Complex tunnels refurbishment in Paris area
Example of Nogent Tunnel
Renovation works: DIRIF’s Program
1. Road tunnels Security: a national priority
2. Key challenges of this refurbishment program
3. Shared goals for all tunnels
4. Scheduling of roadworks
Road tunnels Security: a national priority

National Program to improve tunnels safety after number incidents in Europe (Mont-Blanc, Saint Gothard, Frejus)

The Île de France Road Department (DIRIF) has elaborated a renovation program for all its 22 road tunnels longer than 300 m:

22 tunnels
46 lanes km
972 million € budget
Hundreds of new emergency exits, fans
thousands of m² protected against fire
Key challenges of this refurbishment program

The Ile de France specificity: a high traffic region and a dense area

22 tunnels = 22 projects
Shared goals for all tunnels

Detect an incident as soon as possible
- 24/24, 7/7 tunnel supervision
- Incident and fire detection

Prevent tunnel access to other people
- Controlled remote tunnel closure barriers

Set off and facilitate people evacuation
- Encouragement to self-evacuation (light and sound signals)
- Signalisation of emergency exits
- Access for disable people
- Build more exits

Help the safety services work
- Improve tunnel ventilation systems

Keep your tunnel safe
- Prevent the tunnel collapse

Tunnel Control Station
- Decisions help system for tunnel operators
- AID camera
- Smoke opacimeters and gas sensors
- PAU

Closure barriers
- Stop lights
- Tunnel control Station
- Variable message signs

Self-evacuation devices
- Radio broadcasting
- Extra emergency exits

New ventilation systems
- Fire resistance system
Logical Programming of roadworks

Safety construction, itinerary, Budget and human resources constraints

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Transversal works

Specific Works
Renovation works: DIRIF’s Program
Example of Nogent Tunnel
1. Operation context and scope of works
2. Challenge of this project
3. Phasing conditions of works
4. Specific difficulties met
5. Conclusions
Operation context and scope of works

- 20 years of operation
- 1 800 m long with 2 ventilation plants
- Access and exit ramps
- Passage under the Marne River
- A “naturally” congested area
  - A86 highway (Paris 2nd ring road)
  - Nogent Bridge: one of the most important traffic jam in Europe
- Proximity with railway line and urban public transport line (RER)
Renovation Ventilation works of Nogent Tunnel

Existing Air extraction duct

Futur Air extraction duct

Existing Air supply duct

Futur Air supply duct

Existing Air extraction duct

Futur Air extraction duct

Complex tunnels refurbishment in Paris area_Example of Nogent Tunnel
Challenge of this project

To renovate the tunnel while keeping it in operation

Criteria taken into account:

• Type of works and its effects on operation of Nogent tunnel and associated roads transportation grid
• Users safety
• Workers safety
• General traffic conditions in the area of Nogent
• Equipment and utility networks continuity of service
Phasing conditions of works

According to type of works, specific phasing conditions have been defined:

- Works done **by night** with the tunnel closed:
  - To put passive fire protection
  - To install jet fans

- Works done **by day**:
  - In the tunnel with a lane dedicated to works
  - In ventilation plants

- Works done **by section** (four ventilation sections):
  - To improve the smoke extraction system: works done one ventilation section at a time
Cross section of « Traversée sous-fluviale » during the works

Lane closure dedicated to works
Passive fire protection boards supplying workshop

Narrowness of lane dedicated to works led to organize:

• vehicles for the supplying

• workshops (no possibility for vehicles to cross each other)
Extension works of access and exit ramps to install jet fans

During the day: Works have been realized in two steps with a dedicated lane on right and then on left for side walls of this access

During the night: Installation of custom-made prefabricated concrete slab elements under night closure of Nogent tunnel
Works done by night

Passive fire protection works have been made during a short period (5 hours max of effective work) by night with the tunnel closed.

Jet fans installation
Specific difficulties met (and not planned !)

Lead deposits on the walls of tunnel and ducts due to 20 years of heavy traffic

- Vacuuming in ventilation ducts
- Washing with water recovery for sidewalls

Obtaining night closures for works by night
Number of night closures per month from 2 to 10
Conclusions

Organization and phasing are two major components of the renovation works for an operating tunnel.

A double challenge to be faced:

• Ensure to maintain tunnel operation: safety conditions for the users similar to those in force outside periods of works
• Carry out the renovation works providing satisfied safety conditions for the works teams

A permanent compromise between the respect of:

• Works costs
• Deadlines of realization
• Maintenance of satisfactory operation (user service, safety)
Thanks for your attention