P36	297240.6220	2914099.3013
P37	297311.8196	2914107.9558
P38	297283.3825	2914139.1261
P39	297262.9312	2914169.1185
P40	297243.9731	2914189.8987
P41	297243.1087	2914155.5881
P42	297227.8098	2914172.1205
P43	297049.3951	2914350.5263
P44	297031.4636	2914384.2176
P45	297021.1367	2914489.7924
P46	297031.2426	2914527.3495
P47	297008.2479	2914395.5723
P48	297006.1297	2914417.2276
P49	296988.4225	2914450.7326
P50	296936.8391	2914493.8237
P51	296910.2426	2914544.4563
P52	296902.9914	2914419.5164
P53	296859.3266	2914440.0018
P54	296833.5855	2914461.2515

GENERAL NOTES

1. ALL ENTRANCE ROADWAY, PUBLIC SURFACE PARKING AREAS AND PARKING GARAGE ACCESS CURBING SHALL BE TYPE I GRANITE VERTICAL CURB.
2. CONCRETE CURBING SHALL BE USED IN THE EMPLOYEE PARKING LOTS.
3. DIMENSIONS ARE TO FACE OF CURB UNLESS OTHERWISE INDICATED.
4. SEE ARCHITECTURAL PLANS FOR CONCRETE SIDEWALK JOINT PATTERN AND LAYOUT AT THE 25 FOOT WIDE ENTRANCE WALK.
5. SEE STRUCTURAL PLAN S12.01 FOR RADIANT HEATING DETAILS IN SIDEWALK AND COMPACTOR PAD. SEE MECHANICAL PLAN M02.02.00 FOR RADIANT PIPING LOCATIONS.
6. CONTRACTOR SHALL PROVIDE A TEMPORARY WATER MAIN TO MAINTAIN THE LOOP SYSTEM REQUIRED BY PORTLAND WATER DISTRICT. THE TEMPORARY DESIGN FOR THIS WATER MAIN AND OTHER REQUIRED SERVICES SHALL BE REVIEWED AND APPROVED BY PORTLAND WATER DISTRICT AND THE CITY OF PORTLAND FIRE DEPARTMENT.
7. PEDESTRIAN SIDEWALKS RAMPS SHALL BE PROVIDED AT ALL STREET CORNERS, CROSSWALKS AND DRIVEWAYS.

Portland International Jetport

1001 Westbrook Street
Portland, Maine 04102

Gensler
2020 K Street, NW
Suite 200
Washington, DC 20006
Telephone 202.721.5200
Facsimile 202.872.8587

oest ASSOCIATES, INC.
343 Gorham Road, South Portland, ME 04106 P: (207) 761-1770 F: (207) 774-1246 www.oest.com
engineers · architects · surveyors · construction managers

△	Issue	Date & Issue Description	By	Check
--	1	07/11/08 SCHEMATIC DESIGN	WJW	AWL
--	2	09/22/08 DESIGN DEVELOPMENT	WJW	AWL
--	3	12/03/08 75% CONSTRUCTION DOCUMENTS	WJW	AWL
--	4	01/23/09 95% CONSTRUCTION DOCUMENTS	WJW	AWL
--	5	10/26/09 ISSUED FOR PERMIT	WJW	FEM
2	6	11/12/09 ADDENDUM #2	WJW	FEM
4	7	01/12/10 BULLETIN #1	WJW	TM

Seal/Signature

PROGRESS SET NOT FOR CONSTRUCTION

Project Name
PWM Terminal Enhancement

Project Number
09.6395.000

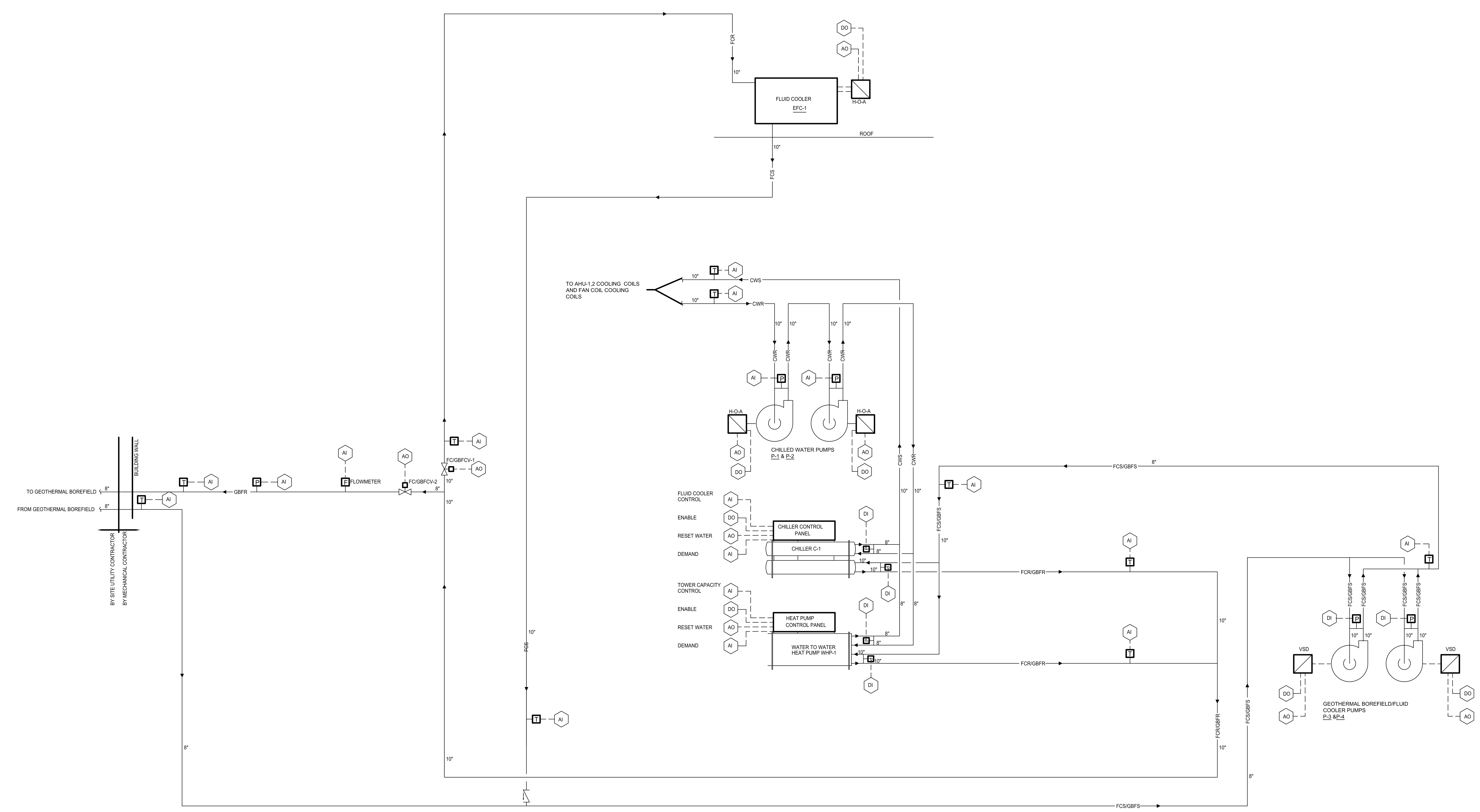
CAD File Name
T:\5330101\SHEETS\C02.01.DWG

Description
SITE LAYOUT & UTILITIES PLAN

Scale
1" = 40'

Ref. North

C02.01



NOTE:
FOR SEQUENCE OF OPERATION REFER TO SHEET M12.05B

COOLING PLANT SCHEMATIC
SCALE: NOT TO SCALE

2

SHEET NOTES

GENERAL NOTES

A SEE SHEET M00.00 FOR LEGEND AND GENERAL NOTES.

B ALL ITEMS IDENTIFIED UNDER BULLETIN 4 SHALL MEET THE REQUIREMENTS OF SPEC SECTION 00 22 13

Portland International Jetport

1001 Westbrook Street
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Facsimile 202.872.8587

oest ASSOCIATES, INC.
engineers • architects • surveyors • construction managers

△	Issue	Date & Issue Description	By	Check
	01	12/03/08	PWZ	RHB
		75% DESIGN DEVELOPMENT		
	02	01/23/09	PWZ	RHB
		95% CONTRUCTION DOCUMENTS		
	03	10/26/09	PWZ	RHB
		ISSUED FOR PERMIT		
2	04	11/12/09	PWZ	RHB
		ADDENDUM #2		
7	05	01/15/10	RHB	RHB
		BULLETIN #4		

Seal/Signature

STATE OF MAINE ★ ROBERT H. BROWN No. 4602 LICENSED PROFESSIONAL ENGINEER ★

Robert H. Brown 01/15/10

Project Name
PWM Terminal Enhancement

Project Number
09.6395.000

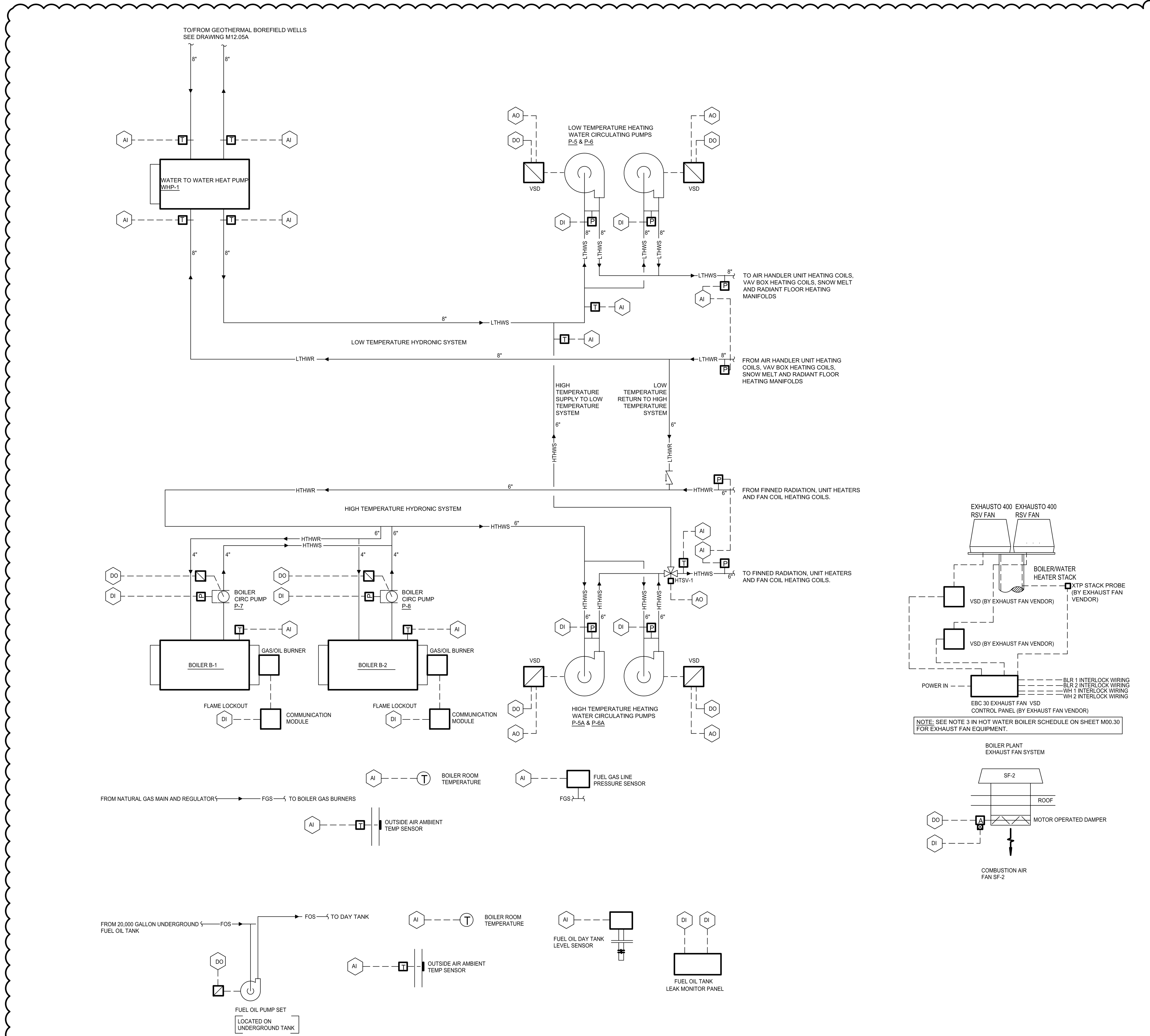
CAD File Name
T:\5330101\Mechanical\GeothermalEquipmentSchedules\M12.05A.dwg

Description
MECHANICAL COOLING PLANT SCHEMATIC AND CONTROL DIAGRAM

Scale
NOT TO SCALE

Ref. North

M12.05A



HEATING PLANT CONTROL SCHEMATIC

SCALE: NOT TO SCALE

1

SEQUENCE OF OPERATION:

HEATING PLANT:

THE JETPORT TERMINAL EXPANSION HEATING SYSTEM CONSISTS OF A HIGH TEMPERATURE (180 DEG F) HEATING WATER LOOP AND A LOW TEMPERATURE (130 DEG F) HEATING WATER LOOP.

WATER-TO-WATER HEAT PUMP WHP-1 SHALL PROVIDE 130 DEG F WATER FOR THE LOW TEMPERATURE HYDRONIC HEATING SYSTEM DURING THE HEATING SEASON. THE HEAT SOURCE FOR THE HEAT PUMP SHALL BE A GEOTHERMAL BOREFIELD ON THE JETPORT PROPERTY.

THE PLANT SHALL ALSO CONTAIN TWO NATURAL GAS/NO. 2 FUEL OIL FIRED HOT WATER BOILERS B-1 AND B-2. EACH BOILER SHALL BE EQUIPPED WITH A MODULATING BURNER INCLUDING A VFD ON THE BURNER MOTOR. THE DDC SYSTEM SHALL ENABLE THE BOILERS FOR OPERATION WHEN THE OUTDOOR AIR TEMPERATURE IS BELOW 50 DEG F. (ADJUSTABLE) THE BOILER BURNER SHALL MODULATE TO MAINTAIN THE BOILER WATER SUPPLY SET POINT WHICH WILL BE RESET BY THE DDC SYSTEM TO FOLLOW THE AMBIENT TEMPERATURE. AN ASSOCIATED BOILER CIRCULATING PUMP SHALL CYCLE TO PROVIDE HEAT TO THE HIGH TEMPERATURE HYDRONIC WATER LOOP TO MAINTAIN THE SYSTEM SUPPLY SETPOINT TEMPERATURE. WHEN ANY BOILER OR WATER HEATER CALLS FOR HEAT, SUPPLY FAN SF-2 SHALL START AND THE ASSOCIATED MOTOR OPERATED DAMPER SHALL OPEN. SF-2 SHALL RUN UNTIL THE CALL FOR HEAT IS SATISFIED. A SYSTEM OF EXHAUST FANS MOUNTED AT THE FLUE OUTLET SHALL MODULATE TO MAINTAIN A CONSTANT DRAFT PRESSURE SET POINT. THE BOILER PLANT SHALL PROVIDE HIGH TEMPERATURE WATER FOR THE HYDRONIC HEATING SYSTEM AND SHALL PROVIDE DOMESTIC HOT WATER DURING THE HEATING SEASON. DURING THE SUMMER MONTHS, THE BOILERS SHALL BE SHUT OFF.

THE BOILERS SHALL BE ARRANGED TO PROVIDE SUPPLEMENTAL HEATING TO THE LOW TEMPERATURE HYDRONIC LOOP AS REQUIRED. IN CASE OF A POWER OUTAGE, THE BOILERS SHALL RUN FROM THE EMERGENCY GENERATOR TO PROVIDE HEAT TO THE HIGH AND LOW TEMPERATURE HYDRONIC LOOPS FOR FREEZE PROTECTION.

DOMESTIC WATER HEATING:

DURING THE SUMMER MONTHS, THE BOILERS SHALL BE LOCKED OUT AND DOMESTIC HOT WATER SHALL BE SUPPLIED BY THE WATER-TO WATER HEAT PUMP SUPPLEMENTED BY A PAIR OF NATURAL GAS/NO. 2 FUEL OIL FIRED DOMESTIC WATER HEATERS. A SYSTEM OF EXHAUST FANS MOUNTED AT THE FLUE OUTLET SHALL MODULATE TO MAINTAIN A CONSTANT DRAFT PRESSURE SET POINT. A DOMESTIC HOT WATER RECIRCULATION PUMP SHALL RUN CONTINUOUSLY TO MAINTAIN HOT WATER FLOW TO REMOTE FIXTURES. (NOTE: SEE PLUMBING DRAWING P00.30 WATER HEATER SCHEDULE FOR EQUIPMENT **EXCEPT** WATER HEATERS SHALL BE GAS-FIRED ONLY AND SUPERSTOR STORAGE TANKS SHALL BE FURNISHED WITH DUAL COILS. IN EACH STORAGE TANK, ONE COIL SHALL BE PIPED TO THE WATER-TO-WATER HEAT PUMP AND THE OTHER COIL SHALL BE PIPED TO A GAS-FIRED WATER HEATER.)

HYDRONIC SYSTEM SUPPLY PUMPS:

THE DDC SYSTEM SHALL ENABLE THE HIGH TEMPERATURE AND LOW TEMPERATURE HYDRONIC SYSTEM SUPPLY PUMPS FOR OPERATION WHEN THE OUTDOOR AIR TEMPERATURE IS BELOW 50 DEG F. (ADJUSTABLE) THE HYDRONIC SYSTEMS SUPPLY PUMPS SHALL BE ARRANGED IN A LEAD/LAG SEQUENCE. IF A LEAD HYDRONIC SYSTEM SUPPLY PUMP FAILS TO START, THE LAG PUMP WILL BE STARTED AND THE DDC SYSTEM SHALL SEND AN ALARM TO THE DESIGNATED MAINTENANCE REPRESENTATIVE. THE LEAD AND LAG PUMPS SHALL BE SWITCHED OVER ON A WEEKLY BASIS. THE PUMPS SHALL BE FURNISHED WITH VFDS AND THE PUMP RPM SHALL BE MODULATED TO ADD HIGH TEMPERATURE WATER MAINTAIN A LOW TEMPERATURE LOOP SUPPLY TEMPERATURE OF 130DEG F.

HYDRONIC SYSTEM DDC CONNECTION:

THE DDC SYSTEM SHALL MONITOR THE HYDRONIC SYSTEMS SUPPLY TEMPERATURE, RETURN TEMPERATURE, SUPPLY PRESSURE OFF THE PUMPS; RETURN PRESSURE JUST BEFORE THE PUMPS; AND GPM FLOW TO THE BOREFIELD.

HIGH TEMPERATURE LOOP

THE HIGH TEMPERATURE HYDRONIC LOOP SHALL SUPPLY HEAT TO THE FINNED RADIATION ALONG THE EXTERIOR WALLS, UNIT HEATERS IN STAIRWELLS AND BAGGAGE HANDLING SPACES, FAN COIL UNITS AND A SMALL NUMBER OF RADIANT FLOOR MANIFOLDS.. THE HYDRONIC LOOP SUPPLY TEMPERATURE SHALL BE RESET FROM THE OUTDOOR AIR TEMPERATURE IN ACCORDANCE WITH THE FOLLOWING SCHEDULE:

OUTDOOR AIR TEMPERATURE	HIGH TEMPERATURE HYDRONIC WATER SUPPLY TEMPERATURE
50 DEG F (ADJUSTABLE)	140 DEG F (ADJUSTABLE)
0 DEG F (ADJUSTABLE)	180 DEG F (ADJUSTABLE)

LOW TEMPERATURE LOOP

THE LOW TEMPERATURE HYDRONIC LOOP SHALL SUPPLY HEAT TO AIR HANDLING UNIT 1 AND 2 HEATING COILS, VAV BOX HEATING COILS, MOST SNOW MELT AND RADIANT FLOOR MANIFOLDS AND ONE UNIT HEATER. THE WATER SUPPLY TEMPERATURE SHALL BE 130 DEG F SUPPLIED BY WATER-TO-WATER HEAT PUMP WHP-1. THE DDC SYSTEM SHALL CONTROL THE LOW TEMPERATURE HYDRONIC SUPPLY PUMP TO MAINTAIN A 20 DEG F TEMPERATURE DIFFERENTIAL. (ADJUSTABLE) THE WATER-TO-WATER HEAT PUMP HEAT SOURCE SHALL BE THE GEOTHERMAL BOREFIELD AND THE SOURCE WATER SHALL BE CIRCULATED TO AND FROM THE BOREFIELD BY BOREFIELD/FLUID COOLER PUMP P-3 WITH PUMP P-4 AS BACKUP. THE HEAT SOURCE SHALL BE CONTROLLED AS FOLLOWS: PUMP P-3 SHALL RUN CONTINUOUSLY. ON A CALL FOR HEAT BY THE LOW TEMPERATURE HEATING LOOP, WHP-1 SHALL RUN TO PRODUCE 130 DEG F WATER AND SHALL REJECT COOLED WATER TO THE BOREFIELD. PUMP P-3 SHALL MODULATE ITS SPEED TO MAINTAIN THE BOREFIELD SUPPLY WATER TEMPERATURE BETWEEN 80 DEG F AND 39.5 DEG F. IF THE BOREFIELD SUPPLY TEMPERATURE DROPS TO 39.5 DEG F, THE GAS-FIRED BOILERS AND ASSOCIATED CONTROL VALVE SHALL MODULATE TO INJECT HIGH TEMPERATURE LOOP WATER TO MAINTAIN A WATER SUPPLY TEMPERATURE OF 130 DEG F IN THE LOW TEMPERATURE HEATING LOOP SUPPLY MAIN.

COOLING PLANT:

THE COOLING PLANT SHALL CONSIST OF WATER-TO-WATER HEAT PUMP WHP-1, CENTRIFUGAL CHILLER C-1, A GEOTHERMAL BOREFIELD OF DRILLED WELLS, FLUID COOLER EFC-1 ON THE MECHANICAL ROOM ROOF, AND CHILLED WATER AND FLUID COOLER/GEOTHERMAL BOREFIELD CIRCULATING PUMPS.

THE COOLING PLANT SHALL BE ENABELED AS FOLLOWS: THE WATER-TO-WATER HEAT PUMP SHALL BE ENABLED AT ALL TIMES. THE CENTRIFUGAL CHILLER SHALL BE ENABLED WHEN THE OUTDOOR TEMPERATURE IS ABOVE 55 DEG F. (ADJUSTABLE) BOTH THE WATER TO WATER HEAT PUMP AND THE CENTRIFUGAL CHILLER SHALL BE UNDER LOCAL CONTROL AUTHORITY; BUT BOTH SHALL BE CAPABLE OF REPORTING AND DOCUMENTING OPERATING PARAMETERS TO THE OWNERS DDC SYSTEM, INCLUDING PRODUCTION OF DAILY REPORTS AND STORAGE OF 12 MONTHS WORTH OF OPERATING DATA AS DESCRIBED IN THE SPECIFICATIONS.

BOTH THE WATER-TO-WATER HEAT PUMP AND THE CENTRIFUGAL CHILLER SHALL TAKE HEAT FROM THE BUILDING AND REJECT IT TO THE BOREFIELD AND/OR THE FLUID COOLER. THE HEAT REJECTION CONTROL SHALL BE AS FOLLOWS: AS THE COOLING LOAD (AND ASSOCIATED CONDENSER LOAD) INCREASES, THE GEOTHERMAL BOREFIELD WELL SYSTEM PUMP SPEED SHALL INCREASE UP TO UP TO 435 GPM DIRECTED TO THE BOREFIELD. AS THE BOREFIELD RETURN WATER TEMPERATURE INCREASES ABOVE 80 DEG F, THE FC/GBF CONTROL VALVES WILL OPEN TO THE FLUID COOLER AND THROTTLE TO THE BOREFIELD AND THE PUMP SPEED WILL INCREASE TO SUPPLY BOTH THE BOREFIELD AND THE FLUID COOLER. AT MAXIMUM COOLING LOAD, THE BOREFIELD RETURN WATER TEMPERATURE SHALL BE NO HIGHER THAN 80 DEG F. WHEN THE OUTDOOR AIR TEMPERATURE IS BELOW 40 DEG F (ADJUSTABLE), THE FLUID COOLER BASIN PUMP SHALL BE SHUT OFF AND THE BASIN SHALL BE DRAINED.

SHEET NOTES

1. SEE SPECIFICATION SECTION 23 09 00 INSTRUMENTATION AND CONTROL FOR HVAC FOR MATERIALS AND LABOR REQUIREMENTS.

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GENERAL NOTES

A SEE SHEET M00.00 FOR LEGEND AND GENERAL NOTES.

B ALL ITEMS IDENTIFIED UNDER BULLETIN 4 SHALL MEET THE REQUIREMENTS OF SPEC SECTION 00 22 13

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△	Issue	Date & Issue Description	By	Check
	01	12/03/08	PWZ	RHB
		75% DESIGN DEVELOPMENT		
	02	01/23/09	PWZ	RHB
		95% CONTRUCTION DOCUMENTS		
	03	10/26/09	PWZ	RHB
		ISSUED FOR PERMIT		
2	04	11/12/09	PWZ	RHB
		ADDENDUM #2		
7	05	01/15/10	RHB	RHB
		BULLETIN #4		

Seal/Signature

STATE OF MAINE ROBERT H. BROWN No. 4602 LICENSED PROFESSIONAL ENGINEER

Robert H Brown 01/15/10

Project Name
PWM Terminal Enhancement

Project Number
09.6395.000

CAD File Name
T:\5330101\Mechanical\GeothermalEquipmentSchedules\M12.05B.dwg

Description
MECHANICAL CONTROL DIAGRAMS

Scale
NOT TO SCALE

Ref. North

M12.05B