

Montreal Metro's AZUR Cars

2017 Canadian Consulting Engineering Awards

Groupement DST



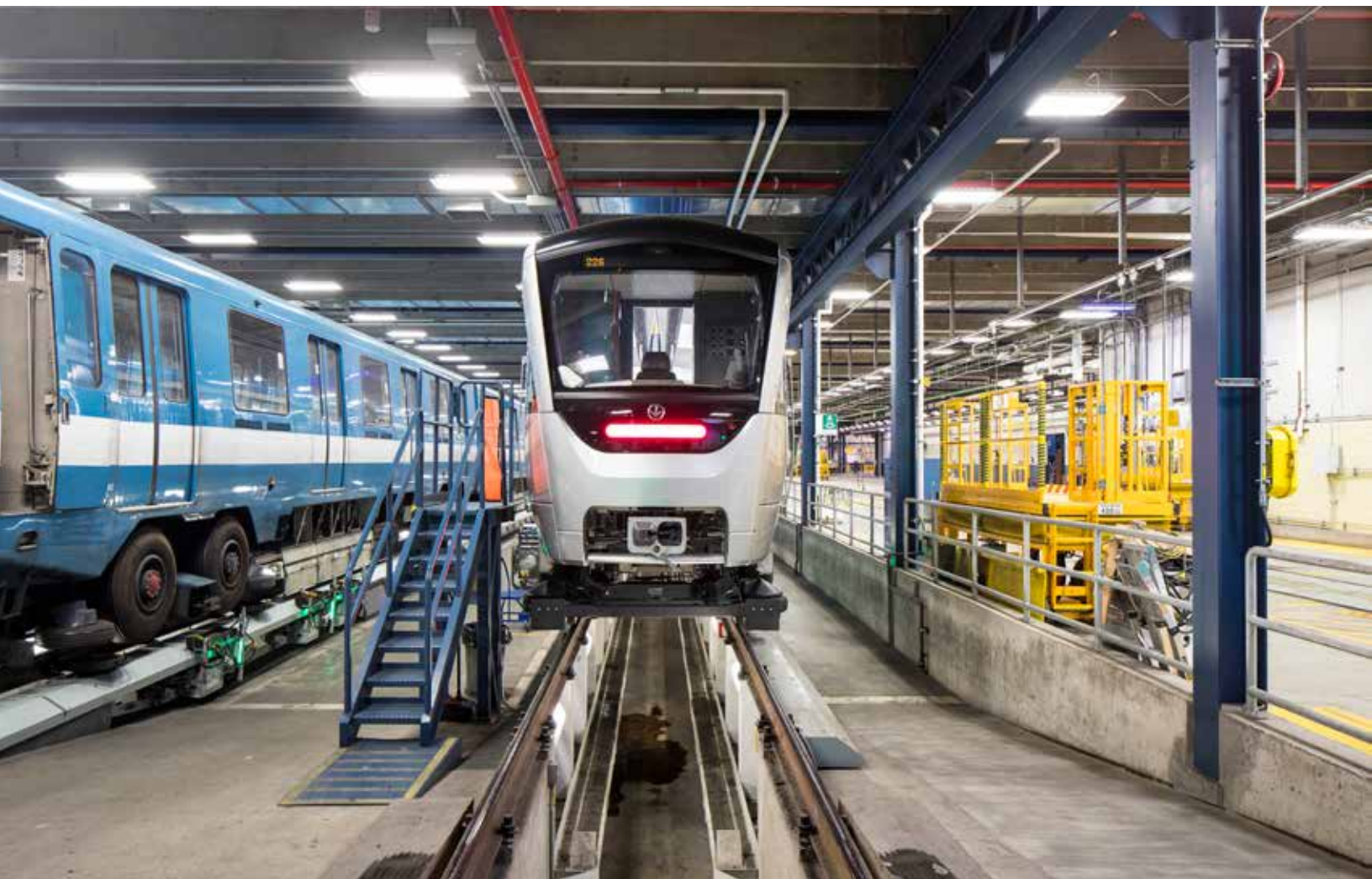
Stantec



SNC · LAVALIN

AECOM





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Project Overview

468

new AZUR cars in 2018

17

trains in service as of April 1, 2017

\$1.2B

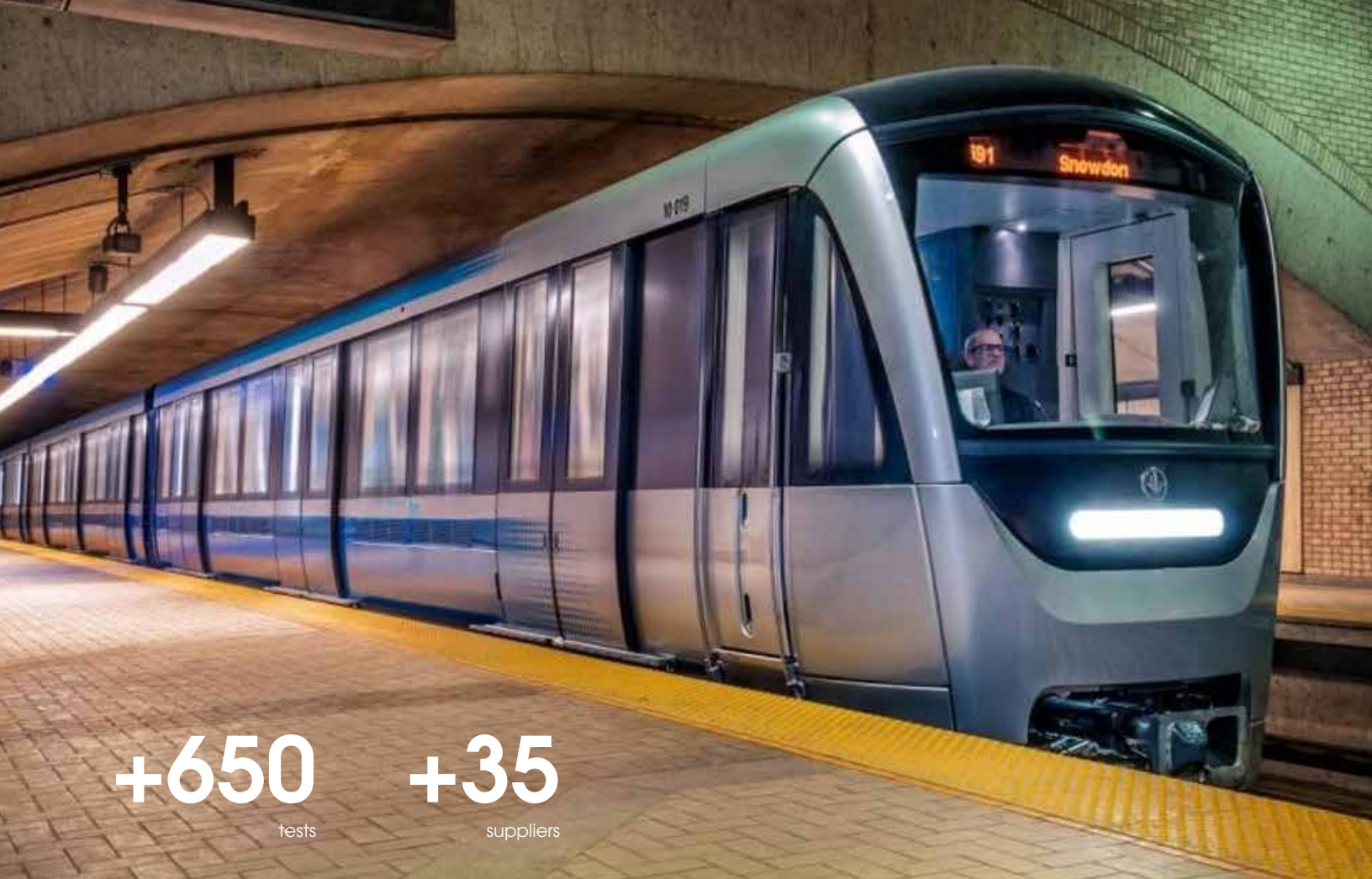
investment

As one of the dominant players in Quebec's public transit sector, the Société de transport de Montréal / Montreal Transit Corporation (STM) provides more than 70% of all public transit trips made throughout the province. In its metro network modernization plan, the STM was seeking to update its fleet of cars, a number of which dated back to the network's 1966 inauguration. Each of the MR-63 (1963 metro rolling stock) cars had travelled more than 3.2 million kilometres and needed to be progressively replaced, thereby improving metro performance while enhancing the experience for Montreal's public transit users.

To achieve this, the STM was looking to acquire new cars—ones that would integrate into the existing infrastructure—to better serve their clientele's needs, and all at the right price. The STM partnered with Groupement DST, the joint venture bringing together Stantec, SNC-Lavalin, and AECOM, to accompany the STM in this massive project. A project office was put in place in 2006, formed by STM and Groupement DST employees, to ensure the project's success.

In 2010, the STM awarded the contract to the Bombardier-Alstom joint venture, for the acquisition of 468 new metro cars to replace all MR-63 cars while increasing service on the busiest metro lines, namely lines 1 and 2 (green and orange lines).

In February 2016, the STM commissioned its first AZUR train—a major step in the progressive replacement of the cars. As of April 1, 2017, 17 trains (each comprising nine cars) had been delivered to the STM. By 2018, once the project is completed, there will be 52 trains in service. Spanning several years, this project represents a \$1.2B investment.



+650
tests

+35
suppliers



AZUR, a truly unique train

- 152 metres long
- 9 cars per train
- Free movement between cars (boa)
- 27% wider doors
- 8% increased passenger capacity
- Top-of-the-line PA system
- Panoramic windows
- Indirect lighting for better visual comfort
- Pneumatic suspension for a smoother ride
- Obstruction-detecting smart doors
- High-tech information, security, and diagnostic systems

Innovation

The Montreal metro car modernization project is a shining example of technological innovation and serves as a model for sustainable development, both in Quebec and elsewhere in the world. A public transit project of this nature and scope is quite rare—one must go back to the 1970s for an endeavor of this scale in Quebec—which is exactly what led our team to push the design envelope while constantly integrating the evolving technology into the design.

In 2006, the Groupement DST (Stantec, SNC-Lavalin, and AECOM) joint venture joined the Société de transport de Montréal / Montreal Transit Corporation (STM) project office, to provide cutting-edge expertise in large-scale engineering project management as well as passenger transport systems, and to support the STM for the entire AZUR car procurement process.

Our team was actively involved from the project's preliminary phase—helping the client define their needs, in consultation with numerous stakeholders, prepare technical along with contractual specifications, and navigate negotiations and awarding of the contract to the manufacturer, namely the Bombardier-Alstom joint venture. We also ensured the management and input of technical expertise on multiple engineering projects arising from the integration of this new rolling stock. Furthermore, we supervised the manufacturing and final

product design, through quality audits of more than 35 suppliers worldwide, and carried out the qualification of systems and of the train—650 tests in all—at suppliers' premises, on Bombardier's test track, and on the metro network.

Meeting the STM's heightened requirements, in addition to those of its clientele, meant that no aspect of the design could be left to chance—from the modular equipment facilitating train maintenance, to the latest in public address system technology for commuter information. An in-depth analysis of needs, various operational contexts, and existing infrastructures, formed the basis for our choice of optimal combinations. We went for a boa-type train comprising seven motor cars and two cab cars, enabling passengers to move about freely between cars. AZUR boasts seven separate intelligent systems seamlessly interacting with each other, including traction and braking, electrical power supply, train control, and diagnostic systems.

Our team participated in the design of an ultra-modern train with unparalleled features in terms of operation and maintenance as well as user experience. Beyond its ergonomic seating and panoramic windows, AZUR stands out for its improved ventilation plus larger and obstruction-detecting smart doors.

Complexity

2

generations of trains
operating simultaneously

+500

operators and maintenance
employees trained

The car manufacturer selection process led to the forming of a joint venture to bring together two worldclass leaders in railway transportation, even if they remain competitors. This required very rigorous management of internal processes and more complex technical integration. In fact, the Bombardier-Alstom joint venture required additional measures to govern document management confidentiality, and called for the implementation of two distinct digital networks within the same train, so as to protect their respective digital protocols and data.



What's more, numerous projects were developed in parallel, in an aim to ensure the integration and operation of the new trains. The STM's main workshop was completely modified while passenger services were maintained, in line with AZUR's maintenance principles. New equipment was purchased and training programs developed—including a full-scope simulator. A recovery and recycling program was also set up for the old MR-63 cars.

Train test schedule constraints were another factor to consider, as such tests had to be carried out predominantly outside regular metro hours, typically at night (restricted to four hours only), for minimal impact on commuters and to accommodate various concurrent tunnel works. Since all stakeholders would need to be present for the tests, this activity entailed a high level of planning, flexibility, and coordination.

Lastly, the simultaneous operation of two different train types—the old MR-63 and new AZUR cars—brought added complexity to the mix in terms of different operating conditions and maintenance programs for two products at the same time.





Social and Economic Benefits

The AZUR train offers a number of advantages to the greater Montreal community. The cars meet the highest standards for universal accessibility due to their reserved spaces as well as adapted communication systems and signage. The project office worked closely with a range of local organizations to better identify needs and clearly communicate these to the manufacturers.

Moreover, the train was designed and manufactured by Quebec and Canadian suppliers, thus promoting job creation, innovation, and a dynamic economy for the country. In fact, Bombardier's main production plant, located in La Pocatière, Quebec, has generated hundreds of jobs. Furthermore, the production of bogies at Alstom's plant in Sorel-Tracy, Quebec, has led to major technological advancements in the welding field.

The modernization of cars will also facilitate a reduction in maintenance costs related to Montreal metro operations. In effect, the new train could go 20,000 kilometres before requiring an inspection, meaning twice the distance of MR-63 cars, which need to be inspected every 10,000 kilometres.

By improving the service to users as a result of more reliable trips, this project helps enhance the population's quality of life while increasing the attraction of public transit. The acquisition of these new trains is also part of the STM's 2020 Strategic Plan, aimed at increasing overall public transit for the city by 40%, with the goal of reaching 540 million trips by 2020.

Environmental Benefits

AZUR was designed to meet eco-design criteria (ISO 14040) and life-cycle analysis concepts (ISO 14062) that require the integration of environmental impacts into every step of a product's life cycle—from raw materials extraction until managing the product's end of life. In that regard, 97% of all materials used in manufacturing the cars are recyclable or recoverable. As well, the elimination of hazardous substances and toxic emissions was a central concern for the STM in their quest to offer a healthier and safer environment for their users as much as for their employees.

Numerous sustainable development requirements were integrated into the project specifications, to ensure that manufacturers' supply chains would meet STM objectives regarding environment, economy, and social responsibility. Our specialized sustainable development team carried out audits of various suppliers participating in the production of the new green train. The team visited around 20 sites, to certify companies' compliance with laws, standards, and contractual requirements.

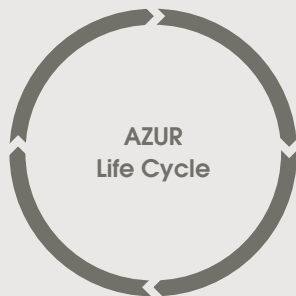
The AZUR train also benefits from increased energy efficiency owing to a regenerative braking system, which plays a key role in minimizing energy consumption. An AZUR metro car transporting a passenger for a distance of one kilometre, generates 99% less CO₂ than a similar trip by car. With the network's renewed reliability, the STM hopes to attract new public transit users and thereby reduce single-occupancy vehicle use in the metropolitan region.



Material production



Design and manufacturing



AZUR Life Cycle



End of life



Operation and Maintenance

14040

ISO standards series on life-cycle analysis

99%

less CO₂ than a car

97%

recyclable or recoverable materials



1

unique travel
experience

10

years of
collaboration

+2,500

meetings with manufacturers

Meeting Client's Needs

In awarding the contract to the Groupement DST joint venture, the STM was seeking for its team experts in passenger transit rolling stock procurement and design, to support them throughout the car modernization process. Our team had strong expertise in this particular area as a result of having carried out similar projects elsewhere in Canada, the United States, and internationally, for major transit authorities such as VIA Rail, Toronto Transit Commission, and New York City Transit Authority, as well as partnering with the Régie Autonome des Transports Parisiens (RATP).

Our specialists ensured that the elements proposed by manufacturers met the heightened requirements for this project. Our team also demonstrated a firm commitment to the project's success, given that we had participated in more than 2,500 meetings with manufacturers and suppliers, both locally and abroad.

The creation of a project office was also a key factor in the project's successful outcome. By relying on a well-established structure with adapted processes, our team instilled a climate of openness and collaboration, which helped maximize the involvement of all team members—nearly 100 employees from the STM and more than 100 resources from the Groupement DST joint venture, over a 10-year period.

Thanks to the synergy developed between our resources and those of the STM, a substantial knowledge transfer was accomplished. The project team brought together its strengths for the purpose of designing a cutting-edge train that is now making its mark across the globe, offering a unique travel experience since February 2016.