I. SUMMARY

A. This report is intended to supplement the San Francisco Permit Application Checklist for Diesel Generators, Diesel Fire Pumps, and Fuel Tanks Serving Generators and Fire Pumps. The permit checklist has been included in the 100% Construction Documents for permit review on Plumbing/Fire Protection Sheet P1-5062.

B. This report also documents the applicable code references that affect the minimum size requirements for the onsite fuel system supply.

C. In addition to the code required durations and the related capacity of diesel fuel storage onsite, the TJPA has requested that additional fuel be provided to extend the time of operation during a utility power outage to support the facility emergency, legally required standby and optional systems for the building. The limited physical building site for the Transit Center prevents installation of underground fuel storage tanks within the property, and the current design is constrained by the applicable codes and regulations for fuel storage within the building.

D. To address the request for increased capacity, a proposed design modification that is described in this report includes provisions for additional fuel storage capacity to support the Transit Center, and is included for review and consideration.

II. CODE REQUIREMENTS FOR GENERATOR FUEL CAPACITY

A. For the purpose of determining the amount of fuel required by the applicable codes to be stored on site for the Transbay Transit Center, the following requirements are summarized:

1. The 2007 California Building Code (CBC) and California Fire Code (CFC) as adopted and amended by the City of San Francisco are the governing fire and life safety codes for the base building design. The Trainbox and the Bus Deck Level are also governed by NFPA 130 as agreed by the Authority Having Jurisdiction (AHJ). The 2007 California Electrical Code with San Francisco amendments is also a required code.

2. The suite of NFPA standards, including NFPA 110 (Standard for Emergency Power Supply and Standby Power Systems), provides design guidance for the various building provisions that are required by the CBC or CFC for this building. In San Francisco, NFPA 110 is not adopted as code in its entirety. NFPA 72 (2010 version, Fire Alarm Signaling) is adopted as clarified in the RFLE#5 documentation.

3. The secondary power supply for the transit center is provided by diesel generators. For fire life safety purposes, secondary power supply is not required to be more than 8 hours in duration for any of the fire life safety provisions (e.g. emergency exiting lighting, exit signs, fire command center equipment, emergency ventilation systems (train platform, lower concourse, selected pressurized stairs), fire pump, elevators, accessible means of egress, protective signaling systems, fire alarm etc.) as indicated in the CBC and CFC.

4. San Francisco Fire Department publication states that the “Emergency Power Supply System for the life safety systems in a building shall be operational at all times while the building is occupied.” This requires the generators and fuel
systems supplying all building life safety systems to be available for use during occupancy in the event that utility power is interrupted.

III. CODE REFERENCES FOR FUEL STORAGE CAPACITY

A. Fuel Supply Requirements for Fire Pump: Reference NFPA 20.9.6.2.2 (2003). “The fuel supply capacity shall be sufficient to provide 8 hours of fire pump operation at 100% of the rated pump capacity in addition to the supply required for other demands.”


C. Fuel Requirements for NFPA 130 Stations: Reference NFPA 130. 5.4.11: “Enclosed stations shall be provided with Type 1 Class 60 emergency power” for fire alarm, emergency communication, emergency lighting and fire command center. Class 60 designates 60 minutes (1 hour) operation.

IV. DESCRIPTION OF CURRENT FUEL SYSTEM DESIGN

A. Refer to the Generator Fuel Use Projection Table at the end of this report for the calculation of the generator run time estimates for the fuel storage system capacity. The calculation accounts for maintaining reserve fuel supply for the code required fire pump and smoke ventilation systems, and it identifies the remaining fuel available for operation of the facility during a utility power outage. Based on the current design that provides separate fuel tanks for each generator, the reserve fuel capacity provides approximately twenty four hours of supply for the center generator, and longer fuel storage time provided for the west generator and the east (Phase 2) generator.

B. The diesel fuel system supplying emergency generators includes fuel storage for the generator’s running at full load for minimum 8 hours. The west and center generators are both 2,000kW (2,500kVA) in capacity and their fuel oil consumption at full load is 139 gallons per hour (gph) each.

$$139 \text{ gph} \times 8 \times 1.33 = 1,479 \text{ gallons}$$

C. The West emergency generator is supplied by a 2,000 gallon storage tank located in a dedicated room on the Train Platform Level (B2) and a 400 gallon day tank located in the emergency generator room on Level 2. The center emergency generator is supplied by a 4000 gallon storage tank located in a dedicated room in the Lower Concourse Level (B1) and a 400 gallon day tank located in the emergency generator room on Level 2. The aggregate volume of diesel fuel in the building (for Phase 1) is 6,800 gallons.

D. The diesel fuel storage rooms are less than 1,000 sq. ft. (2007 CBC, Section 415.3, exception 2).

E. The diesel fuel storage rooms are located in a fully sprinklered building per NFPA 13. The rooms are classified as Extra Hazard Group 2 (2002 NPA 13, Section 5.42) and the sprinkler density coverage is 0.40 gal/sq.ft.

F. The diesel fuel storage rooms are classified as H-3 occupancy (2007 CBC, Table 508.3.3) with minimum 3 hours rated walls, exhaust enclosure (2007 CFC, Sections
G. The diesel fuel storage tanks are Fireguard type, UL 2085, double wall.

H. The diesel fuel storage rooms are provided with secondary containment per 2007 CFC, Section 2704.2.2 for spill control. The curb around the diesel fuel storage rooms are calculated to include the volume of the fuel tank plus 20 minutes of sprinkler design flow. Leak detection for the containment area is provided (2007 CBC, Sections 415.6.2.6 and 415.6.2).

I. Fuel tank is filled via a closed piping system with remote fill (2007 SFFC, Section 7901.1.1.1). Remote fill inlet is located outside of building. Opening is provided with a tamper-proof, liquid-tight cap which is closed when not in use and is properly identified (2007 CFC, Sections 3402.7.5.2 and 3402.7.5.6). Remote fill inlet is provided in accordance with the 2007 CFC, Section 3404.2.7.5.8, 3404.2.9.6.6, 3404.2.9.6.6.1 and 3404.2.9.6.6.2. All tank openings are in accordance with 2007 CBC, Section 415.6.2.10; 2007 CFC, Section 3403.6.7; and 2003 NFPA, Section 4.3.4.7.

J. Piping systems are supported and protected against physical damage and excessive stresses in accordance with MSS SP-69, Pipe Hangers & Supports-Selection and Application. Flexible connectors are provided to protect the piping system against damage caused by settlement vibration, expansion, contraction, or corrosion (2002 NFPA 37, Section 6.8.2). Fuel piping supports are protected against exposure to fire by draining liquid away from piping system at a minimum slope of not less than 1 percent and providing protection with a fire-resistive enclosure rated of not less than 2 hours (2003 NFPA 30, Sections 5.5.2; 2002 NFPA 37, 6.8; and 2007 CFC, Sections 3403.6.2 and 3403.6.8).

K. The fuel tanks are provided with vents for normal venting in accordance with 2007 CFC, Section 3404.2.7.3 and emergency venting (2003 NFPA 30, Section 4.2.5.2).

L. Diesel fuel storage tank supports and connection are designed to resist damage as a result of seismic activity (2007 CFC, Section 2703.2.8, 3404.2.9; and 2003 NFPA 30, 4.2.4).

M. The fuel supply system is provided with a comprehensive fuel management, monitoring and alarm system (2002 NFPA 37, Section 6.5.2).

N. All fuel piping is double-walled (2007 CFC, Section 2703.2.2, 2704.2.2.5, 3403.6 and 7902.1.10.8) and is provided with a leak-detection system (CBC Section 415.6.2, 414.7 and CFC 2704.2.5.5).
# Diesel Fuel System Report

**Generator Fuel Use Projection**

<table>
<thead>
<tr>
<th>Load Description</th>
<th>kVA</th>
<th>kVA</th>
<th>kVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egress Ltg/Exit Signs (0.25W/SF incl retail SF)</td>
<td>64.4</td>
<td>191.2</td>
<td>66.3</td>
</tr>
<tr>
<td>Low Voltage/PA/Security Systems</td>
<td>188.0</td>
<td>285.0</td>
<td>58.0</td>
</tr>
<tr>
<td>HVAC Systems for Optional Loads (80% diversity)</td>
<td>289.5</td>
<td>408.4</td>
<td>362.7</td>
</tr>
<tr>
<td>Sewage Ejectors, Fuel Oil Pumps</td>
<td>77.0</td>
<td>236.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Elevators (1 per bank)</td>
<td>127.0</td>
<td>232.7</td>
<td>164.5</td>
</tr>
<tr>
<td>Fire Alarm System</td>
<td>25.0</td>
<td>25.0</td>
<td>25.0</td>
</tr>
<tr>
<td><strong>SUBTOTAL- Loads to support for outage duration</strong></td>
<td>770.9</td>
<td>1,378.3</td>
<td>676.5</td>
</tr>
<tr>
<td>% of Generator full load</td>
<td>31 %</td>
<td>55 %</td>
<td>27 %</td>
</tr>
<tr>
<td>Fuel consumption-gph @ % load</td>
<td>51.0 gph</td>
<td>93.0 gph</td>
<td>45.0 gph</td>
</tr>
</tbody>
</table>

Stair Pressurization System Fans to center only

Add Stair Press Fans (1 hour) | 25.0 kVA | 25.0 kVA | 25.0 kVA |
Add sump pumps (run 1 hour)   | 53.0 kVA | 167.0 kVA |         |
Add Trainbox Fan Systems (run 1 hour) | 932.0 kVA | 0.0 kVA | 804.0 kVA |

**TOTAL GEN LOAD- Run for 1 hour**

| % of Generator full load                              | 71 %   | 76 %   | 60 %   |
| Fuel consumption- gph @ % load                        | 99.7 gallons | 119.1 gallons | 84.3 gallons |
| 1 hour fuel consumption with trainbox fans            | 99.7 gallons | 119.1 gallons | 84.3 gallons |

Reserve 8 hr fuel for Fire Pump

|          | 307.0 kVA | 320.0 gallons |

**Generator Runtime hours w/2000 gallon tanks**

|          | 43 hours | 24 hours | 48 hours |
Notes to Fuel Use
Projection

*Loads include Ph1 and Ph2 Emergency, Standby and Optional Loads connected to the generators
*Escalators- Not required and not included on generator power
*275 gallon daytanks included
*Runtime hours include all generator loads for duration except trainbox fans(1 hour), stair press fans(1 hour), sump pumps(1 hour), and fire pump (8 hours)
*Retail SF is based on 50% CD areas
*Bus deck fans assumed at :Zone A- 100 hp; Zone B- 100; Zone C- 100; Zone D- 100