Epsilon
ASSOCIATES INC.

May 13, 2016

Secretary Matthew A. Beaton
Executive Office of Energy & Environmental Affairs
Attn: Alexander Strysky
100 Cambridge Street, Suite 900
Boston, MA 02114

Subject: Single Environmental Impact Report – MIT Central Utilities Plant Second Century Project, EEA#15453

Dear Secretary Beaton:

On behalf of the Massachusetts Institute of Technology, enclosed please find the Single Environmental Impact Report (EEA#15453) for MIT's Central Utilities Plan Second Century Project proposed in Cambridge, Massachusetts.

Please notice the SEIR in the *Environmental Monitor* to be published on May 25, 2016. The Public Comment period will extend through June 24, 2016, and the Certificate will be issued on July 1, 2016.

By copy of this letter, I am advising recipients of the SEIR that written comments may be filed during the comment period, sent to the address above.

Copies of the SEIR may be obtained from Epsilon Associates at (978) 897-7100, or via e-mail at csnowdon@epsilonassociates.com.

Thank you for your attention to this matter.

Sincerely,

EPSILON ASSOCIATES, INC.

A.J. Jablonowski, PE
Principal

Enclosure

cc: Circulation List

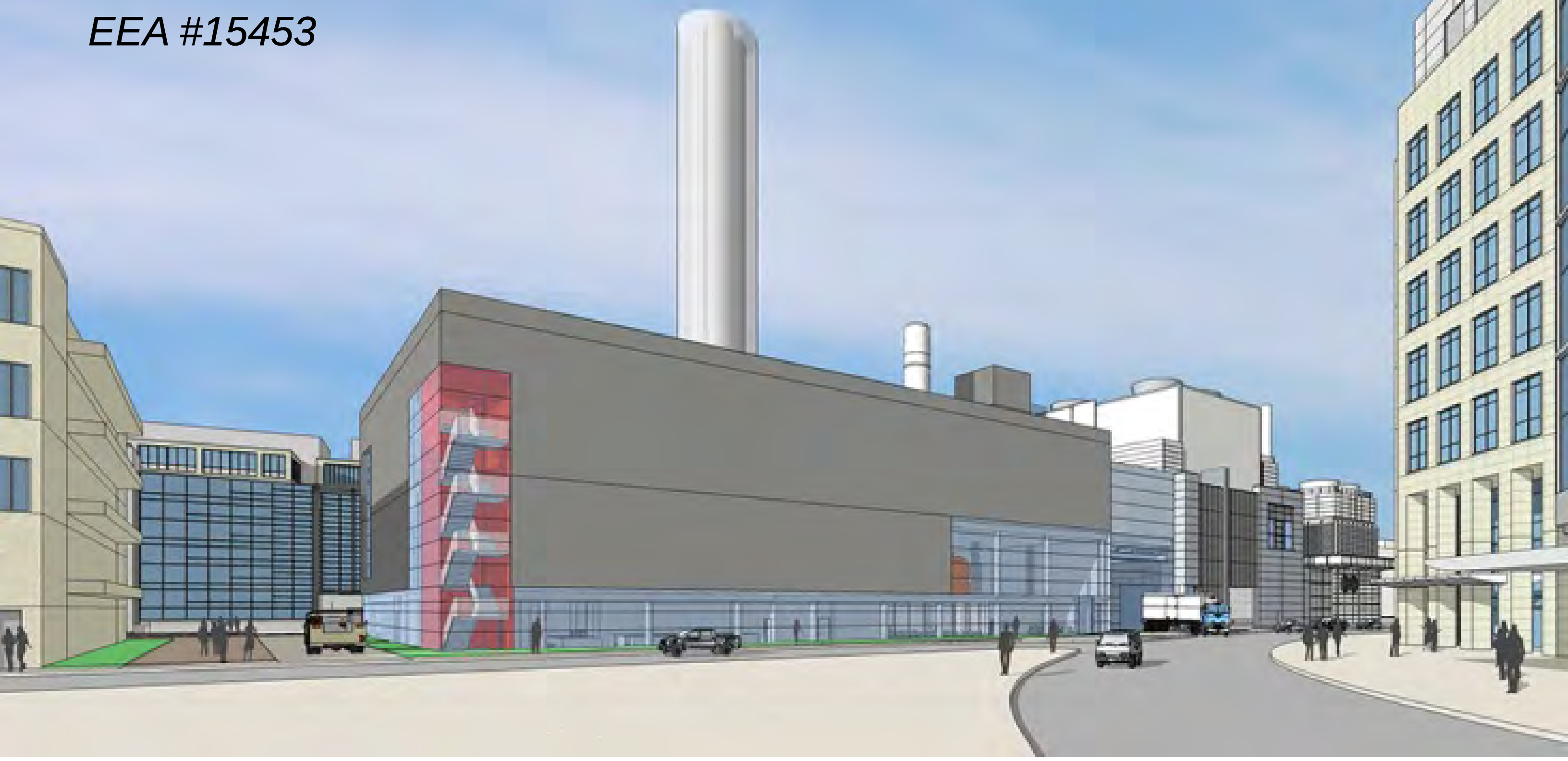
3 Clock Tower Place, Suite 250
Maynard, MA 01754
www.epsilonassociates.com

978 897 7100
FAX 978 897 0099

Massachusetts Institute of Technology

Central Utilities Plant Second Century Project

EEA #15453



Single Environmental Impact Report
EEA #15453

Submitted to:
EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS
MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Submitted by:
MASSACHUSETTS INSTITUTE OF TECHNOLOGY
Building NE49, 2nd Floor
600 Technology Square
Cambridge, MA 02139

Prepared by:
EPSILON ASSOCIATES, INC.
3 Clock Tower Place, Suite 250
Maynard, MA 01754

In Association with:
R.G. VANDERWEIL ENGINEERS, LLP
ACENTECH INC.

May 13, 2016

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1.0 OVERVIEW AND DESCRIPTION

1.1 Project Overview

1.1.1 Combustion Turbine Upgrade

The Massachusetts Institute of Technology (MIT) is located on 168 acres that extend more than a mile along the Cambridge side of the Charles River Basin. The upgraded MIT Central Utilities Plant (CUP) has been designed to provide near 100 percent reliability through maintaining standby units at all times, as the heat and electrical power generated is used to maintain critical research facilities, laboratories, classrooms and dormitories. The CUP provides electricity, steam heat, and chilled water to more than 100 MIT buildings.

The existing CUP consists of a Siemens (ABB) GT10A Combustion Turbine (CT), heat recovery steam generator (HRSG), electric generator rated at approximately 21 megawatt (MW), and ancillary equipment that started up circa 1995 located in Building 42. It also includes five existing boilers, designated Boilers 3, 4, 5, 7 and 9, an emergency generator, and a number of cooling towers. The CT provides about 60 percent of current campus electricity, and the steam from the HRSG is used for heating and steam driven chillers for cooling (cogeneration) many campus buildings via steam and chiller water distribution systems.

MIT has retained Epsilon Associates Inc. (Epsilon) of Maynard, Massachusetts to prepare an air permit application for its proposed development of two nominal 22 MW CTs with supplemental gas-fired (134 million Btu per hour [MMBtu/hr] higher heating value [HHV]) HRSGs and other proposed changes to the CUP (the Project).

1.2 Project Description

1.2.1 Project Site

MIT is a world-class educational institution which admitted its first students in 1865. Teaching and research—with relevance to the practical world as a guiding principle—continue to be its primary purpose. MIT is independent, coeducational, and privately endowed. Its five schools and one college encompass numerous academic departments, divisions, and degree-granting programs, as well as interdisciplinary centers, laboratories, and programs whose work cuts across traditional departmental boundaries.

MIT is an academic and research facility, and has steam and electricity reliability needs that exceed those of typical industrial facilities. The MIT CUP has been designed to provide near 100 percent reliability through maintaining standby units at all times, as the heat and electrical power generated is used to maintain critical research facilities, laboratories, classrooms and dormitories in the event of a power outage, gas curtailment, or other emergency.

The existing CUP is housed in Building 42 (N16, N16A, N16C and 43) which is located between Vassar Street and Albany Street in Cambridge, MA, as shown in Figure 1-1.

Table 1-1 describes the key equipment at the CUP, and lists the equipment designation abbreviations used in the operating permit (Application MBR-95-OPP-026). An existing conditions site plan is provided as Figure 1-2.

Table 1-1 Key Existing Equipment at the MIT Plant

Turbine #1	ABB GT10 (GT-42-1A) and Heat Recovery Steam Generator #1 (HRSG-42-1B) (collectively the Cogeneration Unit)
Boiler #3	Wickes 2 drum type R dual fuel (BLR-42-3)
Boiler #4	Wickes 2 drum type R dual fuel (BLR-42-4)
Boiler #5	Riley type VP dual fuel (BLR-42-5)
Generator #01	Emergency Diesel Generator Caterpillar #3516B 2MW (DG-42-6)
Boiler #7	Indeck Dual Fuel BLR-42-7
Boiler #9	Rentech Boiler rated at 125 MMBtu/hr firing natural gas with Ultra Low Sulfur Diesel (ULSD) backup (BLR-42-9)
Cooling Towers	Wet mechanical towers #1,2,3,4,5,6,7,8,9,10.

The CUP provides energy (electricity, heating, and/or cooling) to the buildings listed in Table 1-2, below. Building locations are shown on the campus map, Figure 1-3.

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

MIT CUP Second Century Project **Cambridge, Massachusetts**

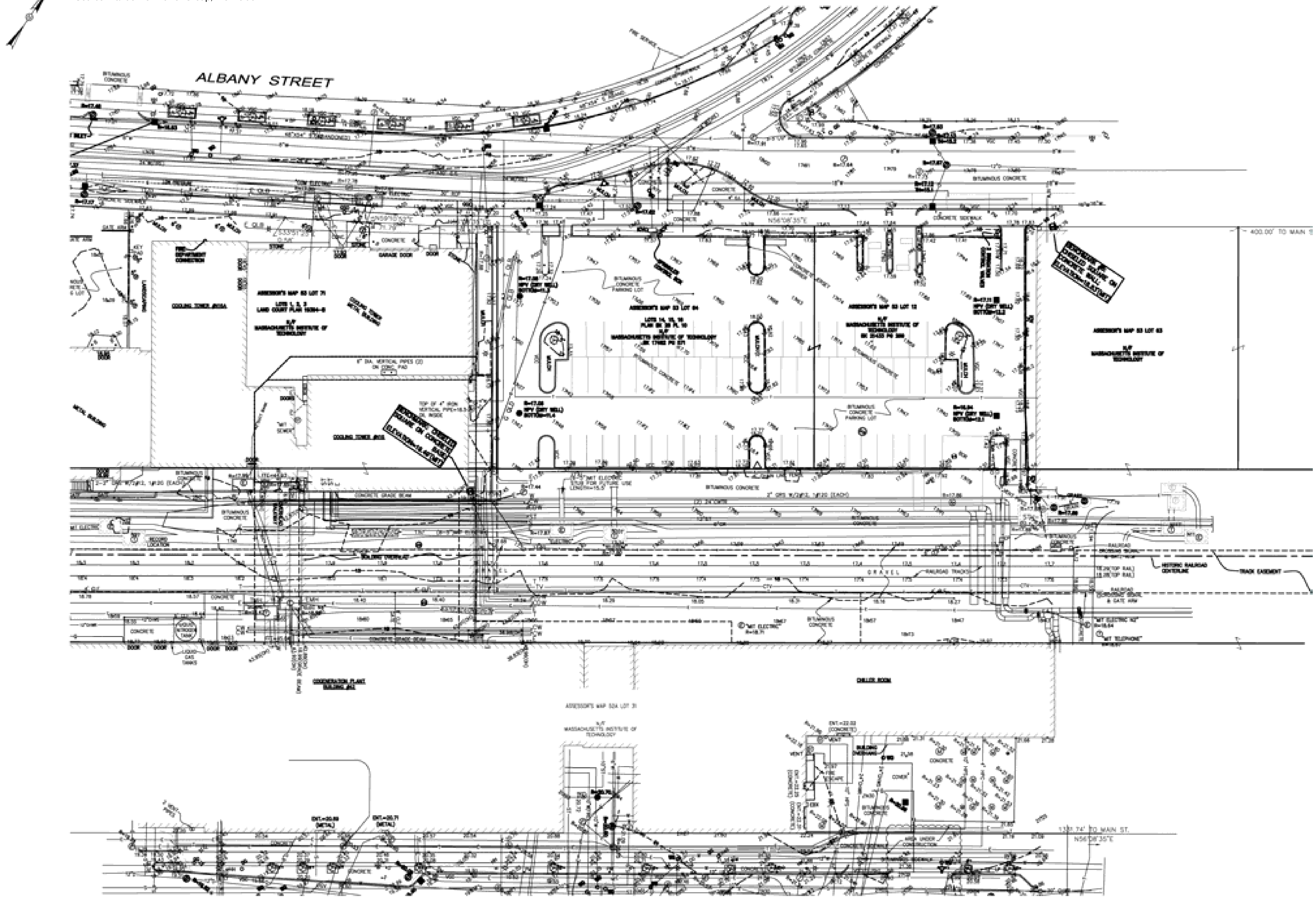
Massachusetts Institute of Technology

Epsilon

Figure 1-1

Aerial Locus Map

Source: Vanderweil Power Group, Kleinfelder



MIT CUP Second Century Project Cambridge, Massachusetts

Figure 1-2

Existing Conditions Site Plan

Table 1-2 Buildings Served by MIT Plant

Building Number	*Building Name*	*Street Address*	*ELECTRICITY*	*HEATING*	*COOLING*
1	PIERCE LABORATORY	33 MASSACHUSETTS AVE	A	X	X
2	BUILDING 2	182 MEMORIAL DR	X	X	X
3	MACLAURIN BUILDINGS (3)	33 MASSACHUSETTS AVE (REAR)	X	X	X
4	MACLAURIN BUILDINGS (4)	182 MEMORIAL DR (REAR)	X	X	X
5	PRATT SCHOOL	55 MASSACHUSETTS AVE	X	X	X
6	EASTMAN LABORATORIES	182 MEMORIAL DR (REAR)	X	X	X
6B	SOLVENT STORAGE	182 MEMORIAL DR (REAR)	X	X	X
6C	BUILDING 6C	182 MEMORIAL DR (REAR)	X	X	X
7	WILLIAM BARTON ROGERS BUILDING	77 MASSACHUSETTS AVE	X	X	X
7A	ROTCH LIBRARY EXTENSION	77 MASSACHUSETTS AVE	X	X	X
8	BUILDING 8	21 AMES ST	X	X	X
9	SAMUEL TAK LEE BUILDING	105 MASSACHUSETTS AVE	X	X	X
10	MACLAURIN BUILDINGS (10)	222 MEMORIAL DR	X	X	X
11	HOMBERG BUILDING	77 MASSACHUSETTS AVE (REAR)	X	X	X
13	BUSH BUILDING	105 MASSACHUSETTS AVE (REAR)	X	X	X
14	HAYDEN MEMORIAL LIBRARY	160 MEMORIAL DR	X	X	X
16	DORRANCE BUILDING	21 AMES ST	X	X	X
17	WRIGHT BROTHERS WIND TUNNEL	76 VASSAR ST	X		X
18	DREYFUS BUILDING	21 AMES ST	X	X	X
24	BUILDING 24	60 VASSAR ST	X	X	X
26	COMPTON LABORATORIES	60 VASSAR ST	X	X	X
31	SLOAN LABORATORIES	70 VASSAR ST (REAR)	X	X	X
32	STATA CENTER	32 VASSAR ST	X	X	X
32P	STATA CENTER GARAGE	32 VASSAR ST	X	X	X
33	GUGGENHEIM LABORATORY	125 MASSACHUSETTS AVE	X	X	X
34	EG&G EDUCATION CENTER	50 VASSAR ST	X	X	X
35	SLOAN LABORATORY	127 MASSACHUSETTS AVE	X	X	X
36	FAIRCHILD BUILDING (36)	50 VASSAR ST	X	X	X
37	MCNAIR BUILDING	70 VASSAR ST	X	X	X
38	FAIRCHILD BUILDING (38)	50 VASSAR ST	X	X	X
39	BROWN BUILDING	60 VASSAR ST	X	X	X

Table 1-2 Buildings Served by MIT Plant (Continued)

Building Number	*Building Name*	*Street Address*	*ELECTRICITY*	*HEATING*	*COOLING*
41	BUILDING 41	77 VASSAR ST	X	X	X
42	COGENERATION PLANT	59 VASSAR ST	X	X	X
43	POWER PLANT ANNEX	57 VASSAR ST	X	X	X
44	CYCLOTRON	51 VASSAR ST	X		X
46	BCSC	43 VASSAR ST	X		
48	PARSONS LABORATORY	15 VASSAR ST	X	X	X
50	WALKER MEMORIAL	142 MEMORIAL DR	X		X
51	WOOD SAILING PAVILION	134 MEMORIAL DR	X		X
54	GREEN BUILDING	21 AMES ST	X	X	X
56	WHITAKER BUILDING	21 AMES ST	X	X	X
57	MIT ALUMNI POOL	6 VASSAR ST	X		X
62	ALUMNI HOUSES: MUNROE HAYDEN WOOD	3 AMES ST (REAR)	X		X
64	EAST CAMPUS: WALCOTT BEMIS GOODALE	3 AMES ST	X		X
66	LANDAU BUILDING	25 AMES ST	X	X	X
68	KOCH BIOLOGY BUILDING	31 AMESST	X	X	X
76	D H KOCH IN FICR	500 MAIN ST	X	X	X
E1	GRAY HOUSE	111 MEMORIAL DR	X		X
E2	SENIOR HOUSE	4 AMES ST	X	X	X
E14	BUILDING E14	75 AMHERST ST	X	X	X
E15	WIESNER BUILDING	20 AMES ST	X	X	X
E17	MUDD BUILDING	40 AMES ST	X	X	X
E18	FORD BUILDING (E18)	50 AMESST	X	X	X
E19	FORD BUILDING (E19)	400 MAIN ST	X	X	X
E23	HEALTH SERVICES	25 CARL ETON ST	X	X	X
E25	WHITAKER COLLEGE	45 CARLETON ST	X	X	X
E33	RINALDI TILE	34 CARLETON ST	X		X
E34	BUILDING E34	42-44 CARLETON ST	X	X	X
E38	SUFFOLK BUILDING	292 MAIN ST	X	X	X
E40	MUCKLEY BUILDING	1 AMHERST ST	X	X	X
E51	TANG CENTER	70 MEMORIAL DR	X	X	X
E52	SLOAN BUILDING	50 MEMORIAL DR	X	X	X
E53	HERMANN BUILDING	30 WADSWORTH ST	X	X	X
E55	EASTGATE	60 WADSWORTH ST	X	X	X
E60	ARTHUR D LITTLE BUILDING	30 MEMORIAL DR	X		
E62	BUILDING E62	100 MAIN ST	X		
N4	ALBANY GARAGE	32 ALBANY ST	X		X
N9	SUPERCONDUCTING TEST FACILITY	68 ALBANY ST	X		X

Table 1-2 Buildings Served by MIT Plant (Continued)

Building Number	Building Name	Street Address	ELECTRICITY	HEATING	COOLING
N10	HIGH VOLTAGE RESEARCH LAB	155 MASSACHUSETTS AVE	X		X
N16	COOLING TOWER & OIL RESERVE	60 ALBANY ST	X		
N16A	BUILDING N16A	60 ALBANY ST	X		
N16B	FIRE PUMP ROOM	60 ALBANY ST	X		
N16C	BUILDING N16C	60 ALBANY ST	X		
W1	FARIBORZ MASEEH HALL	305 MEMORIAL DR	X		X
W2	BUILDING W2	311 MEMORIAL DR	X	X	X
W4	MCCORMICK HALL	320 MEMORIAL DR	X	X	X
W5	GREEN HALL	350 MEMORIAL DR	X		
W7	BAKER HOUSE	362 MEMORIAL DR	X	X	X
W8	PIERCE BOATHOUSE	405 MEMORIAL DR	X		X
W15	MIT CHAPEL	48 MASSACHUSETTS AVE (REAR)	X	X	X
W16	KRESGE AUDITORIUM	48 MASSACHUSETTS AVE (REAR)	X	X	X
W20	STRATTON STUDENT CENTER	84 MASSACHUSETTS AVE	X	X	X
W31	DU PONT ATHLETIC GYMNASIUM	120 MASSACHUSETTS AVE	X		X
W32	DU PONT ATHLETIC CENTER	100 MASSACHUSETTS AVE	X	X	X
W33	ROCKWELL CAGE	106 VASSAR ST	X	X	X
W34	JOHNSON ATHLETICS CENTER	120 VASSARST	X	X	X
W35	SPORTS & FITNESS CENTER	120 VASSAR ST	X	X	X
W45	WEST GARAGE	125 VASSARST	X		X
W51	BURTON-CONNER HOUSE	410 MEMORIAL DR	X		X
W53	CARR INDOOR TENNIS FACILITY	410 MEMORIAL DR (REAR)	X		X
W53A	CARR INDOOR TENNIS FACILITY (OFFICE)	410 MEMORIAL DR (REAR)	X		X
W53B	DUPONT TENNIS COURTS (OFFICE)	410 MEMORIAL DR (REAR)	X		X
W53C	BUILDING W53C	410 MEMORIAL DR (REAR)	X		X
W53D	CARR INDOOR TENNIS FACILITY(SVC)	410 MEMORIAL DR (REAR)	X		X
W56	BUILDING W56	1 69 VASSAR ST	X		
W57	BUILDING W57	169 VASSAR ST	X		
W57A	BUILDING W57A	1 69 VASSAR ST	X		
W61	MACGREGOR HOUSE	450 MEMORIAL DR	X	X	X

Table 1-2 Buildings Served by MIT Plant (Continued)

Building Number	*Building Name*	*Street Address*	*ELECTRICITY*	*HEATING*	*COOLING*
W70	NEW HOUSE	471-476 MEMORIAL DR	X	X	X
W71	NEXT HOUSE	500 MEMORIAL DR	X	X	X
W79	SIMMONS HALL	229 VASSAR ST	X	X	X
W84	TANG HALL	550 MEMORIAL DR	X	X	X
W85	WESTGATE	540 MEMORIAL DR (REAR)	X	X	X
W85ABC	WESTGATE (ABC)	11-13-15 AUDREY ST	X	X	X
W85DE	WESTGATE (DE)	292-290 VASSAR ST	X	X	X
W85FG	WESTGATE (FG)	286-284 VASSAR ST	X	X	X
W85HJK	WESTGATE (HJK)	282-280-278 VASSAR ST	X	X	X
W91	INFORMATION SYSTEMS OPERATIONS	565-570 MEMORIAL DR	X		X

1.2.2 Proposed Project

MIT's upgraded cogeneration facility utilizes natural gas to power two turbine engines that produce heat and spins shafts that drive electrical generators. The waste heat from the turbine engine is converted to steam that is used to heat buildings, heat water, and chill water. Electricity from the generator is used for campus electrical needs and centralized chilled water generation. The chilled water plant can utilize electricity, steam from the waste heat, or both.

A combined heat and power (CHP) system has significant efficiency and environmental advantages, as described by the Massachusetts Department of Environmental Protection (MassDEP)[1]:

> *"In a CHP system, the engine or combustion turbine is connected to an electrical generator for electrical power production. The hot exhaust gasses from the engine or combustion turbine are directed through a heat recovery system, such as a boiler, to recover thermal energy for use in heating, cooling, or other uses. This approach eliminates the need for a second combustion unit and therefore eliminates the emissions such a combustion unit would produce. CHP systems make more efficient use of fuel, such as natural gas or fuel oil, than two, separate stand alone, combustion units, one for electricity and one for thermal energy such as steam thus reducing the net emissions of greenhouse gas and other air contaminants."*

The proposed Project consists of two nominal 22 MW Solar Titan 250 CT units fired primarily on natural gas. Backup ULSD will be used for up to the equivalent heat input of 48 hours per year for testing, and up to the equivalent heat input of 168 hours per year

[1] Proposed Amendments to 310 CMR 7.00, March 2008

Figure 1-3

Campus Map

per turbine including testing and periods when natural gas is unavailable. Each turbine will exhaust to its own HRSG with a 134 MMBtu/hr HHV gas-fired duct burner. The HRSG will include SCR for NOx control and an oxidation catalyst for CO and VOC control.

Under normal operations, both the new CTs and HRSGs provide steam, medium temperature hot water (MTHW), and electricity to the campus year-round. Gas compressors will be used to boost the main pressure of the gas supplying the CTs and will be modulated through variable frequency drives (VFDs) to minimize parasitic loads and take advantage of the highest street pressure available. MTHW secondary economizer coils (with an install capacity of approximately 16 MMBtu / hour per unit) on the HRSGs will harvest low grade heat to offset steam currently used to heat buildings on campus. This heat will be harvested whenever the CTs are running.

The sizing of the cogeneration plant gas turbines and HRSGs has taken into account the MIT load growth projections. The existing boilers will serve as back-up capacity with the ability to supplement steam at peak load. MIT will continue to supplement and back up its utility operations with electricity from the grid.

Tables 1-3 and 1-4 below are based on a dispatch model that satisfies campus loads and the equipment utilization dispatched to meet loads. Additionally, the annual electric and thermal energy used is also presented.

Table 1-3 Equipment Utilization to Meet Anticipated Loads

Year	Total Run Time (2 CTs)	Percent of available operating hours utilized (2 CTs)	Percent of available waste heat utilized (2 CTs)
	(hours)		
2019	13,246	78%	93%
2020	13,160	77%	94%
2021	13,322	78%	94%
2022	14,216	84%	95%
2023	14,219	84%	95%
2024	14,219	84%	95%
2025	14,219	84%	95%
2026	14,219	84%	95%
2027	14,219	84%	95%
2028	14,219	84%	95%
2029	14,219	84%	96%
2030	14,360	84%	96%

Based upon Vendor Guarantee of 97% availability.

Table 1-4 Anticipated Annual Electric and Thermal Energy

Year	Total Generated Electricity	Steam Generated	Total CT Gas Usage	Total DB Gas Usage
	MW	MMBtu	MMBtu	MMBtu
2019	242,170	1,332,774	2,290,260	312,573
2020	249,648	1,327,743	2,322,499	296,872
2021	254,064	1,344,244	2,359,125	297,732
2022	273,880	1,446,257	2,537,015	324,255
2023	273,964	1,446,663	2,537,725	324,375
2024	273,964	1,446,663	2,537,725	324,375
2025	273,964	1,446,663	2,537,725	324,375
2026	273,964	1,446,663	2,537,725	324,375
2027	273,964	1,446,663	2,537,725	324,375
2028	273,964	1,446,663	2,537,725	324,375
2029	277,368	1,448,187	2,561,783	318,208
2030	281,140	1,468,108	2,594,771	324,982

In their first year of operation (2019-2020), the two CTs are projected to operate 78 percent of the time to meet MIT campus load requirements. That percentage is projected to remain constant or increase slightly over the 20-year life of the system. When the CTs are operating, the HRSGs are projected to satisfy 93 percent of the campus's thermal load during the first year of operation. That percentage is projected to remain constant or increase slightly over the 20-year life of the system. The Project is right-sized for the MIT campus load and is not designed to reserve capacity for redundancy of the entire campus.

In addition to the two new CTs, MIT plans to add a 2- MW ULSD-fired cold start engine unit to be used to start the turbines in emergency conditions.

The Project also includes the following:

- Existing Boilers 3, 4, and 5 will cease burning #6 fuel oil and only burn natural gas, with ULSD as a backup fuel for up to the equivalent heat input of 48 hours per year for testing, and up to the equivalent heat input of 168 hours per year including testing and periods when natural gas is unavailable.

- Existing Boilers 7 and 9 will fire natural gas only, with ULSD as a backup fuel for up to the equivalent heat input of 48 hours per year for testing, and up to the equivalent heat input of 168 hours per year including testing and periods when natural gas is unavailable. MIT proposes removal of the annual operating restrictions for Boilers 7 and 9, to allow more use of these efficient resources.

The fuel changeover to ULSD from #6 oil will occur within 12 months of the startup of the new CTs. This will allow for adequate time to finish construction and remove the old tanks to allow for new fuel storage to be built. Once the Project's additional ULSD storage tanks are installed, #6 oil will be eliminated from all MIT operations.

The existing boilers will be used to provide additional steam generating capacity to the CHP systems and to provide steam generating capacity when the CHP is offline (maintenance, repair, etc). Boilers 7 and 9 will be utilized first when additional steam generating capacity is required. Boilers 3, 4, and 5 will be used to satisfy any remaining load demands or backup needs. It is expected that with the current design for the Project, the boilers will provide less than one percent of the steam needs of the campus. MIT will continue to maintain enough boiler capacity to meet the campus' needs should the CTs not be available.

In conjunction with this Project, MIT is also replacing cooling towers 3 and 4 with three new cooling towers. Cooling towers 1, 2, 5, and 6 will be retired. Towers 7, 8, 9 and 10 will remain.

1.2.3 Exhaust Design Configurations

Emissions from the existing Boilers 3, 4 and 5 are vented out the brick stack on the roof of the CUP. The existing turbine 1 stack and the emergency generator stack are also located on the roof of the CUP. Existing Boilers 7 and 9 are located adjacent to Building N16A at 60 Albany Street, across the railroad tracks from the main CUP building. Exhaust from both Boiler #7 and Boiler #9 are combined and vent through a common stack.

The two new CTs with HRSGs and ancillary equipment will be located in an addition to Building 42 to be built in an existing parking lot along Albany Street between the cooling towers and an existing parking garage. The addition to the existing building would be approximately 184' x 118' by 63' above ground level (AGL) tall with two 167' AGL high flues centrally co-located in a common stack structure. There will be a flue for each turbine vented through its respective HRSG. The cold start engine flue will be located atop its housing (93.5' AGL).

Figure 1-4 shows the proposed Project layout. A detailed site plan of proposed conditions is provided as Figure 1-5. Additional drawings are provided in Appendix 1.

Project Schedule

Pending approvals, MIT intends to have the first CT operating in 2019, followed by the second unit in 2020. The existing Siemens CT will be fully retired following commissioning of the second unit. Other Project changes (cold start engine, cooling towers, Boilers 3, 4, and 5 fuel switch) will be scheduled through 2019 and early 2020. MIT proposes to increase allowable operating hours of the more efficient Boilers 7 and 9 immediately upon approval.

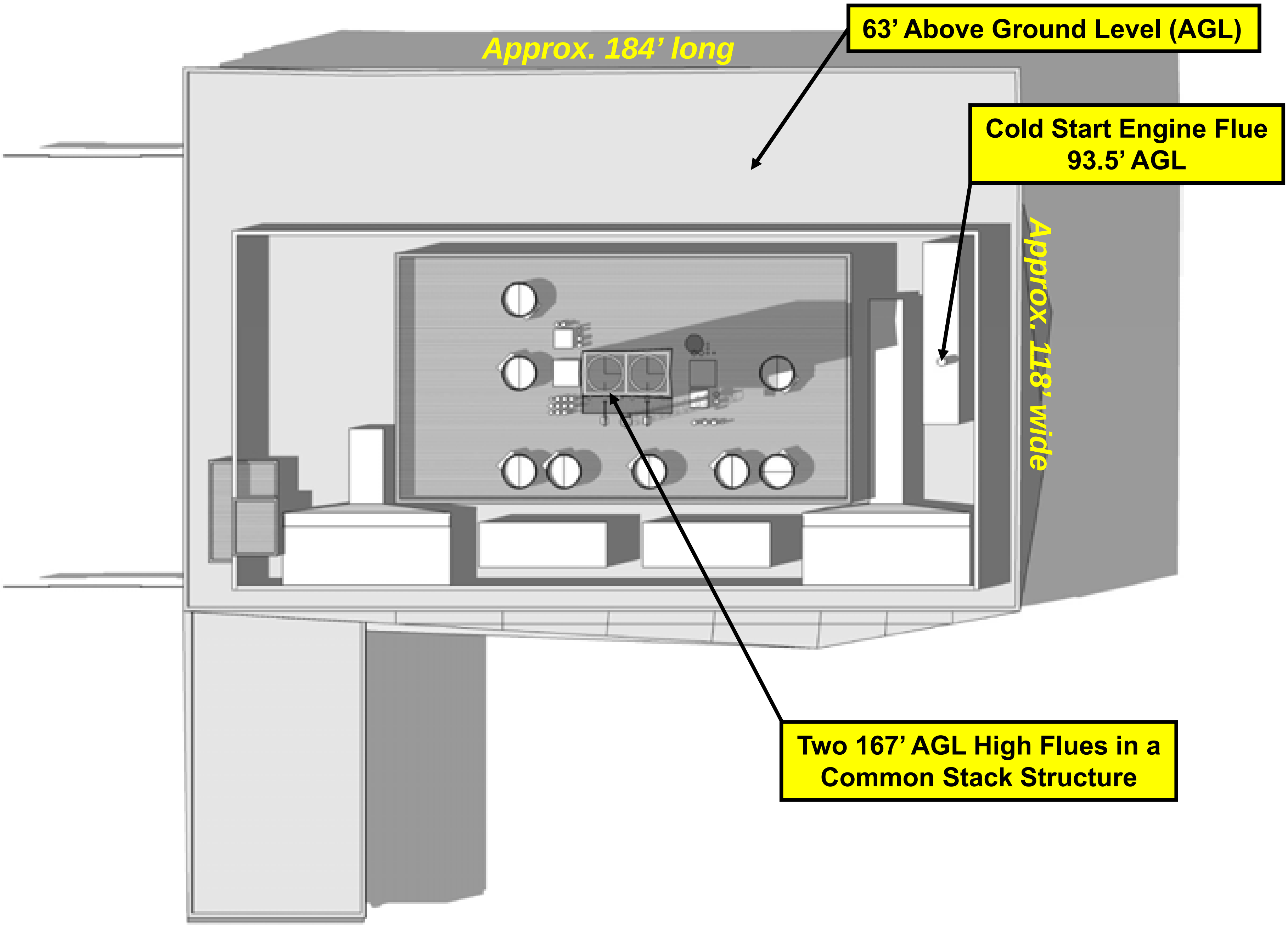
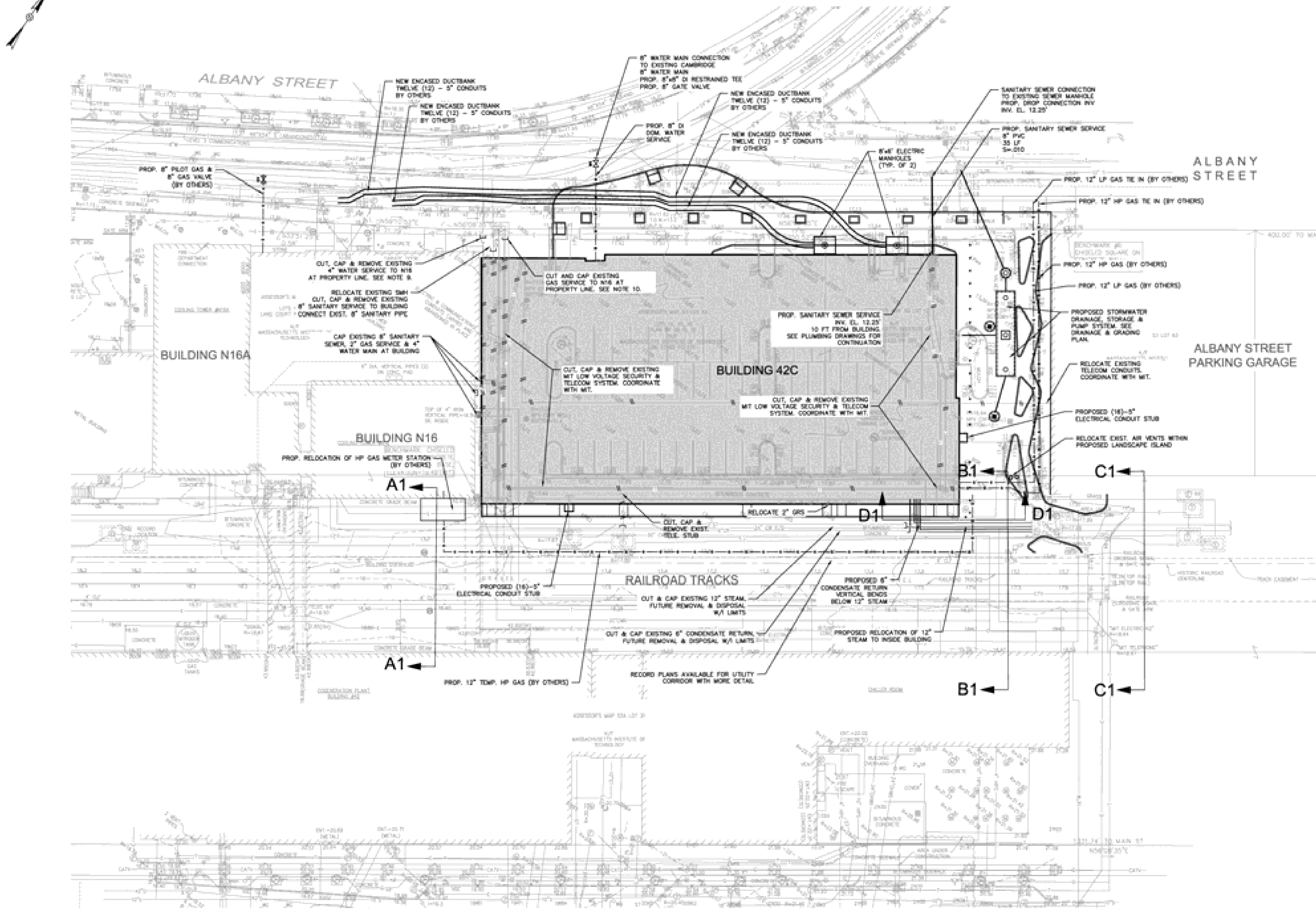


Figure 1-4

Proposed Project Layout

Source: Vanderweil Power Group, Kleinfelder



MIT CUP Second Century Project Cambridge, Massachusetts

Massachusetts Institute of Technology

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Figure 1-5

Proposed Utility Plan

1.3 MEPA History

1.3.1 Expanded Environmental Notification Form

An Expanded Environmental Notification Form (EENF) requesting the Secretary's approval of a Single Environmental Impact Report (SEIR) process was submitted for this Project on December 15, 2015. As detailed in the following section, publication of the EENF and open comment period took place in compliance with enhanced Environmental Justice standards, and a fact sheet describing the Project and how to obtain the EENF and provide comments was distributed in English, Spanish, Portuguese, Chinese, and French through local newspapers and the Cambridge Public Library Central Square Branch. On January 14, 2016, MEPA held a public scoping session at MIT with Spanish, Portuguese, Chinese (Cantonese), and French interpreters in attendance. On January 29, 2016, the Secretary issued a Certificate on the EENF allowing for an SEIR to be submitted in in lieu of a Draft and Final EIR. This document responds to the Certificate's scope and public comments provided.

1.3.2 Changes to Proposed Project

The EENF (at Subsection C-2.4) noted that the turbine selection was not final, and options were being considered for slightly smaller turbines. The EENF described the largest of the options being considered, and noted that other options would retain the same general configuration and operation. MIT has completed its review of options and identified the Solar Titan 250 turbines as optimal for the project. The slightly smaller CTs performed better on a modeled campus-wide GHG impact basis, because they allowed more hours of cogeneration (where fuel is fired into the CT to generate electricity, and heat from the turbine creates useful heat energy for the campus). This SEIR presents the use of Solar Titan 250 turbines as the preferred alternative.

A review of the alternative to provide summertime combustion air cooling has shown that, for the Solar Titan 250 CTs and expected hour-by-hour operation at MIT, the use of combustion air cooling does not show a GHG benefit. Similarly, wintertime combustion air heating does not show a GHG benefit with the updated Project configuration. These Project elements are therefore removed from the proposed GHG mitigation measures; the Project design will allow their retrofit in the future if appropriate.

This SEIR also clarifies that once the Project's additional ULSD storage tanks are installed, #6 oil will be eliminated from all MIT operations.

1.4 Applicable Regulatory Requirements

The Project will require the following State Agency Permits:

- Massachusetts Historical Commission: Determination of No Adverse Effect on Historic Properties;
- Department of Environmental Protection, Division of Air Quality Control: Major Comprehensive Plan Approval (MCPA); and

- ♦ Massachusetts Department of Transportation: Approval for building permit on land on or adjacent to railroad corridor (Chapter 40 §54A).

In addition to the permits identified above, under federal and state air laws, the MassDEP and the U.S. Environmental Protection Agency (EPA) have promulgated air quality regulations that establish ambient air quality standards and emission limits. These standards and limits impose design constraints on new facilities and provide the basis for an evaluation of the potential impacts of proposed projects on ambient air quality. This section briefly describes these regulations and their relevance to the proposed CHP expansion.

Regulatory requirements are summarized in Table 1-5.

Table 1-5 Summary of Applicable Requirements

Regulatory Program	Brief Description	Applicability
Ambient Air Quality Standards and Policies	Limitations on concentrations of specific criteria pollutants in public areas to protect public health and welfare.	Applies, and air quality dispersion modeling in the air plan approval process documents that the Project will not cause or significantly contribute to any violation of ambient air quality standards.
Prevention of Significant Deterioration (PSD) Review	PSD is designed to protect public health and welfare by ensuring that no major new sources or modifications to existing sources significantly decrease the quality of ambient air. PSD requires applicants to perform a Best Available Control Technology (BACT) analysis, an air quality analysis, and have public involvement in the approval process.	Applies and is the subject of a PSD air permit application.
Non-Attainment New Source Review	Requirements that apply to areas not in attainment with the Ambient Air Quality Standards. These requirements include the installation of the Lowest Achievable Emission Rate (LAER), emission offsets, and the opportunity for public involvement.	Does not apply because the Project does not have potential emissions of Non-Attainment Pollutants above regulatory thresholds.
New Source Performance Standards	Federal Air Pollution Emission Standards that establish what the acceptable level of pollution that new stationary sources can produce.	The CTs are subject to 40 CFR 60 Subpart KKKK. The cold-start emergency engine is subject to 40 CFR 60 Subpart Mil. Boilers 7 and 9 continue to be subject to 40 CFR 60 Subparts Dc and Db, respectively.
National Emission Standards for Hazardous Air Pollutants	Federal stationary source standards for hazardous air pollutants (HAPs). These standards cover HAPs that are not directly covered by the Ambient Air Quality Standards.	Subpart ZZZZ for cold-start engine.
Emissions Trading Programs	Program that sets a cap on emissions while also creating allowances to emit up to the cap. Sources can then buy or sell allowances or save them for use in future years. Sources can buy/trade allowances with other sources as well. Sources must hold enough allowances to cover their emissions.	The new CTs are subject to 310 CMR 7.32 as applicable. The new units are too small to be subject to the federal Acid Rain Program or the Regional Greenhouse Gas Initiative.
Visible Emissions	Massachusetts limits on the amount of visible emissions a source can emit, measured by opacity.	Applies and will be complied with.
Noise Control Regulation and Policy	Massachusetts limits on the amount of noise a source can generate above ambient levels.	Applies and is satisfied through the noise analysis in the air plan approval process.

Table 1-5 Summary of Applicable Requirements (Continued)

Regulatory Program	Brief Description	Applicability
Air Plan Approval	Requires sources to get approval for air emissions and obtain a permit to operate the source.	Applies and is satisfied through the air plan approval application.
Operating Permit	Facilities are required to hold an up to date operating permit from the governing body. This permit allows the facility to operate under certain limitations set forth by the governing body.	Applies and will be satisfied through an operating permit modification application after the air plan approval is issued.
Compliance Assurance Monitoring	Requires demonstration of compliance with applicable requirements for large emission units that rely on pollution control devices to achieve compliance with limitations.	Does not apply because the controlled pollutants will have continuous emissions monitoring.
Historic Railroad 40 §54A permit	Any construction project in Massachusetts that involves land formerly used by a railroad company or as a railroad right-of-way requires a local permit from MassDOT.	Applies and will be satisfied through a request for consent document, with a period of public review and comment.

Section 2.0

Environmental Justice

2.0 ENVIRONMENTAL JUSTICE

2.1 Introduction

On February 11, 1994, then President Clinton issued Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations."[2] This Executive Order was designed to ensure that each federal agency "make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations."

The assessment of environmental justice (EJ) considers the following:

- The areas in which the proposed Project may result in significant adverse environmental effects;
- The presence and characteristics of potentially affected minority and/or low-income populations ("communities of concern") residing in these study areas; and
- The extent to which these communities are disproportionately affected in comparison to the effects experienced by the population of the greater geographic area within which the affected area is located is determined.

Guidance documents define minorities as including American Indian or Alaskan natives, Asian or Pacific Islanders, Black, or Hispanic persons. For the purposes of this analysis, a community may be considered to have a minority population when the percentage of minorities in a study area is "meaningfully greater" than the minority percentage of the general population.

A community of concern can also be similarly identified by the presence of low-income populations within the affected study area. The existence of these populations can be identified using the poverty thresholds available from the U.S. census and a comparison to the general population sets the context for the assessment. Poverty level is defined by the U.S. Census Bureau, which considers a variety of factors including family size, number of children and the age of the householder.

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[2] Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations. Available from U.S. Environmental Protection Agency (EPA) at http://www.epa.gov/fedreg/eo/eo12898.htm.

Massachusetts has established the *Environmental Justice Policy of the Executive Office of Environmental Affairs*. Per that policy, the MEPA office and MassDEP must enhance public participation opportunities for projects that potentially affect populations that are low-income, minority, foreign-born, or lack English proficiency.

Per Figure 2-1, there are areas with minority populations and low-income populations in the vicinity of MIT. These areas were identified using the Massachusetts GIS online EJ mapping tool. Per the Massachusetts Office of Geographic Information[3]: "Polygons in the 2010 Environmental Justice (EJ) Populations layer represent areas across the state with high minority, non-English speaking, and/or low-income populations. Data in this layer were compiled for Census 2010 block groups from the 2010 census redistricting tables and from the American Community Survey (ACS) 2006-2010 5 year estimates tables."

MIT contacted the EEA Environmental Justice Director on December 22, 2015 regarding the overall approach to ensure consistency with the EJ Policy, and again on April 14, 2016 regarding the proposed circulation and participation plan for the EIR.

2.2 Environmental Justice Analysis

The Project's PSD permit application includes documentation to enable MassDEP to fulfill its obligation under the provisions of the April 11, 2011 PSD Delegation Agreement between MassDEP and EPA to "identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations."

The air quality dispersion modeling analysis conducted for the PSD application, available online at powering.mit.edu, documents that there will be no disproportionately high and adverse human health or environmental effects related to the Project on any areas including minority populations and low-income populations. To determine this, a population-weighted average concentration for PM_{10} (particulate matter with a diameter of 10 micrometers or less) and $PM_{2.5}$ (particulate matter with a diameter of 2.5 micrometers or less) was computed using the worst case AERMOD impacts Operating Scenario from all of the MIT sources for each averaging period. The population-weighted concentrations were calculated for areas classified as EJ areas and compared to population weighted concentrations in areas not classified as EJ areas within five miles of the Project. The results are presented in Table A-23 of the PSD application and reproduced below. The results demonstrate that the impacts from the proposed Project are not disproportionately high in the EJ areas when compared to areas not classified as EJ areas.

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[3] Accessed April 2015 and available at http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/cen2010ej.html.

Table 2-1 Population-weighted Predicted Impacts

		Population-weighted Concentration (μg/m3)	
Pollutant	Averaging Period	Non-EJ Areas	EJ Areas
$PM_{2.5}$	24-hour	1.12	1.23
	Annual	0.04	0.04
PM_{10}	24-hour	1.58	1.70

As described in section 4.5.6 of this SEIR, the Project impacts for all pollutants and operational scenarios are below the National Ambient Air Quality Standards (NAAQS), which are considered protective of the health of sensitive populations such as asthmatics, children and the elderly. The total impacts presented in Tables 4-16 and 4-17 of this SEIR include modeled impacts from all MIT sources (existing plus new sources), plus modeled impacts from other significant emitters within 10 kilometers (km) of MIT, plus ambient monitored values. Therefore, it has been demonstrated that there is no adverse impact expected within in any EJ areas within 10 km of MIT.

2.3 Enhanced Public Participation

Because MIT is within five miles of an EJ community, the filing of the ENF in December 2015 triggered enhanced public participation.[4]

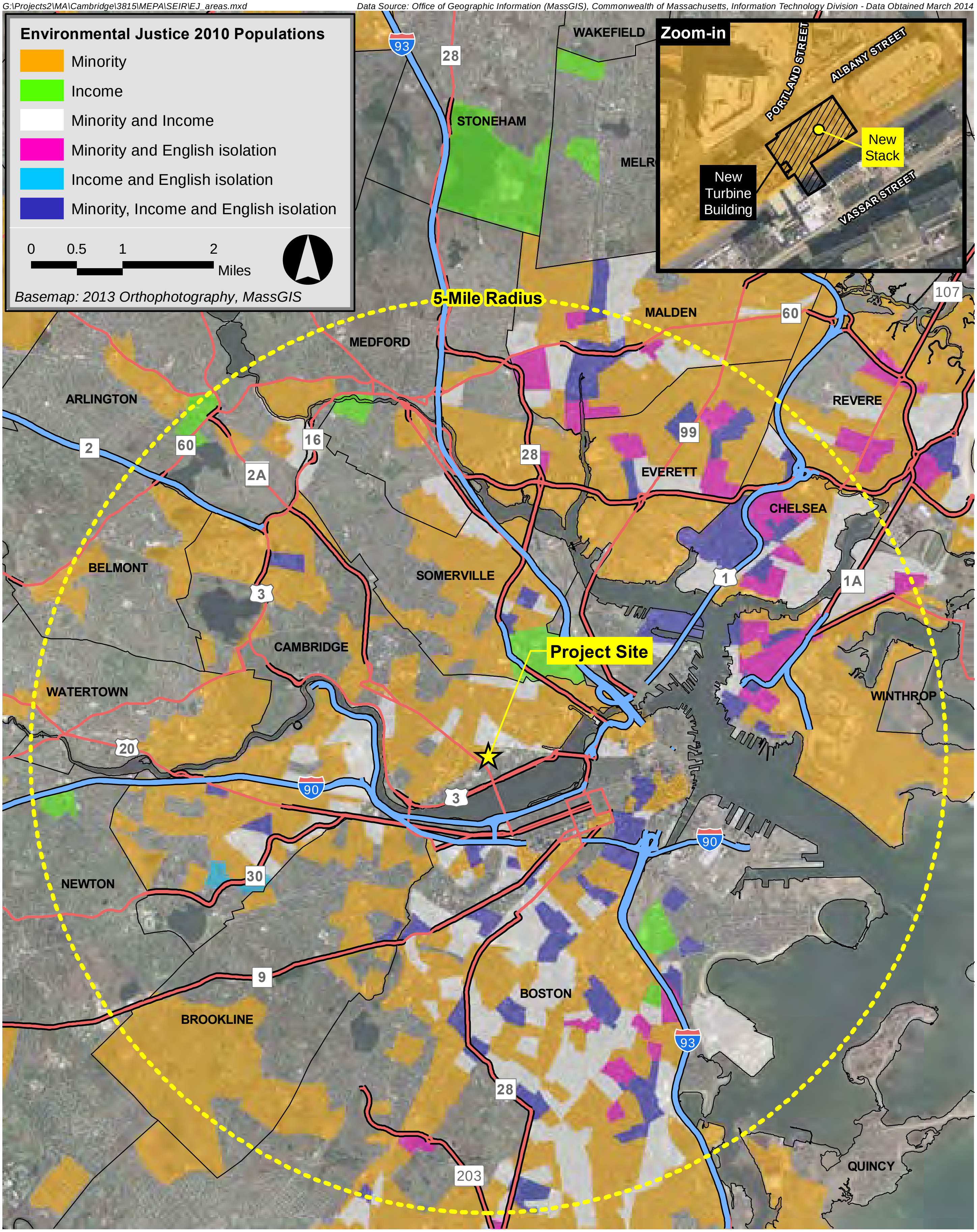
MIT took the following measures to perform expanded public outreach during review of the Expanded ENF:

- Preparation of a Fact Sheet briefly describing the Project, its impacts, and opportunities to provide comments;
- Translation of fact sheet into Spanish, Portuguese, Cantonese, and French;
- EENF public scoping session notices placed in the Boston Herald (12/18/15), Cambridge Chronicle (12/24/15 and 1/7/16), El Mundo - *Spanish* (1/7/16), O Jornal - *Portuguese* (1/8/16), and Sampan – *Chinese* (1/8/16);
- All fact sheets and the ENF were sent to the Cambridge Public Library, Central Square Branch; and
- Fact sheets and Spanish, Portuguese, Cantonese, and French interpreters were available during MEPA's public scoping session on January 14, 2015.

[4] Environmental Justice Policy of the Executive Office of Environmental Affairs. Available at http://www.mass.gov/eea/docs/eea/ej/ej-policy-english.pdf.

For public review of this SEIR, enhanced public outreach includes:

- Translation of updated fact sheets into Spanish, Portuguese, Cantonese, and French;
- Notice of SEIR and opportunity to comment placed in the Cambridge Chronicle, O Jornal – *Portuguese*, El Mundo – *Spanish*, and Sampan – *Chinese*; and
- All fact sheets and the SEIR will be sent to the Cambridge Public Library, Central Square Branch.



MIT CUP Second Century Project   Cambridge, Massachusetts

Figure 2-1
Environmental Justice 2010 Populations

Section 3.0

Alternatives

3.0 ALTERNATIVES

3.1 Introduction

Due to the existing site and building conditions, the on-site alternatives would be limited to a smaller CHP unit that would not meet the long term needs of MIT, or nothing could be done and MIT would over time need to find alternative methods to meet their electric, steam and cooling needs (such as outside, less efficient generating facilities or units). Given the space available at the existing site, the facility's efficiency at producing electricity, steam and chilled water, and the proximity to the buildings on campus it will provide for, installing the CUP upgrade/attachment is the only feasible alternative.

3.2 CUP Alternatives Reviewed

As mentioned, the existing CT is nearing the end of its service life. To continue to meet the expected electric and steam needs of its campus, MIT examined five options to replace the existing CT, as discussed below.

3.2.1 Retire existing CT and purchase all electricity from utility (No-Build Option)

In the No-Build Alternative, the existing MIT CUP facility would remain open, and the proposed CoGen system would not be installed. To offset the loss of the existing cogeneration heat recovery steam boiler, MIT would have to install an additional boiler to maintain firm steam capacity on campus. In the short term, MIT would continue to operate as it currently does, with fuel use and air emissions approximately unchanged. As demand increases on the MIT campus, the No-Build Alternative would have two effects:

1. More electricity would be imported from the grid; and
2. MIT would operate boilers that are less efficient than the CHP process to meet the demand for heating and cooling.

The environmental impacts of increased electricity imports would include additional air quality impacts at the electric generation sources and a potential decrease in grid reliability associated with the extra load. Although this option simplifies the operation of the CUP, the elimination of the generating capacity exposes the campus to outages of the grid without local backup. With the increasing demand on the grid and the increasing frequency of severe storms, the grid's reliability can be expected to be challenged. The environmental impacts of additional use of older equipment at the MIT facility would include increased air emissions (although this would not cause air quality to exceed any National Ambient Air Quality Standard [NAAQS]). As demand increases, the No-Build Alternative would result in greater environmental impacts, grid stress, reduced campus resiliency, and increased imported utility cost to MIT. The lifecycle cost of this option is higher than the other options considered.

3.2.2 *Rebuild existing CT with spare parts*

This option would include upgrading the CT to a level the manufacturer would support through a new Long Term Service Agreement (LTSA). This LTSA would provide support for approximately ten years after construction. It is unlikely that the service contract would be extended after the ten-year term as this would constitute the third service life extension on the 1993 gas turbine. Under this scenario, MIT would install a new CT at year 11 in order to meet the comparative 20-year life. This option would add a small increase in the capacity of the system due to increased efficiency and newer components. During normal operation, the grid would provide backup capacity for the system in the event of component failure or service interruption. Select campus loads would be covered in an island mode if the CT is available at the same time as a utility grid outage. This option would require MIT to continue to rely on older, less efficient equipment and technology, and would not provide the environmental benefits of a new turbine package. This option would also be anticipated to be susceptible to flooding in the future. In addition, the life cycle cost of this option is the second highest of the five options considered.

3.2.3 *Replace existing CT with new turbine package in the location of the existing CT*

In this option, the existing CT would be replaced by a new nominal 22 MW unit and would have new auxiliaries. The engine reliability, availability, and efficiency would be improved over the option described in Section 3.2.2. During normal operation, the grid would provide backup capacity for the system in the event of component failure or service interruption. Select campus loads would be covered in an island mode if the CT is available at the same time as a utility grid outage. This option would be anticipated to be susceptible to flooding in the future. In addition, the lifecycle cost of this option is higher than the proposed Project. In addition, MIT would have an increased dependence on the grid for its future electrical needs, which would create more emissions than the proposed Project.

3.2.4 *Expand existing capacity with new, approximately 30 MW turbine*

This option would replace the existing 21 MW CT with a larger 30 MW CT. This option would offer the same increase in reliability as the option described in Section 3.2.3 with new CT packaged equipment. The new package in this option would be installed in a new addition, including newer support systems and components elevated to protect against flooding. The need for higher gas pressure would require the use of a fuel gas compressor for this higher capacity unit. The installation of a single new combustion turbine does not provide the reliability that a redundant system offers. In addition, MIT would have an increased dependence on the grid for its future electrical needs, which would create more emissions than the proposed Project.

3.2.5 *Expand existing capacity with two new turbines (Proposed Project)*

This option is the proposed Project (as described in detail in Section 1.2), which allows for redundancy to minimize dependence on the utility grid, will be protected against flooding, and offers the lowest lifecycle cost. In addition, more energy would be created by the cogeneration plant, resulting in fewer air emissions due to a decreased need to rely on less efficient energy methods (e.g., the electric grid, stand-alone boilers).

3.3 Other Alternatives Considered

Regarding other alternatives considered by MIT:

- A CUP expansion powered by other fuels (e.g. oil, biomass) would not provide the reliability offered by a natural gas-fired project, supported by firm gas capacity. Also, local air quality impacts would be higher, fuel storage would be difficult, and transportation impacts would be substantial.

- A project with no capability to fire ULSD during emergencies would provide less resiliency than the proposed Project, would negatively impact the electrical grid during emergencies, and would not meet MIT's reliability goals.

- The use of onsite renewable energy and the reduction in energy use are being actively pursued campus-wide as part of MIT's ongoing commitment to reduce campus greenhouse gas emissions. Neither strategy would eliminate the need for campus energy services, and although the energy needs of individual buildings is anticipated to decrease, the growth of the campus and the addition of energy-intensive research activities will continue to require the energy that will be provided by the Project. The proposed Project will allow MIT to reduce environmental impacts on a growing campus, with growing energy demands, in conjunction with alternative energy generation and energy use reductions.

- The purchase of offsite renewable energy is also being pursued as part of MIT's ongoing commitment to reduce campus greenhouse gas emissions, but this strategy would not meet MIT's goals of increasing energy reliability and campus resiliency, as the campus would remain dependent on the grid.

3.4 Renewable Energy and Energy Efficiency Alternative

If on-campus demand is lower in the future, the CUP will be required to produce less energy and will have lower emissions. The two-turbine system is flexible enough to accommodate a reduction in demand over time and is designed to operate effectively and efficiently under reduced demand profiles (utilizing just one turbine, for example). CUP operations can be reduced to 20 percent of capacity and will still meet emissions requirements while maintaining resiliency.

In addition to lowering demand from buildings, MIT is pursuing other efficiency strategies, including renewables such as wind, solar, and geothermal. MIT is always evaluating new opportunities as technology evolves. For more information about on-site generation of clean energy, please see Section 7.1.

MIT-produced electricity, steam, and chilled water are currently less-carbon intensive than what can be purchased on the local grid. It is anticipated that MIT-generated electricity will continue to be less carbon intensive than grid-supplied electricity for the entire planned life of the new cogeneration turbines even given the required increases in the grid renewable energy standards over the next 20 years.

Given the efficiency of cogeneration and the flexible design of the CUP upgrade, it is expected that reduced demand for power on campus will reduce the use of fuel and will therefore reduce emissions.

3.5 Preferred Alternative

As described above, the Preferred Alternative consists of the installation of two nominal 22 MW CTs. Each CT will exhaust to its own HRSG with a 134 MMBtu/hr HHV gas-fired duct burner. The proposed Project is described in detail in Section 1. As noted, the Project is proposed to include two Solar Titan 250 turbines based on a review of performance in terms of greenhouse gas emissions and costs for the scale at which the CUP will operate.

Each CT will fire natural gas with Ultra Low Sulfur Diesel (ULSD) as a backup fuel for up to the equivalent heat input of 48 hours per year for testing, and up to the equivalent heat input of 168 hours per year per turbine including testing and periods when natural gas is unavailable (the 48 hours of testing is included in as part of the total 168 allowable hours). Each CTG will exhaust to its own HRSG with a 134 million Btu per hour (MMBtu/hr) HHV gas fired duct burner. The HRSGs will include selective catalytic reduction (SCR) for Oxides of Nitrogen (NOx) control, and an oxidation catalyst for the control of Carbon Monoxide (CO) and Volatile Organics (VOC).

The two new CTs with HRSGs and ancillary equipment will be located in an addition to Building 42 to be built in an existing parking lot along Albany Street between the cooling towers and an existing parking garage. The addition to the existing building would be approximately 184' x 118' by 63' above ground level (AGL) tall with two 167' AGL high flues centrally co-located in a common stack structure. There will be a flue for each turbine vented through its respective HRSG. The cold start engine flue will be located atop its housing (93.5' AGL).

Proposed mitigation measures under the Preferred Alternative include, fundamentally, the use of CHP to maximize energy efficiency, the use of existing infrastructure, and the selection of efficient equipment. Additionally, the use of the cleanest available fuels, advanced combustion design, and air pollution control catalysts would minimize air quality impacts under the Preferred Alternative. All new equipment will be ensured to have minimal noise impact as discussed in Section 3.5 below.

3.6 Comparison of Environmental Impacts

Table 3-1 below describes and compares the anticipated environmental impacts of the No Action Alternative and Preferred Alternative.

Table 3-1 Comparison of Environmental Impacts

Impact	No Action	Preferred Alternative
Air Quality	MIT will need to obtain electricity, steam heat, and chilled water from an outside source to supplement the existing Central Utilities Plant. This would apply across its more than 100 MIT-related buildings. The units generating the electricity, steam heat, and chilled water are unlikely to be as efficient as the proposed CoGen Project and will likely generate more pollution for the same generation needs. Installation of a new boiler would be needed for reliability.	The Preferred Alternative will use Best Available Control Technology (BACT) to minimize air emissions. Ambient impacts of the proposed Project will not cause or significantly contribute to exceedance of any air quality standard. MassDEP will review the control technologies and predicted impacts as described in the MCPA. Compliance will be documented through operational controls, stack testing, and continuous emissions monitoring systems.
Greenhouse Gas Emissions	Without the proposed CoGen Project, older units that are more polluting will need to run more often, resulting in an increase in GHG emissions. One new boiler would be added, but it would be less efficient overall than the proposed Project. MIT will also potentially have to outsource some of its steam heat, electricity, and chilled water generation needs to plants running less efficient older units that will generate more GHG emissions for the same generation needs.	The greenhouse gas (GHG) analysis (Section 5 of this document) documents that the Preferred Alternative will reduce GHG emissions compared to separate heat and power generation, and that the Project will mitigate GHG impacts to the maximum extent feasible through the selection of efficient generation and support equipment.

Table 3-1 Comparison of Environmental Impacts (Continued)

Impact	No Action	Preferred Alternative
Noise	The baseline case involves some incremental additional operation of existing MIT equipment (and a new boiler) onsite and some additional incremental operation of electric generating equipment offsite. This could potentially generate some incremental outside noise.	The noise section (Section 6 of this document) provides an in-depth analysis of noise impacts of the Preferred Alternative. The CHP equipment will be located near existing railroad tracks and support systems. The CTG will be enclosed, and the compressor and cold start engine will be installed in sound-attenuated enclosures. The Project incorporates sound mitigation to minimize noise impact.
Infrastructure	A new boiler (sized to provide approximately 100,000 pounds/hour of steam) would be added for reliability. If the Project does not proceed, it could influence decisions elsewhere on the MIT campus to install equipment.	The Preferred Alternative will be installed in an attachment to an existing building. This attachment would be on an existing parking lot on the MIT campus.
Historic Resources	Depending on final boiler location, the No-Build case would have no impact to historic resources. If the Project does not proceed, it could influence decisions elsewhere on the MIT campus to install equipment, which could have an impact.	There are no historic resources listed on the State or National Registers of Historic Places or included in the Inventory of Historic and Archaeological Assets of the Commonwealth on the Project site; several such sources are located in the vicinity. The project is unlikely to affect significant historic resources as it is located within a densely developed urban area with similarly scaled structures.
Construction	The Baseline case would have no major construction, although MIT would still proceed with the installation of a boiler and new electrical switchgear. If the Project does not proceed, it could influence decisions elsewhere on the MIT campus to install equipment, which could have an impact.	Construction-related impacts will generally be limited to the Project site and immediately adjacent streets (Albany and Vassar Streets). During the construction of the new plant, there will be some short-duration impacts to the traffic and surrounding streets, which will be reviewed and approved by the City of Cambridge and will be designed to minimize impact when possible. Construction work will also involve managing the flow of foot traffic to ensure the safety of pedestrians.

Section 4.0

Air Quality

4.0 AIR QUALITY

4.1 Source Emissions Discussion

The Project will combust natural gas (with ULSD backup) to generate electricity and steam. Generally, the combustion (burning) process involves combining the hydrocarbon fuel with oxygen to create carbon dioxide and water vapor. Carbon dioxide emissions are addressed in Section 5. The water vapor has no measureable impact on local climate or humidity.

The two new CTs will emit products of combustion from the firing of natural gas or ULSD. Air pollutants can be generated in the combustion process in three ways. First, incomplete combustion can allow the emission of CO, VOC, and particulate matter (PM). Second, high-temperature combustion can cause nitrogen in the air to NOx. Third, impurities in the fuel can allow emissions of SO_2, NOx, and PM. Emissions are minimized through the use of clean burning fuels, in combination with post combustion controls.

MIT minimizes the CO and VOC emissions through good combustion control, and use of an oxidation catalyst (similar to the catalytic converters installed on automobiles). The NOx emissions are minimized through low-NOx combustors and use of selective catalytic reduction (that reverses the reaction that forms NOx). Because proposed ULSD use is very limited, the new CTs have the opportunity to use dry low-NOx combustors instead of water injection. MIT minimizes the emissions from fuel impurities by using the cleanest available fuels (natural gas and ULSD).

Emissions from the new cold-start engine will be minimized through the use of clean burning fuels. Existing boilers will have the same short-term emission rates as currently permitted, with the same emissions controls. The new cooling towers will emit particulates. Emissions will be minimized through the use of high efficiency drift eliminators.

MassDEP is reviewing the MCPA application for MIT. Per the MCPA regulation at 310 CMR 7.02(3)(j), MassDEP will only issue an approval if the Project will comply with air quality rules, utilize BACT, and not result in air quality exceeding either the Massachusetts or National Ambient Air Quality Standards (MAAQS or NAAQS).

4.2 Emission Rates

The new expansion will emit products of combustion from the firing of natural gas or ULSD. Emissions are minimized as specified in the above section. Potential short-term and long-term emission rates of the CHP (turbine and duct-burner) are summarized in Tables 4-1 and 4-2.

Table 4-1 Proposed Emission Rates for CTs

Pollutant	Emission Rate, Natural Gas fired	Emission Rate, ULSD fired	Duct Burner Emission Rate (Natural Gas only)	Control Technology
Nitrogen oxides (NO_x)	2.0 ppm	9.0 ppm	0.011 lb/MMBtu	SCR
Carbon Monoxide (CO)	2.0 ppm	7.0 ppm	0.011 lb/MMBtu	Oxidation Catalyst
Volatile Organic Compounds (VOC)	1.7 ppm	7.0 ppm	0.03 lb/MMBtu	Oxidation Catalyst
Particulate Matter ($PM/PM_{10}/PM_{2.5}$)	0.02 lb/MMBtu	0.04 lb/MMBtu	0.02 lb/MMBtu	Low ash fuels
Sulfur dioxide (SO_2)	0.0029 lb/MMBtu	0.0016 lb/MMBtu	0.0029 lb/MMBtu	Low sulfur fuels
Carbon Dioxide (CO_2)	119 lb/MMBtu	166 lb/MMBtu	119 lb/MMBtu	N/A
Ammonia (NH_3)	2.0 ppm	2.0 ppm	2.0 ppm	SCR

ppm = parts per million (dry volume, corrected to 15% oxygen)
lb/MMBtu = pounds per million British Thermal Unit
Short-term NO_x, CO, VOC, and NH_3 emission rates are for full-load, steady-state operations.

Table 4-2 Proposed Project Potential Emissions

	Turbines & HRSGs	Cold-start Engine	Boiler 7	Boiler 9	Cooling Towers	Total
NO_x	21.1	5.3	1.9	0.65	-	28.9
CO	15.1	0.33	2.2	2.8	-	20.3
VOC	20.9	0.17	7.7	9.7	-	38.5
PM	50.0	0.06	1.9	2.6	0.92	55.4
SO_2	7.0	0.004	0.35	0.45	-	7.8
CO_2	294,970	480	29,320	37,970	-	362,740

Boiler 7 and Boiler 9 are proposed increases in potential emissions
CO_2 emission rates are rounded to the nearest ten tons

4.3 Pollution Controls and Their Effectiveness

The primary method that the Project will use to minimize air emissions will be to avoid the unnecessary generation of air emissions. Modern combustion turbines are designed and operated to ensure complete combustion, and avoid “hot spots” which could generate NOx. The Project will use the cleanest available fuels (natural gas and ULSD backup).

The proposed post-combustion pollution controls are a SCR system and an oxidation catalyst. EPA[5] describes SCR as follows:

> *"The SCR process chemically reduces the NOx molecule into molecular nitrogen and water vapor. A nitrogen based reagent such as ammonia or urea is injected into the ductwork, downstream of the combustion unit. The waste gas mixes with the reagent and enters a reactor module containing catalyst. The hot flue gas and reagent diffuse through the catalyst. The reagent reacts selectively with the NOx within a specific temperature range and in the presence of the catalyst and oxygen."*

EPA[6] describes catalytic oxidation as follows:

> *"Carbon monoxide oxidation catalysts are typically used on turbines to achieve control of CO emissions... CO catalysts are also being used to reduce VOC and organic HAPs emissions... The CO catalyst promotes the oxidation of CO and hydrocarbon compounds to carbon dioxide (CO_2) and water (H_2O) as the emission stream passes through the catalyst bed. The oxidation process takes place spontaneously, without the requirement for introducing reactants."*

Proposed Project emission rates are based on the operation of these pollution control systems to meet BACT as described below. The systems will be designed and operated to meet BACT limits over the full range of operating conditions. Pollution control efficiency is therefore more a function of the pre-control emission rates than the post-combustion systems themselves. Based on turbine exhaust data, and BACT emission limits as discussed below, the SCR system will control about 92 percent of NOx emissions, and the oxidation catalyst will control about 96 percent of CO emissions.

4.4 Best Available Control Technology (BACT)

The MIT CHP expansion will meet Massachusetts and federal BACT through the use of clean fuels, clean combustion, and post-combustion controls (Selective Catalytic Reduction and oxidation catalyst). Different pollutants are subject to different BACT requirements.

The plan approval requirements at 310 CMR 7.02(5) require BACT. BACT is defined in 310 CMR 7.00 as,

> *"... an emission limitation based on the maximum degree of reduction of any regulated air contaminant emitted from or which results from any regulated facility which the Department, on a case-by-case basis taking into account*

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5 EPA-423/F-03-032 Air Pollution Control Technology Fact Sheet – Selective Catalytic Reduction.

6 EPA AP 42, Fifth Edition, Volume I, Section 3.1.4.3.

energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems and techniques for control of each such contaminant. The best available control technology determination shall not allow emissions in excess of any emission standard established under the New Source Performance Standards, National Emission Standards for Hazardous Air Pollutants or under any other applicable section of 310 CMR 7.00, and may include a design feature, equipment specification, work practice, operating standard, or combination thereof."

Historically, MassDEP uses a "top-down" approach to a BACT analysis. The process begins with the identification of control technology alternatives for each pollutant. Technically infeasible technologies are eliminated and the remaining technologies are ranked by control efficiency. These technologies are evaluated based on economic, energy and environmental impacts. If the most stringent technology is eliminated based on these criteria, the next most stringent technology is evaluated until BACT is selected.

MassDEP has a lengthy history of determining BACT for combustion sources of the size proposed for the CHP expansion, and has applicable regulations and guidance defining "top-case BACT." For pollutants where top-case BACT is proposed, a detailed, exhaustive top-down analysis would be "reinventing the wheel." This SEIR presents a formal BACT analysis for PM, CO, VOC and CO_2, and relies on MassDEP guidance and information from other available resources for other pollutants. A separate BACT analysis is provided for the proposed ULSD fired cold start engine.

4.4.1 Top-case BACT from MassDEP Guidance for Combustion Turbines & Duct Burners

Where available, MIT proposes to use the MassDEP Top Case (BACT) Guidelines for Combustion Sources[7] to document BACT. As stated in the guidelines: "Use of the applicable top-case BACT emissions limitations contained herein may preclude the need for applicants to prepare and submit a 'top-down BACT analysis' for MassDEP's review, and will streamline the Air Quality permitting process for both the applicants and MassDEP."

Specifically, the emission rates in Table 4-1 above are consistent with MassDEP guidelines for top-case BACT for all pollutants for which guidelines are available (NO_x, CO, VOC, NH_3).

While not specifically listed in the MassDEP guidance, MIT proposes the following as top-case BACT:

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7 http://www.mass.gov/eea/docs/dep/air/approvals/bactcmb.pdf, accessed 7/10/14

- SO_2 BACT is met through the use of low-sulfur fuels (natural gas and ultra-low sulfur diesel) and efficient operation. MIT will track sulfur content through vendor-posted data and fuel receipts.

The Solar Titan 250 combustion turbine that has been chosen as the new model for the Project, replacing the LM2500s proposed in the EENF, will continue to meet the determined emission limits from the top-case and top-down BACT analyses performed for the EENF. The turbine will also require fewer variations and less relief from Top-case BACT for transient operations than the originally proposed LM2500 model. These variations from Top-case BACT are discussed in Section 4.4.2.

4.4.2 Proposed Variations from Top-case BACT

MIT proposes the following changes from Massachusetts guidance for top-case BACT for the new turbine:

- MIT proposes a NOx emission rate of 9 parts per million by volume, dry (ppmvd) at 15 percent O_2 when firing ULSD, instead of the Massachusetts top-case BACT guidance of 7 ppmvd at 15 percent O_2. This proposed change allows the use of a dry low-NOx combustor for the CTs, which has environmental and reliability benefits such as reduced water usage and simpler operation.

- MIT proposes to meet other top-case BACT guidance during full-load, steady state conditions. However, the CTs must be able to quickly and reliably respond to changes in campus energy demand. Meeting the same limits as those that apply for full-load steady-state conditions will not be possible over the short term. The proposed emission limits during transient operations are:

  - Proposed NOx firing gas from the CT of 3.2 ppmvd at 15 percent O_2 during transient operations.

  - Proposed CO firing gas from the CT of 5.0 ppmvd at 15 percent O_2 during transient operations.

  - Proposed VOC firing gas from the CT of 3 ppmvd at 15 percent O_2 during transient operations.

  - Proposed NH_3 firing gas from the CT of 5.0 ppmvd at 15 percent O_2 during transient operations.

When operating load is changing significantly, the turbine controls can automatically transition out of dry-low-NOx (DLN) mode. MIT proposes that when the unit is not in DLN mode, a higher emission limit is needed. The emission limits that apply when the unit is not in DLN mode are the transient operations emissions values.

4.4.3 Particulate Matter (PM) BACT

A complete BACT analysis addressing PM emissions is available in the MCPA application. This BACT analysis follows the federal guidance in the New Source Review Workshop Manual, Prevention of Significant Deterioration and Nonattainment Area Permitting, EPA Draft October 1990 document. The BACT analysis follows the guidance in the NESCAUM BACT Guideline dated June 1991, as well as the referenced NSR Workshop Manual.

Available fuels and emission controls are the same for the turbine and the duct burner. Also, data on emission limits achieved-in-practice are generally based on total emissions from turbine and duct burner firing. This BACT analysis therefore applies to the combined emissions of the turbine and the duct burner.

The BACT analysis shows that post-combustion control is considered technically infeasible for the Project. All available post-combustion controls (e.g., filters) have a limitation to how clean an exhaust concentration they can achieve. The minimum outlet concentration achievable using post-combustion control is generally higher than the inlet concentration achievable using clean fuels. Therefore, the installation of post-combustion controls will not reduce particulate emissions.

The only remaining control technology in this analysis is the use of clean fuels and clean combustion. The effectiveness of this approach is summarized in Table 4-3 below.

Table 4-3 Summary of PM Effectiveness of Clean Fuels and Combustion

Control efficiencies (percent pollutant removed)	Not applicable (inherently clean technology used)
Expected emission rate (tons per year, pounds per hour)	Potential emissions are 7.1 lb/hr firing gas, 11.9 lb/hr firing ULSD in each turbine (and gas in the duct burner), and 50 tons/year combined total. Expected emission rates are lower.
Expected emissions reduction (tons per year)	Not applicable (inherently clean technology used)
Economic impacts	In most cases, clean fuels are more expensive than higher-polluting fuels. As of the time of this application, natural gas prices are low on an annual basis, but high during peak winter use periods.
Environmental impacts [includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants]	The use of clean fuels can have lower water, wastewater, solid waste, and toxic/hazardous air impacts than higher-polluting fuels.
Energy impacts	Energy use is a function of system efficiency; the proposed CHP is an efficient combustion turbine with heat recovery and low energy impacts.

Consistent with the analysis presented in the MCPA, MIT proposes the use of a clean fuels and clean combustion, achieving a total $PM/PM_{10}/PM_{2.5}$ emission rate of 0.02 lb/MMBtu firing gas and 0.04 lb/MMBtu firing ULSD as the top alternative for BACT. These limits are comparable to (and slightly lower than) recent projects of similar size (Cornell, UMass Amherst, Gillette, and Harvard). The proposed BACT emission limitations are the maximum degree of reduction achievable, taking into account the scarcity of comparable units with emission limits demonstrated-in-practice, the continued concerns with the accuracy and repeatability of the stack test method (EPA Method 202), and the limited technical opportunities to directly control and reduce particulate emissions.

4.4.4 Carbon Dioxide BACT

A complete BACT analysis addressing CO_2 emissions is available in the MCPA application. CO_2 emissions are also addressed as greenhouse gas emissions per the MEPA GHG Policy and Protocol in Section 5 of this document.

The BACT analysis shows that post-combustion control (carbon capture and sequestration) is considered technically infeasible for the Project. Problems include: lack of space for the required absorption and compression system, compressor noise, lack of a pipeline or other transportation system, and lack of a storage site.

The only remaining control technology is the use of clean fuels and clean combustion. Requested data is summarized in Table 4-4 below.

Table 4-4 Summary of CO_2e Effectiveness of Clean Fuels and Combustion

Control efficiencies (percent pollutant removed)	Not applicable (inherently clean technology used)
Expected emission rate (tons per year, pounds per hour)	Potential emissions are 40,934 lb/hr firing gas, 50,065 lb/hr firing ULSD in each turbine (and gas in the duct burner), and 294,970 tons/year combined total.
Expected emissions reduction (tons per year)	Not applicable (inherently clean technology used)
Economic impacts	In most cases, clean fuels are more expensive than higher-polluting fuels. As of the time of this SEIR, natural gas prices are low on an annual basis, but high during peak winter use periods.
Environmental impacts [includes any significant or unusual other media impacts (e.g., water or solid waste), and, at a minimum, the impact of each control alternative on emissions of toxic or hazardous air contaminants]	The use of clean fuels can have lower water, wastewater, solid waste, and toxic/hazardous air impacts than higher-polluting fuels.
Energy impacts	Energy use is a function of system efficiency; the proposed CHP is an efficient combustion turbine with heat recovery and low energy impacts.

Consistent with the analysis presented in the MCPA, MIT proposes the use of clean fuels and clean combustion, achieving a total CO_2e emission of 40,934 lb/hr firing gas and 50,065 lb/hr firing ULSD in the turbine (and gas in the duct burner) as the top alternative for BACT.

4.4.5 Top-Case BACT for Cold-Start Engine

Where available, MIT proposes to use the MassDEP Top Case (BACT) Guidelines for Combustion Sources to document BACT for the cold-start engine.

Table 4-5 below contains the MassDEP top-case BACT Guideline for Emergency IC Engines equal to or greater than 37 kW.

Table 4-5 Top-case BACT from MassDEP Guidance for Emergency IC Engines

Source	Fuel	Air Contaminant	Emission Limitations	Control Technology
IC Engines equal to or greater than 37 kw (Emergency Engines)	ULSD (0.0015%)	NOx, PM, CO, VOC	Comply with applicable emission limitations set by EPA for non-road engines at 40 CFR 89	N/A

The cold-start engine falls within the range of sources subject to the MassDEP Environmental Results Program (ERP) Standards for emergency engines and turbines at 310 CMR 7.26(42). The ERP limitations for emergency engines and turbines are compliance with the applicable emission limits set by the EPA for non-road engines (40 CFR 89), use of ULSD fuel and hours of operation limited to no more than 300 per 12-month rolling period. The Proponent will obtain the appropriate engine supplier certification for these units. These design and operating restrictions constitute BACT pursuant to 310 CMR 7.02(5).

Specifically regarding BACT for PSD-applicable Pollutants:

- Particulate Matter: Available control technologies are clean combustion and use of an active diesel particulate filter (DPF). Both of these technologies are technically feasible, although MIT is not aware of any use of a DPF for an emergency engine, so the use of a DPF is not demonstrated in practice for this category of equipment. A DPF could be more effective than the use of clean combustion alone, but given the very low annual PM emission rates for the cold-start engine, its use would not be cost-effective (control costs would likely exceed $100,000 per ton of PM removed).

- GHG: Add-on controls (CCS) are not technically feasible. The application (emergency black-start power generation) requires reliable on-site fuel storage with no outside energy required to start the generator. The use of ULSD is the lowest-emitting fuel for this purpose that can be reliably obtained and safely and simply stored.

4.4.6 Top-case BACT for Boilers 7 and 9

The existing operating permit limits for Boilers 7 and 9 comply with MassDEP guidance for top-case BACT. Table 4-6 below compares the proposed limits for Boilers 7 and 9 compared to the relevant BACT Guidance. While Boiler 7 is rated at just under 100 MMBtu/hr, it is compared to top-case BACT for boilers 100 MMBtu/hr and larger.

Table 4-6 Proposed Top-case BACT for Boilers 7 and 9

Pollutant	Natural Gas		ULSD	
	Limit (lb/MMBTU)	BACT Guidance (lb/MMBTU)	Limit (lb/MMBTU)	BACT Guidance (lb/MMBTU)
CO	0.011*	0.011	0.035	0.035
NO_x	0.011	0.011	0.1	0.1
$PM_{10}/PM_{2.5}$	0.01	0.01	0.03	0.03
SO_2	0.0014	N/A	0.0016	N/A
VOC	0.03	0.03	0.03	0.03
CO_2	119	N/A	166	N/A

* Boiler 9 has a CO limit of 0.033 lb/MMBtu at loads below 33%.

Specifically regarding BACT for PSD-applicable Pollutants:

- Particulate Matter: Available control technologies are clean fuels and clean combustion. The use of add-on controls (fabric filtration, electrostatic precipitation, scrubbing) is not technically feasible because the inlet particulate loading is too low for any of these to effectively remove further particulates.

- GHG: Add-on controls (CCS) are not technically feasible. The use of natural gas with ULSD backup is the lowest-emitting fuel choice that allows MIT to meet the project's reliability needs.

4.5 Air Quality Impacts

As part of the MCPA and PSD air applications, MIT has documented that the proposed Project will not lead to a condition of unhealthy air. This is done by using computer dispersion modeling, as described in this section. The key analysis documents that MAAQS and NAAQS will not be exceeded; separate analyses address air toxics and PSD increments.

4.5.1 MAAQS and NAAQS

EPA[8] describes NAAQS as follows:

> *"The Clean Air Act, which was last amended in 1990, requires EPA to set National Ambient Air Quality Standards... for pollutants considered harmful to public health and the environment. The Clean Air Act identifies two types of national ambient air quality standards. Primary standards provide public health protection, including protecting the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection, including protection against decreased visibility and damage to animals, crops, vegetation, and buildings."*

Table 4-7 shows the applicable NAAQS/MAAQS.

Table 4-7 National and Massachusetts Ambient Air Quality Standards

Pollutant	Averaging Period	NAAQS/MAAQS ($\mu g/m^3$)	
		Primary	Secondary
NO_2	Annual (1)	100	Same
	1-hour (2)	188	None
SO_2	Annual (1)	80	None
	24-hour (3)	365	None
	3-hour (3)	None	1300
	1-hour (4)	196	None
$PM_{2.5}$	Annual (1)	12	15
	24-hour (5)	35	Same
PM_{10}	24-hour (6)	150	Same
CO	8-hour (2)	10,000	Same
	1-hour (2)	40,000	Same
Ozone	8-hour (8)	148	Same
Pb	3-month (1)	1.5	Same

(1) Not to be exceeded.
(2) 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
(3) Not to be exceeded more than once per year.
(4) 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years.
(5) 98th percentile, averaged over 3 years.
(6) Not to be exceeded more than once per year on average over 3 years.
(7) Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years.

[8] http://www.epa.gov/air/criteria.html, accessed April 2015.

The facility cannot cause or contribute to the violation of any NAAQS or MAAQS. Air quality dispersion modeling is used to demonstrate compliance with these thresholds for NO_2, SO_2, $PM_{2.5}$, PM_{10}, and CO. The Project does not directly emit ozone; Project impacts to ambient ozone concentrations are minimized by applying BACT controls to ozone precursors (NOx and VOC) as described in Section 4.4 above. Lead emissions and impacts are negligible.

For the modeled pollutants, the compliance demonstration broadly uses the following steps:

- Identify which operating conditions cause the worst-case impact from the proposed new project equipment (for each pollutant and averaging time);
- For pollutants and averaging times where the project impacts are above Significant Impact Levels (SILs), identify significant nearby sources;
- Identify background (ambient) measured concentrations from nearby monitoring stations;
- Document that the combined impact of the new project sources, the existing CUP sources, the significant nearby sources (if applicable), and the background remain below the MAAQS/NAAQS for each pollutant and averaging time.

4.5.2 Modeling Methods

The EPA approved air quality model used for this analysis is AERMOD. The AERMOD model is a steady state plume model using Gaussian distributions that calculates concentrations at each receptor for every hour in the year. The model is designed for rural or urban applications, and can be used with a rectangular or polar system of receptors that are allowed to vary with terrain. AERMOD is designed to operate with two preprocessor codes: AERMET processes meteorological data for input to AERMOD, and AERMAP processes terrain elevation data and generates receptor information for input to AERMOD. The AERMOD model was selected for the air quality modeling analysis because of several model features that properly simulate the proposed facility environs.

The AERMOD model is the most appropriate for projecting impacts from the Project. It is a refined modeling technique per the EPA Guideline on Air Quality Models (40 CFR 51 Appendix W) and is the EPA-recommended model for this type of analysis. MassDEP guidance states that use of modeling platforms other than AERMOD must be approved by MassDEP and EPA. While any modeling technique will be less accurate in areas subject to major topographic influences that experience meteorological complexities, wind direction specific building parameters generated by the latest version of the EPA Building Profile Input Program (BPIP-Prime) were input into AERMOD to account for potential downwash from nearby structures in the dispersion calculations. Also, while a steady-state Gaussian plume model does not apply during calm conditions, AERMOD contains algorithms for dealing with low wind speed (near calm) conditions.

4.5.3 Project Source Data

In addition to modeling the impacts from the new units, the Project includes modeling of the existing units at the MIT CUP to determine full facility impacts. Some modifications are proposed for the operations of the existing units while operating coincident with the new turbines, including new restrictions proposed on oil firing for existing Boilers 3, 4, 5, 7 and 9. A range of potential operating loads (40%, 50%, 60%, 65%, 75%, and 100%) were modeled for the new units using a range of ambient temperatures (0, 50, and 60 degrees Fahrenheit). The parameters for each operating case are listed in Attachment A of CPA Appendix D. Modeling for the turbines was also performed over a range of loads and ambient temperatures to determine the case resulting in the highest air quality impact of each pollutant. The worst case scenario is then modeled with the existing facility to demonstrate compliance with the NAAQS. The cooling tower emissions are below the MassDEP threshold for inclusion in air quality modeling; however, because this is a PSD project for $PM_{2.5}$ and PM_{10}, the cooling towers are included in the modeling analysis.

Table 4-8 summarizes the physical stack parameters for the new stacks and cooling towers. Note that the cooling towers have multiple cells, denoted with a letter in the naming convention. The UTM coordinates are located in zone 19.

Table 4-8 Physical Stack Characteristics for the New Sources

Stack	UTM E (m)	UTM N (m)	Base Elevation (m)	Stack Height (m)	Stack Diameter (m)
Turbine/HRSG 1	327593.31	4692056.99	5.5	50.9	2.13
Turbine/HRSG 2	327595.85	4692058.57	5.5	50.9	2.13
Merged Turbine Stack	327594.54	4692057.79	5.5	50.9	3.02
2 MW Cold Start Engine	327612.55	4692070.18	5.5	28.5	0.61
Cooling Tower 11A	327552.38	4692017.83	2.73	29.69	6.78
Cooling Tower 11B	327545.00	4692012.54	2.73	29.69	6.78
Cooling Tower 12A	327558.64	4692008.53	2.73	29.69	6.78
Cooling Tower 12B	327550.46	4692003.71	2.73	29.69	6.78
Cooling Tower 13A	327563.45	4692001.47	2.73	29.69	6.78
Cooling Tower 13B	327555.91	4691996.01	2.73	29.69	6.78

Oil is intended to be used only in the case of gas interruption (curtailment, gas supply emergency, or any required testing); however, it is still included in the modeling. The source parameters and emission rates are shown in Tables 4-9 and 4-10 for the worst case load conditions for each pollutant and averaging time. The source parameters and emission rates for the 2 MW cold-start emergency engine and new cooling towers are provided in Table 4-11.

Table 4-9 New Turbine Source Characteristics and Emission Rates for 1 Turbine with Duct Burner/HRSG (Operational Scenario 1)

Pollutant	Avg. Period	Exit Velocity	Exit Temp	Emission Rate	Fuel	Load Condition
SO_2	1-Hour	19.7	355.4	0.12	NG	Case 1: 50F, 100% Load, Duct Burners On, Turbine A
	3-Hour	19.7	355.4	0.12	NG	Case 1: 50F, 100% Load, Duct Burners On, Turbine A
	24-Hour	19.7	355.4	0.12	NG	Case 1: 50F, 100% Load, Duct Burners On, Turbine A
	Annual	17.2	355.4	0.12[1]	NG	I.Annual, Duct Burners On, Turbine A
NOx	1-Hour	21.5	380.4	1.11	ULSD	Case 9: 60F, 100% Load, Duct Burners On, Turbine B
	Annual	17.2	355.4	0.35[1]	NG	I.Annual, Duct Burners On, Turbine A
PM_{10}	24-Hour	21.5	380.4	1.39	ULSD	Case 9: 60F, 100% Load, Duct Burners On, Turbine A
$PM_{2.5}$	24-Hour	21.5	380.4	1.39	ULSD	Case 9: 60F, 100% Load, Duct Burners On, Turbine A
	Annual	17.2	355.4	0.88[1]	NG	I.Annual, Duct Burners On, Turbine A
CO	1-Hour	21.5	380.4	0.62	ULSD	Case 9: 60F, 100% Load, Duct Burners On, Turbine A
	8-Hour	21.5	380.4	0.62	ULSD	Case 9: 60F, 100% Load, Duct Burners On, Turbine B

[1] Emission rate reflects the potential emission limit specified in the air plan approval application.

Table 4-10 New Turbine Source Characteristics and Emission Rates for Two Turbines with Duct Burners/HRSGs (Operational Scenario 2)

Pollutant	Avg. Period	Exit Velocity. (m/s)	Exit Temp (°K)	Emission Rate[1] (g/s)	Fuel	Load Condition[2]
SO_2	1-Hour	19.7	355.4	0.25	NG	Case 2a: 50F, 100% Load, NG, Duct Burners On
	3-Hour	19.7	355.4	0.25	NG	Case 2a: 50F, 100% Load, NG, Duct Burners On
	24-Hour	17.2	355.4	0.21	NG	Case 2c: 60F, 75% Load, NG, Duct Burners On
	Annual	17.2	355.4	0.25[3]	NG	II.Annual
NOx	1-Hour	24.1	380.4	2.40	ULSD	Case 2.j: 0F, 100% Load, ULSD, Duct Burners On
	Annual	17.2	355.4	0.70[3]	NG	II.Annual
PM_{10}	24-Hour	19.2	380.4	2.35	ULSD	Case 2.k: 60F, 75% Load, ULSD, Duct Burners On
$PM_{2.5}$	24-Hour	24.1	380.4	2.99	ULSD	Case 2.j: 0F, 100% Load, ULSD, Duct Burners On
	Annual	17.2	355.4	1.76[3]	NG	II.Annual
CO	1-Hour	19.2	380.4	1.05	ULSD	Case 2.k: 60F, 75% Load, ULSD, Duct Burners On
	8-Hour	21.5	380.4	1.24	ULSD	Case 2.i: 60F, 100% Load, ULSD, Duct Burners On

1 Emission rate is the total for both turbines.
2 Condition is modeled as a merged flue for Turbine 1 and 2.
3 Emission rate reflects the potential emission limit specified in the air plan approval application

Table 4-11 New 2 MW Cold-start Emergency Engine and Cooling Tower Source Characteristics and Emission Rates

Source	Averaging Time	Exit Temp (K)	Exit Velocity (m/s)	PM_{10}/ $PM_{2.5}$ (g/s)	SO_2 (g/s)	NOx (g/s)	CO (g/s)
2 MW Cold-Start Emergency Engine	Short-Term	673.2	24.7	1.6E-2[1]	3.7E-3	1.5E-1[2]	2.8E-1
	Annual[3]			1.7E-3	1.3E-4	1.5E-1	N/A
Cooling Towers #11, 12, 13 per cell (6)	N/A	298.7	8.0	4.4E-3	N/A	N/A	N/A

1 Assumes cold start emergency engine will not operate more than 8 hours in a single day.
2 This emission rate is scaled by the permitted hours of operation per EPA Guidance. (http://www.epa.gov/nsr/documents/20100629no2guidance.pdf)
3 Annualized emissions assuming a maximum of 300 hours per year.

4.5.4 Existing Source Data

As part of the permitting effort, MassDEP has the option to require demonstration that the full MIT CUP will comply with the NAAQS. Boiler 9 was recently permitted (2011) and full facility compliance was achieved then. However, since then there have been new nearby structures built or proposed. This modeling analysis takes those new structures into account. In addition, MIT is proposing several operational changes to existing sources including: removing the residual (No. 6) oil firing for existing Boilers 3, 4, and 5, the boilers will be capable of firing ULSD in emergencies (with a burner tip change to allow firing the cleaner fuel); removing the ULSD firing for existing Boilers 7 and 9 (maintaining ULSD firing capability for emergencies) and increasing (gas-fired) operating hours for Boilers 7 and 9 to allow year-round operation. The source parameters and emission rates used for this analysis and are presented in Tables 4-12, 4-13, and 4-14.

Table 4-12 Physical Stack Characteristics for the MIT Existing Sources

Stack	UTME (m)	UTMN (m)	Base Elevation (m)	Stack Height (m)	Stack Diameter (m)
Boilers 7 & 9 Stack	327510.2	4692006.1	2.73	35.05	1.68
Boilers 3,4,5	327570.3	4691983.3	2.74	53.95	3.35
Turbine #1	327575.2	4691973.9	2.74	36.58	1.83
Generator #01	327595.7	4691984.2	2.74	19.43	0.41
Cooling Tower 1A	327604.2	4692009.7	2.73	18.15	4.42
Cooling Tower 1 B	327609.4	4692013.8	2.73	18.15	4.42
Cooling Tower 2A	327614.7	4692016.6	2.73	18.15	4.42
Cooling Tower 2B	327619.5	4692020.0	2.73	18.15	4.42
Cooling Tower 3A	327545.7	4692010.4	2.73	20.57	6.16
Cooling Tower 3B	327541.6	4692016.3	2.73	20.57	6.16
Cooling Tower 4A	327553.7	4692015.4	2.73	20.57	6.16
Cooling Tower 4B	327549.8	4692021.9	2.73	20.57	6.16
Cooling Tower 5	327571.0	4691990.9	2.73	17.37	2.52
Cooling Tower 6	327576.8	4691994.7	2.73	17.37	2.52
Cooling Tower 7A	327522.7	4691998.6	2.73	20.57	4.94
Cooling Tower 7B	327528.5	4692002.2	2.73	20.57	4.94
Cooling Tower 7C	327518.9	4692004.9	2.73	20.57	4.94
Cooling Tower 7D	327523.9	4692008.3	2.73	20.57	4.94
Cooling Tower 8A	327513.3	4692013.3	2.73	20.57	5.03
Cooling Tower 8B	327518.5	4692016.4	2.73	20.57	5.03
Cooling Tower 8C	327514.5	4692022.9	2.73	20.57	5.03
Cooling Tower 8D	327509.3	4692019.3	2.73	20.57	5.03

Table 4-12 Physical Stack Characteristics for the MIT Existing Sources (Continued)

Stack	UTME (m)	UTMN (m)	Base Elevation (m)	Stack Height (m)	Stack Diameter (m)
Cooling Tower 9A	327501.1	4691981.7	2.73	10.03	3.96
Cooling Tower 9B	327497.6	4691980.0	2.73	10.03	3.96
Cooling Tower 9C	327493.8	4691976.7	2.73	10.03	3.96
Cooling Tower 9D	327490.3	4691975.0	2.73	10.03	3.96
Cooling Tower 10A	327542.2	4692034.4	2.73	30.21	6.78
Cooling Tower 10B	327534.2	4692027.3	2.73	30.21	6.78

Table 4-13 Worst-case Operating Conditions for Existing MIT Stacks by Pollutant and Averaging Period

Pollutant	Averaging Period	Boiler 7/9 Stack	Boilers #3,4,5	Turbine
PM_{10}	Short-term	Boiler #9 alone full load	Full load	Full load
$PM_{2.5}$	Short-term	Boilers #7 and #9	Full load	Full load
	Annual	Boiler #9 alone full load	Minimum Load	Full load
NO_2	Short-term	Boiler #9 alone full load	Full load	Full load
	Annual	Boiler #9 alone full load	Full load	Full load
SO_2	Short-term	Boiler#7and#9	Full load	Full load
	Annual	Boiler #9 alone full load	Minimum Load	Full load
CO	Short-term	Boiler#7and#9	Full load	Full load

Table 4-14 Existing MIT Source Characteristics and Emission Rates

Stack	Operating Condition	Short-Term/ Annual	Exit Temp (K)	Exit Velocity (m/s)	PM_{10} (g/s)	$PM_{2.5}$ (g/s)	SO_2 (g/s)	NOx (g/s)	CO (g/s)
Boilers 7 & 9	Boilers 7 & 9 (full load)	Short-Term	473.7	17.68	0.83	0.83	4.16E-2	2.09	0.97
		Annual			-	0.29	4.16E-2	0.35	-
	Boiler 9 only (full load)	Short-Term	430.4	8.06	0.45	0.45	2.27E-2	1.50	0.53
		Annual			-	0.164	2.27E-2	0.20	-
Boilers 3,4,5	Full Load	Short-Term	430.4	5.91	2.62	2.62	7.18E-2	14.27	1.90
		Annual			-	1.45	7.18E-2	9.61	-
	Minimum Load	Short-Term	405.4	0.73	0.32	0.32	8.82E-3	1.76	0.23
		Annual			-	0.179	8.82E-3	1.18	-
Turbine #1	Full Load	Short-Term	405.4	35.79	1.756	1.756	5.92E-2	5.87	0.88
		Annual			-	0.63	5.92E-2	3.13	-
Generator	Full Load	Short-Term	790.3	61.94	9.58E-2	9.58E-2	4.03E-3	0.15	0.28
		Annual			-	3.28E-3	1.39E-4	0.15	N/A
Cooling Tower 1 per eel I (2)	N/A	N/A	298.7	8.0	3.33E-3	3.33E-3	N/A	N/A	N/A
Cooling Tower 2 per cell (2)	N/A	N/A	298.7	8.0	3.33E-3	3.33E-3	N/A	N/A	N/A
Cooling Tower 3 per cell (2)	N/A	N/A	298.7	8.0	5.86E-3	5.86E-3	N/A	N/A	N/A
Cooling Tower 4 per eel I (2)	N/A	N/A	298.7	8.0	5.18E-3	5.18E-3	N/A	N/A	N/A
Cooling Tower 5	N/A	N/A	298.7	8.0	2.15E-3	2.15E-3	N/A	N/A	N/A
Cooling Tower 6	N/A	N/A	298.7	8.0	2.15E-3	2.15E-3	N/A	N/A	N/A
Cooling Tower 7 per cell (4)	N/A	N/A	298.7	8.0	4.91 E-3	4.91 E-3	N/A	N/A	N/A
Cooling Tower 8 per eel I (4)	N/A	N/A	298.7	8.0	4.91 E-3	4.91 E-3	N/A	N/A	N/A
Cooling Tower 9 per eel I (4)	N/A	N/A	298.7	8.0	2.65E-3	2.65E-3	N/A	N/A	N/A
Cooling Tower 10 per cell (2)	N/A		298.7	8.0	4.40E-3	4.40E-3	N/A	N/A	N/A

' This emission rate is scaled by the permitted hours of operation per EPA Guidance, (http://www.epa.gov/nsr/documents/20100629no2guidance.pdf)

4.5.5 Background Air Quality Data

Modeled concentrations due to emissions from the Project are added to ambient background concentrations to obtain total concentrations. These total concentrations were compared to the NAAQS and MAAQS. To estimate background pollutant levels representative of the area, the most recent air quality monitor data reports published by MassDEP were obtained for 2012 through 2014. Data is also available via the EPA website (http://www.epa.gov/airquality/airdata) and was used for the 3-hour and 24-hour SO_2 averages since these are no longer included in the published monitor reports. Background concentrations were determined from the most representative available monitoring stations to the MIT CUP. The most representative monitoring site is also the closest monitoring site, located at Kenmore Square in Boston, MA, approximately 0.9 miles from the MIT CUP. All pollutants are monitored at Kenmore Square—i.e., SO_2, CO, NO_2, PM_{10}, and $PM_{2.5}$. A summary of the background air quality concentrations based on the 2012-2014 data are presented in Table 4-15. For the short-term averaging periods, the form of the standard value is used, and the highest monitored value is used for annual averages.

Table 4-15 Observed Ambient Air Quality Concentrations and Selected Background Levels

Pollutant	Averaging Period	2012	2013	2014	Background Level	NAAQS
SO_2 ($\mu g/m^3$)	1-hour	13.2	31.4	25.4	23.3	196
	3-Hour[a]	27.8*	36.4*	24.6*	36.4	1,300
	24-Hour[b]	14.1	15.7*	13.1*	15.7	365
	Annual	4.9	2.6	2.5	4.9	80
CO ($\mu g/m^3$)	1-Hour	1489.8	1489.8	1962.4	1962.4	40,000
	8-Hour	1031.4	1031.4	1260.2	1260.2	10,000
NO_2 ($\mu g/m^3$)	Annual	33.5	33.5	32.3	33.1	100
PM_{10}($\mu g/m^3$)	24-Hour	28.0	50.0	53.0	53.0	150
$PM_{2.5}$ ($\mu g/m^3$)	Annual[c]	9.0	8.0	6.0	*7.7*	12

Notes:

* (conversion factors of 1 ppm = 2620 $\mu g/m^3$ SO_2; =1146 $\mu g/m^3$ CO; and 1882 $\mu g/m^3$ NO_2 used).

* data obtained from EPA at http://www.epa.gov/airquality/airdata;

[a] Background level for 3-hour SO_2 is the highest-second-high SO_2 value (obtained from EPA website).

[b] Background level for 24-hour SO_2 and PM_{10} is based on the highest-second-high value.

[c] Background level for Annual $PM_{2.5}$ is the average concentration of three years.

4.5.6 *National Ambient Air Quality Standards Analysis*

Since the proposed Project is a modification to an existing facility, a compliance demonstration was conducted to ensure that the combined emissions from the existing facility and the proposed modification will not cause or contribute to a NAAQS violation for that pollutant (MassDEP, 2011). For the pollutants and averaging periods which had Project impacts below the SILs, the appropriate modeled concentrations were combined with appropriate ambient background concentrations prior to comparison with the NAAQS. For those pollutants and averaging periods with Project impacts above the SILs, cumulative source modeling was conducted.

AERMOD modeling was performed for the pollutants and averaging periods which had Project impacts below the SILs. The new MIT sources were modeled with the existing MIT sources; then the appropriate modeled concentrations were combined with appropriate ambient background concentrations prior to comparison with the NAAQS. For Operational Scenario 1 when only one new turbine is in operation, the existing turbine is still operating. The existing turbine will be shut down once two new turbines are in operation (Operational Scenario 2). For Operational Scenario 2, the flues for the two new turbines are merged and modeled with an effective diameter of 9.9 feet. Table 4-16 presents the criteria pollutant concentrations compared to the NAAQS for each operating scenario. The total concentration (modeled plus background) are below the NAAQS for all pollutants.

Table 4-16 AERMOD Model Results for the Full MIT Facility for Operational Scenarios 1 & 2 Compared to the NAAQS1

Poll.	Avg. Period	Form	AERMOD Modeled Conc.	Background Conc. (µg/m³)	Total Conc. (µg/m³)	NAAQS (µg/m³)	% of NAAQS	Period	Receptor Location (m)
Operational Scenario 1 (1 new turbine/HRSG)									
SO_2	1-Hour	H4H	3.0	23.3	26.3	196	13%	2010-2014	327500.08, 4692212.84, 2.73
	3-Hour	H2H	2.8	36.4	39.2	1300	3%	3/12/13 Hr: 12	327500.08, 4692212.84, 2.73
	24-Hour	H2H	1.7	15.7	17.4	365	5%	3/12/13 Hr: 24	327500.08, 4692162.84, 2.73
	Annual	H	0.26	4.9	5.2	80	6%	2010	327550.08, 4692062.84, 2.73
CO	1-Hour	H2H	67.1	1962.4	2029.5	40000	5%	7/26/11 Hr: 13	327500.08, 4692212.84, 2.73
	8-Hour	H2H	44.2	1260.2	1304.4	10000	13%	5/16/14 Hr: 16	327500.08, 4692162.84, 2.73
Operational Scenario 2 (2 new turbines/HRSGs)									
SO_2	1-Hour	H4H	3.0	23.3	26.3	196	11%	2010-2014	327450.08, 4692162.84, 2.73
	3-Hour	H2H	2.7	36.4	39.1	1300	7%	5/16/14 Hr: 12	327500.08, 4692212.84, 2.73
	24-Hour	H2H	1.67	15.7	17.4	365	10%	12/30/12 Hr: 24	327550.08, 4692062.84, 2.73
	Annual	H	0.22	4.9	5.12	80	4%	2010	327550.08, 4692062.84, 2.73
CO	1-Hour	H2H	57.0	1962.4	2019.4	40000	5%	7/10/10 Hr: 11	327500.08, 4692212.84, 2.73
	8-Hour	H2H	38.5	1260.2	1298.7	10000	13%	5/16/14 Hr: 16	327500.08, 4692162.84, 2.73

[1] PM_{10} 24-hour, $PM_{2.5}$ 24-hour, $PM_{2.5}$ Annual, NO_2 1-hour, NO_2 Annual impacts from MIT are reported in 4-17

[2] High 4th High (99th%) maximum daily 1-hour concentration averaged over 5 years.

The results of the SILs analysis are used as the basis for the cumulative impact modeling. The Project's impacts are above the 24-hour and annual $PM_{2.5}$, 24-hour PM_{10} and 1-hour and annual NO_2 SILs at some receptor locations. Cumulative impact modeling is required at these receptors to verify that the Project is not contributing significantly to a violation of the NAAQS.

Non-MIT facilities required for inclusion in the cumulative modeling are those emission sources within 10 km of the MIT CUP that emit significant $PM_{2.5}$, PM_{10} or NO_2 emission rates (>10 tpy $PM_{2.5}$, > 15 tpy PM_{10} or >40 tpy NO_2 based on reported actual emissions). Four nearby facilities have been identified satisfying the criteria for PM_{10} and $PM_{2.5}$. Two additional sources were identified satisfying the criteria for NO_2. The following facilities were identified as interactive sources for modeling purposes:

1. Veolia Kendall Station (~1.2 km to the east-northeast of MIT CUP)
2. Harvard Blackstone (~1.8 km to the west-northwest of MIT CUP)
3. MATEP (~3.0 km to the southwest of MIT CUP)
4. Boston Generating Mystic Station (~3.8 km to the north-northeast of MIT CUP)
5. (NO_2 Only) Logan Airport (~5.9 km to the east-northeast of the MIT CUP)
6. (NO_2 Only) Kneeland Street (~3.2 km to the east-southeast of the MIT Cup)

Cumulative AERMOD modeling was conducted for each of the Project Operating Scenarios with predicted impacts above the SILs. The results of the cumulative source air quality modeling are presented in Table 4-17. The cumulative AERMOD modeling demonstrates that the Project sources in any of the Operating Scenarios will not cause or contribute to a violation of the NAAQS.

Table 4-17 AERMOD Model Results for the Full MIT Facility with Interactive Sources for Operational Scenarios 1 &2 Compared to the NAAQS

Poll.	Avg. Period	Form	Total Conc (μg/m3)	AERMOD Predicted Contribution (μg/m3)							Background Conc.	NAAQS	% of NAAQS	Period	Receptor Location (m) (UTME, UTMN, Elev.)
				MIT	Kendall Station	Harvard Blackstone	MATEP	Mystic Station	Kneeland Street	Logan Airport					
Operational Scenario 1 (1 new turbine/HRSG)															
NOx	**1-Hour**	H8H	155.2	82.5	0.01	0.01	0.02	0.02	0.011	0.042	72.6	188	82.5%	2010-2014	327500.08, 4692212.84, 2.73
	Annual	H	54.8	4.5	1.03	1.01	0.78	0.61	0.47	0.25	46.2	100	54.8%	2010	327550.08, 4692112.84, 2.73
PM_{10}	**24-Hour**	H6H	84.7	31.6	0.002	0.04	0.021	0.0047	N/A	N/A	53	150	56.5%	12/13/10 Hr: 24	327500.08, 4692212.84, 2.73
$PM_{2.5}$	**24-Hour**	H8H	33.4	16.3	0.01	0.34	0.00	0.02	N/A	N/A	16.7	35	95.4%	2010-2014	327550.08, 4692062.84, 2.73
	Annual	H	11.2	2.6	0.18	0.51	0.05	0.21	N/A	N/A	7.7	12	93.6%	2010-2014	327550.08, 4692112.84, 2.73
Operational Scenario 2 (2 new turbines/HRSCs)															
NOx	**1-Hour**	H	139.7	54.3	0.129	0.106	0.058	0.033	0.043	0.038	85.0	188	74%	2010-2014	327550.08, 4692062.84, 2.73
	Annual	H	54.4	4.1	1.0	1.0	0.8	0.6	0.5	0.3	46.2	100	46.2%	2010	327550.08, 4692112.84, 2.73
PM_{10}	**24-Hour**	H	76.7	23.6	0.0032	0.0092	0.01452	0.0099	N/A	N/A	53	150	51%	5/23/11 Hr: 24	327500.08, 4692162.84, 2.73
$PM_{2.5}$	**24-Hour**	H	34.4	18.1	0.014	0.40	0.010	0.014	N/A	N/A	15.9	35	98%	2010-2014	327550.08, 4692062.84, 2.73
	Annual	H	11.0	2.34	0.18	0.51	0.05	0.21	N/A	N/A	7.7	12	92%	2010-2014	327550.08, 4692062.84, 2.73

High 8th High (98th%) maximum daily 1-hr concentration averaged over 5 years with seasonal/diurnal background; PVMRM used for conversion of NOx to NO2

[2] Annual NO_2 uses ARM for NOx to NO_2 conversion of 0.75 per EPA Guidance http://www.epa.gov/scram001/guidance/clarification/Additional_Clarifications_AppendixW_Hourly-NO2-NAAQS_FINAL_03-01-2011.pdf

4.5.7 PSD Increment Modeling

The Project is a major modification of an existing major source, subject to the requirement to obtain a PSD permit. Beyond the MAAQS/NAAQS modeling presented above, PSD increment modeling is required for fine particulates (PM_{10} and $PM_{2.5}$). A PSD increment is the maximum allowable increase in concentration that is allowed to occur above a baseline concentration for a pollutant. The baseline concentration is defined for each pollutant (and relevant averaging period) and, in general, is the ambient concentration existing at the time that the first complete PSD permit application affecting the area is submitted. Significant deterioration is said to occur when the amount of new pollution would exceed the applicable PSD increment.

Modeling to show that allowable increments are not exceeded must include existing sources that are both within the baseline area and were constructed after the PSD baseline date, and can include credit for increment expanding sources (those that have added controls or stopped operating) after the PSD baseline date.

For the PSD increment modeling, new project sources are be modeled at their maximum allowable emissions rates, while the increment expanding sources at MIT (i.e., retiring existing turbine, switch from No. 6 oil to No. 2 oil on Boilers 3, 4, 5, 7 and 9, and retiring cooling towers) are modeled at their maximum actual emission rates (using a negative emission rate in AERMOD). Since the baseline has not been previously established for $PM_{2.5}$, there are no other $PM_{2.5}$ increment-consuming sources in the baseline area to include in the PSD Increment Modeling. However, for PM_{10}, the baseline has been established and the following sources are included as increment consuming: GenOn Kendall Station, Harvard Blackstone, MATEP, and Mystic Generating Station.

The PSD increment comparison was run for Operational Scenario 2 only as this is the final build scenario for this project. The maximum resultant impact is used for annual averages and the highest second-high resultant impact is used for the 24-hr averages.The results of the PSD increment analysis are presented in Table 4-18. The analysis show that applicable PSD increments are not exceeded at any receptor for any Project Operating Scenario.

Table 4-18 AERMOD Model Results for Operational Scenario2 compared to PSD Increments

Poll.	Avg. Period	Form	Resultant Modeled Conc. ($\mu g/m^3$)	Increment (μg/m3)	% of Increment	Period	Receptor Location (m) (UTME, UTMN, Elev.)
Operational Scenario 2 (2 new turbines/HRSGs)							
PM_{10}	24-hr	H2H	8.85	30	29.5	5/9/10 hr 24	327650.08, 4692062.84, 2.74
$PM_{2.5}$	24-hr	H2H	8.25	9	91.7%	11/14/11 hr 24	327850.08, 4692362.84, 2.74
	Annual	H	1.34	4	33.5%	2010	327550.08, 4692062.84, 2.73

4.5.8 Non-Criteria Pollutant Modeling

In addition to the MAAQS/NAAQS analysis, an air quality impact assessment of the non-criteria pollutants emitted from the proposed combustion sources (two new turbines and 2-MW cold-start emergency engine) was conducted. EPA AP-42 and California Air Toxics Emission Factor (CATEF) emission factors were used to derive the emission rates. The highest 24-hour and annual normalized AERMOD predicted concentrations were used, and then scaled by the pollutant emission rate to obtain the predicted concentration of each pollutant. The results in Appendix D of the MCPA application (available online at powering.mit.edu) present the worst-case predicted non-criteria pollutant air quality impacts for those pollutants for which MassDEP has an annual Allowable Ambient Limit (AAL) or a 24-hour Threshold Effects Exposure Limit (TEL). The results show that air quality impacts from the non-criteria emissions are well below the threshold levels of the corresponding MassDEP AALs and TELs.

Section 5.0

Greenhouse Gas

5.0 GREENHOUSE GAS

This section addresses GHG emissions generated by the Project, and options that may reduce those emissions in accordance with the MEPA Greenhouse Gas Emissions Policy and Protocol (GHG Policy). The GHG Policy requires that certain projects undergoing review by the MEPA Office quantify the Project's GHG emissions and identify measures to avoid, minimize, or mitigate such emissions. In addition to quantifying project-related GHG emissions, the GHG Policy also requires proponents to quantify the impact of proposed mitigation in terms of energy savings and GHG emissions.

The analysis provided herein focuses on emissions of carbon dioxide (CO_2). As noted in the GHG Policy, there are other GHGs, but CO_2 is the predominant contributor to global warming. Furthermore, CO_2 is by far the predominant GHG emitted from the types of sources related to projects subject to the GHG Policy, and CO_2 emissions can be calculated for these source types with readily available data.

MIT met with the MEPA Office and DOER on March 31, 2016 to discuss the scope and content of the GHG analysis for this SEIR. This section accounts for that discussion.

5.1 Updates since the EENF

Section C-2 of the EENF attachments, specifically, Subsection C-2.4, stated: "The project turbine selection is not final, and options are being considered for two slightly smaller CTGs [combustion turbine generators] and duct burners. Generally, the project as described is the largest of the options being considered; other options would maintain the same general configuration and operation while producing less power and having lower impacts."

That consideration of alternatives has continued, focusing on some of the same issues raised in the DOER comment letter, specifically the DOER comment: "The DOER supports the selection of the CTGs and the HRSGs such that the CTG will maximize its annual capacity factor and average electrical generating efficiency." Through the design process, MIT was looking at this issue independently.

Very specifically looking at the options presented in the EENF and looking at the issues raised in the DOER comment letter, MIT's engineering consultant Vanderweil performed hour-by-hour dispatch modeling for each of the years 2019-2030 for different turbine options. The slightly smaller CTs performed better on a campus-wide GHG impact basis, because they allowed more hours of cogeneration (where fuel is fired into the CT to generate electricity, and heat from the turbine creates useful heat energy for the campus). In addition to the overall benefit of operating a cogeneration plant more often vs. buying power from the utility and making steam with conventional boiler, these small units run more efficiently at the forecasted MIT load, thus burning less fuel and consequently generating fewer GHG emissions. The duct burner size remains unchanged.

This SEIR presents the design decision to use the smaller turbine (Solar T250). The better GHG profile as modeled by Vanderweil is presented, along with additional analysis that shows the load profile over the design period (2019-2030), a breakdown of expected firing of the CTs, their associated duct burners, and existing boilers, and further quantification of the major sources of parasitic electric consumption of electricity due to auxiliary and the balance of plant systems.

5.2 GHG Policy Summary

The GHG Policy requires the Proponent to calculate and compare the GHG emissions in two cases, and then consider other mitigation.

Case 1 is the baseline from which change in energy use and GHG emissions reductions are measured.

Case 2 represents the proposed project, including measures incorporated to reduce GHG emissions.

Other Mitigation. In addition to these two cases, the GHG Policy requires that all feasible mitigation measures that could reduce GHG emissions be considered.

For quantifying emissions, the GHG Policy focuses on three categories: building-related stationary source emissions; process-related stationary source emissions; and indirect emissions from transportation. Of these, the Project nearly exclusively involves process-related stationary source emissions. The Project will have direct emissions from fuel consumption and indirect emissions from electricity/energy consumption.

The proposed Project consists of the extension of an existing building with a footprint of approximately 26,500 square feet and 63' AGL tall, with two 167' AGL high flues centrally co-located in a common stack structure, and one 93.5' AGL high cold-start engine flue located atop its housing. The new space will predominantly house the energy generation and support equipment, and will not be subject to the same HVAC demands as typical office, commercial, or residential space. The building extension will comply with Cambridge building code requirements, including compliance with the Stretch Energy provisions of the State Building Code. No significant new water use or wastewater generation is proposed, and no net new traffic trips are expected.

5.3 Baseline and Proposed Cases

5.3.1 Identified Baseline and Proposed Cases

The GHG Policy provides the following guidance for identifying the baseline case:

establish a project baseline for the industrial component of the project by estimating the amount of fuel or electricity to be consumed by the specific processes without any mitigation measures (sometimes referred to as the "business as usual" scenario). The intent of this calculation is to estimate emissions from GHG-intensive industrial processes such as power plants, energy-intensive manufacturing processes, or other industrial processes, in order to provide a better understanding of overall project emissions.

And the following guidance for the proposed case:

calculate emissions reductions associated with upgrading the efficiency of industrial processes (by calculating reduced fuel or electricity consumption).

The "business as usual" scenario would be the separate generation of electricity and thermal energy. This choice of baseline is consistent with MassDEP and EPA precedent. Specifically, the MassDEP Environmental Results Program (ERP) regulations "encourage the installation of Combined Heat and Power (CHP) systems" by establishing "a methodology that enables the applicant to...take into account emissions that will not be created by omitting a conventional separate system (e.g., boiler) to generate the same thermal output." (quote from 2008 regulatory proposal). The EPA Energy Star CHP Award is for "fuel and emissions savings over comparable, state-of-the-art separate heat and power generation."

The proposed case is consistent with the air plan approval application and includes the CTs and duct burner. Emissions in the proposed case are calculated based on full-load, year-round operation firing natural gas; this is consistent with the use of a natural gas-fired boiler in the baseline case. Although the Project will have backup ULSD firing, the ULSD would be used in situations where a boiler would also be firing ULSD. Keeping both the baseline and proposed cases as gas-only allows a consistent comparison.

The calculation conservatively does not take credit for the fact that the duct burner will be more efficient than a similarly-sized boiler, because the combustion air is preheated.

5.3.2 Other Alternatives

The DOER comment letter states "As the proposed facility will operate essentially as a behind the meter source for the MIT campus loads, the DOER agrees with the selection of the Base case as used in this submittal." The calculation of net source GHG reduction is based on the calculation methodology provided by DOER for this Project on November 7, 2014. The selections of baseline and alternative cases, and calculation methodologies, were reviewed with the MEPA Office and DOER for this Project during pre-filing meetings on November 10, 2014 and August 11, 2015.

During the March 31, 2015 meeting with DOER and MEPA staff, an option was discussed to establish the baseline as the potential emissions from the Project as applied-for in the MassDEP MCPA application, the proposed case established as any proposed measure that would reduce that emission rate, and further mitigation as any feasible measure beyond what is proposed by MIT. As described in Section 4 of this SEIR, the potential emission rate of CO_2 from the Project, as applied for in the MCPA application, is 362,740 tons per year. These are direct emissions from fuel combustion from the affected air emission units in the MCPA. Potential emissions account for the rated capacity of the equipment and any proposed federally-enforceable operating restrictions, and do not reflect practical downstream bottlenecks that would limit actual emissions. In this case, the potential emission rate could not be actually emitted because MIT would have nowhere to put the steam generated. Improvements to the net amount of electricity or steam generated by the Project would not change the Project's potential emission rate in the MCPA process; consistent with MassDEP guidance and precedent for CHP projects, the proposed emission limits are calculated per unit of fuel burned. Therefore, on the same basis, the proposed-case and mitigated-case emission rates would be the same potential 362,740 tons per year as none of the energy efficiency measures would decrease the amount of fuel that could be fired in the combustion units, or impose any federally-enforceable operating restriction. Note that in the purely hypothetical case where MIT could utilize all the electricity and steam generated, the use of the CHP would have lower overall CO_2 emissions than using grid electricity and steam from conventional boilers.

5.4 Quantifying Emissions

The GHG Policy has the following guidance for quantifying GHG emissions:

> *In order to quantify direct emissions, the proponent should estimate fuel consumption associated with industrial processes and then derive the approximate CO_2 emissions by using a reliable data source that contains emission factors for CO_2 based on fuel type. To quantify indirect emissions, the proponent should estimate the amount of electricity to be consumed by the industrial processes and then multiply total purchased electricity usage by an emissions factor that calculates the CO_2 emitted through the generation of electricity.*

The emission factors used in the GHG calculations are:

- 117 pounds of CO_2 per MMBtu of natural gas used, consistent with US Energy Information Administration national average;
- 941 pounds of CO_2 per megawatt hour electricity generated, the current Marginal Emission Factor for the ISO-NE Grid (2014) as provided in example DOER calculations for analysis of CHP as discussed in Section 5.9 below; and

- 726 pounds of CO_2 per megawatt hour of electricity generated, the current Annual Average Emission Factor for the ISO-NE Grid (2014 draft) for calculation of balance-of-plant GHG savings per the GHG Policy.

In its comments, the City of Cambridge requests that this SEIR evaluate GHG impacts assuming a declining GHG emissions factor for electricity purchased from the grid (as more grid electricity is obtained from renewable sources). For consistency with the EENF calculations and the GHG Policy, the calculations in this GHG analysis continue to use the most recent emission factors as provided by ISO-NE. However, MIT has conducted a separate analysis that includes an expected decline in GHG emissions from grid electricity. The results of this separate analysis are presented in Section 12, Response to Comments (CAM.1); the results show a significant GHG benefit associated with the Project.

5.5 Other Mitigation

To identify all feasible mitigation measures that could reduce GHG emissions, MIT considered the following:

- Renewable energy generation: The use of solar photovoltaic (or solar hot water) is precluded by the lack of available roof or ground space for solar panels at the CUP. Similarly, there is no feasible location for a wind turbine or a ground source heat pump system. MIT continues separate efforts to incorporate solar energy elsewhere on campus. MIT currently has approximately 70 kw of installed capacity of solar photovoltaics on campus and (separate from this Project) is undertaking a comprehensive assessment of roofs to identify opportunities for application of a range of sustainable roof technologies such as solar photovoltaic, green/white/blue roof, and increased insulation.

- Selection of a different CHP technology: For a project of this size, a combustion turbine is more efficient and cost-effective than other technologies such as fuel cells. Gas engines were discounted due to the electric power and steam production needs being considered. The engines had higher emissions and a larger footprint, and were rejected as an option for size constraint, local air emissions, and cost reasons. Note that while the electrical efficiency of gas engines can be higher, the overall plant efficiency would be lower because MIT does not currently have a reasonable use for thermal energy from low grade jacket water produced by the engine.

- Selection of a different combustion turbine: As discussed in Section 5.6 below, the turbine options selected are the most efficient available to meet the identified Project need. A review of turbine options has resulted in MIT selecting a slightly smaller turbine than was used for the EENF impact assessments. This turbine was selected because it provides better GHG benefits for MIT's load profile.

- Minimization of parasitic loads: As discussed in Section 5.7 below, MIT will minimize loads to the extent technically and economically feasible.

5.6 Minimize GHG Emissions: Turbine Selection

When identifying candidate turbines for the Project, MIT reviewed options based on four general criteria:

- Ability to meet the needs of the MIT campus for capacity and reliability;
- First cost and long-term operating cost;
- Ease of integration into existing facility; and
- Ability to supply electric and thermal energy efficiently and cost-effectively.

MIT has continued its review of turbine options since filing the EENF to identify a configuration that best fits campus needs. Electrical generation efficiency is only one element of a properly-designed CHP system. The overall CHP project efficiency is for the combination of electric power and thermal energy; if less energy is converted to electricity, more is available for thermal energy. A well-designed CHP system is well matched to the electric and thermal loads it is serving.

As part of its evaluation, MIT performed an hour-by-hour model of CUP operation (including the proposed turbines, associated duct burners, and existing boilers) against projected MIT campus electric and thermal loads. This model was run for the entire Project design period (2019-2030), with two different sets of assumptions for MIT campus electric and thermal loads. The model results consistently showed that a slightly smaller turbine model (Solar Titan 250) met MIT's needs with lower GHG emissions than the turbine that was used for the EENF evaluation. Both turbine/HRSG combinations had similar full load electric and thermal efficiencies. The key difference was the ability of the smaller turbine to effectively meet MIT's energy needs for more hours of the year using fuel fired in the combustion turbine, allowing more hours of true cogeneration (where fuel is fired in the turbine to generate electricity, and the hot exhaust is used to generate useful thermal energy). For the larger turbine configuration, there were more modeled hours when one turbine would be shut off and a larger portion of the campus energy needs would be met using grid electricity and duct firing.

Table 5-1 below provides an apples-to-apples comparison of two turbine configuration options, and annotation explaining how the slightly smaller turbine is a better fit to maximize efficient cogeneration.

Table 5-1 Comparison of CHP Configurations

CT Model	Total Run Time (2 CTs) (hrs/year)	Total Generated Electric (MWh/yr)	Total Purchased Electric (MWh/yr)	Total CT Gas Usage (MMBtu/yr)	Total DB Gas Usage (MMBtu/yr)	Steam Generated by CT & DB (mmBtu/yr)	Total Existing Boiler Gas Usage (MMBtu/yr)
Solar T250	14,219	273,964	85,882	2,537,725	324,375	1,446,663	2,154
GE LM2500	11,695	234,421	125,115	2,353,174	337,896	1,463,185	1,675
Notes	The T250 turbines can remain operating for more hours of the year, generating more electricity.		This results in lower electricity purchases, and lower GHG emissions from grid electricity.	More fuel is fired in the CTs, and less in the duct burners, allowing for more cogeneration.		For both cases, the CTs and duct burners provide almost all the campus steam needs. Existing boilers remain for reliability, but generally do not run.	

Basis: 2023 modeled loads, B39 load estimate case, with medium-temperature hot water

Vendor brochures for the Titan 250 turbine are presented in Appendix 2. Turbine manufacturers add and modify turbine models over time. If by the time the turbine order is being placed a new or modified turbine model is available, and that turbine meets the descriptions in the MassDEP application and MEPA review processes, MIT will consider the new turbine model.

The thermal efficiency of the HRSG will be significantly higher than for an equivalent stand-alone boiler. MIT expects a 95 percent thermal efficiency in the final design. As such, MIT expects to use the HRSGs to meet most of the campus thermal energy needs, keeping the existing boilers as backup units. The thermal efficiency of the final design will be a function of space constraints, the mechanical and structural considerations involved in integrating the HRSG with the rest of MIT's steam generation and supply equipment, catalyst placement requirements, etc.

5.7 Minimize GHG Emissions: Balance of Plant

Balance-of-Plant project elements include design of the HRSG, implementation of turbine support systems such as inlet air cooling/heating, and parasitic loads. Parasitic loads are electrical loads associated with the generating equipment that decrease the net electrical output of the system. These are typically support equipment necessary for plant operation. MIT has evaluated each load and minimized energy use to the extent feasible.

Much of the support equipment for the Project is in place at MIT (transformers, switchgear, cooling equipment, etc.). MIT has identified the following balance-of-plant elements where energy savings are possible:

1) Fuel Gas Compressors: The turbines need high-pressure natural gas for efficient operation. The compressor can be fitted with a variable frequency drive (VFD) to increase efficiency at part load. If significant part load operation is expected, 10 percent to 20 percent efficiency gain is possible. *MIT proposes to use a VFD fuel gas compressor.*

2) Combustion Air Cooling: Combustion turbines are more efficient with denser, colder air. Combustion air cooling only occurs on warmer days when additional electric generation is needed. The additional electricity generated by lower temperature inlet air exceeds the parasitic power of the chillers. The incremental electricity generated by the turbines will likely be lower-emitting than other grid generators called to meet the increased demand. For this application, chilled water from the existing chilled water system would be used to reduce the combustion air temperature to 60°F. This includes sensible and latent cooling. This can result in a net GHG savings in some conditions, but model results do not show a GHG savings for this application. *MIT proposes to install the connections and leave space to retrofit combustion air cooling in the future.*

3) Chilled Water Free Cooling (Combustion Air Heating): During cold weather conditions (below 35°F), some turbines can be operated more efficiently with warmer combustion inlet air. While this was true for the larger turbine model used as the design basis in the EENF, different turbines have different efficiency profiles and the Titan 250 turbine does not show an efficiency improvement. Inlet air heating can still provide protection against water/ice formation in the inlet air duct, and improved SCR performance, which reduces water and chemical consumption. Rather than using electric heaters, the Project can use the Combustion Air Cooling coils to chill the Campus Chilled Water System while simultaneously increasing the inlet air temperature (and providing an energy improvement by cooling the chilled water stream). This is only available if the Combustion Air Cooling coils are installed. *MIT proposes to install the connections and leave space to retrofit chilled water free cooling in the future.*

4) Turbine Enclosure Support Systems: Fans and pumps are required to maintain the turbine operation. High-efficiency motors could provide some marginal energy use reductions in fans and pumps, and VFDs could provide some energy savings for motors serving variable loads. Project design has not progressed to the point where specific energy savings can be identified. *MIT will consider high-efficiency motors and VFDs (for motors serving variable loads) in the final Project design.*

5) Urea vaporization: The SCR uses ammonia for air pollution control; MIT will transport and store urea, a safer material to transport and store, vaporizing that urea to generate ammonia as it is needed. Rather than relying solely on electric heaters, available heating can be used to preheat urea, lowering the overall electric load to heat the urea to vaporization. The heat source can be flue gas, steam, or a combination; MIT has selected flue gas heat. *MIT proposes to use waste heat to assist in urea vaporization.*

6) Compressed air drying: Compressed air is needed in the CUP for instrument air and other uses. Moisture must be removed from the compressed air for freeze protection and to avoid fouling instruments. Typically, a desiccant is used to dry the compressed air, and that desiccant material is regenerated by driving the moisture off with an electric heater. Instead, a heat of compression dryer ("MD" model rotary drum adsorption dryer or equivalent) uses compressor waste heat to efficiently separate the water. There is a possible annual savings of 0.98 MWH associated with using an adsorption dryer instead of a desiccant dryer with electric heat regeneration (0.4 tpy CO_2 savings). *MIT proposes to use a heat of compression (adsorption rotary drum) dryer associated with the compressed air system.*

7) Medium Temperature Hot Water: Additional surface area can be built into HRSG for heat recovery that would serve a future medium temperature hot water system on campus. Such a system could be used for heating dormitories or other spaces, using energy that would otherwise be wasted. This future enhancement would reduce overall fuel used to generate additional steam for an energy transfer station. *MIT proposes to construct the HRSG with the surface area and piping required to implement a Medium Temperature Hot Water system, and is initiating a separate project to design and install systems to serve campus thermal loads with medium temperature hot water.*

8) Building Energy Use: The building expansion will include only a nominal amount of conditioned space, with the remainder of the building housing power generation and support equipment. Heating of the conditioned spaces will be done using waste heat from flash steam within the plant. Cooling will be accomplished only to the extent necessary for personnel and equipment. Although there is relatively little opportunity to save energy from heating and cooling, any opportunity will be maximized. MIT has identified lighting in the building expansion as an opportunity to save energy. *MIT proposes to use LED and a occupancy lighting system to reduce energy use in the building expansion.*

For some specific options presented above, MIT has performed energy modeling to quantify the GHG impact of each option compared to a case where none of the options are implemented. Appendix 3 presents the results of this analysis, and includes a list of each significant parasitic load on the CHP system. Table 5-2 below summarizes the GHG impacts from parasitic loads and other balance-of-plant energy uses, potential improvements, and the GHG impacts associated with those improvements.

Table 5-2 GHG Impacts from Balance-Of-Plant Energy Use

Process	Turbine inlet air cooling
Energy Benefits	Generation of ~8000 kW of additional cogenerated electricity during peak summer conditions, providing an GHG improvement over grid-purchased electricity
Energy Costs	Approximately 1200 kW of energy loss associated with chilled water use. Approximately 100 kW of energy loss associated from pumping of glycol heat transfer fluid.
CO_2 impacts	A small *increase* (31 tons CO_2/year) over the same modeled conditions without inlet air cooling.
Notes	MIT has electric and steam-driven chillers, and MIT shifts load between the two chiller types depending on energy available, reliability, and other factors. The modeling also does not address the small efficiency loss associated with pressure drop from the coils. Changes to the chiller energy consumption assumptions could change the model results, but the model shows that combustion air inlet cooling will generally have a neutral GHG impact. MIT will retain the space needed to retrofit combustion air cooling in the future if appropriate.
Process	Turbine Inlet Heating/Winter Free Cooling
Energy Benefits	Small increase in generation cogenerated electricity (~30 kW) during peak winter conditions, providing a small GHG improvement over grid-purchased electricity. Approximately 130 kW of energy saved in the chilled water system.
Energy Costs	Approximately 10 kW of energy loss associated from pumping of glycol heat transfer fluid.
CO_2 impacts	A very small increase (3 tons CO_2/year) over the same modeled conditions without turbine inlet heating/winter free cooling.
Notes	If combustion air cooling is not implemented, the equipment will not be in-place for Turbine Inlet Heating/Winter Free Cooling. MIT will retain the space needed to retrofit combustion air cooling in the future if appropriate.
Process	Fuel Gas Compressor VFD
Energy Benefits	Decrease in parasitic energy use (80 to 120 kW lower) in most conditions, particularly part-load, associated with compressing the fuel gas.
Energy Costs	Slight increase in energy use (~8 kW) during full load winter conditions.
CO_2 impacts	A decrease (65 tons CO_2/year) over the same modeled conditions without VFD on the fuel gas compressor.
Notes	Actual savings will depend on how frequently Eversource provides natural gas at high pressure, and the fuel gas compressors can be turned down.
Process	Ammonia Vaporization with Flue Gas
Energy Benefits	Significant decrease in parasitic energy use (1100 to 1400 kW lower at full load), associated with reduced electric heating of the urea reagent.
Energy Costs	None identified.
CO_2 impacts	A significant decrease (577 tons CO_2/year) over the same modeled conditions without using flue gas heat to vaporize ammonia.
Notes	Some reliability concerns and concerns that the vaporized ammonia may not be available as quickly during a system startup.

Table 5-2 GHG Impacts from Balance-Of-Plant Energy Use (Continued)

Process	Medium Temperature Hot Water
Energy Benefits	Very significant fuel use reduction (~160,000 MMBtu/year) to generate the same amount of useful heat.
Energy Costs	None identified at this stage.
CO_2 impacts	A very significant decrease (9335 tons CO_2/year) over the same modeled conditions without using flue gas heat to vaporize ammonia.
Notes	The design and installation of systems to serve thermal loads with medium temperature hot water is part of a future project. MIT proposes to construct the HRSG with the surface area and piping required to implement a Medium Temperature Hot Water system.
Process	Blowdown Heat Recovery
Energy Benefits	Fuel use reduction (~7,000 MMBtu/year) to generate the same amount of useful heat.
Energy Costs	None identified at this stage.
CO_2 impacts	Decrease (422 tons CO_2/year) over the same modeled conditions without blowdown heat recovery.
Notes	Blowdown heat recovery is being evaluated as part of a future project.

5.8 Concurrent Facility Upgrades

As part of ongoing improvements in the operations at the MIT campus, several upgrade projects are being reviewed for the same time frame as the Project that will serve to improve the overall energy efficiency of MIT's operations. These include:

- Heat recovery for use in heating campus dormitories through medium temperature hot water system. At the conceptual stage, medium temperature hot water can be used to heat buildings in colder months, alternatively producing chilled water when there is excess hot water. MIT is designing the Project to support this as a future addition, as part of the overall existing utilities master plan.
- Automation of the chilled water system to maximize overall efficiency.
- Blow down heat recovery for all boilers.
- Capture of rain water for use in cooling tower make up, reducing use from city water system.
- Improved cooling tower efficiency using permanent magnet motors to drive the cooling tower fans, reducing electrical power usage.
- Improved chilled water efficiency through high efficiency series counter flow chillers.

- Connecting buildings with standalone compressors to the CUP air system. The CUP air system is more efficient than the standalone compressors.

MIT is not in a position to commit to any of these specific measures, and none of them are part of the proposed Project. However, the ongoing efforts to identify and implement energy savings measures will continue and are supported by the proposed Project.

5.9 Revised Energy Model Results

As part of the design evaluation process, MIT has performed an updated technical assessment that included an hour-by-hour model to show how the inclusion of the Project would affect how MIT operates other electricity and steam generating equipment onsite, and how much electricity would be imported from the electric grid for use on campus. This model varies the electric and thermal energy demand across all 8,760 hours/year for each modeled year, based on weather and campus energy use profiles. The operation of the new turbines, the new duct burners, and existing boilers is varied to match the hourly load, and electricity imports are similarly calculated hourly. This model covered expected campus loads from 2019 through 2030, using two different load estimation methodologies. That model showed that, the operation of the Project will minimize the use of the older boilers and reduce the electrical load on the Eversource feeders. This means that the Project will generally reduce the usage of older, less efficient onsite steam generation, reduce the need for imported electricity, and create more thermal energy through efficient cogeneration.

A summary spreadsheet is provided in Appendix 3 which follows a sample calculation provided by DOER and shows the annual results of the plant-wide analysis. This DOER-provided calculation compares, for the same amount of electricity and useful heat, the CO_2 emissions generated by the CHP versus the CO_2 emissions that would be generated by the import of electricity from the distribution grid and creation of the useful heat with conventional natural gas boilers.

Key results are summarized in Tables 5-3 and 5-4, showing that the CHP provides very significant improvements over the separate generation of electricity and thermal energy.

Table 5-3 CHP Fuel Use and Generation, by Year

Year	Total Generated Electricity	Steam Generated	Total CT Gas Usage	Total DB Gas Usage	CHP Electrical Generating Efficiency	Overall CHP Efficiency
	MW	MMBtu	MMBtu	MMBtu	%	%
2019	242,170	1,332,774	2,290,260	312,573	36%	83%
2020	249,648	1,327,743	2,322,499	296,872	37%	83%
2021	254,064	1,344,244	2,359,125	297,732	37%	83%
2022	273,880	1,446,257	2,537,015	324,255	37%	83%
2023	273,964	1,446,663	2,537,725	324,375	37%	83%
2024	273,964	1,446,663	2,537,725	324,375	37%	83%
2025	273,964	1,446,663	2,537,725	324,375	37%	83%
2026	273,964	1,446,663	2,537,725	324,375	37%	83%
2027	273,964	1,446,663	2,537,725	324,375	37%	83%
2028	273,964	1,446,663	2,537,725	324,375	37%	83%
2029	277,368	1,448,187	2,561,783	318,208	37%	83%
2030	281,140	1,468,108	2,594,771	324,982	37%	83%

Table 5-4 GHG Quantification, by Year

Year	Site (CHP) Gross (Stack) Emissions, tons	GHG Displaced from Grid Electricity	GHG Displaced from Conventional Useful Heat System	Total Source GHG Displaced	Net Source GHG Reduction	
	tons/year	tons	tons	tons	tons	%
2019	133,980	113,941	97,459	211,400	77,420	37%
2020	135,866	117,460	97,091	214,551	78,685	37%
2021	138,009	119,537	98,298	217,835	79,826	37%
2022	148,415	128,860	105,758	234,618	86,203	37%
2023	148,457	128,900	105,787	234,687	86,230	37%
2024	148,457	128,900	105,787	234,687	86,230	37%
2025	148,457	128,900	105,787	234,687	86,230	37%
2026	148,457	128,900	105,787	234,687	86,230	37%
2027	148,457	128,900	105,787	234,687	86,230	37%
2028	148,457	128,900	105,787	234,687	86,230	37%
2029	149,864	130,501	105,899	236,400	86,536	37%
2030	151,794	132,276	107,355	239,632	87,838	37%

5.10 Conclusions and Commitments

The Project is an opportunity to provide more efficient and reliable energy to the MIT campus. Through the use of CHP, the Project will improve MIT's energy efficiency, resulting in lower emissions of CO_2 per unit of electricity, steam, and chilled water supplied. This analysis shows that the use of CHP provides a substantial (approximately 37%) GHG reduction compared to the "business as usual" case of separate electricity and steam production, and it further shows that MIT has selected appropriate equipment and operations to minimize the impact of CO_2 emissions.

MIT commits to the following specific GHG reduction measures as part of the Project:

- MIT will purchase and install a combustion turbine that fits the Project description in this SEIR and the related air plans application; final model selection will be made by MIT considering environmental, facility and equipment integration, and economic factors.
- MIT proposes to use VFD for the fuel gas compressor.
- MIT will consider high-efficiency motors and VFDs (for motors serving variable loads) in the final Project design.
- MIT proposes to use waste heat to assist in urea vaporization.
- MIT proposes to use a heat of compression (adsorption rotary drum) dryer associated with the compressed air system.
- MIT proposes to construct the HRSG with the surface area and piping required to implement a Medium Temperature Hot Water system. Installation of the piping loops, etc. to distribute medium temperature hot water is not part of this Project.
- MIT proposes to use LED and occupancy lighting systems to reduce energy use in the building expansion.
- MIT will submit a self-certification to the MEPA Office at the completion of the Project. This certification will identify the GHG mitigation measures incorporated into the Project and will illustrate the degree of GHG reductions from a Baseline case, as Baseline is defined herein, and how such reductions are achieved. Details of the MIT's implementation of operational measures will also be included.

Section 6.0

Noise

6.0 NOISE

6.1 Summary of MCPA Noise Analysis

MassDEP will review Project noise impacts through the MCPA process. The MCPA Noise Analysis (Appendix E of the MCPA) was performed by Acentech. The noise analysis provides a description of the applicable noise regulatory requirements, a brief explanation of noise terminology, a summary of the results of a complete ambient sound level monitoring program, and a discussion of the sound level modeling analysis for operation of the Project.

The results of the sound level assessment in context of the MassDEP Noise Policy are provided below in Sections 6.2 and 6.3. In addition to these results, the Acentech report provides a thorough explanation of environmental noise metrics and sound level measurement methodology. It also describes measurement methods and results establishing background sound levels for comparison to proposed conditions. In brief, there are several ways in which sound (noise) levels are measured and quantified, each of which uses the logarithmic decibel ("dB") scale. An understanding of the effects of equipment sound on the human ear requires "A-weighted" sound level data ("dBA"), while the design of noise control treatments requires octave-band frequency data.

Acentech collected short-term ambient sound measurements and observations at six locations on Friday and Saturday nights (August 8-9 and August 9-10, 2014). Consistent with technical instructions provided by MassDEP, short-term (60-minute) A-weighted broadband and octave band sound level measurements were collected at each location at a height of approximately five feet (1.5 meters) above the ground, under low wind conditions, and during periods with no precipitation. In addition, Acentech collected long-term measurements at the location representative of the closest noise sensitive receptors (residences) to the Project over a nominal two-week period from August 5 to 20, 2016. Established background sound levels at each measurement location are provided below in Table 6-2. Measurement locations are shown on Figure 6-1.

Acentech

Aerial Photograph Showing Planned Location for MIT CHP Addition and Distances to Property Line (PL) and Residential (R) Locations for August 2014 Ambient Sound Survey and Analysis.

Six short-term measurement locations and one long-term measurement location (marked by *); ambient sound measured at long-term Location R-1A is representative of sound at Location R-1.

Location	Approximate Distance from Project Center (ft)
PL-1 (North)	70
PL-2 (Northeast)	650
PL-3 (Southwest)	650
R-1 (Newtowne Ct. Apts.)	580
R-2 (MIT Housing)	1200
R-3 (MIT Housing)	1100

N

6.2 Consistency with Noise Policy

6.2.1 MassDEP Regulatory Context

MassDEP has the authority to regulate noise under 310 CMR 7.10, which is part of the Commonwealth's air pollution control regulations. Under the MassDEP regulations, noise is considered to be an air contaminant and, thus, 310 CMR 7.10 prohibits "unnecessary emissions" of noise.

MassDEP administers this regulation through Noise Policy DAQC 90-001 dated February 1, 1990. The policy limits new noise-generating equipment to a 10-dBA increase in the ambient sound measured (L_{90}) at the property line and at the nearest residences. For developed areas, MassDEP has utilized a "waiver provision" at the property line in certain cases. This is appropriate when are there are no noise-sensitive land uses at the property line and the adjacent property owner agrees to waive the 10-dBA limit. The residences nearest to the Project include the Newtowne Court Apartments on Main Street, which are about 580 feet north of the Project site.

The ambient level is defined as the background A-weighted sound level that is exceeded 90 percent of the time (L_{90}), measured during equipment operating hours. For new noise-generating equipment which will or could operate 24-hours per day, the ambient level typically occurs during the quietest nighttime period (midnight to 4:00 a.m.).

The MassDEP policy further prohibits "pure tone" conditions where one octave-band frequency is 3 dB or more greater than both adjacent frequency bands. An example of a "pure tone" is a fan with a bad bearing that is producing an objectionable squealing sound.

6.2.2 City of Cambridge Noise Requirements

The City of Cambridge has its own noise requirements set forth in Title 8, Chapter 8.16, Noise Control of the City of Cambridge Code of Ordinances. Due to the Project's location in Cambridge, MA, it is subject to these noise requirements as well as the MassDEP requirements set forth above. The standards are enforced only for the source sound levels as a project owner has no control over ambient sound levels. The CUP will be operated continuously and thus must address the more stringent nighttime noise standards for the nearest residential and commercial receptors in the surrounding area. The noise standards can be found in Table 6-1 below.

Table 6-1 City Of Cambridge Zoning District Noise Standards (ref: Table 8.16.060E)

Maximum Allowable Octave Band Sound Pressure Levels (dB)

Octave Band Center Frequency (Hz)	Residential Area		Residential in Industrial		Commercial Area	Industry Area
	Daytime	Other Times	Daytime	Other Times	Anytime	Anytime
31.5	76	68	79	72	79	83
63	75	67	78	71	78	82
125	69	61	73	65	73	77
250	62	52	68	57	68	73
500	56	46	62	51	62	67
1,000	50	40	56	45	56	61
2,000	45	33	51	39	51	57
4,000	40	28	47	34	47	53
8,000	38	26	44	32	44	50

Single Number (dBA)

Equivalent (dBA)	60	50	65	55	65	70

6.2.3 Results

The sound emissions from the Project, which includes the combustion turbine generator packages, heat recovery steam generators, fuel gas compressors, chillers, new cooling towers, cold start generator, support equipment, and cogeneration building, will be specified and designed to address compliance with the MassDEP noise guidelines and City of Cambridge Noise Standards. The tables below present the sound estimates for the Project at the nearest property line and residential locations. As noted below the table, the estimates at the nearest location (PL-1) are based on sound levels measured on the existing new cooling tower, information provided on the CHP equipment and building layout, recommended noise specification values, and the expected building design to meet the overall Project sound criteria. The estimates at the other five more distant property line and community residential locations are based on the PL-1 levels with attenuation to account for distance (i.e., hemi-spherical spreading), but with no additional attenuation associated with other factors, such as shielding by intervening buildings, air absorption, or anomalous excess attenuation.

The results of the sound level modeling for the Project are presented in Table 6-2 below. These results are extracted from the Acentech Noise Report and represent the modeling at Property Line points (PL) and Residential points (R).

Table 6-2 Sound Level Modeling Results Summary Table

Location	Measured Background Sound Level	Modeled Project-Only Sound Level	Combined Project + Background Sound Level	Increase Over Background	Meets MassDEP Noise Policy?
	dBA	dBA	dBA	dBA	
PL-1	61	62	64	3	YES
PL-2	59	43	59	0	YES
PL-3	63	43	63	0	YES
R-1	58	44	58	0	YES
R-2	57	37	57	0	YES
R-3	56	38	56	0	YES

For purposes of evaluating the MassDEP noise policy, future worst-case sound levels would arise by combining the contribution from the Project with the quietest nighttime background sound levels. These totals and their increases are shown in Table 6-2 above. The increase over background at the nearest receptors during these nighttime conditions is expected to range from 0 dBA to 3 dBA, within the relevant MassDEP policy limit of 10 dBA. The results can be broken down to be considered at individual octave bands as well. These results can be found in Table 6-3 below.

Table 6-3 Estimates of Project-Only Sound Pressure Levels and Overall A-Weighted Sound Levels

	Octave Band Center Frequency (Hz)								
Location	31.5	63	125	250	500	1000	2000	4000	8000
PL-1	76	75	70	65	59	53	48	44	41
PL-2	57	56	51	46	40	34	29	25	22
Pl-3	57	56	51	46	40	34	29	25	22
R-1	58	57	52	47	41	35	30	26	23
R-2	51	50	45	40	34	28	23	19	16
R-3	52	51	46	41	35	29	24	20	17

Notes:

1. All data rounded to nearest whole decibel.

The modeled project-only impacts at the residential receptors are below the Cambridge Zoning District Noise Standards, on an octave band and an equivalent dBA basis.

The MassDEP will issue post-construction noise testing requirements as part of the MCPA. MIT will document compliance with the applicable noise standards using the procedures and instructions provided by MassDEP in the MCPA.

6.3 Avoidance, Minimization, and Mitigation

Noise levels from the Project at each of the modeled noise-sensitive receptors, taking into account attenuation due to distance, structures, and noise control measures, are predicted to remain below 10 dBA during even the quietest nighttime hours and will comply with all MassDEP A-weighted and "pure tone" noise limits.

The sound emissions from the Project , which includes the combustion turbine generator packages, heat recovery steam generators, fuel gas compressors, chillers, new cooling towers, cold start generator, support equipment, and new building, will be specified, designed, and operated to address compliance with the MassDEP Noise Criteria and the City of Cambridge Noise Standards. Abatement methods to be employed to control the sound of the Project will include the following:

- Combustion turbine generator sets will be installed in sound-attenuated enclosures.
- Majority of cogeneration equipment will be installed in an acoustically-designed building with appropriate treatments for building ventilation systems and access openings.
- Mufflers will be installed as necessary on the gas turbine air intake, gas exhaust, and turbine enclosure ventilation systems.
- Mufflers will be installed as needed on non-emergency steam vents.
- Reduced-noise lube oil cooler model will be used or sound barrier walls will be installed for the standard model as needed.
- The fuel gas compressor and drive motor will be installed in a sound-attenuated enclosure located on the roof with treated ventilation air paths.
- The cold start diesel generator will be installed in a sound-attenuated enclosure located on the roof with treated ventilation air paths.
- New mechanical draft wet cooling towers will include reduced-noise fans with variable frequency drives to meet sound ordinance.

Administrative spaces will be located on the northern section of the building toward Albany Street. As noted above, the CT will be enclosed and located within the new building, and the fuel gas compressor and cold start diesel generator will be installed in sound-attenuated enclosures located on the roof with treated ventilation air paths. The average sound levels around the enclosed CT and the balance of the CHP area are estimated to be 85 dBA or less. The building walls and roof will have a minimum surface weight of 8 psf or a composite structure that can provide a minimum Sound Transmission Class (STC) rating of STC 30. The equipment and building air ventilation paths will include treatments (e.g., mufflers, lined ducts, acoustic louvers, and local barriers) with suitable sound attenuation. The personnel doors and overhead doors that directly access the main CHP room from outdoors will be specified with an appropriate STC rating. The overall design and construction of the building shell will aim to achieve 55 to 60 dBA directly outside the building walls facing the community.

Section 7.0

Climate Change and Resiliency

7.0 CLIMATE CHANGE AND RESILIENCY

The Proponent recognizes that climate-induced changes in precipitation, sea level, and heat island effect are manifest and will become more pressing. MIT is currently focusing planning resources on identifying where campus vulnerabilities exist and how best to position investments to enhance climate resiliency. The Project directly incorporates resiliency and climate adaptation strategies. MIT will be pursuing both mitigation and adaptation strategies simultaneously.

The expected life of the Project is anticipated to be approximately 20 years. Therefore, the Proponent planned for climate change conditions projected at a 20-year time span. Given the preliminary level of design, these responses are also preliminary and will continue to be evaluated as the Project design progresses.

7.1 Project Context

MIT has a long history of investing in clean energy paired with energy conservation and efficiency to minimize energy input and power output, from the design and development in 1916 of a central heating plant fired by coal, to the adoption of cogeneration using natural gas in 1995. Since the cogeneration facility at the CUP came online in 1995, MIT's annual GHG emissions have been 15-20 percent lower than emissions would have been with conventional energy generation. During its 20 years of cogeneration, MIT has avoided an average of 68,000 metric tons of CO_2 emissions each year compared with conventional energy sources, according to EPA models. The existing facility has used close to one-third less fuel than conventional energy sources would have consumed to generate the same amount of electricity and steam. In recognition, MIT's cogeneration facility received the Energy Star Combined Heat and Power Award in 2002 for environmental excellence from the EPA and U.S. Department of Energy.

MIT's energy conservation program, Efficiency Forward, has been operating since 2010 and continues to implement highly successful conservation measures to reduce energy use across campus. MIT's Efficiency Forward Program is a partnership with NSTAR (now Eversource) that enables the Institute to implement crucial energy efficiency measures across campus.

- Upgrades have included high-efficiency equipment and components in new buildings, upgraded lighting and associated controls in existing buildings, and additional retrofits to improve the efficiency of existing mechanical systems and HVAC systems.

- In its first three-year term, Efficiency Forward helped MIT achieve its annual reduction target of 34 million kilowatt-hours. These savings are equivalent to the electricity consumed annually by 3,000 Massachusetts homes.

- Now in its fifth year, the Efficiency Forward partnership has enabled MIT to achieve an annual reduction of 47 million kilowatt-hours, and the Institute is expecting to reach an annual reduction of 55 million kilowatt-hours by June 2016.

- At the same time, Efficiency Forward is now helping MIT reduce natural gas consumption on campus as well. The initial goal of saving 350,000 therms of natural gas by June 2016 has been far surpassed, as MIT is already on track to reduce consumption by more than 900,000 therms by that date.

In 2015, MIT made an ambitious commitment to reduce GHG emissions by at least 32 percent by 2030, and to proactively strive toward carbon neutrality. To achieve this goal, MIT must adopt a portfolio of GHG reduction strategies to reach its GHG reduction goal. One of several strategies includes the upgrade of the CUP. In addition to the significant reduction of GHG emissions related to the increased efficiency from the Project, as described in Section 5, the upgraded CUP will accommodate and facilitate additional reductions in GHG through the following strategies:

- Reduced carbon fueling:
  - MIT research identifies natural gas as an essential bridge fuel for power generation through 2050. Under a scenario that envisions a federal policy aimed at cutting GHG emissions to 50 percent below 2005 levels by 2050, researchers found a substantial role for natural gas (Scientific America, 2010).
    - Because national energy use is substantially reduced, the share represented by natural gas is projected to rise from about 20 percent of the current national total to around 40 percent in 2040.
    - The study concludes gas is an important option for cutting power plant emissions and addressing global warming in the short term.
    - The study also concludes that preparations need to be made to prepare for the new low-carbon energy future in 2050.
  - Consistent with these findings, switching fuels at MIT from numbers 6 and 2 oil to an all natural gas production (except for testing and in emergencies when gas is not available) will bring significant reductions in emissions due to the lower carbon content of natural gas vs. fuel oil.
  - MIT's CUP-produced electricity is currently less carbon intensive than what is available on the local grid and therefore has lower GHG emissions.
    - As new lower carbon fuels become available and economically feasible, the CUP can be modified to accommodate them, thanks to its flexible design.

- Transmission and distribution improvements:
  - To accommodate and facilitate further GHG reductions, investments in improving the efficiency of MIT's energy distribution system will be undertaken in a phased approach.
  - Important to this is a transition from steam distribution systems for heating to medium or low temperature Hot Water Distribution systems. MIT will be making strategic investments to build out hydronic distribution systems to increase efficiency and reduce GHG emissions.
  - Where conversion to hydronic systems is not economically feasible, existing steam systems will be overhauled to improve efficiency and reduce GHG emissions.
  - At the building level, a move towards hydronic systems can be leveraged by making efficiency improvements in building systems to take full advantage of low and medium hot water distribution. This will facilitate additional reductions in GHG emissions
- Demand-side energy reductions:
  - MIT has initiated an unprecedented expansion of campus-wide energy efficiency programs focused on reducing energy use at the building and individual level—reductions that will be reflected in operations at the CUP.
  - Substantial MIT capital renewal funds are being deployed strategically to simultaneously address deferred maintenance needs and implement additional energy efficiency measures and additional GHG reductions.
  - A new program of conducting multidisciplinary "deep dives" for deep energy retrofits in a priority set of high-energy use buildings will address energy efficiency measures in a comprehensive and multi-system approach to maximize energy and GHG reductions.
  - A new Energy and GHG Working Group has been established to facilitate and coordinate cross-departmental initiatives to reduce GHG emissions beyond MIT's 32 percent reduction goal.
- Renewable energy production and procurement:
  - MIT currently has approximately 70 kw of installed capacity of solar photovoltaics on campus.

- MIT is currently undertaking a comprehensive assessment of roofs to identify opportunities for application of a range of sustainable roof technologies including solar photovoltaic, green/white/blue roof, increased insulation, etc. There is significant potential for expanded renewable energy system development on campus, and with net metering, MIT can continue to integrate expanded solar photovoltaic systems into the CUP distribution system, thus displacing conventionally produced electricity in a near-zero carbon power source.

- MIT will retain its ability to invest in the development of large, off-campus renewable energy systems using best contracting practices that ensure new capacity is being added in a manner that secures new GHG emission reductions.

- As a wholesale purchaser of grid-supplied electricity, MIT will maintain the ability to procure "green electricity" from renewable energy sources, thus offering an additional GHG reduction opportunity.

♦ Enhanced CUP control dispatching systems and strategies:

  - MIT can accommodate and facilitate additional energy and GHG emission reductions through the deployment of a more advanced, predicative dispatch model that can save fuel and GHG emissions. In addition, MIT can seek additional GHG reductions by moving to a clean emission objective over an economic dispatch model.

A key strength of the upgraded cogeneration system is that it will serve as a bridge to future energy technologies and equipment. With the CUP enhancements proposed, MIT will be positioned to explore additional sustainability and efficiency measures, and will be able to incorporate emerging technologies as they become available. CUP designers and managers are collaborating closely with MIT's Office of Sustainability on honing an energy strategy that defines goals for the future, including the 32 percent (minimum) reduction of campus GHG emissions by 2030. The upgraded plant is central to MIT's efforts to ensure that climate action and energy efficiency are an inherent part of planning the future of the campus.

7.2 Climate Resilience

In addition to climate change mitigation and minimization of impacts, MIT is committed to addressing climate vulnerability through resiliency planning and climate adaptation efforts. The proposed Project acknowledges and anticipates climate-induced changes in precipitation and flooding, as well as increased outdoor temperature and local heat island effect.

The City of Cambridge recently completed a Climate Change Vulnerability Assessment (CCVA) to provide the technical groundwork and establish priorities for a city-wide climate resilience plan. MIT is using the same engineering company that Cambridge used for the CCVA study.

As a result of climate change, the Northeast is expected to experience more frequent and intense storms. The CCVA model of the 2070 10-year and 100-year storms have flood elevation of approximately two feet and three feet above grade, respectively. Based on review of preliminary FEMA flood elevations for Suffolk County (November 2013), MIT determined that the electrical equipment in the new CUP should be located above 26 feet elevation (Cambridge Datum) to protect it against the 500-year flood, which is shown as approximately 23.1 feet in elevation (Cambridge Datum) in Boston Inner Harbor. To mitigate risk of damage from storms and flooding, all critical equipment will be installed above elevation 26 feet.

The Intergovernmental Panel on Climate Change (IPCC) has predicted that in Massachusetts the number of days with temperatures greater than 90°F will increase from the current five-to-twenty days annually, to thirty-to-sixty days annually.[9] The Project design will incorporate a number of measures to minimize the impact of high temperature events. Equipment inside the CUP addition will be designed to operate in conditions of up to a 104-degree outdoor air temperature. Based on the design's target temperature and the 20-year life of the equipment, the plant is designed for the expected temperature range listed in the 2015 CCVA Report into the 2030s. The heat island effect will be addressed with landscape features including maximum possible planting and high albedo paving, as well as the installation of a reflective (white) roof on the facility.

Climate change is anticipated to strain city resources as emergency situations such as flooding and power outages occur with more frequency. As a part of the City of Cambridge, MIT will support the needs of the residents in an emergency when and where possible. If MIT's plant is operating in an emergency, MIT's first responsibility will be to provide for its students, faculty, and staff so that they are not displaced. In terms of providing assistance to the larger community, such as providing power to charge community members' cell phones, MIT would evaluate options on a case-by-case basis, taking into account the circumstances of the emergency and MIT's ability to help.

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[9] IPCC (Intergovernmental Panel on Climate Change), 2007. Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Solomon, S., D. Qin, M. Manning, Z. Chen, M. Marquis, K. B. Avery, M. Tignor, and H. L. Miller (eds.)]. Cambridge University Press, Cambridge, UK, and New York, 996 pp.

A main goal of the Project is to improve MIT's resilience during extreme weather events. The CHP will be designed and operated to allow continued campus operation during an extended outage of the larger electrical distribution grid. The cold-start generator allows starting the CTs during blackout and similar emergency conditions.

The new electrical distribution equipment increases the number of distribution points, which will be located and separated to add resiliency and provide a more stable distribution of power to campus while increasing efficiency in the use and distribution of thermal energy to campus buildings.

Currently, distribution is through seven circuits (campus loops). The Project provides MIT with up to 20 circuits, reducing the load on any one loop and allowing for better load shedding control strategies. In terms of resiliency, the increased number of circuits enables MIT to better prioritize and shift distribution of campus power from the CUP in the event of an outside utility power loss. The additional loops also enable MIT to use a phased process to bring load back on, adding load in increments to avoid stalling the plant.

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Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division

MIT CUP Second Century Project Cambridge, Massachusetts

Massachusetts Institute of Technology
Epsilon

Figure 7-1
FEMA Flood Zones

Section 8.0

Public Benefit Determination

8.0 PUBLIC BENEFIT DETERMINATION

In November 2007, the Massachusetts House and Senate passed An Act Relative to the Licensing Requirements for Certain Tidelands (HB 4324), which was signed by Governor Patrick on November 15, 2007 (Chapter 168 of the Acts of 2007) (the "Landlocked Tidelands Legislation"). The legislation, among other things, names the Secretary of Energy and Environmental Affairs (EEA) as the "administrator of tidelands," and requires the Secretary of EEA to conduct a "public benefit review" for certain projects on tidelands and to issue a written determination (the "Public Benefit Determination") for these projects. Specifically, the Secretary must conduct a public benefit review for any proposed project located on tidelands and/or on landlocked tidelands that requires an Environmental Impact Report (EIR), pursuant to the Massachusetts Environmental Policy Act.

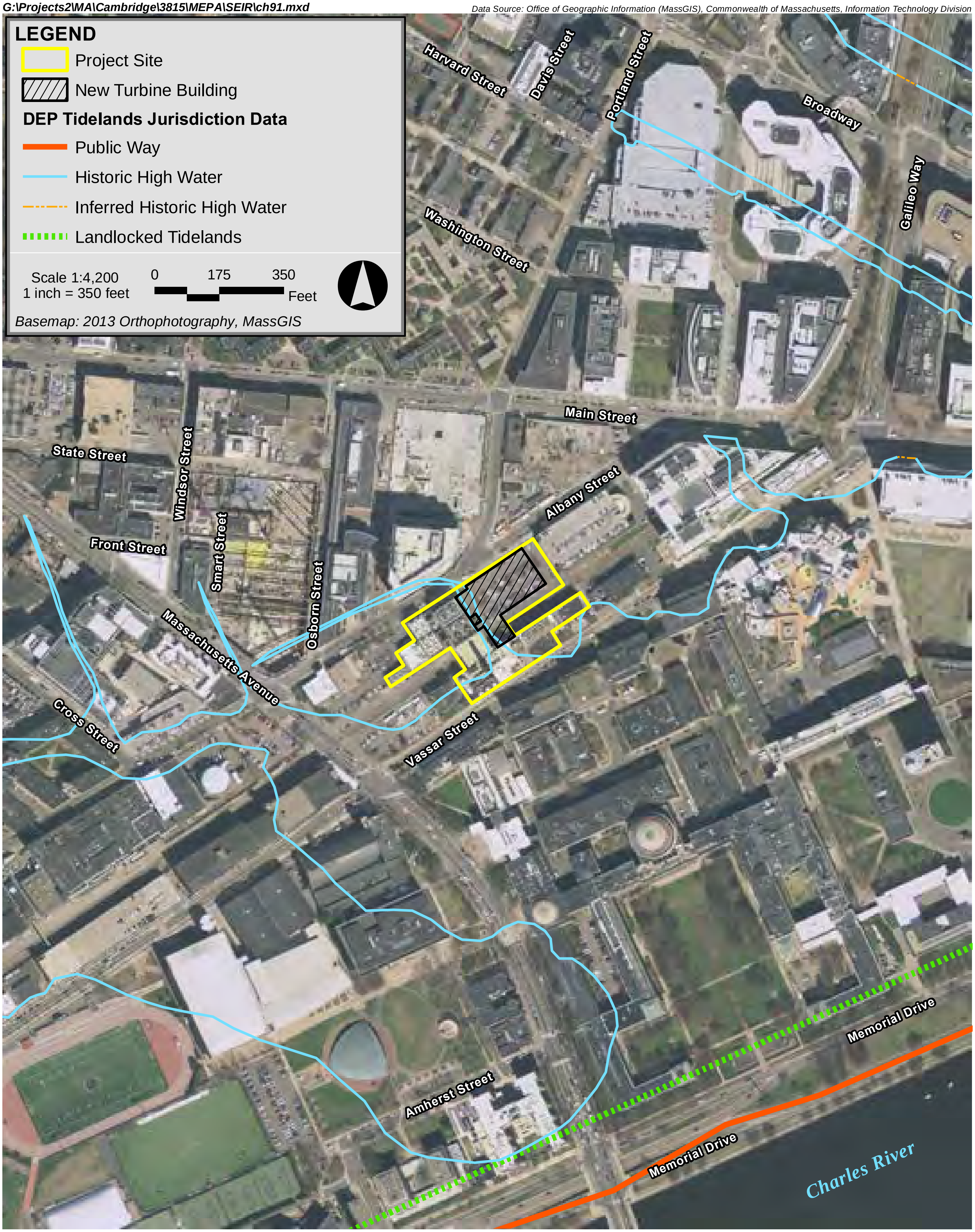
Under the Landlocked Tidelands Legislation, in making the Public Benefit Determination, the Secretary shall consider the following:

> "Purpose and effect of the development, the impacts on abutters and the surrounding community; enhancement to the property, benefits to the public trust rights in tidelands or other associated rights, including but not limited to, benefits provided through previously obtained municipal permits; community activities on the development site; environmental protection and preservation; public health and safety; and the general welfare; provided further that the secretary shall also consider the differences between tidelands and landlocked tidelands and great ponds when assessing the public benefit and shall consider the practical impact of the public benefit on the development."

The legislation outlined above requires analysis of a project's impacts on the public's rights of access, use and enjoyment of tidelands that are protected by Chapter 91, and identification of measures to avoid, minimize, and mitigate any adverse impacts on such rights. Given the Project's location, no impacts to the access, use and enjoyment of tidelands protected by Chapter 91 are anticipated. It should also be noted that most of the site is located in uplands, and only a very limited portion of this site is presumed to be landlocked tidelands pursuant to 310 CMR 9.02.

The following sections address the considerations identified in the Landlocked Tidelands Legislation.

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



MIT CUP Second Century Project Cambridge, Massachusetts

Figure 8-1

DEP Tidelands Jurisdiction

8.1 Purpose and Effect of the Development

The Project is an expansion of MIT's existing Central Utility Plant (CUP), and includes the construction of a new structure attached to the existing CUP that will house two new nominal 22 megawatt (MW) combustion turbine (CT) units fired primarily on natural gas, one of which will replace the existing 21 MW CT. The Project also includes a 2 MW ultra low sulfur diesel (ULSD) fired cold start engine unit to be used to start the CTs in emergency conditions, as well as accessory mechanical equipment and a regulator station.

The regulator station provides Eversource Energy access to the high-pressure gas system on MIT's campus for distribution to the surrounding neighborhood during periods of maintenance, repair, and expansion of Eversource Energy's infrastructure in the surrounding area. It is anticipated that Eversource Energy's access to the regulator station will reduce service interruptions to Eversource Energy clients' facilities.

MIT is proposing the project with the intent of meeting the following goals:

- To increase the resiliency of the campus, safeguarding crucial research and public safety by enabling MIT to function during a power-loss event;
- To equip the MIT community with an efficient, reliable power source capable of supporting their groundbreaking work and experimentation; and
- To continue conserving energy and reducing MIT's impact on the environment.

8.2 Impact on Abutters and the Surrounding Community

The Project will provide a reliable power source to the MIT campus and improve MIT's self-sufficiency, thereby reducing the burden on the community in a power-loss situation. As a further benefit, MIT is providing Eversource Energy (formerly NSTAR) with a location inside the new addition to the plant for a regulator station that gives Eversource Energy access to high-pressure gas on campus. With this access, Eversource Energy can continue providing service to this area of Cambridge even as it develops and expands, without digging up city streets and replacing pipes. The Project will allow and host new Eversource Energy equipment to provide the City of Cambridge back-up gas supply to the existing natural gas users, a significant public benefit.

The facility will additionally incorporate a cooling tower water storage system designed to retain rainwater rather than discharging it to the City of Cambridge stormwater system.

The Project location serves to consolidate MIT's energy facility at a single location where such use is already active, minimizing impacts to landlocked tidelands. In addition, MIT maintains the adjacent sidewalk allowing for safe access along the edge of the site.

8.3 Enhancement to the Property

The Project site is currently a surface parking lot adjacent to the existing CUP. Access to the surface parking lot is restricted to MIT affiliated vehicles. The Project will include the construction of a new addition to the existing CUP, as well as reconstruction of adjacent sidewalks. The new addition will collect rainwater from the roof and discharge it to an existing approximately 145,000 gallon water holding basin located on the roof of Building N16. From the N16 basin, the water will be used in the facility's cooling towers, rather than allowing it to flow into the City of Cambridge stormwater system. The reuse of stormwater will thereby decrease the need for potable water from the City water system and reduce the facility's burden on the City's stormwater system during precipitation events.

8.4 Benefits to the Public Trust Rights in Tide lands or Other Associated Rights

The Project site is located more than one-quarter-mile from the flowed tidelands of the Charles River, is separated from the River by several public right-of-ways, and will not impede public access to or from the waterway. The new addition will be built on an existing private parking lot, and construction will include the reconstruction of the adjacent sidewalk, thereby allowing for safe access by the site.

8.5 Community Activities on the Development Site

Given the nature of the Project (energy production facility with combustion, mechanical, and electrical equipment), the Project site will remain closed to the public.

8.6 Environmental Protection and Preservation

The Project will add an addition to an existing energy facility on a site currently used for surface parking in an urban area. The goals of the Project are:

- To increase the resiliency of the campus, safeguarding crucial research and public safety by enabling MIT to function during a power-loss event;
- To equip the MIT community with an efficient, reliable power source capable of supporting their groundbreaking work and experimentation;
- To continue conserving energy and reducing MIT's impact on the environment.

The Project meets these goals by:

- Placing the equipment above the flood level, safeguarding it against potential future flooding and thereby allowing the system to continue to provide energy to MIT's campus during certain flooding events;

- Providing a reliable source of energy that is more efficient than conventional energy sources; and

- Keeping harmful pollutants out of the air. The expanded plant will reduce EPA-regulated emissions of nitrogen oxides (NOx) and sulfur dioxide (SO_2) by almost 80 percent compared to conventionally produced energy and by 68 percent compared with the existing single-turbine system. MIT will increase its plant energy efficiency by approximately 7 percent and reduce its greenhouse gas emissions by approximately 5 percent compared to using conventional energy sources. These energy savings are equivalent to the total annual electricity used in 3,400 single-family homes.

8.7 Public Health and Safety

The Project will use the Best Available Control Technology (BACT) to minimize air emissions. As noted, the expanded plant will reduce EPA-regulated emissions of nitrogen oxides (NOx) and sulfur dioxide (SO_2) by almost 80 percent compared to conventionally produced energy and by 68 percent compared with the existing single-turbine system. MIT will increase its plant energy efficiency by approximately 7 percent and reduce its greenhouse gas emissions by approximately 5 percent compared to using conventional energy sources.

8.8 General Welfare

The Project will not result in any adverse impacts to the general welfare of the public.

8.9 Conclusion

The Project will not adversely impact the public's rights to access, use, or enjoy area tidelands. The Project will reconstruct adjacent sidewalks, allowing for safe passage by the site. The Project will allow for increased stability of natural gas provision to the surrounding area and will increase MIT's self-reliance and public safety capabilities during power-loss and flooding events. The Project will also create fewer air pollutants compared to conventionally produced energy, a benefit to the local and regional area. These significant public benefits are achieved with de minimis impact to public trust rights in the limited area of landlocked tidelands on the Project site.

Section 9.0

Construction Activities

9.0 CONSTRUCTION ACTIVITIES

9.1 Introduction

A Construction Management Plan (CMP) will be submitted to the City of Cambridge for approval. This CMP will comply with the City's Construction Management Guidelines and will include general project information as well as details related to work hours, delivery and truck routes, worker access and parking plans, police details, truck unloading and staging, construction site signs, on-street parking occupancy, pedestrian access, sidewalk obstruction, modes of transportation for construction workers, and initiatives for reducing driving and parking demands.

The CMP will demonstrate the intent to maintain public safety throughout the construction period through barricades, defined temporary walkways, signage, and other protective measures. The Proponent does not anticipate the need to close roads. If it becomes necessary to temporarily close sidewalks, then appropriate signage and fencing will ensure safe pedestrian passage. The CMP will also highlight the protection of utilities and the control of noise and dust. This chapter includes an overview of what is anticipated to be included in the CMP.

During the construction phase of the Project, the Proponent will provide the name, telephone number and address of a contact person to communicate with on issues related to the construction.

9.2 Construction Methodology

The Proponent will follow City and MassDEP guidelines which will direct the evaluation and mitigation of construction impacts. As part of this process, the Proponent and construction team will evaluate the Commonwealth's Clean Air Construction Initiative.

Construction methodologies that ensure public safety will be employed. Although specific construction and staging details have not been finalized, the Proponent and its construction management consultant will work to ensure that staging areas will be located to minimize impacts to pedestrian and vehicular flow. Secure fencing and barricades, as well as signage, will be used to isolate construction areas from pedestrian traffic adjacent to the project site.

Construction management and scheduling will minimize impacts on the surrounding environment and will include plans for construction worker commuting and parking, routing plans for trucking and deliveries, staging areas and the control of noise and dust. It is anticipated that space on-site will be made to allow workers to leave their tools and machinery so they do not have to be brought to the site every day. The construction manager will also provide information about public transportation to minimize the number of construction vehicles at the site. Construction procedures will be designed to meet all Occupational Safety and Health Administration (OSHA) safety standards for specific site construction activities.

Typical construction hours will be from 7:00 a.m. to 6:00 p.m., Monday through Friday, with most shifts ordinarily ending at 3:30 p.m. No substantial sound-generating activity will occur before 7:00 a.m. It is noted that some activities such as finishing activities could run beyond 6:00 p.m. to ensure the structural integrity of the finished product.

9.3 Air Quality

The construction contract will require contractors to use a number of measures to reduce potential emissions and minimize impacts from construction vehicles, including:

- Certification of construction equipment prior to mobilizing to the site;
- Construction equipment will meet or exceed EPA Exhaust Emission Standards;
- Use wetting agents where needed on a scheduled basis;
- Use covered trucks;
- Minimize exposed storage of debris on-site;
- Monitor construction practices to minimize unnecessary transfers and mechanical disturbances of loose materials;
- Store aggregate materials away from the areas of greatest pedestrian activity, where and when possible;
- Establish a tire cleaning area at the exit gate to prevent dirt from reaching the street;
- Clean streets and sidewalks regularly to minimize dust accumulations; and
- Turn off idling equipment.

The project has established Environmental Health and Safety Requirements which include the requirement to monitor dust at the site limit of work perimeter to provide verification that dust mitigation measures are acceptable. A Certified Industrial Hygienist will develop the Dust Mitigation Plan prior to the start of construction and will oversee implementation with established air quality requirements at the perimeter and within the breathing zone during activities that involve possible exposure of the general public and workers to contaminated soil or groundwater or other hazardous conditions.

9.4 Noise

The construction contract will require contractors to use a number of measures to minimize potential noise impacts, including:

- Use appropriate mufflers on equipment, and properly maintain intake and exhaust mufflers;
- Use muffling enclosures on continuously-operating equipment (e.g., air compressors and welding generators);
- Use the most quiet construction operations, techniques, and equipment, where feasible;
- Schedule equipment operations to keep average noise levels low, synchronize noisiest operations with times of highest ambient noise levels, and maintain relatively uniform noise levels;
- Turn off idling equipment; and
- Use shielding or distance to separate noisy equipment from sensitive receptors.

9.5 Demolition

All demolition activities will comply with Solid Waste and Air Pollution Control Regulations in accordance with M.G.L. Chapter 40 Section 54. All debris from demolition or construction activities which cannot be recycled will be disposed of at a permitted and licensed facility in compliance with the requirements of M.G.L. Chapter 111 section 150A.

All demolition activities shall conform to current Massachusetts Air Pollution Control regulations including those defined by 310 CMR 7.01, 7.09 and 7.10. The following measures will be instituted on the project to mitigate dust, noise, and odor nuisance conditions:

- Dust Control: Dust suppression techniques will include wetting, soil covering, wheel wash, or acceptable tracking pads for all construction vehicle upon entering or exiting the site. If determined necessary, strategic placement of wind barriers and or application of long duration foam shall be employed to reduce dust levels. Dust monitoring shall be employed at the perimeter of the limits of work to document compliance.
- Noise: All noise levels will be maintained at or below the defined limit of work defined by City of Cambridge Noise Regulations. Mitigation measures will include but are not limited to: sound dampening exhaust systems on all equipment; site fencing with scrim; and placement of acoustical treatment if required.

- Odor Nuisance: Odor mitigation, if required, will include but is not limited to covering of stockpiled materials through strategic excavation and capping odorous material with impermeable material. If required, daily or more frequent application of long duration foam will be instituted to mitigate odors.

9.6 Solid Waste and Recycling

MIT and its Construction Manager (Bond Bros.) have established a Construction Waste Management Plan to address waste and recycling efforts during the construction phase of the Project.

The project will divert construction waste from local landfills by recycling waste material generated on the project site as feasible. The disposal contract between the developer and construction manager will include specific requirements to ensure that construction procedures require the necessary segregation, reprocessing, reuse, and recycling of materials when possible. For the materials that cannot be recycled, solid waste will be transported in covered trucks to an approved solid waste facility per MassDEP Regulations for Solid Waste Facilities, 310 CMR 16.00.

9.7 Hazardous Materials

In an effort to identify and mitigate contaminated soils, a pre-characterization program was conducted in December of 2014, which consisted of sampling and chemical testing of soils within the proposed limits of excavation. If contaminated soils will be removed from the site, they will be removed with covered trucks and in accordance with local, state and federal regulations.

A hazardous material survey will be conducted to identify hazardous materials. Testing will be performed and data provided to the construction managers prior to the start of construction. If additional possible asbestos-containing materials or other hazardous materials are discovered during construction, all work will be stopped, the suspect materials will be tested, and appropriate abatement measures will be implemented.

No demolition is currently proposed. If demolition is required, the Project will obtain the BWP AQ06 demolition notification permit at least 10 days prior to the start of any onsite demolition and/or construction, and, if required, a BWP AQ04 (ANF 001) Asbestos Removal permit.

9.8 Dewatering

All required dewatering will discharge to on-site recharge pits. In the unlikely event ground water infiltration into a recharge pit exceeds the infiltration capacity of the subsurface soils, MIT will obtain the required National Pollutant Discharge Elimination System (NPDES) Remediation General Permit (RGP), and all further discharge will meet NPDES RGP permit criteria.

9.9 Stormwater

The project site is under one acre, therefore a NPDES construction permit is not required. MIT and applicable contractors will, however, have in place a stormwater pollution prevention plan (SWPPP) that would generally meet the SWPPP requirements of a USEPA-NPDES General Permit for Storm Water Discharges. The Project will also comply with the City of Cambridge Stormwater Control standards.

9.10 Gas Pipeline Relocation

A relocation of the current gas pipeline will be required as part of the Project. Eversource will perform all work associated with the gas pipeline relocation. The relocated gas pipeline will move to the east end of the facility and a new gas regulation station will be incorporated into the project which will provide improved gas distribution capability back to the City of Cambridge.

Section 10.0

Stormwater

10.0 STORMWATER

The Project site is primarily a surface parking lot with a drainage system that consists of several infiltrating catch basins that infiltrate 100 percent of captured water within the site. There is no connection from the infiltrating catch basins to the City of Cambridge stormwater system.

With the proposed Project, building footprint will cover the majority of the site. The new addition will collect rainwater from the roof and discharge it to an existing approximately 145,000 gallon water holding basin located on the roof of Building N16. Site surface water will also be collected. From the N16 basin, the water will be used in the facility's cooling towers, rather than allowing it to flow into the City of Cambridge stormwater system and into the Charles River. If the cooling towers cannot accept the stormwater (for example the cooling tower common sump is under repair), the stormwater will bypass to the infiltrating catch basins.

Section 11.0

Mitigation and Proposed Section 61 Findings

11.0 MITIGATION AND PROPOSED SECTION 61 FINDINGS

11.1 Introduction

M.G.L. c. 30, s. 61 requires that "[a]ll authorities of the commonwealth ... review, evaluate, and determine the impact on the natural environment of all works, projects or activities conducted by them and ... use all practicable means and measures to minimize [their] damage to the environment. ... Any determination made by an agency of the Commonwealth shall include a finding describing the environmental impact, if any, of the project and a finding that all feasible measures have been taken to avoid or minimize said impact." Each state agency that issues a permit for the Project shall issue a Section 61 Finding in connection with permit issuance, identifying mitigation that is relied upon to satisfy the Section 61 requirement. A proposed Section 61 Finding is provided in Section 11.3, and a table of mitigation measures is included as part of the Section 61 Finding. All mitigation will be the responsibility of the Proponent.

11.2 Anticipated State Permits and Approvals

Table 11-1 identifies the Agencies that are expected to take Agency Action on the proposed Project and, therefore, issue Section 61 Findings. It also identifies the Agency Actions anticipated to be required.

Table 11-1 Agency Actions Required for the Project

AGENCY	*APPROVAL/ACTION*
Department of Environmental Protection, Division of Air Quality Control	Major Comprehensive Plan Approval
Massachusetts Department of Transportation	Approval for building permit on land on or adjacent to railroad corridor (Chapter 40 §54A)
Massachusetts Historical Commission	Determination of No Adverse Effect

11.3 Proposed Section 61 Finding

Project Name: Central Utilities Plant Second Century Plant Expansion

Project Location: Cambridge, MA

Project Proponent: Massachusetts Institute of Technology

EEA Number: 15453

Date Noticed in Monitor:

The potential environmental impacts of the Project have been characterized and quantified in the ENF dated December 15, 2015 and the SEIR dated [Insert Date], which are incorporated by reference into this Section 61 Finding. Throughout the planning and environmental review process, the Proponent has been working to develop measures to mitigate significant impacts of the Project. With the mitigation proposed and carried out in cooperation with state agencies, the [Agency] finds that there are no significant unmitigated impacts.

The Proponent recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Project, is central to its responsibilities under the Massachusetts Environmental Policy Act (MEPA). The Proponent has accordingly prepared the annexed Table of Mitigation Measures that specifies, for each potential state permit category, the mitigation that the Proponent will provide.

Now, therefore, [Agency], having reviewed the MEPA filings for the Project, including the mitigation measures itemized on the annexed Table of Mitigation Measures, finds pursuant to M.G.L. C. 30, S. 61 that with the implementation of the aforesaid measures, all practicable and feasible means and measures will have been taken to avoid or minimize potential damage from the Project to the environment.

____

[AGENCY]

____

By

____

[Date]

To be attached: Table A, describing the measures to be implemented to mitigate the effects of the Project related to the required state permits and the schedule for implementation.

Table A Summary of Mitigation Measures

MITIGATION	*SCHEDULE*	*COST*
Air Quality		
Use of clean fuels and clean combustion to minimize air quality impacts.	During operation	Part of project cost
Removing the residual (No. 6) oil firing for existing Boilers 3, 4, and 5.	During operation	Part of project cost
Removing the ULSD firing for existing Boilers 7 and 9.	During operation	Part of project cost
Minimize CO and VOC emissions through good combustion control, and use of an oxidation catalyst.	During operation	Part of project cost
The NOx emissions are minimized through low-NOx combustors and use of selective catalytic reduction (that reverses the reaction that forms NOx).	During operation	Part of project cost
The new CTs have the opportunity to use dry low-NOx combustors instead of water injection.	During operation	Part of project cost
Emissions from the new cooling towers will be minimized through the use of high efficiency drift eliminators.	During operation	Part of project cost
Use wetting agents where needed on a scheduled basis.	During construction	Part of project cost
Use covered trucks for the removal of soil.	During construction	Part of project cost
Minimize exposed storage of debris on-site.	During construction	Part of project cost
Monitor construction practices to minimize unnecessary transfers and mechanical disturbances of loose materials.	During construction	Part of project cost
Store aggregate materials away from the areas of greatest pedestrian activity, where and when possible.	During construction	Part of project cost
Establish a tire cleaning area at the exit gate to prevent dirt from reaching the street.	During construction	Part of project cost
Clean streets and sidewalks regularly to minimize dust accumulations.	During construction	Part of project cost
Turn off idling equipment.	During construction	Part of project cost
A Certified Industrial Hygienist will develop the Dust Mitigation Plan prior to the start of construction and will oversee implementation with established air quality requirements at the perimeter and within the breathing zone during activities that involve possible exposure of the general public and workers to contaminated soil or groundwater or other hazardous conditions.	During construction	Part of project cost
Greenhouse Gas Emissions		
Purchase and install a combustion turbine that fits the Project description in this SEIR and the related air plans application	During construction	Part of project cost
Use VFD for the fuel gas compressor	During operation	Part of project cost

Table A Summary of Mitigation Measures (Continued)

MITIGATION	*SCHEDULE*	*COST*
Greenhouse Gas Emissions		
Consider high-efficiency motors and VFDs (for motors serving variable loads) in the final Project design.	During operation	Part of project cost
Use waste heat to assist in urea vaporization.	During operation	Part of project cost
Use a heat of compression (adsorption rotary drum) dryer associated with the compressed air system.	During operation	Part of project cost
Cnstruct the HRSG with the surface area and piping required to implement a Medium Temperature Hot Water system.	During operation	Part of project cost
Use LED and occupancy lighting systems in the building expansion.	During operation	Part of project cost
Self-certification of GHG mitigation.	Following construction	Part of project cost
Noise		
Combustion turbine generator sets will be installed in sound-attenuated enclosures.	During operation	Part of project cost
Majority of cogeneration equipment will be installed in an acoustically-designed building with appropriate treatments for building ventilation systems and access openings.	During operation	Part of project cost
Mufflers will be installed as necessary on the gas turbine air intake, gas exhaust, and turbine enclosure ventilation systems.	During operation	Part of project cost
Mufflers will be installed as needed on non-emergency steam vents.	During operation	Part of project cost
Reduced-noise lube oil cooler model will be used or sound barrier walls will be installed for the standard model as needed.	During operation	Part of project cost
The fuel gas compressor and drive motor will be installed in a sound-attenuated enclosure located on the roof with treated ventilation air paths.	During operation	Part of project cost
The cold start diesel generator will be installed in a sound-attenuated enclosure located on the roof with treated ventilation air paths.	During operation	Part of project cost
New mechanical draft wet cooling towers will include reduced-noise fans with variable frequency drives and louvered barrier walls as required to meet sound ordinance.	During operation	Part of project cost
The building walls and roof will have a minimum surface weight of 8 psf or a composite structure that can provide a minimum Sound Transmission Class (STC) rating of STC 30.	During operation	Part of project cost
The equipment and building air ventilation paths will include treatments (e.g., mufflers, lined ducts, acoustic louvers, and local barriers) with suitable sound attenuation.	During operation	Part of project cost

Table A Summary of Mitigation Measures (Continued)

MITIGATION	*SCHEDULE*	*COST*
Noise		
The personnel doors and overhead doors that directly access the main CHP room from outdoors will be specified with an appropriate STC rating.	During operation	Part of project cost
The overall design and construction of the building shell will aim to achieve 55 to 60 dBA directly outside the building walls facing the community.	During operation	Part of project cost
Certification of construction equipment prior to mobilizing to the site.	During construction	Part of project cost
Construction equipment will meet or exceed EPA Exhaust Emission Standards.	During construction	Part of project cost
Use appropriate mufflers on equipment, and properly maintain intake and exhaust mufflers.	During construction	Part of project cost
Use muffling enclosures on continuously-operating equipment (e.g., air compressors and welding generators).	During construction	Part of project cost
Use the most quiet construction operations, techniques, and equipment, where feasible.	During construction	Part of project cost
Schedule equipment operations to keep average noise levels low, synchronize noisiest operations with times of highest ambient noise levels, and maintain relatively uniform noise levels.	During construction	Part of project cost
Turn off idling equipment.	During construction	Part of project cost
Use shielding or distance to separate noisy equipment from sensitive receptors.	During construction	Part of project cost
Climate Change Resilience		
Locating critical equipment above 26 feet in elevation, above the 500-year flood elevation.	During construction	Part of project cost
The enhanced CUP will reduce net emissions despite projected growth in campus energy demand and is essential for MIT to support rapidly changing and expanding research activities in a manner that is cleaner and more resilient than conventional power arrangements.	During operation	Part of project cost
The project will allow students, faculty and staff at MIT to shelter in place in a weather-related emergency event.	During operation	Part of project cost

Table A Summary of Mitigation Measures (Continued)

MITIGATION	*SCHEDULE*	*COST*
Construction		
A Construction Management Plan (CMP) will be submitted to the City of Cambridge for approval. This CMP will comply with the City's Construction Management Guidelines and will include general project information as well as details related to work hours, delivery and truck routes, worker access and parking plans, police details, truck unloading and staging, construction site signs, on-street parking occupancy, pedestrian access, sidewalk obstruction, modes of transportation for construction workers, and initiatives for reducing driving and parking demands.	During construction	Part of project cost
Stormwater		
The rainwater from the roof will be collected and discharged into an existing approximately 145,000 gallon water holding basin located on the roof of Building N16. From the N16 basin, the water will be used as make-up water for the cooling towers.	During operation	Part of project cost
There will be no new stormwater connections to the city sewer.	During operation	Part of project cost
The reuse of stormwater will decrease the need for potable water from the City water system.	During operation	Part of project cost
Water		
Water conservation measures will include: ♦ Capturing roof rain water for cooling tower make-up (Towers 11, 12, and 13 draining into common sump); ♦ Capturing cooling coils condensation as make-up (GT10 cooling coils and E40 rooftop AHU condensation gets put into cooling towers as make-up); ♦ Running cooling tower cycles as high as possible without causing a chloride issue; ♦ Running boiler cycles as high as possible without causing boilers deposit formation; and ♦ Installing high efficiency fill and drift eliminators on new cooling towers.	During operation	Part of project cost

Section 12.0

Response to Comments

The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Charles D. Baker
GOVERNOR

Karyn E. Polito
LIEUTENANT GOVERNOR

Matthew A. Beaton
SECRETARY

Tel: (617) 626-1000
Fax: (617) 626-1181
http://www.mass.gov/envir

January 29, 2016

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
EXPANDED ENVIRONMENTAL NOTIFICATION FORM

PROJECT NAME	: Central Utilities Plant Second Century Plant Expansion
PROJECT MUNICIPALITY	: Cambridge
PROJECT WATERSHED	: Charles River
EEA NUMBER	: 15453
PROJECT PROPONENT	: Massachusetts Institute of Technology
DATE NOTICED IN MONITOR	: December 23, 2015

Pursuant to the Massachusetts Environmental Policy Act (M.G.L. c. 30, ss. 61-62I) and Sections 11.06 of the MEPA Regulations (301 CMR 11.00), I hereby determine that this project **requires** a Mandatory Environmental Impact Report (EIR). The Proponent submitted an Expanded Environmental Notification Form (EENF) with a request that I allow a Single EIR to be submitted in lieu of the usual two-stage Draft and Final EIR process pursuant to Section 11.06(8) of the MEPA regulations. I am confident that the Proponent can adequately address the Scope included in this Certificate; however, I do reserve the right to require Proponent to file a supplemental EIR in accordance with 301 CMR 11.07 (301 CMR 11.08(8)(d)(3)) if I determine that the Single EIR is not adequate.

Project Description

As described in the EENF, the project will expand the Proponent's Central Utilities Plant (CUP) to meet future energy demand, increase reliability and resilience, and meet energy efficiency and carbon emissions reduction goals. The CUP includes a Combined Heat and Power (CHP) system that provides electricity, heat, and steam to over 100 buildings on the campus of the Massachusetts Institute of Technology (MIT), including dormitories, classroom buildings, laboratories, offices, and recreational facilities. The project will include the following components:

- Replacement of a 21-megawatt (MW) combustion turbine generator (CTG) with two nominal 22-MW gas-fired CTGs, each with a heat recovery steam generator (HRSG) with a gas fired duct burner;
- Addition of a two-MW cold-start engine to start the CTGs in an emergency;
- Conversion of five boilers from Ultra Low Sulfur Diesel (ULSD) fuel to natural gas;
- Seek an increase in permitting limits of two gas-fired boilers to take advantage of the energy-efficiency of the units;
- Replacement of six cooling towers with three new cooling towers (three existing cooling towers will be retained); and
- Installation of a new gas regulator station.

The CTGs and boilers will use natural gas as the primary fuel source, and ULSD for testing purposes and as a backup fuel source when gas is not available. Use of backup fuel will not exceed 168 hours per year. The duct burners, using gas as a fuel source, will provide a supplemental heat source to the HRSGs to produce additional steam when necessary.

The new CTGs, HRSGs, pollution control equipment, and regulator station will be installed within a 224-foot by 118-ft by 63-ft high addition to the CUP. It will be constructed in a parking lot adjacent to the CUP. Air emissions will be released through a 165-ft high stack containing flues from each HRSG. The emergency generator will be mounted on the roof of the new building and will have its own exhaust stack extending 165 feet above ground level. A new gas line will be constructed to the site from a nearby gas main. Critical project components will be elevated above the 500-year flood elevation to provide resiliency from extreme storm events.

Project Site

The existing CUP commenced operations in 1995. It provides 60 percent of the electricity on the MIT campus and generates steam for heating and for cooling via steam-driven chillers. The CUP is linked to the campus by electrical, steam, and chilled water distribution systems. It is located in Building 42, which is bordered by Vassar Street to the south and Albany Street to the north. MIT buildings surround the CUP to the east and west. The facility is located on either side of the Grand Junction rail right-of-way (ROW). An elevated and enclosed walkway spans the railroad tracks.

The existing CUP includes a 21-MW CTG with an HRSG and duct burner, five boilers, a 2-MW emergency generator, and ten cooling towers. Exhaust gasses are vented from stacks ranging in height from 115 to 177 feet above ground level.

Portions of the existing CUP and the area of its proposed expansion are located within landlocked tidelands. The site does not contain any properties listed in the State Register of Historic Places or the Inventory of Historic and Archaeological Assets of the Commonwealth. Four nearby buildings are listed in the State Register of Historic Places. The site is located near three Historic Districts, including the MIT Historic District encompassing the original campus, the Charles River Basin Historic District, and the Old Cambridgeport Historic District.

The project site is located within a five-mile radius of Environmental Justice (EJ) communities in Cambridge, Boston, Brookline, Newton, Watertown, Arlington, Medford, Malden, Everett, Somerville, and Revere. According to the EEA Environmental Justice Viewer (http://maps.massgis.state.ma.us/map_ol/ej.php), the EJ communities in these municipalities are classified as: minority; income; English isolation; minority and income; minority and English isolation; income and English isolation; and, minority, income, and English isolation.

Jurisdiction and Permitting

The project is subject to a Mandatory EIR pursuant to 301 CMR Section 11.03(8)(a)(2) of the MEPA regulations because it requires a State Agency Action and will modify an existing Stationary Source with federal potential emissions that collectively will result, after construction and the imposition of required controls, in 75,000 tons per year (tpy) of GHGs based on CO_2 equivalent. The project exceeds the ENF threshold at 301 CMR 11.03 (7)(b)(2) because it consists of expansion of an existing electric generating facility by 25 or more MW. The project requires a Major Comprehensive Air Plan Approval (MCPA) from the Massachusetts Department of Environmental Protection (MassDEP).

The project requires a Public Benefits Determination and is subject to review under the May 2010 MEPA Greenhouse Gas (GHG) Emissions Policy and Protocol ("the Policy"). In addition, the project is subject to the Executive Office of Energy and Environmental Affairs (EEA) EJ Policy.

The project requires federal air permitting under the Clean Air Act (CAA), specifically the Prevention of Significant Deterioration (PSD) permitting requirements. Pursuant to the Agreement for Delegation of the Federal Prevention of Significant Deterioration Program, dated April 2011, by the United States Environmental Protection Agency (EPA), Region I with MassDEP, MassDEP is delegated to administer the federal PSD program in Massachusetts.

The project is not seeking Financial Assistance from the Commonwealth. Therefore, MEPA jurisdiction is limited to the subject matter of required State Agency Actions that are likely, directly or indirectly, to cause Damage to the Environment as defined in the MEPA regulations. These include GHG emissions, land alteration, air quality, and tidelands.

Environmental Impacts

Potential environmental impacts of the project include emissions of air pollutants, emissions of GHG, and noise. Emissions will include 32.2 tons per year (tpy) of nitrous oxide (NO_x), 22.4 tpy of carbon monoxide (CO), 39.2 tpy of volatile organic compounds (VOC), 62 tpy of particulate matter (PM), 8.7 tpy of sulfur dioxide (SO_2); and 401,300 tpy of carbon dioxide (CO_2). The EENF identified general measures to avoid, minimize and mitigate potential impacts of the project including using clean fuels and pollution control technologies, such as selective catalytic reduction (SCR) and oxidation catalysts. The project will mitigate noise impacts by installing the CTGs and other equipment in acoustically designed enclosures and using mufflers on ventilation, intake and exhaust systems. The EENF briefly addressed measures that will be used to reduce construction period impacts.

The project will be supported primarily by existing infrastructure. The project will increase the CUP's water use by 65,600 gallons per day (gpd) and decrease its wastewater generation by 3,200 gpd. Stormwater from the roof of the new building will be collected for use on campus and will not be directed into the City of Cambridge's stormwater system.

Single EIR Request

The Proponent requested that it be allowed to file a Single EIR in lieu of a Draft and Final EIR. The MEPA regulations indicate a Single EIR may be allowed provided I find that the EENF:

a) describes and analyzes all aspects of the project and all feasible alternatives, regardless of any jurisdictional or other limitation that may apply to the Scope;

b) provides a detailed baseline in relation to which potential environmental impacts and mitigation measures can be assessed; and,

c) demonstrates that the planning and design of the Project use all feasible means to avoid potential environmental impacts.

Conclusion

Based on a review of the ENF, consultation with MassDEP and review of comment letters, I am granting the Proponent's request to file a Single EIR. The EENF meets the criteria for a Single EIR, and it was subject to an extended comment period. It provided a detailed project description and a baseline for evaluating environmental impacts. The EENF identified how the project will be designed to achieve consistency with regulatory standards, including measures to avoid, minimize and mitigate project impacts. The project will provide more reliable and efficient energy to the MIT campus using a CHP system that reduces emissions of CO_2 per unit of electricity, steam and chilled water supplied. The EENF included a copy of the MCPA application filed with MassDEP. Comments from MassDEP do not express concern with a Single EIR.

SCOPE

General

The Single EIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope.

Project Description and Permitting

The EENF described the project, including its major components such as the CTGs, HRSGs, boilers, and cooling towers. It identified the impacts of the project, including emission of air pollutants and noise, and mitigation measures to minimize these impacts. The EENF included an analysis of alternatives for meeting the energy reliability and demand needs of the campus. For the Preferred Alternative, the EENF described the Best Available Control Technologies (BACT) selected for the design of the CUP to comply with regulatory requirements for minimizing emissions. The EENF analyzed the effect on air quality to the surrounding areas based on modeling of the project's emissions compared to background air quality. The EENF also provided a GHG analysis of the CUP and described measures incorporated into the design to minimize GHG emissions. The EENF included a copy of the MCPA application submitted to MassDEP.

The Single EIR should provide a project description and detailed plans that depict project MEPA.1
components, including auxiliary equipment, and describe expected normal CUP operations and
procedures for its use at maximum efficiency. It should describe how the project will meet
current and future demand for electricity and steam, and any other sources of electricity and MEPA.2
steam that will be used. As requested by the Department of Energy Resources (DOER), the
Single EIR should include a discussion of the full load capacity factor for the CTGs when they MEPA.3
are fully operational and the extent to which capacity will be reserved for redundancy. The
Single EIR should describe operating scenarios for the boilers as described in DOER's letter. It MEPA.4
should include plan and elevation views of existing conditions, the proposed building and MEPA.5
interior components, and associated infrastructure, including the location of connection to the gas
main. It should identify any changes proposed since the filing of the EENF, including selection MEPA.6
of final design and generating capacity of the CTG and duct burner units. It should identify all
State Agency permits and approvals required for the project and how the project will be MEPA.7
developed consistent with regulatory standards and requirements.

The Proponent's *Plan for Climate Action*, released in 2015, established a goal of reducing
GHG emissions from campus activities by at least 32 percent by 2030. The EENF identified
GHG reduction efforts, such as integration of on-site renewable energy generation and clean
power purchased from off-site sources that are being explored as ways to meet the GHG goals.
The SEIR should provide a thorough and comprehensive analysis of how the proposed CUP can MEPA.8
accommodate and facilitate further reductions in GHG emissions. The Single EIR should MEPA.9
identify specific goals for energy use reductions and on-site generation or purchase of off-site MEPA.10
clean energy and discuss CUP operations and emissions in light of the reduced demand that
could result from achieving those goals. MEPA.11

As noted in the EENF, an important goal of the project is to provide redundancy to ensure that critical research projects will not be interrupted or negatively affected by disturbances to CUP generating capacity or external power sources. As requested by DOER, the Single EIR should provide a more detailed discussion of how much of the capacity of the proposed CUP will be devoted, over time, to meeting energy demand and how much will be dedicated to ensuring redundancy and reliability of the on-site power grid. To the extent that the Proponent anticipates that the campus-wide demand for energy will increase and be met by the CUP, the Single EIR should present more detailed evaluations of GHG mitigation measures than were presented in the EENF. The Single EIR should also provide more information about operating scenarios for the boilers and whether they will be used to provide additional steam generating capacity or serve as a steam generating backup to the CHP system. MEPA.12 MEPA.13 MEPA.14

Environmental Justice

The project exceeds an EIR threshold for air and is located within five miles of designated EJ populations. Therefore, it is subject to the EJ Policy, which requires enhanced public participation and enhanced analysis of impacts and mitigation under MEPA. Enhanced outreach included:

- Preparation of a fact sheet, translated into Spanish, Portuguese, Chinese, and French, providing a summary of the project, its impacts, and public comment opportunities;
- Notice of the ENF review was placed in newspapers with local circulation, including newspapers that publish in Portuguese, Spanish, and Chinese; and
- Spanish, Cantonese, and Portuguese interpreters were available at the MEPA Consultation meeting on January 14, 2016.

The air quality dispersion modeling conducted for the PSD application included an analysis of the project's effects on EJ populations. The analysis calculated the population-weighted average concentration of NO_2, PM_{10}, and $PM_{2.5}$ for averaging times above Significant Impact Levels (SIL) using worst case impacts from modeling of the CUP operations. The population weighted averages for EJ communities within five miles of the site were compared to those of non-EJ communities. The analysis concluded that the differences were not significant and that the project impacts will not disproportionately affect EJ communities. This analysis and any additional information prepared for the Single EIR should be provided in a chapter on compliance with the EJ Policy. It should clearly identify potential impacts and the applicability of impacts to the EJ communities. MEPA.15

Alternatives Analysis

The purpose of the project is to replace the existing cogeneration system as it nears the end of its service life, maintain reliability and resilience of the energy system, meet the energy demand of the campus, and to incorporate energy efficiency and other measures to reach MIT's GHG reduction goals. The EENF evaluated four options to the Preferred Alternative for meeting the project purpose. The alternatives vary in the extent to which energy is derived from less efficient sources, such as the existing CUP or grid electricity. According to the EENF, the use of energy from these less efficient sources would result in greater emissions of pollutants and GHG than the proposed CUP.

Option 1 would retire the existing CUP and purchase electricity and gas from utility companies. The CUP would no longer use co-generation to efficiently generate steam from turbines and would the boilers would be powered separately to produce steam for heating and cooling purposes, resulting in greater overall emissions. This alternative would not achieve reliability or resiliency objectives because the campus would be dependent on the delivery of electricity and gas from utility companies. Option 2 would rebuild the existing CUP to extend its service life by ten years, but a new CT would have to be installed after 11 years. This option would not meet the project purpose because it would rely on the electricity grid and gas suppliers to provide reliability and resiliency, and to meet its future energy demands.

Option 3 would replace the existing CT with a new 22-MW unit and new auxiliary equipment. This option would improve efficiency and reliability, but would not provide a redundant system that could function if one of the CTs is out of service. It would rely on the electricity grid to provide backup capacity when fuel is not available or if the CUP is out of service, as well as for meeting future capacity needs above the generating capacity of the CUP. The new CT would be installed in the same location as the existing unit and be vulnerable to flooding in extreme storm events. This alternative would also have higher life cycle costs than the Preferred Alternative. Option 4 would replace the existing CT with a 30-MW CT in a new building. This alternative would improve reliability and resiliency. It would have sufficient capacity to partially meet future energy needs, but would not provide desired redundancy. Energy demand beyond 30 MW would be supplied by the electrical grid.

The EENF listed other alternatives that were considered during the development, including:

- A CUP powered by other fuels such as biomass or oil, which would have greater air quality impacts, and have disadvantages with respect to fuel storage, transportation of fuel, and reliability;
- Eliminating ULSD as a backup fuel, which would not provide the reliability of the Preferred Alternative;
- Using onsite renewable energy sources coupled with reducing energy use which would not meet campus energy needs, but are being pursued as part of the Proponent's overall project goals; and
- Purchasing off-site renewable energy which would not increase reliability, but is also being pursued as part of the Proponent's overall project goals.

The Single EIR should include an analysis that considers CUP operations and resulting impacts (emissions) under lower future demand scenarios, including energy efficiency, use of on-site solar photovoltaic (PV) systems, and purchase of clean energy through the grid. The Single EIR should qualitatively compare the Preferred Alternative to scenarios in which the Proponent has met or made significant progress toward achieving its energy use reduction goals. MEPA.16 MEPA.17

Air Quality

The EENF reviewed pollution emission controls through a series of BACT analyses for pollutant emissions from the CTGs, duct burners, cold-start engine, and boilers. The EENF described the project's air quality impacts based on the selected emissions controls. These analyses were prepared as part of the project's MCPA application submitted to MassDEP.

BACT Analysis

The Proponent will use the Top-Case BACT for the CTGs and duct burners as defined in MassDEP guidelines. The Top-Case BACT specified potential emissions control technologies that can be used for the CTGs and duct burners and the resulting emission rates. The project will use Selective Catalytic Reduction (SCR) as the control technology for NO_x and ammonia (NH_3) and oxidation catalysts to control CO and VOC. The project will use clean fuels (natural gas and ULSD) that are low in sulfur to control SO_2. The CTGs and duct burners will meet the Top-Case BACT emission rates during full-load, steady state operations. The EENF noted that emission rates for NO_x, CO, VOC, and NH_3 will be slightly higher when the CTGs and duct burners are operating in certain conditions, such as operating loads below 90 percent or cold temperatures.

The EENF provided the results of Top-Down BACT analyses for emissions of PM and CO_2 from the CTGs and duct burners. Top-Down analyses consider the feasibility of technologies that vary in their effectiveness for controlling emissions. The technologies are first ranked by effectiveness, and then evaluated on the basis of economic, energy, and environmental impacts. The most effective feasible technology must be selected for use. The BACT selected for PM is the use of low ash fuels (ULSD and natural gas). The analysis concluded that post-combustion controls are not feasible because they are not effective in particulates from emissions at low concentrations, such as is the case when a clean fuel is used. According to the EENF, the resulting emissions rates for PM will be comparable to other recent projects of similar size. The analysis for CO_2 also concluded that the use of clean fuel is the BACT because post-combustion controls such as carbon capture or sequestration are not feasible due to a lack of space and infrastructure available for the controls. Measures to minimize and mitigate impacts from CO_2 are addressed in more detail in the GHG section below.

The EENF also presented separate Top-Case BACT analyses for the cold-start engine and for Boilers 7 and 9, which are proposed to be used for periods longer than they are presently authorized. The Top-Case BACT for the cold-start engine specifies the use of ULSD, operating limits of 300 hours per 12-month period, and emission rates that meet EPA limits for off-road engines. According to the EENF, the Proponent evaluated the use of an active diesel particulate filter (DPF) to control PM, but determined that these have not been used for emergency engines and would not be more effective than the use of ULSD. The Top-Case BACT for boilers 7 and 9 will also involve the use of clean fuels to meet the BACT emissions rates for CO, NO_x, PM, SO_2, VOC, and CO_2.

Based on the use of BACT as described above, consisting of SCR, oxidation catalysts, and the use of clean fuels, the total potential emissions of the project are: 21.3 tpy of NO_x; 22.4

tpy of CO; 39.2 tpy of VOC; 62 tpy of PM; 8.7 tpy of SO_2; and 401,300 tpy of CO_2. As discussed in the GHG section below, the expected actual CO_2 emissions are 192,000 tpy.

MassDEP indicated that it has conducted a preliminary review of the MCPA application and will complete its review after the MEPA process has concluded. MassDEP did not identify any additional information required with regard to the BACT analysis. If applicable, the Single EIR should include BACT analyses for any changed or additional project components. MEPA.18

Modeling and Potential Impacts

The EENF provided a summary of the air dispersion modeling analysis of the project that was included in the MCPA application. This analysis was performed to demonstrate that the project will not cause or contribute to the violation of National Ambient Air Quality Standards (NAAQS) or Massachusetts Ambient Air Quality Standards (MAAQS). The EENF described the methodology and models used in the analysis, including limitations and assumptions, and the sources of data used to establish concentrations for all pollutants.

The EPA-approved AEROMOD model was used for the analysis. This analysis was prepared by first determining the operating conditions under which the model predicts that the CUP would have its worst-case impact on air quality. Two scenarios were developed. Scenario 1 represented an initial short-term operating condition when the existing CTG (and associated duct burner, HRSG, and boilers) will be operating alongside one new CTG unit. Scenario 2 represented the proposed project. To determine the worst case scenarios for each scenario, the model calculated the short-term (24 hours or less) and long-term (annual) emissions generated by the CTGs, duct burners, cold-start engine, and boilers under a range of operating conditions.

The modeled concentrations of emissions from the CUP under both scenarios were then compared to Significant Impact Levels (SILs), which are the levels below which a source is expected to have insignificant impact on air quality. Concentrations of SO_2 and CO were below SILs. The emissions of these pollutants were then modeled with ambient concentrations of these contaminants as measured at the nearby Kenmore Square air monitoring station in Boston. The physical dimensions of the stacks and meteorological data were incorporated into the dispersion model. The combined effect of the CUP and ambient air concentrations of SO_2 and CO was compared to the NAAQS/MAAQS to determine if the project will cause any of the contaminants to exceed the standards. The analysis concluded that, for both scenarios, the modeled maximum daily one-hour and three-hour concentrations, as well as the 24-hour and annual concentrations of SO_2 and CO would be less than 14 percent of the corresponding NAAQS/MAAQS.

Because the model determined that the CUP would emit concentrations of PM and NO_2 that exceeded SILs, a cumulative analysis of the CUP emissions and emissions of these contaminants from six nearby facilities was conducted. The purpose of the cumulative analysis was to determine if the CUP emissions would contribute to a violation of NAAQS or MAAQS in combination with the other facilities. The model results indicated that the addition the cumulative impact of the CUP would not contribute to violations of NAAQS or MAAQS. The cumulative concentrations of pollutants for the averaging periods fell below 91 percent of NAAQS/MAAQS for all contaminants and averaging periods.

Greenhouse Gas Emissions (GHG)

This project is subject to review under the May 5, 2010 MEPA Greenhouse Gas Emission Policy and Protocol (GHG Policy). The GHG Policy requires identification of GHG emissions associated with the project and adoption of all feasible measures to avoid, minimize and mitigate these increases. The GHG Policy is one element of a comprehensive effort to meet the Commonwealth's obligations under the Global Warming Solutions Act (GWSA) which include reducing carbon emissions by between 10 and 25 percent below 1990 emissions levels by the year 2020, and by 80 percent below 1990 emissions levels by the year 2050. Consistent with MEPA's overall purpose to evaluate alternatives that avoid, minimize and mitigate environmental impacts to the maximum extent practicable (301 CMR 11.01), the Policy requires that GHG impacts of projects have been carefully considered and that all feasible means and measures to reduce those impacts are adopted. The Policy requires that all projects that are subject to an EIR quantify GHG emissions, evaluate measures that could reduce GHG emissions and quantify potential reductions of mitigation measures. This is a case-by-case inquiry that allows project proponents to select mitigation measures that are determined to be feasible for the particular project being proposed, thereby providing project proponents with maximum flexibility to design their projects.

The EENF evaluated GHG emissions from two alternatives, a Base Case representing a "business as usual" scenario with separate generation of electricity and steam, and the Preferred Alternative. GHG emissions for both cases were calculated based on the following emissions factors:

- 117 pounds of CO_2 per million British Thermal Unit (BTU) of natural gas based on the U.S. Energy Information Administration national average;
- 941 pounds of CO_2 per megawatt-hour of electricity generated based on current Marginal Emission Factor for the *Independent System Operator-New England (ISO-NE) Electric Generator Air Emissions Report (January 2016)* for calculation involving the analysis of a CHP system; and
- 726 pounds of CO_2 per megawatt-hour of electricity generated for calculation of balance of plant GHG savings based on the ISO-NE *Electric Generator Air Emissions Report (January 2016).*

The EENF described features of the Preferred Alternative that would serve to minimize GHG emissions. The EENF did not specify the efficiency of the CTG units used for the calculation of GHG emissions. However, the energy efficiency of a CHP system is a combination of both the electricity and steam that is generated, and less efficient production of electricity can result in more heat available to generate steam. The HRSGs are expected to have a 95 percent thermal efficiency. The Preferred Alternative will also include the following measures to reduce GHG emissions from balance of plant project elements:

- Fuel Gas Compressors with variable frequency drives (VFD) can increase efficiency by 10-20 percent, and will reduce GHG emissions by 19 tpy;

- Combustion Air Cooling will allow the CTGs to operate more efficiently on hot days using chilled water from the existing chilled water system, but the benefits of this measure have not yet been calculated;
- Chilled Water Free Cooling (Combustion Air Heating) will allow the CTGs to operate more efficiently on cold days using by increasing the inlet air temperature using Combustion Air Cooling coils, reducing GHG emissions by two tpy;
- High-efficiency motors will be used to drive the fans and pumps that maintain the operation of the CTGs, but the benefits of this measure have not yet been calculated;
- Urea used to produce ammonia for pollution control will be heated using available heat rather than electrical heat, reducing GHG emissions by 8.5 tpy;
- A compression dryer will use waste heat to dry compressed air used in the CUP, for a GHG reduction of 0.4 tpy;
- HRSGs will be manufactured with additional surface area that can be used to produce medium temperature hot water that could be used to heat dormitories and other buildings. This measure may be implemented in the future and the benefits of this measure have not yet been calculated; and
- The new building housing the CUP will be equipped with light-emitting diode (LED) lighting and an occupancy lighting system to reduce the use of electricity, but the benefits of this measure have not yet been calculated;

GHG emissions of the Base Case were compared to those of the Preferred Alternative, using a model that determined how operation of the proposed CUP would affect the use of electricity and steam onsite and how much electricity would have to be imported from the grid. In this analysis, the difference between the GHG emissions of the Preferred Alternative and the displaced emissions from grid electricity and conventional heating systems represents the overall reduction in GHG emissions as a result of the implementation of the Preferred Alternative. According to the EENF, the GHG emissions of the Preferred Alternative would be 192,000 tpy. GHG emissions that would be displaced by the project include 113,000 tpy from grid electricity and 104,000 tpy from natural gas used to power a conventional heating system, for a total of 217 tpy. The Preferred Alternative would reduce GHG emissions by 25,000 tpy, or approximately 12 percent.

The EENF reviewed other alternatives for generating all or a portion of the electricity and steam needed at the campus. According to the EENF, the campus does not have sufficient space on rooftops or on the ground to install a solar photovoltaic (PV) or solar hot water heating system, wind turbines, or ground source heat pumps to an extent that could help meet the energy demand of the campus. The Proponent is continuing its efforts to install solar energy systems to a more limited extent where appropriate on the campus.

The Single EIR should expand upon the GHG analysis provided in the EENF. It should explain in more detail the model used to compare the GHG emissions of the Preferred Alternative to the emissions displaced from other sources as a metric of GHG reductions, and explicitly identify all components of the modeled system, including parasitic loads. The Single EIR should provide additional information on the performance of the selected and alternative CTGs in light of the electrical and thermal loads it will be serving. MEPA.19 MEPA.20 MEPA.21

The GHG analysis should be supplemented with the information and analyses identified in DOER's comment letter. The Single EIR should clarify the modeled operating condition used to produce the results in Attachment C-1 and provide results for both the first year, when the existing CTG will operate with a new CTG, as well as the proposed condition with two new CTGs. The analysis presented in Attachment C-1 should be revised to present the results accordance with DOER's comment letter. I recommend that the Proponent consult with DOER and the MEPA office prior to preparing the Single EIR. MEPA.22 MEPA.23 MEPA.24

Noise

The EENF included an analysis of the noise that will be generated by the CUP to demonstrate that it will comply with MassDEP's Noise Policy and the City of Cambridge's Noise Ordinance. Noise generated by the project will include sound from the CTGs, HRSGs, fuel gas compressors, chillers, new cooling towers, cold-start engine, and supporting equipment. Ambient noise levels were sampled on two consecutive nights in August, 2014. The analysis in the EENF estimated sound levels at the property lines and nearest residential locations and compared these levels to ambient noise levels at the quietest time of the day (midnight to 4:00 AM). The noise levels at the project site will be approximately 85 dBA or less. The project will raise noise levels at three property lines and at the closest residential locations by three decibels (dBA) or less, which meets the standard of a 10 dBA increase allowed by MassDEP's Noise Policy and will meet the standard for pure tones.

Mitigation measures will include:

- Noise producing equipment (e.g. CTGs and equipment associated with the CUP) will be enclosed in sound-attenuating materials or behind sound barrier walls;
- Mufflers will be installed on the gas turbine air intake, gas exhaust, turbine enclosure ventilation systems, and non-emergency steam vents;
- Reduced-noise fans with VFDs will be used in the cooling towers; and
- The shell of the new building will be designed to reduce noise levels to 55 to 60 dBA directly outside the building walls facing the neighborhood.

The Proponent should review MassDEP's comment letter and revise the noise analysis as necessary. MassDEP recommends background sound monitoring for a minimum of three days, including at least one weekend day. The City of Cambridge has noise limits for specific sound intervals projects based on the time of day the noise is generated and surrounding uses. According to the noise modeling results, it does not appear that the project will meet the City's noise limits. The Single EIR should review the project's compliance with MassDEP's Noise Policy and the City of Cambridge's Noise Ordinance and identify any additional mitigation measures that may be required. The mitigation measures should be based on a Best Available Noise Mitigation Technology analysis for the site pursuant to MassDEP's Noise Policy. MEPA.25 MEPA.26 MEPA.27

Climate Change Adaptation and Resiliency

According to the EENF, the site may experience flooding in severe storm events, such as the 500-year storm. The CUP is being designed to maintain operations during large storm events. Critical project components will be constructed above this flood elevation and the cold-start engine will be located on the roof of the building. The Single EIR should identify the 500-year flood elevation, include a map of the 500 –year floodplain, document the storm parameters used in the analysis, and describe how the facility will be constructed to withstand impacts from these storms. MEPA.28

The Single EIR should discuss the potential effects of climate change, including the potential for more frequent and intense storms and rising temperatures to affect the site, and identify any measures that will be implemented to adapt to these conditions. The Single EIR should present an analysis of scenarios based on modeling of these risks in the Cambridge Climate Change Vulnerability Assessment (CCVA). As requested by the City of Cambridge, the Single EIR should identify potential roles of the campus in increasing community resilience, such as allowing the general public to charge cell phones during prolonged power outages. MEPA.29 MEPA.30 MEPA.31

Stormwater

The site is currently a paved parking lot and the project will not increase impervious area. The EENF did not describe how stormwater runoff is currently managed at the site. The project will collect rainwater in the cooling towers for use on campus and will not discharge stormwater from the site into the City of Cambridge stormwater system. The Single EIR should describe the rooftop water reclamation system and identify its capacity, and discuss how any overflow will be discharged. The Single EIR should review current stormwater patterns on the site and discuss how stormwater from areas outside the footprint of the building will be managed. MEPA.32 MEPA.33

Construction

The EENF identified mitigation measures to minimize impacts during construction, including dust and noise control measures. The Single EIR should provide a more detailed description of construction activities, including installation of the gas pipeline, management and recycling of waste material, and transportation and disposal of contaminated soil. It should identify potential impacts of these activities, and describe mitigation measures that will be implemented. The Proponent should review MassDEP's comment letter for additional information on managing solid waste and hazardous materials during construction. The EENF As noted by the Massachusetts Water Resources Authority (MWRA), the site is not located in a combined sewer area, and therefore discharge of groundwater into the sanitary sewer is prohibited. MEPA.34 MEPA.35

Landlocked Tidelands/Public Benefits Determination

A portion of the project will occur within landlocked tidelands as defined by the MassDEP's Waterways Regulations (310 CMR 9.00) and is subject to the Public Benefit Determination regulations (301 CMR 13.00). The SEIR provided a public benefits analysis of the project consistent with the provisions of *An Act Relative to Licensing Requirements for Certain Tidelands* (2007 Mass. Acts ch. 168) (the Act).

The proposed public benefits of the project identified in the EENF include providing resiliency to the campus to protect research and public safety, and promoting energy conservation and GHG reduction. The project will include a new regulator station to be used by Eversource Energy that will improve gas supply to the site and the surrounding area of Cambridge. The project will capture and use rainwater to reduce stormwater.

Comments from the City of Cambridge, the Cambridge Bicycle Committee, and the Friends of the Grand Junction Path expressed concern that the project could restrict public access or otherwise impact future development and use of the planned Grand Junction Path. The EENF did not discuss the proposed path or how the project may impact the design of the path adjacent to the project site. The Single EIR should include a plan showing how the ROW cross-sections provided in the City of Cambridge's comment letter can be implemented adjacent to the project site, and identify any restrictions in design or use that the project may impose on the path. MEPA.36

Consistent with Section 8 of the Act, I must conduct a Public Benefits Review as part of the EIR review of projects located on landlocked tidelands that entail new use or modification of an existing use. I will issue a Public Benefits Determination (PBD) within 30 days of the issuance of the final Certificate for this project.

Mitigation and Section 61 Findings

The Single EIR should include a separate chapter on mitigation with a summary of mitigation measures to which the proponent is committed. The Single EIR should describe and assess measures and management techniques designed to limit negative environmental impacts or cause positive environmental impacts during development and operation of the project. MEPA.37

The Single EIR should include draft Section 61 Findings for MassDEP Permits. The proposed Section 61 Findings should specify in detail all feasible measures the proponent will take to avoid, minimize and mitigate potential environmental impacts to the maximum extent practicable. The proposed Section 61 Findings should identify parties responsible for funding and implementation, and the anticipated implementation schedule that will ensure mitigation is implemented prior to or when appropriate in relation to environmental impacts. MEPA.38 MEPA.39

To ensure that all GHG emissions reduction measures adopted by the Proponent in the Preferred Alternative are actually constructed or performed, the Proponent must provide a self-certification to the MEPA Office signed by an appropriate professional (e.g., engineer, architect, transportation planner, general contractor) indicating that all of the required mitigation measures, or their equivalent, have been completed as a condition of a Certificate approving a Single EIR (or Supplemental Single EIR if necessary). The commitment to provide this self-certification should be incorporated into the draft Section 61 Findings included in the Single EIR. MEPA.40

Responses to Comments

The Single EIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the Single EIR should include direct responses to comments to the extent that they are within MEPA MEPA.41

jurisdiction. This directive is not intended, and shall not be construed, to enlarge the scope of the Single EIR beyond what has been expressly identified in this certificate.

Circulation

The Proponent should circulate the Single EIR to those parties who commented on the EENF, to any State Agencies from which the Proponent will seek permits or approvals, and to any parties specified in section 11.16 of the MEPA regulations. A copy of the Single EIR should be made available for public review at the Cambridge Public Library and at other neighborhood locations to enhance public participation among the EJ population in the project area. The proponent should consult with the EEA Environmental Justice Director during preparation of the Single EIR regarding the proposed circulation and participation plan to ensure compliance with the EJ Policy.

MEPA.42
MEPA.43
MEPA.44

January 29, 2016
Date

Matthew A. Beaton

Comments received:

01/19/2016	Max Dunitz
01/21/2016	Massachusetts Water Resources Authority (MWRA)
01/22/2016	Charles River Watershed Association (CRWA)
01/22/2016	Massachusetts Department of Environmental Protection (MassDEP) – Northeast Regional Office (NERO)
01/22/2016	City of Cambridge
01/22/2016	John Sanzone, Friends of the Grand Junction Path
01/22/2016	Cambridge Bicycle Committee
01/22/2016	Jeremy Poindexter
01/22/2016	Patrick Brown
01/25/2016	Department of Energy Resources (DOER)

MAB/AJS/ajs

12.0 RESPONSES TO COMMENTS

Massachusetts Environmental Policy Act Office

MEPA.1 **The Single EIR should provide a project description and detailed plans that depict project components, including auxiliary equipment, and describe expected normal CUP operations and procedures for its use at maximum efficiency.**

As described in more detail in Section 1.2, the Project proposes to retire and replace the existing aging cogeneration combustion turbine and heat recovery steam generator. The existing nominal 21 MW combustion turbine engine will be replaced with two nominal 22 MW combustion turbine engines housed in an addition to the existing cogeneration plant. The new engines and heat recovery steam generators are sized to serve the current and future energy needs of MIT and to provide redundancy and reliability to critical operations on campus.

Detailed plans are shown in Section 1.2 and Appendix 1 of this SEIR.

MEPA.2 **Describe how the project will meet current and future demand for electricity and steam, and any other sources of electricity and steam that will be used.**

The sizing of the cogeneration plant gas turbines and HRSGs has taken into account the MIT load growth projections. The existing boilers will serve as back-up capacity with the ability to supplement steam at peak load. MIT will continue to supplement and back up its utility operations with electricity from the grid. Additional details can be found in Section 1.2.

MEPA.3 **As requested by the Department of Energy Resources (DOER), the Single EIR should include a discussion of the full load capacity factor for the CTGs when they are fully operational and the extent to which capacity will be reserved for redundancy.**

As discussed in Section 1.2, in their first year of operation (2019-2020), the two CTs are projected to operate 78 percent of the time, and that percentage is projected to remain constant or increase slightly over the 20-year life of the system. When the CTs are operating, the HRSGs are projected to satisfy 93 percent of the campus's thermal load during the first year of operation; that percentage is projected to remain constant or increase slightly over the 20-year life of the system.

MEPA.4 Describe operating scenarios for the boiler as described in DOER's letter.

The existing boilers will be used to provide additional steam generating capacity to the CHP systems and to provide steam generating capacity when the CHP is offline (maintenance, repair, etc). Boilers 7 and 9 will be utilized first when additional steam generating capacity is required. Boilers 3, 4, and 5 will be used to satisfy any remaining load demands.

MEPA.5 Include plan and elevation views of existing conditions, the proposed building and interior components, and associated infrastructure, including the location of connection to gas main.

Detailed plans are shown in Section 1.2 and Appendix 1 of this SEIR.

MEPA.6 Identify any changes proposed since the filing of the EENF, including selection of final design and generating capacity of the CTG and duct burner units.

As stated in Section 1.4, the Project will now include Solar Titan 250 turbines in place of the GE LM2500s described in the EENF.

MEPA.7 Identify all State Agency permits and approvals required for the project and how the project will be developed consistent with regulatory standards and requirements.

As stated in Section 1.5, the Project will require the following State Agency Permits:

- Massachusetts Historical Commission: Determination of No Adverse Effect on Historic Properties;

- Department of Environmental Protection, Division of Air Quality Control (MassDEP): Major Comprehensive Plan Approval (MCPA);

- Massachusetts Department of Transportation: Approval for building permit on land on or adjacent to railroad corridor (Chapter 40 §54A)

These permits set out regulatory standards and requirements, and the Project will be developed consistent with these standards and requirements.

MEPA.8 Provide a thorough and comprehensive analysis of how the proposed CUP can accommodate and facilitate further reductions in GHG emissions.

Please see Section 7.1 for a discussion of how the Project will facilitate further reductions in GHG emissions.

MEPA.9 Identify specific goals for energy use reductions.

MIT has conducted modeling that indicates that it may be possible to reduce existing building energy use campus-wide by an additional 15-40 percent by 2030. This reduction of existing building energy use at this level constitutes a key strategy for reaching or surpassing MIT's GHG emission reduction goals. Reducing demand-side energy use at the building level is a significant step but is not the only strategy for campus GHG emission reduction. MIT will also focus on fuel switching, Scope 1 mobile emissions, Scope 2 emissions from purchased electricity, and select Scope 3 emissions from waste management, commuting, and procurement.

MEPA.10 Identify specific goals for on-site generation or purchase of off-site clean energy.

As discussed in Section 7.1, MIT is currently undertaking a comprehensive assessment of roofs to identify opportunities for application of a range of sustainable roof technologies including solar PV, green/white/blue roof, increased insulation, etc. As a wholesale purchaser of grid-supplied electricity, MIT will maintain the ability to procure "green electricity" from renewable energy sources, thus offering an additional GHG reduction opportunity.

MEPA.11 Discuss CUP operations and emissions in light of the reduced demand that could result from achieving those goals [MEPA.9 and MEPA.10].

The CUP upgrade project is designed to accommodate fluctuations in on-campus energy demand as a function of new demand growth from new construction as well as accrual of demand-side reductions from energy management programs. The two turbine units can be operated effectively and efficiently to accommodate future demand reductions without losing power resiliency and protection. The units are designed to run efficiently at less than 100 percent capacity and will support additional GHG emission reductions as MIT's long-term demand-side energy reductions are realized.

MEPA.12 As requested by DOER, the Single EIR should provide a more detailed discussion of how much of the capacity of the proposed CUP will be devoted, over time, to meeting energy demand and how much will be dedicated to ensuring redundancy and reliability of the on-site power grid.

Please see Section 1.2 and response to comment MEPA.3.

MEPA.13 The Single EIR should present more detailed evaluations of GHG mitigation measures than were presented in the EENF.

The SEIR provides an evaluation and summary of impacts of proposed balance-of-plant Project elements that serve to minimize GHG emissions in Section 5.7.

MEPA.14 Provide more information about operating scenarios for the boilers and whether they will be used to provide additional steam generating capacity or serve as a steam generating backup to the CHP system.

As discussed in further detail in Section 1.2, the existing boilers will be used to provide steam generating capacity to supplement the upgraded CHP systems and to provide steam generating capacity when the CHP is offline (maintenance, repair, etc).

MEPA.15 A chapter on compliance with the EJ Policy should include the air quality dispersion modeling conducted for the PSD application. It should clearly identify potential impacts and the applicability of impacts to the EJ communities.

As described in Section 2.2 of this SEIR, Section 4.2 of the PSD permit application includes documentation to enable MassDEP to fulfill its obligation under the provisions of the April 11, 2011 PSD Delegation Agreement between MassDEP and EPA to "identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies, and activities on minority and low-income populations as set forth in Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." The Executive Office of Energy and Environmental Affairs (EEA) has established Environmental Justice neighborhoods which identify areas with minority populations and low-income populations. Per Figure A-9 in the PSD application, there are areas with minority populations and low-income populations in the vicinity of MIT.

In order to demonstrate that the project's impacts will not have a disproportionately high effect on minority and low-income populations, a population weighted average concentration for PM_{10} and $PM_{2.5}$ was computed using the worst case AERMOD impacts Operating Scenario from all of the MIT sources for each averaging period. The results are presented in Table A-21 of the PSD application and reproduced in Section 2.2 of this SEIR. The results demonstrate that the impacts from the proposed project are not disproportionately high in the Environmental Justice areas when compared to areas not classified as Environmental Justice areas.

MEPA.16 Include an analysis that considers CUP operations and resulting impacts (emissions) under lower future demand scenarios, including energy efficiency, use of on-site solar photovoltaic (PV) systems, and purchase of clean energy through the grid.

If on-campus demand is lower in the future, the CUP will be required to produce less energy and will have lower emissions. The two-turbine system is flexible enough to accommodate a reduction in demand over time and is designed to operate effectively and efficiently under reduced demand profiles (utilizing just one turbine, for example). CUP operations can be reduced to 20 percent of capacity and will still meet emissions requirements while maintaining resiliency.

In addition to lowering demand from buildings, MIT is pursuing other efficiency strategies, including renewables such as wind, solar, and geothermal. We are always evaluating new opportunities as technology evolves. For more information about on-site generation of clean energy, please see Response to Comment MEPA.10.

MIT-produced electricity, steam, and chilled water are currently less-carbon intensive than what can be purchased on the local grid. It is anticipated that MIT-generated electricity will continue to be less carbon intensive than grid-supplied electricity for the entire planned life of the new cogeneration turbines even given the required increases in the grid renewable energy standards over the next 20 years.

Given the efficiency of cogeneration and the flexible design of the CUP upgrade, it is expected that reduced demand for power on campus will reduce the use of fuel and will therefore reduce emissions.

MEPA.17 Qualitatively compare the Preferred Alternative to scenarios in which the Proponent has met or made significant progress towards achieving its energy use reduction goals.

The design of the proposed system gives MIT the flexibility to adapt CUP operations as campus loads change. The system's equipment is fully capable of meeting smaller campus loads. Should this occur, MIT will change its dispatch operation to the most efficient production mode to meet campus needs.

MEPA.18 If applicable, the Single EIR should include BACT analyses for any changed or additional project components.

Section 4.4.1 includes a BACT analysis.

The Project will now include Solar Titan 250 turbines in place of the GE LM2500s described in the EENF. The Titan 250 turbines will continue to meet the BACT emission limits determined from the top-case and top-down BACT analyses performed for the EENF. The lower heat input of the Titan 250 turbines results in a reduction of overall mass emissions for all pollutants compared to the emissions proposed for the LM2500s in the EENF. The Titan 250 turbines also require fewer variations from top-case BACT for transient operations.

MEPA.19 **Explain in more detail the model used to compare the GHG emissions of the Preferred Alternative to the emissions displaced from other sources as a metric of GHG reductions.**

Section 5.9 describes the model used to compare the GHG emissions of the Preferred Alternative to the emissions displaced from other sources as a metric of GHG reductions. The model varies the electric and thermal energy demand across all 8,760 hours/year for each modeled year, based on weather and campus energy use profiles. The operation of the new turbines, the new duct burners, and existing boilers is varied to match the hourly load, and electricity imports are similarly calculated hourly. This information is used in a DOER-provided calculation that compares, for the same amount of electricity and useful heat, the CO_2 emissions generated by the CHP versus the CO_2 emissions that would be generated by the import of electricity from the distribution grid and creation of the useful heat with conventional natural gas boilers.

MEPA.20 **Explicitly identify all components of the modeled system, including parasitic loads.**

Please see the table below for the base case; evaluated alternatives are reviewed in Table 5-2 and Appendix 3. The central plant energy model included all auxiliary loads associated with the new cogeneration system and all other CUP loads. While lighting in the new building is an additional parasitic load, it is independent of CHP operating rates and is treated as house load for this calculation. Existing CUP loads were included in the central plant energy model in the kW and thermal load profiles, including large chillers and small miscellaneous auxiliary loads.

MIT - WP3 Cogen Heat Balance Auxiliary Loads 2016-04-25

		Base		
	Units	Case 1	Case 2	Case 3
GENERATION		Summer	Winter	Minimum
CTG-200 (Max load 100% turbine output)	kW	16,990	22,898	15,716
CTG-300 (Max load 100% turbine output)	kW	16,990	22,898	0
Winter free cooling credit*	kW	0	0	0
GENERATION SUBTOTAL	kW	33,980	45,796	15,716
PARASITIC				
FGC-100 SERVING CTG-200	kW	-160	-385	-160
CTG-200 PACKAGE AUX LOADS	kW	-65	-40	-65
FGC-200 SERVING CTG-300	kW	-160	-385	0
CTG-300 PACKAGE AUX LOADS	kW	-65	-40	0
HRSG-200 AUX LOADS	kW	-21	-21	-21

MIT - WP3 Cogen Heat Balance Auxiliary Loads 2016-04-25 (Continued)

	Units	Base Case 1	Case 2	Case 3
UFU-200 AMMONIA VAPORIZATION SERVING HRSG-200	kW	-602	-753	-365
HRSG-300 AUX LOADS	kW	-21	-21	0
UFU-300 AMMONIA VAPORIZATION SERVING HRSG-300	kW	-602	-753	0
DI WATER BOOSTER PUMPS	kW	-9	-10	-1
FUEL OIL FORWARDING PUMPS*	kW	0	0	0
CHILLED WATER FOR INLET AIR COOLING*	kW	0	0	0
INLET AIR COOLING GLYCOL PUMPS*	kW	0	0	0
PROCESS COOLING WATER PUMPS	kW	-91	-115	-49
ELECTRIC DRIVE BOILER FEED PUMPS	kW	-142	-168	-13
COOLING TOWER WATER FOR PROCESS COOLING	kW	-103	-14	-6
CONDENSATE TRANSFER PUMPS	kW	-14	-16	-2
PARASITIC SUBTOTAL	kW	-2,055	-2,719	-681
NET (GENERATION - COGEN AUX LOADS)	kW	31,925	43,077	15,035

* not operating in the base case

MEPA.21 Provide additional information on the performance of selected and alternative CTGs in light of the electrical and thermal loads it will be serving.

As stated in Section 1.4 of the SEIR, the Project now proposes to use Solar Titan 250 turbines in place of the GE LM2500s described in the EENF. Because the Solar engine is a slightly smaller unit it will be dispatched at a higher load more hours of the year. This results in lower greenhouse gas emissions and cost for the CUP. The table below highlights the differences in the heat rates (BTU/KWh) of the units.

For more information about turbine selection, please see Section 5.6.

GE LM2500			
Temp	Part Load		
	100%	**75%**	**50%**
0	9,988	10,929	11,422
10	9,681	10,657	11,268
20	9,694	10,752	11,579
30	9,707	10,847	11,890
40	9,720	10,941	12,201
50	9,733	11,036	12,512
60	9,746	11,131	12,823
70	9,840	10,879	12,148
80	9,934	10,627	11,473
90	10,028	10,374	10,797
100	10,122	10,122	10,122

Solar Titan 250			
Temp	Part Load		
	100%	**75%**	**50%**
0	8,849	10,328	10,551
10	8,868	10,157	10,594
20	8,890	7,495	11,701
30	8,913	9,837	12,188
40	8,950	9,742	12,069
50	9,007	9,784	12,094
60	9,164	9,974	12,294
70	9,352	10,202	12,784
80	9,573	10,439	13,322
90	9,825	10,731	13,940
100	10,074	11,075	14,470

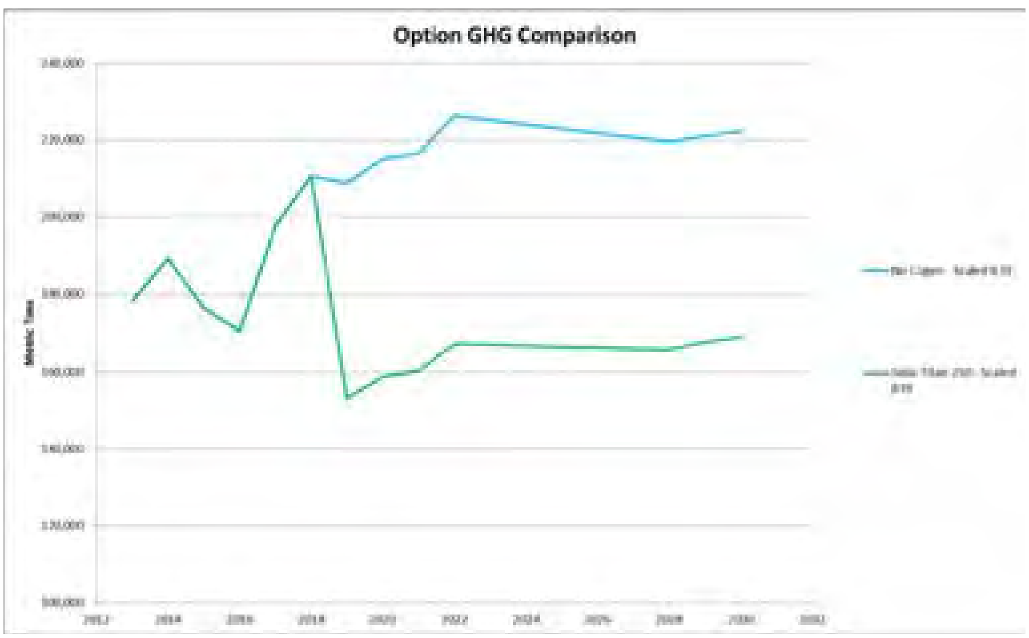
MEPA.22 The GHG analysis should be supplemented with the information and analyses identified in DOER's comment letter.

Please refer to Response to Comment DOER.13.

MEPA.23 Clarify the modeled operating condition used to produce the results in EENF Attachment C-1, and provide results for both the first year, when the existing CTG will operate with a new CTG, as well as the proposed condition with two new CTGs.

New modeled operating conditions are presented in Section 5, reflecting design refinements (and GHG improvements) since the filing of the EENF. As presented in Section 5.9, the new modeling covers expected campus loads from 2019 through 2030. Section 5.9 provides the clarified methodology.

Regarding the overlap period when the existing CT will operate with a new CT, this operating method is expected to last less than one year. This case is not specifically modeled in the results presented in Section 5; however expected results can be interpolated from the graphic below; GHG emissions decrease as the new CTs are brought online. Note that this graphic was produced based on an MIT analysis that assumes a decreasing CO_2 emission factor for grid electricity (as the electric grid becomes cleaner over time), so the results do not exactly match the results in Section 5 (as Section 5 follows the GHG Policy when calculating CO_2 from grid electricity).



MEPA.24 Consult with DOER and the MEPA Office prior to preparing the Single EIR.

The Proponent met with MEPA Analyst Alex Strysky and John Ballam of DOER to discuss the SEIR on Thursday, March 31, 2016.

MEPA.25 Review MassDEP's comment letter and revise the noise analysis as necessary. MassDEP recommends background sound monitoring for a minimum of three days, including at least one weekend day.

An ambient sound monitoring program reviewed by MassDEP was developed prior to conducting the survey. The program included long-term sound monitoring in the residential community nearest to the Project site over a two-week period in August 2014. Section 6 includes the noise analysis, which is included in its entirety in the MCPA application which can be found online at http://powering.mit.edu. Please see Responses to Comments DEP.4 and DEP.5.

MEPA.26 The City of Cambridge has noise limits for specific sound intervals projects based on the time of day the noise is generated and surrounding uses. According to the noise modeling results, it does not appear the project will meet the City's noise limits.

The Project is designed to meet the City of Cambridge Noise Standards at the nearest commercial and residential receptors in the surrounding area for both daytime and nighttime plant operation. Table 6-2 in Section 6.2 presents the estimates for the Project-only sound.

MEPA.27 The Single EIR should review the project's compliance with MassDEP's Noise Policy and the City of Cambridge's Noise Ordinance and identify any additional mitigation measures that may be required. The mitigation measures should be based on a Best Available Noise Mitigation Technology analysis for the site pursuant to MassDEP's Noise Policy.

As described in Section 6 and Appendix E of the MCPA application (located at http://powering.mit.edu), the Project is designed to meet the MassDEP and City of Cambridge noise requirements to be a good acoustical neighbor and avoid community noise complaints. Mitigation measures are incorporated in the Project design that will limit the Project sound to below that of the existing ambient sound at the nearest noise sensitive receptors (residences in the community). Noise impacts are reviewed by MassDEP as part of the MCPA process to ensure compliance with MassDEP requirements. The Proponent will also continue to evaluate the Project's noise impacts in relation to the City of Cambridge noise requirements to ensure compliance.

MEPA.28 Identify the 500-year flood elevation, include a map of the 500-year floodplain, document the storm parameters used in analysis, and describe how the facility will be constructed to withstand impacts from these storms.

As discussed in Section 7.2, based on review of preliminary FEMA flood elevations for Suffolk County (November 2013), which show the 500-year flood elevation in Boston Inner Harbor at approximately 23.1 feet (Cambridge Datum), MIT determined that the electrical equipment in the new CUP should be located above 26 feet elevation (Cambridge Datum) to protect it against the 500-year flood.

MEPA.29 Discuss the potential effects of climate change, including the potential for more frequent and intense storms and rising temperatures to affect the site, and identify any measures that will be implemented to adapt to these conditions.

Equipment inside the addition will be designed to handle a 104-degree outside air temperature. All critical equipment will be installed above elevation 26 feet, which is above the 500-year flood elevation.

MEPA.30 Present an analysis of scenarios based on modeling of risks in the Cambridge Climate Change Vulnerability Assessment (CCVA).

MIT is using the same engineering company that Cambridge used for the CCVA study. All critical equipment will be at elevation 26 feet, which is 9 feet above site grade.

MEPA.31 As requested by the City of Cambridge, the Single EIR should identify potential roles of the campus in increasing community resilience, such as allowing the general public to charge cell phones during prolonged power outages.

MIT is a part of the City of Cambridge, and we will support the needs of the residents in an emergency when and where possible. If MIT's plant is operating in an emergency, MIT's first responsibility will be to provide for our students, faculty, and staff so that they are not displaced. In terms of providing assistance to the larger community (such as providing power to charge community members' cell phones), MIT would evaluate options on a case-by-case basis, taking into account the circumstances of the emergency and MIT's ability to help.

MEPA.32 Describe the rooftop water reclamation system and identify its capacity, and discuss how any overflow will be discharged.

As discussed in Section 10, the rainwater from the roof will be collected and discharged into an existing approximately 145,000 gallon water holding basin located on the roof of Building N16. From the N16 basin, the water will be used as make-up water for the cooling towers. If the cooling towers cannot accept the stormwater (for example the cooling tower common sump is under repair), the stormwater will bypass to the infiltrating catch basins. There is no connection from the infiltrating catch basins to the City of Cambridge stormwater system.

MEPA.33 **The Single EIR should review current storm water patterns on the site and discuss how storm water from areas outside the footprint of the building will be managed.**

Please see Section 10. The current parking lot drainage system consists of several infiltrating catch basins. There is no connection from the infiltrating catch basins to the city stormwater system. In the proposed project, the new building will take up a majority of the site. There will be no new stormwater connections to the city sewer. The stormwater will bypass to the leaching field for emergency maintenance on the new common sump.

MEPA.34 **The Single EIR should provide a more detailed description of construction activities, including installation of the gas pipeline, management and recycling of waste material, and transportation and disposal of contaminated soil.**

Please see Section 9 for a discussion of construction activities.

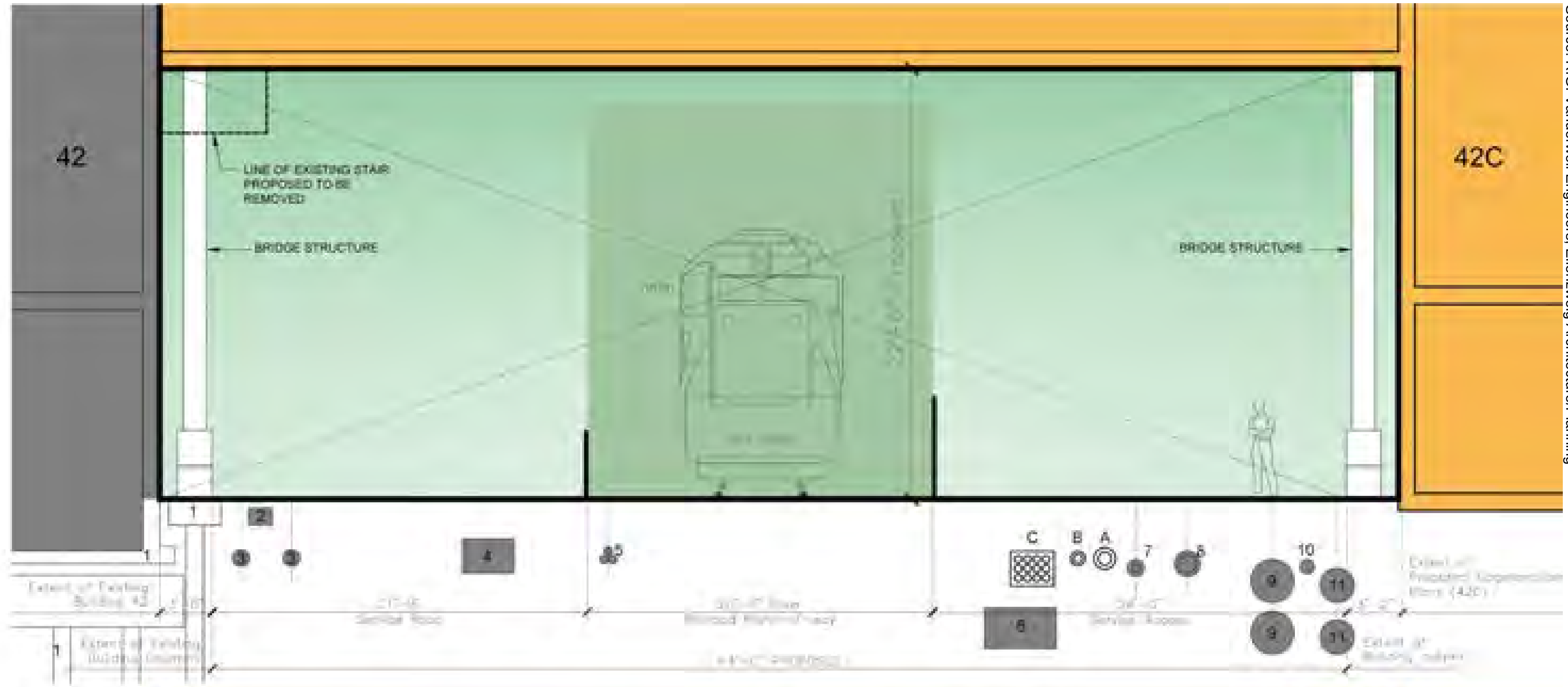
MEPA.35 **Identify potential impacts of these activities [listed in MEPA.34], and describe mitigation measures that will be implemented. Review MassDEP's comment letter for additional information on managing solid waste and hazardous materials during construction. As noted by the Massachusetts Water Resources Authority (MWRA), the site is not located in a combined sewer area, and therefore discharge of groundwater into the sanitary sewer is prohibited.**

Please see Section 9 for a discussion of the impacts of the activities and related mitigation.

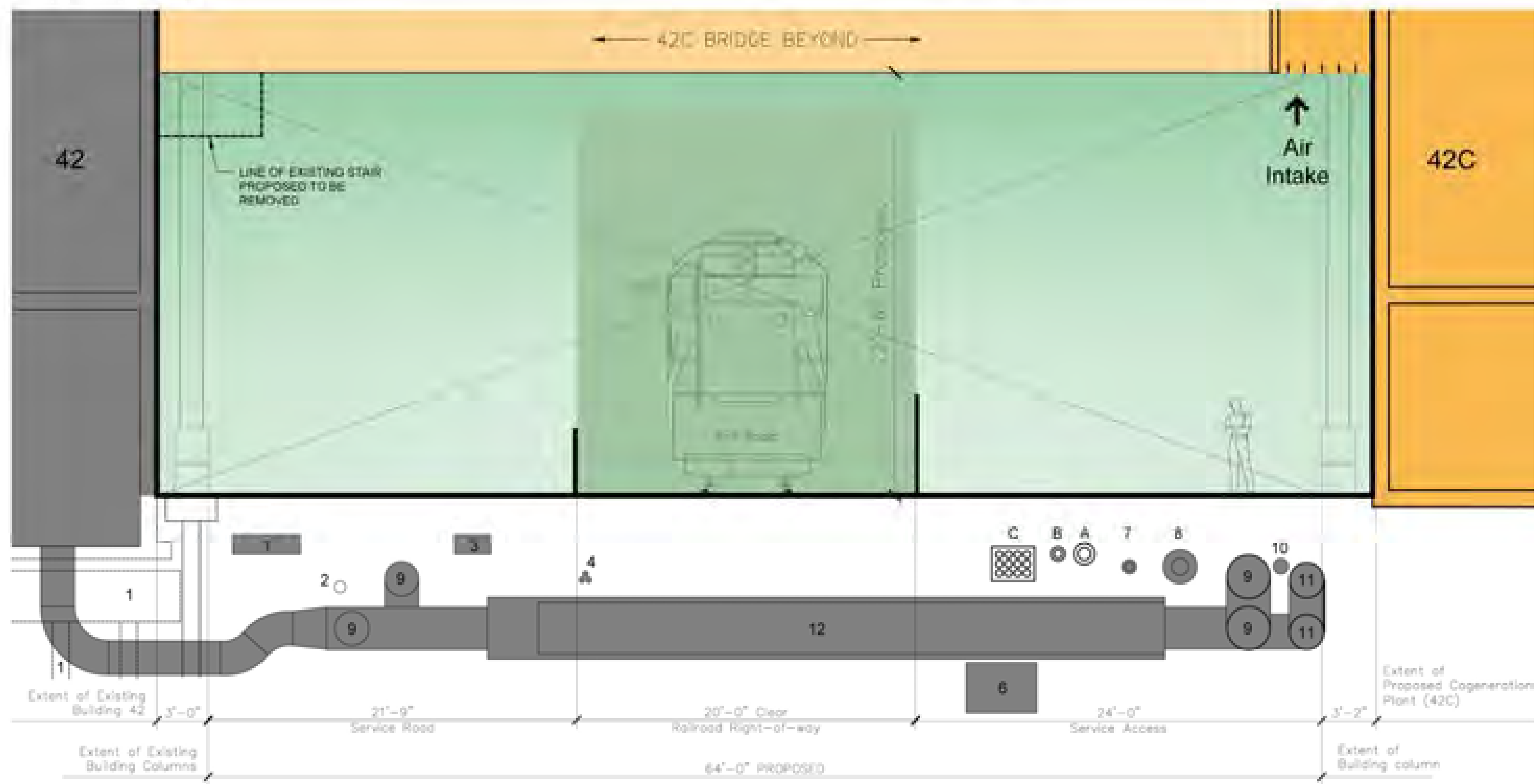
MEPA.36 **The Single EIR should include a plan showing how the right-of-way (ROW) cross-sections provided in the City of Cambridge's comment letter can be implemented adjacent to the project site, and identify any restrictions in design or use that the project may impose on the path.**

The proposed Project will not encroach upon the area of the separate multi-use pathway contemplated for the Grand Junction and, when complete, will not interfere with any future construction of such a path. The cross section of the project in the Grand Junction is the same or more open than previous projects, such as the Chiller & Cooling Tower Building N16 or the Brain and Cognitive Sciences Building. Please see the figure below. There will be a service drive in the rear of the building, similar to many parts of the Grand Junction owned by MIT on the north and south side of the tracks and also east and west of Massachusetts Avenue. For more information on the function of the corridor and its intersection with a multi-use path see the MIT Property Feasibility Study, October 2014 at http://www.cambridgema.gov/CDD/Projects/Transportation/grandjunctionpathway

Proposed Conditions at Central Utility Plant Building 42C Bridge



Proposed Conditions at Central Utility Plant Building 42C



KEY TO EXISTING UNDERGROUND UTILITIES

1. EXISTING FOUNDATIONS
2. EXISTING ELEC DUCT BANK
3. EXISTING (2) 12" CHILLED WATER LINES
4. EXISTING TELECOM DUCT BANK
5. EXISTING TELECOM FIBER OPTIC
6. MIT DUCTBANK
7. EXISTING 6" CONDENSATE
8. EXISTING 12" STEAM
9. EXISTING (2) 30" CONDENSER WATER
10. EXISTING 10" FIRE
11. EXISTING (2) 24" CHILLED WATER
12. (2) 44" DIA., 40' LONG STEEL CASING PIPE
    (1) 36" DIA., 40' LONG STEEL CASING PIPE
    (1) 36" DIA., 37' LONG STEEL CASING PIPE
    CASING SEALS AT EACH END OF ACH CASING PIPE

KEY TO NEW UNDERGROUND UTILITIES

A. HP GAS
B. LP GAS
C. 12" ELECTRICAL FEED DUCTBANK

MEPA.37 **The Single EIR should include a separate chapter on mitigation with a summary of mitigation measures to which the proponent is committed. Describe and assess measures and management techniques designed to limit negative environmental impacts or cause positive environmental impacts during development and operation of the project.**

Proposed mitigation measures are summarized in SEIR Section 11.

MEPA.38 **The Single EIR should include draft Section 61 Findings for MassDEP permits. The proposed Section 61 Findings should specify in detail all feasible measures the proponent will take to avoid, minimize, and mitigate potential environmental impacts to the maximum extent practicable.**

Draft Section 61 Findings are provided in SEIR Section 11.

MEPA.39 **The proposed Section 61 Findings should identify parties responsible for funding and implementation, and the anticipated implementation schedule that will ensure mitigation is implemented prior to or when appropriate in relation to environmental impacts.**

Draft Section 61 Findings are provided in SEIR Section 11. MIT is the party responsible for funding and implementation of the project and its associated mitigation of environmental impacts. Mitigation is built into the Project design and will be implemented as part of the project.

MEPA.40 **To ensure that all GHG emissions reduction measures adopted by the Proponent in the Preferred Alternative are actually constructed or performed, the Proponent must provide a self-certification to the MEPA Office signed by an appropriate professional (e.g., engineer, architect, transportation planner, general contractor) indicating that all of the required mitigation measures, or their equivalent, have been completed. The commitment to provide this self-certification should be incorporated into the draft Section 61 Findings included in the Single EIR.**

The Proponent commits to self-certification requirements for GHG emissions, as stated in SEIR Section 11.

MEPA.41 **The Single EIR should contain a copy of this Certificate and a copy of each comment letter received, and direct responses to comments to the extent that they are within MEPA jurisdiction.**

Comments and responses are provided in this section of the SEIR.

MEPA.42 **The Proponent should circulate the Single EIR to those parties who commented on the EENF, to any State Agencies from which the Proponent will seek permits or approvals, and to any parties specified in section 11.16 of the MEPA regulations.**

The Proponent commits to producing and circulating copies of the SEIR as required by MEPA regulations.

MEPA.43 A copy of the Single EIR should be made available for public review at the Cambridge Public Library and at any other neighborhood locations to enhance public participation among the EJ population in the project area.

The Proponent commits to providing copies of the SEIR to the Cambridge Public Library Central Square branch, which is the nearest public library to the Project site. The SEIR will also be made available to the public on the Proponent's website, http://powering.mit.edu.

MEPA.44 The proponent should consult with the EEA Environmental Justice Director during preparation of the Single EIR regarding the proposed circulation and participation plan to ensure compliance with the EJ policy.

The Proponent conducted enhanced public outreach during the EENF production and public review period in order to ensure access for Environmental Justice community members. Specifically, a fact sheet describing the Project, availability of the EENF, and MEPA's public meeting was translated and reproduced in Spanish, Portuguese, and Chinese language newspapers. The fact sheet was provided to the Cambridge Public Library in Spanish, Portuguese, Chinese, French, and English. The Proponent also provided Spanish, Portuguese, Chinese (Cantonese), and French interpretation services at MEPA's January 14, 2016 public meeting.

Upon publication of this SEIR, the Proponent has arranged for the translation of updated fact sheets into the same languages listed above, along with notices of the availability of the SEIR and opportunity to comment in the same news outlets and library, as proposed to the EJ Director via email on April 4, 2016.

Strysky, Alexander (EEA)

From:	mhdunitz@gmail.com on behalf of Max Dunitz [mdunitz@mit.edu]
Sent:	Tuesday, January 19, 2016 9:15 PM
To:	Strysky, Alexander (EEA)
Subject:	MIT CUP Second Century Project

How will this proposed expansion to the campus natural gas heat and power plant coexist with MIT's and Cambridge's net carbon neutrality goals? MD.1

Max

MD.1 How will this proposed expansion to the campus natural gas heat and power plant coexist with MIT's and Cambridge's net carbon neutrality goals?

MIT recognizes that to minimize the worst impacts of climate change, global energy systems need to move toward a low carbon future and GHG reductions as indicated by scientific study. Locally, MIT has actively participated in the City-sponsored Getting to Net Zero Task Force and has endorsed the incremental and phased approach identified and required to move toward net zero emissions and 80 percent reductions by 2050. MIT's CUP upgrade plan is not only compatible with these long-term goals, but is an essential transitional step—a bridge toward a low-carbon energy future at MIT.

The City has recognized that an incremental and phased transition toward net zero emissions is necessary given current available technologies and economic conditions. MIT's CUP enhancement plan is one of several phased activities that are necessary at MIT to keep MIT moving toward net zero emissions. The enhanced CUP will reduce net emissions despite projected growth in campus energy demand, and is essential for MIT to support rapidly changing and expanding research activities in a manner that is cleaner and more resilient than conventional power arrangements. No other feasible lower carbon emissions solution is available to MIT that can provide the power resiliency necessary to safeguard research and MIT's residential community. During the 20-year lifespan of the enhanced cogeneration system, MIT will continue planning for a lower carbon future and will be well positioned to adopt new technologies—possibly an all-electric system or some as yet unknown innovation—for the next phase on the path toward a lower carbon environment.

In addition to upgrading the CUP, MIT will in parallel implement a portfolio of enabling strategies as listed in Section 7.1. A formal climate action plan is currently being developed and will provide the specific mix of measures and strategies to meet or surpass MIT's GHG goal. The Project, coupled with a mix of these strategies, will provide a credible and achievable move towards net zero emissions.

MASSACHUSETTS WATER RESOURCES AUTHORITY

Charlestown Navy Yard
100 First Avenue, Building 39
Boston, MA 02129

Frederick A. Laskey
Executive Director

Telephone: (617) 242-6000
Fax: (617) 788-4899
TTY: (617) 788-4971

January 21, 2016

Matthew A. Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge St, Suite 900
Attn: MEPA Office, Alex Strysky
Boston, MA 02114

Subject: EOEEA #15453 – Expanded Environmental Notification Form
Central Utilities Plant Second Century Plant Expansion
Cambridge, MA

Dear Secretary Beaton:

The Massachusetts Water Resources Authority (MWRA) appreciates the opportunity to comment on the Expanded Environmental Notification Form (EENF) for the Central Utilities Plant Second Century Plant Expansion (the "Project") submitted by the Massachusetts Institute of Technology (MIT). To meet anticipated future electrical needs, MIT (the "Proponent") is proposing a 44 MW addition to their existing Central Utilities Plant (CUP) with the intent of meeting the following goals: to insure the resiliency of the campus, safeguarding crucial research by enabling MIT to function during a power-loss event; to equip the MIT community with efficient, reliable power source capable of supporting their groundbreaking work and experimentation; and to continue conserving energy and reducing MIT's impact on the environment.

The Project site is located on the MIT campus in Cambridge and includes the MIT CUP, housed in Building 42, and an adjacent surface parking lot. The site is bordered by Albany Street to the north, a separate parking lot to the west, a parking garage to the east, and Vassar Street to the south. The existing MIT CUP consists of a Siemens (AAB) GT10A Combustion Turbine (CT), heat recovery steam generator (HRSG), and electric generator rated at approximately 21 megawatt (MW) and ancillary equipment. It also includes five existing boilers, designated as 3, 4, 5, 7 and 9, an emergency generator and several cooling towers. The CUP was designed to provide near-100% reliability by having standby units at all times, because the facility's heat and power generation is used to maintain critical research facilities, U.S. government Research, classrooms and dormitories. The CUP provides electricity, steam heat, and chilled water to more than 100 MIT buildings. The existing CT provides about 60% of current campus electricity, and steam from the HRSG is used for heating and for driving chillers for cooling many campus buildings.

The existing CT has been in service since its installation in 1995 and will soon reach the end of its service life. Based on the current campus loads and expected growth, it is anticipated that service demand will exceed capacity of the CUP and Eversource feeders by 2018.

MWRA comments focus on permitting from the Toxic Reduction and Control (TRAC) Department.

Toxic Reduction & Control Permitting

Pursuant to 360 C.M.R. 10.023(1), MWRA prohibits the discharge of groundwater to the sanitary sewer system, except in a combined sewer area when permitted by the Authority and the municipality. The Project site is not located in a combined sewer area; therefore, the discharge of groundwater to the sanitary sewer system associated with this Project is prohibited. MIT must secure a USEPA-NPDES General Permit for Storm Water Discharges for its construction activities. MWRA.1 MWRA.2

Currently, MIT's Central Utility Plant holds MWRA Sewer Use Discharge Permit #09101084, Category 01, Significant Industrial User (SIU), for its facility located on 59 Vassar Street, Cambridge, Massachusetts. The MIT CUP is a cogeneration plant that produces steam, chilled water and electricity for the MIT campus. The plant utilizes natural gas and diesel fuel for the boilers. MIT discharges treated wastewater from its CUP into the MWRA sanitary sewer system. MIT shall continue to adhere to its MWRA Sewer Use Discharge Permit. If MIT intends to change its current operation(s) and/or discharge(s) such as increasing its daily wastewater discharge flow from the cogeneration plant processes it must provide at least 90 days advance written notification to Mr. Walter Schultz, MWRA Industrial Coordinator within the TRAC Department located at 2 Griffin Way, Chelsea, MA 02150. The notification is required before it takes any action which may substantially change the volume or nature of its discharge including an increase of daily discharge flow or character of pollutants in its discharge, from any compliance measurement location or any sewer connection. For further assistance related to any discharge changes, MIT should contact Mr. Schultz directly at (617) 305-5665. MWRA.3

If you have any questions or need additional information, please do not hesitate to contact me at (617) 788-1165.

Sincerely,

Marianne Connolly

Marianne Connolly
Senior Program Manager
Environmental Review and Compliance

cc: Kattia Thomas, MWRA TRAC

C:MEPA:15453CentralUtilitiesPlantExpansionCambridgeExpENF.docx

MWRA.1 **Pursuant to 360 C.M.R. 10.023(l), MWRA prohibits the discharge of groundwater to the sanitary sewer system, except in a combined sewer area when permitted by the Authority and municipality. The Project site is not located in a combined sewer area; therefore, the discharge of groundwater to the sanitary sewer system associated with this Project is prohibited.**

The Project is designed in accordance with 360 C.M.R 10.023(1). The final design will not include pumping groundwater to the sanitary system.

MWRA.2 **MIT must secure a USEPA-NPDES General Permit for Storm Water Discharges for its construction activities.**

The Project site is under one acre, therefore a NPDES construction permit is not required. MIT and applicable contractors will, however, have in place a SWPPP that would generally meet the SWPPP requirements of a EPA-NPDES General Permit for Storm Water Discharges. The Project will also comply with the City of Cambridge Stormwater Control standards.

MWRA.3 **MIT shall continue to adhere to its MWRA Sewer Use Discharge Permit. If MIT intends to change its current operations and/or discharges such as increasing its daily wastewater discharge flow from the cogeneration plant processes, it must provide at least 90 days advance written notification to Mr. Walter Schultz, MWRA Industrial Coordinator.**

The MWRA will be given advanced notice, at least 90 days, for any change to the cogeneration plant's current operations and/or discharges to MWRA sewers.

CRWA

<u>Via Email and Mail</u>
January 22, 2016

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Attn: Alex Strysky, MEPA Office

Re: ***Central Utilities Plant Second Century Plant Expansion, Cambridge, MA, EOEEA No. 15453***

Dear Secretary Beaton:

The Charles River Watershed Association (CRWA) has reviewed the Expanded Environmental Notification Form (EENF) for the above referenced project and submits the following comments.

- The proponent should clarify its use of ultra low sulfur diesel (ULSD). According to the ENF, each of the proposed 22 MW Combustion Turbines (CT) will fire natural gas with ULSD as a backup fuel for up to 48 hours a year for "testing, and up to the equivalent heat input of 168 hours per year including testing and <u>periods when natural gas is unavailable</u>." EENF Attachment C-2. The DEIR should discuss why USLD is necessary for testing and quantify its testing needs with ULSD in detail. It should also clarify whether the 48 hours is included in the 168 hours per year of total ULSD use. The proponent should also confirm that ULSD use is for testing and emergency use <u>only</u> should natural gas not be available. Given the air impacts,[1] the proponent should commit, if it has not already to ULSD operation as a true emergency source only.

CRWA.1

CRWA.2

CRWA.3

- The proponent should similarly explain the 48 hours of USLD use for testing and 168 hours per year for testing and also when natural gas is not available for Boilers 3,4, 5 and 7 and 9.

CRWA.4

- It should also explain its statement that accessing the electrical grid during natural gas shortages (instead of using ULSD) would not meet the project's "reliability goals." EENF at C-14.

CWRA.5

- The proponent should explain in detail its request for removal of annual operating restrictions on boilers 7 and 9 "to allow more use of these efficient resources." *See*, EENF at 4 and Appendix C-7.

[1] For the CTGs, the NOx emission rate for ULSD fired is over four times that of natural gas firing; CO and VOC emissions are over three times; particulate matter is two times that of natural gas; and carbon dioxide emissions increase from 119 lb/MMBtu to 166 lb/MMBtu. EENF at C-18, Table C-5.

CWRA.6

- The proponent should also discuss its statement that the new CTG units will burn # 6 fuel oil left in the tanks or run for 48 hours of testing per year whichever is greater. It should provide the size of the fuel oil tanks, an estimate of the amount of fuel oil expected to be in the tanks at fuel changeover, an estimate of the number of hours the CTG units will operate on fuel oil after changeover, and emissions resulting from this use. We believe the proponent should commit in MEPA not to use this fuel for operating and to eliminate (or reduce the number) of tanks at startup or no later than 12 months after start up.

CWRA.7

- The proponent should detail its use of "onsite renewable energy, and the reduction in energy use [that] is being actively pursued campus-wide as part of MIT's ongoing commitment to reduce campus greenhouse gas emissions." EENF at C-14.

CWRA.8

- The facility is subject to the Charles River Nutrient Total Maximum Daily Loads (TMDLs). Pursuant to the *Total Maximum Daily Load for Nutrients in the Lower Charles River Basin, Massachusetts* (2007), the plant's phosphorus load needs to be reduced by at least 62 percent to meet the TMDL.[2] Under *the Upper/Middle Charles River Nutrient Total Maximum Daily Load* (2011), this industrial land use requires a 65% phosphorus reduction. Removing 0.55 acres of surface parking and capturing roof and stormwater runoff for water reuse will reduce the facility's phosphorus load as well as conserve water. The proponent should provide drainage calculations, stormwater BMPs, and discuss how the project will meet the nutrient TMDL.

CWRA.9
CWRA.10

- While the proponent states that water use is not expected to increase, EENF at 6, the "Summary of Project Size and Environmental Impacts" shows an increase of 65,650 gpd, for a total water use of 457,871 gpd. This water comes from City of Cambridge surface water reservoirs that are part of the Charles River system; water use by plant component should be broken out and discussed in the environmental impact report. The proponent should elaborate on its statement that the new CTs "have the opportunity" to use dry low NOx (DLN) combustors instead of water injection" and how often the plant is expected to operate in DLN. EENF at C-18. The proponent should discuss water conservation efforts campus-wide and include MIT's water use volumes over the past five years.

CWRA.11
CWRA.12

- The proponent should explain why it is not in a position now to capture rainwater for use in cooling tower make up to reduce its city water system use. EENF at C-53. It should also discuss and reconcile the discrepancy between this statement and its statement in the EENF at C-60 discussing the public benefit determination that the facility "will incorporate a cooling tower water storage system designed to retain rainwater rather than discharging it to the City of Cambridge stormwater system." *See also*, EENF at C-61.

CWRA.13

- The EIR should include a map showing c. 91 tidelands.

[2] The phosphorus reduction pursuant to the Lower Basin nutrient TMDL is 62%. Under *the Upper/Middle Charles River Nutrient Total Maximum Daily Load* (2011), this industrial land use requires a 65% phosphorus reduction.

Thank you in advance for your consideration of these issues.

Sincerely,

Margaret Van Deusen

Margaret Van Deusen
Deputy Director and General Counsel

CRWA.1 The proponent should clarify its use of ultra low sulfur diesel (ULSD). According to the ENF, each of the proposed 22 MW combustion turbines will fire natural gas with USLD as a backup fuel for up to 48 hours a year for "testing, and up to the equivalent heat input of 168 hours per year including testing and periods when natural gas is unavailable" (EENF Attachment C-2). Discuss why ULSD is necessary for testing and quantify its testing needs with ULSD in detail. Also clarify whether the 48 hours is included in the 168 hours per year of total ULSD use.

In the case of an emergency that interrupts the CUP's supply of natural gas, the plant is designed to run on ULSD. It is necessary to prepare for this possibility by running the turbines on ULSD for up to 48 hours/year for the following purposes: emissions testing, operational reliability, and operator training. Each turbine is expected to be tested for 8 hours twice a year. The 48-hour time period gives MIT the flexibility to conduct additional testing if a problem is identified.

Should an emergency occur that interrupts the natural gas supply, causing the system to switch over to ULSD, the CUP will need as much as seven days (168 hours) of operation to return to normal functioning. The 48 hours/year is included in the 168 hours/year of total ULSD use.

CRWA.2 Confirm that ULSD use is for testing and emergency use only should natural gas not be available. Given air impacts, the proponent should commit, if it has not already, to USLD operation as a true emergency source only.

Testing of ULSD as a backup fuel is necessary to ensure that the equipment will function as designed in case natural gas is not available. Emergency generators are tested regularly for the same reason. In the CUP, ULSD will be used only for testing or in emergency circumstances.

CRWA.3 Explain the 48 hours of ULSD use for testing and 168 hours per year for testing and also when natural gas is not available for Boilers 3, 4, 5, 7 and 9.

Testing will be necessary to ensure that the CUP will function on ULSD as designed in the event that natural gas is not available. Each turbine is expected to be tested for 8 hours twice a year for the following purposes: emissions testing, operational reliability, and operator training. The 48-hour time period gives MIT the flexibility to conduct additional testing if a problem is identified. In the event of an emergency that disrupts the supply of natural gas, the permit will allow Boilers 3, 4, 5, 7 and 9 to run on ULSD for up to 168 hours/year. The 48 hours of testing is included as part of the total 168 allowable hours per year.

CRWA.4 Explain the EENF statement that accessing the electrical grid during natural gas shortages (instead of using ULSD) would not meet the project's "reliability goals" (EENF C-14).

The ISO grid electricity is largely produced from natural gas, so a natural gas shortage could be expected to compromise accessibility and/or reliability of the grid's electrical supply. Possible scenarios such as ice storms, floods, or other extreme weather conditions could eliminate MIT's natural gas supply and electrical connection at the same time. Without an electric connection and gas connection, MIT could not shelter in place and protect vital research.

CRWA.5 Explain in detail the request for removal of annual operating restrictions on Boilers 7 and 9 "to allow more use of these efficient resources" (EENF 4 and Attachment C-7).

Boilers 7 and 9 currently have a permit limit of 3,600 operating hours. Boilers 3, 4, and 5 have no limitation on operating hours. Boilers 7 and 9 are newer than Boilers 3, 4, and 5, and they operate at a higher efficiency than the older boilers. If MIT is able to run Boilers 7 and 9 more often (and the less-efficient Boilers 3, 4, and 5 less often), overall operational efficiency would be improved. Running the newer, more efficient boilers instead of the older, less efficient boilers will have a net environmental benefit.

CRWA.6 Discuss the EENF statement that the new CTG units will burn #6 fuel oil left in the tanks or run for 48 hours of testing per year, whichever is greater. Provide the size of the fuel oil tanks, an estimate of the amount of fuel oil expected to be in the tanks at fuel changeover, an estimate of the number of hours the CTG units will operate on fuel oil after changeover, and emissions resulting from this use. The proponent should commit not to use this fuel for operating and to eliminate (or reduce the number of) tanks at startup or no later than 12 months after startup.

Once the Project's additional ULSD storage tanks are installed, #6 oil will be eliminated from all MIT operations. The new CTs will run primarily on natural gas and also on ULSD. ULSD will only be used up to 48 hours/year for testing purposes and up to 168 hours/year in an emergency situation.

CRWA.7 Detail the use of "onsite renewable energy, and the reduction in energy use [that] is being actively pursued campus-wide as part of MIT's ongoing commitment to reduce campus greenhouse gas emissions" (EENF C-14).

Please see Section 7.1 for a discussion of MIT's efforts regarding renewable energy, energy efficiency and GHG emissions reduction.

CRWA.8 **Pursuant to Total Maximum Daily Load (TMDL) for Nutrients in the Lower Charles River Basin, Massachusetts (2007), the plant's phosphorus load needs to be reduced by at least 62 percent to meet the TMDL. Under the Upper/Middle Charles River Nutrient Total Maximum Daily Load (2011), this industrial land use requires a 65 percent phosphorus reduction. Provide drainage calculations and storm water BMPs, and discuss how the project will meet the TMDL.**

The existing site currently captures storm water and infiltrates 100 percent of captured water within the site. As described in Section 10, the Project design will capture and reuse roof water and capture and infiltrate surface water. The roof water will be collected and discharged to an approximately 145,000 gallon holding basin on the roof of N16. The water will be reused by the cooling towers.

CRWA.9 **The proponent should elaborate on its statement that the new CTs "have the opportunity" to use dry low NOx (DLN) combustors instead of water injection and how often the plant is expected to operate in DLN (EENF C-18).**

The new CTs will use dry low NOx combustion technology 100 percent of the time while firing on natural gas and will use water injection 100 percent of the time while firing on oil, which is 168 hours/year maximum.

CRWA.10 **Discuss water conservation efforts campus-wide and include MIT's water use volumes over the past five years.**

Water conservation measures taken in the CUP Project include:

- ♦ Capturing roof rain water for cooling tower make-up (Towers 11, 12, and 13 draining into common sump);
- ♦ Capturing cooling coils condensation as make-up (GT10 cooling coils and E40 rooftop AHU condensation gets put into cooling towers as make-up);
- ♦ Running cooling tower cycles as high as possible without causing a chloride issue;
- ♦ Running boiler cycles as high as possible without causing boilers deposit formation; and
- ♦ Installing high efficiency fill and drift eliminators on new cooling towers.

MIT understands that water is a finite natural resource and that clean water is critical to healthy ecosystems and people. MIT strives to pursue sustainable water management strategies across the campus systems that use water, such as energy production, heating and cooling, restrooms, drinking water faucets, showers, cafeterias, laboratories, landscaping, and more. MIT is taking steps to reduce consumption of potable water, deploy effective stormwater management strategies, and protect the local and regional water infrastructure.

Water conservation: MIT works extensively to reduce its water usage through a variety of strategies, including the deployment of technologies such as: installation of low-flow shower heads and toilets, educational signs, and efficient washing machines; and installation of a centralized irrigation system at the Stata Center, which uses weather data to control water flow and can identify leaks and cut off water flow in order to minimize watering. These initiatives have saved 70,000,000 gallons of water per year and have helped MIT's water usage fall 60 percent between 1997 and 2005.

At the CUP, water usage over the past five years has been steadily declining due to efficiency improvements at the plant and building-level, primarily in the steam and chilled water systems. The table below shows the total water use at the plant for campus heating and cooling.

Building Group	Utility Source	Utility	Unit of Measure	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015
CUP	Purchased	Water	CCF	222,930	200,561	199,412	197,424	188,975

Rainwater harvesting: Rainwater harvesting and reuse systems are in place in the Brain and Cognitive Sciences Building and at the Stata Center where reclaimed water is used for irrigation and toilet flushing. MIT won a 2010 Cambridge GoGreen award for the Stata Center's stormwater management successes.

Charles River: MIT has also played a role in the ongoing revitalization of the Charles River in response to the EPA's Clean Charles River Initiative. The Institute has joined Boston-area community stewardship activities including numerous river cleanup events, water sampling for the Charles River Watershed Association, and stormwater management on campus.

CRWA.11 The proponent should explain why it is not in a position to capture rainwater for use in cooling tower makeup to reduce its city water system use (EENF C-53).

MIT will be capturing rainwater on the roof of the plant to be used by the cooling towers.

CRWA.12 **Discuss and reconcile the discrepancy between this statement [CRWA.11] and the statement in the EENF at C-60 discussing the public benefit determination that the facility "will incorporate a cooling tower water storage system designed to retain rainwater rather than discharging it to the City of Cambridge storm water system" (see EENF C-61).**

Please refer to Response to Comment CRWA.11 above.

CRWA.13 **Include a map showing c.91 tidelands.**

Please see the Chapter 91 Tidelands map provided in Section 8.

Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

January 22, 2016

Matthew A. Beaton, Secretary
Executive Office of
Energy & Environmental Affairs
100 Cambridge Street
Boston MA, 02114

RE: Cambridge
Central Utilities Plant Second Century Plant Expansion
59 Vassar Street, Building 42C
EEA # 15453 (previously EEA #7856)

Attn: MEPA Unit

Dear Secretary Beaton:

The Massachusetts Department of Environmental Protection Northeast Regional Office (MassDEP-NERO) has reviewed the Expanded Environmental Notification Form (EENF) submitted by the Massachusetts Institute of Technology to add two, nominal 22 MW combustion turbines to the existing Central Utilities Plant, which currently consists of a 21 MW combustion turbine, heat recovery steam generator (HRSG) and electric generator, five boilers, an emergency generator, and cooling towers on a 2.4 acre site in Cambridge (EEA #15453). The turbines will be fueled primarily by natural gas with ultra low sulfur diesel (ULSD) as a backup for up to 168 hours per year for testing and when natural gas is unavailable. In addition, a 2 MW ULSD fired cold-start engine, to be mounted on the roof, is proposed for starting the turbines during emergency conditions.

An 80,942 square foot (sf) addition to the existing, 203,082 sf building (three floors) will be constructed for the project. The addition is reported to be approximately 224 feet x 118 feet x 63 feet above ground level. A 165 foot tall stack with two 165 foot high flues also is proposed. In conjunction with the project, Boilers 3, 4, 5, 7, and 9 will burn only natural gas with ULSD as backup for up to 168 hours per year for testing and when natural gas is unavailable. Three new cooling towers will replace Towers 1, 2, 3, 4, 5, and 6. Towers 7, 8, 9, and 10 will remain. Indoor space will be provided to Eversource for a regulator station to provide high-pressure natural gas to improve natural gas availability to the area of Cambridge around MIT.

Currently the existing combustion turbine at the Central Utilities Plant provides about 60 percent of the electricity on campus. The steam is used for heating, and steam-driven chillers for cooling buildings on campus. The existing combustion turbine was installed in 1995 and is reaching the end of its useful service life. The existing turbine will be retired following the commissioning of the second turbine unit in 2019. The project is categorically included for the preparation of an environmental impact report, and the proponent is requesting submittal of a single environmental impact report (SEIR). Based on MassDEP's review to date, MassDEP does not object to the request to use the SEIR process. MassDEP provides the following comments.

Stormwater

The runoff from the proposed project would be reduced by collection and reuse of rainwater. Although the existing drainage system was not explained in the EENF, stormwater is conveyed to the City's drainage system and the Charles River. Stormwater discharges to the Charles River needs to be consistent with the established water quality standards and goals for phosphorus and pathogen removal in the *Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin* (June, 2007) and the *Total Maximum Daily Loads for Pathogens within the Charles River Watershed* (January 2007). Accordingly, the EIR should provide sufficient information to demonstrate that the stormwater management system would be designed to address the water quality impairments covered by the applicable TMDL. DEP.1

The EENF reports that the preferred alternative provides protection from flooding (page 7), but does not explain the existing flooding conditions. The EIR should describe the extent of flooding in context with historical flooding events, and take into consideration the potential for increased flooding due to more frequent extreme storm events associated with climate change. MassDEP also requests that the EIR explain the proposed protection from flooding. DEP.2

State Air Quality Permitting

The EENF notes that MIT has submitted to MassDEP for review and approval a Major Comprehensive Plan Approval Application (MCPA Application) that Epsilon Associates, Inc. prepared pursuant to 310 CMR 7.00. Attachment D of the EENF includes an electronic version of the MCPA Application. MassDEP may not take action on the MCPA Application until the MEPA process has concluded. To date, MassDEP has conducted a preliminary review of the Application, but will conduct a thorough and comprehensive review prior to taking action on the MCPA Application. Relating to the EENF and the MCPA application, MassDEP NERO further notes:

A. The MCPA Application, among other things, provides a Best Available Control Technology (BACT) analysis to demonstrate that the proposed project represents BACT, which will be reviewed by MassDEP.
   1. If not already done, the proponent should ensure that its BACT Analysis includes: DEP.3
      i. Top down BACT analysis for all ancillary equipment;
      ii. Top-case BACT for all turbine operating conditions

B. The MCPA Application, among other things, provides an air dispersion modeling analysis of the proposed project to determine compliance with the National Ambient Air Quality Standards (NAAQS), which will be reviewed by MassDEP.

C. The MCPA Application, among other things, provides an air quality impact assessment analysis for non-criteria pollutants emitted from the proposed project to determine compliance with MassDEP Allowable Ambient Limit (AAL) and Threshold Effects Exposure Limit (TEL), which will be reviewed by MassDEP.

D. The MCPA Application also provides a Noise Analysis (e.g., a sound level assessment) of the proposed project to determine compliance with 310 CMR 7.01, 310 CMR 7.10, and MassDEP's Noise Policy DAQC 90-001, which will be reviewed by MassDEP.

1. If not already done, the proponent should ensure that its Noise Analysis includes noise emissions from: DEP.4
   - i. the proposed new fuel gas compressor;
   - ii. the proposed new fuel gas compressor enclosure design;
   - iii. the proposed new cooling towers;
   - iv. inlet air intakes for the proposed new turbines;
   - v. exhaust vents for the proposed new turbines;
   - vi. the proposed new combustion exhaust stacks for the proposed new turbines;
   - vii. air intakes for the proposed new black-start generator;
   - viii. exhaust vents for the proposed new black-start generator;
   - ix. the proposed black-start generator enclosure design;
   - x. the proposed new building design;
   - xi. all existing equipment that could have a contributing impact to existing sound levels, including but not limited to existing engine generators, rooftop cooling towers and any other existing sound generating equipment that contributes to existing noise levels; and
   - xii. daytime and nighttime existing ambient sound levels.
2. Pursuant to MassDEP's customary pre-construction guidance for determining ambient sound levels at locations potentially exposed to sound emissions from facilities subject to MassDEP plan approval, the Noise Analysis should include a complete background sound monitoring for a minimum of three (3) continuous 24-hour days, including at least one weekend day (e.g., Thursday- Friday- Saturday, Saturday-Sunday-Monday, or Sunday-Monday-Tuesday). DEP.5
3. The Noise Analysis should include a Best Available Noise Mitigation Technology (BANMT) analysis taking into account the technical and economic feasibility of sound abatement options in order to determine a Facility Sound Level that is representative of Best Available Noise Mitigation Technology at this Facility. Sound from the proposed project, when combined with that from the existing facility equipment, should comply with MassDEP's noise regulation and policy while providing a reasonable margin of safety. DEP.6

E. All combustion equipment employed during construction of the project should be equipped with appropriate air pollution control technology designed to reduce air emissions. DEP.7

F. MassDEP has identified the following discrepancies in the EENF and requests clarification:

1. Attachment A-5 indicates that the exhaust stack for the cold-start engine is 165 feet above ground level (AGL) however Pages C-3 and C-9 indicate that it is 96.5 feet AGL. DEP.8
2. Page C-3 identifies three 165 feet AGL exhaust flues however MassDEP understands there are to be two flues, one for each proposed turbine. DEP.9
3. Page C-25 refers to "these" units however MassDEP understands that there is to be one single cold-start engine. DEP.10
4. Page C-9 indicates that the Facility wants to increase operating hours on the existing Boilers No. 7 and No. 9 immediately upon MCPA Approval allowing such but does not mention filing a Significant Modification Application (BWP AQ13) for their existing Operating Permit No. MBR-95-OPP-026, as required under Regulation 310 CMR 7.00: Appendix C(4)(b). DEP.11

Federal Air Quality PSD Permitting

MassDEP notes that the proposed project not only triggers Massachusetts state air quality permitting, (the MCPA requirement under Massachusetts Clean Air Act and 310 CMR 7.00), but also triggers federal air permitting requirements under the federal Clean Air Act, specifically the Prevention of Significant Deterioration (PSD) permitting requirements. *See* Clean Air Act (CAA) Chapter I, Part C (42 U.S.C. Section 7470, et *seq.*), and the regulations found at the Code of Federal Regulations Title 40, Section 52.21. Pursuant to the Agreement for Delegation of the Federal Prevention of Significant Deterioration Program, dated April 2011, by the United States Environmental Protection Agency, Region 1 (EPA), MassDEP is delegated to administer the federal PSD program in Massachusetts.

A. MIT has submitted its Prevention of Significant Deterioration (PSD) Permit Application to MassDEP. Because the PSD Permit Application is integrally related to the MCPA Application, MassDEP recommends that it may be helpful to the public if the PSD Application is physically appended to the next MEPA filing and/or if the PSD Application is made available through a website accessible to members of the public without any website registration requirement (i.e., anonymously, without barriers to viewing or printing the Application). DEP.12

B. As part of the PSD review, MIT is required to address federal Environmental Justice issues.[1] MIT is required to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies and activities on minority and low-income populations, as set forth in *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Executive Order 12,898, 59 Federal Register 7,629 (February 16, 1994). See also the May 1, 2013 EPA document Draft Technical Guidance for Assessing Environmental Justice in Regulatory Analysis which addresses the executive order (focusing on rulemaking activities). DEP.13

Greenhouse Gas Emissions (GHG)

[1] The federal Environmental Justice requirements are in addition to Massachusetts' Environmental Justice requirements.

The GHG analysis in the EENF estimated a net GHG emissions reduction of 12 percent (25,000 tons per year (tpy)) from source energy that is replaced by the proposed CHP, when compared with Case 1, the separate generation of electricity and thermal energy. The analysis used the *Estimated Tool: Net GHG Reduction Achieved by a CHP System Operating in Mass. (ISO-NE Region)*, which is adapted from DOER 11/2014. Total CO_2 emissions from the project are estimated at 286,000 tpy (page B-2).

The EENF indicates that GE LM-2500 or equivalent combustion turbine units are proposed (page C-7). The energy efficiency and emissions control features of these units are not specifically considered in the EENF; however, it is stated on Page C-50 that "the turbine options selected are the most efficient available to meet the identified project need." MassDEP requests DEP.14 that the EIR explain in greater detail the energy efficiency of the preferred and alternative combustion turbines available. Although energy efficiency equates to a well-designed CHP system which matches the electrical and thermal loads it is serving, it is not obvious from the limited information provided that energy efficiency equipment would be exploited fully. Therefore, it is requested that the EIR consider and explain the extent to which the proposed DEP.15 turbines and associated equipment will utilize efficiency measures, such as advanced combustion, high efficiency air handling, advanced controls, advanced ignition systems, and advanced waste heat recovery systems.

Recycling

The project includes demolition and reconstruction, which will generate a significant amount of construction and demolition (C&D) waste. The EENF has made a general commitment to recycle C&D waste as a sustainable measure for the project. In addition, the proponent is advised that demolition activities must comply with both Solid Waste and Air Pollution Control regulations, pursuant to M.G.L. Chapter 40, Section 54, which provides: DEP.16

> "Every city or town shall require, as a condition of issuing a building permit or license for the demolition, renovation, rehabilitation or other alteration of a building or structure, that the debris resulting from such demolition, renovation, rehabilitation or alteration be disposed of in a properly licensed solid waste disposal facility, as defined by Section one hundred and fifty A of Chapter one hundred and eleven. Any such permit or license shall indicate the location of the facility at which the debris is to be disposed. If for any reason, the debris will not be disposed as indicated, the permittee or licensee shall notify the issuing authority as to the location where the debris will be disposed. The issuing authority shall amend the permit or license to so indicate."

For the purposes of implementing the requirements of M.G.L. Chapter 40, Section 54, MassDEP considers an asphalt, brick, and concrete (ABC) rubble processing or recycling facility, (pursuant to the provisions of Section (3) under 310 CMR 16.05, the Site Assignment regulations for solid waste management facilities), to be conditionally exempt from the site assignment requirements, if the ABC rubble at such facilities is separated from other solid waste materials at the point of generation. In accordance with 310 CMR 16.05(3), ABC can be crushed on-site with a 30-day notification to MassDEP. However, the asphalt is limited to weathered bituminous concrete, (no roofing asphalt), and the brick and concrete must be uncoated or not impregnated with materials such as roofing epoxy. If the brick and concrete are not clean, the material is defined as construction and demolition (C&D) waste and requires either a Beneficial Use Determination (BUD) or a Site Assignment and permit before it can be crushed.

Pursuant to the requirements of 310 CMR 7.02 of the Air Pollution Control regulations, if the ABC crushing activities are projected to result in the emission of one ton or more of particulate matter to the ambient air per year, and/or if the crushing equipment employs a diesel oil fired engine with an energy input capacity of three million or more British thermal units per hour for either mechanical or electrical power which will remain on-site for twelve or more months, then a plan application must be submitted to MassDEP for written approval prior to installation and operation of the crushing equipment.

Asbestos removal notification on permit form BWP AQ04 (ANF 001) and building demolition notification on permit form BWP AQ06 must be submitted to MassDEP at least 10 working days prior to initiating work. If any asbestos-containing materials will need to be abated through non-traditional abatement methods, the proponent must apply for and obtain approval from MassDEP, through Application BWP AQ36 - Application for Non-Traditional Asbestos Abatement Work Practice Approval. Except for vinyl asbestos tile (VAT) and asphaltic-asbestos felt and shingles, the disposal of asbestos containing materials within the Commonwealth must be at a facility specifically approved by MassDEP, (310 CMR 19.061). No asbestos containing material including VAT, and/or asphaltic-asbestos felts or shingles may be disposed at a facility operating as a recycling facility, (310 CMR 16.05). In addition, the demolition project contain asbestos, the project proponent is advised that asbestos and asbestos-containing waste material are a special waste as defined in the Solid Waste Management regulations, (310 CMR 19.061). The disposal of the asbestos containing materials outside the jurisdictional boundaries of the Commonwealth must comply with all the applicable laws and regulations of the state receiving the material. DEP.17

The demolition activity also must conform to current Massachusetts Air Pollution Control regulations governing nuisance conditions at 310 CMR 7.01, 7.09 and 7.10. As such, the proponent should propose measures to prevent and minimize dust, noise, and odor nuisance conditions, which may occur during the demolition. Again, MassDEP must be notified in writing, at least 10 days in advance of removing any asbestos, and at least 10 days prior to any demolition work. The removal of asbestos from the buildings must adhere to the special safeguards defined in the Air Pollution Control regulations, (310 CMR 7.15 (2)). DEP.18

Waste Ban Regulation – 310 CMR 19.017

Section 310 CMR 19.017 *Waste Bans* of the Massachusetts Solid Waste regulations prohibit the disposal of certain wastes in Massachusetts. These wastes include, but are not limited to, recyclable paper (including cardboard). On October 1, 2014, the Massachusetts Organics Waste Ban on the disposal of commercial organic wastes by businesses and institutions takes effect. It prohibits the disposal of organic wastes from businesses and institutions that generate a ton or more of organic materials per week, which necessitates the composting, conversion (such as anaerobic digestion), recycling or reuse of organic the waste. DEP.19

Massachusetts Contingency Plan (MCP)/M.G.L. c.21E

Contaminated Soil and Groundwater: The ENF indicates that the project has been regulated under the MCP/MGL c21E, and there is one open remediation site, Release Tracking Number (RTN) 3-28407. There also is an Activity and Use Limitation on the site, RTN 3-10471 (RAO A3). Other remediation work has been undertaken for RTN 3-28424 (RAO A3), RTN 3-11358 (RAO A2), RTN 3-18830 (RAO A2), RTN 3-26482 (RAO A2), RTN 3-28301 (RAO A1), and RTN 3-21265 (RAO A1).

The EENF reports that the AUL for the parking lot area requires compliance with the applicable regulations and an approved health and safety plan for disturbance of the site. Accordingly, the proponent has made a commitment in the EENF to excavating, removing and/or disposing of contaminated soil, pumping of contaminated groundwater, or working in contaminated media under the provisions of MGL c.21E (and, potentially, c.21C) and OSHA. If permits and approvals under these provisions are not obtained beforehand, considerable delays in the project can occur. The project proponent cannot manage contaminated media without prior DEP.20 submittal of appropriate plans to MassDEP, which describe the proposed contaminated soil and groundwater handling and disposal approach, and health and safety precautions. If contamination at the site is known or suspected, the appropriate tests should be conducted well in advance of the start of construction and professional environmental consulting services should be readily available to provide technical guidance to facilitate any necessary permits. If dewatering DEP.21 activities are to occur at a site with contaminated groundwater, or in proximity to contaminated groundwater where dewatering can draw in the contamination, a plan must be in place to properly manage the groundwater and ensure site conditions are not exacerbated by these activities. Dust and/or vapor monitoring and controls are often necessary for large-scale projects in contaminated areas. The need to conduct real-time air monitoring for contaminated dust and to implement dust suppression must be determined prior to excavation of soils, especially those DEP.22 contaminated with compounds such as metals and PCBs. An evaluation of contaminant concentrations in soil should be completed to determine the concentration of contaminated dust that could pose a risk to health of on-site workers and nearby human receptors. If this dust concentration, or action level, is reached during excavation, dust suppression should be implemented as needed, or earthwork should be halted.

Potential Indoor Air Impacts: Parties constructing and/or renovating buildings in contaminated areas should consider whether chemical or petroleum vapors in subsurface soils and/or groundwater could impact the indoor air quality of the buildings. All relevant site data, DEP.23 such as contaminant concentrations in soil and groundwater, depth to groundwater, and soil gas concentrations should be evaluated to determine the potential for indoor air impacts to existing or proposed building structures. Particular attention should be paid to the vapor intrusion pathway for sites with elevated levels of chlorinated volatile organic compounds such as tetrachloroethylene (PCE) and trichloroethylene (TCE). MassDEP has additional information about the vapor intrusion pathway on its website at http://www.mass.gov/dep/cleanup/laws/vifs.htm.

New Structures and Utilities: Construction activities conducted at a disposal site shall not prevent or impede the implementation of likely assessment or remedial response actions at the site. Construction of structures at a contaminated site may be conducted as a Release

Abatement Measure if assessment and remedial activities prescribed at 310 CMR 40.0442(3) are completed within and adjacent to the footprint of the proposed structure prior to or concurrent with the construction activities. Excavation of contaminated soils to construct clean utility corridors should be conducted for all new utility installations.

The MassDEP Northeast Regional Office appreciates the opportunity to comment on this proposed project. Please contact Edward.Braczyk@state.ma.us at (978) 694-3289 for further information on the issues. If you have any general questions regarding these comments, please contact Nancy.Baker@state.ma.us , MEPA Review Coordinator at (978) 694-3338.

Sincerely,

This final document copy is being provided to you electronically by the Department of Environmental Protection. A signed copy of this document is on file at the DEP office listed on the letterhead.

John D. Viola
Deputy Regional Director

cc: Brona Simon, Massachusetts Historical Commission
Susan Ruch, Ed Braczyk, Susan McConnell, MassDEP-NERO
Margaret VanDeusen, Charles River Watershed

DEP.1 **The EIR should provide sufficient information to demonstrate that the storm water management system would be designed to address the water quality impairments covered by the established water quality standards and goals for phosphorus and pathogen removal in the *Final Total Maximum Daily Load for Nutrients in the Lower Charles River Basin* (June 2007) and the *Total Maximum Daily Loads for Pathogens within the Charles River Watershed* (January 2007).**

As discussed in Section 10, the existing site currently captures storm water and infiltrates 100 percent of captured water within the site. As described in Section 10, the Project design will capture and reuse roof water and capture and infiltrate surface water. The roof water will be collected and discharged to a ±145,000 gallon holding basin on the roof of N16. The water will be reused by the cooling towers.

DEP.2 **Describe the extent of flooding in context with historical flooding events, and take into consideration the potential for increased flooding due to more frequent extreme storm events associated with climate change. Explain the proposed protection from flooding.**

As discussed in Section 7.2, based on review of preliminary FEMA flood elevations for Suffolk County (November 2013), which show the 500-year flood elevation in Boston Inner Harbor at approximately 23.1 feet (Cambridge Datum), MIT determined that the electrical equipment in the new CUP should be located above 26 feet elevation (Cambridge Datum) to protect it against the 500-year flood.

DEP.3 **If not already done, the proponent should ensure that its BACT Analysis includes:**

- **i. Top down BACT analysis for all ancillary equipment;**
- **ii. Top-case BACT for all turbine operating conditions.**

The BACT analysis is included in Section 4, as well as the MCPA application.

DEP.4 **If not already done, the proponent should ensure that its Noise Analysis includes noise emissions from:**

- **i. the proposed new fuel gas compressor;**
- **ii. the proposed new fuel gas compressor enclosure design;**
- **iii. the proposed new cooling towers;**
- **iv. Inlet air intakes for the proposed new turbines;**

- **iv. exhaust vents for the proposed new turbines;**
- **v. the proposed new combustion exhaust stacks for the proposed new turbines;**
- **vi. air intakes for the proposed new black-start generator;**

vii. **exhaust vents for the proposed new black-start generator;**

ix. **the proposed black-start generator enclosure design;**

x. **the proposed new building design;**

xi. **all existing equipment that could have a contributing impact to existing sound levels, including but not limited to existing engine generators, rooftop cooling towers and any other existing sound generating equipment that contributes to existing noise levels; and**

xii. **daytime and nighttime existing ambient sound levels.**

As described in Section 6, the Project's noise control design considers sound from exterior sources, sound from inside the building that propagates through the building shell and its openings, and the sound in the community from existing MIT and non-MIT ambient sources from the August 2014 sound survey, described in Response to Comment DEP.5 below.

DEP.5 **The Noise Analysis should include a complete background sound monitoring for a minimum of three (3) continuous 24- hour days, including at least one weekend day (e.g., Thursday-Friday-Saturday, Saturday-Sunday-Monday, or Sunday-Monday-Tuesday).**

The MIT Project Team developed an ambient sound monitoring program, which was reviewed by MassDEP prior to the conducting of the survey. As described in Section 6.1, Acentech collected short-term ambient sound measurements and observations at six locations on Friday and Saturday nights (8-9 August and 9-10 August 2014). Consistent with technical instructions provided by MassDEP, short-term (2060-minute) A-weighted broadband and one-third octave band sound level measurements were collected at each location at a height of approximately five feet (1.5 meters) above the ground, under low wind conditions, and during periods with no precipitation. In addition, Acentech collected long-term measurements at the location representative of the closest noise sensitive receptors (residences) to the project over a nominal two-week period from 5 to 20 August 2016. Established background sound levels at each measurement location are provided in Table 6-2 of the SEIR. Measurement locations are shown on Figure 6-1.

DEP.6 **The Noise Analysis should include a Best Available Noise Mitigation Technology (BANMT) analysis taking into account the technical and economic feasibility of sound abatement options in order to determine a Facility Sound Level that is representative of Best Available Noise Mitigation Technology at this Facility. Sound from the proposed project, when combined with that from the existing facility equipment, should comply with MassDEP's noise regulation and policy while providing a reasonable margin of safety.**

As described in Section 6 and Appendix E of the MCPA application (located at http://powering.mit.edu), the Project is designed to meet the MassDEP and City of Cambridge noise requirements to be a good acoustical neighbor and avoid community noise complaints. Mitigation measures are incorporated in the Project design that will limit the Project sound to below that of the existing ambient sound at the nearest noise sensitive receptors (residences in the community). The Project (combined with sound from existing facility equipment) will comply with the MassDEP noise regulation and policy at noise sensitive receptors in the community. Noise impacts are reviewed by MassDEP as part of the MCPA process to ensure compliance with MassDEP requirements. The Proponent will also continue to evaluate the Project's noise impacts in relation to the City of Cambridge noise requirements to ensure compliance.

DEP.7 **All combustion equipment employed during construction of the project should be equipped with appropriate air pollution control technology designed to reduce air emissions.**

The Project will require all construction equipment to provide certification prior to mobilizing to the site. Equipment used during construction will meet or exceed EPA Exhaust Emission Standards.

DEP.8 **Request for clarification: EENF Attachment A-5 indicates that the exhaust stack for the cold-start engine is 165 feet above ground level (AGL); however Pages C-3 and C-9 indicate that it is 96.5 feet AGL.**

The cold start engine's exhaust stack is proposed to stand 93.5 feet above ground level. Please see Figure 1-4.

DEP.9 **Request for clarification: EENF Page C-3 identifies three 165 feet AGL exhaust flues however MassDEP understands there are to be two flues, one for each proposed turbine.**

As stated in Section 1.2.3, there will be two 167′ AGL high flues centrally collocated in a common stack structure. There will be a flue for each turbine vented through its respective Heat Recovery Steam Generator (HRSG). The cold start engine flue will be located atop its housing (93.5′ AGL).

DEP.10 **Request for clarification: EENF Page C-25 refers to "these" units; however, MassDEP understands that there is to be one single cold-start engine.**

One single cold start engine is included in the Project.

DEP.11 **Request for clarification: EENF Page C-9 indicates that the Facility wants to increase operating hours on the existing Boilers No. 7 and No. 9 immediately upon MCPA Approval allowing such, but does not mention filing a Significant Modification Application (BWP AQ 13) for their existing Operating Permit No. MBR-95-0PP-026, as required under Regulation 310 CMR 7.00: Appendix C(4)(b).**

Section 3.13 of the MCPA application addresses the requirement to modify the operating permit application. MIT looks forward to discussing the timing of the operating permit modification application with MassDEP as the review of the MCPA application continues.

DEP.12 **MassDEP recommends that it may be helpful to the public if the PSD Application is physically appended to the next MEPA filing and/or if the PSD Application is made available through a website accessible to members of the public without any website registration requirement (i.e., anonymously, without barriers to viewing or printing the Application).**

The PSD application is available to the public without restriction as an easily-viewed PDF on the Project website http://powering.mit.edu.

DEP.13 **As part of the PSD review, MIT is required to address federal Environmental Justice issues. (The federal Environmental Justice requirements are in addition to Massachusetts' Environmental Justice requirements.) MIT is required to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of federal programs, policies and activities on minority and low-income populations, as set forth in *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, Executive Order 12,898, 59 Federal Register 7,629 (February 16, 1994).**

Federal environmental justice issues are addressed in Section 4.2 of the PSD permit application and Section 2 of this SEIR.

As described in Section 2, air quality dispersion modeling has demonstrated that the impacts from the proposed project are not disproportionately high in the environmental justice areas when compared to areas not classified as Environmental Justice areas.

DEP.14 **The energy efficiency and emissions control features of the proposed GE LM-2500 combustion turbine units are not specifically considered in the EENF; however, it is stated on page C-50 that "the turbine options selected are the most efficient available to meet the identified project need." Explain in greater detail the energy efficiency of the preferred and alternative combustion turbines available.**

As stated in Section 1.4 of the SEIR, the Project now proposes to use Solar Titan 250 turbines in place of the GE LM2500s described in the EENF. Because the Solar engine is a slightly smaller unit it will be dispatched at a higher load more hours of the year. This results in lower greenhouse gas emissions and cost for the CUP. Table 5-1 provides a comparison between the previously proposed and currently proposed CTs.

For more information about turbine selection, please see Section 5.6.

DEP.15 **Although energy efficiency equates to a well-designed CHP system which matches the electrical and thermal loads it is serving, it is not obvious from the limited information provided that energy efficiency equipment would be exploited full. Consider and explain the extent to which the proposed turbines and associated equipment will utilize efficiency measures, such as advanced combustion, high efficiency air handling, advanced controls, advanced ignition systems, and advanced waste heat recovery systems.**

As stated in Section 5.6, MIT has identified that a slightly smaller turbine model (Solar T250) will be able to meet MIT's needs with lower GHG emissions than the turbine that was used for the EENF evaluation. The key difference is the ability of the smaller turbine to meet MIT's energy needs for more hours of the year using fuel fired into the CT, allowing more hours of true cogeneration (where fuel is fired into the CT to generate electricity, and the hot exhaust is used to generate useful thermal energy).

The proposed CT uses a state of the art combustor system that uses dry low NOx for gas and water injection for ULSD. The plant will have advanced switchgear controls that interact with the turbine controls. This system will manage load sharing and load shedding of the plant. The waste heat recover utilizes all available thermal energy by using flue gas for urea vaporization and a hot water economizer loop on the back end for campus dorm domestic heating.

Each of the specific efficiency measures mentioned by MassDEP is discussed below:

Advanced combustion: Modern combustion turbines incorporate advanced combustion. For example, the technical brochure in Appendix 2 states that the Titan 250 adds combustion advancements, including 14 dry, lean-premixed SoLoNOx injectors and an Augmented Backside Cooled combustion liner.

High efficiency air handling: Modern CTs incorporate high efficiency air handling. For example, the technical brochure in Appendix 2 states that the Titan 250 incorporates a 16-stage compressor producing a 24:1 pressure ratio.

Advanced controls: Modern CTs incorporate advanced controls. For example, the technical brochure in Appendix 2 states that the Titan 250 uses Solar's *InSight System* with advanced diagnostics, condition monitoring, and predictive recommendations.

Advanced ignition systems: Modern combustion turbines incorporate advanced ignition systems. For example, the technical brochure in Appendix 2 states that the Titan 250 uses a torch igniter system.

Advanced waste heat recovery systems: The proposed Project is a CHP which will use advanced waste heat recovery systems. As stated in Section C-5.5. of the EENF, the thermal efficiency of the heat recovery steam generator will be significantly higher than for an equivalent stand-alone boiler. MIT expects a 95 percent thermal efficiency in the final design.

DEP.16 **Demolition activities must comply with both Solid Waste and Air Pollution Control regulations, pursuant to M.G.L. Chapter 40, Section 54, which provides: "...the debris resulting from such demolition, renovation, rehabilitation or alteration be disposed of in a properly licensed solid waste disposal facility, as defined by Section one hundred and fifty A of Chapter one hundred and eleven. Any such permit or license shall indicate the location of the facility at which the debris is to be disposed. If for any reason, the debris will not be disposed as indicated, the permittee or licensee shall notify the issuing authority as to the location where the debris will be disposed."**

All demolition activities will comply with Solid Waste and Air Pollution Control Regulations in accordance with M.G.L. Chapter 40 Section 54. All debris from demolition or construction activities which cannot be recycled will be disposed of at a permitted and licensed facility in compliance with the requirements of M.G.L. Chapter 111 section 150A.

DEP.17 **Asbestos removal notification on permit form BWP AQ04 (ANF 001) and building demolition notification on permit form BWP AQ06 must be submitted to MassDEP at least 10 working days prior to initiating work. If any asbestos-containing materials will need to be abated through non-traditional abatement methods, the proponent must apply for and obtain approval from MassDEP, through Application BWP AQ36.**

A hazardous material survey will be conducted to identify hazardous materials. Testing will be performed and data provided to the construction managers prior to the start of construction. If additional possible asbestos-containing materials or other hazardous materials are discovered during construction, all work will be stopped, the suspect materials will be tested, and appropriate abatement measures will be implemented.

DEP.18 **The demolition activity must conform to current Massachusetts Air Pollution Control regulations governing nuisance conditions at 310 CMR 7.01, 7.09 and 7.10. The proponent should propose measures to prevent and minimize dust, noise, and odor nuisance conditions, which may occur during the demolition.**

All demolition activities shall conform to current Massachusetts Air Pollution Control regulations including those defined by 310 CMR 7.01, 7.09 and 7.10. The following measures will be instituted on the project to mitigate dust, noise, and odor nuisance conditions:

- Dust Control: Dust suppression techniques will include wetting, soil covering, wheel wash, or acceptable tracking pads for all construction vehicle upon entering or exiting the site. If determined necessary, strategic placement of wind barriers and or application of long duration foam shall be employed to reduce dust levels. Dust monitoring shall be employed at the perimeter of the limits of work to document compliance.

- Noise: All noise levels will be maintained at or below the defined limit of work defined by City of Cambridge Noise Regulations. Mitigation measures will include but are not limited to: sound dampening exhaust systems on all equipment; site fencing with scrim; and placement of acoustical treatment if required.

- Odor Nuisance: Odor mitigation, if required, will include but is not limited to covering of stockpiled materials through strategic excavation and capping odorous material with impermeable material. If required, daily or more frequent application of long duration foam will be instituted to mitigate odors.

DEP.19 **Section 310 CMR 19.017 *Waste Bans* of the Massachusetts Solid Waste regulations prohibit the disposal of certain wastes in Massachusetts. These wastes include, but are not limited to, recyclable paper (including cardboard). The Massachusetts Organics Waste Ban prohibits the disposal of organic wastes from businesses and institutions that generate a ton or more of organic materials per week, which necessitates the composting, conversion (such as anaerobic digestion), recycling or reuse of organic the waste.**

MIT and its construction manager have established a Construction Waste Management Plan to establish waste and recycling efforts during the construction phase of the Project. MIT's Department of Facilities includes an Office of Recycling & Materials Management. With regard to organic food waste MIT operates in compliance with the state Organics Water Ban regulation. In 2015, MIT received a Food Recovery Challenge Regional Achievement Certificate from the EPA.

DEP.20 **The ENF indicates that the project has been regulated under the MCP/MGL c21E, and there is one open remediation site (RTN 3-28407), and an Activity and Use Limitation on the site, RTN 3-10471 (RAO A3). The project proponent cannot manage contaminated media without prior submittal of appropriate plans to MassDEP which describe the proposed contaminated soil and groundwater handling and disposal approach, and health and safety precautions. If contamination at the site is known or suspected, the appropriate tests should be conducted well in advance of the start of construction and professional environmental consulting services should be readily available to provide technical guidance to facilitate any necessary permits.**

In an effort to identify and mitigate contaminated soils, a pre-characterization program was conducted in December of 2014 which consisted of sampling and chemical testing of soils within the proposed limits of excavation. Haley and Aldrich has been retained as the Environmental Consultant / Licensed Site Professional for the Project to ensure that all Federal, State and Local regulations will be satisfied as they relate to contamination on the site and the potential dewatering required for the Project.

DEP.21 **If dewatering activities are to occur at a site with contaminated groundwater, or in proximity to contaminated groundwater where dewatering can draw in the contamination, a plan must be in place to properly manage the groundwater and ensure site conditions are not exacerbated by these activities.**

All required dewatering will discharge to on-site recharge pits located within the limit of work area. In the unlikely event that groundwater infiltration into a recharge pits exceeds the infiltration capacity of the subsurface soils, MIT will obtain the required NPDES RGP, and all further discharge will meet NPDES RGP permit criteria.

DEP.22 **The need to conduct real-time air monitoring for contaminated dust and to implement dust suppression must be determined prior to excavation of soils, especially those contaminated with compounds such as metals and PCBs. An evaluation of contaminant concentrations in soil should be completed to determine the concentration of contaminated dust that could pose a risk to health of on-site workers and nearby human receptors.**

The Project has established Environmental Health and Safety Requirements which include the requirement to monitor dust at the site limit of work perimeter to provide verification that dust mitigation measures are acceptable. A Certified Industrial Hygienist will develop the Dust Mitigation Plan prior to the start of construction and will oversee implementation with established air quality requirements at the perimeter and within the breathing zone during activities that involve possible exposure of the general public and workers to contaminated soil or groundwater or other hazardous conditions.

DEP.23 **Parties constructing and/or renovating buildings in contaminated areas should consider whether chemical or petroleum vapors in subsurface soils and/or groundwater could impact the indoor air quality of the buildings. All relevant site data, such as contaminant concentrations in soil and groundwater, depth to groundwater, and soil gas concentrations should be evaluated to determine the potential for indoor air impacts to existing or proposed building structures.**

In an effort to identify and mitigate contaminated soils, a pre-characterization program was conducted in December of 2014, which consisted of sampling and chemical testing of soils within the proposed limits of excavation. Groundwater elevations have been established. Prior to construction, a Certified Industrial Hygienist and the appropriate consulting engineers will review the data and establish mitigation strategies to ensure that groundwater and indoor air quality will not be compromised due to site contamination.

City of Cambridge

Richard C. Rossi • City Manager

Executive Department

Lisa C. Peterson • Deputy City Manager

January 22, 2016

Matthew A. Beaton, Secretary
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office
Alex Strysky, EEA No. 15453
100 Cambridge Street, Suite 900
Boston MA 02114

Re: City of Cambridge comments on Expanded ENF for MIT Central Utilities Plant Expansion

Dear Secretary Beaton:

The City of Cambridge appreciates this opportunity to comment on the Expanded Environmental Notification Form (EENF) proposed expansion of the Central Utilities Plant at MIT.

In general, the City views the proposed project as beneficial in terms of reducing greenhouse gas emissions in the near term, reducing conventional air pollutants, and increasing resiliency for the MIT campus. In times past, this project would be seen clearly as an environmental improvement. However, in the context of climate change and given state, local, and MIT climate change policy and goals, the City believes it is important for MIT to take this opportunity before finalizing its plans to look at the project and how it relates to moving toward net zero or at least an 80 percent reduction in greenhouse gas emissions by 2050. The City also has some questions about the plant expansion and how it might affect the planned use of the Grand Junction right of way for a multi-purpose path as well as some other issues. Our detailed comments are attached.

Regarding the proponent's request to submit a Single EIR instead of the usual draft and final EIR, the City does not have any objection. We defer to the MEPA Office to determine whether our comments and those of others can be adequately addressed in a Single EIR or should be handled through the normal process.

If you have any questions about our comments, please contact Susanne Rasmussen on my staff at srasmussen@cambridgema.gov or 617-349-4607. Thank you.

Very truly yours,

Richard C Rossi

Richard C. Rossi
City Manager

City of Cambridge Comments

Expanded ENF for MIT Central Utilities Plant Expansion - EEA No. 15453

January 22, 12016

Greenhouse Gas Emissions

The EENF estimates that the proposed project will reduce its campus greenhouse gas (GHG) emissions compared to a scenario using conventional sources of energy. Based on the analysis in Attachment C-5, it appears the EENF assumes a static emissions factor for electricity over the lifetime of the proposed facility. The Commonwealth expects that this factor will decline over time as the Renewable Portfolio Standard increases the proportion of electricity generated by renewable sources and possibly from the importation of hydropower. The EIR should assess the emissions associated with the proposed project over time using a GHG emissions factor that declines in accordance with the Commonwealth's projections. The update to the Massachusetts Clean Energy and Climate Plan for 2020 was issued on January 19th and may be a source for this information. CAM.1

The ENF considered 5 alternatives in selecting the preferred option proposed in the EENF. The City requests that the EIR analyze at least two other alternatives: CAM.2

- Reducing campus energy demand through more aggressive energy efficiency improvements coupled with renewable energy installations (primarily solar photovoltaic) on the campus.
- Making direct purchases of grid-supplied electricity from a cleaner source coupled with steam supplied by the nearby Veolia district steam system.

The first additional option should assess whether sufficient reductions in demand could create the possibility of downsizing the CUP expansion and reduce emissions. The EENF does not describe a planning process for the project that closely couples energy efficiency and renewable deployment with the cogeneration supply. With the second additional option, we realize this does not necessarily create the level of reliability that proponent is seeking. But the EIR should assess the emissions reduction potential and consider whether there are alternative means of providing reliable energy supply. We note that disruptions in electricity and steam supply in our area tend to be short-term.

The City requests the broadening of the alternatives analysis in order to inform long term energy and emissions reduction planning. The proposed project is expected to have a lifetime that extends well into the 2050s. However, we know that it is necessary to achieve an 80 to 95 percent reduction in global greenhouse gas emissions by 2050 in order to keep global temperatures from rising more than 2 degrees Celsius. This has been recognized by the Commonwealth under the Global Warming Solutions Act and the Massachusetts Clean Energy and Climate Plan; Governor Baker's commitment under the Under 2 Subnational Global Climate CAM.3

Leadership MOU; the Cambridge Net Zero Action Plan; and the MIT Plan for Action on Climate Change. The 2015 Update to the Clean Energy & Climate Plan states: "... the only viable path to deep reductions in GHG emissions is through a combination of reduced energy consumption (through increased energy efficiency in vehicles and buildings), expanded availability of clean electricity, and electrification of the transportation and heating sectors." This implies that at some point before 2050 everyone, including MIT, will need to begin the transition to a fossil-free future before the life of the CUP facility is reached. As efficient as it is, a natural gas-fired cogeneration facility would not be compatible with this goal. We believe the CUP expansion CAM.4 should be viewed as a bridge to a fossil-free future and the project needs to be part of a larger transition plan. The EIR should survey best practices from other universities, such as the CAM.5 University of California and Stanford University, and international examples where appropriate. The City notes that this is a challenge for all. MIT, with its intellectual and institutional resources is better positioned than most to address this challenge. The EIR should describe any CAM.6 elements of the proposed CUP upgrade that will lead to more efficient power generation, such as using hot water rather than steam distribution, and flexibility built into the upgrade that will enable de-carbonization to occur more easily.

Air Quality

The EIR should discuss how current air quality levels compare with expected future air quality CAM.7 levels and how these relate to regulatory limits. Ambient temperature increases from climate change over the lifetime of the facility may affect air pollution levels, particularly ozone formation. The EIR should also assess the formation of steam plumes from the proposed facility CAM.8 and identify measures to mitigate the plumes.

Resilience

The MIT campus contains a large amount of sensitive and high value research which cannot be disrupted by loss of energy supply. An on-campus energy system that can meet all of the institutions needs is important. Due to climate change, the risks that the campus and the community will face from increasing temperatures and flooding are expected to grow in frequency and severity. The City and MIT have been cooperating in the Cambridge Climate Change Vulnerability Assessment (CCVA) to understand future risks. Modeling of flooding from storm surges associated with sea level rise and from increased precipitation, projections of temperature increases, and mapping of urban heat islands has been completed. In the vicinity of the project site, the CCVA uses projections that show greater flooding from precipitation (causing storm water system backups) under current conditions and increasing in 2030 and 2070. Storm surge flood risks associated with sea level rise start to emerge, based on the CCVA modeling, around 2050. The 2070 maps show the project site is in an area that has a 0.1 to 0.5% annual risk of flooding. Before 2050, the risks appear to be quite low. It should be noted the flood risks from precipitation and storm surges have been modeled separately for the most part. We are hoping to develop a methodology to model the joint probability of storm surges with heavy precipitation. The EIR should assess the specific flood risks of the site. GIS data is CAM.9 available for this purpose.

Temperatures are also projected to increase significantly over time. The CCVA projects that by 2030 we could experience a tripling of days over 90 degrees Fahrenheit and by 2070 see 4 to 6 times more days over 90 degrees F with a significant number of days over 100 degrees. In large parts of the city, including the project site, temperatures will be exacerbated by the urban heat island effect. The EIR should address whether these temperatures would have an effect on the operations of the facility. CAM.10

MIT is actively working to address campus vulnerabilities to climate change and we are confident the facility will be designed for future conditions. We note that the EENF indicates that key equipment will be elevated above the 500 year flood. The EIR should provide more details about which type of 500 year flood is being used for planning. CAM.11 Specifically, the EIR should describe how backup fuel supply will be stored and protected from floods. CAM.12 In regard to heat vulnerability, opportunities to mitigate the urban heat island on the project site should be identified.

We also request that MIT consider possible measures that could increase community resilience. CAM.13 Increasing the resilience of the campus will help the community by allowing the City to devote more of its resilience efforts to off-campus areas. But there could be modest measures that would assist the community. For example, since the CUP facility will be able to island the campus if there is a power outage, it would be helpful for there to be a means for community members to charge mobile phones in the event the electric grid is not available for an extended period. After Superstorm Sandy in New York City, the ability to charge mobile telephones was critical to enable people to communicate with family and emergency services, but the ability in some areas to charge phones was very limited and had to be supplemented with portable generators. There may be other types of resilience measures that could be enabled by a small amount of power supplied by the islanded CUP.

Noise

The EENF assessment of noise impacts including measurement of baseline ambient noise levels. The EIR should describe how the post-construction noise levels compare to current noise levels and discuss how noise levels will be verified in relation to the projections and how monitoring will be conducted to ensure that regulatory requirements are met. CAM.14

Traffic & Parking

While the proposed project does not involve a large number of on-site employees, there are some issues affecting traffic and parking that should be addressed in the EIR, including:

- Provide details about the existing parking lot in regard to ownership, users, occupancy, and where the parkers will be relocated. CAM.15
- Indicate how many employees will be located in the CUP facility and how TDM measures will be provided. CAM.16
- Describe how much bicycle parking will be required and how it will be provided. Bicycle parking layout plans should be provided. CAM.17

- Assess whether electric vehicle recharging stations for cars, trucks, and buses can be provided. CAM.18
- Assess whether bus stop shelters are needed in the area. CAM.19

Grand Junction Greenway

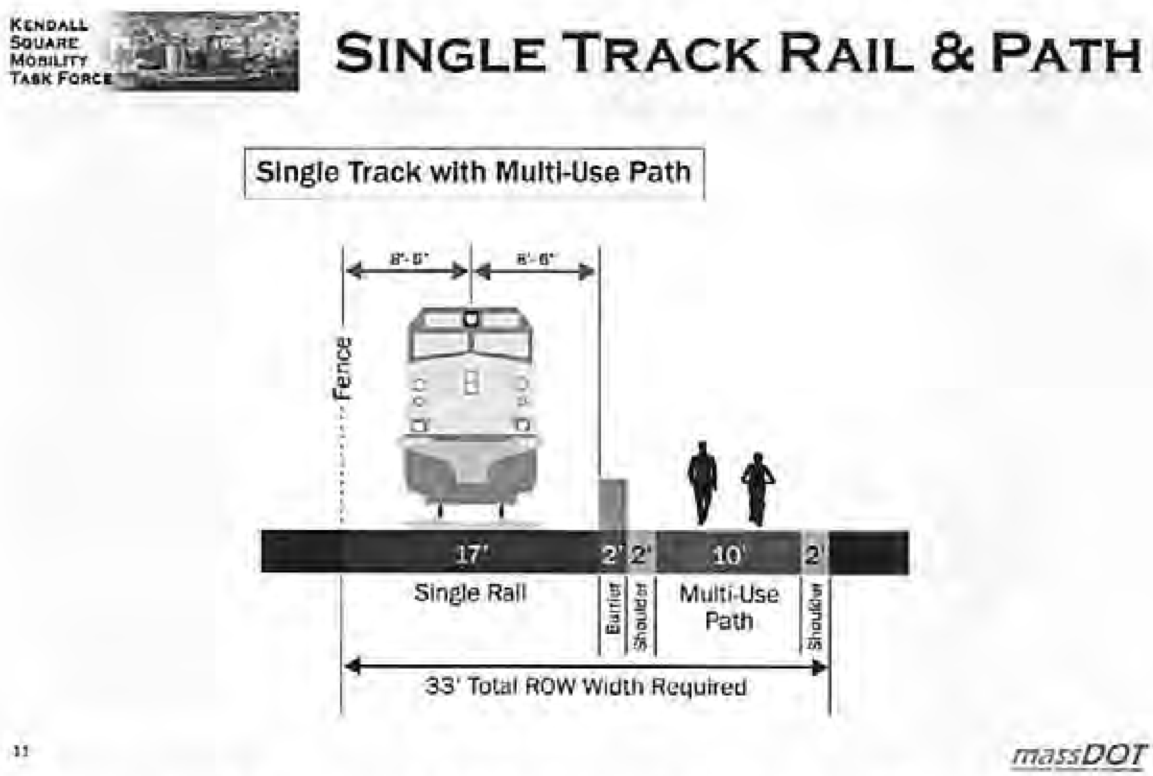
The proponent should ensure that the proposed project will not adversely affect the ability to construct the planned separate multi-use pathway on the Grand Junction right of way. We also urge that the project mitigation include construction of the separate multi-use pathway as detailed below. CAM.20

Background

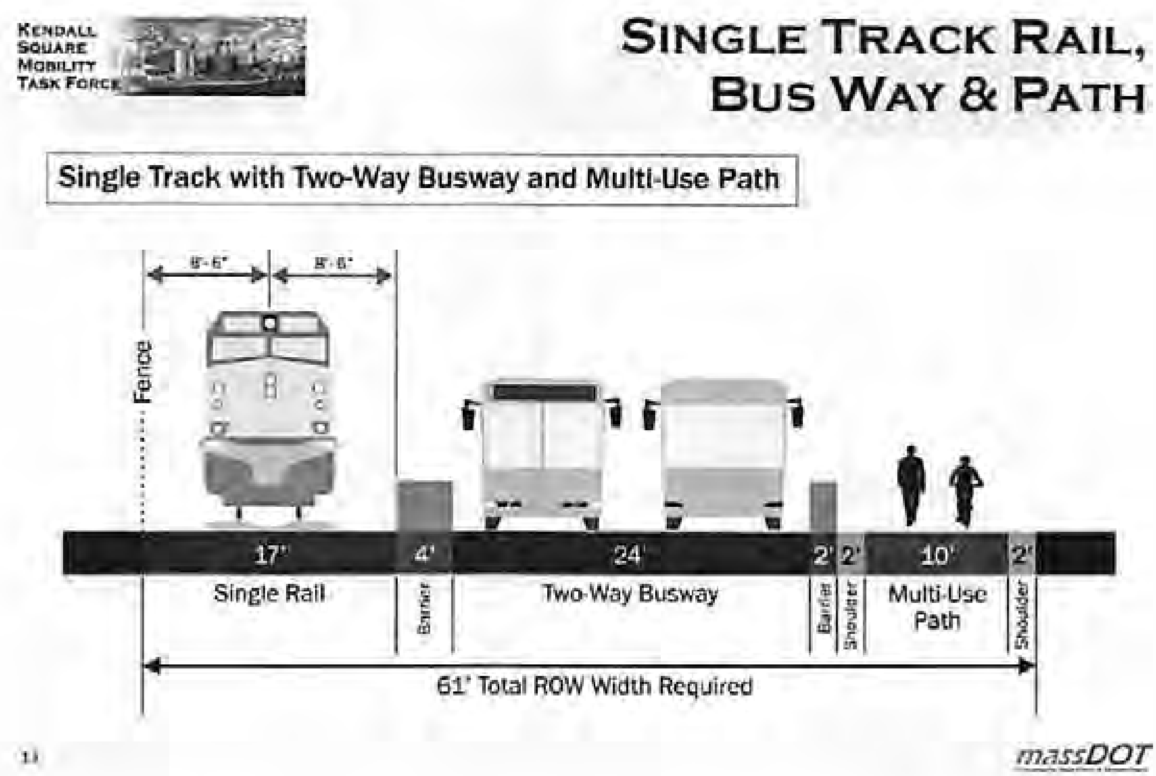
- The City of Cambridge has long identified the Grand Junction railroad right of way as a location for a multi-use pathway (see http://www.cambridgema.gov/CDD/Projects/Transportation/grandjunctionpathway.aspx for more information). A Grand Junction Rail-with-Trail Feasibility study was conducted by the City and Cambridge Bicycle Committee and published in 2006. In addition, the use of the right of way for passenger transit service has long been discussed by the City and MassDOT (see https://www.massdot.state.ma.us/theurbanring/).
- Two nearby MIT projects have reserved right of way for a multi-use path through Special Permits by the Cambridge Planning Board, and the State's 40/54A process. The projects include the Brain and Cognitive Sciences Building and the first Central Utility Plant upgrade project in 2009. In addition, the Brain and Cognitive Sciences Building reserved 50 feet so that with relocation of the existing track, an additional 33 feet would be available for future "Urban Ring" or other transit treatments.
- A follow-up study for a pathway in the Grand Junction right of way was completed by MIT in 2014 and came to the conclusion that a path could be constructed. It defined preferred cross sections and pinch points that could affect the ability to create the preferred cross sections.
- The first portion of the multi-use path along the Grand Junction right of way is near completion on a parcel being redeveloped by Cambridge Redevelopment Authority as open space between Main Street and Broadway. This segment has a 14 foot two-way path with 4 foot buffers on each side (more than the proposed 2 feet on other portions of the greenway). MIT contributed funds to this effort as part of a zoning change. (See http://www.cambridgeredevelopment.org/grand-junction-pathway for more information).
- The MassDOT-led Kendall Square Mobility Task force is exploring transit options for the corridor. (See https://www.massdot.state.ma.us/planning/Main/CurrentStudies/KendallSquareMobility.aspx for more information). At the most recent task force meeting on November 16, 2015, MassDOT showed typical cross sections and constrained points for the right of way, including at the Brain and Cognitive Sciences Building.

Space Required

- MassDOT requires a minimum setback of 8.5 feet from the centerline of the existing track. In addition, a 2 foot buffer should be provided before the path, which should itself have 2 foot buffers on each side. The graphic below shows the minimum width from the MassDOT presentation to the Kendall Square Task Force on November 16, 2015 (page 11). Note that the City standard for a path of this type is consistent with the CRA portion of the multi-use path which is 14', i.e. 4 feet should be added to the MassDOT required minimum cross section to meet the City's standard. CAM.21



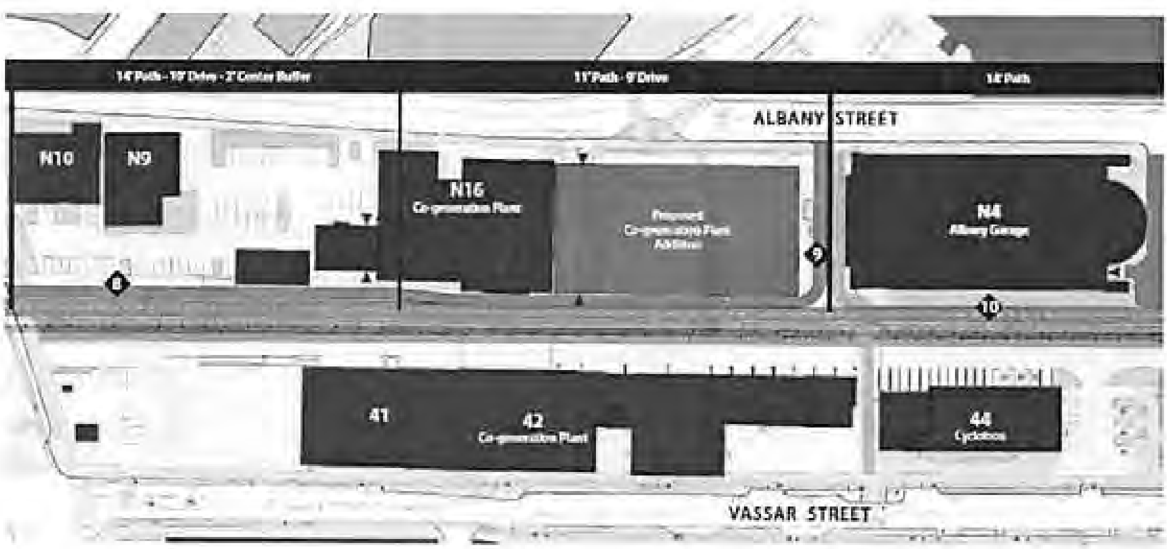
- If a section of the right of way is to include other transit uses, the amount of right of way needed can increase up to 61 feet+ 4 feet for the wider path (65 feet total), if the proposed solution is two-way bus rapid transit, (BRT). 65 feet should accommodate any of the options, including a second track.



Discussion of Project Impacts
No detailed design information is available yet related to the proposed building and additional structure that will be built over the Grand Junction right of way. The City's primary concern is to ensure that the right of way reserved by MIT is sufficient to accommodate a multi-use path as well as possible transit options. The City is anxious to see a multi-use path be built along the entirety of the Grand Junction as soon as feasible.

MIT and its consultants have reported that the edges of the proposed building and overhead structure will retain the same ROW as currently exists under the structure at 59 Vassar St/60 Albany St (building N16) that spans the tracks and houses the current cooling towers (see image below). CAM.22

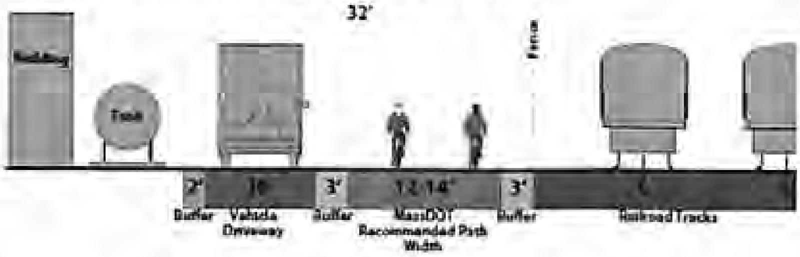
The 2014 Grand Junction Community Path and MIT Property Feasibility Study shows that this location is a pinch point for the Grand Junction Greenway / multi-use path, where a proposed service drive will overlap with the multi-use path. Note that the cross sections shown above do not include consideration of a service drive, which would be at least an additional 10 feet and likely a buffer. The image from page 9 of the MIT report below shows that an 11 foot path and 9 foot drive would fit in this segment, though a 9 foot drive would not necessarily fully accommodate all types of vehicles. CAM.23



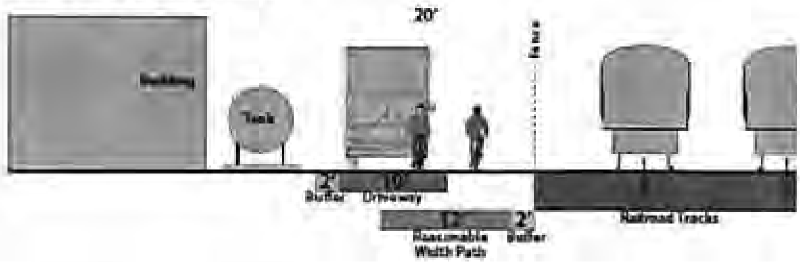
The preferred MassDOT cross section shown in the MIT report for a path and service drive is shown below to take up 32 feet. If the total space available is 20 feet, it would only be possible to CAM.24

achieve something like the overlapping cross section below. Both cross sections are available on page 10 of the MIT report.

Recommended MassDOT multi-use path plus service drive



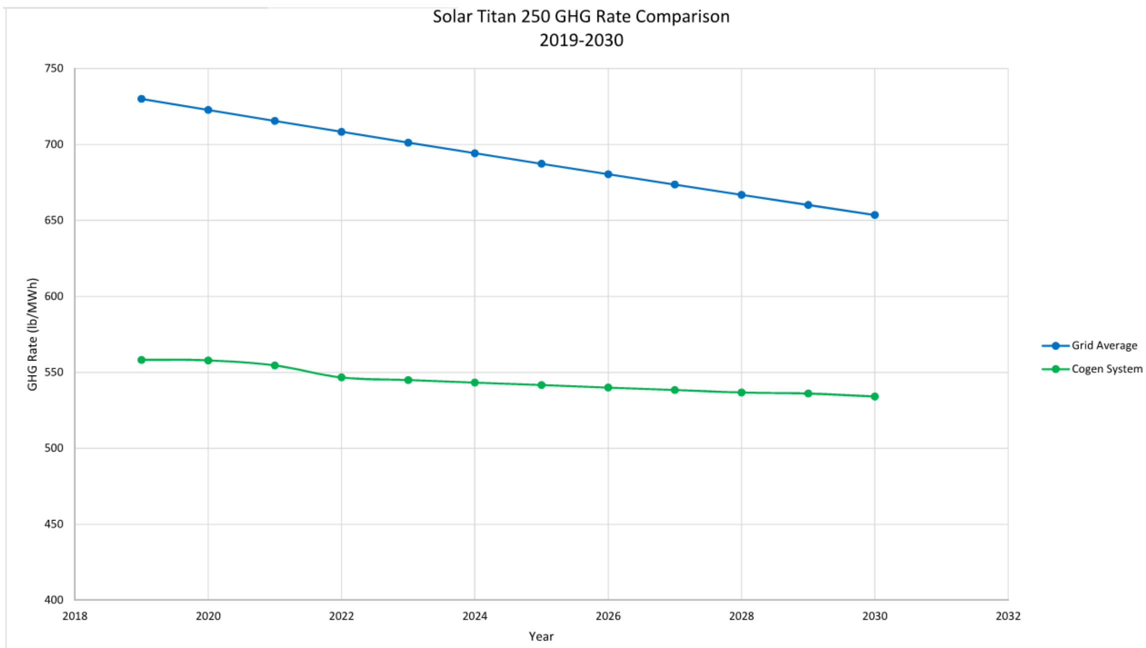
Overlapping cross sections



Mitigation / Comments

- Rather than continuing the pinch point created by the existing structure, the design of the buildings and overhead structure should provide the width needed for the MassDOT recommended cross section for the path and road (32 feet from the fence which could be placed at the edge of the 8.5 foot required offset). This space should be clear of all meters, pipes, doors, services, etc. that may extend beyond that of the proposed building thereby reducing the overall usable space of the corridor. This will be particularly important if the upgraded facility is expected to result in any increase in traffic using the service drive. CAM.25
- In addition, on the south side of the tracks, an additional 30 -33 feet (starting from the edge of the required 8.5 foot offset) should be reserved for possible future transit uses, the minimum being what is shown in the current MassDOT cross section as needed for BRT, and maximum being what was reserved in the design of the Brain and Cognitive Sciences building. CAM.26
- The MIT feasibility study also identified this location as an opportunity for open space and an entry treatment to the path. This should be incorporated into the design. CAM.27
- Other features, including lighting, should be incorporated into the design that make the experience of travelling through and under the overhead structures a pleasant and safe one. CAM.28
- The building's loading docks should not be located within the Grand Junction pathway, reducing traffic and travel conflicts. CAM.29
- We urge MIT to construct the path along the Grand Junction in the block between Mass. Ave. and Main Street as part of the mitigation for this project. CAM.30

CAM.1 Based on the analysis in Attachment C-5, it appears the EENF assumes a static emissions factor for electricity over the lifetime of the proposed facility. The Commonwealth expects that this factor will decline over time as the Renewable Portfolio Standard increases the proportion of electricity generated by renewable sources and possibly from the importation of hydropower. The EIR should assess the emissions associated with the proposed project over time using a GHG emissions factor that declines in accordance with the Commonwealth's projections. The update to the Massachusetts Clean Energy and Climate Plan for 2020 was issued on January 19th and may be a source for this information.



MIT's current analysis of GHG emissions for purchased-only electricity is conservative, having used a constant emissions factor for ISO-NE grid purchased electricity. MIT's calculated reduction in GHG emissions through 2030 does not currently reflect the additional emissions reductions that may accrue due to more renewable power sources being added to the standard offering.

The graph above shows the Commonwealth's projections for grid electric emissions and the anticipated emissions of the proposed Solar Titan 250 turbine over time. As shown, it is anticipated that MIT-generated electricity will continue to be less carbon intensive than grid-supplied electricity for the entire planned life of the new CTs even given the required increases in the grid renewable energy standards over the next 20 years.

CAM.2 **The City requests that the EIR analyze at least two other alternatives:**

- Reducing campus energy demand through more aggressive energy efficiency improvements coupled with renewable energy installations (primarily solar photovoltaic) on the campus;
- Making direct purchases of grid-supplied electricity from a cleaner source coupled with steam supplied by the nearby Veolia district steam system.

The first additional option should assess whether sufficient reductions in demand could create the possibility of downsizing the CUP expansion and reduce emissions. With the second additional option, the EIR should assess the emissions reduction potential and consider whether there are alternative means of providing reliable energy supply. On the issue of reliability, the City notes that disruptions in electricity and steam supply in our area tend to be short-term.

MIT is working to lower demand from buildings and is pursuing other efficiency strategies, including renewables such as wind, solar, and geothermal. MIT is always evaluating new opportunities as technology evolves. For more information about on-site generation of clean energy, please see Section 7.1.

The CUP project is right-sized for the projected MIT campus load and is adaptable to load fluctuation. If on-campus demand is lower in the future, the CUP will produce less energy and will have lower emissions. The two-turbine system is flexible enough to accommodate a reduction in demand over time and is designed to operate effectively and efficiently under reduced demand profiles (utilizing just one turbine, for example). CUP operations can be reduced to 20 percent of capacity and will still meet emissions requirements while maintaining resiliency.

MIT-produced electricity, steam, and chilled water are currently less-carbon intensive than what can be purchased on the local grid. It is anticipated that MIT-generated electricity will continue to be less carbon intensive than grid-supplied electricity for the entire planned life of the new CTs even given the required increases in the grid renewable energy standards over the next 20 years.

Note that if Veolia steam is a product of fossil fuel combustion, then the process is similar to MIT's cogeneration process. Should it be demonstrated that a less carbon-intensive source of steam is available, MIT will certainly consider that option.

CAM.3 **The City requests the broadening of the alternatives analysis in order to inform long term energy and emissions reduction planning. The proposed project is expected to have a lifetime that extends well into the 2050s. However, we know that it is necessary to achieve an 80 to 95 percent reduction in global greenhouse gas emissions by 2050 in order to keep global temperatures from rising more than two degrees Celsius.**

MIT recognizes that to minimize the worst impacts of climate change, global energy systems need to move toward a low carbon future and GHG reductions as indicated by scientific study. Locally, MIT has actively participated in the City-sponsored Getting to Net Zero Task Force and has endorsed the incremental and phased approach identified and required to move toward net zero emissions and 80 percent reductions by 2050. MIT's CUP upgrade plan is not only compatible with these long-term goals but is an essential transitional step—a bridge toward a low-carbon energy future at MIT.

The City has recognized that an incremental and phased transition toward net zero emissions is necessary given current available technologies and economic conditions. MIT's CUP enhancement plan is one of several phased activities that are necessary at MIT to keep MIT moving toward net zero emissions. The enhanced CUP will reduce net emissions despite projected growth in campus energy demand and is essential for MIT to support rapidly changing and expanding research activities in a manner that is cleaner and more resilient than conventional power arrangements. No other feasible lower carbon emissions solution is available to MIT that can provide the power resiliency necessary to safeguard research and our residential community. During the 20-year lifespan of the enhanced cogeneration system, MIT will continue planning for a lower carbon future and will be well positioned to adopt new technologies—possibly an all-electric system or some as yet unknown innovation—for the next phase on the path toward a lower carbon environment.

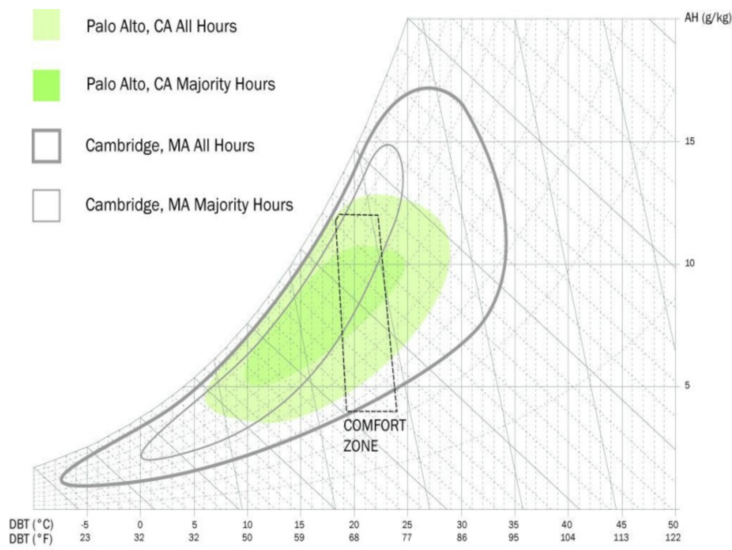
In addition to upgrading the CUP, MIT will in parallel implement a portfolio of enabling strategies as described above in Section 7.1. A formal climate action plan is currently being developed and will provide the specific mix of measures and strategies to meet or surpass MIT's GHG emissions reduction goal. The CUP upgrade project, coupled with a mix of these strategies, will provide a credible and achievable move towards net zero emissions.

CAM.4 **The CUP expansion should be viewed as a bridge to a fossil-free future and the project needs to be part of a larger transition plan.**

The Proponent agrees. The Project, coupled with a mix of GHG reduction strategies (described in Section 7.1), will provide a credible and achievable move towards net zero emissions.

CAM.5 **The EIR should survey best practices from other universities, such as the University of California and Stanford University, and international examples where appropriate.**

MIT conducted an extensive review of the Stanford Energy System Innovation (SESI) project. The genesis of the SESI project was the realization that Stanford has approximately 80 percent simultaneous heating and cooling. MIT's load profile is different from Stanford's, primarily as a result of different climates as demonstrated in the figure below. However, MIT could have as much as 40 percent simultaneous heating and cooling in its load profile.



The fundamentals of the SESI system are centered on a heat recovery chiller (HRC), also known as a heat pump. The HRC produces both hot and chilled water to be pumped to campus buildings through miles of hot and chilled water piping. Stanford, like MIT, previously had a significant steam supply and condensate return system. In order for the SESI project to be viable, Stanford had to replace its entire steam distribution system with a hot water distribution system. In addition to the new hot water distribution system, Stanford had to convert all of its buildings from a steam supply to a new hot water system. Fortunately for Stanford, the vast majority of its buildings were already hot water heating based. At MIT, approximately 25 percent of all heating applications across campus require direct steam (not steam converted to hot water).

The next significant component of the SESI system is thermal storage (both hot and chilled water). Thermal storage tanks allow Stanford to operate the HRCs at a higher utilization rate, thus improving efficiency and giving Stanford an opportunity to peak shave (reduce peak load using stored thermal energy) when the utility is in a high demand situation. MIT has less of an opportunity to create thermal storage based on the limited real estate available for large thermal tanks on campus.

The SESI system is primarily driven by electricity from the utility. Stanford has a bulk utility substation at its Central Utility Plant that is provided power at 115KVA. Stanford is supplied by two independent feeds from the utility which provide plant redundancy. However, a failure of the utility would render Stanford's Central Utility Plant inoperable once the thermal storage has been depleted.

In order to further leverage the efficiency of SESI, Stanford teamed up with a developer to build a solar photovoltaic farm that produces half of Stanford's power. The net result of the SESI and solar power purchase agreement reduced Stanford's GHG footprint by 65 percent.

As can be seen in the figure above, Cambridge's climate is significantly different from Palo Alto's, and therefore the potential of a heat pump solution is limited. Since MIT's simultaneous heating and cooling profile is approximately 40 percent, supplemental heating and cooling equipment would be necessary to meet the 60 percent of thermal load that the heat pump would not satisfy.

MIT currently heats the vast majority of its buildings from approximately 2.7 miles of steam pipe serving 100+ buildings, as well as approximately 0.5 mile of medium temperature hot water piping serving three buildings. MIT intends to expand on the medium temperature hot water (MTWH) system over the next five to seven years. This system currently runs at temperatures ranging from 200°F to 230°F. Plans include evaluating buildings in order to see if this temperature can be reduced to a range that could allow use of heat pump technology. In order to be effective, the system would have to be able to operate at 160°F or lower. The current plan, proposed herein, is to capture as much of the low grade heat as possible from the planned Cogen plant. This heat is to be used in a hot water system that will provide MIT with future optionality as technologies improve or are developed in both the building load side and the production side.

The vast majority of MIT buildings are not currently capable of operating with low temperature hot water. In order to make the switch to a low temperature heating system, a number of the building HVAC systems and envelopes would need to be upgraded. This past winter, although mild for the most part, included a near record-setting -10°F cold snap. Under a SESI-like system, this extreme weather event could have had a devastating impact on the MIT buildings in their current condition.

If MIT were able to overcome the on-campus challenges stated earlier, an additional issue would be the electrical grid supply. Conversion to an all-electric campus would result in a significant increase in the electrical supply requirement from

Eversource. The increased electrical supply requirements would likely triple or quadruple MIT's electrical load. This increase in load could not be supported with Eversource's existing infrastructure. If Eversource were to upgrade its Cambridge infrastructure, that infrastructure would likely be supported from a single 115KVA feed, making MIT subject to single point of failure.

In summary, there is a potential to deploy heat pump technology on the MIT campus; however, there are a number of barriers to overcome. These barriers are significant but not insurmountable. The upgraded cogeneration system will meet MIT's current needs while providing an immediate reduction in GHG and preserving the future flexibility to work through existing challenges in aging infrastructure.

CAM.6 The EIR should describe any elements of the proposed CUP upgrade that will lead to more efficient power generation, such as using hot water rather than steam distribution, and flexibility built into the upgrade that will enable de-carbonization to occur more easily.

The new cogeneration system and HRSGs include an additional hot water heater section. This will capture additional waste heat by lowering the final exhaust gas temperature at the stack. The addition of the hot water heater section will allow for existing steam users to switch to hot water and reduce overall energy consumption on campus.

CAM.7 Discuss how current air quality levels compare with expected future air quality levels and how these relate to regulatory limits. Ambient temperature increases from climate change over the lifetime of the facility may affect air pollution levels, particularly ozone formation.

As shown in Section 4, MIT has documented that the proposed project will not lead to a condition of unhealthy air; MAAQS and NAAQS will not be exceeded.

Emissions are minimized through the use of clean burning fuels in combination with post combustion controls. The project does not directly emit ozone; project impacts to ambient ozone concentrations are minimized by applying BACT controls to ozone precursors (NOx and VOC) as described in Section 4.

Future air quality levels cannot be predicted with certainty, and such predictions are outside the scope of this project. MIT shares the City of Cambridge's concern regarding climate change and its long-term effects on air quality. MIT notes that the proposed Project reflects a decrease in air emissions, and that ambient air monitoring shows a current downward trend in ambient air concentrations of ozone and other regulated pollutants (see for example Massachusetts Ambient Air

Monitoring Network Assessment, October 19, 2015, and Massachusetts 2014 Air Quality Report, June 2015, at http://www.mass.gov/eea/agencies/massdep/air/reports/).

CAM.8 **Assess the formation of steam plumes from the proposed facility and identify measures to mitigate the plumes.**

Steam plumes may be formed during start-up and transient overpressure situations. The design of the new heat recovery steam generators is intended to only vent steam for short durations through vent silencers. Flash steam and low quality steam are intended to be used for domestic heating within the plant.

CAM.9 **In the vicinity of the project site, the Cambridge Climate Change Vulnerability Assessment (CCVA) uses projections that show greater flooding from precipitation (causing storm water system backups) under current conditions and increasing in 2030 and 2070. Storm surge flood risks associated with sea level rise, start to emerge, based on the CCVA modeling, around 2050. The 2070 maps show the project site is in an area that has a 0.1 to 0.5 percent annual risk of flooding. Before 2050, the risks appear to be quite low. The City is hoping to develop a methodology to model the joint probability of storm surges with heavy precipitation. The EIR should assess the specific flood risks of the site. GIS data is available for this purpose.**

The CCVA model of the 2070 10-year and 100-year storms have flood elevation of approximately 2-feet and 3-feet above grade, respectively. Based on review of preliminary FEMA flood elevations for Suffolk County (November 2013), MIT determined that the electrical equipment in the new CUP should be located above 26 feet elevation (Cambridge Datum) to protect it against the 500-year flood. All critical equipment will be installed above elevation 26 feet, which will keep the equipment above the 500-year flood elevation.

CAM.10 **The CCVA projects that by 2030 we could experience a tripling of days over 90 degrees Fahrenheit and by 2070 see four to six times more days over 90 degrees F with a significant number of days over l00 degrees. In large parts of the city, including the project site, temperatures will be exacerbated by the urban heat island effect. The EIR should address whether these temperatures would have an effect on the operations of the facility.**

The new plant is designed to operate with an outdoor air temperature of 104 degrees F. Based on the design's target temperature and the 20-year life of the equipment, the plant is designed for the expected temperature range listed in the 2015 CCVA Report into the 2030s.

CAM.11 The EENF indicates that key equipment will be elevated above the 500-year flood. The EIR should provide more details about which type of 500-year flood is being used for planning. Specifically, the EIR should describe how backup fuel supply will be stored and protected from floods.

Based on review of preliminary FEMA flood elevations for Suffolk County (November 2013), MIT determined that the electrical equipment in the new CUP should be located above 26 feet elevation (Cambridge Datum) to protect it against the 500-year flood. The fuel storage room will be constructed to prevent water influx. It will resist uplift from the flood water and walls. The walls will be structured to resist applicable loads and will terminate above this 500-year flood elevation. Additionally, the fuel storage room will be built to conform to all applicable codes including NFPA 30 (2015).

CAM.12 In regard to heat vulnerability, opportunities to mitigate the urban heat island on the project site should be identified.

The heat island effect will be addressed with landscape features including maximum possible planting and high albedo paving as well as the installation of a reflective (white) roof on the facility.

CAM.13 MIT should consider possible measures that could increase community resilience. For example, since the CUP facility will be able to island the campus if there is a power outage, it would be helpful for there to be a means for community members to charge mobile phones in the event the electric grid is not available for an extended period. There may be other types of resilience measures that could be enabled by a small amount of power supplied by the islanded CUP.

MIT is a part of the City of Cambridge, and we will support the needs of the residents in an emergency when and where possible. If MIT's CUP is operating in an emergency, MIT's first responsibility will be to provide for its students, faculty, and staff so that they are not displaced. In terms of providing assistance to the larger community (such as providing power to charge community members' cell phones), MIT would evaluate options on a case-by-case basis, taking into account the circumstances of the emergency and MIT's ability to help.

CAM.14 The EIR should describe how the post-construction noise levels compare to current noise levels and discuss how noise levels will be verified in relation to the projections and how monitoring will be conducted to ensure that regulatory requirements are met.

Please see Responses to Comments DEP.4 and DEP.5 and SEIR Section 9. The Project team will develop and conduct a post-construction sound survey to demonstrate Project compliance with regulatory noise requirements.

CAM.15 Provide details about the existing parking lot in regard to ownership, users, occupancy, and where the parkers will be relocated.

The 2015-2016 Parking Inventory, submitted to the City of Cambridge in February 2016, includes a map and parking stall count. The portion of the N10 Annex lot that will be eliminated by the CUP upgrade contains 90 parking stalls for academic parking. MIT plans to move these spaces into the planned Kendall garage. The users of the N10 Annex lot will park in adjacent facilities owned by MIT (such as the Albany Garage (N4) and the remainder of the N10 Annex lot adjacent to Building N9 and N10) or will use parking leased by MIT in Kendall Square.

CAM.16 Indicate how many employees will be located in the CUP facility and how TDM measures will be provided.

The number of employees working at the CUP facility will not change from current conditions following completion of the Project. These employees will continue to have access to the benefits of MIT's Commuter Connection transportation demand management program. More information on the Commuter Connections program can be found at: http://web.mit.edu/facilities/transportation/index.html.

CAM.17 Describe how much bicycle parking will be required and how it will be provided. Bicycle parking layout plans should be provided.

Article 6.000 of City of Cambridge, Massachusetts Zoning Ordinance defines the required quantity of bike parking spaces as a function of building area. Per 6.107 Required Quantities of Bicycle Parking:

	Building Area	Rate of Spaces	# of Spaces
Long-term Bike Parking Spaces	12,152 sf	0.20/1000 sf	3
Short-term Bike Parking Spaces		0.40/1000 sf	5

The long-term spaces will be housed inside the facility, while short-term bicycle racks will be provided outdoors.

CAM.18 Assess whether electric vehicle recharging stations for cars, trucks, and buses can be provided.

There is no parking for vehicles in or around the building, so recharging stations will not be available.

CAM.19 **Assess whether bus stop shelters are needed in the area.**

There are currently two MBTA bus shelters at the corner of Albany Street and Massachusetts Avenue, 570 feet from the site. As stated in Response to Comment CAM.16, the Project will not result in any new employees being added to the CUP facility, so new demand for transit is not expected and seeking re-routing of existing bus routes would not be advised. The EZ Ride shuttle does have tops on both sides of Albany Street in front of the site. Collaboration with Charles River Transportation Management Association on optimal improvements in the area is planned.

CAM.20 **The proponent should ensure that the proposed project will not adversely affect the ability to construct the planned separate multi-use pathway on the Grand Junction right of way. The project mitigation should include construction of the separate multi-use pathway as detailed [in the City of Cambridge letter].**

The proposed Project will not encroach upon the area of the separate multi-use pathway contemplated for the Grand Junction and, when complete, will not interfere with any future construction of such a path. The cross section of the project in the Grand Junction is the same or more open than previous projects, such as the Chiller & Cooling Tower Building N16 or the Brain and Cognitive Sciences Building. There will be a service drive in the rear of the building, similar to many parts of the Grand Junction owned by MIT on the north and south side of the tracks and also east and west of Massachusetts Avenue. For more information on the function of the corridor and its intersection with a multi-use path see the MIT Property Feasibility Study, October 2014 at http://www.cambridgema.gov/CDD/Projects/Transportation/grandjunctionpathway

There are no plans to construct any portion of the multi-use path in the Grand Junction corridor at this time or as part of the CUP upgrade project.

CAM.21 **MassDOT requires a minimum setback of 8.5 feet from the centerline of the existing track. In addition, a two-foot buffer should be provided before the path, which should itself have two-foot buffers on each side. If a section of the right-of-way is to include other transit uses, the amount of right of way needed can increase up to 61 feet + 4 feet for the wider path (65 feet total), if the proposed solution is two-way bus rapid transit (BRT). Sixty-five feet should accommodate any of the options, including a second track.**

The proposed Project maintains the 64-foot horizontal clearance in the area of the former railroad property that has been established by MassDOT in its consent for MIT construction in 2009 and 2011 following public hearing conducted pursuant to Chapter 40, Section 54A.

CAM.22 **MIT and its consultants have reported that the edges of the proposed building and overhead structure will retain the same ROW as currently exists under the structure at 59 Vassar St/60 Albany St (Building N16) that spans the tracks and houses the current cooling towers.**

The dimension from the railroad fence to the building structure in the proposed Project is 24 feet, identical to the dimension provided by the directly adjacent Utility buildings. The MIT Property Feasibility Study demonstrates the feasibility of this cross section to accommodate a service drive and a multi-use path.

CAM.23 **The 2014 Grand Junction Community Path and MIT Property Feasibility Study shows that this location is a pinch point for the Grand Junction Greenway / multi-use path, where a proposed service drive will overlap with the multi-use path.**

The proposed Project has 24 feet of horizontal clearance from the train fence to the column line holding up the Building 42C bridge, which is a foot wider than the more conservative estimate in the earlier MIT Property Feasibility Study. The Project will retain a service drive, but only emergency vehicles will be permitted to access the railroads track-facing side of the building. The Feasibility Study referenced demonstrated that the 24-foot width would be sufficient for a side-by-side service drive and path. No overlap of these two uses would be required.

CAM.24 **The preferred MassDOT cross section shown in the MIT report for a path and service drive is shown to take up 32 feet. If the total space available is 20 feet, it would only be possible to achieve something like the overlapping cross section. Both cross sections are available on page 10 of the MIT report.**

Commenting on the dimension required for the "Recommended MassDOT multi-use path plus service drive," the MIT Report (pg. 10) also notes that, "There are limited locations in the corridor that can accommodate this cross-section." The proposed Project provides a 24 foot cross-section opening, substantially better than the 20 foot opening available in other portions of the corridor (see the MIT Report, pg. 10). No overlapping driveway and path would be required in the vicinity of the proposed Project.

CAM.25 **Rather than continuing the pinch point created by the existing structure, the design of the buildings and overhead structure should provide the width needed for the MassDOT recommended cross section for the path and road (32 feet from the fence which could be placed at the edge of the 8.5 foot required offset). This space should be clear of all meters, pipes, doors, services, etc. that may extend beyond that of the proposed building thereby reducing the overall usable space of the corridor.**

The benefit of the wider cross section for only 350 feet along the Grand Junction corridor is quite limited, when the adjacent parcel has only the 24-foot dimension. As noted above, there are limited locations throughout the MIT-owned corridor that a 32-foot dimension could be obtained. The 24-foot dimension, which will be clear of meters, pipes and doors, is sufficient to accommodate the train, the multi-use path, and the service drive. Only emergency vehicles are planned to access the service drive.

CAM.26 **On the south side of the tracks, an additional 30-33 feet (starting from the edge of the required 8.5 foot offset) should be reserved for possible future transit uses, the minimum being what is shown in the current MassDOT cross section as needed for bus rapid transit (BRT), and maximum being what was reserved in the design of the Brain and Cognitive Sciences building.**

The proposed project requires only air rights on the south side of the track and has no relation to the existing conditions on the ground on the south side of the tracks. The current dimensions from the fence line to the building structures on the south side of the tracks range from 17′8″ at Brain and Cognitive Science to 21′9″ at the Building 16 connection to Building 42. Creating a 30-33-foot dimension on the south side of the tracks would require demolition of Buildings 41, 42 and 46. On the south side of the tracks, the proposed project places a column in line with the column already in place for Building N16.

CAM.27 **The MIT feasibility study also identified this location as an opportunity for open space and an entry treatment to the path. This should be incorporated into the design.**

Improvements to the mid-block crossing from Albany Street to the railroad tracks between the CUP upgrade and the Albany Garage (N4) are planned to enhance this as open space, allowing pedestrians and cyclists to use this critical mid-block crossing.

CAM.28 **Other features, including lighting, should be incorporated into the design that make the experience of travelling through and under the overhead structures a pleasant and safe one.**

Adequate lighting for a safe and pleasant experience will be part of the proposed Project.

CAM.29 **The building's loading docks should not be located within the Grand Junction pathway, reducing traffic and travel conflicts.**

There is no loading dock on the south façade along the Grand Junction corridor.

CAM.30 The City urges MIT to construct the path along the Grand Junction in the block between Mass. Ave. and Main Street as part of the mitigation for this project.

There are no plans to construct any portion of the multi-use path in the Grand Junction corridor at this time or as part of the CUP Project.

John Sanzone
President & Co-Founder
Friends of the Grand Junction Path
facebook.com/grandjunctionpath
Cambridge, MA

January 22, 2016

Secretary of Energy and Environmental Affairs
Executive Office of Energy and Environmental Affairs (EEA)
Attn: MEPA Office, 100 Cambridge Street, Suite 900
Boston MA 02114
alexander.strysky@state.ma.us

Sarah Gallop, MIT
seg@mit.edu

Alexander,

Please consider the Friends of the Grand Junction Path in support of MIT's cogen plant improvements, which will help supply much-needed energy resources to help the campus carry out its many important missions.

Our specific on-site concerns are the following:

1. The project should anticipate, if not build, the relevant Grand Junction Path section between the existing rail crossing at the northeast of the site, and Mass. Ave. This means that appropriate widths and clearances should be maintained as per MIT's 2014 Grand Junction Path feasibility study, and that the service drives are built specifically to be shared-use, as per the study. FGJP.1
2. The project should not preclude any future path access points, nor safe travel along the corridor next to the cogen plant. FGJP.2

3. Final designs for the site should consult the Cambridge Bicycle Committee, and the Cambridge Community Development Department (CDD) to ensure the best possible site plan relevant to this central piece of the Grand Junction Path, a crucial regional walk/bike connection. The Friends of the Grand Junction Path, which includes engineers, architects, students, community experts, etc., would be more than happy to be party to these conversations. The Friends have a positive working history with MIT and other stakeholders toward finding productive and creative solutions. FGJP.3

Please refer to MIT's 2014 study of Grand Junction Path feasibility, which specifically anticipates the cogen plant improvements and details how a shared-use path/service drive could work in this area.

I am happy to discuss any of this in more detail.

Sincerely,

John Sanzone
President & Co-Founder
Friends of the Grand Junction Path
john@johnsanzone.com

FGJP.1 **The project should anticipate, if not build, the relevant Grand Junction Path section between the existing rail crossing at the northeast of the site, and Mass. Ave. This means that appropriate widths and clearances should be maintained as per MIT's 2014 Grand Junction Path feasibility study, and that the service drives are built specifically to be shared-use, as per the study.**

As stated in the Response to Comment CAM.20 above, there are no plans to construct any portion of the multi-use path in the Grand Junction corridor at this time or as part of the Project.

The proposed Project will not encroach upon the area of the separate multi-use pathway contemplated for the Grand Junction and, when complete, will not interfere with any future construction of such a path. The cross section of the project in the Grand Junction is the same or more open than previous projects, such as the Chiller & Cooling Tower Building N16 or the Brain and Cognitive Sciences Building. There will be a service drive in the rear of the building, similar to many parts of the Grand Junction owned by MIT on the north and south side of the tracks and also east and west of Massachusetts Avenue. For more information on the function of the corridor and its intersection with a multi-use path see the MIT Property Feasibility Study, October 2014 at http://www.cambridgema.gov/CDD/Projects/Transportation/grandjunctionpathway

FGJP.2 **The project should not preclude any future path access points, nor safe travel along the corridor next to the cogeneration plant.**

As stated in Responses to Comments CAM.20 and CAM.29 above, the proposed Project will not encroach upon the area of the separate multi-use pathway contemplated for the Grand Junction and, when complete, will not interfere with any future construction of such a path. The cross section of the project in the Grand Junction is the same or more open than previous projects. The service drive in the rear of the building will be similar to many parts of the Grand Junction owned by MIT on the north and south side of the tracks and also east and west of Massachusetts Avenue.

FGJP.3 **Designers for the site should consult the Cambridge Bicycle Committee and the Cambridge Community Development Department (CDD) to ensure the best possible site plan relevant to this central piece of the Grand Junction Path, a crucial regional walk/bike connection. The Friends of the Grand Junction Path, which includes engineers, architects, students, community experts, etc., would be more than happy to be party to these conversations.**

As stated in Response to Comment CAM.20 above, the Project will maintain clearance of the area designated for the Grand Junction path. MIT looks forward to future conversations with the Friends of the Grand Junction Path.

Cambridge Bicycle Committee
Cambridge City Hall Annex
344 Broadway
Cambridge, MA 02139

January 22, 2016

Secretary, Matthew A. Beaton
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston MA 02114
By Email (alexander.strysky@state.ma.us, csnowdon@epsilonassociates.com)

Re: MIT Central Utilities Plant Second Century Plant Expansion & Impact on Grand Junction Community Path

Dear Mr. Beaton,

Thank you for soliciting comments on the proposed MIT Central Utilities Plant Second Century Plant Expansion. As the Cambridge Bicycle Committee, we would like to offer up our recommendations for assuring a feasible, community-friendly and constructive upgrade of MIT's utilities plant. Your consideration of the following points means a lot to the committee, as it assures a robust collaboration between MIT and the community at large. While many of these points have been considered, we would like to reiterate the importance of the following aspects to the viability of the project.

- *Management of the Grand Junction Right of Way.* Detailed management of the Grand Junction pathway should be included, covering how the new structure will interact with the Grand Junction, with plans for snow removal, safety, pathway upkeep, etc. CBC.1
- *Maintain Current Width of Grand Junction.* It is vital that the new structure maintains the current width of the Grand Junction, allowing a 12-foot multi-use path with 3-foot shoulders, even with the proposed structure over the Grand Junction route. This requires close attention to meters, pipes, doors, service entrances, etc. that might extend beyond the proposed building width, reducing the overall usable space of the corridor. CBC.2
- *Adequate Lighting.* Lighting around and under the building must be adequate and maintained to provide a safe, welcoming and pleasing pathway. CBC.3

- *Loading Docks.* The building's loading docks should be located significantly away from the Grand Junction pathway. Loading docks, even with deliveries scheduled at low-demand times, reduce pathway throughput and create travel and safety conflicts. CBC.4

- *Presence/Absence of Service Equipment.* This expansion will undoubtedly affect the shared use of the roadways for service equipment traveling up and down the Grand Junction pathway. Considering the frequency and size of the delivery vehicles is a vital requirement of this project. How may the service truck deliveries and the Grand Junction pathway coexist? CBC.5

- *Grand Junction Advancement.* MIT is driving a continual increase of pedestrian and bicycle traffic in and around the Cambridge campus. Moving the Grand Junction project forward is a vital step for the campus and surrounding neighborhood success. As mitigation for this project, we propose the construction of the Grand Junction pathway between Main Street and Massachusetts Avenue, to serve as a clear reinforcement of MIT's commitment to the community. Traffic flow, access to the campus, and safety for pedestrians and cyclists will improve as the Grand Junction pathway is extended. As articulated in the City's original Grand Junction feasibility study, path connections, even only blocks in length, have high value. This should be the assumption moving forward. CBC.6

We thank you for your attention to this matter, and for your continued support of bicycle and pedestrian facilities through this, and many more, Cambridge projects. We would like to emphasize our belief that a shared-use pathway, used by the 'eight-to-eighty' crowd, will attract a diversity of users to this unique and exciting corridor, making their commute, recreation, and other activities safer and more enjoyable, while also meeting the needs of the MIT campus.

Yours Sincerely,

Jonathan Adams, Chair

On behalf of the Cambridge Bicycle Committee

CBC.1 **Management of the Grand Junction pathway should be detailed, including how the new structure will interact with the Grand Junction, with plans for snow removal, safety, pathway upkeep, etc.**

The agreements for the management of the path will be determined by a discussion between the interested parties.

CBC.2 **It is vital that the new structure maintains the current width of the Grand Junction, allowing a 12-foot multi-use path with 3-foot shoulders, even with the proposed structure over the Grand Junction route. This requires close attention to meters, pipes, doors, service entrances, etc. that might extend beyond the proposed building width, reducing the overall usable space of the corridor.**

A noted in Response to Comment CAM.25, the 24-foot dimension is sufficient to accommodate a multi-use path, the service drive, and the railroad. It will be clear of meters, pipes and other obstacles. There are plans for person-access doors in the rear of the building, but they will not interfere with the 24-foot clear horizontal dimension.

CBC.3 **Lighting around and under the building must be adequate and maintained to provide a safe, welcoming and pleasing pathway.**

As stated in Response to Comment CAM.28, adequate lighting for a safe and pleasant experience will be part of the proposed Project.

CBC.4 **The building's loading docks should be located significantly away from the Grand Junction pathway.**

As stated in Response to Comment CAM.29, there is no loading dock on the south façade along the Grand Junction corridor.

CBC.5 **This expansion will undoubtedly affect the shared use of the roadways for service equipment traveling up and down the Grand Junction pathway. How may the service truck deliveries and the Grand Junction pathway coexist?**

As stated in Responses to Comments CAM.23 and CAM.24 above, the Grand Junction cross-section for the proposed Project provides for a 24-foot opening between the building structure and the railroad fence. This 24-foot cross-section opening is substantially better than the 20-foot opening available in other portions of the corridor.

As stated in Response to Comment CBC.4 above, there is no loading dock on the building's south façade along the Grand Junction corridor. There are no plans to allow service vehicles in the rear of the building, except in emergencies.

CBC.6 **MIT is driving a continual increase of pedestrian and bicycle traffic in and around the Cambridge campus. Moving the Grand Junction project forward is a vital step for the campus and surrounding neighborhood success. As mitigation for this project, Cambridge Bicycle Committee proposes the construction of the Grand Junction pathway between Main Street and Massachusetts Avenue, to serve as a clear reinforcement of MIT's commitment to the community.**

As stated in Response to Comment CAM.20 above, there are no plans to construct any portion of the Grand Junction pathway at this time or as part of the Project.

Strysky, Alexander (EEA)

From:	Jeremy Poindexter [jpoindex@mit.edu]
Sent:	Friday, January 22, 2016 9:33 PM
To:	Strysky, Alexander (EEA)
Subject:	MIT CUP Second Century Project

Hello,

As a current MIT graduate student, I have a few questions about the proposed upgrade to the central utilities plant.

First, how renewable energy alternatives were considered during the project review process? JP.1
The ENF document mentions vaguely that renewable energy is being "actively pursued" but is otherwise vague. During the public meeting on January 14th, AJ Jablonowski of Epsilon Associates, Inc. mentioned that renewable energy generation was being considered on campus through other projects, e.g., rooftop solar. Tony Sharon, Deputy Executive Vice President of MIT, responded that such projects were being considered on a building-by-building basis as part of the capital campaign. Is there a reason that a more campus-wide solar system was not considered as part of this project? I imagine taking a campus-wide approach would have cost savings by reducing redundant labor and engineering work needed when designing systems one-by-one. I also mention this aware of the stated goals of the CUP Second Century Project, which include building campus sustainability and reducing pollution -- two things that solar seems to achieve more effectively than cogeneration.

Second, how does this project fit in with MIT's goal of reducing campus greenhouse gas JP.2
emissions by at least 32% by 2030 and aspiring to carbon neutrality, as stated on the Office of Sustainability's website? 2030 is fifteen years away, but the proposed lifespan for this project is 20
years, and by themselves, these new turbines will not accomplish this 32% reduction goal. What JP.3
other pathways have been considered for campus greenhouse gas reduction? How was that goal weighed among the others (namely, campus resiliency, in addition to the aforementioned sustainability and pollution reduction goals)?

As a comment, I was pleased to hear that these new turbines would be operated in "lowest greenhouse gas emission" mode rather than "lowest cost" mode. I think that is a welcome commitment to reducing emissions on campus, and I'm interested to hear more details about how campus power will emphasize emissions reduction.

Thank you for your time and consideration,

Jeremy R. Poindexter

Jeremy Poindexter

JP.1 **How were renewable energy alternatives considered during the project review process? The ENF document mentions that renewable energy is being "actively pursued" but is otherwise vague. During the public meeting on January 14th, AJ Jablonowski of Epsilon Associates, Inc. mentioned that renewable energy generation was being considered on campus through other projects, e.g., rooftop solar. Tony Sharon, Deputy Executive Vice President of MIT, responded that such projects were being considered on a building-by-building basis as part of the capital campaign. Is there a reason that a more campus-wide solar system was not considered as part of this project? Taking a campus-wide approach would have cost savings by reducing redundant labor and engineering work needed when designing systems one-by-one. The stated goals of the CUP Second Century Project include building campus sustainability and reducing pollution – two things that solar seems to achieve more effectively than cogeneration.**

MIT has been evaluating on-site renewable energy opportunities on campus including wind, solar and geothermal as part of broad environmental efforts. Due to the variations in the structural capacity of campus roofs and age of building electrical systems, a single system approach to the campus is not possible. MIT remains committed to integrating solar installations on our campus as part of overall efforts to reduce greenhouse gas emissions. MIT currently has four solar installations on campus totaling approximately 70 kW. MIT has identified over 70 roofs where solar power generation is possible; however, even with the most advanced technology available today, the available square footage on our rooftops would likely generate less than two percent of MIT's total power needs and will not result in the reduction of greenhouse gas emissions on the scale desired. As a result, MIT's approach to reducing campus emissions includes multiple strategies including on-site cogeneration, renewables, and energy efficiency gains in campus buildings. MIT is always evaluating new opportunities as technology evolves. For more information, please on on-site generation of clean energy, see Section 7.1.

JP.2 **How does this project fit in with MIT's goal of reducing campus greenhouse gas emissions by at least 32 percent by 2030 and aspiring to carbon neutrality, as stated on the Office of Sustainability's website? 2030 is fifteen years away, but the proposed lifespan for this project is 20 years, and by themselves, these new turbines will not accomplish this 32 percent reduction goal.**

MIT recognizes that to achieve its goal of reducing GHG emissions at least 32 percent by 2030 and to continue striving for climate neutrality in the future, nearly all available strategies will need to be deployed. The upgrade of the cogeneration plant is just one of these strategies.

A key strength of the upgraded cogeneration system is that it will serve as a bridge to future energy technologies and equipment. With the CUP enhancements proposed, MIT will be better positioned to explore additional sustainability and efficiency measures, and will be able to incorporate emerging technologies as they become available. The upgraded CUP is central to MIT's efforts to ensure that climate action and energy efficiency are an inherent part of planning the future of the campus.

For additional details, please see Section 7.1.

JP.3 **What other pathways have been considered for campus greenhouse gas reduction? How was that goal weighed among the others (namely, campus resiliency, in addition to the aforementioned sustainability and pollution reduction goals)?**

To achieve its goal of reducing GHG emissions at least 32 percent by 2030 and to continue striving for climate neutrality in the future, MIT recognizes that nearly all strategies available will need to be deployed. Consistent with current research, significant reductions in institutional GHG will need to include numerous approaches, and MIT's GHG reduction planning has identified the following priority strategies:

- Demand-side management investments to reduce energy use within existing buildings, including campus-wide energy conservation measures such as building systems retrofits, building re-commissioning and continuous commissioning, building controls changes, including set-backs, and turn-offs, occupant behavior change, etc.;

- Power plant and distribution system upgrades and enhancements for greater efficiency, including improvements to existing steam systems and the expansion of hot water distribution systems across campus and within buildings;

- Fuel switching at the power plant to reduce greenhouse gas emissions, moving MIT toward an all natural gas dispatch model which would eliminate the use of fuel oil except in the case of testing and emergencies when natural gas is not available;

- Sustainable design standards for new construction and major renovations to promote best-in-class energy efficiency performance and minimize impact of campus growth;

- Transportation-related GHG emissions reductions including (for Scope 1 direct mobile emissions) increasing the MIT vehicle fleet energy efficiency average, right-sizing vehicles, and expanding the integration of alternative fuel vehicles; and (for Scope 3 indirect mobile emissions) aggressive (and expanding) transportation demand management programs that are driving up the rate of faculty, staff, and students taking alternative forms of transportation to work;

- Continued consideration of the wholesale purchase of less carbon intensive sources of electricity as those markets mature and the economics continue to improve;

- Continued consideration of ways to expand renewable power systems on campus, including the execution of a campus-wide roof assessment to help prioritize investments in renewable energy and sustainable design approaches; and

- Continued monitoring of the GHG off-set market as a possible strategy to further reduce GHG emissions beyond what can be achieved on campus thought mitigation strategies.

In MIT's climate action planning, a first priority continues to be the mitigation of GHG emissions from campus operations as quickly and practically as possible. We are committed to reducing not only MIT's Scope 1 (direct) and Scope 2 (indirect/purchased) emissions, but where possible also Scope 3 (indirect) emissions associated with activities we do not own or control, such as emissions associated with MIT faculty, staff, and student commuting. A second priority is to focus on climate vulnerability and resiliency planning in conjunction with mitigation efforts. MIT recognizes that climate-induced changes in precipitation, sea-level, and heat-island effect are manifest and will become more pressing. Therefore, MIT is focusing planning resources on identifying where campus vulnerabilities exist and how best to position investments to enhance climate resiliency. Current CUP expansion plans are directly incorporating resiliency and climate adaptation strategies. MIT will be pursuing both mitigation and adaptation strategies simultaneously.

MIT's recently completed Sustainability Working Group Recommendations identify numerous strategies for addressing non-energy and GHG emissions-related activities to advance sustainability including reducing impacts from procurement, waste management, laboratory use, and storm water and land management. These sustainability impact areas continue to be a focus and priority for MIT.

Strysky, Alexander (EEA)

From: Patrick Brown [prbrown@mit.edu]
Sent: Friday, January 22, 2016 12:27 PM
To: Strysky, Alexander (EEA)
Subject: MIT CUP Second Century Project

Hello,

I would like to submit the following questions for review:

- The MIT Greenhouse Gas Inventory, on the Office of Sustainability website, states: "We aspire to carbon neutrality and challenge our community and partners to invent solutions that would make this goal achievable as soon as possible". But the proposed plant - particularly with no ability for carbon capture - would lock MIT into unabated carbon emissions through 2040. How can MIT aspire to carbon neutrality while building a new fossil-fuel-fired power plant? PB.1
- MIT highlighted the importance of keeping the world below 2°C temperature rise in its recently released Climate Action Plan. The proposal states that this plant will decrease emissions by ~10% below 2015 levels, and that level will be locked in until 2040. But staying below the 2°C target means reducing emissions in industrialized countries more than 80% by 2050, and more than 50% by 2040. How can MIT be consistent with the 2°C target if the emissions from this plant continue unabated through 2040? PB.2
- Cambridge recently passed a Net Zero Action Plan, on a 25 year timeline. How is the proposed plant compatible with Cambridge's net zero ambitions? PB.3
- How does MIT plan to choose between electricity delivered from the proposed plant and electricity available from the grid? How will the carbon intensity of the available electricity factor into that decision? Will the cheapest electricity be purchased, or will the lowest-carbon electricity be purchased? PB.4
- Meeting the goal of keeping global temperature rise below 1.5-2°C would require a much steeper decline in emissions from electricity than the "~10% below 2015 levels" projected to result from the proposed plant. Does MIT plan to progressively decrease the capacity factor (i.e. increase the fraction of time the plant is left idle) and supply more of its energy from renewable sources before 2040 as part of its emissions reduction goals? Or does MIT plan to run the plant at the highest capacity possible through the end of its life? PB.5

Thank you,
Patrick

PB.1 **The proposed plant - particularly with no ability for carbon capture - would lock MIT into unabated carbon emissions through 2040. How can MIT aspire to carbon neutrality while building a new fossil-fuel-fired power plant?**

MIT recognizes that to achieve its goal of reducing GHG emissions at least 32 percent by 2030 and to continue striving for climate neutrality in the future, nearly all available strategies will need to be deployed. The upgrade of the cogeneration plant is just one of these strategies.

A key strength of the upgraded cogeneration system is that it will serve as a bridge to future energy technologies and equipment. With the CUP enhancements proposed, MIT will be better positioned to explore additional sustainability and efficiency measures, and will be able to incorporate emerging technologies as they become available. The upgraded plant is central to the Institute's efforts to ensure that climate action and energy efficiency are an inherent part of planning the future of the campus.

For additional details about MIT strategies to reduce GHG emissions, please refer to Section 7.1.

PB.2 **The proposal states that this plant will decrease emissions by 10 percent below 2015 levels, and that level will be locked in until 2040. But staying below the 2°C target means reducing emissions in industrialized countries more than 80 percent by 2050, and more than 50 percent by 2040. How can MIT be consistent with the 2°C target if the emissions from this plant continue unabated through 2040?**

As mentioned in Response to Comment PB.1 above, a key strength of the upgraded cogeneration system is that it will serve as a bridge to future energy technologies and equipment. With the CUP enhancements proposed, MIT will be better positioned to explore additional sustainability and efficiency measures, and will be able to incorporate emerging technologies as they become available.

MIT recognizes that to achieve climate neutrality in the future, nearly all available strategies will need to be deployed. The upgrade of the cogeneration plant is just one of these strategies—and is essential to MIT's efforts.

For additional details about MIT strategies to reduce GHG emissions, please refer Section 7.1.

PB.3 How is the MIT plant compatible with the City's net-zero ambitions?

As stated above in Response to Comment CAM.3, MIT has actively participated in the City-sponsored Getting to Net Zero Task Force and has endorsed the incremental and phased approach identified and required to move toward net zero emissions and 80 percent reductions by 2050. MIT's CUP upgrade plan is not only compatible with these long-term goals but is an essential transitional step—a bridge toward a low-carbon energy future at MIT.

The City has recognized that an incremental and phased transition toward net zero emissions is necessary given current available technologies and economic conditions. MIT's CUP enhancement plan is one of several phased activities that are necessary at MIT to keep MIT moving toward net zero emissions. The enhanced CUP will reduce net emissions despite projected growth in campus energy demand and is essential for MIT to support rapidly changing and expanding research activities in a manner that is cleaner and more resilient than conventional power arrangements. During the 20-year lifespan of the enhanced cogeneration system, MIT will continue planning for a lower carbon future and will be well positioned to adopt new technologies—possibly an all-electric system or some as yet unknown innovation—for the next phase on the path toward a lower carbon environment.

In addition to upgrading the CUP, MIT will in parallel implement a portfolio of enabling strategies as described in Section 7.1. A formal climate action plan is currently being developed and will provide the specific mix of measures and strategies to meet or surpass MIT's GHG goal. The Project, coupled with a mix of these strategies, will provide a credible and achievable move towards net zero emissions.

PB.4 How does MIT plan to choose between electricity delivered from the proposed plant and electricity available from the grid? How will the carbon intensity of the available electricity factor into that decision? Will the cheapest electricity be purchased, or will the lowest-carbon electricity be purchased?

A core objective of the Project is to reduce the carbon-intensity of MIT's produced utilities. This will be achieved through increasing plant efficiencies, decreasing distribution inefficiencies, and eliminating the use of fuel oil in the CUP, deploying an all natural gas dispatch model. Critical to this change is MIT's move away from lowest cost only dispatch models at the CUP, to a dispatch model that seeks reduced air and GHG emissions.

MIT-produced electricity, steam, and chilled water are currently less-carbon intensive than what can be purchased on the local grid. It is anticipated that MIT-generated electricity will continue to be less carbon intensive than grid-supplied electricity for the entire planned life of the new CTs even given the required increases in the grid renewable energy standards over the next 20 years. As it moves forward toward that point, MIT will continue to assess the best strategies and invest appropriately to support and create a low-carbon future.

PB.5 **Does MIT plan to progressively decrease the capacity factor (i.e., increase the fraction of time the plant is left idle) and supply more of its energy from renewable sources before 2040 as part of its emissions reduction goals? Or does MIT plan to run the plant at the highest capacity possible through the end of its life?**

The current CUP expansion and enhancement plans are centered around the deployment of two right-sized gas-fired turbines that are designed to maximize efficiency, power reliability, and low emissions. The equipment is designed to operate efficiently at less than full capacity to enable the best combination of reliability, efficiency, and reduced emissions. This flexibility in design will allow for MIT to take advantage of demand-side reductions, increased installed capacity of renewable energy sources on campus, and cleaner grid-supplied electricity as it becomes available. By moving from a primarily economic/low-cost dispatch model to a low-emissions dispatch model, MIT will be able to leverage additional strategies for reducing emissions.

COMMONWEALTH OF MASSACHUSETTS
EXECUTIVE OFFICE OF
ENERGY AND ENVIRONMENTAL AFFAIRS
DEPARTMENT OF ENERGY RESOURCES
100 CAMBRIDGE ST., SUITE 1020
BOSTON, MA 02114
Telephone: 617-626-7300
Facsimile: 617-727-0030

Charles D. Baker
Governor

Karyn E. Polito
Lt. Governor

Matthew A. Beaton
Secretary

Judith F. Judson
Commissioner

January25, 2016
Alex Strysky, MEPA Analyst

Subject: MIT Central Utilities Plant 2nd Century Plant Expansion – Stationary GHG Sources DOER Comments

The general intent of the DOER review of this submittal is to both ensure that the content submitted conforms to the guidance provided for the application of the MEPA GHG Policy and Protocol (the Policy) for this project, and to point out areas and aspects of the design and proposed mitigation as described in the GHG related content that ether require further clarification and/or may present opportunities for further reductions in both energy usage and GHG emissions. Where these opportunities appear to exist, these comments also suggest measures and/or approaches that the DOER puts forward that should be considered for adoption with the goal of achieving further reductions in both energy consumption and source GHG emissions.

The DOER commends MIT for the decision to implement an expanded combined heat and power (CHP) capacity as the primary source of both electricity and heat to be supplied by the expanded Central Utility Plant (CUP) to the intra-campus distributed energy system. CHP is an inherently more efficient technology for generating electricity and useful heat than obtaining electricity and heat from the electric grid and conventional on-site boilers or furnaces, which is the business as usual (BAU) scenario. When fueled primarily by natural gas, both the lower emission per MWH due to a lower GHG emitting fuel and the overall reduction in fuel consumed per unit energy generated combine to achieve a significant reduction in overall source emissions of GHG when compared with the BAU. DOER.1

The DOER also commends the proposed project on the incorporation of measures that will provide vital energy resiliency capabilities, including the ability of the system to start and continue operating to supply power, heating and cooling to the MIT campus during grid outages.

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Project Description:

The DOER commends the proponent on the generally high level of detail provided.

January 25, 2015
MIT Central Utility Plant Expansion - EENF
DOER Comments

The Central Utility Plant expansion project consists primarily of the replacement of an existing combined heat system and the addition of another. The two combined heat and power systems represent largest of the project's direct stationary sources. Each CHP system includes a dual fuel (natural gas and ULSD) 22 MW combustion gas turbine (CGT) driven generator coupled via the CTG exhaust breeching to a heat recovery steam generator (HRSG) which can be also be fired with either gas or ULSD to supplement the steam output for meeting the campus thermal demand. In addition to the CHP system, there are a number of dual fuel and gas only steam boilers which serve either in either a supplementary or auxiliary capacity.

The DOER is aware that in addition to the scope of the project as described in the EENF, there is a large companion effort underway to improve both the reliability and efficiency of both the natural gas supply to the CUP and the intra-campus electrical distribution system that will in effect add to both the energy resiliency and efficiency of the as proposed expansion of the CUP. The DOER suggests that including a description of these efforts sufficient to provide added context to the CUP expansion project would be helpful. DOER.2

The as-proposed case for the quantification of the expected GHG emissions is based on the first year operation of the expanded CUP. Based on a telephone conversation with A. J. Jablonowski (Epsilon), this includes the fuel consumption and output from the built out facility (i.e. with both CHP systems operating). It is evident from the results that the capacity factor of the CGTs for the firs year will be range of 60 to 65%. This would seem to indicate, that for the first year of operation at a 44 MW capacity, most of the capacity above 22 MW will be providing resiliency by what approximates an n+1 redundancy. The FEIR should include information about what the full load capacity factor will be for the combined 44 MW of CTG capacity and when this projected to occur along with a discussion of any capacity which will be reserved for redundancy purposes. DOER.3

The nominal heat rates for the CTGs, not including the fuel consumption of the HRSGs, should be shown DOER.4

The description should include more details regarding the projected duty for the existing boilers, including: DOER.5

a) The expected operating scenarios (e.g. To provide additional steam generating capacity to the CHP systems or, to replace CHP steam generating capacity only in the event of a shutdown or diminished capacity for the CHP systems)
b) Identifying which scenario applies to which boiler.

Establishment of the Base Case and As-proposed Case

As the proposed facility will operate essentially as a behind the meter source for the MIT campus loads, the DOER agrees with selection of the Base case as used in the submittal. The DOER suggests that an as-proposed case be included in the FEIR based on system operating at the full average expected capacity.. DOER.6

The major sources of combustion should be specifically identified, including the CTGs and the HRSG duct burners so that the fuel consumption and associated direct source GHG emissions can be computed separately for each. DOER.7

The major sources of parasitic electric consumption of electricity due to auxiliary and balance of plant systems should be identified so that they can be included in the computation of the net output of the as-proposed generating project. DOER.8

All indirect sources, i.e. auxiliary or balance of plant systems that will be energized by grid electricity should be identified. DOER.9

Quantification of GHG Emissions from Stationary Sources

The computation of the net source GHG emissions should be revised as follows: DOER.10

1) System energy outputs:
    a. Should be in terms of the *net* output.
    b. Should show gross, and net (gross minus parasitic) as well identify major parasitic loads and consumption for each.
2) System energy inputs: DOER.11
    a. Should be by component and fuel
3) Attachment C-1: The DOER tool is limited to a CHP system and does not include other sources that will exist in the CUP expansion project. Due to this Attachment C-1 should be revised as follows to include DOER.12
    a. An iteration of the DOER tool for each CHP system
        i. First year and at full expected capacity
    b. The electrical generation efficiency of each CTG should be shown
    c. The fuel consumption and stack emissions for boilers and HRSG
    d. Add the consumption and GHG stack emissions for operations using ULSD.

The DOER suggest that the DOER GHG estimating tool can still be used to summarize the projected stack and net source GHG emissions, if the information in 1 through 3 above as determined by the available energy mode results is also included in a table and referenced in the summary. . DOER.13

Discussion of Results:

The overall efficiency at full load of 68% is lower than ideal. The DOER supports the final selection of a CTG, HRSG and balance of plant components, which would meet a target of at least an 80 % overall efficiency when operating at the final expected capacity factor. DOER.14

Mitigation:

The DOER commends the proponent for the identification and adoption of measures 3 through 8 on pages C-51&52 as well as the bulleted items on page C-53.

Selection of an Efficient CTG+HRSG Combination
The DOER supports the selection of the CTGs and the HRSGs such that the CTG will maximize its annual capacity factor and average electrical generating efficiency.

Fuel Gas Compressors:
Clarify whether or not the project intends use the existing equipment or a combination of new and existing. The book value efficiency of existing with a VFD mitigation and new with and without mitigation should be included. If the opportunity for more than a 10% decreasing in the parasitic load in replacing the existing equipment with new, a justification for not including this as a commitment should be included in the FEIR. DOER.15

Combustion Air Cooling:
The DOER suggests that the project consider using absorption chillers to provide some or all of the cooling capacity for this important mitigation measure. The resulting addition thermal load provided by the absorption units may allow the CHP systems to operate at a higher capacity factor during the cooling season, In addition replacement of older electrically driven chillers with absorption units qualifies for the ISO-NE forward capacity market payments. DOER.16

Section 61 GHG related Commitments:

In the FEIR, this section should include a more detailed and comprehensive list of all significant measures for which the project commits to implement. DOER.17
A minimum overall and target efficiency should be included.

John Ballam
Engineering Manager
CHP Program Manager
MA Dept. of Energy Resources

cc: Arah Schuur
Ian Finlayson

DOER.1 **The DOER commends MIT for the decision to implement an expanded combined heat and power (CHP) capacity as the primary source of both electricity and heat to be supplied by the expanded Central Utility Plant (CUP) to the intra-campus distributed energy system. CHP is an inherently more efficient technology for generating electricity and useful heat than obtaining electricity and heal from the electric grid and conventional on-site boilers or furnaces, which is the business as usual (BAU) scenario. When fueled primarily by natural gas, both the lower emission per MWH due to a lower GHG emitting fuel and the overall reduction in fuel consumed per unit energy generated combine to achieve a significant reduction in overall source emissions of GHG when compared with the BAU. The DOER also commends the proposed project on the incorporation of measures that will provide vital energy resiliency capabilities, including the ability of the system to start and continue operating to supply power, heating and cooling to the MIT campus during grid outages.**

The new system places vital equipment at specified locations to enhance resiliency and increase site power for critical loads on campus. The overall configuration improves efficiency over the grid, lowers emissions (including greenhouse gas emissions), and supports campus load growth.

DOER.2 **As described in the EENF, there is a companion effort underway to improve both the reliability and efficiency of both the natural gas supply to the CUP and the intra-campus electrical distribution system that will in effect add to both the energy resiliency and efficiency of the as proposed expansion of the CUP. DOER suggests including a description of these efforts to provide added context to the CUP expansion project.**

The new electrical distribution equipment increases the number of distribution points, which will be located and separated to add resiliency and provide a more stable distribution of power to campus while increasing efficiency in the use and distribution of thermal energy to campus buildings.

Currently, distribution is through seven circuits (campus loops). The Project provides MIT with up to 20 circuits, reducing the load on any one loop and allowing for better load shedding control strategies. In terms of resiliency, the increased number of circuits enables MIT to better prioritize and shift distribution of campus power from the CUP in the event of an outside utility power loss. The additional loops also enable MIT to use a phased process to bring load back on, adding load in increments to avoid stalling the plant.

DOER.3 **The FEIR should include information about what the full load capacity factor will be for the combined 44 MW of CTG capacity and when this is projected to occur, along with a discussion of any capacity which will be reserved for redundancy purposes.**

In 2019-2020, the two CTs will operate for 78 percent of the total hours available for operation based upon vendor availability and maintenance periods. In that year, there will be about 1,000 hours per CT where a unit would be able to provide redundancy. This number will decrease each year thereafter.

The two CT/HRSGs utilize 93 percent of their available thermal capacity during their operating hours in the first year of operation and increase each year. This equates to a total of about 1,051,000 MMbtu (unfired steam) for 2019-2020 which provides approximately or 71 percent of total thermal requirements of campus.

DOER.4 **The nominal heat rates for the CTGs, not including the fuel consumption of the HRSGs, should be shown.**

Please see the engine performance table below.

Solar Titan 250			
Temp	Part Load		
	100%	75%	50%
0	8,849	10,328	10,551
10	8,868	10,157	10,594
20	8,890	7,495	11,701
30	8,913	9,837	12,188
40	8,950	9,742	12,069
50	9,007	9,784	12,094
60	9,164	9,974	12,294
70	9,352	10,202	12,784
80	9,573	10,439	13,322
90	9,825	10,731	13,940
100	10,074	11,075	14,470

DOER.5 **The description should include more details regarding the projected duty for the existing boilers, including the expected operating scenarios (e.g., to provide additional steam generating capacity to the CHP systems, or, to replace CHP steam generating capacity only in the event of a shutdown or diminished capacity for the CHP systems). Identify which scenario applies to which boiler.**

Please see response to comment MEPA.14. The existing boilers will be used to provide steam generating capacity to supplement the upgraded CHP systems and to provide steam generating capacity when the CHP is offline (maintenance, repair, etc). Boilers 7 and 9 will be utilized first when additional steam generating capacity is required. Boilers 3, 4, and 5 will be used to satisfy any remaining load demands or back up needs. It is expected with our current design for the upgrade of the CHP system, the boilers will provide less than one percent steam needs of campus.

DOER.6 The DOER suggests that an as-proposed case be included in the EIR based on system operating at the full average expected capacity.

Year	Total Run Time (2 CTGS)	CTG & HRSG Hour Utilization	CTG Steam Waste Heat Utilization
	(hours)		
2019	13,246	78%	93%
2020	13,160	77%	94%
2021	13,322	78%	94%
2022	14,216	84%	95%
2023	14,219	84%	95%
2024	14,219	84%	95%
2025	14,219	84%	95%
2026	14,219	84%	95%
2027	14,219	84%	95%
2028	14,219	84%	95%
2029	14,219	84%	96%
2030	14,360	84%	96%

- Based upon Vendor Guarantee of 97% availability.

DOER.7 The major sources of combustion should be specifically identified, including the CTGs and the HRSG duct burners so that the fuel consumption and associated direct source GHG emissions can be computed separately for each.

Total CTG Gas Usage (MMBtu)	Total DB Gas Usage (MMBtu)	Total Boiler Gas Usage (MMBtu)
2,290,260	312,573	506
2,322,499	296,872	282
2,359,125	297,732	385
2,537,015	324,255	2,142
2,537,725	324,375	2,154
2,537,725	324,375	2,154
2,537,725	324,375	2,154
2,537,725	324,375	2,154
2,537,725	324,375	2,154
2,537,725	324,375	2,154
2,561,783	318,208	2,044
2,594,771	324,982	2,639

DOER.8 **The major sources of parasitic electric consumption of electricity due to auxiliary and balance of plant systems should be identified so that they can be included in the computation of the net output of the as proposed generating project.**

Key parasitic loads are described for the base case and alternatives in Appendix 3, for full-load summer, full load winter, and minimum load operation. Appendix 3 and Section 5.7 review specific alternatives to minimize parasitic consumption of energy, and describe MIT's commitment to each alternative. While lighting in the new building is an additional parasitic load, it is independent of CHP operating rates and is not quantified in the list in Appendix 3. MIT proposes to use LED and occupancy lighting systems to reduce energy use in the building expansion.

DOER.9 **All indirect sources, i.e. auxiliary or balance of plant systems that will be energized by grid electricity should be identified.**

All balance-of-plant systems listed above in Response to Comment DOER.8 are backed up by the grid and cold start CHP generator.

DOER.10 **Revision of computation of net source GHG emissions: System energy outputs should be in terms of the net output, and should show gross and net (gross minus parasitic), identifying major parasitic loads and consumption for each.**

The revised computation of source GHG emissions is presented in Section 5.9. Identification of major parasitic loads and consumption for each is presented in Section 5.7. As shown in Section 5.7, MIT has minimized the parasitic loads to the maximum extent feasible, such that the total difference between gross and net (gross minus parasitic) is only about three percent.

DOER.11 **Revision of computation of net source GHG emissions: System energy inputs should be by component and fuel.**

Please refer to Response to Comment DOER.7 above.

DOER.12 **The DOER tool is limited to a CHP system and does not include other sources that will exist in the CUP expansion project. Due to this, EENF Attachment C-1 should be revised to include:**

- **a. An iteration of the DOER tool for each CHP system**
  - **i. first year; and**
  - **ii. at full expected capacity**
- **b. The electrical generation efficiency of each CTG**
- **c. The fuel consumption and stack emissions for boilers and HRSG**
- **d. The consumption and GHG stack emissions for operations using ULSD.**

See the table in Response to Comment DOER.7 for GHG emissions 2019-2030.

DOER.13 **The DOER GHG estimating tool may be used to summarize the projected stack and net source GHG emissions if the information requested in [DOER.10 through DOER.12] above, as determined by the available energy mode results, is included in a table and referenced in the summary of the EIR.**

The revised computation of source GHG emissions is presented in Section 5.9. Key results are summarized in Tables 5-3 and 5-4, showing that the CHP provides very significant improvements over the separate generation of electricity and thermal energy.

DOER.14 **The overall efficiency at full load of 68% is lower than ideal. The DOER supports the final selection of a CTG, HRSG and balance of plant components, which would meet a target of at least an 80 percent overall efficiency when operating at the final expected capacity factor.**

As shown in Table 5-3, overall efficiency is expected to be 83 percent.

DOER.15 **Clarify whether the project intends use the existing equipment or a combination of new and existing. The book value efficiency of existing with a VFD mitigation and new with and without mitigation should be included. If the opportunity for more than a 10 percent decrease in the parasitic load in replacing the existing equipment with new, a justification for not including this as a commitment should be included in the EIR.**

The Project uses new and existing equipment. All large BOP motor loads are on VFDs.

DOER.16 **The DOER suggests that the project consider using absorption chillers to provide some or all of the cooling capacity for this important mitigation measure.**

MIT considered using absorption chillers and has opted instead to use existing steam-powered chilled-water equipment.

DOER.17 **In the EIR, the proposed Section 61 GHG-related commitments should include a more detailed and comprehensive list of all significant measures for which the project commits to implement. A minimum overall and target efficiency should be included.**

Section 5.10 and Section 11 of the SEIR provide an updated list of all significant GHG-related measures that MIT commits to implement. Consistent with the instructions in the MEPA GHG Policy and Protocol and in comment MEPA 40, Section 5.10 of this FEIR includes a commitment to provide a self-certification to the MEPA Office at the completion of the Project that will be signed by an appropriate professional (e.g. engineer, architect, transportation planner, general contractor) indicating that all of the GHG mitigation measures, or equivalent measures that are designed to collectively achieve identified reductions, have been incorporated into the Project. Section 11 of this SEIR summarizes mitigation commitments, including GHG mitigation commitments, and includes draft Section 61 findings for use by agencies issuing Project permits, including a draft Section 61 finding that the Project will provide the self-certification.

Strysky, Alexander (EEA)

From: Sullivan, Jan (DPH)
Sent: Friday, January 29, 2016 3:39 PM
To: Strysky, Alexander (EEA)
Cc: Fraser, Alicia (DPH); Nascarella, Marc (DPH); Knorr, Robert (DPH)
Subject: FW: MEPA MIT project

Dear Mr. Strysky :

The Massachusetts Department of Public Health, Bureau of Environmental Health (MDPH/BEH) is aware of the proposed MIT Central Utilities Plant Expansion. According to the Environmental Notification Form (ENF), this project consists of several components, including: replacement of an existing 21-megawatt (MW) turbine with two new 22 MW turbines; conversion of three existing boilers from burning #6 fuel oil to burning combined natural gas/#2 fuel; replacement of six cooling towers with three newer cooling towers; addition of a 2 MW ultra-low-sulfur diesel fired cold start engine; creation of a new natural gas regulator station inside the plant; as well as a number of additional actions.

According to the ENF, the cogeneration plant expansion will increase emissions of a number of air pollutants, most notably particulate matter (PM), carbon monoxide, volatile organic compounds (VOCs), and carbon dioxide. While the proponent asserts that estimates are below applicable air quality standards, additional details are needed to fully evaluate potential health impacts to the surrounding communities, many of which are Environmental Justice (EJ) designated areas. For example, a more complete evaluation of various configurations (e.g., generation technology, feedstock, and pollutant control combinations) and an assessment of the resultant acute exposure to peak levels of HAPs and criteria air pollutants would be useful. A more thorough presentation of air dispersion modeling results for key air pollutants would also be helpful for identifying the direction and extent of greatest impact. DPH.1 DPH.2

Given the siting of the project in close proximity to EJ designated areas, we would also recommend that the proponent consider evaluating the baseline health status of the potentially affected populations. This would inform mitigation needs that are based on possible health impacts. The Environmental Public Health Tracking website (https://matracking.ehs.state.ma.us) contains health data that can be used for such an analysis. For example, health outcomes are available for small areas such as census tracts or for particular schools within a community. Please let me know if you would like us to provide additional guidance on determining the appropriate metrics for the consideration of health status in this EIR. DPH.3

We appreciate the opportunity to provide input into this process.

Sincerely,
Jan Sullivan

Jon Sullivan, Acting Director
Bureau of Environmental Health
Director, Community Assessment Program
Bureau of Environmental Health
Mass. Dept. of Public Health
250 Washington Street, 7th floor
Boston, MA 02108

Jan Sullivan, Acting Director
Bureau of Environmental Health
Director, Community Assessment Program
Bureau of Environmental Health

Mass. Dept. of Public Health
250 Washington Street, 7th floor
Boston, MA 02108

ian.sullivan@state.ma.us
617 624-5757
Cell: 617 620-8019

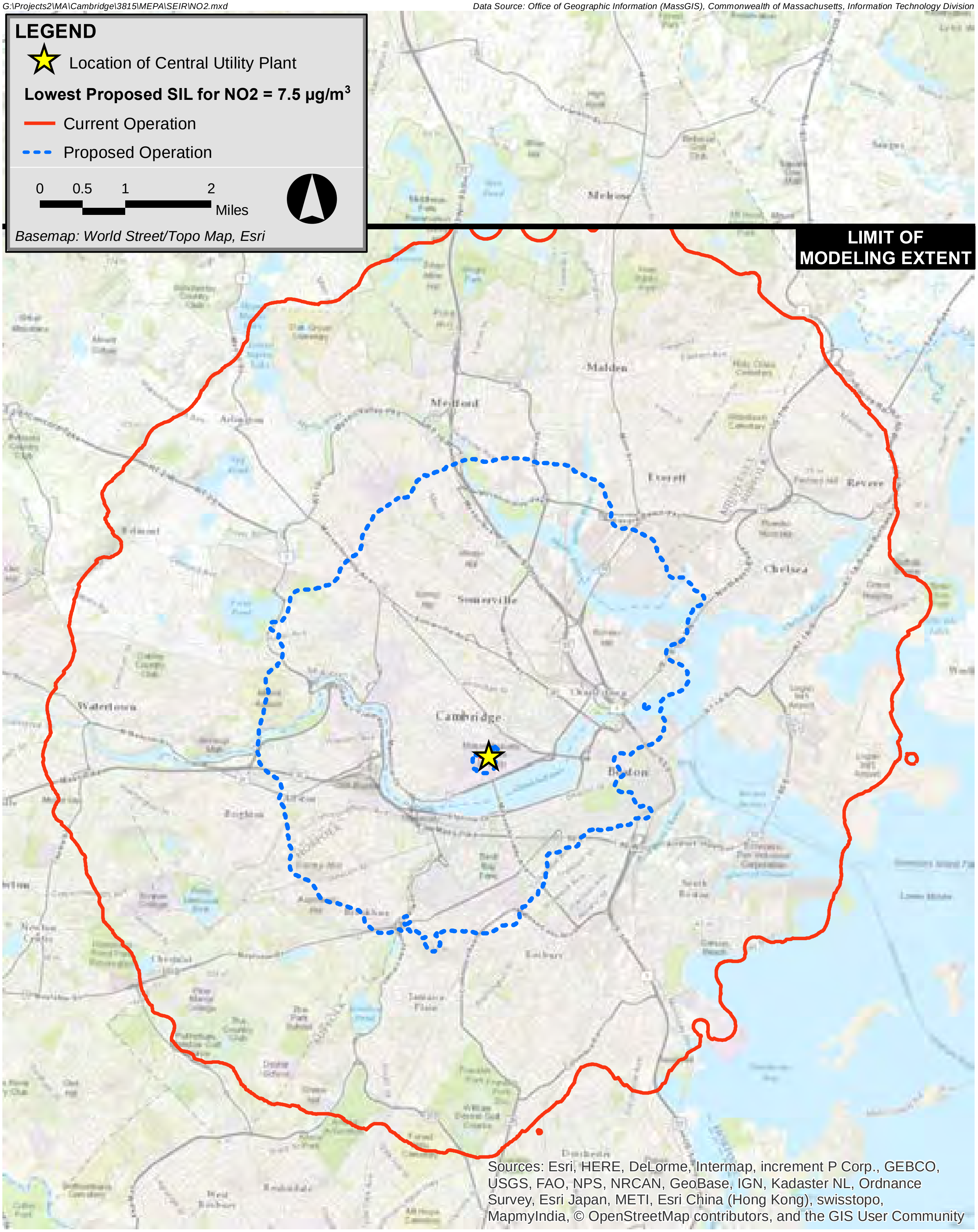
If you need immediate assistance for an emergency outside regular business hours, please call the Office of Preparedness and Emergency Response Duty Officer at 617 339-8351.

DPH.1 **According to the ENF, the cogeneration plant expansion will increase emissions of a number of air pollutants, most notably particulate matter (PM), carbon monoxide, volatile organic compounds (VOCs), and carbon dioxide. While the proponent asserts that estimates are below applicable air quality standards, additional details are needed to fully evaluate potential health impacts to the surrounding communities, many of which are Environmental Justice (EJ) designated areas. For example, a more complete evaluation of various configurations (e.g., generation technology, feedstock, and pollutant control combinations) and an assessment of the resultant acute exposure to peak levels of HAPs and criteria air pollutants would be useful.**

A discussion of various configurations considered by MIT is contained in the Section 3 of this SEIR; this discussion includes a discussion of alternative generation technologies and alternative feedstock (e.g. oil, biomass). Broadly, local air quality impacts will be higher under these alternatives. A full discussion on pollution control and potential options for controlling air pollutants from the new CT is contained in the BACT analysis in Section 4.0 of the MCPA Application (located at http://powering.mit.edu). An evaluation of the peak ground level concentrations from HAPs and criteria air pollutants is contained in Section 4.5.

DPH.2 **A more thorough presentation of air dispersion modeling results for key air pollutants would also be helpful for identifying the direction and extent of greatest [health] impact.**

Air dispersion modeling was performed to compare the current operations of the CUP to how the CUP will operate once the new CTs are online. In conjunction with this Project, MIT is moving to a firm gas contract, which will enable MIT to reduce oil firing across all sources at the CUP to a maximum of 168 hours per year. This reduction in oil firing has the added benefit of reducing peak concentrations of NO_2 and $PM_{2.5}$ in the vicinity of MIT by 53 percent and 58 percent compared to their present levels. Please see the maps below demonstrating the impact this reduction has on the Significant Impact Levels for these pollutants in the vicinity of MIT.



MIT CUP Second Century Project **Cambridge, Massachusetts**

Massachusetts Institute of Technology

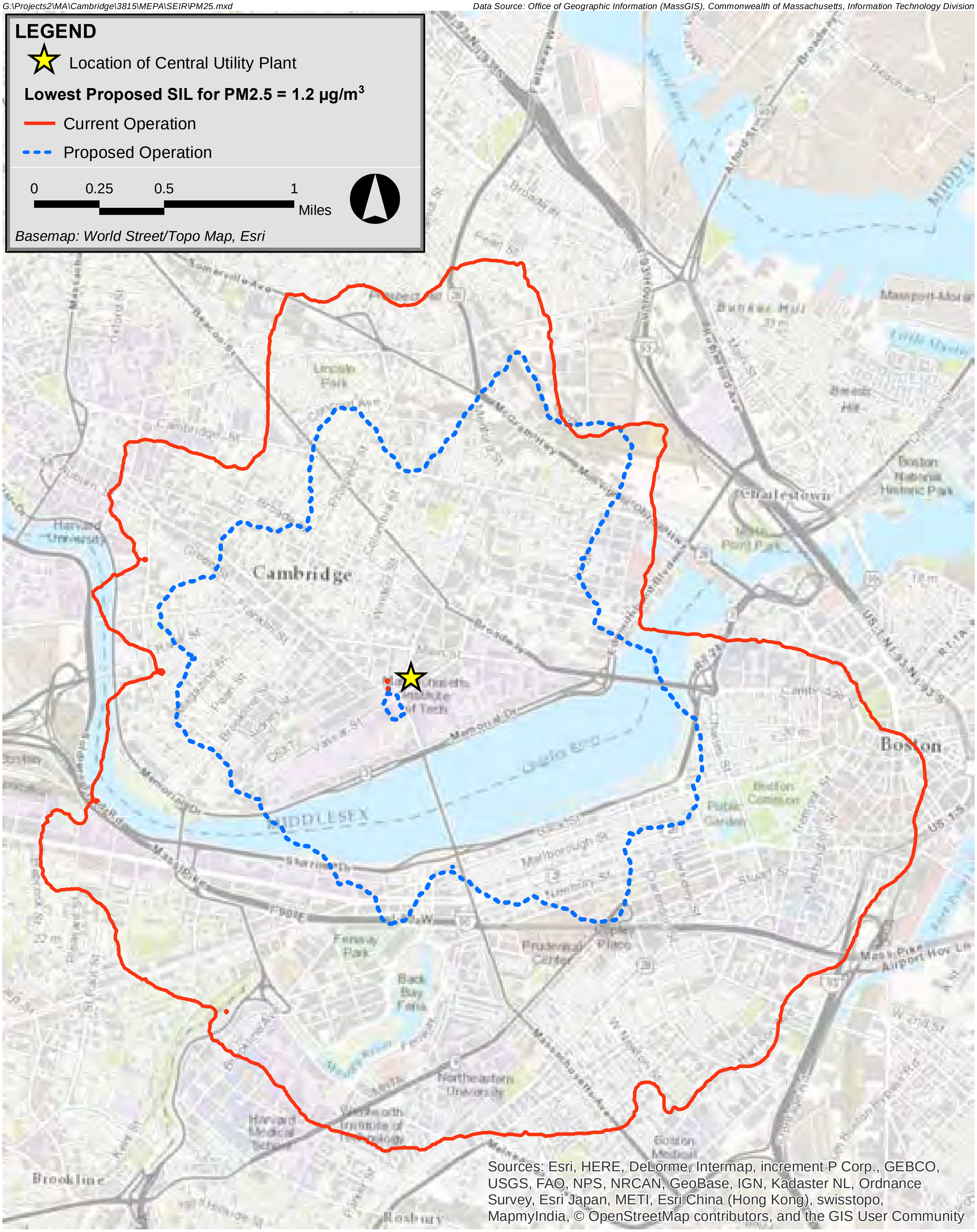
Epsilon

Figure 12-2

Predicted 1-hour NO2 Concentration Contours (µg/m³)

G:\Projects2\MA\Cambridge\3815\MEPA\SEIR\PM25.mxd

Data Source: Office of Geographic Information (MassGIS), Commonwealth of Massachusetts, Information Technology Division



MIT CUP Second Century Project **Cambridge, Massachusetts**

Massachusetts Institute of Technology Epsilon

Figure 12-3

Predicted 24-hour PM2.5 Concentration Contours (µg/m^3)

DPH.3 **Given the siting of the project in close proximity to EJ designated areas, DPH recommends that the proponent consider evaluating the baseline health status of the potentially affected populations. This would inform mitigation needs that are based on possible health impacts. The Environmental Public Health Tracking website (https://matracking.ehs.state.ma.us) contains health data, and DPH can provide additional guidance on determining the appropriate metrics for the consideration of health status in this EIR.**

MIT reviewed the Massachusetts Environmental Public Health Tracking (MA EPHT) website mentioned above, which contains a variety of environmental and health data as a tool for evaluating the baseline health of the environmental justice areas and in the broader Cambridge area.

The MA EPHT website contains information at community level or smaller geography for cancer incidence, asthma hospitalization rates, pediatric prevalence of asthma, and heart attacks. Each of these health statistics were reviewed in order to determine the baseline health of the environmental justice area and broader Cambridge community.

The MA EPHT website contains health data on 25 different cancers and four different pediatric cancers. Data for this health statistic is available at the Census Tract level as well as the Community level. This data was reviewed for the 2007 – 2011 period for males and females combined for all census tracts in Cambridge as well as the entire community of Cambridge for all available cancer types. The results demonstrate that cancer rates in the Cambridge area are similar to the statewide rate of cancer.

The MA EPHT website contains data on asthma hospital admissions and asthma emergency department visits. Asthma hospital admissions are individuals residing in Cambridge who were admitted to the hospital overnight with a diagnosis of asthma. Asthma emergency department visits are individuals residing in Cambridge who received care at a hospital emergency room and were released (i.e., they were not admitted to the hospital). The MA EPHT tracks these two metrics separately. The most recent 5-year periods (2008-2012) for both of these statistics were reviewed to further understand the burden of asthma in Cambridge among the general population. The age-adjusted rate for asthma hospital admissions and asthma emergency department admissions is not statistically significantly elevated when compared to the statewide rate (i.e. results are similar to the state-wide rate for asthma). Results for the 5-year period (2008-2012) are presented below in the tables below.

Age Adjusted Rates of Hospital Admissions for Asthma for 10,000 People for Males and Females Combined for 2008-2012 in Cambridge			
Year	Age-Adjusted Rate (per 10,000 people)	95% Confidence Interval	Statistical Significance
2008	13.5	10.8-16.3	Not Statistically Significantly Different from the Statewide Rate
2009	12.1	9.6-14.7	Not Statistically Significantly Different from the Statewide Rate
2010	12.5	9.9-15.0	Not Statistically Significantly Different from the Statewide Rate
2011	9.9	7.7-12.0	Not Statistically Significantly Different from the Statewide Rate
2012	8.8	6.9-10.8	Not Statistically Significantly Different from the Statewide Rate

Age Adjusted Rates of Hospital Admissions for Asthma for 10,000 People for Males and Females Combined for 2008-2012 in Cambridge			
Year	Age-Adjusted Rate (per 10,000 people)	95% Confidence Interval	Statistical Significance
2008	54.4	49.2-59.6	Not Statistically Significantly Different from the Statewide Rate
2009	59.8	54.4-65.3	Not Statistically Significantly Different from the Statewide Rate
2010	67.9	61.9-73.8	Not Statistically Significantly Different from the Statewide Rate
2011	78.8	72.6-85.0	Not Statistically Significantly Different from the Statewide Rate
2012	79.6	73.7-85.5	Not Statistically Significantly Different from the Statewide Rate

In addition to asthma tracked through receiving care at a hospital, MassDEP also tracks and reports on the MA EPHT website the prevalence of pediatric asthma. This data is obtained through school health records in students in both public and private schools in kindergarten through 8th grade. Therefore, this health statistic records the prevalence or the number of students reported to have asthma during a school year. This data is reported both by school and by community. The data from the MA EPHT website was reviewed for the community of Cambridge as well as by public and private schools in Cambridge. Results are reported in the table below. Cambridge pediatric asthma prevalence is generally similar to the statewide rate. Results at individual schools are varied with several schools in the vicinity of the

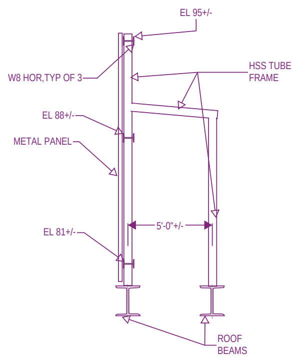
Project reporting a rate of asthma in students that is higher than the average rate across the state and others reporting a rate of asthma in students that is below the average statewide rate. As indicated in Response to Comment DEP.2, peak concentrations from the CUP will decrease from present levels once the two new CTs have been installed because MIT will reduce oil firing and use oil only for testing and during emergency periods (not to exceed 168 hours/year). This reduction across all emission units will decrease peak airborne concentrations by 58 percent for 24-hr $PM_{2.5}$ and 53 percent of 1-hour NO_2 concentrations.

Prevalence of Pediatric Asthma per 100 Students for Males and Females for School Years 2009 to 2014

School	Distance from Project (mi)	2009-2010	2010-2011	2011-2012	2012-2013	2013-2014
Fletcher/Maynard Academy	0.36	**23.7****	**21.2****	10	17.1	15.6
Prospect Hill Academy	0.53	12.1	*2.4**	11	*6.8**	*9.2**
Community Charter	0.55	14.2	14.8	9.9	16.3	**21.3****
Cambridgeport	0.56	**18.8****	**18.2****	*8.1**	12.5	11
Kennedy-Longfellow	0.61	**21****	**16.2****	**17.3****	**20.9****	**18.7****
King Open	0.69	12.2	13.5	14.9	**28.3****	**28.2****
Amigos School	0.76	12.3	*8.2**	*8.3**	13.7	13.3
Putnam Ave Upper School	1.03	NC	NC	NC	17	**18.7****
Morse	1.05	12.6	12	13.5	14	13.1
Martin Luther King Jr	1.06	9.4	10.2	11.2	13	9.9
Boston Arch Choir	1.3	NS	26	**38.1****	18.9	**27.9****
Maria L. Baldwin	1.82	13.9	10.5	13.2	12.7	9.1
Graham and Parks	2.1	11.3	9.5	10.6	*6.8**	*4.9**
St Peter Elem	2.27	*7.1**	*3.7**	8	*6.7**	*3.8**
Shady Hill	2.42	11.7	14	**16.2****	**15.7****	12.7
Cambridge Montessori	2.55	11	12.5	15.7	15.3	NS
Cambridge Friends	2.57	*7.4**	*6**	*4.9**	10.5	13.2
Peabody	2.73	13.2	*7.3**	*8.7**	**23.6****	12
Rindge Ave Upper School	2.74	NC	NC	NC	0	12.8
John M Tobin	2.8	11.9	13.1	16.7	**31.4****	**25.9****
Benjamin Banneker	2.83	13.2	13.5	**16.4****	**22.9****	**18.6****
Haggerty	3.2	7.9	9.2	15.6	13.3	**19****
International School of Boston	3.41	*5.8**	11.8	10.7	10.7	11.8
Fayerweather Street	3.71	NS	*6.4**	*5.5**	*4.5**	*6.2**

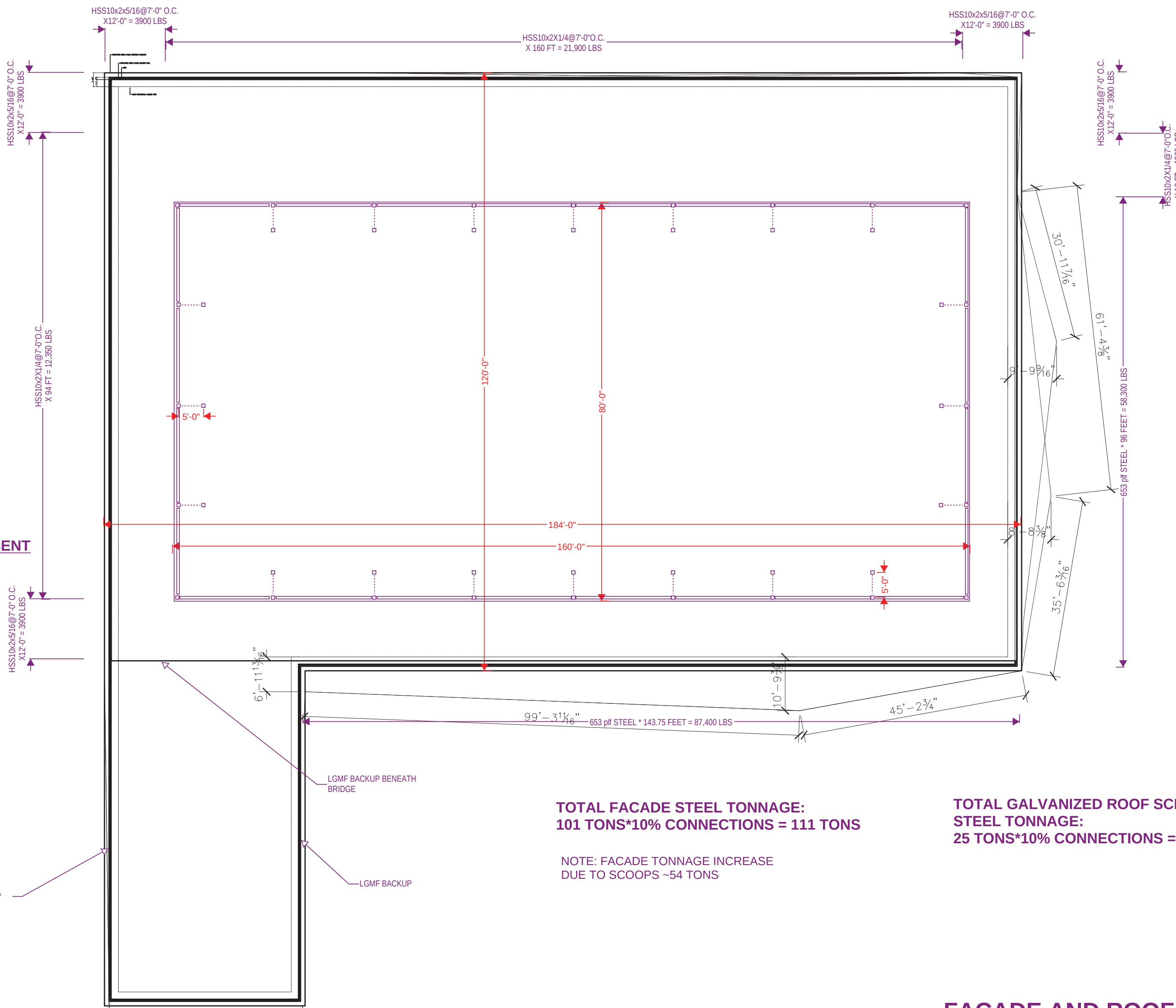
Note: The following health outcomes are only available at a county geography: Birth Defects and Reproductive Outcomes. Given the size of Middlesex County and the relatively small (in comparison) impact area for this project, health-statistic data only available at a county geography were not reviewed. Additionally, there are several health statistics which the Project is not anticipated to impact, and which MIT did not consider in the review of the baseline health status. These health statistics include: Carbon Monoxide Poisoning, Childhood Blood Lead, Heat Stress, and Pediatric Diabetes.

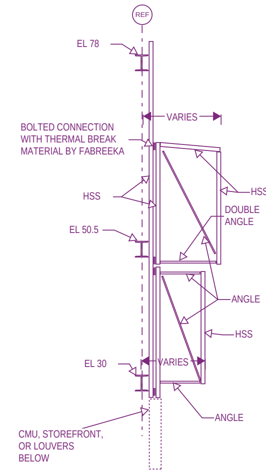
Appendix 1



TYPICAL SECTION AT ROOF SCREEN BENT

NOT TO SCALE





TYPICAL SECTION AT SCOOP

NOT TO SCALE

TOTAL FACADE STEEL TONNAGE:
101 TONS*10% CONNECTIONS = 111 TONS

NOTE: FACADE TONNAGE INCREASE
DUE TO SCOOPS ~54 TONS

TOTAL GALVANIZED ROOF SCREEN
STEEL TONNAGE:
25 TONS*10% CONNECTIONS = 28 TONS

FACADE AND ROOF SCREEN TONNAGES
MIT SECOND CENTURY CUP EXPANSION
JANUARY 8, 2016

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

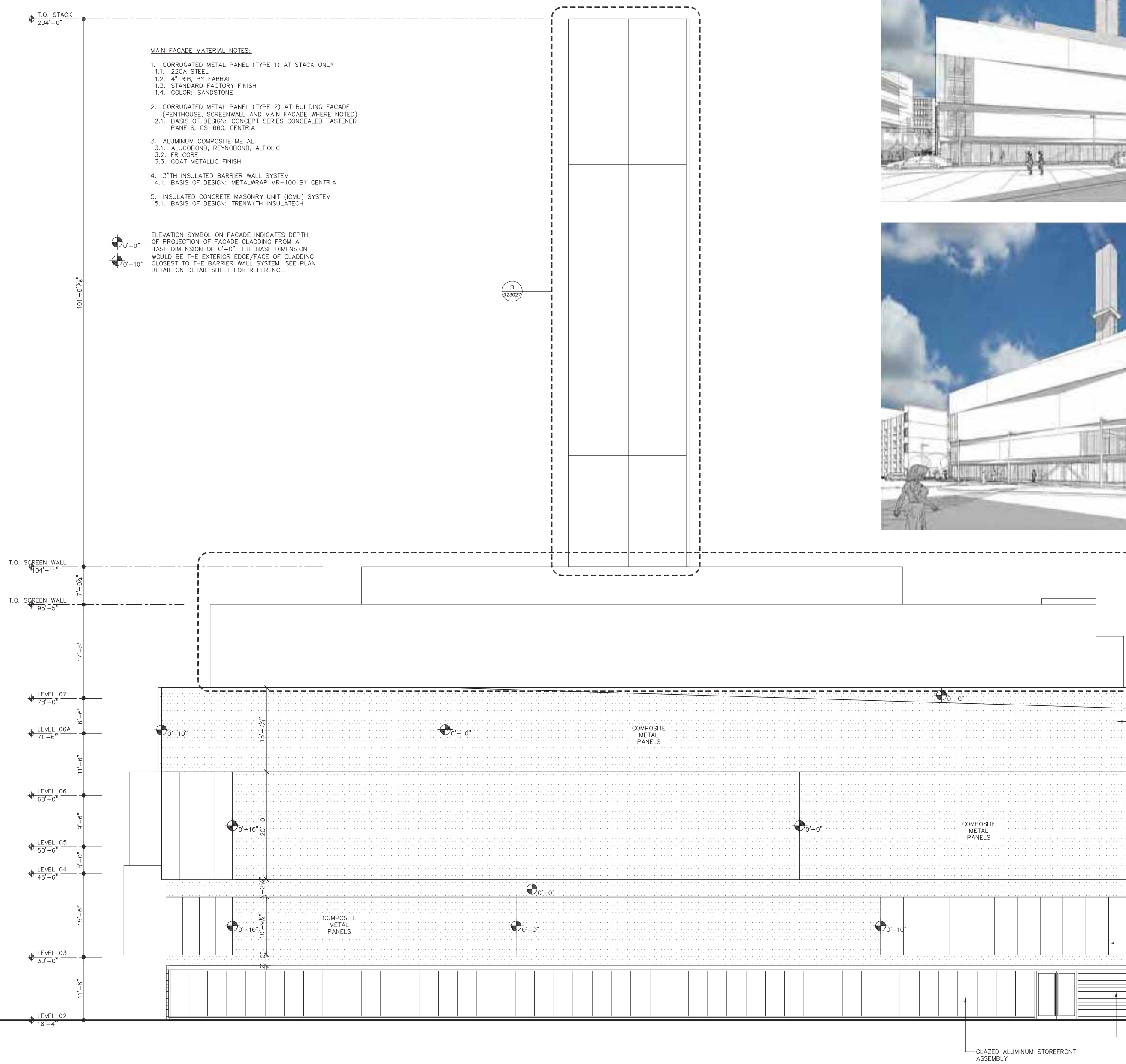
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

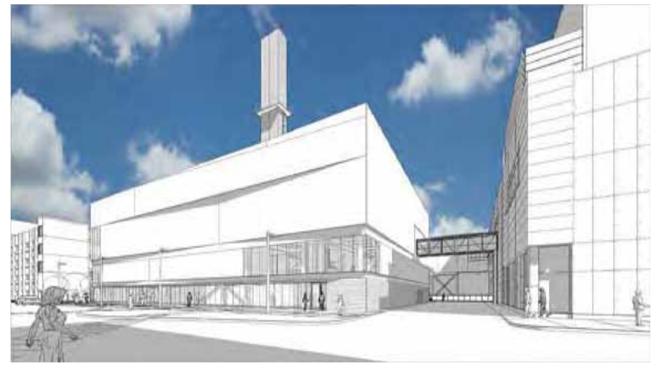
5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



1 NORTH ELEVATION - MAIN FACADE
1/8" = 1'-0"



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R.G. Vanderweil Engineers, LLP
274 Summer Street
Boston, MA 02210
617.423.7423 TEL
617.423.7401 FAX
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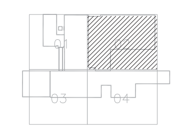
Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

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Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

NORTH ELEVATION

AREA 02

A-023018

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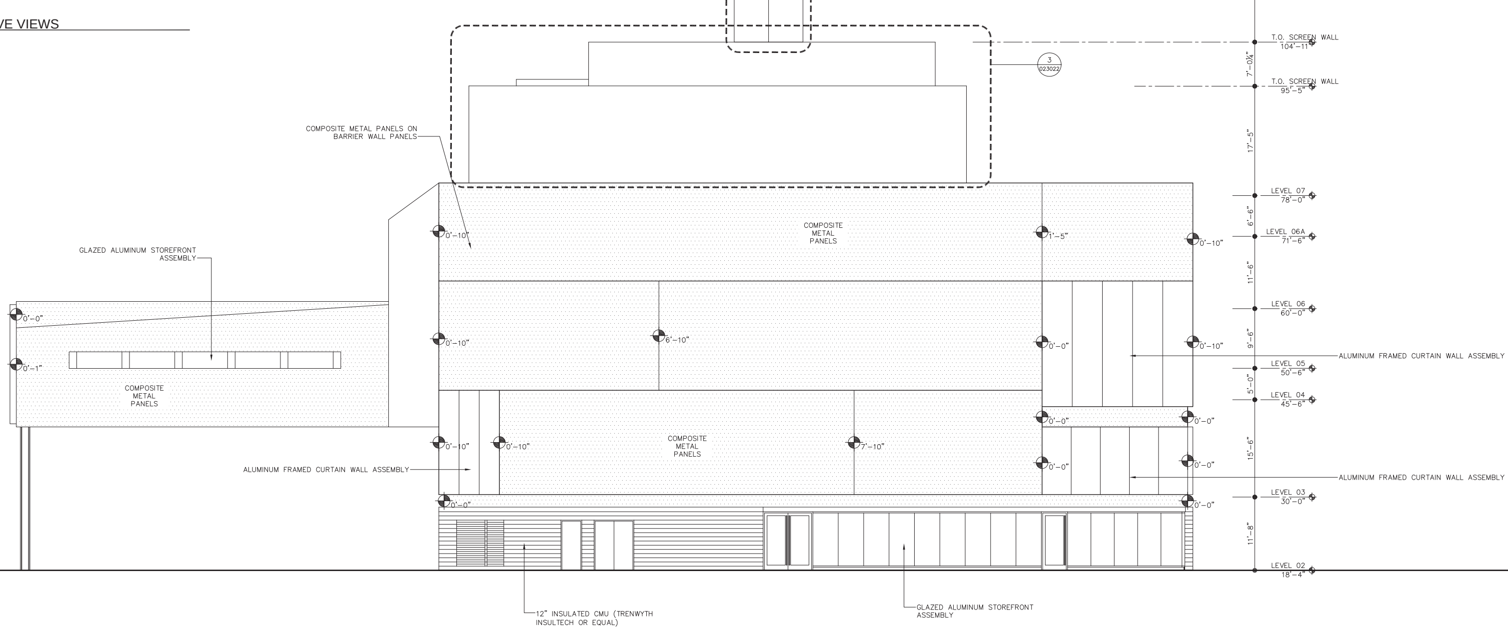

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"
ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.

1 EAST ELEVATION - MAIN FACADE
1/8" = 1'-0"

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R.G. Vanderweil Engineers, LLP
274 Summer Street
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617.423.7423 TEL
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B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

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Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

EAST ELEVATION

AREA 02

A-023019

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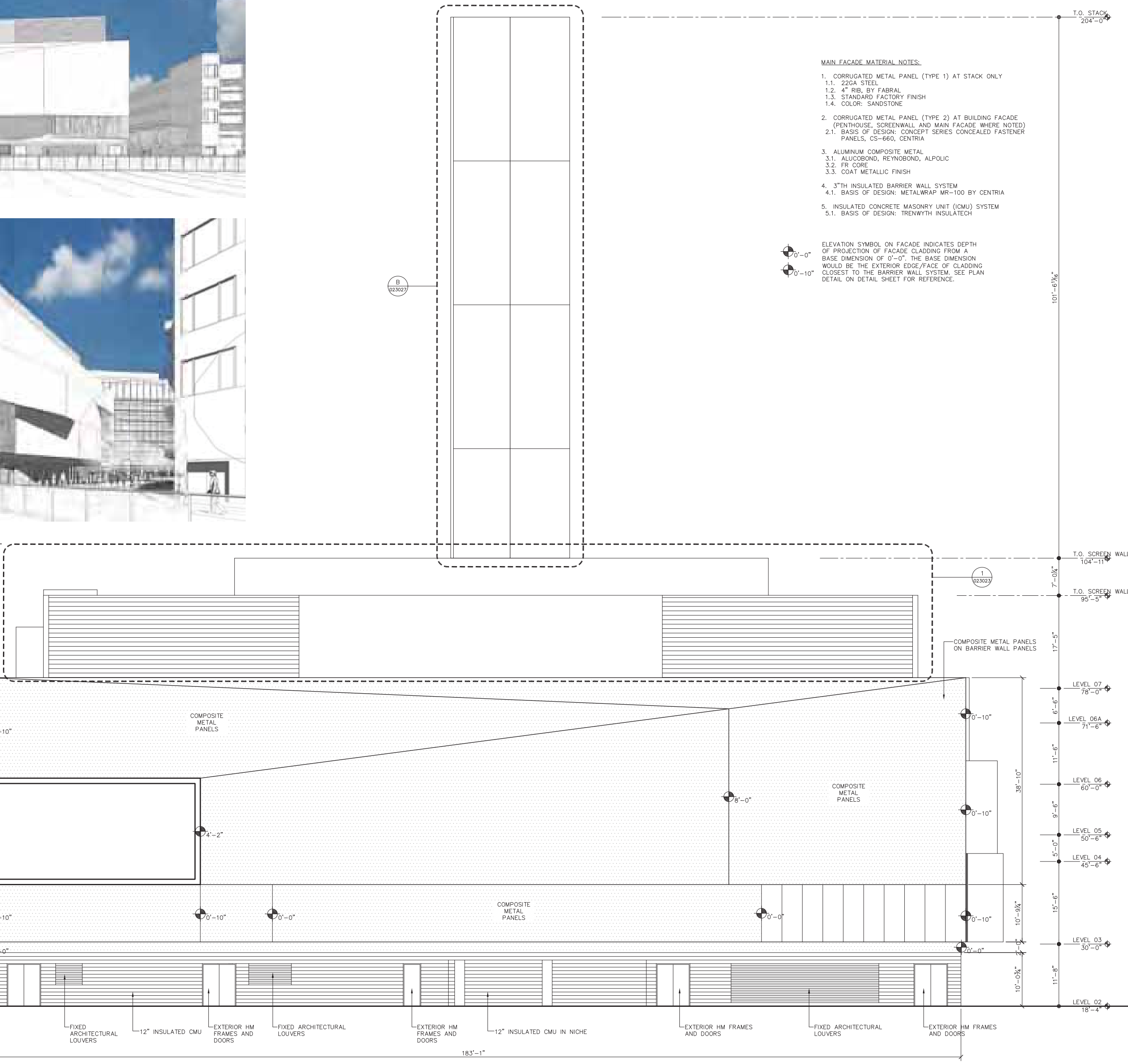

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"
ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.

1 SOUTH ELEVATION - MAIN FACADE
1/8" = 1'-0"

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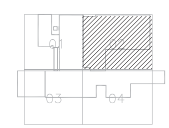

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B	09-25-15	WP3 75% ISSUE
A	05-15-15	WP3 60% DESIGN

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Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

SOUTH ELEVATION

AREA 02

A-023020

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

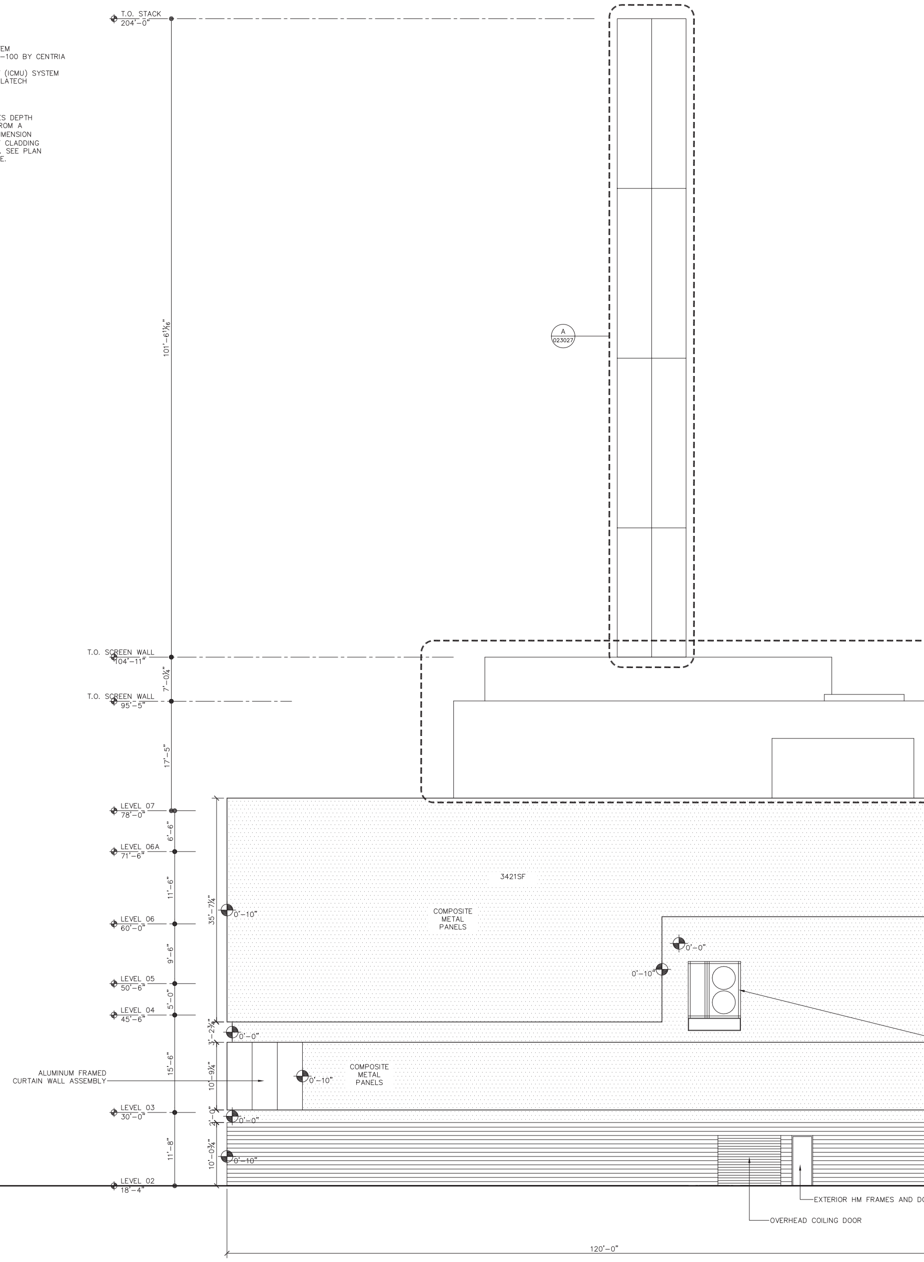
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

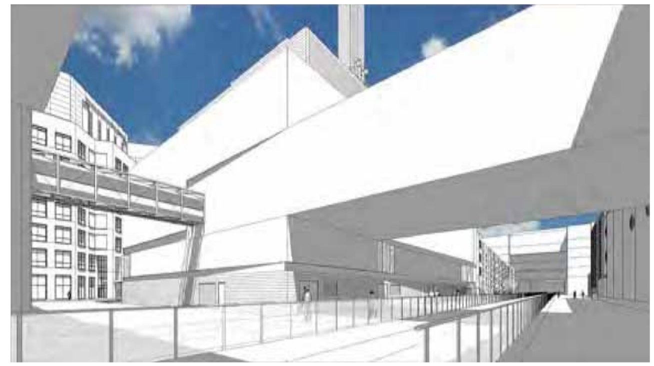
5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



1 WEST ELEVATION - MAIN FACADE
1/8" = 1'-0"



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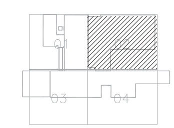

REV.	DATE	DESCRIPTION
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B	09-25-15	WP3 75% ISSUE
A	05-15-15	WP3 60% DESIGN

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Scale: 1/8" = 1'-0"

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MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

WEST ELEVATION

AREA 02

A-023021

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

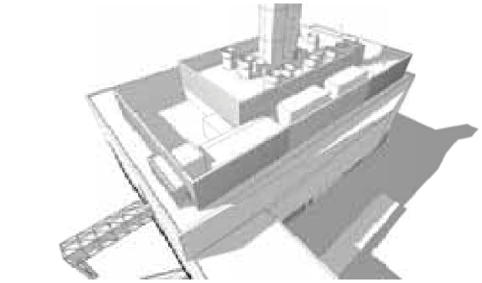
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

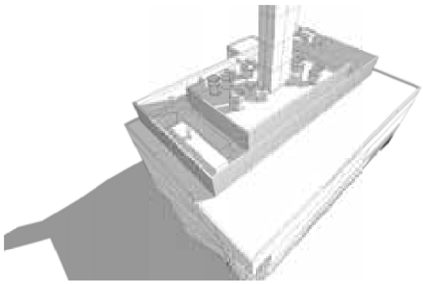
4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.





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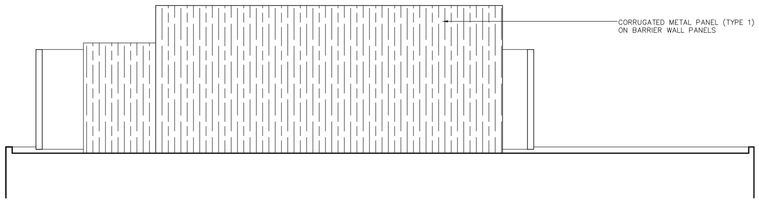
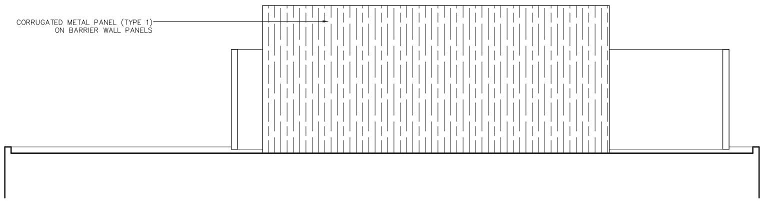
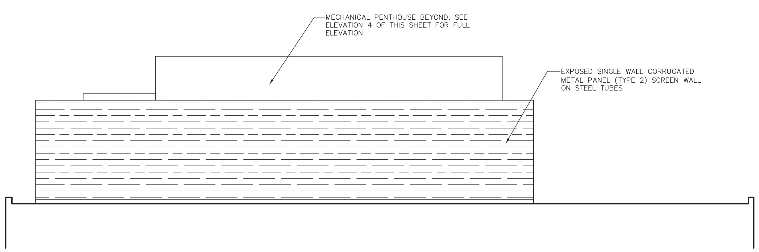


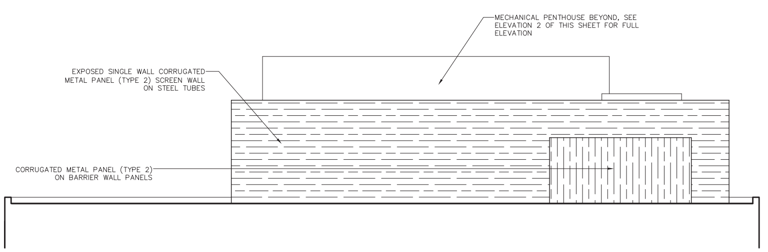
4 EAST ELEVATION - MECHANICAL PENTHOUSE
1/8" = 1'-0"



2 WEST ELEVATION - MECHANICAL PENTHOUSE
1/8" = 1'-0"



3 EAST ELEVATION - ROOF SCREEN
1/8" = 1'-0"



1 WEST ELEVATION - ROOF SCREEN
1/8" = 1'-0"

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R.G. Vanderweil Engineers, LLP
274 Summer Street
Boston, MA 02210
617.423.7423 TEL
617.423.7401 FAX
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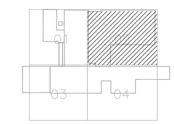
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
C	01-08-16	WP3 75% COST VALIDATION
B	09-25-15	WP3 75% ISSUE
A	05-15-15	WP3 60% DESIGN

RGV Job No. 27664.00 | MIT Job No. 14133

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Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

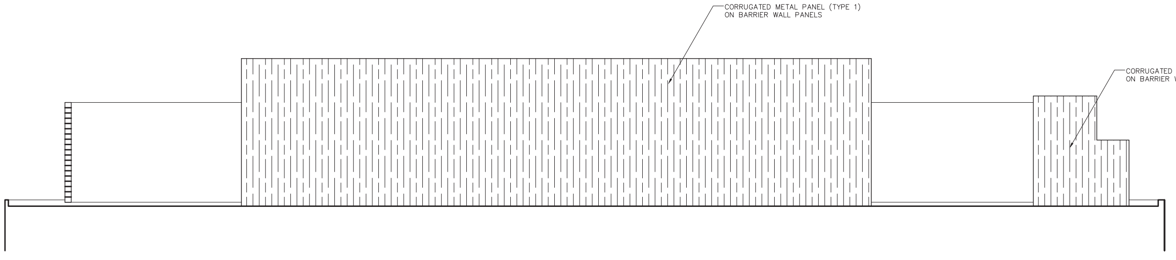
MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

WEST ELEVATION

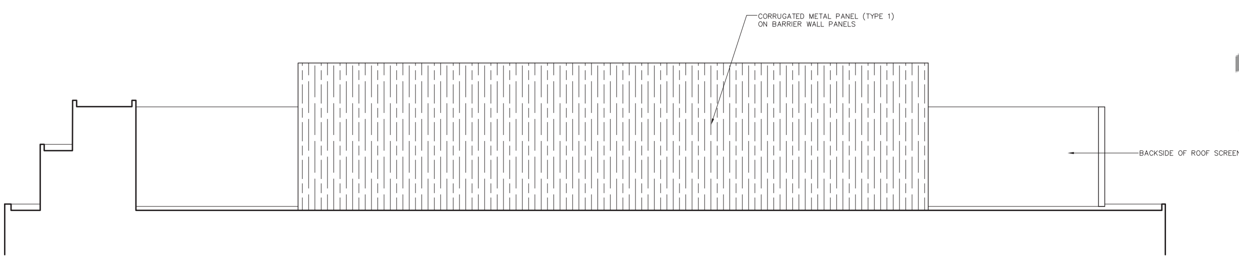
AREA 02

A-023022

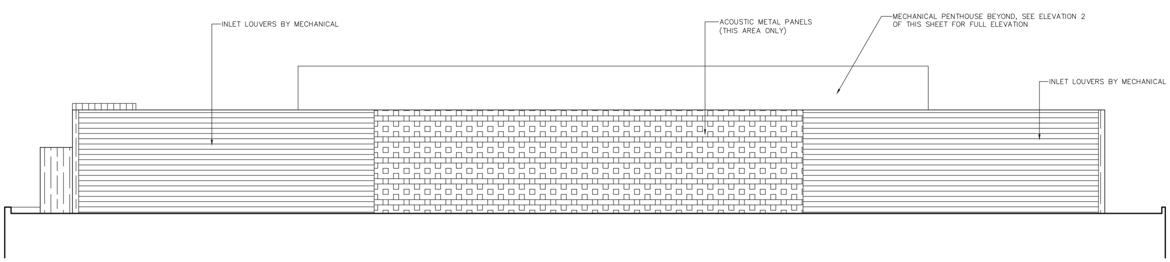


4 NORTH ELEVATION - MECHANICAL PENTHOUSE
1/8" = 1'-0"

3 NORTH ELEVATION - ROOF SCREEN
1/8" = 1'-0"



2 SOUTH ELEVATION - MECHANICAL PENTHOUSE
1/8" = 1'-0"



1 SOUTH ELEVATION - ROOF SCREEN
1/8" = 1'-0"

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

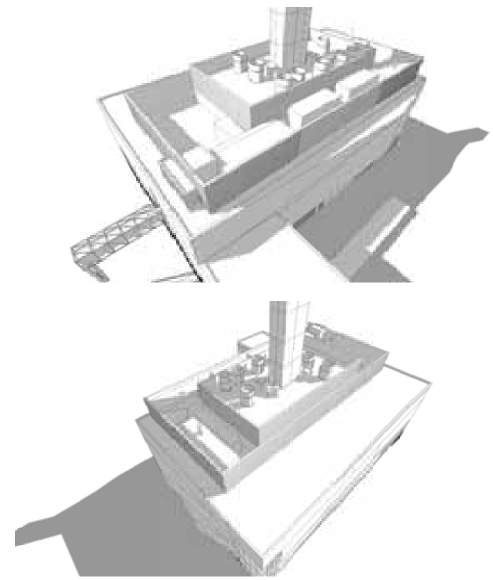
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



A REPRESENTATIVE VIEWS
NTS

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617.423.7401 FAX
vanderweil.com

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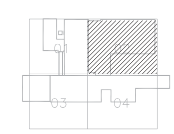
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
C	01-08-16	WP3 75% COST VALIDATION
B	09-25-15	WP3 75% ISSUE
A	05-15-15	WP3 60% DESIGN

RGV Job No. 27664.00 | MIT Job No. 14133
Drawn by:
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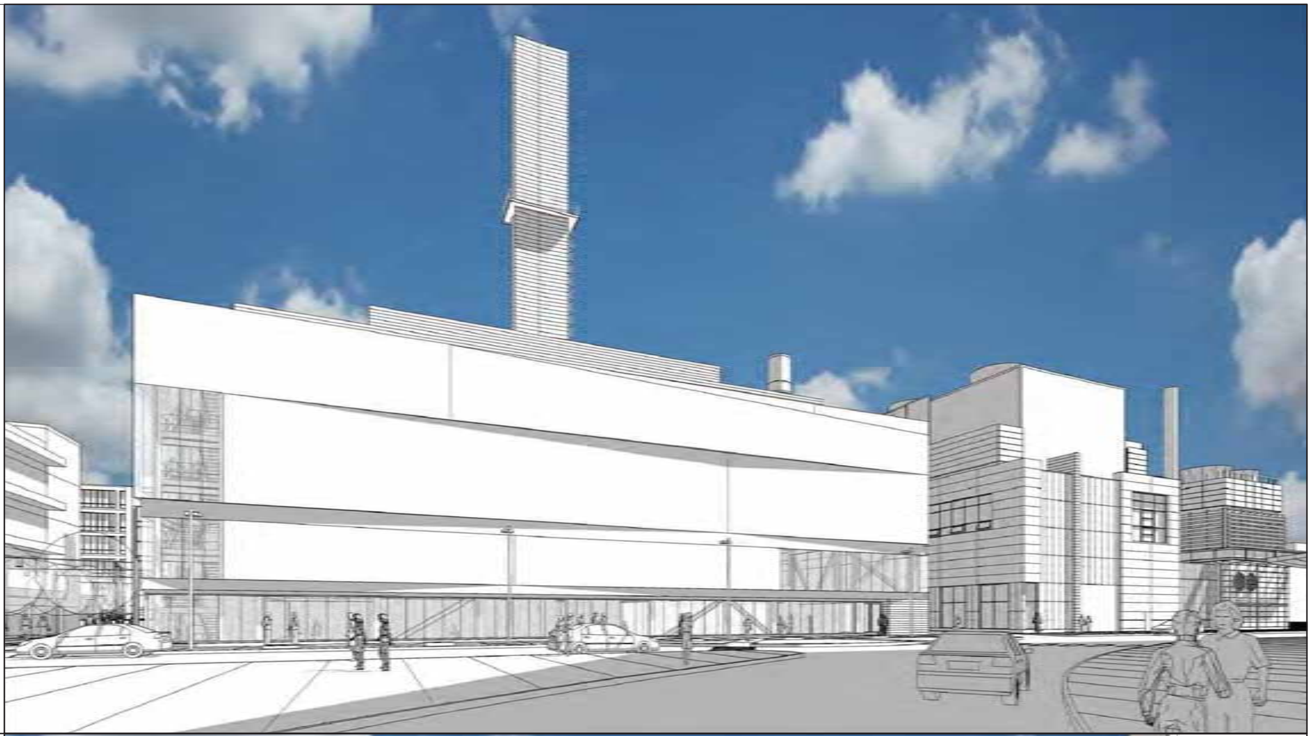
Date of original:
Scale: 1/8" = 1'-0"

Project
MIT SECOND CENTURY PLANT UPGRADE

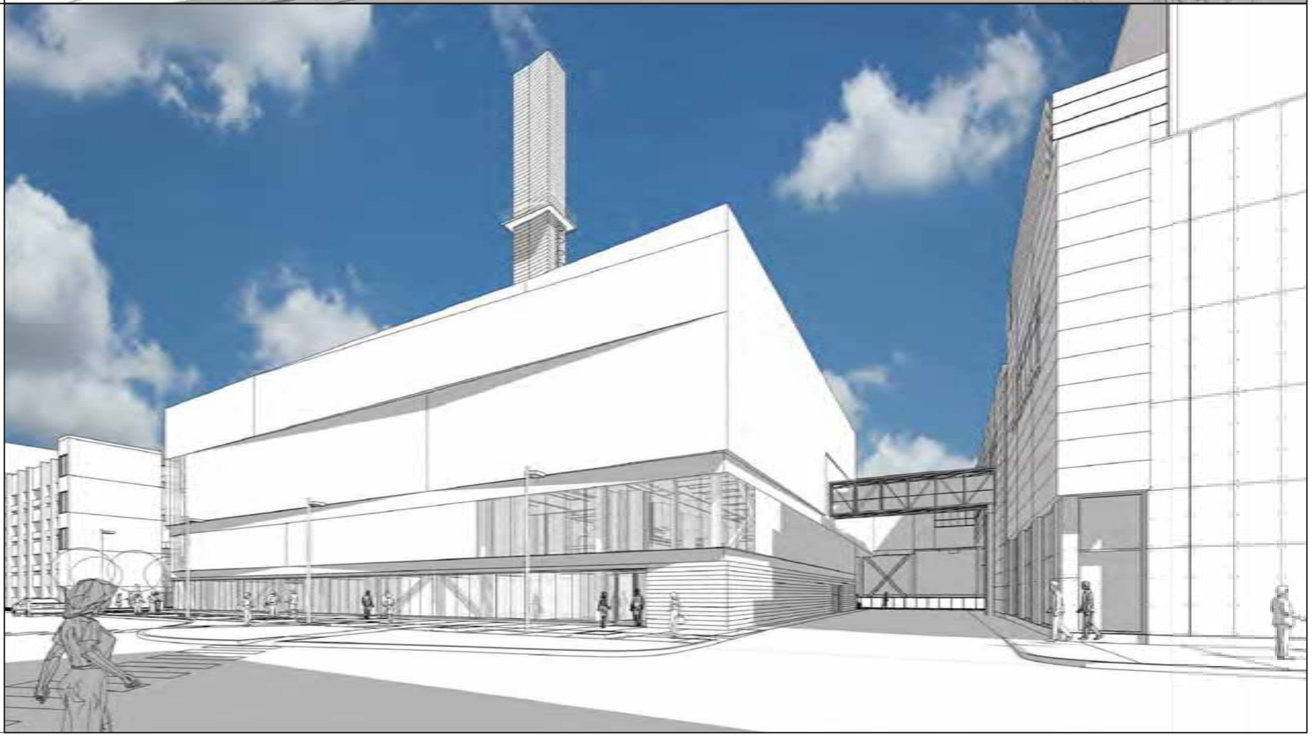
Sheet Title
WEST ELEVATION

AREA 02

A-023023



VIEW FROM NORTH



VIEW FROM NORTHWEST

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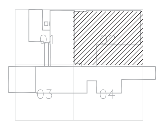
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

Drawn by:

Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

BUILDING VIEWS

AREA

ELEV.

A-023024

VIEW FROM EAST

VIEW FROM SOUTHEAST

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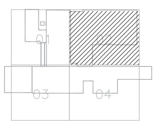
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

Drawn by:

Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

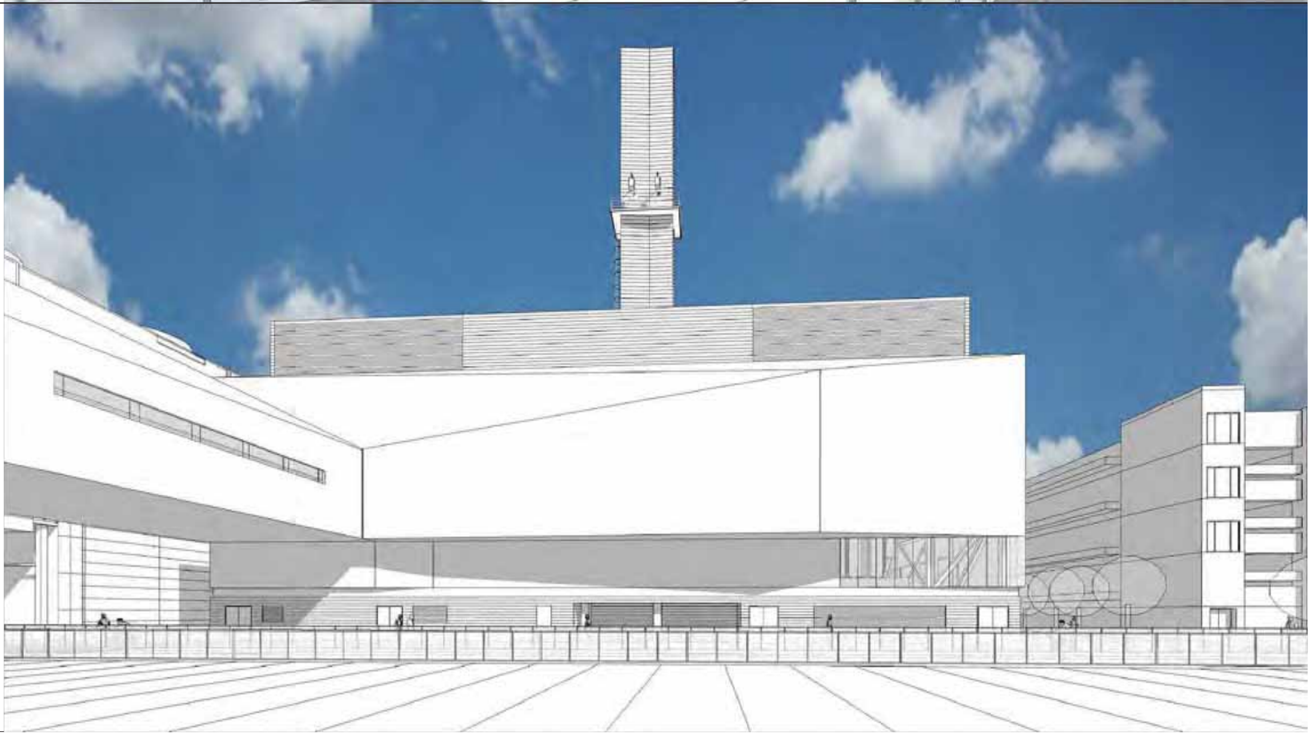
BUILDING VIEWS

AREA

ELEV.

A-023025

VIEW FROM SOUTHWEST



VIEW FROM SOUTH

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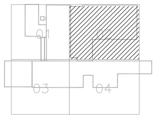
T 617.491.5575 F 617.868.2318 W ellenzweig.com

Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 MIT Job No. 14133

Drawn by:

Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY
PLANT UPGRADE

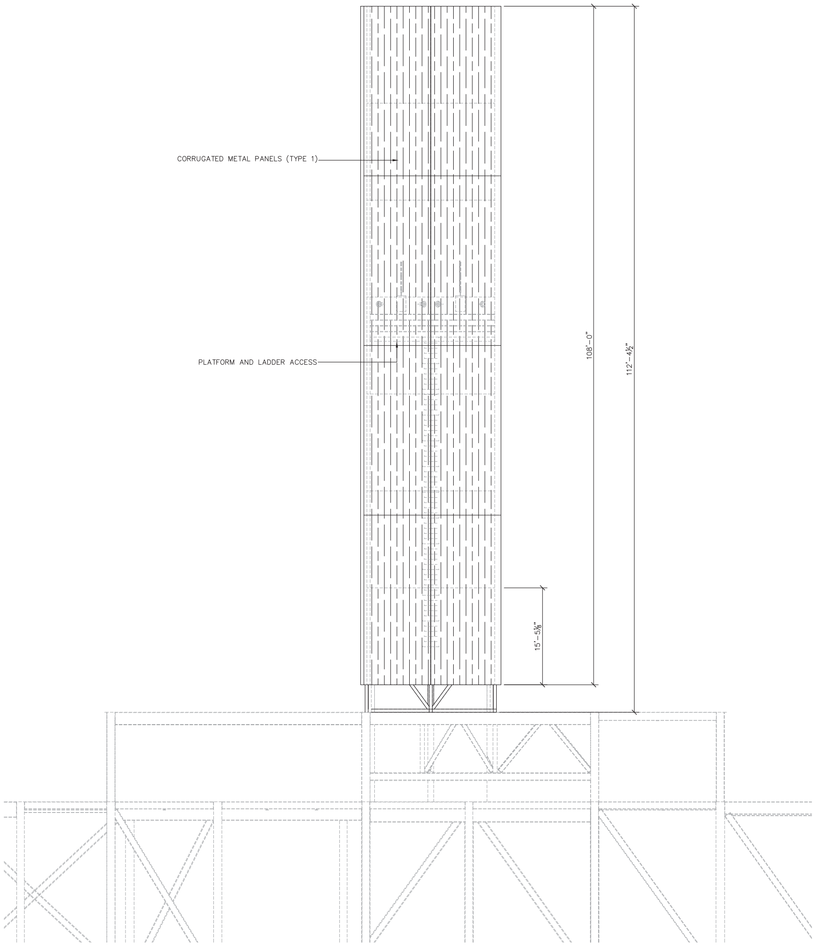
Sheet Title

BUILDING VIEWS

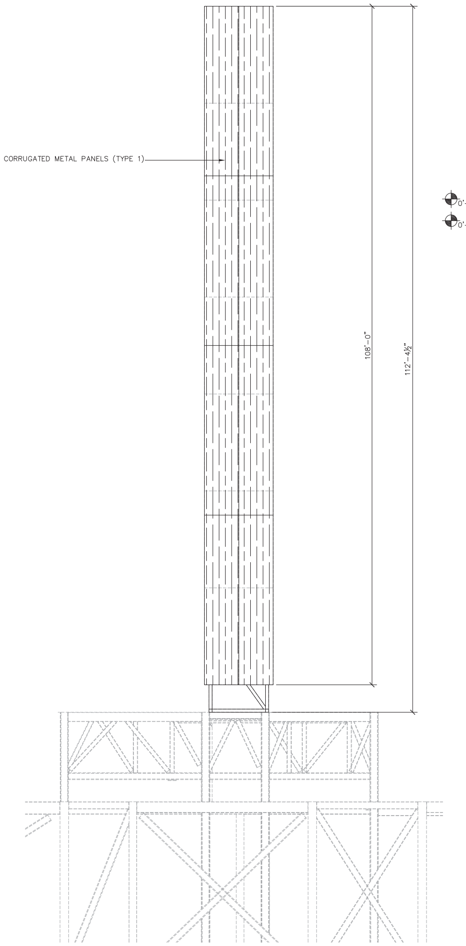
AREA

ELEV.

A-023026



B STACK 01 - STRUCTURAL TOWER LONGITUDINAL ELEVATION
1/8" = 1'-0"



A STACK 01 - STRUCTURAL TOWER TRANSVERSE ELEVATION
1/8" = 1'-0"

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

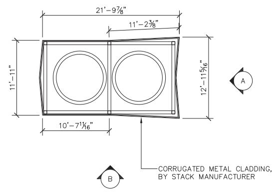
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

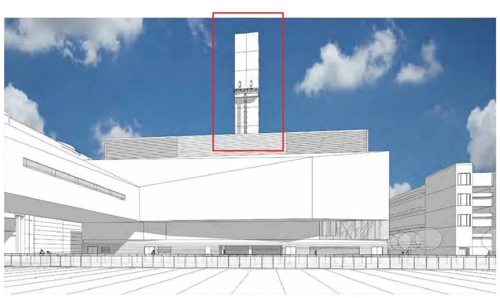
5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

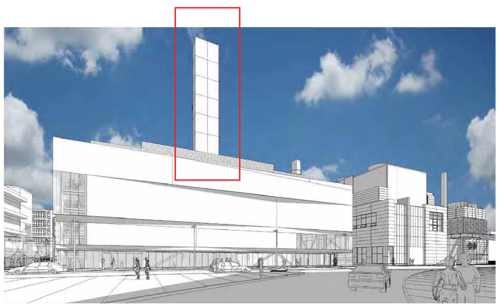
0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



1 STACK 01 - STRUCTURAL TOWER PLAN VIEW
1/8" = 1'-0"





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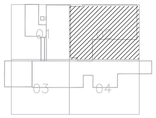
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

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Scale: 1/8" = 1'-0"

Project

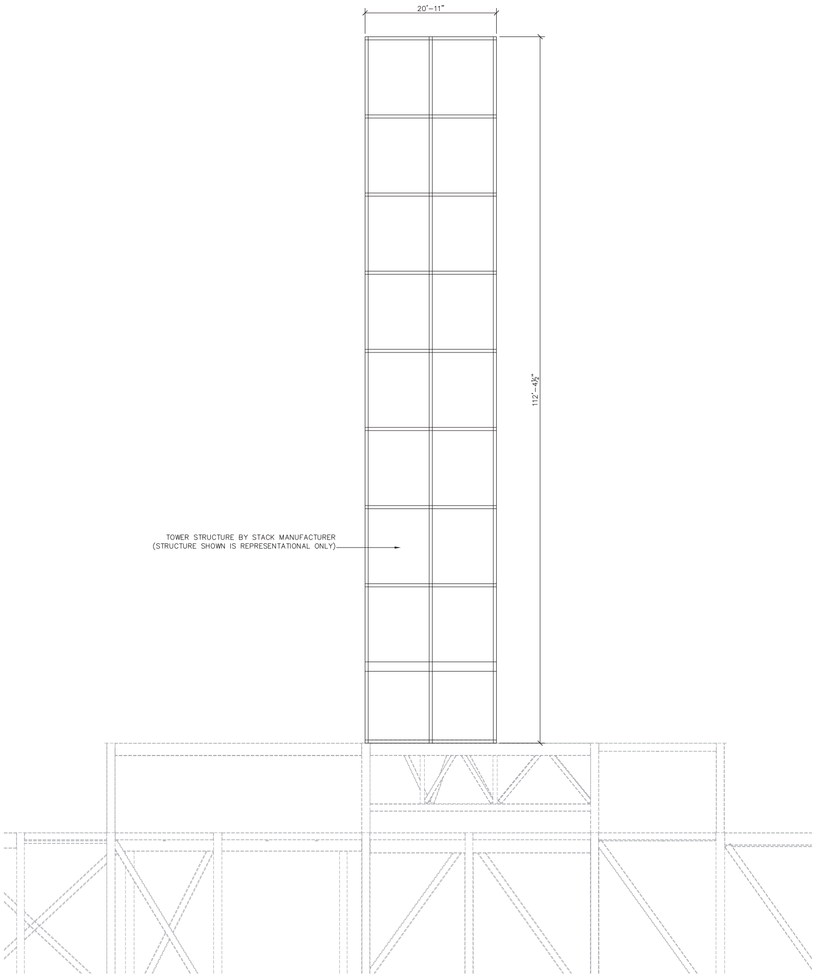
MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

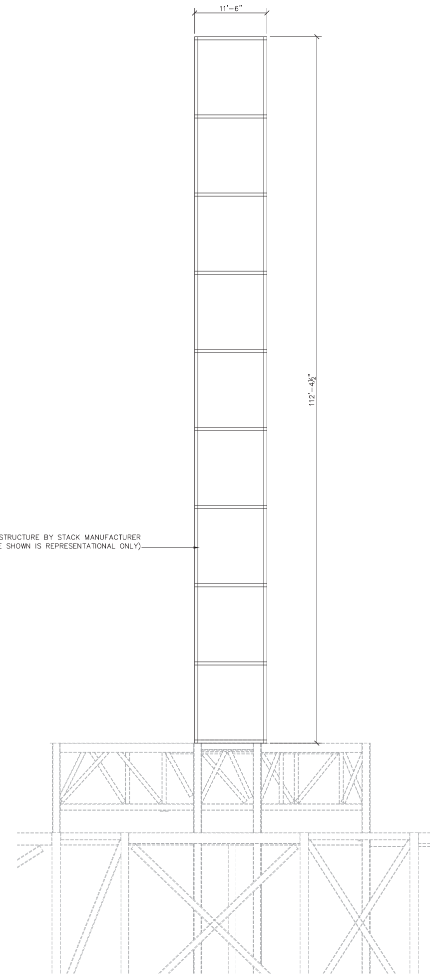
STACK DESIGN 01 ENCLOSURE

AREA 02

A-023027



B STACK 01 - STRUCTURAL TOWER LONGITUDINAL SECTION
1/8" = 1'-0"



A STACK 01 - STRUCTURAL TOWER TRANSVERSE SECTION
1/8" = 1'-0"

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
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   1.4. COLOR: SANDSTONE

2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

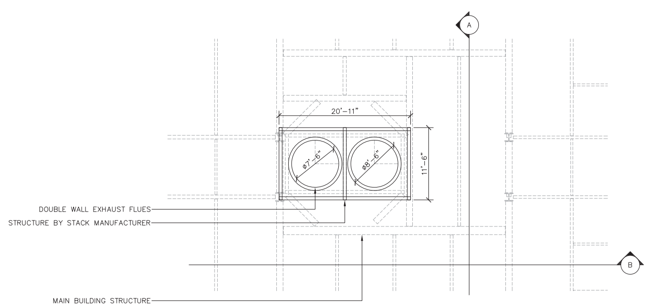
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"

ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



1 STACK 01 - STRUCTURAL TOWER PLAN VIEW
1/8" = 1'-0"

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617.423.7423 TEL
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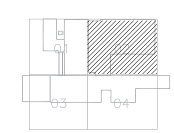
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
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RGV Job No. 27664.00 | MIT Job No. 14133

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Scale: 1/8" = 1'-0"

Project

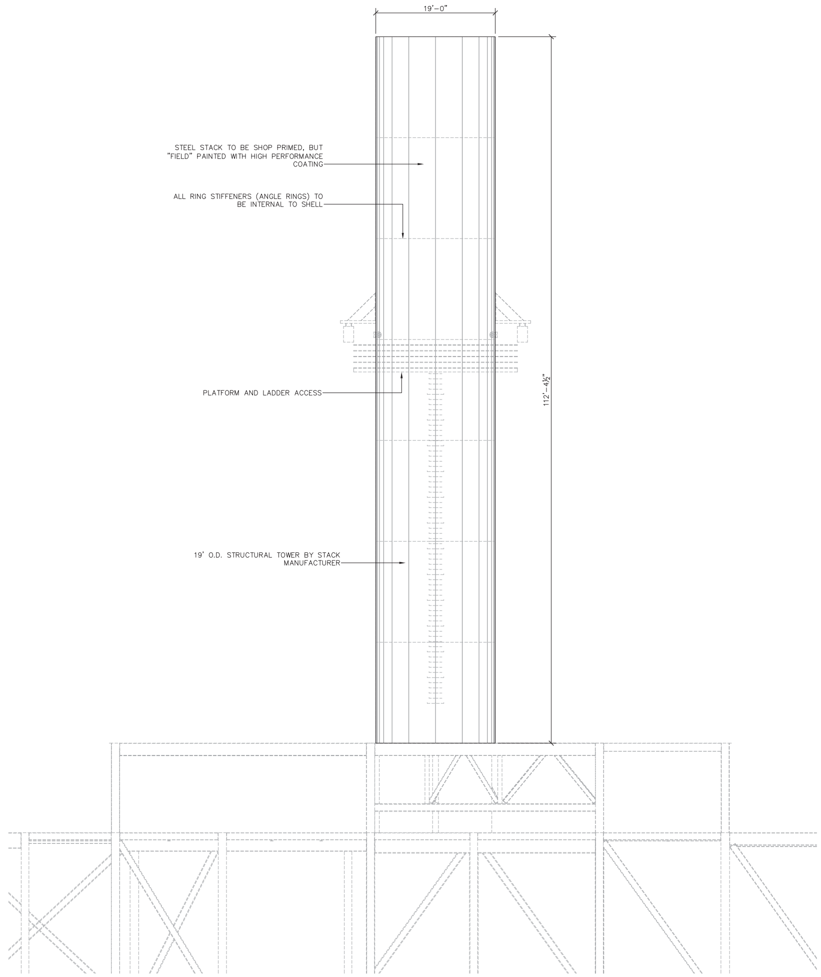
MIT SECOND CENTURY
PLANT UPGRADE

Sheet Title

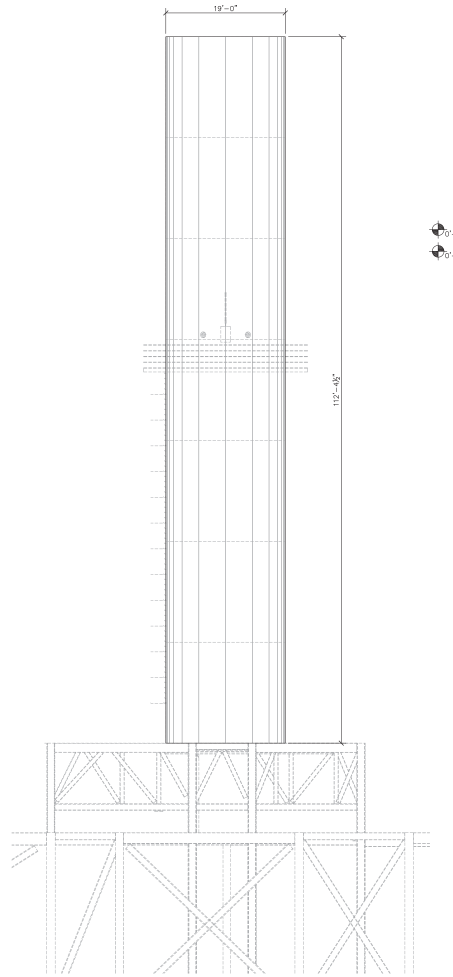
STACK DESIGN 01
STRUCTURE

AREA
02

A-023028



B STACK 01 - STRUCTURAL TOWER LONGITUDINAL SECTION
1/8" = 1'–0"



A STACK 01 - STRUCTURAL TOWER TRANSVERSE SECTION
1/8" = 1'–0"

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
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   1.4. COLOR: SANDSTONE
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   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA
3. ALUMINUM COMPOSITE METAL
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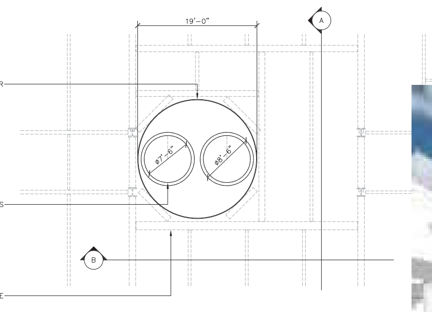
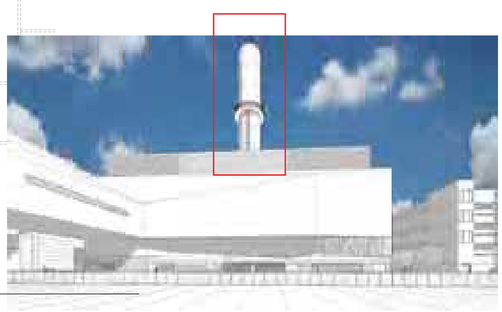
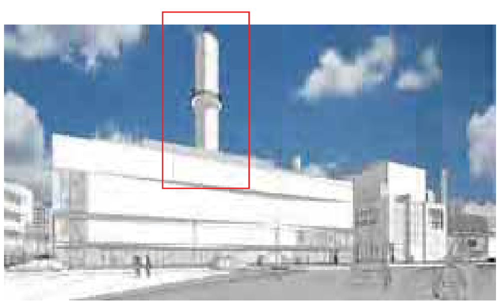
   3.2. FR CORE
   3.3. COAT METALLIC FINISH
4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA
5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'–0"
0'–10"
ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'–0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.



1 STACK 01 - STRUCTURAL TOWER PLAN VIEW
1/8" = 1'–0"





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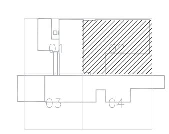
Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 MIT Job No. 14133
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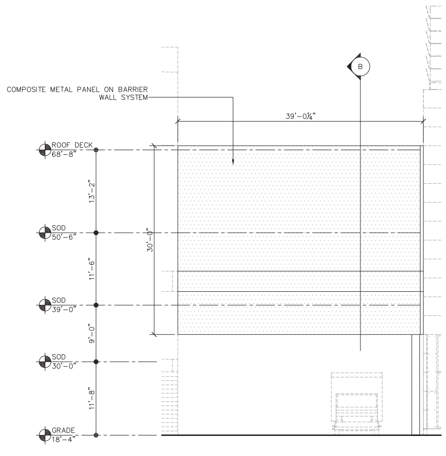
Date of original:
Scale: 1/8" = 1'-0"

Project
MIT SECOND CENTURY PLANT UPGRADE

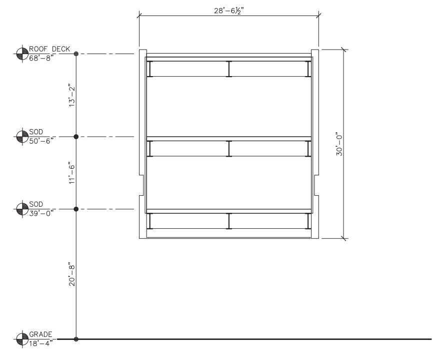
Sheet Title
STACK DESIGN 02

AREA 02

A-023029

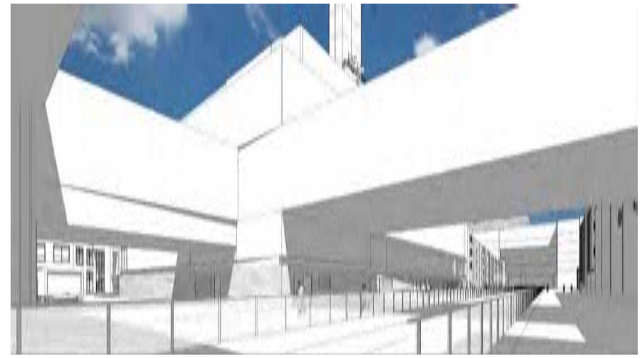


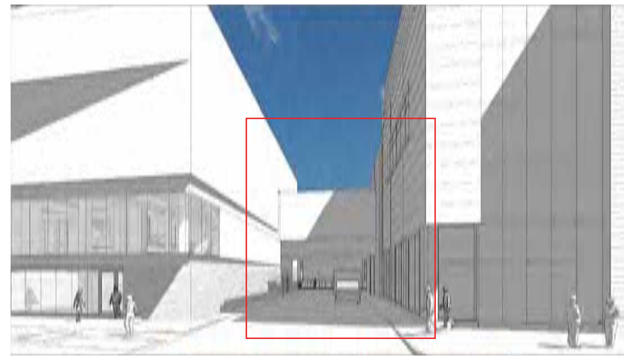
2 NORTH ELEVATION - UTILITY BRIDGE
1/8" = 1'-0"

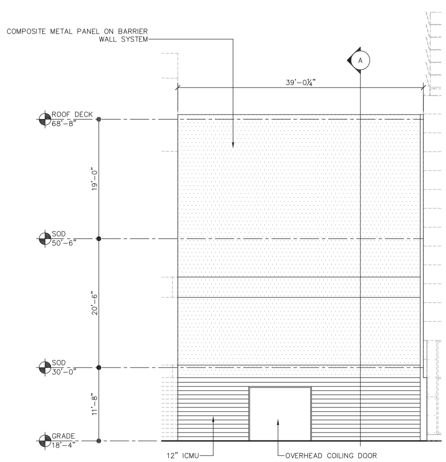


B SECTION FACING EAST - UTILITY BRIDGE
1/8" = 1'-0"

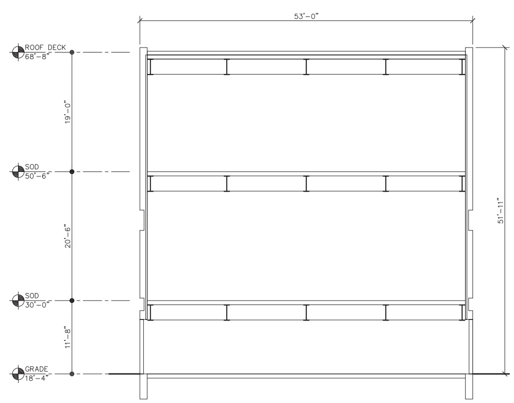
ALTERNATE 02 - UTILITY BRIDGE





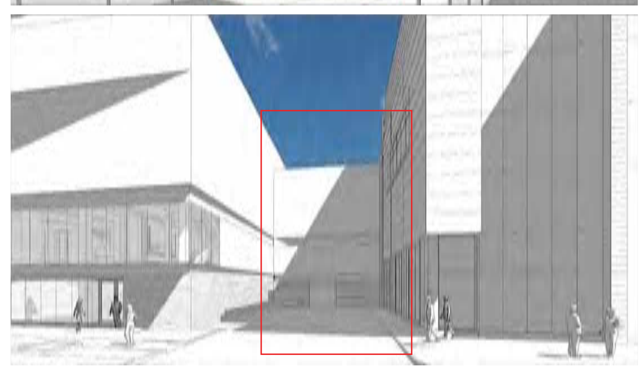


1 NORTH ELEVATION - UTILITY BUILDING
1/8" = 1'-0"



A SECTION FACING EAST - UTILITY BUILDING
1/8" = 1'-0"

ALTERNATE 01 - UTILITY BUILDING



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Graphic Scale

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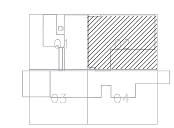

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B	01-08-16	WP3 75% COST VALIDATION
A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

Drawn by:

Checked by:

Date of original:

Scale: 1/8" = 1'-0"

Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

UTILITY CROSS-OVER
TWO OPTIONS
ALTERNATE ONE
ALTERNATE TWO

AREA 02

A-023030

MAIN FACADE MATERIAL NOTES:

1. CORRUGATED METAL PANEL (TYPE 1) AT STACK ONLY
   1.1. 22GA STEEL
   1.2. 4" RIB, BY FABRAL
   1.3. STANDARD FACTORY FINISH
   1.4. COLOR: SANDSTONE

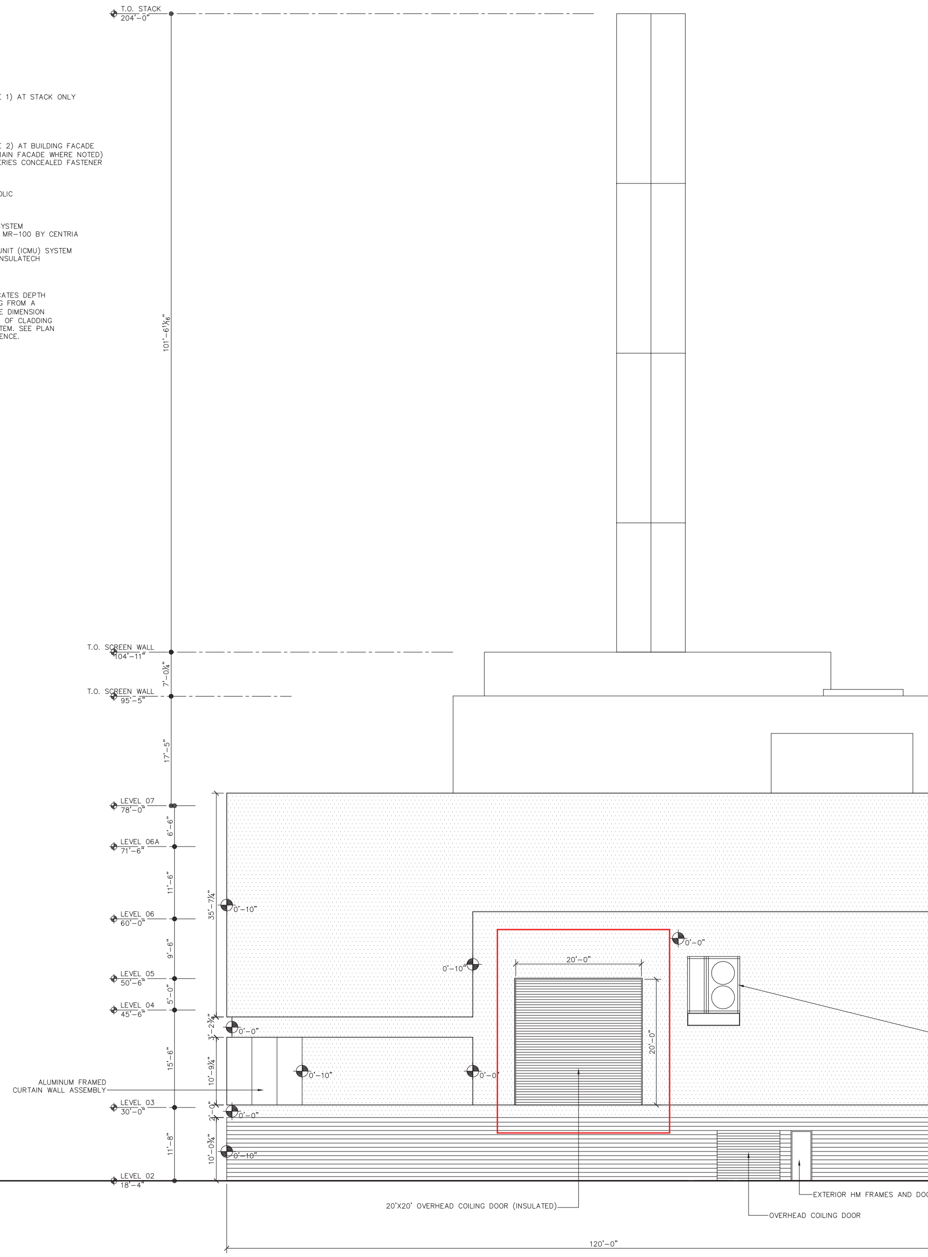
2. CORRUGATED METAL PANEL (TYPE 2) AT BUILDING FACADE (PENTHOUSE, SCREENWALL AND MAIN FACADE WHERE NOTED)
   2.1. BASIS OF DESIGN: CONCEPT SERIES CONCEALED FASTENER PANELS, CS-660, CENTRIA

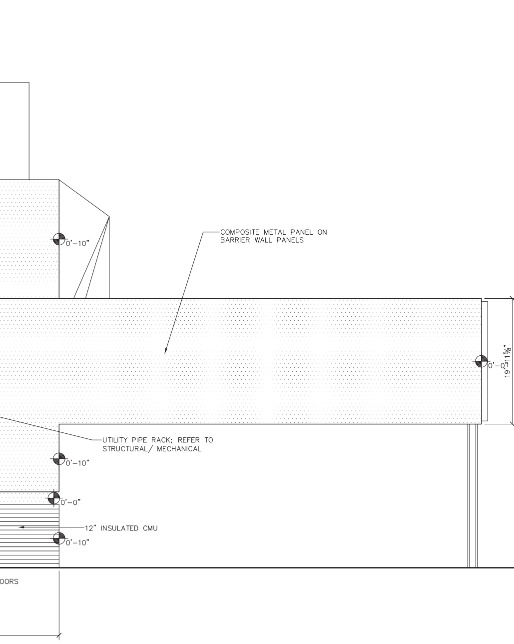
3. ALUMINUM COMPOSITE METAL
   3.1. ALUCOBOND, REYNOBOND, ALPOLIC
   3.2. FR CORE
   3.3. COAT METALLIC FINISH

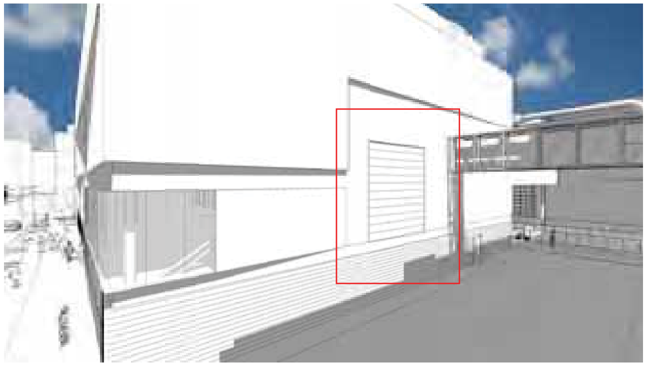
4. 3"TH INSULATED BARRIER WALL SYSTEM
   4.1. BASIS OF DESIGN: METALWRAP MR-100 BY CENTRIA

5. INSULATED CONCRETE MASONRY UNIT (ICMU) SYSTEM
   5.1. BASIS OF DESIGN: TRENWYTH INSULATECH

0'-0"
0'-10"
ELEVATION SYMBOL ON FACADE INDICATES DEPTH OF PROJECTION OF FACADE CLADDING FROM A BASE DIMENSION OF 0'-0". THE BASE DIMENSION WOULD BE THE EXTERIOR EDGE/FACE OF CLADDING CLOSEST TO THE BARRIER WALL SYSTEM. SEE PLAN DETAIL ON DETAIL SHEET FOR REFERENCE.







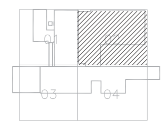
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

VANDERWEIL POWER GROUP
R.G. Vanderweil Engineers, LLP
274 Summer Street
Boston, MA 02210
617.423.7423 TEL
617.423.7401 FAX
vanderweil.com

ELLENZWEIG
ARCHITECTURE | PLANNING

Graphic Scale

Key Plan



REV.	DATE	DESCRIPTION
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A	09-25-15	WP3 75% ISSUE

RGV Job No. 27664.00 | MIT Job No. 14133

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Project

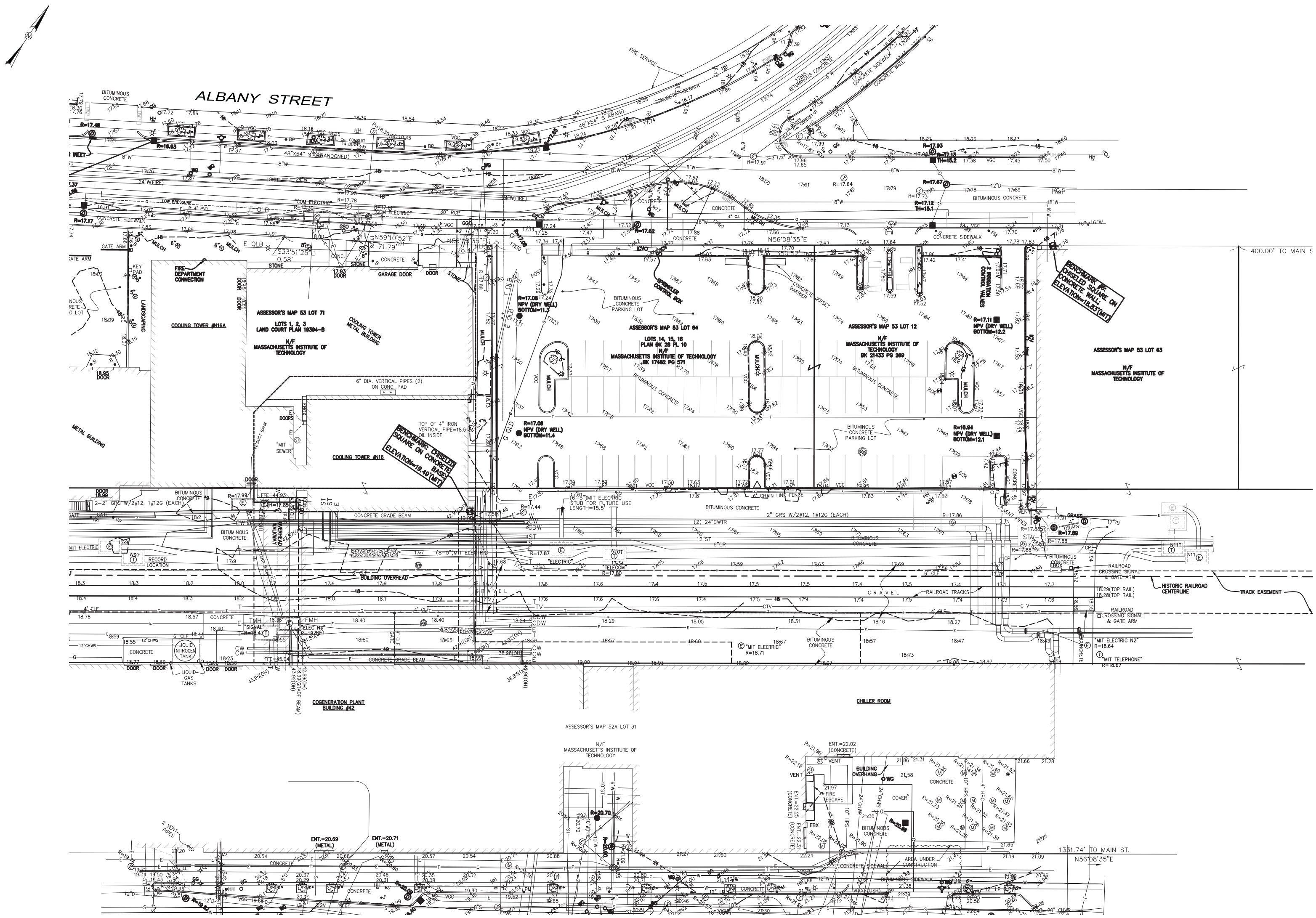
MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

OVERHEAD COILING DOOR EQUIPMENT REMOVAL ALTERNATE THREE

AREA 02

A-023031



UTILITY INFORMATION STATEMENT

1. THE SUB–SURFACE UTILITY INFORMATION SHOWN HEREON IS COMPILED BASED ON FIELD SURVEY INFORMATION, RECORD INFORMATION AS SUPPLIED BY THE APPROPRIATE UTILITY COMPANIES, AND PLAN INFORMATION SUPPLIED BY THE CLIENT, IF ANY; THEREFORE WE CANNOT GUARANTEE THE ACCURACY OF SAID COMPILED SUB–SURFACE INFORMATION TO ANY CERTAIN DEGREE OF STATED TOLERANCE. ONLY PHYSICALLY LOCATED SUB–SURFACE UTILITY FEATURES FALL WITHIN NORMAL STANDARD OF CARE ACCURACIES.

2. THE LOCATIONS OF UNDERGROUND PIPES, CONDUITS, AND STRUCTURES HAVE BEEN DETERMINED FROM SAID INFORMATION, AND ARE APPROXIMATE ONLY. COMPILED LOCATIONS OF ANY UNDERGROUND STRUCTURES, NOT VISIBLY OBSERVED AND LOCATED, CAN VARY FROM THEIR ACTUAL LOCATIONS.

3. ADDITIONAL BURIED UTILITIES/STRUCTURES MAY BE ENCOUNTERED.

4. THE STATUS OF UTILITIES, WHETHER ACTIVE, ABANDONED, OR REMOVED, IS AN UNKNOWN CONDITION AS FAR AS OUR COMPILATION OF THIS INFORMATION.

5. IT IS INCUMBENT UPON INDIVIDUALS USING THIS INFORMATION TO UNDERSTAND THAT COMPILING UTILITY INFORMATION IS NOT EXACT, AND IS SUBJECT TO CHANGE BASED UPON VARYING PLAN INFORMATION RECEIVED AND ACTUAL LOCATIONS.

6. THE ACCURACY OF MEASURED UTILITY INVERTS AND PIPE SIZES IS SUBJECT TO FIELD CONDITIONS, THE ABILITY TO MAKE VISUAL OBSERVATIONS, DIRECT ACCESS TO THE VARIOUS ELEMENTS AND OTHER MATTERS.

7. THE PROPER UTILITY ENGINEERING/COMPANY SHOULD BE CONSULTED AND THE ACTUAL LOCATIONS OF SUBSURFACE STRUCTURES SHOULD BE VERIFIED IN THE FIELD (V.I.F.) BEFORE PLANNING FUTURE CONNECTIONS. CONTACT THE DIG SAFE CALL CENTER AT 1–888–344–7233, SEVENTY–TWO HOURS PRIOR TO EXCAVATION, BLASTING, GRADING, AND/OR PAVING.

NOTES

1.) THIS DOCUMENT IS AN INSTRUMENT OF SERVICE OF NITSCH ENGINEERING. IT IS ISSUED TO THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY FOR PURPOSES RELATED DIRECTLY AND SOLELY TO NITSCH ENGINEERING'S SCOPE OF SERVICES UNDER CONTRACT WITH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY FOR COGENERATION PLANT. ANY USE OR REUSE OF THIS DOCUMENT FOR ANY REASON BY ANY PARTY FOR PURPOSES UNRELATED DIRECTLY AND SOLELY TO SAID CONTRACT AND PROJECT SHALL BE AT THE USER'S SOLE AND EXCLUSIVE RISK AND LIABILITY, INCLUDING LIABILITY FOR VIOLATION OF COPYRIGHT LAWS, UNLESS WRITTEN AUTHORIZATION IS GIVEN THEREFOR BY NITSCH ENGINEERING.

2.) THE PURPOSE OF THIS PLAN IS TO SHOW EXISTING CONDITIONS AS THE RESULT OF AN ON–THE–GROUND INSTRUMENT SURVEY OCCURRED BETWEEN JANUARY 14, 2015 AND FEBRUARY 6, 2015.

3.) PORTIONS OF MAPPING SHOWN WERE TAKEN FROM PREVIOUS SURVEYS BY NITSCH ENGINEERING.

4.) THE PROJECT IS REFERENCED HORIZONTALLY AND VERTICALLY TO CONTROL PROVIDED BY THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

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Graphic Scale

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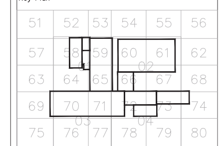
Key Plan



B	09–25–15	WP3 75% ISSUE
A	05–15–15	WP3 60% DESIGN
REV.	DATE	DESCRIPTION

RGV Job No. 27664.00	MIT Job No. 14133
Drawn by:	MBC
Checked by:	MMW
Date of Original:	SEPTEMBER 5, 2014
Scale:	AS NOTED

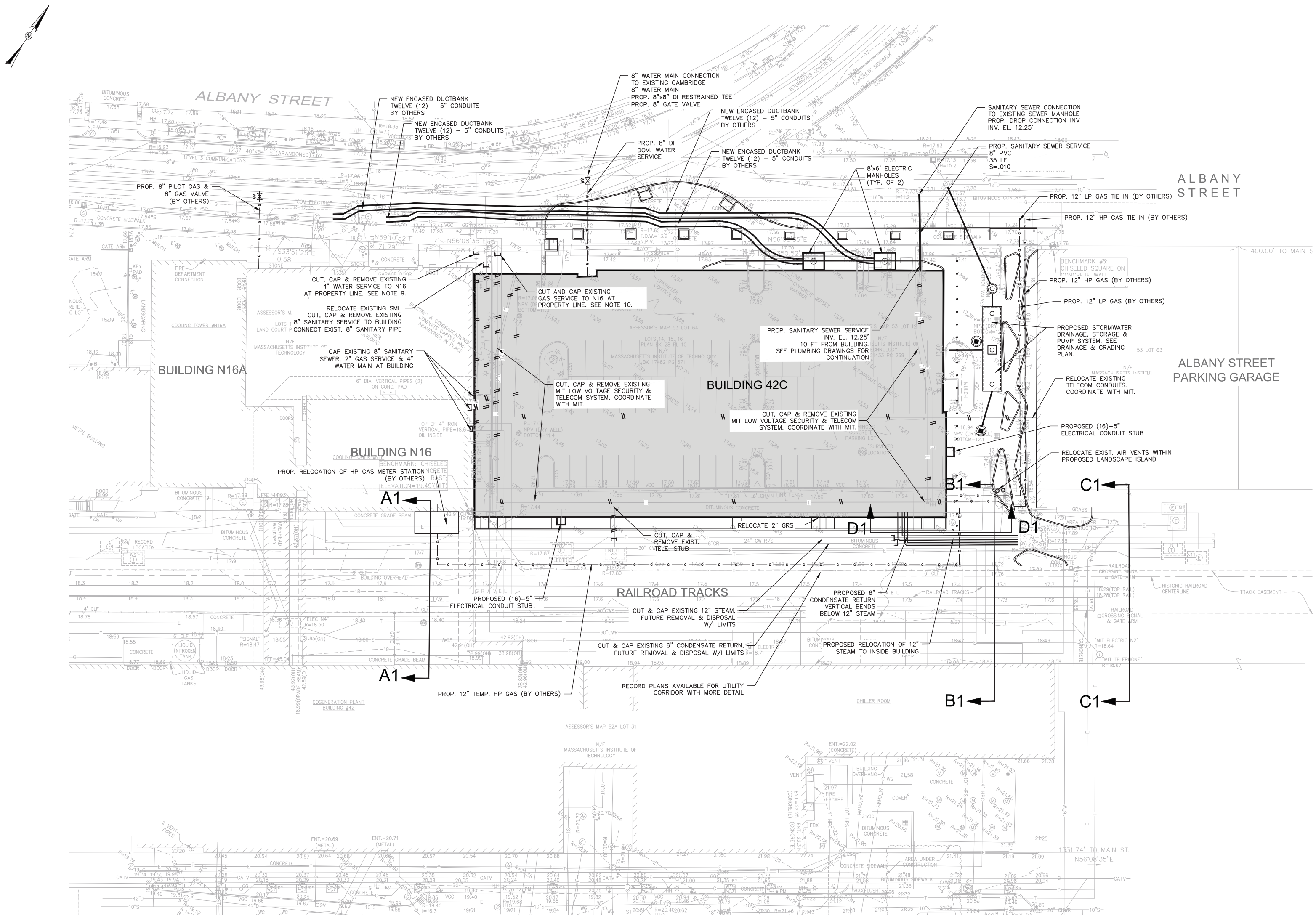
Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

EXISTING CONDITIONS PLAN

C–00221



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Graphic Scale

0 20 40 60

SCALE: 1" = 20' SCALE IN FEET

Key Plan

51 52 53 54 55 56
57 58 59 60 61 62
63 64 65 66 67 68
69 70 71 72 73 74
75 76 77 78 79 80

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B	09-25-15	WP3 75% ISSUE
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Drawn by: MBC

Checked by: MMW

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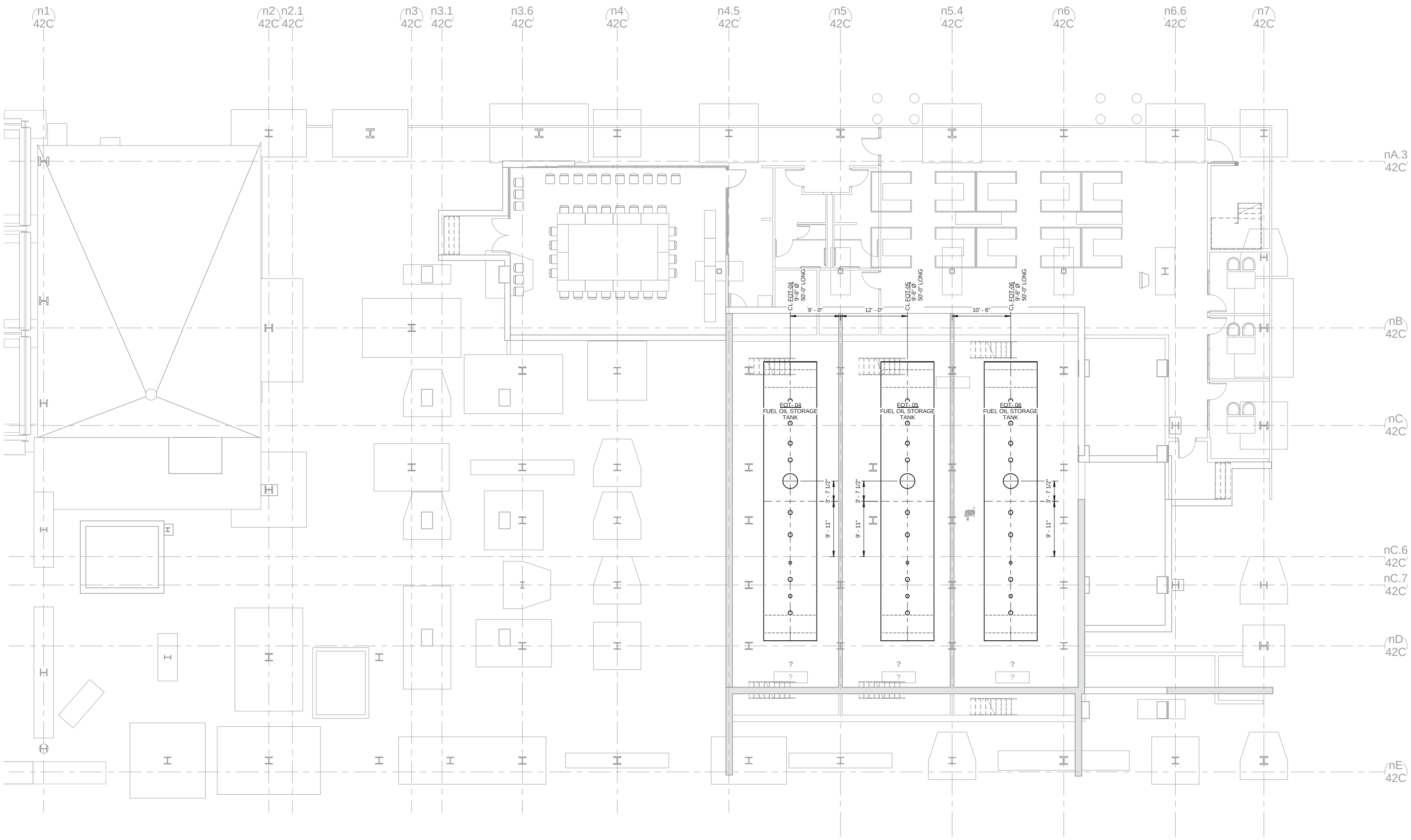
Project

MIT SECOND CENTURY PLANT UPGRADE

Sheet Title

PROPOSED UTILITY PLAN

C-00224



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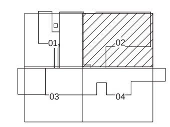
Key Plan



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B	09/25/15	WP3 - 75% ISSUE
A	05/15/15	WP3 60% DESIGN

RGV Job No. 27664 MIT Job No. 14133

Drawn by: J. HALASKA

Checked by: D. RIFE

Date of Original: 01/30/15

Scale: 1/8" = 1'-0"

Project:

MIT SECOND CENTURY PLANT UPGRADE

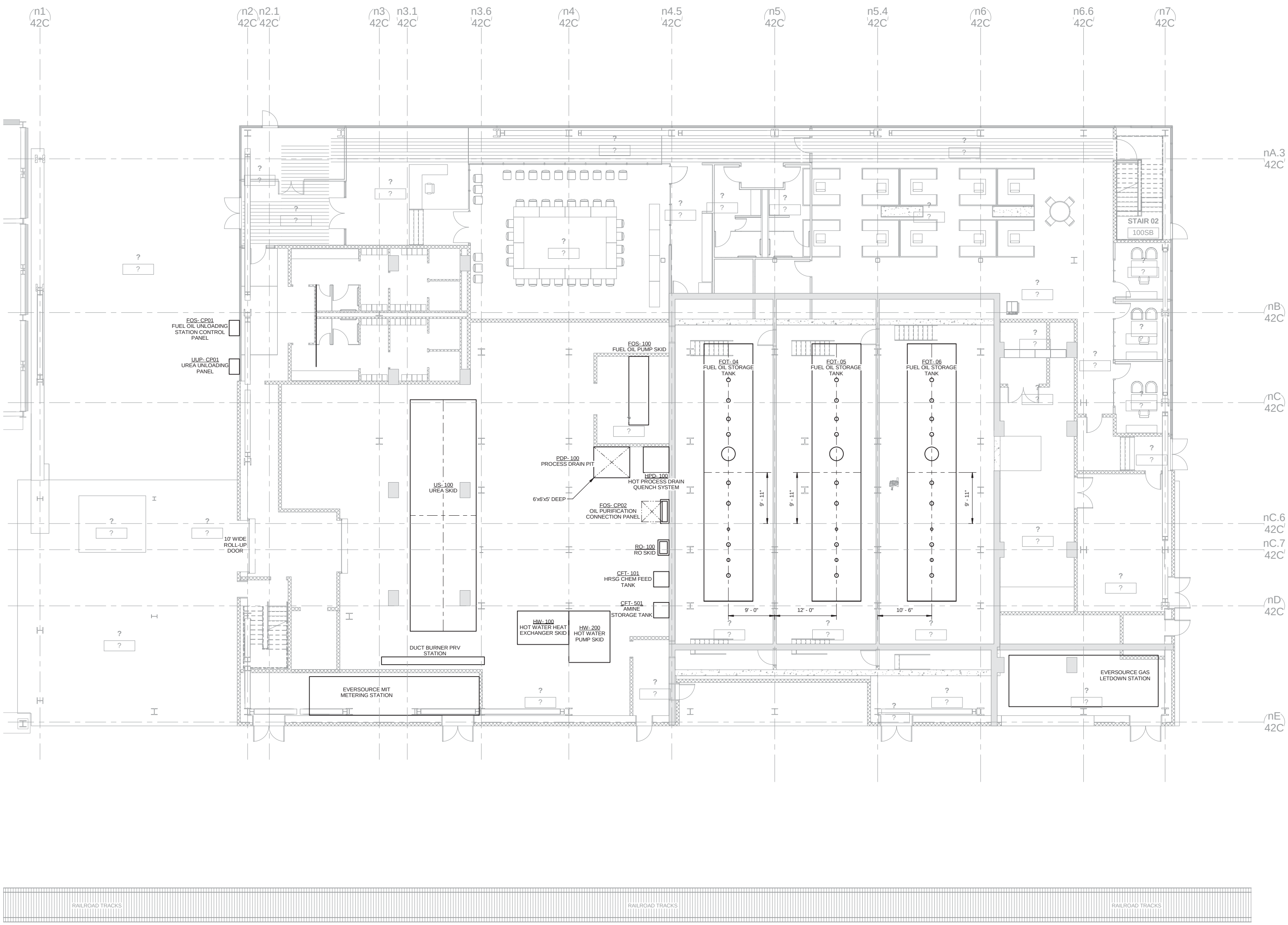
Sheet Title:

MECHANICAL GENERAL ARRANGEMENT PLAN

AREA 02

ELEV. 14'-0"

G-022100



MIT

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Graphic Scale:

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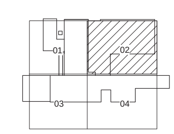
SCALE IN FEET

Key Plan



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B	09/25/15	WP3 - 75% ISSUE
A	05/15/15	WP3 60% DESIGN

RGV Job No. 27664 MIT Job No. 14133

Drawn by: J. HALASKA

Checked by: D. RIFE

Date of Original: 02/05/15

Scale: 1/8" = 1'-0"

Project:

MIT SECOND CENTURY PLANT UPGRADE

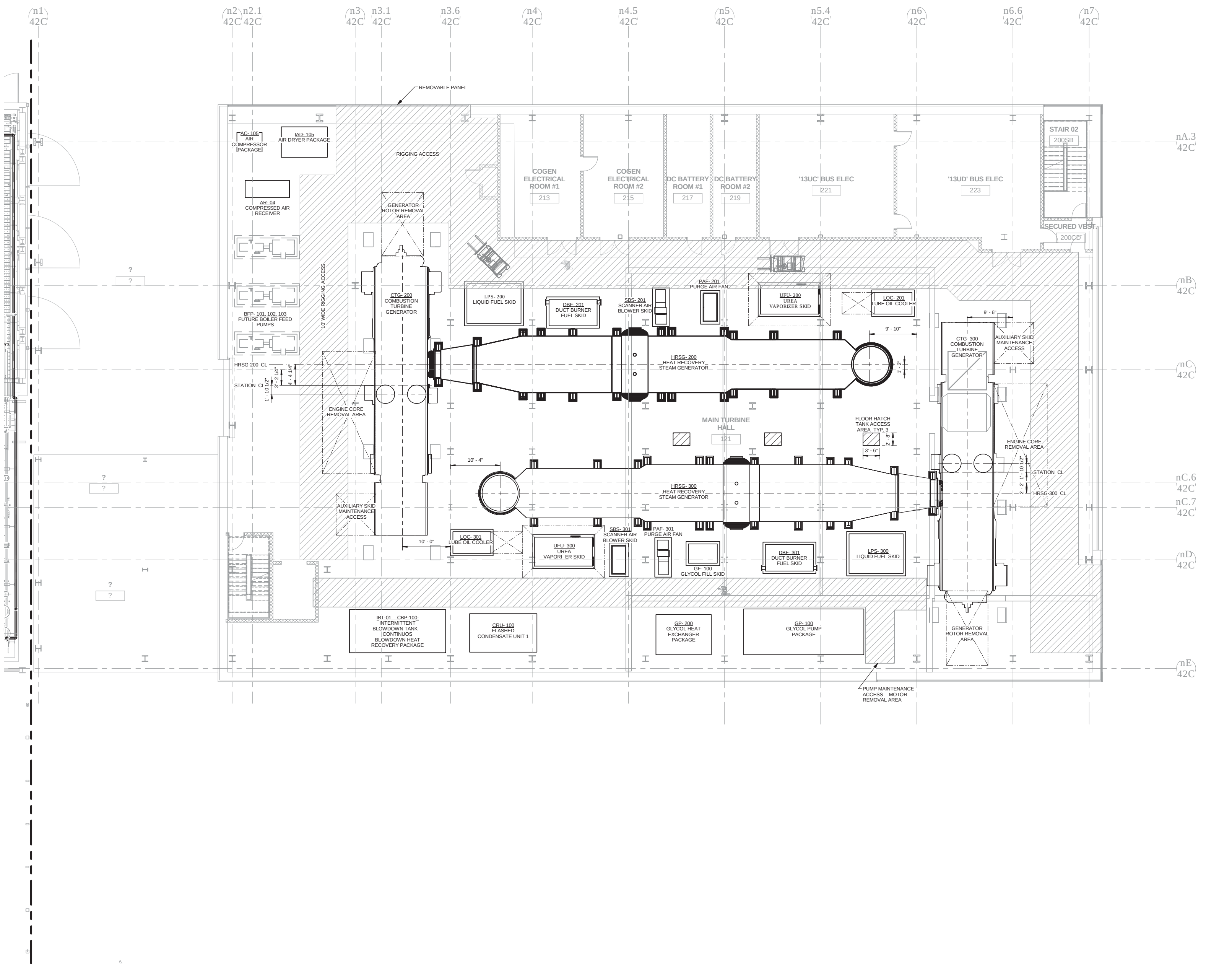
Sheet Title:

MECHANICAL GENERAL ARRANGEMENT PLAN

AREA 02

ELEV. 19'-0"

G-022200



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Graphic Scale:

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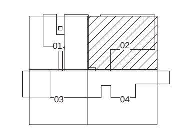
SCALE IN FEET

Key Plan



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B	09/25/15	WP3 - 75% ISSUE
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RGV Job No. 27664 MIT Job No. 14133

Drawn by: J. HALASKA

Checked by: D. RIFE

Date of Original: 02/05/15

Scale: 1/8" = 1'-0"

Project:

MIT SECOND CENTURY PLANT UPGRADE

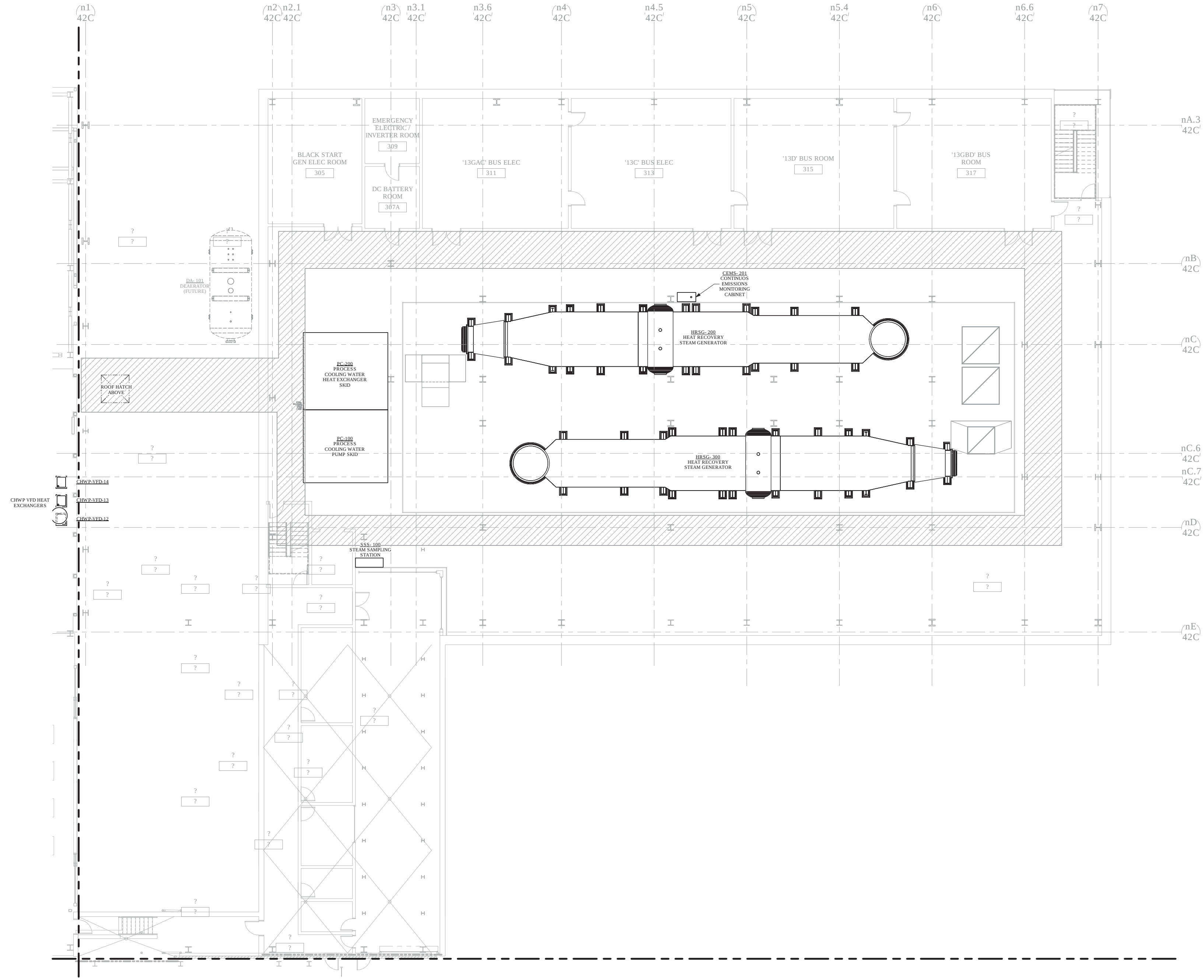
Sheet Title:

MECHANICAL GENERAL ARRANGEMENT PLAN

AREA 02

ELEV. 30'-0"

G-022300



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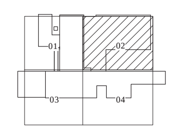
SCALE IN FEET

Key Plan



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B	09/25/15	WP3 - 75% ISSUE
A	05/15/15	WP3 60% DESIGN

RGV Job No. 27664	MIT Job No. 14133
Drawn by:	J. HALASKA
Checked by:	D. RIFE
Date of Original:	02/05/15
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Project:

MIT SECOND CENTURY PLANT UPGRADE

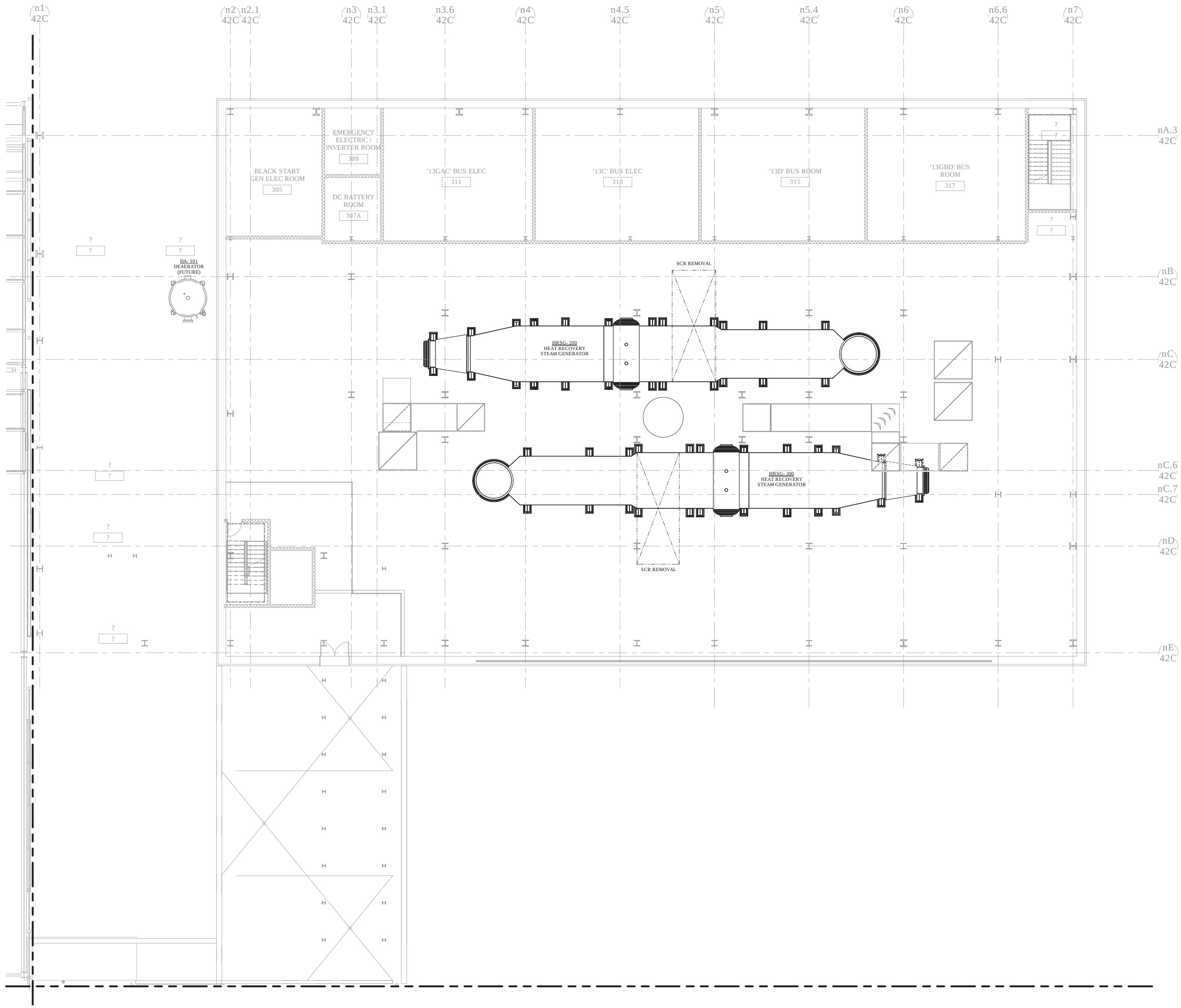
Sheet Title:

MECHANICAL GENERAL ARRANGEMENT PLAN

AREA 02

ELEV. 50'-6"

G-022400



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Graphic Scale:

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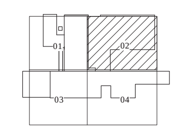
SCALE IN FEET

Key Plan



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A	05/15/15	WP3 60% DESIGN

RGV Job No. 27664 MIT Job No. 14133

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Date of Original: 02/05/15

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Project:

MIT SECOND CENTURY PLANT UPGRADE

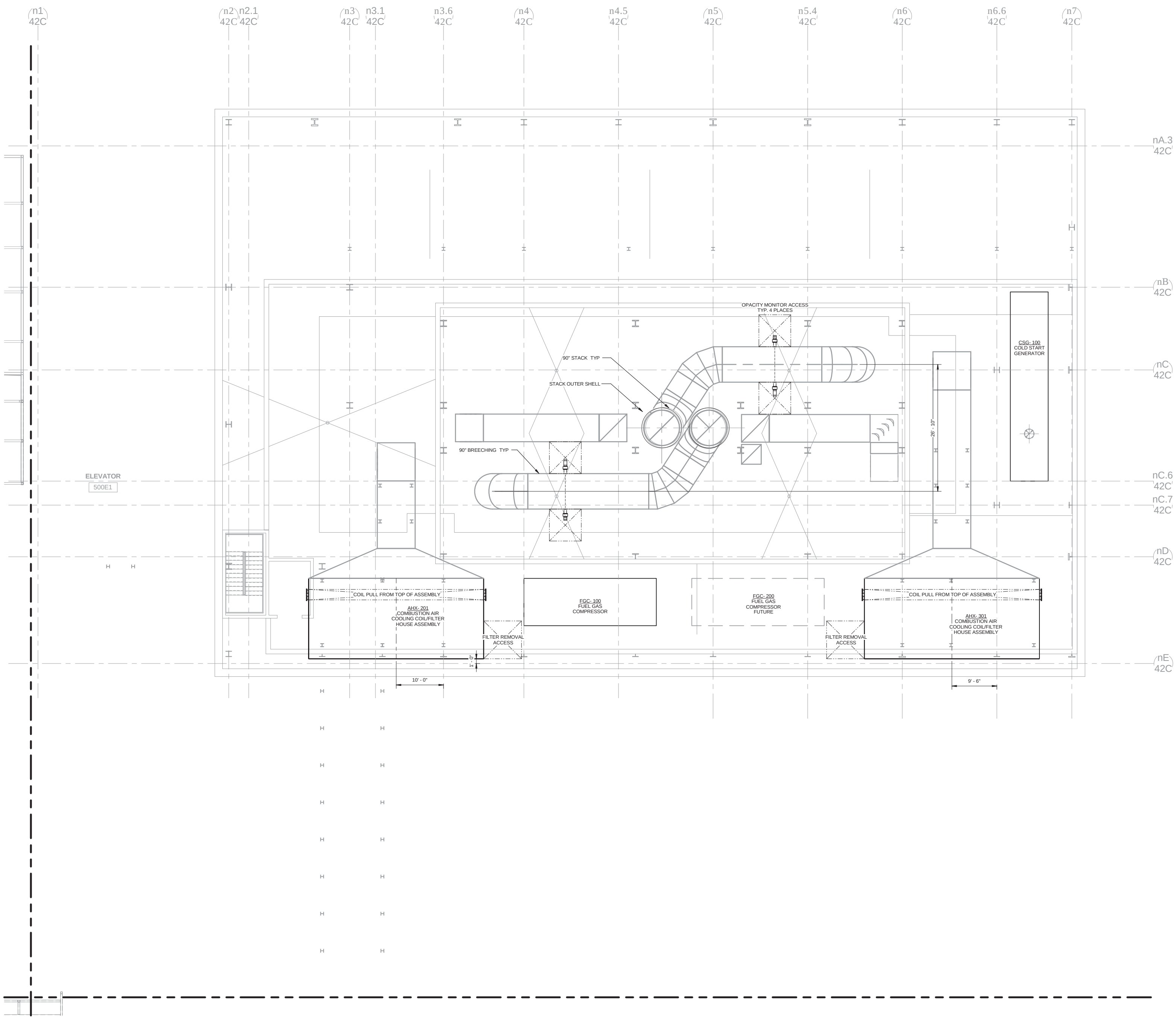
Sheet Title:

MECHANICAL GENERAL ARRANGEMENT PLAN

AREA 02

ELEV. 61'-0"

G-022500



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SCALE IN FEET

Key Plan

01 02 03 04

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Checked by: D. RIFE

Date of Original: 02/05/15

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Project:

MIT SECOND CENTURY
PLANT UPGRADE

Sheet Title:

MECHANICAL
GENERAL ARRANGEMENT
PLAN

AREA
02

ELEV.
78'-0"

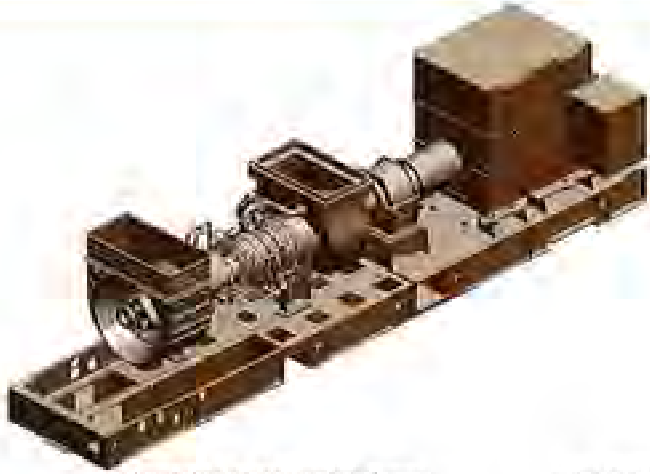
G-022600

Appendix 2

Solar Turbines
A Caterpillar Company

TITAN 250
Gas Turbine Generator Set

Power Generation



General Specifications

Titan™ 250 Gas Turbine
- Industrial, Two-Shaft
- 16 Stage Axial Compressor
  - Variable Inlet Guide Vanes
  - Pressure Ratio: 24:1
  - Inlet Airflow: 67.3 kg/sec (148 lb/sec)
  - Vertically Split Case
- Combustion Chamber Annular-Type
  - 14 Lean-Premixed, Dry Low Emissions Injectors
  - Torch Ignitor System
- Gas Generator Turbine
  - 2-Stage Reaction
  - Max. Speed: 10,500 rpm
- Power Turbine
  - 3-Stage Reaction
  - Max. Speed: 7000 rpm
- Bearings
  - 5 Radial Journal, Tilt-Pad
  - 2 Active Thrust, Tilt-Pad
  - 2 Inactive Thrust, Fixed Tapered Land
- Coatings
  - Compressor: Inorganic Aluminum
  - Turbine and Nozzle Blades: Precious Metal Diffusion Aluminide
- Vibration Transducer Type
  - Proximity Probes , 2 per Radial Bearing/2 per Thrust Bearing

Main Reduction Drive
- Epicyclic Type
  - 1500 rpm (50 Hz) or 1800 rpm (60 Hz)
  - Accessory Power Take-Off

Generator
- Salient Pole, 3 Phase, 6 Wire, Wye Connected, Synchronous, with Permanent Magnet Generator Exciter
- Available Construction Types:
  - Duct In/Duct Out
  - Totally Enclosed Air-to-Air Cooled
  - Totally Enclosed Water-to-Air Cooled
- Sleeve Bearings
- Oil Jacking System
- NEMA Class F Insulation
- Class B Temperature Rise
- Voltages: 1100 to 13,800 VAC
- Frequency: 50 or 60 Hz

Package
- Mechanical Construction
  - Steel Base Frame with Drip Pans
  - 316L Stainless Steel Piping ≤8" dia.
  - Compression-Type Tube Fittings
- Electrical System
  - NEC, Class 1, Group D, Div 2
  - CENELEC/ATEX Zone 2
  - Cable Tray Wiring
  - 120 VDC Battery/Charger System
- Direct-Drive AC Start System
- Fuel System
  - Dry Low Emission (*SoLoNOx*)
  - Conventional
- Fuel Types
  - Natural Gas or Dual (Gas/Distillate)
- Integrated Lube Oil System
  - Turbine-Driven Main Pump
  - AC Motor-Driven Pre/Post Pump
  - DC (120 V) Motor-Driven Backup Pump
  - Oil Cooler and Oil Heater*
  - Tank Vent Separator and Flame Trap
  - Lube Oil Filter
- Turbine Compressor Cleaning System
  - On-Crank/On-Line
  - Portable Cleaning Tank*
- Air Inlet and Exhaust System
  - Carbon Steel
  - Stainless Steel
  - Coastal Type Filters
- Enclosure
  - Driver Only
  - Fire Detection and Suppression
- *Turbotronic*™ 4 Control System
  - Onskid Control System
    - Digital Onskid Display Panel
  - 24 VDC Control Power (120 VDC Input)
  - Serial Link Supervisory Interface
  - Field Programmable
  - Vibration Monitoring
  - Temperature Monitoring
  - Generator Control
    - Selectable Control Modes
    - Solid-State Voltage Regulation
    - Automatic Synchronization
    - Metering Panel with Manual Synchronization*
    - KW Control*
  - Heat Recovery Application Interface
  - Multiple Operator Display Screens
  - Data Collection and Playback
  - Turbine Performance Map*
  - *InSight System*™ Equipment Health Management*
  - Printer/Logger*
- Documentation
  - Electrical Drawings
  - Mechanical Drawings
  - Quality Control Data Book
  - Inspection and Test Plan
  - Test Reports
  - O&M Manuals
- Factory Testing of Turbine
- Factory Testing of Package
  - Non-Dynamic
  - Dynamic

* Option

Solar Turbines

A Caterpillar Company

TITAN 250

Gas Turbine Generator Set

Power Generation

Performance

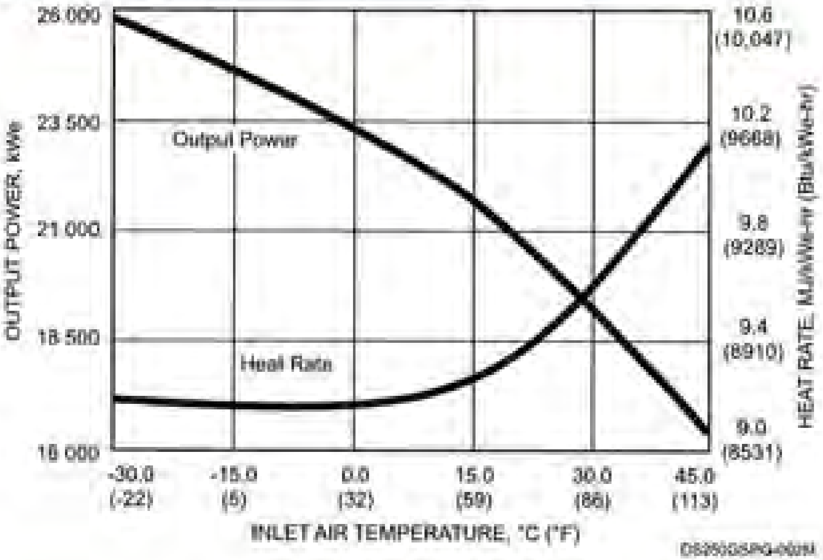
Output Power	21 745 kWe
Heat Rate	9260 kJ/kWe-hr (8775 Btu/kWe-hr)
Exhaust Flow	245 660 kg/hr (541,590 lb/hr)
Exhaust Temp.	465°C (865°F)

Application Performance

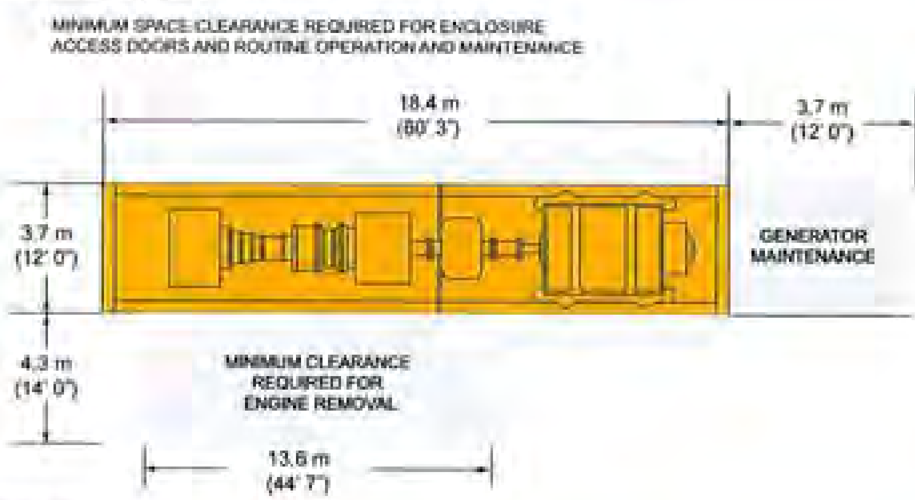
Steam (Unfired)	35.2 tonnes/hr (77,600 lb/hr)
Steam (Fired) 1536°C (2800°F)	184.8 tonnes/hr (407,490 lb/hr)
Chilling (Absorp.)	30 340 kW (8620 refrigeration tons)

Nominal rating – per ISO
At 15°C (59°F), sea level
No inlet/exhaust losses
Relative humidity 60%
Natural gas fuel with
LHV = 31.5 to 43.3 MJ/Nm³ (940 Btu/scf)
No accessory losses
Engine efficiency: 38.9%
(measured at generator terminals)

Available Power



Enclosure Access and Maintenance Space



Package Height: 4.1 m (13' 5")
Package Weight: 125 000 kg (276,000 lb)

Solar Turbines Incorporated
P.O. Box 85376
San Diego, CA 92186-5376

FOR MORE INFORMATION

Telephone: (+1) 619-544-5352
Telefax: (+1) 858-694-6715
Email: powergen@solarturbines.com
Internet: www.solarturbines.com

Solar Turbines
A Caterpillar Company

POWERING THE GLOBAL ENERGY DEMAND

TITAN 250
Gas Turbine System
For Power Generation Applications

Maximize Life-Cycle Benefits

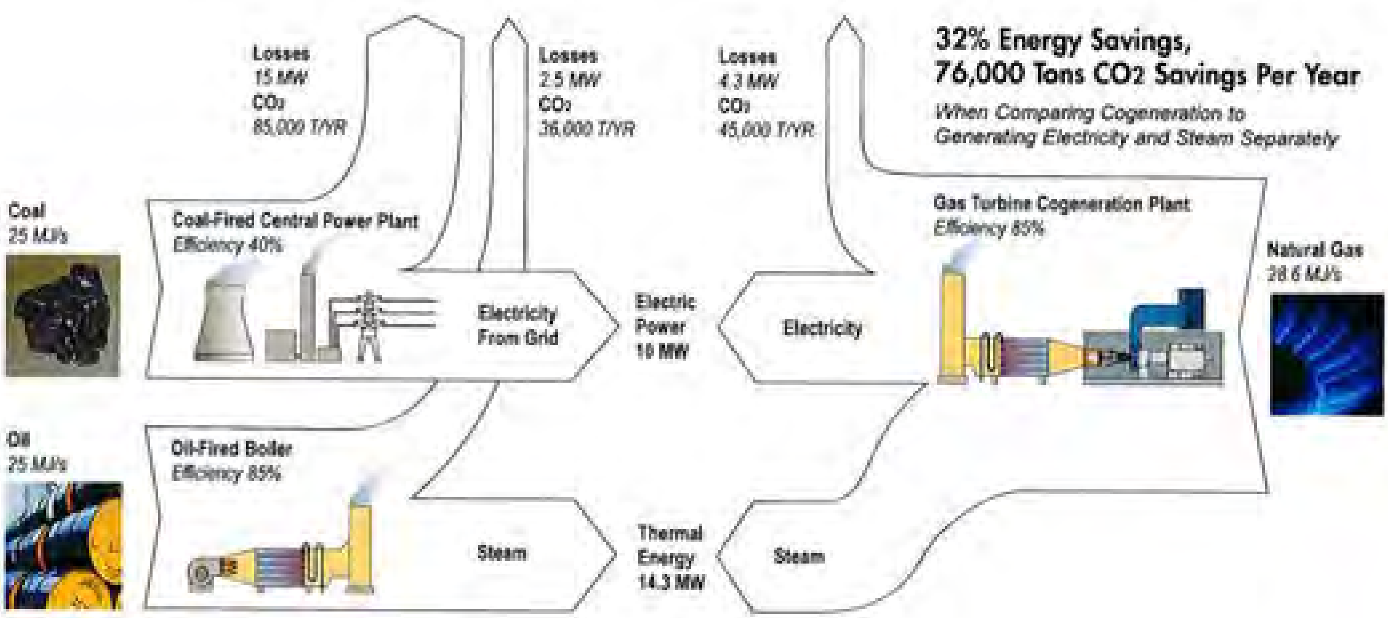
Built on six decades of field-proven technology and experience, the *Titan* 250 will maximize the life-cycle benefits of your application. It can operate on a wide range of gaseous and liquid fuels and delivers 22 MW (21 745 kWe) of power and 77,000 pounds of steam per hour in a highly compact package.

The *Titan* 250 was designed to give customers many years of productivity with low life-cycle cost. This means a gas turbine with high availability, reliability and durability that delivers best-in-class 39% efficiency, saving on fuel and reducing emissions. No other gas turbine system gives you better power density and efficiency with lower emissions while costing you less per kilowatt-hour. The *Titan* 250 provides all of these benefits and more throughout the entire life cycle of the package, adding more dollars to your bottom line.

Industrial Combined Heat and Power Energy Star Award

University Combined Heat and Power Energy Star Award

Hospital Combined Heat and Power LEED Platinum Award



32% Energy Savings, 76,000 Tons CO_2 Savings Per Year

When Comparing Cogeneration to Generating Electricity and Steam Separately

Sustainable Solutions that Fit Your Application

Solar maintains a clear focus on providing customer satisfaction by designing products that lead their categories in critical performance and environmentally sustainable operation. *Solar®* gas turbines meet customer needs in ways that limit the impact on the environment, protect people who operate the equipment, and respect people who live nearby.

These products, including the *Titan* 250, provide sustainable solutions through the application of advanced technologies that enable high operating efficiency and low greenhouse gas emissions. Solar's industry-exclusive *SoLoNOx™* dry low-emissions combustion technology has been proven to lower emissions and ensure compliance with stringent exhaust emission regulations worldwide. *SoLoNOx* technology cuts NOx emissions up to 90% and CO emissions are reduced as much as 30% over conventional combustion systems.

Municipal Power Energy Star Award

Solar gas turbines incorporating *SoLoNOx* combustion systems, have logged more than 86 million operating hours, saving 2.1 million tons of NOx emissions, improving air quality for millions of people around the world. And many of our gas turbines have helped our customers win Energy Star, LEED and other awards recognizing efficiency and sustainability.

The *Titan* 250 gas turbine generator set can be applied in a variety of applications, including combined heat and power, peaking power/load management, district heating and cooling, and base load power. It will meet your requirements in a wide variety of industries and facilities, including hospitals, universities, rural electric cooperatives, municipal utilities, food processing, pulp and paper mills, manufacturing facilities, mining and refineries.

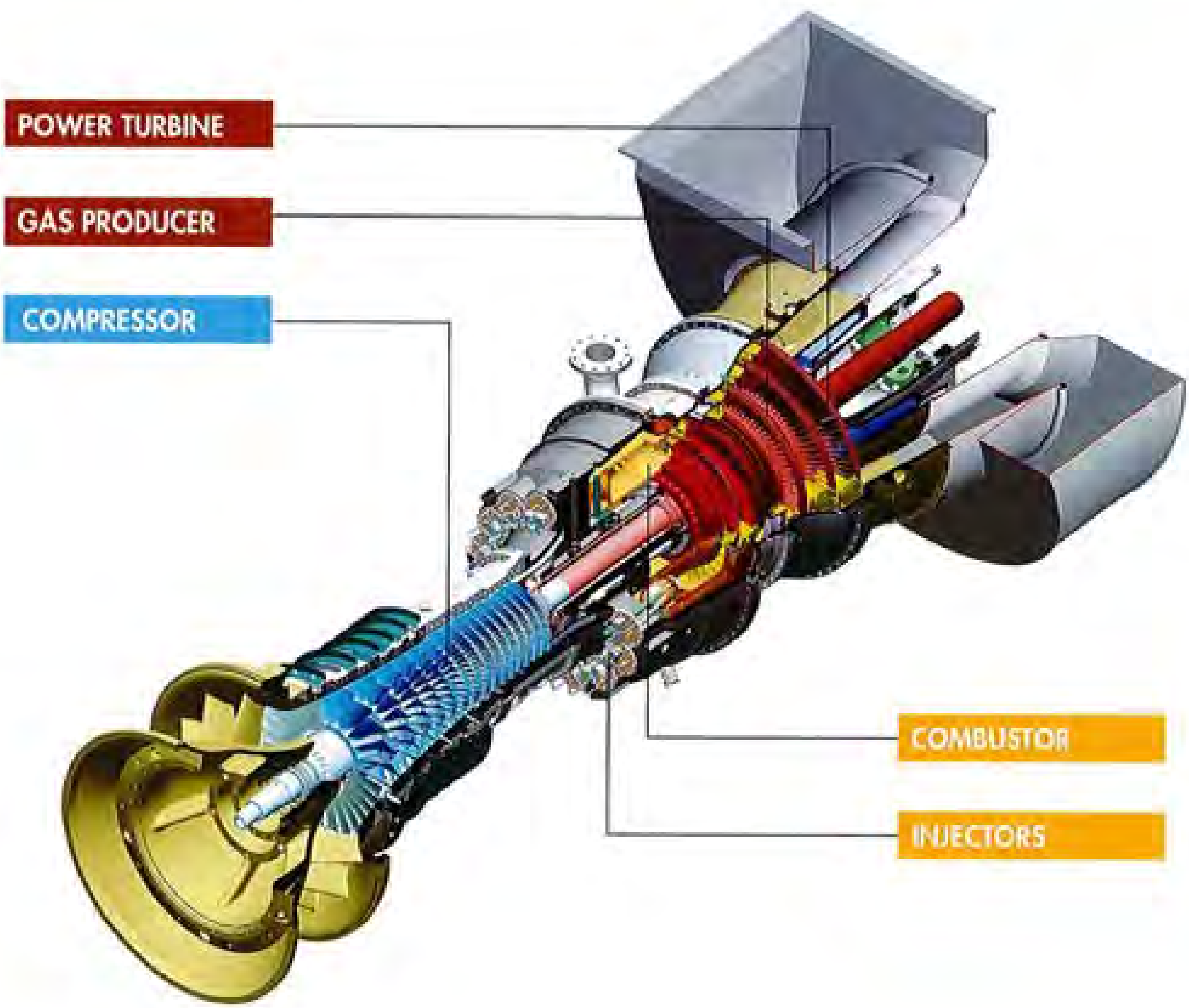
For combined heat and power applications, the *Titan* 250 generator set can be coupled with heat recovery equipment to optimize your application by capturing otherwise wasted thermal energy from the exhaust to produce steam for space, water or process heating, maximizing energy efficiency and increasing sustainability.

Because the *Titan* 250 is extremely reliable and efficient, utilities can benefit by using it to provide power to isolated communities, commercial centers and industries. Utilities will also benefit their communities by using the *Titan* 250 in peaking applications to reduce the incremental cost of additional generation.

Leveraging Proven Technology

The *Titan* 250 is a familiar machine, yet still a gas turbine like no other – taking the best from Solar's proven products. Each advancement builds on experience gained from our latest and most proven designs, while adding thoroughly tested technologies in critical areas of compressor aerodynamics, combustion, advanced materials, cooling performance and package design.

Configured for power generation, the *Titan* 250 comes fully integrated and self-contained with lube oil, fuel and *Turbotronic*™ control systems on board. Modular inlet, exhaust and ancillary systems can be adjusted to suit your application in enclosed or unenclosed packages.



Engineered for Excellence

Titan 250 gas turbines deliver best-in-class performance while saving on fuel and reducing emissions. Above all, the *Titan* 250 is engineered for durability, reliability and availability. Using smart diagnostics, remote monitoring and onsite maintenance capabilities, the *Titan* 250 takes advantage of advanced features to keep your operation online and producing for many years to come.

Look at the technologies behind the *Titan* 250 and you'll recognize key contributions from our most widely accepted products:

Compressor Section Technology

A 16-stage compressor produces a 24:1 pressure ratio. Coated components provide corrosion resistant surfaces for durability. The four-piece, split-case design allows for easy field maintenance. Variable guide vanes and stators permit smooth, reliable starting and stopping.

Combustion Section Technology

The 14 dry, lean-premixed *SoLoNOx* injectors deliver less fuel than conventional designs resulting in lower emissions.

The combustion liner is an Augmented Backside Cooled (ABC) configuration providing maximum cooling ensuring long-term durability.

Hot Section Technology

The two-stage gas producer features internally air-cooled first and second stage nozzle vanes as well as internally cooled first stage rotor blades. The design provides cylindrical blade tips and a rub-tolerant coating for improved tip control increasing efficiency.

The power turbine is a three-stage configuration utilizing shrouded blades to maximize efficiency and flatten the power curve.

And the *Titan* 250 gas turbine was designed with the same rigorous approach that has always served our customers well — extending these proven technologies to new products and advancing the state of the art.

The latest proven engineering methods give the *Titan* 250 its performance edge. Tools like computational fluid dynamics (CFD) and computer-aided thermal and mechanical analysis ensure achievement of design and performance objectives. A comprehensive reliability analysis gives you refinements in design and processes that further enhance availability:

- Adding redundancy
- Improving controls and optimizing shutdown logic
- Enhancing component reliability and durability
- Minimizing service events and their duration
- Expanding machine health monitoring and predictive maintenance

This design methodology ensures that customers receive robust equipment ready for long, reliable service across the entire life cycle of their project.

Higher Availability

Tougher projects and challenging markets demand maximum equipment availability. The *Titan* 250 promises more productive hours with less repair and fewer and shorter planned service intervals. It continues a design tradition of modular components for the ultimate in operational flexibility and service simplicity.

Monitoring and Diagnostics: Cornerstones of Productivity

Titan 250 packages provide remote monitoring and predictive diagnostics enabled by Solar's *InSight System*™, the industry's most advanced equipment health management system. This system provides a clear vision, focus and understanding of your equipment and is designed to save you time and money.

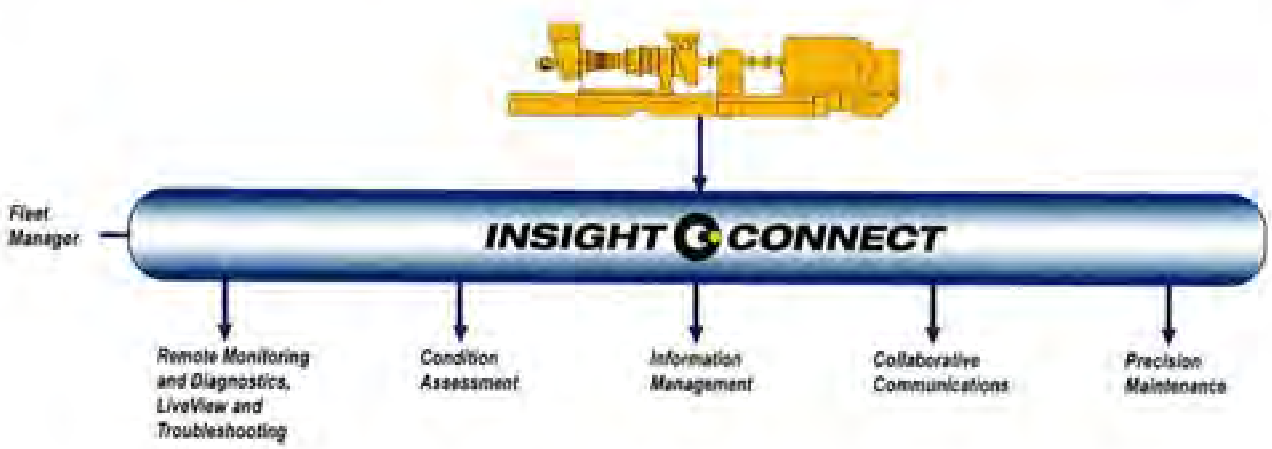
With *InSight System*, problems once found only by a technician's visit can be detected online from anywhere — even half a world away — so you can avoid unscheduled downtime.

Capabilities include:

- Advanced diagnostics
- Condition monitoring
- Remote troubleshooting
- E-mail alert notifications
- Predictive recommendations
- Equipment operation summary reports

Features delivered by *InSight System* rely on a dedicated connectivity solution, *InSight Connect*™, allowing reliable access to critical operational information. This secured web connection provides a standardized method for the acquisition and transmission of information while minimizing the impact to an existing customer network.

InSight System monitors your operation 24 hours a day. If trouble is detected at any time it helps you determine the prognosis, forecast the outcome, and decide whether to repair now or wait for the next scheduled service. With built-in predictive capability, some events that previously would have shut the package down now trigger fall-back to a safe operating mode and alert service personnel of the machine's status. The system also gathers and analyzes information — performance maps, historical displays, reports on availability and life-cycle cost — to help you make operational decisions that maximize your investment.



Designed for Productivity

The *Titan* 250 gas turbine system has been designed to give customers many years of productivity with the highest life-cycle value at the lowest life-cycle cost. This means equipment with the highest availability, reliability and durability, and machines that are easy to maintain and service.

Our complete approach to machinery management includes digital monitoring and control systems that help further minimize emissions, support predictive maintenance, increase availability, enable unattended operation, and reduce life-cycle costs.

All regularly serviced components are placed near the sides of the package for ease of access and fast service. With our lateral and axial engine repair and maintenance system, you have the option of doing in situ condition-based repair, modular component exchange, or a complete exchange of major engine components.

Easy Access to Major Components

Onsite Inspection Capability

Lateral Rail System

Axial Rail System

The rail-mounted service system supports the turbine from below and allows easy access to inspect, repair or replace hot section components, bearings, blades and seals. Technicians can also remove and replace the gas producer independently of the power turbine, avoiding realignment of the power turbine and driven equipment. The rails can also be used to roll the entire turbine out for factory overhaul or exchange, minimizing downtime.

Contact Us and Put the Titan 250 to Work

Let us show you the true power and value of *Titan* 250 turbomachinery package. We stand on our experience gained from more than 13,600 turbine packages in 96 countries with over 1.5 billion hours of operation. In addition to expert application advice, you'll get in-depth technical assistance through our global customer support system.

We're ready to serve you from locations all over the world:

- 13 repair and overhaul centers
- 19 parts facilities
- 43 service locations

For more information, contact one of our representatives. To see a complete listing of our worldwide locations, visit our website or contact us at one of the phone numbers listed below.

Worldwide Headquarters

Solar Turbines Incorporated
P.O. Box 85376
San Diego, California 92186-5376
Telephone: +1 (619) 544-5352
email: powergen@solarturbines.com

www.solarturbines.com

Turbomach S.A
Via Campagna 15
6596 Riazzino, Switzerland
Telephone: +41 91 851 15 11
email: contact@turbomach.com

www.turbomach.com

B250PG/210/5M

Appendix 3

Solar Titan 250 - with MTHW and Building 39									
Year	**Total Run Time (2 CTGS)**	**Total Generated Electric**	**Total Purchased Electric**	**Steam Generated**	**Total CTG Gas Usaged**	**Total DB Gas Usage**	**Total Boiler Gas Usage**	**CHP Electrical Generating Efficiency**	**Overall CHP Efficiency**
	(hours)	(MW)	(MW)	(mmBtu)	(MMBtu)	(MMBtu)	(MMBtu)		
2019	13,246	242,170	78,837	1,332,774	2,290,260	312,573	506	36%	83%
2020	13,160	249,648	95,154	1,327,743	2,322,499	296,872	282	37%	83%
2021	13,322	254,064	95,124	1,344,244	2,359,125	297,732	385	37%	83%
2022	14,216	273,880	85,879	1,446,257	2,537,015	324,255	2,142	37%	83%
2023	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2024	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2025	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2026	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2027	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2028	14,219	273,964	85,882	1,446,663	2,537,725	324,375	2,154	37%	83%
2029	14,219	277,368	90,735	1,448,187	2,561,783	318,208	2,044	37%	83%
2030	14,360	281,140	89,683	1,468,108	2,594,771	324,982	2,639	37%	83%

Year	**Total Run Time (2 CTGS)**	**CTG Hour Utilization**	**CTG Steam Waste Heat Utilization**	**Total CTG Gas Usage**	**Total DB Gas Usage**	**Total Boiler Gas Usage**	CHP Electric Generation		CHP Fuel Consumption	CHP Useful Waste Heat	CHP Electical Generating Efficiency	CHP Overall Efficiency @Full Load	**Site (CHP) Gross (Stack) Emissions, tons**
	(hours)			(MMBtu)	(MMBtu)	(MMBtu)	MWh	MMBTU	MMBTU	MMBTU			tons/year
2019	13,246	78%	93%	2,290,260	312,573	506	242,170	826527	2290260	1,051,459	36%	82%	**133,980**
2020	13,160	77%	94%	2,322,499	296,872	282	249,648	852050	2322499	1,060,559	37%	82%	**135,866**
2021	13,322	78%	94%	2,359,125	297,732	385	254,064	867121	2359125	1,076,285	37%	82%	**138,009**
2022	14,216	84%	95%	2,537,015	324,255	2,142	273,880	934752	2537015	1,154,428	37%	82%	**148,415**
2023	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2024	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2025	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2026	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2027	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2028	14,219	84%	95%	2,537,725	324,375	2,154	273,964	935039	2537725	1,154,726	37%	82%	**148,457**
2029	14,219	84%	96%	2,561,783	318,208	2,044	277,368	946655	2561783	1,161,799	37%	82%	**149,864**
2030	14,360	84%	96%	2,594,771	324,982	2,639	281,140	959531	2594771	1,175,624	37%	82%	**151,794**

97% reliability

Year	GHG Displaced from Grid Electricity, tons
2019	**113,941**
2020	**117,460**
2021	**119,537**
2022	**128,860**
2023	**128,900**
2024	**128,900**
2025	**128,900**
2026	**128,900**
2027	**128,900**
2028	**128,900**
2029	**130,501**
2030	**132,276**

CHP Fuel: Natural Gas

117.00	CHP Fuel Specific Emission Factor (lbs/MMBTU)
941.00	Current Marginal Emission Factor for the ISO -NE Grid, lb/MWh
80%	Average Thermal Efficiency of Facility Conventional Thermal Systems

Year	GHG Displaced from Conventional Useful Heat System	Total Source GHG Displaced	Net Source GHG Reduction	
	tons	tons	tons	%
2019	**97,459**	**211400**	**77420**	**37%**
2020	**97,091**	**214551**	**78685**	**37%**
2021	**98,298**	**217835**	**79826**	**37%**
2022	**105,758**	**234618**	**86203**	**37%**
2023	**105,787**	**234687**	**86230**	**37%**
2024	**105,787**	**234687**	**86230**	**37%**
2025	**105,787**	**234687**	**86230**	**37%**
2026	**105,787**	**234687**	**86230**	**37%**
2027	**105,787**	**234687**	**86230**	**37%**
2028	**105,787**	**234687**	**86230**	**37%**
2029	**105,899**	**236400**	**86536**	**37%**
2030	**107,355**	**239632**	**87838**	**37%**

Heat Balance Results and 2019 Annual Projected Energy Savings

	Units	Base			Alternate #1 - Turbine Inlet Air Cooling			Alternate #2 - Turbine Inlet Heating/Winter Free Cooling			Alternate #3 - Fuel Gas Compressor VFD			Alternate #4 - Ammonia Vaporization with Flue Gas			Alternate #5 - HRSG MTHW Heater Section			Alternate #6 - Blowdown Heat Recovery		
		Summer	Winter	Minimum	Summer	Winter	Minimum	Summer	Winter	Minimum	Summer	Winter	Minimum	Summer	Winter	Minimum	Summer	Winter	Minimum	Summer	Winter	Minimum
GENERATION																						
CTG-200 (Max load 100% turbine output)	kW	16,990	22,898	15,716	***20,956***	22,898	15,716	16,990	***22,925***	15,716	16,990	22,898	15,716	16,990	22,898	15,716	16,990	22,898	15,716	16,990	22,898	15,716
CTG-300 (Max load 100% turbine output)	kW	16,990	22,898	0	***20,956***	22,898	0	16,990	***22,925***	0	16,990	22,898	0	16,990	22,898	0	16,990	22,898	0	16,990	22,898	0
Winter free cooling credit	kW	0	0	0	0	0	0	0	***127***	0	0	0	0	0	0	0	0	0	0	0	0	0
GENERATION SUBTOTAL	kW	33,980	45,796	15,716	41,912	45,796	15,716	33,980	45,977	15,716	33,980	45,796	15,716	33,980	45,796	15,716	33,980	45,796	15,716	33,980	45,796	15,716
PARASITIC																						
FGC-100 SERVING CTG-200	kW	-160	-385	-160	-160	-385	-160	-160	-385	-160	***-121***	***-393***	***-102***	-160	-385	-160	-160	-385	-160	-160	-385	-160
CTG-200 PACKAGE AUX LOADS	kW	-65	-40	-65	-65	-40	-65	-65	-40	-65	-65	-40	-65	-65	-40	-65	-65	-40	-65	-65	-40	-65
FGC-200 SERVING CTG-300	kW	-160	-385	0	-160	-385	0	-160	-385	0	***-121***	***-393***	0	-160	-385	0	-160	-385	0	-160	-385	0
CTG-300 PACKAGE AUX LOADS	kW	-65	-40	0	-65	-40	0	-65	-40	0	-65	-40	0	-65	-40	0	-65	-40	0	-65	-40	0
HRSG-200 AUX LOADS	kW	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21	-21
UFU-200 AMMONIA VAPORIZATION (HRSG-200)	kW	-602	-753	-365	-602	-753	-365	-602	-753	-365	-602	-753	-365	***-34***	***-36***	***-97***	-602	-753	-365	-602	-753	-365
HRSG-300 AUX LOADS	kW	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0	-21	-21	0
UFU-300 AMMONIA VAPORIZATION (HRSG-300)	kW	-602	-753	0	-602	-753	0	-602	-753	0	-602	-753	0	*-34*	*-36*	0	-602	-753	0	-602	-753	0
DI WATER BOOSTER PUMPS	kW	-9	-10	-1	-10	-10	-1	-9	-10	-1	-9	-10	-1	-9	-10	-1	-9	-10	-1	-9	-10	-1
FUEL OIL FORWARDING PUMPS	kW	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CHILLED WATER FOR INLET AIR COOLING	kW	0	0	0	***-1,212***	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
INLET AIR COOLING GLYCOL PUMPS	kW	0	0	0	***-104***	0	0	0	***-11***	0	0	0	0	0	0	0	0	0	0	0	0	0
PROCESS COOLING WATER PUMPS	kW	-91	-115	-49	-101	-115	-49	-91	-115	-49	-91	-115	-49	-91	-115	-49	-91	-115	-49	-91	-115	-49
ELECTRIC DRIVE BOILER FEED PUMPS	kW	-142	-168	-13	-168	-168	-13	-142	-168	-13	-142	-168	-13	-142	-168	-13	-142	-168	-13	-142	-168	-13
COOLING TOWER WATER FOR PROCESS CLG	kW	-103	-14	-6	-114	-14	-6	-103	-14	-6	-103	-14	-6	-103	-14	-6	-103	-14	-6	-103	-14	-6
CONDENSATE TRANSFER PUMPS	kW	-14	-16	-2	-16	-16	-2	-14	-16	-2	-14	-16	-2	-14	-16	-2	-14	-16	-2	-14	-16	-2
PARASITIC SUBTOTAL*	kW	-2,055	-2,719	-681	-3,420	-2,719	-681	-2,055	-2,730	-681	-1,977	-2,735	-623	-919	-1,286	-413	-2,055	-2,719	-681	-2,055	-2,719	-681
NET (GENERATION - COGEN AUX LOADS)	kW	31,925	43,077	15,035	38,492	43,077	15,035	31,925	43,247	15,035	32,003	43,061	15,093	33,061	44,510	15,303	31,925	43,077	15,035	31,925	43,077	15,035
PREDICTED ANNUAL ENERGY USE/GENERATION (2019)	MWh	246,029			247,149			246,032			245,626			242,768			245,816			246,029		
	mmbtu	2,774,591			2,781,443			2,774,534			2,773,486			2,764,735			***2,615,012***			***2,767,384***		
PREDICTED ANNUAL ENERGY SAVINGS (2019)	MWh	Base			-1,120			-3			403			3,262			213			0		
	mmbtu	Base			-6,852			57			1,105			9,856			159,579			7,207		
Purched power (2019)	MWh	78,820			77,802			78,837			78,820			78,820			78,820			78,820		
GHG (2019)	Tons	190,925			190,956			190,928			190,861			190,349			181,590			190,504		
GHG Savings (2019)	Tons	Base			-31			-3			65			577			9,335			422		

726 lb/MW NEISO grid average green house gas rate in 2014 (consistent with GHG Policy)

117 lb/mmbtu CHP fuel specific emissions factor

* while lighting in the new building is an additional parasitic load, it is independent of CHP operating rates and is treated as house load for this calculation.

Appendix 4

APPENDIX 4 CIRCULATION LIST

Matthew A. Beaton, Secretary
Executive Office of Energy and
Environmental Affairs
Attn: MEPA Office
100 Cambridge Street, Suite 900
Boston, MA 02114

Department of Environmental Protection
Attn: Commissioner's Office/MEPA
Coordinator
One Winter Street
Boston, MA 02108

Department of Environmental Protection
Northeast Regional Office
Attn: MEPA Coordinator
205B Lowell Street
Wilmington, MA 01887

Massachusetts Department of Transportation
Public/Private Development Unit
10 Park Plaza
Boston, MA 02116

Massachusetts Department of Transportation
District #6
Attn: MEPA Coordinator
185 Kneeland Street
Boston, MA 02111

Massachusetts Historical Commission
The MA Archives Building
220 Morrissey Boulevard
Boston, MA 02125

Department of Public Health
Director of Environmental Health
250 Washington Street
Boston, MA 02115

Energy Facilities Siting Board
Attn: MEPA Coordinator
One South Station
Boston, MA 02110

Division of Energy Resources
Attn: MEPA Coordinator
100 Cambridge Street, 10th floor
Boston, MA 02114

Massachusetts Water Resource Authority
Attn: MEPA Coordinator
100 First Avenue
Charlestown Navy Yard
Boston, MA 02129

Cambridge City Council
Attn: Richard Rossi, City Manager
City Hall
795 Massachusetts Avenue
Cambridge, MA 02139

Community Development Department
City of Cambridge
344 Broadway
Cambridge, MA 02139

Cambridge Bicycle Committee
Cambridge City Hall Annex
344 Broadway
Cambridge, MA 02139

Charles River Watershed Association
190 Park Road
Weston, MA 02493

Cambridge Public Library
Central Square Branch
45 Pearl Street
Cambridge, MA 02139

John Sanzone
Friends of the Grand Junction Path
john@johnsanzone.com

Jeremy Poindexter
jpoindex@mit.edu

Patrick Brown
prbrown@mit.edu

Max Dunitz
mhdunitz@gmail.com