

On Motivating People to Implement Systems Engineering

Getting from the Necessary to the Impossible

Oliver M. Hoehne, PMP

Senior Engineering Manager

Parsons Brinckerhoff, Transit & Rail Systems, Newark, NJ, USA





Agenda

- **Why SE / Value of SE for Transportation & Infrastructure Projects**
- **SE Challenges in Transportation & Infrastructure Projects**
- **Recommendations to address the Challenges**
- **SE Opportunities**
- **California High-Speed Rail Project Overview**
- **Introducing & Applying SE:**
 - The Necessary – Tasks already required by Project
 - The Possible – Performing accepted tasks differently
 - The Impossible – Things that were never done before
- **Summary**



TRANSPORTATION & INFRASTRUCTURE

WHY SYSTEMS ENGINEERING



ISSUE: Due to a *disagreement over technical details*, the approval process for the train ended up *taking two years longer than planned*. Siemens will *now deliver 17 trains instead of the 16* originally ordered -- with one thrown in for free as an *apology for the delay* -- and will likely *pay compensation* on top of that. The company's transport division now has accrued *liabilities of €360 million*, largely because of the Velaro D.

Source: <http://www.spiegel.de/international/germany/velaro-d-new-generation-ice-high-speed-trains-approved-a-955754.html>



TRANSPORTATION & INFRASTRUCTURE

WHY SYSTEMS ENGINEERING (CONT'D)

REASONS:

Unclear Operational Requirements: ... *there were a number of disagreements over operational philosophy* ...

Unclear Technical (System) Requirements: ... *the disagreements were over other issues, like whether it was acceptable for there to be a 1.6-second delay between the moment the driver operates the brakes and when the brakes actually engage*

...

LESSONS LEARNED:

Fixing problems later (e.g. production, testing) cost far more than fixing them earlier (e.g. during design): ... *that sort of change in a train whose design is already complete is a protracted process. That half second cost the company years*

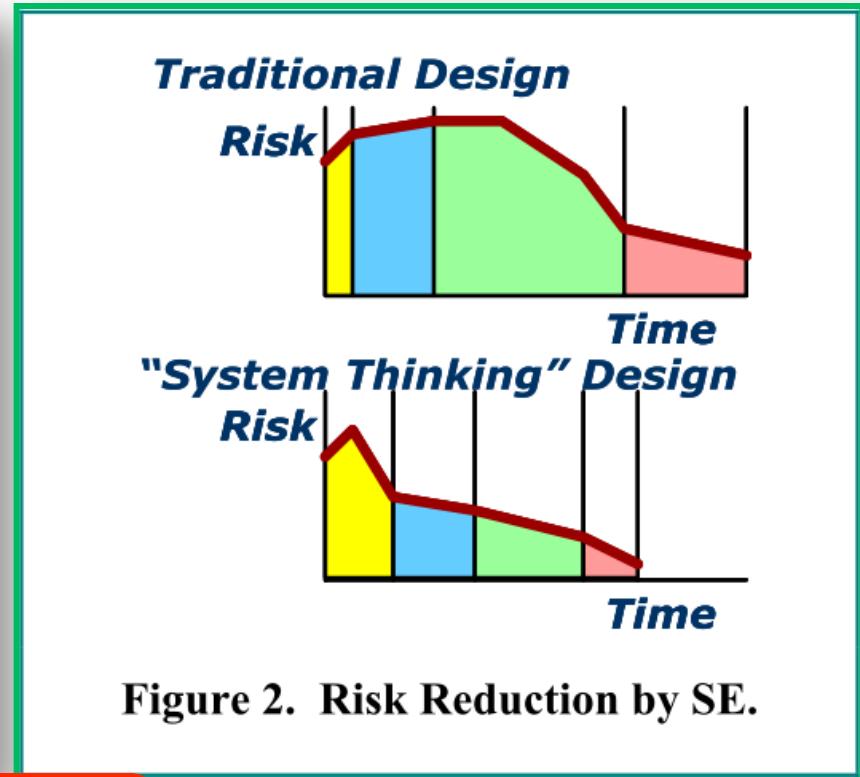
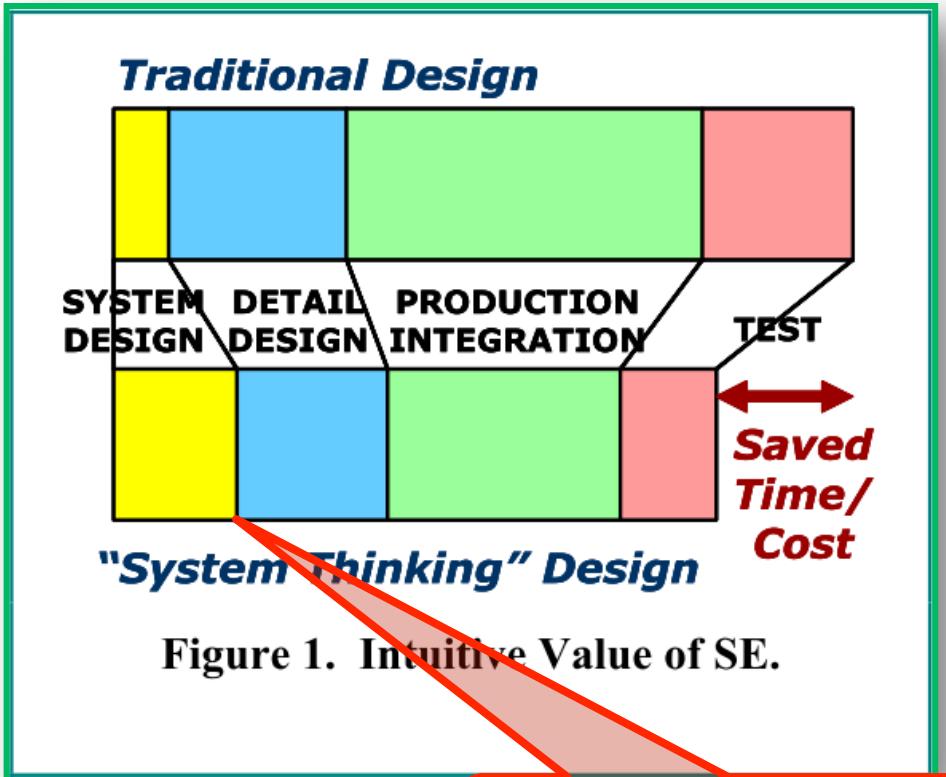
...

Frontloaded (Systems) Engineering / Requirements Management: ... *the developers want to work closely with the Federal Railway Authority's experts from day one, to avoid unpleasant surprises down the line (understand the requirements before offering a solution)* ...



TRANSPORTATION & INFRASTRUCTURE

VALUE OF SYSTEMS ENGINEERING



Benjamin Franklin — 'If you fail to plan, you are planning to fail!'

Systems Engineering reduces risk, rework, schedule delays and cost overruns.

Source: Eric Honour: Understanding the Value of Systems Engineering



TRANSPORTATION & INFRASTRUCTURE CHALLENGES

➤ Funding of Highly Visible Projects

- Capital (Construction) vs. Operating Cost

➤ Project Fragmentation / Accountability

- Owner, Environmental Review, Preliminary Engineering, Final Design, Construction, Construction Management, Integration, Testing & Certification, Program Oversight, etc.

➤ Low-Tech Industry

- Infrastructure (Concrete, Steel, Earthwork, Utilities, etc.) with relatively small Systems Content (Electrification, Signals, Communications)

➤ Expertise & Experience

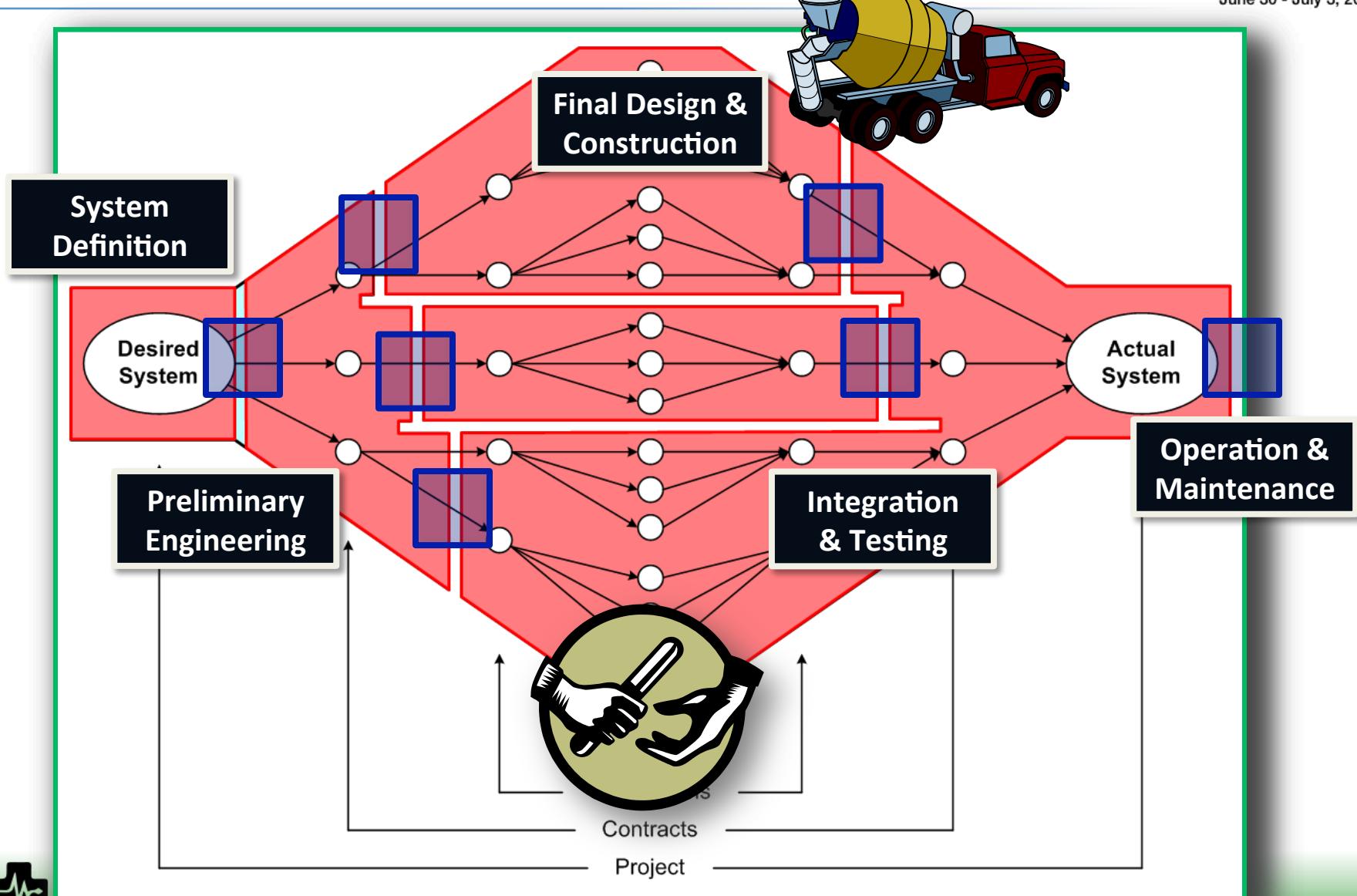
- Civil / Structural Engineers lacking SE knowledge, Systems Engineers lacking infrastructure domain knowledge

➤ Resistance to Change

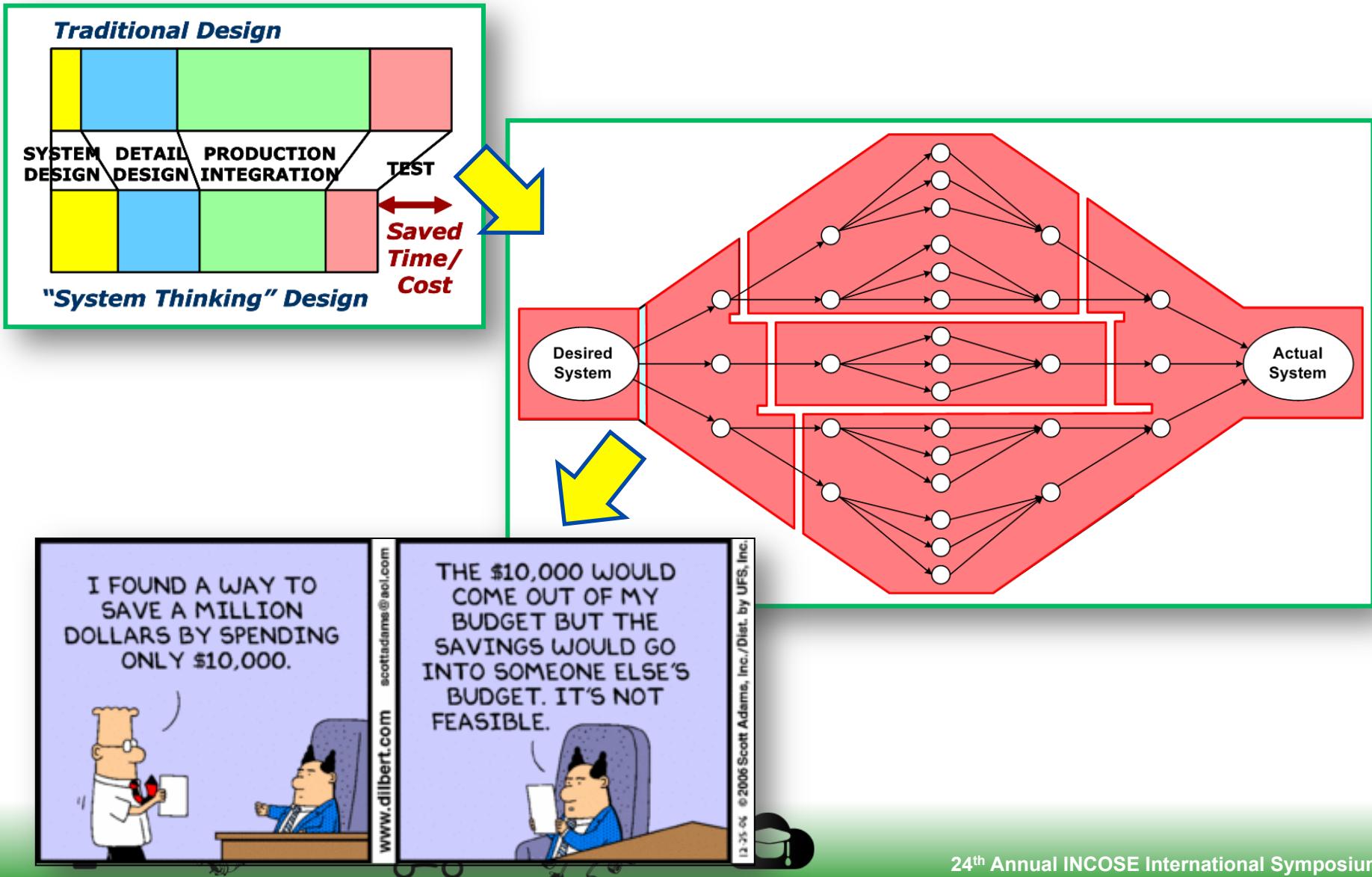
- Safety conscious industry, failures are punished, successes hardly rewarded



TRANSPORTATION & INFRASTRUCTURE CHALLENGES (CONT'D)



TRANSPORTATION & INFRASTRUCTURE CHALLENGES (CONT'D)



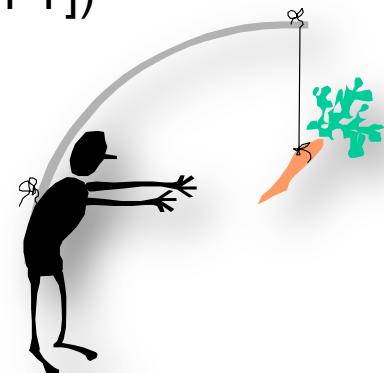
TRANSPORTATION & INFRASTRUCTURE RECOMMENDATIONS TO ADDRESS CHALLENGES

➤ Top-Down

- Obtain Client & Management **Buy-In**
- Provide Credibility, Show **Applicability** to Your Industry
- Demonstrate **Practical Value** for overall Program Approach
- Achieve **Early Benefits** within Project / Phase

➤ Bottom-Up

- Install Systems Engineering **Champion**
- Identify and Work with **Early Adaptors**
- **Communicate Clearly** (Why, What Is In It For You [WIIFY])
- Help Others Achieving **Short-Term Results**
- Do Not Add Just Another Process
- Introduce **Accountability** (What, Who, When)
- **Just do it**, Ask for Forgiveness Later
- Be Persistent, **Don't Give Up**



TRANSPORTATION & INFRASTRUCTURE SYSTEMS ENGINEERING OPPORTUNITIES

➤ **Federal, State and Local Regulations (Compliance)**

- Code of Federal Regulations
- California Proposition 1A
- California Public Utilities Commission

➤ **Safety, Security & System Certification (Compliance)**

- Preliminary Hazard Analysis Mitigations
- Threat and Vulnerability Assessment Mitigations
- Demonstration that System is Ready to Operate

➤ **Multi-Contract Environments (Complexity)**

- Requirements Management
- Interface and Integration Management
- Inspection and Test Management

➤ **Operations and Maintenance (User Needs)**

- Operating Plan, Concept of Operations, Operational Scenarios
- Maintenance of Infrastructure, Rolling Stock, Storage & Maintenance Facilities



CALIFORNIA HIGH-SPEED RAIL

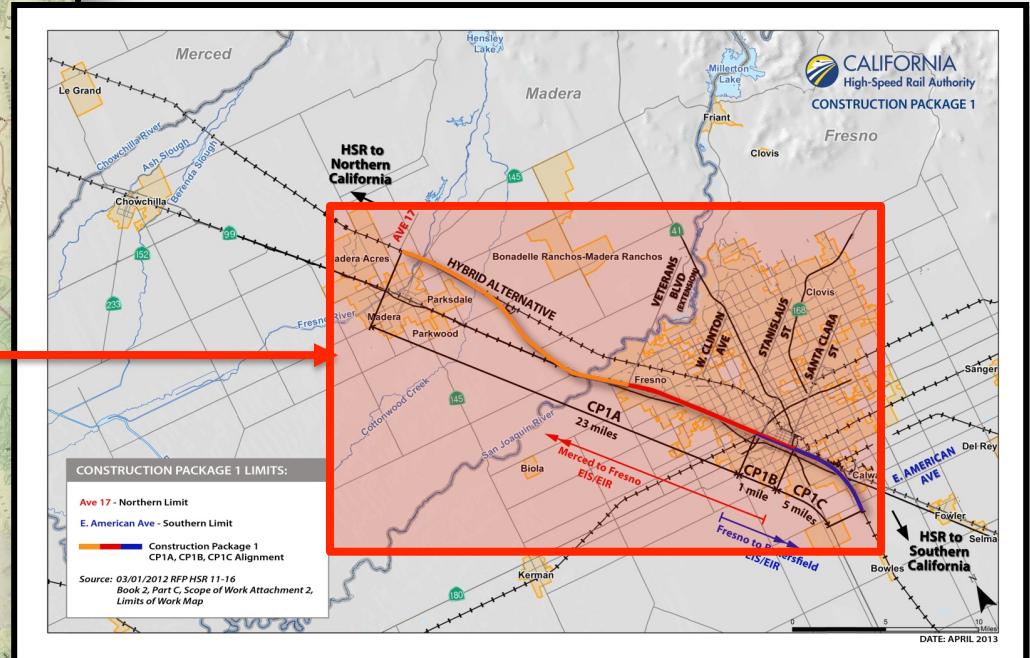
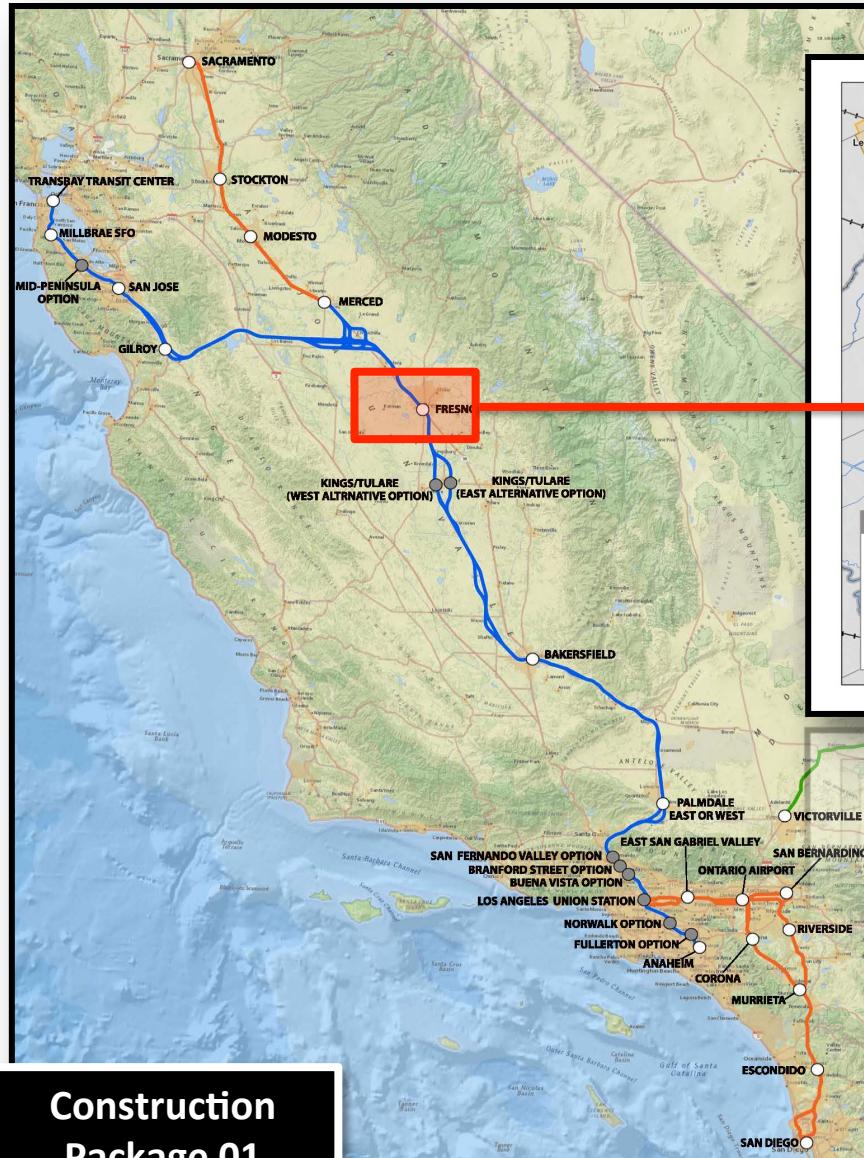
PROJECT BACKGROUND



- First High-Speed Rail in U.S.
- Construction has started
- SF to LA in under 3 hours by 2029
- 800 Miles, 24 stations
- Operating Speed of 220 mph



CALIFORNIA HIGH-SPEED RAIL PROJECT BACKGROUND (CONT'D)



- 29 Miles
- ~ 1 Billion Dollar
- Civil / Structural Work
- Started



CALIFORNIA HIGH-SPEED RAIL

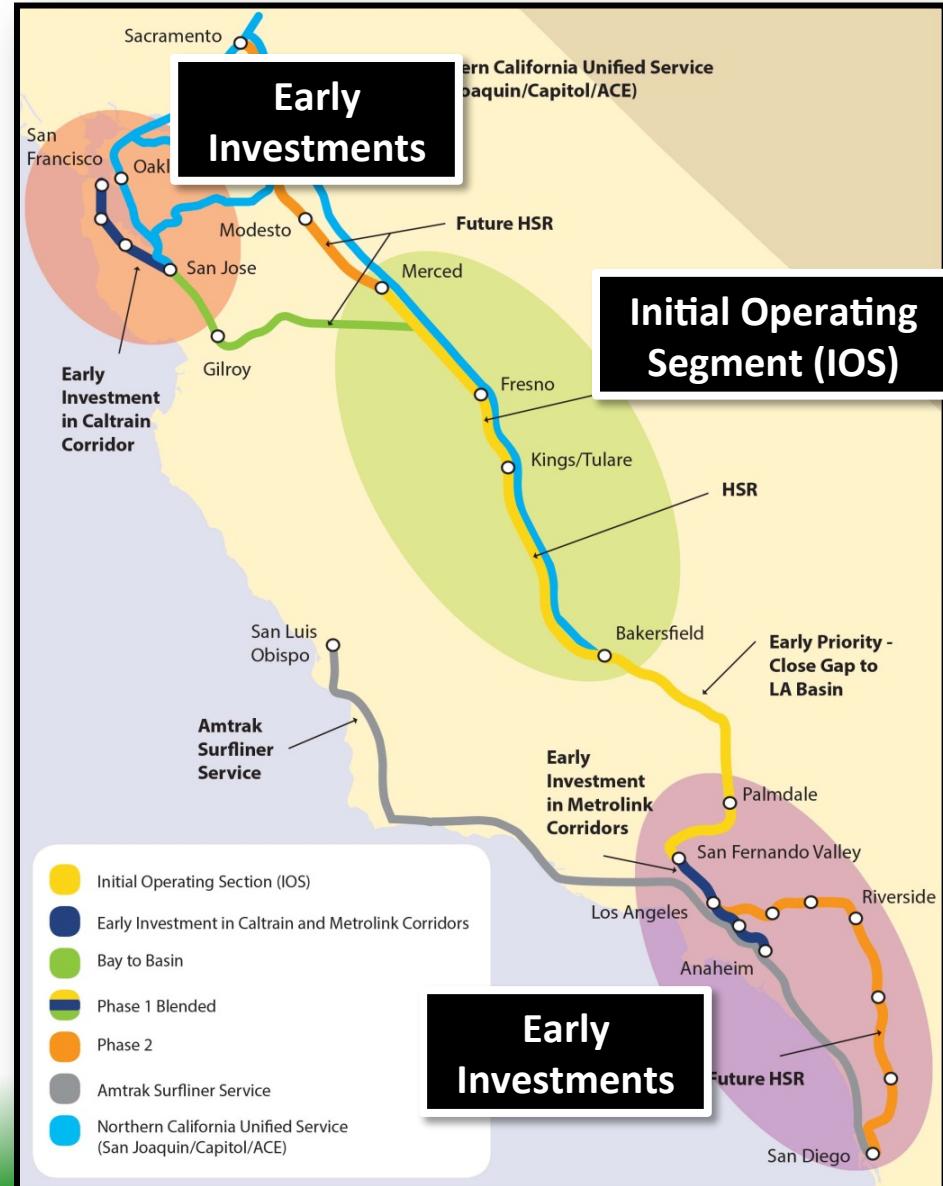
PROJECT BACKGROUND (CONT'D)

Initial Operating Segment (IOS)

- Central Valley to San Fernando Valley
- “Backbone” of High-Speed Rail
- 300 Miles
- First Step Towards a Statewide High-Speed Rail System by 2022

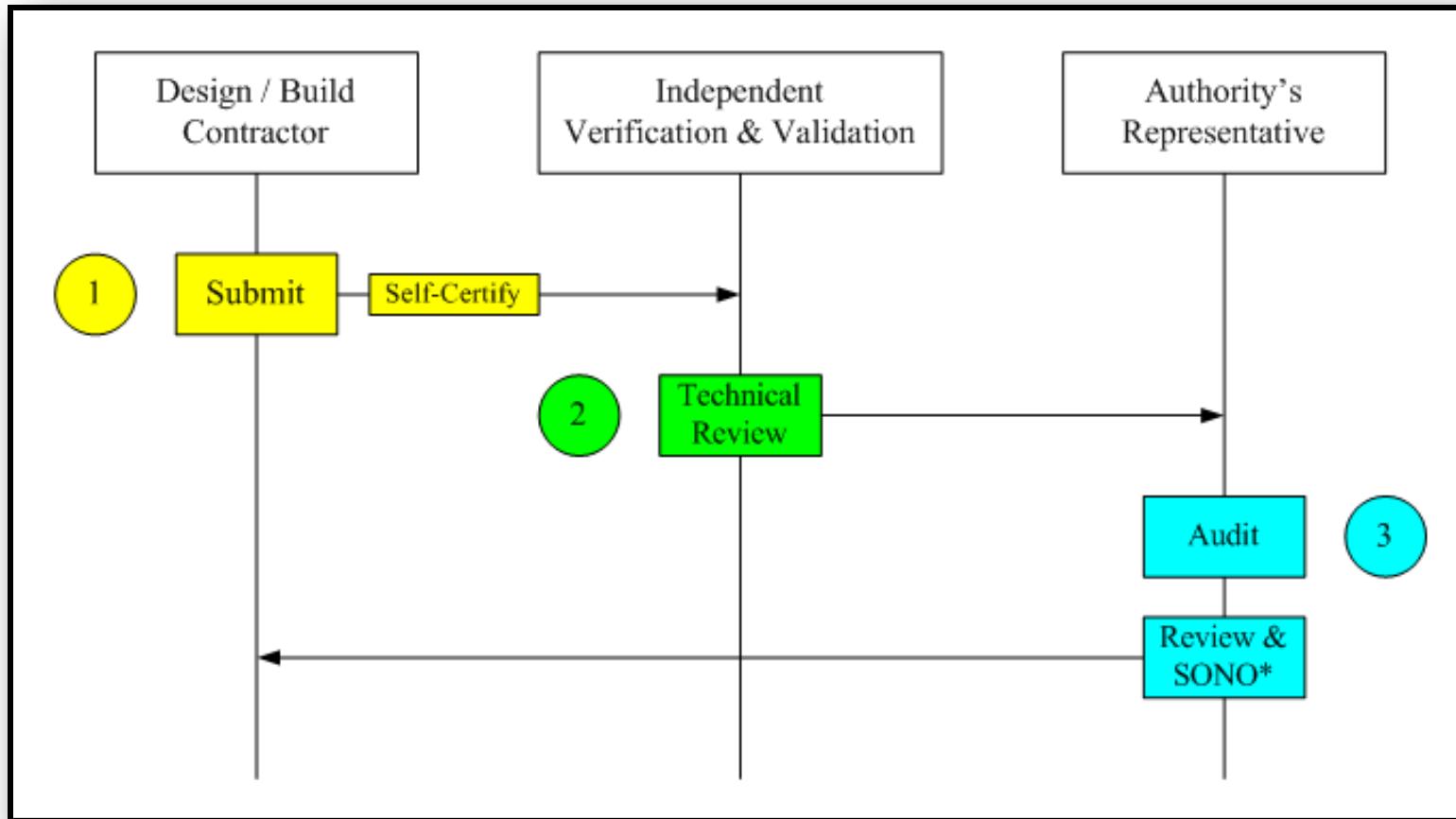
Early Investments Underway

- Caltrain Electrification & Early Investments in the Corridor
- Regional Enhancements in Southern California
- Statewide Connectivity Projects & Investments



THE NECESSARY

CONTRACTOR SELF-CERTIFICATION WITH INDEPENDANT CONFORMITY ASSESSMENT



SONO: Statement of No Objection

Contractor Self-Certification Process



THE NECESSARY

CONTRACTOR SELF-CERTIFICATION (CONT'D)

California High-Speed Train Project

California High-Speed Train Project



Request for for Design-Bu

RFP No.: H
Verification, Validation

Revision No.	Date	Description
0	01 Mar 12	Initial Release
1	04 Jun 12	Interoperability
2	23 Aug 12	Third Party Review
3	13 Dec 12	Minor Clarification

RFP Book 3
Part B: V&V

California High-Speed Train Project

Table of C

1	1	INTRODUCTION
2	1.1	Reference Standards.....
3	1.2	Scheduling.....
4	1.3	V&V Submittals.....
5	1.4	Self Certification Process Overview
6	1.5	Terms and Acronyms
7	2	PRODUCTS.....
8	2.1	Verification and Validation Plan
9	2.1.1	Verification and Validation Process.....
10	2.1.2	Requirements Management.....
11	2.1.3	Design Management.....
12	2.1.4	Interface Management
13	2.1.5	Inspection and Testing Program Management.....
14	2.1.6	Change Management.....
15	2.2	Requirements Management Tool
16	2.2.1	Parse the Contract for Technical Contract Requirements.....
17	2.2.2	Capture Technical Contract Requirements.....
18	2.2.3	Document Technical Contract Requirements.....
19	2.2.4	Analyze Technical Contract Requirements.....
20	2.2.5	Derive Technical Contract Requirements.....
21	2.2.6	Apportion Technical Contract Requirements.....
22	2.2.7	Trace Technical Contract Requirements.....
23	2.2.8	Manage Technical Contract Requirements.....
24	2.2.9	Verify Technical Contract Requirements.....
25	2.2.10	Validate Technical Contract Requirements.....
26	2.2.11	Reporting
27	2.3	Requirements Verification and Traceability
28	2.3.1	Submittals.....
29	2.4	Certifiable Items List
30	2.5	Contractor Verification and Validation Requirements
31	2.6	Contractor Verification and Validation Submittals
32	3	EXECUTION.....
33	3.1	Self-certification
34	3.2	Self-certification
35	3.3	Contract
36	3.3.1	Contract
37	3.3.2	Verification
38	3.3.3	Requirements
39	3.3.4	Requirements
40	3.3.5	Certification
41	3.3.6	Verification
42	3.4	Independent
43	3.4.1	General

RFP No. HSR 11-16

California High-Speed Train Project

3 Execution

3.1 Self-certification Process Overview

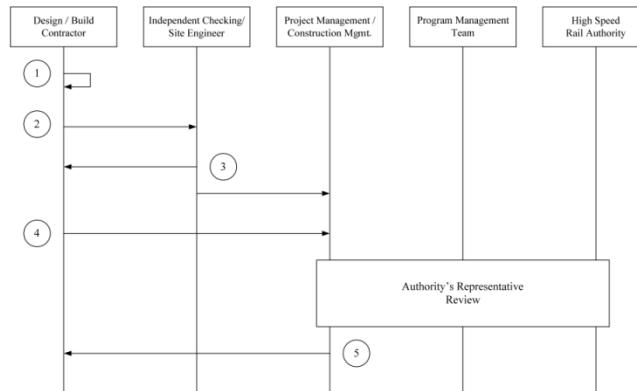


Figure 2: Self-Certification Process

Follow the self-certification process as presented in Figure 2.

1. Contractor shall prepare Technical Contract Submittal (including final design, construction, inspection and test submittals) as specified in the Contract and shall perform quality procedures as stipulated by the Contract. Contractor shall self-certify compliance with Contract Requirements and fitness for purpose.

- Support from Senior Management
- Credibility due to proven Asian & European HSR Application
- Benefits due to early Verification results (i.e. Design)
- Major component of Risk and Quality Management

THE POSSIBLE COMPLIANCE WITH REGULATORY REQUIREMENTS

CALIFORNIA HIGH-SPEED TRAIN PROJECT

GUIDANCE DOCUMENT OF RECOMMENDED SAFETY ELEMENTS NECESSARY FOR FRA REGULATORY APPROVAL

DRAFT FOR REVIEW

Parsons Brinckerhoff

4/6/2012

1.3.4 Infrastructure and Track

1.3.4.1 Material and Operational Design Criteria

The Railroad will construct its track and infrastructure to meet all material and operational design criteria, within normal acceptable construction tolerances, and to meet the requirements proposed in this Guidance Document.

1.3.4.2 Nominal Track Gauge

The Railroad will operate on 56.5 inches wide nominal standard gage track.

1.3.4.3 Structure Gauge

The infrastructure will allow safe clearance for the passage of trains complying with the High-Speed Rolling Stock requirements and the overhead catenary system.

1.3.4.4 Track Centers

The Railroad will install and operate on double track throughout its entire length. The distance between track centers will be based on that required for aerodynamic considerations, design speed, and ease of maintenance. The minimum nominal distance between track centerlines will be 16.5 feet at operating speeds up to 220 mph. In Shared Track conditions where maximum

49 CFR Part No.	49 CFR Part Title	Guidance Document Section No.	Guidance Document Section
49CFR Part 214.301	Railroad Workplace Safety	4.1.2	Track Personnel
49CFR Part 217	Railroad Operating Rules	2.14	Rules Compliance Procedures Rules Program
49CFR Part 217.7	Railroad Operating Rules	5.1.1.1	Filing and Recordkeeping
49CFR Part 217.9	Railroad Operating Rules	1.3.5.2	Overall Functionality
49CFR Part 217.9	Railroad Operating Rules	2.14	Rules Compliance Procedures Rules Program
49CFR Part 217.9	Railroad Operating Rules	5.1.1.2	Operational Tests and Inspections
49CFR Part 217.11	Railroad Operating Rules	5.1.1.3	Operating Rules Instructional Program
49CFR Part 218	Railroad Operating Practices	2.14	Rules Compliance Procedures Rules Program
49CFR Part 218	Railroad Operating Practices	2.17	Rail Corridor Safety Program

This document formulates minimum safety requirements for design, construction and operation of the California High-Speed Rail system.

THE POSSIBLE COMPLIANCE WITH REGULATORY REQ. (CONT'D)

'CFR' current 0.0 in /CHSTP/10 External Requirements/10 Code of Federal Regulations (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Standard View All levels

5 Title 49 Transportation

- 5.1 Part 37 Transportation Services F
- 5.1.1 Part 37 Transportation Serv
- 5.1.2 Subpart A - General
 - 5.1.2.1 49CFR37.001 Purpos
 - 5.1.2.2 49CFR37.003 Definiti
 - 5.1.2.3 49CFR37.005 Nondis
 - 5.1.2.4 49CFR37.007 Standar
 - 5.1.2.5 49CFR37.009 Standar
 - 5.1.2.6 49CFR37.011 Admini
 - 5.1.2.7 49CFR37.013 Effecti
 - 5.1.2.8 49CFR37.015 Interpre
- 5.1.3 Subpart B - Applicability
- 5.1.4 Subpart C - Transportation I
- 5.1.5 Subpart D - Acquisitio
- 5.1.6 Subpart E - Acquisitio
- 5.1.7 Subpart F - Para
- 5.1.8 Subpart G - Prov
- 5.1.9 Subpart H - Over
- 5.1.10 49CFR37.991 A
- 5.1.11 49CFR37.992 A
- 5.1.12 49CFR37.993 A
- 5.1.13 49CFR37.994 A
- 5.2 Part 38 Americans with
- 5.3 Part 172 Hazardous Materials Tal
- 5.4 Part 200 Informal Rules Of Practic
- 5.5 Part 201 Reserved
- 5.6 Part 207 Railroad Police Officers
- 5.7 Part 209 Railroad Safety Enforce
- 5.8 Part 210 Railroad Noise Emission
- 5.9 Part 211 Rules Of Practice
- 5.10 Part 212 State Safety Participati
- 5.11 Part 213 Track Safety Standard
- 5.12 Part 214 Railroad Workplace Sa
- 5.13 Part 215 Railroad Freight Car Sa
- 5.14 Part 216 Special Notice And Em

REG-SR Regulatory System Requirements from DB

3-02

3.2 Nominal track gauge

(a) Track gauge is measured between the heads of the rails at right angles to the rail in a plane five-eighths of an inch below the top of the rail head.

(b) Nominal track gauge shall be 4'-8½"

Traced From: CFR (LM)

[CFR]

213 Track Safety Standards Subpart G
49CFR213.323
Track gage

CFR_1671 5.1.3.6 49CFR37.031 Vanpools.

CFR_1672 5.1.3.7 49CFR37.033 Airport transportation systems.

CFR_1673 5.1.3.8 4

CFR_1674 5.1.3.9 4

CFR_1675 5.1.3.10

CFR_1827 5.1.4 Subpart

CFR_1676 5.1.4.1 4

CFR_1677 5.1.4.2 4

Systems Engineering Champion

Show Applicability

Communicate Clearly (WIIFY)

Demonstrate Practical Value

Achieve Early Benefits



THE POSSIBLE REQUIREMENTS MANAGEMENT (TOOL)

'CFR Full' current 0.0 in /CHSTP/10 External Requirements/10 Code of Federal Regulations (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Standard View All levels

5 Title 49: Transportation

5.1 PART 37-TRANSPORTATION

5.1.1 Subpart A-General

5.1.2 Subpart B - Applicab

5.1.3 Subpart C-Transport

5.1.3.1

5.1.3.1.1 § 37.41

5.1.3.1.2 § 37.42

(a) In addition

5.1.3.1.3 § 37.43

5.1.3.1.4 § 37.45

5.1.3.1.5 § 37.47

5.1.3.1.6 § 37.49

5.1.3.1.7 § 37.51

5.1.3.1.8 § 37.53

5.1.3.1.9 § 37.55

5 Title 49: Transportation

5.11 PART 213—TRACK SAFETY STANDARDS

5.11.7 Subpart G—Train Operations at Track Classes 6 and Higher

5.11.7.1

5.11.7.1.13 § 213.329 Curves; elevation and speed limitations.

(a) The maximum elevation of the outside rail of a curve may not be more than 7 inches. The outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions; the limits in § 213.331 apply in all cases.

(b) The maximum allowable posted timetable operating speed for each curve is determined by the following formula:

5.11.7.1.13 § 213.329 Curves; elevation and speed limitations.

(a) The maximum elevation of the outside rail of a curve may not be more than 7 inches. The outside rail of a curve may not be lower than the inside rail by design, except when engineered to address specific track or operating conditions; the limits in § 213.331 apply in all cases.

CFR Language

elevation, E_a , for each 155-foot track segment in the body of the curve is determined by averaging the elevation for 11 points through the segment at 15.5-foot intervals. If the curve length is less than 155 feet, the points are averaged over the full length of the body of the curve.

qualified cant deficiency ⁷ (inches) of the vehicle type.

If the actual elevation, E_a , and degree of curvature, D , change as a result of track degradation, then the actual cant deficiency for the maximum allowable posted timetable operating speed, V_{max} , may be greater than the qualified cant deficiency, E_u . This actual cant deficiency for each curve may not exceed the qualified cant deficiency, E_u , plus one-half inch.

D = Degree of curvature (degrees).⁸

⁸ Degree of curvature, D , is determined by averaging the degree of curvature over the same track segment as the elevation.

(c) All vehicles are considered qualified for operating on track with a cant deficiency, E_u , not exceeding 3 inches. Table 1 of appendix A to this part is a table of speeds.

Traced To: REG-SRs (SM)

[30 REG-SRs INF] INF-3-10: Track Geometrical Quality and limits on isolated defects

[30 REG-SRs INF] INF-3-08.2: Abrupt change of unbalanced superelevation on diverging track of switches

[30 REG-SRs INF] INF-3-07: Actual Superelevation (Ea)

[30 REG-SRs INF] INF-3-07: Actual Superelevation (Ea)

[30 REG-SRs INF] INF-3-06: Minimum Superelevation

[30 REG-SRs INF] INF-3-07: Actual Superelevation (Ea)

System Requirement

THE POSSIBLE REQUIREMENTS MANAGEMENT TOOL (CONT'D)



Screenshot of a Requirements Management Tool (DOORS) interface showing a traceability matrix and detailed requirements for track cant.

Header: '10 TSI-INF_A current 1.0 in /CHSTP/10 External Requirements/20 Technical Specifications for Interoperability (Formal module) - DOORS

Left Sidebar: Navigation tree for requirements, including sections 4.2 Functional and technical, 4.2.1 General provisions, 4.2.2 Nominal track, 4.2.3 Minimum infrastructure, 4.2.4 Distance between tracks, 4.2.5 Maximum rising and falling gradients, 4.2.6 Lines of category I, 4.2.7 Track cant, 4.2.8 Cant deficiency, 4.2.9 Equivalent cornering force, 4.2.10 Track Geometry, 4.2.11 Rail inclination, 4.2.12 Switches and crossings, 4.2.13 Track resistance, 4.2.14 Traffic load or capacity, and 4.2.15 Global track standards.

Table: Tracing matrix showing requirements mapped to standards.

ID	Description	Traced To: REG-SRs (LM)	Traced To: TSI IF-REG (LM)
33	4.2.5 Maximum rising and falling gradients	[30 REG-SRs INF] INF-3-05: Maximum Grade	[80 TSI IF-REG] Interface between INF Maximum Rising and Falling Gradients and RST Maximum Gradients
34	Lines of category I		[80 TSI IF-REG] Interface between INF Maximum Rising and Falling Gradients and RST Brake Performance on Steep Gradients
37	4.2.7 Track cant	[30 REG-SRs INF] INF-3-07: Actual Superelevation (Ea)	[80 TSI IF-REG] Interface between INF Minimum Radius of Curvature and RST Minimum Curve Radius
38	Lines of category I, II and III		

Annotations:

- TSI Language** callout pointing to requirement 34.
- System Requirement** callout pointing to requirement 37.
- Yellow arrow pointing from requirement 37 to its standard trace [30 REG-SRs INF] INF-3-07: Actual Superelevation (Ea).

Bottom Navigation: Username: oliverhoehe, Exclusive edit mode.

THE POSSIBLE REQUIREMENTS MANAGEMENT TOOL (CONT'D)

'30 REG-SRs INF' current 0.1 in /CHSTP/20 Internal Requirements/30 Regulatory Approvals/30 REG-SRs (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Standard View (Traced F) All levels

Regulatory System Requirements from DB

3.5 Maximum Grade

The alignment shall have the smoothest practical profile. Grades shall be as low as practical. Maximum grade shall not exceed 3.5%.

The following maximum grade requirements shall be observed:

- the slope of the Grade of main track shall be less than or equal to 2.5%
- the maximum length of 20,000 feet shall not be greater than 0.25%

3.6 Minimum

The minimum radius of the curve is the maximum speed for which the curve is designed, the unbalanced superelevation does not exceed the values indicated in System Requirements

System Requirement

CFR Reference

TSI Reference

Traced From: CFR (LM) Traced From: TSI (LM)

[10 TSI-INF_A] 4.2.5 Maximum rising and falling gradients

[CFR] 213 Track Safety Standard 49CFR213.329

[TSI-INF_A] Minimum radius of curve

3.7 Actual Superelevation (Ea)

Actual Superelevation (Ea) is the maximum difference in height between outer and inner rails measured at the center of the rail head surface (in inches). The maximum actual superelevation shall be limited to 7 inches. In addition, approved HSR rolling stock equipment may be operated at curving speeds determined by the CHSTP System Requirement 3-06 provided:

- (1) It is demonstrated when positioned on a track with uniform superelevation, Ea, reflecting the intended target cant deficiency, Eu, no wheel of the equipment unloads to a value of 60 percent or less of its static value on perfectly level track and, for passenger-carrying equipment, the roll angle between the floor of the vehicle and the horizontal does not exceed 5.7 degrees.
- (2) It is demonstrated when positioned on a track with a uniform 7-inch superelevation, no wheel unloads to a value less than 60% of its static value on perfectly level track and, for passenger-carrying equipment, the angle, measured about the roll axis, between the floor of the vehicle and the horizontal does not exceed 8.6 degrees.

3.19 Noise and Vibration

3.19.1 Noise Prevention

3.19.2 Vibration Prevention

3.20 Station Platforms (P)

3.20.1 Speed of train

3.20.2 Usable length

3.20.3 Usable width

3.20.4 Platform height

3.20.5 Distance from

3.20.6 Track layout

3.20.7 Prevention of

3.8.1 Unbalanced Superelevation on curves containing turnouts

Unbalanced superelevation on curves containing turnouts shall be limited to 2 inches.

3.8.2 Abrupt change of unbalanced superelevation on diverging track of switches

Abrupt change of unbalanced superelevation on curves through the diverging track of turnouts on CHSTP shall not exceed 4.5 inches per second.

[CFR] 213 Track Safety Standards Subpart G 49CFR213.329

Curves, elevation and speed limitations

[10 TSI-INF_A] 4.2.7 Track cant

Systems Engineering Champion

Communicate Clearly (WIIFY)

Show Applicability

Management Buy-In

Early Adaptors

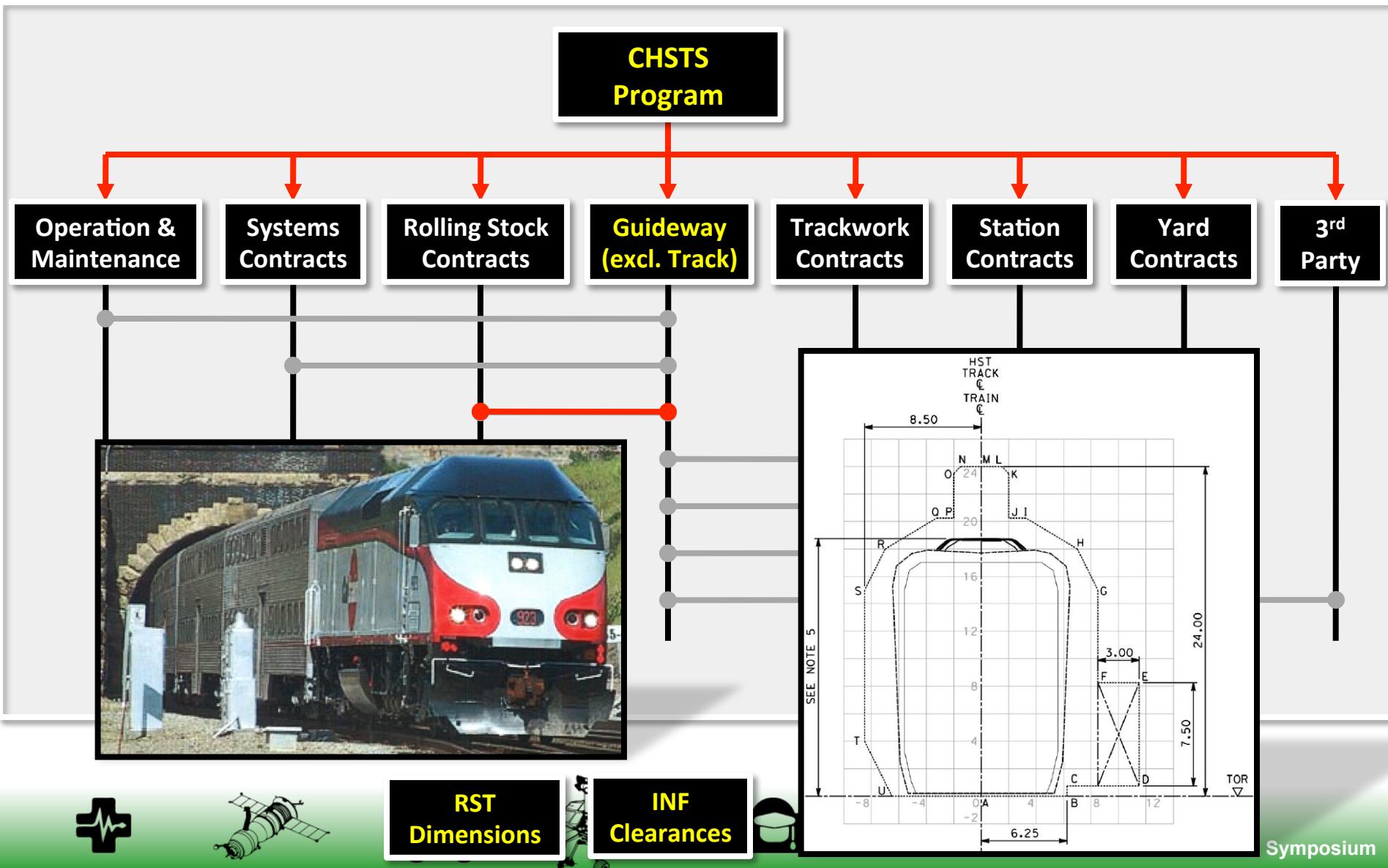
THE POSSIBLE

COMPLIANCE WITH PROGRAM PERFORMANCE REQUIREMENTS



'BoD' current 0.1 (R2b) in /CHSTP/20 Internal Requirements/20 System Definition/10 Basis of Design (Formal module) - DOORS			
File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help			
	View	OH Standard View	All levels
Absolute	_CHSTS S	Based on TM 0 3 Basis of Design R3 120723 tracked changes.docx	Traced To: SyRS (LM)
21	---	2.1 Governing Legislation and Environmental Documentation	
23	INF RST SYS O&M	2704.09. The high-speed train system to be constructed pursuant to this chapter shall have the following characteristics:	[SyRS-INF] ID: 2113 Governing Legislation ar [SyRS-RST] ID: 103 Governing Legislation ar [SyRS-SYS1] ID: 252 Governing Legislation ar [SyRS-O] on ar [SyRS-R] on ar
24	RST	(a) Electric trains that are capable of sustained maximum revenue operating speeds of no less than 200 miles per hour.	[SyRS-O] on ar
352	O&M RC	(b) Maximum nonstop service travel times for each corridor that shall not exceed the following: (1) San Francisco-Los Angeles Union Station: two hours, 40 minutes. (2) Oakland-Los Angeles Union Station: two hours, 40 minutes. (3) San Francisco-San Jose: 30 minutes. (4) San Jose-Los Angeles: two hours, 10 minutes. (5) San Diego-Los Angeles: one hour, 20 minutes. (6) Inland Empire-Los Angeles: 30 minutes. (7) Sacramento-Los Angeles: two hours, 20 minutes	[SyRS-O] on ar
33	SYS O&M	(c) Achievable operating headway (time between shall be five minutes or less.	
34	INF O&M	(d) The total number of stations to be served by all of the corridors described in subdivision (b) shall not exceed 24. There shall be no station between the San Jose station and the Merced station.	
35	INF O&M	(e) Trains shall have the capability to transition or to bypass those stations, at mainline operating speed.	
36	INF O&M	(f) For each corridor described in subdivision (b), passengers shall have the capability of traveling from any station on that corridor to	[SyRS-INF] ID: 2116 Governing Legislation ar [SyRS-OPS] ID: 128 Governing Legislation ar

THE POSSIBLE INTERFACE VERIFICATION

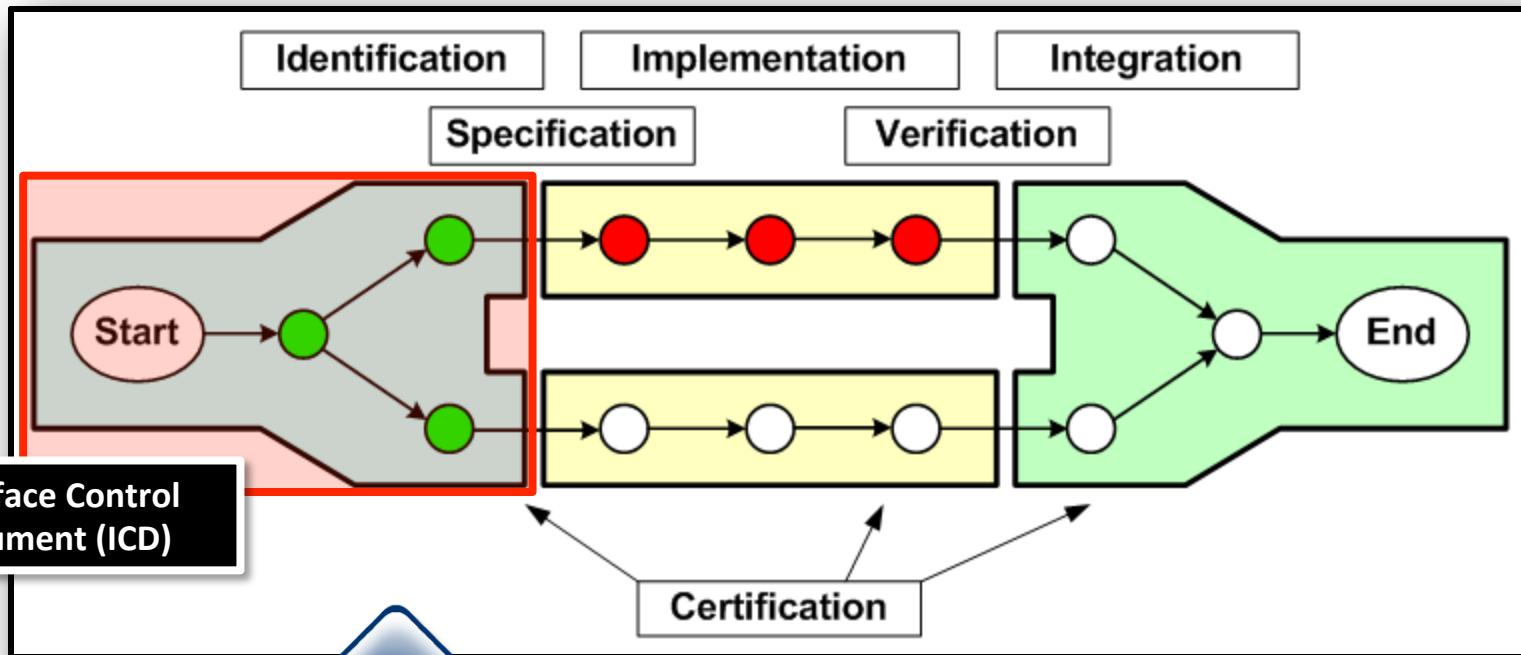


THE POSSIBLE INTERFACE VERIFICATION (CONT'D)

Environmental Review
Preliminary Engineering

Design / Build
Contracts

Final Integration,
Testing & Certification



THE POSSIBLE

INTERFACE VERIFICATION (CONT'D)

RFP No. HSR 11-16

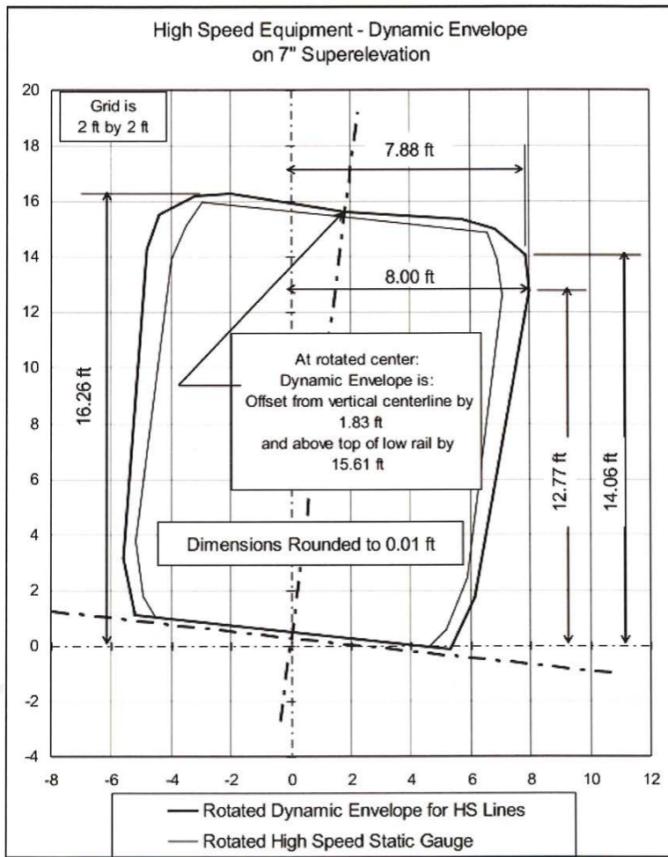
California High-Speed Train Project

6.2	Shared Use Track	62
6.2.1	Interfaces with Guideway (excl. Trackwork)	62
6.2.1.1	Vehicle Static Gauge & Dynamic Envelope.....	62
6.2.1.1.1	Interface between EXT Shared Use Track Trainset Dynamic Envelope Requirements and GWY Infrastructure.....	62
6.2.1.2	Loads & Forces	62
6.2.1.2.1	Interface between EXT Shared Use Track Axe Loads and GWY Infrastructure	62
6.2.1.2.2	Interface between EXT Shared Use Track Trainset Dynamic Train-Structure Interaction Analysis and GWY Infrastructure	62
6.2.1.2.3	Interface between EXT Shared Use Track Trainset Derailment/Collision Loads and GWY Infrastructure	62
6.3	Amtrak	62
6.3.1	Interfaces with Guideway (excl. Trackwork)	62
6.3.1.1	Vehicle Static Gauge & Dynamic Envelope.....	62
6.3.1.1.1	Interface between EXT Amtrak Trainset Dynamic Envelope Requirements and GWY Infrastructure.....	63
6.3.1.2	Loads & Forces	63
6.3.1.2.1	Interface between EXT Amtrak Trainset Axe Loads and GWY Infrastructure	63
6.3.1.2.2	Interface between EXT Amtrak Trainset Dynamic Train-Structure Interaction Analysis and GWY Infrastructure	63
6.3.1.2.3	Interface between EXT Amtrak Trainset Derailment/Collision Loads and GWY Infrastructure	63
6.4	High/Roadways.....	63
6.4.1	Interfaces with Guideway (excl. Trackwork)	63
6.4.1.1	Intrusion Protection.....	63
6.4.1.1.1	Interface between GWY Roadway Intrusion Protection Spatial Needs and GWY Infrastructure.....	64
6.5	Pedestrians & Wildlife	64
6.5.1	Interfaces with Guideway (excl. Trackwork)	64
6.5.1.1	Access Control	64
6.5.1.1.1	Interface between GWY Pedestrian/Wildlife Access Control Requirements and GWY Infrastructure.....	65
6.6	Construction Equipment.....	65
6.6.1	Interfaces with Guideway (excl. Trackwork)	65
6.6.1.1	Loads & Forces	65
6.6.1.1.1	Interface between EXT Construction Equipment Axe Loads and GWY Infrastructure	66
6.6.1.1.2	Interface between EXT Construction Equipment Dynamic Train-Structure Interaction Analysis and GWY Infrastructure	66



THE POSSIBLE INTERFACE VERIFICATION (CONT'D)

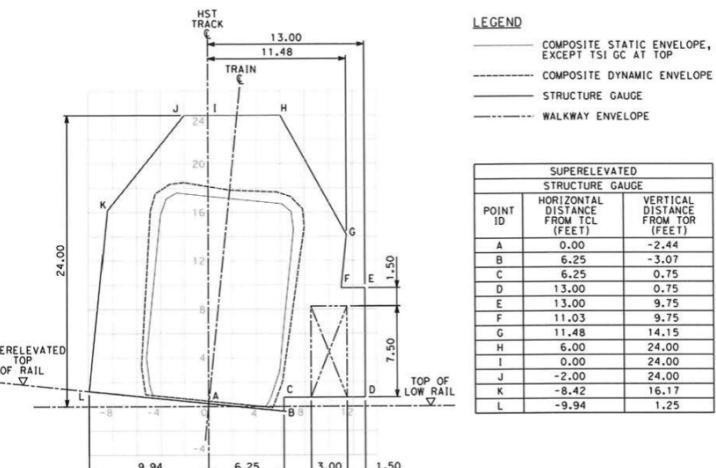
CALIFORNIA HIGH-SPEED TRAIN PROJECT – STANDARD SPECIFICATIONS



Rolling Stock Interface Requirements

California High-Speed Train Project Design Criteria
Chapter 3 – Trackway Clearances

Appendix 3.B Structure Gauge, Superelevated Track



- 1
- 2 Notes:
- 3 See Appendix 3.A for structure gauge notes.

Infrastructure Interface Provisions

THE POSSIBLE INTERFACE VERIFICATION (CONT'D)

CHSTP Verification, Validation and Self-Certification - Certifiable Items List (CIL) - Certification Sheet CIL Item No. IF0489 - Certification Sheet Page 2 of 2

IF#	Interface Description	Traceability	In. & Date
IF0489	Interface between RST HST Trainset Actual Superelevation Requirements (incl. Tilting) and GWY Infrastructure	External Links: https://ww3.projectsolve2.com/eRoomReq/Files/SFOF7/Engineering/0_cc285%200489%20-20Interface%20between%20RST%20HST%20Trainset%20Actual%20Superelevation%20Requirements%20incl.%20Tilting%20and%20GWY%20Infrastructure.Re df	
	Purpose/Scope: Ensures that the RST HST trainset actual superelevation requirements have been addressed by the INF team		
	Specification: Defines the RST HST trainset actual superelevation requirements as specified by the RST team.	RST Specs, 2.3, Design of Trains (S-01.2)	
	Verification #1 (Design Criteria): Verifies that the INF team has addressed the alignment design criteria.		
	Verification #2 (Spatial Integration/Coordination): Verifies that the INF team has addressed the clearance design criteria, including but not limited to: <ul style="list-style-type: none"> Dynamic equipment envelope Fixed equipment envelope Structure gauge Horizontal clearances Vertical clearances Catenary clearances Track clearances Walkway clearances Utility clearances Underground clearances Other clearances (e.g. electrical clearance) 		

References to Interface Requirements and Design



CHSTP Verification, Validation and Self-Certification Certifiable Items List (CIL) - Certification Sheet

CIL Item No. IF0489

Certification Signoff Sheet Page 1 of 2

To all signatories: Please review the included information and sign and date in the appropriate spaces. By signing this form, you are certifying that the critical item described has been coordinated between the Specifier and all Verifiers, and that the documentation referenced accurately and completely describes the specification and verification of the critical item to your satisfaction.

To Specifier: After reviewing the contents, please sign the front page and initial the individual entries in the attached table. By signing this form, you hereby certify that:

1. the documentation referenced by you accurately specifies the requirements of the critical item, and
2. the documentation referenced by the Verifier fully satisfies the requirements of the critical item.

Specifier Signature

Systems:



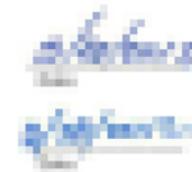
To Verifiers: After reviewing the contents, please sign the front page and initial the individual entries in the table. By signing this form, you hereby certify that:

1. you understand the documentation referenced by the Specifier,
2. the documentation referenced by you accurately and completely verifies that the requirements of the critical item have been addressed, and
3. entries marked "(Not applicable)" accurately reflect that the requirement for that discipline does not apply.

Verifier Signatures

Track:

Track:



Interface Sign-Off by Involved Parties



THE POSSIBLE INTERFACE VERIFICATION (CONT'D)

'IF-REG' current 2.0 (CP01-AD.9) in /CHSTP/40 Interface Register (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH RST (Working) All levels

Interface Traced To: TCs (LM)

4 Rolling Stock

4.1 HST Trainset

4.1.6 Interfaces with Stations

4.1.6.2 Usable Platform Length

4.1.6.2.1 Interface between RST HST Maximum Trainset Length and STA Usable Platform Length

Purpose/Scope:
Ensures that the RST HST trainset length requirements have been addressed in the INF design criteria.

Interface Requirements Specification:
Defines the RST HST design criteria.

Interface Design Description:
Defines the INF/STA design criteria in response to the interface requirements.

► DCM [GEN] 1.2.4 Rolling Stock
[RST Spec] 12.3.27 Platforms
► DCM [STA] 14.3.1.4.2 Station Size
DCM [STA] 14.3.2.1.1 Length

Username: oliverhoehne Exclusive edit mode

- Systems Engineering Champion
- Just do it, Ask Forgiveness Later
- Help Others Achieving Short-Term Results
- Introduce Accountability (What, Who, When)



THE POSSIBLE SAFETY & SECURITY CERTIFICATION

CERTIFIABLE ELEMENT: SUB-ELEMENT: REVISION: CHECKLIST TYPE: MASTER: _____ SUB: _____		TRANS HUDSON EXPRESS TUNNEL PROJECT SAFETY AND SECURITY CERTIFICATION PROGRAM SPECIFICATION CONFORMANCE & OPERATIONAL READINESS CHECKLIST				DATE: _____	PAGE _____ OF _____	
		SAFETY: _____	SECURITY: _____	PREPARED BY: _____	APPROVED BY: _____	VERIFICATION APPROVAL: _____	Date _____	

ITEM NO.	DESCRIPTION - DCM REFERENCE	DESIGN PHASE*		CONSTRUCTION/INSTALLATION/TEST PHASE*		FINAL VERIFICATION*		
		NJT/PA DCM/SPEC OR DWG REF	CONTRACT PKG SPEC. OR DCM REF	DATE INSTALLED/TESTED	FIELD VERIFIED BY	STATUS	VERIFIED BY	DATE VERIFIED
008	All new water mains and relocations and rearrangements or extensions of existing water mains shall comply with applicable Federal, State and local standards, and the applicable standards of ANSI and AWWA (For this contract, United Water requirements shall be complied with).	DCM Ch. 7, Sec. 7.2.7	UP-51209 UP-51210 UP-51102	PCAP 3-7-09				
009	All new water mains and relocations shall be designed to the criteria of and shall be approved by municipality/agency (For this contract, the agency is United Water).	DCM Ch. 7, Sec. 7.2.7						
010	Overhead utility lines clearances shall be in accordance with the standards adopted by the utilities involved, and those specified in the National Electrical Safety Code shall be considered the minimum requirements with respect to NJ TRANSIT's ROW crossings catenary system, and structures.	DCM Ch. 7, Sec. 7.2.7	Exemption Category Clearance 40 ft					
011	The geotechnical design shall be in accordance with the current editions of codes, manuals or specifications, listed in the DCM Section 8.1.1	DCM Ch. 8, Sec. 8.1.1						
012	In addition to the applicable subsections from AREMA cited in Sections 8.2.1 and 8.2.2, foundation design requirements shall consider building codes listed in Section 8.1.1 (For this contract, NJ DOT	DCM Ch. 8, Sec. 8.2	Design per Geotechnical design memoranda or Geotechnical	JFP 27mar09 CCJ 3-26-09				

THE POSSIBLE SAFETY & SECURITY CERTIFICATION (CONT'D)

'10 CEHL' current 0.1 in /CHSTP/20 Internal Requirements/40 Operations and Maintenance/30 Safety (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH CEHL (Working) All levels Absolute Hazards & Mitigations Traced To: TCs (LM)

10 CEHL

1 Infrastructure

1.1 R-O-W, Generally

1.1.1 Derailment

1.1.1.1 Track Failure

1.1.1.1.1 Mitigation

1.1.1.1.2 Mitigation

1.1.1.1.3 Mitigation

1.1.1.1.4 Mitigation

1.1.1.1.5 Mitigation

1.1.1.2 Track Abnormal

1.1.1.2.1 Mitigation

1.1.1.2.2 Mitigation

1.1.1.2.3 Mitigation

1.1.1.2.4 Mitigation

1.1.1.2.5 Mitigation

1.1.1.3 Roadbed Fail

1.1.1.3.1 Mitigation

1.1.1.3.2 Mitigation

1.1.1.3.3 Mitigation

1.1.1.4 Washout cat

1.1.1.4.1 Mitigation

1.1.1.4.2 Mitigation

1.1.1.4.3 Mitigation

1.1.1.5 Slide, Stormw

1.1.1.5.1 Mitigation

1.1.1.5.2 Mitigation

1.1.1.5.3 Mitigation

1.2.1.9 Train falls from elevated structure.

1.2.1.9.1 Mitigations #1

[1] INF:
Include derailment containment wall in design of structure that keeps train on the bridge.

CEHL Mitigation

1.2.1.9.2 Mitigations #2

[2] RST:
Install device on vehicle trucks that keeps train in the alignment.

1.2.1.10 Person falls from elevated structure.

1.2.1.10.1 Mitigation #1

[1] INF:
Install fall prevention barriers (handrailing or wall) where exposed edge allows potential fall of greater than 30".

DCM [IPR] 6.4 Containment of HST Rolling Stock
DCM [STR] 12.5.2.13 Derailment Loads (DR)
DCM [STR] 12.5.2.13.2 Track Side Containment
DD-ST-001 TYPICAL CROSS SECTION, AERIAL STRUCTURE, TWO TRACK NO
DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NO
DD-ST-003 TYPICAL CABLE TROUGH DETAILS , AERIAL STRUCTURE
DD-ST-004 TYPICAL CABLE TROUGH DETAIL, AERIAL STRUCTURE, AT OCS PO
DD-ST-017 TYPICAL CROSS SECTION, AERIAL STRUCTURE, FOUR TRACK NO

References to Technical Criteria

Username: oliverhoehne

Exclusive edit mode

CEHL in DOORS



THE POSSIBLE SAFETY & SECURITY CERTIFICATION (CONT'D)

B. Track Side Containment

16 Derailment protection walls shall be provided on mainline aerial structures at locations 6 feet
 17 minimum to 7 feet maximum from TCL toward the outside edge of deck. The height of the wall
 18 shall be minimum 0.67 feet above the level of the adjacent track's lower rail. A transverse
 19 horizontal concentrated load of 35 kips shall be applied at top of the wall at any point of
 20 contact. A load factor of 1.4 shall be applied to the 35-kip load.

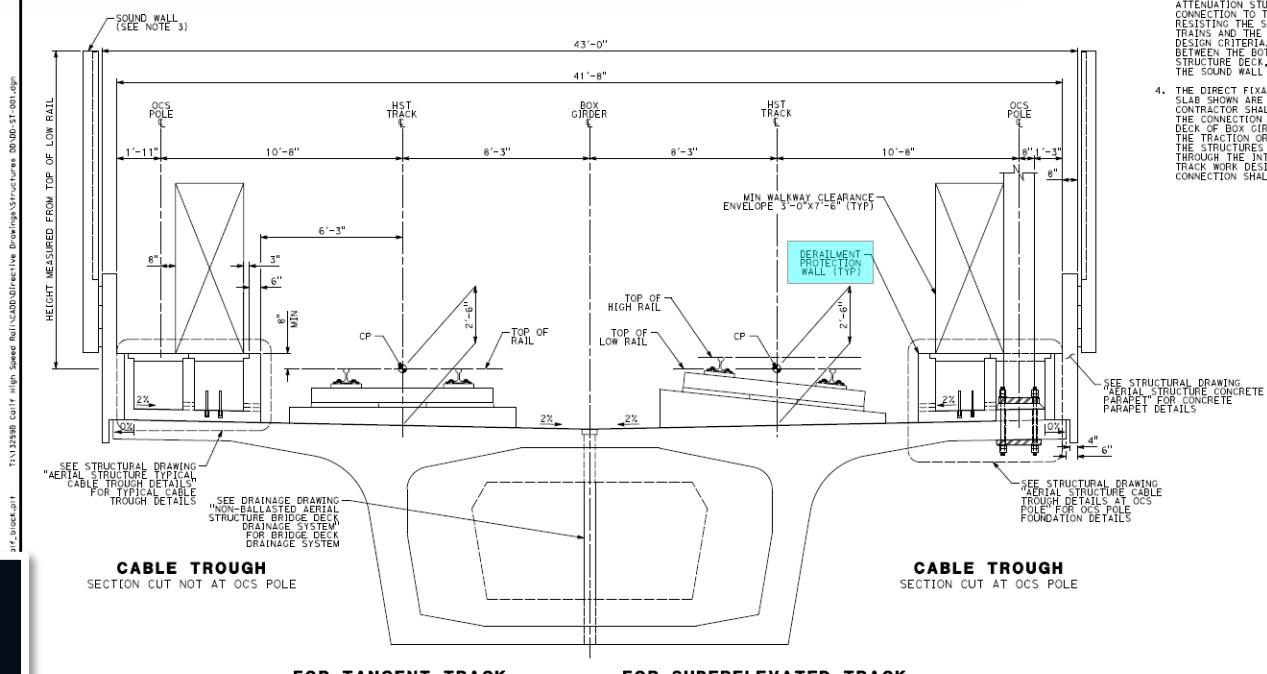
Design Criteria Manual (DCM)

NOTES:
 1. TRACK SYSTEMS AND DRAINAGE ARE SCHEMATIC AND DO NOT REPRESENT DESIGN.

2. ON CURVED ALIGNMENT, THE RELATIVE DIMENSIONS BETWEEN BRIDGE DECK AND BOX GIRDERS SHALL BE ADJUSTED PROPERLY. IF A STRAIGHT DECK EDGE IS SELECTED, THE WIDER DECK WIDTH MAY BE REQUIRED.

3. THE HEIGHT OF THE SOUND WALL SHALL BE DETERMINED BASED ON NECESSARY NOISE ATTENUATION STUDY. THE SOUND WALL ITSELF AND ITS CONNECTION TO THE STRUCTURE SHALL BE CAPABLE OF RESISTING THE UPSTREAM EFFECTS FROM PASSING TRAINS AND THE WIND LOADS AS DESCRIBED IN THE DESIGN CRITERIA. NO GAP SHALL BE PERMITTED BETWEEN THE BOTTOM OF SOUND WALL AND THE STRUCTURE DECK, NOR VERTICAL GAPS BETWEEN THE SOUND WALL PANELS.

4. THE DIRECT FIXATION RAIL SYSTEM AND THE TRACK SLAB DRAWN ARE FOR ILLUSTRATION ONLY. THE CONTRACTOR SHALL CONSIDER IN THEIR DESIGN THAT THE DIRECT FIXATION RAIL SYSTEM AND THE TOP OF DECK OF BOX GIRDERS IS CAPABLE OF TRANSFERRING THE TRACTION OR BRAKING FORCES AS DESCRIBED IN THE DESIGN CRITERIA. THIS CONNECTION SHALL BE MADE THROUGH THE INTERFACE COORDINATION WITH THE TRACK WORK DESIGNER. ANY EMBEDDED ITEMS OF THIS CONNECTION SHALL BE INSTALLED BY THE CONTRACTOR.



Directive Drawings



DESIGNED BY	DRAWN BY	APPROVED BY	CONTRACT NO.
P. LIOU	J. GO	K. PUASAP	DD-ST-001
DATE	DATE	DATE	SCALE
7/25/12	7/25/12	7/25/12	AS SHOWN
160	160	160	SHED NO.
DATE	DATE	DATE	
BY	BY	BY	
CAM	CAM	CAM	
APP	APP	APP	
DESCRIPTION			
03/01/2012			

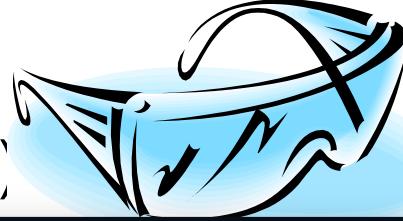
PARSONS
 BRINCKERHOFF

CALIFORNIA
 HIGH-SPEED TRAIN PROJECT
 STRUCTURAL DIRECTIVE

AERIAL STRUCTURE
 TWO TRACK NON-BALLASTED
 TYPICAL CONFIGURATION ON TOP OF DECK

THE POSSIBLE

SAFETY & SECURITY CERTIFICATION (CONT'D)



CHSTP Verification, Validation and Self-Certification - Certifiable Elements and Hazards List (CEHL) - Certification Sheet

Item CEHL 0276- Certification Sheet

Page 2 of 2

CEHL#	Certifiable Element or Hazard Description	Traced To	Initial & Date
0276	R-O-W Structures/Elevated Structures 1.2.1.10: Person falls from elevated structure – Mitigation 1: Install fall prevention barriers (handrailing or wall) where exposed edge allows potential fall of greater than 30". <i>Height changed to 30" per Cal/OSHA regulations 12/18/12.</i>	<p>CEHL Mitigation</p> <p>CHSTS Verification, Validation and Safety/Security Certification Certifiable Elements and Hazards Log (CEHL) - Certification Sheet</p> <p>R-O-W Structures/Elevated Structures 1.2.1.10: Person falls from elevated structure – Mitigation 1: Install fall prevention barriers (handrailing or wall) where exposed edge allows potential fall of greater than 30". <i>Height changed to 30" per Cal/OSHA regulations 12/18/12.</i></p> <p>Phase: PE – Preliminary Engineering</p> <p>critical item described has ce with the CHSTS return the form</p> <p>by certify that:</p> <p>that:</p>	<p>References to Design Criteria</p> <p>DCM [STR] 12.2 Regulations, Codes, Standards, and Guidelines DCM [STR] 12.7.1.6 Miscellaneous Loads DCM [STR] 12.8.6.17 Walkways, Parapets, and Sound Walls [2013 0531] DCM [SSS] 32.18.6.1 Walkways Rev.1 DRAFT [2013 0531] DD-ST-001 TYPICAL CROSS SECTION, AERIAL STRUCTURE, TWO TRACK NON-BALLASTED, TYPICAL CONFIGURATION ON TOP OF DECK DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NON-BALLASTED, TYPICAL CONFIGURATION ON TOP OF DECK DD-ST-003 TYPICAL CABLE TROUGH DETAILS, AERIAL STRUCTURE STRUCTURE, CONCRETE PARAPET STRUCTURE, TYPICAL SPAN, EXPANSION JOINT DETAILS CROSS SECTION, AERIAL STRUCTURE, FOUR TRACK CROSS SECTIONS FOR BOX GIRDERS</p>

End of Certification Sheet for CEHL Item 0276

- Systems Engineering Champion
- Communicate Clearly (WIIFY)
- Show Applicability
- Help Others Achieving Short-Term Results
- Introduce Accountability (What, Who, When)

1. you understand the documentation referenced by the Specifier,
2. the documentation referenced by you accurately and completely verifies that the requirements of the critical item have been addressed, and
3. entries marked "Not applicable" accurately reflect that the requirement for that discipline does not apply.

Verifier Signatures



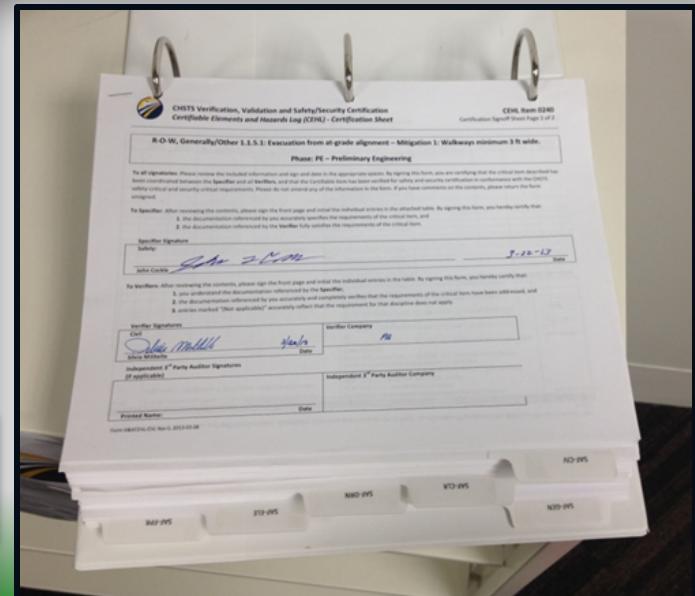
Verifier Company

Independent 3rd Party Auditor Signatures
(if applicable)

Printed Name:

Date

Certification Sign-Off



THE POSSIBLE IMPACT ASSESSMENT

'DCM Rev 0 AD3-6' current 0.1 (Rev 0 with changes from Addenda 3-6) in /CHSTP/50 Design Manual (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Critical Items All levels

Design Criteria Manual Table of Contents Traced From: Critical Requirements

4.4.5 Superelevation

4.4.5.1 Equilibrium (Balanced) Superelevation

4.4.5.2 Actual Superelevation

Actual Superelevation Ea

4.4.5.3 Unbalanced Superelevation

4.4.5.4 Ride Quality and Superelevation

Design Criteria Manual

Traces from Higher-Level Requirements

Design Criteria Manual Table of Contents, CP1 Version Rev 13 Jul 31 Traced From: All

- On aerial structures, protection shall be provided by a derailment protection wall designed so that the HST remains within its operating infrastructure. Refer to the *Structures* chapter.
- [10 SyRS-INF] ID: 1620 Train falls from elevated structure.

THE POSSIBLE VERSION MANAGEMENT

'BoD' current 0.1 (R2b) in /CHSTP/20 Internal Requirements/20 System Definition/10 Basis of Design (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

Save (Ctrl+S) Standard View (Working) All levels

BoD

- 1 Introduction
- 2 Program Implementation
- 3 Performance Requirements
- 4 Infrastructure
 - 4.1 Track Alignment
 - 4.2 Stations
 - It is the Authority's objective to m...
 - The specific station configuration...
 - Stations and station areas will be...
 - Where applicable, stations and n...
 - 4.2.1 Terminal Stations / Interme...
 - 4.2.2 Shared-use Tracks
 - 4.2.3 Passenger Facilities
 - 4.2.4 Station Security
 - 4.2.5 Track and Platform Configu...
 - Station platforms are planned for...
 - Intermediate station platform...
 - Terminal stations may have c... - 4.2.6 Station Area Amenities
 - 4.2.7 Postal/Mail Capabilities
- 4.3 Utilities
- 5 Systems
- 6 Rolling Stock
- 7 Train Storage and Maintenance Facilities
- 8 Operations

Absolute Based on TM 0 3 Basis of Design R3 120723 tracked changes.docx

262 4.2.5 Track and Platform Configuration

263 Station platforms are planned for a length of approximately 1400 feet to accommodate a range of existing high-speed trainsets.

367 Intermediate station platform configurations must ensure customer safety as trains may operate through or in proximity to the station area without stopping. Platform layout and station operations will mitigate potential hazards.

267 Terminal stations may have center or side platforms based on the specific station. Center platforms have two platform "edges" with a track on each side to allow boarding and alighting on either side from either of the two tracks. Because all trains will stop at terminal stations, there is no need to mitigate issues created by a fast-moving through train.

268 4.2.6 Station Area Amenities

269 Design, Development, and Handover

373 The

272 4.2.7 Postal/Mail Capabilities

Baseline Comparison Results - DOORS

Plain View Redlining View

#263 has differing Object Text

Station platforms are planned for a length of approximately ~~1380~~1400 feet to accommodate a range of existing high-speed trainsets.

#267 has differing Object Text

Terminal stations may have center or side platforms based on the specific station. Center platforms have two platform "edges" with a track on each side to allow boarding and alighting on either side from either of the two tracks. Because all trains will stop at terminal stations, there is no need to mitigate issues created by a fast-moving through train.

#273 has differing Object Text

Station area amenities ~~shall~~will be designed with a focus on convenience and ease of transfer to and from the CHST System and to other modes of transportation.

#274 has differing Object Text

Close

Username: oliverhoehne Exclusive edit mode

Basis of Design

THE POSSIBLE VERSION MANAGEMENT (CONT'D)

Absolute	Hazards & Mitigations	Date Identified	Traced To: TCs (LM)
1	1 Infrastructure	---	---
2	1.1 R-O-W Generally	---	---
14	1.1.4 Close Proximity	---	---
418	1.1.4.13 Adjacent oil/gas well has surface-level blowout. Result is fire earth displacement and intrusion into the ROW by debris from the explosion.	---	CEHL Mitigations
406	1.1.4.13.2 Mitigation #2 [2] INF: Establish minimum setbacks or buffer zones of two hundred (200) feet (measured from the centerline of the nearest CHSTS track) relocating all currently active oil or gas wells	11/15/2012	DCM [UTL] 9.5.5 Utility Clearances DCM [CLR] 3.3.3 Clearances to Third Party Facilities

Baseline Comparison Results - DOORS

Plain View Redlining View

#402 only exists in current
#403 only exists in current
#405 only exists in current
#406 only exists in current
#407 only exists in current

New
Mitigation

#412 only exists in current
#413 only exists in current
#414 only exists in current
#415 only exists in current
#417 only exists in current
#418 only exists in current
#420 only exists in current

Baseline Comparison Results - DOORS

Plain View Redlining View

#241 has differing Object Text
[2] INF:
Emergency access and egress at nominal 2.5 mile intervals [with a maximum interval of 3.0 miles](#).

Changed
Mitigation

#247 has differing Object Text
[3] INF:
Intrusion protection berms, walls, and other barriers to prevent the intrusion of persons, animals, rail or highway vehicles as identified through site-specific hazard analysis or threat/vulnerability assessment

Close

THE POSSIBLE DESIGN SUBMITTAL REVIEW CHECKLISTS

'DCM' current 3.0 (CP01-AD.9) in /CHSTP/50 Design Manual (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Critical Items (SR99) All levels

1 General

Design Criteria Manual Table of Contents, CP1 Version Rev 13 Jul 31

1 General

1.2 Basis of Design

1.2.1 Infrastructure

- [INF/GSP]: Fully Grade Separated Crossings
- [INF/CIV]: Fully Access Controlled Railway
- [INF/ALG]: Dual-Track Mainline Tracks
- [INF/ALG]: Separate Station Stopping Tracks

1.2.4 Rolling Stock

- [INF/CIV]: Double-Trainsets (Platform Length)
- [INF/STA]: 450-500 Passenger Capacity per Trainset (Platform Width)

1.2.5 Design and Operating Speeds

- [INF/ALG]: Design Speed: Mainline

1.2.7 Comfort

- [INF/ALG]: Lateral and Vertical Acceleration (Curve Radii)

1.3 Regulations, Codes, Standards, and Guidelines

1.3.1 Regulations and Codes

1.3.1.2 Federal and National Regulations and Codes

- [CHSTS]: Emergency Access & Egress: NFPA 130 Compliant

1.4 General Design Parameters

1.4.6 Design Life

- [CHSTS]: Reliability & Availability

Critical Items as described in DCM CH 1

Username: oliverhoehne Exclusive edit mode

THE POSSIBLE DESIGN SUBMITTAL REVIEW CHECKLISTS

Critical Item		Cheat-Sheet Data	DCM Reference
ID	DCM Checklist	Cheat-Sheet	Traced To: TC Section Heading (LM)
1	1 General		
2	1.1 Basis of Design		
11	1.1.1 Design and Operating Speeds		
12	[INF/ALG]: Design Speed: Mainline	Design Speed = 250 mph Operating Speed= 220 mph	DCM [GEN] 1.2.5 Design and Operating Speeds
54	2 Track Geometry		
55	2.1 Horizontal Alignment		
56	2.1.1 Minimum Radii		
57	[INF/ALG]: Minimum Radii	250 mph: R=45,000, M=28,000 220 mph: R=35,000, M=22,000	DCM [ALG] 4.4.3 Minimum Radii
58	2.1.2 Superelevation		
59	2.1.2.1 Actual Superelevation		
60	[INF/ALG]: Actual Superelevation Ea	Ea = 6" max	DCM [ALG] 4.4.5.2 Actual Superelevation
61	2.1.2.2 Unbalanced Superelevation		
62	[INF/ALG]: Unbalanced superelevation Eu	Eu = 3" max	DCM [ALG] 4.4.5.3 Unbalanced Superelevation
63	2.2 Vertical Align	[DCM] ID: 4300 1.2.5 Design and Operating Speeds	
73	2.2.1 Vertical Cur	A design speed of 250 mph where cost-effective and where topographic, geometric, operational, and environmental conditions permit. The design shall allow for sustained operating speed of 220 mph.	Vertical Curve Lengths
74	2.2.1.1 Minimum		
75	[INF/ALG]: Vertical C	[DCM] ID: 4301 1.2.5 Design and Operating Speeds In areas where shared-use track is anticipated, such as San Francisco–San Jose and Los Angeles–Anaheim, the maximum design speed is 125 mph.	DCM Language



THE POSSIBLE DESIGN SUBMITTAL REVIEW CHECKLISTS

ID	DCM Checklist	Cheat-Sheet	QA/QC
1	1 General		
2	1.1 Basis of Design		
11	1.1.1 Design and Operating Speeds		
12	[INF/ALG]: Design Speed: Mainline	Design Speed = 250 mph Operating Speed= 220 mph	
54	2 Track Geometry		
55	2.1 Horizontal Alignment		
56	2.1.1 Minimum Radii		
57	[INF/ALG]: Minimum Radii	250 mph: R=45,000, M=28,000 220 mph: R=35,000, M=22,000	
58	2.1.2 Superelevation		
59	2.1.2.1 Actual Superelevation		
60	[INF/ALG]: Actual Superelevation Ea	Ea = 6" max	
61	2.1.2.2 Unbalanced Superelevation		
62	[INF/ALG]: Unbalanced Superelevation Eu	Eu = 3" max	
63	2.2 Vertical Alignment		
73	2.2.1 Vertical Curves		
74	2.2.1.1 Minimum Vertical Curve Lengths (LVC)		
75	[INF/ALG]: Vertical Curve Lengths	L VC = 3.5 V or L VC = 2.15 V 2 ('%/100) / 0.90 ft/sec 2 but not less than 200 '%	

Requirements as Input
into QA/QC Checklists



THE POSSIBLE DESIGN SUBMITTAL REVIEW CHECKLISTS

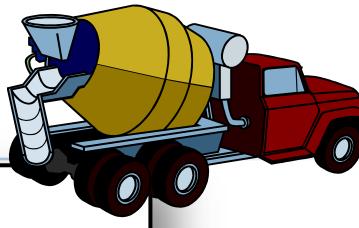
ID	DCM Checklist	Cheat-Sheet	QA/QC	RVTM
1	1 General			
2	1.1 Basis of Design			
11	1.1.1 Design and Operating Speeds			
12	[INF/ALG]: Design Speed: Mainline	Design Speed = 250 mph Operating Speed= 220 mph		CP01OP1 T0150-A HYBRID ALIGNMENT - TRA ... CP01A TT-D0001 PACKAGE 1A - TRACK GUIDE ... CP01C TT-D0002 PACKAGE 1C - TRACK GUIDE ...
54	2 Track Geometry			
55	2.1 Horizontal Alignment			
56	2.1.1 Minimum Radii			
57	[INF/ALG]: Minimum Radii	250 mph: R=45,000, M=28,000 220 mph: R=35,000, M=22,000		
58	2.1.2 Superelevation			
59	2.1.2.1 Actual Superelevation			
60	[INF/ALG]: Actual Superelevation Ea	Ea = 6" max		
61	2.1.2.2 Unbalanced Superelevation			
62	[INF/ALG]: Unbalanced Superelevation Eu	Eu = 3" max		
63	2.2 Vertical Alignment			
73	2.2.1 Vertical Curves			
74	2.2.1.1 Minimum Vertical Curve Lengths (LVC)			
75	[INF/ALG]: Vertical Curve Lengths	$L_{VC} = 3.5 V$ or $L_{VC} = 2.15 V_2 \left(\frac{\%}{100} \right) / 0.90$ ft/sec^2 $but not less than 200 \ ' \%$		

- Systems Engineering Champion
- Communicate Clearly (WIIFY)
- Show Applicability
- Help Others Achieving Short-Term Results
- Early Adaptors

Building an RVTM



THE IMPOSSIBLE CONCEPT OF OPERATIONS



System Operation

Alerts detected by the IDS will be sent to Operations Control Center (OCC) via the WDS system. Receipt of a designated control ce

Why

system to automatically impose a s area. Based on the type, severity, the alarm will trigger one of followin

- Level 1 –Potentially critical subsystem and requiring st affected trains by the train
- Level 2 –Intrusion event de commands b
- Level 3 – Intrusion alarm tr definitive action is taken. R dispatcher.

Specific details regarding what eve and vulnerability analysis conducte

Operational Scenario

Scenario 4-4.1a: CHST Train on CHST Track – IDS Detects Level 1 Intrusion Event

The IDS detects intrusion indications from two or more different intrusion detection subsystems at a roadway overpass. A Level 1 alarm is sent to the train dispatcher and other designated OCC workstations via the WDS system. In this case, the initiation of the alarm will cause the train control system to automatically initiate a brake application on trains approaching the overpass that will bring them to a stop.

User	Location	Role and Responsibilities
Immediate Reactions to Event Occurrence		
Engineer	Train Cab	<ul style="list-style-type: none">• Engineer receives a Level 1 intrusion event indication on OCD.• Train brakes apply automatically until train stops.
Train Dispatcher	OCC	<ul style="list-style-type: none">• TD receives visual and audible alert on workstation indicating a Level 1 intrusion event.
DOC	OCC	<ul style="list-style-type: none">• DOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.
SOC	OCC	<ul style="list-style-type: none">• SOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.
IOC	OCC	<ul style="list-style-type: none">• IOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.
Users Assess Conditions and Initiate Response		
Engineer	Train Cab	<ul style="list-style-type: none">• Monitor train's automatic brake response.• After stopping, contact OCC by radio to confirm event and request instructions.• Contact and inform conductor by intercom• After receiving permission from TD, proceed at Reduced Speed to point of incursion and report conditions to OCC. (In this instance,
Who	Where	What



THE IMPOSSIBLE CONCEPT OF OPERATIONS

6.3.7.1.1 System Operation

Alerts detected by the IDS will be sent to Operations Control Center (OCC) via the WDS system. Receipt of an alert will trigger an audible and visual alarm on train dispatcher and other designated control center workstations. The initiation of this alarm may cause the train control system to automatically impose a stop command or speed restriction ~~on trains approaching that area. Based on the two, severity, location or other~~

factors related to the alert, the

- Level 1 –Potentially critical in commands be immediately and
- Level 2 –Intrusion event detected issued to affected trains by the
- Level 3 – Intrusion alarm that

Radio contact with trains may Specific details regarding what analysis conducted at a later date

DOORS Import

6.3.7.1.2.1 Scenario 4-4.1a: CHST Train on CHST Track – IDS Detects Level 1 Intrusion Event

The IDS detects intrusion indications from two or more different intrusion detection subsystems at a roadway overpass. A Level 1 alarm is sent to the train dispatcher and other designated OCC workstations via the WDS system. In this case, the initiation of the alarm will cause the train control system to automatically initiate a brake application on trains approaching the overpass that will bring them to a stop.

User	Location	Role and Responsibilities
Immediate Reactions to Event Occurrence		
Engineer	Train Cab	<ul style="list-style-type: none"> • Engineer receives a Level 1 intrusion event indication on OCD. • Train brakes apply automatically until train stops.
Train Dispatcher	OCC	<ul style="list-style-type: none"> • TD receives visual and audible alert on workstation indicating a Level 1 intrusion event.
DOC	OCC	<ul style="list-style-type: none"> • DOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.
SOC	OCC	<ul style="list-style-type: none"> • SOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.
IOC	OCC	<ul style="list-style-type: none"> • IOC receives visual and audible alert on workstation indicating a Level 1 intrusion event.

User	Location	Role and Responsibilities
Users Assess Conditions and Initiate Response		
Engineer	Train Cab	<ul style="list-style-type: none"> • Monitor train's automatic brake response. • After stopping, contact OCC by radio to confirm event and request instructions. • Contact and inform conductor by intercom or radio of condition. • After receiving permission from TD, proceed at Reduced Speed to point of incursion and report conditions to OCC. (In this instance, upon arrival at scene engineer reports that a car has crashed into the overpass barrier and a piece of concrete is resting on the track.) • Receives instructions from the TD to return to the previous station and off-load passengers for alternative bus service.



THE IMPOSSIBLE DERIVED SYSTEM REQUIREMENTS

Scenario Overview

It is early evening on a rainy, gray day and an CHSRA Train is approaching Fresno headed south-bound at a speed of 190mph. The train is decreasing in speed as it approaches an HST bridge viaduct just south of the 7th Street and SR-99 intersection. As the train approaches the viaduct, seismic activity, in conjunction with unstable ground from record rainfall, compromises track. The train is upright, but tilted and derailed. There is minimal visual, structural damage and no danger of the train coming off the elevated structure. The nearest access gate is about 1000' north of the incident and is secured per CAHSR protocol.

The incident is reported by the train engineer to the Operations Control Center (OCC) of the CHSRA [Event 1]. The OCC then reported the event to the first responders via 911 with an official report of the incident [Event 2]. First responders mobilized and deployed to the opening of access gate, and no access gate [Event 3]. Pass first responders enter the RO

Operating Scenario

Derived (Re-Phrased) Operation Need

Derived Functional Requirements

Operational Scenario

Agency/Facility	Location	Scenario
Event 1: Report of Derailment CHSRA Train crew reports incident to CHSRA OCC		
Agency/Facility Location Scenario		
Train Engineer	Incident train	<p>1) Train Engineer contacts OCC with notice of incident, including train/crew identification, status of train, location and condition of vehicle, visible or known damage, status of passengers and other crew.</p>

Operational Need	Functional Requirement	How well
E1.1.a. Train Engineer (TE) communicates with the Train Dispatcher (TD) in the OCC using voice communication.	E1.1.a. On-board communication systems in the cab shall enable the TE to have real-time voice communications with the TD in the OCC.	E1.1.a. real-time = within 500 ms On-board = in viewing frame of TE
E1.1.b. TE knows train and crew identification. (How does TE know this?)	E1.1.b. Crew Management System shall display crew names and identification numbers from in cab.	
E1.1.c. TE knows health status of train.	E1.1.c. Health Status System (?) shall display system conditions in the cab.	
E1.1.d. TE knows location of the train vehicle in a	E1.1.d. ATS System shall display location of train in the cab.	
	E1.1.e. CCTV System(/ rear view mirrors?) shall provide a real-time visibility of the outside of the train.	

'00 SyRS-CHSTS Temp Module WORKING' current 0.0 in /SandBox/Srini (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Standard View (Structure) All levels

Absolute Object Level

2	1	2 CHSTS Functional Requirements
90	2	2.4 Locomotive Systems
225	3	2.4.1 Cab
226	4	2.4.1.1 Train Engineer (TE)
236	5	2.4.1.5 Onboard Radio
237	6	2.4.1.5.1 Communicate with Train Dispatcher in OCC

Username: oliverhoechne Read-only mode - write locked

CHST Document Structure

THE IMPOSSIBLE DERIVED SYSTEM REQUIREMENTS (CONT'D)

FLS Table Top OpScen 20140409 with functions - PDF-XChange Viewer

File Edit View Document Comments Tools Window Help

Download PDF Creation Tools

Open... Save... Print... OCR... DRAFT...

Zoom In 100% Zoom Out

Typewriter Text Drawing Tools

FLS Table Top OpScen 20140409 with functions

Operational Need	Functional Requirement	How well
E1.1.a. Train Engineer (TE) communicates with the Train Dispatcher (TD) in the OCC using voice communication.	E1.1.a. On-board communication systems in the cab shall enable the TE to have real-time voice communications with the TD in the OCC.	E1.1.a. real-time = within 500 ms
E1.1.b. TE knows train and crew identification. (How does TE know this?)	E1.1.b. Crew Management System shall display crew names and identification numbers from in cab.	On-board = in viewing frame of TE
E1.1.c TE knows health status of train.	E1.1.c. Health Status System (?) shall display system conditions in the cab.	
E1.1.d. TE knows location of the train vehicle in a way that can be understood by the OCC and first responders.	E1.1.d. ATS System shall display location of train in the cab.	
E1.1.e TE can do a visual inspection of the internal and external vehicles from the cab.	E1.1.e. CCTV System/(rear view mirrors?) shall provide a real-time visibility of the outside of the train.	
stem		
Operational Need	Functional Requirement	How well
E1.2. TE communicates verbally from the cab with the Conductor in the vehicle.	E1.2. Hand held radio system shall provide a real-time audio connection between the TE in the cab and the Conductor in the vehicle.	
E1.3. TE communicates verbally from the cab with the passengers in the vehicle.	E1.3. The PA system shall allow the TE in the cab to make announcements to the passengers in the vehicle.	
E1.4. TD communicates verbally from the OCC with the TE in the cab.	E1.4. Communication systems in the OCC shall enable the TD to have real-time voice communications with the TE in the	

17.00 x 11.00 in

Options

'00 SyRS-CHSTS Temp Module WORKING' current 0.0 in /SandBox/Sriniv (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Change Management Help

View OH Standard View (Structure) All levels

Absolute Object Level

2 1 2 CHSTS Functional Requirements

2.1 Control Center (Office) Systems

2.1.1 Operations Control Center (OCC)

2.1.1.1 Train Dispatcher (TD)

2.1.1.1.1 ATC System

2.1.1.1.1.1 Stop the Train

2.1.1.1.1.2 Display Enroute Trains Location

2.1.1.1.1.3 Stop the Trains Enroute

2.1.1.1.1.4 Re-route the Train

2.1.1.1.2 ATS System

2.1.1.1.2.1 Display Train Location

2.1.1.1.2.2 Display Route Status

2.1.1.1.3 Crew Management System

2.1.1.1.3.1 Identification of Crew in a Train Cab

2.1.1.1.4 Office Communications System

2.1.1.1.4.1 Communicate with Train Engineer in Train Cab

2.1.1.1.5 Telephone and Intercom System

2.1.1.1.5.1 Call another OCC Controller

2.1.1.1.5.2 Call 911 Call Center

2.1.1.2 Power Operations Controller (POC)

2.1.1.2.1 TES System (TP/OCS)

2.1.1.2.1.1 De-Energize OCS Segment

2.1.1.2.2 TES SCADA System

2.1.1.2.2.1 Act on Emergency Alarm from TES SCADA System

2.1.1.2.2.2 Transmission Link down from TES SCADA System

2.1.1.2.2.3 Display Power Status for OCS Segment Limits/Track

2.1.1.3 Automated System Functions

2.1.1.3.1 Critical Incident Alerting System

2.1.1.3.1.1 Display Emergency Alarms on Workstations of SOC, DOC, DDOC, POC, ROC and PIC

2.1.1.4 Security Operations Controller (SOC)

2.1.1.4.1 Radio Systems

2.1.1.4.1.1 Communicate Incident Segment Limits to Police/Patrol HQ's.

2.1.1.5 Infrastructure Operations Controller (IOC)

2.1.1.5.1 Access Management System (AMS)

2.1.1.5.1.1 Remote Open Access Gates

2.1.1.5.1.2 Report Gate Status to Control Stations in OCC

2.1.1.5.2 MOI Asset Management System

2.1.1.5.2.1 Unlock ROW Access Gate

2.1.2 Regional Control Center (RCC)

2.2 Communication Transmission Systems

2.2.1 Wayside/Trackside Location

2.2.2 Traction Power Facility

2.2.2.1 Automated System Functions

2.2.2.1.1 Operations Radio System

2.2.2.1.1.1 Do something

2.3 Wayside Systems

2.3.1 Wayside/Trackside Location

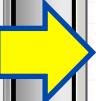
2.3.1.1 Automated System Functions

2.3.1.1.1 Intrusion Detection System

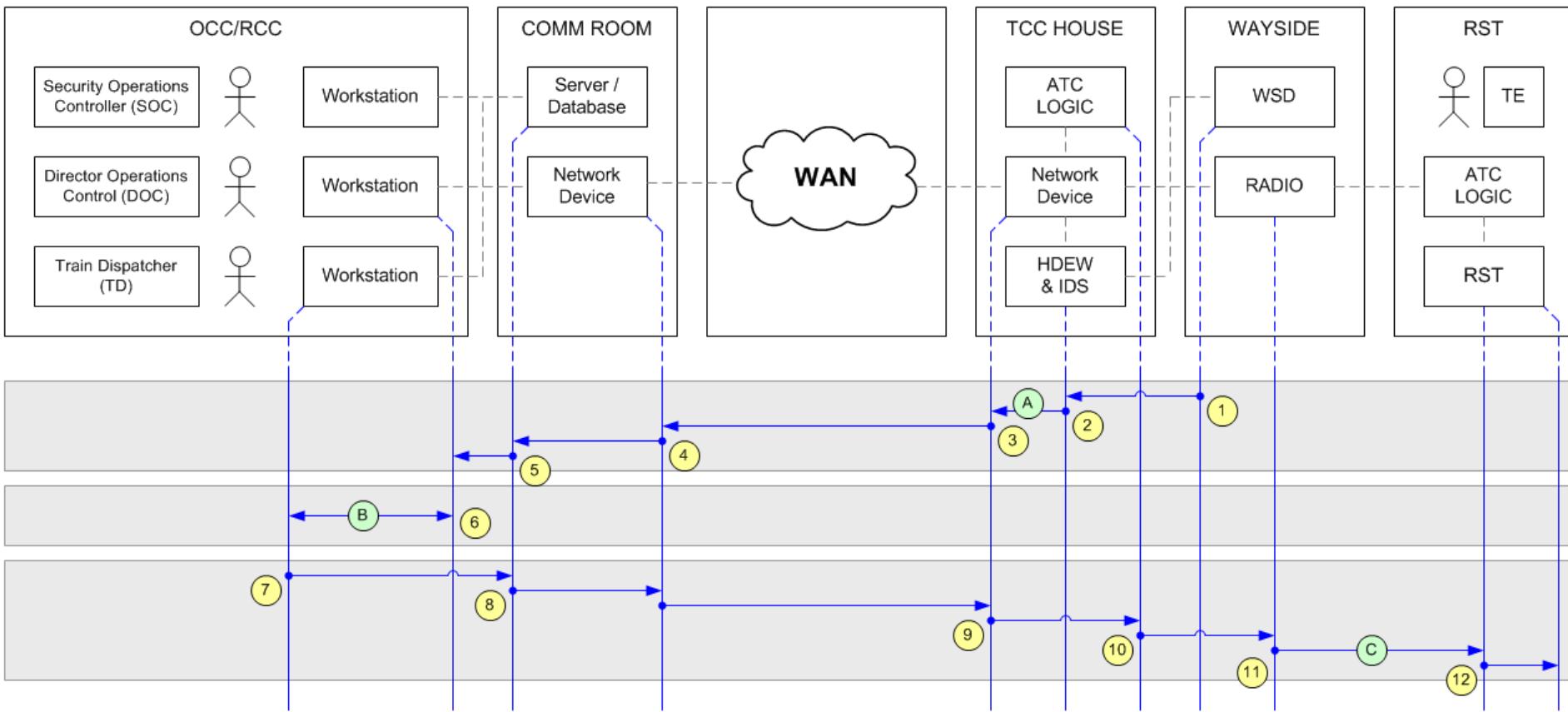
2.3.1.1.1.1 Detect Intrusion

2.3.2 Traction Power Facility

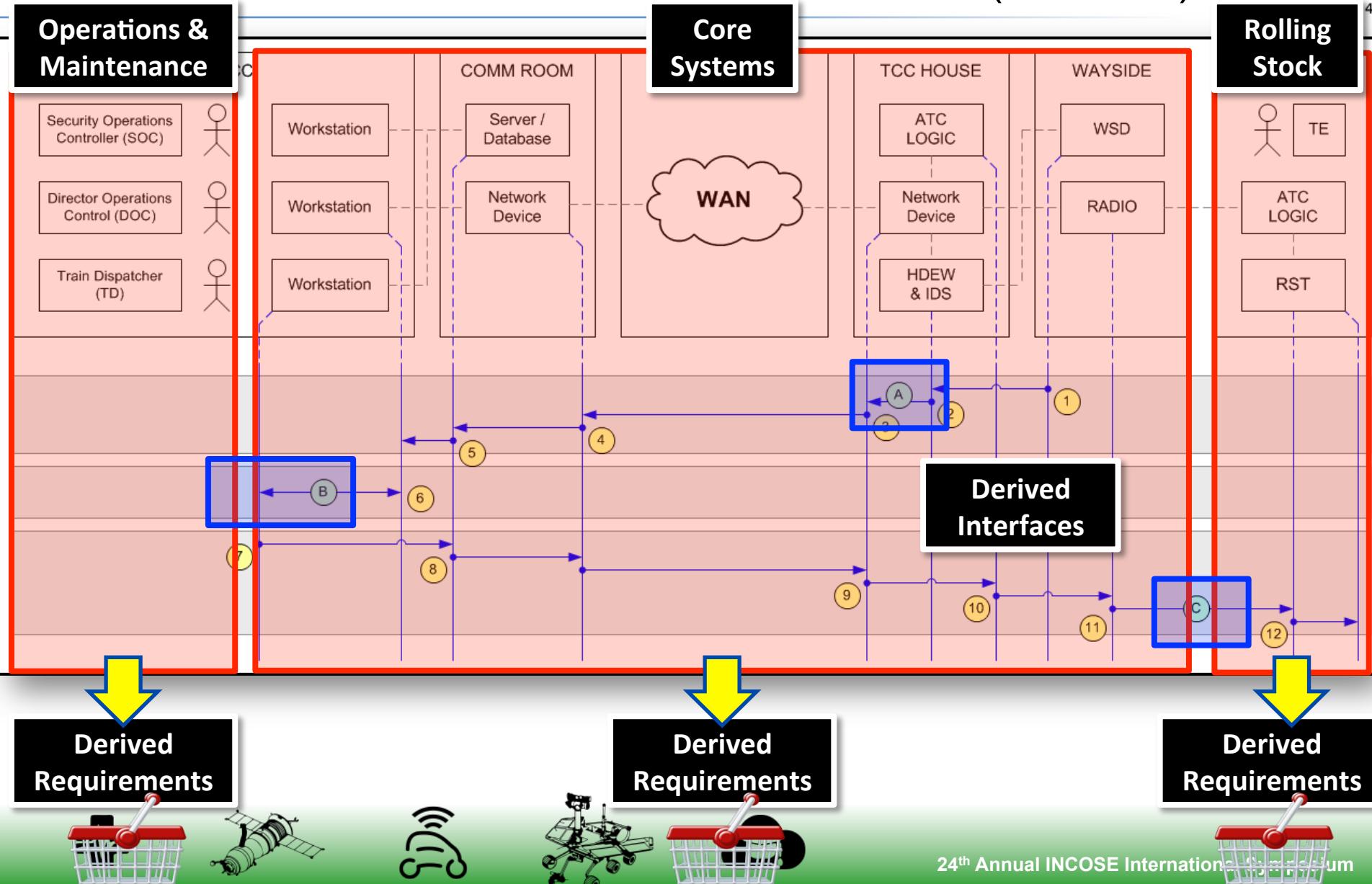
2.3.3 Universal Interlocking



THE IMPOSSIBLE SYSTEM ARCHITECTURE & CONCEPT OF EXECUTION



THE IMPOSSIBLE SYSTEM ARCHITECTURE & CONCEPT OF E. (CONT'D)



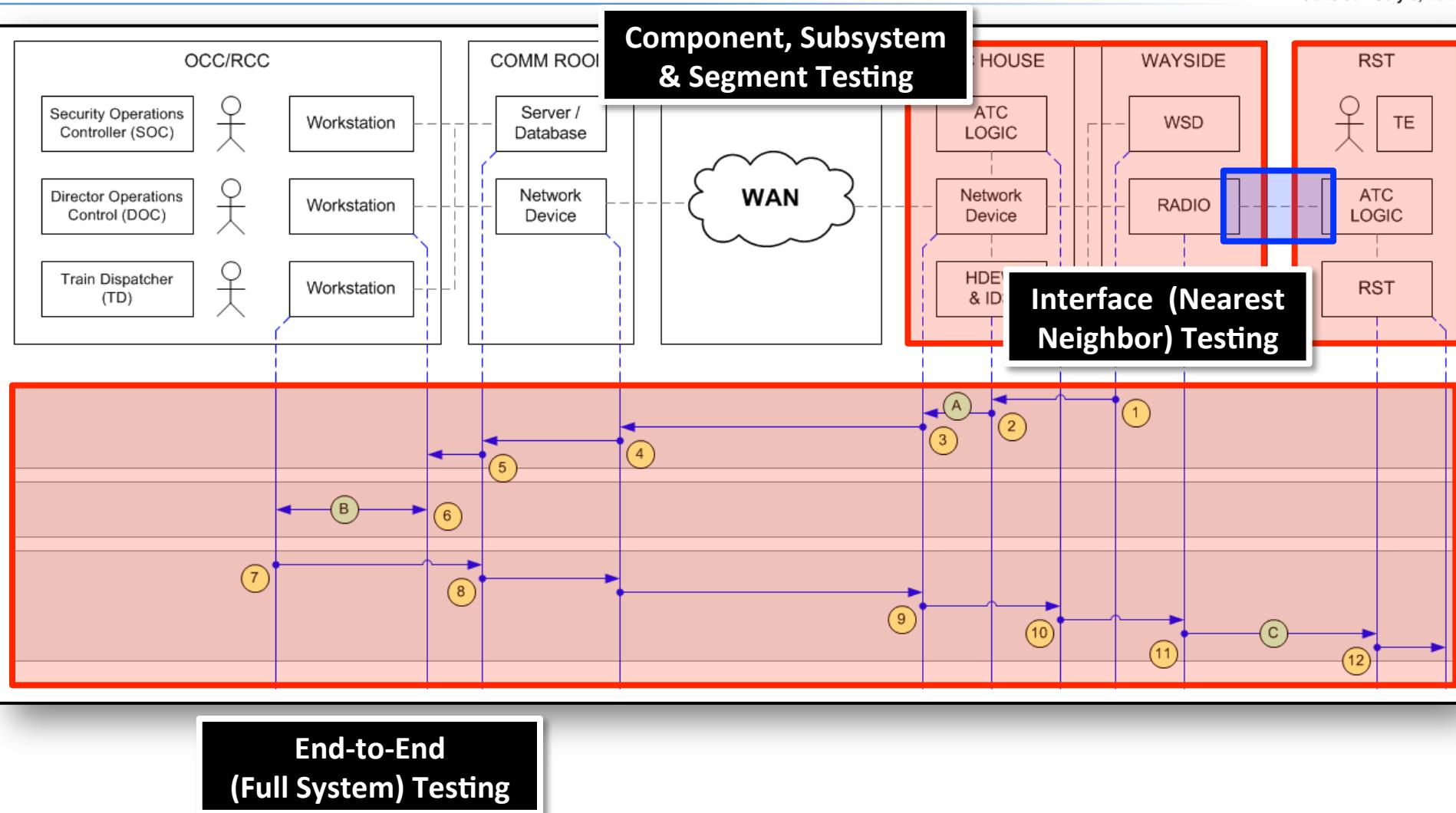
Derived
Requirements



Derived
Requirements



THE IMPOSSIBLE SYSTEM TESTING



THE IMPOSSIBLE SYSTEM ARCHITECTURE & CONCEPT OF E. (CONT'D)

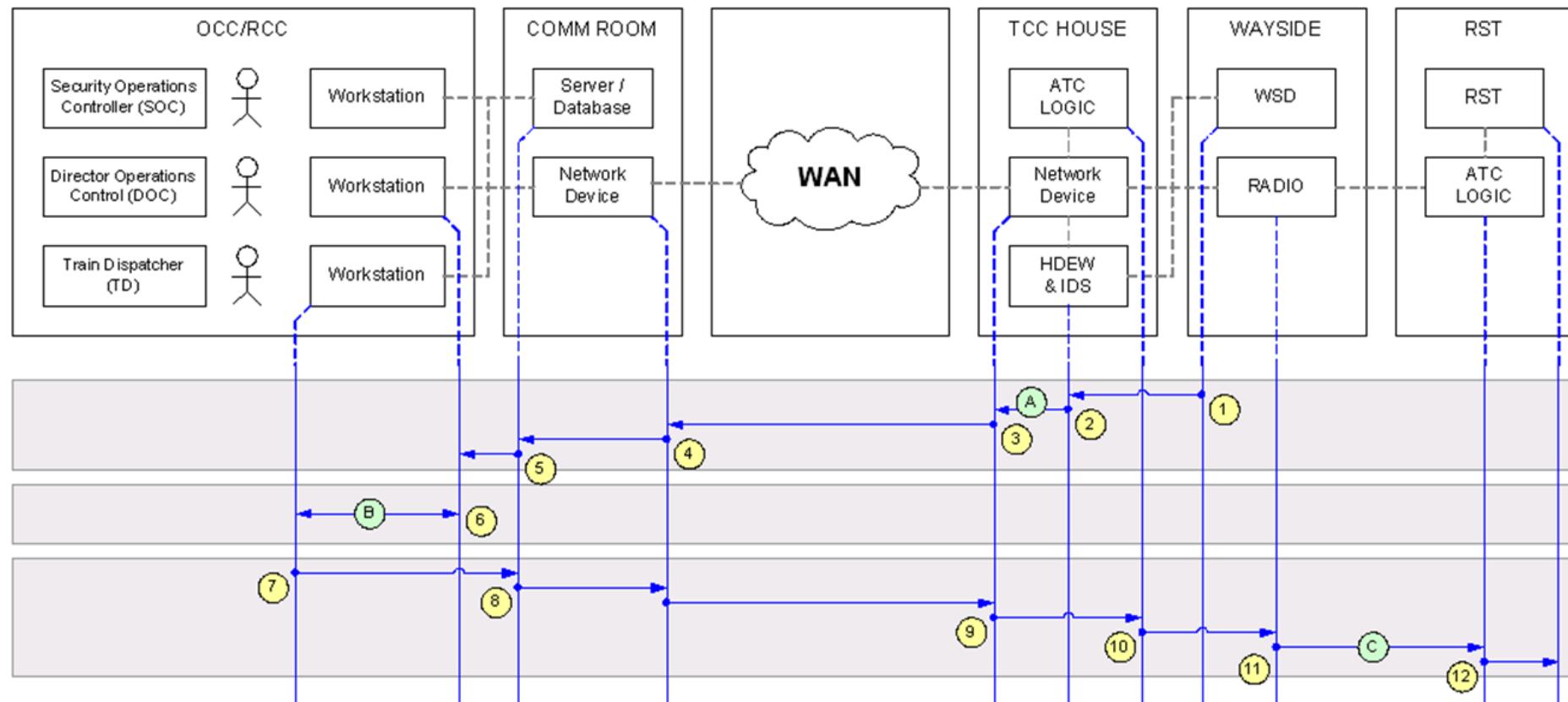
1 CHSTS Operational Requirements

1.1 General System Operation

1.1.1 Normal Operation

1.1.2 Intrusion Detection System

1.1.2.1 Concept of Execution



(1) The Wayside Detection (WDS) system detects an intrusion and forwards the detection to the Hazard Detection Early Warning (HDEW) system.

(2) HDEW system processes intrusion alarm and forwards it to OCC via TCC house Network Device.

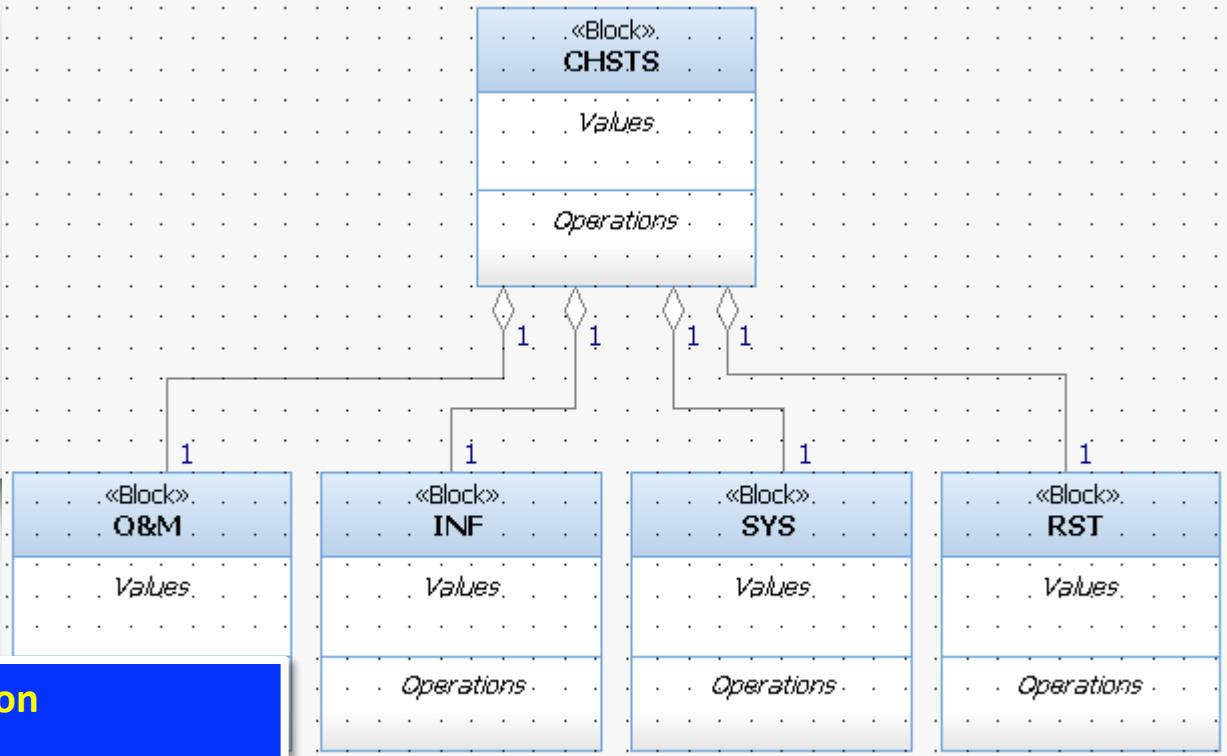
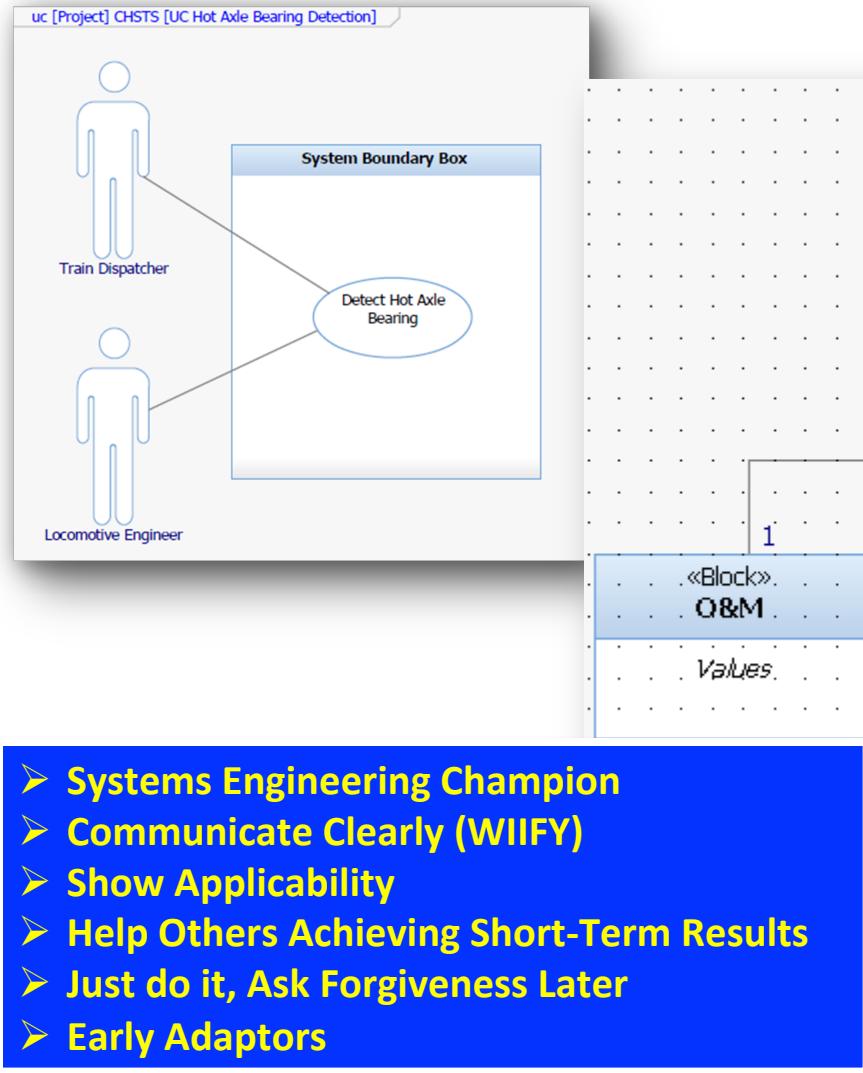
(3) TCC House Network Device processes intrusion alarm and forwards it to OCC via Wide Area Network.

(4) OCC Network Device processes intrusion alarm and forwards it to OCC Server / Database.

(5) OCC Server processes intrusion alarm and initiates audible and visual alarm on OCC Workstation(s).

THE IMPOSSIBLE

MODEL BASED SYSTEMS ENGINEERING (PLANNED)

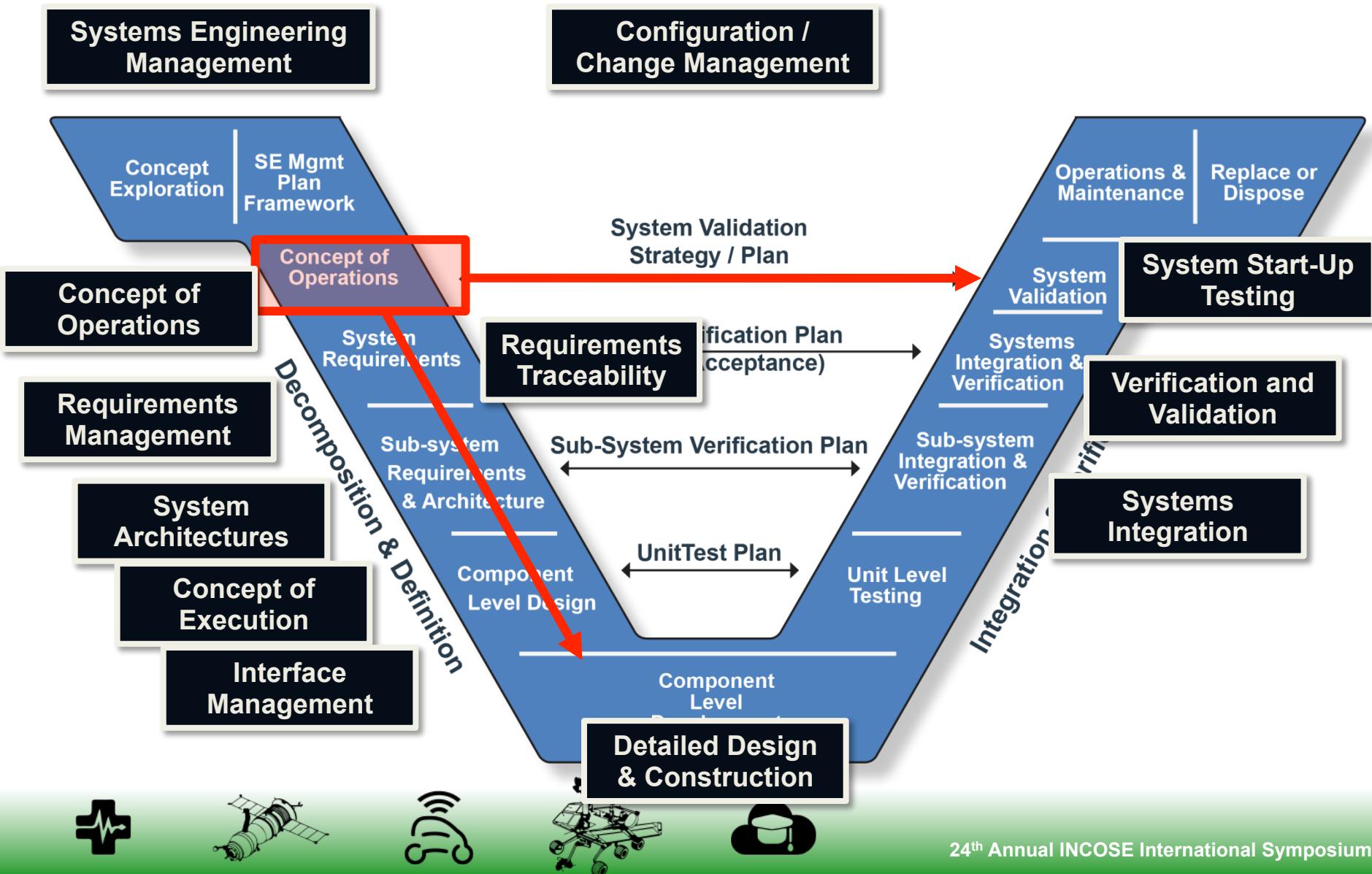


- Systems Engineering Champion
- Communicate Clearly (WIIFY)
- Show Applicability
- Help Others Achieving Short-Term Results
- Just do it, Ask Forgiveness Later
- Early Adaptors



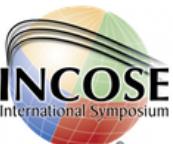
SUMMARY

JUST DO IT!



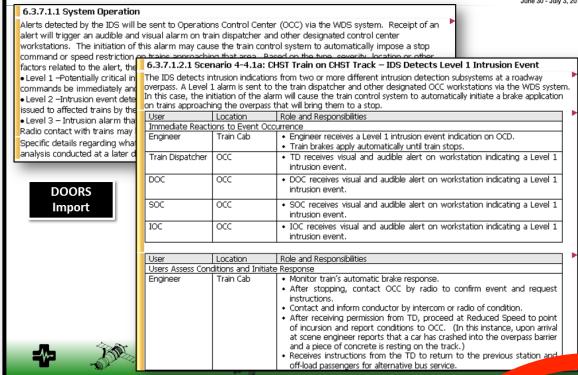
SUMMARY

DO NOT GIVE UP!



Las Vegas, NV
June 30 - July 3, 2014

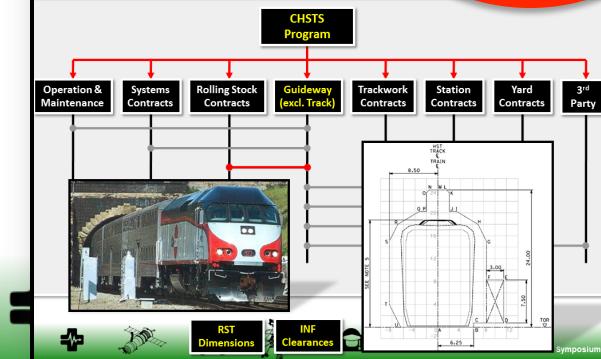
THE IMPOSSIBLE CONCEPT OF OPERATIONS



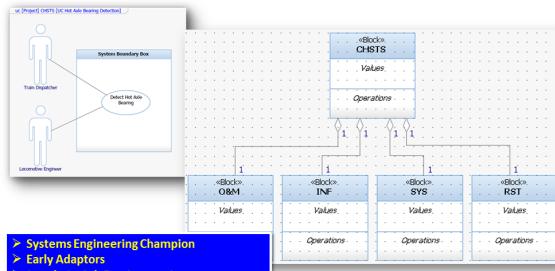
We are Here = Sweet Spot



THE POSSIBLE INTERFACE VERIFICATION



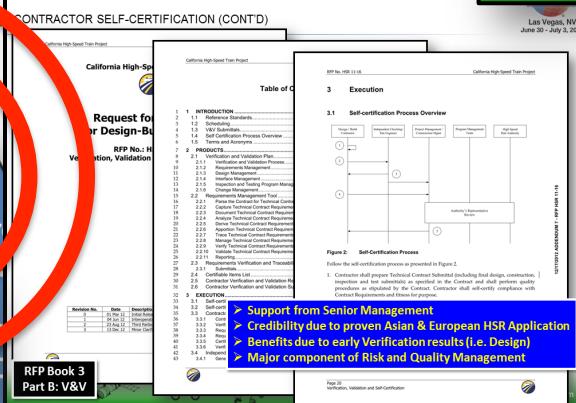
System Validation Strategy / Plan



- Systems Engineering Champion
- Early Adaptors
- Just do it, Ask Forgiveness Later
- Communicate Clearly (WIIFY)
- Show Applicability
- Help Others Achieving Short-Term Results

24th Annual INCOSE International Symposium

THE NECESSARY



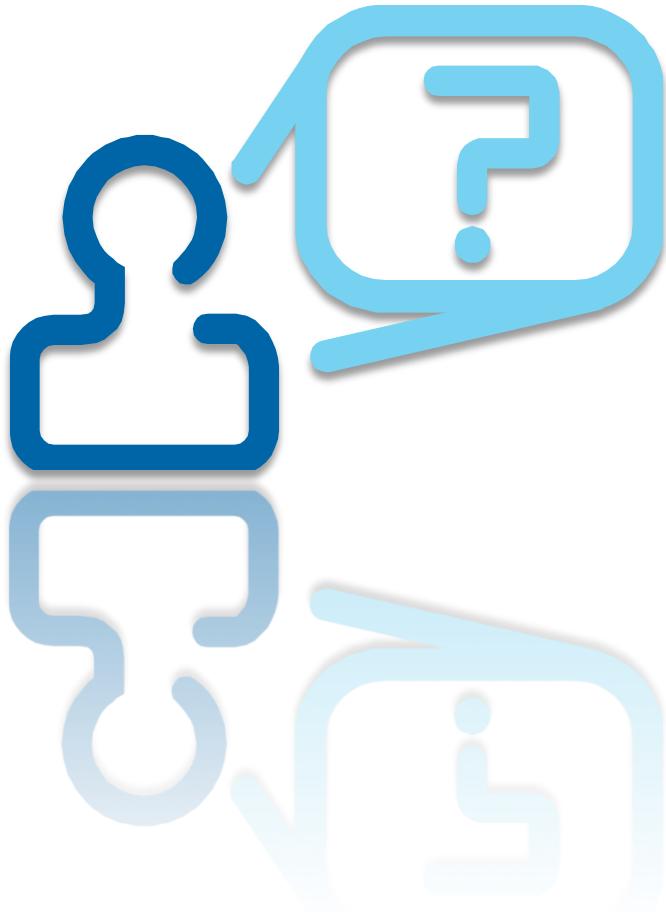
Component Level Development



24th Annual INCOSE International Symposium

QUESTIONS & ANSWERS

REMEMBER THE WIIFY



Oliver M. Hoehne, PMP
Senior Engineering Manager
Parsons Brinckerhoff, Transit & Rail Systems,
Newark, NJ, USA

**PARSONS
BRINCKERHOFF**

