



## **CHAPTER 19.      RADIOFREQUENCY ELECTROMAGNETIC FIELDS**

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### **19.1 INTRODUCTION**

#### **19.1.1 CONTEXT**

The proposed buildings of the World Trade Center Memorial and Redevelopment Plan (Proposed Action) are being designed to accommodate a variety of rooftop telecommunications and broadcast services. In addition, they may contain cellular and other communication services. These facilities will create radiofrequency electromagnetic fields (RFEMF). This chapter discusses whether the strength of the RFEMF created by these proposed facilities would pose any significant risks to human health.

#### **19.1.2 CONCLUSIONS**

The Proposed Action has been examined with respect to RFEMF for two scenarios—the Pre-September 11 Scenario and the Current Conditions Scenario.

##### ***PRE-SEPTEMBER 11 SCENARIO***

With the Proposed Action, a variety of rooftop TV and radio broadcast facilities, microwave, and other telecommunication are expected to be built. RFEMFs with the Proposed Action would be expected to be comparable to levels that existed before September 11. RFEMF with the Proposed Action, and with the pre-September 11 facilities at the Project Site, would be at levels below those specified in applicable guidelines and standards, and below the levels that would result in any adverse health effects. Consequently the Proposed Action would not result in any significant adverse RFEMF impacts.

##### ***CURRENT CONDITIONS SCENARIO***

Currently, there are no rooftop and other significant telecommunications or broadcast facilities located at the Project Site. With the Proposed Action, a variety of rooftop TV and radio broadcast facilities, microwave, and other telecommunication would be built. These facilities would be designed so that RFEMF levels would be below those specified in applicable guidelines and standards, and below the levels that would result in any adverse health effects.

### **19.2 BACKGROUND**

Electromagnetic radiation can be described as the propagation of electrical-field and magnetic-field energy through space in the form of waves. These waves are generated by the movement of electrical charges. For example, the alternating movement of charge (i.e., the “current”) in a radio or television broadcast antenna generates electromagnetic waves that radiate from the transmitting antenna and are then intercepted by a receiving antenna. At any given point in space, these electromagnetic waves result in an electromagnetic field. This field can be described in terms of the electric and magnetic field strength at the particular point in space. The frequency

of the field is the number of times electromagnetic waves passing a given point in space over a one second interval. Frequency is typically measured in units of “hertz,” where 1 hertz equals one cycle per second.

The electromagnetic spectrum includes low frequency sources (such as power lines), radiofrequency sources (such as radio, television, and microwaves), and increasing in frequency, infra-red, visible light, ultraviolet, X-ray, and gamma ray sources. The acronym RFEMF refers to the emission and propagation of electromagnetic waves in the frequency range 3 kilohertz (kHz) to 300 gigahertz (GHz). This frequency range encompasses the radio and television frequency and microwave frequency ranges. Electromagnetic waves within the RFEMF range are characterized as non-ionizing because the intrinsic (quantum) electromagnetic energy absorbed by a body at any frequency within the RFEMF range is much too low to ionize (eject) electrons from molecules of the body.

Radiofrequency energy is used to provide telecommunication services, including radio and television broadcasting, cellular telephone services, personal communication services, pagers, cordless telephones, business radio, radio communications, microwave point-to-point radio links, and satellite communication. Non-communication uses of radiofrequency energy include microwave ovens, radar, and industrial heating and sealing applications.

The RFEMF has both electrical and magnetic field components, with the electric field expressed in terms of volts per meter (V/m), and the magnetic field expressed in terms of amperes per meter (A/m). Another measurement used to characterize RFEMF is power density, which is often expressed in terms of milliwatts per square centimeter ( $\text{mW}/\text{cm}^2$ ). A measurement used in determining how much RFEMF energy is absorbed (by humans), and therefore of potential harm, is called the specific absorption rate (SAR), which is often expressed in terms of watts per kilogram ( $\text{W}/\text{kg}$ ).

Potential adverse biological effects of RFEMFs are principally due to the thermal effects of radiofrequency energy. Exposure to high levels of RFEMF radiation can be harmful due to the ability of radiofrequency energy to heat biological tissue rapidly. This is the principal by which microwave ovens cook food. Exposure to very high radiofrequency power densities can result in heating of biological tissue and an increase in body temperature. The extent of this heating is a function of several factors, including: radiation frequency; size, shape, and orientation of the exposed object; duration of exposure; environmental conditions; and efficiency of heat dissipation. Typical levels of RFEMF encountered by the general public are well below the levels necessary to produce any adverse thermal effects. In general, there are no definitive studies that indicate that non-thermal biological effects from RFEMF have adverse health effects, such as cancer, or pose any type of human health hazard.

Over the past several decades, various organizations and entities have developed exposure guidelines and standards for RFEMF to protect the general public and/or to protect workers. These organizations include the American National Standards Institute (ANSI), the Institute of Electrical and Electronics Engineers (IEEE), Occupational Safety and Health Administration (OSHA), HEW Bureau of Radiological Health, National Council on Radiation Protection and Measurements (NCRP), and the Federal Communication Commission (FCC). Table 19-1 shows the FCC exposure limits for transmitters operating at frequencies from 300 kHz to 100 GHz (the range of frequencies at facilities at the Project Site).

**Table 19-1**  
**FCC Limits for Maximum Permissible Exposure (MPE)**

Limits for Occupational/Controlled Exposure				
Frequency Range (f) (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> , or S (minutes)
0.3-3.0	614	1.63	(100) <sup>*</sup>	6
3.0-30	1842/f	4.89/f	(900/f <sup>2</sup> ) <sup>*</sup>	6
30-300	61.4	0.163	1.0	6
300-1,500	—	—	f/300	6
1,500-100,000	—	—	5	6
Limits for General Population/Uncontrolled Exposure				
Frequency Range (f) (MHz)	Electric Field Strength (E) (V/m)	Magnetic Field Strength (H) (A/m)	Power Density (S) (mW/cm <sup>2</sup> )	Averaging Time  E  <sup>2</sup> ,  H  <sup>2</sup> , or S (minutes)
0.3-3.0	614	1.63	(100) <sup>*</sup>	30
3.0-30	824/f	2.19/f	(180/f <sup>2</sup> ) <sup>*</sup>	30
30-300	27.5	0.073	0.2	30
300-1,500	--	--	f/1500	30
1,500-100,000	--	--	1.0	30
0.3-3.0	614	1.63	(100) <sup>*</sup>	30
<sup>*</sup> Plane-wave equivalent power density <b>Notes:</b> Occupational/controlled limits apply in situations in which persons are exposed as a consequence of their employment provided those persons are fully aware of the potential for exposure and can exercise control over their exposure. Limits for occupational/controlled exposure also apply in situations when an individual is transient through a location where occupational/controlled limits apply provided he or she is made aware of the potential for exposure. General population/uncontrolled limits apply in situations in which the general public may be exposed, or in which persons that are exposed as a consequence of their employment may not be fully aware of the potential for exposure or can not exercise control over their exposure.				

In general the amount of RFEMF energy that the public and workers might be exposed to as a result of broadcast antennas and microwave facilities depends upon several factors, including: the type and design of the station; the characteristics and design of the antenna being used; the power transmitted to the antenna; the height of the antenna; and the distance from the antenna. The FCC reports that there are currently approximately 14,000 radio and TV stations on the air in the United States. Measurements made by the FCC, EPA, and others have shown that RFEMF levels in inhabited areas near broadcast facilities are typically well below the exposure levels recommended by current standards and guidelines. Similarly, measurements at microwave transmission facilities, which transmit signals using a directed beam of energy between transmitting antenna and receiving antenna, have shown power densities at publicly accessible locations are typically a thousand times or more below recommended safety levels, and significant exposures from these antennas could only occur in the unlikely event that an individual were to stand directly in front of and very close to an antenna for a period of time.

### **19.3 CURRENT CONDITIONS SCENARIO**

#### **19.3.1 EXISTING CONDITIONS 2003**

Currently, with the exception of the 130 Liberty Street building (which is vacant and shrouded in protective netting and surrounded by scaffolding) and the temporary WTC PATH station, the Project Site has been cleared of debris and is vacant. The temporary WTC PATH station has some limited telecommunications systems for communications in the immediate vicinity of the station. In addition, there may be some relatively small public safety radio systems operating at the Project Site. RFEMF emissions from these systems conform to FCC and all other applicable regulations. With these exceptions, there are no other sources of RFEMF emissions at the Project Site.

#### **19.3.2 FUTURE WITHOUT THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO**

In 2009 without the Proposed Action, the WTC Site would remain vacant except for the permanent WTC PATH Terminal. The Terminal would have some limited telecommunications systems for communications in the immediate vicinity of the station, and there is likely to be some relatively small public safety radio systems operating at the Project Site. RFEMF emissions from these systems would conform to FCC and all other applicable regulations. However, there would be no significant rooftop, or significant telecommunications or broadcast facilities located at the Project Site. With the exception of the permanent WTC PATH Terminal and some limited telecommunication systems noted above, there would be no appreciable sources of RFEMF emissions at the Project Site.

#### **19.3.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009—CURRENT CONDITIONS SCENARIO**

In 2009, the WTC Site would change from a mostly vacant site to a mixed-use development with a Memorial and museum and office, cultural, retail, and open space. Freedom Tower, at the northwest corner of the site, would be completed. This building would contain broadcast antenna and possibly microwave and other telecommunication equipment on its roof. While these facilities are still in the preliminary design stage and no detailed analyses have been performed, the facilities would be designed so that RFEMF levels would be below those specified in all applicable guidelines and standards, including FCC limits for maximum permissible exposure, and below the levels that would result in any adverse health effects.

In terms of public exposure, in general, there would be a significant distance between the broadcast antenna and any publicly accessible locations (i.e., the highest location in Freedom Tower where the public would have access would be the observation deck at approximately 1,365 feet, and the broadcast antenna would extend from elevation 1,500 feet to elevation 1,776 feet). RFEMF levels decrease rapidly with distance. Consequently, RFEMF levels at publicly accessible locations would be expected to be relatively low. In terms of worker exposure, protective gear and other measures would be taken to ensure that workers servicing and maintaining this equipment are not exposed to levels which would exceed applicable regulations or pose potential adverse health effects.

#### **19.3.4 FUTURE WITHOUT THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO**

Without the Proposed Action, the WTC Site would remain vacant except for the permanent WTC PATH Terminal and two office towers (130 and 140 Liberty Street) on the Southern Site. Site 26 at Battery Park City would be occupied. At the Project Site, the permanent WTC PATH Terminal would have some limited telecommunications systems for communications in the immediate vicinity of the station, and there is likely to be some relatively small public safety radio systems operating at the Project Site. The 130 and 140 Liberty Street and Site 26 Battery Park City building may contain some rooftop telecommunication and microwave systems. However, these systems would not be expected to be major, and they would not be expected to contain any major broadcast or other types of systems. RFEMF emissions from all of these systems will conform to FCC and all other applicable regulations. There would be no significant rooftop, or significant telecommunications or broadcast facilities located at the Project Site. With the exception of the permanent WTC PATH Terminal and some limited telecommunication systems noted above, there would be no appreciable sources of RFEMF emissions at the Project Site.

RFEMF levels in the project area and conditions at the Project Site at publicly accessible locations would be expected to remain similar to those described above for existing conditions.

#### **19.3.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015—CURRENT CONDITIONS SCENARIO**

By 2015, it is assumed that development at the Project Site would be completed. In addition to the Memorial, museum, office, cultural, retail, open space, and one office tower (Freedom Tower) that are expected to be completed by 2009, four additional office towers, a hotel with conference facilities, and additional retail space are assumed to be completed. Some of these buildings, in addition to Freedom Tower, may contain some broadcast equipment and are likely to contain microwave and other telecommunication equipment on their roofs. In general, the exact facilities that each building may contain are unknown and/or, in some cases, in the preliminary or conceptual design stage at this time, and no detailed RFEMF analyses have been performed for any facilities that would be part of the Proposed Action. However, LMDC and the Port Authority will require that all facilities be designed so that RFEMF levels would be below those specified in applicable guidelines and standards, including FCC limits for maximum permissible exposure, and below the levels that would result in any adverse health effects. RFEMF effects of the proposed facilities on the roof of the Freedom Tower building are discussed in section 19.3.3. Similarly, any broadcast, telecommunication, or microwave equipment located on the roof of other buildings would not be expected to have any significant adverse effects. This equipment is located on the rooftop of buildings and the public would not be allowed access to these areas. RFEMF levels at publicly accessible locations would be expected to be well below FCC-recommended levels and well below any levels that would result in adverse health effects. In terms of worker exposure, protective gear and other measures would be taken to ensure that workers servicing and maintaining this equipment are not exposed to levels which would exceed applicable regulations or pose potential adverse health effects.

## **19.4 PRE-SEPTEMBER 11 SCENARIO**

### **19.4.1 BASELINE CONDITIONS**

As discussed in previous chapters of this GEIS, the Pre-September 11 Scenario reflects anticipated conditions at the Project Site absent the tragic events of September 11. Pre-September 11, the WTC Site contained the Twin Tower buildings (both with heights of approximately 1,350 feet), several smaller (but still tall) buildings, and the large Austin J. Tobin Plaza. Radio and television broadcast antennas, and other telecommunication and microwave facilities were located on the roof of the Twin Tower buildings, and some limited telecommunication and microwave facilities were located on the roofs of some of the other buildings. The Port Authority required that all of these facilities be designed so that RFEMF levels would be below those specified in applicable guidelines and standards, including FCC limits for maximum permissible exposure for the public and workers, and below the levels that would result in any adverse health effects.

### **19.4.2 FUTURE WITHOUT THE PROPOSED ACTION 2009— PRE-SEPTEMBER 11 SCENARIO**

Without the Proposed Action, it is assumed that the WTC Site would contain all of the buildings that existed prior to September 11 and that no additional construction would occur on-site. Absent the building of any new broadcasting, telecommunication, or microwave facilities, conditions would remain the same as for baseline conditions. Namely, RFEMF levels would be below those specified in applicable guidelines and standards, and below the levels that would result in any adverse health effects.

### **19.4.3 PROBABLE IMPACTS OF THE PROPOSED ACTION 2009— PRE-SEPTEMBER 11 SCENARIO**

In terms of RFEMF, the Proposed Action would have a comparable effect to that described above for the future conditions without the Proposed Action, under the Pre-September 11 Scenario. With the Proposed Action, Freedom Tower, at the northwest corner of the site, would be completed by 2009, and this building would contain broadcast antenna and possibly microwave and other telecommunication equipment on its roof. While these facilities are still in the preliminary design stage and no detailed analyses have been performed, the facilities would be designed so that RFEMF levels would be below those specified in applicable guidelines and standards, including FCC limits for maximum permissible exposure, and below the levels that would result in any adverse health effects.

In the Freedom Tower building, there would be a significant distance between the broadcast antenna and any publicly accessible locations. Since RFEMF levels decrease rapidly with distance, RFEMF levels at publicly accessible locations would be expected to be relatively low. In terms of worker exposure, protective gear and other measures would be taken to ensure that workers servicing and maintaining this equipment are not exposed to levels which would exceed applicable regulations or pose potential adverse health effects.

Therefore, RFEMF levels would be comparable to those that would have existed at the Project Site absent the events of September 11, and the Proposed Action would not result in any significant adverse RFEMF impacts.

#### **19.4.4 FUTURE WITHOUT THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO**

Without the Proposed Action, it is assumed that the WTC Site would contain all of the buildings that existed prior to September 11 and that no additional construction would occur on-site. Absent the building of any new broadcasting, telecommunication, or microwave facilities, conditions would remain the same as for baseline conditions. Namely, RFEMF levels would be below those specified in applicable guidelines and standards, and below the levels that would result in any adverse health effects.

#### **19.4.5 PROBABLE IMPACTS OF THE PROPOSED ACTION 2015— PRE-SEPTEMBER 11 SCENARIO**

In terms of RFEMF, the Proposed Action would have an effect comparable to that described above for the future conditions without the Proposed Action, under the Pre-September 11 Scenario. By 2015, it is assumed that development at the Project Site would be completed. In addition to the Memorial, museum, office, cultural, retail, open space, and one office tower (Freedom Tower) that are expected to be completed by 2009, four additional office towers, a hotel with conference facilities, and additional retail space are assumed to be completed. Some of these buildings, in addition to Freedom Tower, are likely to contain some radio and television broadcast antenna and/or microwave and other telecommunication equipment on their roofs. In general, the exact facilities that each building may contain are unknown and/or, in some cases, in the preliminary or conceptual design stage at this time, and no detailed RFEMF analyses have been performed for any facilities that would part of the Proposed Action.

However, LMDC and the Port Authority will require that all facilities be designed so that RFEMF levels would be below those specified in applicable guidelines and standards, including FCC limits for maximum permissible exposure, and below the levels that would result in any adverse health effects. RFEMF effects of the proposed facilities on the roof of the Freedom Tower building are discussed in section 19.4.3. Similarly, broadcast, telecommunication, and microwave equipment located on the roof of other buildings would not be expected to have any significant adverse effects. This equipment would be located on the rooftop of buildings and the public would not be allowed access to these areas. RFEMF levels at publicly accessible locations would be expected to be well below FCC-recommended levels and well below any levels that would result in adverse health effects. In terms of worker exposure, protective gear and other measures would be taken to ensure that workers servicing and maintaining this equipment are not exposed to levels which would exceed applicable regulations or pose potential adverse health effects.

Consequently, RFEMF levels would be comparable to those that would have existed at the Project Site absent the events of September 11, and the Proposed Action would not result in any significant adverse RFEMF impacts. \*