

Fire Life Safety for an Underground Wye Junction

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RAIL CONFERENCE //



Challenges associated with Underground Wye Junctions

- Why are Wyes Challenging for FLS?
 - Location where multiple trains can stop during normal operations
 - FLS Design criteria and standard practices less prevalent unlike for an underground station, tunnels and crossovers
 - Emergency egress is a challenge, multiple paths of egress to manage
 - Push-pull ventilation scheme may not be appropriate
 - No firewall separation



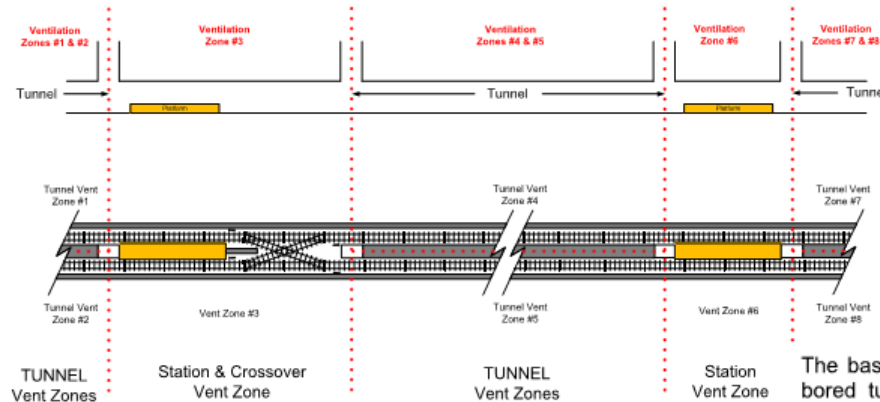
Current status of criteria in addressing Complex Wye junctions

- Los Angeles Metro criteria

2.3.9.2 Trains in Ventilation Zone

A ventilation zone is defined as the area between two adjacent ventilation shafts inlets and/or portals that allows control of smoke and heat to be contained within its boundaries. via an inlet and an outlet shaft (or opening) for air movement. A pictorial representation of this is provided in Figure 2- below:

Figure 2-2 Ventilation Zones



The basis of design for the emergency ventilation system is one train per ventilation zone in single bored tunnels or any trainways with a fire separation between them. See Figure 2-2. The diagram in Figure 2-2 assumes a vent shaft at each of the boundaries of the ventilation zones.

Cross-passages open: One cross-passage open

Bypass Dampers: All enclosed heavy and light rail stations will include by-pass dampers.

Overview of Regional Connector

- Critical link for downtown Los Angeles

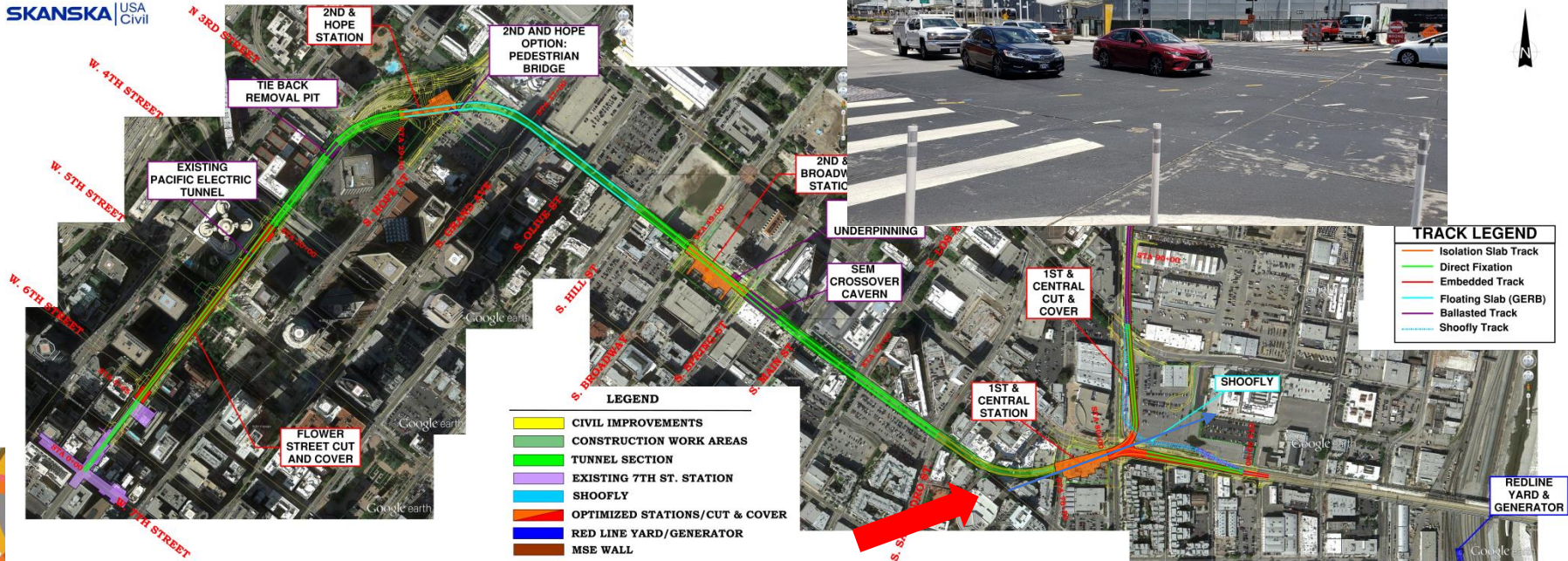


Alameda Wye

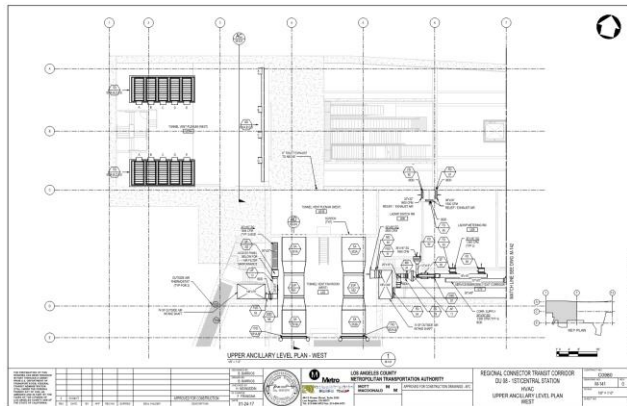
Overview of Regional Connector

- Everything is underground!!!

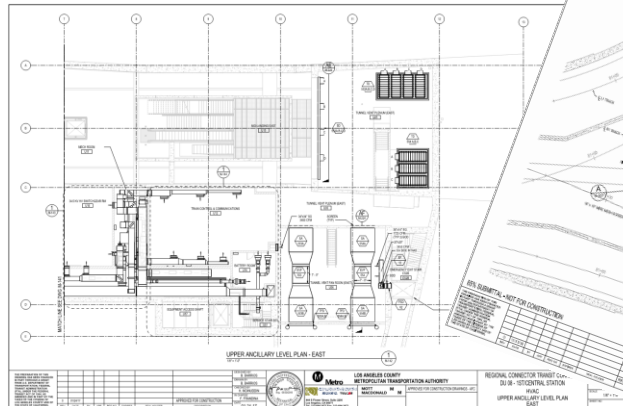
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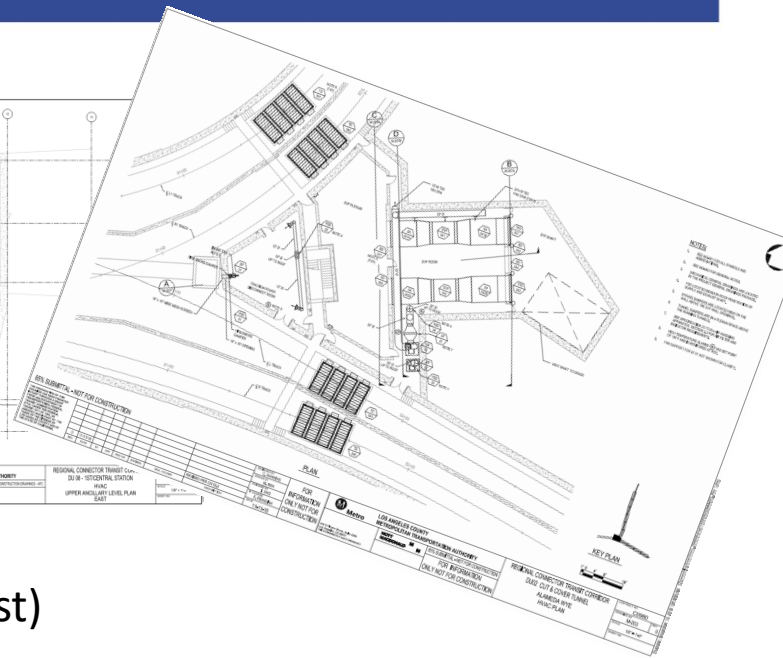
1st Central Station and Alameda Wye Design Drawings



1st/Central (West)



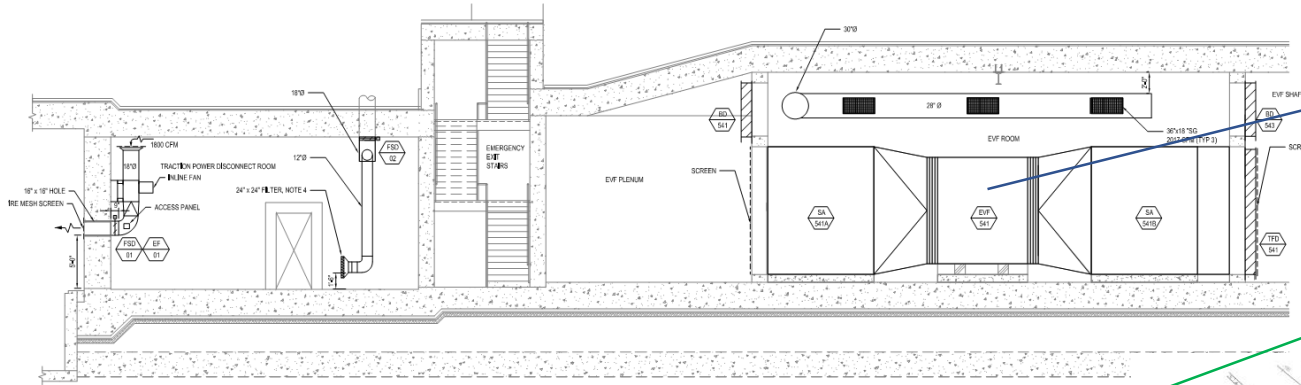
1st/Central (East)



Alameda Wye

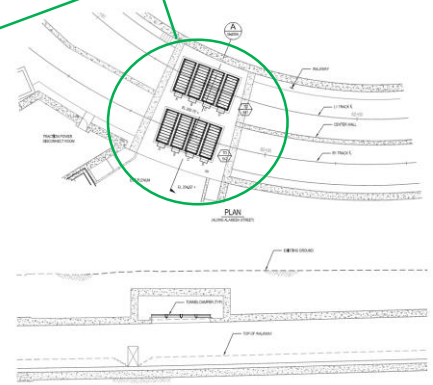
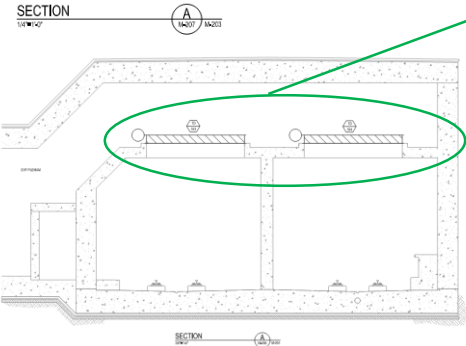


Alameda Wye Mechanical Drawings



Tunnel Ventilation Fans

Track/Tunnel Dampers



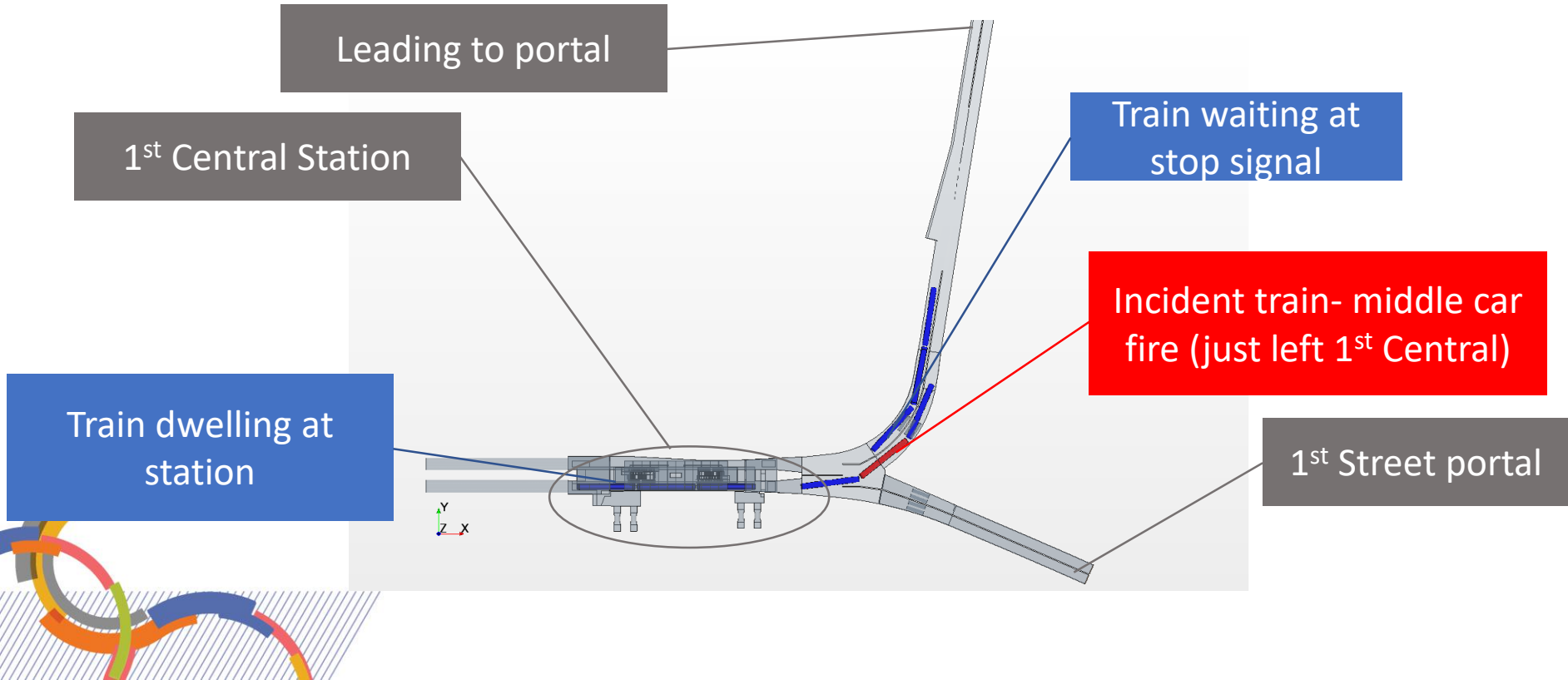
Analysis

- Computational Fluid Dynamics
 - CCM+ multi-physics software, fully validated
 - Steady/Transient
 - Smoke model
- Fire Scenario
 - Single train car fire (fire inside car)
 - 19.84 MW medium fire growth
 - Beneficial effect of sprinklers not included
- Pass/Fail Criteria
 - Provision of a tenable environment during egress

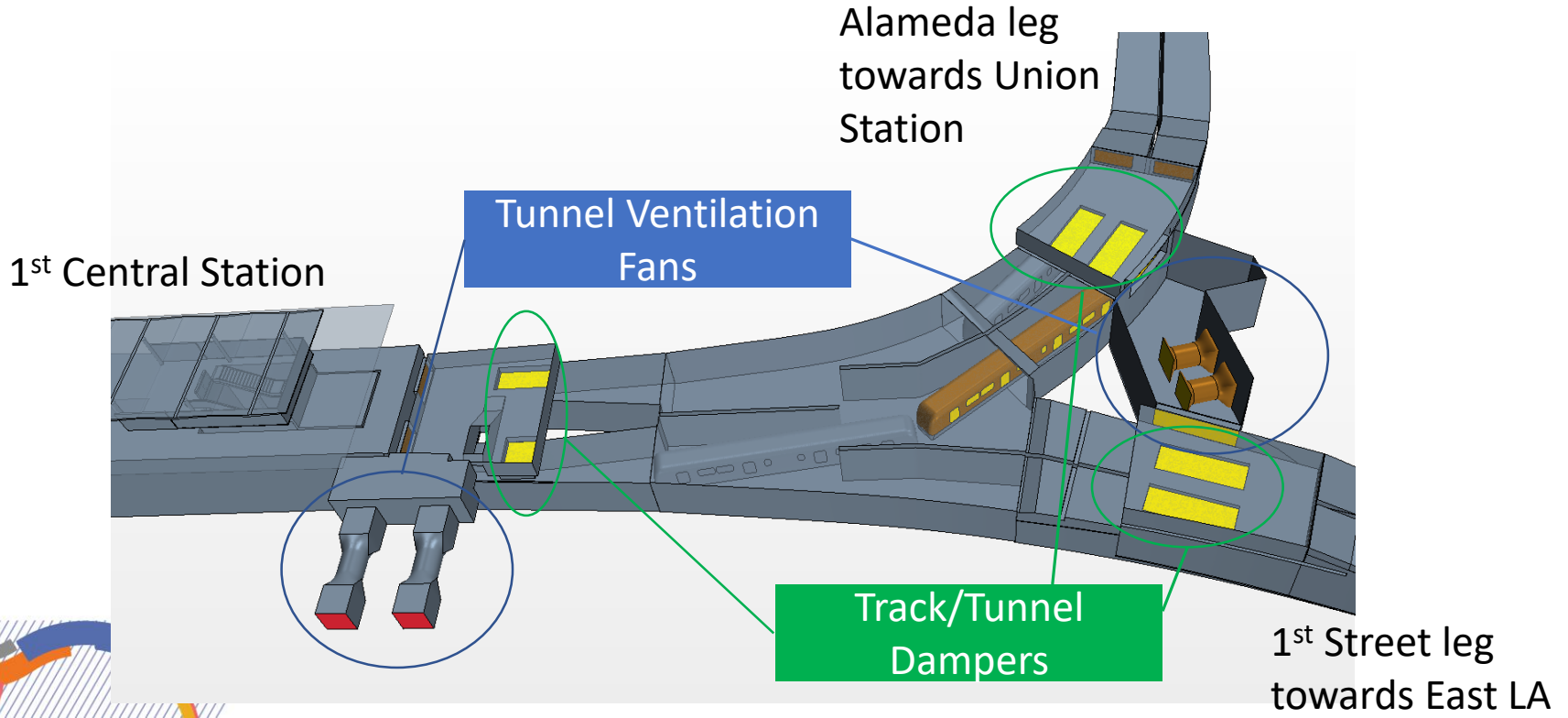


Train locations for analysis

Evolution of events



Alameda Wye Junction Fire Scenario



Proposed Ventilation for Mode 1

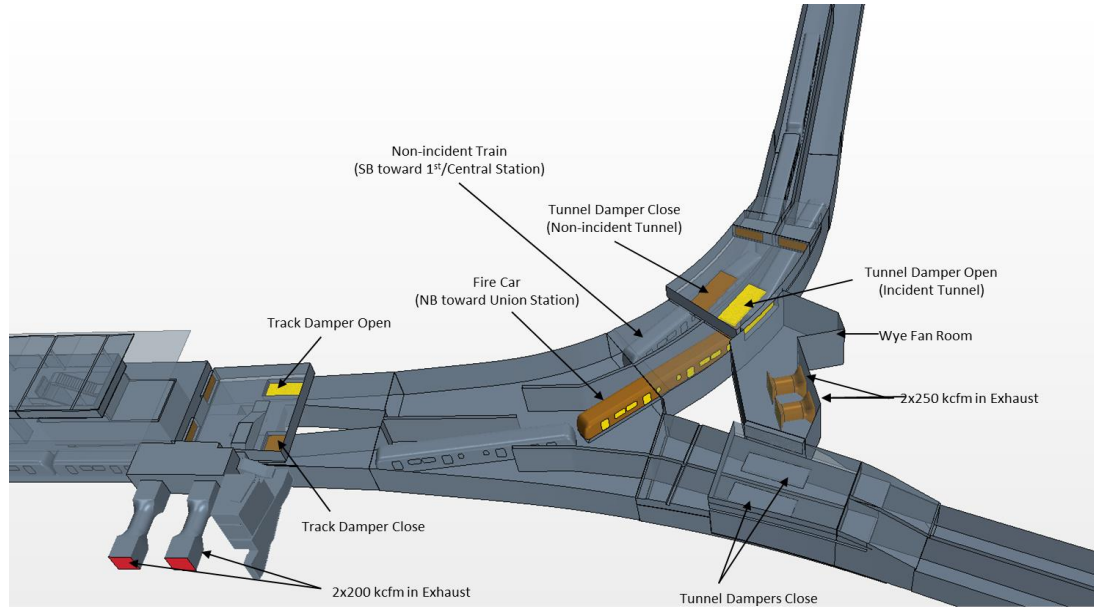
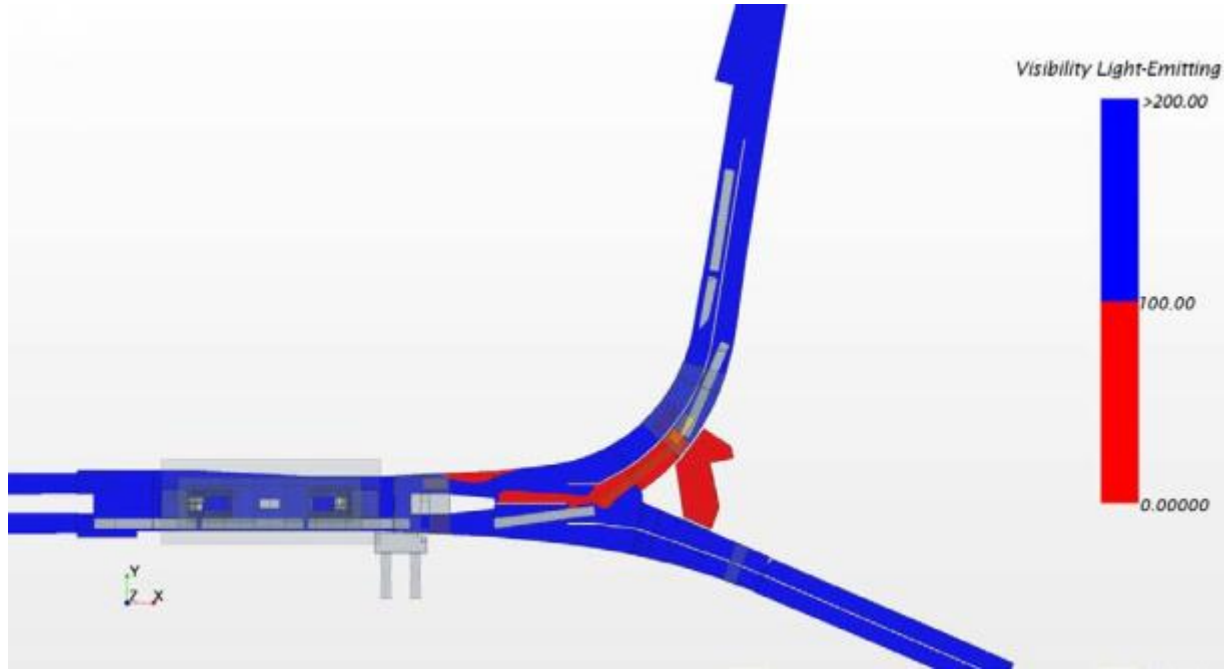


Figure J10-1 – Proposed Ventilation Mode 1 for Alameda Wye Junction Fire-All Fans Available.

Results for Mode 1



Results for Mode 1

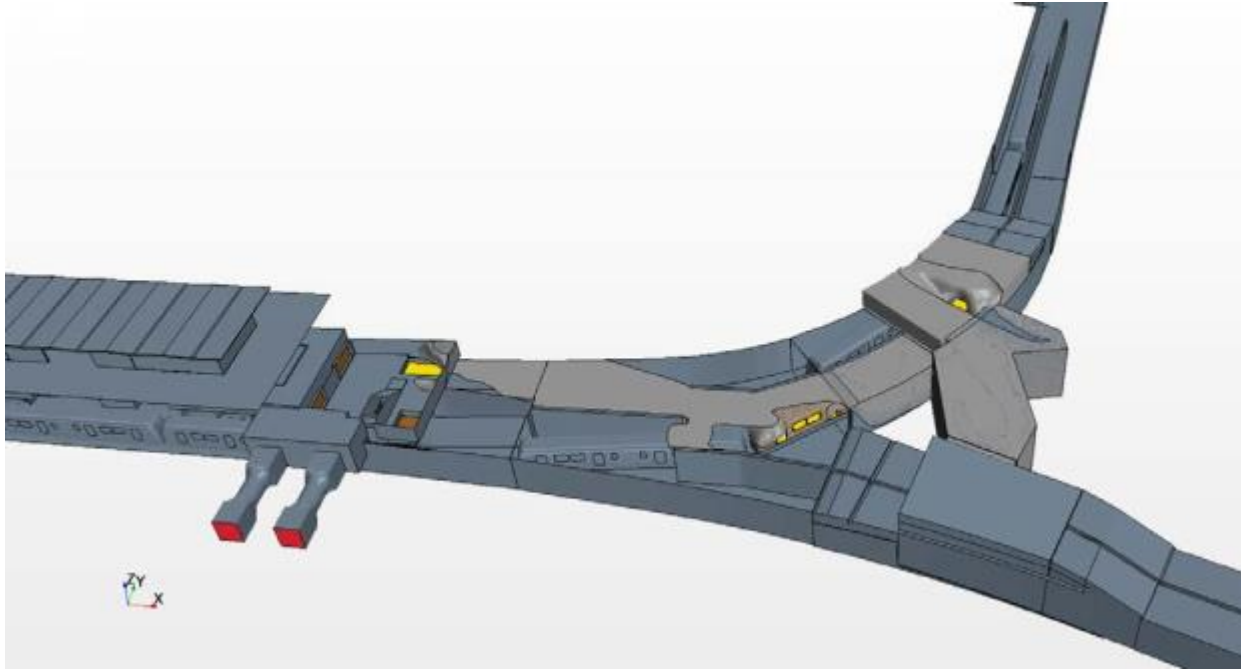


Figure J10-3 – Smoke Illustration (Steady State) with Proposed Ventilation Mode 1 -All Fans Available.

Results for Mode 1 (with one fan out)

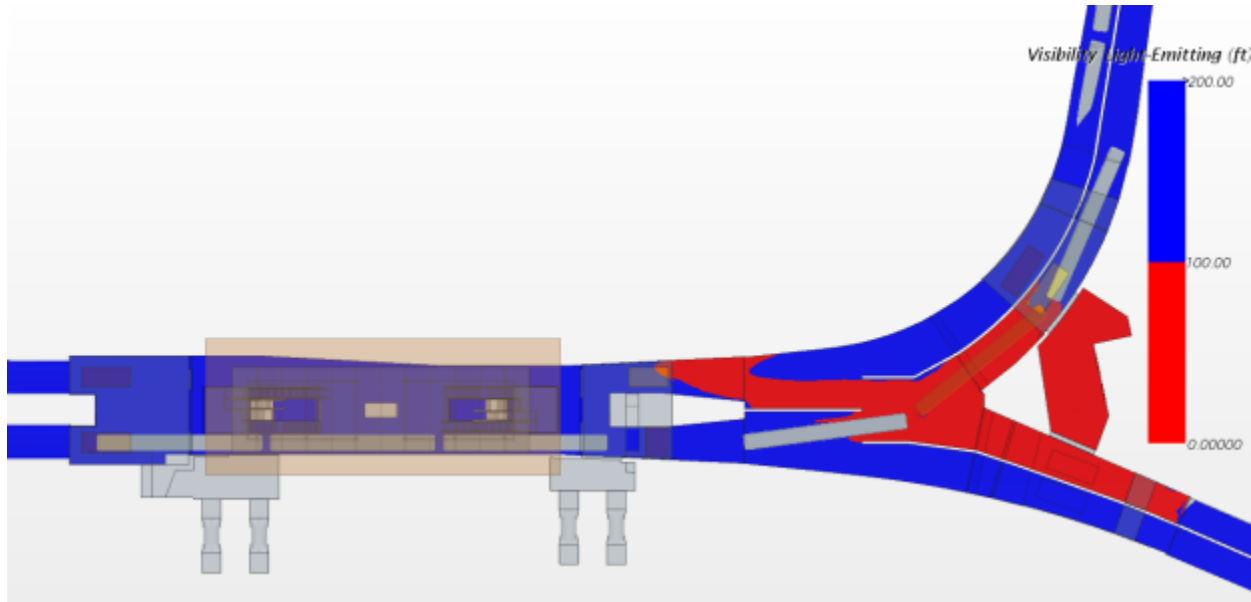


Figure J10-5 – Visibility Plot (Steady State) at 8.2 ft. above walkway with Proposed Ventilation Mode 1 -One Fan Out (1st/Central West End Fans are in Exhaust in Addition to the 1st/Central East End Fans and One Fan in the Wye Fan Plant).

Results for Mode 1 (with one fan out)

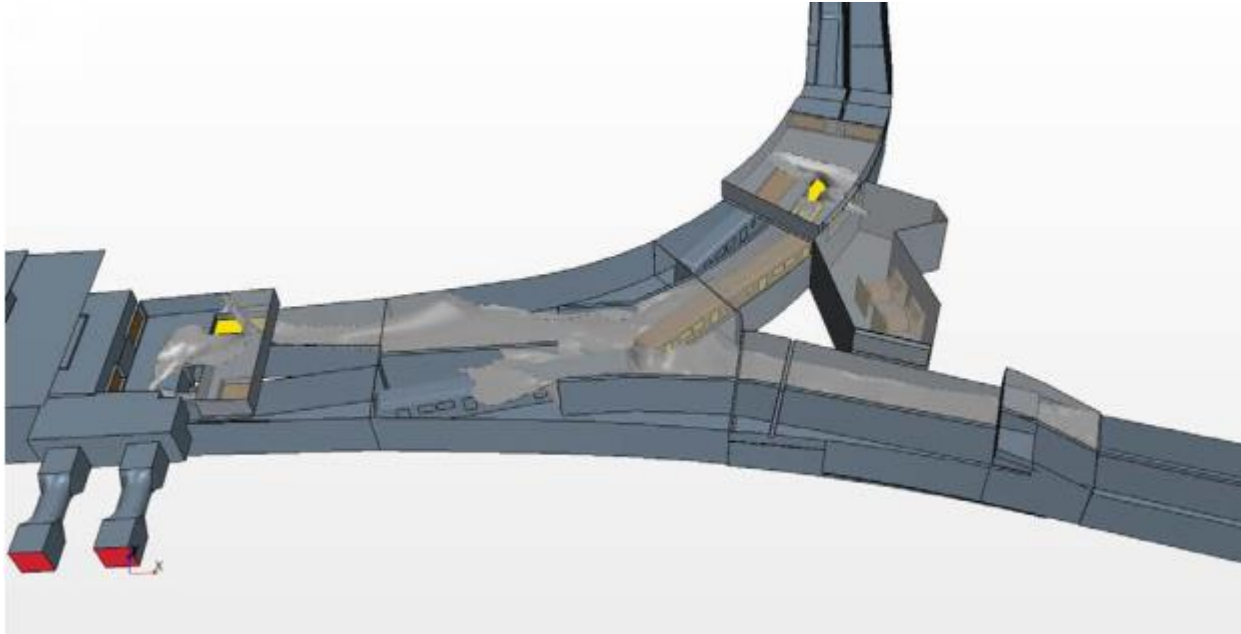


Figure J11-6 – Smoke Illustration (Steady State) with Proposed Ventilation Mode 1 -One Fan Out (1st/Central West End Fans are in Exhaust in Addition to the 1st/Central East End Fans and One Fan in the Wye Fan Plant).

Proposed Ventilation for Mode 2 (final recommendation)

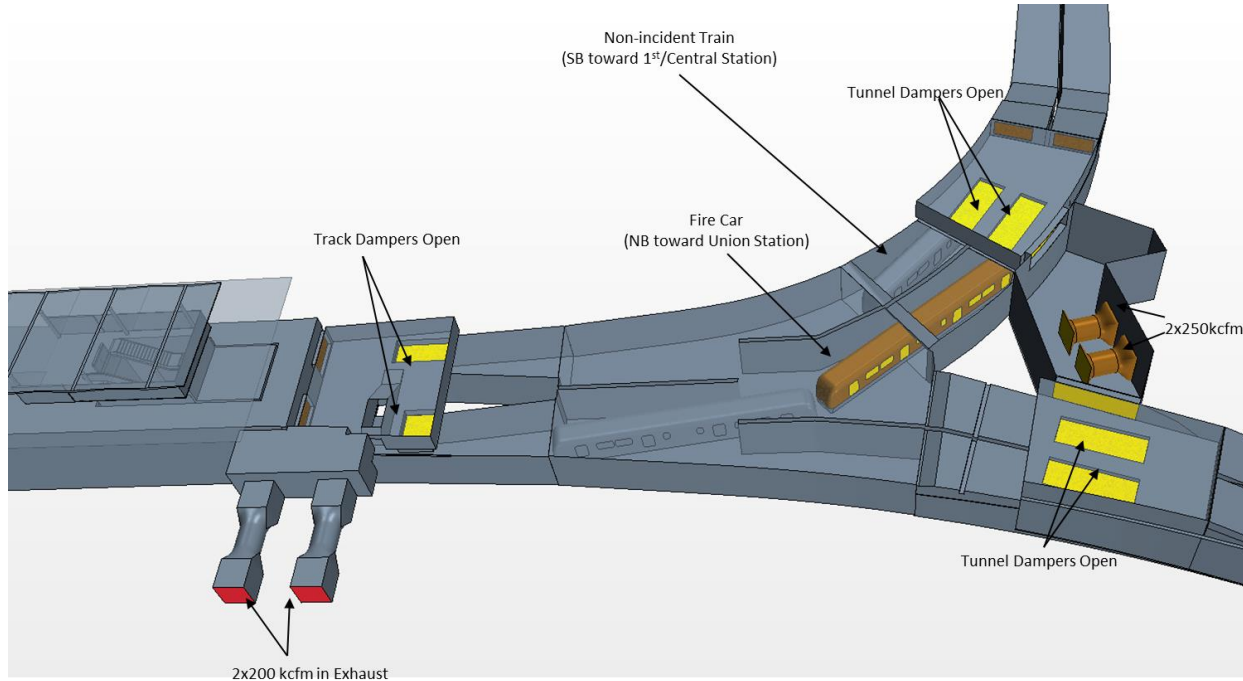


Figure J11-1 – Proposed Ventilation Mode 2 for Alameda Wye Junction Fire-All Fans Available.

Results for Mode 2

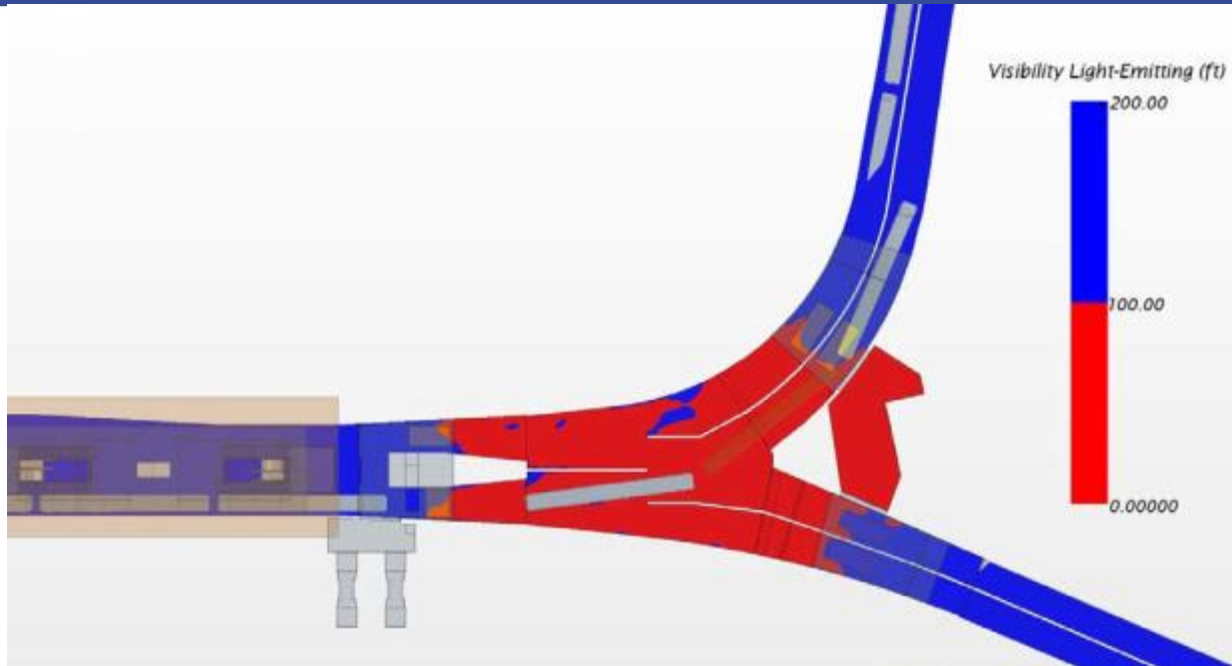


Figure J11-2 – Visibility Plot (Steady State) at 8.2 ft. above walkway with Proposed Ventilation Mode 2 -All Fans Available.

Results for Mode 2

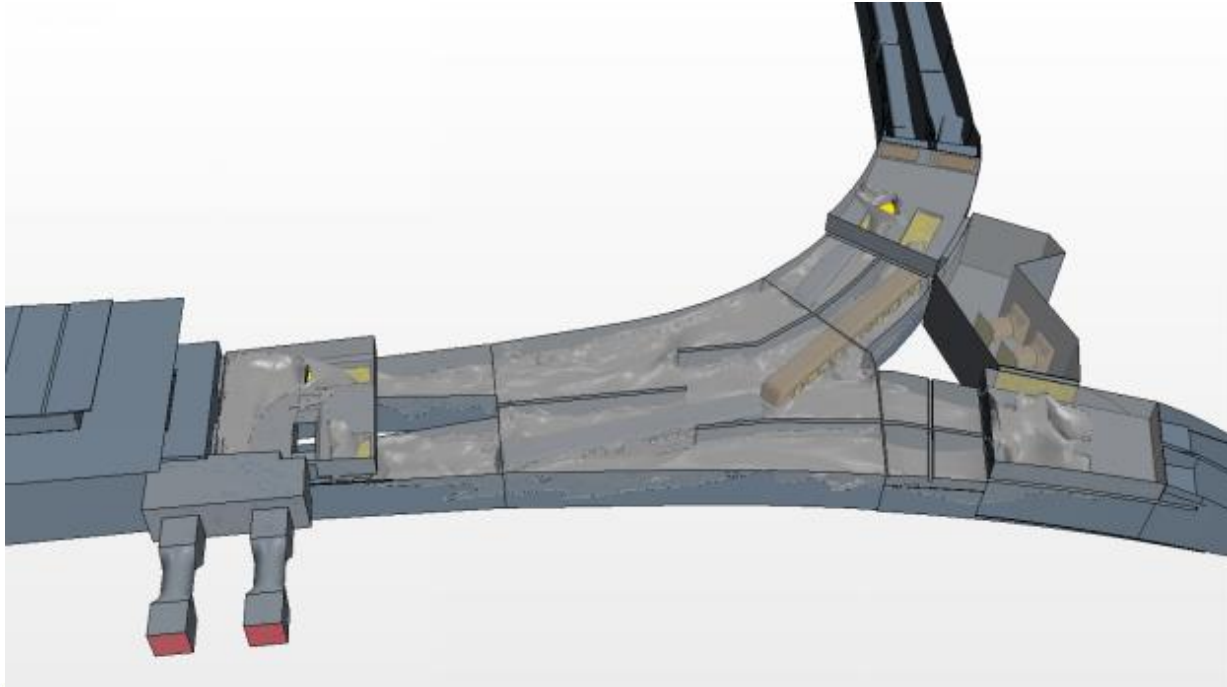


Figure J11-3 – Smoke Illustration (Steady State) Proposed Ventilation Mode 2 -All Fans Available.

Proposed Ventilation for Mode 2 – one fan out

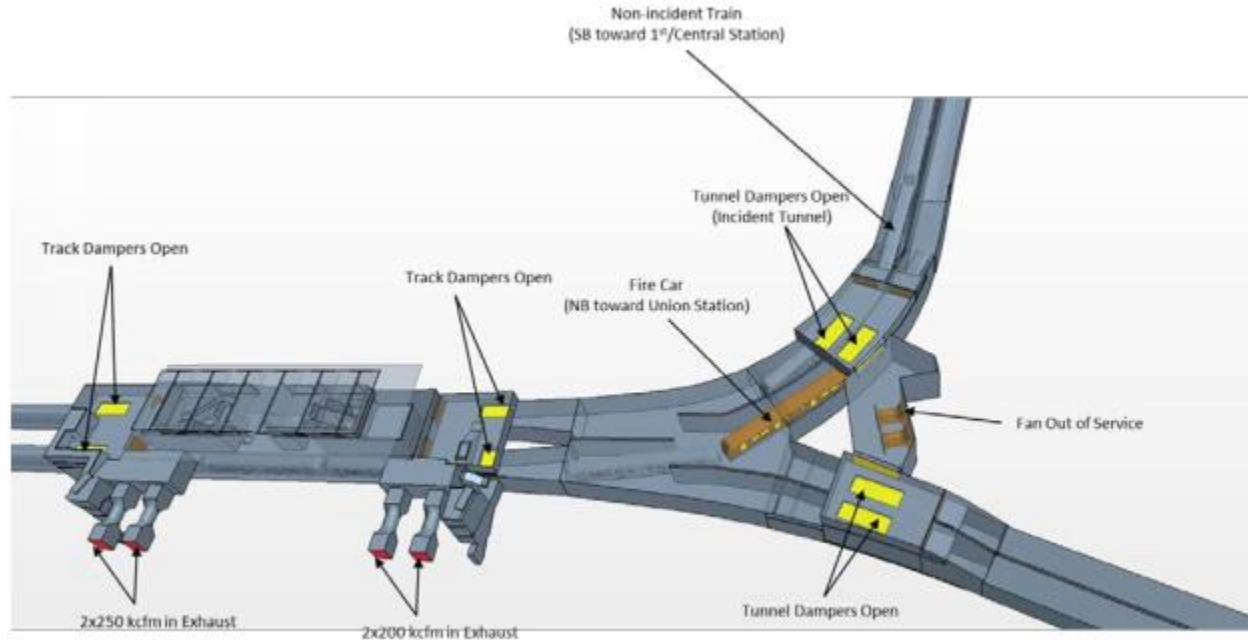


Figure J11-5 – Proposed Ventilation Mode 2 for Alameda Wye Junction Fire-One Fan Out.

Results for Mode 2 (one fan out)

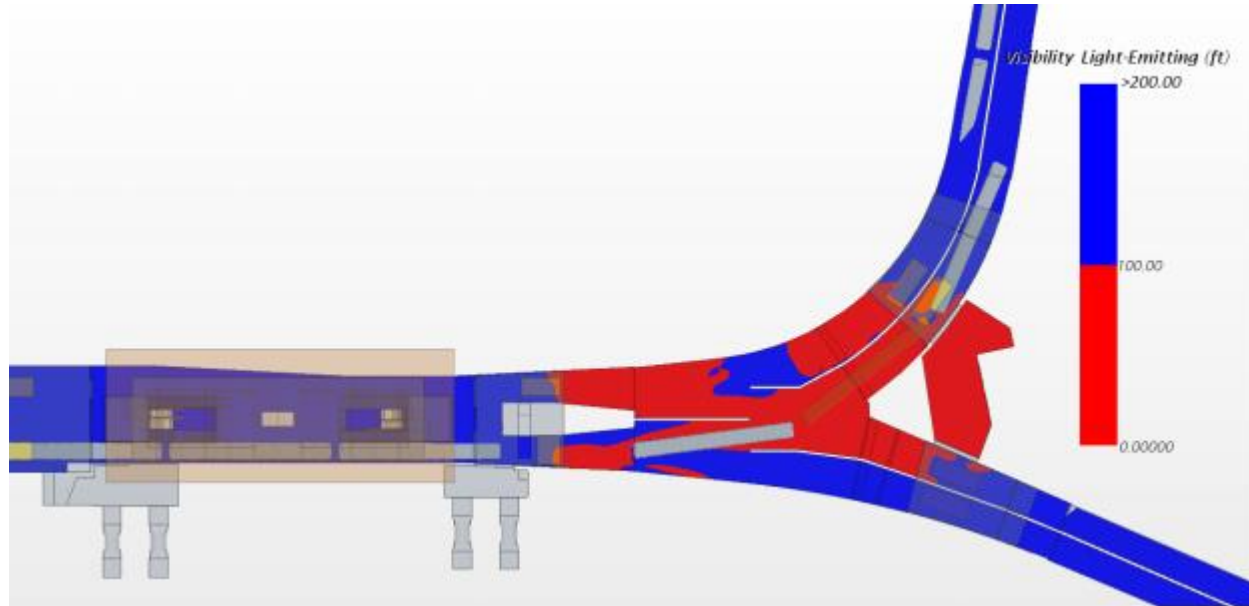


Figure J11-6 – Visibility Plot (Steady State) at 8.2 ft. above walkway with Proposed Ventilation Mode 2 -One Fan Out.

Results for Mode 2 (one fan out)

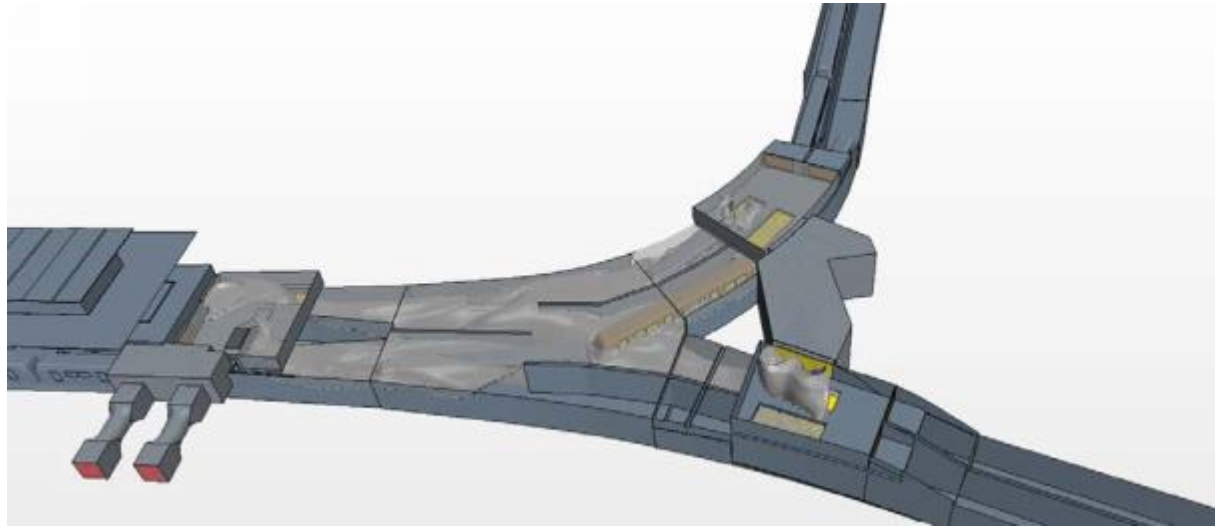
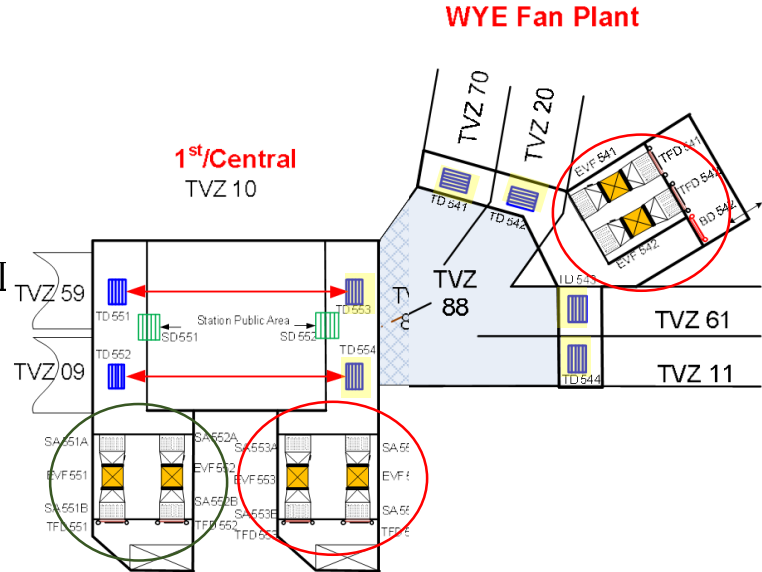


Figure J11-7 – Smoke Illustration (Steady State) with Proposed Ventilation Mode 2 -One Fan Out.



Mode Table Implementation

EV-88-RL-21	EVOP	WYE	88
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1st/Central										Wye Junction Fan Plant									
West					East														
EVF 551	EVF 552	TD 551	TD 552	SD 551	EVF 553	EVF 554	TD 553	TD 554	SD 552	EVF 541	EVF 542	TD 541	TD 542	TD 543	TD 544	BD 541	BD 542	BD 543	BD 544
Off	Off	C	C	C	E	E	O	O	C	E	E	O	O	O	O	C	C	C	C

E	E	O	O	O	E	E	O	O	C	E	E	O	O	O	O	C	C	C	C
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ONE OF THE TWO FANS IS OUT OF SERVICE

TURN ON THESE TWO FANS*

All fans available

One fan out

Mode Recommendations

- While Mode 1 provides better visibility in the Wye, the damper control is highly based on the fire location.
- The operator in the ROC needs to know which tunnel the fire is to determine the ventilation mode, which will increase the ventilation response time.
- Mode 2 also contains the smoke within the Wye and the single response irrespective of the exact fire location can reduce the response time. (Consideration to activate west fans)
- Therefore Mode 2 is recommended as it is 'less' location dependent

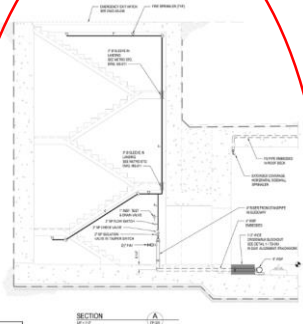


Additional Enhanced FLS provisions

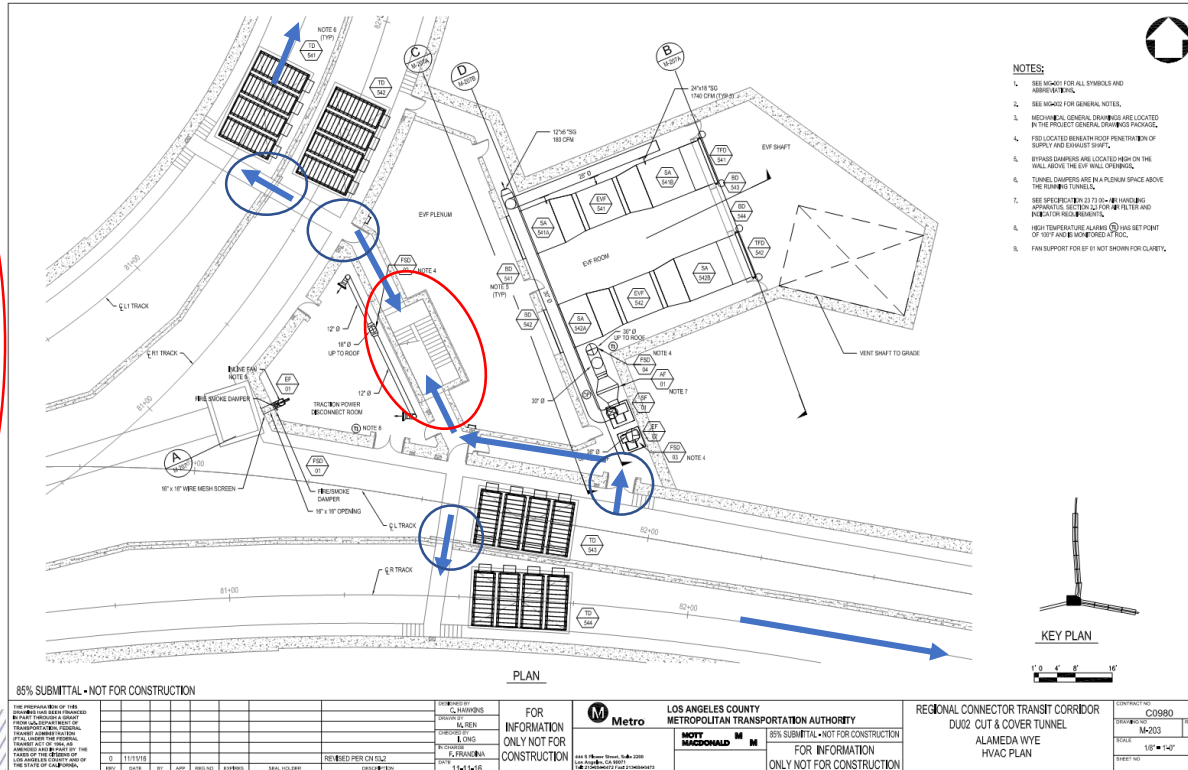
- Enhanced egress
- Fire Suppression System



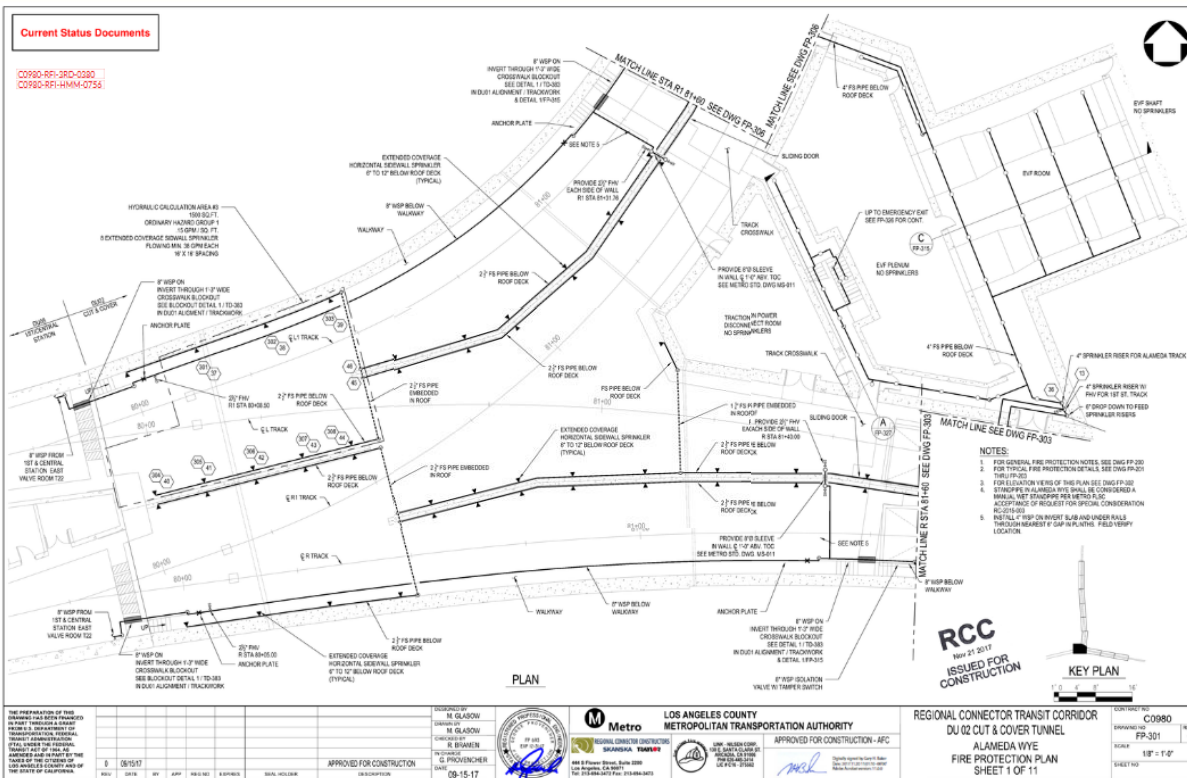
Enhanced Egress



Section of Egress Stairwell



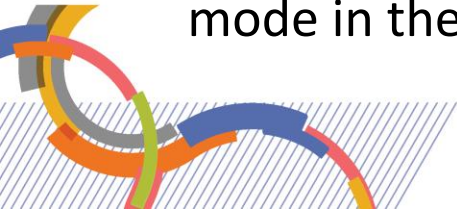
Wye Fire Suppression System



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 PLOT: 11/21/2017 10:58:42 AM

Final Recommendations

- CFD showed that Mode 1 is more effective even though Mode 2 is acceptable... many modes can address a particular event... for simplicity there is only **one** mode
- Ventilation principle is based on 'containment'
- Egress direction is to move out of the incident ventilation zone.. To egress exits or station or portal
- Safety is enhanced with the installation of Fire Suppression (Sprinklers) owing to complexities associated with egress
- Control system flexibility required to start supplemental ventilation mode in the case of critical fan failure during an incident



Thank you

