CALIFORNIA HIGH-SPEED TRAIN SYSTEM (CHSTS)

[INCOSE IW14, Los Angeles, Jan 28, 2014]

Applying Verification & Validation for CHSTS Safety Certification

Presented by Jon Tapping

VERIFICATION & VALIDATION (V&V)
AGENDA

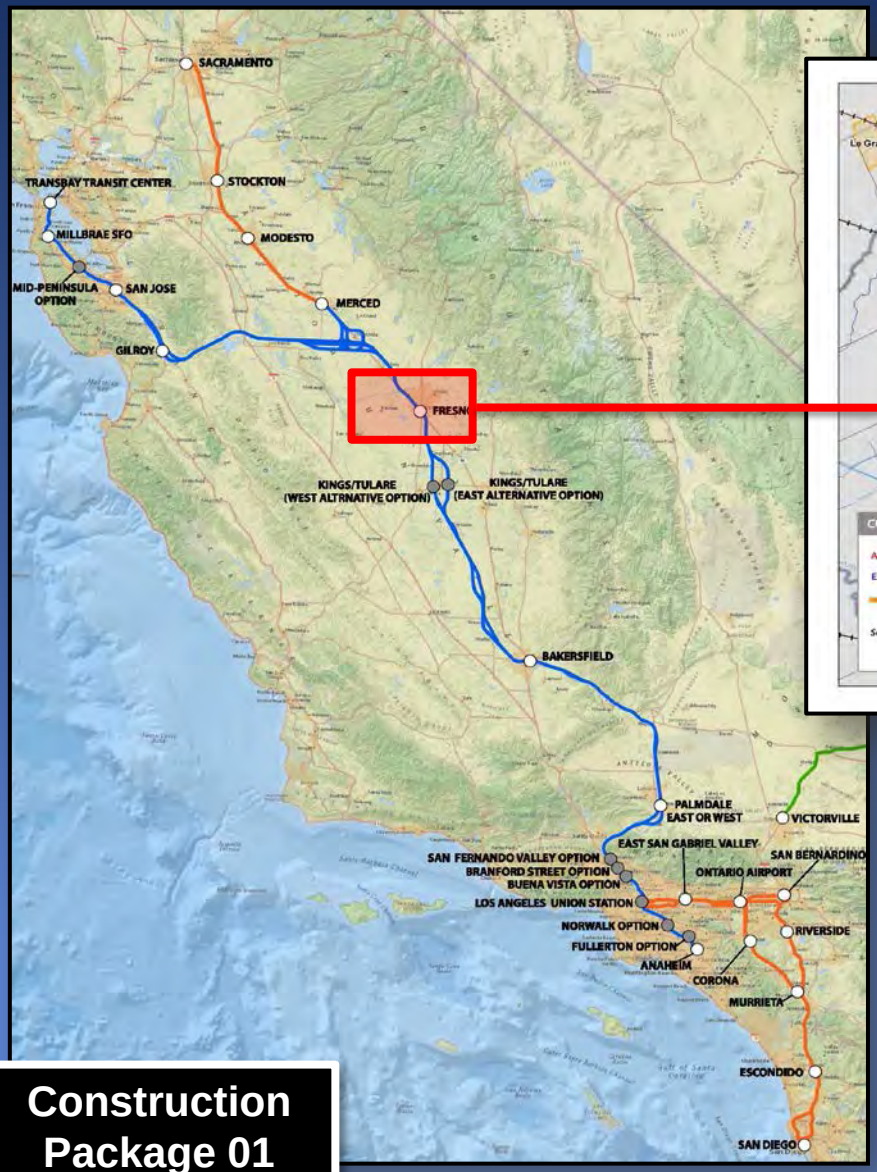
- CHSTS Program Overview
- Master Quality Plan – Overview
- CHSTS V&V Program – Overview
- Traditional Safety Certification
- CHSTS Safety Certification using V&V
- Walk-Through of Sample Safety Certification
- Practical Value of V&V
- V&V during Construction and Testing
- Summary

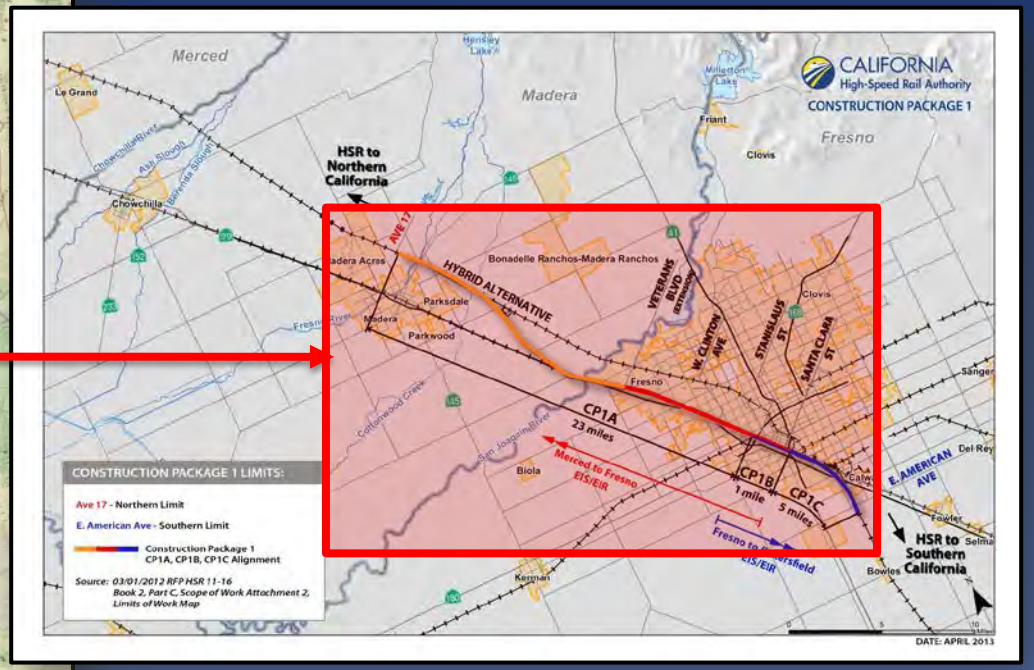
VERIFICATION & VALIDATION (V&V)
PROJECT BACKGROUND

- 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

VERIFICATION & VALIDATION (V&V)

PROJECT BACKGROUND (CONT'D)





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

Construction Package 01

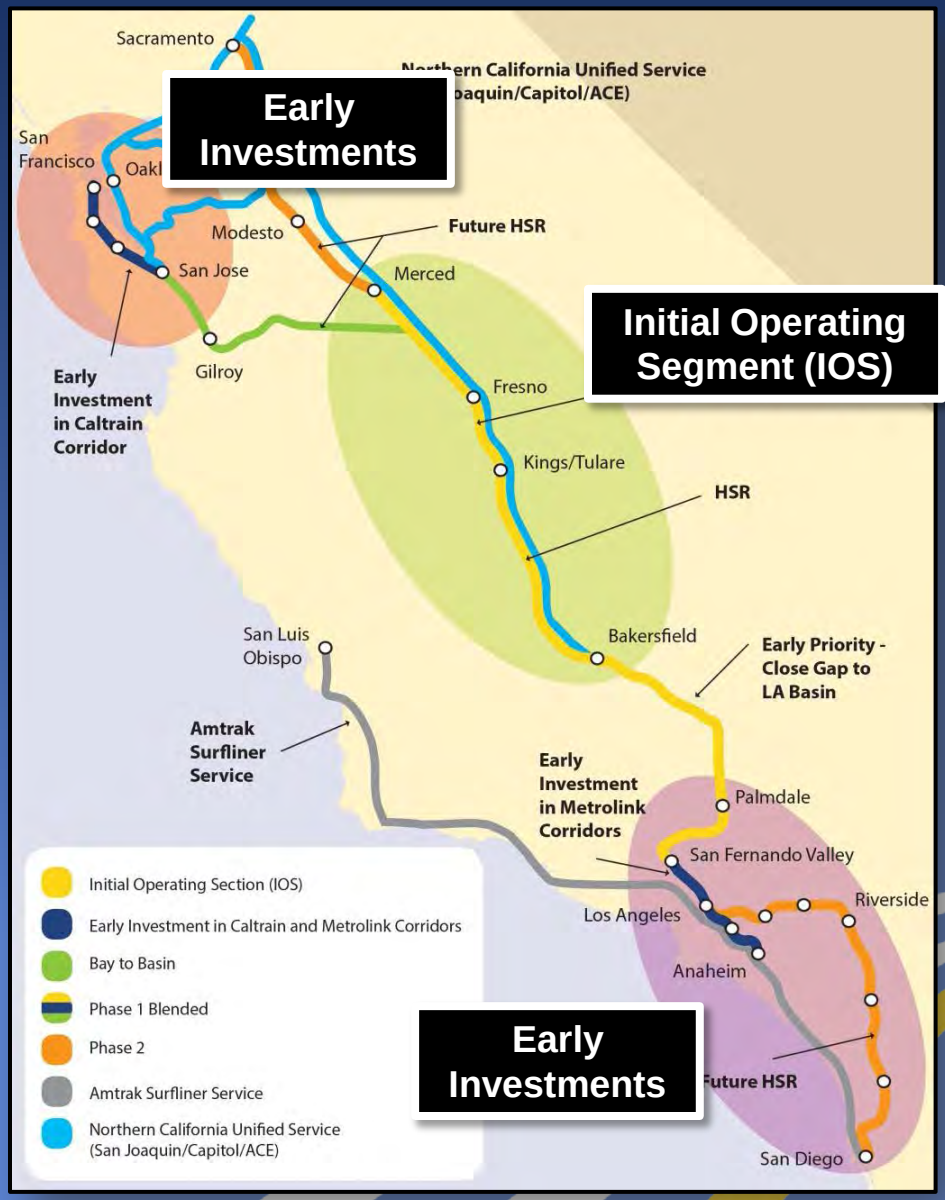
VERIFICATION & VALIDATION (V&V)
PROJECT BACKGROUND (CONT'D)

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



VERIFICATION & VALIDATION (V&V)

V&V PART OF CHSTS MASTER QUALITY PLAN

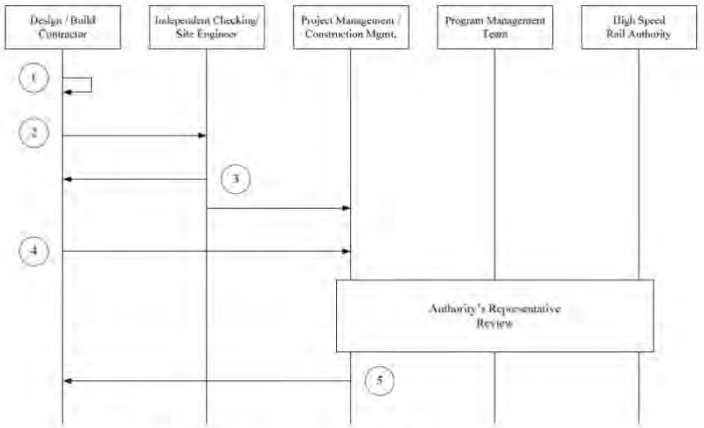


Figure 2.4.2 – Verification, Validation, & Self Certification Process

1. Contractor prepares Technical Contract Submittal and performs quality procedures as specified in the Contract. Contractor must self-certify its compliance with Contract Requirements and fitness for purpose.
2. Contractor submits Technical Contract Submittal together with Contractor V&V submittal to Independent Checking Engineer (ICE) and Independent Site Engineer (ISE).
3. ICE and ISE assess and evaluate the Technical Contract Submittal in order to be able to certify that the final design/construction meets the Contract Requirements as detailed in the Contract and as reasonably inferred therefrom. ICE/ISE submits an assessment report and certification to the Authority's Representative with a copy to the Contractor.
4. C submits Technical Contract Submittal, including self-certification, V&V submittal, ICE/ISE assessment report, and certification to the Representative.
5. rity's Representative performs audit and re-review as required and ement of No Objection (SONO) or Approval, if given, based upon audit nal review results and ICE/ISE assessment report and certificate.

VERIFICATION & VALIDATION (V&V)
WHY VERIFICATION & VALIDATION

2.1 GOVERNING LEGISLATION AND ENVIRONMENTAL DOCUMENTATION

Governing legislation and other legal documentation dictate performance characteristics of the CHSTP. Proposition 1A was passed by the voters of the state of California on November 4, 2008. The following language outlines the requirements from the proposition which have since been added as Chapter 20 to Division 3 of the State Streets and Highways Code:

2704.09. The high-speed train system to be constructed pursuant to this chapter shall have the following characteristics:

(a) Electric trains that are capable of sustained maximum revenue operating speeds of no less than 200 miles per hour.

(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.

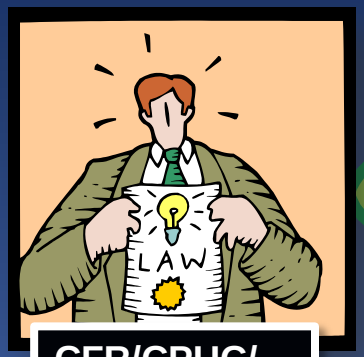
(7) Sacramento-Los Angeles: two hours, 20 minutes.

(c) Achievable operating headway (time between successive trains) shall be five minutes or less.

Basis of Design Rev. 3

VERIFICATION & VALIDATION (V&V)

WHY VERIFICATION & VALIDATION (CONT'D)



CFR/CPUC/…

EIR/S

OPS

MTC

SAF

SEC

SYS

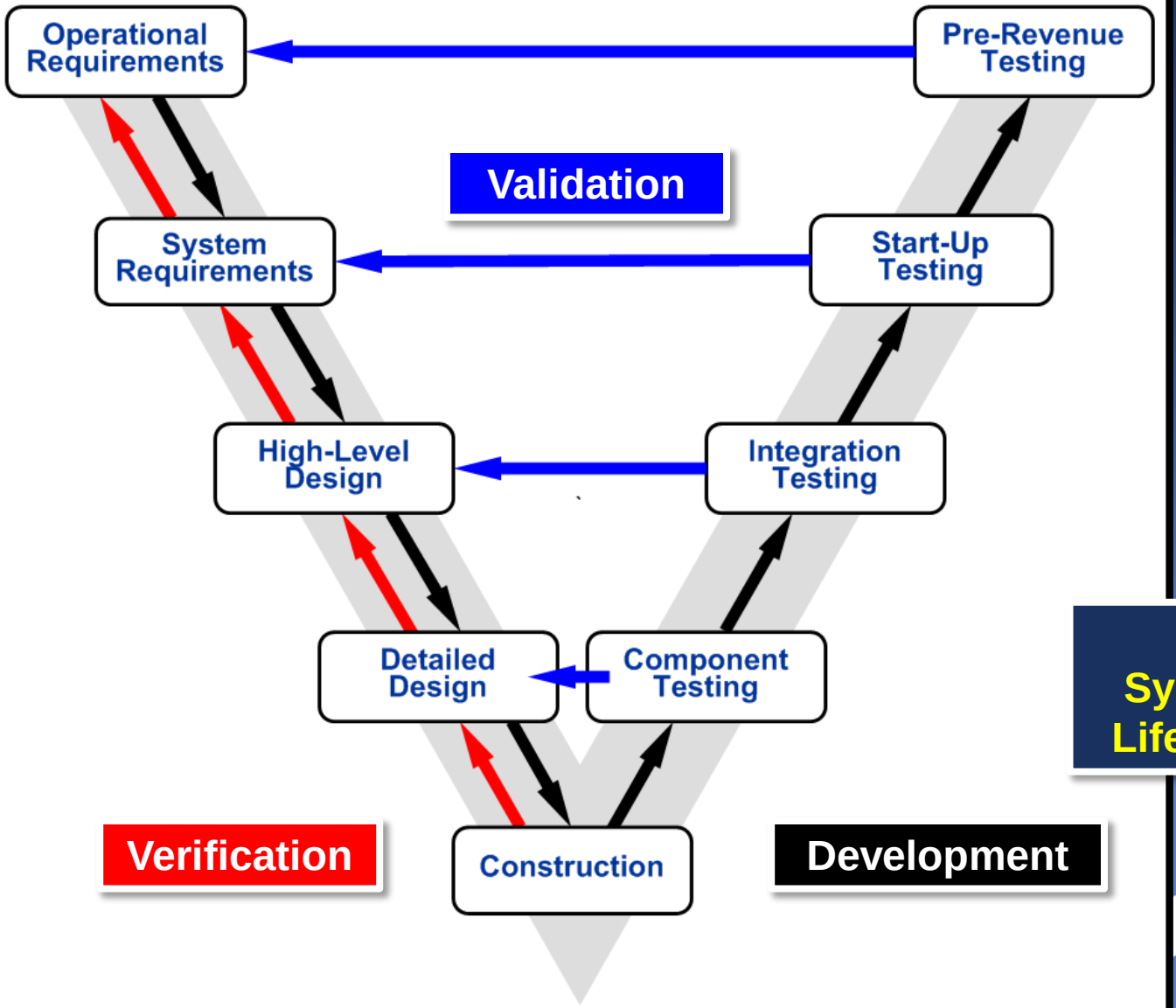
RST

TRK

INF

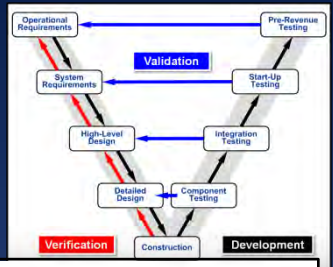
VERIFICATION & VALIDATION (V&V)

CHSTS V&V PRINCIPLES



Generic System Development Life Cycle / "V" Model

VERIFICATION & VALIDATION (V&V)
TRADITIONAL SAFETY CERTIFICATION



Status	Means of Verification - Design	Means of Verification - Construction
C = Compliance N = Noncompliance P = Partial Compliance	S = Submittal D = Design	M = Measurement T = Test V = Visual Inspection

Certifiable Element:_____
Checklist Type: Master:_____ Sub:_____
Sub-Element:_____
Contract Number:_____
Safety:_____ Security:_____
Specification/Drawing Reference:_____
Document Control Number:_____
Revision:_____

NOTES OR RESTRICTIONS:

Verification **Validation**

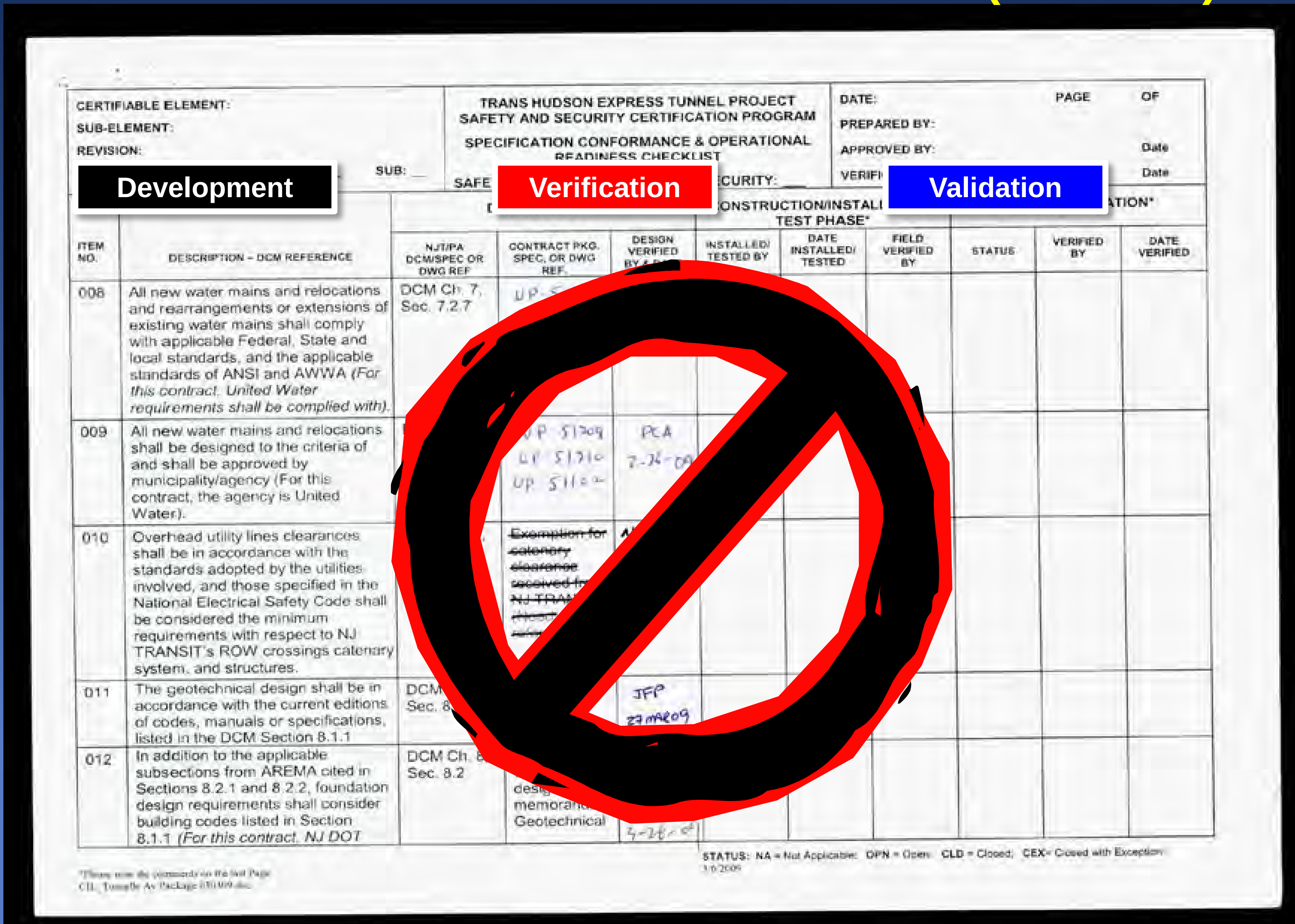
Item No.	Description	Design Cross Reference	Design				Construction			
			Status	Initial	Date	Means of Verification	Status	Initial	Date	Means of Verification

Development →

FTA Sample Design and Construction Conformance Checklist (Page 25)

VERIFICATION & VALIDATION (V&V)

TRADITIONAL SAFETY CERTIFICATION (CONT'D)



CERTIFIABLE ELEMENT:
SUB-ELEMENT:
REVISION:

TRANS HUDSON EXPRESS TUNNEL PROJECT
SAFETY AND SECURITY CERTIFICATION PROGRAM
SPECIFICATION CONFORMANCE & OPERATIONAL READINESS CHECKLIST

DATE: PAGE OF
PREPARED BY:
APPROVED BY: Date
VERIFI... Date

SUB: ___ SAFE... ...CURITY: ___

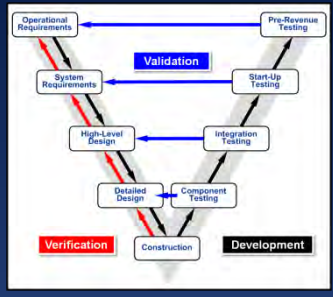
...ONSTRUCTION/INSTALL... TEST PHASE*

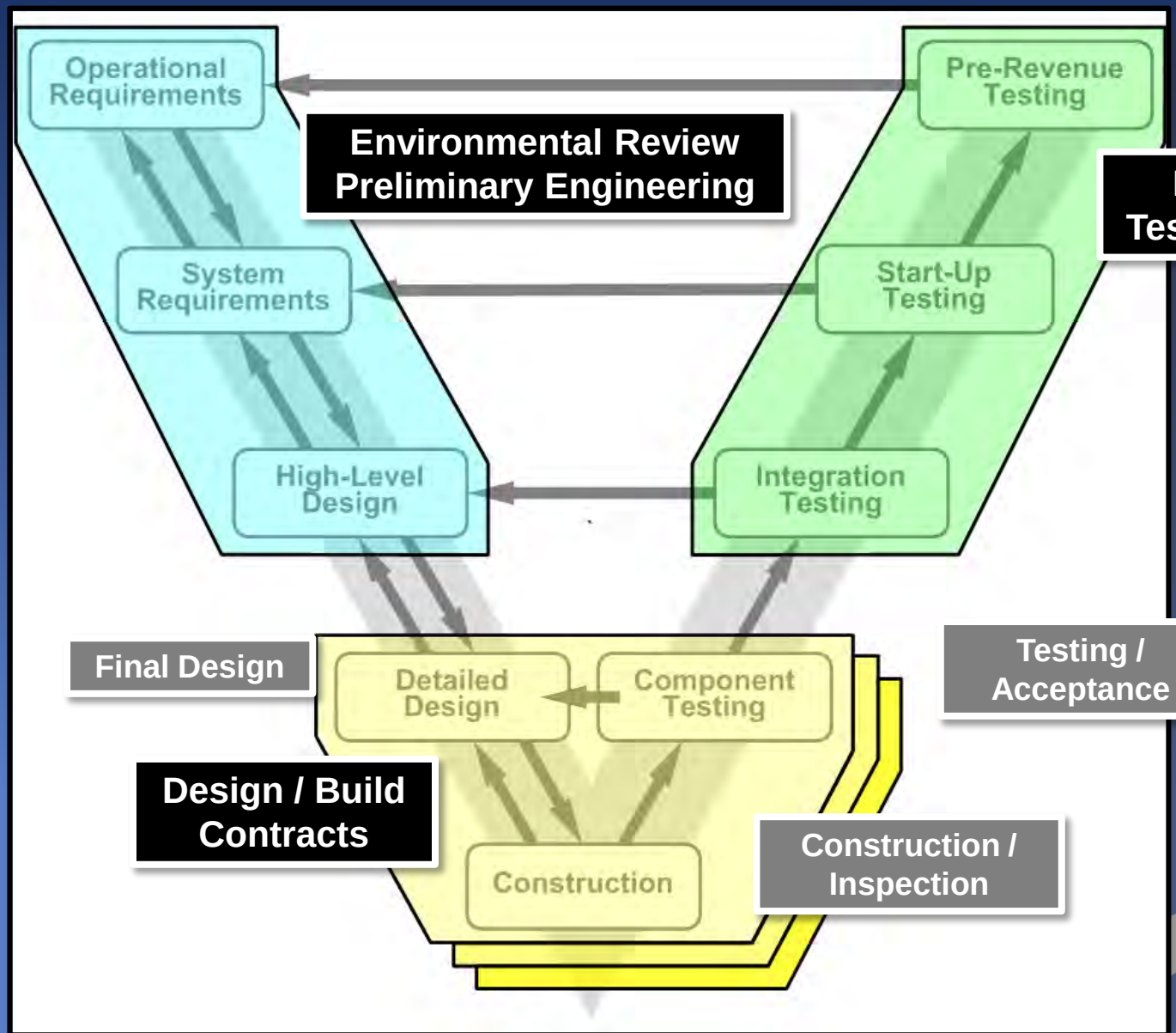
ITEM NO.	DESCRIPTION – DCM REFERENCE	NJT/PA DCM/SPEC OR DWG REF	CONTRACT PKG. SPEC. OR DWG REF.	DESIGN VERIFIED BY & DATE	INSTALLED/ TESTED BY	DATE INSTALLED/ TESTED	FIELD VERIFIED BY	STATUS	VERIFIED BY	DATE VERIFIED
008	All new water mains and relocations and rearrangements or extensions of existing 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-5...							
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).		UP 51709 UP 51710 UP 51102	PCA 7-26-09						
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.		~~Exemption for catenary clearance received fr... NJ TRAN...~~	A...						
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 ... Sec. 8...		JFP 27 MAR 09						
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	desig... memoran... Geotechnical	4-26-0...						

STATUS: NA = Not Applicable; OPN = Open; CLD = Closed; CEX = Closed with Exception

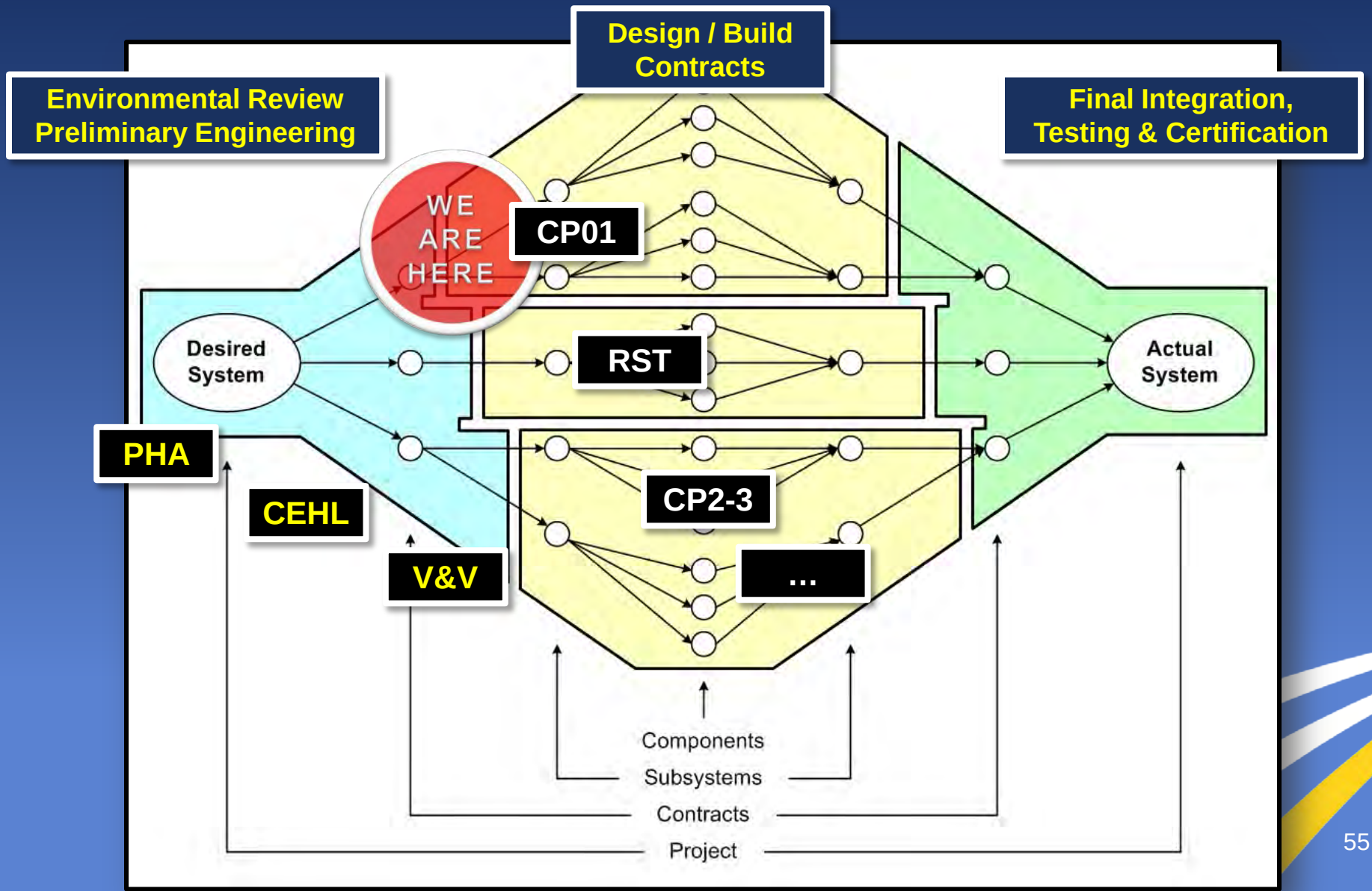
VERIFICATION & VALIDATION (V&V)
HOW COULD IT BE DONE BETTER?

VERIFICATION & VALIDATION (V&V)
CHSTS PROGRAM STAGES & STEPS

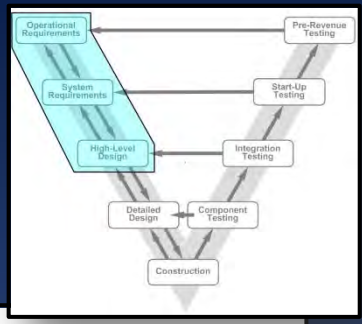




VERIFICATION & VALIDATION (V&V)
SAFETY CERTIFICATION STAGES & STEPS



VERIFICATION & VALIDATION (V&V)
SAFETY CERTIFICATION GOALS



1.5 SSMP Goals and Objectives

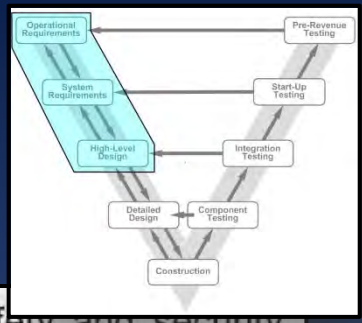
1.5.1 Goals

The goals of the SSMP are as follows:

- Achieve an acceptable level of risk through a systematic approach to hazard and threat/vulnerabilities management
- Ensure that the system initiated into revenue service is safe and secure for passengers, employees, emergency response personnel, and the general public through a formal program of safety and security certification
- Ensure that the design, acquisition, construction, fabric ting of critical elements of the CHST system will be verified for conf ed safety and security requirements and validated for effectiveness in achieving an effective level of safety and security
- Ensure that a mechanism is provided to follow to completion the resolution of any restriction to full safety and security certification
- Establish an effective, proactive Construction Safety and Security Program that results in no accidents for construction employees and the public, as well as minimizes security breaches, during all CHSTP work activities

Formal Certification Program

VERIFICATION & VALIDATION (V&V)
SAFETY CERTIFICATION ACTIVITIES

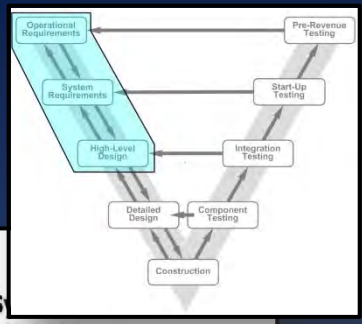


Leading up to and through the Preliminary Engineering phase of the project, the safety and security activities encompass the following activities:

- Develop the SSMP, including a process for achieving safety and security certification, to meet all Federal Railroad Administration (FRA) requirements for a safety and security management plan in a major capital project, in conformance with the Federal Transit Administration's Circular 5800.1 *Safety and Security Management guidance for Major Capital Projects*.
- **Identify** t of safety-critical and security-critical elements and items for the CHSTP Preliminary ses.
- Specify safety and security certification requirements, in conformance with the *CHSTP Verification and Validation Plan*, in contract documents. Safety and security certification requirements will be part of the scope of work for the design/build contractors during the Final Design and Construction phases of the project, with oversight provided by the PMT.
- Implement a hazard and certification tracking system, to be developed by the PMT's System Safety Manager working with the PMT's Verification and Validation Manager. **Implement**
- Perform Preliminary Hazard Analyses (PHA) and a Threat and Vulnerability Assessment (TVA) to identify certifiable elements and hazards/vulnerabilities requiring mitigation. Identify hazard/vulnerability mitigation from the PHA and TVA to be incorporated into preliminary and final designs. Perform additional analysis as required.
- Develop design criteria conformance checklists. The tracking system will be an integrated subset of the Verification & Validation program applied throughout the CHSTP. **Verify/Certify**

VERIFICATION & VALIDATION (V&V)

STATE-OF-THE-ART SAFETY CERTIFICATION



California High-Speed Train Project

Agreement No.: HSR 13-06
Book 3, Part B, Subpart 6

Safety and Security Management Plan

Revision No.	Date	Description
0	01 Mar 12	Initial Release, R0
1	27 Apr 12	Addendum 1
2	31 Jul 13	EXECUTION VERSION

Prepared for CALIFORNIA High-Speed Rail Authority

California High-Speed Train S

TECHNICAL MEMORANDUM

Verification and Validation Management Plan (VVMP)
TM 1600.01

Prepared by:	Oliver Hoehne	17 Jun 13 Date
Checked by:	Vladimir Kanevskiy, PE	17 Jun 13 Date
Approved by:	John Chirco, PE, Engineering Manager	17 Jun 13 Date
Released by:	Brent Felker, PE Program Director	6-18-13 Date

Revision	Date	Description
0	06/17/2013	Initial Release, R0

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

Prepared by PARSONS BRINCKERHOFF for the California High-Speed Rail Authority

Integrated Approach

VERIFICATION & VALIDATION

PRELIMINARY HAZARD ANALYSIS (PHA)

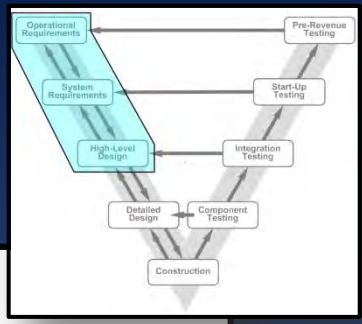


Figure 4-1 Sample PHA

System: Infrastructure			**California High-Speed Train Project**				**Prepared by:** Date	
Subsystem: R-O-W, Generally			**Preliminary Hazard Analysis (PHA)**				**Reviewed by:** Date	
PHA No. 1.1.1 **Rev. No.** 0			**DRAFT 12/08/2011**				**Approved by:** Date	
General Description Derailment			**Hazard Cause / Effect**		**Hazard Risk Index**		**Corrective Action**	
No.	**System Mode**	**Hazard Description**	**Potential Cause**	**Effect on Subsystem / System**	**Initial**	**Residual (Projected)**	**Controlling Measures and Remarks**	**Resolution / Reference**
4	A	Washout	Flooding, scouring	Derailment w/mass casualties, property damage, service interruption	I-B Unacceptable	II-E Acceptable w/Review	1) Perform hydraulics analysis and incorporate results into sub-grade design, slope protection and setting of profile. 2) Install appropriate drainage. 3) Inspection and maintenance of drainage systems. 4) Identification and monitoring by O&M of potential hazardous locations.	

Hazard

epresentation only. Refer to current PHA for identified hazards and controlling measures.

Safety and Security Management Plan

VERIFICATION & VALIDATION

CERTIFIABLE ELEMENTS AND HAZARDS LOG (CEHL)

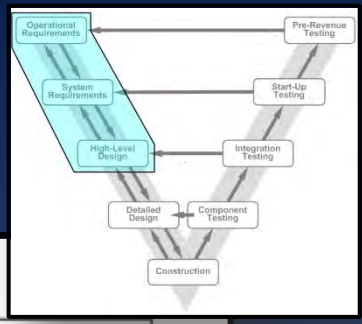


Figure 7-1 Sample CEHL

Certifiable Elements and Hazards Log

Certifiable Elements			Hazards			Mitigations		
No.	System Elements	Sub-Elements	No.	Date Identified	Description	Mitigation Description	PE Phase Reference	FD Phase Reference
1.1	R-O-W Generally							
1.1.1	R-O-W Generally	Derailment	1.1.1.1	8/30/2011	Track Failure - Cracked or broken track component	1) Implement an inspection program and remedial maintenance methodology that meet or exceed FRA Guidelines for Track Class to operate at 220 MPH (when developed)		
						2) Implement track component quality standards that meet or exceed AREMA requirements.	DM 5.4.2 DM 5.5.1 DM 5.5.3	
						3) Install on-board derailment containment devices.		
						4) Install in-track derailment containment elements.		
						5) Require positive indication of broken rail through track circuit system.		
			1.1.1.2	8/30/2011	Track Abnormality - Worn track components, cross-level	1) Implement an inspection program and remedial maintenance methodology that meet or exceed FRA Guidelines for Track Class to operate at 220 MPH (when developed)		
						2) Implement track component quality standards that meet or exceed AREMA requirements.	DM 5.4.2 DM 5.5.1 DM 5.5.3	
						3) Install on-board derailment containment devices.		
						4) Install in-track derailment containment elements.		
						5) Require positive indication of broken rail through track circuit system.		
			1.1.1.3	8/30/2011	Roadbed failure due to subsidence, shifting ground, etc.	1) Perform geotechnical analysis and incorporate results into sub-grade design.	DM 10.5	
						2) Install appropriate drainage.	DM 8.4.3 DM 8.4.9	
						3) Inspection and maintenance of drainage systems.		
			1.1.1.4	8/30/2011	Washout caused by flooding or scouring	1) Perform hydraulics analysis and incorporate results into sub-grade design, slope protection and setting of profile.	DM 10.5 DM 10.8	
						2) Install appropriate drainage.	DM 8.4.3 DM 8.4.9	
						3) Inspection and maintenance of drainage systems.		
						4) Identification and monitoring by O&M of potential hazardous locations.		

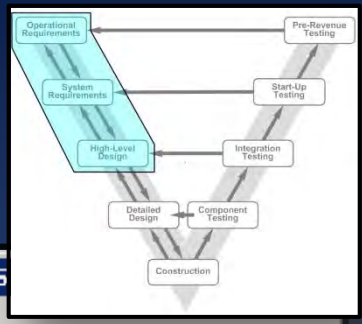
Mitigations

ample representation only. Refer to current CEHL for identified hazards and required considerations Figure 7-1 only depicts Preliminary Engineering and Final Design phases; dded as the project matures.

Safety and Security Management Plan

VERIFICATION & VALIDATION

CEHL MITIGATIONS IN V&V DATABASE (DOORS)



'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

- 10 CEHL
  - 1 Infrastructure
    - 1.1 R-O-W, Generally
      - 1.1.1 Derailment
        - 1.1.1.1 Track Failure : Cracked or bro
          - 1.1.1.1.1 Mitigation #1: [1] O&M: (
          - 1.1.1.1.2 Mitigation #2: [2] INF: Tr
          - 1.1.1.1.3 Mitigation #3: [3] RST: I
          - 1.1.1.1.4 Mitigation #4: [4] INF: In
          - 1.1.1.1.5 Mitigation #5: [5] SYS: F
        - 1.1.1.2 Track Abnormality: Worn track
          - 1.1.1.2.1 Mitigation #1: [1] O&M: (
          - 1.1.1.2.2 Mitigation #2: [2] INF: Tr
          - 1.1.1.2.3 Mitigation #3: [3] RST: I
          - 1.1.1.2.4 Mitigation #4: [4] INF: In
          - 1.1.1.2.5 Mitigation #5: [5] SYS: F
        - 1.1.1.3 Roadbed Failure: Subsidence,
          - 1.1.1.3.1 Mitigation #1: [1] INF: Pe
          - 1.1.1.3.2 Mitigation #2: [2] INF: In
          - 1.1.1.3.3 Mitigation #3: [3] O&M: I
        - 1.1.1.4 Washout caused by flooding c
          - 1.1.1.4.1 Mitigation #1: [1] INF: Pe
          - 1.1.1.4.2 Mitigation #2: [2] INF: In
          - 1.1.1.4.3 Mitigation #3: [3] O&M: I
        - 1.1.1.5 Slide: Stormwater runoff, hillsid

Absolute	Hazards & Mitigations	Date Identified
4	**1.1.1.1 Track Failure** Cracked or broken track component (rail, ties, welds, fasteners, switch components, etc)	---
16	**1.1.1.1.1 Mitigation #1** [1] O&M: O&M program and remedial maintenance methodology that meet or exceed FRA Guidelines for Track Class to operate at 220	2011/08/30
20	**1.1.1.1.2 Mitigation #2** [2] INF: Track component quality standards that meet or exceed AREMA requirements.	2011/08/30
19	**1.1.1.1.3 Mitigation #3** [3] RST: Install on-board derailment containment devices.	
18	**1.1.1.1.4 Mitigation #4** [4] INF: Install in-track derailment containment elements.	
17	**1.1.1.1.5 Mitigation #5** [5] SYS: Require positive indication of broken rail through track circuit system.	

O&M

INF

RST

INF

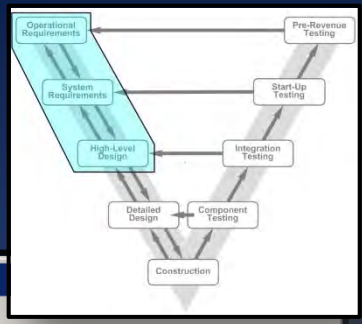
SYS

Username: oliverhoehne | Exclusive edit mode

CEHL in DOORS

VERIFICATION & VALIDATION

TRACKING SAFETY MITIGATIONS



'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

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 Mitigati
        - 1.1.1.1.2 Mitigati
        - 1.1.1.1.3 Mitigati
        - 1.1.1.1.4 Mitigati
        - 1.1.1.1.5 Mitigati
      - 1.1.1.2 Track Abnorr
        - 1.1.1.2.1 Mitigati
        - 1.1.1.2.2 Mitigati
        - 1.1.1.2.3 Mitigati
        - 1.1.1.2.4 Mitigati
        - 1.1.1.2.5 Mitigati
      - 1.1.1.3 Roadbed Fai
        - 1.1.1.3.1 Mitigati
        - 1.1.1.3.2 Mitigati
        - 1.1.1.3.3 Mitigati
      - 1.1.1.4 Washout cau
        - 1.1.1.4.1 Mitigati
        - 1.1.1.4.2 Mitigati
        - 1.1.1.4.3 Mitigati
      - 1.1.1.5 Slide: Stormw
        - 1.1.1.5.1 Mitigati
        - 1.1.1.5.2 Mitigati

Absolute	Hazards & Mitigations	Traced To: TCs (LM)
104	**1.2.1.9 Train falls from elevated structure.**	
273	**1.2.1.9.1 Mitigations #1** [1] INF: Include derailment containment wall in design of structure that keeps train on the bridge.	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 NON DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NON 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 NOI
274	1.2.1.9.2 Mitigations #2 [2] RST: Install device on vehicle trucks that keeps train in the alignment.	
105	**1.2.1.10 Person falls from elevated structure.**	
276	**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 [STR] 12.7.1.6 Miscellaneous Loads DCM [STR] 12.8.6.15 Walkways, Parapets, and Sound Walls DD-ST-001 TYPICAL CROSS SECTION, AERIAL STRUCTURE, TWO TRACK NON DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NON DD-ST-003 TYPICAL CABLE TROUGH DETAILS , AERIAL STRUCTURE DD-ST-005 AERIAL STRUCTURE, CONCRETE PARAPET DD-ST-007 AERIAL STRUCTURE,TYPICAL SPAN, EXPANSION JOINT DETAILS DD-ST-017 TYPICAL CROSS SECTION, AERIAL STRUCTURE, FOUR TRACK NOI

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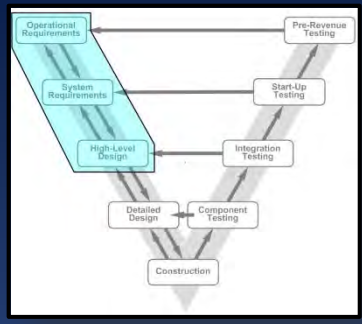
CEHL Mitigation

References to Technical Criteria

CEHL in DOORS

VERIFICATION & VALIDATION

VERIFYING REFERENCES – OBJECTIVE EVIDENCE

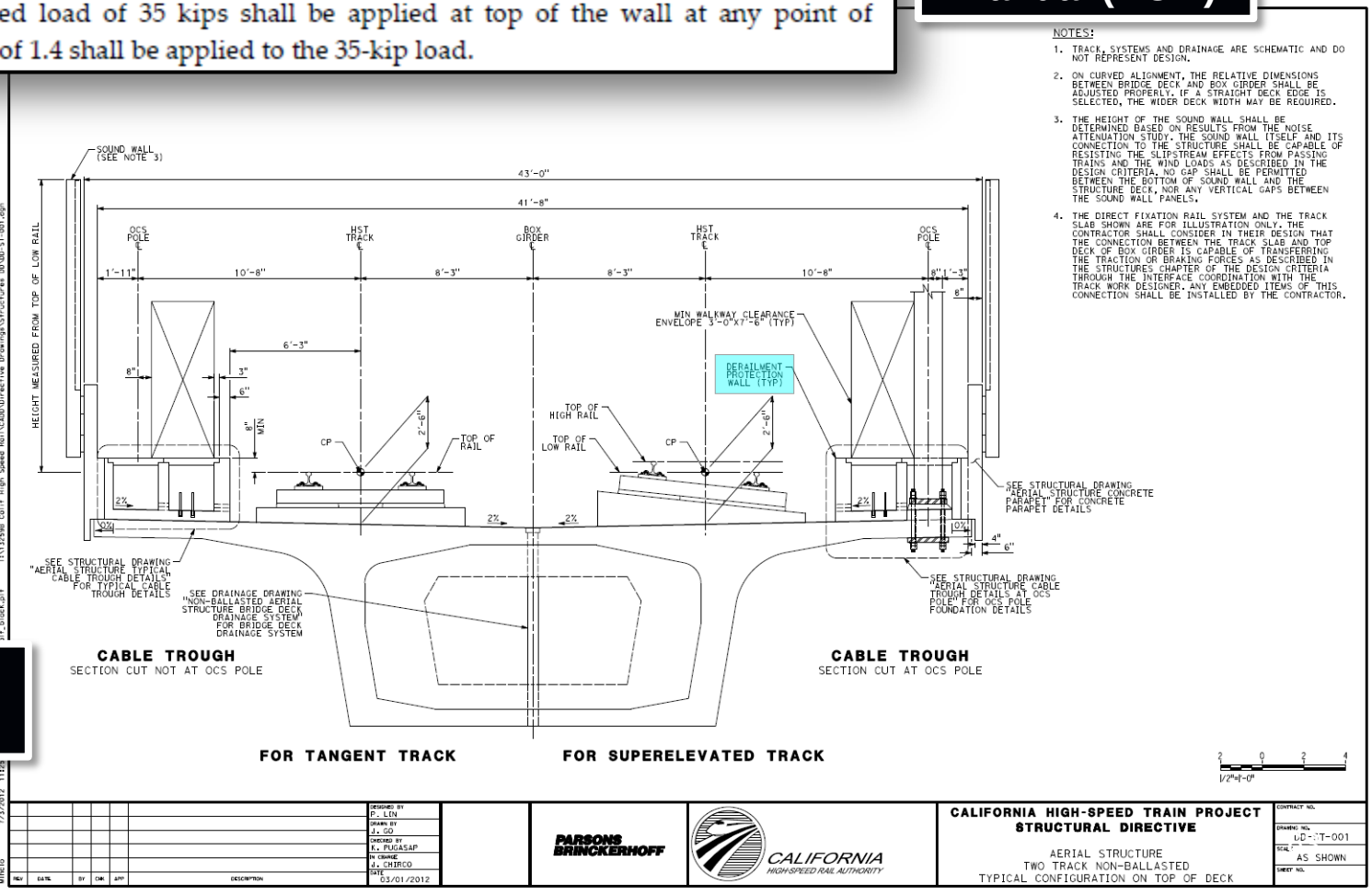


Design Criteria Manual (DCM)

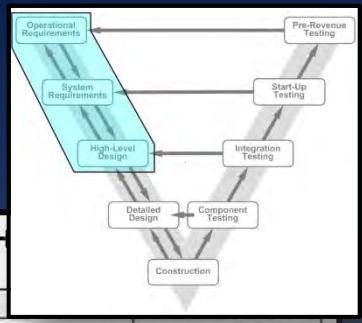
B. Track Side Containment

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

Directive Drawings



VERIFICATION & VALIDATION
CERTIFICATION PACKAGE



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

CEHL#	Certifiable Element or Hazard Description	Traced To
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". *Height changed to 30" per Cal/OSHA regulations 12/18/12.*	*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 Rev.1 DRAFT* *D TRACK* *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* *DD-ST-005 AERIAL STRUCTURE, CONCRETE PARAPET*

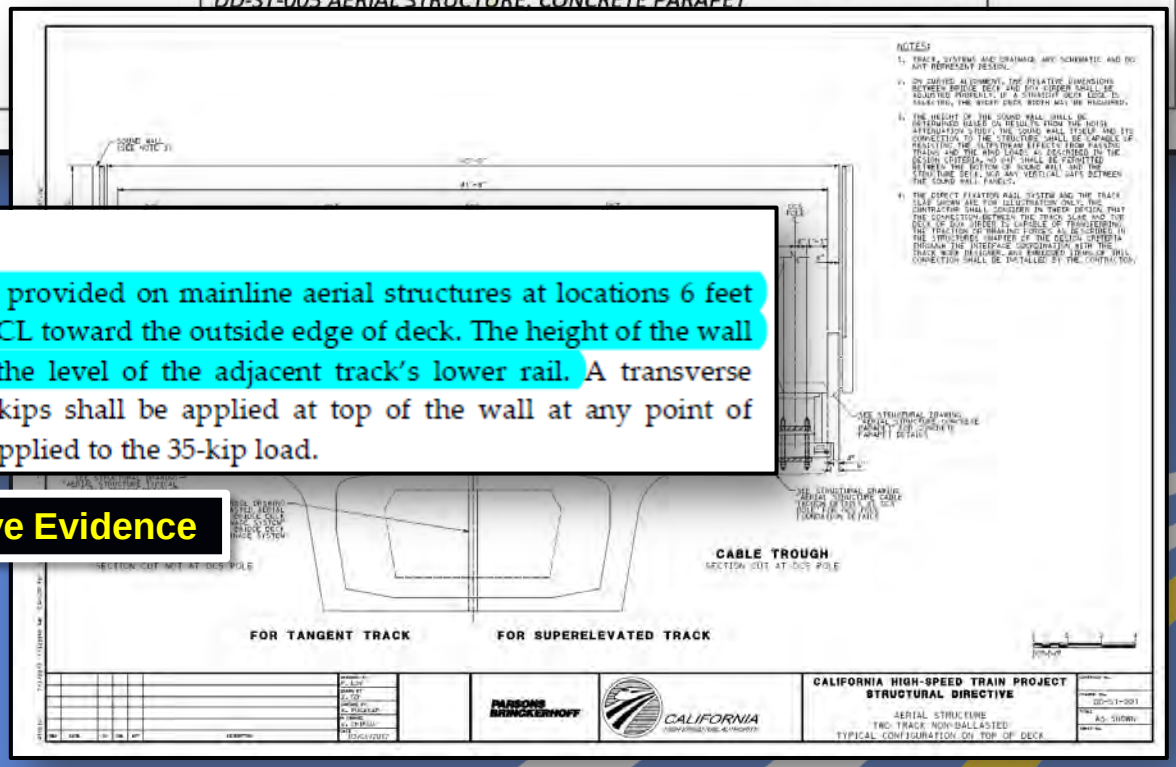
CEHL Mitigation

References to Technical Criteria (Objective Evidence)

B. Track Side Containment

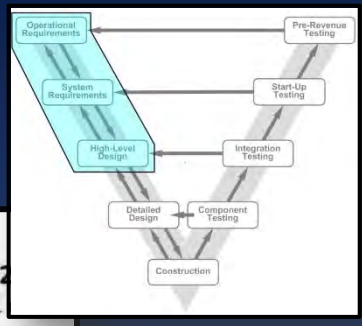
Derailment protection walls shall be provided on mainline aerial structures at locations 6 feet minimum to 7 feet maximum from TCL toward the outside edge of deck. The height of the wall shall be minimum 0.67 feet above the level of the adjacent track's lower rail. A transverse horizontal concentrated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

Objective Evidence



VERIFICATION & VALIDATION

CERTIFICATION – SIGN-OFF



CHSTS Verification, Validation and Safety/Security Certification
Certifiable Elements and Hazards Log (CEHL) - Certification Sheet

CEHL Item 02
Certification Signoff Sheet Page 1

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". *Height changed to 30" per Cal/OSHA regulations 12/18/12.*

Phase: PE – Preliminary Engineering

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 Certifiable Item has been verified for safety and security certification in conformance with the CHSTS safety-critical and security-critical requirements. Please do not amend any of the information in the form. If you have comments on the contents, please return the form unsigned.

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

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

Verifier Company

Independent 3rd Party Auditor Signatures (if applicable)

Printed Name: **Date**

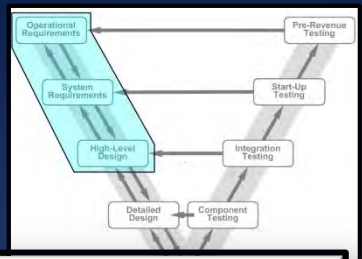
Independent 3rd Party Auditor Company

Form V&VCEHL-CIV, Rev 0, 2013-03-08

1 of 14

VERIFICATION & VALIDATION (V&V)

PRACTICAL VALUE USING V&V



'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

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 Mitigati
        - 1.1.1.1.2 Mitigati
        - 1.1.1.1.3 Mitigati
        - 1.1.1.1.4 Mitigati
        - 1.1.1.1.5 Mitigati
      - 1.1.1.2 Track Abnorr
        - 1.1.1.2.1 Mitigati
        - 1.1.1.2.2 Mitigati
        - 1.1.1.2.3 Mitigati
        - 1.1.1.2.4 Mitigati
        - 1.1.1.2.5 Mitigati
      - 1.1.1.3 Roadbed Fai
        - 1.1.1.3.1 Mitigati
        - 1.1.1.3.2 Mitigati
        - 1.1.1.3.3 Mitigati
      - 1.1.1.4 Washout cau
        - 1.1.1.4.1 Mitigati
        - 1.1.1.4.2 Mitigati
        - 1.1.1.4.3 Mitigati
      - 1.1.1.5 Slide: Stormw
        - 1.1.1.5.1 Mitigati
        - 1.1.1.5.2 Mitigati

Absolute	Hazards & Mitigations	Traced To: TCs (LM)
104	**1.2.1.9 Train falls from elevated structure.**	
273	**1.2.1.9.1 Mitigations #1** [1] INF: Include derailment containment wall in design of structure that keeps train on the bridge.	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 NON DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NON 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 NOI
274	1. [2] Install device on vehicle trucks that keeps train in the alignment.	
105	**1.2.1.10 Person falls from elevated structure.**	
276	**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 [STR] 12.7.1.6 Miscellaneous Loads DCM [STR] 12.8.6.15 Walkways, Parapets, and Sound Walls DD-ST-001 TYPICAL CROSS SECTION, AERIAL STRUCTURE, TWO TRACK NON DD-ST-002 TYPICAL CROSS SECTION, AERIAL STRUCTURE, ONE TRACK NON DD-ST-003 TYPICAL CABLE TROUGH DETAILS , AERIAL STRUCTURE DD-ST-005 AERIAL STRUCTURE, CONCRETE PARAPET N JOINT DETAILS E, FOUR TRACK NOI

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Safety & Security Group

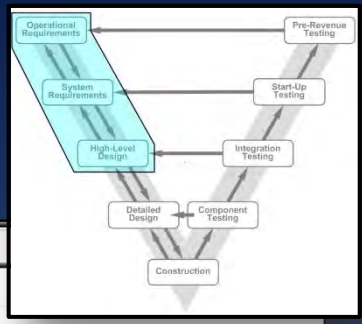
Engineering Group

1. **Central Repository**
2. **Side-by-Side Review**
3. **Increased Awareness of Dependencies**
4. **Impact Assessment**

CEHL in DOORS

VERIFICATION & VALIDATION (V&V)

PRACTICAL VALUE USING V&V (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.	--	
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

Change / Configuration Management

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
#4
#4
#4
#4
#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

New Mitigation

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.

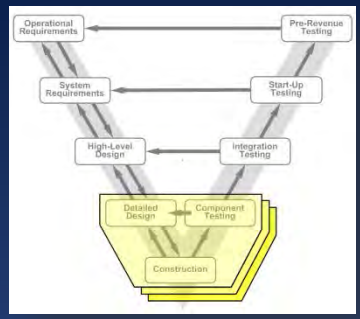
Changed Mitigation

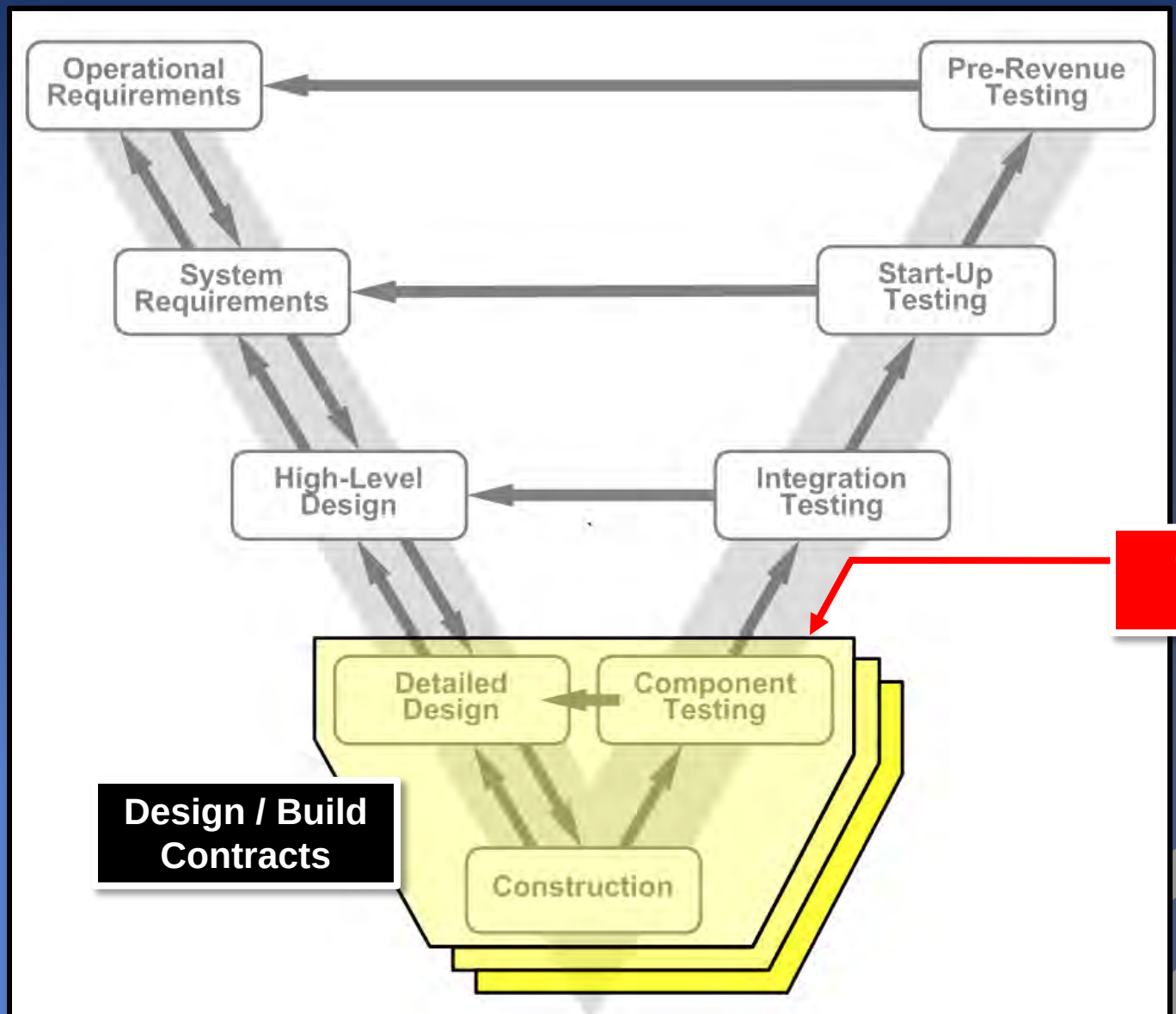
ext
e rolling stock doorways.

#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

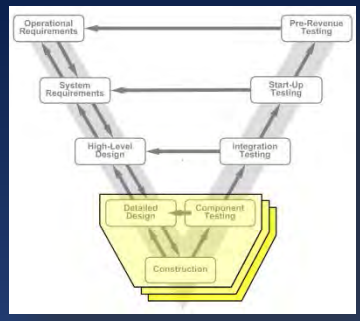
VERIFICATION & VALIDATION
DESIGN-BUILD STAGE

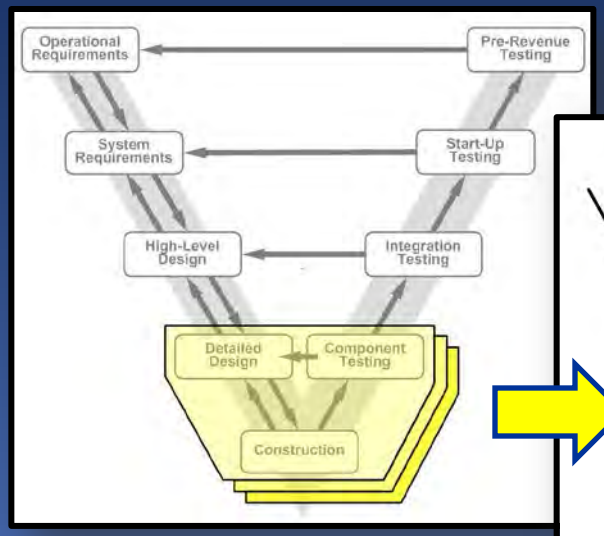


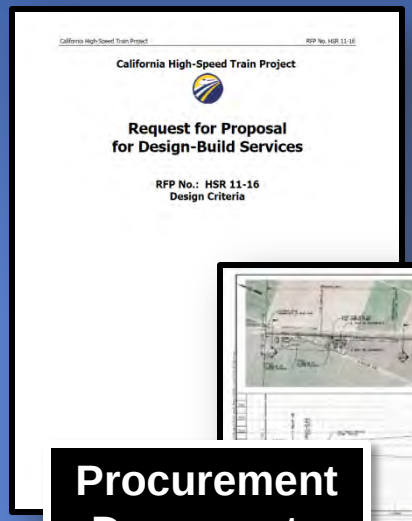


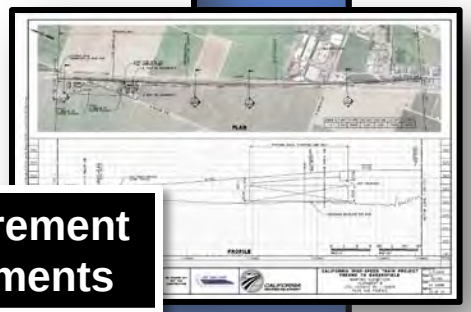
VERIFICATION & VALIDATION (V&V)

SAFETY CERTIFICATION USING V&V

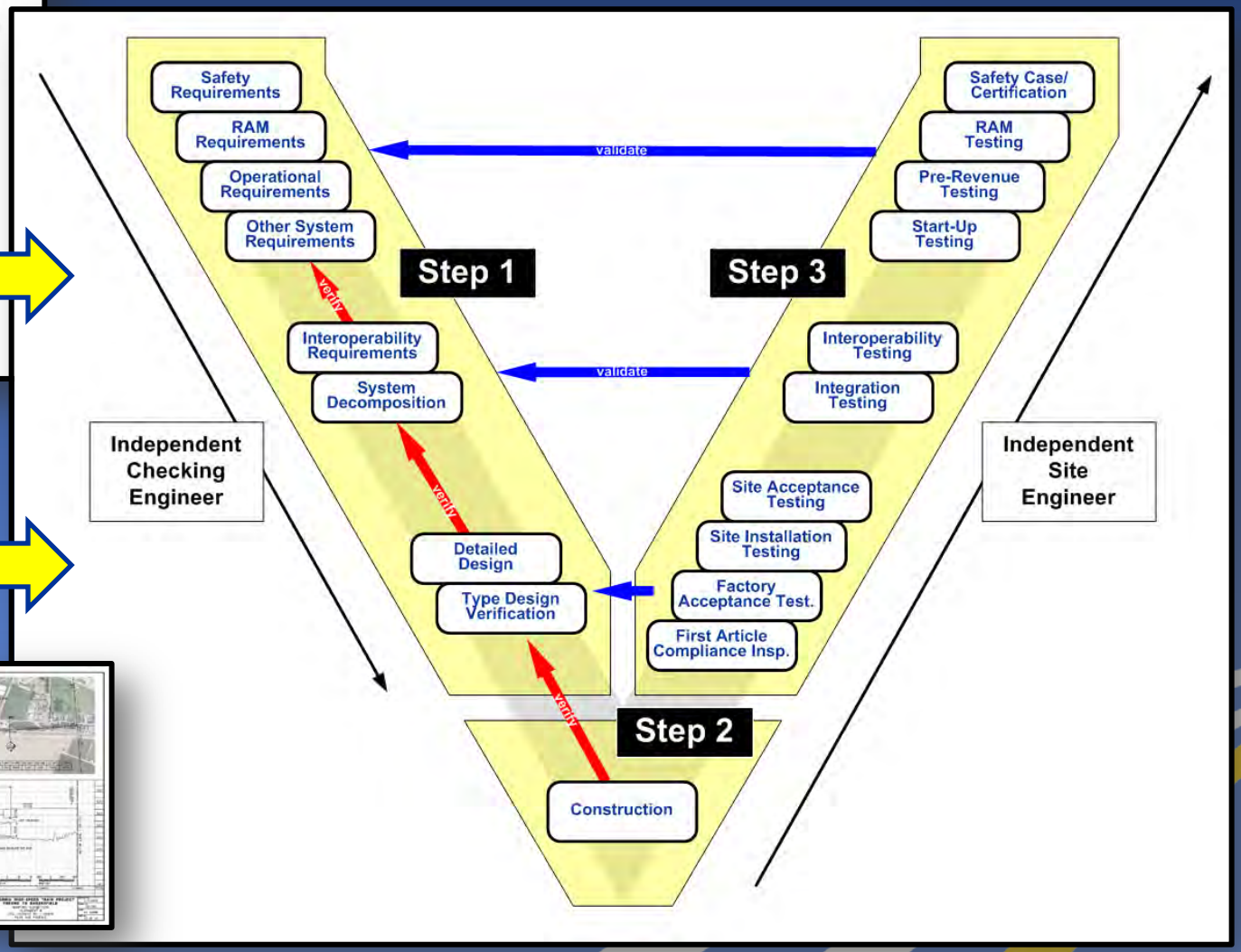




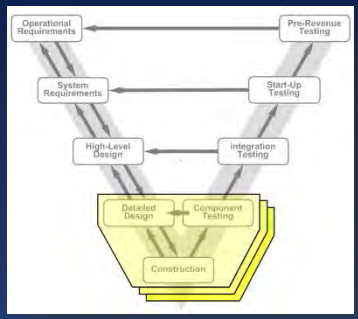




Procurement Documents



VERIFICATION & VALIDATION (V&V)
DEMONSTRATION OF COMPLIANCE



Technical Contract Requirements | **Design References** | **Certification of Critical Items** | **Contractor QA/QC**

	Procurement Documents		Final Design		Self-Certification, Verification & Validation	
ID #	Requirements Description	Requirements Reference	Design Reference	Verified By & Date	Contractor QA/QC	Independent Check. Eng.
...	Contract Req. #1	Spec # ... / Section ...	Plan / Spec xxx	N/A	Initial	Initial
...	Contract Req. #2	Drawing # / ...	Plan / Spec xx	N/A	Initial	Initial
...	...	...	...	...	...	...
...	Environmental Mitigations	EIR/S # ...	Plan / Spec x	/ Date	Initial	Initial
...	Hazard Mitigations	PHA # ...	Plan / Spec xxx	Date	Initial	Initial
...	Threat Mitigations	TVA # ...	Plan / Spec xxx	Initial /	Initial	In
...	Interoperability (Interface xxx)	CIL # ...	Plan / Spec xxx	Initial / Date	Initial	Initial
...	...	...	...	...	...	

Requirements

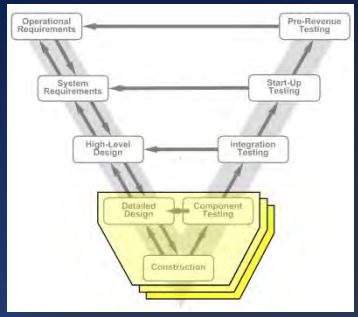
Critical Items

Requirements Verification Traceability Matrix (RVTM)

Audit & Due Diligence Check by Authority's Representative

Independent Checking Engineer

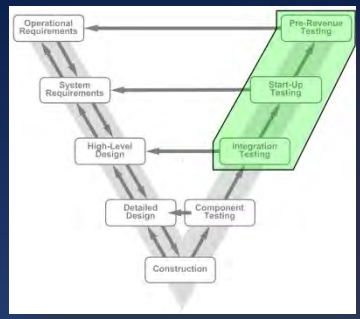
VERIFICATION & VALIDATION (V&V)
INDEPENDENT VERIFICATION & VALIDATION

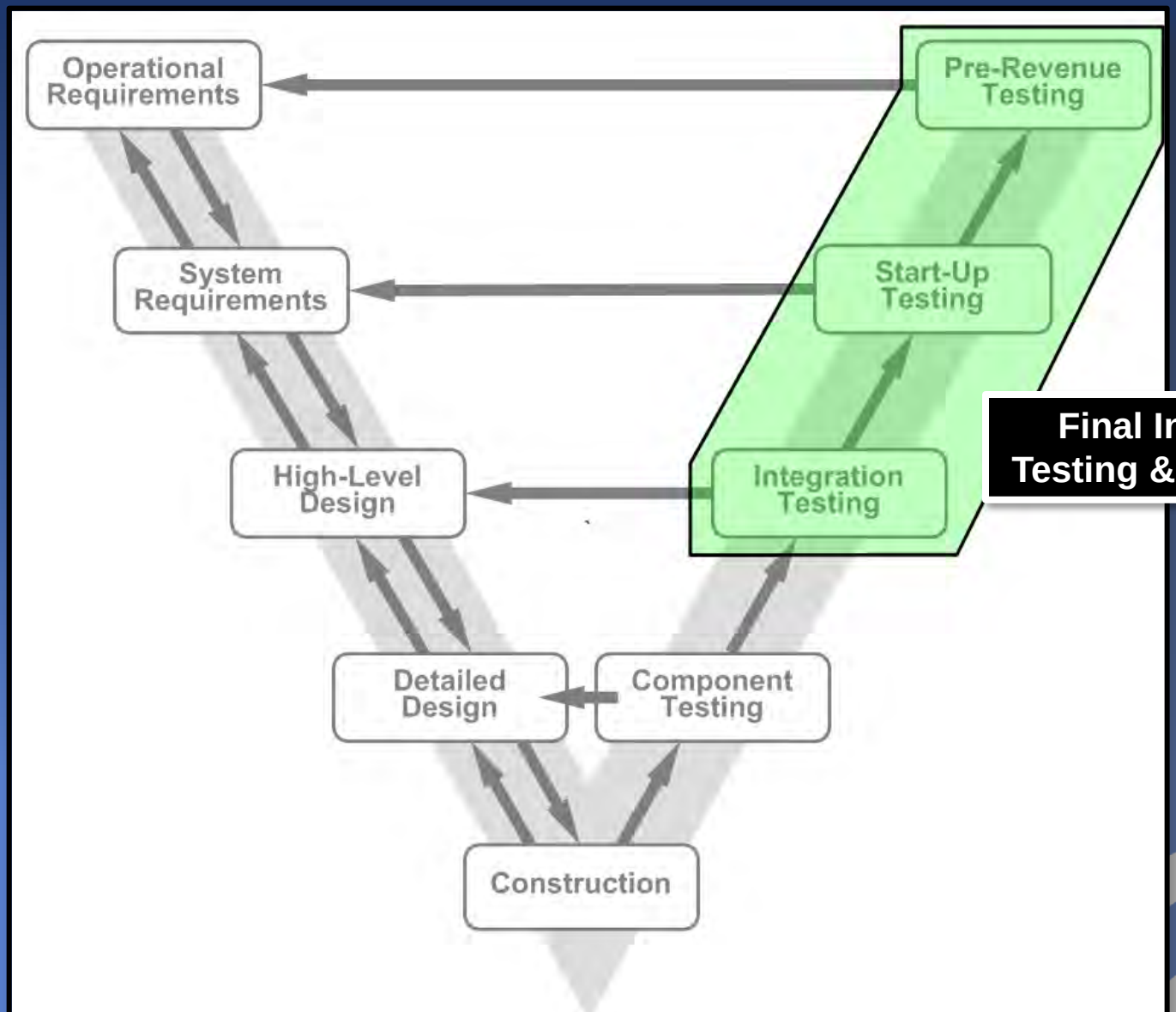


- Independent entity, not associated/affiliated in any way with Contractor
- Performs *Independent Conformity Assessment* of Contractor Submittals against Contract
- *Full Check of every Technical Contract Submittal* prior to Submittal to Authority's Representative:
  - Independent Checking Engineer (ICE, during Design)
  - Independent Site Engineer (ISE, during Construction)
- *Certify Compliance* with Contract and provide *Assessment Report*
- *Reports directly to Authority*
- Based on Proven and *Internationally Accepted Standards and Practices*:
  - European Norm applied by European Railroads (Notified Bodies)
  - Used by International Firms in Taiwan High Speed Rail
  - EN 50126 Specification & Demonstration of RAMS
  - INCOSE Systems Engineering Handbook

VERIFICATION & VALIDATION (V&V)

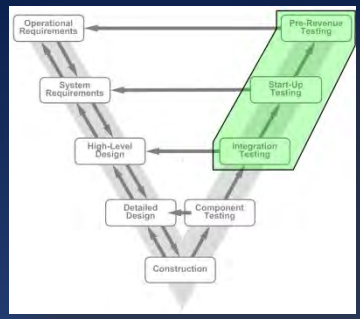
FINAL INTEGRATION, TESTING & CERTIFICATION





Final Integration, Testing & Certification

VERIFICATION & VALIDATION (V&V)
CONTRACT INTEGRATION & STARTUP



Civil — Design Safety Case

Trackwork — Design Safety Case

Systems — Design Safety Case

Rolling Stock — Design Safety Case

Other — Design Safety Case

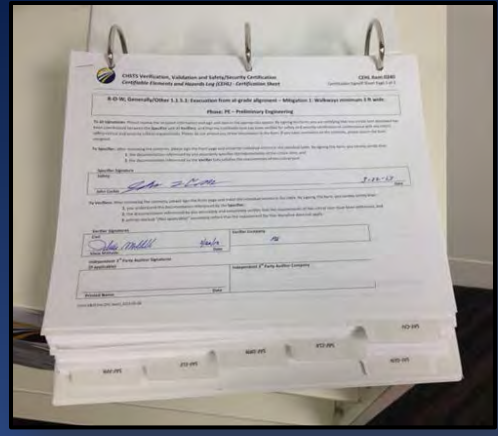
Operations & Maintenance:
- ✓ Rules
- ✓ Procedures
- ✓ Competencies

Integrated HSR System
- ✓ Start-Up Testing
- ✓ Pre-Revenue Testing
- ✓ Safety Procedures

Operating Safety Case

Revenue Operation

VERIFICATION & VALIDATION
SUMMARY



Verification and Validation

- Fully Embedded in CHSTS Delivery Method
  - Design, Construction, Integration, Testing, Certification
- Used as a Formal Safety Certification Program
- Demonstrates Compliance with Requirements
- Provides Objective Evidence
- Improves Team Communication
- Fewer Claim Opportunities for Contractors
- Facilitates Impact Assessment
- Get it Right the First Time

VERIFICATION & VALIDATION (V&V)

Q&A

Thank you for your attention