TETRA TECH

September 4, 2013

Mr. James Belsky, Permit Chief
MassDEP Northeast Region
205B Lowell Street
Wilmington, MA 01887

Re: Major Comprehensive Plan Application
Salem Harbor Redevelopment (SHR) Project (Transmittal Number X254064)
Additional Information

Dear Mr. Belsky:

This information is being submitted to respond to technical questions raised by MassDEP in a telephone call on August 27, 2013 with respect to the Major Comprehensive Plan Application (MCPA) submitted on December 21, 2012, the First and Second Supplements submitted in April and June, 2013, and additional material submitted in July and August 2013. This information is being submitted on behalf of Footprint Power Salem Harbor Development LP ("Footprint"). This technical information includes: (1) noise octave band analysis for all noise modeling receptors, (2) additional details on turbine exhaust and transformer silencing, (3) clarification on discrepancies in noise receptor addresses, (4) proposed loads for combustion turbine performance testing, (5) performance testing and compliance loads for auxiliary boiler, (6) permissives for start of SCR system ammonia injection, (7) GE load range for emissions guarantees, (8) proposed lb/MWhr limits for duct firing conditions, (9) clarification for proposed long-term GHG BACT limit, and (10) explanation of the VOC compliance basis for the emergency diesel generator and the emergency diesel fire pump.

(1) Noise Octave Band Analysis for all Modeling Receptors

Attachment 1 provides the octave band impact analysis values for all 14 noise modeling receptors. These values are the total of the background and facility contributions for each octave band. These results confirm that no pure tone conditions are predicted at any of these receptors. For compliance purposes, Footprint is committing to achieve the total A-weighted facility sound level contribution at each receptor (facility only), and to the absence of any pure tone conditions (facility plus background) per the MassDEP Noise Policy.

(2) **Additional Details on Turbine Exhaust and Transformer Silencing**

In order to achieve the projected far-field sound pressure levels at the designated receptor locations, silencers will be installed in the HRSG discharge flow path, either in the connecting ducts and/or in each vertical stack flue so that the total 90-degree directional sound power level is no more than 83 dBA at the stack exits. This is the stack silencing included in Option 2 as referenced in Table 1 of our June 18, 2013 Supplement. The total sound power attenuation of the silencers is currently estimated to be 22 dBA (15 dBA in the duct and 7 dBA in the stack silencer). A cost optimization will be done during final design to determine if the total 22 dBA

attenuation can be provided in a single larger silencer in the duct at a lower cost and gas flow pressure loss.

The generator step-up (GSU) transformers will be specified as the "ultra-low noise" type, providing a sound power level (L_w) of 90 dBA for the ST GSUs and 83 dBA for the CT GSUs; with further mitigation provided by sound barrier walls constructed partially around the transformers and extending above the top of the equipment. The "ultra-low noise transformers" are reflected in Option 2 as referenced in Table 1 of our June 18, 2013 Supplement. "Low-noise transformers" (per Option 1 in Table 1 of our June 18, 2013 Supplement) would have a sound power level (L_w) of 95 dBA for both the ST GSUs and CT GSUs.

(3) Clarification of Discrepancies in Noise Receptor Location Addresses

Attachment 2 provides a corrected Table with the noise impact receptor addresses.

(4) Proposed Loads for Combustion Turbine Performance Testing

Footprint Power proposes to conduct emission compliance tests for each combustion turbine (CT) unit at four (4) CT load conditions, as follows:

- CT MECL (Minimum Emission Compliance Load), which is a function for ambient temperature as provided in (7) below.
- 75% CT Load
- 100% (Base) CT Load without duct firing
- Peak CT Load (approximately 102% load) with duct firing

These four (4) loads cover the entire normal operating range of the CT units for demonstrating compliance with the emission limits.

(5) Performance Testing and Compliance Loads for Auxiliary Boiler

The auxiliary boiler for the SHR Project has not yet been purchased, so the specific "turndown' ratio for this boiler is not yet available. The inverse of the "turndown" ratio is the minimum load at which a boiler will maintain stable operation and be in compliance with the emission limits. For example, a "turndown" ratio of 5 (or 5:1) means the boiler will maintain stable operation and be in compliance with the emission limits at 1/5 (i.e., 20%) load. It is expected that the boiler purchased by Footprint Power will have a turndown ratio of 5 or greater, meaning that the minimum load at which the boiler will maintain stable operation and be in compliance with the emission limits will be 20% or less. The boiler will be able to comply with the emission limits over the full range between this minimum load and 100% load. Footprint Power proposes to also conduct emission compliance tests for the auxiliary at four (4) normal operating load conditions, as follows:

- Boiler MECL (Minimum Emission Compliance Load), which is a function of the turndown ratio of the boiler as purchased.
- 50% Load
- 75% Load
- 100% Load

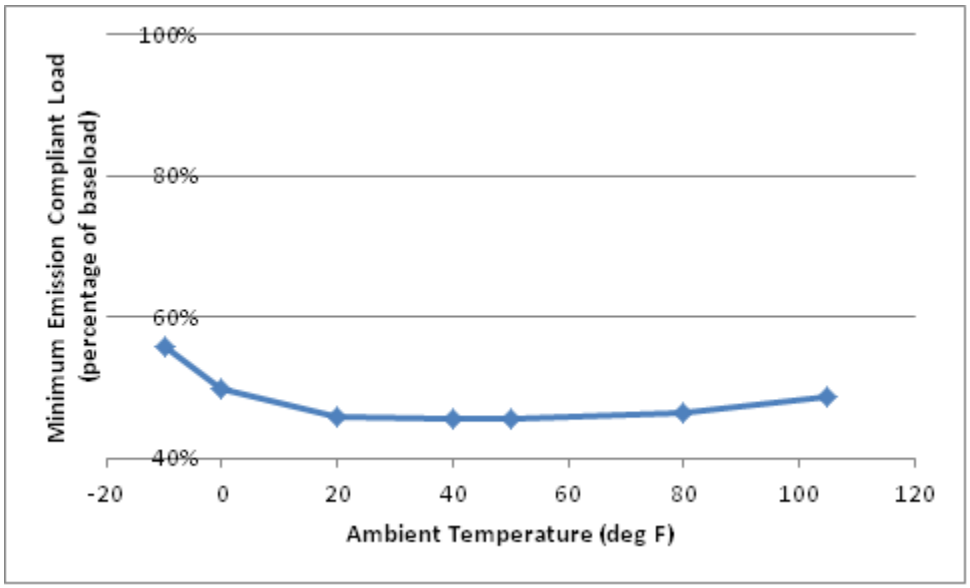
Footprint also proposes to conduct emission testing for startup and shutdown operation of the auxiliary boiler. During startup and shutdown, emission of some pollutants (NO_x, CO and perhaps VOC) may exceed the lb/MMBtu limits for normal operation, and may also exceed maximum full load lb/hr limits. It is not possible to provide specific values at this time since (as noted above) the auxiliary boiler has not yet been purchased. In the event we do find lb/hr emissions during auxiliary boiler startup and/or shutdown that exceed the maximum full load lb/hr limits, we will develop a worst-case correction factor for startup and/or shutdown hours to apply to the total rolling 12-month operating limit of 6570 hours. For example, if we find startup emissions of any pollutant are (at worst case) twice the maximum full load allowable value in lb/hr, then each startup hour will be counted as 2 normal operating load hours versus the 6570 hours rolling 12-month limit.

(6) Permissives for Start of SCR System Ammonia Injection

The SCR systems for the SHR Project have not yet been purchased, so the specific minimum operating conditions for commencement of ammonia injection as provided by the selected catalyst vendor are not yet available. In general, SCR systems control the initiation of ammonia injection based on the exhaust temperature as well as other variables such as the time/temperature duration to allow adequate warm-up of the catalyst surface and ammonia injection vaporization system. A typical overall system temperature at which the initiation of ammonia injection may be allowed is on the order of 550°F. Footprint Power will ensure that the SCR control equipment for each combustion turbine is operational whenever the turbine exhaust temperature attains the minimum exhaust temperature specified by the SCR vendor and other system permissives are satisfied for SCR operation. The specific CT load at which this exhaust temperature and other system permissives are achieved will vary based on ambient conditions and whether the startup is cold, warm, or hot.

(7) GE load range for emissions guarantees

GE has guaranteed compliance with emission limits over a CT load range from "MECL" to Peak firing conditions. MECL as a function of ambient temperature is shown below.



(8) lb/MW-hr Limits for Duct Firing Conditions

Proposed emission limits on an energy output basis (lbs of emissions per net MWhr to the grid) for duct firing conditions are provided below. These limits are based on initial compliance tests at full (base) load (100%) load with duct firing, with compliance demonstrations made by testing within 180 days of initial startup unless an alternate schedule is approved by the MassDEP.

Short-Term Emission Rates (lb/MWhr) for Combined Cycle Units for Duct Firing Conditions

Pollutant	pounds/MWhr
NO_x	0.055
CO	0.033
VOC	0.016
SO_2	0.011
PM	0.049
PM_{10}	0.049
$PM_{2.5}$	0.049
NH_3	0.020

(9) Rolling 12-Month GHG BACT Limit

In our letter dated August 21, Footprint proposed a rolling 12-month GHG BACT limit of 895 lb CO_2e/MWhr (net to grid) for the CTG/HRSG/duct burner units. Footprint confirms that this limit may also be applied on a rolling 365-day basis.

We are aware that the Brockton Power Project (Plan Approval 4B08015, July 20, 2011) was approved for a rolling 12-month CO_2 emission limit of 842 lb/MWhr. In the Plan Application for the Brockton Project, the basis for the 842 lb/MWhr limit is stated *to include operation at a variety of loads, ambient temperatures, with and without evaporative cooling, and with and without duct firing, and including starts and stops* (Brockton Power Plan Application at page 4-30). However, there is no mention of any allowance for heat rate (efficiency) degradation over the life of the project or between major turbine overhauls. We believe this is a significant consideration which renders this value of 842 lb CO_2/MWhr not appropriate as a GHG BACT precedent. The Brockton Project has not been constructed, and the 842 lb/MWhr value therefore has not been demonstrated in practice. In addition, it is noted that the Brockton Project has not specifically undergone a PSD review for GHG BACT.

Several factors of relevance to the Brockton Project are also of note. In the Plan Application for the Brockton Project, it is stated that the 842 lb/MWhr value is based on a CO_2 emission factor of 117 lb/MMBtu. As we have noted in our August 21, 2013 submission, our proposed limit of 895 lb/net MWhr is based on a CO_2e emission factor of 119 lb/MMBtu. Adjusting the Brockton value of 842 lb/MWhr by 119/117, the Brockton rate (based on 119 lb CO_2/MMBtu would be 856 lb/MWhr. In this case, the SHR Project value (895 lb/MWhr) is 4.6% higher than the adjusted Brockton value (856 lb/MWhr). In addition, the Brockton Project design is based on

wet cooling, while the SHR Project will use dry cooling. Projects utilizing dry cooling have higher heat rates (lower efficiency), particularly during warm weather periods. Reasonable allowance for heat rate (efficiency) degradation over the life of the project and between major turbine overhauls, as well as the impact of wet vs. dry cooling, explains the proposed GHG BACT for the SHR Project of 895 lb/net MWhr compared to the proposed Brockton limit.

In addition, the PVEC Project used a CO_2e emission factor of 116 lb/MMBtu. Since the SHR factor is 119 lb CO_2e/MMBtu, this makes SHR's proposal to meet the same limits as PVEC actually 2.6% more stringent than PVEC's approved limits.

We believe the GHG BACT precedent of 895 lb CO_2e/net MWhr, as established by the Pioneer Valley Energy Center Project, is an appropriate GHG precedent which includes a reasonable allowance for the various factors affecting the long-term GHG emissions, including performance degradation.

(10) VOC Compliance Basis for the Emergency Diesel Units

As presented in Section 3.0 of the MCPA, Footprint proposed that the Emergency Diesel Generator (EDG) will meet EPA Tier 2 standards and the Emergency Fire Pump (FP) will meet Tier 3 standards, both for off-road diesel engines. This corresponds to the applicable requirements specified in 40 CFR 89, as specified at 310 CMR 7.26(42)(b) and the MassDEP's June 2011 BACT Guidelines.

For hydrocarbons, the applicable limit under Tier 2 for the EDG is 6.4 grams/kWhr (for NO_x + NMHC combined), and under Tier 3 for the FP is 4.0 grams/kWhr (also for NOx + NMHC combined). For combustion of ULSD, it is reasonable to consider that VOC emissions will be essentially the same as non-methane hydrocarbon emissions (NMHC).

The calculations for gaseous testing procedures per 40 CFR 89 are found at 40 CFR 89.424. With respect to hydrocarbons, the direct measurement of hydrocarbons is in parts per million (ppm) by volume, carbon equivalent. Then, for No. 2 diesel exhaust, the mass of hydrocarbons is calculated assuming that each carbon atom is accompanied (on average) by 1.8 atoms of hydrogen (i.e., NMHC as $CH_{1.8}$), which corresponds to a gas density of 0.5746 kg/m^3.

If you have additional questions, please contact either me at (617) 803-7809 or George Lipka at (617) 443-7545.

Sincerely,

Keith H. Kennedy

Keith H. Kennedy
Senior Consultant – Energy Programs

Attachments

Attachment 1
Octave Band Analysis by Receptor
(Octave band values are unweighted dB)

Receptor	31 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz		A-weighted Total
ST 1	66.3	60.2	52.6	43.4	42.2	36.4	31.9	24.4	2.1		44.0
ST 2	69.9	64.8	55.7	41.9	37.7	32.4	27.7	22.2	8.5		44.0
ST 3	65.0	59.0	50.3	40.4	38.9	32.3	27.2	17.6	-12.9		41.0
ST 4	67.2	62.5	53.7	42.1	38.6	33.7	28.5	21.5	0.5		43.0
ST 5	67.7	63.1	54.4	43.6	40.1	35.3	29.9	20.8	-6.7		44.0
ST 6	55.4	50.4	43.6	35.2	31.7	26.3	16.1	-15.5	-125.7		34.0
ST 7	59.8	54.5	47.3	38.1	36.1	33.4	27.9	13.6	-31.1		39.0
ST 8	56.9	51.3	41.7	32.0	29.7	26.8	19.4	-1.3	-69.8		33.0
ST 9	62.6	58.0	50.8	42.4	39.4	35.4	28.7	15.9	-21.1		42.0
ST 10	63.6	59.0	50.8	40.7	37.6	33.6	27.8	15.7	-21.4		41.0
ST 11	59.9	55.4	46.0	36.5	34.0	30.0	23.8	8.7	-39.0		37.0
ST 12	54.7	50.4	42.6	32.1	28.3	23.8	15.5	-8.8	-90.9		32.0
WITI 1	55.0	49.6	40.9	33.4	31.5	26.0	17.7	-5.1	-81.6		33.0
WITI 2	54.4	48.9	42.1	33.8	31.1	25.5	17.3	-5.4	-81.7		33.0

ATTACHMENT 2

Location	Ambient (L_{90},dBA) (1)	Facility (L_{90},dBA)	Ambient and Facility (L_{90},dBA)	Increase Over Ambient (dBA)
ST1 – Located to the North/ Residences near 39 Fort Avenue	47	44	49	2
ST2 - Existing Property Line to the West/Block House Square/Residences near Fort Avenue and Derby Street Intersection	42	44	46	4
ST3 – Located to the Northeast/25 Memorial Drive/Bentley Elementary School	39	41	43	4
ST4 – Existing Property Line to the Southwest/Residences near Intersection of Webb Street and Derby Street/23 Derby Street	39	43	44	5
ST5 – Existing Property Line to the Southwest/59 Derby Street	39	44	45	6
ST6 – Located to the East across Salem Harbor/76 Naugus Avenue (Marblehead)	36	34	38	2
ST7 – Located to the East/Winter Island Park (Harbormaster Office)	39	39	42	3
ST8 – Located to the Northeast/Intersection of Fort Avenue and Winter Island Road/Winter Island Road	38	33	39	1
ST9 – Existing Property Line to the South/Blaney Street Pier on Salem Wharf	39	42	44	5

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Location	Ambient (L_{90},dBA) (1)	Facility (L_{90},dBA)	Ambient and Facility (L_{90},dBA)	Increase Over Ambient (dBA)
ST10 – Southwest Corner of the Existing Property/Mackey Building/Art Gallery	36	41	42	6
ST11 – Near House of Seven Gables across from 41 Turner Street	39	37	41	2
ST12 – Pickering Wharf near Victoria's Station approximately 100 feet behind Sail Schooner "Fame" Kiosk	41	32	42	1
R1 – Plummer House	40	33	41	1
R2 – Winter Island Road Residences	34	33	38	4