Contracts for the Installation of Mechanical and Electrical Systems

» E4 The Stockholm Bypass
The Stockholm bypass is a new link of the E4 west of Stockholm that will simplify everyday life and create opportunities for further development in a rapidly growing region. The link connects the northern and southern parts of the county, relieves Essingeleden and the inner city of traffic and reduces the sensitivity of the Stockholm traffic situation. The travel time for the entire route is estimated at 15 minutes. The entire link is 21 km, whereof 18 km runs in tunnel. The project is ongoing since 2006. The construction period is approximately ten years.

The Stockholm bypass will be a modern traffic solution when it opens for traffic, and will meet the requirements of road users, the vehicle industry and road operators. It will be constructed to be highly accessible and robust, with sufficient redundancy for safety functions. A number of mechanical and electrical systems will be installed for operation and safety.

Installation of Mechanical and Electrical Systems

The tunnels are monitored by camera twenty-four hours a day from the Traffic Control Centre. They receive instant notification if a vehicle is standing still or if a door to an evacuation route is opened. In the event of an accident, the Traffic Control Centre can close and limit sections of the tunnel.

A fire fighting system for extinguishing or confining fires will be installed in the tunnels. Fans in the tunnels and ramps will be activated depending on traffic levels and air quality. Air exchange stations along the route will exchange the tunnel air.

The lighting in the tunnel will help to contribute to a safe and pleasant journey. The lighting design is intended to counteract monotony.

Digital information systems give immediate warnings should there be an obstruction on the road. Route information via signs will provide road users with timely and clear information.

During evacuation, emergency lighting will show the way to the evacuation routes. Information signs will instruct road users of how to act.

The road surface will be made of concrete. It is lighter and tougher than asphalt which reduces particle levels. Concrete is more expensive but cheaper to maintain. They are equal in terms of traffic safety.

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Introduction to the Facility

Safety
As a basis for the safety work associated with the Stockholm bypass, a safety concept has been developed. Its aim is to reduce the likelihood of accidents and decrease their impact. The safety concept incorporates administrative measures as well as active and passive safety systems, creating a robust safety system that can handle temporary disruptions, incidents and serious situations.

Two cornerstones of the safety concept are the separation of traffic in two one way tubes, and the principle of self-evacuation in the event of an accident or fire. The concept includes active safety systems such as: a fixed fire fighting system, lighting, a smoke control system, fire alarms, emergency phones, camera surveillance, emergency radio broadcasting (break-in radio), tunnel information signs, road signs and traffic lane signals.

Should a road accident, fire or other type of dangerous incident occur, the stretch of road affected will be closed temporarily and the traffic rerouted.

Control and Monitoring
The traffic in the tunnel system will be controlled and monitored twenty-four hours a day by Trafik Stockholm, the Swedish Transport Administration’s Traffic Control Centre in Stockholm.

The personnel manning the Traffic Control Centre are assisted by a number of technical systems. With the help of cameras and sensors, the traffic controllers can monitor the traffic and, in the event of an incident or accident, alert and support the road assistance crews, police rescue services.

Aided by the system, traffic controllers will also be able to direct and control traffic in the Stockholm bypass by reducing speed limits, closing lanes or initiating an evacuation of the tunnel system.

The Traffic Control Centre monitors, controls and directs traffic and facilities with the aid of a National Traffic Control Support system (NTS) which is an advanced operator support system.

Operation Areas and Electrical Power Service Stations
The road facility will be divided into operation areas (Swedish: driftområde [DO]). Each operation area will cover 2,000 meters of one tunnel tube. This is a fundamental feature of the safety concept for the tunnels. Subdivision of the operation areas will provide a sectioning of the mechanical and electrical systems, which will limit the impact in each operation area in the event of an accident or loss of function.

The electrical power service stations (Swedish: eldriftutrymme [ELDU]) will be, partially complete with transformers and switchgears. They will then be installed in the rock space next to the traffic area.

ETDKs and Technical Equipment Buildings
A utility culvert will run alongside the traffic area containing equipment for power supply, data and communication. This equipment will meet at integrated cabinets called ETDKs (Swedish: el-, tele-, data- och kommunikationsplats [ETDK]). At surface interchanges, all equipment will be located in technical equipment buildings. All electrical and signal equipment within an operation area will connect to an electrical power service station via either an ETDK or technical equipment building.

This sectioning gives a decentralised facility, which also increases the efficiency of the installation and commissioning work.

Totals within the facility
Number of electrical power service stations (ELDU):
30 beside traffic areas (prefabricated)
Approx. 20 in other technical spaces (e.g. fan stations, wastewater treatment stations)
Number of ETDKs: Approx. 210
Number of technical equipment buildings: 10
Control and Monitoring System
This contract includes the facility’s comprehensive control and monitoring system (Swedish: anläggnings-overgripande styrs och övervakningssystem [ASÖ]). ASÖ controls the safety functions and will also be used for the operation and maintenance of the mechanical and electrical systems serving the facility.

The ASÖ will be connected to the Swedish Transport Administration’s National Traffic Control Support System for road traffic control and road infrastructure monitoring (NTS), which follows regulations for interfaces, information on alarm management status, as well as control and operation with the NTS.

ASÖ will be designed to achieve a high level of availability and robustness with redundancy for safety functions. Control functions that are common for several operation areas will be performed by control units that are physically separated, located at each end of the facility. In each operation area, the ASÖ will be completely autonomous and manage all control and monitoring. The central units for the mechanical and electrical systems will be placed in the ELDUs.

The system structure follows the PCMS/ASÖ concept that is applied in the Stockholm Ring Road Northern and Southern Link tunnels. The solution is based on autonomous control units with redundancy for operator interfaces and general tunnel safety functions such as lighting, safe evacuation and tunnel ventilation.

Communication Platform
The Local Communication Platform (LCP) will be Ethernet-based and handle all communication between all parts of the facility.

Fibre-optic cables for the communication network will be laid in a concrete duct that will run in the utilities culvert along the tunnels.

The technical solution for LCP is expected to be specified by the client since the platform is an integrated part of the Transport Administration’s central camera system.

Camera Surveillance
Camera surveillance, CCTV, will cover the entire road area, giving the Traffic Control Centre a comprehensive overview of the entire facility. The system will include functions for coding, decoding and video storage.

Radio and Mobile Telephone Network
Systems will be installed in the tunnels in order to maintain radio and mobile phone coverage. The radio system will guarantee access to functioning mobile telephony, secure communications for the emergency services and relay public radio services.

Loudspeaker System
The loudspeaker system will make it possible to provide information to people inside the rescue rooms that will be located in some of the evacuation routes.

Telephony
Emergency phones will be installed in all evacuation routes. The solution is expected to be specified by the client since the facility will be connected to Trafikverkets, the Swedish transport administration’s, central telephony solution.

Fire Detection
Fire detection in traffic areas and other spaces will be included in the contract.

Access Control
The contract will include access control systems for the regulation of access to areas that are not open to the public. The technical solution is expected to be specified by the client as the facility will be connected to Trafikverkets central access control solution.

Incident Detection System
A comprehensive incident detection system, SDS, for the detection of stationary vehicles, dropped loads and other incidents.

It is possible that the Incident Detection System technical solution will be camera or radar based.

Facts about FSE901
The number of I/O signals (incoming and outgoing control and measurement signals) for the facility will be approx. 70 000.
Number of cameras: approx. 900-1000
Fibre network: approx. 55 km
FSE902 Power Supply, Lighting and HVAC

Power Supply and Electrical Systems
Two external networks will supply the long tunnel with electricity. The networks will be connected to supply centres situated at the northern and the southern ends of the tunnel. The high voltage network will be ring shaped, with two separate loops. Switching the power supply can occur via Stockholms Traffic Control Centre. If a fault should occur in the grid, one main power supply centre will be capable of supplying the entire facility with electricity.

A third external network will supply the short tunnel with electricity. This network will also be connected to supply centres at the northern and southern ends of the tunnel.

Switchgears and transformers for 33/0.4kV will be placed in ELDUs. Certain ELDUs will be supplied with transformers for 33/0.69kV and switchgears for operation of fans and pumps.

The contract includes electrical systems up to the equipment that is supplied under other contracts. The cabling will be laid in embedded fireproof ducting that will run along the tunnels in a utility culvert.

UPS
Equipment for Uninterruptible Power Supply (UPS) will ensure battery operation for at least an hour to supply safety functions with electricity. UPSs will be installed in ELDUs and ETDKs.

Lighting
Lighting will be installed in traffic areas. For example: road lighting, access road lighting, evacuation route lighting, architectonic lighting, sign lighting and evacuation sign lighting.

General Power and Lighting
General power and lighting in technical spaces, utility culverts, wastewater treatment plants and fan stations are included in this contract.

General Ventilation and Cooling
All HVAC services such as general ventilation and cooling for all technical spaces throughout the entire facility. Special air purification requirements will apply for the general ventilation in ELDUs. If required there will also be access to water in fan stations and ELDUs.

Facts about FSE902
Number of main power supply centres: 2
Total length of high voltage cable: approx. 55 km
Estimated total load for the road facility: approx. 30 MVA
UPS total: approx. 250
Light Emitting Diode (LED) luminaires: approx. 20 000
General building services: approx. 3 000 m²
General ventilation in spaces with a total area of about 1 500 m²
Cooling in spaces with a total area of approx. 200 m²
FSE903 Tunnel Ventilation

The contract comprises a tunnel ventilation system with reversible jet fans in the traffic area, four exhaust air stations, six air exchange stations and a smoke exhaust station.

The natural air flow generated by the traffic will be supported by longitudinal ventilation by means of jet fans and air exchange stations. Fire ventilation will ensure that the smoke from fires is regulated in a controlled way.

The long tunnel between Hjulsta and Kungens kurva will be supplied with fresh air via six air exchange stations, three along each tube. The stations will handle both exhaust and supply air where air exchange will take place via a tower located above ground.

A smoke exhaust station in Sätra will be constructed in order to manage and reduce smoke generation in the event of heavy smoke production.

Exhaust air stations will be built to maintain good air quality around the tunnel portals. These are located near the exits at Hjulsta, Vinsta, Smista and Kungens kurva.

FSE904 Traffic Systems

Motorway Control System
The Motorway Control System, MCS, will be used to collect data on traffic flow and control the traffic using lane signals. The technical solution for MCS is expected to be specified by the client since the facility is part of the Transport Administration's central motorway control system.

Road Closure Devices
Boom gates and energy-absorbing road closure devices that will be used to stop traffic flows and as a form of personal safety during maintenance work on tunnels.

Variable Message Signs
Fully graphic variable message signs, VMS, for different applications, for example: road directions, traffic information and evacuation messages.
FSE905 Wastewater Systems and Fire Fighting

Wastewater Treatment Plant and Wastewater Systems

The contract includes equipment such as pumps, valves, sensors for the wastewater systems, including control and monitoring systems for eight pumping stations, a wastewater treatment plant at Kungens kurva and in the Akalla tunnel, as well as a wastewater storage on Lovö. Pipes outside the pumping stations and the construction of the wastewater treatment plant are included in another contract.

The facility’s wastewater systems will handle the wastewater and drainage water as well as supplying fire hydrants and the fixed fire fighting system with water. The lowest points in the tunnel system are almost 100 m below ground level. The large differences in elevation between ground and tunnel levels will lead to considerable pressure differences in the wastewater systems.

The wastewater plant will be used for treatment and sedimentation of the tunnel wastewater. It will also manage oil separation and the dosing of flocculants. After measurement, sampling treatment and sedimentation the water will be discharged into the municipal wastewater system.

Fixed Fire Fighting System

The contract includes a water based fixed fire fighting system that will be positioned centrally in the roof of the main tunnel and ramps.

The fire fighting system will be divided into sections that are approximately 50 meters long in the main tunnel, and 75 metres long in the ramp runnels. The sections will be connected to the nearest emergency exit where valves are located.

Facts about FSE905

- Pumping stations: Capacity varies from approx. 45 l/s–75 l/s and slump volumes from 5 m³ to approx. 640 m³.
- One wastewater treatment plant with a volume of approx. 2000 m³.
- Total area to be covered by the fixed fire fighting system: approx. 600 000 m².
E4 The Stockholm Bypass in brief

› Length: 21 km
› Length of tunnels: 18 km
› Number of lanes: 3 in each direction
› Number of interchanges: 6
› Maximum speed: 80-100 km/h
› Travel time: approximately 15 minutes
› Completion: about 10 years
› Construction cost: EUR 3.1 billion (2009 prices)

For more information, please visit our website: www.trafikverket.se/thestockholmbypass