NEC FUTURE

TIER 1 DRAFT ENVIRONMENTAL IMPACT STATEMENT

7.17 Electromagnetic Fields and Electromagnetic Interference Assessment

7.17 ELECTROMAGNETIC FIELDS AND ELECTROMAGNETIC INTERFERENCE ASSESSMENT

7.17.1 Introduction

Rail infrastructure associated with electric propulsion systems—including substations and the overhead catenary system (OCS)—produce electromagnetic fields (EMF) and electromagnetic interference (EMI). Data monitoring systems and in-vehicle and wayside communication systems are also capable of producing EMF and EMI. This chapter identifies potential effects from EMF/EMI at sample locations where receptors sensitive to EMF/EMI are located within the Affected Environment of the Tier 1 Draft Environmental Impact Statement (Tier 1 Draft EIS) Action Alternatives. This chapter also describes potential mitigation procedures to minimize EMF and EMI effects caused by the Action Alternatives.

7.17.1.1 Definition of Resources

The Federal Railroad Administration (FRA) defines EMF and EMI below:

- **EMFs** occur throughout the electromagnetic spectrum, are found in nature, and are generated both naturally and by human activity. Electric fields describe forces that electric charges exert on other electric charges. Magnetic fields describe forces that a magnetic object or moving electric charge exerts on other magnetic materials and electric charges.
- **EMI** occurs when the EMFs produced by a source adversely affect operation of an electric, magnetic, or electromagnetic device such as a magnetic resonance imaging (MRI) machine. EMI is a concern at medical and university research facilities that house sensitive imaging equipment that could be adversely affected by EMF from train operations along rail corridors.

EMFs associated with electric conventional or high-speed train operations are typically 60 hertz (Hz) alternating current (AC) magnetic fields that result from current flowing in the traction power distribution system through an OCS, electrified third rail, or the rails themselves. A variety of communications, data transmission, and monitoring systems—both on and off vehicles—produce radio frequency EMFs.

7.17.1.2 Effects-Assessment Methodology

The FRA developed an effects-assessment methodology to evaluate potential EMF/EMI effects. The methodology defines EMF/EMI and data sources used in the analysis, and explains how the FRA defined and established the Affected Environment. Table 7.17-1 summarizes key factors associated with the EMF/EMI methodology. Appendix E, Section E.17, contains additional information, including the results of the full analysis and assumptions on electric traction, OCSs, and rolling stock.

Table 7.17-1: Effects-Assessment Methodology Summary: Electromagnetic Fields / Electromagnetic Interference

Resource	Affected Environment	Type of Assessment	Outcome
Electromagnetic Fields (EMF)/ Electromagnetic Interference (EMI)	2,000-foot-wide swath centered on Representative Route for each Action Alternatives	Different EMI scenarios (mainly steady state and short duration) resulting from different operational conditions across several construction types. The scenarios assume a "maximum draw" or "worst case" in which EMF/EMI would be produced.	§ Identification of the potential effects of the Action Alternatives on sensitive receptors at sample (*representative*) locations.

Source: NEC FUTURE EMI/EMF Effects-Assessment Methodology, Appendix E, Section E.17, 2014

Effects of EMF/EMI are based on the distance of a sensitive receptor to the EMF/EMI source. For NEC FUTURE Action Alternatives, the EMF/EMI source is related to train operations. Train operations contribute to EMF/EMI through electric traction, OCSs, and the type of rolling stock. The FRA conducted EMF/EMI simulations based on use of Tier III[1] trainset equipment, which are trainsets that can operate at speeds exceeding 150 mph, with maximum passenger operation speeds of up to 220 mph. The FRA also considered two simulation scenarios:

- **Maximum steady state interferences** occur when the railroad is operating at capacity where there are a maximum number of trains accelerating or decelerating simultaneously. The FRA considered these EMF/EMI calculations as a baseline for systems that could be affected by EMF.
- **Maximum short-duration interferences** result during a malfunction in the electric traction system, such as a short circuit between OCS and the negative return. Maximum short durations typically occur prior to the fault protection system being activated. Short-duration interferences may be critical for systems like safety, but are less important to other systems because of their short duration and infrequent occurrence.

To identify sample locations of sensitive receptors, FRA undertook the following steps:

- Identify "developed" (medium or high density) land cover types within the Affected Environment that could include specific land uses sensitive to EMF/EMI: For this Tier 1 Draft EIS, the FRA identified land cover types based on the National Land Cover data base (see Chapter 7.2). The National Land Cover database provides general land cover types but does not specific land uses. The FRA identified land cover types within the Affected Environment that could include specific land uses sensitive to EMF/EMI. The land cover types most likely to include these types of specific land uses is "developed" (medium or high density).
- Identify areas of at-grade construction type for each Action Alternative: The FRA identified sensitive receptors only in close proximity to at-grade construction types. Potential effects on

[1] The equipment used in the EMF/EMI simulations is similar to the Tier III trainsets used to develop service plans, and represents equipment that would likely be used for Intercity-Express, Intercity-Corridor, and Metropolitan services. Decisions on rolling stock procurement, including the configuration and maximum speed of high-performance trainsets, would be decided as part of Tier 2 actions.

sensitive receptors adjacent to other construction types (e.g., tunnel, aerial structure) are less likely because they shield EMF/EMI signals. The FRA then reviewed the Representative Routes for each Action Alternative to denote where at-grade construction type is proposed.

- Identify receptors that are sensitive to EMF/EMI (universities, medical institutions, high-tech businesses, and governmental facilities that could be affected by new sources of EMFs) within 500 feet of the Representative Route using aerial imagery (sample locations).

Sample locations are presented by state and county for each Action Alternative. No site-specific sensitive receptors are named, but rather are presented by land uses (that could contain similar sensitive receptors) that may exist along the Representative Routes of the Action Alternatives.

The equipment used in the EMF/EMI simulations is similar to the Tier III trainsets used to develop service plans, and represents equipment that would likely be used for Intercity-Express, Intercity-Corridor, and Metropolitan services. The FRA will decide on rolling stock procurement, including the configuration and maximum speed of high-performance trainsets, as part of Tier 2 actions after completion of the Tier 1 EIS. (Appendix E, Section E.17, contains additional information, including the results of the full analysis and assumptions on electric traction, OCSs, and rolling stock.)

7.17.2 Resource Overview

Railroad infrastructure (e.g., substations, and communication and signal systems) and operations (e.g., electric locomotives, OCS) provide EMF/EMI; therefore, the presence of EMF/EMI would be wherever most railroad infrastructure is located and where trains operate. There was little value in identifying the "presence" of EMF/EMI in the Study Area similar to how natural resources like freshwater wetlands are evaluated. Instead, the FRA identified sample locations and potential sensitive receptors to EMF/EMI based on representative land cover and land uses, and proposed at-grade construction of the Action Alternatives.

The FRA identified two potential sources of EMF/EMI:

- **Electric traction systems:** EMF/EMI produced by electric traction systems would result from the power required to operate the railroad, using the same frequency (60 Hz) as other systems on the power grid. EMF/EMI caused by electric traction systems affects limited areas because their frequencies are low and decrease rapidly over the distance from the source point.

- **Communications and signaling systems:** Modern railway signaling systems, such as Positive Train Control, rely on wireless communication to transmit data to Operation Control Centers, trains, operators, maintenance crews, and even passengers. Communications and signaling systems are usually confined to an area along the track through directional antennas and limited power emissions.

EMF/EMI can affect sensitive equipment, such as Magnetic Resonance Imaging (MRI) machines or research equipment like electron microscopes. The fluctuation of EMF/EMI resulting from normal rail operations[2] could disrupt the equipment or cause it to malfunction. EMF of 0.01 μT is a potentially

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[2] **Normal operation** represents the maximum EMF that would be expected from normal rail operations. The threshold identified where EMF/EMI might affect potential sensitive receptors is 0.01 μT. The distance of

harmful source of interference for research equipment on university campuses.[3,4] Section 7.17.3 identifies sensitive receptors that are representative of the types of sensitive receptors located along the Representative Routes (sample locations).

To date, research has not identified any potential health effects associated with EMF/EMI to passengers and employees on-board existing and proposed electric trainsets. The FRA's document entitled *EMF Monitoring on Amtrak's of Transportation Northeast Corridor: Post-Electrification Measurements and Analysis*[5] determined that EMF/EMI exposure to the public inside passenger coaches does not exceed the occupational limits established by the Federal Communications Commission.

7.17.3 Affected Environment

Using the process described in section 7.17.1.2 to identify sample locations of sensitive receptors, the FRA identified 20 counties and Washington, D.C., where the land cover is developed (medium or high density) and the proposed construction type is at-grade. Table 7.17-2 and Table 7.17-3 provide the counties with locations meeting these criteria, identified by state, county, and Action Alternative.

7.17.4 Environmental Consequences

The FRA further reviewed the 21 locations presented in Table 7.17-2 and Table 7.17-3 using aerial mapping to identify sample locations along the Representative Routes. Using a screening distance of 500 feet, the FRA identified specific land uses within the Representative Route for each Action Alternative that might be sensitive and most vulnerable to EMF/EMI (hospitals, universities, research facilities, etc.) under normal rail operations. Within these land uses, FRA then identified sample locations of facilities that may use equipment sensitive to EMF/EMI. These sample locations are considered to be representative of the types of sensitive receptors occurring end-to-end along the Representative Routes. Table 7.17-4 and Table 7.17-5 identify the state and county where sample locations were identified for each Action Alternative. Table 7.17-4 also provides the approximate distance from the land use to the Representative Route.

Effects from EMF/EMI resulting from train operations could disrupt equipment sensitive to EMF/EMI or cause it to malfunction. The discussion below identifies those sample locations that could be affected by EMF/EMI.

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approximately 745 feet from the source indicates the range where normal operations might cause interference with sensitive equipment without proper protections in place.

[3] Maryland Transit Administration. (2010). *Electromagnetic Emissions and Mitigation Measures.*

[4] T. Dan Bracken, Inc. (2008). *Survey of Ambient Magnetic Fields on the University of Maryland Campus. Prepared for John Brandon & Associates:* *http://rethinkcollegepark.net/blog/wp-content/uploads/2009/01/08-1006-umd-final-text-r3.pdf*

[5] *EMF Monitoring on Amtrak's Northeast Corridor: Post-Electrification Measurements and Analysis*, U.S. Department of Transportation, Office of Research and Development, DOT/FRA/RDV-06/01, Final Report, October 2006

Table 7.17-2: Affected Environment: Locations Potentially Sensitive to Electromagnetic Fields/Electromagnetic Interference (Action Alternatives)

Geography	County	Developed Land Cover	Existing NEC	Alt. 1	Alt. 2	Alt. 3
D.C.		High Density	X	X	X	X
MD	Ann Arundel	Medium Density				
	Baltimore City	High Density				
	Cecil	High and Medium Density	X	X	X	X
DE	New Castle	High and Medium Density	X	X	X	X
PA	Delaware	High Density	X	X	X	X
	Philadelphia		X	X	X	X
NJ	Union	High Density	X	X	X	X
	Essex		X	X	X	X
	Hudson		X	X	X	X
NY	New York	High Density	X	X	X	X
	Brooklyn		X	X		X
	Bronx		X	X		X
	Suffolk	Open Space				X
CT	New Haven	Medium Density	X	X		X
	Hartford	High Density			X	X
	New London	Medium Density	X	X		
RI	Kent	Medium Density	X	X		
	Providence	High Density	X	X	X	X
MA	Worcester	High Density		—	—	X
	Suffolk		X	X	X	X

Source: NEC FUTURE team, 2015
Note: Representative locations are at-grade construction types only
X = Representative location within the affected environment of specified alternative; specific names and locations have not been identified for this analysis. Specific locations and effects determination would be subject to Tier 2 analysis.
Blank Cell = Representative location is not present within specified alternative.
— = Not applicable within that alternative/option.

Table 7.17-3: Affected Environment: Locations Potentially Sensitive to Electromagnetic Fields/Electromagnetic Interference (Alternative 3 Route Options)

Geography	County	Alternative 3				
			New York City to Hartford		Hartford to Boston	
		D.C. to NYC	via Central Connecticut	via Long Island	via Providence	via Worcester
D.C.		X	—	—	—	—
MD	Ann Arundel	X	—	—	—	—
	Baltimore City	X	—	—	—	—
	Cecil	X	—	—	—	—
DE	New Castle	X	—	—	—	—
PA	Delaware	X	—	—	—	—
	Philadelphia	X	—	—	—	—
NJ	Union	X	—	—	—	—
	Essex	X	—	—	—	—
	Hudson	X	—	—	—	—
NY	New York	—	X	X	—	—
	Brooklyn	—	X	X	—	—
	Bronx	—	X	—	—	—
	Suffolk	—	—	X	—	—
CT	New Haven	—	—	X	—	—
	Hartford	—	—	—	X	X
RI	Kent	—	—	—	—	
MA	Worcester	—	—	—	—	X
	Suffolk	—	—	—	X	X

Source: NEC FUTURE team, 2015
Note: Representative locations are at-grade construction types only
X = Representative location within the affected environment of specified alternative; specific names and locations have not been identified for this analysis. Specific locations and effects determination would be subject to Tier 2 analysis.
Blank Cell = Representative location is not present within specified alternative.
— = Not applicable within that alternative/option.

Table 7.17-4: Environmental Consequences: Land Uses Potentially Sensitive to Electromagnetic Fields/Electromagnetic Interference (Action Alternatives)

ID	State	County	Existing NEC	Alt. 1	Alt. 2	Alt. 3	Land Cover	Representative Land Use	Observed Distance to Representative Route (feet)
1	MD	Cecil	X	X	X	X	Barren Land	Industrial, Transportation	<500
2	DE	New Castle			X		Developed, High Density	Industrial, University	<500
3					X		Developed, Medium Density	Medical	
4	PA	Delaware			X	X	Developed, High Density	Aviation, Manufacturing	<500
5									
6	NY	Suffolk				X	Developed, Open Space	Utility	<100
7						X			
8	MA	Suffolk				X	Developed, High Density	Government	<500
9					X	X		University	

Source: NEC FUTURE team, 2015
X = Representative land use present within Representative Route of Alternative.
Blank Cell = No effects identified for subject resource for listed station for specified alternative.

Table 7.17-5: Environmental Consequences: Land Uses Potentially Sensitive to Electromagnetic Fields/Electromagnetic Interference (Alternative 3)

ID	State	County	Alternative 3				
				New York City to Hartford		Hartford to Boston	
			D.C. to NYC	via Central Connecticut	via Long Island	via Providence	via Worcester
1	MD	Cecil	X	—	—	—	—
5	PA	Delaware	X	—	—	—	—
6	NY	Suffolk	—	—	X	—	—
7			—	—	X	—	—
8	MA	Suffolk	—	—	—	X	—
9			—	—	—	—	X

Source: NEC FUTURE team, 2015
Note: Records are applicable to Alternative 3 only; IDs are not sequential. Refer to Table 7.17-4 for detailed information on representative land cover, land use, and observed distance to Representative Route.
X = Representative land use present within Representative Route of Alternative.
— = Not applicable within that alternative/option.

7.17.4.1 Existing NEC

There is one potential sensitive location along the existing NEC in Cecil County, MD. The existing land use is industrial and associated with an existing transportation facility.

7.17.4.2 Alternative 1

There are two potentially sensitive locations near the Representative Route of Alternative 1. One is located in Cecil County, MD, near an industrial use. The other location is in New London County, CT, and is a medical facility.

7.17.4.3 Alternative 2

There are five potentially sensitive locations near the Representative Route of Alternative 2. Four are south of New York City—one of which is near aviation and manufacturing land uses in Delaware County, PA, near Philadelphia International Airport. The fifth location is near a government or civic use in Suffolk County, MA.

7.17.4.4 Alternative 3

<u>Washington, D.C., to New York City</u>

There are two potentially sensitive locations near the Representative Route of this portion of Alternative 3—one of which is near aviation and manufacturing land uses in Delaware County, PA.

<u>New York City to Hartford</u>

Via Central Connecticut

There is one potentially sensitive location near the Representative Route of the Alternative 3 via Central Connecticut route option. The location—in Suffolk County, NY—is industrial.

Via Long Island

There are two potentially sensitive locations near the Representative Route of the Alternative 3 via Long Island route option. Both are located in Suffolk County, NY, and are utilities.

<u>Hartford to Boston</u>

Via Providence

There is one potentially sensitive location near the Representative Route of the Alternative 3 via Providence route option. The receptor, located in Suffolk County, MA, is a government or civic use.

Via Worcester

There is one potentially sensitive location near the Representative Route of the Alternative 3 via Worcester route option. The receptor, located in Suffolk County, MA, is a university.

7.17.4.5 Stations

There are no potentially sensitive receptors near stations in any of the Action Alternatives.

7.17.5 Context Area

Within the Context Area, the areas of greatest concern are those with the greatest concentration of sensitive receptors such as universities and medical facilities. Should the Representative Route shift during future stages of the development process, more site-specific analysis and mitigation strategies would be conducted.

7.17.6 Potential Mitigation Strategies

Electromagnetic compatibility ensures that systems function properly when in conflict with EMF/EMI. The FRA identified potentially sensitive receptors for each Action Alternative but did not identify specific effects on resources. The type of mitigation used to offset potentially adverse effects to sensitive receptors should be reviewed case by case, depending on the resource affected. However, typical mitigation strategies for EMF/EMI when dealing with rail infrastructure include the following:

- Modification of the electrical feeding system
- Consideration of voltage levels
- Positioning of OCS wires and traction power substations
- Changes to operations
- Incorporating electromagnetic interference transmission media through shields or filters

7.17.7 Subsequent Tier 2 Analysis

Subsequent Tier 2 actions should be reviewed for site-specific sensitive receptors to EMF/EMI. If sensitive receptors are identified, analysis to determine the extent of effects on these receptors should be undertaken. Subsequent Tier 2 analysis may include the development of a frequency management plan. The frequency management plan would more accurately analyze the strength and intensity of EMF/EMI emissions based on the service plan, equipment selection, and final design of the selected alternative.