NORDSYDAXELN, STOCKHOLM

Introduction to the Scope of works including reconstruction of bridges and the tunnel Söderledstunneln in Stockholm, Sweden

Client: The City of Stockholm

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Contents

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Nordsydaxeln

Introduction to the Scope of works including reconstruction of bridges and the tunnel Söderledstunneln.

Introduction

The aim with this document is to shortly describe the Scope of Work for Nordsydaxeln (could be translated as “the axis from north to south”) and for which the City of Stockholm is asking for tenders. The tender document is built up of three parts. For Söderledstunneln and Centralbron Tegelbacken Detail Design is provided by the Client and included in the tender documents. For the Installation Works the Contractor shall provide the Detail Design.

Executive Summary

The project Nordsydaxeln consists of a 1600 m long tunnel and several bridges with a total length of 1900 m. The tunnel is a double tube with two traffic lanes in each tube, the bridges normally have three lanes in each direction. Several ramps are connecting to the tunnel and the bridges from the surrounding streets. Nordsydaxeln is connecting the south of Stockholm with the centre of the City and is a very essential part of the road system. It is in fact one of the routes with the most intensive traffic in the whole of Stockholm.

The bridges are in need of repair regarding some of the concrete surfaces, the water proofing, some of the joints, the tarmac etc. New lighting is going to be installed. An improvement of the collection of rainwater will be implemented with a new storm water system and treatment of this water before discharging into the sea.

The tunnel is constructed in stages with the oldest parts more than 60 years old and the newest about 2 years. The concrete walls in the tunnel are in need of repair due to deteriorated concrete. Salt from deicing of roads has caused high levels of chloride in the concrete and corrosion of the reinforcement. Installations like lighting, ventilation, control systems, traffic control system etc have been degraded over the years and will be replaced with new installations. On both sides of the tunnel are a total of 8 equipment rooms supporting the tunnel with Electrical power, Ventilation, Lighting, Traffic information, Communication and Security systems. These rooms, which are referred to below are named from north to south: Överkikaren, Västra Galleriet (pumping station), Östra Galleriet, Göta Ark, Folkungagatan, Ölbryggaren, Gamen, Ringvägen and Skansbron.

Due to the normally intensive traffic through the tunnel and the lack of adequate alternate routes it will not be possible to close both tubes at the same time. The traffic will be diverted to run in one tube (two way traffic) when the other tube is being repaired. Furthermore the plan is to carry out the tunnel repair only during a part of the summer, 15 of June until 15 of August, as during this period there is a slightly lower traffic flow. This means that the repair work in the tunnel is planned to go on for four years, 2007 to 2010, with breaks during the winter periods. During the winter/spring/autumn periods and especially before the first summer 2007 work with installations in the electrical rooms etc. and some other preparation works have to be carried out. Minor works in the tunnels can also be carried out during these periods by closing one tube at the time during night hours. The repair

of the bridges is scheduled for three summer periods, 2007 – 2009. After each break the tunnel have to be commissioned with the new installations and not yet repaired installations working during the autumn/winter/spring period.

1. Scope of Work for Installation Works.

1.1 Design Works

In the Tender Documents a proposed design is included for some of the installations systems. It will however be the full responsibility of the appointed contractor to perform a complete design of all the installation and construction works.

1.2 Construction Works

Adjacent to the tunnel, Söderledstunneln, there are. 8 existing equipment rooms and a few other auxiliary rooms placed next to and under the tunnel. In these rooms rebuilding works will take place for the installation of new stand-by power stations, new holes for ventilation pipes, etc. One new equipment room in concrete will also be included in these works.

The civil works which will take place in the equipment and side rooms will in short terms be:

- New rooms inside existing rooms for new stand-by power stations. The new rooms includes walls of gypsum wallboards, fire safety doors, foundations for the power station, floor grating etc.
- New holes in existing concrete walls for air supply for the plant, including in-situ cast reinforcement of the walls.
- New doorways in existing concrete walls for in- and out-transport of the reserve power plant.
- Rebuilding of steel stairs.
- Balustrade works outside the air supply openings.
- A new equipment room in prefabricated concrete or in-situ cast, including foundations and weatherproofing layer on the roof.
- Cleaning and painting of equipment rooms.

1.3 Traffic Management System

The traffic control system for the Nordsydaxeln has the following objectives:

- To monitor traffic
- To give driver information
- To warn drivers
- To direct traffic during incidents and maintenance of the road

Fully operational the system will cover the roads and bridges between the Nynäsvägen south of Stockholm to Norra Länken in the north. This project comprises the roads through Söderledstunneln and on Centralbron mainly.

The following components are included in the system:

- Lane signals for lane management. Symbols to be used are recommended highest speed, closed lane, green arrow, red circle, end of restriction.
- A system for incident detection and collection of data.
- A system for detection of Ghostdrivers.
- A system for detection of high vehicles on Centralbron driving south.
- Variable direction signs to use when a portion of the road ahead is closed.
- Automatic barriers for closing portions of the road. Barriers are to be monitored using CCTV. Inductive loops connected to the barriers controlunits for detecting vehicles in the barriers area of operation.
- Variable information signs for the Söderledstunnel. These are to be used to inform drivers to turn of the engine or to evacuate the tunnel.
- Variable road signs, these are mainly when the system to redirect traffic into one tunnel tube are used.
- Automatic barriers for redirecting traffic into one tunnel tube during maintenance.
- An automatic device for opening the barrier on Centralbron to give the rescue service access to the tunnel.
- Cables for communication and power and in applicable cases for lighting the equipment mentioned above.

The traffic management system should be integrated with the system for the overall control of all the installations within the tunnel and on the bridge.
The system is to be controlled from the city's control center as well as from the Stockholm Traffic control Center (Trafik Stockholm). It should also be able to control it locally from within the local control room in Söderledstunneln.

1.3.1 Lane Signals

The lane signals should function according to the Dutch MTM-2 system as modified buy the Swedish NRA. It is not necessary for the system to be a MTM-2 system though.

1.3.2 Automatic Barriers

Automatic barriers will be used at both the main entrances to the tunnel and bridges according to the plans and lists enclosed. When operational they will be used together with signals with flashing red lights. Traffic will be redirected to the surface road net.
A loop detector within the barriers working area detects the presence of vehicles and connects a CCTV camera to the location.

1.3.3 Variable Direction Signs

Variable direction signs will be used together with Lane signals and barriers to redirect traffic from the main road in case of incidents.

1.3.4 Tunnel Information Signs

Tunnel information signs will be used to give driver information in the Söderledstunneln in case they need to turn off the engine or evacuate the tunnel.

1.3 Electrical Installations

1.3.1 Power Systems

Existing installation

In ”Söderledstunneln” there are eight substations. One 12 kV substation (Gamen) will receive incoming power from Fortum Distribution AB. From Gamen the 12 kV power will be distributed to the different substations where it is transformed to low-voltage.

Each station has one power transformer, except one station with two transformers and one that is fed with low voltage.

In Gamen there is one stand-by generator set rated 142 kVA and one UPS (Uninterruptible Power System) unit rated 100 kVA.

New installation
The new 12 kV- and low voltage switchgears shall be commissioned in the same areas as the existing equipment. Both new and existing switchgears shall be energized during the rebuilding line.

The 12 kV switchgear shall be replaced with cast-resin insulated switchgear in steel sheet enclosure with no requirement of expansion areas.

New 12 kV cables from “Gamen” to the different transformers shall be installed in cable protection pipes in the roadway.

Two power transformers shall be replaced, all the other existing shall be used.

All low voltage switchgears shall be replaced and equipped with remote controlled starters for jet fans. All lighting panel boards shall be replaced.

All existing raised access floors in switchgear rooms shall be rebuild during the installation time of the new switchgears.

Three new stand-by power sets (ratings 550, 350 and 350 kVA) shall be installed.

Close to the stand-by power sets UPS-units each rated 60 kVA shall be installed. The UPS-unit consists of rectifier, inverter, static transfer switch, battery, bypass and maintenance bypass.

1.3.2 Motor operation

Cables from switchgears to jet-fans, auxiliary fans, pump stations etc shall be installed.

1.3.3 Utility rooms

All electrical installation in the utility rooms shall be replaced.

Sufficient lighting must be installed and it shall be fitted with High Frequency-ballasts and fluorescent tubes.

1.3.4 CCTV Surveillance System

A CCTV system shall be installed to monitor traffic in the tunnel and to facilitate traffic rerouting when one tube has to be closed during service periods of tunnel works.

Digital CCD cameras of 480 lines resolution with pan, tilt and zoom functions shall be used. Cables from camera to video sub units in 8 equipment rooms shall be 2-core optical cable of single mode quality.

Camera units shall be powered by 230V UPS incorporated into video sub units and they shall feed cameras over fire rated cables protected for 1 hour and 250 centigrade according to IEC 332.

Cameras for use outside of the tunnel shall have provision for remote controlled cleaning incorporated into the system.

An optical fibre cable network shall be installed between equipment rooms.

Video mainframe shall be fully digital with remote control and monitoring functions from three or more locations communicating over a wide area network.

Automatic recording of all cameras with continuous 10 minutes of picture storage as an option shall be a system feature.

Control protocol of the video system shall communicate over Ethernet and/or RS 485.

1.5 Control and Instrumentation

As part of the renovation of the tunnel almost all of the existing control systems shall be replaced and new functions will be added.

1.5.1 Tunnel tubes

The renovation of the tunnel tubes will take place during the summer season (holiday period). One tube will be closed for traffic and the other tube will be used for two-direction traffic.

All control systems, existing and/or new systems, shall be in operation for all the tunnels carrying traffic. Some of the systems shall even be in operation for the tunnel tube that is under renovation.

Renovation of the engineering and utility service room will be done at another time of the year.

1.5.2 Engineering and utility service room (utility room)

There are eight utility rooms along the tunnel. These rooms shall be equipped with the following systems (All systems are not installed in each utility room):

High and low voltage switchgear, stand-by power, UPS, control systems, tunnel lighting, electrical heating, tunnel ventilation, pumps, emission control, fire alarm, security systems, distress telephone, radiocom, CCTV, traffic control.

1.5.2.1 Control systems

The existing control system is divided into 13 subsystems, 8 for HVAC and electrical systems and 5 for traffic control. All subsystems are connected to a common SCADA-system.

The new control system shall be equipped with a redundant SCADA-server, SCADA-clients and new PLC-based subsystems in each utility rooms. Field buses shall be used where it is possible. Most of the equipment will include field buses nodes.

The existing communication system based on coax cable, shall be replaced with a optic fibre cable based network.

1.5.2.2 Network

The common network will be a optic fibre cable double ring network. The utility rooms will be equipped with switches supporting at least three independent VLAN´s.

1.5.3 Replacing the control system

As mentioned above, most of the renovation will take place during the summer period. All work regarding control system shall be carefully planned to secure all necessary functions needed during and after the tunnel renovation period. This work may include temporary changes in the existing system and/or data exchange between the two systems.

1.5.4 Connection to Trafik Stockholm (TS)

TS is a common traffic control room for all traffic on all main roads in the Stockholm area.

The data exchange will use a TCP/IP connection and a special protocol, owned by Vägverket (The National Swedish Road Administration), shall be used.

This connection to TS will be constructed as an option.

1.6 Ventilation of tunnel, control rooms, electrical rooms etc.

1.6.1 Ventilation of the Tunnel

Ventilation principle

The ventilation systems work with the principle longitudinal ventilation. Normally the tunnels are self-ventilated by the force from through passing vehicles. However in queuing situations the mechanical ventilation systems are working, using jet fans, placed in the tunnel, and large axial fans placed in fan rooms for supply of air to the tunnel and to exhaust air from the tunnel.

In case of fire in the tunnel jet fans are working to create an airflow that makes all smoke from the fire go in the direction of the traffic.

Renovation

The main assignments are:

- Dismount all of the jet fans (198 pcs.).
- According to the proposal in the tender documents, 21 of the oldest jet fans will be replaced. 76 of the newer jet fans will be renovated or replaced.
- The two horizontal axial fans (each 100 m³/s) for supply air will be replaced or renovated.
- Four of the five vertical axial fans (each 100 m³/s) for exhaust air will be replaced. The fifth fan will be taken down, and might in the future be replaced.
- Two of the three horizontal axial fans (each 100 m³/s) for exhaust air will be replaced. The third fan will be taken down, and might in the future be replaced.

1.6.2 HVAC for the associated operating areas (control rooms etc.)

For the tunnels there are eight equipment rooms, containing electrical rooms, electrical switchgear, UPS, emergency power plant, etc. which are going to have renovated ventilation systems. Necessary cooling of the rooms with large heat emission will be achieved by outdoor air (ventilation), except for the battery rooms serving the UPS units. In these rooms there will be small cooling units.

The main assignments are:

- Air handling units, fans and cooling units will be replaced.
- Supply air for cooling of new emergency power plants.
- Existing ventilation duct systems will mainly be replaced.
- New ventilation supply- and exhaust air devices.
- New smoke and fire valves.

2. Scope of Work for Söderledstunneln (repair of the tunnel)

2.1 Civil Works

2.1.1 Construction Works

Söderledstunneln consists of several different structures constructed between the year of 1935 to 2002. The tunnel is built up of 65 monoliths with dilation joints in between and the total length of the tunnel is appox. 2 x 1600 m, where approx. 2 x 150 metres is a tunnel in rock and the rest is a tunnel of concrete. The concrete tunnel is mainly in-situ cast frame structure, but there are also parts of prefabricated slabs on in-situ cast walls. Above the tunnel there are several buildings containing apartments, shopping centers, schools etc. The tunnel has been used for traffic since 1984.

When the load bearing system of the tunnel was examined extensive damage was discovered, e.g. areas of loose concrete cover on the lowest parts of the tunnel walls due to chloride initiated reinforcement corrosion.

To repair the damage the lower parts of the walls will be water cut and 3900 mm tall prefabricated concrete elements will be placed with a nominal distance of 80 mm from the existing wall. The lower edge of the element will extend 500 mm below the road surface. Between the new concrete element and the water cut surface an in-situ self-compacting concrete will be cast.

The civil works in the tunnel of Söderledstunneln will in short terms be:

- Dismounting of noise reduction ceiling in a smaller part of the tunnel. Erection of a new ceiling with similar function.
- Demolition of emergency lighting concrete columns in the rock tunnel.
- Cleaning of the ceiling and the walls above the upper edge of the new prefabricated concrete elements.
- Application of plaster for fire protection to the ceiling.
- Impregnation of the ceiling and walls above the upper edge of elements.
- Attaching anchor bars to the ceiling for hanging of cable trays.
- Demolition of cable ducts in ground.
- Water cutting of the concrete walls and exchange of damaged reinforcement if required. Cleaning of the surface.
- Casting of inclined concrete on the base slab for water rejection.
- For the prefabricated elements the following works will be included in the contract: Dimensioning, drafting of production drawings, production of the elements, impregnation, scrawl protection, erection adjacent to the existing wall including dimensioning of the fastening devices.
- The space between the new concrete element and the existing wall will be cast with nominal 80 mm of self-compacting concrete.

- Application of sprayed concrete for protection of exposed reinforcement, for water cut areas where concrete elements will not be erected and for protection of cabling above the concrete elements.
- Sealing of the upper edge of the concrete elements and the in-situ casting.
- Injection of cracks.
- Actions for taking care of infiltrated water from above the tunnel.
- Holes for cable ducts.
- A new sedimentary basin of in-situ cast concrete in an old rock railway tunnel. The old railway tunnel is placed approx. 10 m below the Söderledstunneln tunnel.
- New pumping station of in-situ cast concrete in the side room of Västra galleriet.

2.1.2 Drainage Works

2.1.2.1 Summary

Flushing water from tunnel cleaning shall be separated from other wastewater and conducted to a basin for sedimentation before the clear water phase is released to the combined pipeline system. The basin shall be located in an old railway tunnel beneath the Söderleden Tunnel.
Pumping stations for the pumping of flushing water shall be arranged in Västra Galleriet, Blekingegatan (conversion of existing pumping station) and outside the tunnel entrance at Skanstull.

Fire hydrant system: Every second hydrant shall be replaced by fire hydrants with double connection couplings. Service pipes to these fire hydrants shall be replaced with larger diameter lines.

2.1.2.2 Flushing water management

The existing wastewater system in the Söderleden Tunnel is a combined system, and conversion works are needed in order to separate flushing water from the other wastewater.

The new system means that the flushing water is collected in existing stormwater drains and the existing pipeline system. The existing system will be reconnected at a number of points in order to separate the combined wastewater from the flushing water.

2.1.2.3 Pumping stations

Pumping stations shall be provided in order to be able to convey flushing water from the entire tunnel to a sedimentation basin.

Västra Galleriet Pumping Station
To be located inside the existing equipment room.
Blekingegatan Pumping Station
Conversion of existing pumping station.

Skanstull Pumping Station
Surface level pumping station outside the tunnel entrance.

2.1.2.4 Pipeline works

Reconnections
In order to separate the combined wastewater from the flushing water, reconnections will be needed in the existing network at a number of points.

Long-hole boring
Long-hole boring shall be carried out from the Söderleden Tunnel to the old railway tunnel so that a waste pipe can convey the flushing water to the sedimentation basin.

New pipelines
In addition to the pressure pipes that are needed from the pumping stations to connection points on the gravity line, new wastewater lines will need to be laid at the Östra and Västra Galleriet.

2.1.2.5 Sedimentation basin

Flushing water from tunnel cleaning shall be conveyed to a basin located in an old railway tunnel beneath the Söderleden Tunnel (roughly at Högbergsgatan).
The function of the basin is to separate sediment and any oil that may be present before the wastewater is discharged into the combined wastewater system.
The basin shall be made of concrete and have a volume of approximately 100 m^3.

2.1.2.6 Fire-fighting water supply

The fire water system shall be changed by replacing the service lines at every second water hydrant by 100 mm diameter pipes, and at these points installing fire hydrant devices with two connection couplings. This will provide fire hydrants at c/c distances of approximately 120 m.
Every second fire hydrant will retain its small-diameter hose coupling (flushing pipes).

2.1.2.7 Other installations

Equipment room, Gamen Block
In the equipment room at the Gamen Block, west of the tunnel, there is an existing waste water service line that connects up with the pipeline which, after the conversion works, shall be used for removing flushing water. A pumping station shall be installed in the equipment room where the waste water service line can be connected.

2.1.3 Roads

It will be necessary to close one of the tunnel-tubes to traffic so that the contractors can carry out their work. This will result in general traffic being diverted into the other tunnel-tube using a contra-flow system.

Repairs and new ducting work require disturbing the current road structure. Excavations will be made parallel to and across the direction of traffic. Road works consist principally of

restoring the tunnel after the main repairs and installations have been carried out. In addition to that, kerbs in the tunnel and by the entrances will be removed. These will be replaced in the final outcome.

During the works, arrangements shall be made to allow site traffic to transport goods and materials along the tunnel and not be prevented by open excavations in the road. Fire and Safety requirements are stated in section 4.1 below.

Relaying of the road structure will be of the highest grade and consists of bitumen matrix with “loose crushed rock”

The wearing course consists of stonerich tarmac concrete (ABS-asfaltbetong) where the ballast material is of porfyr and/or quartzite. These materials do not exist within the Stockholm area, but can easily be transported from other regions in the country.

2.2 Electrical Installations

2.2.1 Existing cable routes

The existing cable routes in Söderledstunneln are in principle undertaken with:
- Cable ladders at tunnel walls (were also the tunnel lightning is mounted).
- Concrete cable ducts with concrete lids in the roadbed along the tunnel walls.
- Cable protection pipes in roadbed along the tunnel walls.
- Cable ladders in the ”cable culvert” in connection with the station ”Gamen”.
- Cable ladders in the parking-house between the stations ”Göta Ark” and ”Östra Galleriet”.
- Cable protection pipes across the roadbed.

2.2.2 New cable routes

The above cable routes shall be demolished and replaced with new. Exception:
- Cable ladders in the ”cable culvert” in connection with the station ”Gamen”.
- Cable ladders in the parking-house between the stations ”Göta Ark” and ”Östra Galleriet”.
- Cable protection pipes across the roadbed.

Cables in existing cable routes shall be identified before demolition. Some cables shall be replaced with provisional cables in order to maintain proper operation in the tunnels.

Cable ladders shall be installed on ceiling pendants on both the sides of the tunnels.

Prefabricated blocks of cable protection pipes cast in concrete shall be installed in the roadbed at each side of the tunnels. At intervals these pipe-blocks shall be connected to concrete cable-pits with covers. From the cable-pits vertical cable protection pipes shall be installed behind the wall-elements to the cable ladders.

Pipe-blocks shall also be installed across the roadbed to connect the transformer stations with cable-pits on the opposite walls of the tunnels.

The earth-wires and cable protection pipes for the 12 kV cables shall be installed in the roadbed.

2.2.3 Tunnel lighting

The tunnel lighting system, both the system for nighttime lighting and for daytime lighting shall follow the recommendations in VGU.

The nighttime/daytime lighting system shall be done with fluorescent tubes, Longlife Thermo, 2x58W (or 2x2x36W), asymmetrical lighting distribution with two High-Frequency operating ballasts in each fitting.

The fittings for the threshold lighting shall have metal halide lamps. The lighting shall be adjusted in steps corresponding to the luminance levels outside the tunnel.

A panel board for the lighting system shall be installed in each transformer station.

2.2.4 Safety and Emergency lighting

Fittings for guidance to emergency-doors shall be mounted in the new concrete wall-elements. The emergency-door shall be illuminated with one sign above the door and another one in the doorway together with two green LED-fittings.

A panel board for the lighting system and the electrical heating system shall be installed in each transformer station.

2.2.5 Electrical Heating

Electrical heating cables shall be installed on hydrants and their service pipes, a pressure pipe for wastewater and for drainage of the ceiling in the rock tunnel.

2.2.6 Telecommunications and Security Systems

The following systems are existing or new systems to be installed into the tunnel.

2.2.6.1 Fire alarm and Emergency Evacuation System

A premises Fire alarm system has a main unit in equipment room “Gamen” in the middle of the tunnel. Two sub units are interconnected to the main unit at each end of the tunnel on a Local Area Network. Equipment rooms have analogue addressable detectors.

The tunnel is protected with a thermal sensitive cable having a sensor spacing of 20 m. Sensor cable shall be replaced.

An evacuation alarm system shall be installed into the tunnel with sirens and beacon flashlights. The system shall be supervised. Control and monitoring shall be incorporated into the BMS system covered in another section of this tender.

All cabling shall be fire rated and protected for 1 hour and 250 centigrade according to IEC 332.

2.2.6.2 Emergency Telephones

At an interval of 100 m there shall be an emergency telephone installed into a cubicle of stainless steel. Each telephone shall be supervised on a separate network connected to the BMS system and interconnected to an exchange PABX unit in equipment room “Gamen”.

Emergency calls shall be monitored on the BMS system and automatically transferred to the Traffic Control Centre “Trafik Stockholm” as well as the monitoring system at the Clients controlroom.

2.2.6.3 Radio Communication System

Two Coaxial radiating 7/8” cables are installed in each tube of the tunnel carrying radio channels for use by Police, Fire brigade, Ambulance crew as well as public service radio channels.

Cables shall be replaced as an effect of reconstruction works.

2.2.6.4 Mobile Telephone Systems

Cellular network operators have concession to provide GSM and 3G radio coverage into the tunnel. Five operators have their antennas installed in the tunnel. Scope of works includes replacing existing equipment and cables while the operators shall support with installation information and products.

3. Scope of Work for Centralbron Tegelbacken (reconstruction of bridges)

3.1 Civil Works

3.1.1 Concrete repair and Water Proofing

The repair works includes re-insulation of pavement structure, improvement of traffic safety and new lightings. New places for by-pass routes shall be arranged with new solutions for stop ends, e.g. new swing barriers will be installed.

In total 16 bridges are included in the works, with a total length of approx. 1900 m. The total area of paved surfaces is about 31 000 m^2.

The civil works for the bridges, will in short terms be:

- Replacement of pavement and insulation layers, new middle barrier.
- Replacement of surface water drains, ground water drains and drainage.
- Replacement of some joint constructions.
- Installation of new system for collection and sedimentation of surface water.
- New lighting and longitudinal cable ducts.
- New traffic control system.

3.1.2 Drainage Works

3.1.2.1 Summary

For the collection of storm water from the bridges across Söderström and Norrström, gullies shall be provided beneath the bridges. The storm water will be conveyed to 2 treatment plants, in the form of screening basins, to be located in Söderström and Norrström respectively.

3.1.2.2 Centralbron, section across Söderström

The bridge has a slight downward slope northwards towards Riddarholmen and the storm water can be conveyed in gullies beneath the bridge to a treatment plant to be installed beneath Centralbron next to Gamla Stan underground station.
The existing storm water drains that are situated in the roof of the underground shall also be connected to this treatment plant.

3.1.2.3 Centralbron, ground section across Riddarholmen

North of the Gamla Stan underground station there is an existing storm water pipe that runs northwards and discharges into Norrström. This storm water pipe collects storm water from

the road section north of the underground station up to the bridge across Norrström and discharges it below the level of Lake Mälaren.
The pipe shall be connected to the treatment plant that is to be laid near the bridge abutment and next to Riddarholmen.

3.1.2.4 Centralbron, section across Norrström

The bridge slopes slightly to the south towards Riddarholmen and the storm water can be conveyed in gullies beneath the bridge to the treatment plant that is to be located near the bridge abutment and next to Riddarholmen.

3.1.2.5 Treatment facilities at Riddarholmen-Gamla Stan

The treatment facilities shall take the form of two plants with through-flow arrangements in the form of screening basins, which at the inlet, shall be provided with a pre-sedimentation well that is accessible for sludge suction collection. The function of the basins is to collect sediment prior to the discharge of storm water into Riddarfjärden.
One of the plants shall be located at the southern abutment for the bridge across Norrström next to Riddarholmen and the other shall be built alongside the northern abutment for the bridge across Söderström near Gamla Stan underground station.

3.1.3 Roads

The repairs of the bridges will include new concrete block barriers, between the lanes, laid on a base of ABS. Dismantling of the current road surface and barriers are described in 3.1.1.

The road structure consists of a bitumen matrix with loose crushed rock stuck to a layer of protective concrete.

The wearing course on the bridges consists of stonerich tarmac concrete (ABS-asfaltbetong) where the ballastmaterial will be of porfyr and/or quartzite. These materials do not exist within the Stockholm area, but can easily be transported from other regions in the country.

Also included is the relaying of cobbles and slabs on Riddarholmen, after the pipe work has been completed. Kerbstones of granite are required for the new-concreted pavements, which will need to be specially ordered, as their low profile is not of a standard measurement.

3.2 Electrical installations

3.2.1 Cable routes

Cable protection pipes shall be laid in a bottom recess under the barrier-elements in the middle of the road for the cables to roadway lighting, traffic equipment etc.

A cable trunk system shall be built on the edge beam of the bridges. This system (consisting of cable protection pipes in an enclosure combined with cable ladders under the bridge) shall provide a cable connection between “Söderledstunneln” and “Blekholmstunneln”.

3.2.2 Roadway lighting

The Roadway lighting system shall follow the recommendations in VGU.
Spacing shall be 20m between the poles which shall be mounted on barrier-elements in the middle of the road. Mounting height shall be about 10m.

The fitting shall have a metal halide lamp that is operated with a HF-ballast.
The Client will give special installation specifications.

4. General Conditions for all Works

4.1 Fire Safety Strategy

This section is a summary of the general fire safety strategy. The detailed design and specification of the fire safety precautions are described in each technical section (electrical, ventilation, construction etc.) in other parts of this document.

Current Fire Safety Strategy for the existing tunnel

- Fire compartmentation: Each tunnel tube is a separate fire compartment with unidirectional traffic.
- Means of egress: The strategy is to evacuate occupants via the cross-passage doors to the adjoining “safe” tunnel and then to the outside via the tunnel exits or via a couple of fire isolated staircases located near the middle of the tunnel. The distance between cross-passage doors in the tunnel does not exceed 75 meter.
- Smoke Ventilation: The main smoke management strategy is based on longitudinal ventilation using jet fans. There is also a possibility to use vertical ventilation shafts but these are not evenly distributed along the tunnel.
- Fire Fighting Water: Wet Hydrants are placed in each tunnel tube, The distance between two hydrants does not exceed 75 meters.
- Emergency Communication: Emergency phones are located at the cross-passages.
- Fire alarm: A heat detection cable is located along the roof in each tunnel tube, through the full length of the tunnel. The alarm is separated into approximately 15 sections.
- Emergency lightning: The tunnel tubes have emergency lights and signage equipped with backup power supply (UPS).

Upgrade measures regarding fire safety:

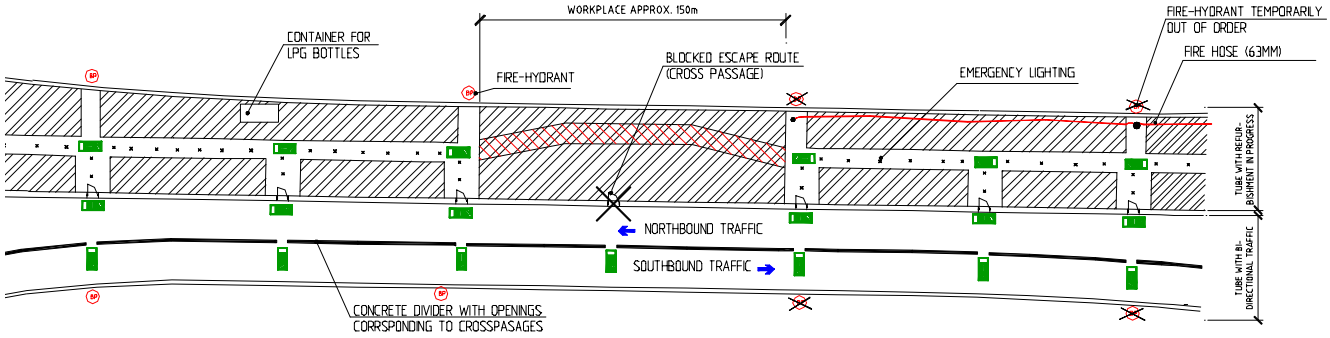
- New cross-passage doors and door closers and openers.
- Improved design to make the cross-passage doors more visible
- Improved lightning, emergency lights and exit signs
- Modernization of traffic regulation system (VMS, tunnel closure system, ITV etc.)
- Improved water supply for the fire brigade, every second hydrant is replaced
- New tunnel lining to improve structural fire resistance
- New jet fans and operational system
- Improved emergency power supply
- New evacuation alarm

Fire Safety Strategy during construction

During the construction one of the tubes will be closed for construction work and the traffic is then rerouted to the other tube (bi-directional traffic). The following safety measures are proposed:

- The traffic in the bidirectional tube will be separated with a concrete divider. The divider will have openings corresponding to the cross-passages.

- The maximum speed shall be reduced to 30 kilometres per hour.
- No more than one cross-passage at the time may be closed for construction.
- Inside the tube under construction, escape routes and access routes for the fire brigade must be kept free from obstructions, se pict 1.



Picture 1. Escape and access routes, hydrants.

- Closed hydrants shall be replaced by a temporary hose system inside the tunnel tube under construction and marked as closed in the traffic tube.

All other systems regarding fire safety shall be fully operational.

4.2. Environmental requirements of the Contractual Works

Negative environmental consequences which could occur during the construction /demolition works are to be avoided or as far as possible minimized. The contractor shall work out an environmental plan, adapted to the current project. This plan shall identify and describe the environmental aspects significant for this project. The plan shall also describe the education for the different categories of employees. The contractor is responsible for the observance of applicable laws, regulations and directions.
The environmental plan is to be ratified by the client, before works are started.

4.2.1 Environmental requirements for the repaired, improved structure

The contractor is responsible for that the specified sound volumes are not exceeded in the tunnel and dwelling houses close to air intake and exhaust towers.

Air pollution in the tunnel air shall be below 400 µg/m^3 NO_2, measured as a rolling average per hour. The measuring instruments are to be placed where the worst conditions are expected.

Authority requirements and standards for fixed installations applies in all aspects with regard to noise and vibrations requirements on axial fans and jet fans, as well as noise from jet fans transmitted via constructions.

Choice of material and chemical products

Materials and products shall fulfil technical and functional demands as well as minimized environmental impact. The contractor shall account for the product choice 20 labour days before the works are to be started. The client must ratify the material and product choice before the actual works will be started.

The contractor shall have a current list of chemical products used in the project. The contractor must show building material declarations for all materials and goods used, showing the contents and make up of the product, the quantity and also where it is to be used.

The declarations are to be made in accordance with Byggsektorns Kretsloppsråd's (The Eco-cycle Council for the Building Sector Sweden) form for building declarations. The list is to be ratified by the client.

4.2.2 Environmental requirements during the construction phase

Water

General requirements, issued by Stockholm Vatten (Stockholms Water Company), for the treatment of water used during constructing and demolition works are to be fulfilled. Cleaning of the tunnel must be performed without detergents. Polluted water shall be taken cared of in certain ways. Polluted water shall be purified in local sedimentation basins, before it is discharged to the pipeline system or to the recipient.

The contractor shall perform a Control Programme concerning the handling of water during the renovation process according to the requirements and environmental demands of Stockholm Vatten and Miljöförvaltningen (Environmental and Health Protection, City of Stockholm).

Noise, vibrations

The contractor shall perform a Control Programme for noise and vibrations during construction and demolition work. The noise must not exceed specified levels.

Vibrations are gauged to consider damage risk to constructions, sensitive equipment and man comfort. A detailed risk analysis, including inventory, inspections and Control Programme are to be performed before the works are started. All works must be performed so that vibration doe not harm constructions or surrounding environment.

Pollutions

Vehicles and machines have to fulfil the low discharge requirements issued by Stockholm's City Council.

The contractor shall produce an Environmental Plan, accounting for how these environmental demands shall be carried out during the working period. The contractor shall fulfil all the requirements of Stockholm's City Council.

Waste management

Handling of waste, poison, and dangerous waste must follow certain procedures. Special rules apply to containers for chemical substances and dangerous waste. The contractor is responsible for inventory and inspection of existing material, which are to be demolished.

The contractor shall prepare a demolition plan, adapted to these projects, and shall apply for the necessary permissions.

The contractor shall produce a plan for recycling. Recycling shall be carried out at least to the standards set by the local authority. Waste is to be divided in fractions and contained in an environmentally friendly way. Appropriate waste shall by sorted out for reuse and recycling.

Storage of fuel, oils, maintenance, filling and cleaning of vehicles

The contractor shall in the environmental plan, record how working and maintenance of vehicles and machines will be carried out, giving this account before the works starts. There are general requirements on machines, fuel, oils, lubricants etc. There are special requirements regarding containers for fuel, oils and chemical substances.

Readiness for distress

The contractor’s plan for Distress Readiness is to be ratified by the client. The contractor shall have routines for environmental accidents and maintain the necessary information to the employees.