

Case story | VLT® HVAC Drive FC 102

# Next stop: Copenhagen

## Cityringen - Tight spaces made manageable

**90%**

heat removed due to  
back channel cooling

**Cityringen** is the imposing structure that will bring a new, **completely automated** underground line into the center of the Danish capital.



Two tunnels of 17 km each



Diameter of 5.5 m



17 new main stations



30 m below street level



Systemair Srl, H.S. Progetti and Danfoss Drives Italy collaborated to supply the permanent

emergency ventilation systems as well as the temporary ventilation systems, operational during the excavation work.

Copenhagen will have a fully automated line, running 24 hours a day, at an interval of just 100 seconds between trains.



The structure has been given the name Cityringen based on the ring-like construction of the route. It runs right below the city centre and it is a technical challenge in terms of both complexity and importance.



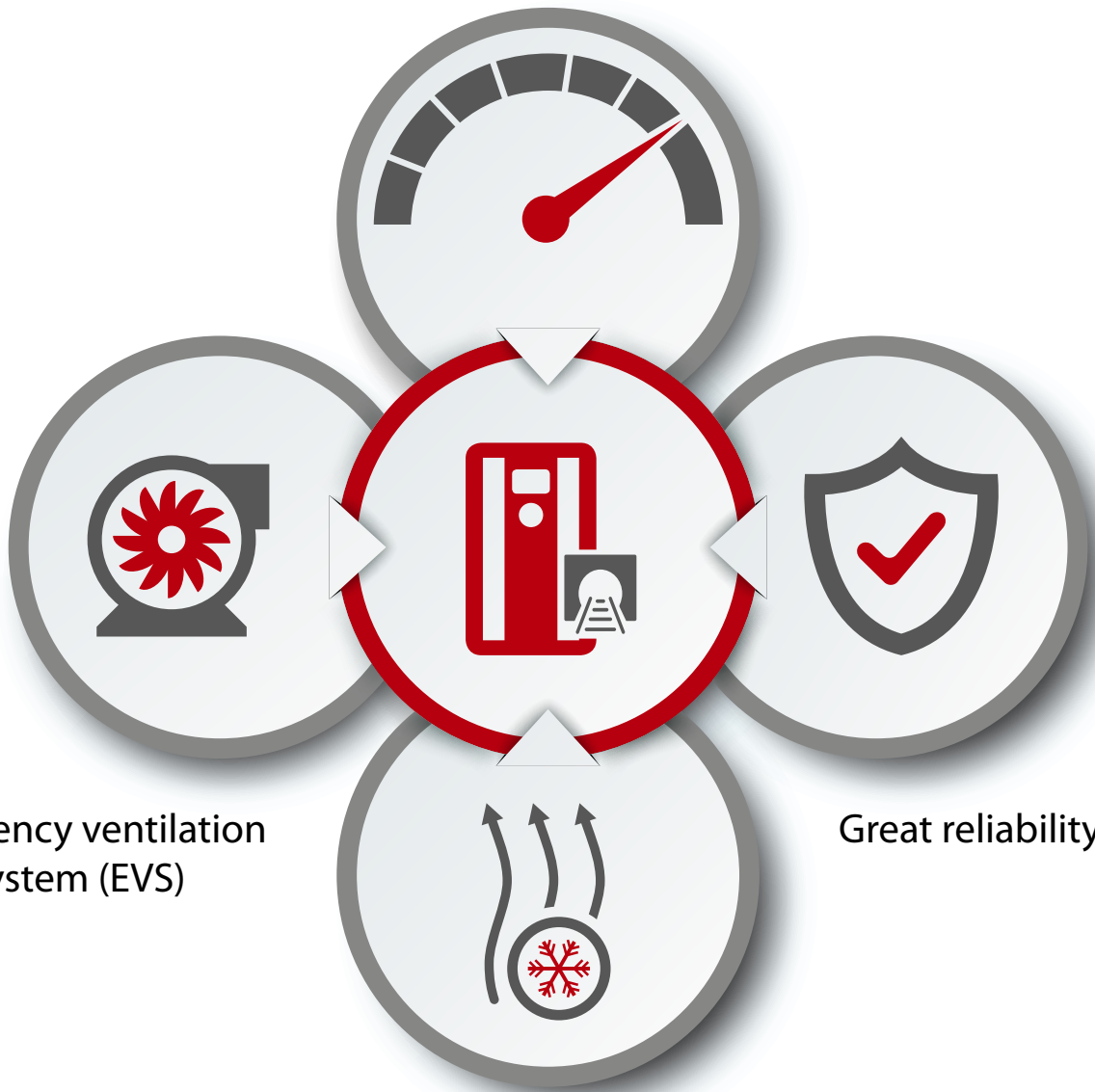
As a subcontractor of CMT (Copenhagen Metro Team, an Italian consortium led by the Salini-Impregilo Group),

Systemair was tasked with the construction of the new line. The company provided the temporary ventilation solution for the project as well as the entire emergency ventilation system including the electrical control panels. H.S. Progetti was the manufacturer of the control panels.



Scheduled for inauguration in 2019, Cityringen will enable the transport of over 240,000 passengers per day, equivalent to 72 million per year. Already boasting one of the most advanced public mobility systems

High-performance,  
even in harsh environments



Emergency ventilation  
system (EVS)

Great reliability

Superior cooling capacity  
for tight spaces



*"This important project," explains **Andrea Valente, Systemair Tunnel & Metro Ventilation Engineer**, "was made possible thanks to our company's business partnerships and its ability to engineer, implement and assemble all the components involved under a single brand. ". In particular, all the different elements are capable of interfacing with the SCADA supervision system, which will enable the complete remote management and control of this part of the plant. These elements are the main fans, the dampers for the regulation of air inside the ducts, the silencers, and the electrical control panels for the control of the emergency fans, as well as other pneumatic control panels for the activation of the damper actuators."*



*Panels from the station named "FBA" already placed on the technical floor and photographed during the tests carried out jointly by Systemair and H.S. Progetti.*

### **Performance and efficiency in synergy**

Logistical and operational issues related to civil works in areas of high population and housing density, as well as limited space available for the installations in the stations all needed to be addressed, at the start of the project.

*"Due to the limited space granted, these stations are admittedly not comparable to the underground stations we are used to seeing in, for example, Italy.- Consequently, we met difficulties in the design and installation of the system, says **Andrea Valente, Systemair Tunnel & Metro Ventilation Engineer** "*

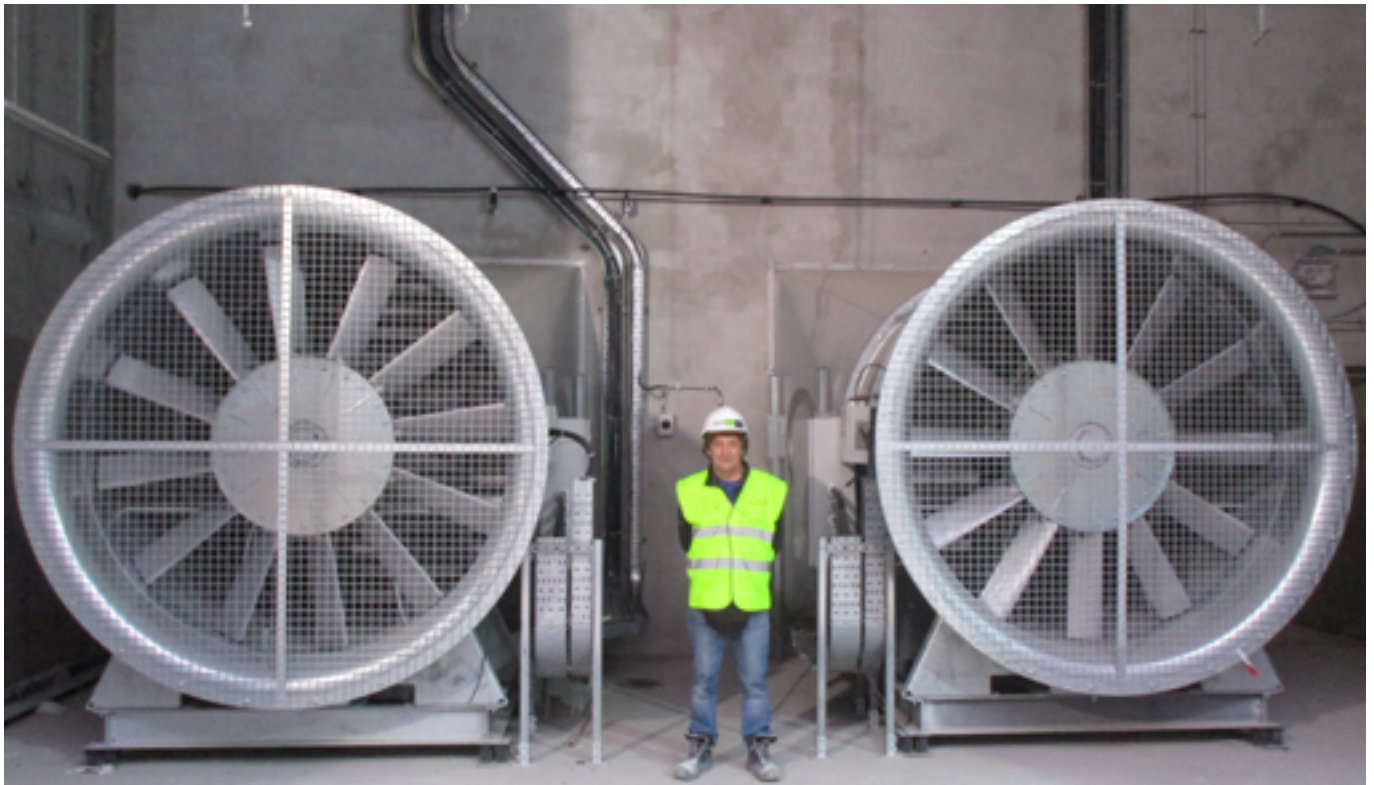
In accordance with the specifications received, Systemair planned the

installation of 4 fans with a diameter of 1400 mm in four stages. They were installed in the temporary ventilation of excavations, and were equipped with a VLT® HVAC Drive FC 102, 75 kW from Danfoss.

*"The equipment in use," **states Valente**, "is for the excavation phase with the TBM, the mechanical mole. As soon as the spaces between the future stations had been opened, 117 induction fans in the Systemair series IV with low-profile configuration were installed"*



*Systemair 4 x 75 kW four-phase fan.*



N.2 Reversible axial fans model AXR 2000-12, certified for operation at 250 °C for two hours in the event of fire and equipped with 250 kW three-phase electric motors.

*"Due to concerns related to safety and redundancy," states Valente, "the EVS fans are installed in pairs inside the various stations." Each of them is equipped with an electrical control panel and operated by drives from Danfoss.*

*"One feature of the drives from Danfoss, which is very much appreciated," adds Leone, "is the fact they are easy to mount and install. The "back channel cooling", a rear ducting kit that allows optimal and efficient heat management, reduces our installation and operating costs. It means we do not need to rely on additional air conditioning systems."*

### Emergency ventilation system (EVS)

In the event of a fire in the tunnel, approximately 40, 250 kW, 2000 mm diameter reversible A series fans serve as the primary fans for smoke extraction. They are also used for additional ventilation if the trains are prevented from circulating. These fans can be installed both vertically and horizontally, they are able to withstand temperatures up to 250 °C, and they offer a nominal air flow rate of 100 m<sup>3</sup> per second with pressures of approximately 1500 Pa.

### Great reliability and ease of use

The Turin company H.S. Progetti, produced all the electrical control panels for the above mentioned permanent emergency ventilation.

*"Because they are part of a safety system," explains the Managing Director Daniele Leone, "the electrical control panels have redundant components, and they are therefore double for each station. The VLT® HVAC Drive FC 102, 250 kW, new D frames series, are perfect for the prescribed requirements, we had. Extremely compact, reliable, high performance and easy to use."*

*"Tight spaces are a challenge," observes Leone, "and so was the request for the production of electrical control panels with type 4a segregation. Each functional element inside the panel must be separate from the others."*



Danfoss Drives VLT® FC102 250 kW drive mounted inside its cubicle.



*"The IP20 enclosure, used here" comments Andrea Peraboni, Key Account Manager at Danfoss Drives Italy, "is optimized for the installation inside an electrical control panel with all the electrical parts protected from accidental contacts. As an option, this drive can also be ordered with integrated fuses while maintaining the overall dimensions. The ergonomics are ensured by a cable entry designed in the lower part of the drive with separate paths for the signal cables and for the power cables."*

### **Compact and high-performance, even in harsh environments**

Despite the compact dimensions, the Danfoss VLT® HVAC Drive FC 102, integrate, the RFI filter (giving up to 150 m of shielded motor cable) and the chokes, on the intermediate circuit. This protects systems and minimize harmonic distortion and electromagnetic interference.

In addition the ease of programming and set-up featured by these drives is highly valued by the H.S. Progetti technicians, these features have been made possible thanks to a configuration wizard via graphic display and the VLT Motion Control Tool MCT 10 software, which allows rapid configuration of parameters on a PC while enabling a complete view of the variables of the entire system.

*"Another interesting feature of our drives," adds Peraboni in conclusion, "concerns the possibility of controlling any type of motor, from asynchronous used in this application, to permanent open-loop magnet motors, to synchronous reluctance motors."*

*In more general terms, it is worth noting the following features: the Fire Mode function, which ensures the rotation of the motor for as long as possible in the event of a fire; and the Smart Logic Controller, i.e. an integrated mini PLC where up to 20 functional blocks can be created, making the use of the PLC superfluous in some cases. The MyDrive Connect option, enables the control and management of all the features by means of a proprietary app as an alternative to the graphic display and USB connection, ensuring greater flexibility and operational versatility."*



Panels for the station named "FBA" in Frederiksberg Allé, just tested in the H.S. Progetti Production Department and waiting to be packed.



*Copenhagen, work in progress*

### **CMT**

#### ***Italian excellence for the new Copenhagen underground line.***

CMT, Copenhagen Metro Team, is the Italian consortium led by the Salini-Impregilo Group, tasked with constructing Copenhagen's new ring-shaped underground line. The excavation of the two planned tunnels, one for each direction of travel, was carried out with four tunnel boring machines (TBM), which made their way below the surface of Copenhagen. With the inauguration

of the new line, 85% of the population will have at least one station at a distance of no more than 600 meters from their doorstep.

### **Systemair**

Systemair develops, manufactures and markets high-quality products in the ventilation sector, based on the fundamental values of simplicity and reliability. It has 5200 employees in more than 60 companies and branches.

### **H.S. Progetti**

H.S. Progetti Srl, based in Ferriera di Buttigliera Alta (Turin), is specialized in the design and construction of special automatic machines for production, construction of control and test benches, supply and development of software for PLC, supervision software and service.



*Ventilation chamber inspection at the "EHP" station with Systemair personnel.*



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