

- Floors 11 and 12. As described in Section 3.3.5 and shown in Figure 3–7, these floors were divided into individual offices, rather than open landscaped. There were approximately 130 offices per floor, distinctly fewer than the number of cubicles on a fully landscaped floor. The mass of the furnishings per office was not known; the mass of additional paper materials was described as very high. As indicated in Section 9.3.1, the Investigation Team began with an initial estimation of the combusted fuel load of approximately 32 kg/m^3 (6.4 lb/ft^2). Simulations of the fires with a lower combusted fuel load (Chapter 9) resulted in poor agreement with the observed fire spread rates.
- Floor 13. There was little information regarding the combustibles on this floor, and there was little visual evidence for estimating the effect of different combustible mass loadings on agreement with the observed fire growth patterns. NIST assumed a combusted mass similar to that on the 11th and 12th floors.

3.4.2 Diesel Fuel

There was considerable capacity for diesel fuel storage within and under WTC 7. The Investigation Team compiled information in order to estimate how much diesel fuel might have been available to feed fires in various locations in the building on September 11, 2001. The information collected (NIST NCSTAR 1-1J) is summarized as follows.

Fuel Tanks

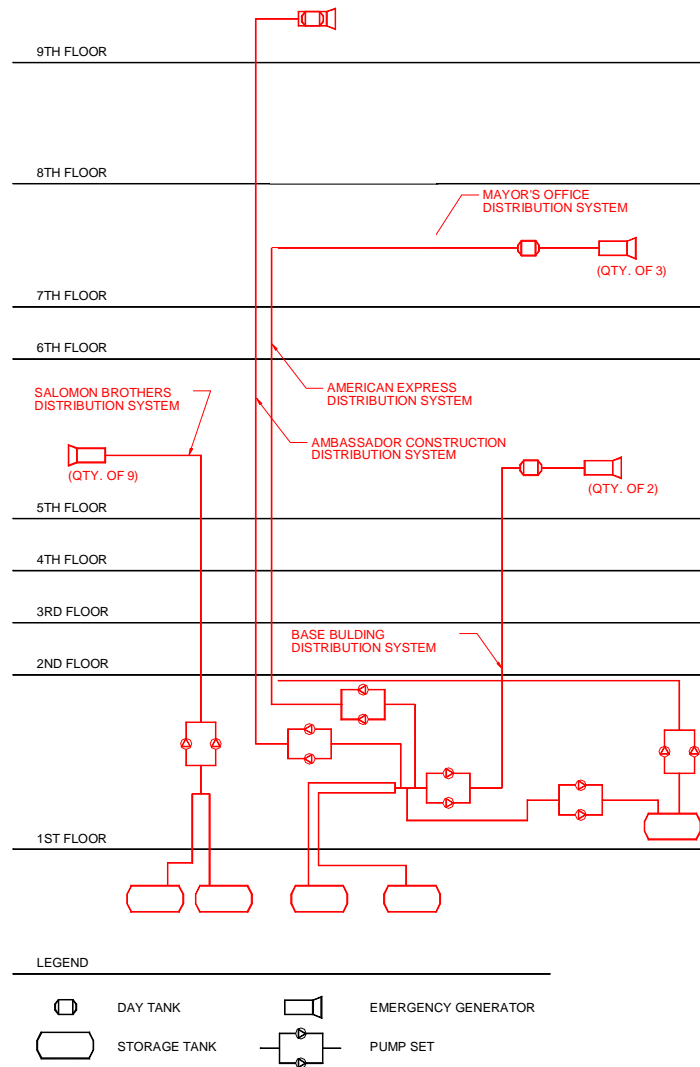
Figure 3–11 through Figure 3–13, reproduced from NIST NCSTAR 1-1J, depict the floor-by-floor locations of the electrical generators, the day tanks, and the fuel lines that connected them to the below ground fuel tanks. The text in this section is abridged from that report, as well.

There were two 55 m^3 (12,000 gal) tanks located below the loading dock. These provided the primary supply for what was known as the *base building system*. This system, installed in 1987, consisted of two generators installed on the 5th floor of WTC 7, along with a 1.25 m^3 (275 gal) day tank, which was set within a 2.5 m^3 (550 gal) capacity collecting tank. The day tank was replenished with a 0.33 L/s (4.4 gal/min) pump. Additions to the system in 1994 were:

- A single generator located on the 8th floor, along with a separate 1.25 m^3 (275 gal) day tank (American Express modification). The 8th floor generator and the day tank were removed in 2000.³
- A single generator on the 9th floor with a 0.23 m^3 (50 gal) day tank located on the generator (Ambassador modification for the U.S. Secret Service).

The pumps that filled the three day tanks from the large storage tanks were located on the 1st floor.

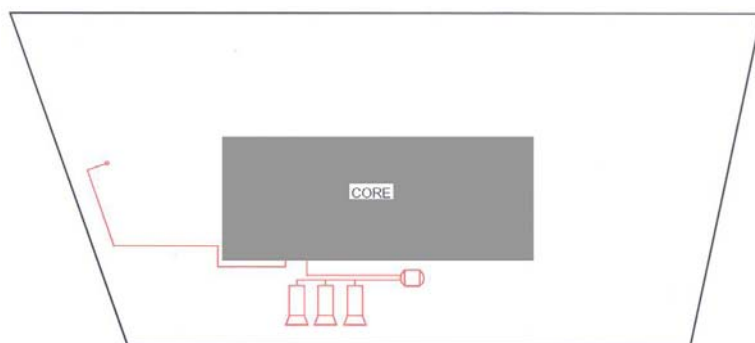
The Salomon Brothers¹¹ system was installed in 1990. This consisted of two 27 m³ (6,000 gal) tanks located under the loading dock and pumps located on the 1st floor in a separate space from the base building pump sets. The Salomon Brothers system's nine generators were all located on the 5th floor. Since the New York City regulations had a limit of one day tank up to 1.25 m³ (275 gal) per floor, and since the base generators located on the 5th floor already made use of a 1.25 m³ (275 gal) day tank, the Salomon Brothers system used a pressurized fuel distribution system, in which the pumps continuously circulated fuel whenever the generators were running. There was enough fuel (160 L, 35 gal) stored at pressure in the valve rig and piping located on the ceiling near the northeast corner of the 5th floor (Figure 3-1) to start the diesel engines, which, in turn, would supply power to operate the circulating pump. The maximum fuel flow was 5.3 L/s (70 gal/min) at 340 kPa (50 psi).



NCSTAR 1-1J, based on Figure 8-1

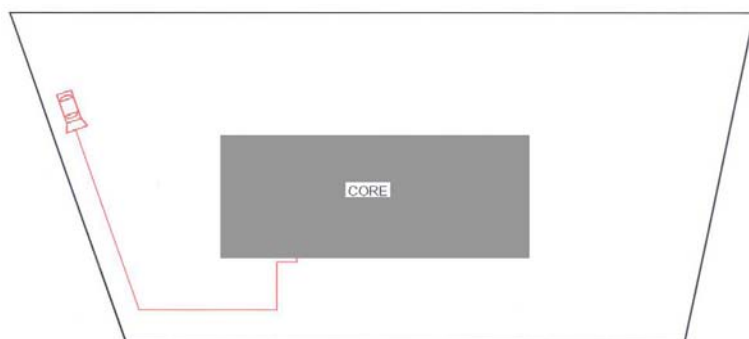
Figure 3-11. Section view of fuel oil distribution components in WTC 7.

¹¹ Renovations were made in 1988 and 1989 to the space leased by Salomon Brothers Inc. in WTC 7. In 1998, Smith Barney Inc. merged with Salomon Brothers Inc. to form Salomon Smith Barney. In 1999, Salomon Smith Barney Inc. merged with Citicorp Inc. to form Citigroup Inc.



NCSTAR 1-1J, Figure 6-2

Figure 3-12. Schematic of the 7th floor of WTC 7 showing the locations of electrical generators and the fuel lines that connected them to below-ground fuel tanks.



NCSTAR 1-1J, Figure 4-2

Figure 3-13. Schematic of the 9th floor of WTC 7 showing the locations of the electrical generator and the fuel line that connected it to below-ground fuel tanks.

The Mayor's OEM system, installed in 1999, consisted of a separate 27 m³ (6,000 gal) storage tank located on the 1st floor of the building, along with its pumps, in a separate space from the other pumps. Three generators and a 1.25 m³ (275 gal) day tank were located on the 7th floor.

Fuel Accounting

The Silverstein Properties building management had a contract with a fuel oil supplier to check and fill the base building system supply tanks (which had a total capacity of 110 m³ (24,000 gal)) regularly. Thus, NIST assumed that the base building tanks were full on September 11, 2001. In the days following the attacks on the WTC, a contractor (GZA 2002) recovered an estimated 100 m³ (23,000 gal) of fuel from these tanks. The uncertainty in these volumes is unknown, and NIST assumed that approximately 10 m³ ± 10 m³ was unaccounted.

The distribution system was designed to keep the three day tanks full by transferring fuel from the base building supply tanks, so NIST also assumed that these day tanks (total capacity of 2.7 m³ (600 gal)) were full on September 11, 2001. The fate of this fuel is unknown. The volume of the riser pipes was modest compared to the volume of the tanks, and it was not known how full of fuel they might have been. Thus, NIST assumed that the most fuel that could have been supplied to fires from the base building system was about 2.7 m³ (600 gal).

The two 27 m³ (6,000 gal) tanks for the Salomon Brothers system were found to be damaged by WTC 7 collapse debris and were empty; there was no significant quantity of fuel identified in the soil and gravel below the tanks. Thus, all 55 m³ (12,000 gal) of fuel from this system would have been available to feed

fires either at ground level or on the 5th floor. The latter scenario would have required power to the pumps to remain, and a breach in the 5th floor fuel system that was not sensed by the leak detection system in the outer pipe. (Refer to Chapter 9 for further details on this scenario.)

No trace of the Mayor's OEM system tank nor the 27 m³ (6,000 gal) of fuel it contained was ever found, so NIST assumed that the full volume might have been available to the building fires. This tank was located in a 1st floor room adjacent to the elevator bank, enclosed in 4 h fire rated construction, and provided with a total flooding fire suppression system. Since the pumps used to fill the day tank on the 7th floor would only run when the low fuel switch came on, and since the distribution piping would drain by gravity when the pumps were off, most of this fuel likely would only have been available on the 1st floor. It is, however, possible that a break in the day tank supply line on the 7th floor could have led to a diesel fuel pool on this floor. (See Section 9.2.2.)

3.4.3 Other Combustibles

In interviews with staff of WTC tenants, The Port Authority, and Silverstein Properties, NIST was told that there were no exceptional combustibles in the building other than the aforementioned small arms and limited ammunition on the 9th floor.

3.5 REFERENCES

Cantor 1985. Irwin G. Cantor P.C., Structural Engineers, Structural Drawings, 7 World Trade Center.

Flack and Kurtz 1988. Flack and Kurtz Mechanical Engineers, Mechanical and Electrical Drawings for Salomon Brothers 7 World Trade Center Headquarters.

GZA GeoEnvironmental, Inc. 2002. Underground Storage Tank Closure Report, September 9.

Roth 1985. Emery Roth & Sons P.C., Architects, Architectural Drawings, 7 World Trade Center.

SOM 1988. Skidmore, Owings & Merrill, Architects / Engineers, Architectural Drawings for Salomon Brothers 7 World Trade Center Headquarters.

Syska & Hennessy 1985. Syska & Hennessy Engineers, Mechanical, Electrical, and Plumbing Drawings, 7 World Trade Center.