37TH INTERNATIONAL NO-DIG FLORENCE 2019

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# THE CORNEGLIANO LAUDENSE NATURAL GAS STORAGE PROJECT: HDD AS SOLUTION FOR PIPELINE INSTALLATION IN URBAN AREAS

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# THE CORNEGLIANO LAUDENSE NATURAL GAS STORAGE PROJECT: HDD AS SOLUTION FOR PIPELINE INSTALLATION IN URBAN AREAS

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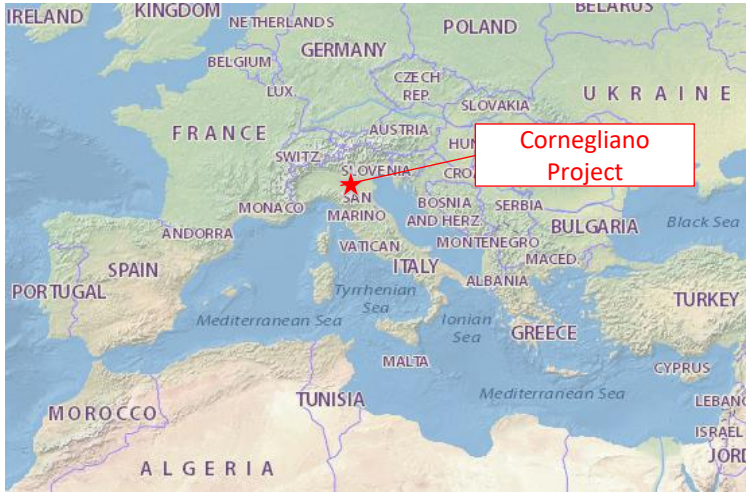
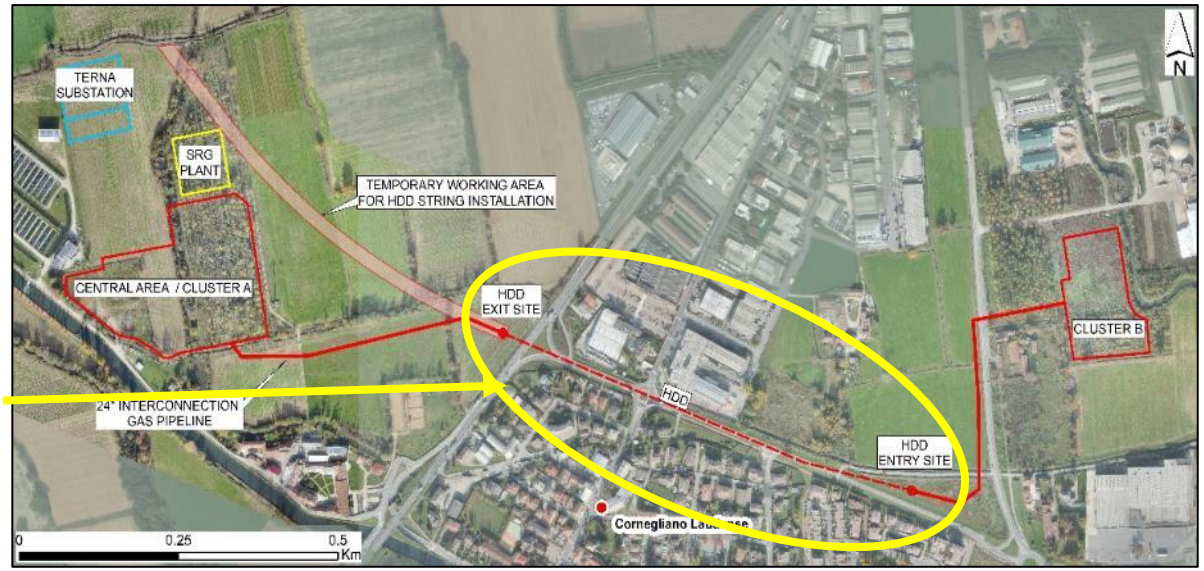
## GENERAL SETTINGS




- ✓ In 2016 SAIPEM has been awarded from ITAL GAS STORAGE the EPC project of a gas storage system converting an underground depleted gas field located at Cornegliano Laudense, 30km SE of Milan, ITALY.
- ✓ The gas storage project consists in:

1. **Surface facilities**
   for gas treatment & distribution into national gas network;
2. **Wells in the reservoir**
   to inject/extract gas grouped in two Clusters (Cluster A & B);
3. **Interconnection gas pipeline**
   Cluster A and Cluster B: **DN650 (24”), 170 barg, L=1.8km**

A 700m long section of the Interconnection gas pipeline crosses a densely urbanized area characterized by residential and commercial districts.

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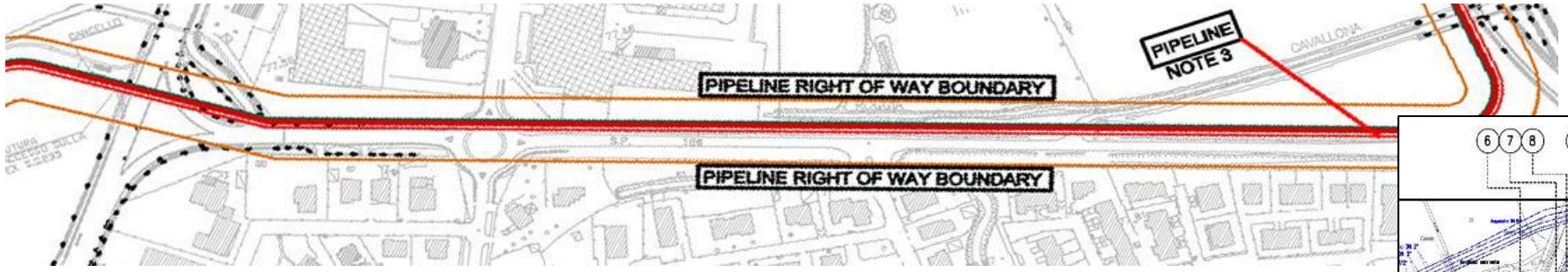
## FEED DESIGN MAJOR ISSUE

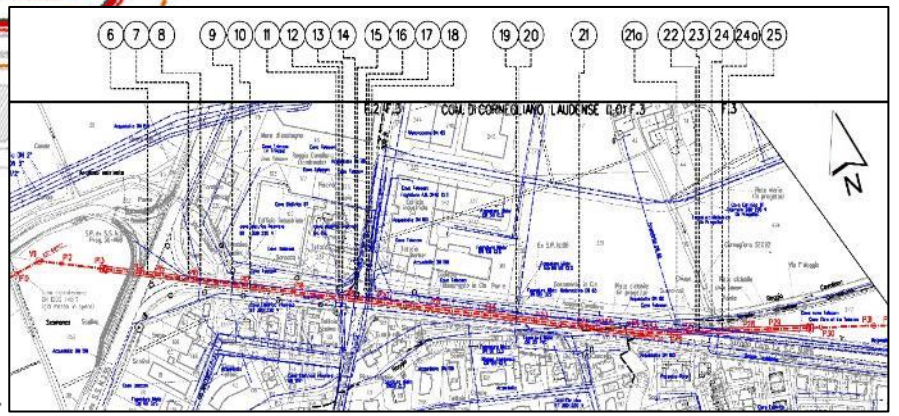
Project FEED foreseen for the DN650 (24”), 170 barg gas pipeline an OPEN CUT crossing of the urbanized area.

Major issues identified in this design:

- ✓ Critical distance between pipeline and existing buildings on roadside;
- ✓ Numerous existing services crossings;
- ✓ Strong impact of construction activities on traffic road;
- ✓ Strong impact of construction activities on local residential area (i.e. noise, vibration, pollution, etc.)




Existing services crossings

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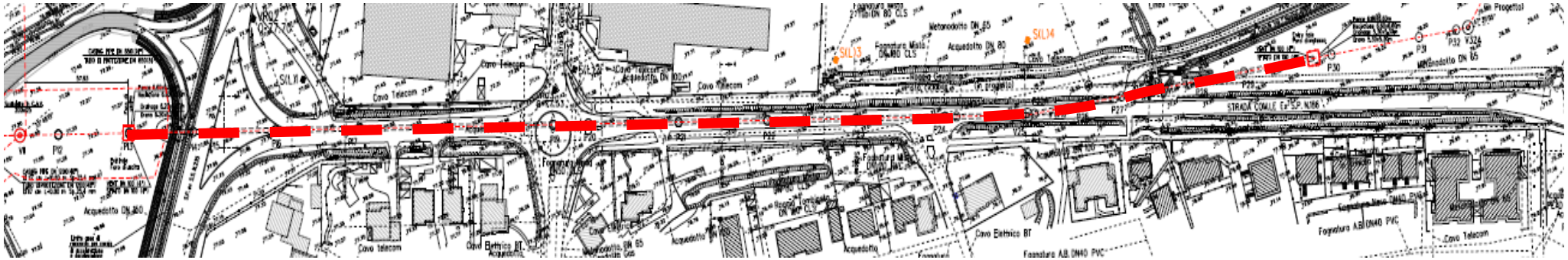
# PROPOSED DETAIL DESIGN SOLUTION

A 700m long TRENCHLESS SOLUTION was proposed to cross this densely urbanized area



## MAJOR ISSUE TO THIS TRENCHLESS SOLUTION:

According to the National Gas Regulation, trenchless solution for pipeline crossing densely urbanized area shall be installed into a casing pipe, with seals and vents every 150m.

This code requirement represented a severe constrain to the proposed trenchless solution: L= 700m.

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# CHALLENGING SOLUTIONS FOR CROSSING DESIGN

A special design was developed for this crossing to request a Concession to Gas Regulation Authorities:

## LOSS PREVENTION SAFE DESIGN

- ✓ Loss Prevention casing pipe design;
- ✓ Venting system designed as long-term safe mitigation measure.

## HDD CROSSING DESIGN

- ✓ HDD crossing profile;
- ✓ Production pipe installation;
- ✓ Major road crossing contingency measures.

## MONITORING OF HDD CONSTRUCTION

- ✓ Noise & Vibration monitoring;
- ✓ Pollution reduction measures;
- ✓ Remote-sensing monitoring.

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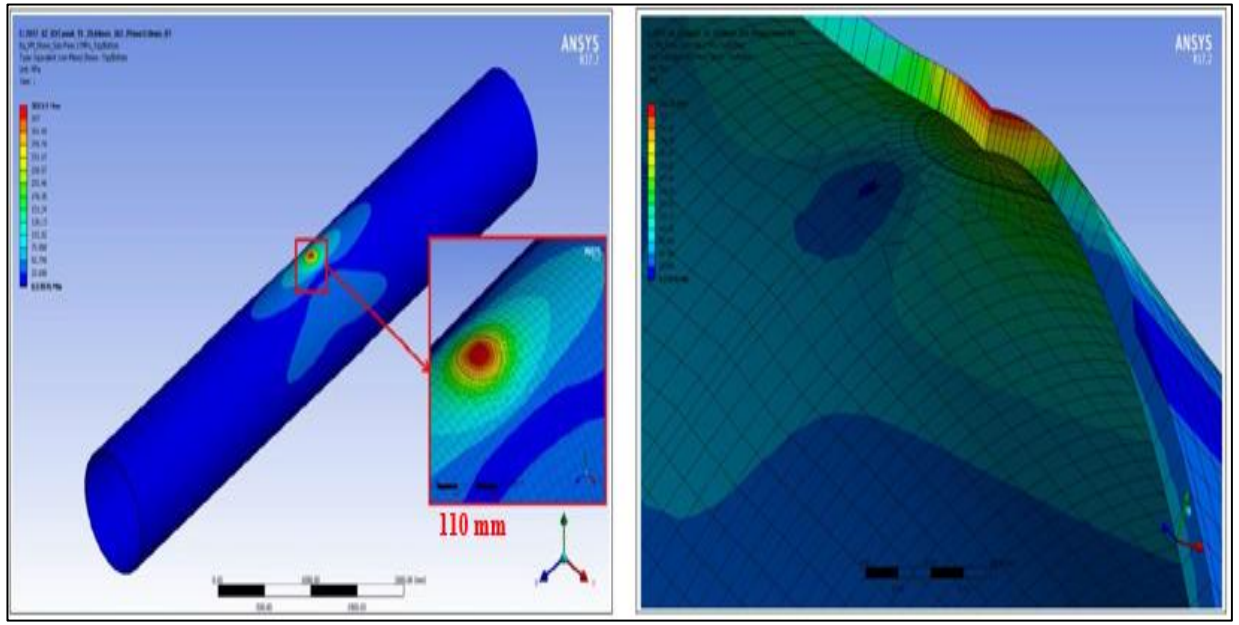
# LOSS PREVENTION & SAFE DESIGN

Major design topics of loss prevention and safe design approach for risk mitigation of crossing were:

1. Loss prevention design of the steel casing pipe;
2. Safe design of casing pipe venting system.




Loss prevention design of the steel casing pipe based on an accurate risk assessment:

- ✓ Steel grade (L450MB) and wall thickness (25.4mm): design to withstand possible product pipe gas leakage event and to convey potential leakages to a venting system;
- ✓ Casing pipe diameter: minimum allowable casing pipe diameter (DN850(34”) to ensure successful installation and operation of the DN600(24”) 170 barg product pipe;
- ✓ Venting system adequately sized and located far from residential area.

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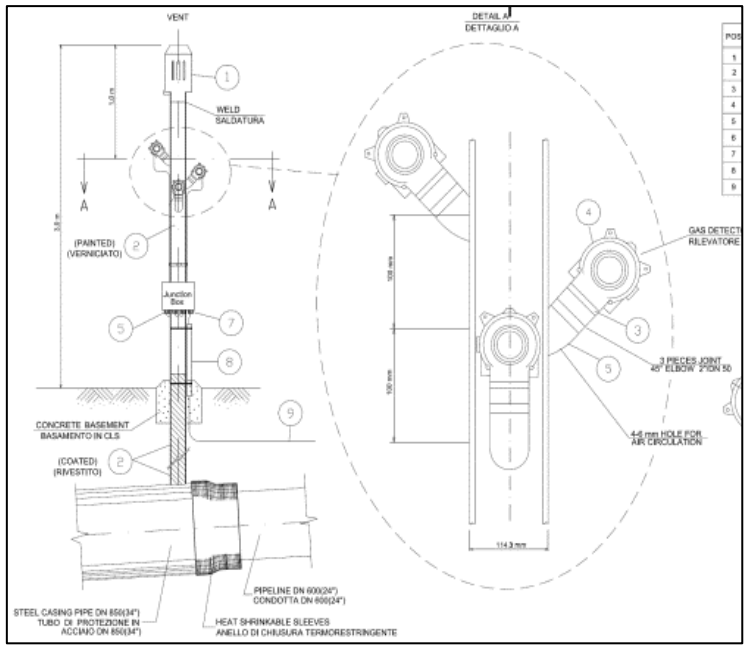
## LOSS PREVENTION & SAFE DESIGN

Design of venting system as mitigation measures to ensure long-term safety of infrastructure during operational design life:




Special concession issued by National Gas Authority for this crossing

A. Gas detection monitoring:

- ✓ Nos. 3 real-time remote-controlled GAS DETECTORS installed on each vent located at casing pipe ends;
- ✓ Permanent gas leakage ALARM SYSTEM;

B. Product pipe design:

- ✓ welding and NDT in comply with approved international standards;
- ✓ L450ME steel grade, wt=31.75mm, with 3mm 625 alloy cladding;
- ✓ Nos. 3 layers of PE external coating;
- ✓ permanent cathodic protection by impressed current;
- ✓ corrosion monitoring during operational phase with intelligent pigging system.

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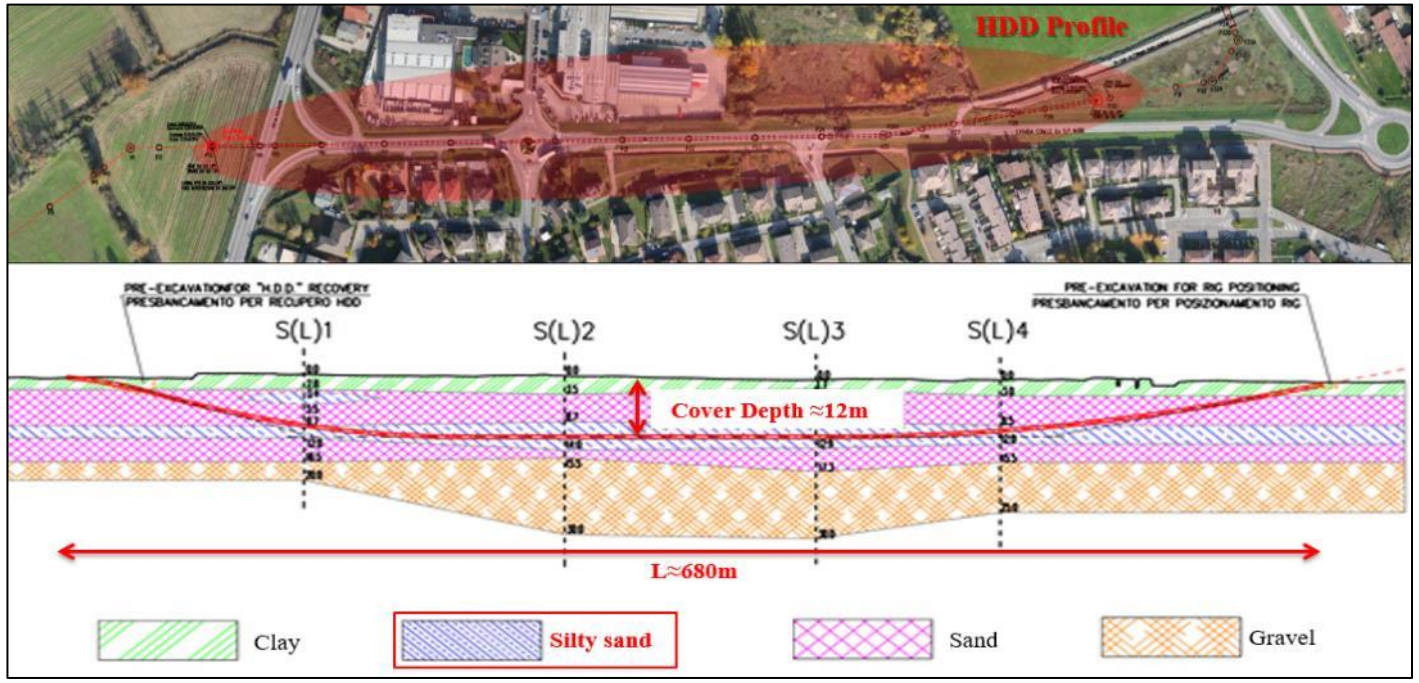
## HDD CROSSING PROFILE DESIGN

HDD trenchless solution was design with the product pipe DN600(24”), 170 barg installed into DN850 (34”) steel casing.

| | | Diameter DN (“) | Wall thickness (mm) | Material | External coating |
|---|---|---|---|---|---|
| | Product pipe | DN 600 (24") | 31.75 mm + 3 mm Alloy 625 cladding | Gr. L450ME PSL2 | 3LPE (3mm) |
| **HDD** | Casing pipe | DN 850 (34") | 25.4 mm | Gr. L450MB PSL2 | bare |
| **HDD** | FOC conduit | DN 150 (6") | 7.1 mm | Gr. L360MB | 3LPE (3mm) |




**HDDs Length=680m.**

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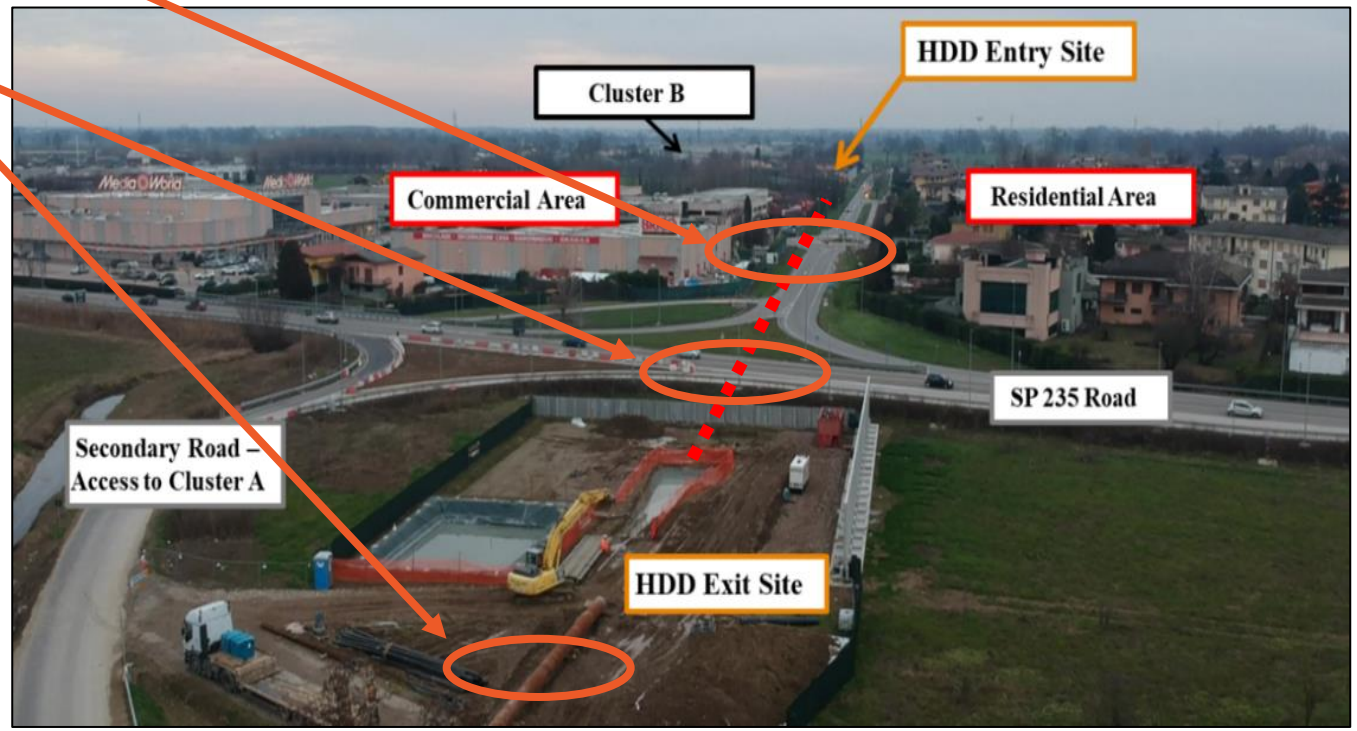
## HDD CROSSING PROFILE DESIGN

Major issues identified during HDD profile design were:

a) Ensure minimum horizontal distance of 20m from existing buildings (as per National Gas Regulation);

b) Suitable launch way corridor for the 700m long HDD pipe string;

c) Undercrossing of high traffic major road (provincial road SP 235) and several existing services.

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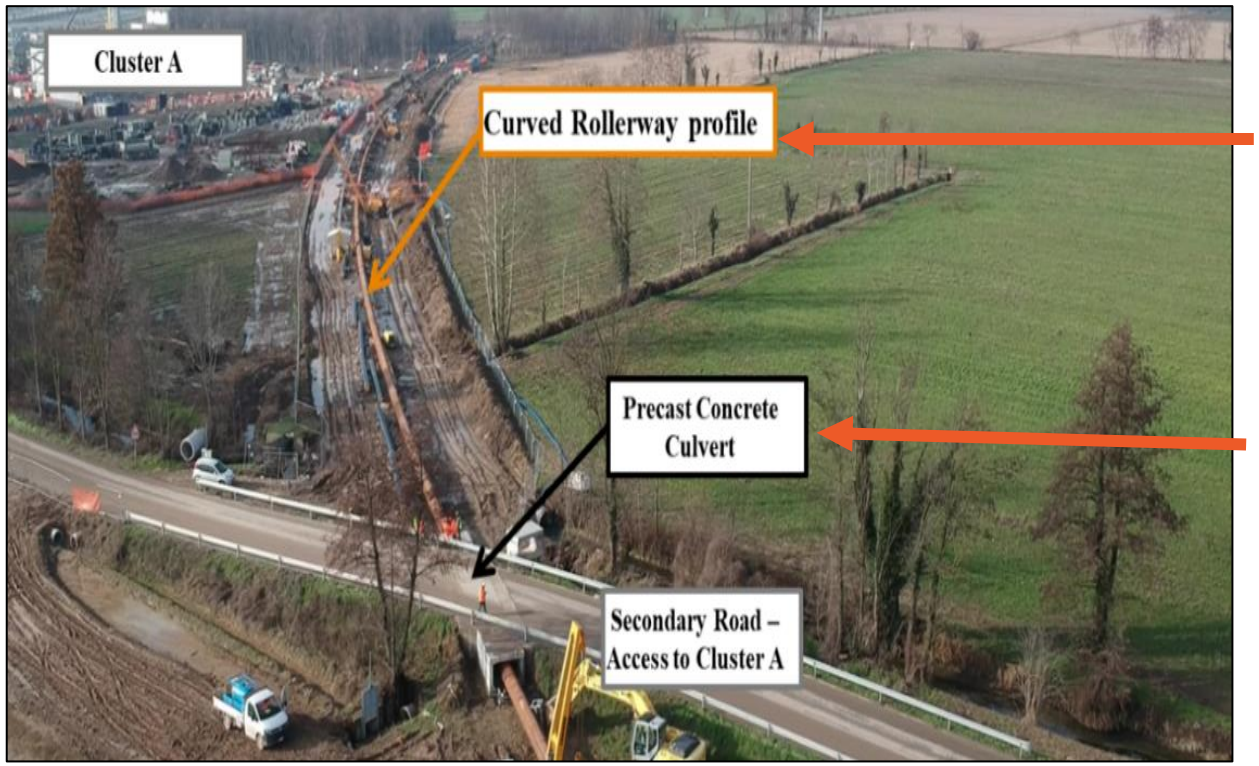
# HDD CROSSING PROFILE DESIGN

Major issues for definition of suitable launch way corridor for the 700m long pipe stringing:

1. Available area for launch way corridor not long enough;
2. Interference of pipe string launch way with existing access road to Cluster A plant.




Curve corridor (700mx21m) for pipe string launch (R=1000m horizontal elastic bend radius)

Installation of precast culvert at crossing existing access road.

Culvert was designed to:

- sized allow pullback works;
- Removable concrete slab at road level as cover, as contingency in case of pipe string uplifting during pullback.

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## HDD CROSSING CONTINGENCY MEASURES


- ✓ Road crossing length: 40m;
- ✓ HDD coverage depth: approx. 6.5m;
- ✓ DN80 (3”) injection pipes installed on top of the DN850 (34”) casing pipe: Nos. 2 pipes;
- ✓ Length of the Nos.2 injection pipes installed on casing pipe: 60 m;
- ✓ Volume of injected mortar for filling of HDD casing pipe overcut: 18 $m^3$;
- ✓ Pressure of injected mortar for filling of HDD casing pipe overcut: 3 bar.

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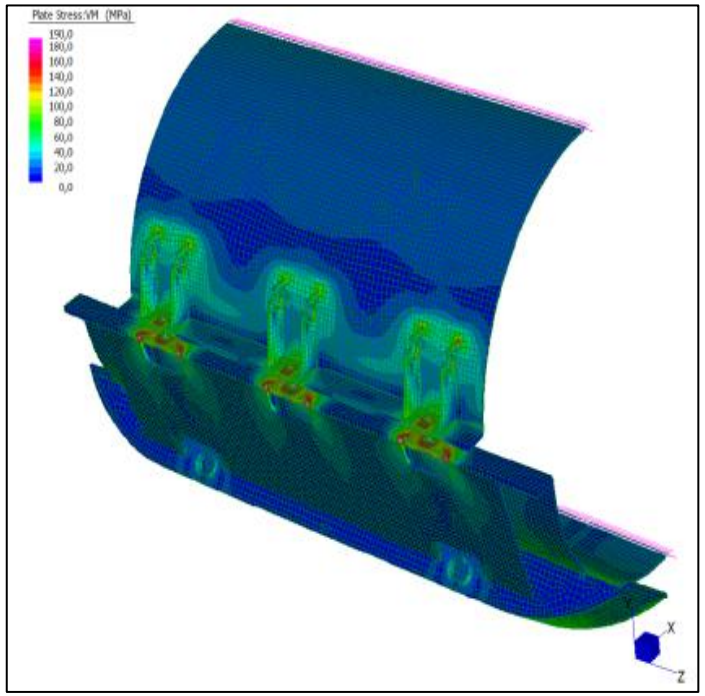
## HDD CROSSING INSTALLATION DESIGN

A special design of steel slit supporting DN600(24”) product pipe into the DN850(34”) steel casing pipe.

**Target**: ensure suitable and reliable supporting system for product pipe during insertion works, post-installation hydrotest and operational phase.




A. Design:

- ✓ FEM analysis of slit mechanical and structural response in different conditions;
- ✓ assessment of closure bolts structural response;
- ✓ Assessment of slit wheel pins and bushing response during installation and hydrotest phases.

B. Application:

- ✓ Friction factor approx. 0.1;
- ✓ Steel slit self-weight approx. 410kg,
- ✓ Installed with 6m interaxis.

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## HDD CROSSING WORKS

| | Expected Maximum Pulling Force | Actual Maximum Pulling Force |
|---|---|---|
| Casing pipe DN850( 34'') | 1000 kN | 600 kN |
| Product pipe DN650(24'') | 370 kN | 300 kN |

Pullback DN850(34") pipe string

RIG side (Capability 2500 kN)

Pullback DN650(24") pipe string

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## HDD CROSSING WORKS

**Nov. 2017 - Mar. 2018**

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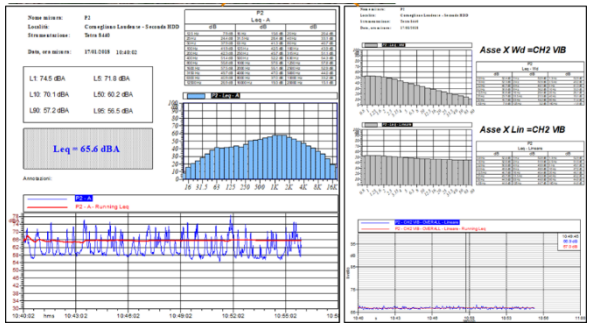
## HDD CONSTRUCTION WORKS MONITORING AND MITIGATION

Air pollution emission reduction: all equipment outfitted with special device (compliance with EU directive 2004/26/EC and 2000/14/EU).

Noise mitigation measures were designed on noise propagation numerical modelling:

- ✓ Noise reduction site layout design;
- ✓ Installation of noise reduction systems:
  - HDD exit side: 60m long x 5m high sound-absorbing walls;
  - HDD rig side: 120m long x 5m high sound-absorbing walls.
- ✓ Noise and vibration monitoring survey: Nos. 11 stations
- ✓ Maximum recorded noise level: 66dB;

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## HDD CONSTRUCTION WORKS MONITORING AND MITIGATION

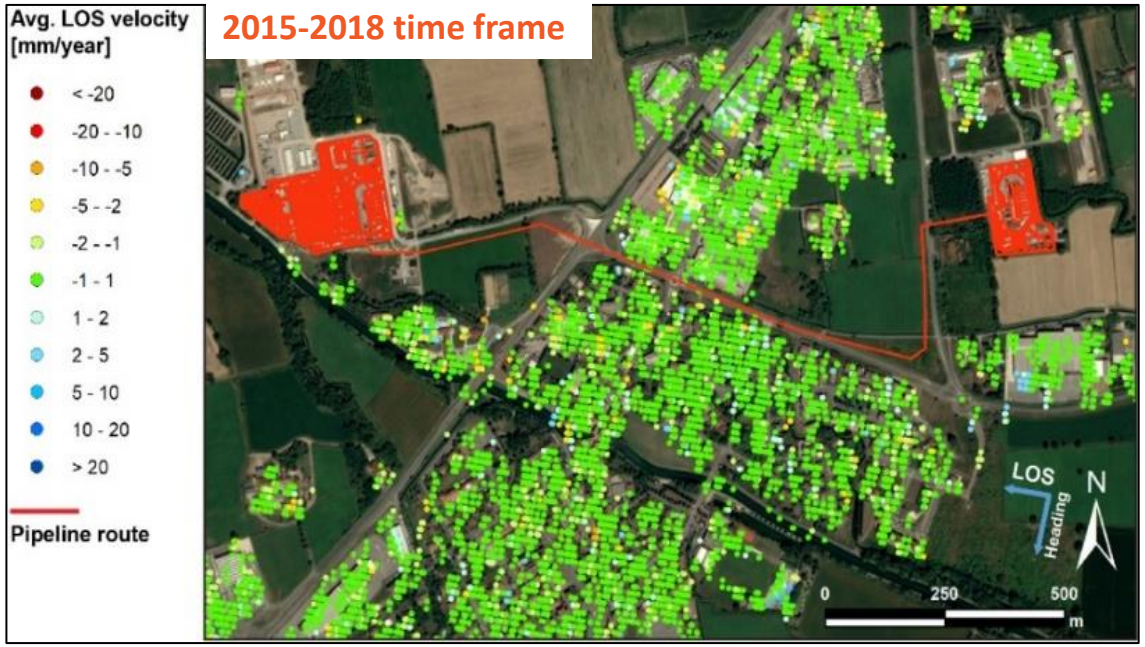
InSAR remote sensing technique for work induced settlement evaluation

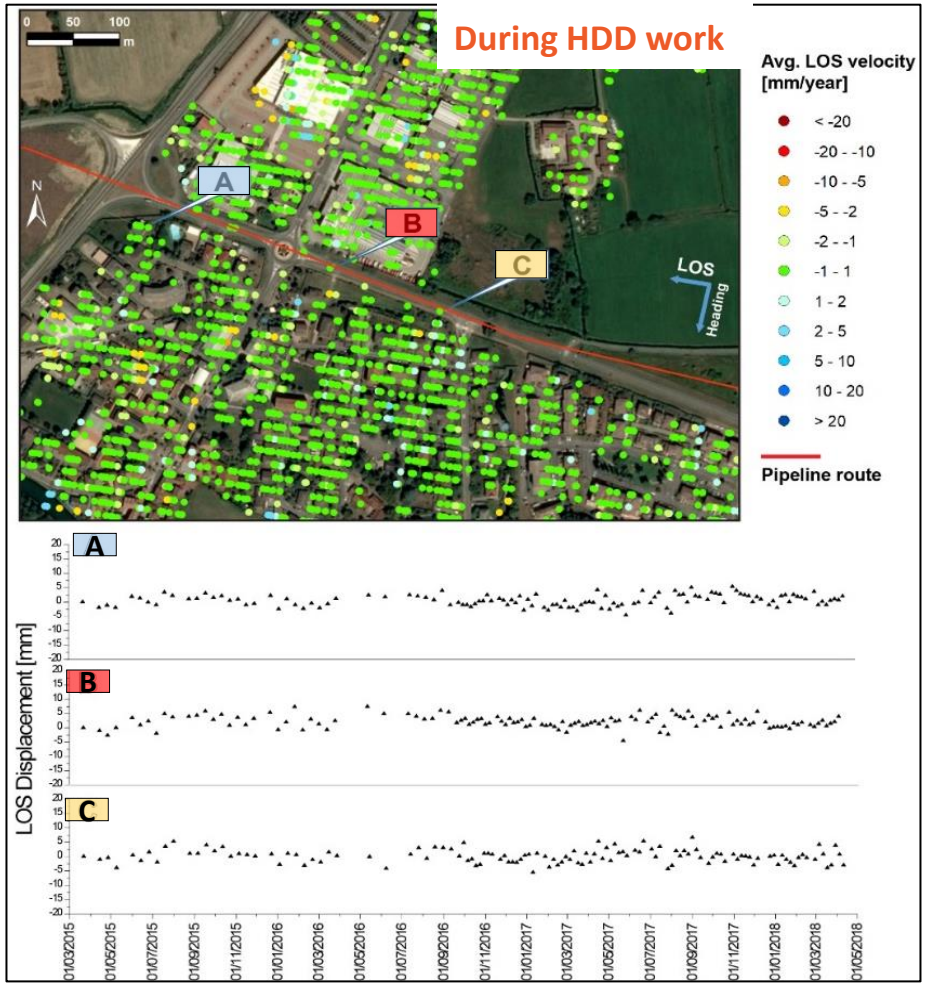
Persistent Scatters Interferometry (PSI) analysis prior, during and after construction works was performed in the Cornegliano area:

- ✓ Nos. 123 radar acquisition images;
- ✓ from March 2015 to April 2018 ;
- ✓ Accuracy: ±5mm;

**Results**:

None instability on the surrounding urban area induced by HDD works

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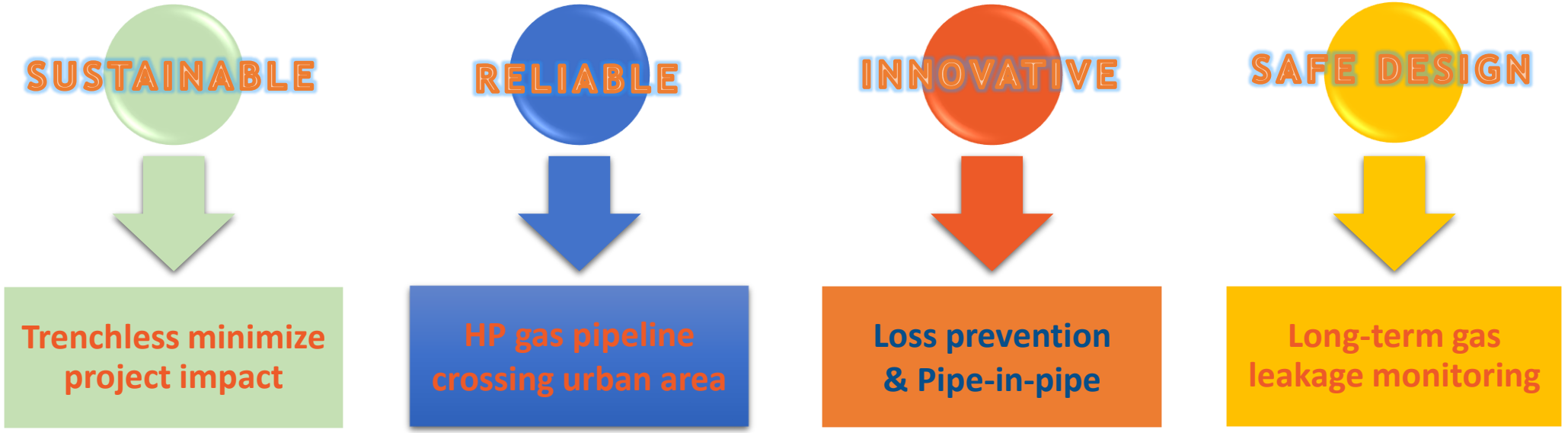
# CONCLUSIONS

## DESIGN




## CONSTRUCTION

✓Low impact on local community of works with noise and vibration monitoring and mitigation measures

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# THANK YOU

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