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HYDROELECTRIC PIPELINE REHABILITATION
BLUELINE - UV LINER SYSTEM

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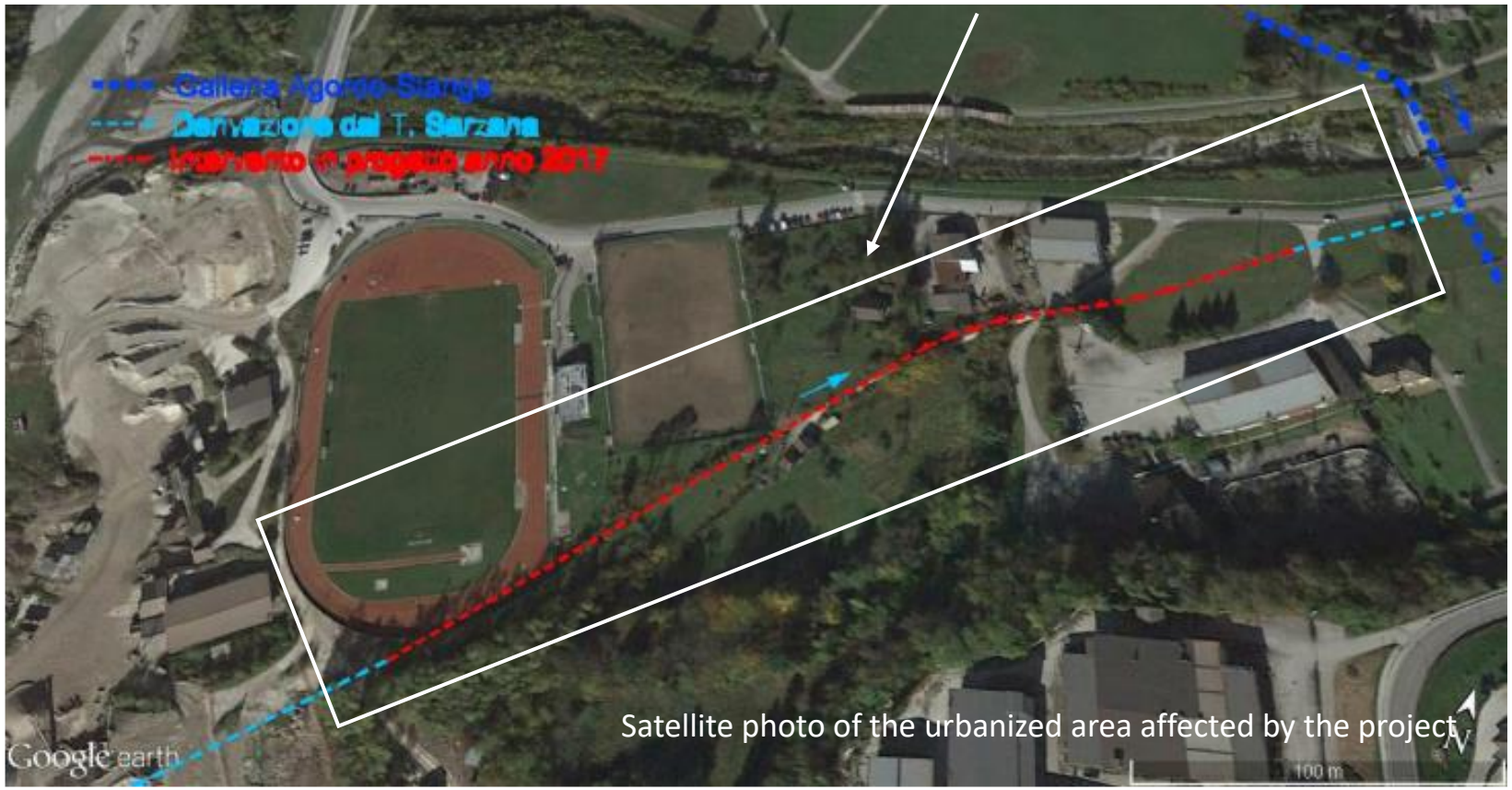
HYDROELECTRIC PIPELINE REHABILITATION, BLUELINE - UV LINER SYSTEM

Geographical context in which the project is located.

The pipeline to be restored is part of the La Stanga hydroelectric plants (Belluno) and it is the Sarzana intake; the maximum water flow rate, that the pipeline can handle, is 400 l/s, while the average flow is about 270 l/s.

The underground pipeline passes through an urbanized area with the presence of public buildings, houses, municipal warehouses and sports facilities, all of which were built years after the construction of the pipeline.



Satellite photo of the urbanized area affected by the project

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State of fact

- Existing pipe is made of reinforced concrete
- Internal circular diameter of DN 700mm
- External rectangular section of 0,94xh0,90m.

The canal is accessible through a 5,5m high manholes with a circular section and there are another 11 manholes with a circular section DN 500mm at a variable distance from 50 to 230m.

Necessity to restore the pipe

Traditional method Vs Trenchless solution

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Main Criteria to garantee the duration and reliability of the work

- **safety**
- **feasibility**
- **timing**
- **costs / benefits.**

ENEL GREEN POWER CONSIDERED

solution through traditional method with excavation

lengthening of construction time, costs and, above all, to a bigger environmental impact

NoDig Technologies

2014
previous positive experience with the UV Liner realized in the initial section of the pipeline

2017 Planning

2018 Realization

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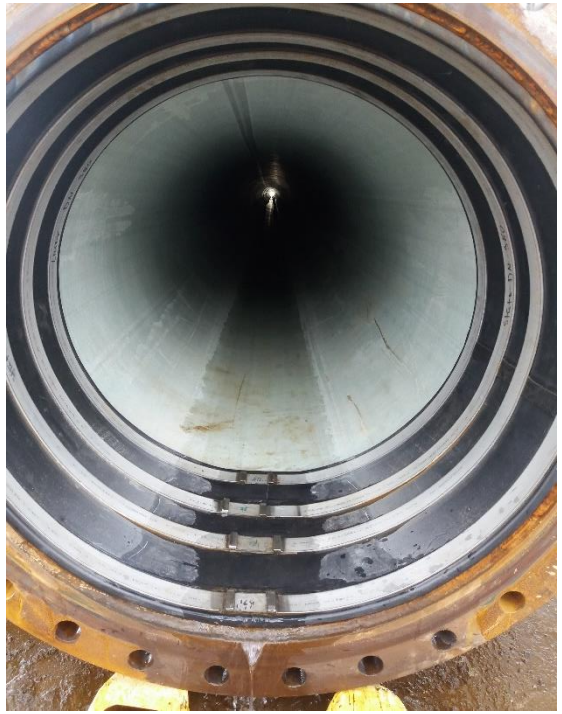
The pipe to be rehabilitated had different problems and operating conditions compared to the section restored in 2014, in particular an important parameter that was taken into account was that the sections to be renovated had to guarantee to withstand about 3,5 bar of operating pressure so two systems were considered

the Inversion System (BlueLine)

the Pressure UV Liner System



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Main issues related to the two different technologies

UV Liner:

- The necessity of excavations with dimensions about 3m bigger than the ones already planned
- The irregularities inside the existing pipeline
- The presence of two curves with angles of 15 and 33 degrees, where the UV lamps, going forward during polymerization, could have damaged the Liner.
- Technology used less in pressure pipes compared to the BlueLine

BlueLine (Inversion):

- Impregnation on site
- Use of a special drum with a diameter of 3,0 m
- Maximum length of 130m (comparing 230 m max for UV Liner)
- Construction of an intermediate manhole involving the passage on private

Enel decided in favor of the UV technology

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On January 25, 2018, SAERTEX announced that it had suffered a major fire in its production plant and stated that it was not in a position to provide the Liner on time.

The final decision, because of the severe deadlines to be respected and because of the experience that the company already had in the realization of the inversion system for drinking water fell on the Blue Line System in agreement with the owners of the respective private areas.

BLUELINE

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The Liner impregnated with epoxy resin for pressure pipes was requested in compliance with some design variables

- Liner totally structural
- Minimum thickness of 9.0mm
- Depression in the pipeline of 1.0 bar
- Working pressure 3,5 bar
- Road-type overloads
- Test pressure of 5.25 bar

The completely structural thickness of the Liner was verified through the static calculation carried out according to the ASTM F1216 standard and the customer was provided with all the test certificates carried out on the Liner

- creep factor
- abrasion test
- resistance to physical agents
- burst test

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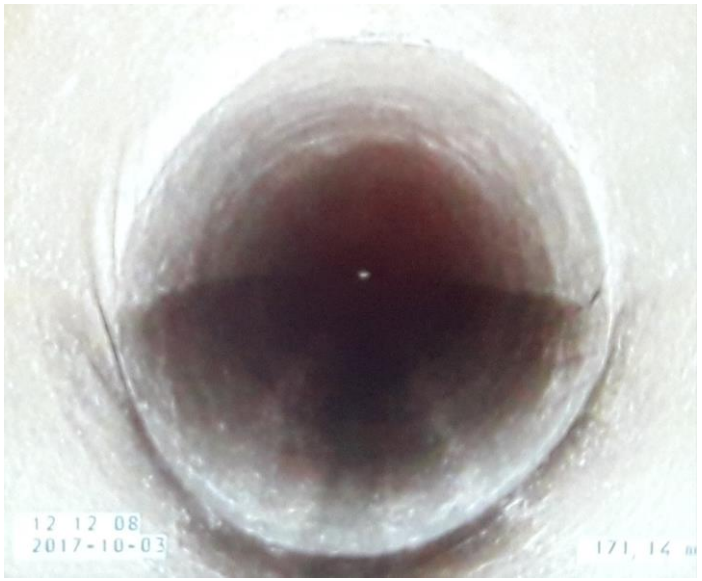
After a video inspection, the cleaning of the existing pipeline, and the internal calibration for the detection of the right diameter and the presence of any deformations, the installation phase began.



The dimensions of the manholes DN 500 mm did not allow a safe insertion of the Liner without damages. The project therefore required the rebuilding of some intermediate manholes with the insertion of a disassembly joint and a removable pipe that was 1500 mm in length.

Advandages:

- no wrinkles in the Liner (low roughness)
- improvement of the health and safety for the worker

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Liner insertion phase

The resin impregnation phase was carried out directly on site by means of a mobile High-Tech plant, in a vacuum environment and with automated dosing and mixing systems with continuous digital control and recording of all the important data indicated by the manufacturer.

- controlled pressure inversion drum
- steam hardening equipped with a pumping tool
- digital control system for pressure

Impregnation phase

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Liner insertion phase

The Limit of the installation length was effectively overcome by using a special drum with a diameter of 3m, that allow an installation length of 130,00m. The insertion of the liner took place thanks to the controlled pressure inversion drum and a steam hardening equipped with a pumping tool and a digital control system for pressure, temperature and removal of condensation.

Special drum that could guarantee the fixed length of installation

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Liner insertion phase

Three installations of 125m, 125m and 105m were carried out respectively, the resin impregnation time was about 6 hours and the hardening time about 7 hours. After the polymerization of the Liner with steam, the pressure tests were performed; furthermore the vendor restored the connections to the old pipe.

Time:

- resin impregnation time – in average 6 hours
- the hardening time – in average 7 hours

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Cured Pipe

After polymerization of the liner a final video inspection was carried out

Cured Pipe
final result BlueLine

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Cured Pipe

After the polymerization of the Liner, all the connections were restored and the pressure tests started.

The set up for the hydraulic pressure test

First the upstream section was filled and tested, with a maximum test pressure of 4 bar, then the water was transferred to the downstream section and integrated with a further 40m3 and tested at a pressure of 5.3 bar.

Success of all the tests

The BlueLine technology has been shown to be flexible and suited to a successful project.

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