REM CANADA:
not a standard light rail project

BONOMI
moving energy since 1928

⌗ INDEX

ABOUT THE PROJECT

RESEAU EXPRESS METROPOLITAIN

What about the project?

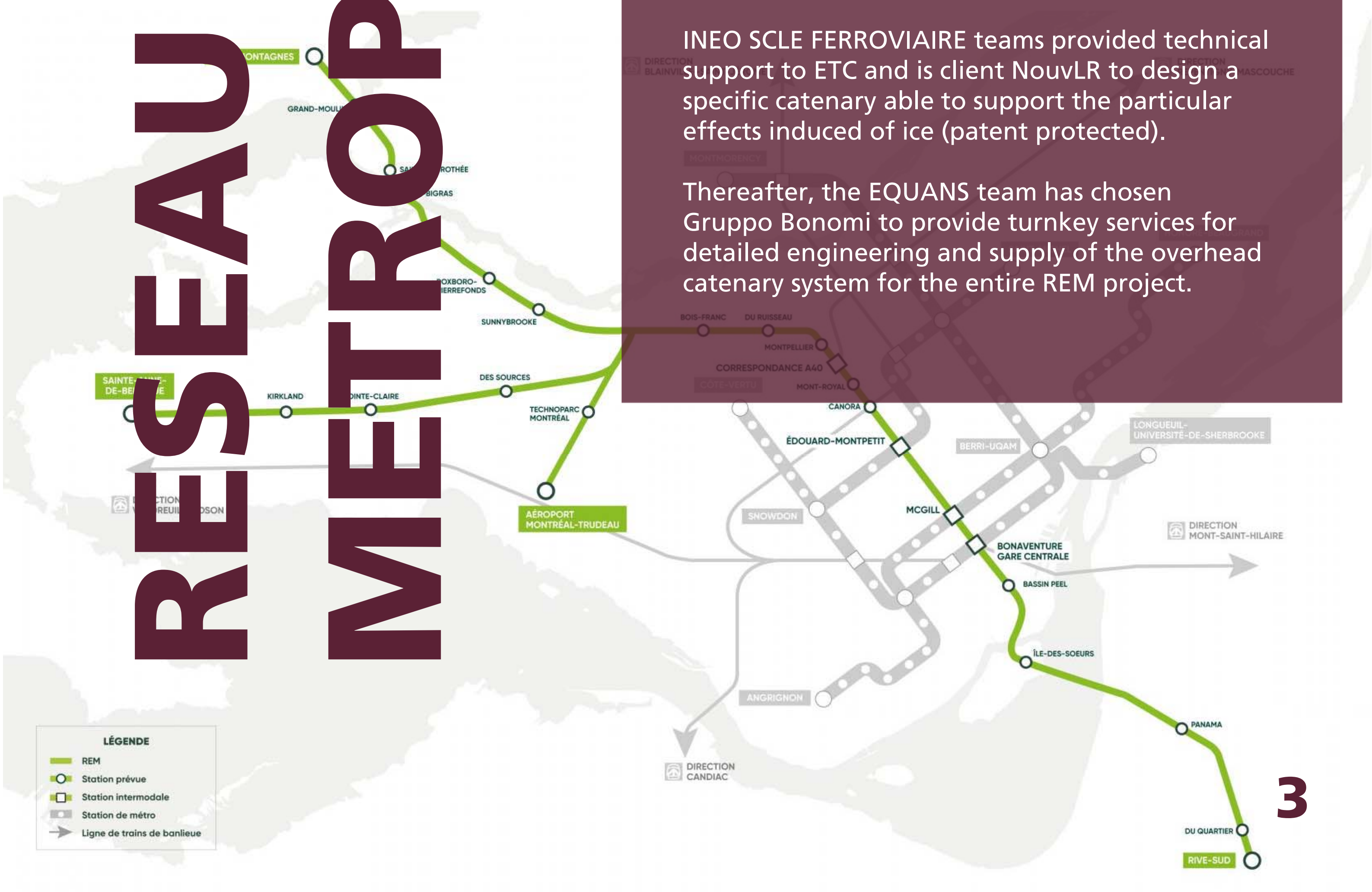
The Réseau express métropolitain (REM) is a light rail rapid transit system under construction in the Greater Montreal area.
Today, the Montreal metro carries daily 1,200,000 passengers on a network of 71 kilometers, 4 lines and 69 stations. It is the most popular system in terms of passengers per kilometer in North America after New York (APTA data).
Trains on the network are expected to be fully automated and driveless.

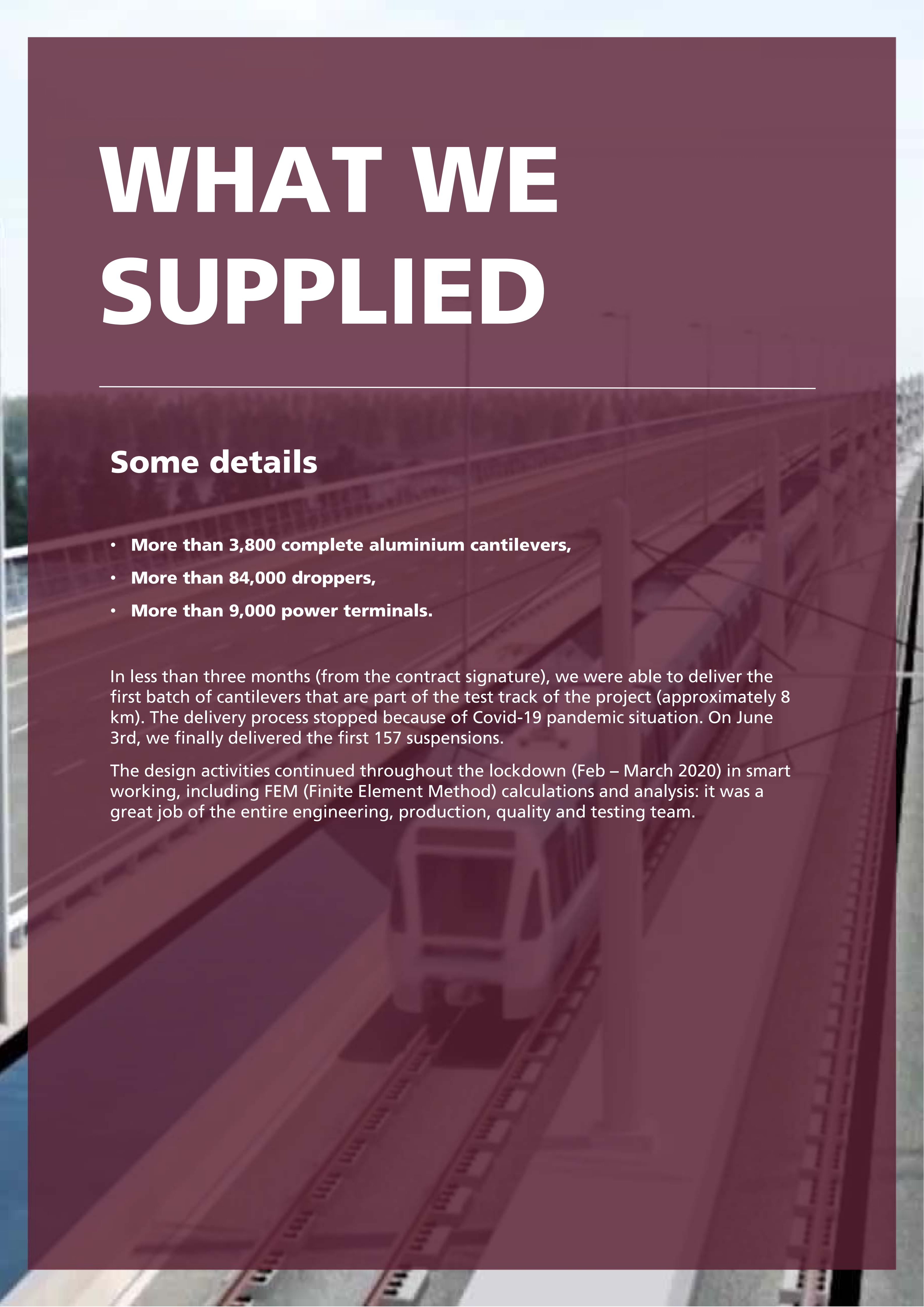
ABOUT THE CLIENT

EQUANS TRANSPORT CANADA is responsible for the rail electrification, engineering, procurement and construction of the Réseau Express Métropolitain (REM) project.

INEO SCLE FERROVIAIRE teams provided technical support to ETC and is client NouvLR to design a specific catenary able to support the particular effects induced of ice (patent protected).

Thereafter, the EQUANS team has chosen Gruppo Bonomi to provide turnkey services for detailed engineering and supply of the overhead catenary system for the entire REM project.





WHAT WE SUPPLIED

Some details

- **More than 3,800 complete aluminium cantilevers,**
- **More than 84,000 droppers,**
- **More than 9,000 power terminals.**

In less than three months (from the contract signature), we were able to deliver the first batch of cantilevers that are part of the test track of the project (approximately 8 km). The delivery process stopped because of Covid-19 pandemic situation. On June 3rd, we finally delivered the first 157 suspensions.

The design activities continued throughout the lockdown (Feb – March 2020) in smart working, including FEM (Finite Element Method) calculations and analysis: it was a great job of the entire engineering, production, quality and testing team.

Engineering and testing in Covid-19 Era

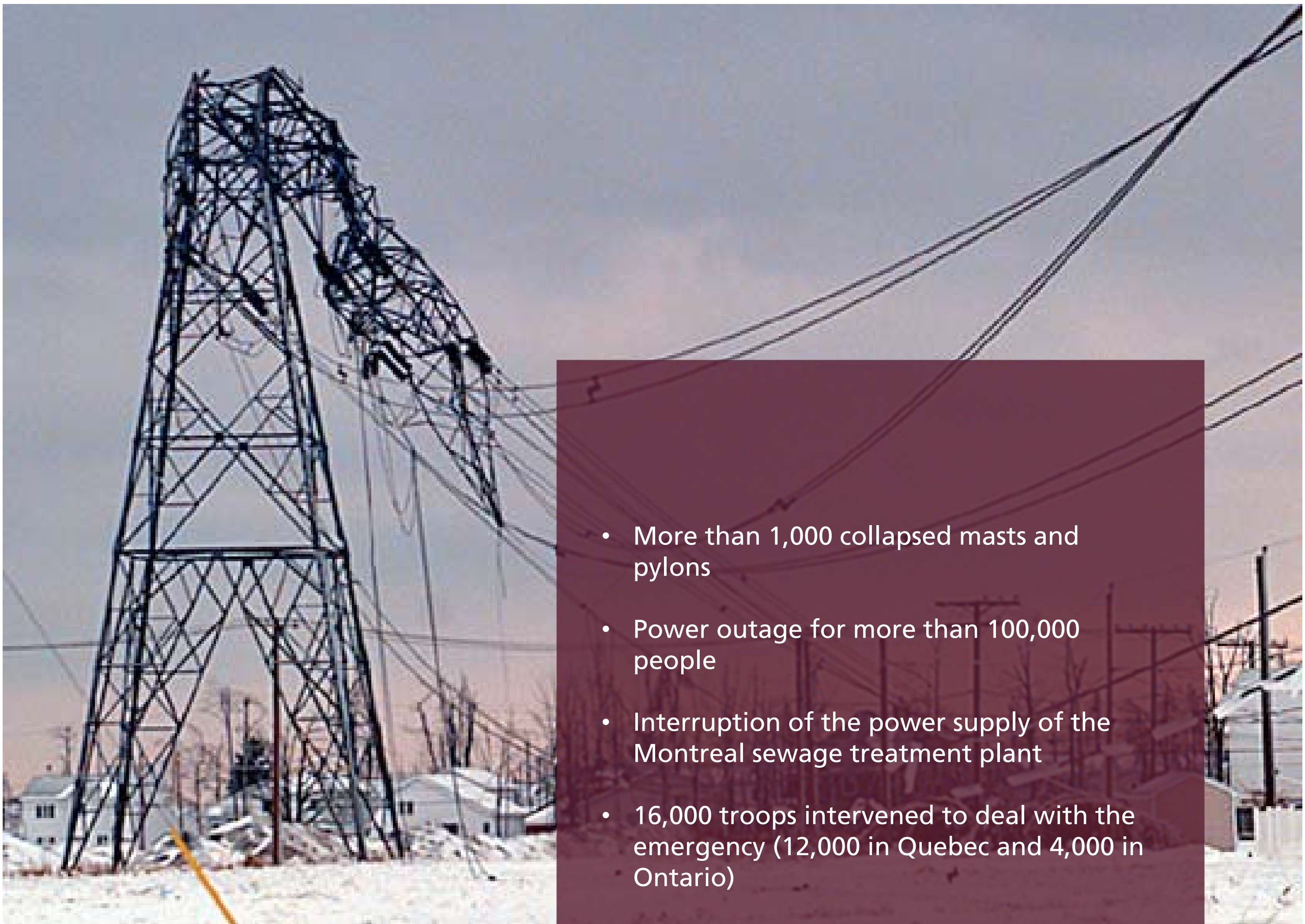
Due to the pandemic occurred in Feb-March 2020, the FAT acceptance tests (normally conducted at the presence of the customer) were led in streaming with Engie Ineo and NouvLR (Canadian customer).

All tests were conducted on the critical configurations of complete cantilevers, in order to verify the absence of plastic deformations due the enormous loads caused by extremely severe environmental conditions of Canada, taking into account all safety factors.

The customers were very satisfied and appreciated the commitment made by the whole Bonomi team to manage the urgent delivery of this catenary system, in consideration of the great restrictions governments undersigned in this period of Covid-19.

REM IN DETAILS

5th January 1998
The Great Ice Storm of North America



- More than 1,000 collapsed masts and pylons
- Power outage for more than 100,000 people
- Interruption of the power supply of the Montreal sewage treatment plant
- 16,000 troops intervened to deal with the emergency (12,000 in Quebec and 4,000 in Ontario)

OHL Features

THE CATENARY

• 2 messenger wires	2 x 253 mm²
• 1 contact wire	178 mm²
• Contact wire tension	2 x 1250 daN
• Messenger wire tension	1250 daN
• Max. span	55 m
• Min. curve radius	100 m

THE PANTOGRAPH

• Pantograoh width	1700 ± 10 mm
• Max. uplift	40 mm
• Pantograph sway up to	745 mm

WEATHER CONDITIONS

• Min. Temp.	-40 °C
• Max. Temp.	+40 °C
• Wind speed	> 100 km/h
• Ice Thickness	32 mm

CAN – CSA C22.3 n°60826-10 ed. 2010
(coming from EN 60826:2017)
DESIGN CRITERIA OF OVERHEAD TRANSMISSION LINES

LOADS ON THE SUSPENSION

Max. loads (excess loads included) are:

• Total Max vertical load (P.F.)	1500 daN

Requested tests

MAX. WORKING CONDITIONS (EN 50119)

Loads according to the European regulation

- Ice thickness — 7 N/m (around 12,5 mm)
- Max. wind speed — 130 km/h

✓ Mechanical check of the **safety factors** required by the regulation

✓ Check that the **deformation** under the effect of the previously mentioned loads is less than 1% of the distance of the catenary from the surface of the mast.

EXTREME LOAD CONDITION (CAN – CSA C22.3 n°60826-10)

Loads according to the Canadian regulation

- Ice thickness — 32 mm

✓ Mechanical check of the **safety factors** that are requested by the regulation.

INTERESTING FACTS

Vertical loads are more than twice if compared to the Italian standard catenary.

ITERATIVE DESIGN

COMPONENTS

- INSULATORS
- CLAMPS
- CONNECTIONS

SUSPENSION

- TUBE SECTION
- GEOMETRY

APPLICATION

- MAIN LINE
- INSULATED AND UNINSULATED OVERLAPS
- CROSS-OVERS
- REDUCED ENCUMBRANCE CANTILEVERS
- WAREHOUSE CANTILEVERS

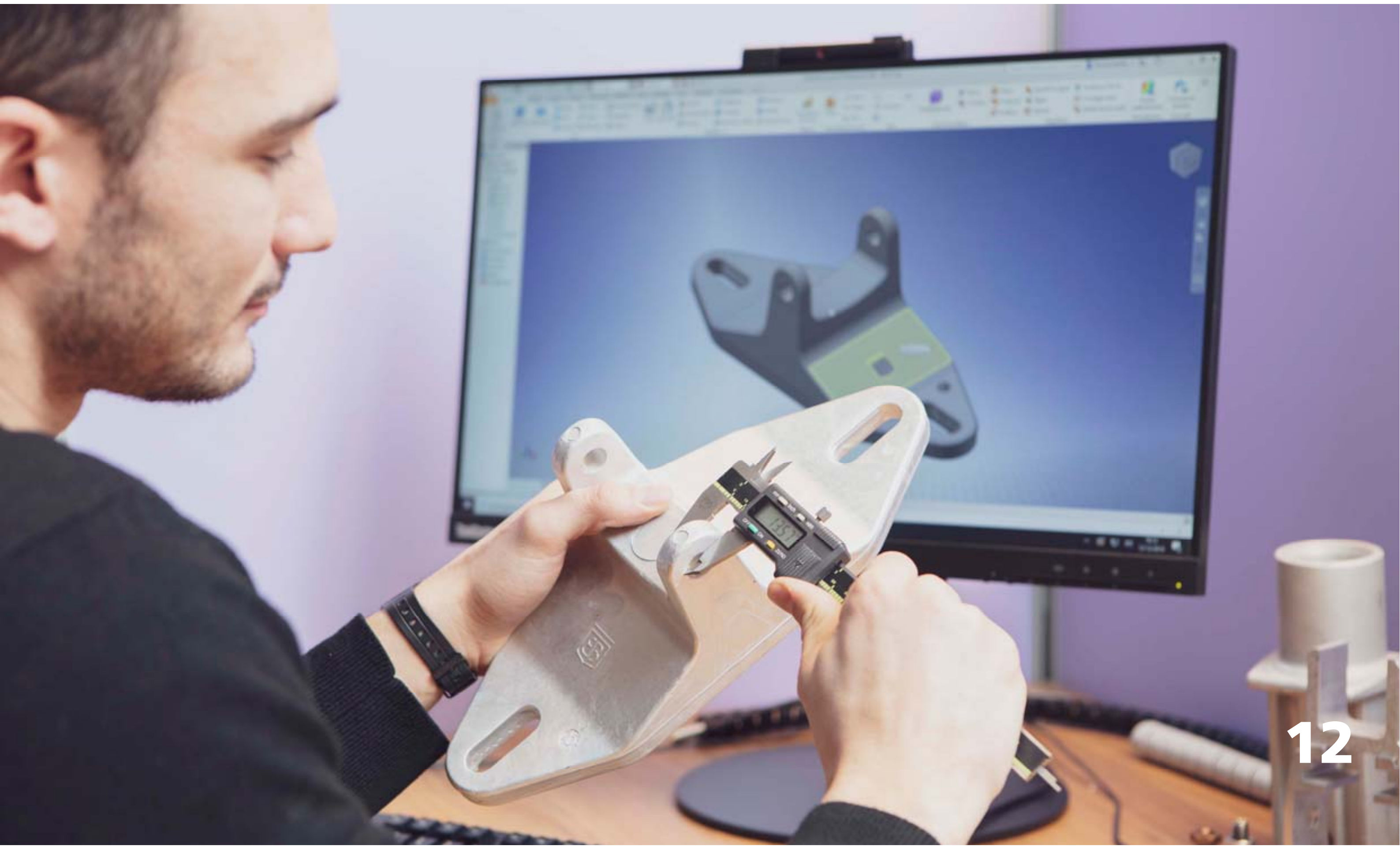
LOADS

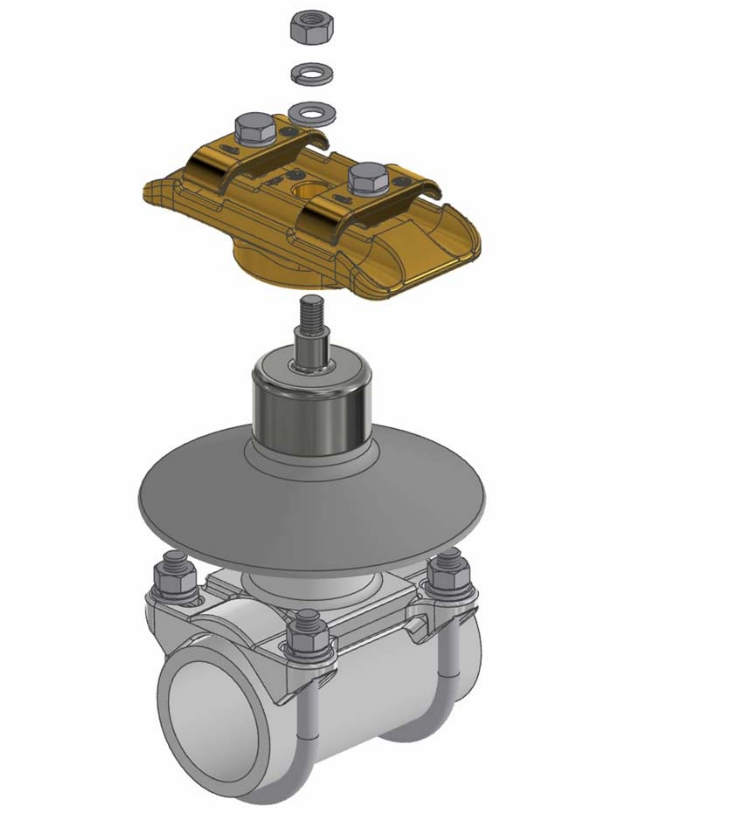
- WEIGHT
- CONDUCTORS HORIZONTAL LOADS
- WIND LOAD

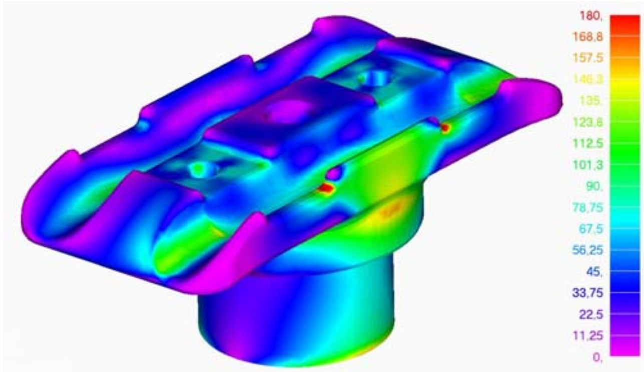
COMPONENTS DESIGN AND VERIFICATION

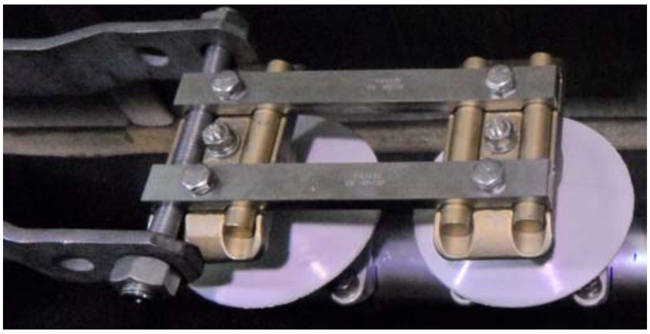
OUR CHALLENGES

- Designing components that are suitable for exceptional loads without increasing their geometric dimensions. This allows to avoid further amplification of the internal structure efforts.







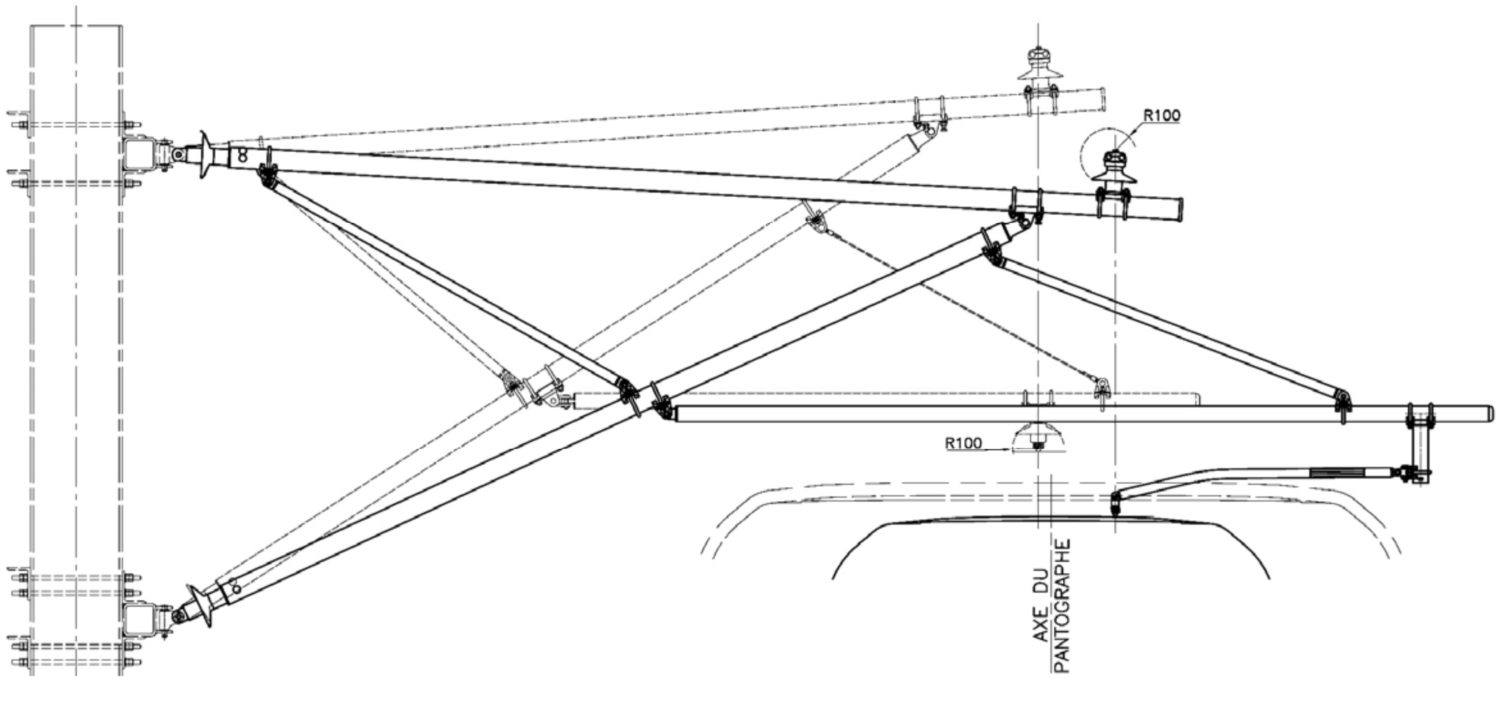


- Avoiding the sliding of the connecting elements between the pipes, in particular on the connection between the strut and the cantilever.

Introduction of further pressure screws

GEOMETRICAL CONSTRAINTS VERIFICATION

- Adjustment: 100 mm ± 100 mm (extra-adjustment)
- Respect for mechanical and electrical clearences compared to the swayed pantograph
- Respect of the mechanical and electrical clearences between the conductors and the cantilevers in the case of side-by-side cantilevers (insulated and uninsulated overlaps, cross-overs...)

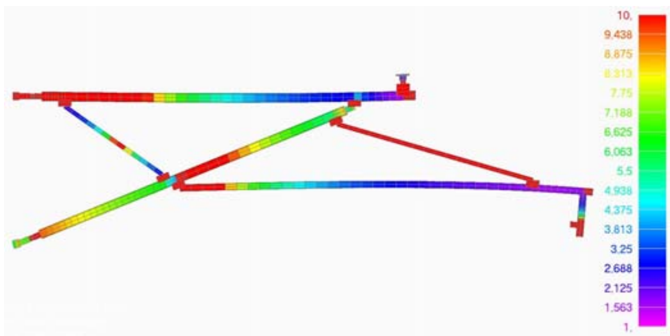


MECHANICAL CONSTRAINTS VERIFICATION

- Verification of the tubes S.A.F.
- Verification of the cantilever buckling safety factors
- Verification of the components safety factors
- Verification of the cantilever deflection under maximum working loads

<u>S.A.F. verification</u>

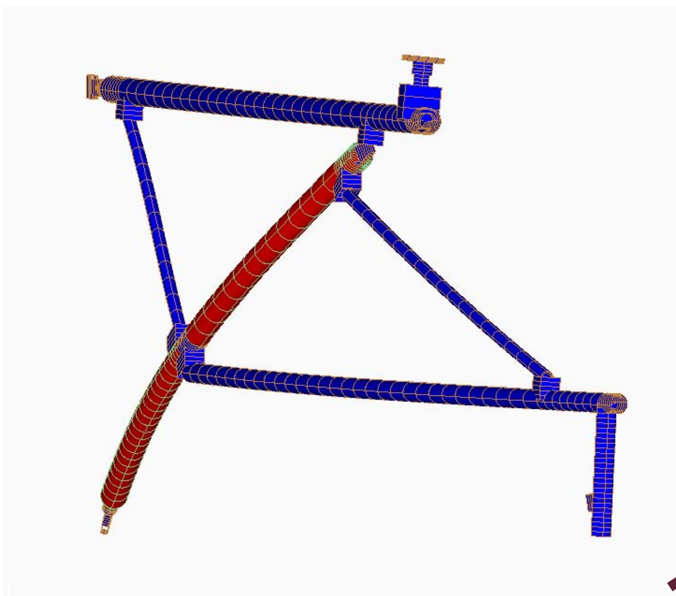
Push-off cantilever CF33jc2



<u>Buckling verification</u>

Push-off cantilever CF33jc2

Buckling safety factor: 1.4



<u>Deflections (mm)</u>

Push-off cantilever CF33jc2

Notes

Apr 2022

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