

# California High-Speed Rail Program



## TECHNICAL MEMORANDUM

### CHSTP Implementation Stage EMC Program Plan (ISEP) TM 300.10

Prepared by: Signed document on file 26 Jan 2014  
David Turner Date

Checked by: Signed document on file 26 Jan 2014  
Andy Pattantyus Date

Approved by: Signed document on file 29 Jan 2014  
John Chirco, PE, Engineering Manager Date

Released by: Signed document on file 5 Feb 2014  
James R. Van Epps, Program Director Date

Revision	Date	Description
0	26 Jan 14	Initial Release, R0

Note: Signatures apply for the latest technical memorandum revision as noted above.

## System Level Technical and Integration Reviews

The purpose of the review is to ensure:

- Technical consistency and appropriateness
- Check for integration issues and conflicts

System level reviews are required for all technical memoranda. Technical Leads for each subsystem are responsible for completing the reviews in a timely manner and identifying appropriate senior staff to perform the review. Exemption to the system level technical and integration review by any subsystem must be approved by the Engineering Manager.

### System Level Technical Reviews by Subsystem:

Systems:	<u>Signed document on file</u> Bradley Banks, PE	<u>04 Dec 13</u> Date
Infrastructure:	<u>Signed document on file</u> Gene Lusherovich, PE	<u>22 Nov 13</u> Date
Operations & Maintenance:	<u>Signed document on file</u> Joseph Metzler	<u>20 Dec 13</u> Date
Safety:	<u>Signed document on file</u> John Cockle	<u>17 Dec 13</u> Date
Regulatory Approvals:	<u>Signed document on file</u> Vladimir Kanevskiy, PE	<u>9 Dec 13</u> Date
Rolling Stock:	<u>Signed document on file</u> Frank Banko	<u>24 Sept 13</u> Date
System Integration:	<u>Signed document on file</u> Oliver Hoehne	<u>07 Oct 13</u> Date

Note: Signatures apply for the technical memorandum revision corresponding to revision number in header and as noted on cover.



## ABSTRACT

The California High-Speed Rail Authority (Authority) established and is executing an Electromagnetic Compatibility Program Plan (EMCP) that:

- Ensures electromagnetic compatibility (EMC) of California High-Speed Train System (CHSTS) equipment and facilities with themselves, with equipment and facilities of the CHSTS neighbors, and with passengers, workers, and neighbors of the CHSTS
- Guides and coordinates the EMC design, analysis, test, documentation, and certification activities between California High-Speed Train Project (CHSTP) project management, systems, and sections through the project phases
- Conforms with and extends the TM 300.02, Planning Stage Electromagnetic Compatibility Program Plan, the Design Criteria Manual (DCM), and the Performance Specifications
- Complies with applicable regulatory requirements, including EMC requirements in 49CFR 200-299, particularly Parts 229, 236, and 238, for the CHSTS systems and sections

The Implementation Stage includes Final Engineering 100% design, Construction, Procurement, System Integration, and operation of the CHSTS.

This Implementation Stage EMC Program Plan (ISEP) guides and coordinates EMC design, analysis, test, documentation, and certification activities for participants in the CHSTP implementation stages and phases. These EMC requirements and plans apply to CHSTS systems and equipment, to facilities and structures which affect EMC characteristics of CHSTS systems and equipment, and to work including Design, Construction, Installation, System Integration, Testing and Commissioning, Operation and Maintenance, and Upgrades and Modifications.

Major EMC responsibilities are held by the Authority and Contractors.

Authority EMC work consists of EMC management:

- Develop Implementation Stage EMC Plan
- Program management
- Monitor and evaluate contractors and suppliers EMC tasks and deliverables
- Project-wide System EMC Integration

Contractor and Supplier EMC work consists of EMC implementation:

- Contractor EMC Plans (CMCPs)
- EMC Design Analyses and Safety Analyses for each design phase
- EMC Qualification Test Planning
- EMC Qualification Testing

This ISEP:

- Fulfills the EMC Program requirements listed above;
- Ensures conformance to EMC Design Criteria in CHSTP Design Criteria Manual Chapter 26; and
- Defines scope, organization, responsibilities, tasks, deliverables, milestones, requirements, analysis, testing, feedback, and reporting for the EMC Program.



# Table of Contents

<b>System Level Technical and Integration Reviews .....</b>	<b>i</b>
<b>1 Introduction.....</b>	<b>1</b>
1.1 Project Overview.....	1
1.2 ISEP Objective.....	1
1.3 EMC Program Scope.....	2
1.4 EMC Program Activities.....	3
1.5 Reference Information .....	3
1.6 Acronyms and Abbreviations.....	6
1.7 ISEP Definitions .....	7
1.8 Contents of this Plan .....	8
<b>2 EMC Program Requirements.....</b>	<b>9</b>
2.1 Design Criteria Manual EMC-Related Requirements.....	9
2.1.1 Electromagnetic Design Criteria.....	9
2.1.2 Grounding and Bonding Requirements .....	10
2.2 CPUC EMC-Related Requirements.....	11
2.3 FRA EMC-Related Requirements .....	11
<b>3 Implementation Stage EMC Program .....</b>	<b>12</b>
3.1 Implementation Stage EMC Program Participants .....	12
3.1.1 California High-Speed Rail Authority .....	12
3.1.2 Contractors and Equipment Suppliers.....	12
3.2 Implementation Stage EMC Program Activities and Deliverables .....	12
<b>4 Authority ISEP Activities and Deliverables.....</b>	<b>15</b>
4.1 Authority ISEP Tasks and Deliverables Overview .....	15
4.2 Implementation Stage EMC Plan.....	15
4.3 Coordination with Third Parties .....	15
4.4 EMC System Integration .....	16
4.4.1 Authority Apply EMC Program Requirements To Each Procurement.....	16
4.4.2 Monitoring and Evaluation .....	17
4.4.3 EMC Qualification Test .....	17
4.5 Construction-Related EMC Issues .....	17
<b>5 Contractor ISEP Program Activities and Deliverables .....</b>	<b>18</b>
5.1 Contractor ISEP Program Overview.....	18
5.2 Contractor EMC Plans .....	19
5.3 EMC Design Analysis.....	19



5.3.1 Emissions Analysis..... 20

5.3.2 Immunity Analysis..... 20

**5.4 EMI Safety Analysis ..... 20**

**5.5 EMC Qualification Test Planning..... 20**

**5.6 Emission and Susceptibility Limit Qualification Tests..... 21**

**5.7 Automatic Train Control System Qualification Tests..... 21**

5.7.1 ATC System Immunity ..... 21

5.7.2 Emissions Affecting ATC System..... 21

**5.8 Radio Susceptibility Qualification Test..... 21**

**5.9 Electromagnetic Emissions Tests..... 22**

**5.10 Structure Design Analysis for EMC..... 22**



# 1 Introduction

## 1.1 Project Overview

The California High-Speed Train System (CHSTS) will provide safe, comfortable and reliable intercity travel in California using electrically powered, high-speed, steel-wheel-on-steel-rail trains with proven train control, communication, and traction power systems.

The Authority has established an Electromagnetic Compatibility Program Plan (EMCP) and is executing an Electromagnetic Compatibility (EMC) program for the California High-Speed Train Project (CHSTP) that:

- Defines EMC requirements
  - Among CHSTS equipment and facilities
  - Between CHSTS and the equipment and facilities of CHSTS neighbors
  - With passengers, workers, and neighbors of the CHSTS;
- Guides and coordinates the EMC design, analysis, test, documentation, and certification activities between CHSTP project management, systems, and sections through the project phases;
- Conforms with and extends the TM 300.02, Planning Stage Electromagnetic Compatibility Program Plan; and
- Complies with applicable regulatory requirements, including EMC requirements in 49CFR 200-299, particularly Parts 236 and 238, for CHSTS systems and sections.

The Implementation Stage covers activities following completion of the TM300.02 Planning Stage EMCP activities which continue through Construction, Procurement, System Integration, and operation of the CHSTS.

This Implementation Stage EMC Program Plan (ISEP) guides and coordinates EMC design, analysis, test, documentation, and certification activities for participants in the CHSTP implementation stages and phases. These EMC requirements and plans apply to CHSTS systems and equipment, to facilities and structures which affect EMC characteristics of CHSTS systems and equipment, and to work including Design, Design-Build, Construction, Installation, System Integration, Testing and Commissioning, Operation and Maintenance, and Upgrades and Modifications.

As design and build contracts are awarded, each section contractor, system supplier, and subcontractor with EMC program responsibilities (contractor) must prepare a contractor EMC Plan (CMCP) for its covered scope, and each CMCP document shall reference and integrate with this ISEP.

## 1.2 ISEP Objective

The CHSTP EMC Program objective is to achieve EMC:

- Among CHSTS equipment and facilities;
- Between CHSTS equipment and facilities, and the equipment and facilities of CHSTS neighbors; and
- With Passengers, workers, and neighbors of the CHSTS.

The EMC program must ensure that electromagnetic interference (EMI) does not adversely affect:

- The health of passengers, staff, and neighbors;
- The safety or dependability of the CHSTS and its passenger service; and
- The safety or dependability of neighboring equipment and facilities.



To meet the EMC Program objective, this ISEP specifies:

- Activities and deliverables at each project stage and phase for the Authority, equipment suppliers, design/builders, construction contractors, and subcontractors;
- EMC design requirements to be included in the Performance Specifications and EMC Design Criteria Manual (DCM) Chapter 26 (DCM26) for each affected system or piece of equipment;
- EMC analyses and tests to demonstrate compliance with CHSTP EMC requirements; and
- EMC design guidelines, criteria, and methods.

### 1.3 EMC Program Scope

This ISEP defines participants, activities, and deliverables in the CHSTP Implementation Stage EMC Program.

The Authority EMC Program scope includes the following:

- Electromagnetic interactions and related design characteristics
- CHSTS equipment and facilities
- Equipment and facilities of CHSTS neighbors

CHSTS equipment and facilities must work with and not interfere with other CHSTS equipment and facilities and with neighboring equipment and facilities, in the CHSTS environment.

The CHSTP EMC design scope includes:

- Design aspects of the CHSTS equipment and facilities which can electromagnetically interact with themselves, with other CHSTS equipment and facilities, and with the equipment and facilities of CHSTS neighbors; and
- CHSTS train control and communications, traction electrification system, rolling stock, and station equipment.

Generally, if a change is required in existing neighbor equipment and facilities to resolve an EMC issue, the CHSTP must make a specific agreement with the neighbor.

CHSTP EMC interaction scope includes:

- Design scope equipment and facilities;
- Passengers, staff, and neighbors;
- Neighboring equipment and facilities; and
- Electronic devices carried or used by CHSTS passengers and staff in CHSTS facilities and trains.

Neighboring equipment and facilities include:

- Electronic devices of neighbors and of California public safety, government, utility, and industrial staff;
- Implanted medical devices in CHSTS passengers, staff, and neighbors;
- Commercial, residential, and industrial buildings and the industrial and commercial equipment used by the buildings and their occupants;
- Freight, passenger, commuter, and transit railroads, in shared corridors and adjacent land;
- Airports;
- Parallel fences, pipelines, metal structures; and
- Farms and feedlots and their animals.



EMC Program interfaces with other CHSTP elements include the following:

- System Assurance
  - CHSTP System Safety Program
  - Hazard Management, including hazard analyses
  - CHSTP System Security Program
  - CHSTP Fire and Life-Safety Program
- Performance Specifications

The CHSTP EMC Program scope excludes:

- Equipment, activities, and responsibilities outside the scope of the CHSTP;
- Systems and facilities and their suppliers that do not and will not interact with CHSTS equipment; and
- Future neighbor equipment.

## 1.4 EMC Program Activities

Authority EMC Program activities during the Implementation Stage are to:

- Create and maintain the ISEP and execute the EMC program;
- Perform the Authority ISEP activities and create the required deliverables; and
- Track and report on ISEP task completion status and EMC issues.

During the Implementation Stage, each CHSTS Contractor and Equipment Supplier shall:

- Develop a Contractor EMC Plan (CMCP) conforming to this ISEP for its scope of supply, perform the planned activities, and create the required deliverables;
- Fulfill the EMC requirements per the Design Criteria and Performance Specifications; and
- Track and report on ISEP task completion status and EMC issues.

## 1.5 Reference Information

Table 1-1 identifies project documents and standards for the CHSTP EMC Program.

**Table 1-1**

CHSTS EMC Program – Reference Project Documents and Standards		
ID	Issued By	Title
SS-E-10-98	APTA	Standard for the Development of an Electromagnetic Compatibility Program Plan, edited 2-23-04
	AREMA	Manual for Railway Engineering
	AREMA	Communications and Signals Manual of Recommended Practice
	Authority	CHSTS Business Plan, California High-Speed Rail Authority
TM 300.02	Authority	CHSTP Planning Stage Electromagnetic Compatibility Program Plan (PSEP)
CEC	CBSC	California Electrical Code, California Building Standards Commission
EN 45502-2-2:2004 E	CENELEC	EN 45502-2-2:2008 E, Active implantable medical devices – Part2-1: Particular requirements for active implantable medical devices intended to treat bradyarrhythmia (includes cardiac pacemakers)







## SIGNATURE/APPROVAL ROUTING SHEET

1307

### DOCUMENT(S) INFORMATION

To: Jennifer Thommen

From: Kris Livingston

Subject: TM 300.10 CHSTP Implementation Stage EMC Program Plan, Revision 0

**Description of Enclosed Document(s):**

The Technical Memo 300.10 CHSTP Implementation Stage EMC Program Plan, Revision 0, is attached for your review and concurrence.

 Expedite

Due Date:

### REVIEWER INFORMATION

Reviewer #1 Name (Print):

Jim Van Epps

Reviewer's Initial/Date:

JKDZ 2/5/14

Comments:

Recom. approval.

Reviewer #2 Name (Print):

Frank Vacca

Reviewer's Initial/Date:

FV 2/7/2014

Comments:

Reviewer #3 Name (Print):

Reviewer's Initial/Date:

Comments:

Reviewer #4 Name (Print):

Reviewer's Initial/Date:

Comments:

Reviewer #5 Name (Print):

Reviewer's Initial/Date:

Comments:

 Approval/Signoff (initials) Information Signature Do Not Release – Call When Signed Hand Carry or Call for Pick up Release When Signed

Name: Kris Livingston Ext.: 384-9515

**Executive Office Control No.:****Name of Contact Person:****Phone Number:****Office:****Office Control No.:**

<b>CHSTS EMC Program – Reference Project Documents and Standards</b>		
<b>ID</b>	<b>Issued By</b>	<b>Title</b>
EN 45502-2-2:2008 E	CENELEC	EN 45502-2-2:2008 E, Active implantable medical devices – Part2-2: Particular requirements for active implantable medical devices intended to treat tachyarrhythmia (includes implantable defibrillators)
EN 45502-2-2:2010 E	CENELEC	EN 45502-2-3:2010 E, Active implantable medical devices – Part2-3: Particular requirements for cochlear and auditory brainstem implant systems
EN 50121-1:2006	CENELEC	Railway applications - Electromagnetic Compatibility, Part 1: General
EN 50121-2:2006	CENELEC	Railway applications - Electromagnetic compatibility Part 2: Emission of the whole railway system to the outside world
EN 50121-3-1:2006	CENELEC	Railway applications – Electromagnetic compatibility – Part 3-1: Rolling stock – Train and complete vehicle
EN 50121-3-2:2006	CENELEC	Railway applications - Electromagnetic compatibility – Part 3-2: Rolling stock – Apparatus
EN 50121-4:2006	CENELEC	Railway applications - Electromagnetic Compatibility, Part 4: Emission and immunity of signaling and telecommunications apparatus
EN 50121-5:2006	CENELEC	Railway applications - Electromagnetic compatibility -- Part 5: emission and immunity of fixed power supply installations and apparatus
EN 50155:2007	CENELEC	Railway applications – Electronic equipment used on rolling stock
EN 50238-1:2003	CENELEC	Railway applications - Compatibility between rolling stock and train detection systems
EN 50238-2:2010	CENELEC	Railway applications - Compatibility between rolling stock and train detection systems - Railway applications - Part 2: Compatibility with track circuits
EN 50238-3:2010	CENELEC	Railway applications - Compatibility between rolling stock and train detection systems - Railway applications - Part 3: Compatibility with axle counters
EN 50388:2012	CENELEC	Railway applications - Power supply and rolling stock - Technical criteria for the coordination between power supply (substation) and rolling stock to achieve interoperability
DCM	CHSTS	CHSTP Design Criteria Manual
TM 300.02	CHSTS	CHSTP Planning Stage EMC Program Plan, Technical Memorandum TM 300.02, Rev 0, Aug 15, 2011
	CPUC	EMF Design Guidelines for Electrical Facilities, July 21, 2006
GO 52	CPUC	Construction and operation of power and communication lines for the prevention or mitigation of inductive interference, August 1918
GO 95	CPUC	California Public Utilities Commission General Order 95, Overhead Electric Line Construction, January 2012
GO 131-D	CPUC	California Public Utilities Commission General Order 131, Rules Relating to the Planning and Construction of Electric Generation, Transmission/Power/Distribution Line Facilities and Substations Located in California. September 1995



<b>CHSTS EMC Program – Reference Project Documents and Standards</b>		
<b>ID</b>	<b>Issued By</b>	<b>Title</b>
CPUC d93-11-013	CPUC	California Public Utilities Commission Decision 93-11-013, interim EMF Policy
CPUC d06-01-042	CPUC	California Public Utilities Commission Decision 06-01-042, updated EMF Policy
FCC OET-65	FCC	Evaluating Compliance with FCC Guidelines for Human Exposure to Radio frequency Electromagnetic Fields, FCC Office of Engineering and Technology Bulletin 65, Edition 97-01, August 1997
FCC OET-65c	FCC	Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, FCC Office of Engineering and Technology Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01)
FCC Part 15	FCC	Part 15 of Title 47 of the Code of Federal Regulations
49CFR 229	FRA	Railroad Locomotive Safety Standards
49CFR 236	FRA	Rules, Standards, and Instructions Governing the Installation, Inspection, Maintenance, and Repair of Signal and Train Control Systems, Devices, and Appliances
49CFR 238	FRA	Passenger Equipment Safety Standards
UMTA-MA-06-0153-85-11	FTA	Radiated Interference in Rapid Transit Signaling Systems - Volume II: Suggested Test Procedures
UMTA-MA-06-0153-85-6 (also identified as UMTA-MA-06-0153-87-2)	FTA	Conductive Interference in Rapid Transit Signaling Systems Volume II: Suggested Test Procedures
UMTA-MA-06-0153-85-8	FTA	Inductive Interference in Rapid Transit Signaling Systems - Volume II: Suggested Test Procedures
IEEE Std C95.1-2005	IEEE	IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 3 kHz - 300 GHz
IEEE Std C95.6-2002	IEEE	IEEE Standard for Safety Levels with Respect to Human Exposure to Electromagnetic Fields, 0 - 3 kHz
ICNIRP Static Guidelines	ICNIRP	Guidelines On Limits Of Exposure To Static Magnetic Fields, International Commission on Non-Ionizing Radiation Protection, Health Physics Society, 2009
ICNIRP TV Guidelines	ICNIRP	Guidelines For Limiting Exposure To Time-Varying Electric and Magnetic Fields (1 Hz – 100 kHz), International Commission on non-Ionizing Radiation Protection, Health Physics Society, 2010
IEEE Std 1100-2005	IEEE	Recommended Practice for Powering and Grounding Electronic Equipment
IEEE Std 1143-1994	IEEE	IEEE Guide on Shielding Practice for Low Voltage Cables
IEEE Std 142-2007	IEEE	Recommended Practice for Grounding of Industrial and Commercial Power Systems
IEEE Std 518-1982	IEEE	IEEE Guide for the Installation of Electrical Equipment to Minimize Electrical Noise Inputs to Controllers from External Sources



<b>CHSTS EMC Program – Reference Project Documents and Standards</b>		
<b>ID</b>	<b>Issued By</b>	<b>Title</b>
IEEE Std 519–1992	IEEE	Recommended Practice and Requirements for Harmonic Control in Electrical Power Systems
IEEE Std 525-2007	IEEE	IEEE Guide for the Design and Installation of Cable Systems in Substations
IEEE Std C2 – 2007	IEEE	National Electrical Safety Code
	IEEE	Architectural Electromagnetic Shielding Handbook, Leland H. Hemming, Wiley-IEEE Press, 2000
NFPA 70-2011	NFPA	2011 National Electric Code, NFPA 70, National Fire Protection Association
NFPA 780-2011	NFPA	Standard for the Installation of Lightning Protection Systems
MIL-HDBK-419A	USDOD	Grounding Bonding and Shielding for Electronic Equipment and Facilities (Volume I, Basic Theory, 1987)
	PG&E	Pacific Gas & Electric Company Transmission Line EMF Design Guidelines, May 1994
	SCE	Southern California Edison EMF Design Guidelines For Electrical Facilities, September 2004
CPUC Summary	SDGE	San Diego Gas and Electric, summary of California EMF Regulatory Activity, <a href="http://www.sdge.com/safety/research-regulatory-activities-and-standards/california-emf-regulatory-activity">http://www.sdge.com/safety/research-regulatory-activities-and-standards/california-emf-regulatory-activity</a>

Refer to Section 2 for EMC requirement sources.

## 1.6 Acronyms and Abbreviations

Table 1-2 lists acronyms and abbreviations in the ISEP.

**Table 1-2**

### Acronyms and Abbreviations

ATC	Automatic Train Control
Authority	California High-Speed Rail Authority or its representatives including PMT
CMCP	Contractor EMC Plan
CENELEC	European Committee for Electrotechnical Standardization
CFR	Code of Federal Regulations
CHSRA	California High-Speed Rail Authority
CHST	California High-Speed Train
CHSTP	California High-Speed Train Project
CHSTS	California High-Speed Train System
CPUC	California Public Utilities Commission
DCM	Design Criteria Manual
DCM22	Design Criteria Manual Chapter 22 Grounding and Bonding
DCM26	Design Criteria Manual Chapter 26 Electromagnetic Compatibility
EDA	EMC Design Analysis
EMC	Electromagnetic Compatibility



### Acronyms and Abbreviations

EMI	Electromagnetic Interference
EN	Euro Norm
EQTP	EMC Qualification Test Plan
ESA	EMI Safety Analysis
FCC	Federal Communications Commission
FMECA	Failure Modes and Effects Criticality Analysis
FRA	Federal Railroad Administration
FTA	Fault Tree Analysis
GO	General Order (issued by the CPUC)
ISEP	Implementation Stage EMC Plan (this document)
NTP	Notice to Proceed
O&M	Operations and Maintenance
OCS	Overhead Contact System
PHA	Preliminary Hazard Analysis
PM	Program Management
PMT	Program Management Team
PRA	Preliminary Reliability Analysis
PTC	Positive Train Control
RAM	Reliability, Availability, and Maintainability
ROW	Right-of-Way
RS	Rolling Stock
RSQT	Radio Susceptibility Qualification Test
SFE	Station and Facility Equipment
SR	System Requirements
SSMP	Safety and Security Management Plan
TCC	Train Control and Communication
Tenco	Turner Engineering Corporation
TES	Traction Electric System
V&V	Verification and Validation

## 1.7 ISEP Definitions

The following definitions apply to the ISEP.

**Infrastructure** is any CHSTS structure, including buildings, bridges, culverts, drainage, and other structural works.

**Contractor** is a CHSTS Section contractor, design/builder, system supplier, or subcontractor with EMC program responsibilities.

**General Order (GO)** is a regulation issued by the California Public Utilities Commission (CPUC).

**Rolling Stock (RS)** is any CHSTS steel-wheel-on-steel-track vehicle, including locomotives, railcars, and self-propelled railcars.



## **1.8 Contents of this Plan**

Section 1 provides the Implementation Stage EMC Program objectives, scope, and activities.

Section 2 provides the CHSTS Implementation Stage EMC Program requirements.

Section 3 provides the Implementation Stage EMC Program Participants.

Section 4 provides the Project Management Team EMC program activities and deliverables.

Section 5 provides the Contractor EMC Program activities and deliverables.

Section 6 provides the EMC Activities and CHSTS Implementation Steps.



## 2 EMC Program Requirements

### 2.1 Design Criteria Manual EMC-Related Requirements

The CHSTP developed the Design Criteria Manual (DCM) to specify functional, performance, assurance, and integration characteristics of the CHSTS. DCM26, Electromagnetic Compatibility, establishes EMC requirements for systems, equipment, and facilities. DCM Chapter 22, Grounding and Bonding (DCM22), provides related requirements related to electrical protection. CHSTS systems, equipment, and related facilities provisions must conform to these criteria.

#### 2.1.1 Electromagnetic Design Criteria

DCM26 provides EMC design criteria for the CHSTS equipment and facilities. The EMC design criteria cover CHSTS systems and related facilities:

- Communications
- Train Control System
- Traction Electrification System and Overhead Contact System
- Rolling Stock
- Station and Facility Equipment

The EMC design criteria include the following:

- Cable
- Grounding
- Equipment
- Facility Power and Traction Power
- Motors and Controllers
- Equipment Rooms and Location
- Emission and Immunity Limits
- FCC Type-Accepted Radio Equipment
- Human Exposure

Table 2-1 is an overview of CHSTS EMC design criteria.

**Table 2-1**

EMC Design Criteria Overview	
Item	Design Criteria
Cable	Cables shall be designed with proper shielding, shield grounding, entry protection, and termination. Each cable may only be grouped with others with similar signal type and energy level, and each cable or group shall be segregated appropriately from other cable groups. Cable runs shall be placed in conduit, raceway, or duct as needed to provide segregation and prevent magnetic or electric coupling from high-energy sources. Use fiber optic cable where practical for EMC. Power cables shall be treated according to required practice for their voltage class.
Grounding	Grounding shall conform to the listed standards, provide a suitable safety ground, and signal reference structure ground connections. Long adjacent fences and pipelines shall be regularly grounded or if not grounded, divided into insulated sections to prevent electric shock.
Equipment	Equipment designs shall control emissions and enhance immunity. Design considerations shall include placement, enclosures, filters, modulation methods, interconnect design, and component characteristics.



EMC Design Criteria Overview	
Item	Design Criteria
Facility Power	AC power for equipment shall be properly taken from separate feeder and branch circuits, isolated, regulated, backed up, and protected as required. AC power for remote trackside locations can be taken from the negative feeder by a dedicated transformer and disconnect. High-current power supply ac cables shall be run twisted together, in metal conduit where possible, to minimize magnetic coupling. Traction power cables shall be run with the smallest feasible separation of supply feed and return cables. Layout shall minimize the loop area of high current cables. Utility power distribution lines shall be routed and carried to system facilities following applicable electromagnetic interference / electromagnetic field (EMI/EMF) regulations and guidelines.
Motors and Controllers	Motor starter or inverters shall be provided with suitable protection and line and load filtering to minimize transients and surges at start and stop. Wiring shall be by twisted and/or shielded cables in conduit as appropriate.
Equipment Rooms and Location	Within physical constraints of planned facilities, equipment shall be located so that high-power sources are physically separated as far as practical from most vulnerable susceptible equipment. Shielding shall be provided as needed.
Emission and Immunity Limits	Equipment shall be designed and tested to conform to the selected emission and immunity limits. Commercial off the shelf (COTS) equipment shall meet the specified standards. Custom equipment shall meet the selected standards, which are FCC Part 15, EN 50121-4, and applicable standards. In cooperation with the adjacent railroad, mitigate coupling of system 60 Hz power into track circuits of adjacent railroads. Coordinate with the operators of airports adjacent to the alignment regarding EMC.
FCC Type-Accepted Radio Equipment	Radio equipment shall be FCC type-approved. Frequencies for licensed radio equipment shall be coordinated within the system and with other California users. Equipment that transmits or receives on a specific frequency shall be coordinated with the established list of frequencies used by other equipment. Industrial, scientific and medical device frequency band (ISM) equipment shall be FCC type-accepted ISM band equipment, e.g., 2.4 or 5.8 GHz. ISM design applications shall operate adequately with interference from other ISM band users.
Human Exposure	Placement of radio transmit antennas shall not result in human exposure to fields above limits. Traction electrification facilities shall be posted with signs alerting staff with pacemakers of potentially hazardous EMF levels. Measurements shall confirm limits are met.

DCM26 provides detailed EMC design criteria for the CHSTS systems and equipment.

### 2.1.2 Grounding and Bonding Requirements

DCM22 provides Grounding and Bonding requirements for the CHSTS equipment and facilities. The Grounding and Bonding design criteria address three purposes:

- Personnel safety
- Equipment, cabling and building protection
- Equipment noise reduction

DCM section 22.5.5 addresses grounding requirements for rebar in track support structures, to mitigate the adverse effects of inductive loading or undesired coupling between track circuits.

DCM section 22.5.13 addresses grounding requirements for third-party metallic structures, including fences and pipelines, which are parallel and adjacent to the CHSTS right-of-way (ROW).





## 2.2 CPUC EMC-Related Requirements

The California Public Utilities Commission (CPUC) establishes requirements to protect consumers and provide safe, reliable utility service and infrastructure. To prevent or mitigate electromagnetic interference and electromagnetic field effects on human health, the CPUC regulates the design, construction, and operation of electrical facilities, power lines and communication lines. Table 2-2 lists CPUC documents with EMC considerations.

**Table 2-2**

<b>CHSTP EMC Program – CPUC Requirements</b>			
<b>No.</b>	<b>Source</b>	<b>ID</b>	<b>Title</b>
1	CPUC		EMF Design Guidelines for Electrical Facilities, July 21, 2006
2	CPUC	General Order 52	Construction and operation of power and communication lines for the prevention or mitigation of inductive interference

## 2.3 FRA EMC-Related Requirements

The U.S. Department of Transportation Federal Railroad Administration (FRA) regulates the safety of railroads through the Code of Federal Regulations (CFR). 49 CFR 200-299, particularly Parts 236 and 238, require qualitative and quantitative safety and availability analysis for signaling systems, microprocessor based systems and PTC. The CHSTP EMC Program must assure the FRA electromagnetic compatibility requirements are met. Table 2-3 lists FRA regulations that include EMC considerations.

**Table 2-3**

<b>CHSTP EMC Program – FRA Requirements</b>			
<b>No.</b>	<b>Source</b>	<b>ID</b>	<b>Title</b>
1	FRA	49CFR 229, Appendix F	Railroad Locomotive Safety Standards. Appendix F, Guidance Regarding the Application of Human Factors in the Design of Products, I.(b).(1) thru (4) and II.(b).7.
2	FRA	49CFR 236.8	Rules, Standards, And Instructions Governing The Installation, Inspection, Maintenance, And Repair Of Signal And Train Control Systems, Devices, And Appliances
3	FRA	Appendix C to part 236, sec.(b)	Safety Assurance Criteria and Processes.
4	FRA	49CFR 238.425, 238.225.d	Passenger Equipment Safety Standards



## 3 Implementation Stage EMC Program

### 3.1 Implementation Stage EMC Program Participants

#### 3.1.1 California High-Speed Rail Authority

Section 4 describes the Authority's activities and deliverables for the EMC program in detail. In general, the Authority performs EMC management:

- Establishes the system-wide EMC Program
- Defines EMC requirements including the DCM emission and immunity limits
- Assesses EMC characteristics of system designs
- Defines EMC requirements for performance and procurement specifications
- Coordinates EMC activities with third parties
- Monitors and evaluates EMC work by Contractors.

The EMC Manager acts for the Authority:

- Manage the EMC engineering processes
- Lead the project EMC related activities
- Cooperate with the Project Safety Manager to integrate EMC and safety activities are closely integrated
- Prepare procurement documents that include appropriate EMC requirements for the covered scope
- Coordinate between involved parties so that EMC activities have the correct priority and are properly conducted
- Assess and report on whether sufficient resources are working to complete the EMC activities within schedule
- Issue and distribute project EMC documentation
- Be the point of contact on CHSTP EMC matters
- Monitor progress and report on the status of EMC activities.

#### 3.1.2 Contractors and Equipment Suppliers

Section 5 describes Contractor activities and deliverables for the EMC program in detail. In general, contractors, design/builders, and equipment suppliers implement the EMC program and activities:

- Establish and perform an EMC Program for the covered section, structure, system, and/or equipment, including developing and submitting Contractor EMC Program Plans (CMCPs)
- Perform EMC analyses in each engineering phase
- Plan and perform EMC qualification tests, per approved CMCPs and Procedures
- Integrate EMC with system safety, O&M, manuals, and Verification and Validation (V&V) activities, and with activities of other contractors

### 3.2 Implementation Stage EMC Program Activities and Deliverables

Table 3-1 lists Implementation Stage EMC Program activities and deliverables for the Authority and for contractors and equipment suppliers. The activities and deliverables are described in following ISEP sections.



Table 3-1

<b>Implementation Stage EMC Program Activities and Deliverables</b>			
<b>No.</b>	<b>Task</b>	<b>Authority</b>	<b>Contractor</b>
<b>1</b>	<b>EMC Planning and Program Management</b>		
1.1	Implementation Stage EMC Program Plan (ISEP)	Develop the ISEP	Review and accept the ISEP
1.2	Contractor EMC Plan (CMCP)	Approve the CMCPs	Develop a CMCP per the ISEP requirements.
1.3	Implementation Stage EMC Program	Perform ISEP tasks. Determine EMC interfaces between contracts, allocate responsibilities, and manage coordination. Track EMC Program completion, report on status. Update EMC Design Criteria, Performance Specifications, and other documents as needed.	Perform CMCP tasks, track EMC Program completion, report on status. Coordinate EMC activities with related tasks.
1.4	EMC Coordination with Third Parties, including: <ul style="list-style-type: none"> <li>• Airports</li> <li>• Shared Corridor Railroads</li> <li>• Affected Neighbors</li> </ul>	Provide EMC coordination direction to Contractors	Perform EMC Coordination as directed.
<b>2</b>	<b>EMC Design Analysis</b>		
2.1	Emissions Analysis	Approve the Emissions Analyses	Perform the Emissions Analysis
2.2	Immunity Analysis	Approve the Immunity Analyses	Perform the Immunity Analysis
2.3	Design Report	Approve the Design Report	Perform the Design Report
<b>3</b>	<b>EMI Safety Analysis</b>		
3.1	EMI Safety Analysis	Approve the EMI Safety Analyses	Perform the EMI Safety Analysis
3.2	EMI Risk Analysis	Develop the Project EMC Risk Assessment to identify coordination tasks	Provide required information and analysis as needed for EMC risk assessment and resolution
<b>4</b>	<b>EMC Qualification Test Planning</b>		
4.1	Project-wide System Integration EMC Qualification Test Plan	Develop the Project EMC Qualification Test Plan	
4.2	Contractor and Supplier EMC Qualification Test Plan	Approve the EMC Qualification Test Plans	Develop the EMC Qualification Test Plan
4.3	EMC Qualification Test Procedures	Approve the EMC Qualification Test Procedures	Develop the EMC Qualification Test Procedures
<b>5</b>	<b>EMC Qualification Tests</b>		
5.1	Emission and Susceptibility Limit	Approve Emission and Susceptibility Qualification Tests.	Perform Emission and Susceptibility Qualification Tests for equipment units



<b>Implementation Stage EMC Program Activities and Deliverables</b>			
<b>No.</b>	<b>Task</b>	<b>Authority</b>	<b>Contractor</b>
5.2	ATC System Immunity	Approve ATC Immunity Qualification Tests	Perform ATC Immunity Qual Test, as directed
5.3	Emission Affecting ATC System	Approve Emission Affecting ATC Qualification Tests	Perform Emission Affecting ATC Qualification Test, as directed
5.4	Radio Susceptibility	Approve Radio Susceptibility Qualification Tests	Perform Radio Susceptibility Qualification Tests, as directed
5.5	Electromagnetic Field (EMF) Exposure	Approve EMF Qualification Tests	Perform EMF Qualification Tests, as directed



## 4 Authority ISEP Activities and Deliverables

### 4.1 Authority ISEP Tasks and Deliverables Overview

Authority EMC work consists of EMC management:

- Develop the Implementation Stage EMC Program Plan (ISEP)
- Update ISEP as necessary
- EMC Program Management
- Identify, specify, and verify EMC interface issues involving rolling stock, systems, equipment, infrastructure, RAM, safety, security, and operations
- Update as necessary the DCM chapters affected by EMC and Grounding and Bonding
- Set EMC requirements for Contractor performance and procurement specifications, including hazard analysis and risk acceptance criteria for EMC Safety Analysis
- Conduct new and update existing EMC Technical Investigations as necessary to respond to EMC issues as they arise
- Coordinate ISEP with third parties, including neighbors, airports, shared corridor railroads and rail transit systems, parallel metal structures, and sensitive facilities
- Develop the Project-wide System Integration EMC Plan and test procedures, and manage and supervise system integration EMC tests

EMC work related to Contractor EMC activities includes guidance, review, monitoring, evaluation, and assessment of the following:

- Contractor EMC Plans
- Contractor and Supplier Design Analyses and Design Reports
- Contractor and Supplier EMC Safety Analyses
- Contractor and Supplier EMC Qualification Test Plans
- Contractor and Supplier EMC Qualification Test Reports

### 4.2 Implementation Stage EMC Plan

The ISEP is an Authority EMC Program deliverable. The ISEP provides the CHSTS Implementation Stage EMC Program objectives, scope, requirements, organization, activities, methodologies, and deliverables.

The ISEP implements the CHSTP EMC Program which will achieve the following:

- Fulfill the EMC Program requirements listed above
- Require EMC of CHSTS equipment and facilities with themselves, with equipment and facilities of the CHSTS neighbors, and with passengers, workers, and neighbors of the CHSTS
- Guide and coordinate the EMC design, analysis, test, documentation, and certification activities between CHSTP project management, systems, and sections through the project phases
- Conform with and extend the TM 300.02, Planning Stage Electromagnetic Compatibility Program Plan, the DCM, and the Performance Specifications
- Comply with applicable regulatory requirements, including EMC requirements in 49CFR 200-299, particularly Parts 236 and 238, for CHSTS systems and sections

### 4.3 Coordination with Third Parties

The Authority will perform EMC coordination work with the following third parties:

- Owners and regulators of utilities and infrastructure that might impact or disrupt CHSTS operation
- Owners and regulators of utilities and infrastructure that could be affected by CHSTS operation



This requires coordination with third party owners of the following:

- Airports. Coordination may require identification of susceptible aviation equipment, determination if a conflict can occur, and mitigation if needed.
- Railroads in shared corridors or on adjacent land, including freight, passenger, commuter, and electric rail transit railroads. Equipment requiring consideration includes train control and track circuits, traction electrification and overhead contact system, and communications. This includes BNSF, UPRR, Amtrak, BART, Santa Clara Valley Transportation Authority, Caltrain, Metrolink, and LACMTA. Coordination may require identification and mitigation of potentially susceptible equipment operated by the adjacent railroad.
- Sensitive electronic systems potentially disrupted by CHSTS electromagnetic fields (EMF). Coordination may require identification and mitigation of potentially susceptible electronic systems.
- Parallel metal structures including gas and other pipelines, fences, bridges, utility lines, farms, and others. Coordination may require identification and mitigation of parallel metal structures, and action to ground or isolate the metal structure.

As part of the EMC Safety Analysis, the Authority will perform an EMC risk assessment to identify necessary coordination activities.

Coordination activities include joint work with the third party owner on impact assessment, mitigation design, mitigation implementation, and resolution assurance.

#### **4.4 EMC System Integration**

The Authority will identify, specify, and verify EMC interface issues involving rolling stock, systems, equipment, infrastructure, RAM, safety, security, and operations.

##### **4.4.1 Authority Apply EMC Program Requirements To Each Procurement**

The Authority has established EMC requirements and EMC design provisions covering CHST systems and equipment. The Authority will apply the EMC requirements and design provisions to each procurement, so that each Contractor's scope includes required EMC activities and interfaces. The procurement EMC requirements will include requirements for each affected supplier and contractor such as the following:

- Develop, deliver, and follow an EMC Plan
- Use and document appropriate EMC design guidelines, criteria, and methods in its equipment and construction
- Perform required EMC analysis and reporting
- Perform required EMC testing and reporting
- Coordinate EMC activities with contractors for other related scopes

The procurement specifications will apply the EMC requirements from DCM26. The EMC design criteria are summarized in this ISEP Table 2-1. The procurement specifications will apply the Grounding and Bonding design requirements from DCM22.

Procurement specifications will include specific EMC requirements as appropriate to the procurement scope. The following are examples:

- Procurement of equipment will include and apply emission and immunity limits for conducted and radiated emissions, conducted and radiated immunity, surge and impulse, etc.
- Procurement of track slabs will consider the effect of steel reinforcing bar (rebar) loops in concrete support structures near the running rails, which can cause inductive loading or undesired coupling between track circuits.



- Procurement specifications for a specific scope will include provisions for EMC coordination between the Contractor for the specific scope and other CHSTS contractors that have EMC interfaces to the specific scope.

#### **4.4.2 Monitoring and Evaluation**

The Authority will monitor and evaluate the EMC status, deliverables, and results of the contractors and suppliers during each construction, installation, integration, and test phase.

The Authority will track and report on system EMC status, deliverables, and results using the V&V process.

#### **4.4.3 EMC Qualification Test**

The Authority will develop a Project-wide System Integration EMC Qualification Test Plan. Equipment suppliers will support the Project-wide System Integration EMC Qualification Test Plan per Procurement and Performance Specification requirements. EMC Qualification Tests will be tracked for completion under the CHSTP Verification and Validation program.

### **4.5 Construction-Related EMC Issues**

Possible construction-related EMC issues involve high-power equipment, temporary communications, temporary power, grounding, and temporary and permanent metal structures. Metal structures close to power lines, communications lines, and controls can impact or disrupt neighbor operation, or be impacted by neighbor operation. Such structures also have the potential to impact or disrupt CHSTS operation, or to be impacted by CHSTS operation, if construction and CHSTS operations overlap during a later phase.

Procurement specifications will require the Contractor to notify the Authority and work to resolve construction-related EMC issues. The Authority will monitor field conditions to determine if EMC issues arise, and require that the appropriate parties act to resolve them.



## 5 Contractor ISEP Program Activities and Deliverables

### 5.1 Contractor ISEP Program Overview

Contractor work with EMC responsibilities includes infrastructure, rolling stock, and systems.

Systems, equipment, and operations with EMC responsibilities include:

- Communications, Automatic Train Control, Traction Power, and Overhead Contact systems;
- Rolling stock;
- Other CHSTS systems and equipment including fare collection, passenger information, and hazard detection systems;
- Electrical systems, including facility power, ventilation, fire alarms and fire suppression systems; and
- Utility services provided by third parties, including power and communications.

Infrastructure work with EMC responsibilities include:

- Grounding and Bonding;
- Reinforced and metallic structures within 1 foot of a CHSTS running rail;
- Parallel metallic structures and pipes within EMF range;
- Trackwork and track components which can affect Automatic Train Control track circuits;
- Utility structures;
- Support Facilities;
- Facility Power and Lighting Systems;
- Fire Protection, Security Systems, and Access Monitoring and Control Systems; and
- Building Automation and Management Systems.

Each CHSTS Contractor shall perform all EMC activities for the elements with EMC responsibilities in their contracts. Contractor EMC activities shall include the following:

- Develop and deliver a detailed Contractor EMC Plan (CMCP)
- Coordinate Contractor EMC and System Safety work with Authority EMC and System Safety programs
- Use and document appropriate EMC design guidelines, criteria, and methods in its equipment and construction
- Design equipment per EMC requirements in technical contract documents
- Perform required EMC analysis and reporting
- Integrate EMC design and analysis results into test planning
- Perform required EMC testing and reporting
- Provide all necessary reports and documentation and track them in a compliant V&V process
- Coordinate EMC work with related activities of other contractors

Each Contractor shall apply design methods as required by the following DCM sections:

- The Electromagnetic Compatibility and Interference methods from DCM26
- The Bonding and Grounding methods from DCM22

Equipment EMC design provisions shall consider conducted and radiated emissions, conducted and radiated immunity, surge and impulse, etc.

Infrastructure EMC design provisions shall consider inductive phenomena for track support structures and other structures within 1 foot of a CHSTS running rail or in close proximity to the OCS. For example, steel reinforcing bar (rebar) loops in concrete supporting running rails can cause inductive loading or undesired





coupling between track circuits. EMC design analysis and design provisions for infrastructure shall consider such inductive phenomena and use design criteria methods to mitigate the effects.

Each Contractor shall ensure that its suppliers and subcontractors perform all needed work to fulfill the EMC requirements, and that the results are recorded using a compliant V&V process.

This ISEP and the Performance Specifications require each Contractor to perform and report on EMC qualification tests to demonstrate that the supplied equipment conforms to the applicable CHSTP EMC requirements. The Contractor shall execute and certify completion of all Implementation Stage tasks.

## 5.2 Contractor EMC Plans

Each CHSTP section contractor, design/builder, system supplier, and subcontractor with infrastructure, systems, or equipment EMC scope shall develop a Contractor EMC Plan (CMCP) for its scope of supply and submit the CMCP for review.

The CMCP shall:

- Implement all activities required in this ISEP as appropriate to the Contractor scope;
- Conform with the CHSTS Safety and Security Management Plan (SSMP);
- Fulfill DCM22 requirements for Grounding and Bonding and DCM26 requirements for EMC design criteria for the CHSTS structures, systems and equipment;
- Define CMCP scope, tasks, techniques, deliverables, and milestones;
- Provide a CMCP schedule, which identifies specific tasks, with start and completion dates, and explain how these tasks are coordinated and integrated with major program milestones for design, manufacturing, and testing;
- Provide the organization of personnel responsible for performing the EMC Program;
- Address potential construction-related EMC issues, including from high-power equipment, temporary communications, power, grounding, metal structures, and other equipment;
- State methodology to predict compliance with the EMC requirements;
- State methodology to resolve EMC interfaces with neighbors including adjacent railroads, airports, parallel fences, and sensitive neighbor equipment;
- Provide demonstration testing plans for verification of compliance with EMC requirements;
- Describe monitoring and control of Contractor's subcontractors and suppliers;
- Define interfaces to and coordination with other CHSTS system assurance activities such as system safety, design, procurement, and quality assurance; and
- Define interfaces to and coordinate with EMC activities of other CHSTS contractors;

The CMCP shall establish procedures for the Contractor to track all necessary reports and documentation in a compliant V&V process, and provide them as required for review. Contractors and suppliers may include additional tasks or task modifications with supporting rationale for each addition or modification.

The CHSTS procurement documents will define the schedule for each Contractor's work, including for submittal of draft and revised CMCPs. Each contractor will coordinate its EMCP schedule with the schedule for the work.

## 5.3 EMC Design Analysis

This ISEP and Performance Specifications require each system supplier to provide an EMC Design Analysis Report (EDA) which shows that the systems and equipment to be supplied conforms with and satisfies all applicable CHSTP EMC design requirements. The EDA will include Emissions Analysis and Immunity Analysis.



### 5.3.1 Emissions Analysis

Each Contractor shall develop an Emissions Analysis for each equipment item or system with a peak power rating greater than 10 kW.

### 5.3.2 Immunity Analysis

Each Contractor shall develop an Immunity Analysis for each equipment item or system with electrical or electronic equipment which could be affected by other electrical equipment.

## 5.4 EMI Safety Analysis

This ISEP and Performance Specifications require each Contractor to provide an EMI Safety Analysis (ESA) for its scope of supply. The Contractor shall integrate and coordinate the ESA with the CHSTS hazard management program and other system safety activities as described in the CHSTS Safety and Security Management Plan (SSMP) and as required in the procurement documents.

The objective of the ESA is to demonstrate that the CHSTS and its infrastructure and systems:

- Provide adequate protection against hazards due to EMI;
- Are safe under normal conditions;
- Detect, annunciate, and respond to failures, preventing EMI from increasing beyond acceptable levels;
- Address potential construction-related EMC issues, including from high-power equipment and temporary communications, power, grounding, metal structures, and other equipment; and
- Resolve all potential EMC hazards involving neighbors, including adjacent railroads, airports, fences, and sensitive neighbor equipment.

The criteria for EMI related hazards are that:

- No single point failure can cause an unacceptable hazard;
- No unannunciated failure can combine with a later failure to cause an unacceptable hazard; and
- No unacceptable hazard can result if maintenance is performed as required and the equipment is operated in the specified environment.

The ESA shall include at least these elements, which shall be integrated and coordinated with safety analyses for the covered scope:

- EMI Preliminary Hazard Analysis (PHA)
- EMI Fault Tree Analysis (FTA)
- EMI Failure Modes and Effects Criticality Analysis (FMECA) or other system hazard analysis
- ESA Report

For metal structures near CHSTS energized tracks and OCS, the ESA and other safety analyses shall address EMI safety. Electrical and magnetic fields from the energized track and OCS may induce significant currents in loop structures formed by welded rebar and in parallel conductive metal elements such as pipelines, conduit or fences.

The Contractor shall provide the ESA and all necessary reports, data, and technical information on EMC aspects of its scope, so that complete information is available to the Authority and its other contractors. The Contractor ESA and support information shall give the Authority's other contractors sufficient information on the Contractor scope to provide the Authority with an acceptable Safety Certificate showing resolution of EMC safety issues related to the Contractor equipment or facility.

## 5.5 EMC Qualification Test Planning

This ISEP and the Performance Specifications require each contractor and system supplier with EMC scope to provide an EMC Qualification Test Plan (EQTP).



This ISEP and Performance Specifications require the following from the supplier of each item subject to an EMC qualification test requirement:

- Submit a test procedure to the CHSTP engineer for review and approval
- Perform the test per the test procedure and the applicable CHSTP Bid Specification requirement
- Submit a test report for approval

## **5.6 Emission and Susceptibility Limit Qualification Tests**

All equipment units, regardless of supplier, must conform to CHSTP-specified standard emissions and susceptibility limits. The Performance Specifications require each individual equipment item in the design scope to be tested by its system supplier and demonstrated to conform to the applicable limits.

The following are required of equipment suppliers:

- Submit a test procedure to the CHSTP engineer for review and approval
- Perform the test per the test procedure and the applicable CHSTP Bid Specification requirement
- Submit a test report for approval

## **5.7 Automatic Train Control System Qualification Tests**

### **5.7.1 ATC System Immunity**

The Automatic Train Control (ATC) system supplier must document and demonstrate the immunity levels of the ATC system, and particularly of its track circuits with respect to rolling stock conducted and inductive interference.

### **5.7.2 Emissions Affecting ATC System**

For equipment that can potentially interfere with the CHSTP ATC system, the following conditions and requirements apply:

- Performance Specifications will require the rolling stock supplier and suppliers of other significant emitters, if any, to perform a set of EMC tests demonstrating compatibility.
- Tests will demonstrate compatibility with the CHSTP requirements for rolling stock conducted, inductive, and radiated interference, with an important focus on emissions that can affect ATC track circuit equipment.

## **5.8 Radio Susceptibility Qualification Test**

The Performance Specifications will require appropriate equipment in the design scope to be tested in a Radio Susceptibility Qualification Test (RSQT). The RSQT will:

- Subject the selected electrical and electronic equipment to radiated emissions from a selected set of portable radios and cellular telephones in use at and around the CHSTS;
- Subject CHSTS radio communication equipment to tests to ensure that its functions are not disturbed by the normal or abnormal operation of CHSTS equipment and trains, by the normal interactions with neighbor radio communications, equipment, and utilities, or by jamming signals of defined level and location;
- Monitor the integrity of the equipment functions during the test, with the equipment in applicable operating modes; and
- Monitor the integrity of equipment functions in maintenance mode, such as when normally closed equipment enclosures are opened for inspection.



## **5.9 Electromagnetic Emissions Tests**

The Performance Specifications will require each supplier of radio transmitter equipment to perform a set of tests to demonstrate that the resulting electromagnetic emissions (EME) comply with the CHSTP limits for human exposure to EME, summarized in DCM26.

## **5.10 Structure Design Analysis for EMC**

Structures containing rebar require an EMC Design Analysis (EDA) to show how the design complies with DCM section 22.5.5 Track Support Structure, which requires specific design features to avoid creating inductive loading or undesired coupling between track circuits. Typical structures close to the railhead include bridges and track support.



February 3, 2014

PMT-CHSRA-03990

Frank Vacca  
Chief Program Manager  
California High-Speed Rail Authority  
770 L Street, Suite 800  
Sacramento, CA 95814

RE: Request for Authority review and concurrence of TM 300.10, CHSTP Implementation Stage EMC Program Plan (ISEP), R0

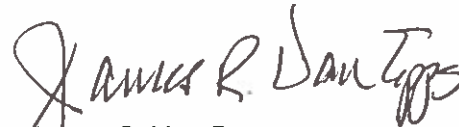
To Frank Vacca,

TM 300.10, CHSTP Implementation Stage EMC Program Plan (ISEP) Rev 0 is enclosed for your review and concurrence. The ISEP guides and coordinates EMC design, analysis, testing, documentation, and certification activities for participants in the CHRSP implementation stages and phases.

This ISEP requires compliance with the EMC Design Criteria in CHTP Design Criteria Manual Chapter 26, and defines scope, organization, responsibilities, tasks, deliverables, milestones, requirements, analysis, testing, feedback, and reporting for the EMC Program for the Authority, PMT, contractors, designers, builders, and equipment suppliers.

This ISEP is a living document which will be updated as required. If this meets with your requirements, please sign below acknowledging your concurrence for adoption and use on the program.

Sincerely,

  
James R. Van Epps  
Program Director  
Program Management Team

California High-Speed Rail Authority  
Concurrence

  
Frank Vacca, Chief Program Manager

Date: 2/7/2014

Enclosure: TM 300.10, CHSRP Implementation Stage EMC Program Plan (ISEP), R0



## SIGNATURE/APPROVAL ROUTING SHEET

*[Handwritten initials]*

### DOCUMENT(S) INFORMATION

To: Jennifer Thommen

From: Kris Livingston

Subject: TM 300.10 CHSTP Implementation Stage EMC Program Plan, Revision 0

#### Description of Enclosed Document(s):

The Technical Memo 300.10 CHSTP Implementation Stage EMC Program Plan, Revision 0, is attached for your review and concurrence.

Expedite

Due Date:

### REVIEWER INFORMATION

Reviewer #1 Name (Print):

Jim Van Epps

Reviewer's Initial/Date:

*JVE 2/5/14*

Comments:

*Recom. approval.*

Reviewer #2 Name (Print):

Frank Vacca

Reviewer's Initial/Date:

*FV 2/7/2014*

Comments:

Reviewer #3 Name (Print):

Reviewer's Initial/Date:

Comments:

Reviewer #4 Name (Print):

Reviewer's Initial/Date:

Comments:

Reviewer #5 Name (Print):

Reviewer's Initial/Date:

Comments:

Approval/Signoff (initials)

Information

Signature

Do Not Release – Call When Signed

Hand Carry or Call for Pick up

Release When Signed

Name: Kris Livingston Ext.: 384-9515

Executive Office Control No.:

Name of Contact Person:

Phone Number:

Office:

Office Control No.: