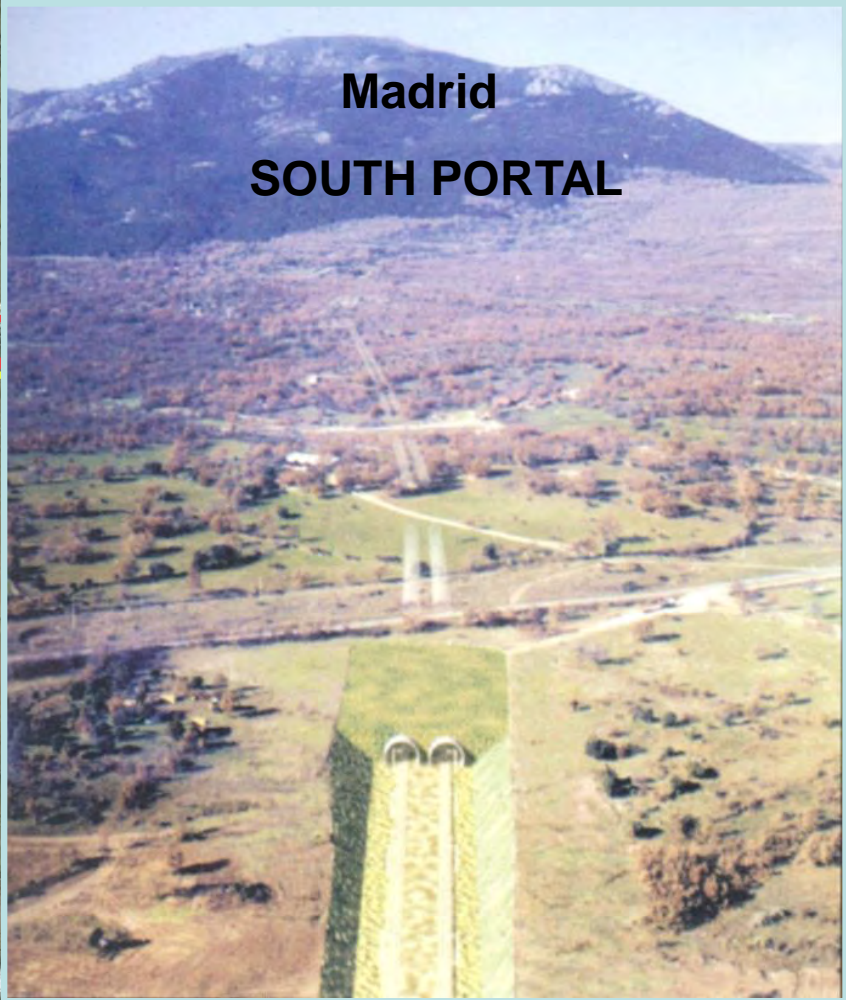
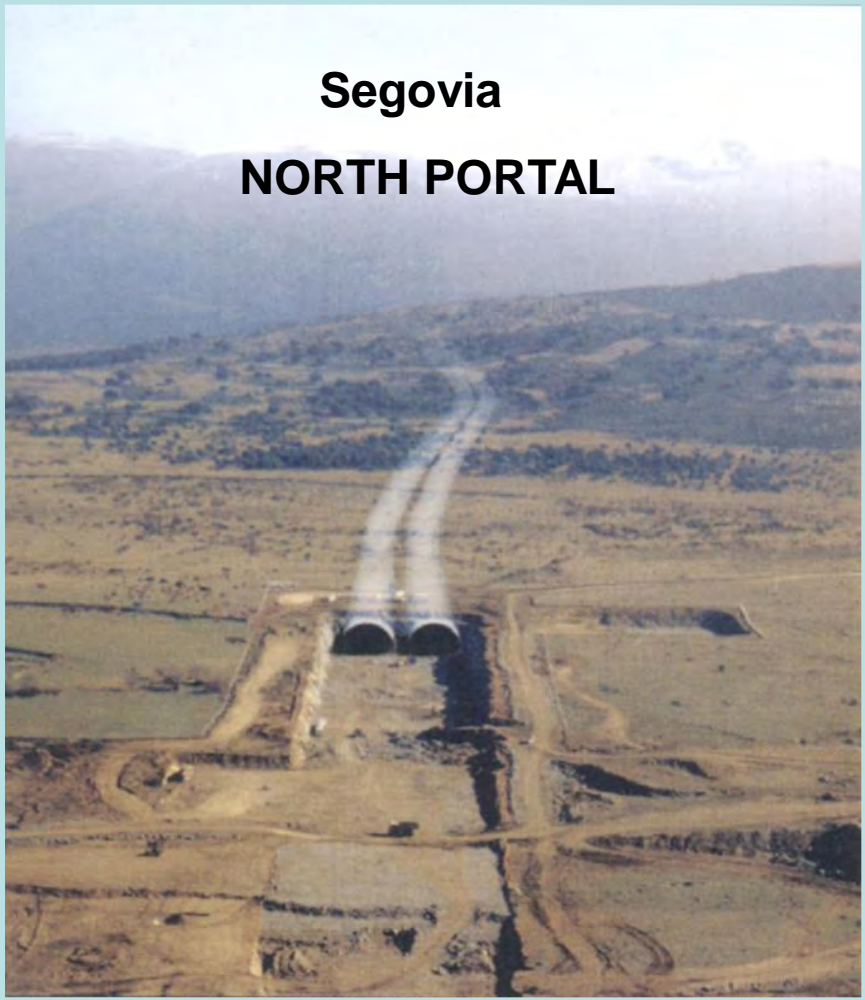


# VENTILATION HIGH SPEED RAILWAY Guadarrama Tunnels

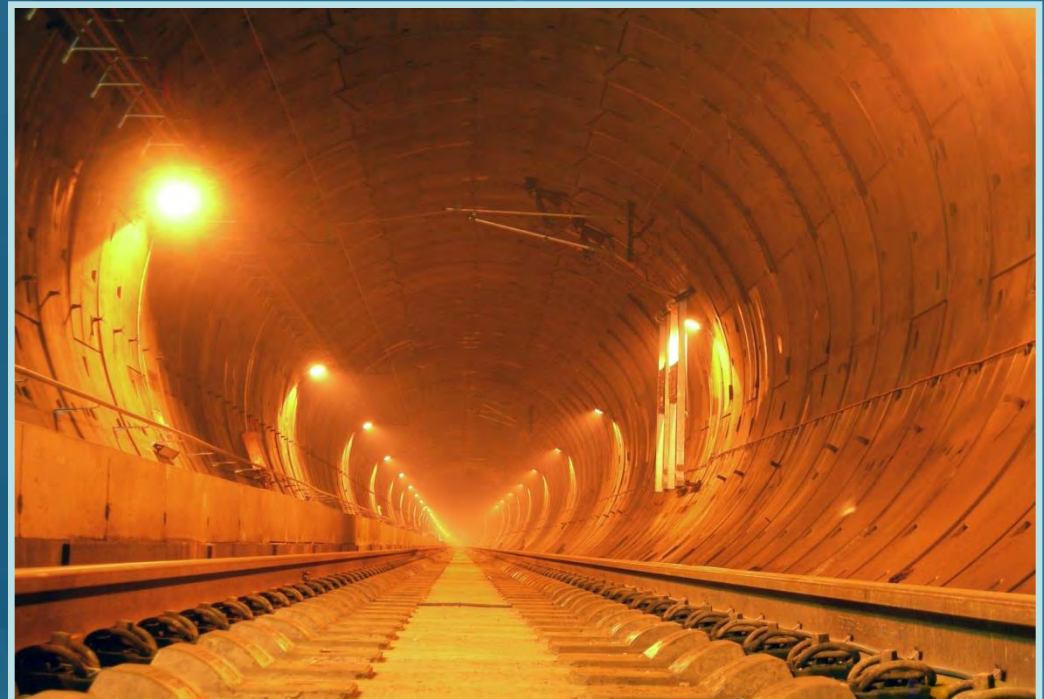




# GUADARRAMA TUNNELS



- 2 Parallel Tunnels
- Length 28 Km.
- 4 TBM
- Section : 52 m<sup>2</sup>
- Emergency Galleries : 250 m



# GUADARRAMA TUNNELS

## 5th TUNNELS LONGEST

- Saint Gottardo (57 Km) (Switzerland)
- Seikan (54 Km) (Japan)
- Eurotunnel (50 Km) (France- United Kingdom)
- Lötschberg (34 Km) (Switzerland)
- Guadarrama (28 Km) (Spain)



**NO INTERMEDIATE SHAFTS**

**SACCARDO NOZZLES**



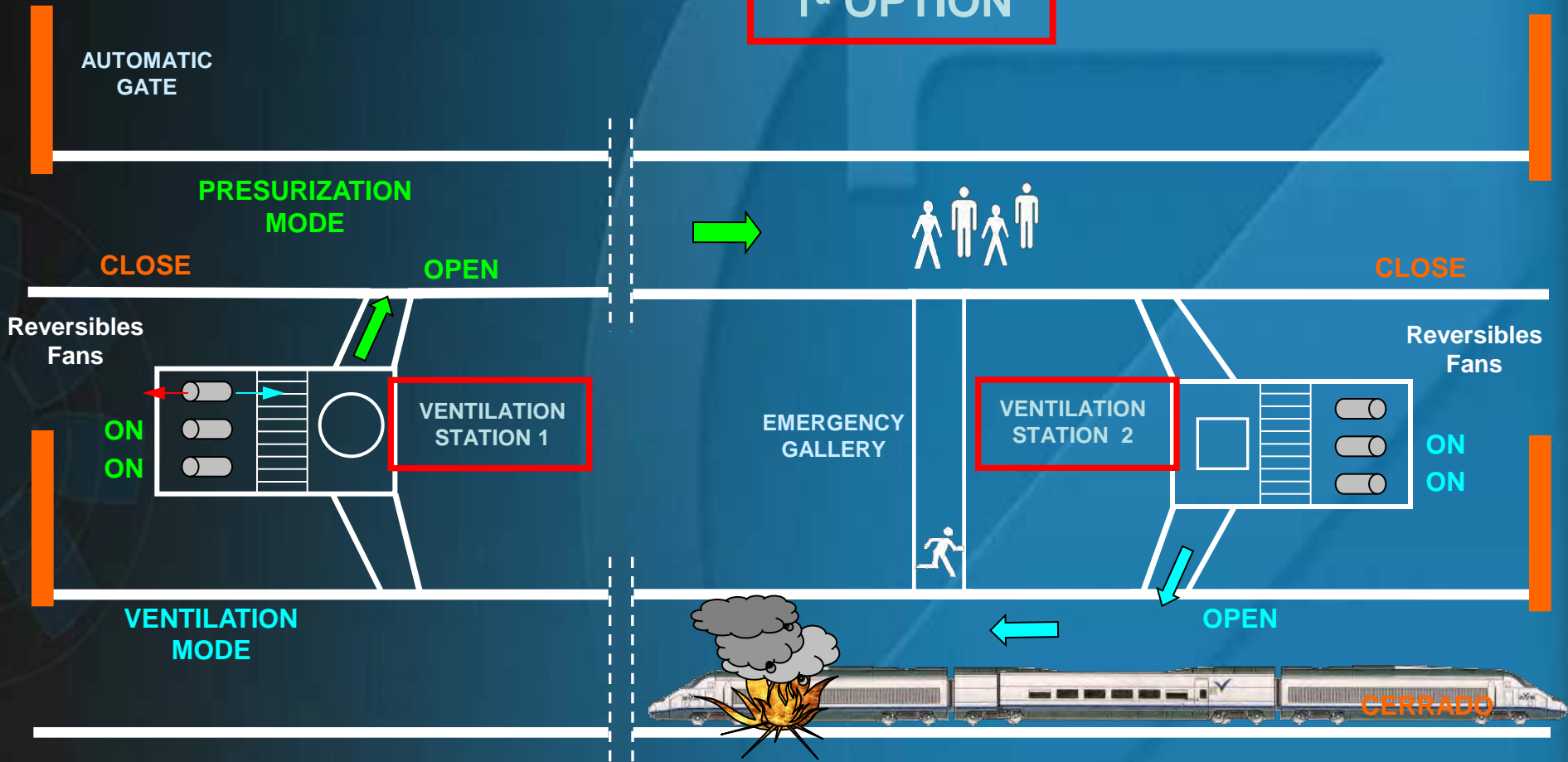
# DEFINITIVE VENTILACION SYSTEM

(Emergency Stage)



# VENTILATION SISTEM INITIAL

**1ª OPTION**

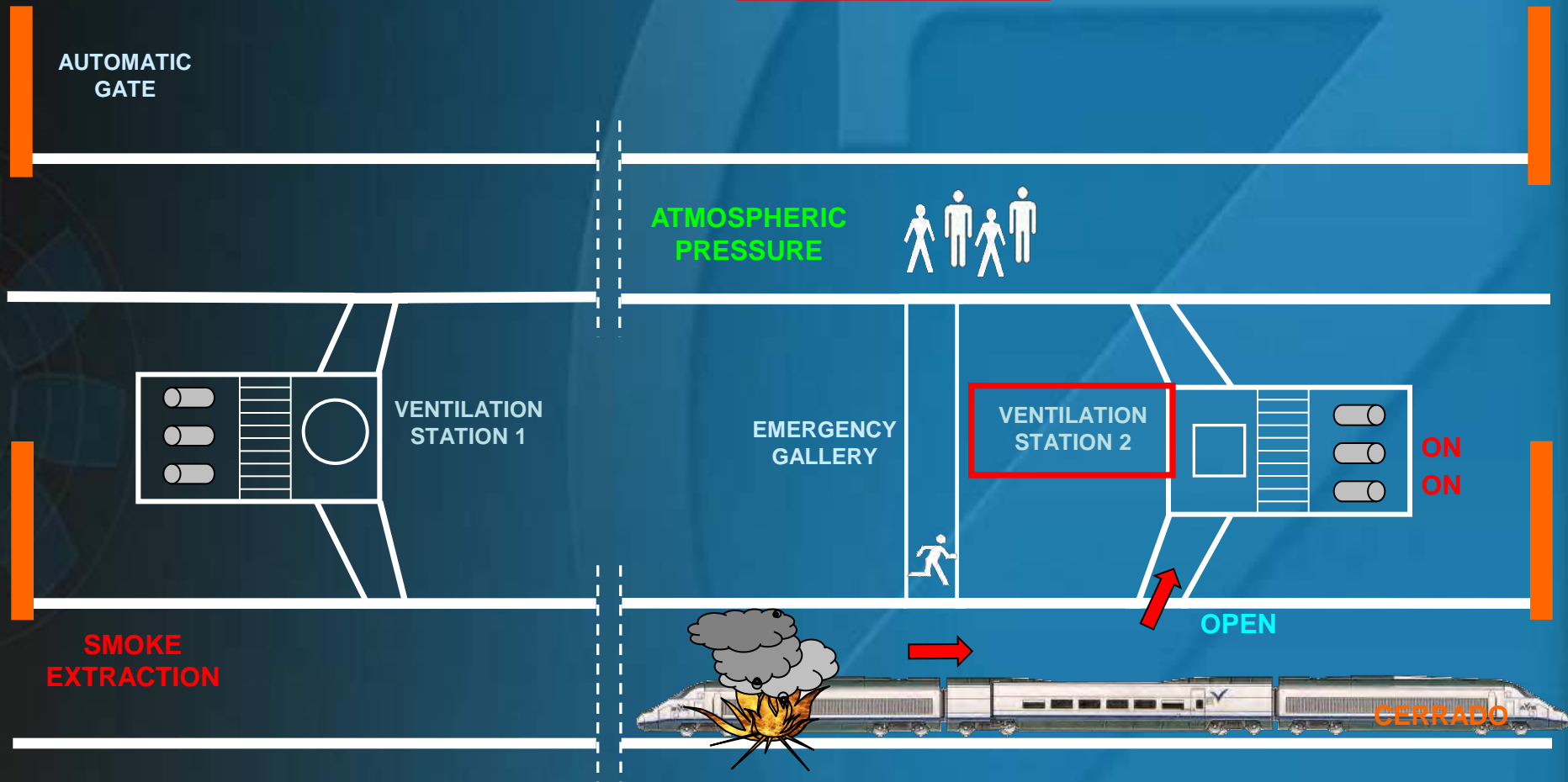


Length 28 Km

**HIGH SPEED RAILWAY TUNNELS - Guadarrama**

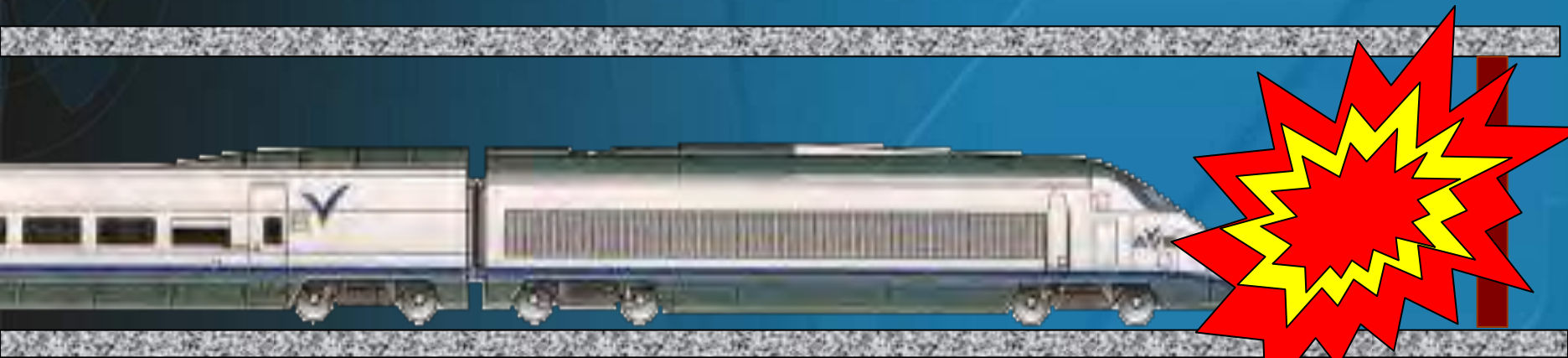
# VENTILATION SYSTEM INITIAL

**2<sup>a</sup> OPTION**



Lenght 28 Km

iiiiii **PROBLEMS**  
with  
**AUTOMATIC**  
**GATES!!!!**

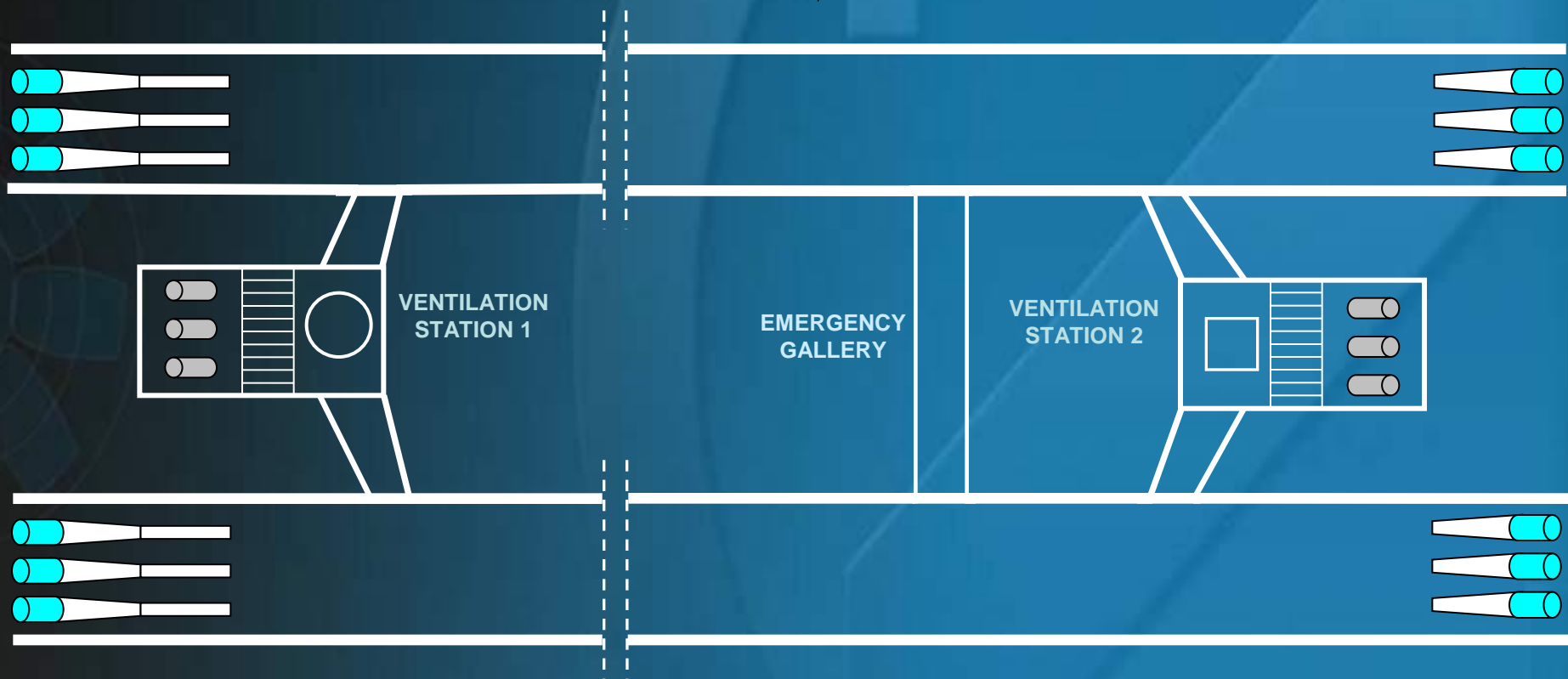


# VENTILATION SYSTEM

**AUTOMATIC GATES**

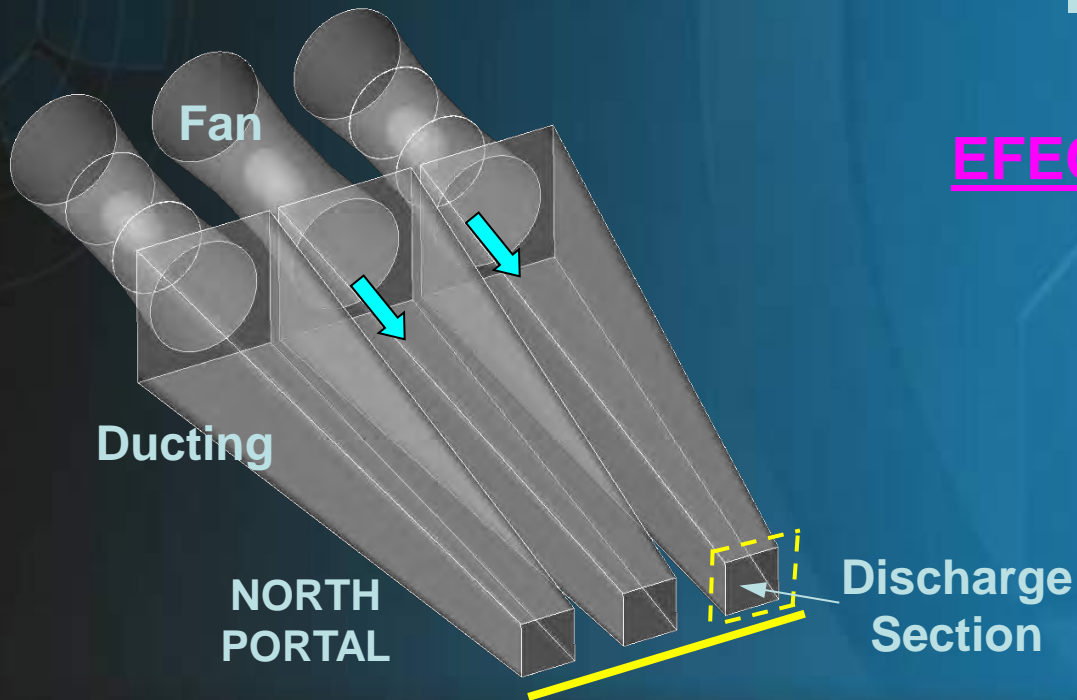
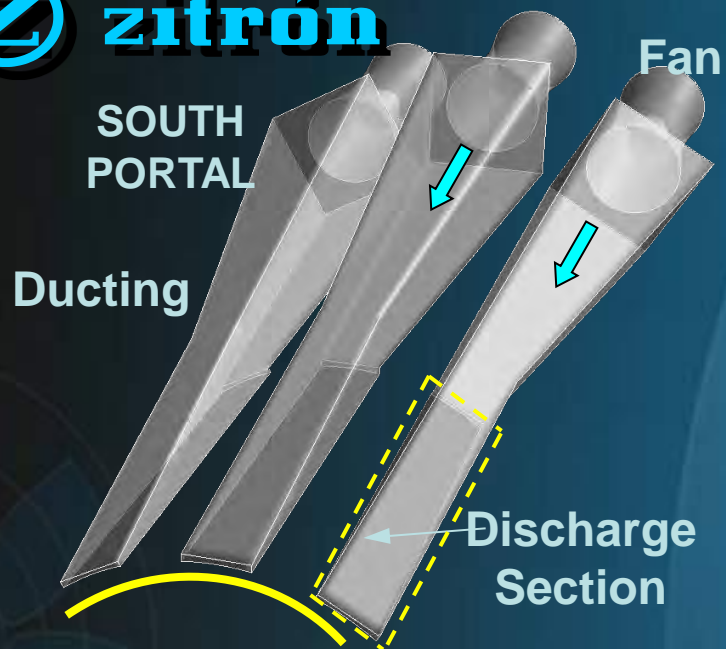


**SACCARDO NOZZLES**



Length 28 Km

**HIGH SPEED RAILWAY TUNNELS - Guadarrama**



# ¿ SACCARDO NOZZLE?

DUCTING + FAN

## OPERATION MODE

- VENTURI EFFECT
- INCREASE VELOCITY
- DECREASE PRESSURE

## EFFECTIVINESS

- INJECTION ANGLE
- DISCHARGE SECTION

TUNNEL 28 Km

CFD

WHOLE TUNEL

NORTH / SOUTH PORTAL

MAIN STATIONS

SACCARDO STATIONS



?? CFD ??

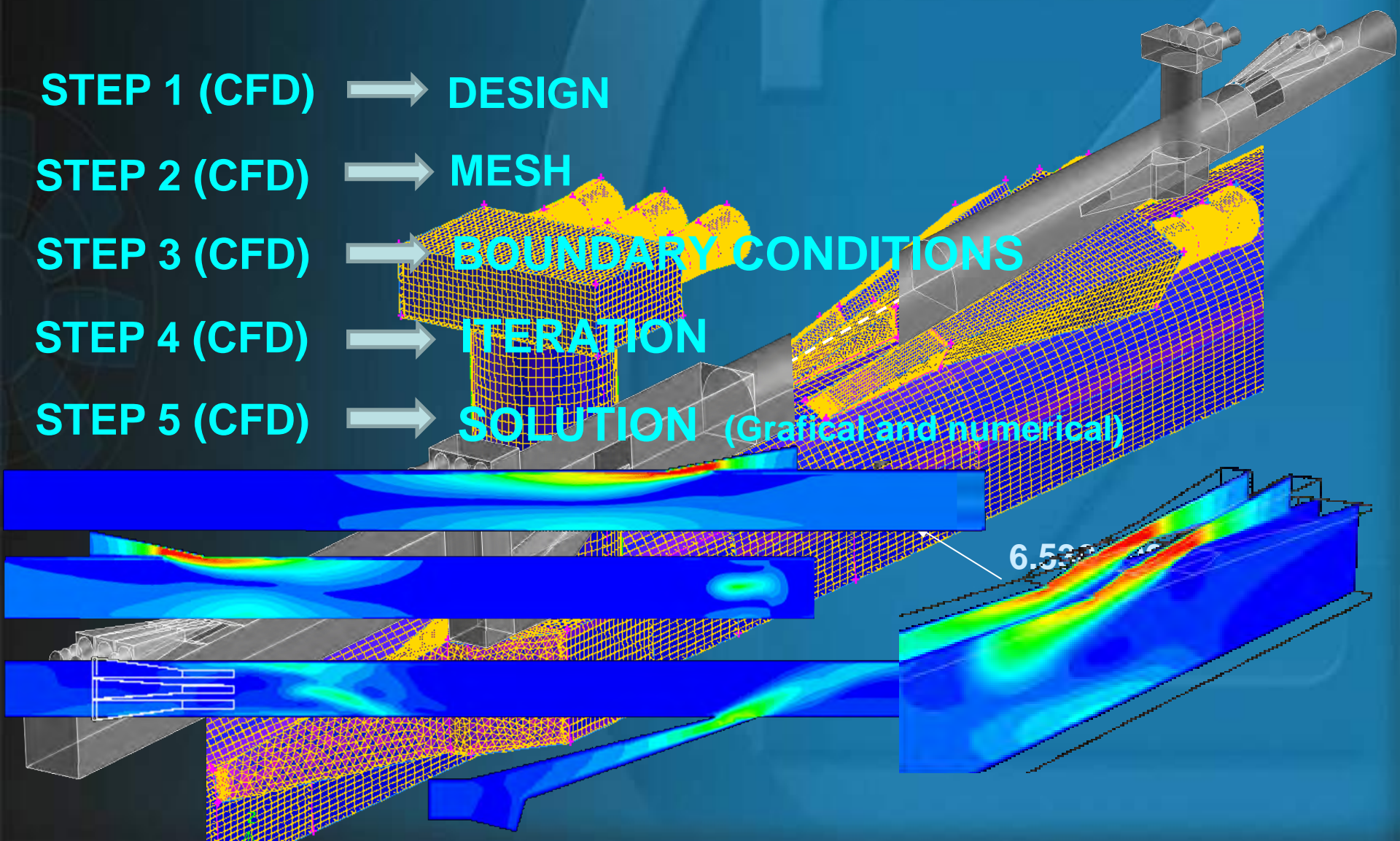
**TO FIND A SUITABLE  
FLOW FOR EACH FAN**

**VENTILATION MODE (Damaged Tunnel) : Velocity 3 m/s**

**PRESURIZATION MODE (Safe Tunnel) : 50 Pa more than in damaged tunnel**

# CFD - Computational Fluid Dynamics

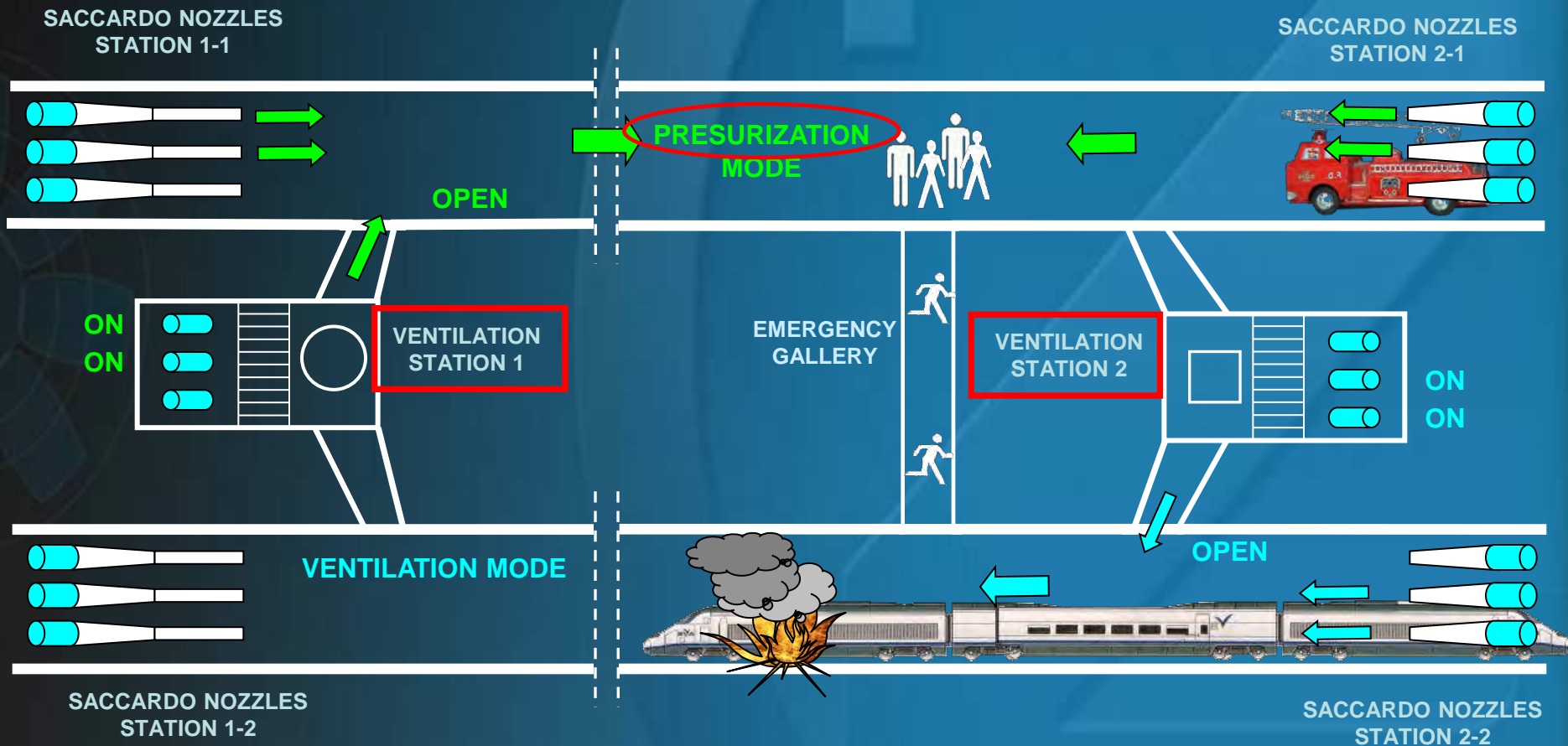
- STEP 1 (CFD) → DESIGN
- STEP 2 (CFD) → MESH
- STEP 3 (CFD) → BOUNDARY CONDITIONS
- STEP 4 (CFD) → ITERATION
- STEP 5 (CFD) → SOLUTION (Grafical and numerical)



# DEFINITIVE VENTILATION SYSTEM

## HIGH SPEED RAILWAY GUADARRAMA TUNNELS

### SOLUTION CHOSEN



- VENTILATION MODE (Damaged Tunnel) : Velocity 3 m/s
- PRESURIZATION MODE (Safe Tunnel) : 50 Pa more



Main Station

3 x ZVN 1-20-560/4

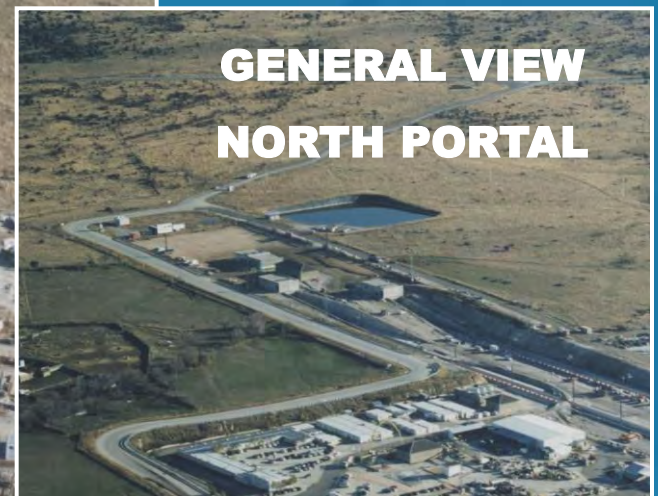
Saccardo Station 1

3 x ZVN 1-20-450/4

Saccardo Station 2

3 x ZVN 1-20-450/4

Transformers  
Room

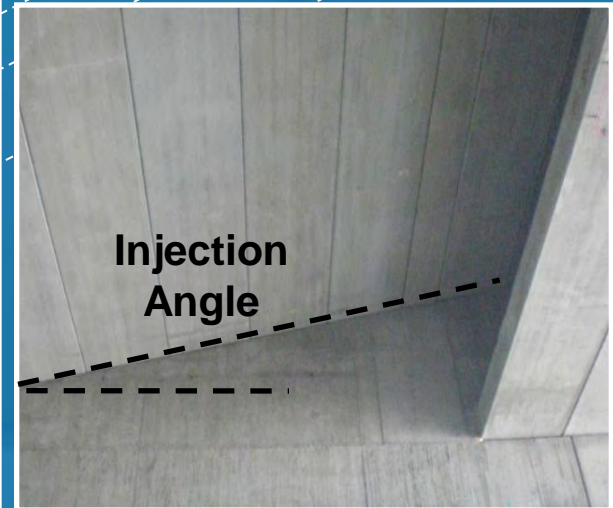
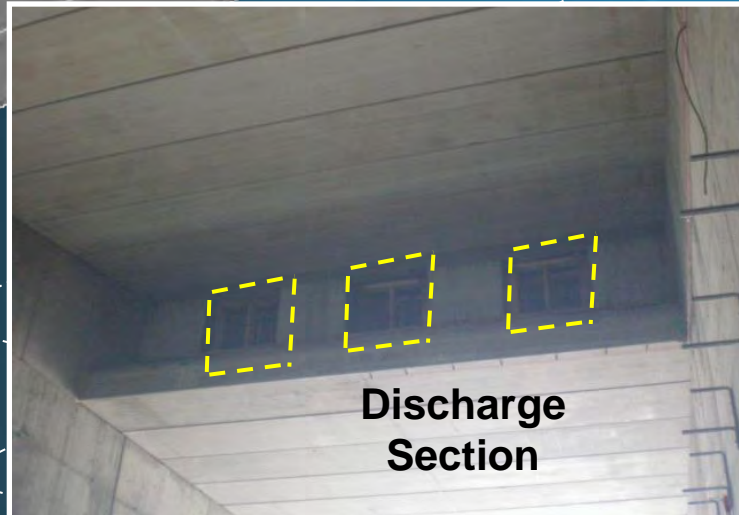
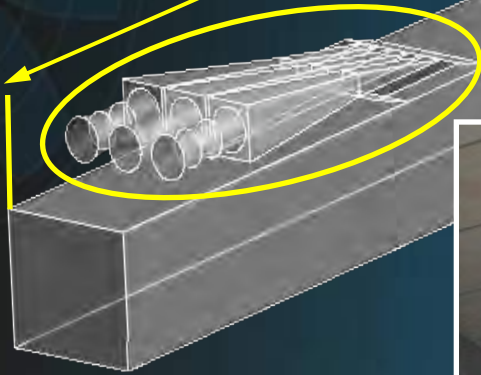


**GENERAL VIEW  
NORTH PORTAL**

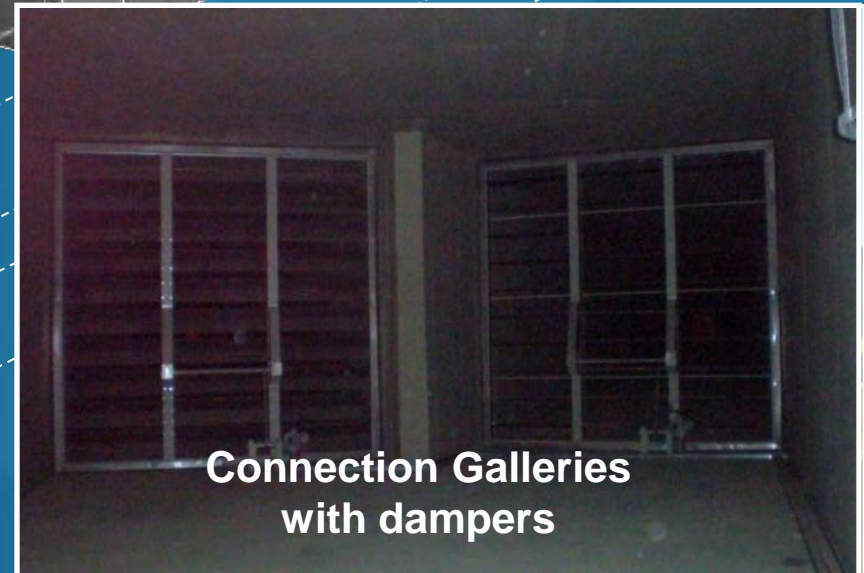
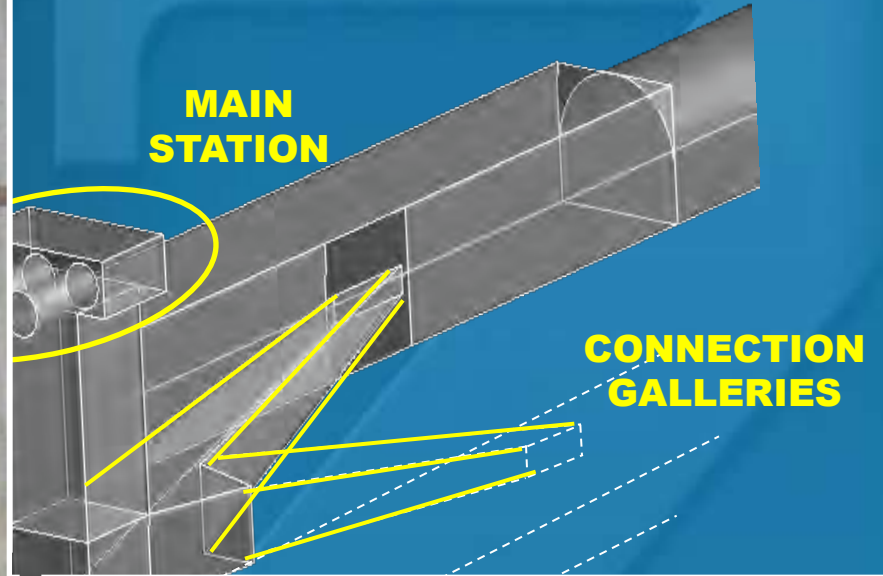
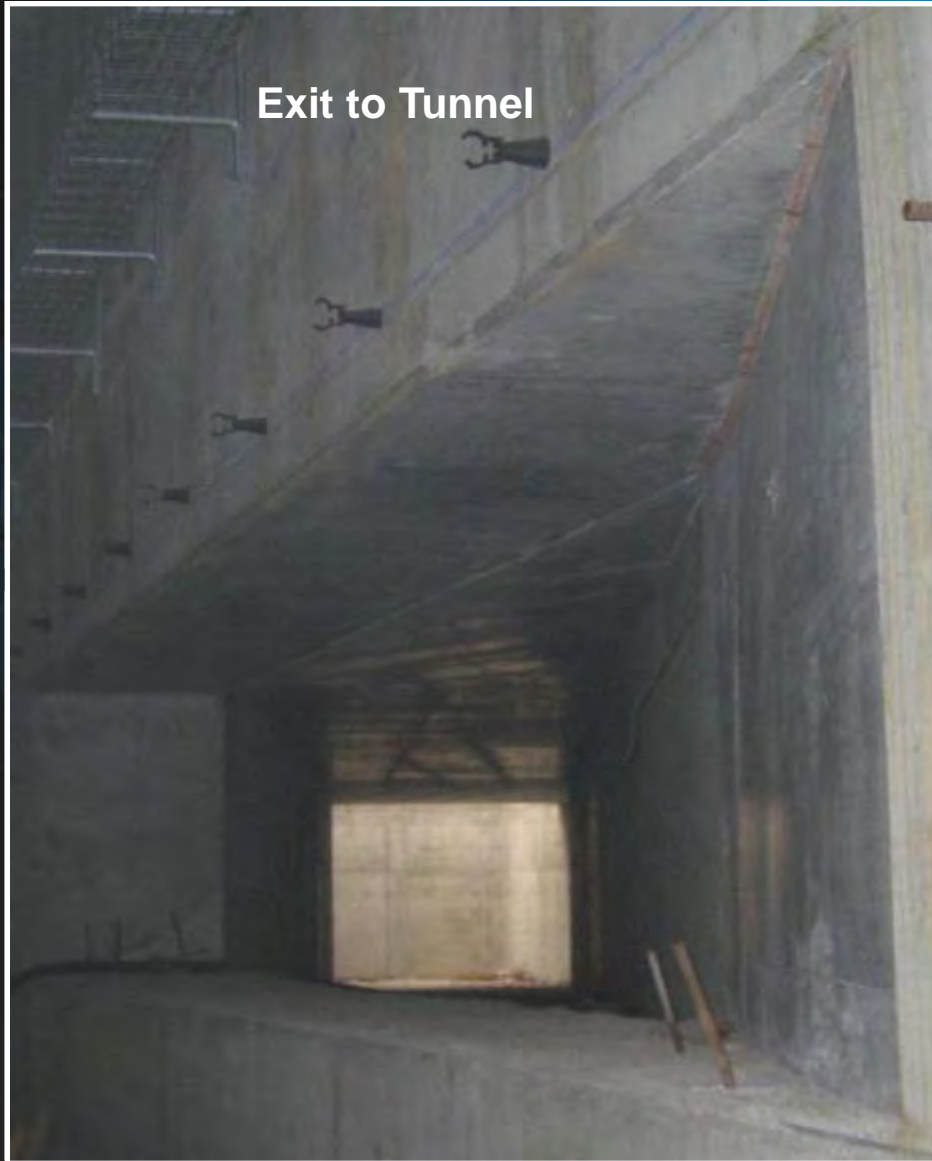
# NORTH PORTAL Ventilation Elements



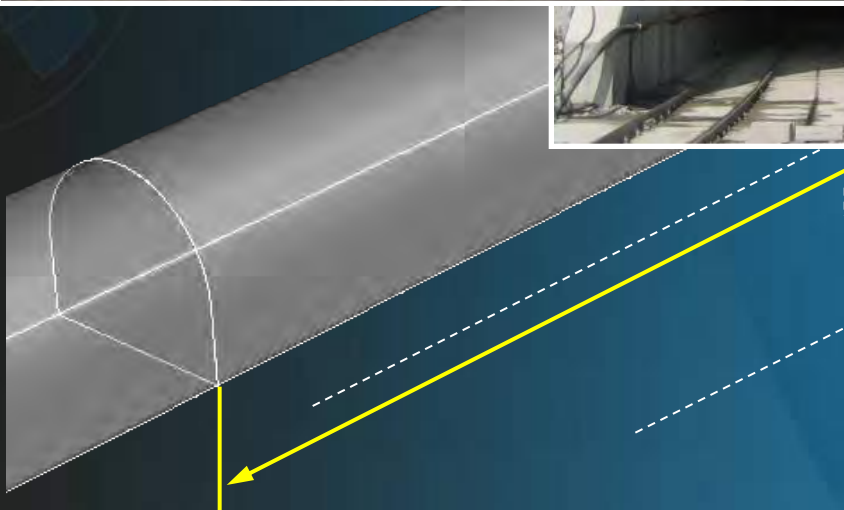
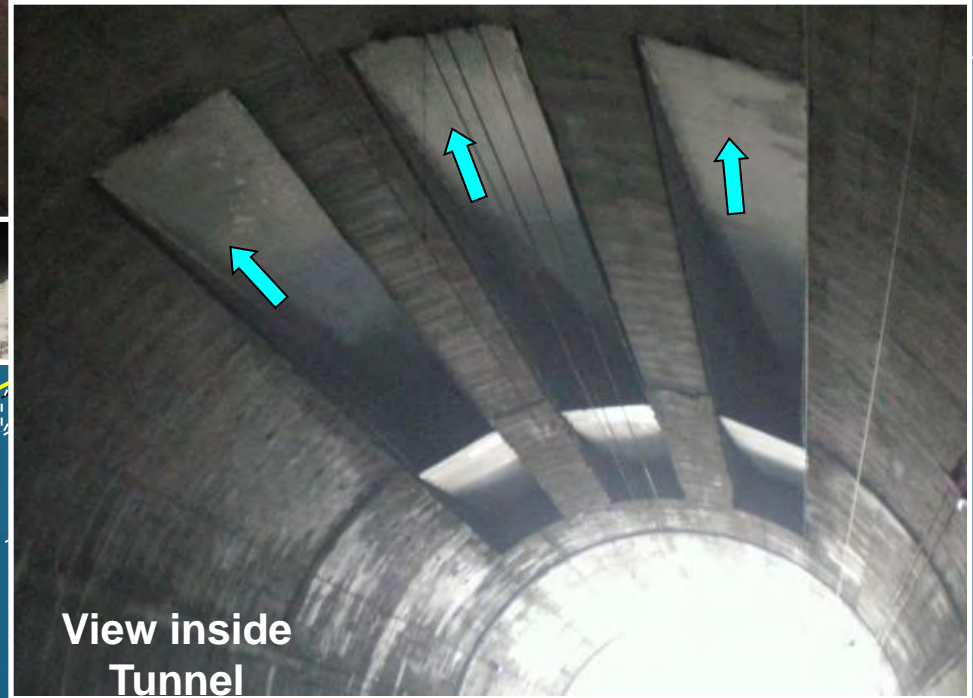
**SACCARDO  
NOZZLES**



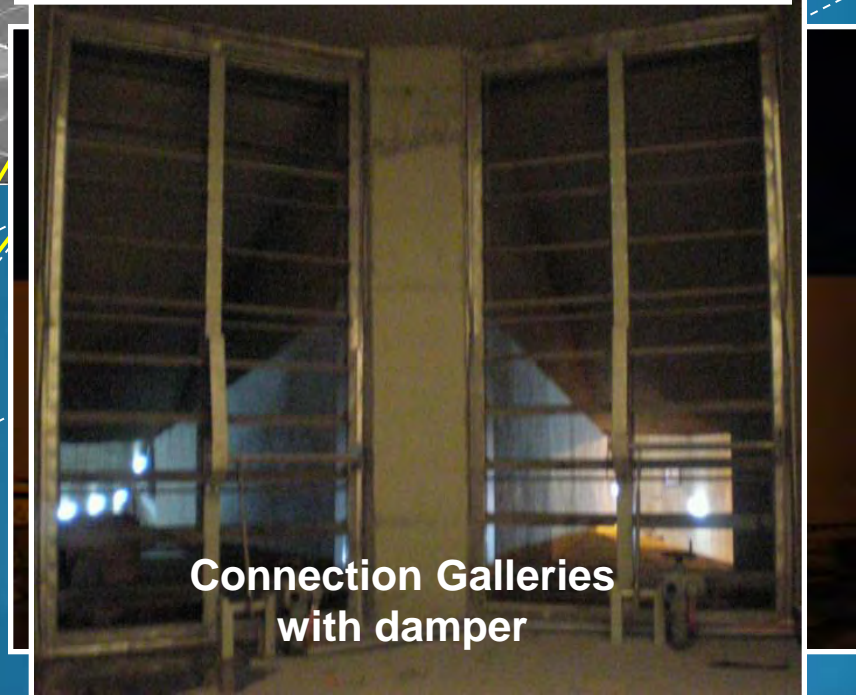
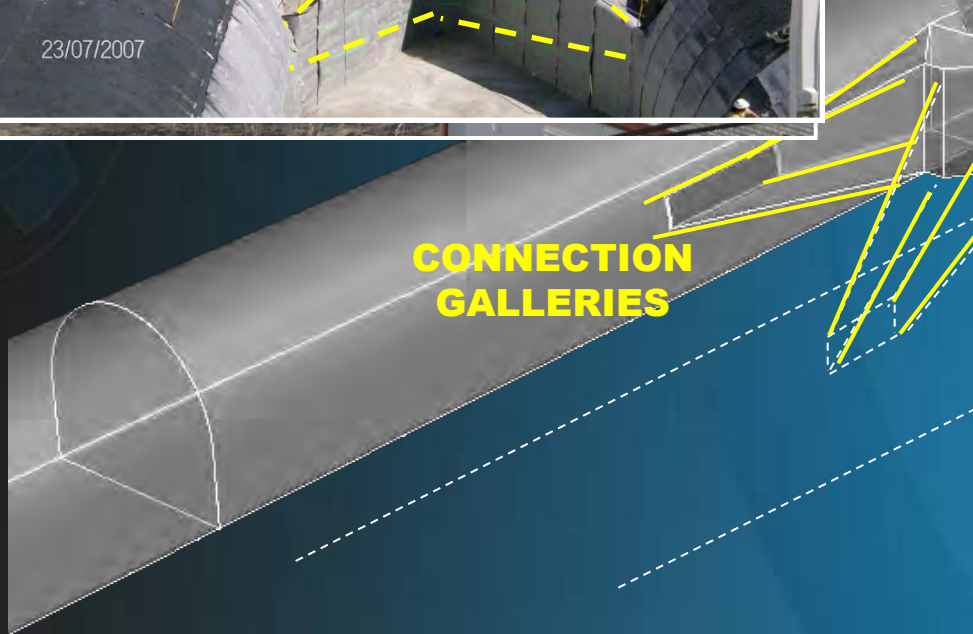
# NORTH PORTAL Ventilation Elements



# SOUTH PORTAL Ventilation Elements



# SOUTH PORTAL Ventilation Elements



**! THANKS  
FOR YOUR  
ATTENTION !**