3.5 Electromagnetic Fields and Electromagnetic Interference

This section of the Draft Supplemental Environmental Impact Report/Environmental Impact Statement (EIR/EIS) provides an evaluation of electromagnetic fields (EMF) and the potential for electromagnetic interference (EMI) along the F-B LGA and compares the F-B LGA to the complementary portion of the Preferred Alternative that was identified in the *Fresno to Bakersfield Section California High-Speed Train Final Project EIR/EIS*. As discussed in Section 1.1.3 of this Draft Supplemental EIR/EIS, the complementary portion of the Preferred Alternative consists of the portion of the BNSF Alternative from Poplar Avenue to Hageman Road and the Bakersfield Hybrid from Hageman Road to Oswell Street (further referenced as the “May 2014 Project” in this Draft Supplemental EIR/EIS). Since the Fresno to Bakersfield Section Final EIR/EIS does not evaluate the May 2014 Project as a discrete subsection of the Fresno to Bakersfield Project (as it did for example for the Allensworth Bypass), affected environment and impact summary discussion included in this section for the May 2014 Project has been extrapolated from the available information contained within the Fresno to Bakersfield Section Final EIR/EIS.

This Draft Supplemental EIR/EIS section describes the measured levels, as well as the potential for EMI from operation of the high-speed rail (HSR) specific to the Fresno to Bakersfield Locally Generated Alternative (F-B LGA). This section focuses on land uses that are particularly sensitive to EMFs, such as businesses and institutions that use equipment that may be highly susceptible to EMI, or that engage in medical research activities that might be affected by HSR-operation EMFs.

EMFs are electric and magnetic fields. 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. EMFs occur throughout the electromagnetic spectrum, are found in nature, and are generated both naturally and by human activity. Naturally occurring EMFs include the Earth’s magnetic field, static electricity, and lightning. EMFs also are created by the generation, transmission, and distribution of electricity; the use of everyday household electric appliances and communication systems; industrial processes; and scientific research.

EMI occurs when the EMFs produced by a source adversely affect operation of an electrical, magnetic, or electromagnetic device. EMI may be caused by a source that intentionally radiates EMFs (such as a television broadcast station), or one that does so incidentally (such as an electric motor).

The information presented in this section primarily concerns EMFs at the 60 hertz (Hz) power frequency, and at radio frequencies produced intentionally by communications or unintentionally by electric discharges. EMFs from the HSR operation would consist of the following:

- Power-frequency electric and magnetic fields from the traction power system, traction power substations (TPSS), emergency generators that provide backup power to the stations in case of a power outage, and utility feeder lines: 60 Hz electric fields would be produced by the 25-kilovolt (kV) operating voltage of the HSR traction system, and 60 Hz magnetic fields would be produced by the flow of currents providing power to the HSR vehicles. Along the tracks, the magnetic fields would be produced by the flow of propulsion currents to the trains in the overhead contact system (OCS) and rails.
- Harmonic magnetic fields from vehicles: Depending on the design of power equipment in the HSR trains, power electronics would produce currents with frequency content in the kilohertz range. Potential sources include power conversion units, switching power supplies, motor drives, and auxiliary power systems. Unlike the traction power system, these sources are highly localized in the trains, and move along the track as the trains move.
- Radio frequency (RF) fields: The HSR system would use a variety of communications, data transmission, and monitoring systems—both on and off vehicles—that operate at radio frequencies. These wireless systems would meet the Federal Communications Commission (FCC) regulatory requirements for intentional emitters (Code of Federal Regulations [C.F.R.],

Title 47, Part 15 and FCC DET Bulletin No. 65, Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields).

Of these EMFs, the dominant effect is expected to be the 60 Hz alternating current (AC) magnetic fields from the propulsion currents flowing in the traction power system; that is, the OCS and rails.

Facilities and populations sufficiently close to the HSR can be adversely affected by these fields. Sensitive facilities such as medical laboratories, research parks, and colleges, as well as certain infrastructure elements such as underground cables and pipelines all need to be considered and mitigation strategies developed as needed.

This Draft Supplemental EIR/EIS evaluation consisted of baseline measurements—documented in Technical Appendix 3.5-A of the Fresno to Bakersfield Section Final EIR/EIS—that characterize the existing electromagnetic environment, analysis of sensitive receptors, National Environmental Policy Act (NEPA) impacts, significance evaluation with respect to California Environmental Quality Act (CEQA), and mitigation discussion.

3.5.1 Regulatory Setting

Federal, state, and local laws, regulations, orders, or plans relevant to EMF/EMI affected by the project are presented below. National Environmental Policy Act (NEPA) and California Environmental Quality Act (CEQA) requirements for assessment and disclosure of environmental impacts are described in Section 3.1, Introduction, of this Draft Supplemental EIR/EIS.

3.5.1.1 Federal

Federal regulations applicable to the F-B LGA are listed below. These regulations are discussed in further detail in Section 3.5.2.2 of the Fresno to Bakersfield Section Final EIR/EIS (Authority and FRA, 2014b page 3.5-5).

- U.S. Department of Transportation, Federal Railroad Administration, 49 CFR Parts 236.8, 238.225, and 236 Appendix C
- U.S. Department of Commerce, FCC, 47 CFR Part 15
- U.S. Department of Commerce, FCC, Office of Engineering and Technology (OET) Bulletin 65
- Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields
- FCC Regulations at Title 47 CFR 1.1310 are based on the 1992 version of the ANSI/IEEE C95.1 safety standard
- U.S. Department of Labor, OSHA, 29 CFR 1910.97 Nonionizing Radiation, safety standards for occupational exposure to RF emissions

3.5.1.2 State

State regulations applicable to the F-B LGA are listed below. These regulations are discussed in further detail in Section 3.5.2.3 of the Fresno to Bakersfield Section Final EIR/EIS (page 3.5-6).

- California High-Speed Rail Authority—Electromagnetic Compatibility Program Plan (EMCPP)
- California Department of Education, California Code of Regulations, Title 5, Section 14010(c)
- California Public Utilities Commission (CPUC) Decision D.93-11-013

New state regulations that would apply to both the May 2014 Project and the F-B LGA include:

- **California Public Utilities Commission Decision D.06-01-042:** The California Public Utilities Commission decision updates the EMF policy originally defined in D.93.11.013
- **California Public Utilities Commission EMF Guidelines for Electrical Facilities:** These California Public Utilities Commission guidelines, based on D.93-11-013 and D.06-01-042, establish priorities between land use classes for EMF mitigation. While the California Public

Utilities Commission decisions, general orders, and guidelines do not directly apply to the HSR, they are listed because:

- The project will handle environmental impacts of the HSR project TPSS and associated electric power substations, station switches, and high-voltage transmission lines consistent with California Public Utilities Commission D.93-11-013 and D.06-01-042.
  - Decision D.06-01-042 reaffirms the key elements of the updated EMF policy.

3.5.2 Methods for Evaluating Impacts

Based on the similarities in land use, power and communications infrastructure, and similar environment, it was concluded that the prevailing electromagnetic fields along the F-B LGA were effectively the same as at locations along the May 2014 Project alignment from Shafter to Bakersfield. There have been no changes to the methods for evaluating impacts. Therefore, the methods identified in Section 3.5.3 of the Fresno to Bakersfield Section Final EIR/EIS (pages 3.5-6 through 3.5-8) are still applicable.

3.5.2.1 Methods for Evaluating Effects Under NEPA

In the Fresno to Bakersfield Section Final EIR/EIS, analysts applied specified thresholds for each resource topic to assess whether the intensity of each impact is negligible, moderate, or substantial for the Build Alternatives, and provided a conclusion of whether the impact was “significant.” Since the Fresno to Bakersfield Section Final EIR/EIS does not evaluate the May 2014 Project as a discrete subsection of the Fresno to Bakersfield Project (as it did for example for the Allensworth Bypass), it does not provide conclusions using intensity thresholds for the May 2014 Project. Therefore, intensity thresholds are not used for the F-B LGA. Instead, the evaluation of impacts under NEPA in this Draft Supplemental EIR/EIS focuses on a comprehensive discussion of the project’s potential impacts in terms of context, intensity, and duration and provides agency decision makers and the public with a comparison between the May 2014 Project and the F-B LGA.

3.5.2.2 CEQA Significance Criteria

A significant impact on the environment would occur if the HSR project exposes people to a documented EMF health risk, or if HSR operations interfere with implanted biomedical devices and unshielded sensitive equipment. Based on the CEQA Guidelines, the project would have a significant impact if it would:

- Expose a person to an EMF health risk, including field intensity over the limit of an applicable standard, an electric shock, or interference with an implanted biomedical device.
- Disrupt agricultural activities near the HSR alignment.
- Interfere with nearby sensitive equipment, including at hospitals, industrial and commercial facilities, railroads, rail transit systems, or airports.

For the purposes of the CEQA analysis, human exposure and interference has been defined as follows:

- **Human Exposure:** The maximum permissible exposure (MPE) (which is the highest exposure considered safe to human beings) limit (Institute of Electrical and Electronic Engineers Standard C95.6) for 60 Hz magnetic fields for the instantaneous exposure for the general public is 9.04 Gauss (904 microtesla); the MPE for controlled environments where only employees work is 27.12 Gauss (2,712 microtesla). The MPE limit (Institute of Electrical and Electronic Engineers Standard C95.6) for 60 Hz electric fields for the general public is 5,000 volts per meter, or 5 kilovolts per meter (kV per meter). The MPE is 20 kV per meter for controlled environments in which only HSR employees would work.
- **Interference:** The Footprint Report provides the typical interference levels for common types of sensitive equipment. These reported levels are used as the significance criteria for this impact analysis. From the Footprint Report, 2 milligauss (mG) is used as a screening level for

potential disturbance to unshielded sensitive equipment. In addition, 2 mG is a typical EMF level from early epidemiological studies, which showed that it is the lowest level of chronic, long-term magnetic field exposure with no statistical association with a disease outcome (Savitz et al. 1988; Severson et al. 1988). The value of 2 mG also is a typical EMF level emitted from household appliances (California High-Speed Rail Authority [Authority] and FRA 2010).

3.5.2.3 Study Area for Analysis

The study area for EMFs is limited to either side of the planned track, as described in Section 6.3.2 of the *Draft Environmental Impact Report/Environmental Impact Statement Assessment of California High-Speed Train Alignment Electromagnetic Field Footprint* prepared by Turner Engineering in July 2010 (Authority and FRA 2010). The study area is as follows:

- 200 feet on both sides of the proposed HSR right-of-way centerline (a 400-foot-wide strip centered on the proposed HSR alignment). For the F-B LGA, the study area includes urban and developed areas in Shafter and Bakersfield.
- 200 feet on both sides of the proposed HSR right-of-way centerline (a 400-foot-wide strip) from the transmission lines supplying TPSS.

Computer modeling shows that the EMF level will decay to a level below 2 mG at 200 feet from either side of the HSR right-of-way centerline.

The study area sampled for radio-frequency interference was extended beyond 200 feet on each side of the proposed HSR right-of-way centerline as follows:

- 500 feet on both sides of the proposed HSR right-of-way centerline (a 1,000-foot-wide strip centered on the proposed HSR alignment).

The potential for EMI would no longer exist for equipment beyond 500 feet from the HSR right-of-way centerline.

3.5.3 Affected Environment

3.5.3.1 Summary of the May 2014 Project Affected Environment

A review of land uses along the May 2014 Project alignment identified two potentially sensitive receptors (i.e., medical imaging) within the 200-foot study area. Both receptors, Mercy Hospital and Truxtun Radiology Medical Group, are located in Bakersfield and utilize medical imaging equipment. As such, the susceptibility levels, if they use unshielded equipment, would typically be in the 1 to 3 mG range.

3.5.3.2 Fresno to Bakersfield Locally Generated Alternative

To characterize the existing electromagnetic environment along the May 2014 Project, baseline electromagnetic measurements were recorded at 10 representative locations for the entire Fresno to Bakersfield Section. This survey involved measurements of radiated electric field strengths (RF levels) from 10 kilohertz up to 6 gigahertz, along with measurements of direct current (static) and power-frequency magnetic field strengths. The magnetic field measurements encompassed the ambient geomagnetic field along with other local direct current sources, while the AC, or power-frequency, measurements encompassed fields from the power system including overhead power lines, substations, transformers, and associated power system components. The RF measurement frequencies encompass many different applications, including broadcast radio and television signals, communications, cellular telephone, radar and navigation systems. In general, highest RF electric field levels occur, especially at the broadcast frequencies, in the Bakersfield urban area. The maximum 60 Hz magnetic fields recorded in the survey ranged from 0.46 mG to 10.94 mG, depending on the measurement locations and their proximity to local distribution and transmission power lines.

The 10 original baseline measurement locations documented in the Fresno to Bakersfield Section Final EIR/EIS were reviewed and compared with land uses along the F-B LGA. As noted above, the F-B LGA route would differ from the May 2014 Project between Shafter and Bakersfield, and of the 10 measurement locations, 6 of the measurement locations from Fresno down to Shafter are located in areas with comparable land uses to the F-B LGA. Given the similarities in land use, environment, and the power and communications infrastructure, it was concluded that the electromagnetic fields along the F-B LGA would be adequately represented by the four measurement locations along the May 2014 Project from Shafter to Bakersfield.

Table 3.5-1 provides an EMF-EMI comparison of the May 2014 Project and F-B LGA routes. The left side of Table 3.5-1 lists the 10 measurement locations along the May 2014 Project and the right side lists comparable land use locations along the F-B LGA. This illustrates the similarities in the prevailing electromagnetic environment between the two routes, and thus additional measurements would be expected to provide similar baseline readings. Full details of the original baseline readings are provided in Appendix 3.5-A of the Fresno to Bakersfield Section Final EIR/EIS.

Table 3.5-1 Basic EMF-EMI Comparison of the May 2014 Project with F-B LGA

F B Site Location	Land Uses May 2014 Project Measurement Sites June 2, 2010	Land Uses F B LGA Google Earth File Oct. 12, 2015
–	Alignment parallel to Santa Fe Way	Alignment parallel to Santa Fe Way
–	Alignments diverge SE of Shafter at Hwy 43	Alignments diverge SE of Shafter at Hwy 43
–	May 2014 Project alignment parallel to Santa Fe Way	F-B LGA parallel to SR 99 and existing rail right-of-way
01 – Urban, Office high-rise	Rooftop radio/TV Tower	Rooftop radio/TV Tower
02 – Rural, Agriculture	Transmission lines parallel Distribution line cross	Transmission lines parallel Distribution line cross
03 - Aviation	General Aviation Airport Salyer Farms Airport	Commercial Aviation Airport Meadows Field Airport (BFL) East of SR 99 at Merle Haggard Drive
04 – Rural, Agriculture	Remote Location	Remote Location
05 – Rural, Agriculture, Light Industrial	69 kV sub-transmission Distribution Lines Communications Broadcast Tower	Transmission lines parallel Distribution line cross
06 – Suburban, Residential	Residential Area Bakersfield Homeless Center	Residential Area Bakersfield Homeless Center
07 – Electric power Infrastructure	Power Plant Transmission lines cross Residential Area	Power Plant Transmission Lines Cross
08 – Urban, Medical	Mercy Hospital	San Joaquin Community Hospital
09 – Urban, Imaging	Sierra Radiology Medical Group	Olive Drive Animal Hospital Physicians Automated Laboratory Inc.
10 – Urban, First Responder, Safety	Police plus communication Tower	Bakersfield Fire Station 2
–	Alignments converge	Alignments converge

BFL = Bakersfield Meadows Field Airport
EMF = electromagnetic compatibility
EMI = electromagnetic interference
F-B LGA = Fresno to Bakersfield Locally Generated Alternative
Hwy = Highway
kV = kilovolt
SE = South/East
SR = State Route

In Table 3.5-1, both routes would pass near residential areas, medical facilities, first-responder facilities, and the existing electric power infrastructure (overhead power lines) and are broadly similar with respect to both the EMF environment and the types of receptors vulnerable to EMI effects. The primary difference between the May 2014 Project and the F-B LGA would be that the F-B LGA would be closer to a larger commercial aviation airport (Meadows Field Airport [BFL]), and the San Joaquin Community Hospital medical facilities would be more distant from the F-B LGA than the Mercy Hospital facilities are from the May 2014 Project. The closest point of Mercy Hospital was approximately 180 feet from the May 2014 Project, while the San Joaquin Community Hospital is more than 1,000 feet from the F-B LGA. This is discussed in more detail in Section 3.5.3.3 of this Draft Supplemental EIR/EIS.

3.5.3.3 Receivers Susceptible to EMF/EMI/RF Interference Effects

The potential for interference in any situation is specific to the susceptibility of the system/instrument being evaluated and the field strengths of external EMI. However, a general description of sensitive receivers can be developed based on the dominant electromagnetic fields expected from operation of the HSR system. The main impact will be the 60 Hz magnetic fields associated with the propulsion currents flowing on the traction system. As such, the expected susceptible facilities are:

- High-tech semiconductor (e.g., electron microscopes [transmission electron microscope/ scanning electron microscope], electron-beam lithography, ion-writing systems, focused ion-beam systems)
- High-tech biology (e.g., nuclear magnetic resonance, magnetic resonance imaging, electron microscopes)
- Medical imaging (e.g., computed tomography scanners, magnetic resonance imaging systems)
- University/research (instrumentation for chemistry, physics, electrical engineering, and similar systems to those mentioned for high-tech and medical facilities)

These specialized systems require a very stable magnetic field environment.

The BFL is not one of the sensitive facility types for magnetic fields. Power-frequency magnetic fields are not an EMI concern and HSR RF equipment must meet FCC requirements. Therefore, interference to the airport is not expected. Furthermore, the airport would be located approximately 3,400 feet from the F-B LGA, and thus, the magnetic fields from the HSR traction system would not be detected at these distances.

The land use review of the F-B LGA did not identify any significant semiconductor, biology or university research facilities. The two closest hospitals and associated medical facilities with potentially sensitive imaging equipment were identified as the San Joaquin Community Hospital, south of the alignment at 26th Street and Chester Avenue, and the Bakersfield Memorial Hospital, well north of the F-B LGA at 34th Street and San Dimas Street. These hospitals and medical facilities are situated further than 500 feet from the F-B LGA footprint, and thus, far enough away that EMI would not be an issue. The northeast corner of the San Joaquin Hospital is approximately 1,500 feet away from the F-B LGA footprint as shown in Figure 3.5-1.

Other noted medical facilities near the San Joaquin Community Hospital are:

- Physicians Automated Laboratory
- Bakersfield Pathology
- Bariatric Solutions
- Kern Faculty Medical Group
- Kaiser Permanent Kern County Neurological

These facilities are all greater than 1,000 feet from the F-B LGA footprint, and thus, located at a sufficient distant to preclude EMI with any sensitive imaging equipment.

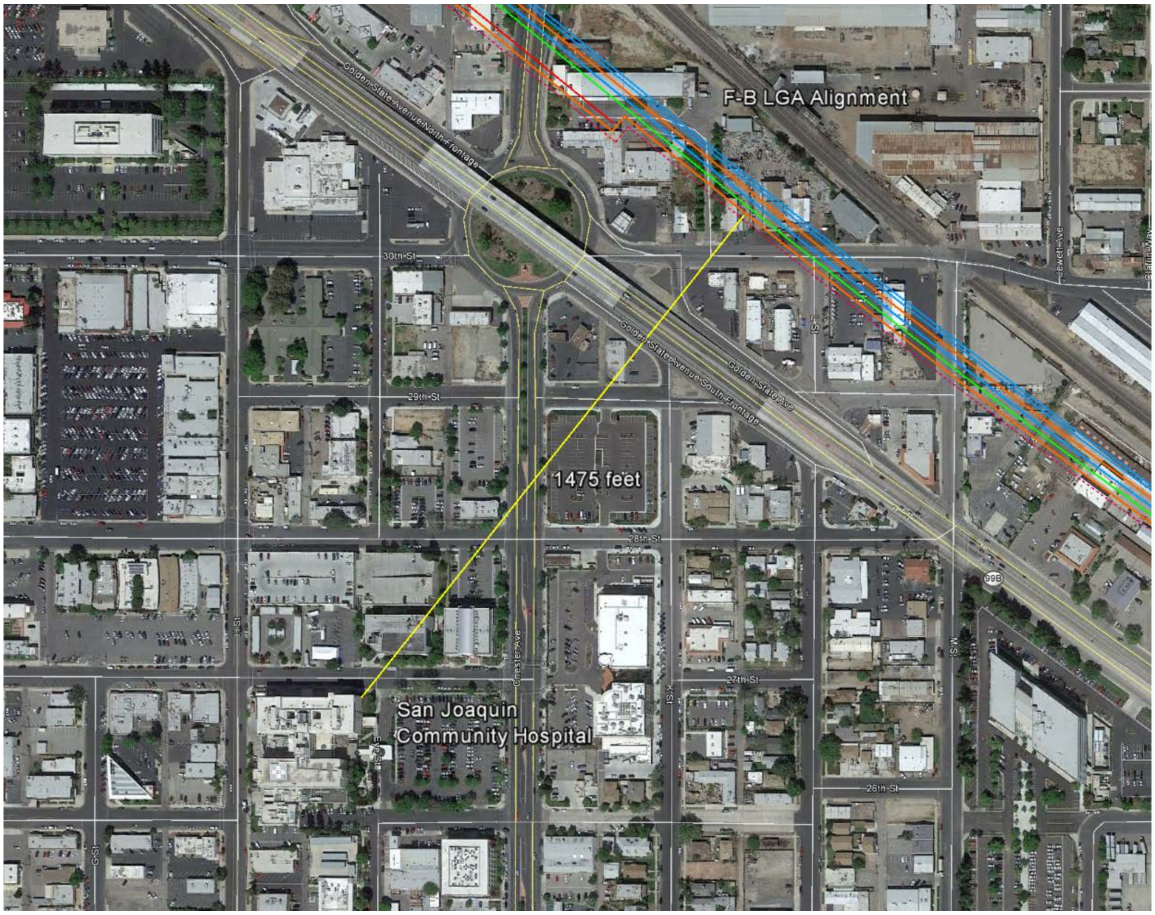

Figure 3.5-1 Proximity of the San Joaquin Community Hospital to the F-B LGA

3.5.4 Environmental Consequences

This section describes the environmental consequences of EMF/EMI for the May 2014 Project and the F-B LGA. This section lists the magnetic field levels used to evaluate whether an impact would be significant, and discusses measures to reduce impacts.

3.5.4.1 Summary of Analysis for the May 2014 Project

This section provides a summary of those effects of the May 2014 Project using information from the Fresno to Bakersfield Section Final EIR/EIS.

Construction Period Impacts

Construction of the HSR system will require the use of trucks, heavy equipment, and other items that generate EMFs. In moving away from the construction area itself, however, such fields are reduced to near background levels and would not present an EMI risk or hazard to workers.

Radios and other communications equipment used by construction crews would also generate RF fields. All such equipment for the HSR project would comply with FCC regulations that require devices not cause interference and must accept interference from other sources.

As a result, EMF/EMI effects that would occur during construction would be less than significant under CEQA because only a slight measurable increase of EMF/EMI levels would occur and within a very limited geographical area.

High-Speed Rail Operating Impacts

When the HSR system is operating, the predicted HSR-generated EMF/EMI levels to which members of the general public are expected to be exposed will be lower than the applicable HSR project MPE standards for humans in uncontrolled (open) environments.

The predicted HSR-generated EMF/EMI levels to which the employees working in traction power facilities and emergency back-up generator rooms would be exposed would be lower than the applicable HSR project MPE standards for human exposure in controlled environments.

The effects of induced currents in nearby structures such as oil and natural gas pipelines were examined as well (Authority and FRA 2014a). A number of cases were analyzed to determine the magnitude of induced currents and voltages, and the potential for corrosion of unprotected pipelines. This study concluded that adherence to “recommended practice” measures such as the use of typically-used coatings and grounding eliminates the risk of substantial corrosion due to project EMF/EMI levels on underground pipelines, cables, and adjoining rails. Therefore, project EMF/EMI impacts on corrosion would be less than significant under CEQA.

Operation of the May 2014 Project could result in EMI with medical imaging equipment exposed to EMFs in the range of 1 to 3 mG. These EMFs could have substantial impact on sensitive receptors, in the absence of magnetic shielding installed in accordance with the EMCPP. Therefore, EMI impacts on sensitive receptors in the study area would be significant under CEQA. For the May 2014 project, these impacts would be mitigated through a two-stage (planning and implementation) process defined in California HSR TM 300.02 *Coordinated Human Services Transportation Plan (CHSTP) Planning Stage Electromagnetic Compatibility Program Plan (EMCPP)* (Authority and FRA 2012a), and TM *300.10 CHSTP Implementation Stage EMC Program Plan (ISEP)* (Authority and FRA 2014d). These provide the necessary electromagnetic compatibility (EMC) Technical Investigations, EMC design, and EMC requirements for the California HSR System Contractor and suppliers to ensure that the needed mitigation measures are properly designed and installed.

Similarly, standard HSR project design features would preclude other potentially significant effects, such as nuisance shocks when touching ungrounded metal fences and ungrounded metal irrigation systems, and interference with the signal systems of adjoining rail lines. These design features would include the grounding of fences on affected adjacent properties and coordination with adjoining railroads to implement suitable track signal equipment on adjoining railroad tracks. These design features are described in Chapter 26 of the California High Speed Rail Design Criteria Manual, Electromagnetic Compatibility and Interference” (Authority and FRA 2014c). California HSR Project procurement documents will incorporate procedures and reporting requirements to ensure that the necessary EMC design elements are incorporated in the completed system.

3.5.4.2 Fresno to Bakersfield Locally Generated Alternative

This section discusses the potential EMI and EMF impacts within the F-B LGA study area. The impacts identified and analyzed in Section 3.5.5 of the Fresno to Bakersfield Section Final EIR/EIS (pages 3.5-14 through 3.5-21) (Impacts EMF/EMI #1 through EMF/EMI #9) are still applicable for the F-B LGA.

Construction Period Impacts

Impact EMF/EMI #1 – Impacts During Construction

Construction of the HSR rails, stations, and TPSSs would require use of heavy equipment, trucks, and light vehicles which, like all motor vehicles, generate EMFs. Additionally, many types of construction equipment contain electric motors that also generate EMFs. Communication equipment used by construction crews would include mobile telephones and radios that would generate RF fields. Communications equipment would include off-the-shelf products that comply with FCC regulations designed to prevent EMI with other equipment or hazards to persons. The EMFs generated during project construction would result in a slight measurable increase and would be similar in strength to the EMFs produced at non-project construction sites and would be unlikely to cause EMI with nearby land uses or hazards to workers.

The only EMI that might be generated during construction would be occasional licensed radio transmissions between construction vehicles. This is not considerably different from the number of radio transmissions that occur under existing conditions. The F-B LGA would adhere to 47 C.F.R. 15 and its general provision that devices may not cause interference and must accept interference from other sources, and must prohibit the operation of devices once the operator is notified by the FCC that the device is causing interference. The EMF or EMI effect of project construction would be less than significant under CEQA because construction equipment generates EMF at or near background levels.

Project Impacts

Impact EMF/EMI #2 – General Human Exposure to EMF

Operation of the HSR would generate 60 Hz electric and magnetic fields on and adjacent to trains, including in passenger station areas. Modeling results, discussed more fully in Section 3.5.5.3 the Fresno to Bakersfield Section Final EIR/EIS, give on-platform field strengths of 720 mG, 177 mG at the 30-foot fence line, and less than 1 mG 350 feet from the HSR centerline.

Magnetic field measurements have been made in the passenger compartment onboard other HSR systems such as the Acela Express (119 mG) and French Train à Grande Vitesse A (165 mG) and in the operator's cab of the Acela Express (58 mG) and French Train à Grande Vitesse A (367 mG) (FRA 2006). Measurements on other existing HSR trains are below the MPE limits of 5 kV per meter and 9,040 mG for the public. Therefore, the F-B LGA would have impacts of negligible intensity under NEPA relative to EMF exposure to people, and under CEQA, the impacts would be less than significant.

EMF impacts on people in nearby schools, hospitals, businesses, colleges, and residences would be below the Institute of Electrical and Electronic Engineers Standard 95.6 MPE limit of 9,040 mG for the public because even within the mainline right-of-way, these levels would not be reached. Because the modeled levels of EMF exposure are very near to existing measured values (listed in Table 3.5-4 of the Fresno to Bakersfield Section Final EIR/EIS, page 3.5-11), these impacts would be less than significant under CEQA.

Impact EMF/EMI #3 – People with Implanted Medical Devices and Exposure to EMF

Magnetic fields of 1,000 to 12,000 mG (1 to 12 Gauss) may interfere with implanted medical devices (Electric Power Research Institute 2004). The American Conference of Governmental Industrial Hygienists has recommended magnetic and electric field exposure limits of 1,000 mG and 1 kV per meter, respectively, for people with pacemakers (American Conference of Governmental Industrial Hygienists 1996). Exposure over these levels would occur only inside traction power facilities, which are unmanned and inaccessible to the general public. Therefore, effects on members of the public with implanted medical devices would be less than significant under CEQA.

For the F-B LGA, emergency standby generators would be located at the F Street Station and at the TPSS facilities. EMF would occur due to electrical devices, such as transformers and distribution bus lines common to an electrical substation. EMF would occur primarily to the immediate, secure work area, except where power lines enter and exit the facility, and rapidly decrease with distance from the source located within the study area.

EMF levels above the recommended limits for employees with implanted medical devices could exist inside traction power facilities and emergency power generator rooms. Traction power facilities and emergency power generator room sites would be unmanned, and workers would enter them only periodically (e.g., to perform routine maintenance). An exposure to an EMF level above those recommended for implanted medical devices could result in health effects. With implementation of the EMCPP as defined for this project, persons with an implanted medical device would not be permitted near the traction power facilities. Therefore, these effects on maintenance workers would be avoided and no impacts would occur under CEQA.

Impact EMF/EMI #4 – Livestock and Poultry Exposure

There are four confined animal facilities, specifically livestock and horses, within 1 mile of the F-B LGA. The closest facility is approximately 0.47 mile (2,500 feet) north of the F-B LGA alignment, east of the city of Shafter. In regard to dairy production, McGill University conducted a study that exposed cows in pens to controlled EMF levels of 300 mG and 10 kV per meter, the projected magnetic and electric fields that occur at ground level under a 735 kV line at full load (Nguyen, Richard, Burchard 2006). The researchers measured the following: melatonin levels, prolactin levels, milk production, milk-fat content, dry-matter intake by cows, and reproductive outcomes. While a few statistically significant changes in these factors were found, none of the changes were outside the normal range for cows (Exponent 2008). The study concluded that the EMF exposure did not harm the cows or reduce milk productivity. Various studies cited by other researchers regarding EMF and wildlife suggest a range of effects similar to livestock from nonexistent to relatively small to positive. One study suggests a beneficial application for extremely low frequency-EMF in broiler chickens to fight a common parasitic infection called coccidiosis (Golder Associates, Inc. 2009). For these reasons, EMF effects on livestock and poultry would be less than significant under CEQA.

Impact EMF/EMI #5 – Effects on Sensitive Equipment from EMI

The analysis for the May 2014 alignment identified three potentially sensitive receptors within the 500-foot study area. All three receptors are along the Bakersfield South and Bakersfield Hybrid alternatives, and are sites that use medical imaging. The typical susceptibility levels for such facilities would be in the range of 1 to 3 mG. Under the F-B LGA these sites fall well outside the study area and no additional sites that are sensitive to EMI were identified within 500 feet of the F-B LGA alignment. This EMI effect would be less than significant under CEQA.

Impact EMF/EMI #6 – EMI Effects on Schools

The HSR system would use radio systems for the enhanced automatic train control, data transfer, and communications, raising the concern that HSR operations would result in EMI with the radio systems at use at nearby schools and a college. HSR radio systems would transmit radio signals from antennas located at stations and heavy maintenance facilities, along the track alignment, and on locomotives and train cars. HSR plans to acquire two dedicated frequency blocks, each with a width of 4 megahertz, for use by the enhanced automatic train control systems. These blocks would be at frequencies below 925 megahertz because frequencies higher than 925 megahertz will not function on trains moving at the speed of an HSR. These blocks would be dedicated for HSR use, and EMI with other users would not be expected. Communications systems at stations may operate at wireless fidelity (WiFi) frequencies to connect to stationary trains; channels would be selected to avoid EMI with other users, including WiFi systems at use at nearby schools (Authority 2011b, 2011c).

The Authority will implement an EMCPP during project planning and implementation to ensure EMC with radio systems operated by neighboring uses, including schools and colleges. During the planning stage through system design, the Authority will perform EMC/EMI safety analyses, which will include identification of existing nearby radio systems, design of systems to prevent EMI with identified neighboring uses, and incorporation of these design requirements into bid specifications used to procure radio systems. The implementation stage will include monitoring and evaluation of system performance. Most radio systems procured for HSR use are expected to be commercial off-the-shelf systems conforming to FCC regulations at Title 47 C.F.R., Part 15, which contain emissions requirements designed to ensure EMC among users and systems. The Authority will require all non-commercial off-the-shelf systems procured for HSR use to be certified in conformity with FCC regulations for Part 15, Sub-part B, Class A devices. HSR radio systems will also meet emissions and immunity requirements designed to ensure EMC with other radio users that are contained in the European Committee for Electrotechnical Standardization EN 50121-4 Standard for railway signaling and telecommunications operations (European Committee for Electrotechnical Standardization 2006).

Because the HSR radio system would use dedicated frequency blocks and all HSR equipment will meet FCC regulations (47 C.F.R. Part 15) for EMI, the EMI impacts from the HSR system school communication systems would be less than significant under CEQA.

Impact EMF/EMI #7 – Potential for Corrosion of Underground Pipelines and Cables and Adjoining Rail

TPSSs located every 30 miles would deliver AC current to the HSRs through the OCS, with return current flowing from the trains back to the TPSSs through the steel rails and static wires. At paralleling stations, which would be positioned approximately every 5 miles along the right-of-way, and at regularly spaced bonding locations, some of the return current to the TPSS would be transferred from the rails to the static wires. Most return current would be carried by the HSR rails and the static wire back to the TPSS, but some return current would find a path through rail connections to the ground and through leakage into the ground from the rails via the track ballast.

Soils in the project vicinity tend to be sandy and dry (except where irrigated), so they have higher electrical resistivity and lower ability to carry electrical current than soils with more clay and moisture content (see Section 3.9, Geology, Soils, Seismicity, and Paleontological Resources). Nevertheless, other linear metallic objects such as buried pipelines or cables, or adjoining rails, could carry AC ground current. AC ground currents have a much lower propensity to cause corrosion in parallel conductors than the direct current used by rail transit lines such as Bay Area Rapid Transit or the Los Angeles County Metropolitan Transportation Authority. Nonetheless, the stray AC currents might cause corrosion by galvanic action. If adjacent pipelines and other linear metallic structures are not sufficiently grounded through the direct contact with earth, the project would include additional grounding of pipelines and other linear metallic objects in coordination with the affected owner or utility, as part of the construction of the HSR system. Alternatively, insulating joints or couplings may be installed in continuous metallic pipes to prevent current flow.

The potential for corrosion from ground currents would be avoided by installing supplemental grounding or by insulating sections in continuous metallic objects in accordance with standard HSR designs. Because the potential for corrosion is slight and would be avoided by standard design provisions, effects on underground pipeline and cables from corrosion would be less than significant under CEQA.

Impact EMF/EMI #8 – Potential for Nuisance Shocks

The voltage on and currents running through the OCS have the potential to induce voltage and current in nearby conductors such as ungrounded metal fences and ungrounded metal irrigation systems alongside the HSR alignment. This effect would be more likely where long (1 mile or more), ungrounded fences or irrigation systems are parallel to the HSR, and electrically continuous throughout that distance. Such voltages potentially could cause a nuisance shock to anyone who touches such a fence or irrigation system. An example of an ungrounded metal irrigation system would be a center pivot system on rubber tires. By contrast, the Vermeer-type metal irrigation system is grounded by its metal wheels and therefore offers less shock hazard, because any surface pipe metal irrigation system is grounded through its contact with the ground. Long, ungrounded fences and metal irrigation systems are more common in rural areas than urban areas because they are used to divide or irrigate agricultural fields. Adjacent metal structures are much shorter in length compared to long fences and should already be properly grounded using National Electrical Code guidelines at Article 250 for building and electrical system safety and lightning protections.

To avoid possible shock hazards, the project design includes grounding of HSR fences and the grounding of non-HSR parallel metal fences and parallel metal irrigation systems within a to-be-determined specified lateral distance of the HSR alignment. In addition, insulating sections could be installed in fences to prevent the possibility of current flow. For cases where such fences are purposely electrified to inhibit livestock or wildlife from traversing the barrier, specific insulation design measures would be implemented. Therefore, effects from shock hazards would be less than significant under CEQA.

Impact EMF/EMI #9 – Effects on Adjacent Existing Rail Lines

Signal systems control the movement of trains on the existing BNSF Railway tracks that the BNSF Alternative would parallel. These signal systems serve three general purposes:

- To warn drivers of street vehicles that a train is approaching. The rail signal system turns on flashing lights and warning bells; some crossings lower barricades to stop traffic.
- To warn train engineers of other train activity on the same track a short distance ahead, and advise the engineer that the train should either slow or stop. This is done by using changing, colored (green, yellow, or red) trackside signals.
- To show railroad dispatchers in a central control center where trains are located on the railway so that train movements can be controlled centrally for safety and efficiency.

Railroad signal systems operate in several ways, but generally, they are based on the principle that the railcar metal wheels and axles electrically connect the two running rails. An AC or direct current voltage applied between the rails by a signal system will be shorted out; that is, reduced to a low voltage, by the rail-to-rail connection of the metal wheel-axle sets of a train. The low-voltage condition is detected and interpreted by the signal system to indicate the presence of a train on that portion of track.

The HSR OCS would carry 60 Hz AC electric currents of up to 750 amps per HSR. Interference between the HSR 60 Hz currents and a nearby freight railroad signal system could occur under the following conditions:

- The high electrical currents flowing in the OCS and the return currents in the overhead negative feeder, HSR rails, and ground could induce 60 Hz voltages and currents in existing parallel railroad tracks. If an adjoining freight railroad track parallels the HSR tracks for a long-enough distance (i.e., several miles), the induced voltage and current in the adjoining freight railroad tracks could interfere with the normal operation of the signal system, so that it indicates there is no freight train present when in fact one is; or so that it indicates the presence of a freight train when in fact none is there.
- Higher-frequency EMI from several HSR sources (electrical noise from the contact on the pantograph sliding along the contact conductor, from electrical equipment onboard the HSR, or from the cab radio communication system) could cause electrical interaction with the adjoining freight railroad signal or communication systems.

There are standard design and operational practices that a nonelectric railroad must use to avoid EMI effects on the signal and communication system when electric power lines or an electric railroad are installed adjacent to its tracks. These standard design and operational practices prevent the possible effects that HSR operation might otherwise cause: disruption of the safe and dependable operation of the adjacent railroad signal system, resulting in train delays or hazards, or disruption of the road-crossing signals, stopping road traffic from crossing the tracks when no train is there (Electric Power Research Institute 2006).

Existing railroad tracks (i.e., the adjacent freight and passenger railroad tracks) parallel portions of the F-B LGA alignment. While the total length of parallel track falling within the study area is less than for the May 2014 Project, operation of the HSR system could affect the signaling systems along these existing track lengths.

Interference from HSR currents could result in a nuisance or reduction in operational efficiency by interrupting road and rail traffic. To reduce or avoid this interference, the Authority will work with the engineering department of freight railroads that parallel the HSR line to apply the standard design practices that a nonelectric railroad must use when electric power lines or an electric railroad are installed adjacent to its tracks. This would be documented in the EMCPP. These avoidance and minimization measures include assessment of the specific track signal and communication equipment in use on nearby sections of existing rail lines, evaluation of potential impacts of HSR EMFs and RF interference on adjoining railroad equipment, and the application of suitable design provisions on the adjoining rail lines to prevent interference.

Design provisions often include replacement of specific track circuit types on the adjoining rail lines with other types developed for operation on or near electric railways or adjacent to parallel utility power lines, providing filters for sensitive communication equipment, and potentially relocating or reorienting radio antennas. These design provisions would be put in place and determined to be adequately effective prior to the activation of potentially interfering systems of the HSR. Under CEQA, potential impacts on the adjacent railroads would be less than significant.

3.5.5 Avoidance and Minimization Measures

The Authority and FRA have considered impact avoidance and minimization features (IAMF). IAMF's considered to be part of the project are summarized in Section 3.5.6 of the Fresno to Bakersfield Section Final EIR/EIS (page 3.5-21). The applicable list is provided in Technical Appendix 2-G Mitigation Monitoring and Enforcement Plan. Technical Appendix 2-H describes how implementation of these IAMF's reduces adverse effects on EMF/EMI. The following IAMF's would be applicable to the May 2014 Project as well as the F-B LGA:

- **EMF/EMI – IAMF #1: Preventing Interference with Adjacent Railroads:** This measure reduces potential exceedances to electromagnetic field/electromagnetic interference (EMF/EMI) standards by requiring the construction Contractor to work with railroad engineering departments and apply standard design practices to prevent interference with the electronic equipment operated on parallel railroad facilities.
- **EMF/EMI – IAMF #2: Controlling Electromagnetic Fields/Electromagnetic Interferences:** This measure reduces potential exceedances to EMF/EMI standards by requiring the construction Contractor to design the HSR to international guidelines and comply with federal and state laws and regulations related to electromagnetic fields/electromagnetic interference. Prior to construction the Contractor will prepare an electromagnetic field/electromagnetic interference technical memorandum for review and approval by the Authority. Project design will follow the Implementation Stage Electromagnetic Compatibility Program Plan (ISEP) to avoid EMI and to provide for HSR operational safety.

3.5.6 Mitigation Measures

3.5.6.1 Mitigation Measures identified in the Fresno to Bakersfield Section Final EIR/EIS

The following mitigation measure was approved under the Fresno to Bakersfield Section Mitigation Monitoring and Enforcement Plan (Authority and FRA, 2014). Mitigation Measure EMF/EMI #1 applicable to the May 2014 Project would not be applicable to the F-B LGA as this mitigation measure is site specific to a land use within the May 2014 Project footprint. This mitigation measure was required since the May 2014 Project, under a worst-case scenario, was located close enough to sensitive locations (i.e., Mercy Hospital), to generate EMFs that could be disruptive to hospital equipment.

3.5.6.2 Mitigation Measures Specific to F-B LGA

For the F-B LGA, sensitive locations are greater than 1,000 feet from the proposed alignment. This distance precludes the potential from HSR-produced EMF/EMI, and thus requires no F-B LGA specific mitigation.

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