D. RAILROAD/TRANSPORTATION EQUIPMENT SUSCEPTIBLE TO EMF/EMI/RFI EFFECTS FROM AIRPORTS, MILITARY, OR OTHER COMMERCIAL TRANSMITTERS ALONG THE RIGHT-OF-WAY

Corrosion of underground pipelines, cables, and adjoining rails parallel to the California HST track alignment or interference with existing railroad signaling systems can occur due to HST-generated EMF/EMI emissions, Along the BNSF Alternative, trains use the existing rail line to haul freight and transport passengers (e.g., Amtrak's San Joaquin service). Most of this alignment alternative is adjacent and parallel to the existing BNSF Railway track, except near Hanford. To a lesser extent, the other alignment alternatives also parallel existing railroad tracks.

3.5.5 Environmental Consequences

This section describes the environmental consequences of EMF/EMI for the proposed alternatives. This section lists the magnetic field levels used to evaluate whether an impact would be significant. This section also discusses measures to reduce impacts.

A. OVERVIEW

EMF/EMI effects that would occur during construction are negligible under NEPA and less than significant under CEQA, because only a slight measurable increase of EMI/EMF levels that are very close to the existing conditions would occur. When the California HST project is complete, the predicted HST-generated EMF/EMI levels to which the general public is expected to be exposed will be lower than the applicable HST project MPE standards for humans in uncontrolled (open) environments.

The predicted HST-generated EMF/EMI levels to which the employees working in traction power facilities would be exposed would be lower than the applicable HST project MPE standards for human exposure in controlled environments. Negligible effects would result from corrosion of underground pipelines, cables, and adjoining rails, because installation of standard corrosion protection will eliminate risk of substantial corrosion.

Operation of the alignment alternatives and the HMF could result in EMI with medical imaging equipment exposed to the range of 1 to 3 mG. These EMFs would have negligible effects on sensitive receptors, provided that typical magnetic shielding is installed.

Standard HST 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 grounding of fences and coordination with adjoining railroads to implement suitable track signal equipment on adjoining railroad tracks.

B. NO PROJECT ALTERNATIVE

As discussed in Chapter 1.0, Project Purpose, Need, and Objectives of the Project, and Section 3.18, Regional Growth, the population in the San Joaquin Valley is growing and is projected to continue growing. Section 3.19, Cumulative Impacts, provides foreseeable future projects, which include shopping centers, industrial parks, transportation projects, and residential developments. These development and transportation infrastructure projects are planned or approved to accommodate the growth projections in the area. The use of electricity and RF communication equipment, including high-voltage power lines and directional and non-directional (cellular and broadcast) antennas that result in EMFs and EMI, currently occurs and would continue to occur along the Fresno to Bakersfield Section. Under the No Project Alternative, future conditions would be likely to result in additional use of electricity and RF communications, consistent with that found in the urban and rural environments in the study area today. It is reasonable to assume

that by 2035, the use of electricity and RF communications would increase because of increased development, increased use of electrical devices, and technological advances in wireless transmission (such as wireless data communication). As a result, generation of EMFs and EMI that might affect people and sensitive facilities would continue in the area.

C. HIGH-SPEED TRAIN ALTERNATIVES

The populations and facilities close to the HST that could be affected by exposure to HST-related EMFs and EMI include medical laboratories, research and technology parks, dense housing developments, schools and colleges, employees, underground pipelines and cables, fences, and existing railroads.

Construction Period Impacts

There would be negligible EMF or EMI impacts under NEPA and less than significant impacts under CEQA during construction of the HST alternatives because construction equipment generates low EMF and EMI levels. The only EMI that might be generated during construction would be occasional licensed radio transmissions between construction vehicles.

Project Impacts

Common EMF/EMI Impacts

The operation of any of the project alternatives would result in human exposure to electric and magnetic fields; standard HST design provisions would avoid the potential for corrosion of underground pipelines and cables, nuisance shocks, effects on adjacent existing rail signal systems. The following sections discuss different types of potential EMI/EMF effects.

Human Exposure

Operation of the HST would generate 60-Hz electric and magnetic fields on and adjacent to trains, including in passenger station areas. Table 3.5-3 presents the HST project model results that apply to the alignment alternatives.

Table 3.5-3
Summary of HST EMF Modeling Results

EMF Analysis	Platform – 16 feet from HST Alignment Centerline	Fence Line – 30 feet from HST Alignment Centerline	Study Area – 350 feet from HST Alignment Centerline
Magnetic Field (mG) Single-Train HST	720	73	Less than 1

EMF = electromagnetic field
HST = high-speed train
kV/m = kilovolts per meter
mG = milligauss

Source: Authority and FRA 2011.

Magnetic field measurements have been made in the passenger compartment onboard other HST systems such as the Acela Express (119 mg) and French TGV A (165 mG) and in the operator's cab of the Acela Express (58 mg) and French TGV A (367 mG) (FRA 2006). Because the modeled levels of EMF exposure listed in Table 3.5-3 and measurements on other existing HSTs are below

the MPE limits of 5 kV/m and 9,040 mG for the public, the HST alternatives would have negligible effects under NEPA from EMF exposure to people. Under CEQA, the impacts are considered to be less than significant.

It is expected that the effects to the general public also would be less than significant for people with implanted medical devices, as it has been determined that sensitivity ranges from 1.5 kV/m upward. Magnetic fields of 1,000 to 12,000 mG (1 to 12 G) may interfere with implanted medical devices (EPRI 2004). The American Conference of Governmental Industrial Hygienists has recommended magnetic and electric field exposure limits of 1,000 mG and 1 kV/m, respectively, for people with pacemakers (ACGIH 1996). These levels would occur only inside traction power facilities, which are unmanned and inaccessible to the general public.

The HST EMF analyses indicate that the EMFs generated by an HMF would be less than significant for the main line because HST trains would operate at much lower speeds and would have much lower acceleration rates at the HMF, whether entering or exiting the site or during maintenance and testing. When the trains operate at low speeds and have low acceleration rates, they draw much less current through the OCS and thus produce lower magnetic fields.

EMF impacts on people in nearby schools, businesses, colleges, and residences would be expected to be below the IEEE Standard 95.6 MPE limit of 9,040 mG for the public because, even within the mainline right-of-way, these levels are not expected to be reached. These effects would be negligible under NEPA since the HST will increase magnetic field exposure slightly but not to the level of the IEEE Standard. Under CEQA, the impact would be less than significant.

The IEEE Standard C95.6 MPE for controlled environments in which employees work is 27,120 mG (27.12 G). Because the EMF levels at the HMF are expected to be no higher than on an active rail line, the effect of EMFs on employees at the HMF would be negligible under NEPA. Under CEQA, the impact would be less than significant.

Employees with Implanted Medical Devices

EMF levels above the recommended limits for employees with implanted medical devices could exist inside traction power facilities. Traction power facilities sites would be unmanned and workers would enter them only periodically, for example, to perform routine maintenance. Any exposure to EMF levels above those recommended for implanted medical devices could result in health effects, including death. For this reason, effects on the health of workers with implanted medical devices could be substantial under NEPA. Under CEQA, impacts could be significant.

Sensitive Equipment

As indicated in Table 3.5-2 above, three potentially sensitive receptors were identified within the 500-foot study area. All three receptors are along the Bakersfield South Alternative and are sites that use medical imaging. As such, the typical susceptibility levels would be in the range of 1 to 3 mG. At the time of the baseline survey, one of the sensitive receptors, the Sierra Radiology Group, was no longer occupied or operating. Due to the proximity of sensitive imaging equipment and other medical devices, the potential exists for EMI to occur, which would result in a substantial effect under NEPA and a significant impact under CEQA.

Corrosion of Underground Pipelines and Cables and Adjoining Rail

TPSSs located every 30 miles would deliver AC current to the HSTs 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 HST

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, and Seismicity). 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 separately ground pipelines and other linear metallic objects in coordination with the affected owner or utility, as part of the construction of the HST System. Alternatively, insulating joints or couplings may be installed in continuous metallic pipes to prevent current flow.

The possibility for corrosion from ground currents would be avoided by installing supplemental grounding or insulating sections in continuous metallic objects in accordance with standard HST designs. Because the potential for corrosion is slight and would be avoided, the effect would be considered negligible under NEPA. Under CEQA, the impact would be less than significant.

Nuisance Shocks

The voltage 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 HST alignment. This effect would be more likely where long (1 mile or more), ungrounded fences or irrigation systems are parallel to the HST, 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, since 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. In the project vicinity, most people live in the urban areas of the cities of Fresno, Hanford, Corcoran, Wasco, Shafter, and Bakersfield.

To avoid possible shock hazards, the project design includes grounding of HST fences and the grounding of non-HST parallel metal fences and parallel metal irrigation systems within a to-be-determined specified lateral distance of the HST 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 would be negligible under NEPA and impacts would be less than significant under CEQA.

Effects on Adjacent Existing Rail Lines

Signal systems control the movement of trains on the existing BNSF tracks that one HST 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.

with the engineering department of freight railroads that parallel the HST 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. These standard design practices include assessment of the specific track signal and communication equipment in use on nearby sections of existing rail lines, evaluation of potential impacts of HST EMFs and RFI 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 HST. With regard to the impacts of the alternative HMF sites on underground infrastructure, none of the HMF sites have existing underground pipelines, cables, or other conduits. Therefore, the possibility of effects on the adjacent railroad would be negligible under NEPA. Under CEQA, potential impacts would be less than significant.

3.5.6 Mitigation Measures

The HST project would comply with applicable federal and state laws and regulations. Similarly, project design will follow the EMCPP to avoid EMI/EMC conflicts and to ensure the HST operational safety. The Final Program EIR/EIS for the Proposed California HST System (Authority and FRA 2005) mitigation strategies have been refined and adapted for this project EIR/EIS. During project design and construction, the following mitigation measures (MM) would be implemented to reduce the potential for impacts to human health:

EMF/EMI-MM#1: Protect workers with implanted medical devices. Implement a safety program that includes disclosure of health risks to employees who have implanted medical devices. To protect their health and safety, the safety program precludes workers with implanted medical devices from entering any facility with electrical equipment that could endanger them. This program will include posting warnings as need in high EMF areas such as parts of the HMF and at TPSS to discourage access by employees or visitors who have implanted medical devices.

EMF/EMI-MM#2: Protect sensitive equipment. The Authority will coordinate with affected sensitive medical or research equipment users regarding the potential impacts of HST–related EMF or RF interference on imaging equipment, and make suitable design provisions to prevent interference. The design provisions may include establishing magnetic field shielding walls around sensitive equipment or installing RF filters into sensitive equipment.

3.5.7 NEPA Impacts Summary

The following list summarizes the impacts identified in Section 3.5.5, Environmental Consequences:

- Negligible effects would occur during construction.
- Human exposure to EMF affecting people at station platforms, on the trains, and in the HMFs would be negligible.
- Impacts on sensitive receptors along the alignment or near the HMF site would be negligible.
- With implementation of the HST safety program (MM#1) at HST traction power facilities, exposure of HST workers who have implanted medical devices would be avoided and not result in adverse effects on their health. The impact after mitigation would be negligible.

- During operation, under the Bakersfield South Alternative Alignment, the worst-case EMFs are 1.8 mG at the edge of Mercy Hospital closest to the centerline of the HST right-of-way. Hence, EMI may occur to medical imaging equipment in the study area if the equipment is unshielded. In the absence of effective mitigation measures, these effects could be substantial.
- Grounding systems and/or installation of insulating joints or couplings would prevent corrosion of underground pipelines and cables along the alternatives and the HMF site. With appropriate prevention measures, these effects would be negligible.
- Grounding fences and irrigation systems would prevent nuisance shocks to people touching ungrounded metal fences and ungrounded metal irrigation systems that could result in health effects. The Vermeer-type metal irrigation systems are on metal wheels; therefore, they would be grounded through the wheels. Any surface pipe would be grounded through ground surface contact, so the only issue would be a center pivot system with rubber tires. With appropriate grounding, these effects would be negligible.

3.5.8 CEQA Significance Conclusion

The project would comply with applicable federal and state regulations and implement design strategies as outlined in the Final Statewide Program EIR/EIS (Authority and FRA 2005). Table 3.5-6 summarizes the remaining significant EMF/EMI impacts.

Table 3.5-6
Summary of Potentially Significant EMI/EMF Impacts and Mitigation Measures

Impact	Level of Significance before Mitigation	Mitigation Measure	Level of Significance after Mitigation
Construction Period Impacts			
No significant impacts would occur during construction.			
Project Impacts			
EMF/EMI Impact #1. Effects on workers with implanted medical devices. Under all alternatives, workers with implanted medical devices could be affected by work at electrical facilities.	Significant	EMF/EMI-MM#1	Less than significant
EMF/EMI Impact #2: Sensitive equipment. Under the Bakersfield South Alternative Alignment, the worst-case EMFs are 1.8 mG at the edge of Mercy Hospital closest to the centerline of the HST right-of-way. Hence, EMI may occur to sensitive medical devices or imaging equipment potentially in the study area if the equipment is unshielded.	Significant	EMF/EMI-MM#2	Less than significant
EMF = electromagnetic field EMI = electromagnetic interference mG = milligauss			