

PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Safety and Enforcement Division
Electric Safety and Reliability Branch

Resolution SED-2
November 10, 2016

RESOLUTION

RESOLUTION SED-2 ADOPTING SAFETY REQUIREMENTS GOVERNING THE DESIGN, CONSTRUCTION, INSTALLATION, OPERATION, AND MAINTENANCE OF THE 25 kV AC (Alternating Current) RAILROAD ELECTRIFICATION SYSTEM OF THE PENINSULA CORRIDOR JOINT POWERS BOARD (CALTRAIN) ON THE SAN FRANCISCO PENINSULA RAIL CORRIDOR

PROPOSED OUTCOME:

- This Resolution adopts safety requirements for the design, construction, installation, operation, and maintenance of the Peninsula Corridor Joint Powers Board's ("JPB's") conversion of its rail lines on the San Francisco Peninsula Rail Corridor from diesel-electric locomotive trains to new 25 kilovolt (kV) alternating current (AC) electric trains.

SAFETY CONSIDERATIONS:

- Electrification of the San Francisco Peninsula Rail Corridor by JPB will have environmental and transportation benefits for local and State residents. This Resolution will enhance safety by requiring JPB to comply with the adopted safety requirements.

ESTIMATED COST:

- Costs of compliance with the safety requirements are unknown.

SUMMARY

In this Resolution, the Commission adopts the Requirements for Caltrain 25 kV AC Railroad Electrification System (Requirements) contained in Appendix A. These Requirements govern the design, construction, installation, operation, and maintenance for a new 25 kV AC electrification system that is to be owned and operated by JPB (also called Caltrain) along 51.4 route-miles of railroad line between San Jose and San Francisco, California.

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The adopted Requirements are intended to supplement Commission General Order (GO) 95, GO 128, GO 165, GO 26-D, and those requirements in Federal Pipeline Safety Regulations (Title 49 of the Code of Federal Regulations (49 CFR), Parts 191, 192, 193, and 199) or any guidelines promulgated for 49 CFR implementation.

BACKGROUND

Passenger service on the San Francisco Peninsula Rail Corridor began in 1863, under the authority of the San Francisco and San Jose Railroad Company. In 1870, Southern Pacific Transportation Company (Southern Pacific) acquired the San Francisco and San Jose Railroad Company. Southern Pacific double-tracked the line in 1904, and operated passenger service in the corridor until after World War II. Changing commute patterns affected Southern Pacific along with private carriers all over the country. Southern Pacific petitioned to abandon passenger service in 1977.

From 1980 until mid-1992, Caltrans contracted with Southern Pacific to provide passenger service in the corridor, sharing operating subsidies with San Francisco, San Mateo, and Santa Clara counties until JPB was created.¹ JPB agreed to assume operating responsibilities for the passenger service effective July 1, 1992. In December 1991, JPB purchased the rail right-of-way between San Francisco and San Jose from Southern Pacific.²

Caltrain is a commute alternative to the congested US 101 and Interstate 280 corridors that connect the economic centers of San Francisco and Silicon Valley. Caltrain has experienced six years of consecutive ridership growth and is currently running at operating capacity. It operates 96 passenger trains/day on the 51.4 route-miles of track between San Francisco and San Jose, with a top speed of 79 mph. Caltrain's 34 stations serve approximately 60,000 passengers each weekday and a total of nearly 19.2 million passengers annually.

When Caltrain took over passenger service operations, much of the rail line's infrastructure dated back to the early 1900's. Caltrain has invested hundreds of millions of dollars in the railroad and has decreased travel times between San Jose and San Francisco to within one hour, making the train trip competitive with driving. While much work has been done to improve the railroad, the Caltrain system continues to use an aging diesel train technology that is reaching the end of its useful life. Caltrain primarily deploys 5- or 6-passenger car trains powered by diesel push/pull locomotives, whose operating performance is far below that of modern electric trains.

¹ JPB is a state-authorized joint powers authority controlled by the three counties where Caltrain operates: San Francisco, San Mateo, and Santa Clara counties. See: the Peninsula Rail Transit District, Pub. Util. Code 160000 et seq., and Sections 99420 (joint powers boards for transit) and 99636 ("Allocation for Caltrain capital improvements and acquisition of rights-of-way").

² The Union Pacific Railroad (as successor to Southern Pacific) retains the right to operate freight and intercity passenger trains between San Francisco and San Jose.

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Caltrain has been planning the modernization of its San Francisco-San Jose passenger service for more than ten years. The modernization program to electrify and upgrade the performance, operating efficiency, capacity, safety, and reliability of Caltrain's commuter rail service currently is scheduled to be implemented by 2021. It has obtained environmental approval at both the State and federal levels.

The Peninsula Corridor Electrification Project is a key component of the Caltrain modernization program and consists of converting Caltrain from diesel-hauled passenger rail cars to Electric Multiple Unit (EMU) trains for service between Caltrain's San Francisco Station (at the intersection of Fourth and King Streets in San Francisco)³ and Tamien Station in San Jose. The project will entail the installation of new electrical infrastructure and the purchase of electrified rail cars. EMU trains will be much lighter than the diesel trains, with the ability to accelerate and decelerate faster than diesel trains; this improvement will allow for increased capacity on the corridor. The Final Environmental Impact Report was adopted on January 8, 2015, and a contract was awarded on July 15, 2016, to complete the design and construct the project.

Caltrain will continue diesel passenger service between San Jose and Gilroy, and will continue to support freight and other rail service by existing tenants on the corridor between San Francisco and Gilroy.

Caltrain describes that, while its modernization project does not include all infrastructure that would be necessary to implement high-speed rail service on the corridor, Caltrain is coordinating with the California High-Speed Rail Authority to ensure that Caltrain's electrical infrastructure, including the overhead wire systems, will be compatible with later blended Caltrain and high speed rail service along the corridor.

In 2007, Caltrain asked the Commission to develop a general order of statewide applicability for commuter rail providers with 25 kV AC electrification systems, in Petition (P.) 07-06-028. At Caltrain's request, the Commission dismissed that petition in Decision (D.) 07-12-062. About two years later, Caltrain filed Application (A.) 09-06-009, asking instead for certain variances from General Order 95 that it believed would permit the electrification of its rail line. Following the filing of protests in that proceeding, Caltrain filed a motion to dismiss its application, stating that it preferred to resolve other parties' concerns outside of a Commission proceeding. The Commission dismissed A.09-06-009 in D.09-07-054.

In October 2012, the California High-Speed Rail Authority filed a petition for rulemaking to consider regulations and safety standards for the use of 25 kV AC electric lines to power

³ A "Downtown Extension" project is being undertaken by the Transbay Terminal Joint Powers Authority (of which Caltrain is a member), to construct and own a 1.3 mile segment of track between Caltrain's existing San Francisco Station and the Transbay Terminal. Caltrain plans to operate its passenger trains to the Transbay Terminal. However, the Requirements in Appendix A apply only where Caltrain owns the right-of-way, and thus do not apply to the Downtown Extension.

high-speed trains. The Commission granted the petition and, in D.15-03-029 in Rulemaking 13-03-009, adopted General Order 176. GO 176 contains rules applicable to high-speed rail passenger systems that have 25 kV AC electrification systems and that are “capable of operating at speeds of 150 miles per hour or higher, located in dedicated rights-of-way with no public highway-rail at-grade crossings and in which freight operations do not occur.”

Caltrain has continued to pursue its electrification project. In 2015, Caltrain initiated discussions with Commission staff about safety requirements that would apply only to its proposed 25 kV AC electrification of the San Francisco-San Jose rail corridor. Since that time, there has been a series of meetings between Commission staff, Caltrain, and other interested entities; Caltrain also has worked separately with Communication Infrastructure Providers and other entities with facilities crossing, or in the vicinity of, the Caltrain right-of-way, in an effort to address concerns related to their facilities and operations. These efforts have led to the proposed Requirements in Appendix A to this Resolution.

DISCUSSION

SED recommends that the Requirements for Caltrain 25 kV AC Railroad Electrification System in Appendix A be adopted through a Resolution, rather than through a Rulemaking proceeding, because these safety requirements will apply only to Caltrain’s 25 kV AC electrification system and not to any other rail operations.

In contrast to the high-speed rail facilities addressed by GO 176, Caltrain’s electrified railroad system will be located in an existing non-dedicated, partially unfenced right-of-way through a highly developed urban setting with multiple public highway-rail at-grade crossings and in which freight and other non-Caltrain rail operations occur. Nevertheless, because Caltrain plans a 25 kV AC electrification system for its rail operations, significant portions of GO 176 can be applied to Caltrain’s system. As a result, the basis of the Requirements in Appendix A was formed from a composite of pertinent sections of GO 176, GO 95, and GO 26-D, with modifications and additions as needed to tailor the safety requirements to the unique characteristics of the Caltrain corridor and the Caltrain electrification project.

Caltrain has identified several advantages of its planned electrified service compared to existing diesel power use, including:

- Improved Train Performance, Increased Ridership Capacity and Increased Service. Electrified trains can accelerate and decelerate more quickly than diesel-powered trains, allowing Caltrain to run more safely and efficiently. In addition, because of their performance advantages, electrified trains will enable more frequent and/or faster train service to more riders.
- Increased Revenue and Reduced Fuel Costs. The electrification upgrades will allow increase ridership and revenues while decreasing fuel costs.

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- Reduced Engine Noise Emanating from Trains. Noise from electrified train engines is measurably less than noise from diesel train engines. Train horns will continue to be required at grade crossings, consistent with safety regulations.
- Improved Regional Air Quality and Reduced Greenhouse Gas Emissions. Electrified trains will produce substantially less corridor air pollution compared with diesel trains. Increased ridership is expected to reduce automobile usage, resulting in additional air quality benefits. The reduction of greenhouse gas emissions is not only good for the regional air quality, but also will help meet the State's emission reduction goals.
- Electrical Infrastructure Compatible with High-Speed Rail. While this project will not include all infrastructure necessary to implement high-speed rail service on the corridor, Caltrain's electrical infrastructure (such as overhead wire systems) is expected to be compatible with later blended service.

SED, Caltrain, and other interested parties have developed the Requirements in Appendix A to protect public and worker safety. Factors specific to the Caltrain corridor that have been considered include the following:

- Right-of-way that has been in operation for over 150 years and includes a mix of local and express (up to 79 mph) passenger trains;
- Rails that are shared with freight and tenant passenger lines (ACE, Capitol Corridor, and Amtrak Long-Distance);
- Openness of the right-of-way to public access except in limited areas (in which it is fenced to discourage trespassers); and
- Multiple public highway-rail at-grade crossings and existing utility installations.

The Requirements in Appendix A include, among other provisions, the following types of safety measures:

- Protective measures that Caltrain will implement to protect the public from contact with its facilities;
- Protective measures that other entities, including electric and gas utilities, municipalities, and Communication Infrastructure Providers will implement to protect against accidental contact of their facilities with the electrification system;
- Requirements to ensure the safe operation of the electrification system;
- Measures that Caltrain will implement against a failure of its system;
- Inspection and maintenance requirements for the electrification system to ensure that the system is in good condition and is conforming to the Requirements; and

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- Incident reporting and investigation procedures for incidents meeting criteria specified in the Requirements. Caltrain will report such incidents to the Commission and the Governor's Office of Emergency Services.

In addition, Caltrain has agreed to address any violations of the Requirements immediately upon discovery. If an entity other than Caltrain or its contractors (including subcontractors) caused the violation, Caltrain will contact the responsible entity to provide notice of the violation. Caltrain will create and maintain documentation regarding violations of these Requirements, which Commission staff will be permitted to inspect consistent with Public Utilities Code Section 314(a). This documentation will include the following:

- The Requirement that was violated;
- Date that Caltrain became aware of the problem;
- Facility and location of the violation;
- Inspector or other Caltrain personnel identifying the violation;
- If Caltrain was responsible for the violation:
 - Scheduled date of corrective action;
 - Date that corrective action was completed;
- If an entity other than Caltrain caused the violation:
 - Date that Caltrain notified that entity of the problem; and
 - Date that Caltrain learned that corrective action had been completed.

As a result of the analysis and efforts described above, SED recommends, and the Commission agrees, that the Requirements for Electrification of Caltrain 25 kV AC Railroad System in Appendix A should be approved. These Requirements will provide necessary engineering specifications for the safe design, construction, installation, operation, and maintenance of Caltrain's planned electrification system and will allow Caltrain to increase the capacity of its passenger rail service between San Jose and San Francisco with concurrent environmental and rail service benefits to the corridor communities.

NOTICE

On October 7, 2016, this Resolution was published on the Commission's Daily Calendar and was served on the service list for the GO 176 proceeding R.13-03-009, and on other entities including, but not limited to, cities and counties along the Caltrain corridor, freight companies, other passenger rail companies, electric bus and transit systems, entities with facilities crossing over the Caltrain right-of-way, labor unions, and interested parties from the prior Caltrain proceedings P.07-06-028 and A.09-06-009.

COMMENTS

The proposed resolution of the Safety and Enforcement Division in this matter was mailed in accordance with Section 311 of the Public Utilities Code and Rule 14.2(c) of the Commission's Rules of Practice and Procedure. _____ comments were received.

FINDINGS

1. In 2015, Caltrain initiated discussions with Commission staff about safety requirements that would apply only to its proposed 25 kV AC electrification of the San Francisco-San Jose rail corridor. After discussions among a wide range of interested entities, SED recommends that the Commission adopt the Requirements for Caltrain 25 kV AC Railroad Electrification System (Requirements) contained in Appendix A to this Resolution.
2. GO 176 does not apply to the Caltrain project. While it contains rules for 25 kV AC electrification of rail systems, it applies only to high-speed rail operations in dedicated rights-of-way with no public highway-rail at-grade crossings and in which freight operations do not occur.
3. The basis of the Requirements in Appendix A was formed from a composite of pertinent sections of GO 176, GO 95, and GO 26-D, with modifications and additions as needed to tailor the safety requirements to the unique characteristics of the Caltrain corridor and the Caltrain electrification project.
4. The Requirements in Appendix A will provide necessary engineering specifications for the safe design, construction, installation, operation, and maintenance of Caltrain's planned electrified system and will allow Caltrain to increase the capacity of its passenger rail service between San Jose and San Francisco with concurrent environmental and rail service benefits to the corridor communities.
5. It is reasonable to adopt the Requirements for Caltrain 25 kV AC Railroad Electrification System contained in Appendix A, to apply only to the 25 kV AC electrification system constructed on the Caltrain-owned right-of-way between San Francisco and San Jose.

THEREFORE, IT IS ORDERED THAT:

1. The Requirements for Caltrain 25 kV AC Railroad Electrification System (Requirements) contained in Appendix A are adopted as minimum requirements for the construction, design, operation, and maintenance of the 25 kV AC electrification system that is planned by the Peninsula Corridor Joint Powers Board (Caltrain).
2. The adopted Requirements supplement Commission General Order (GO) 95, GO 128, GO 165, GO 26-D, and those requirements in Federal Pipeline Safety Regulations (Title 49 of the Code of Federal Regulations (49 CFR), Parts 191, 192, 193, and 199) or any guidelines promulgated for 49 CFR implementation.

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3. Caltrain must address immediately upon discovery any violations of the adopted Requirements. If an entity other than Caltrain or its contractors (including subcontractors) caused the violation, Caltrain must contact the responsible entity to provide notice of the violation. Caltrain must create and maintain documentation regarding violations of these Requirements, which Commission staff will be permitted to inspect consistent with Public Utilities Code Section 314(a). This documentation must include the following:
 - a. The Requirement that was violated;
 - b. Date that Caltrain became aware of the problem;
 - c. Facility and location of the violation;
 - d. Inspector or other Caltrain personnel identifying the violation;
 - e. If Caltrain was responsible for the violation:
 - i. Scheduled date of corrective action;
 - ii. Date that corrective action was completed;
 - f. If an entity other than Caltrain caused the violation:
 - i. Date that Caltrain notified that entity of the problem; and
 - ii. Date that Caltrain learned that corrective action had been completed.
4. This resolution is effective today.

I certify that the foregoing resolution was duly introduced, passed and adopted by the Commission at its regularly scheduled meeting on November 10, 2016. The following Commissioners voted favorably thereon:

TIMOTHY J. SULLIVAN
Executive Director

Appendix A

REQUIREMENTS FOR CALTRAIN 25 kV AC
RAILROAD ELECTRIFICATION SYSTEM

Appendix A

REQUIREMENTS FOR CALTRAIN 25 kV AC RAILROAD ELECTRIFICATION SYSTEM

1. GENERAL

1.1 PURPOSE

The purpose of these Requirements for Caltrain 25 kV AC Railroad Electrification System (Requirements) is to establish uniform safety requirements governing the design, construction, installation, operation and maintenance of 25 kV AC (alternating current) electrification facilities of Peninsula Corridor Joint Powers Board (PCJPB or JPB).

These Requirements apply only to the 25 kV AC Electrification System constructed on the Caltrain Corridor, serving an electrified railroad system (ERS) located in non-dedicated rights-of-way with public highway-rail at-grade crossings and in which freight operations may occur.

The basis of these Requirements is a composite of pertinent sections of General Order 176, as adopted by Decision 15-03-029, issued April 3, 2015; General Order 95 (Revision January 2016); General Order 26-D (Revision December 3, 1981); and AREMA manuals (Revision 2016).

The Peninsula Corridor Joint Powers Board (PCJPB or JPB), also known as Caltrain, owns and operates a commuter rail service on a 77-mile corridor between the cities of San Francisco and Gilroy. It is undertaking the Peninsula Corridor Electrification Project, which will electrify the portion of the Caltrain Corridor between San Francisco and San Jose (approximately between San Francisco milepost (MP) 0.0 to the Southbound Home Signals at C.P. Lick, Caltrain MP 50.94/Union Pacific MP 51.64).

These Requirements require coordination and cooperation of Caltrain and non-Caltrain facility owners so that the facilities of both parties are not prevented from performing as required or intended. Nothing in these Requirements will prevent JPB from entering into agreements with non-Caltrain facility owners that establish stricter standards than and/or additional requirements to those specified in these Requirements.

1.2 APPLICATION

These Requirements apply to the design, construction, installation, operation and maintenance of the 25 kV AC Electrification System for an ERS, which comprises:

- a. Overhead Contact System (OCS)
- b. Negative Feeders (where used)
- c. Traction Power Return System

These Requirements apply to all such installations that are planned, acquired or constructed on or after the effective date of these Requirements.

With the exception of Section 9.2, these Requirements do not apply to Caltrain traction power supply facilities, which include Substations, Switching Stations, Paralleling Stations and electrical supply stations. The application of Section 9.2 to such facilities shall not limit or expand the otherwise applicable authority of the Commission to regulate such facilities.

1.3 DESIGN, CONSTRUCTION AND MAINTENANCE

25 kV AC Electrification Systems shall be designed, constructed, installed, and maintained for their intended use, regard being given to the conditions under which they are to be operated to enable the furnishing of safe service, to secure the safety of workers, the public in general, and passengers, to prevent damage to the electrification system components, and to allow adjacent non-Caltrain facilities to perform as required and intended.

Subject to Section 1.7, for all particulars not specified in these Requirements, JPB will be in compliance with these Requirements if it designs, constructs and maintains a facility in accordance with industry accepted good practice, such as American Railway Engineering and Maintenance-of-Way Association (AREMA) Manual for Railway Engineering, Federal Railroad Administration (FRA), NESC and OSHA standards and guidelines for the intended use and known local conditions.

1.4 COOPERATION

JPB, in designing, constructing, installing, or operating a 25 kV AC Electrification System adjacent to or in close proximity to other conductive facilities, such as rail, pipeline, cable, communications, grounded systems, or electric transmission and distribution lines, electric bus and electric transit operators shall confer with the other party or parties concerned to avoid or minimize adverse impacts on the facilities or operations of the other party or parties. Prior to construction, installation, or operation, the party designing the 25 kV AC Electrification System shall include the use of proven and verified software during modeling and design to determine potential adverse impacts on the facilities or operations of the other party or parties and shall include the use of testing prior to operation to avoid any such adverse impacts on the facilities or operations of the other party or parties.

Other public utilities located adjacent to or near such system shall cooperate during such modeling, testing, and efforts to mitigate adverse impacts to either of the proximate facilities or systems. If it is impracticable to avoid the adverse impact, the adverse impact shall be minimized to the parties' mutual satisfaction. Where JPB is seeking to design, construct, install, or operate a 25 kV AC Electrification System and has entered into an agreement establishing additional rights and obligations or stricter standards than these requirements with respect to adverse impacts, such agreements shall govern such matters.

With regard to any dispute between the JPB and electrical (including any dark fiber enterprise), gas and communications utilities, and electric bus and electric transit operators, such parties shall cooperate with regard to the remediation of adverse impacts, with the JPB, electrical and gas utilities, and electric bus and electric transit operators responsible for the remedy of the adverse impacts in proportion to their respective shares of the cause. The remedy shall allow the affected facilities to

perform as required or intended. In the event JPB has entered into an agreement with such utilities for cost allocation, such agreements shall govern.

1.5 DISPUTE RESOLUTION

Parties to disputes arising under these Requirements shall first attempt to resolve their dispute informally. Any party to such a dispute may request to utilize the Commission's Alternative Dispute Resolution processes for this purpose.

If informal dispute resolution is unsuccessful, any party to a dispute related to the design, construction, and maintenance of the 25 kV AC Electrification System arising under these Requirements may seek appropriate relief from the CPUC, or any other appropriate venue.

Nothing set forth in this Section 1.5 or these Requirements will (1) alter, expand or enlarge the Commission's jurisdiction over publicly-owned utilities including without limitation, with respect to cost allocation, relocation, and local right-of-way management, or (2) operate as a waiver of any jurisdictional arguments regarding the same.

1.6 ABBREVIATIONS

AREMA	American Railway Engineering and Maintenance-of-Way Association
AREMA Manual	AREMA Manual for Railway Engineering
CPUC or Commission	California Public Utilities Commission
EN	Euro Norm - European Standards
ERS	Electrified Rail System
GO	General Order
NESC	National Electrical Safety Code

1.7 CONTROLLING PROVISIONS

These Requirements apply exclusively to the Electrified JPB Rail Right-of-Way and are intended to supplement Commission General Order 95, General Order 128, General Order 165, General Order 26-D, and those requirements in Federal Pipeline Safety Regulations (Title 49 of the Code of Federal Regulations (49 CFR), Parts 191, 192, 193, and 199) or any guidelines promulgated for 49 CFR implementation (collectively, "Existing Commission and Federal Rules").

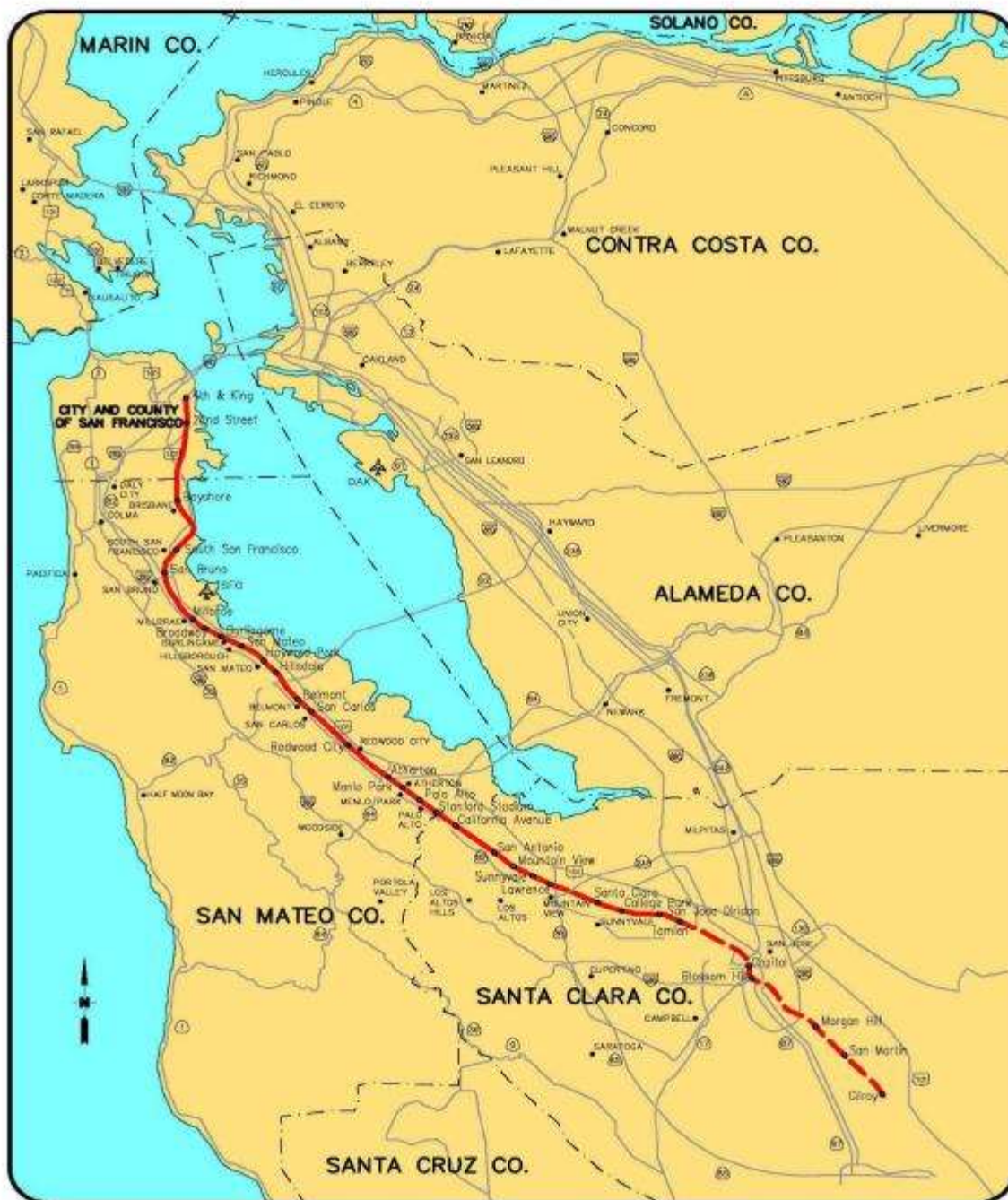
2. PENINSULA CORRIDOR JOINT POWERS BOARD (PCJPB)

2.1. CALTRAIN

The Peninsula Corridor Joint Powers Board (PCJPB or JPB), also known as Caltrain, owns and operates a commuter rail service on a 77-mile corridor between the cities of San Francisco and Gilroy.

The Peninsula Corridor Joint Powers Board is a state-authorized joint powers authority comprised of the three counties where Caltrain operates: San Francisco, San Mateo, and Santa Clara Counties. PCJPB owns approximately 52 route-miles of rail corridor between San Francisco and San Jose, and an additional approximately 25 miles of trackage rights from San Jose to Gilroy. San Mateo County Transit District (SamTrans) provides administrative and staff support for PCJPB. See FIGURE 1 -1 CALTRAIN SYSTEM MAP.

SAN FRANCISCO BAY AREA



Caltrain corridor



UPRR corridor (JPB trackage rights)

FIGURE 1-1 CALTRAIN SYSTEM MAP

2.2. NON-ELECTRIFIED RAIL OPERATORS

Freight and other passenger rail operations exist in the corridor that will not be electrified. Caltrain's electrified operations must be designed and operated for the safe operations of freight and other non-electrified rail operators in the corridor.

2.3 ELECTRIFIED TRANSIT SYSTEMS

Electrified transit systems exist along the Corridor. Caltrain's electrified operations must be designed and operated to ensure the safe operations of rail transit in the corridor.

3. DEFINITIONS

3.1. 25 KV AC ELECTRIFICATION SYSTEM

The Overhead Contact System, Negative Feeders, and Traction Power Return System used to power electrified trains in the Electrified JPB Rail Right-of-Way. Traction power Substations, Switching Stations, Paralleling Stations and electrical supply stations are not included in this definition.

3.2. AUTHORIZED PERSON

A person, who has been authorized by Caltrain or holds existing legal rights to enter the Restricted Area.

3.3. AUTOTRANSFORMER

Apparatus in an electrification system which helps boost the catenary voltage and reduce the Running Rail return current in the 2x25 kV Autotransformer Feed configuration. It uses a single winding having three terminals.

3.4. AUTOTRANSFORMER FEED SYSTEM

A traction power feeding system in which the main transformers and Autotransformers are fitted with a single secondary winding having three terminals. The intermediate terminal, located at the midpoint of the winding, is connected to the Running Rails/ground/Static Wire. The other two are connected to the catenary conductors and to the parallel Negative Feeder(s) respectively, giving rise to the 2x25 kV designation for this feeding system.

3.5. BARRIER

Equipment preventing entry by an unauthorized person to a Restricted Area, structure or building, and providing physical protection against direct contact with Energized Parts under normal circumstances.

3.6. BOND

An electrical connection between conductive elements for the purpose of maintaining a common electrical potential.

3.7. CALTRAIN

Caltrain means the Peninsula Corridor Joint Powers Board (PCJPB or JPB). Caltrain operates a commuter rail service on a 77-mile corridor between the cities of San Francisco and Gilroy.

3.8. CATENARY SYSTEM

That part of an Overhead Contact System that comprises a Messenger Wire

supporting a Contact Wire by means of a number of hangers.

3.9. CATHODIC PROTECTION

A technique to reduce the corrosion rate of a metal surface by making it the cathode of an electrochemical cell.

3.10. COMMUNICATIONS LINES

A conductor or system of communications conductors, including any supporting elements, located outside of buildings and through which an electric current flows or light is transmitted and is used for public or private communications service.

3.11. CONTACT WIRE

A solid grooved, bare aerial, overhead electrical conductor of an Overhead Contact System (OCS) that is suspended above the rail vehicles and which supplies the electrically powered vehicles with electrical energy through roof-mounted current collection equipment (Pantograph) and with which the current collectors make direct electrical contact.

3.12. COUNTERPOISE

A buried wire or a configuration of wires constituting a low resistance grounding system or portion of a grounding system.

3.13. ELECTRICAL CLEARANCES

- a) Passing (Dynamic) Electrical Clearance is defined as the minimum permissible clearance distance between the live parts of either the vehicle or OCS and the Grounded vehicle, overhead structure, or other adjacent fixed structure under dynamic operating conditions.
- b) Static Electrical Clearance is defined as the minimum permissible clearance distance between live parts of either a vehicle Pantograph or the OCS, and Grounded parts of either a vehicle or adjacent fixed structure, while the vehicle is stationary.
- c) Safety Clearance is the distance in a straight line between a standing surface accessible to persons and Energized Parts that is necessary to prevent direct contact with Energized Parts, without the use of objects, as defined in EN 50122-1: 2011 Protective Provisions Relating to Electrical Safety and Earthing - Section 5.

3.14. ELECTRICAL SECTION

The section of the OCS which, during normal system operation, is powered from a Substation (SS) feeder circuit breaker. The SS feed section is demarcated by the Phase Breaks of the supplying SS and by the Phase Breaks at the adjacent Switching Station (SWS) or line end.

3.15. ELECTRIFIED JPB RAIL RIGHT-OF-WAY

A JPB railroad right-of-way for an ERS, including main tracks and all related station, siding, lead and yard tracks. Includes both electrified and non-electrified facilities.

3.16. ELECTRIFIED RAIL SYSTEM (ERS)

A rail passenger system, located in non-dedicated rights-of-way with and without public highway-rail at-grade crossings and in which freight operations may occur.

3.17. ENERGIZED

Electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of the ground in the immediate vicinity.

3.18. ENERGIZED PART

A conductor or conductive part that is Energized under normal service conditions, but does not include the Running Rails or parts connected to them.

3.19. FAULT CONDITION

The presence of an unintended and undesirable conductive path in an electric power system.

3.20. FEEDER

A current-carrying electrical connection between the OCS and a traction power facility (Substation, Paralleling Station or Switching Station). Also, a conductor supported on the same structure as the OCS.

3.21. GROUNDED

Connected to earth through a ground connection or connections of sufficiently low impedance and having sufficient current-carrying capacity to limit the build-up of voltages which may result in undue hazard to persons or connected equipment.

3.22. GROUNDING CONDUCTOR

A conductor used to connect equipment or wiring systems to a ground electrode or ground grid.

3.23. HIGH VOLTAGE

A nominal voltage of 750 Volts or more.

3.24. IMPEDANCE BOND

An electrical device located between the rails consisting of a coil with a center tap used to bridge Insulated Rail Joints in order to prevent Track Circuit energy from bridging the insulated joint while allowing the traction return current to bypass the insulated joint. The center tap can also be used to provide a connection from the rails to the Static Wire and/or traction power facilities for the traction return current.

3.25. INSULATED RAIL JOINT

A joint in the Running Rail used to prevent Track Circuit energy on one side of the joint from leaking to the other side of the joint.

3.26. MESSENGER WIRE

A longitudinal bare stranded conductor that physically supports the Contact Wire and is electrically common with the Contact Wire.

3.27. OCS POLE

Vertical structural element supporting the Overhead Contact System equipment, which provides physical support, registration and/or termination of the OCS conductors including ancillary wires or cables.

3.28. OVERHEAD CONTACT SYSTEM (OCS)

The OCS comprises the aerial supply system that delivers 25 kV traction power from the Substations to the Pantographs of the electric trains, and includes the Catenary System Messenger and Contact Wires, feeder, auxiliary wires and hangers, associated Supports and structures (including poles, portals, headspans and their foundations), manual and/or motor operated isolators, insulators, Phase Breaks, conductor terminations and tensioning devices, downguys, and other overhead line hardware and fittings.

3.29. PANTOGRAPH

Current collector apparatus consisting of spring-loaded hinged arms mounted on top of electrically powered rail vehicles that provides a sliding electrical contact and collects current from the Contact Wire of the Overhead Contact System.

3.30. PARALLELING STATION (PS)

An installation which helps boost the catenary voltage and reduce the Running Rail return current by means of the Autotransformer feed configuration. The Negative Feeders and the catenary conductors are connected to the two outer terminals of the Autotransformer winding at this location with the central terminal connected to the rail return system. The OCS Electrical Sections can be connected in parallel at PS locations.

3.31. PHASE BREAK

An arrangement of insulators and Grounded or non-Energized wires or insulated overlaps, forming a neutral section, which is located between two sections of catenary that are fed from different phases or at different frequencies or voltages, under which a Pantograph may pass without shorting or bridging the phases, frequencies or voltages.

3.32. PRACTICABLE

Capable of being accomplished by reasonably available and economic means.

3.33. PUBLIC AREAS

All portions of the Electrified JPB Rail Right-of-Way that do not satisfy the definition of a "Restricted Area," including areas in passenger stations, grade crossings, and pedestrian crossings that are accessible to the general public.

3.34. QUALIFIED PERSONNEL

In regard to traction electrification system equipment, a JPB employee or contractor who has been trained in and has demonstrated adequate knowledge of the design, analysis, evaluation, specifications, installation, construction, maintenance, and operation of the electrification system equipment and the hazards involved.

3.35. RESTRICTED AREAS

Any tunnels, Substations, Switching Stations, Paralleling Stations or rail maintenance facilities.

3.36. RETURN CABLE

A conductor that forms part of the electrification system return circuit, and which connects the rest of the return circuit to the Substation.

3.37. RUNNING RAILS

The steel rails on which the rail vehicles run and which, in an electrified system, form part of the traction return circuit.

3.38. SCREEN

A Barrier that prevents unintentional direct contact with Energized Parts but does not totally prevent direct contact by deliberate action.

3.39. SHUNT CABLE

Has the meaning set forth in Section 4.1 of these Requirements.

3.40. STATIC WIRE

A wire, usually installed aerially adjacent to or above the catenary conductors and Negative Feeders, that connects OCS Supports collectively to ground or to the Grounded Running Rails to protect people and installations in case of an electrical fault. In an AC electrification system, the Static Wire (sometimes termed aerial ground wire) forms part of the traction power return circuit and is connected, via Impedance Bonds, to the Running Rails at periodic intervals and to the traction power facility ground grids.

3.41. SUBSTATION (SS)

An installation that supplies electrical energy to the OCS and Parallel Negative Feeders (where used), where the incoming High Voltage utility supply is transformed to the electrification system voltage.

3.42. SUPPORTS

The structural elements that support the conductors and their associated line hardware and insulators in an OCS.

3.43. SWITCHING STATION (SWS)

An installation at which electrical energy can be supplied to an adjacent, but normally separated Electrical Section during contingency power supply conditions. It also acts as a Paralleling Station.

3.44. TOUCH POTENTIAL (VOLTAGE)

The potential difference between two points which can be contacted simultaneously by a person's hands or feet. The conductive path through the body is conventionally deemed to be from hand to both feet, from foot to foot or from hand to hand.

3.45. TRACK CIRCUIT

An electrical circuit which uses the track rails as the conductors between transmit and receive devices, the limits of which are often defined by the location of insulated joints. The primary purpose of the Track Circuit is to detect an occupancy or interruption. It may also be used to convey information.

3.46. TRACTION POWER RETURN SYSTEM

The combination of track structure Running Rails, jumpers, Impedance Bonds, static and/or ground wires, and cables which form the path for the traction return current from the train wheels to the Substations.

3.47. TRACTION SYSTEM GROUND

The Traction System Ground consists of the Running Rails, the Static Wires and conductive parts connected thereto and which are connected to ground.

3.48. UPLIFT

The vertical distance by which the Overhead Contact System is raised during the passage of a Pantograph.

4. SYSTEM DESCRIPTION AND PERFORMANCE REQUIREMENTS

4.1. OVERHEAD CONTACT SYSTEM

The Overhead Contact System (OCS), as defined in Section 3.28, supplies power to the electrically powered rail vehicles at 25 kV. The 25 kV AC Electrification System will utilize a catenary configuration, which comprises an Energized and current carrying Messenger Wire (MW) to support a Contact Wire (CW) by means of in-span wire hangers. The typical configuration shown in Figure 4-1 may not have right-of-way fences in some locations.

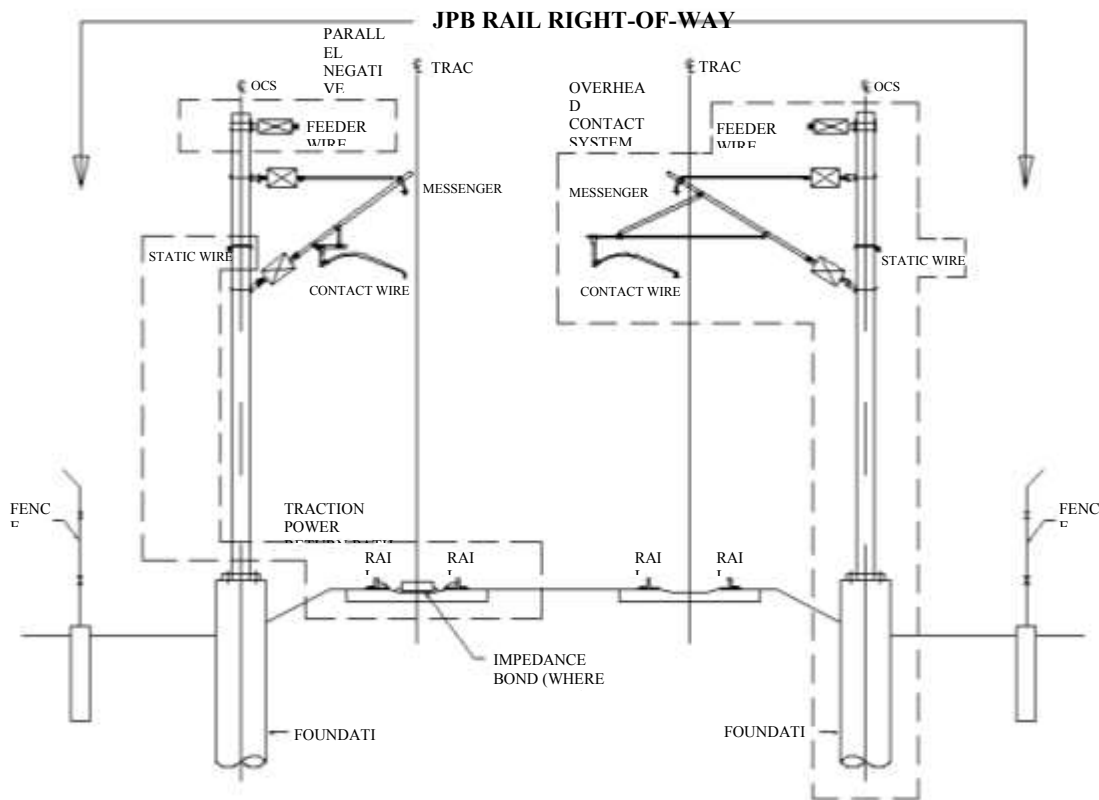


Figure 4-1A Typical 2x25 kV AC Electrification System

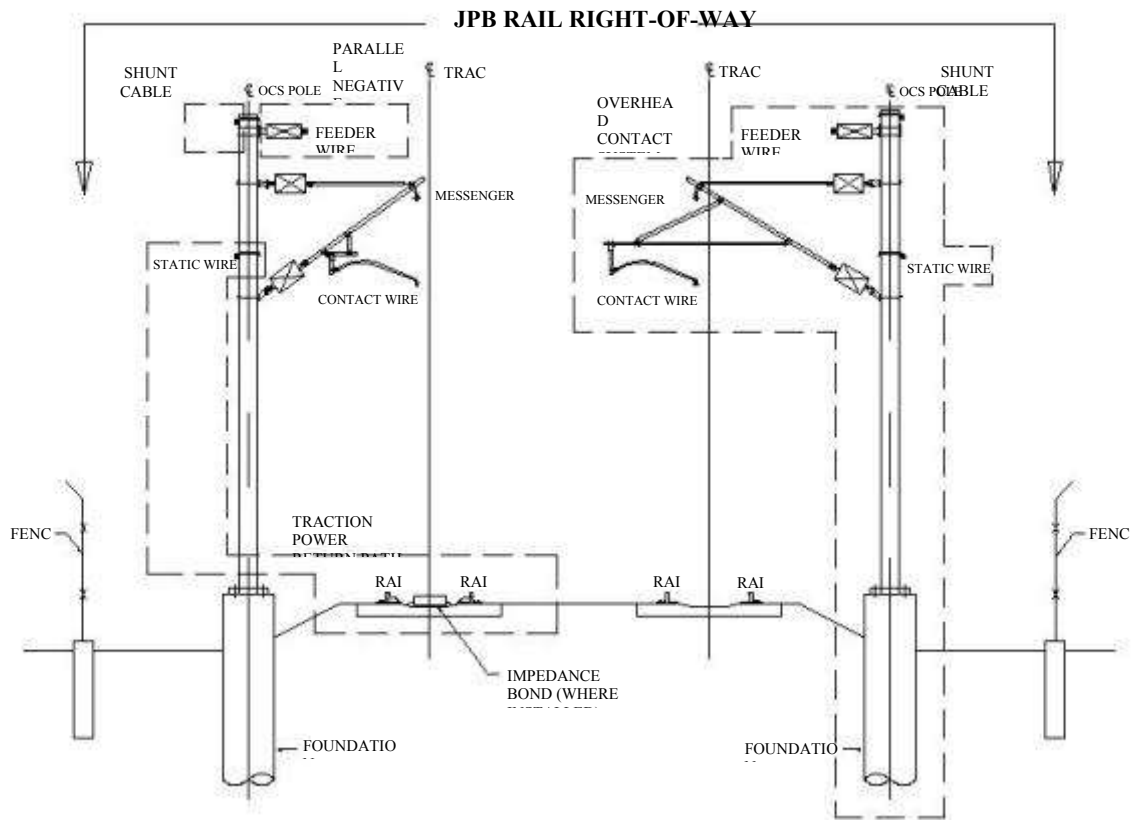


Figure 4-1B Typical 2x25 kV AC Electrification System, with Shunt Cable

The electrification design for Caltrain, as it is in non-dedicated rights-of-way with public highway-rail at-grade crossings and in which freight operations may occur, must satisfy single point of failure requirements and include a Shunt Cable at utility crossings. This single point of failure requirement means that the breaking of a single support attachment or conductor must not allow the Caltrain messenger, contact wire, live span wire, or current carrying connections to come within 10 feet from the ground or from any platform accessible to the general public.

At utility crossings, the Caltrain electrification design shall include protective measures, including installation of a Shunt Cable, as shown in Figure 4-1B, to shunt the utility crossing span to ground to protect the safety of the public and rail or utility workers in case the utility conductors in the crossing span fail. The Shunt Cable or any other cable/wire that is part of the protective measure and installed above the feeder wire, must be consistent with the GO 95 strength requirements for a 50 kV system (GO 95 Section IV).

Single insulation, with no floating sections (neither energized nor grounded) is to be used for the Caltrain 25kV AC Electrification System. Double insulation only applies to Light Rail DC systems, and it shall not apply to the Caltrain 25kV AC Electrification System.

4.2. PARALLEL FEEDERS

In a 2x25 kV Autotransformer Feed System (shown above in Figure 4-1), a bare parallel Negative Feeder (often termed the Autotransformer Feeder) will be mounted aerially on insulators on the OCS Poles, and must form a continuous electrical connection between Substation facilities and is part of the OCS.

There is a 180 degree phase difference between the voltages of the parallel Negative (Autotransformer) Feeder and the Catenary System, giving a 50 kV phase-to-phase voltage difference between these conductors.

In some restricted clearance locations, such as under low clearance overhead bridges which have insufficient vertical clearance from the 25kV conductors to the bottom of bridge to meet AREMA requirements, insulated cables may have to be substituted for the bare feeder conductors.

4.3. TRACTION POWER RETURN SYSTEM

The Traction Power Return System is comprised of the Running Rails, Impedance Bonds, Return Cables, and static or ground wires. The principal return path is through the Running Rails and Static or ground wires. Due to the resistance of the rails, static or ground wires, some residual current will flow through the earth back to the Substation.

In a 2x25 kV Negative (Autotransformer) Feed System, because of the configuration and electrical connectivity arrangement of the Autotransformers, the Autotransformer Feeders also form part of the return system.

4.4. PERFORMANCE REQUIREMENTS

4.4.1. OPERATING VOLTAGE REQUIREMENTS

The operating voltages of the Electrification System, detailed below, establish the limits for which safety clearances and values at the 25 kV level shall apply:

a. Nominal Voltage	25 kV (line to ground),	50 kV (line to line)
b. Maximum Voltage	30 kV (line to ground)	[+ 20% of Nominal]
c. Minimum Voltage	17.5 kV (line to ground)	[- 30% of Nominal]

4.4.2. ENVIRONMENTAL PARAMETERS (CLIMATIC AND GEOGRAPHIC CONDITIONS)

4.4.2.1. The 25 kV AC Electrification System shall be designed to operate safely and satisfactorily within the anticipated environmental conditions. The required clearances shall be maintained at all times. The following factors shall be taken into consideration:

- a. Ambient temperature range
- b. Permissible conductor operating temperature range
- c. Permissible equipment operating temperature range
- d. Wind variations and wind loading effects
- e. Ice loading

- f. Seismic zone
- g. Humidity
- h. Atmospheric pollution
- i. Lightning (Isokeraunic levels)
- j. Elevation
- k. Soil conditions
- l. Soil resistivity

4.4.2.2. Wind and Ice Loading

The 25 kV AC Electrification System Supports, conductors, and appurtenances shall be designed in accordance with the wind and ice loading criteria detailed in GO 95 Rule 43 – Temperature and Loading.

4.4.2.3. Soil Conditions and Soil Resistivity

- a. OCS Pole footings, equipment foundations, and power facility ground grids shall be designed based on detailed geotechnical investigations derived on a project-and location-specific basis.
- b. Soil resistivity tests shall be performed during the geotechnical investigations to permit the development of safe pole grounding and ground mat designs that satisfy Section 6 of these Requirements.

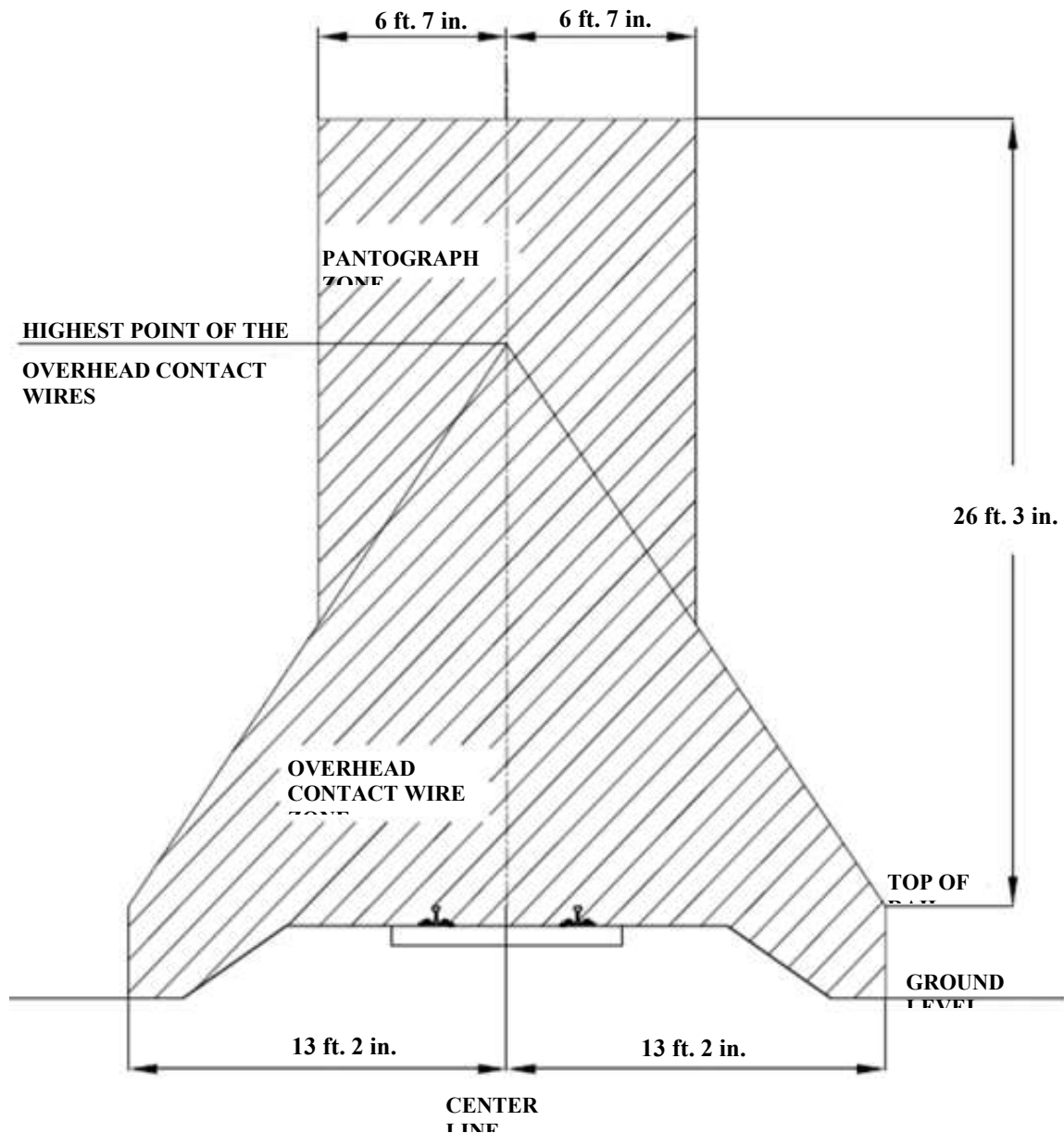
5. CLEARANCES AND PROTECTION

5.1. OVERHEAD CONTACT WIRE ZONE AND PANTOGRAPH ZONE

Energized broken OCS wire(s) or Energized parts of broken or de-wired conductor or pantograph may accidentally come into contact with structures and equipment. Figure 5-1 defines the zone inside which such contact is considered probable, but whose limits are unlikely to be exceeded by a broken Overhead Contact Wire or damaged Energized Pantograph.

Figure 5-1 Overhead Contact Wire Zone and Pantograph Zone

The limits of the Overhead Contact Wire zone below the top of rail extend vertically



down to the earth or structure surface on which the tracks are supported. In the case of out-of-running OCS conductors, the Overhead Contact Wire zone is extended accordingly.

5.2. SAFETY CLEARANCES – PUBLIC AND RESTRICTED AREAS

The minimum clearances from Energized Parts for areas with unconstrained access (no Barriers, Screens or other physical restrictions to movement) are shown in Figure 5-2 for (a) Public Areas and (b) Restricted Areas. Access to Restricted Areas is permitted only for Authorized Persons.

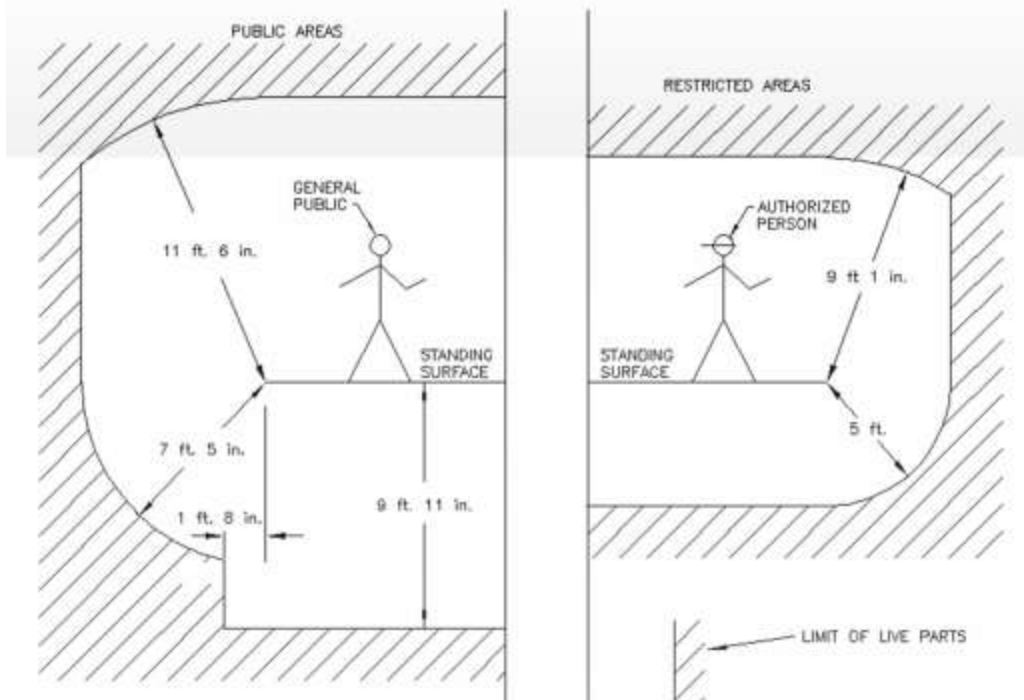


Figure 5-2 Minimum Required Safety Clearances – Unconstrained Access

Note 1: The clearances are based on the straight line reach without the use of tools or other objects. These Requirements include clearances from standing surfaces to accessible Energized Parts on the outside of vehicles as well as to Energized Parts of the OCS.

Note 2: The standing surface indicated in Figure 5-2 does not itself provide protection against contact with exposed Energized Parts located below or to the side. However, dependent on its construction, this surface may meet the Requirements detailed below regarding Barriers and Screens, in which case the lower clearance values appropriate to the type of Barrier may be used.

Note 3: Exposed Energized Parts of the OCS shall be limited to the electrified tracks and adjacent areas that are necessary for support, tensioning and positioning of the OCS. Placing OCS Energized Parts over safety walkways shall be avoided where Practicable.

Note 4: For safe working clearances and approach distances for Qualified Personnel, see Section 8.

5.3. GENERAL REQUIREMENTS FOR PROTECTIVE BARRIERS AND SCREENS

5.3.1. Barriers or Screens shall be of sufficient strength and shall be supported rigidly and securely enough to prevent their being displaced or deflected by a person slipping or falling against them.

5.3.2. Barriers and Screens shall be permanently fixed, and shall be removable

only with tools. Barriers in public areas shall be affixed with non-removable, captive fasteners.

- 5.3.3.** Barriers shall be of solid construction and fabricated from either conductive or non-conductive materials.
- a) Conductive Barriers shall be bonded and Grounded by inter-connection with the Traction System Ground, at not less than two locations.
 - b) Non-conductive Barriers within 3 feet of live parts shall be supported by or attached to a Grounded frame and interconnected with the Traction System Ground, that is at not less than two locations.
- 5.3.4.** Screens shall be of conductive, open mesh materials and Grounded by inter-connection with the Traction System Ground, at not less than two locations.
- a) Mesh Screen construction shall be such that required clearances to Energized Parts are maintained.
 - b) Conductive mesh Screens shall be constructed such that a cylinder, greater than 0.5 inches in diameter, cannot be pushed through the mesh.
 - c) Non-conductive mesh or plastic coated metal shall not be used.
- 5.3.5.** The size of the Barrier or Screen shall be such that Energized Parts cannot be reached by persons on a standing surface.
- 5.3.6.** The metallic part of the overhead bridge screening and Barriers shall be bonded to Static Wires. Other metallic items on the overhead bridge, within a lateral distance of 10 feet from any exposed Energized and uninsulated equipment passing below the structure, shall be bonded to Static Wire.
- 5.3.7.** Barriers and Screens shall be inspected and maintained for their intended use.

5.4. BARRIERS AND SCREENS – PUBLIC AREAS

- 5.4.1.** Where clearances are less than specified in Figure 5-2, the protection shall be of solid Barrier construction for standing surfaces above exposed Energized Parts on the outside of vehicles or above Energized Parts of the 25 kV AC Electrification System. The clearance requirements where Screens and Barriers for standing surfaces in Public Areas are utilized for protection against direct contact with adjacent Energized Parts for nominal system voltages up to 25 kV to ground are depicted in Figure 5-3. For other situations, as depicted in Figure 5-3, Requirements 5.4.2 and 5.4.3 shall be referenced.

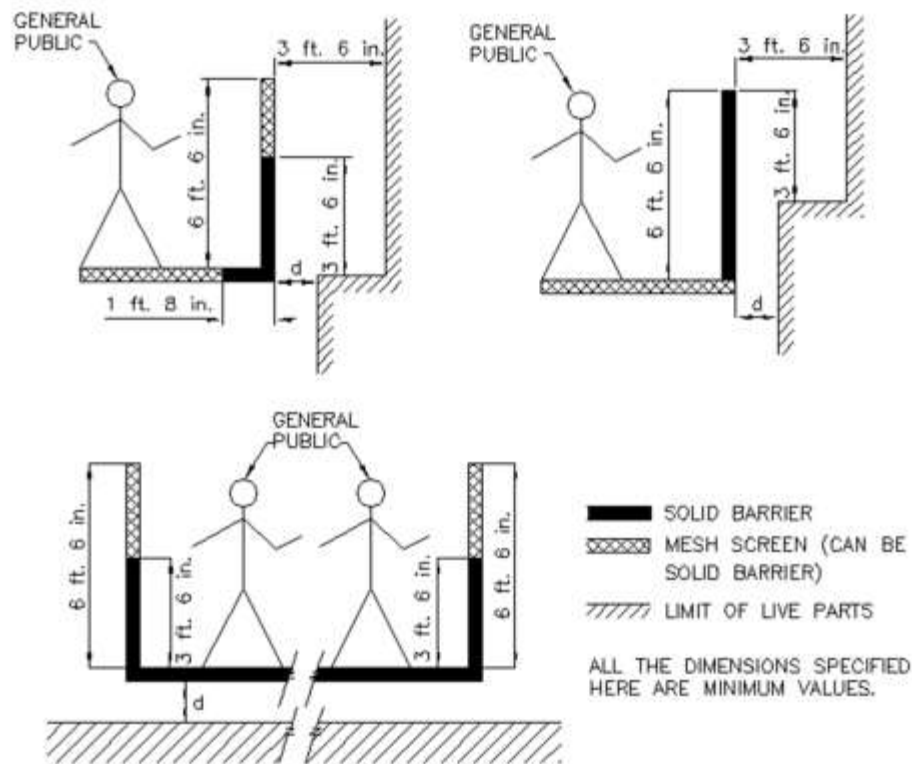


Figure 5-3 Clearance Requirements from Screens and Barriers for Standing Surfaces in Public Areas

5.4.2. The minimum requirements for Barriers and Screens to exposed Energized Parts in Public Areas are 6 feet 6 inches for solid Barriers or a combination of solid Barrier and mesh Screen. The value for dimension “d” between the Screens and Barriers and exposed Energized Parts shown in Figure 5-3 shall be determined from Table 5-1.

5.4.3. The length of the Screen and/or Barrier on structures that cross over Energized Parts, and which protect publicly accessible standing surfaces, shall extend laterally beyond the exposed Energized Parts by not less than 10 feet on each side.

5.5. BARRIERS AND SCREENS – RESTRICTED AREAS

In Restricted Areas, the following shall apply:

5.5.1. Where clearances are less than specified in Figure 5-2, the protection shall be of solid Barrier construction for standing surfaces above exposed Energized Parts on the outside of vehicles or above exposed Energized Parts of the 25 kV AC Electrification System. The requirements for clearances from Screens and Barriers for standing surfaces in restricted areas are shown in Figure 5-4.

- 5.5.2.** The length of the solid Barrier, protecting the standing surface, shall correspond to the Pantograph zone and shall extend beyond the exposed Energized Parts by not less than 20 inches.
- 5.5.3.** The minimum requirements for Barriers and Screens to exposed Energized Parts in restricted areas are 6 feet 6 inches for solid Barriers or a combination of solid Barrier and mesh Screen. The value for dimension “d” between the Screens & Barriers and exposed Energized Parts shown in Figure 5-3 shall be determined from Table 5-1.

Dimension “h” of the Screen and Barrier shall be such that a clearance of 5 feet to Energized Parts is maintained from the top of the Screen and Barrier (see Figure 5-4).

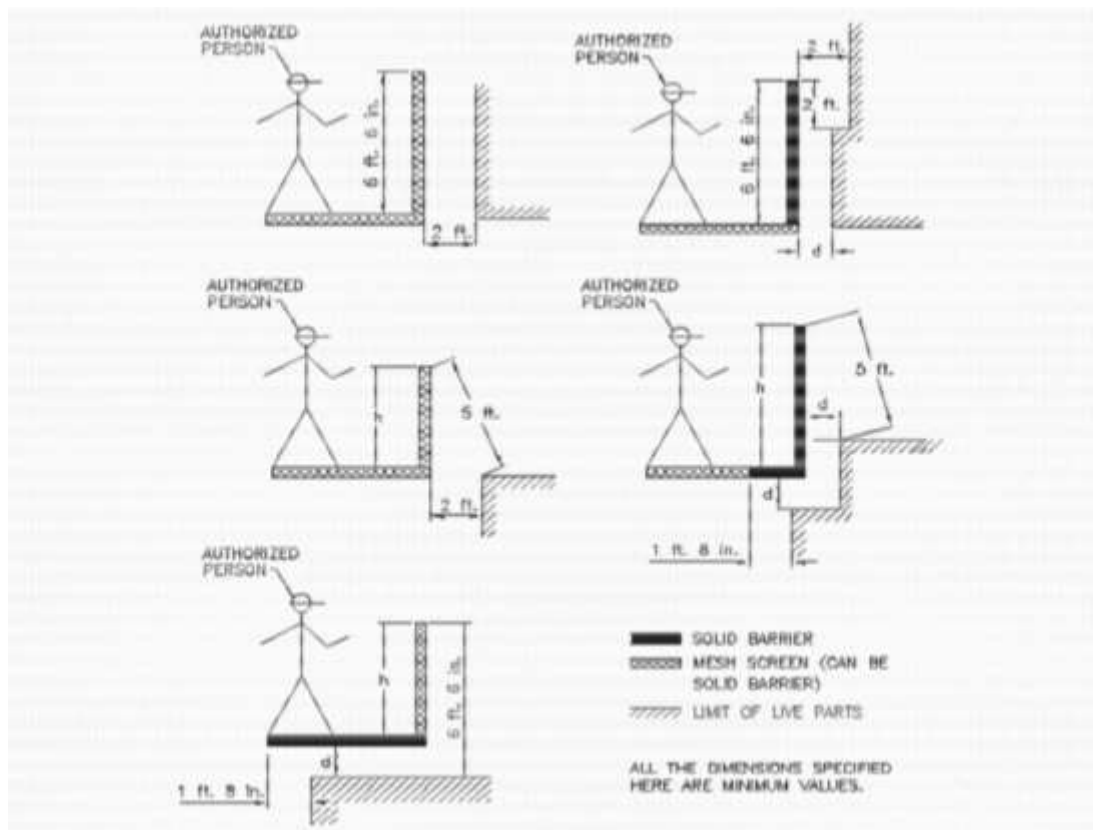


Figure 5-4 Clearance Requirements from Screens and Barriers for Standing Surfaces in Restricted Areas

- 5.5.4.** The height of the side Screens and Barriers must correspond to the height of any necessary safety railing, but must have a minimum height of 3 feet 6 inches.

Exception: For safe working clearances for Qualified Personnel, refer to Section 8.

5.6. PROTECTION AGAINST CLIMBING

- 5.6.1.** Where there is public access or where trespass has occurred, anti-climbing protection shall be provided at buildings and other structures supporting Energized Parts of the OCS. Signs or markings warning of the dangers of electric shock shall also be installed.
- 5.6.2.** Access to fixed ladders, particularly at signal poles and signal gantries, and the means of access to any roof or other place, which could allow unauthorized persons to approach Energized Parts, shall be secured or otherwise protected.

5.7. ELECTRIC OR COMMUNICATIONS LINES CROSSING OVER THE 25 KV AC ELECTRIFICATION SYSTEM

Electric lines (including any dark fiber enterprise) or Communications Lines crossing over the 25 kV AC Electrification System and the Electrified JPB Rail Right-of-Way must be designed, constructed and maintained in accordance with GO 95. Consideration shall be given to the operating voltages for the 25 kV AC Electrification System stated in Section 4.4.1 of these Requirements.

- 5.7.1.** Electric supply lines crossing the 25 kV AC Electrification System shall be in compliance with GO 95 and shall meet the following requirements:
 - a) Compliance with GO 95, Section XI.
 - b) Grade "A" construction strength for lines and structures.
 - c) No splices or taps on the crossing span and next adjacent spans.
 - d) Crossing spans shall be as nearly as practicable in-line with the next adjoining span.
 - e) Crossing spans shall be erected and maintained consistent with the GO 95 strength requirements for a 60 kV system.
- 5.7.2.** Communications Lines crossing the 25 kV AC electrification system shall contain no splices or taps on the crossing span and next adjacent spans, and shall be in compliance with GO 95, consistent with the GO 95 strength requirements for a 50 kV AC system (GO 95, Section IV). They shall either:
 - a) Contain no conductive elements; or
 - b) Be attached to or contain a conductive support structure (e.g., Messenger Wire and lashing wire, if any) that is effectively grounded at or near the crossing span pole.

5.8. NON-CALTRAIN UNDERGROUND PIPELINE, ELECTRIC AND COMMUNICATION FACILITIES

- 5.8.1.** To the extent Practicable, longitudinal encroachment within the Electrified JPB Rail Right-of-Way shall be avoided.
- 5.8.2.** Except as provided below for steel natural gas pipelines, pipes, electric and communication facilities crossing under the Electrified JPB Rail Right-of-Way shall be encased or installed in rigid conduit, and buried at

sufficient depth in accordance with industry standards and GO 128.

Steel natural gas pipeline facilities crossing under the Electrified JPB Rail Right-of-Way may be uncased provided that the natural gas utility submits plans to JPB demonstrating that such installation is in accordance with the AREMA Manual Chapter 5, Section 5.2 and industry standards, and buried at sufficient depth in accordance with industry standards.

Inspection and maintenance of natural gas pipelines crossing under the Electrified JPB Rail Right-of-Way will be performed by the natural gas utility without entering the Restricted Area or, if such inspection and maintenance cannot be performed without entering the Restricted Area, the utility must notify the JPB pursuant to Section 8.1.2.

Sectionalizing valves for natural gas pipelines crossing the Electrified JPB Rail Right-of-Way shall be installed and maintained for new natural gas pipelines in accordance with 49 CFR Part 192, and, in case of emergency, shall be activated where installed to shut off the flow of gas across the Electrified JPB Rail Right-of-Way. If the cause of the emergency is due to the condition of the pipe crossing the Electrified JPB Rail Right-of-Way, a new pipe crossing shall be installed, and the old pipeline shall be filled with grout, abandoned and removed from natural gas service without impacting JPB Rail operations. Alternatively, the existing casing may be used for installation of a new natural gas pipeline or the old pipeline may be used for utility purposes in a manner consistent with existing industry standards and land use rights, or by mutual agreement between JPB and the owner.

5.8.3. New pipe, electric and communication facilities crossing under the Electrified JPB Rail Right-of-Way shall be continuous pipe, perpendicular to the railroad alignment to the extent Practicable, and not less than 45 degrees from railroad longitudinal alignment. For purposes of this section, "continuous pipe" includes pipe that is welded, fused, or glued, as appropriate.

5.8.4. For pipe, electric and communication facilities crossing under the Electrified JPB Rail Right-of-Way; the existing installation, including encasement and valves, which is buried at sufficient depth in accordance with General Orders and industry standards; is acceptable.

5.9. NON-CALTRAIN ABOVE GROUND PIPELINE FACILITIES

5.9.1. To the extent Practicable, new pipeline facilities shall be located underground when crossing the Electrified JPB Rail Right-of-Way.

5.9.2. Pipelines that cannot be located underground shall be located on a new or existing bridge structure, encased in a larger pipe, and appropriately protected from the 25 kV AC Electrification System.

5.10. CLEARANCES TO RAIL VEHICLES AND STRUCTURES

5.10.1. Minimum Electrical Clearances, as specified in Table 5-1 and depicted in Figure 5-5, shall be maintained from exposed Energized Parts to Grounded parts of rail vehicles or structures.

Table 5-1 25 kV AC Electrical Clearances

Condition	Minimum Clearance	
	Static (C _A)	Passing/Dynamic (P _A)
Normal *	10 1/2 in.	8 in.
Absolute *	8 in.	6 in.

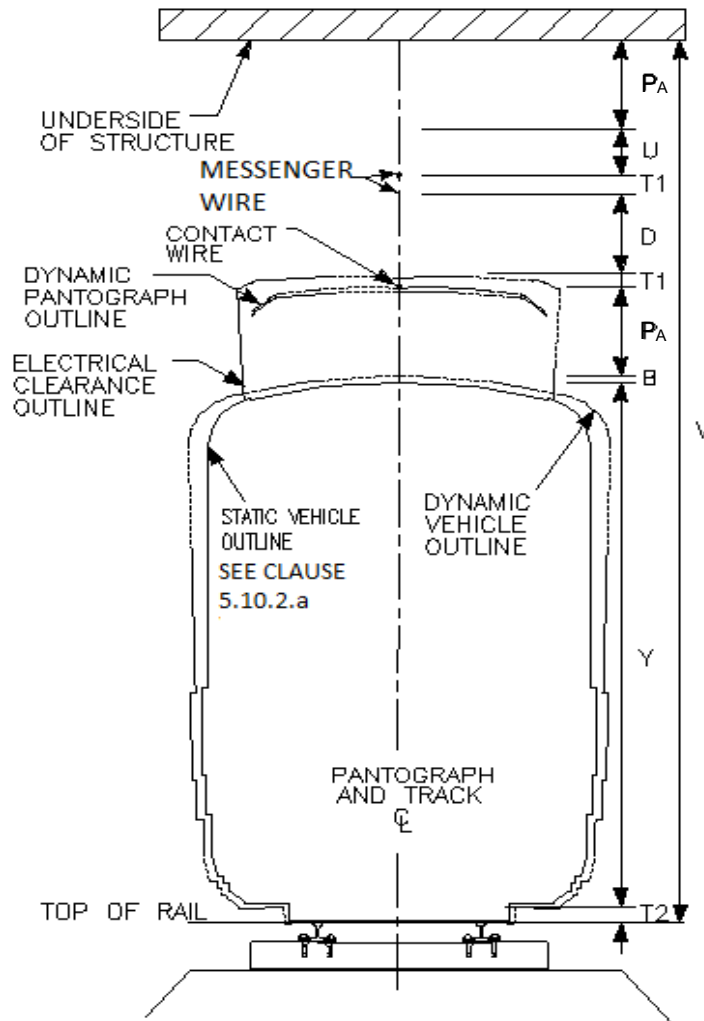
*: See AREMA Manual Chapter 33, Table 33-2-2 (Revision 2016)

Note 1: In a 2x25 kV AC Electrification System, there is a 180 degree phase difference between Energized Parts common to the Negative Feeder and those of the OCS. The minimum clearance between these elements is 21.5 inches under static conditions or 12 inches under worst case dynamic conditions.

5.10.2. Structural Clearance Envelope

In determining the minimum vertical and lateral clearance envelope at fixed structures, including OCS support structures and signal bridges, the following factors shall be assessed (see Figure 5-5):

- The static vehicle outline shall be based on the size of the rail vehicles.
- The dynamic vehicle outline shall take into consideration the dynamic envelope, and track position, condition, and maintenance tolerances.
- The position of Energized Parts on the rail vehicles, including the dynamic Pantograph envelope, and vehicle construction and maintenance tolerances.
- The position and size of Energized Parts of the OCS allowing for installation and maintenance tolerances, and dynamic movements.



V - Total Vertical Clearance Required for Electrification
 P_A - Passing (Dynamic) Electrical Clearance – see Note below
 U - Catenary Uplift
 T1 - Catenary Construction Tolerances
 D - Catenary Depth
 B - Vehicle Bounce
 Y - Static Vehicle Load Height
 T2 - Track Maintenance Tolerance
 CA - Static Electrical Clearance

Note 1: The diagram depicts the dynamic condition. For static situations, the Static Electrical Clearance (CA) – refer to Table 5-1 - shall be not less than $P_A + U$ or $P_A + B$

Note 2: Based on AREMA Manual Chapter 33, Figure 33-2-3 and Figure 33-2-4 (Revision 2016)

Figure 5-5 Vertical Structural Clearance Envelope

5.10.3. Structural Lateral Clearance

The requirements of General Order No. 26-D, the regulation governing clearances on railroads and street railroads with reference to side and overhead structures, parallel tracks, crossings of public roads, highways and streets, must be used in determining the minimum lateral clearance from centerline of track to face of any OCS Structure.

Under General Order 26-D, structures supporting the overhead contact conductors supplying motive power to the track require, on tangent track, a lateral clearance of 8'-6". All such structures adjacent to curved track shall have a minimum side clearance 9'-6", which is one (1) foot greater than the minimum side clearance otherwise required for tangent track.

However, the design of all OCS Structures on tangent track must reflect a minimum lateral clearance from centerline of track to face of pole of 9'-3" as a goal, but not less than 8'-6", and for curved track a required clearance of 9'-6".

All clearances of electrical construction over, above, adjacent to, along or across railroads and street railroads shall conform to the requirements specified in General Order No. 95.

5.11. CLEARANCES TO VEGETATION

- a. Vegetation adjacent to Energized Parts of the 25 kV AC Electrification System shall have a minimum clearance of 4'-0" and there shall be no overhanging vegetation into the Electrical Safety Zone (ESZ), which is an area extending 10 feet from the closest electrical conductor. When Caltrain has actual knowledge, obtained either through normal operating practices, including routine inspections, or notification to Caltrain, that dead, rotten or diseased trees or the dead, rotten or diseased portions of otherwise healthy trees may fall into any parts of the 25 kV AC Electrification System, said trees or portions thereof shall be removed.

This Requirement does not apply where Caltrain has made a good faith effort to obtain permission to trim or remove vegetation but permission was refused or unobtainable. A good faith effort shall consist of current documentation of a minimum of an attempted personal contact and a written communication, including documentation of mailing or delivery. However this does not preclude other action or actions from demonstrating good faith.

- b. In addition, the Electrified JPB Rail Right-of-Way shall be managed by JPB such that vegetation within the JPB right-of-way will not:
 - 1) Constitute a fire hazard or other threat to safety or operations.
 - 2) Obstruct a vehicle or train operator's visibility of signs, signals, or the track ahead.
 - 3) Interfere with personnel in performing normal trackside duties.
 - 4) Obstruct emergency walkways.
 - 5) Interfere with non-JPB electric lines outside the JPB right-of-way.

- c. Electrified JPB Rail Right-of-Way shall be managed by Caltrain such that vegetation will not interfere with utilities' ability to maintain and access and operate its facilities and associated encroachments, subject to the obligations of existing agreements that allocate such responsibilities, as well as applicable law.

5.12. PAVED AREAS IN MAINTENANCE FACILITIES AND YARDS

- 5.12.1.** The normal clearance of the lowest Energized Part of the 25 kV AC Electrification System above paved areas in maintenance facilities, yards and workshops, are specified in Table 5-2. Warning signs shall be provided, per Requirement 5.13.2.
- 5.12.2.** At pedestrian and vehicle crossings in maintenance facilities or yards where vehicles over 8 feet in height are prohibited, a restricted clearance is permitted, as specified in Table 5-2.

Table 5-2 Minimum Clearances above Track Crossings in Paved Areas of Maintenance Facilities, Yards and Workshops

Normal Clearance	20 ft. 4 in.
Restricted Clearance	18 ft. 4 in.

5.13. SIGNAGE

- 5.13.1.** Where required, warning signs bearing the words "No Trespassing," "Warning" and "High Voltage" in letters of 1 inch to 3 inches in height shall be posted. The sign or signs may carry other information relative to the hazard present.
- 5.13.2.** Permanent warning signs shall be posted by JPB:
 - a. In conspicuous places at entrances to locations containing exposed Energized Parts.
 - b. On enclosures that provide access to conductors, equipment, and apparatus Energized at High Voltage.
 - c. At anti-climbing locations.
 - d. At pedestrian and vehicle crossings in maintenance facilities and yards.
 - e. At Barriers and Screens placed in areas accessible to the public during normal operation to guard against exposed Energized Parts.
- 5.13.3.** The warning signs shall be posted at intervals of not more than 500 feet throughout the electrified route and be clearly visible to the public.

5.14. AREAS ACCESSIBLE TO THE GENERAL PUBLIC

The normal clearance of the lowest energized part of the electrification system above grade crossings, railroads and in areas accessible to the public, are specified in Table 5-3.

Warning signs shall be provided, per Requirement 5.13.

Table 5-3 Minimum Clearances above Grade Crossings, Railroads and Areas Accessible to the Public

Basic Minimum Allowable Vertical Clearance of Wires above Railroads, Thoroughfares, Ground accessible to the Public.		
Case No.	Nature of Clearance	Contact Wire, Feeder and Span Wires, 25,000 Volts (Phase to Ground)
1	Crossing above tracks of railroads which transport or propose to transport freight cars where not operated by overhead contact wires.	23 feet
2	Crossing or paralleling above tracks of railroads operated by overhead trolleys.	N/A
3	Crossing or along thoroughfares in urban districts or crossing thoroughfares in rural districts. (See Note 1)	22.0 feet
4	Above ground along thoroughfares in rural districts or across other areas capable of being traversed by vehicles or agricultural equipment. (See Note 1)	22.0 feet
5	Above ground in areas accessible to pedestrians only	19.5 feet
6	Vertical clearance above walkable surfaces on buildings, (except generating plants or substations) bridges or other structures which do not ordinarily support conductors, whether attached or unattached.	12 feet

Note 1 – Due to physical constraints the Minimum Vertical Clearance at 16th Street (Milepost 1.1) and Alma Street (Milepost 29.8) grade crossings will be 20.33 feet.

6. GROUNDING AND BONDING

6.1. GENERAL

6.1.1 Grounding and bonding shall be designed and installed throughout the electrified system to provide proper return circuits for the traction power currents and fault currents. Grounding and bonding conductors and systems shall have sufficient current carrying capacity such that Touch Potentials do not exceed the values in Table 6-1 of these Requirements.

6.1.2 The principal elements of the traction return circuits for normal load or fault currents are the Running Rails and the Static Wire. Exposed normally non-current-carrying metallic parts within the shaded area in Figure 5-1, likely to become Energized under short circuit or Fault Conditions, shall be directly connected to the traction return circuits.

Exception: Where normally non-current-carrying metallic parts cannot be directly connected to the traction return circuits, an alternative method may be used as long as voltages are held to Table 6-1 levels.

6.1.3 The Running Rails and the Static Wires shall be the principal return circuits for normal load or fault currents. However, because some residual current will flow through the earth, Caltrain shall take protective measures to mitigate the effect on current carrying elements and non-Caltrain facilities, such as pipes, electric supply and communications systems, or rails. Protective measures shall be coordinated with the facility owner(s), so that the facilities of both parties are not prevented from performing as required or intended.

6.1.4 25 kV AC Electrification System Adjacent to a DC System
Where a 25 kV AC Electrification System is located adjacent to a dc electrification system, a dc Cathodic Protection system or dc utility facilities, special protection measures may be necessary to avoid interaction of the two systems and to mitigate the effect of leakage currents on either system. Protective measures shall be coordinated with the facility owner(s), such that the facilities of both parties are not prevented from performing as required or intended. When Caltrain has actual knowledge of leakage, or residual currents that may affect the safe operation of the dc electrification system or the Cathodic Protection system, Caltrain shall coordinate with the facility owner(s) to implement mitigation measures to prevent unsafe operation of either system resulting from the leakage, or residual currents.

6.1.5 Coordination with Train Control and Signal Systems
Grounding measures shall be coordinated with the train control and signal systems design so that the integrity of the train control/signal system is not compromised.

6.1.6 Non-Caltrain Grounding Systems
Where non-Caltrain pre-existing grounding systems are encountered, within the Electrified JPB Rail Right-of-Way, coordination with the relevant non-Caltrain system owner shall occur. Future grounding systems within the

Electrified JPB Rail Right-of-Way shall be coordinated with JPB and other operating stakeholders prior to installation.

6.2. RUNNING RAILS

- 6.2.1.** Where Insulated Rail Joints are used to define the limits of Track Circuits in a signaling system, the insulated joints shall be by-passed by Impedance Bonds to provide a continuous return circuit for the traction power supply and short circuit or fault currents.
- 6.2.2.** Suitable connections shall be made between the rails or Impedance Bonds and the adjacent aerial Static Wire, Counterpoise, or traction power facility ground grid. The location of the Impedance Bonds and connections to Grounding Conductors shall be coordinated with the signal system design.

6.3. OCS SUPPORT STRUCTURES AND METALLIC COMPONENTS

6.3.1. General Requirements

- a. Non-current carrying metallic components associated with the OCS shall be Grounded by a direct connection to an aerial Static Wire. OCS Poles, attachments and support structures shall be interconnected by an aerial Static Wire. Multi-track structures supporting more than one OCS shall be interconnected with two separate aerial Static Wires.
- b. Connections shall be made between each aerial Static Wire and the Running Rails, usually at an Impedance Bond as necessary. The spacing of such interconnections must be coordinated with the signaling system. Aerial Static Wires shall also be connected to the ground bus of traction power facilities providing power to the OCS.
- c. The maximum permissible potentials described in Requirement 6.5 shall not be exceeded and, the resistance to ground shall not exceed 25 ohms.

6.3.2. Railroad Passenger Stations

- a. Metallic structures and miscellaneous metallic items, including overhead walkway structures and canopies, located on passenger station platforms, as well as any OCS Poles installed within 8 feet from the platform edge, shall be isolated from the Static Wire and Grounded by a direct connection to a Counterpoise.
- b. One end of the Counterpoise shall be connected to the Running Rails either directly or via an Impedance Bond outside the limits of the station platform. The connections shall avoid interference with broken rail detection and adhere to other requirements of the signaling system.
- c. The maximum permissible potentials described in Requirement 6.5 shall not be exceeded.

6.4. WAYSIDE NORMALLY NON-CURRENT-CARRYING METALLIC PARTS

6.4.1. General Requirements

- a. At concrete or masonry overhead structures, where the structure above Energized OCS conductors or Feeders is within the Overhead Contact System Zone and Pantograph Zone (Figure 5-1), metallic flash plates shall be installed above the conductors.
- b. Flash plates and overhead bridge Barriers/Screens shall be Grounded by a direct connection to the aerial Static Wire.
- c. Facilities, such as pipelines or conduits, crossing over, or paralleling the 25 kV AC Electrification System, may require joint assessment and mitigation. Protective measures, such as shielding or bonding and grounding, shall be coordinated between the owner and JPB.
- d. Wayside equipment enclosures, structures and fences shall be Grounded.
- e. The maximum permissible potentials as specified in requirement 6.5 and the resistance to ground shall not exceed 25 ohms.
- f. Signal equipment shall be separately Grounded and coordinated with the signal system design.

6.5. TOUCH POTENTIALS

- 6.5.1. Touch Potentials of Running Rails and normally non-current-carrying metallic parts shall be controlled within the Electrified JPB Rail Right-of-Way.
- 6.5.2. The requirements specified in Table 6-1 provide values for maximum permissible Touch Potentials for short term conditions of less than 0.5 seconds and also for long term conditions under all power supply feeding conditions.
- 6.5.3. These requirements also address permanent conditions for time intervals greater than 300 seconds. The maximum steady-state (i.e., >300 seconds) Touch Potentials on the Electrified JPB Rail Right-of-Way shall not exceed 60 V RMS.

Table 6-1 Maximum Permissible Touch Potentials as a function of Time ¹

SHORT TERM		SHORT TERM		LONG TERM	
Time - seconds	Voltage – volts	Time - seconds	Voltage – volts	Time - seconds	Voltage – volts
0.02	865	0.3	480	0.7	90
0.05	835	0.4	295	0.8	85
0.1	785	0.5	220	0.9	80
0.2	645	0.6	180	1	75
		< 0.7	155	300	65
				>300	60 [*] , ^{**}

Exception: ^{*} The limit for maintenance shops is 25 V RMS

^{**} In areas where the Union Pacific Rail Road operates on shared electrified track or adjacent non-electrified track, the maximum permissible voltage shall not exceed 50 Volts.

¹ derived from EN 50122-1: 2011 Clause 9.2.2

- 6.5.4.** Whenever JPB determines, through normal operating practice or notification by a non-Caltrain facility operator or others that operation of the JPB Rail System is likely causing or contributing to Touch Potentials on normally non-current carrying metallic parts of non-Caltrain facilities, such that the facilities are prevented from performing as required or intended or are presenting hazardous voltages to the general public and non-Caltrain personnel, JPB shall cooperate with such facility owner and any other involved parties pursuant to Section 1.4 to determine the cause and implement the remedy. The comprehensive remedy shall allow the affected facilities to perform as required or intended.

7. STRENGTH REQUIREMENTS FOR 25 KV AC ELECTRIFICATION SYSTEMS

7.1. LOADING

- 7.1.1.** General Order 95 Rule 43 shall be used for determining the loading condition(s).

Exception: In calculating the strength of the OCS conductors, supporting structures, span wires, backbones, etc., there shall be no requirement to account for additional vertical loads on Supports or conductors imposed by a worker.

- 7.1.2.** Foundations shall be designed on a location-specific basis in accordance with established engineering practices and shall be capable of meeting the structural and OCS loading requirements.

7.2. MINIMUM STRENGTH REQUIREMENTS

The strength requirements specified in General Order 95, Section IV shall apply.

Exception: Messenger and Contact Wires in auto-tensioned equipment are not subject to the standard variations in tension due to temperature changes.

8. SAFE WORKING PRACTICES

8.1. GENERAL

- 8.1.1.** Caltrain shall:

- a. Develop, maintain and follow formal safety rules, procedures and safe working practices pertaining to the operation and maintenance of the 25 kV AC Electrification System.
- b. Provide non-Caltrain personnel with appropriate levels of training in the application of the safety rules, emergency procedures and safe working practices for work within the Electrified JPB Rail Right-of-Way.
- c. When requested, provide non-Caltrain personnel working on or in adjacent worksites, using equipment or processes that may result in an intrusion into the

Electrified JPB Rail Right-of-Way, with appropriate levels of training in the application of the safety rules, emergency procedures and safe working practices.

- d. If Caltrain identifies non-Caltrain personnel working on or in adjacent worksites, using equipment or processes that may result in an intrusion into the Electrified JPB Rail Right-of-Way, such non-Caltrain personnel shall be provided with appropriate levels of training in the application of the safety rules, emergency procedures and safe working practices.
- e. Periodically inspect first aid equipment, personnel protective equipment and protective devices to ensure they are properly located, marked, inventoried and in safe working condition.

8.1.2 Access to Electrified JPB Rail Right-Of-Way requested by Third Parties

Access to the Electrified JPB Right of Way by third parties, including other passenger rail operators, shall be pursuant to contractual rights or the written approval of Caltrain, in coordination with other non-electrified rail operators possessing rights to operate in the Electrified JPB Rail Right-of-Way. In emergency situations requiring immediate action, the third party must provide Caltrain (who must provide notice to other non-electrified rail operators) with oral notice prior to entry. All parties entering the Electrified JPB Right of Way must observe all applicable safety requirements. Except in case of emergency or with the consent of the JPB, inspection and maintenance of overhead utility crossings of the Electrified JPB Rail Right-of-Way, whether imposed by regulatory authorities or by the utility's requirements, shall be performed without entering the Electrified JPB Rail Right-of-Way.

8.2. FAULT LOCATION AND ISOLATION

- 8.2.1.** To provide for maintenance and operational needs, the OCS shall be sectionalized with locally and remotely operable motorized disconnect switches installed to facilitate de-energization of sections and alternate feeding arrangements. At some locations, particularly in the maintenance yards and shops, non-supervised, manually operated disconnect switches will be utilized.
- 8.2.2.** To provide for rapid fault detection and isolation, a relay protection system shall be installed. Where the 25 kV AC Electrification System is remotely supervised, controlled and operated, communication with the appropriate electric service provider control centers shall be maintained.
- 8.2.3.** The relay protection scheme shall:
 - a. Protect the 25 kV AC Electrification System equipment against short-circuit faults, overloading and subcomponent failures
 - b. Provide proper coordination and selectivity for rapid fault clearance to the affected area of the 25 kV AC Electrification System for the protection of people and facilities.

8.3. ACCESS TO ENERGIZED PARTS

- a. Energized Parts, other than rails or rail connected equipment installed or maintained as part of the 25 kV AC Electrification System, shall be located with sufficient clearance or enclosed so as to prevent accidental contact by persons or objects.
- b. OCS switches and enclosures shall be kept locked at all times to prevent unauthorized access or operation.
- c. Access to enclosures containing Energized Parts shall be limited to Qualified Personnel, and to Authorized Persons under the supervision of Qualified Personnel.
- d. Enclosures housing 25 kV Energized Parts and cables accessed by Qualified Personnel or Authorized Persons shall have permanent labels, indicating operating voltage, to aid the personnel in performing maintenance tasks safely.

9. RECORD KEEPING, REPORTING AND INCIDENT INVESTIGATION

9.1. INSPECTIONS AND RECORDS

Caltrain shall prepare and follow procedures for conducting inspections and maintenance for the 25 kV AC Electrification System for the purpose of ensuring that the system is in good condition and is conforming to these Requirements. Caltrain shall maintain records of inspection and maintenance activities. Commission staff shall be permitted to inspect records and procedures consistent with Public Utilities Code Section 314 (a).

9.2. INCIDENT REPORTING AND INVESTIGATION

9.2.1. In the event of an incident meeting the criteria described below, JPB shall send an initial notification to the Commission and to the Governor's Office of Emergency Services per the following guidelines.

- a. If the incident occurs during its normal working hours, the report shall be made as soon as Practicable but no longer than 2 hours after JPB is aware of the incident and its personnel are on the scene.
- b. If the incident occurs outside its normal working hours, the report shall be made as soon as Practicable but no longer than 4 hours after JPB is aware of the incident and its personnel are on the scene.
- c. The notification shall identify the time and date of the incident, the time and date of notice to the Commission, the location of the incident, casualties that resulted from the incident, identification of casualties and property damage, and the name and telephone number of a JPB contact person. This notification may be by (a) using the Commission's Emergency Reporting Web Page, (b) calling an established CPUC Incident Reporting Telephone Number designated by the Commission's Safety and Enforcement Division (SED) or its successor or (c) sending a message to

an electronic mail address designated by the Commission's SED or its successor. Telephone notices provided at times other than normal business hours shall be followed by a facsimile or email report by the end of the next working day.

9.2.2. Reportable incidents are classified as those which:

- a. Result in fatality or injury requiring overnight hospitalization and are attributable or allegedly attributable to the 25 kV AC Electrification System or Caltrain's traction power supply facilities (which include Substations, Switching Stations, Paralleling Stations and electrical supply stations).
- b. Are the subject of significant public attention or media coverage and are attributable or allegedly attributable to the 25 kV AC Electrification System or Caltrain's traction power supply facilities (which include Substations, Switching Stations, Paralleling Stations and electrical supply stations).
- c. Include damage to property of Caltrain or others estimated to exceed \$50,000 that are attributable or allegedly attributable to the 25 kV AC Electrification System or Caltrain's traction power supply facilities (which include Substations, Switching Stations, Paralleling Stations and electrical supply stations).

9.2.3. Not later than 30 days from the end of the month in which the reportable incident occurred, Caltrain shall submit to the CPUC a written account of the incident which includes a detailed description of the nature of the incident, its cause and estimated damage. The report shall include a description of JPB's response to the incident and measures Caltrain took to repair facilities and/or remedy any related problems on the 25 kV AC Electrification System or Caltrain's traction power supply facilities (which include Substations, Switching Stations, Paralleling Stations and electrical supply stations) which may have contributed to the incident.

9.2.4. JPB shall establish procedures for investigating reportable incidents for the purpose of determining the causes of the incident and minimizing the possibility of a recurrence.

9.3. ACCESS BY COMMISSION REPRESENTATIVES

Representatives of the Commission shall be allowed to enter upon Caltrain's property for the purpose of determining compliance with Commission rules, conducting tests, and inspecting records. Commission representatives entering the property shall have appropriate training or be accompanied by appropriately qualified Caltrain personnel

END OF APPENDIX A