

Converting Road Tunnels to Rail

An Evaluation of Cost-Effective Fire Life Safety Design

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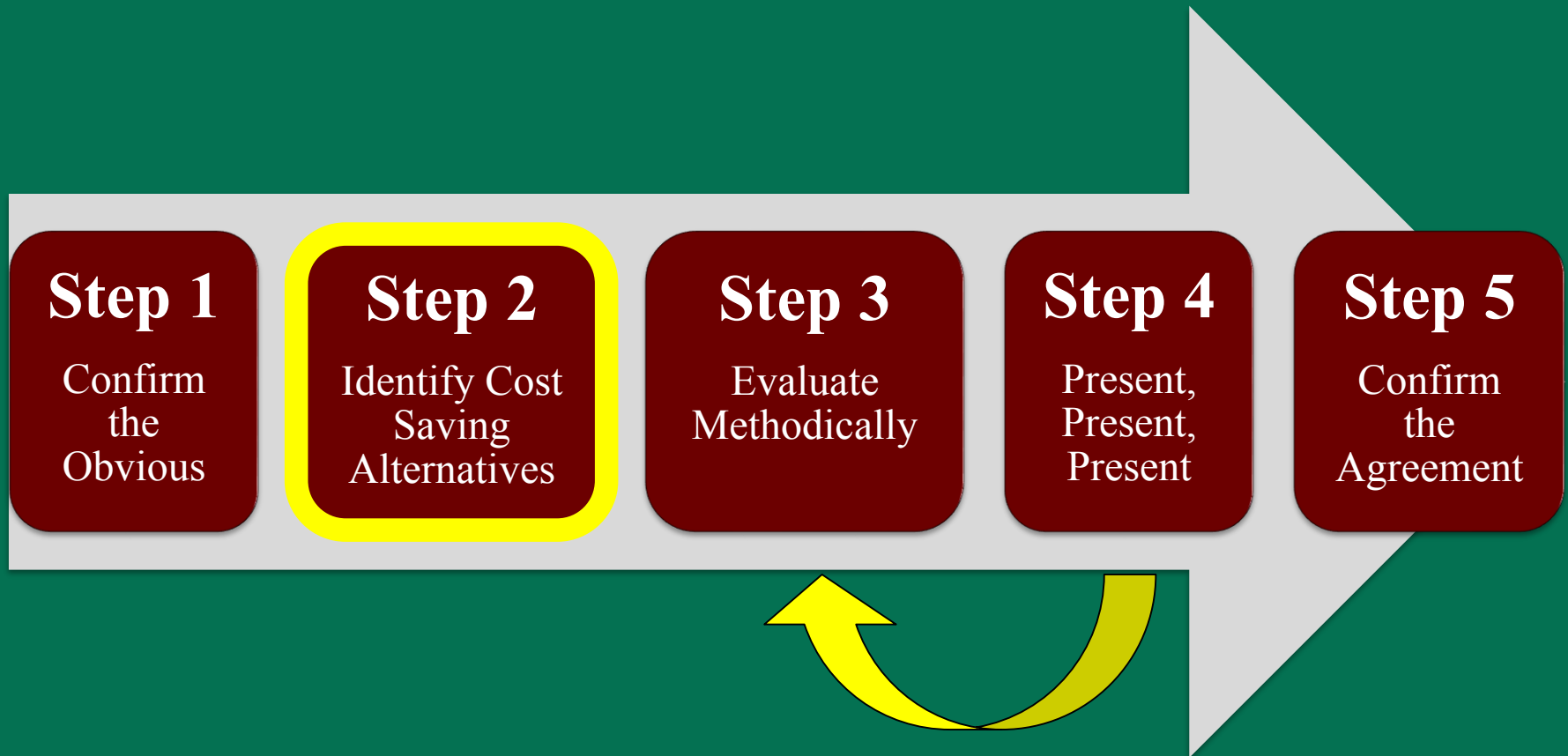
Rail Conference



Presentation Take-Aways

1. Take time to understand the existing fire life safety systems in the Road Tunnel
2. Look at cost savings opportunities and alternatives early
3. Recognize key factors affecting emergency ventilation and egress
4. Consider mitigating hazards with train control system protections

The Retrofit Project: “Know where you’re Going”



Why Convert Road Tunnel to Rail ?

Limited Available Right of Way



Transit Route in median of congested interstate

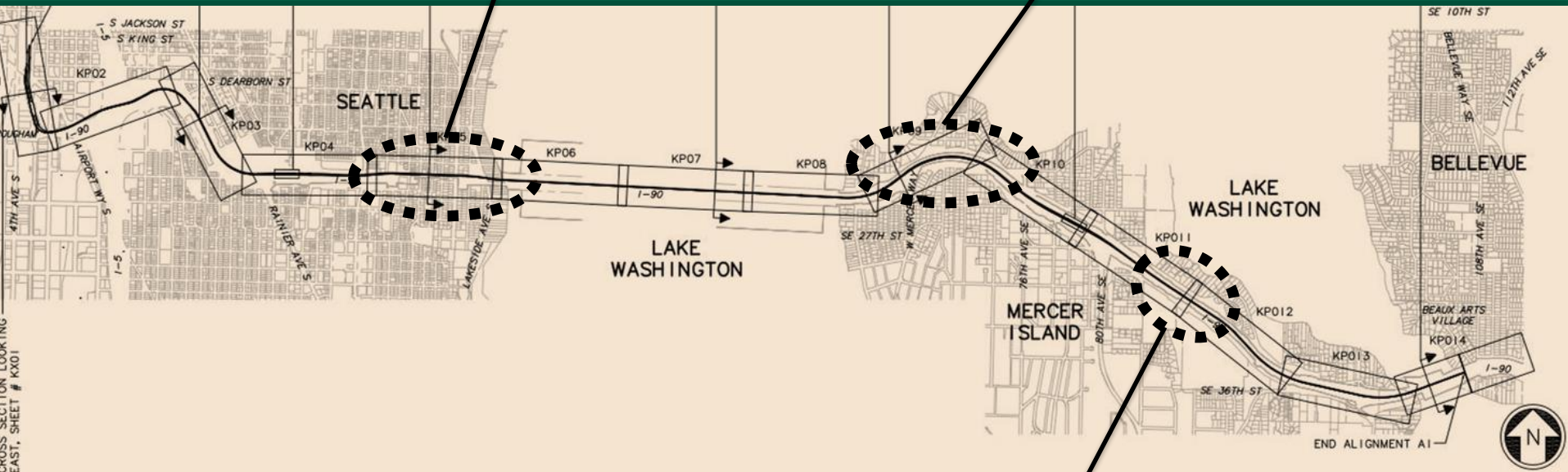


LRT across existing floating bridge

Converting I-90 Road Tunnels to Rail Seattle, WA

Mt. Baker Ridge Tunnel
3500 ft

Mercer Island Lid
2800 ft.



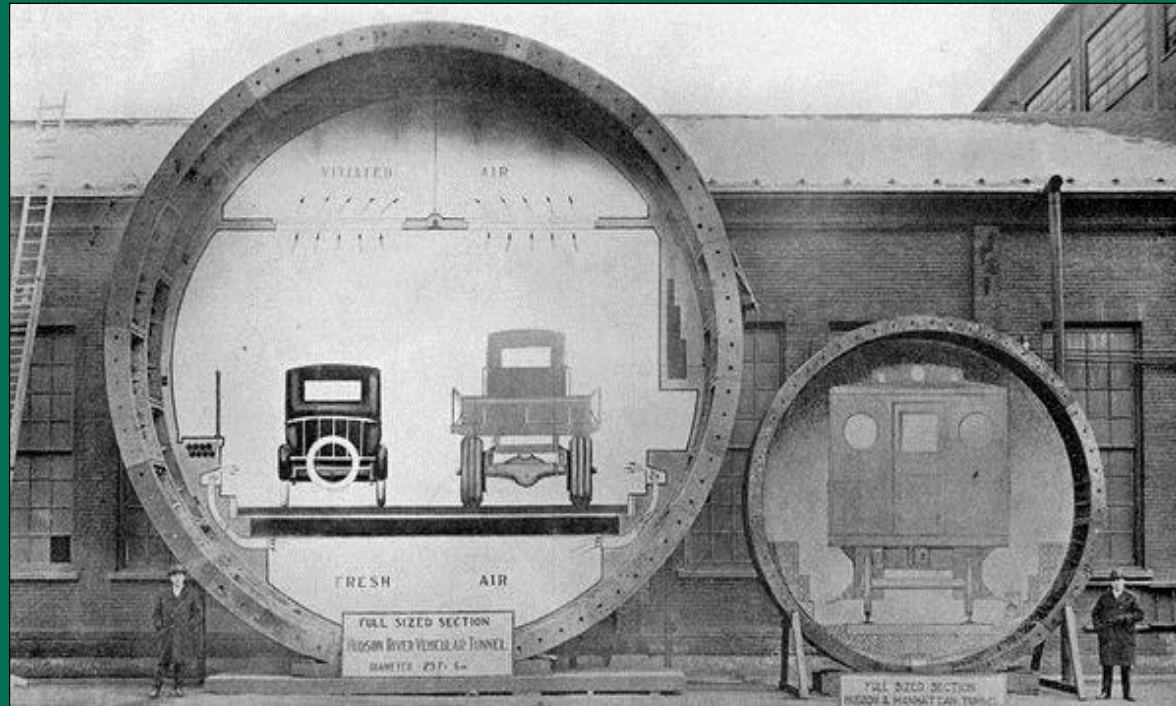
Luther Burbank Lid
400 ft.

Existing Road Tunnel FLS Systems

- Tunnel Ventilation
 - Fully Transverse Systems, Longitudinal Systems
- Tunnel Egress
 - Walkways, Utilidor, Adjacent roadway tunnels
- Tunnel Fire Protection Systems
 - Deluge Systems, Hydrants, Standpipes



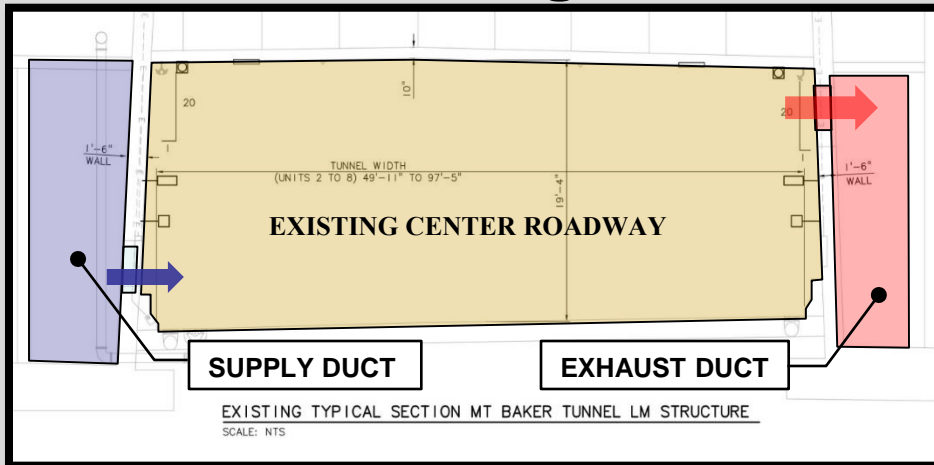
Transverse vs. Longitudinal Ventilation



Full-scale Model Section of the 1927 Holland Tunnel in New York

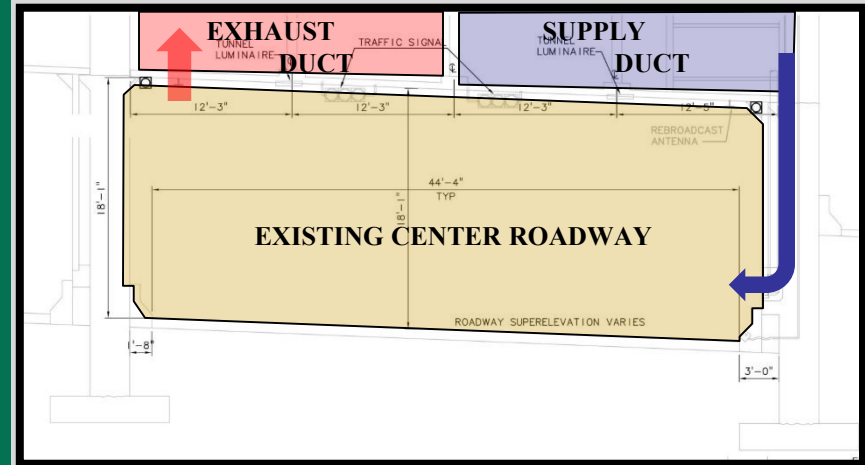
Existing Road Tunnel Ventilation Systems

Mount Baker Ridge



- Ducts along sides of Roadway
- (3) Supply Fans
- (3) Exhaust Fans – 230kcfm/ea

Mercer Island Lid



- Ducts above Roadway
- (3) Supply Fans
- (3) Exhaust Fans – 189kcfm/ea

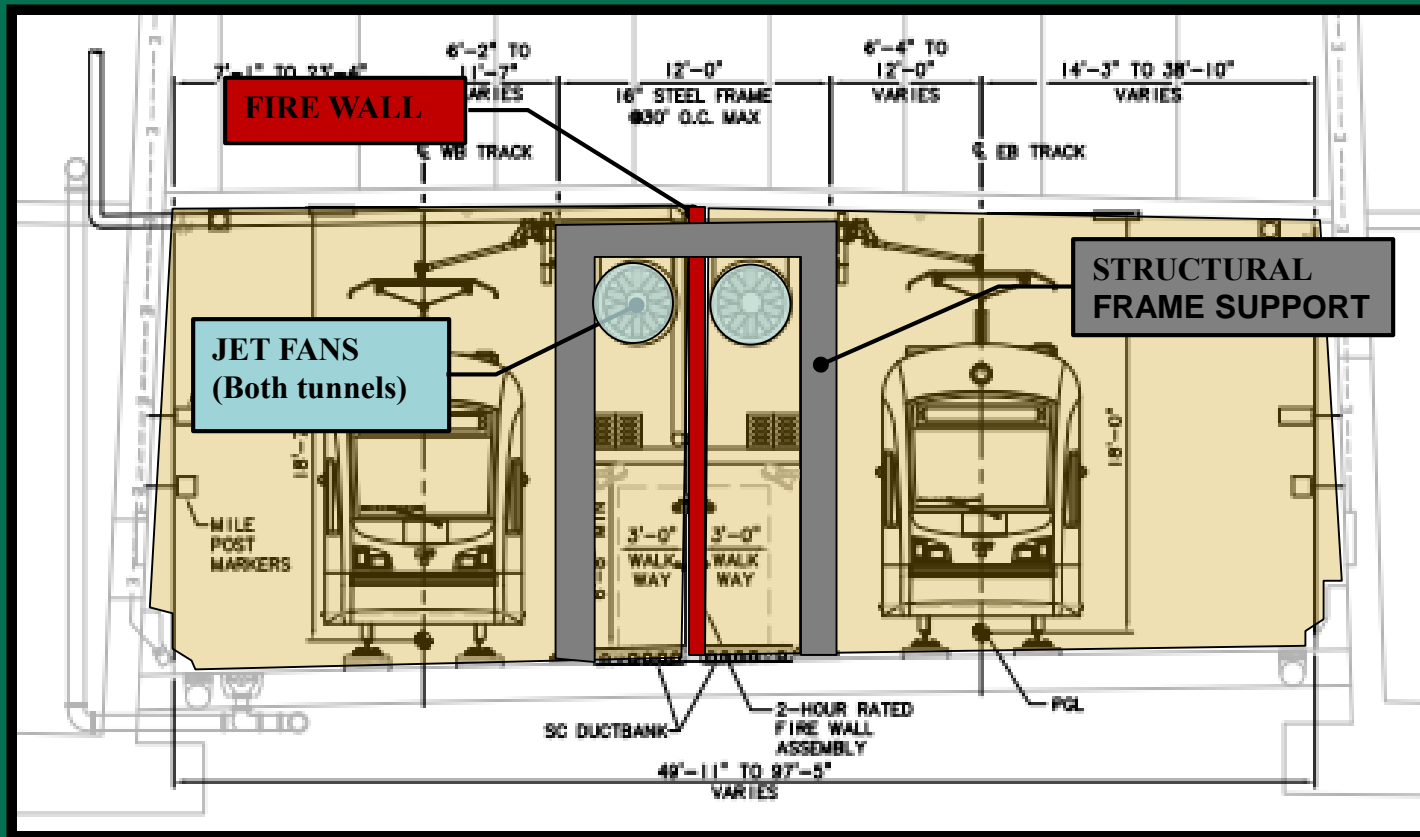
Concept Design

Emergency Ventilation and Egress

- Stakeholders
 - Tunnel owner, Train operator, Fire Departments
- Structural Limitations
 - Center dividing wall construction and support
 - Jet fan support
- Prescriptive approach to Egress
 - Single walkway per tunnel
 - Cross-passage doors 800 feet o.c.

EXAMPLE: Cost Savings Evaluation

Fire Wall and Support Frame \$18M



Factors Affecting Road Tunnel Ventilation

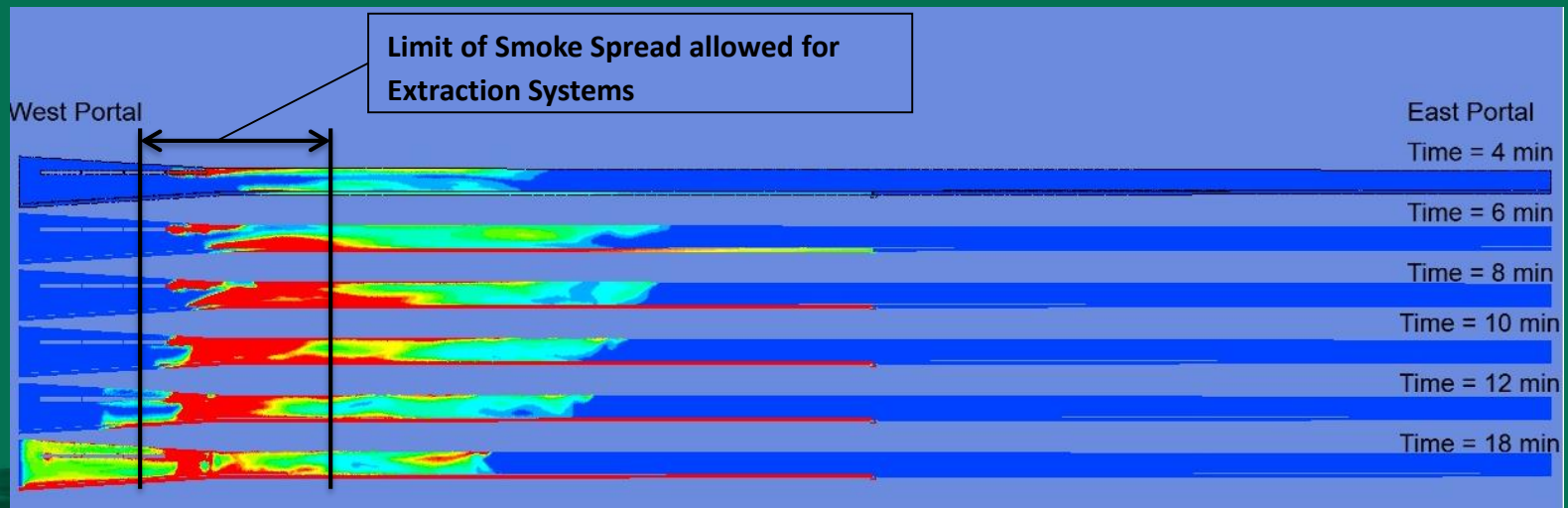
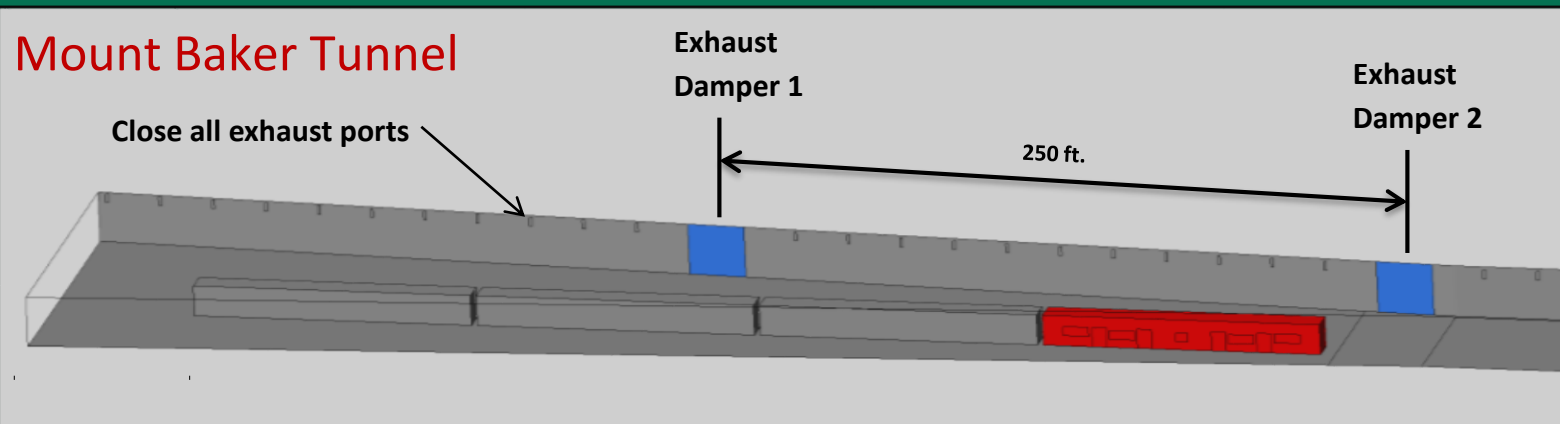
Tunnel Cross-Section & Width

Portal Wind Pressure

Ventilation System Capacity



Investigating Reuse of Transverse Ventilation System



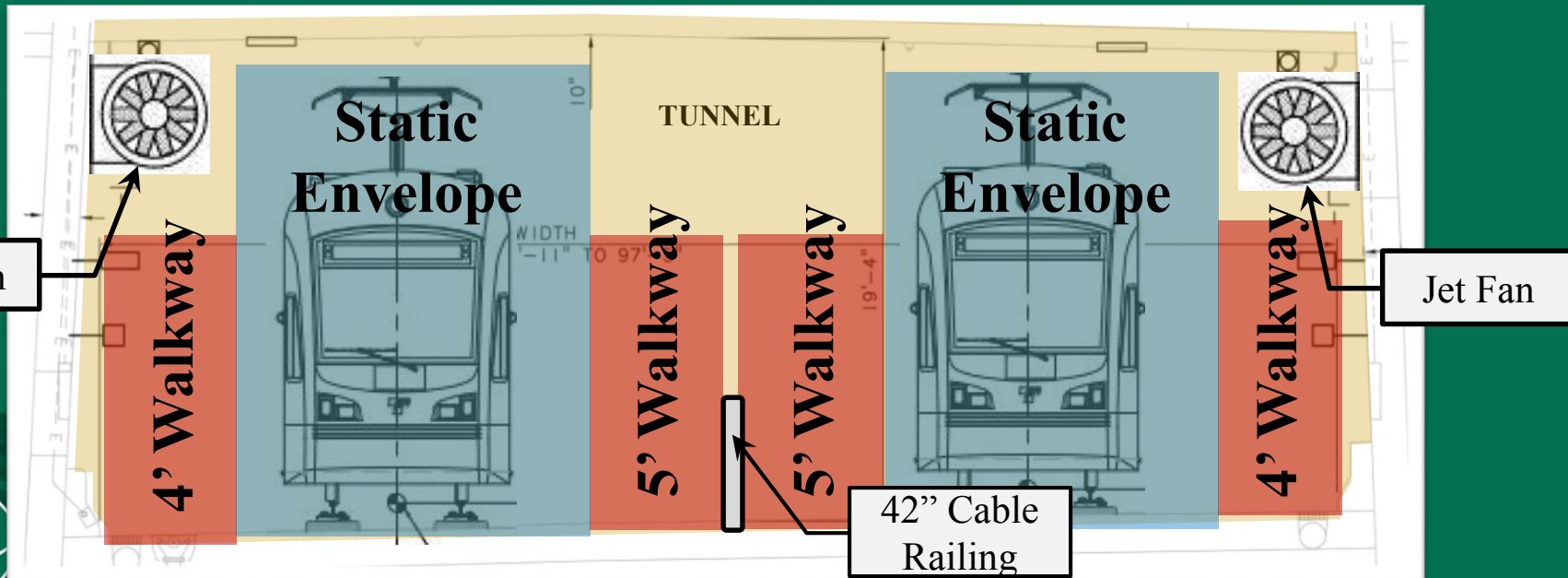
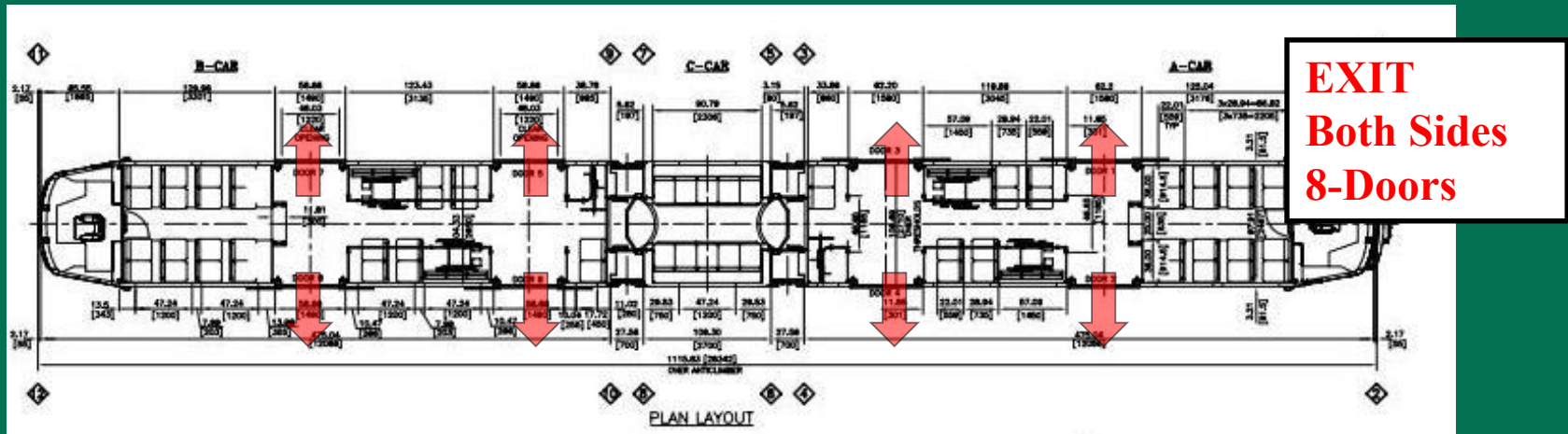
Final Design

Emergency Tunnel Ventilation and Egress

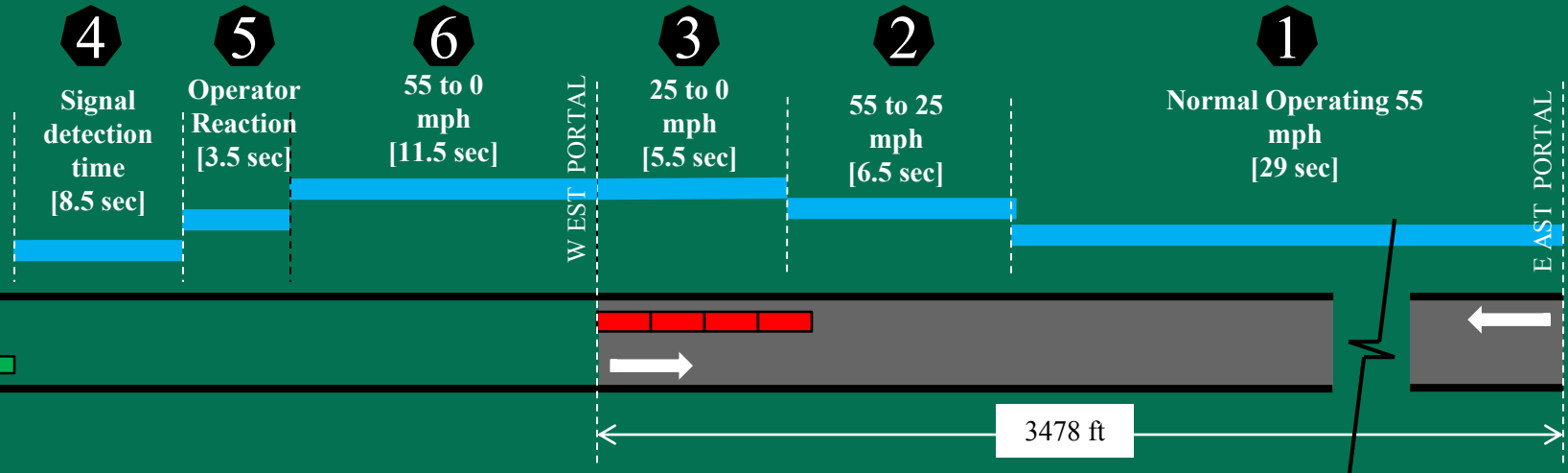
- Cost Savings: Elimination of Center Dividing Wall
- Evaluation of Existing Extraction Ventilation System and New Longitudinal System
- Performance-based Egress Analysis
- Hazard Analysis and Mitigation



Egress Opportunity in Wide Road Tunnel



Train Control System Hazard Mitigation



	Mt. Baker Tunnel		Mercer Island Tunnel	
	Description	Tunnel Time elapsed, [s]		Tunnel Time elapsed, [s]
1	Incident Train enters tunnel at 55 mph	29	Incident train enters tunnel at 45 mph	29
2	55 to 25 mph	6.5	45 to 25 mph	4.5
3	25 to 0 mph	5.5	25 to 0 mph	5.5
4	Signal detection (minus 5.5 s)	8.5	Signal detection (minus 5.5 s)	8.5
5	Non-Incident train reaction	3.5	Non-Incident train reaction	3.5
6	Non-incident train brakes to stop	11.5	Non-incident train brakes to stop	11.5
	Total time needed to Stop Non-Incident train outside tunnel	64.5	Total time needed to Stop Non-Incident train outside tunnel	62.5

Signal System Hazard Mitigation

- Automatic Detection of incident train via track circuit timers
- Target Detection Time (Tid) of 14seconds for trains travelling below 25mph
- Automatic Response by ATP speed commands and automatic braking



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Tunnel Electrical Systems

Rail Conference



Tunnel Electrical Systems Take-Aways

1. Electrical system to support tunnel fire life-safety

- Emergency Ventilation
- Lighting
- Standpipe Control

2. Combine technical advantages with value engineering

3. Engage and include agency maintenance staff

Factors Affecting Tunnel Electrical Systems

Electrical Service

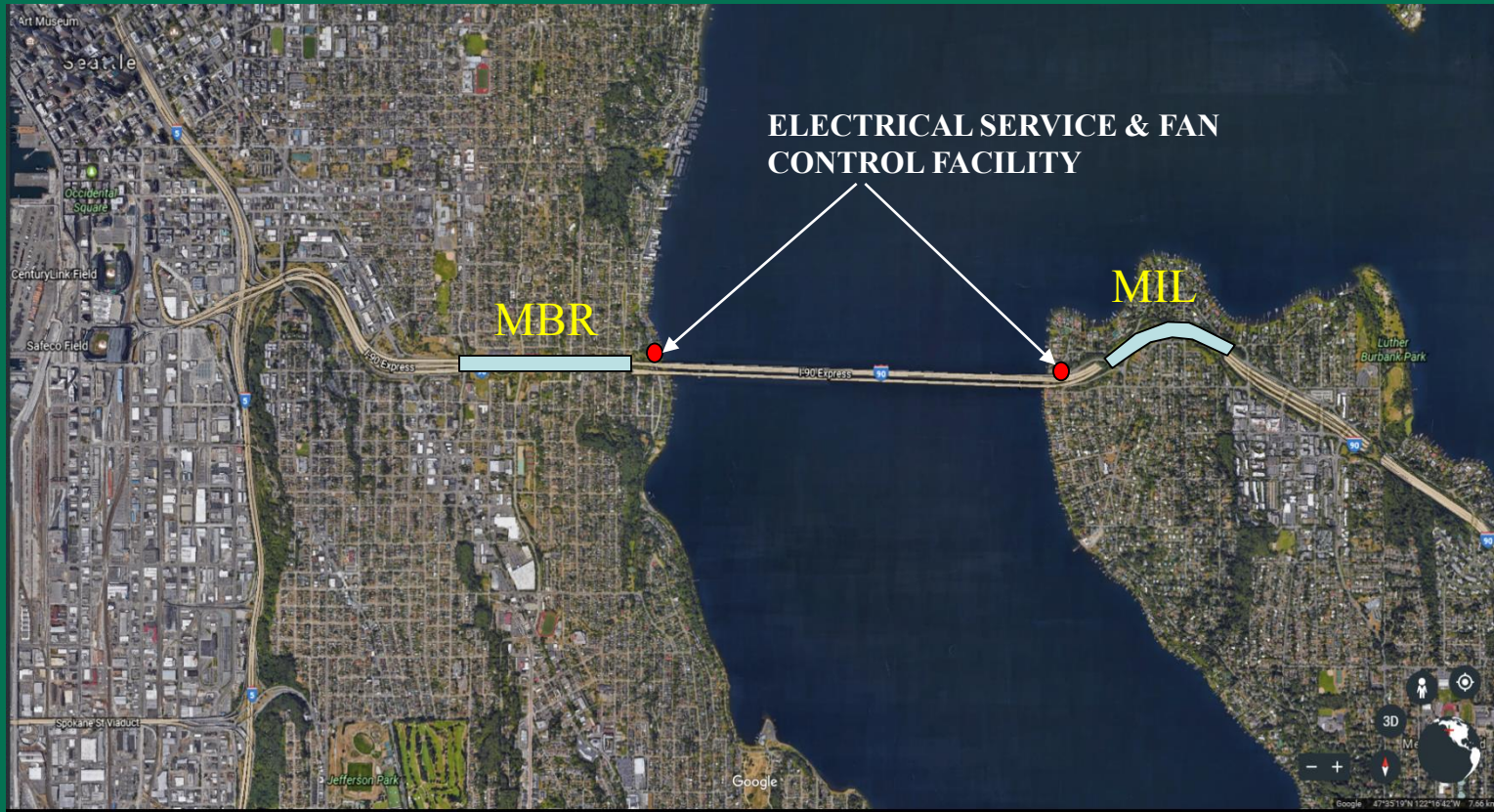
Voltage / Motor Starting

Emergency Power

Fire Rating / Emergency Circuits

A decorative graphic in the bottom-left corner consisting of several thin, white, curved lines that intersect to form a star-like or floral pattern.

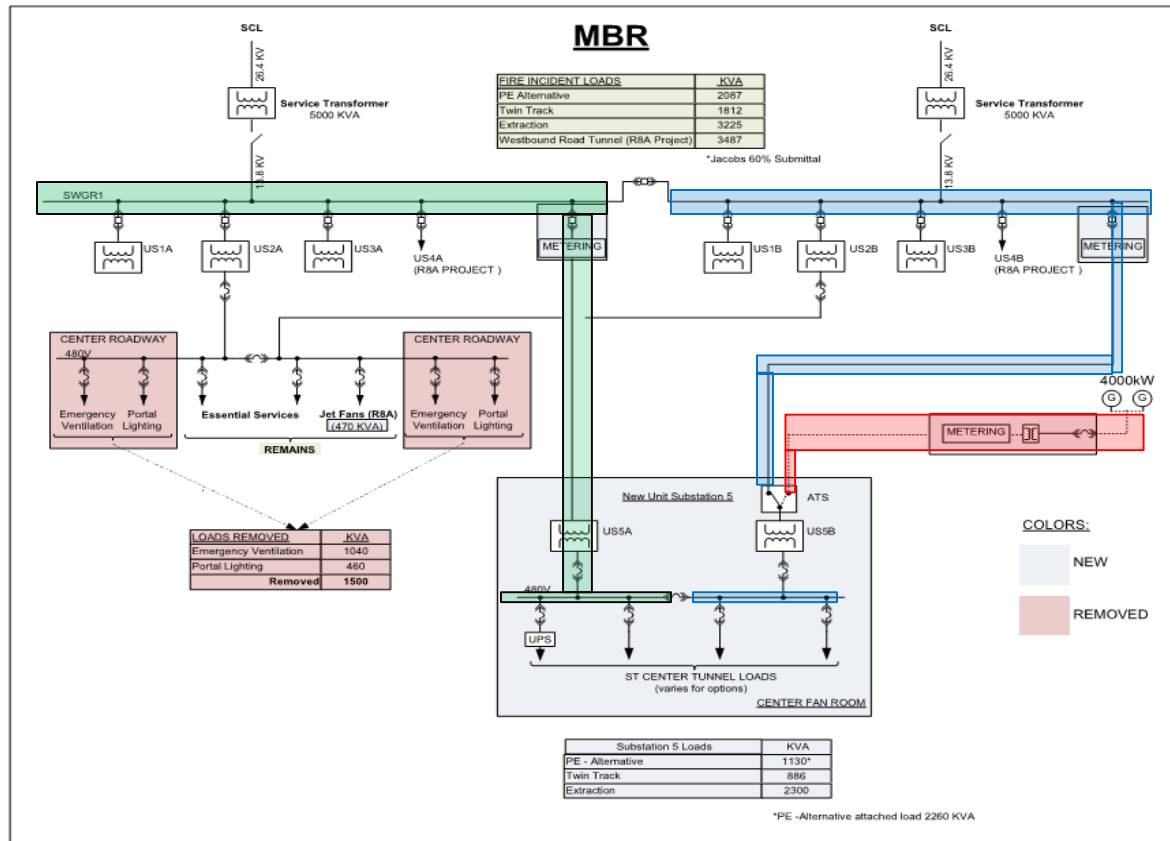
Electrical – Preliminary Engineering Documents



Electrical – Value Engineering

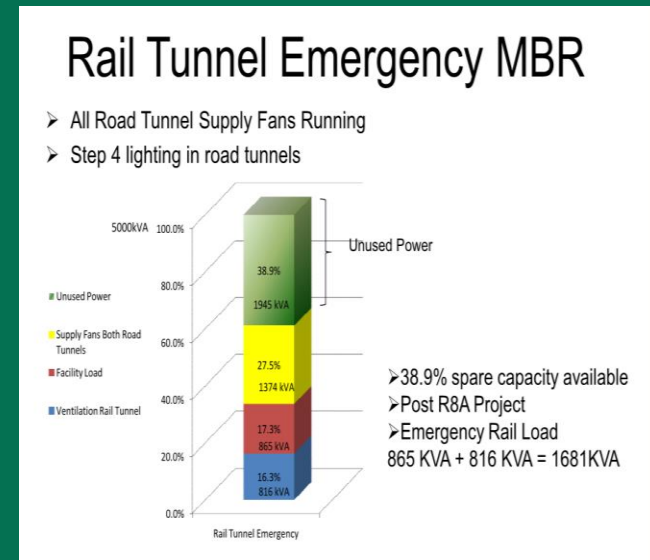


Electrical – WSP Recommendations



Electrical Power Capacity Studies

- Establish key tunnel operating parameters-
“Mutually exclusive incidents”
- Close adjacent tunnels during emergency
- Evaluate power demand vs available power



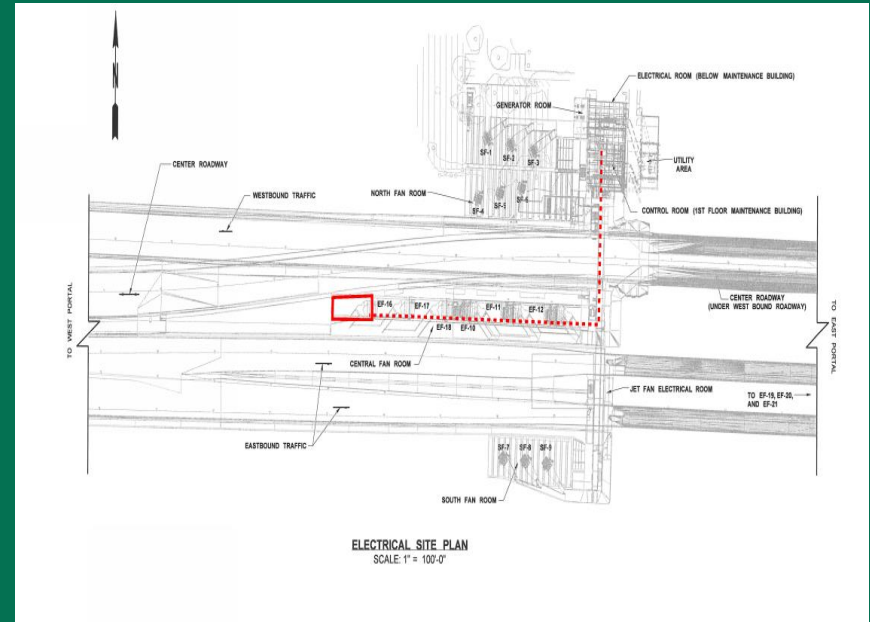
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I-90 First Hill Lid

TYPICAL SECTION FROM L^M STA. 223+93.00 TO L^M STA. 225+85.00 (EAST FAN ROOM)
(SEGMENT NO. 7A)
EXPANSION JOINT G TO L^M STA. 225+85.00 (END OF VENTILATION BLDG.)

SUMMARY REPORT
PLATE 3

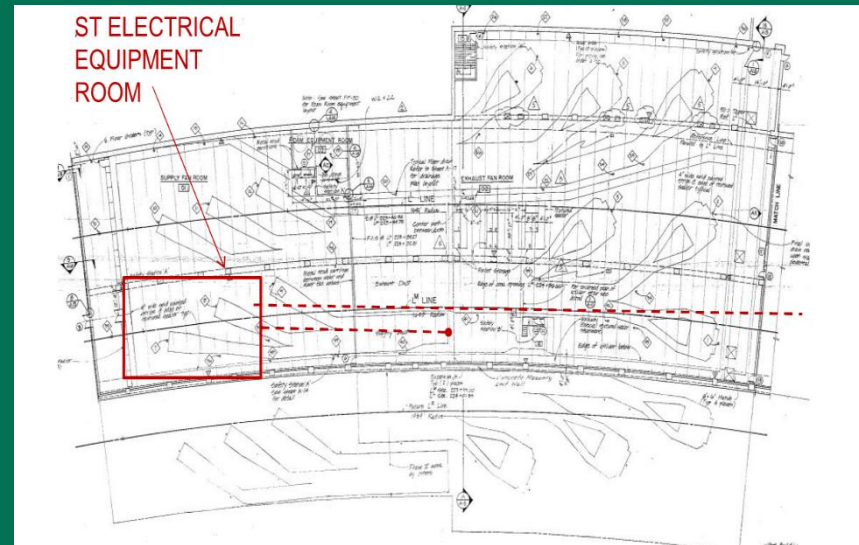
MBR - ST Electrical Room



MBR – ST Electrical Room



MIL – ST Electrical Room



NOTES:
1. TBD.

CONSTRUCTION NOTES:
1. TBD.

SEE DWG E05-EPP205

SEE DWG E05-EPP202

WSDOT THROUGH ACCESS

ST ELECTRICAL ROOM

ST ACCESS

ST COMM ROOM

WSDOT THROUGH ACCESS

E05-USS-05

WEL 243-00

E05-SP-01

EB 243-00

E05-PR2-02

E05-PR4-02

E05-UP5-01

E05-PR4-03

E05-PR2-01

E05-T-03

E05-PR2-01

E05-TC-01

E05-MCC-01

E05-MCC-02

CONDUITS TO TUNNEL IN EXIST SUPPLY DUCT

EXIST SF-27

KEY PLAN

60% SUBMITTAL

DESIGNED BY:
K. GRACE
DRAWN BY:
M. BOPE
CHECKED BY:
K. WARDORP
APPROVED BY:
T. MUDAYANKAVIL

PARSONS
BRINCKERHOFF

SUBMITTED BY:

DATE:
12/15/14

REVIEWED BY:

DATE:
12/15/14

SCALE:
1"=20'
E130-E05-EPP201
CONSTRUCTION:
E130
DATE:
12/15/2014

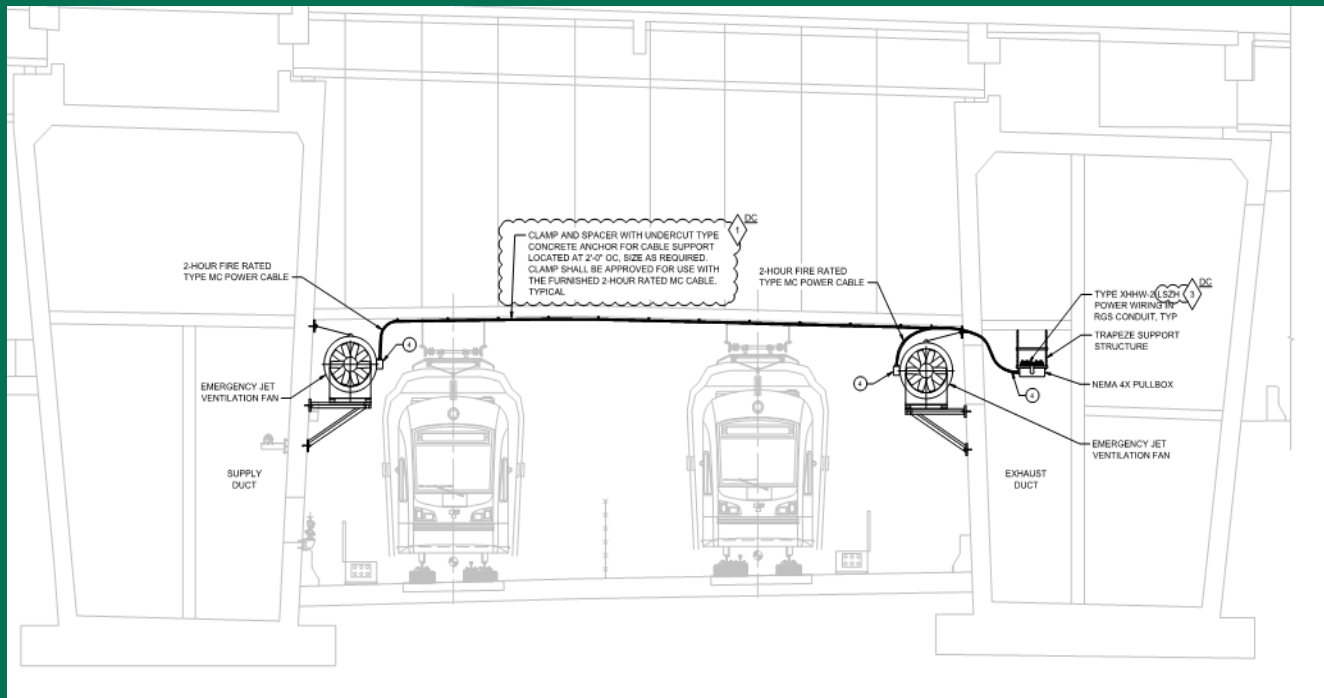
LINK LIGHT RAIL
CONTRACT E130
SEATTLE/9-80 to SOUTH BELLEVUE
MERCER ISLAND TUNNEL
ELECTRICAL PLAN
FAN ROOM

CONSTRUCTION NO.
E05-EPP201

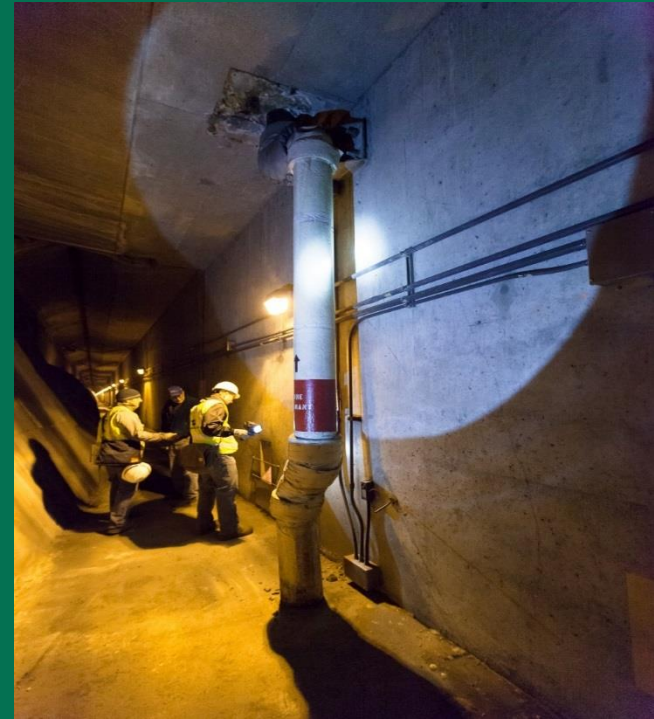
LOCATION NO.
E05

SHEET NO.
544

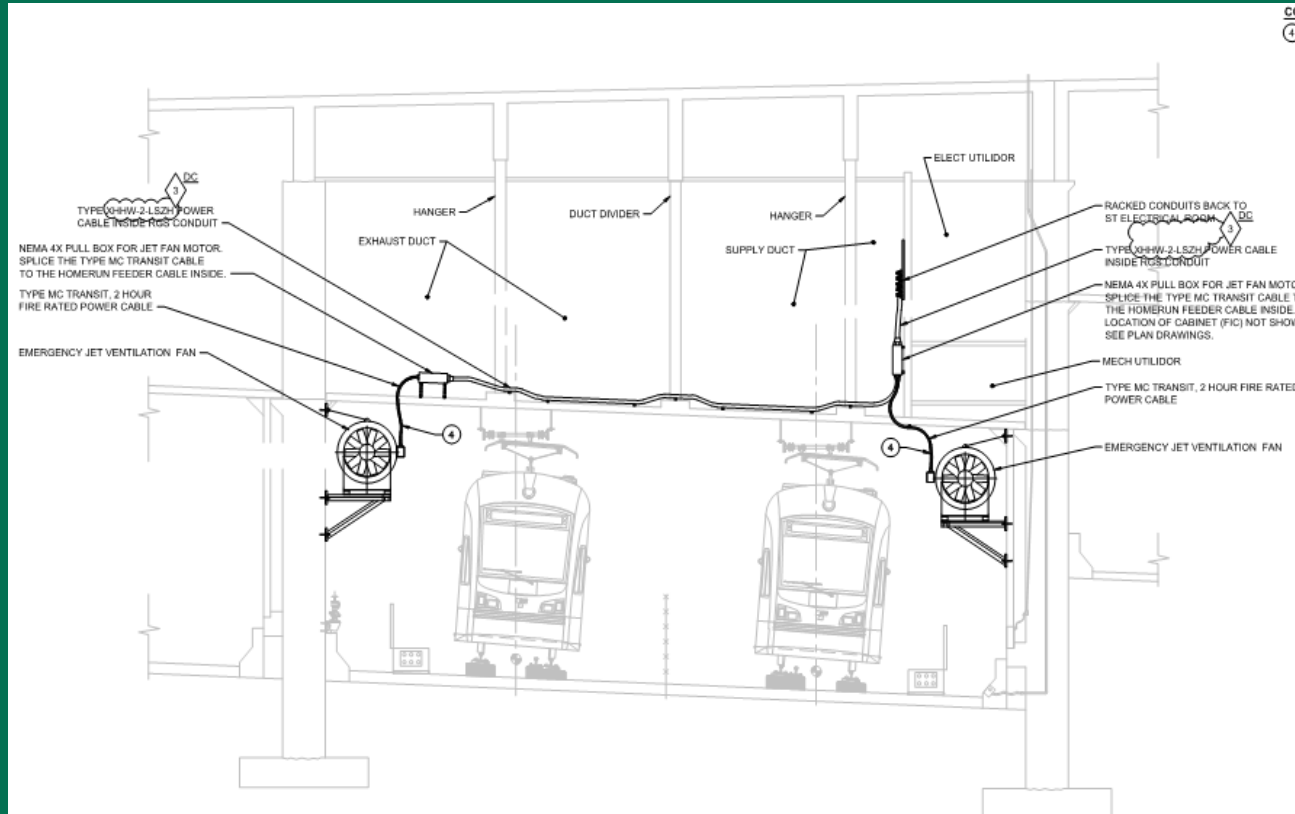
MBR – Fire Rated Wiring



MBR – Fire Rated Wiring



MIL – Fire Rated Wiring



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Questions?

