Section 2.0

Project Description and Emissions

2.0 PROJECT DESCRIPTION AND EMISSIONS

2.1 Project Description

The proposed 116 MW Watson Station is built around two Rolls-Royce Trent 60 WLE gas turbines. The Trent 60 WLE is derived from the Rolls-Royce Trent 800 aircraft engine. The Trent 800 and its predecessor, the Trent 700, have accumulated more than 7,500,000 hours of operation in twin engine long haul aircraft such as the Boeing 777 and the Airbus A330.

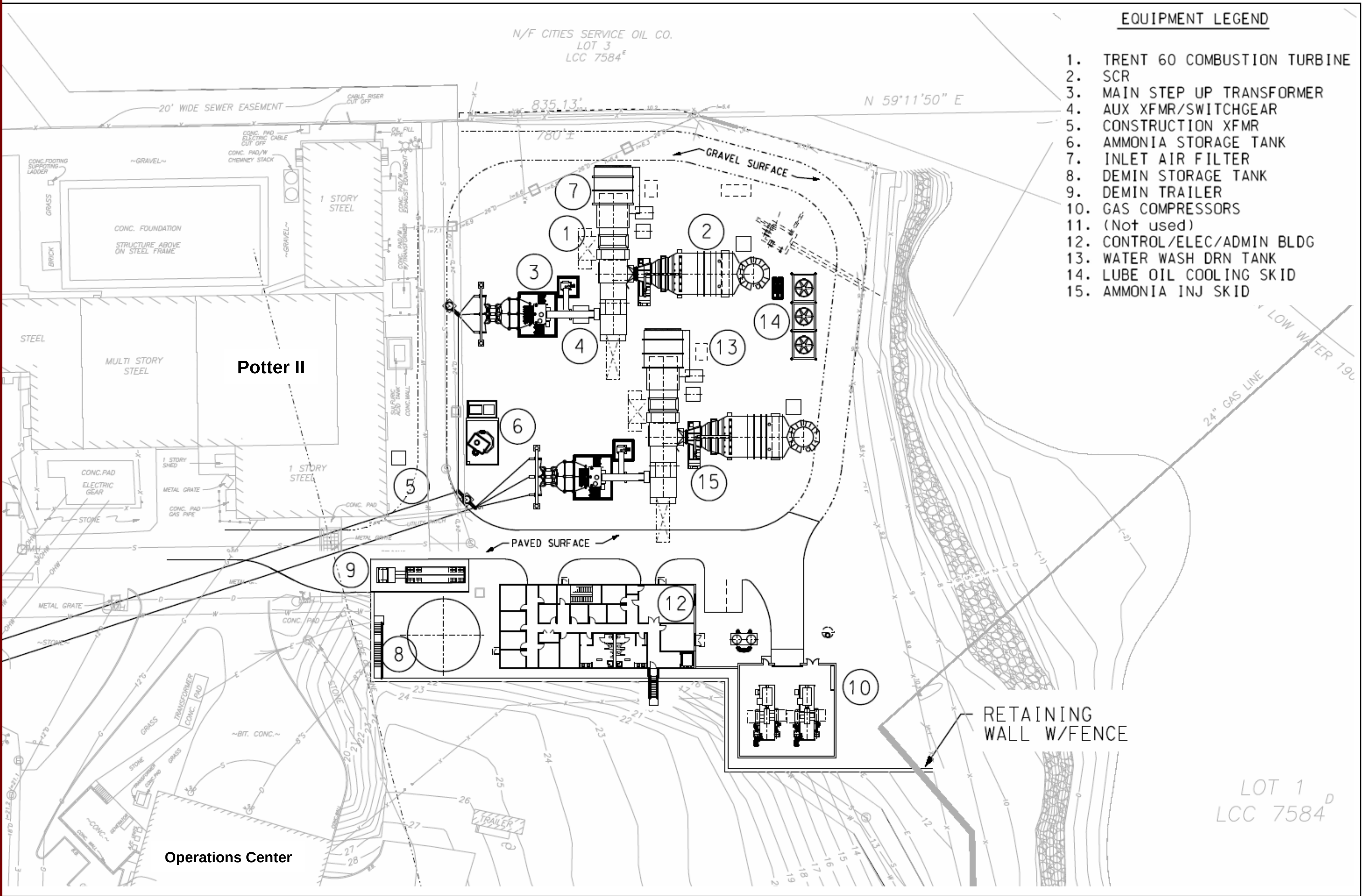
The Rolls-Royce Trent 60 WLE is capable of either base load or peaking duty and is rated at 58 MW. The efficient unit has a heat rate of 9,519 Btu/kW-hr (Higher Heating Value, "HHV") in a simple-cycle mode and can achieve full power within 10 minutes from a cold start on either natural gas or ULSD. The Trent 60 WLE unit is designed to have low NO_x emissions using minimum water to achieve 25 ppm at the turbine exhaust. The Trent 60 package is designed with a modular concept to allow for both quick installation and ease of maintenance. The Trent 60 fleet has accumulated over 130,000 hours of operating experience. An introductory Rolls-Royce brochure on the Trent 60 gas turbine is provided as Appendix B.

The Watson Station will include two Trent 60 gas turbine generators, each with their associated inlet air filter, Selective Catalytic Reduction (SCR) system, ammonia injection skid, oxidation catalyst, exhaust stack, main step-up transformer, auxiliary transformer and switchgear.

The Watson Station also will include a number of common components: a control center, a gas compressor station, a trailer mounted demineralizer system, a lube oil cooling skid, a 400,000 gallon demineralized water storage tank and a 15,000 gallon fully diked vertical aqueous ammonia storage tank and a perimeter access road. A general arrangement drawing is provided as Figure 2-1. A corresponding three dimensional graphic is provided as Figure 2-2.

The proposed Watson Station will occupy a two-acre parcel on the northeast corner of the BELD complex. The gas turbines and the associated equipment will be placed on concrete foundations and pads. The general yard area will be finished with crushed stone. A gravel perimeter access road will provide routine and emergency access to the new facility. The new perimeter road will connect to the internal roadway which currently provides access to Potter II. This internal roadway connects, in turn, to Potter Road. Access to the entire BELD complex can be controlled via security gates at the top of Potter Road, just off Route 53/Quincy Avenue.

The Watson Station includes two buildings, a control center (approximately 50 feet by 100 feet in plan) and a gas compressor station (approximately 50 feet by 50 feet in plan). Two small enclosures for the continuous emissions monitoring system (CEMS) are located at the



Source: C2HMHill

Figure 2-1
General Equipment Arrangement

Thomas A. Watson Generating Station
Braintree, Massachusetts

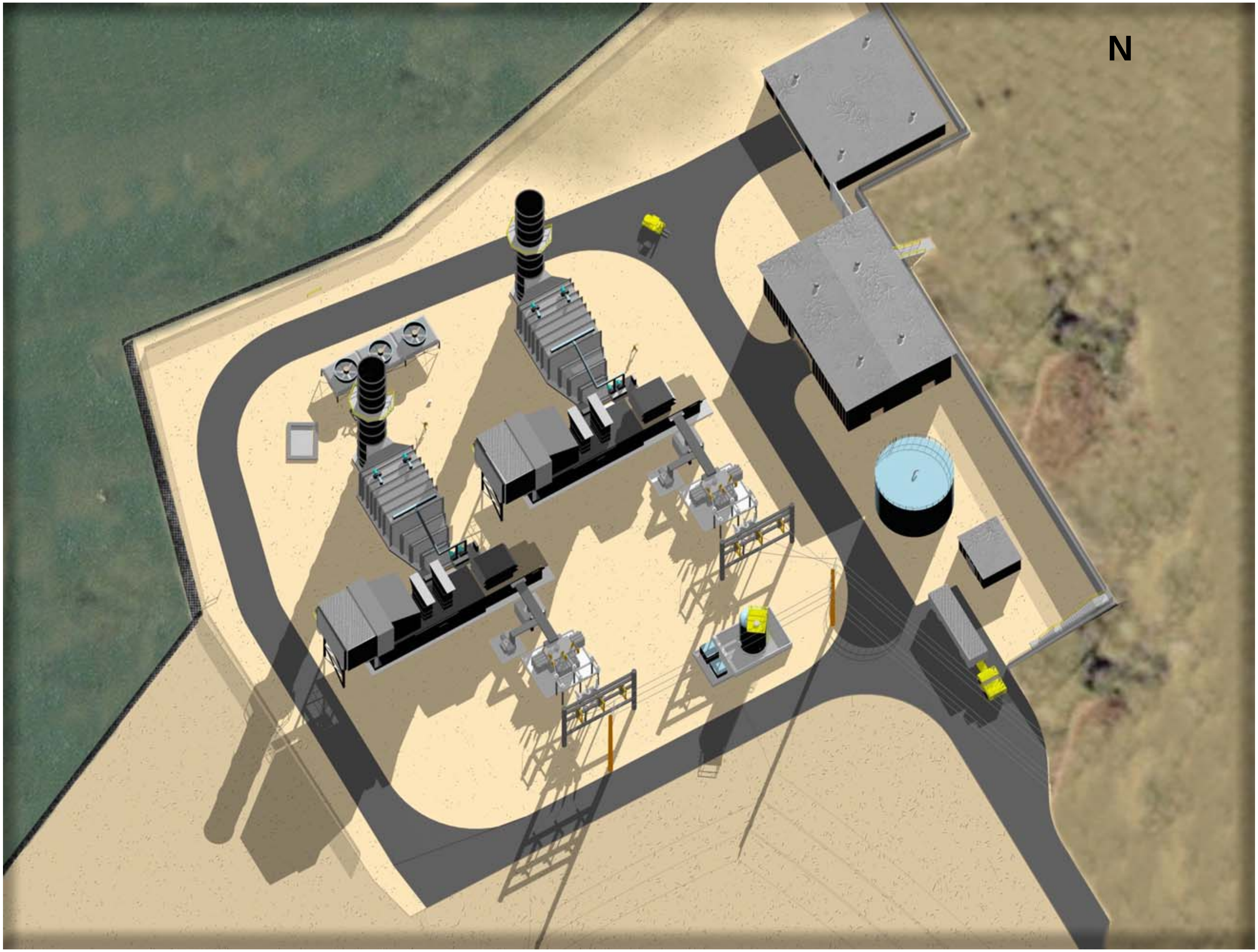


Figure 2-2
Rolls Royce Trent 60 WLE Rendering

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: C2HMHill

base of the gas turbine exhaust stacks. The buildings are located on the south side of the proposed Watson Station site. The two story control center will include the plant control room, office space, a meeting/planning room, restrooms and some storage space. A retaining wall and fence will separate the south side of the Watson Station site from the rest of the BELD complex. Existing fencing along the east side of the site (Fore River side) will be maintained or upgraded.

Preliminary renderings of the proposed Watson Station are provided as Figures 2-3 and 2-4. Figure 2-3 is a view from the BELD administrative offices and employee parking area, looking to the northwest. BELD's existing Potter II station is on the left side of the photo. The facilities visible in the background include the MWRA sludge palletizing facility (white buildings/white stack) and the "Goliath" crane, a visual landmark at the former Fore River shipyard. Figure 2-4 is a view from the residential area of Weymouth, looking across the Fore River to the BELD complex. The existing BELD operations center is visible to the left of the new plant, while Potter II appears on the right. The background includes rising terrain/Potter Road on the left, and the CITGO tanks on the right. The bow section of an oil tanker being unloaded at CITGO is also visible. For perspective, the existing Potter II stack is 130 feet above grade while the stack for the nearby 775 MW Fore River Generating Station is 255 feet in height. The appearance of the new Watson Station is consistent with the surrounding area. Moreover, the new plant is well screened from residential areas to the south and west.

Ancillary facilities include a 300 foot run of 115 kV overhead lines to connect the main step-up transformers to the BELD substation. As shown on Figure 2-1, these lines run between Potter II and the BELD operations center and are entirely within BELD's existing complex. With respect to any offsite transmission upgrades/improvements associated with the new Watson Station, a system interconnection study is underway at ISO-NE. BELD does not anticipate the need for any significant offsite work.

Other ancillary facilities include fuel supply and utility connections. A short run of new high pressure gas line will be installed by AGT from the existing stub on the AGT line to the new gas meter building. The existing stub is located about 100 feet to the east of the BELD employee parking lot. The existing approximately 1,600 foot distillate oil supply line from the CITGO terminal to Potter II will be upgraded to serve the new Watson Station. The Town of Braintree will connect Watson Station to the Town water and sewer lines which traverse the BELD property. The water line connection will supply the demineralization system as well as potable water for restrooms in the control building. The sanitary sewer connection will serve the restrooms in the control building. All of these connections will be within the BELD Potter Road facility.

The balance of Section 2 provides a more detailed description of the major plant components and systems.

Figure 2-3

Rolls Royce Trent 60 WLE Rendering – View from BELD Offices/Parking Lot

Thomas A. Watson Generating Station

Braintree, Massachusetts

Source: C2HMHill

Epsilon ASSOCIATES INC.

Source: C2HMHill

Figure 2-4

Rolls Royce Trent 60 WLE Rendering – View from Weymouth

Thomas A. Watson Generating Station

Braintree, Massachusetts

Epsilon ASSOCIATES INC.

2.1.1 Gas Turbine

The heart of the new Watson Station will be two Rolls-Royce Trent 60 WLE Gas Turbines. These flexible aero-derivative machines can run on either natural gas or distillate fuels (in this case ULSD). They are rated at 58 MW each (at any temperature below 19 degrees Centigrade (°C) (~66 degrees Fahrenheit (°F))). The Trent 60 WLE has a heat rate of approximately 9,500 HHV Btu/kW-hr and a corresponding thermal efficiency of 35.8%. A Trent 60 nominal performance curve is provided as Figure 2-5.

The Trent 60 is a "quick-start" machine. As shown on Figure 2-6, the machine can be started and brought to full power (58 MW) in slightly less than 10 minutes. This response time is very useful to the grid operators (ISO-NE). The Trent 60 can run efficiently at as little as 50% of its full rated power. Accordingly, the two unit facility could operate in a range extending from 29 MW (one unit at 50% load) to 116 MW (two units at 100% load).

Assembled at the Rolls-Royce plant in Mount Vernon, Ohio, the Trent 60 has a weatherproof painted carbon steel enclosure which houses the gas turbine itself, the inlet plenum, fuel and oil systems, exhaust volute and enclosure ventilation air systems. Figure 2-7 provides a photo of the gas turbine enclosure, with the gas turbine itself removed for inspection.

As shown in Figure 2-8, a sizeable inlet filter is located on the top of the gas turbine enclosure. Combustion air and ventilation air for the gas turbine enclosure pass through this inlet filter; the filter removes most of the particulate matter present in ambient air.

2.1.2 AC Generator

Each gas turbine will drive a two pole, open air-cooled AC generator operating at 13.8 kV, three phase, 60 Hz. The generator is housed in an acoustic enclosure. The generator package includes the generator cooling air system and a weatherproof painted carbon steel canopy for sheltering the AC generator, exciter, line and neutral cubicles

2.1.3 Air Pollution Control System

The other major element of the gas turbine package is the air pollution control system. In addition to the combustion chamber water injection system and combustion controls, the air pollution control system includes an SCR system, the associated ammonia injection system, an oxidation catalyst, a Continuous Emissions Monitoring System (CEMS) and an exhaust stack.

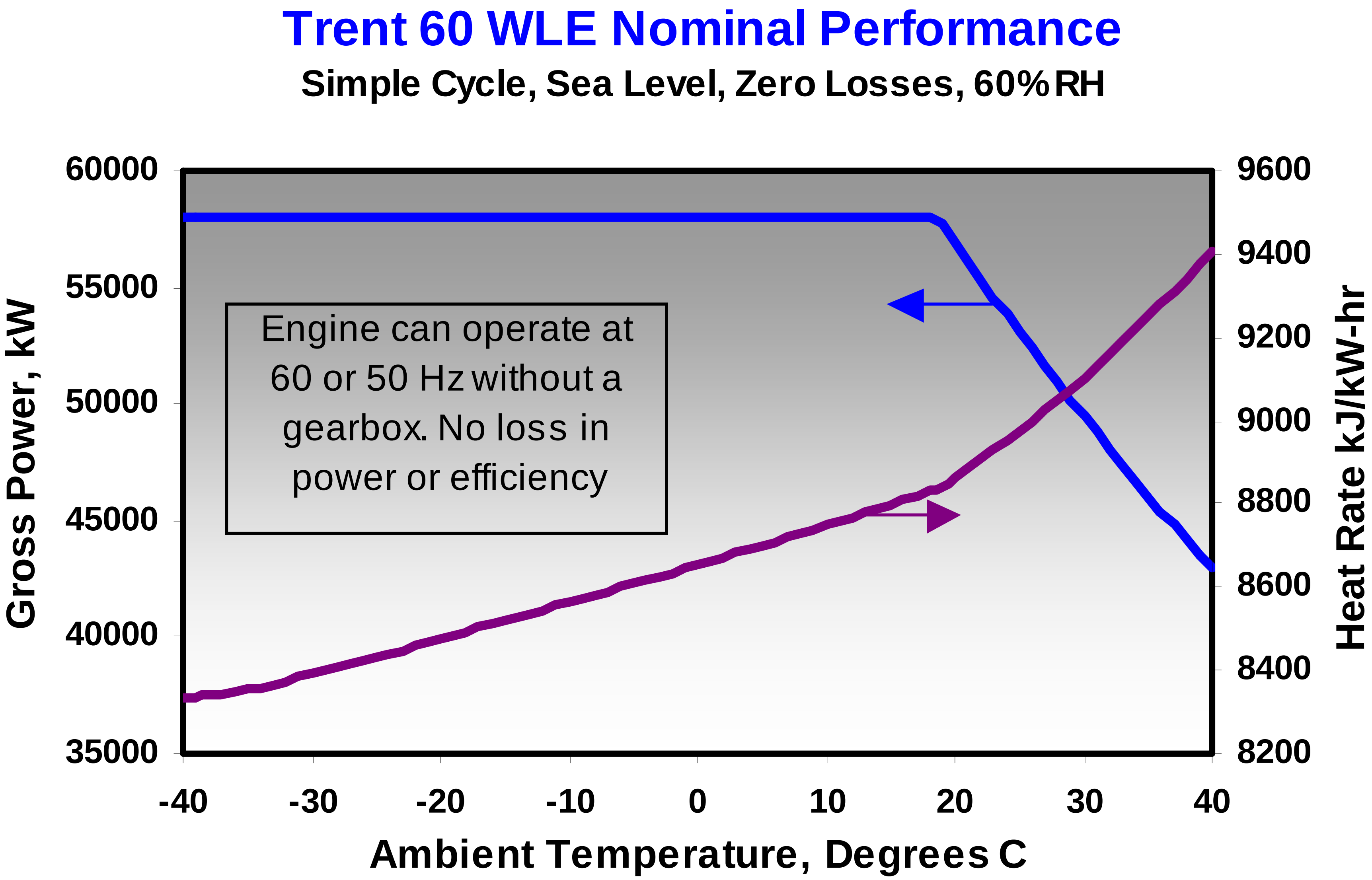


Figure 2-5
Performance Curve Trent 60 (Gas and Oil)

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: Rolls-Royce

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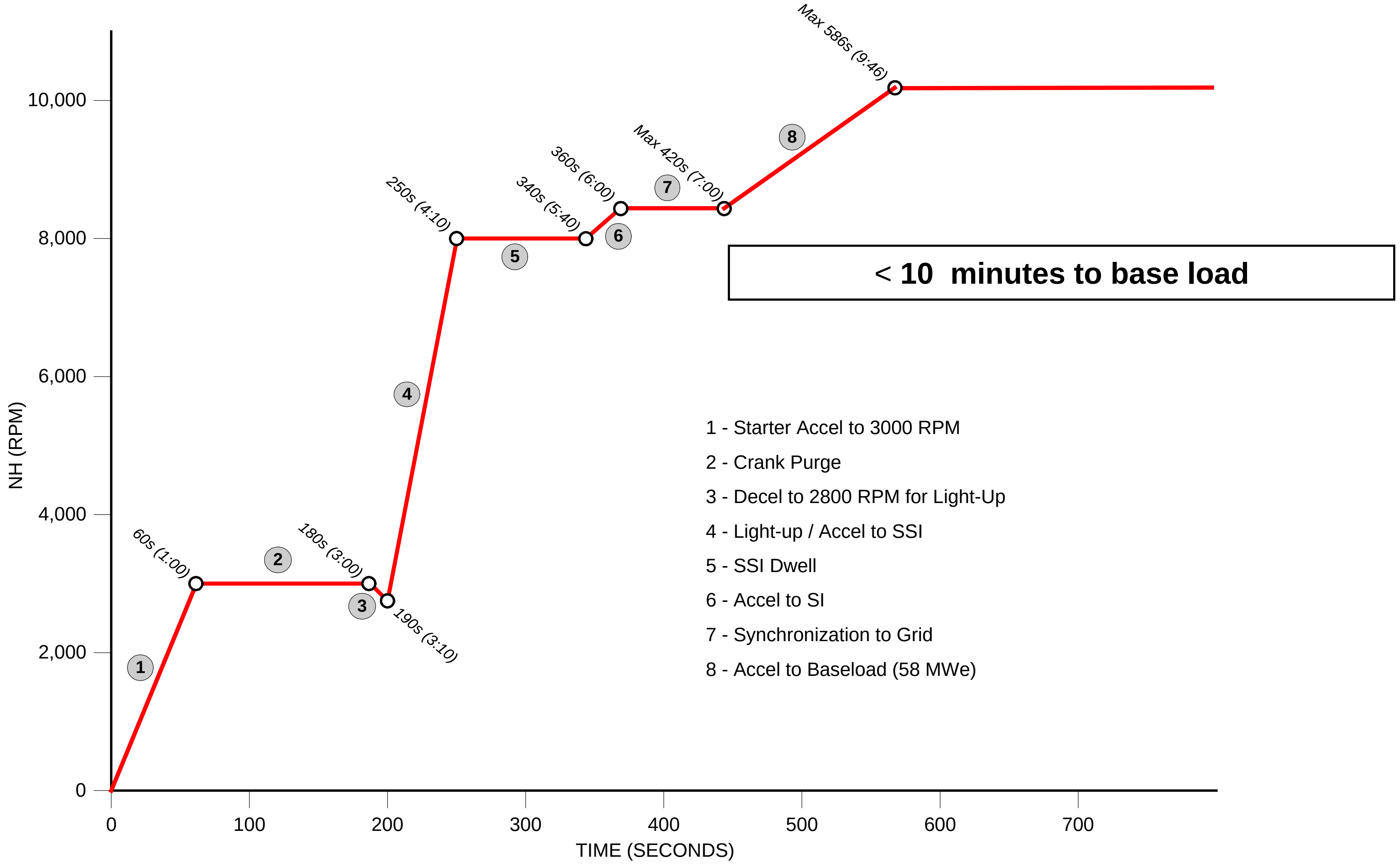

< 10 minutes to base load

Figure 2-6
Start-up Sequence

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: Rolls-Royce

Figure 2-7
Photo of Gas Turbine Enclosure

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: Rolls-Royce

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Trent 60 GenSet - Package

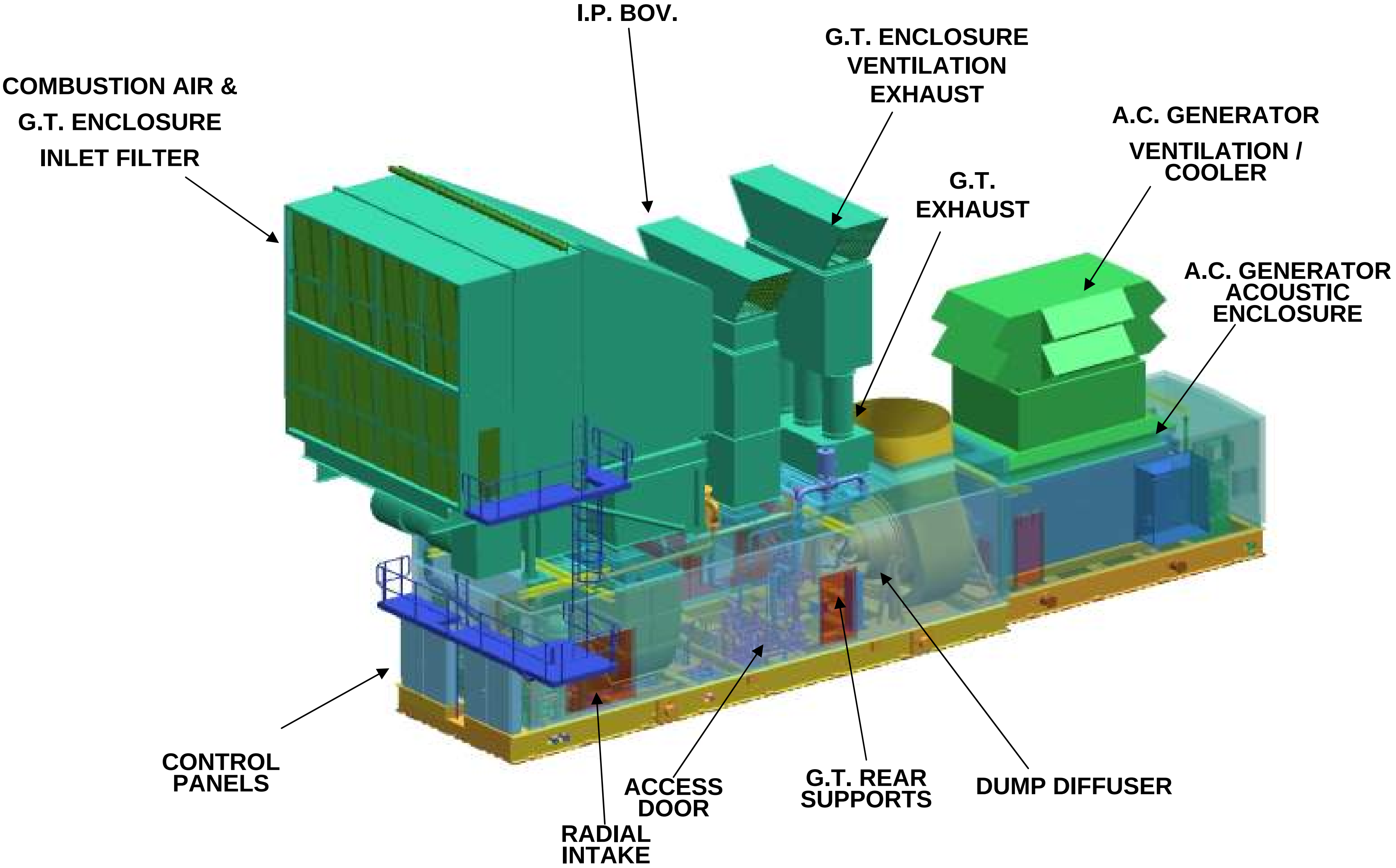

Figure 2-8
Inlet Filter

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: Rolls-Royce

Epsilon Associates Inc.

NO_x emissions will be controlled by the use of water injection and SCR to limit NO_x emissions to 2.5 parts per million, volumetric dry corrected to 15% O_2 (ppmvd)[5] when firing on gas and to 5.0 ppmvd when firing on ULSD oil. CO emissions will be controlled to 5.0 ppmvd when firing gas or ULSD by combustion controls and an oxidation catalyst. VOC emissions will be controlled to a maximum of 2.5 ppm when firing gas or 4.5 ppm when firing ULSD via combustion controls and an oxidation catalyst. PM_{10}/$PM_{2.5}$ emissions will be limited to 0.009-0.012 lb/MMBtu when firing natural gas and 0.027-0.051 lb/MMBtu when firing ULSD.

For each turbine, the SCR system and the oxidation catalyst are housed in an insulated steel enclosure. As shown on Figure 2-9, the enclosure is expected to be approximately 30 feet in length and 22 feet in height. Exhaust gases from the gas turbine pass through the catalyst beds, and then exit via the exhaust stack. The Watson Station will have two 100 foot tall steel stacks.

2.1.4 Water Supply and Demineralization System

The Rolls-Royce Trent 60 WLE introduces demineralized water into the annular combustion system so as minimize the formation of nitrogen oxides. The Trent 60 is equipped with an online monitoring system which allows for a reduction in water usage due to changes in power demand and ambient conditions while continuing to maintain the desired NO_x levels at the turbine exhaust (25 ppm).

Water from the Town of Braintree municipal system will be used to supply a 400 gallon per minute (gpm) trailer-mounted demineralization system. The high purity treated water will be stored in a 400,000 gallon demineralized water storage tank until it is needed. As necessary, the trailer-mounted demineralization system will be removed from the site and replaced by a fresh system. The spent demineralization system will be regenerated at an offsite commercial facility and subsequently reused. At expected load conditions, the demineralizer system will be removed/replaced on a weekly basis.

The proposed Watson Station will use approximately 137,000 gallons per day (gpd) of water when operating under high-demand summer load conditions (two Rolls-Royce Trent 60 combustion turbines at 100% load for 16 hours per day, with evaporative coolers in operation). Demineralized water requirements for the new facility will be considerably lower on an expected annual average basis. Other plant water uses will be minor (control building rest rooms, periodic maintenance wash water). The Town of Braintree Department of Public Works has indicated that the Town system has sufficient capability to provide the water required for operation of the Watson power project.

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[5] All concentration based emissions for turbines are assumed to be corrected to 15%O_2.

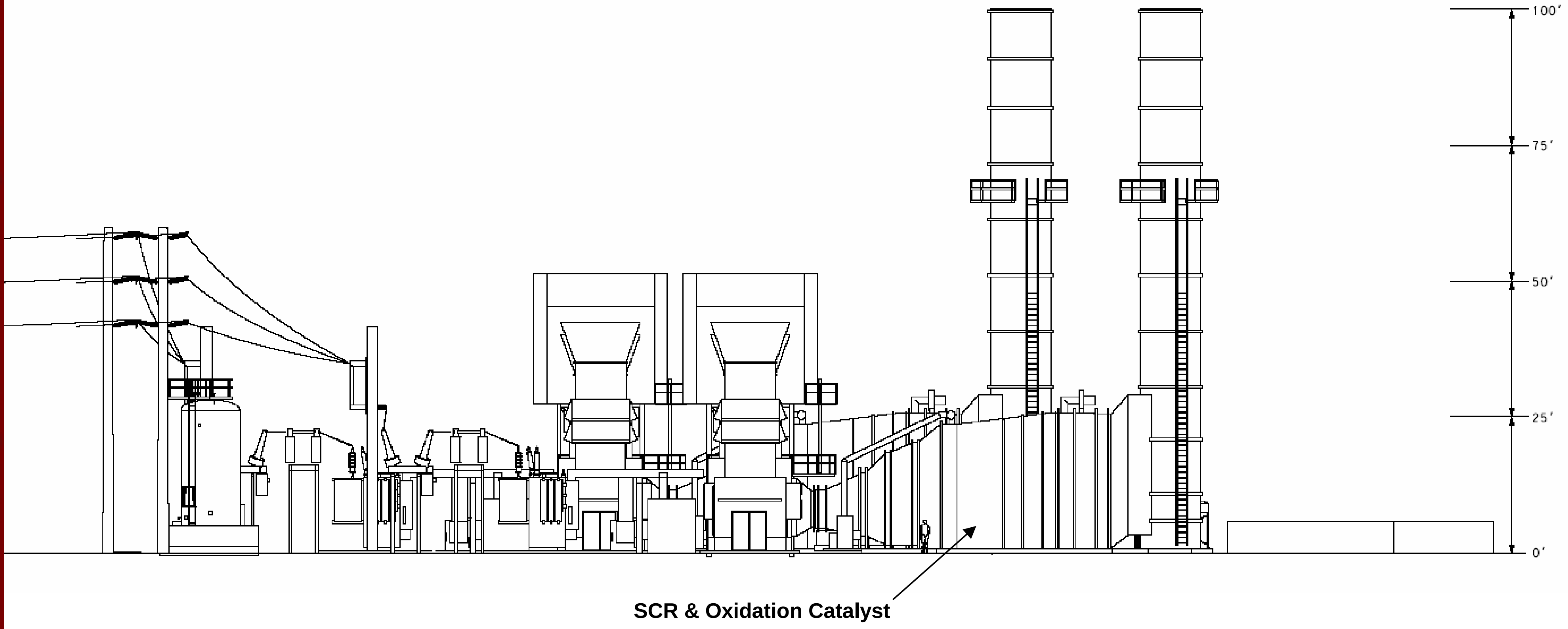

Figure 2-9
SCR System and Oxidation Catalyst

Thomas A. Watson Generating Station
Braintree, Massachusetts

Source: CH2MHILL

Epsilon ASSOCIATES INC.

2.1.5 Aqueous Ammonia Storage

Aqueous ammonia, a water solution containing up to 19% ammonia by weight, is the reagent used in the SCR system. In the presence of a catalyst, ammonia (NH_3) selectively reacts with nitrogen oxides (NO_2, NO) to form water (H_2O) and nitrogen gas (N_2), the primary component of the Earth's atmosphere.

The aqueous ammonia storage tank will have a capacity of approximately 15,000 gallons. This represents about 30 days of storage at the maximum usage rate. This tank size will allow BELD to accept full trailer deliveries (typically 6,000 gallons) thus minimizing the number of deliveries required each year. Aqueous ammonia can be supplied from Borden & Remington Chemicals in Fall River, MA (which currently supplies the Fore River Generating Station) or by other suppliers.

The vertical tank will be approximately 25 feet in height and will be placed in a full capacity (110%) concrete dike. The dike will include a layer of small floatable spheres so as to minimize exposed surface area in the event of a leak or spill. This is a standard mitigation measure for aqueous ammonia storage tanks. The truck offloading area will be properly curbed with a sump to contain any spill during unloading.

2.1.6 Facility Noise Control Features

In addition to full acoustical enclosures for the gas turbines and the generators, the Watson Station will be equipped with a full complement of acoustical controls. These controls will include combustion air inlet silencers, multi layer insulation for the SCR/oxidation catalyst enclosure, additional silencing within the SCR enclosure, gas turbine exhaust silencers, and an acoustically treated building to house the natural gas compressors. A complete discussion of the expected noise control features and their effectiveness in limiting noise at the nearest residences is provided in Section 7.

2.2 Emissions Summary

2.2.1 Criteria Emissions

The proposed emissions rates and annual potential emissions from the Watson Station are summarized in Table 2-1. The potential emissions are calculated based on 8,760 hours per year of full load operation, (5,880 hours on natural gas and 2,880 hours on ULSD). The conservatively assumed sulfur content of natural gas (0.8 gr/ccf) is higher than the sulfur content of ULSD (15 ppm); therefore potential annual SO_2 emissions are conservatively calculated assuming that natural gas is fired 8,760 hours per year.

Facility emissions will be controlled to BACT/LAER levels. The facility proposes to use water injection and SCR to minimize NO_x emissions. Combustion controls and an Oxidation Catalyst will be used to minimize CO and Volatile Organic Compound (VOC) emissions.

Sulfur Dioxide (SO_2) and Particulate Matter (PM_{10} and $PM_{2.5}$) emissions will be controlled via the use of the cleanest fossil fuels, natural gas and ULSD. The full air pollution control technology analysis is presented in Section 4.

Table 2-1 BACT/LAER Emissions Summary, Watson Station

Fuel	Natural Gas		ULSD			
Pollutant	ppm[6]	lb/MMBtu	ppm[6]	lb/MMBtu	tpy	Method
NO_x	2.5	0.0091	5.0	0.019	58.8	Water injection and SCR
CO	5.0	0.011	5.0	0.012	53.5	Combustion Controls and Oxidation Catalyst
VOC	1.0-2.5	0.0013-0.0031	1.5-4.5	0.0020-0.0059	7.6	Combustion Controls and Oxidation Catalyst
$PM_{10}/PM_{2.5}$	NA	0.01-0.02	NA	0.03-0.05	72.9	Use of natural gas and Ultra Low Sulfur Distillate (ULSD)
SO_2	NA	0.0024[7]	NA	0.0015[8]	11.5	Use of natural gas and ULSD.

In concert with the commissioning of the proposed Watson Station, BELD has committed to use ULSD at the existing 95 MW Potter II combined-cycle unit. ULSD has a sulfur content of 0.0015% (15 ppm) as opposed to the current 0.3% (3,000 ppm) distillate used at Potter II. Accordingly, the facility's **potential** and **permitted** SO_2 emissions will be reduced from 1,337 tpy to 40 tpy[9]. As summarized in Table 3-2, **actual** SO_2 emissions from Potter II firing 0.3% sulfur distillate and natural gas have been approximately 62 tons per year in recent years.

Potter II's potential, permitted and proposed permitted emissions are summarized in Table 2-2.

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[6] All turbine emissions reported in ppm are in units of ppmvd @ 15% O_2.

[7] Emission rate conservatively assumes 0.8 gr/ccf sulfur content. The sulfur content in the Algonquin pipeline has never been greater than 0.5 gr/ccf resulting in a conservative estimate of SO_2 emissions for the proposed Watson Station.

[8] Emission rate uses ULSD sulfur content of 15 ppm.

[9] 40 tpy potential/permitted SO_2 emission rate based on 8760 hours per year operation, conservatively firing natural gas with an assumed sulfur content of 3 gr/ccf (per BELD's current operating permit).

Table 2-2 Potter II Emissions Summary (existing 95 MW combined-cycle unit)

Pollutant	Potential Emissions, tpy	Current Permitted Emissions, tpy	Proposed Permitted Emissions, tpy
NO_x	2,029	902	902
CO	655	655	655
VOC	10	10	10
$PM_{10}/PM_{2.5}$	523	523	523
SO_2	1,337	1,337	40

As an existing facility, Potter II is subject to Reasonably Achievable Control Technology (RACT) standards. Under RACT, permitted emissions for NO_x are 42 ppm (0.155 lb/MMBtu) when firing natural gas and 65 ppm (0.253 lb/MMBtu) when firing oil. As Potter II's tested emissions are somewhat higher (approximately 0.22 lb/MMBtu when firing natural gas and 0.47 lb/MMBtu when firing oil), BELD has elected to achieve compliance with its NO_x RACT emission limits by purchasing the necessary emission offsets.

Potter II's actual emissions are summarized in Section 3.1 with respect to Nonattainment New Source Review (NSR) and Prevention of Significant Deterioration (PSD) requirements.

2.2.2 Non-Criteria Emissions

The proposed emissions rates and annual potential non-criteria pollutant emissions from the Watson Station are summarized in Tables 2-3 (Hazardous Air Pollutants) and 2-4 (Other Non-Criteria Pollutants). Identical assumptions were made for full load operation. In the case where the natural gas emission rate is higher than the ULSD emission rate, the natural gas rate is assumed for 8,760 hours per year.

Table 2-3 Non-Criteria Emission Rates (Hazardous Air Pollutants)

Emissions	Natural Gas			ULSD			Maximum
Units	lb/MMBtu[1]	lb/hr[2]	tpy	lb/MMBtu[1]	lb/hr[2]	tpy	tpy
1,3-Butadiene[3]	4.3E-07	4.7E-04	0.002	1.6E-05	1.7E-02	0.025	0.026
Acetaldehyde	4.0E-05	4.4E-02	0.19				0.19
Acrolein	6.4E-06	7.0E-03	0.03				0.03
Benzene	1.2E-05	1.3E-02	0.057	5.5E-05	5.9E-02	0.085	0.12
Ethylbenzene	3.2E-05	3.5E-02	0.15				0.15
Formaldehyde	7.1E-04	7.7E-01	3.39	2.8E-04	3.0E-01	0.432	3.39
Naphthalene	1.3E-06	1.4E-03	0.0062	3.5E-05	3.7E-02	0.054	0.058
PAH	2.2E-06	2.4E-03	0.01	4.0E-05	4.3E-02	0.062	0.07
Propylene oxide[3]	2.9E-05	3.2E-02	0.14				0.14
Toluene	1.3E-04	1.4E-01	0.62				0.62
Xylenes	6.4E-05	7.0E-02	0.31				0.31
Arsenic[4]				1.1E-05	1.2E-02	0.017	0.017
Beryllium[3]				3.1E-07	3.3E-04	0.0005	0.0005
Cadmium				4.8E-06	5.1E-03	0.007	0.007
Chromium				1.1E-05	1.2E-02	0.017	0.017
Lead				1.4E-05	1.5E-02	0.022	0.022
Manganese				7.9E-04	8.5E-01	1.218	1.22
Mercury				1.2E-06	1.3E-03	0.002	0.002
Nickel[3]				4.6E-06	4.9E-03	0.007	0.007
Selenium[3]				2.5E-05	2.7E-02	0.039	0.04
Total HAPs							6.44
Maximum HAP							3.39

1) Emission factors are, except where noted, from AP-42, 4/2000.

2) Maximum hourly emission rate based on oil-firing 100% Load, 59°F ambient temperature, gas-firing based on 100% load, 59ºF.

3) Compound was listed as “not detected” in AP-42. The emission factor denotes one-half the detection limit.

4) Arsenic emissions were based on a Survey of Ultra-Trace Metals in Gas Turbine Fuels, by Rising, Wu and Sorurbakhsh, presented at the 11th Annual International Petroleum Environmental Conference, Oct 12-15, 2004. The paper can be found at: http://ipec.utulsa.edu/Conf2004/Papers/rising_wu_sorurbakhsh.pdf

The emission rates for total Hazardous Air Pollutants (HAPs) are less than 25 tons per year and each individual HAP is less than 10 tons per year. Therefore, the facility is a minor source of HAPs.

Table 2-4 Other Non-Criteria Emission Rates

Emissions	Natural Gas			ULSD			Maximum
Units	lb/MMBtu	lb/hr[1]	tpy	lb/MMBtu[1]	lb/hr[2]	tpy	tpy
Ammonia[2]	6.7E-03	7.32	32.08	7.1E-03	7.64	11.00	32.53
Sulfuric Acid[3]	2.6E-03	2.81	12.29	1.6E-03	1.74	2.50	12.29

[1] Maximum hourly emission rate based on oil-firing 100% Load, 59°F ambient temperature, gas-firing based on 100% load, 59ºF.

[2] Ammonia is based on 5.0 ppmvd corrected to 15% O_2 (ammonia slip) on natural gas and ULSD.

[3] Sulfuric Acid is derived based on a nominal 70 percent conversion of sulfur in fuel to SO_3 by oxidation over the combustion turbine and CO catalyst (if any), and SCR catalyst. It is further conservatively assumed that 100% if the SO_3 converts to $H_2 SO_4$ rather than to ammonium sulfate salts or remaining SO_2.