Case note
ABB standard drives for HVAC improve road tunnel safety

AC drives are used to adjust speed and direction of fans' airflow depending on traffic intensity and prevailing wind.

When the E18 road link between Turku and Helsinki in Finland was to be upgraded to a motorway in its entirety, ABB's channel partner Airwecare, was called upon to supply, dimension and install ABB drives to control the tunnel fans. The fans are part of the whole tunnel ventilation system supplied by Suomen Ilmastointitukku Oy.

The E18 connects major transportation hubs in the Nordic countries and contained throughout the 162 km, Turku - Helsinki route are eight tunnels, seven of which are in the newest section.

ABB drives are used in the four longest tunnels to manage air flow, visibility, fire safety and air quality.

AC drives integrate with sensors and automation system to improve safety

Sixteen, 55 kW ABB standard drives for HVAC control 32 impulse fans, two per drive, which add momentum to the tunnel air and thrust it towards the exit points. Impulse ventilation differs from conventional ventilation in that ducting is not used. Instead, the tunnel itself acts as a duct.

The drives adjust the speed and the direction of the fans air flow depending on the conditions, traffic intensity and prevailing wind. The sensors inside the tunnels measure CO, CO_2 and temperature. Additionally, visibility sensors measure the amount of particles and moisture in the air.

The drives help ensure safe driving conditions in the tunnel by running the fans to demand, using information from sensors connected to an automation management system.

Precise air movement to demand

When data from the sensors indicates that ventilation is needed, the fans at the tunnel openings start and increase speed gradually. If more ventilation is needed, the fans inside the tunnel also start, increasing the air movement through the tunnel.

The fans at the tunnel openings have variable speed, while the fans inside the tunnel use traditional on/off control. This enables the fans at the tunnel openings to run at reduced speed if only a small amount of air movement is needed, providing accurate control and helping to save energy on these fans, which have the longest running hours.

ABB standard drives for HVAC meet the demanding requirements for electromagnetic compatibility.

In the event of fire, the system is programmed to run all fans at full speed to evacuate the smoke from the tunnel by the shortest possible route.

If the impellers are already rotating on start-up, due to the natural draught in the tunnel, they are caught 'on-the-fly' by the drive and brought up to the required speed. This routine is known as flying-start but is not normally used in installations with more than one fan per drive. However, in this particular installation, due to the position of the fans and the way the air moves in the tunnel, flying-start can be used.

Patented swinging choke cuts harmonics

As the tunnels are fitted with sensitive measuring equipment, it is important that the drives cause as little disturbance as possible to the mains supply, to avoid interfering with the instrumentation.

The ABB standard drives for HVAC feature a patented swinging choke that reduces the harmonic signature at low motor speed, fulfilling the international standard IEC/EN 61000-3-12. The swinging choke adjusts itself according to the load circumstances and cuts harmonics, especially at partial load, for a total reduction of up to 25 percent, compared to traditional choke designs.

Separate output chokes limit the electromagnetic interference from the exceptionally long motor cables in this installation. The drives are installed in the electrical equipment room, away from the tunnel itself, with the longest motor cable running over a distance of more than 300 meters.

Challenges

- Need to control air flow through tunnel
- Need for smoke evacuation in case of fire

Solution

- Sixteen ABB standard drives for HVAC control impulse fans at tunnel ends with input from sensors in the tunnels
- Swinging choke reduces the drives' harmonic signature
- Output chokes reduce interference from long motor cables

Benefits

- Good air quality and visibility improves road safety in tunnels
- Reliable arrangement for smoke evacuation in case of fire
- Energy savings as fans run to demand

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