Schedule 5(j)

Medium Voltage Power System (MVPS) and Low Voltage Power System (LVPS)

California High-Speed Rail Authority

Standard Specifications

TSCC Specifications

SPEC-0014 – Medium Voltage Power System (MVPS) and Low Voltage Power System (LVPS)

Rev. 1.0

Authored:		12/22/2025
	Marc Benazech, Power Supply Lead	Date
Checked:	I.Modak	12/22/2025
	Intakhab (Indy) Modak, HV & Traction Power Lead (SME)	Date
Checked:		12/23/2025
	Bruno Comperat, Deputy Director of Rail Engineering	Date
Approved:	Ryan Scott	12/23/2025
	Ryan Scott, Director of Rail Engineering	Date
Released:		12/23/2025
	Amit Joshi, Configuration Manager	Date

Document Revision History – MVPS and LVPS Specifications

Second Edition

December 2025

Revision	Date	Revision Description
0.0	September 2025	First edition
1.0	December 2025	Second Edition for Addendum 2

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Scope of the technical specification

1.1.1 The scope of this Technical Specification is to define the Authority Requirements for the Medium Voltage Power System and Low Voltage Power System, hereinafter: MVPS and LVPS.

1.1.2 The functional architecture of MVPS and LVPS is presented in Appendix A.

1.1.3 The requirements are formulated using the following words and their meanings:

- **"Shall":** Indicates mandatory requirement that must be strictly implemented. Any impossibility to fulfil this requirement must be agreed through a derogation case (see change management procedure).
- **"Should"**: Indicates preferred course of action, recommendations. No agreement of derogation is necessary, there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course - for example the same goal is reached by other solutions, which are permissible within the binding standards or documents.
- **"Must"**: Indicates an obligation or a mandatory requirement.
- **"May"**: Indicates a permissible course of action within the limits of the standards, but which is not mandatory to be fulfilled.

2 REFERENCE STANDARDS AND DOCUMENTS

2.1 General

2.1.1 The TSCC Contractor shall apply the in-force standards, guidelines and specifications provided in this chapter for all stages of the design, test, manufacture, supply, delivery, assembly, installation, testing, commissioning and training.

2.1.2 All generic standards to be used are provided in: Schedule 16.

2.2 TSI

2.2.1 The applicable TSIs are listed below:

ID	Standard	Title
[R1]	ENE TSI	COMMISSION REGULATION (EU) No 1301/2014 of 18 November 2014 on the technical specifications for interoperability relating to the 'energy' subsystem of the rail system in the Union including the Commission Implementing Regulation (EU) 2018/868 of 13 June 2018, Commission Implementing Regulation (EU) 2019/776 of 16 May 2019 and Commission Implementing Regulation (EU) 2023/1694 of 10 August 2023
[R2]	SRT TSI	Commission Regulation (EU) No 1303/2014 of 18 November 2014 - concerning the technical specification for interoperability relating to 'safety in railway tunnels' of the rail system of the European Union including commission regulation (EU) 2016/912 of 9 June 2016 L 153 28 10.6.2016 and commission implementing regulation (EU) 2019/776 of 16 May 2019

TABLE 27 LIST OF TSI AND REGULATIONS

2.3 Standards

2.3.1 The relevant standards to be used for MVPS and LVPS are listed below:

ID	Standard	Title
[R3]	IEC 17000	Conformity assessment — Vocabulary and general principles
[R4]	ISO 50001	Energy management systems - Requirements with guidance for use
[R5]	EN 13501-6	Fire classification of construction products and building elements – Classification using data from reaction to fire tests on power, control and communication cables
[R6]	EN 50110-1	Operation of electrical installations - Part 1: General requirements
[R7]	EN 50160	Voltage characteristics of electricity supplied by public distribution systems
[R8]	EN 50178	Electronic equipment for use in power installations
[R9]	EN 50200	Method of test for resistance to fire of unprotected small cables for use in emergency circuits.

ID	Standard	Title
[R10]	EN 50266	Common test methods for cables under fire conditions - test for vertical flame spread of vertically mounted bunched wires or cables part 2-4: procedures.
[R11]	EN 50267	Common test methods for cables under fire conditions - tests on gases evolved during combustion of materials from cables - part 2-3: procedures - determination of degree of acidity of gases for cables by determination of the weighted average of ph and conductivity.
[R12]	EN 50268	Common test methods for cables under fire conditions. Measurement of smoke density of cables burning under defined conditions. Procedure.
[R13]	EN 50362	Method of test for resistance to fire of larger unprotected power and control cables for use in emergency circuits
[R14]	EN 50399	Common test methods for cables under fire conditions - Heat release and smoke production measurement on cables during flame spread test - Test apparatus, procedures, results
[R15]	EN 50575	Cable Compliance Standards
[R16]	EN 600068-3-3	Environmental testing-Part 3: guidance, Seismic test methods for equipment
[R17]	IEC 60050	International Electrotechnical Vocabulary
[R18]	IEC 60085	Electrical insulation - Thermal evaluation and designation
[R19]	IEC 60255	Electrical Relays
[R20]	IEC 60228	Conductors of insulated cables
[R21]	IEC 60332-1	Tests on electric and optical fiber cables under fire conditions - Part 1-2: Test for vertical flame propagation for a single insulated wire or cable - Procedure for 1 kW pre-mixed flame.
[R22]	IEC 60322-3/C	Tests on electric and optical fiber cables under fire conditions - Part 3-24: Test for vertical flame spread of vertically mounted bunched wires or cables.
[R23]	IEC 60364 series	Low-voltage electrical installations
[R24]	IEC 60479-1	Effects of current on human beings and livestock, Part 1: General aspects.
[R25]	IEC 60529	Degrees of protection provided by enclosures (IP Code)
[R26]	IEC 60670	Boxes and enclosures for electrical accessories for household and similar fixed electrical installations

ID	Standard	Title
[R27]	IEC 60754-1	Test on gases evolved during combustion of materials from cables - Part 1: Determination of the halogen acid gas content
[R28]	IEC 60754-2	Test on gases evolved during combustion of materials from cables - Part 2: Determination of acidity (by pH measurement) and conductivity.
[R29]	IEC 60811	Electric and optical fiber cables - Test methods for non-metallic materials
[R30]	IEC 60947	Low-voltage switchgear and controlgear
[R31]	IEC 60950--1	Information technology equipment – Safety.
[R32]	IEC 61000-3-11	Electromagnetic compatibility (EMC) - Part 3-11: Limits - Limitation of voltage changes, voltage fluctuations and flicker in public low-voltage supply systems - Equipment with rated current ≤ 75 A and subject to conditional connection
[R33]	IEC 61000-3-12	Electromagnetic compatibility (EMC) - Part 3-12: Limits - Limits for harmonic currents produced by equipment connected to public low-voltage systems with input current >16 A and ≤ 75 A per phase
[R34]	EN 61000-6	Electromagnetic compatibility (EMC) - Part 6: Generic Standards
[R35]	IEC 61034	Measurement of smoke density of cables burning under defined conditions
[R36]	IEC 61439	Low-voltage switchgear and controlgear assemblies
[R37]	IEC EN 62040-1	Uninterruptible power systems (UPS) - Part 1: General and safety requirements for UPS.
[R38]	IEC 62208	Empty enclosures for low-voltage switchgear and controlgear assemblies
[R39]	IEC 62262	Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)
[R40]	IEC 62282 Series	Fuel cell technologies
[R41]	FCC CFR47 Part 15	Radio Frequency Devices, Subpart A, B.
[R42]	ETSI EN 300 019: 2-1 (Class 1.2), 2-2 (Class 2.2) & 2-3 (Class 3.2) Equipment	Equipment Engineering (EE); Environmental conditions and environmental tests for telecommunications equipment.
[R43]	EN 300 396 V.1.6.1	Equipment Engineering (EE); Telecommunication network equipment; Electromagnetic Compatibility (EMC) requirements.

TABLE 28 LIST OF APPLICABLE STANDARDS

2.4 National Laws and Regulations

2.4.1 The version of the following indicative national laws and regulations shall be applied. The TSCC Contractor is responsible for the compliance to Federal and State legislation and the correct application of all regulations.

No	Standard	Description
[R44]	California Electrical Code (CEC)	Based on the National Electrical Code (NEC), it regulates the installation and grounding of electrical systems.
[R45]	Title 24, Part 3, California Code of Regulations	Contains specific standards for electrical installations.
[R46]	California Building Standards Code	Regulates the use of cables in construction, including safety and performance requirements.
[R47]	National Electrical Code (NEC)	Although a national code, it is adopted by California to regulate electrical cables.
[R48]	California Fire Code	Establishes standards for fire prevention, including alarm and suppression systems.
[R49]	Title 19, California Code of Regulations	Fire safety in buildings and public facilities.
[R50]	California Public Utilities Commission (CPUC) Regulations	Oversees telecommunications services and their infrastructure.
[R51]	California Building Standards Code	Includes standards for telecommunications installations in buildings.
[R52]	California Public Utilities Code	Regulates railway and public transportation systems.
[R53]	Federal Railroad Administration (FRA) Regulations	Although federal, these regulations also apply in California for railway systems.
[R54]	California Independent System Operator (CAISO) Tarif	Regulates grid management and interoperability with energy providers.

TABLE 3 LIST OF APPLICABLE CALIFORNIAN REGULATIONS

2.5 UIC Recommendations

Not applicable to the MVPS and LVPS.

3 TERMS, DEFINITIONS, AND ABBREVIATIONS

3.1.1 All the terms, definitions, and abbreviations are provided in the Glossary of Terms, Abbreviations and Definitions.

4 SYSTEM DESCRIPTION

4.1 Purpose of MVPS and LVPS

4.1.1 The MVPS and LVPS shall provide a safe, high-quality and reliable power supply for the TSCC systems and subsystems and other consumers as defined in Chapter 4.3.

All references to 34.5 kV in this Specification are indicative only. In the event that upstream clean energy sources are deferred, the TSCC Contractor shall verify and confirm the actual service voltage(s) in coordination with the serving utility during design development. The TSCC Contractor shall ensure that all system architecture, equipment ratings, insulation levels, protection settings, and interface requirements are adapted as necessary. This shall maintain reliable and safe operation of the traction and non-traction power systems, including MVPS and LVPS.

4.1.2 The MVPS and LVPS shall be deployed along the alignmentof CHSR, to include:

- System Equipment Locations along the main line
- Facilities (TCF, LMF, HMF, MOWFs)
- Passenger Stations (Merced, Madera, Kings Tulare, Bakersfield)
- Traction Power SubStations (TPSS)
- Operation Control Center (OCC)
- Other locations identified as part of the TSCC Contractor's scope

4.2 Definition of MVPS and LVPS

4.2.1 The MVPS consists of the following components and systems.

- 34.5 kV cable links connected to the Point of Common Coupling;
- 34.5kV cable rings;
- Ring Main Units (RMUs);
- Three-phase step-down transformers

4.2.2 The LVPS consists of the following components and systems.

- LV production;
- LV switchboards;
- Uninterruptible Power Supply Systems;
- Associated secondary feeders to technical buildings and auxiliary systems.

4.3 Operational context of MVPS and LVPS

4.3.1 MVPS Supply Sources

4.3.1.1 The MVPS, shall be supplied at the MV level of the power structure by two independent medium voltage feeder links originating from the 34,5kV busbar(s) located in the TPSS.

4.3.1.2 The 34.5 kV switchgear at the TPSS shall serve as the primary Point of Common Coupling (PCC) between the traction and non-traction power systems.

4.3.2 Wayside Equipment Location

4.3.2.1 At wayside equipment location, the LVPS system is provided with:

- One or two RMUs connected to the MV rings of the MVPS and MV / LV transformers.

- or alternatively for remote areas featuring a power consumption under 10kVA, one connection to the OCS and a UPS system with an extended autonomy can be proposed to the authority.

4.3.3 Passenger stations

4.3.3.1 At stations, the TSCC Contractor shall provide two Ring Main Units connected to the MVPS.

4.3.3.2 Stations LV Power system is connected to the RMUs, the MV / LV Transformers are in the stations contractor scope.

4.3.3.3 TSCC LVPS to feed TSCC equipment is connected to the stations LV main switchboards provided by the stations contractor.

4.3.4 Facilities

4.3.4.1 At facilities, the TSCC Contractor shall provide two Rings Main Units connected to the MVPS.

4.3.4.2 Facilities LV Power system is connected to the RMU, the MV / LV Transformers are in the facilities contractor scope.

4.3.4.3 TSCC LVPS to feed TSCC equipment in facilities is connected to the facilities LV main switchboards provided by the facilities contractor.

4.3.5 Traction substations, switching stations and paralleling switchyards

4.3.5.1 At Traction substations, switching stations and paralleling switchyards, the LVPS system is provided with RMU(s) (two in substations and switching stations, one in paralleling switchyards) connected to the MV rings of the MVPS and MV / LV transformers.

4.3.6 Power Consumers

4.3.6.1 During the design phase, the TSCC Contractor shall perform the power balance for each MVPS and LVPS location of CHSR.

4.3.6.2 Based on the power balance, the TSCC Contractor shall perform an analysis of the issued connection technical conditions for MVPS and LVPS sites, and shall state:

- a confirmation of connection technical conditions implementation;
- or a justification for the connection technical conditions amendment;
- or a justification for the new connection technical conditions request;
- or a justification for the case when a connection point is not necessary.

4.3.6.3 The TSCC shall retain responsibility for overall integrated design, modelling, and studies of the electrical system downstream of the PCC, as defined in the traction power specification.

4.3.6.4 The TSCC Contractor shall provide all necessary load profiles, connected equipment data, and electrical parameters of the non-traction systems to be connected to the 34.5 kV network, in order for the detailed system modelling, calculations, studies, and integrated power supply design of the overall electrical network to be performed by TSCC as defined in the traction specification.

4.3.7 Class of the loads supplied by the MVPS and LVPS

4.3.7.1 The TSCC Contractor shall design the MVPS and LVPS to supply the systems equipment in compliance with the consumer load class and consumer power supply requirement.

4.3.7.2 The LVPS shall provide power supply to all TSCC subsystems in all locations.

4.3.7.3 The following classification of loads is defined as below:

- Emergency Loads shall be connected to two separate and redundant power supplies and UPS (with minimum 12 hour battery backup) unless they are located in a remote site and feature a power consumption under 10kVA: then a single power supply and a UPS with an extended autonomy can be proposed instead to the Authority.
- Essential Loads shall be connected to two separate and redundant power supplies, unless they are located in a remote site and feature a power consumption under 10kVA: then a single power supply and a UPS with an extended autonomy can be proposed instead to the Authority.
- Non-essential loads shall be connected to one power supply source.

4.3.7.4 The following systems shall be considered as Emergency Loads:

- ETCS
- Interlocking
- Traffic Management System (TMS)
- Hazard Detection and Early Warning System (HDEWS)
- Wireless Communication System (except the Passenger Wi-Fi System)
- Digital Communication Network (DCN)
- Network Timing System (NTS)
- Enterprise Asset Management System (EAMS)
- CCTV
- Electronic Access Control System (EACS)
- Telephony System
- Cybersecurity
- Public Adress and Customer Information System (PACIS)
- Integrated Control and Supervision System (ICSS)
- Fire Protection System (FPS)
- Power SCADA
- All auxiliaries supplying control and monitoring equipment at traction substations, switching stations, and paralleling switchyards shall be considered as emergency loads.
- All TSCC equipment located at the OCC Control Room and OCC Equipment Rooms.
- Intrusion Detection

4.3.7.5 The following systems shall be considered as Emergency Loads:

- Switch motors
- Substations, shelters, switching stations, and paralleling switchyards utilities (lighting, HVAC, household sockets)

4.3.7.6 The loads which do not belong to the TSCC systems shall not be provided with power supply from the LVPS UPS system.

4.4 Design life

4.4.1 The design life of the MVPS and LVPS equipment shall be 30 years in compliance with the requirements of the CHSR Design Criteria Manual, Chapter 2 Basis of Design, section 2.2.2.2.2, Table 2-1.

5 SYSTEM REQUIREMENTS

5.1 General Requirements

5.1.1 The MVPS and LVPS systems shall be future proof, based on the most up-to-date and proven technology.

5.1.2 Proven technology means that the MVPS and LVPS shall be based on components that have been proven in similar service for at least five years and configured in an arrangement that has been demonstrated in a report to provide the required performance.

5.1.3 Low voltage levels of the LV distribution system shall follow IEC 60038.

5.1.4 The voltage level of the LV distribution system shall be selected considering the distance and the power required by the consumer.

5.1.5 The voltage drop shall comply with the requirements of applicable standards and regulations.

5.1.6 Neutral conductors shall be of the same size of the phase conductors to avoid overheating due to intrinsic residual harmonic content and unbalances in the system.

5.1.7 The MVPS and LVPS Power Supply system shall be designed such that it is possible to upgrade it in the future, by installation of the additional equipment only and without necessity of the replacement of initially supplied equipment; therefore, in addition to the spare circuit breakers, a 30% space for circuit breaker future installation shall be foreseen within a LV switchboard.

5.1.8 Adequate space shall be provided at TSCC locations for the future provision of MVPS and LVPS equipment.

5.1.9 As a minimum, the following calculations shall be performed, in compliance to the relevant standards and regulations, and submitted to the Authority for review:

- Detailed load analysis for each circuit, with accurate consideration of the power factor, load factor and simultaneity factor;
- Cable sizing calculation;
- UPS power balance;
- Back-up generator set and fuel storage calculation including autonomy time;
- Battery sizing calculation, accompanied by evidence of discharge/recharge times;
- Power system harmonic impacts/assessments;
- Step and touch voltage analyses;
- Electrical equipment heat dissipation estimation.

5.2 Environmental Requirements

5.2.1 MVPS and LVPS systems shall meet the environmental requirements described in the applicable regulations.

5.2.2 MVPS and LVPS equipment shall be designed to operate satisfactorily under all variations of load, pressure, UV light, ozone, and temperature that may occur under normal and abnormal conditions.

5.2.3 IP rating (according to EN 60529) shall be at least IP31 for indoor MVPS and LVPS equipment and at least IP54 for outdoor MVPS and LVPS equipment.

5.2.4 The MVPS and LVPS equipment shall be protected against pests and local fauna.

5.3 Functional Requirements

5.3.1 The TSCC Contractor shall implement energy efficiency optimization solutions with the support of intelligent metering function and plant automation.

5.3.2 Every switchboard shall be equipped with data acquisition devices to allow the remote monitoring of the health parameters of the system, like phase to phase and phase to ground voltages, phase currents, power factor, energy consumptions, UPS parameters, other relevant parameters.

5.3.3 Remotely controlled switching devices shall be able to be operated from:

- From OCC by dedicated workstation of the Power SCADA (for MVPS) and of the ICSS (for LVPS)
- Locally from the local HMI and manual operation directly from the equipment.

5.3.4 Under normal operating conditions, the MVPS and LVPS system shall be monitored and operated from a dedicated workstation of the Power SCADA and ICSS system in the OCC.

5.3.5 The TSCC Contractor shall implement the programmable logic controller / remote terminal unit / gateways needed for the local control and further data exchange with the TSCC Power SCADA and ICSS.

5.3.6 The TSCC Contractor shall ensure provision of the monitoring data (operating states, alarms, malfunctions, power failures, etc.) and control function of the LV distribution components including switching and metering devices to the ICSS system.

5.3.7 The TSCC Contractor shall ensure provision of the monitoring data and control function of the Uninterruptable Power Supply system components including batteries and chargers to the ICSS system.

5.3.8 Data to be considered for the supervision system are, but not limited to: operation mode, internal UPS temperature, bypass state, battery charging level, battery voltage and impedance, battery room temperature, alarms, malfunctions, power failures, etc.

5.3.9 The TSCC Contractor shall ensure provision of the monitoring data (operating states, alarms, malfunctions, power failures, etc.) and control function of the back-up generators to the ICSS system.

5.3.10 Under abnormal operating conditions, it shall be possible to operate the MVPS and LVPS system locally.

5.3.11 Local HMIs or interface ports shall be available at each location to provide MVPS and LVPS operators with a local control device.

5.3.12 The TSCC Contractor shall provide proper protection coordination, to ensure a high level of vertical and horizontal selectivity and to prevent healthy circuits and loads from being affected by a single fault in a faulty circuit or load.

5.3.13 Cables, busbar, electrical equipment and devices shall be protected against fault and overload effect in compliance with IEC 60364 and other relevant standards.

5.3.14 Energy metering functionality shall be implemented, based on the intelligent metering devices to be provided in each switchboard.

5.3.15 The MVPS and LVPS shall provide timestamped measurement data to the ICSS and Power SCADA covering the metering: energy, power, currents and voltages, power factor, etc.

5.4 Performance Requirements

5.4.1 General

5.4.1.1 The TSCC Contractor shall ensure the redundancy of the MVPS and LVPS system for the essential and emergency loads.

5.4.1.2 The MVPS and LVPS system design shall ensure that redundant cables and equipment are adequately separated or protected so that a single failure of any element of the power supply system does affect the operation or result in the failure of any other MVPS and LVPS element, thus resulting in the total loss of power.

5.4.1.3 The MVPS and LVPS design shall ensure that redundant cables and equipment are adequately separated or protected so that the probability of an incident external to the MVPS and LVPS affecting the operation of the MVPS and LVPS or resulting in a total loss of power distribution to any part of the network, is minimized.

5.4.1.4 The power supply and distribution system and its elements shall be designed to revert to safe modes under failure conditions. The TSCC Contractor shall employ high quality components, proven systems, redundancy, interlocking, checking devices and other techniques to achieve this goal.

5.4.1.5 The power quality of the MVPS and LVPS shall comply with EN 50160.

5.4.1.6 The averaged power factor measured at the Point of Common Coupling shall comply with the local legislation, as referred in Section 2.

5.4.1.7 The TSCC Contractor, if necessary, shall supply power factor correction equipment required to prevent incurred financial penalties under operation.

5.4.1.8 The TSCC Contractor shall develop the MVPS and LVPS architecture ensuring compliance to the MVPS and LVPS RAMS requirements.

5.4.1.9 The TSCC Contractor shall develop the MVPS and LVPS architecture ensuring there are no obstacles for future connection to Solar PV and Battery Energy Storage System (BESS) equipment.

5.4.2 Safety Requirements

5.4.2.1 The MVPS and LVPS shall comply with the safety requirements defined in Authority safety documentation.

5.4.2.2 The TSCC Contractor shall consider the MVPS and LVPS safety as an integral part of the system design. The MVPS and LVPS safety shall be emphasized at the start of design so that potential problems can be identified, assessed and resolved with minimal impact.

5.4.2.3 The MVPS and LVPS design and operational procedures shall include incorporation of fail-safe principles where failures would otherwise disable the system or cause human injury, damage to equipment, or inadvertent operation of critical equipment.

5.4.2.4 The MV MVPS and LVPS design shall include locating equipment so that access to the MVPS and LVPS equipment by the required personnel during operation, maintenance, or repair shall not require exposure to hazards, such as entrapment, chemical burns, electric shock, cutting edges, or toxic atmospheres.

5.4.2.5 The MVPS and LVPS system design and operational procedures shall include providing suitable warning and caution notes in operation, assembly, maintenance and repair instructions, and distinctive markings on hazardous components, equipment, or facilities for personnel protection.

5.4.2.6 Energy equipment shall be placed in locations where it does not affect the movement of people.

5.4.2.7 To provide power supply disconnection in case of fire in TSCC technical rooms, proper emergency buttons shall be provided to isolate the TSCC electrical systems.

5.4.3 RAM Requirements

5.4.3.1 The MVPS and LVPS shall comply with the RAM requirements in Schedule 1.

5.4.3.2 The MVPS and LVPS and related equipment shall be of modular design and of the error-proofing principles.

5.4.3.3 The MVPS and LVPS design and implementation shall be able to contend with any single failure at any level of the power structure with no effect on train operation.

5.4.3.4 Two independent power supplies shall be provided, to ensure the reliability of power supply of the Essential Loads.

5.4.3.5 Two independent power supplies and a UPS system shall be provided to ensure the reliability of power supply of the MVPS and LVPS Emergency Loads, unless they are located in remote areas and feature a power consumption under 10kVA, then a single power supply and a UPS with an extended autonomy can be proposed to the authority.

5.4.3.6 In case of failure of one of the two power supplies, the other power source shall take over and provide power supply to all the MVPS and LVPS Essential and Emergency Loads.

5.4.3.7 Automatic changeover function shall be implemented for the essential and emergency AC loads. For emergency loads no power supply interruption is allowed during the changeover.

5.4.3.8 Dual busbars with anti-backflow diodes, or chargers featuring intrinsically the anti-backflow function, shall be implemented for the essential and emergency DC loads.

5.4.3.9 Power lines outgoing from the UPS system should be of IT system (isolated neutral) to guarantee the continuity of the power supply to MVPS and LVPS Emergency Loads. In case a different system is used, the MVPS and LVPS design shall ensure that any single failure does not cause the loss of power for emergency loads.

5.4.3.10 The MVPS and LVPS equipment layout shall be standardized as much as practical as per location type.

5.4.3.11 Adequate accessibility and maneuverability space for installation, testing, operation, inspection, maintenance, repair and replacement for all MVPS and LVPS equipment shall be provided.

5.4.3.12 The standards to be applied for all MVPS and LVPS equipment shall be as per this specification and those specified in Schedule 16.

5.4.3.13 Each electrical assembly shall be identified by an appropriately sized label which clearly indicates the functional units and their electrical characteristics.

5.4.3.14 The main circuit breaker of a TSCC system or subsystem shall be indicated with a specific label, to support the power supply disconnection procedure in case of emergency or maintenance.

5.4.3.15 The TSCC Contractor shall specify each subcircuit on the switchboard single line diagram and allocate supply phases of each single-phase circuit to balance the load across the phases.

5.5 Security and Cybersecurity Requirements

5.5.1 The MVPS and LVPS shall be fully compliant with CHSR cybersecurity policies and the requirements specified in the document Technical Specification - Cybersecurity.

6 INTERFACES REQUIREMENTS

6.1 General Requirements

6.1.1 Interfaces are classified as below:

- Third Party interfaces: interfaces between TSCC systems and a system or systems provided by a Third Party (excluding CHSR contractors)
- External interfaces: interface between TSCC systems and a system or systems provided by CHSR contractors (Civils packages, stations contractor, facilities contractor, Solar PV and BESS contractors)
- Interfaces between systems within the TSCC scope

6.1.2 The TSCC Contractor shall develop design considering the identified Third Parties, External and Internal interfaces to ensure the required functionalities and performance described in this specification.

6.1.3 The TSCC Contractor shall, if necessary, propose any additional interfaces required to ensure the functionalities and performance described in this specification.

6.2 Third Parties Interfaces

No Third-Party interfaces identified at this stage.

6.3 External Interfaces – Stations contractors

6.3.1 The TSCC Contractor shall install MVPS and LVPS equipment in stations.

6.3.2 The TSCC Contractor shall provide to the stations contractor:

- Equipment dimensions
- Equipment clearances requirements
- Equipment mounting and fixings requirements
- Cable routes/containment requirements
- Equipment loadings
- Installation and maintenance requirements
- Equipment heating loads
- Equipment cooling loads
- Equipment hydraulic requirements

6.3.3 To be provided by stations contractor to accommodate the TCSS equipment installation and operational/maintenance requirements:

- Room dimensions and layouts
- Room facilities (Plumbing, HVAC, Lighting, Fire Protection Systems, Doors, electricity)
- Room raised floor system
- Delivery access routes.
- Maintenance access routes

6.3.4 The TSCC Contractor shall manage the electrical interfaces for the connection of power supply point LV Switchboards provided by TCSS in stations with LV power systems provided by stations contractors.

6.3.5 The TSCC Contractor shall consider that, with the aim of allowing the stations contractors to consider the TSCC load in the sizing of the station power supply system, a preliminary power balance shall be delivered to other contractors as a mean of interface resolution.

6.3.6 Based on the TSCC design development, the TSCC Contractor shall perform necessary coordination and collaboration with the stations contractors to ensure on time implementation of the related interfaces.

6.4 External Interfaces – Facilities Contractors

6.4.1 The TSCC Contractor shall install MVPS and LVPS equipment in facilities.

6.4.2 The TSCC Contractor shall provide to the facilities contractor:

- Equipment dimensions
- Equipment clearances requirements
- Equipment mounting and fixings requirements
- Cable routes/containment requirements
- Equipment loadings
- Installation and maintenance requirements
- Equipment heating loads
- Equipment cooling loads
- Equipment hydraulic requirements

6.4.3 To be provided by stations contractor to accommodate the TCSS equipment installation and operational/maintenance requirements:

- Room dimensions and layouts
- Room facilities (Plumbing, HVAC, Lighting, Fire Protection Systems, Doors, electricity)
- Room raised floor system
- Delivery access routes.
- Maintenance access routes

6.4.4 The TSCC Contractor shall manage the electrical interfaces for the connection of power supply point LV Switchboard provided by TCSS in facilities with LV power systems provided by facilities contractors.

6.4.5 The TSCC Contractor shall consider that, with the aim of allowing the facilities contractors to consider the TSCC load in the sizing of the facility power supply system, a preliminary power balance shall be delivered to other contractors as a mean of interface resolution.

6.4.6 Based on the TSCC design development, the TSCC Contractor shall perform necessary coordination and collaboration with the facilities contractors to ensure on time implementation of the related interfaces.

6.5 Internal Interfaces

6.5.1 LV Power Supply for TSCC Systems

6.5.1.1 The TSCC Contractor shall provide a LV Power Supply to the following systems.

- Train Control Systems
  - Interlocking
  - ETCS
  - Traffic Management System
- Telecommunications Systems
  - Integrated Control and Supervision System
  - Digital Communication Network
  - Wireless Communication Systems

- Telephony
- Network Timing System
- CCTV
- Electronic Access Control System
- Public Adress and Customer Information System
- Hazard Detection and Early Warning System
- Equipment building and housings electromechanical equipment, including lighting, HVAC and Fire Protection Systems.

6.5.2 **Network Timing System (NTS)**

6.5.2.1 The MVPS and LVPS shall interface with the NTS for time distribution and precise synchronization.

6.5.3 **Digital Communication Network (DCN)**

6.5.4 The MVPS and LVPS shall have a redundant interface with the Digital Communication Network (DCN) for the connectivity of MVPS and LVP system.

6.5.5 **Interface with Integrated Control and Supervisory System (ICSS)**

6.5.5.1 The LVPS shall integrate with the ICSS to enable end-to-end monitoring, fault management, and performance reporting. This integration shall support standard interfaces and protocols to ensure compatibility with ICSS subsystems and allow for centralized visibility and control within the broader operational management environment.

6.5.6 **Interface with Power SCADA**

6.5.6.1 The MVPS shall integrate with the Power SCADA to enable end-to-end monitoring, fault management, and performance reporting. This integration shall support standard interfaces and protocols to ensure compatibility with ICSS subsystems and allow for centralized visibility and control within the broader operational management environment.

6.5.7 **Interface with Enterprise Asset Management Systems (EAMS)**

6.5.7.1 The MVPS and LVPS shall provide static Asset Information and dynamic Asset Information to the EAMS for maintenance activities and asset lifecycle management activities, including power consumption.

6.5.8 **Physical integration in traction substations, switching stations and paralleling switchyards and wayside**

6.5.8.1 The MVPS and LVPS shall interface with the TSCC equipment housings and buildings to ensure proper MVPS and LVPS integration.

6.5.8.2 The MVPS and LVPS shall interface with the cable containment system of the TSCC equipment building to ensure proper pathway for the MVPS and LVPS cables.

6.5.9 **Traction Power System**

6.5.9.1 The MVPS and LVPS shall interface its MV cable links with the switchgear of the Point of Common Connection in the traction substations.

6.5.9.2 The MVPS shall provide for the cable terminations to the switchgear of the Point of Common Connection.

7 MATERIALS, PRODUCT, AND COMPONENTS REQUIREMENTS

7.1 General Requirements

7.1.1 All materials supplied shall conform to the requirements and test methods of the relevant standards and regulations.

7.1.2 All materials supplied shall be of sufficient grade and quality to meet the designed life requirements.

7.1.3 Electrical equipment and cables shall be de-rated according to the manufacturer's recommendations, or applicable codes and standards, for the design conditions.

7.1.4 The MVPS and LVPS equipment shall be complete with all parts and accessories or material which are useful for efficient operation of the MVPS and LVPS components. Such accessories and materials shall be deemed to be within the scope of this specification whether specifically mentioned or not.

7.1.5 The supply shall include all supporting structures, embedded parts, auxiliary equipment, mechanical linkages, auxiliary circuits wiring, interlocking devices necessary for their efficient operation. All such parts and accessories shall be deemed to be within the scope of this specification whether specifically mentioned or not.

7.1.6 TSCC power equipment shall be designed ensuring an adequate protection from rodent actions. Additionally, the TSCC Contractor shall implement any measures to provide rodent protection such as expanding foam..

7.2 LV Distribution

7.2.1 Low-voltage AC switchboards shall be used for distribution of AC power.

7.2.2 Low voltage switchboards shall be compliant with the relevant standard (EN 61439 series).

7.2.3 The main LV switchboard shall have a minimum form of segregation 2 to facilitate maintenance activities.

7.2.4 The LV switchboard connected to the Local Facility power supply system / TPSS facility power supply system, shall be provided with all the necessary metering equipment, aligned to the Local Facility / TPSS facility requirement, circuit breakers and load-break isolators/switches, including current/voltage transformers, energy meters, cabinets, fusegear and switchgear as required.

7.2.5 All LV equipment, directly connected to the Local Facility power supply system / TPSS facility power supply system, shall be suitable for use at the voltage and short-circuit rating at the connection point and not less than the tabulated short circuit rating tabulated in the Local Facility power supply system / TPSS facility power supply system requirements and relevant IEC standard.

7.2.6 The LV switchboard connected to Local Facility power supply system / TPSS facility power supply system shall be provided with the required protection system and shall be coordinated with the Local Facility / TPSS facility.

7.2.7 Electrical and mechanical interlocks shall be provided between the incomers and the bus coupler to avoid parallel operation of the external dual supply. Automatic and manual operation shall be possible.

7.2.8 As a minimum, the incoming switching devices to each LV switchboard, the outgoing switching devices for the UPS, major consumers (like point heating, for instance) and consumers that do not belong to the TSCC systems (cross border digital infra, for instance) shall be remotely controlled as required in chapter 5.3.

7.2.9 A Surge Protection Device system shall be provided, as required, to protect against induced voltages in MV (optional scope) and LV distribution networks arising from lightning strikes and grid-related surges (e.g. faults, switching of equipment).

7.2.10 Surge Protection Devices shall be located as close as possible to the system/equipment being protected and/or the main earth terminal of the system/equipment protected in accordance with IEC 60364.

7.2.11 Cable connection to Surge Protection Devices shall be kept as short as possible to avoid excessive voltage drop under surge conditions in accordance with IEC 60364

7.2.12 Insulation monitoring devices shall be provided for IT systems.

7.2.13 LV switchboard main busbars shall be thermally dimensioned for an intensity equal to twice the size of the general switches of the respective section, while the secondary distribution busbars shall be thermally dimensioned for an intensity equal to 1.5 times that of the general switches of the respective section.

7.2.14 Cables within LV switchboards shall be identified by means of specific identification plates, installed at the ends of each cable for their univocal identification; as well as the terminal blocks to which the individual cables abut, of the modular type on a unified guide, shall be numbered corresponding to the electrical diagrams and suitably separated with insulating diaphragms between the various users.

7.2.15 All units of the distribution boards, including supporting frames, shall be made to be rust-proof with at least two coats of primary paint applied on the interior and exterior surface and followed by a finishing coat.

7.2.16 The circuit breaker changeover switch shall be arranged neatly and mounted on the panel which shall be of standard design and provided within a hinged cover to facilitate inspection.

7.2.17 The indicating lamps of the distribution boards shall be of low power consumption; they shall be interchangeable and replaceable from the front of the panel.

7.2.18 All metallic parts of the panel shall be connected to the main earth loop. Suitable earth terminals for this purpose shall be provided.

7.2.19 Short circuit protection devices for TSCC power equipment shall be provided according to applicable standards to avoid development of the fire.

7.2.20 Design (calculations of cable sizes, equipment loading etc.), installation of the TSCC power cables shall comply with International Standards and the good engineering practices to guarantee their proper functioning.

7.3 LV Cables

7.3.1 LV cables shall comply with “Commission Regulation (EU) No. 305 - Construction Products Regulation (CPR)”.

7.3.2 LV electrical cables, control and communication cables installed, even partially, within equipment buildings or locally managed facilities shall be of Medium Fire Risk type, Dca according to the EN 13501-6.

7.3.3 LV electrical cables, control and communication cables travelling, even partially, inside passenger stations and in tunnels shall be of High Fire Risk type, Cca s1 d1 a1 according to the EN 13501-6.

7.3.4 LV electrical cables for the power supply of Safety and Security Systems shall be fire resistant, at least 90min - 830°C in accordance with EN 50200.

7.3.5 The maximum continuous current-carrying capacity, the maximum permissible conductor temperature and the factors for determining such rating and temperature and physical protection for all cables shall be based on IEC 60364-5-52 standards and on the conditions anticipated on site. These conditions shall include, but not be limited to, the following:

- Ground and duct temperature,
- Soil thermal resistivity,
- Ambient air temperature.

7.3.6 The ratings applied to the cable shall be determined by the most onerous installation condition in which the cable is travelling.

7.3.7 The LV electrical cables shall have two types of working temperature: Maximum operating temperature 90°C; Maximum short circuit temperature 250°C.

7.3.8 Electrical cables exposed to external elements shall be protected with the use of additional enclosures (conduits, etc.). Unprotected cables shall be, as minimum, suitable for the typical ambient temperature range and protected against mechanical damage, UV light, ozone and water.

7.3.9 The minimum cross section for main LV electrical cables shall be 4 sqmm for power circuit and 2.5 sqmm for lighting circuit in compliance with IEC standards.

7.3.10 The minimum cross section for terminal LV electrical cables shall be 2.5 sqmm for power circuit and 1.5 sqmm for lighting circuit in compliance with IEC standards.

7.3.11 The LV electrical cables shall be of insulation type 0.6/1 kV.

7.3.12 Insulation type 450/750V cables may be used for protection earth cables and switchboard internal cabling.

7.3.13 The LV electrical cables shall be of conductor class 5 according to IEC 60228. The adoption of lower conductor classes shall be approved by the Authority.

7.3.14 The LV electrical cable joints shall be minimized as practicable.

7.3.15 The LV electrical cable joints shall be identified and shall have an electrical and mechanical performance not less than that of the cable.

7.3.16 Proposals for joints in cable runs shall be submitted for Authority approval on an individual basis.

7.3.17 Any joints and connections shall be located such that they are readily accessible for maintenance purposes.

7.3.18 The LV electrical cables shall have copper conductors.

7.3.19 The LV electrical cable insulation shall be halogen free EPR (Ethylene Propylene Rubber) or XLPE (Cross-Linked-Polyethylene).

7.3.20 A proper grounding of the cable trays and metal conduits shall be provided to avoid touch voltages and maximize shielding in compliance with IEC 61140.

7.3.21 Medium Voltage and Low Voltage circuits shall not be installed in common conduit or containment.

7.3.22 Power and control and communication cables shall not be installed in common conduit or containment.

7.3.23 Circuits energized from different power sources or separately protected circuits energized from the same power source shall not be combined into a single cable.

7.3.24 Emergency circuits shall be separated from non-essential and essential circuits and segregated with dividers or in dedicated cable containment.

7.3.25 Manholes, handholes, vaults and boxes, pulling chambers shall be sufficiently sized to allow easy cable pulling and jointing, to allow cable expansion and contraction and according to cables minimum bending radius, ensuring cables can be pulled manhole to manhole within tolerable cable bending radii.

7.4 Uninterruptable Power Supply System

7.4.1 A UPS system shall be provided for the power supply of MVPS and LVPS emergency loads.

7.4.2 The UPS system shall be of a modular type and shall be designed to withstand a single failure and still be able to deliver the required output to the loads for the designed autonomy (minimum 12 hours), within the acceptable voltage range required by the loads.

7.4.3 UPS modules shall be hot-swappable.

7.4.4 UPS systems shall be equipped with an internal automatic bypass switch designed to transfer the entire uninterruptable load, from the UPS unit output to the main power supply in case of failures of UPS modules.

7.4.5 UPS systems shall be equipped with an external manual bypass switch designed to transfer the entire uninterruptable load, from the UPS system output to the main power supply whenever it's required a maintenance, replacement or repair of UPS or battery bank.

7.4.6 The UPS shall have a network management card, using a standard protocol compatible with the used TSCC ICSS system, to enable monitoring and controlling of the UPS devices.

7.4.7 The UPS systems shall be provided with intrinsic testing functionality.

7.4.8 The precise capacity of the UPS system and batteries shall be determined by the TSCC Contractor to ensure total autonomy of the MVPS and LVPS emergency loads for a time required by the CHSR.

7.4.9 UPS Battery packs shall be divided into separate banks to provide physical redundancy.

7.4.10 UPS batteries shall be equipped with a health remote monitoring system.

7.4.11 UPS batteries shall have a flame retardancy greater or equal than UL94 V-0 or equivalent classification.

7.4.12 UPS batteries shall be maintenance-free industrial type.

7.4.13 UPS batteries shall be in a temperature-controlled room and kept at a temperature range that maximizes battery lifetime.

7.4.14 UPS batteries shall be low emission of dangerous gases.

7.4.15 An adequate system for air exchange shall be guaranteed in the room where the UPS batteries are located to prevent formation of explosive atmosphere in compliance with the IEC 62485 - EN 50272.

7.4.16 UPS batteries shall be ventilated in accordance with IEC 62485-2 to prevent formation of explosive gases.

7.4.17 Battery type for TSCC equipment shall be selected according to applicable standards and considering local environmental characteristics to guarantee their proper functioning and prevent injuries during their maintenance.

7.5 Back-up Generator

7.5.1 Each back-up generator shall have a rated power of a minimum of 20% greater than the maximum power demand calculated that the generator is intended to support.

7.5.2 Back-up generators shall ensure a high level of reliability and shall be designed to provide an autonomy of at least the time necessary for the restoration of the power supply from the main power source at the rated power.

7.5.3 Back-up generators shall be of indoor type and shall be suitable for the environment it will be installed in.

7.5.4 In situations where indoor installation is necessary a separate room for the generator placement shall be provided.

7.5.5 Back-up generator storage tanks shall be installed with all the relative precautions and safety measures.

7.5.6 The back-up generator shall start, operate, and turn off autonomously when requested.

7.5.7 Back-up generator remote control, monitoring and interface to the TSCC ICSS system shall be ensured.

7.6 OCC Power Supply

7.6.1 The OCC Power Supply System main purpose is to supply, 24/7/365, continuous voltage to TSCC system components of the OCC and alternative voltage to the control and monitoring servers and workstations of the OCC.

7.6.2 The design of the OCC Power Supply System shall be of a modular type.

7.6.3 The rated power of the OCC Power Supply System can be adapted to the need by increasing the number of converter/rectifier units.

7.6.4 “N+1” hot redundancy of each component type of the OCC Power Supply System shall ensure the availability of the adequate output even in the event of the failure of one unit.

7.6.5 Each component of the OCC Power Supply System shall be designed so that it can be tested, plugged-in, or unplugged when the OCC Power Supply is operating, without creating disturbance to the output supply.

7.6.6 Dual source (AC & DC) converter units of the OCC Power Supply System shall produce the 230Vac output.

7.6.7 Each converter unit in the OCC Power Supply System shall feature its own static source changeover switch.

7.6.8 AC source of the OCC Power Supply System shall be selected under normal operation conditions (when both supply source active) to lower the chargers load and to improve the efficiency of the conversion,

7.6.9 Upon voltage loss or recovery, AC to DC and DC to AC source switchover time of the OCC Power Supply System shall be 0ms. There shall be no voltage dip at the output.

7.6.10 As required by the OCC designer, DC/DC converters can be set downstream of the batteries, to regulate the DC voltage output, as the battery output voltage varies depending on the charging status, temperature, and age.

7.6.11 The OCC Power Supply System shall be monitored from the ICSS. The monitoring functions shall comprise at least:

- alarms and faults

- display of main electrical values such as but not limited to:
  - voltage and current of batteries
    - voltage and current of converters
    - voltage and current of rectifiers
    - Input voltages
    - Output voltages
  - Battery temperature
  - Battery charge status
  - Estimated time before end of autonomy on power input loss
  - event recorder with local and remote readout.

7.6.12 The TSCC Contractor shall deploy (design, manufacture, deliver, install, inspect, test, commission, supply necessary documentation, spare parts, special tools, and training) the OCC Power Supply system as a part of the TSCC systems dedicated for the power supply of the TSCC systems and subsystems and other consumers as defined in the Chapter 4.3

7.6.13 The TSCC Contractor shall deploy the OCC Power Supply system according to the power supply requirement of each OCC Power Supply consumer, applicable standards and documents for California High Speed Rail (CHSR).

7.7 34.5kV MV System - Production and Distribution

All references to 34.5 kV in this section, section 7.8, 7.9 & 7.10 are indicative. The TSCC Contractor shall comply with Clause 4.1.1 regarding verification and confirmation of actual service voltage with the serving utility.

7.7.1 The MV System shall be tasked with delivering power to the RMUs inserted on the MV rings.

7.7.2 The MV rings outsets shall be in the traction power substations.

7.7.3 Auxiliary systems of the RMUs shall comprise the logic cabinet required for their operation. The logic cabinet will feature the PLC or RTU required to monitor and control the RMU, the gateway/switch to the power SCADA network, a DC charger and its battery rack. It will monitor the MV/LV transformer as well.

7.7.4 A MV ring shall be connected at its endings either to the switchgear of the Point of Common Connection of two different traction substations, either to two different sections of the busbar serving as the point of common connection in the same traction substation.

7.7.5 A single MV ring outset at the traction substation shall be able to take over the full load of the ring which it supplies.

7.8 34.5kV MV system – Field structure and Cable links

7.8.1 The MV system power structure shall be made of open rings routing along the line.

7.8.2 The TSCC Contractor shall lay the 34.5kV cables in duct banks running along the right-of-way.

7.8.3 A RMU shall allow to enable ring continuity, or to sever the MV ring of which it is connected, and to supply power to its site according to the power demand.

7.8.4 Each RMU shall be fitted with a fault detection device allowing for a swift re-mapping of the ring in the event of a fault.

7.8.5 Each RMU shall be motor operated to allow a remote configuration of the rings from the power SCADA.

7.8.6 The design of the RMU control and monitoring subsystem shall meet the IEC 61850 requirements.

7.8.7 Rated voltage of auxiliary control circuits of RMUs shall be supplied from a battery-charger system located on each site.

7.8.8 RMUs shall be gas or vacuum insulated. Switchgear cubicles shall be industrial standard products. They shall be free standing and suitable for indoor service.

7.8.9 The RMU communication abilities shall meet the IEC 61850 requirements.

7.8.10 For maintenance purposes, all RMUs:

- shall be provided by the same manufacturer, in the same factory range,
- shall have the same short-circuit withstand abilities and the same main busbar ampacity,
- shall accommodate various sizes and types of 34.5kV cables.

7.8.11 The Medium Voltage network cable links shall be made primarily of dry insulated, three-core radial-field 26/35(42) kV cables, or dry insulated 26/35(42) kV single cable trefoils, and their connector plugs.

7.8.12 The Medium Voltage network cables shall feature aluminum or copper conducting core(s), semi-conductor over the conducting core, cross-linked polyethylene type (XLPE) insulating sheathing, semi-conducting over the insulating sheathing, screen, insulation and protective sheathing.

7.8.13 The cross-section value of each type of cable shall be the sole liability of the TSCC Contractor, as part of their design works.

7.8.14 The sizing of the 34.5kV cable cross section shall be calculated to ensure that one cable link is able to feed the entire ring which it belongs to.

7.8.15 The MV cables (and their screens) shall withstand the short-circuit current under a given fault elimination time without exceeding the maximum acceptable temperature specified for the insulation material.

7.8.16 The MV cables shall withstand the RMS current without exceeding the normal operating temperature specified for the insulation material.

7.8.17 The standard rated short duration power-frequency withstand voltage and the BIL/LIWL features of the MV cables shall be carefully assessed as part of the insulation coordination design of the 34.5kV network.

7.8.18 Connecting junctions/plugs shall reconstitute perfectly all elements of the MV cables. They will present at least the same ampacity, voltage, standard rated short duration power-frequency withstand voltage and the BIL/LIWL as the cable ones.

7.8.19 If required, the TSCC Contractor shall provide the surge arresters required for cables and cable screens protection and perform intermediate grounding of the screen in cable links if required.

7.8.20 The TSCC Contractor shall design the 34.5 kV cable routing to avoid crossing from one track side to the other track side, as much as it is practically and economically achievable.

7.8.21 In all locations, connecting civil works shall be designed and installed with respect to the acceptable bending radius of the cables and to the cable arrangement design. The required depth of technical basements and/or raised floors in technical rooms housing the RMUs shall be determined with due consideration of these requirements.

7.8.22 At system equipment locations, facilities, traction sites, the 34.5kV cables shall be laid in cable containment.

7.8.23 For burying cables in the ground, the TSCC Contractor shall provide concrete mechanical protective cover and install warning tape 50 cm above.

7.9 34.5kV/LV Distribution Transformers

7.9.1 Distribution Transformers shall step down voltage level from 34.5kV AC to LV AC.

7.9.2 Distribution Transformers shall be three-limbs-wound dry insulated type ones and fitted with off load tap changers (±10% primary voltage, 2,5% steps, same rated power on each tap)

7.9.3 Distribution Transformers shall be Air Natural cooled.

7.9.4 Each distribution transformer shall have a spare power capacity of around 30 % of their nominal AN power rating.

7.9.5 Distribution Transformers shall be fitted with temperature sensors and their monitoring relay. The relay shall be mounted on the transformer enclosure or the fence of the transformer housing or the logic cabinet front panel, as per the TSCC Contractor's submitted layout.

7.9.6 The insulation level of the transformers primary windings shall be consistent with the 34.5 kV switchgear insulation level.

7.10 LV production on remote sites

7.10.1 On remote sites where the TSCC Contractor deems that the installation of a RMU and a 34.5kV/LV transformer will not be cost-effective, the site shall draw the power from the OCS.

7.10.2 Sites where power is drawn from the OCS shall include a fused load-break switch connected to the OCS, and an Oil Natural Air Natural single phase 25kV/LV transformer, mounted on a catenary post or a dedicated post located in the immediate vicinity of the OCS.

7.10.3 Downstream of the single-phase transformer, the TSCC Contractor shall install an AC/AC converter to uphold a consistent LV voltage albeit the voltage variations of the OCS.

7.10.4 Auxiliary systems of the fused load-break switches shall comprise the logic cabinet required for their operation. The logic cabinet will feature the PLC or RTU required to monitor and control the switch, the gateway/switch to the power SCADA network, a DC charger and its battery rack. It will monitor the MV/LV transformer and the AC/AC converter as well.

7.10.5 Voltage level, BIL/LIWL of the fused load-break switches and of the 25kV/LV transformer shall be consistent with the voltage level of the OCS.

7.10.6 As per required, the single-phase transformer primary bushings shall be fitted with arcing horns and/or connected to surge arresters.

7.10.7 On any given traction section, the power drawn from the OCS by the MVPS and LVPS system shall not exceed 500kW.

8 TOLERANCES

Not applicable to MVPS and LVPS.

9 SCOPE OF SUPPLY AND DELIVERY

9.1 General Requirements

9.1.1 General requirements related to the TSCC Contractor Scope of Work are described in Schedule 16

9.2 Specific Requirements

9.2.1 The TSCC Contractor shall supply, deliver, install, test, and commission all components necessary for a fully functional MVPS and LVPS, as specified in this Technical Specification.

9.2.2 The TSCC Contractor shall be responsible for the design, manufacture, factory acceptance testing (FAT), delivery, site installation, integration, site acceptance testing (SAT), and commissioning of the MVPS and LVPS solution to facilitate CHSR in-revenue service.

9.2.3 The scope of supply shall include, but not be limited to

- Cable terminations and connections to the MV switchgear of the Point of Common Connection located in the traction substations.
- MV rings
- RMUs
- Fused load-break switches connected to the OCS
- MV/LV transformers
- Low voltage production
- Low voltage distribution;
- Control and monitoring, and its connection to the power SCADA
- Uninterruptible power supply system;
- Back-up generator at the OCC.
- Hardware and software licences.

9.2.4 The TSCC Contractor shall ensure that all equipment and materials delivered are compliant with relevant standards and project-specific environmental and safety requirements.

9.2.5 The TSCC Contractor shall coordinate all delivery and logistics activities in accordance with the Project Delivery Program and in consultation with the Authority, including any site access restrictions and staging requirements.

9.2.6 The TSCC Contractor shall label and package all equipment and components clearly and securely to facilitate identification, handling, and inventory upon delivery to site.

9.2.7 The TSCC Contractor shall provide a detailed Delivery and Installation Schedule, identifying all major equipment deliveries, installation milestones, and dependencies.

10 MANUFACTURING

10.1 General Requirements

10.1.1 General manufacturing requirements are defined in the Scope of Work.

11 INSTALLATION AND INTEGRATION

11.1 General Requirements

11.1.1 General installation and integration requirements are defined in the Scope of Work and Schedule 3.

11.2 Specific Requirements

11.2.1 The TSCC Contractor shall provide temporary power supplies, if necessary for TSCC Contractor works (construction, installation, test and commissioning, etc.).

11.2.2 Fossil-based power sources should be avoided for temporary power supplies and may be considered only under approval of the Authority.

11.2.3 The TSCC Contractor shall perform the design, manufacturing, delivery, installation, inspection, test, commissioning, supply of necessary documentation, spare parts, special tools, and training for the MVPS and LVPS and its components in accordance with the relevant standards and regulations as it is stated in Section 2.

12 TESTING & ACCEPTANCE

12.1 General Requirements

General testing and acceptance requirements are defined in the Scope of Work and Schedule 3.

13 SUBMITTALS

13.1 General Requirements

13.1.1 The submittals required for the Interlocking system are defined in the Scope of Work.

14 QUALITY MANAGEMENT

14.1 General Requirements

14.1.1 General quality management requirements are defined in the Agreeement and associated Schedules.

15 ADDITIONAL INFORMATION REQUESTED

15.1 General Requirements

15.1.1 In addition to the mandatory requirements outlined in this specification, the Authority reserves the right to request from the TSCC Contractor and related Suppliers information pertaining to the performance of proposed or supplied elements under similar service conditions, with particular emphasis on railway management aspects which may influence reliability availability maintainability characteristics.

16 LOGISTICS

16.1 General Requirements

16.1.1 General logistics requirements are defined in the Agreement.

APPENDIX A TO EXHIBIT 5(J) MEDIUM VOLTAGE POWER SYSTEM (MVPS) AND LOW VOLTAGE POWER SYSTEMS (LVPS)

Schematic plan	Area	System		Kilometer/Mile	Package Stationing	Type	ID	Comment	ID	CP1 0km	OTD	RMU	OCS FEEDER	Power demand on MV system per load	# MV Power supply point	Power demand on per MV supply points (kVA)	Power demand on OCS per load	# OCS supply point	Power demand per OCS supply points (kVA)
	CP1	Telecom		Kilometer	293.23	Shelter	TCEH-CP1-1 (293.230)		1	0.00	267.325	2		30					
	CP1	Radio				FRMCS RRH Radio Site				0.00		0		4	1	35			
	CP1	road vehicule tail	166	267.7	293.7	-30/0/30	LEFT/RIGHT	Avenue 20	0	0.33		0		1					
	CP1	road vehicule tail	170	270.6	296.6	-30/0/30	LEFT/RIGHT	Avenue 17	1	3.26			1				1	1	1
	CP1	Radio				FRMCS RRH Radio Site				4.28		1		4	2	4			
	CP1	Traction		Kilometer		Traction site	SS-RAY		SS-RAY	6.18		2		110	3	111			
	CP1	earthquake	172	273.8	299.8	330	RIGHT	RIGHT SIDE DUE TO BNSF	2	6.48		0		1					
	CP1	road vehicule tail	173	275.4	301.4	-30/0/30	LEFT/RIGHT	Avenue 15 1/2	3	8.09			1				1	2	2
	CP1	road vehicule tail	173	275.4	301.4	-30/0/30	LEFT/RIGHT	Avenue 15	4	8.09			0				1		
	CP1	Radio				FRMCS RRH Radio Site				8.78		0		4	4	84			
Madera	CP1	Signaling		Kilometer	302.109	Shelter	TCEH-CP1-2 (302.109)		2	8.78	276.204	2		80					
Madera	CP1	Signaling		Kilometer	306.132	Shelter	TCEH-CP1-3 (306.132)	Madera Station	3	12.76	280.227	0		80					
	CP1	Passenger station				Station		Madera Station		12.86		2		1000	5	1172			
	CP1	Radio				FRMCS BBU Radio Site				12.86		0		12					
Madera	CP1	Signaling		Kilometer	306.445	Shelter	TCEH-CP1-4 (306.445)	Madera Station	4	13.07	280.54	0		80					
	CP1	Traction		Kilometer		Traction site	PS-12		PS-12	14.46		1		70					
	CP1	rail temperature	177	281.9	307.9	10	LEFT/RIGHT	Madera STN	5	14.53		0		1	6	72			
	CP1	road vehicule tail	177	281.9	307.9	-30/0/30	LEFT/RIGHT	Avenue 12	6	14.53		0		1					
Madera	CP1	Signaling&Telecom		Kilometer	309.044	Shelter	TCEH-CP1-5 (309.044)	Points, back to single track after Madera Station	5	15.64	283.139	2		110		110			
	CP1	road vehicule tail	178	283.5	309.5	-30/0/30	LEFT/RIGHT	Avenue 11	7	16.14			1				1	3	1
	CP1	Radio				FRMCS RRH Radio Site				17.26		1		4	7	4			
	CP1	road vehicule tail	179	285.1	311.1	-30/0/30	LEFT/RIGHT	Avenue 10	8	17.75			1				1	4	1
	CP1	road vehicule tail	180	286.7	312.7	-30/0/30	LEFT/RIGHT	Avenue 9	9	19.36			1				1		
	CP1	earthquake	180	286.7	312.7	330	LEFT/RIGHT		10	19.36			0				1		
	CP1	Hot Box	180	286.7	312.7	0	LEFT/RIGHT		11	19.36			0				1	1	6
	CP1	derailment	180	286.7	312.7	0	LEFT/RIGHT		12	19.36			0				1		
	CP1	wind	180	286.7	312.7	330	LEFT/RIGHT		13	19.36			0				1		
	CP1	rain	180	286.7	312.7	330	LEFT/RIGHT		14	19.36			0				1		
	CP1	road vehicule tail	181	288.3	314.3	-30/0/30	LEFT/RIGHT	Avenue 8	15	20.97		0		1	8	5			
	CP1	Radio				FRMCS RRH Radio Site				20.97		1		4					
	CP1	Traction		Kilometer		Traction site	PS-R33		PS-R33	22.32		1		70	9	71			
	CP1	road vehicule tail	182	289.9	315.9	-30/0/30	LEFT/RIGHT	Avenue 7	16	22.57		0		1					
	CP1	Radio				FRMCS RRH Radio Site				25.36		1		4	10	4			
	CP1	road vehicule tail	185	294.7	320.7	-30/0/30	LEFT/RIGHT	veteran blvd	17	27.40			1				1	6	1
	CP1	Traction		Kilometer		Traction site	SWS-MKT		SWS-MKT	28.86		2		70	11	82			
	CP1	Radio				FRMCS BBU Radio Site				29.86		0		12					
	CP1	road vehicule tail	187	297.9	323.9	-30/0/30	LEFT/RIGHT	shawn avenue	18	30.62			1				1	7	2
	CP1	earthquake	187	297.9	323.9	330	RIGHT	RIGHT SIDE DUE TO UPRR	19	30.62			0				1		
	CP1	road vehicule tail	188	299.6	325.6	-30/0/30	LEFT/RIGHT	ashlan avenue	20	32.23			1				1	8	1
	CP1	Telecom		Kilometer	326.8990882	Shelter	TCEH-CP1-6 (326.899)		6	33.50	316.639	2		30	12	34			
	CP1	Radio				FRMCS RRH Radio Site				33.50		0		4					
	CP1	road vehicule tail	190	302.8	328.8	-30/0/30	LEFT/RIGHT	clinton avenue	21	35.45			1				1	9	2
	CP1	road vehicule tail	190	302.8	328.8	-30/0/30	LEFT/RIGHT	mckinley avenue	22	35.45			1				1		
	CP1	Traction		Kilometer		Traction site	PS-CLI		PS-CLI	36.95		1		70	13	71			
	CP1	road vehicule tail	191	304.4	330.4	-30/0/30	LEFT/RIGHT	olive avenue	23	37.06		0		1					
Fresno	CP1	Signaling		Kilometer	331.13	Shelter	TCEH-CP1-7 (331.130)	Points, dual track around Fresno Station	7	37.49	305.225	2		80	14	84			
	CP1	Radio				FRMCS RRH Radio Site				37.49		0		4					
	CP1	road vehicule tail	192	306.0	332.0	-30/0/30	LEFT/RIGHT	belmont avenue	24	38.67			1				1		
	CP1	landslide	192	306.0	332.0	30	LEFT	fresno trench	25	38.67			0				1		
	CP1	landslide	192	306.0	332.0	30	RIGHT	fresno trench	26	38.67			0				1	10	5
	CP1	flood	192	306.0	332.0	0	LEFT/RIGHT	fresno trench	27	38.67			0				1		
	CP1	earthquake	192	306.0	332.0	330	RIGHT	RIGHT SIDE DUE TO UPRR	28	38.67			0				1		
Fresno	CP1	Signaling		Kilometer	335.084	Shelter	TCEH-CP1-8 (335.084)	Fresno Station	8	41.41	309.179	2		80	15	80			
Fresno	CP1	Signaling		Kilometer	335.415	Shelter	TCEH-CP1-9 (335.415)	Fresno Station	9	41.73	309.511	0		80					
	CP1	rail temperature	194	309.2	335.2	10	LEFT/RIGHT	Fresno STN	29	41.89		0		1					
	CP1	road vehicule tail	194	309.2	335.2	-30/0/30	LEFT/RIGHT	HWY 41	30	41.89		0		1	16	1094			
	CP1	Passenger station				Station		Fresno Station		41.96		2		1000					
	CP1	Radio				FRMCS BBU Radio Site				41.96		0		12					
Fresno	CP1	Signaling		Kilometer	336.715	Shelter	TCEH-CP1-10 (336.715)	Points, back to single track after Fresno Station	10	43.02	310.812	2		80	17	80			
	CP1	landslide	195	310.8	336.8	30	LEFT	fensen trench	31	43.50			1				1		
	CP1	landslide	195	310.8	336.8	30	RIGHT	fensen trench	32	43.50			0				1	11	3
	CP1	flood	195	310.8	336.8	0	LEFT/RIGHT	jensen trench	33	43.50			0				1		
	CP1	Traction		Kilometer		Traction site	PS-CHR		PS-CHR	44.58		1		70	18	70			
	CP1	road vehicule tail	196	312.4	338.4	-30/0/30	LEFT/RIGHT	jensen avenue	34	45.11			1				1	12	1
	CP1	Radio				FRMCS RRH Radio Site				46.22		1		4	19	4			
	CP1	earthquake	199	317.3	343.3	330	RIGHT	RIGHT SIDE DUE TO BNSF	35	49.93			1				1	13	1
Fresno MOWF	CP1	Signaling&Telecom		Kilometer	344.153	Shelter	TCEH-CP1-11 (344.153)	Points, for Fresno MOWF	11	50.38	318.248	2		110					
	CP1	Traction		Kilometer		Traction site	PS-AME		PS-AME	50.52		0		70	20	184			
	CP1	Radio				FRMCS RRH Radio Site				50.52		0		4					
	CP2	road vehicule tail	200	318.9	18.9	-30/0/30	LEFT/RIGHT	lincoln avenue	36	51.54		0		1	21	1801			
	CP2	Facilities						Fresno MOWF/OCC/TCF/ILME/HMF		51.75		2		1600					
Fresno MOWF	CP2	Signaling		Kilometer	19.45	Shelter	TCEH-CP2-1 (19.460)	Points, back to single track after Fresno MOWF	1	52.68	320.575	2		80	22	80			
	CP2	road vehicule tail	201	320.5	20.5	-30/0/30	LEFT/RIGHT	aidan avenue	37	53.15			1				1		
	CP2	rain	201	320.5	20.5	330	LEFT/RIGHT		38	53.15			0				1		
	CP2	Hot Box	201	320.5	20.5	0	LEFT/RIGHT		39	53.15			0				1	14	5
	CP2	derailment	201	320.5	20.5	0	LEFT/RIGHT		40	53.15			0				1		
	CP2	wind	201	320.5	20.5	330	LEFT/RIGHT		41	53.15			0				1		
	CP2	road vehicule tail	202	322.1	22.1	-30/0/30	LEFT/RIGHT	south avenue	42	54.76		0		1	23	5			
	CP2	Radio				FRMCS RRH Radio Site				54.76		1		4					
	CP2	road vehicule tail	203	323.7	23.7	-30/0/30	LEFT/RIGHT	manning avenue	43	56.37			1				1	15	1
	CP2	Traction		Kilometer		Traction site	SS-SPR		SS-SPR	58.50		2		110	24	122			
	CP2	Radio				FRMCS BBU Radio Site				58.50		0		12					
	CP2	road vehicule tail	205	326.9	26.9	-30/0/30	LEFT/RIGHT	floral avenue	44	59.59			1				1	16	1
	CP2	road vehicule tail	206	328.5	28.5	-30/0/30	LEFT/RIGHT	nebraska avenue	45	61.20			1				1	17	1
	CP2	road vehicule tail	207	330.1	30.1	-30/0/30	LEFT/RIGHT	mountain avenue	46	62.81		0		1	25	5			
	CP2	Radio				FRMCS RRH Radio Site				62.81		1		4					
	CP2	earthquake	208	331.7	31.7	330	RIGHT	RIGHT SIDE DUE TO BNSF	47	64.42			1				1	18	1
	CP2	Traction		Kilometer		Traction site	PS-WIL		PS-WIL	66.41		1		70	26	74			
	CP2	Radio				FRMCS RRH Radio Site				66.41		0		4					
	CP2	Telecom		Kilometer	34.48951562	Shelter	TCEH-CP2-2 (34.490)		2	68.38	336.272881	2		30	27	38			
	CP2	road vehicule tail	212	338.2	38.2	-30/0/30	LEFT/RIGHT	elkhorn avenue	48	70.86		0		1	28	6			
	CP2	road vehicule tail	212	338.2	38.2	-30/0/30	LEFT/RIGHT	lowter avenue	49	70.86		0		1					
	CP2	Radio				FRMCS RRH Radio Site				70.86		1		4					
	CP2	Traction		Kilometer		Traction site	PS-DAV		PS-DAV	74.35		1		70	29	82			
	CP2	Radio				FRMCS BBU Radio Site				74.35		0		12					

	CP2	earthquake	215	343.0	43.0	330	LEFT/RIGHT		50	75.68			1				1	19	1
	CP2	Radio				FRMCS RRH Radio Site				78.85		1		4	30	4			
	CP2	road vehicule fail	219	349.4	49.4	-30/0/30	LEFT/RIGHT	dover avenue	53	82.12		0		1					
	CP2	Traction		Kilometer		Traction site	SWS-NOR		SWS-NOR	82.19		1		70	31	75			
	CP2	Radio				FRMCS RRH Radio Site				82.19		0		4					
	CP2	road vehicule fail	220	351.1	51.1	-30/0/30	LEFT/RIGHT	excelsior avenue	52	83.73			1				1	29	1
	CP2	Radio				FRMCS RRH Radio Site				86.69		1		4					
	CP2	earthquake	223	355.9	55.9	330	LEFT/RIGHT		53	88.56		0		1					
	CP2	Hot Box	223	355.9	55.9	0	LEFT/RIGHT		54	88.56		0		1					
	CP2	derailment	223	355.9	55.9	0	LEFT/RIGHT		55	88.56		0		1					
	CP2	wind	223	355.9	55.9	330	LEFT/RIGHT		56	88.56		0		1					
	CP2	rain	223	355.9	55.9	330	LEFT/RIGHT		57	88.56		0		1	32	203			
	CP2	road vehicule fail	223	355.9	55.9	-30/0/30	LEFT/RIGHT	flint avenue	58	88.56		0		1					
	CP2	road vehicule fail	223	355.9	55.9	-30/0/30	LEFT/RIGHT	fargo avenue	59	88.56		0		1					
	CP2	Traction		Kilometer		Traction site	PS-FLI		PS-FLI	88.64		0		70					
	CP2	Radio				FRMCS BBU Radio Site				88.64		0		12					
Kings/Tulure	CP2	Signaling&Telecom		Kilometer	55.876	Shelter	TCEH-CP2-3 (55.876)	Points, dual track around Kings/Tulare Station	3	88.72	357.001	2		110					
	CP2	rail temperature	225	359.1	59.1	10	LEFT/RIGHT	Tulare STN	60	91.78			1				1	21	1
Kings/Tulure	CP2	Signaling		Kilometer	59.416	Shelter	TCEH-CP2-4 (59.416)	Kings/Tulare Station	4	92.22	360.541	0		80					
	CP2	Passenger station				Station		Kings/Tulare Station		92.38		2		1000	33	1164			
	CP2	Radio				FRMCS RRH Radio Site				92.38		0		4					
Kings/Tulure	CP2	Signaling		Kilometer	59.748	Shelter	TCEH-CP2-5 (59.748)	Kings/Tulare Station	5	92.55	360.873	0		80					
	CP2	road vehicule fail	226	360.7	60.7	-30/0/30	LEFT/RIGHT	hanford avenue	61	93.39			1				1	22	1
	CP2	road vehicule fail	227	362.3	62.3	-30/0/30	LEFT/RIGHT	houston avenue	62	95.80			1				1	23	1
Kings/Tulure	CP2	Signaling		Kilometer	62.897	Shelter	TCEH-CP2-6 (62.897)	Points, back to single track after Kings/Tulare Station	6	95.66	364.022	2		80					
	CP2	Traction		Kilometer		Traction site	PS-HOU		PS-HOU	95.97		0		70	34	154			
	CP2	Radio				FRMCS RRH Radio Site				95.97		0		4					
	CP2	road vehicule fail	228	363.9	63.9	-30/0/30	LEFT/RIGHT	iona avenue	63	96.60			1				1	24	1
	CP2	earthquake	229	365.5	65.5	330	LEFT		64	98.21			1				1	25	1
	CP2	road vehicule fail	230	367.1	67.1	-30/0/30	LEFT/RIGHT	idaho avenue	65	99.82		0		1	35	5			
	CP2	Radio				FRMCS RRH Radio Site				99.82		1		4					
	CP2	road vehicule fail	231	368.8	68.8	-30/0/30	LEFT/RIGHT	jackson avenue	66	101.43		0		1	36	111			
	CP2	Traction		Kilometer		Traction site	SS-JAC		SS-JAC	101.75		2		110					
	CP2	road vehicule fail	232	370.4	70.4	-30/0/30	LEFT/RIGHT	HWY 43	67	103.84			1				1	26	1
	CP2	Radio				FRMCS BBU Radio Site				104.32		1		12	37	12			
	CP2	Telecom		Kilometer	72.111	Shelter	TCEH-CP2-7 (72.111)		7	106.00	374.3589141	2		30	38	31			
	CP2	road vehicule fail	234	373.6	70.6	-30/0/30	LEFT/RIGHT	kansas avenue	68	106.26		0		1					
	CP2	Traction		Kilometer		Traction site	PS-LAN		PS-LAN	108.26		1		70	39	74			
	CP2	Radio				FRMCS RRH Radio Site				108.26		0		4					
	CP2	earthquake	236	376.8	73.8	330	LEFT/RIGHT		69	109.48			1				1	27	1
	CP3	Radio				FRMCS RRH Radio Site				112.76		1		4	40	4			
	CP3	Traction		Kilometer		Traction site	PS-NEV		PS-NEV	115.52		1		70	41	74			
	CP3	Radio				FRMCS RRH Radio Site				115.52		0		4					
	CP3	road vehicule fail	242	386.5	83.5	-30/0/30	LEFT/RIGHT	corcoran hwy	70	119.14		0		1					
	CP3	earthquake	242	386.5	83.5	330	LEFT/RIGHT		71	119.14		0		1	42	14			
	CP3	Radio				FRMCS BBU Radio Site				119.14		1		12					
	CP3	Traction		Kilometer		Traction site	SS-ORE		SS-ORE	122.77		1		70	43	74			
	CP3	Radio				FRMCS RRH Radio Site				122.77		0		4					
Corcoran	CP3	Telecom		Kilometer	90.111	Shelter	TCEH-CP3-1 (90.111)		1	124.00	392.3589141	2		30	44	30			
	CP3	Hot Box	246	392.9	89.9	0	LEFT/RIGHT		72	125.57			1				1		
	CP3	derailment	246	392.9	89.9	0	LEFT/RIGHT		73	125.57			0				1	28	5
	CP3	wind	246	392.9	89.9	330	LEFT/RIGHT		74	125.57			0				1		
	CP3	rain	246	392.9	89.9	330	LEFT/RIGHT		75	125.57			0				1		
	CP3	rail temperature	246	392.9	89.9	10	LEFT/RIGHT	colocated with HBD	76	125.57			0				1		
	CP3	Radio				FRMCS RRH Radio Site				127.27		1		4	45	4			
Corcoran	CP3	Signaling		Kilometer	96.807	Shelter	TCEH-CP3-2 (96.807)	Points, entry to Corcoran MOWS	2	128.89	397.613	2		80	46	80			
Corcoran	CP3	Signaling		Kilometer	97.242	Shelter	TCEH-CP3-3 (97.242)	Points, exit to Corcoran MOWS	3	129.66	398.388	2		80	47	80			
	CP3	Facilities						Corcoran MOWS		130.21		2		1600	48	1600			
	CP3	Traction		Kilometer		Traction site	PS-128		PS-128	130.70		1		70	49	74			
	CP3	Radio				FRMCS RRH Radio Site				130.70		0		4					
	CP3	road vehicule fail	250	399.3	96.3	-30/0/30	LEFT/RIGHT	hesse avenue/Ave 120	77	132.01			1				1	29	2
	CP3	earthquake	250	399.3	96.3	330	RIGHT	RIGHT SIDE DUE TO BNSF	78	132.01			0				1		
	CP3	flood	253	404.2	101.2	0	LEFT/RIGHT	culvert	79	136.84			1				1	30	2
	CP3	flood	253	404.2	101.2	0	LEFT/RIGHT	culvert	80	136.84			0				1		
Delano North	CP3	Signaling&Telecom		Kilometer	105.766	Shelter	TCEH-CP3-4 (105.766)	Points, dual track section	4	138.87	406.891	2		110	50	110			
	CP3	road vehicule fail	254	405.8	102.8	-30/0/30	LEFT/RIGHT	avenue 88	81	138.45		0		1					
	CP3	Traction		Kilometer		Traction site	SS-A88		SS-A88	138.66		2		110	51	123			
	CP3	Radio				FRMCS BBU Radio Site				138.66		0		12					
	CP3	earthquake	256	409.0	106.0	330	RIGHT	RIGHT SIDE DUE TO BNSF	82	141.67			1				1	31	1
	CP3	Radio				FRMCS RRH Radio Site				143.16		1		4	52	4			
	CP3	Traction		Kilometer		Traction site	PS-STO		PS-STO	144.47		1		70	53	70			
	CP3	road vehicule fail	259	413.8	110.8	-30/0/30	LEFT/RIGHT	avenue 96	83	146.49			1				1	32	1
	CP3	Radio				FRMCS RRH Radio Site				147.66		1		4	54	4			
	CP3	Traction		Kilometer		Traction site	PS-A36		PS-A36	152.12		1		70	55	74			
	CP3	Radio				FRMCS RRH Radio Site				152.12		0		4					
	CP3	Telecom		Kilometer	122.111	Shelter	TCEH-CP3-5 (122.111)		5	156.00	424.8172826	2		30					
	CP3	Radio				FRMCS BBU Radio Site				156.00		0		12	56	43			
	CP3	earthquake	265	423.5	120.5	330	RIGHT		84	156.15		0		1					
	CP4	Traction		Kilometer		Traction site	SWS-R80		SWS-R80	158.11		2		70	57	70			
	CP4	Radio				FRMCS RRH Radio Site				160.50		1		4	58	4			
Delano South	CP4	Signaling		Kilometer	459.373	Shelter	TCEH-CP4-1 (458.373)	Points, end dual track section	1	163.95	433.043	2		80	59	84			
	CP4	Radio				FRMCS RRH Radio Site				163.95		0		4					
	CP4	Hot Box	271	433.1	459.7	0	LEFT/RIGHT		85	165.81			1				1		
	CP4	derailment	271	433.1	459.7	0	LEFT/RIGHT		86	165.81			0				1		
	CP4	wind	271	433.1	459.7	330	LEFT/RIGHT		87	165.81			0				1	33	6
	CP4	rain	271	433.1	459.7	330	LEFT/RIGHT		88	165.81			0				1		
	CP4	rail temperature	271	433.1	459.7	10	LEFT/RIGHT	colocated with HBD	89	165.81			0				1		
	CP4	earthquake	271	433.1	459.7	330	LEFT/RIGHT		90	165.81			0				1		
	CP4	Traction		Kilometer		Traction site	PS-MAG		PS-MAG	166.66		1		70	60	74			
	CP4	Radio				FRMCS RRH Radio Site				166.66		0		4					
	CP4	Radio				FRMCS BBU Radio Site				171.16		1		12	61	12			
	CP4	Traction		Kilometer		Traction site	PS-BLA		PS-BLA	173.54		1		70	62	70			
	CP4	Telecom		Kilometer	467.569	Shelter	TCEH-CP4-2 (467.569)		2	174.00	441.325	2		30	63	34			
	CP4	Radio				FRMCS RRH Radio Site				174.00		0		4					
	CP4	earthquake	278	444.4	471.0	330	RIGHT	RIGHT SIDE DUE TO BNSF	91	177.87		0		1	63	6			
	CP4	road vehicule fail	278	444.4	471.0	-30/0/30	LEFT/RIGHT	mcombs avenue	92	177.87		0		1					
	CP4	Radio				FRMCS RRH Radio Site				177.87		1		4					
	CP4	Traction		Kilometer		Traction site	SS-46		SS-46	180.60		2		110	64	114			
	CP4	Radio				FRMCS RRH Radio Site				180.60		0		4					
	CP4	Radio				FRMCS BBU Radio Site				184.00		1		12	65	12			
	CP4	Traction		Kilometer		Traction site	PS-DRE		PS-DRE	187.30		1		70	66				
	CP4	Radio				FRMCS RRH Radio Site				187.30		0		4					

	CP4	earthquake		455.9	478.6	330	RIGHT		93	187.68			1				1	34	1
	CP4	road vehicle fall	285	455.7	482.3	30/0/30	LEFT/RIGHT	merced avenue	94	188.34		0		1	67	1001			
	CP4	Facilities				cst terminal		Shatter railhead		186.68		2		1000					
	CP4	Telecom		Kilometer	484.058	Shatter	TCEH-CP4-3 (484.058)		3	190.49	457.814	2		30	68	34			
	CP4	Radio				FRMCS RRH Radio Site				190.49		0		4					