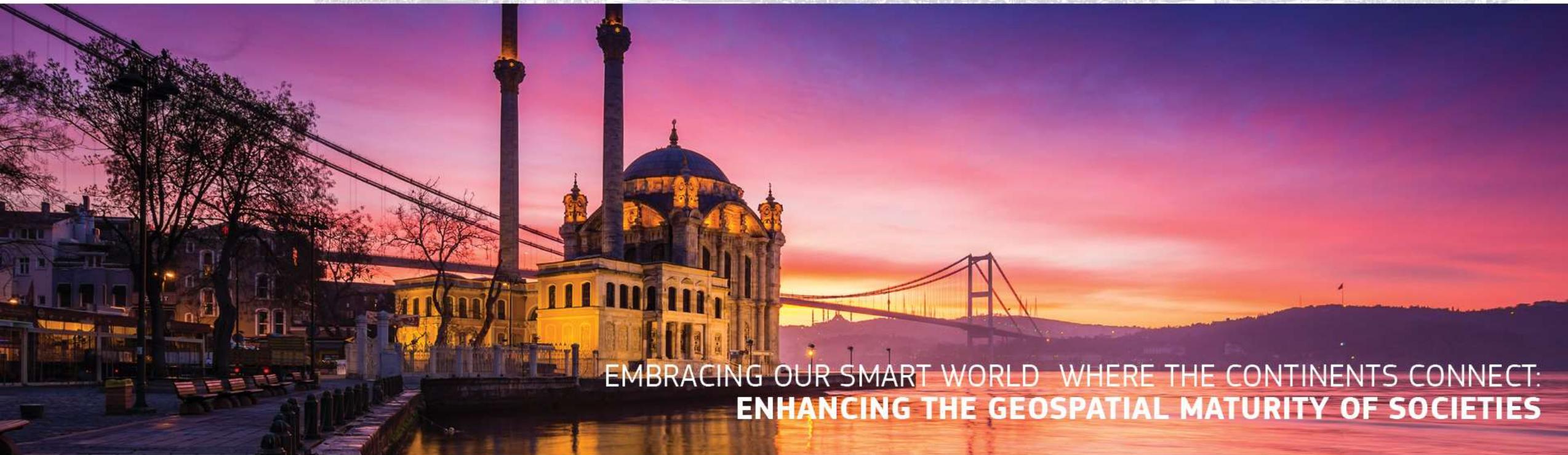
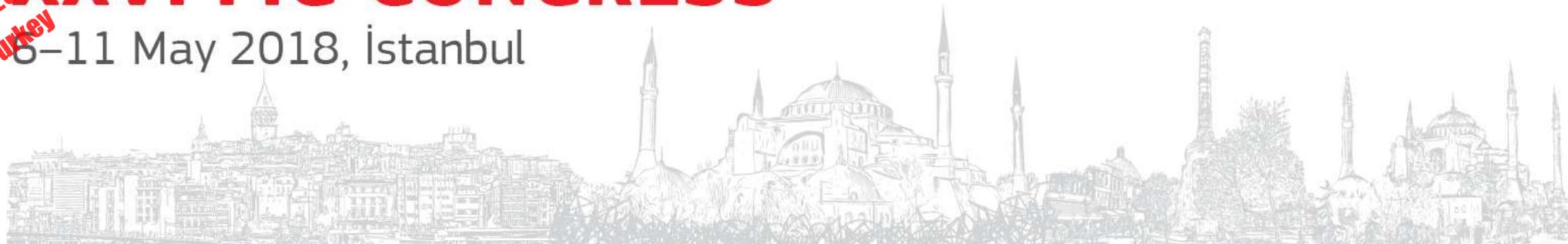


FIG
2018
ISTANBUL

Presented at the FIG Congress 2018
May 6-11, 2018 in Istanbul, Turkey

XXVI FIG CONGRESS

8-11 May 2018, İstanbul



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GIS Application

in Technical and Environmental Safety of Natural Gas Transmission Pipelines,

a Case Study

Tuncer OZEBİL
GEOGIS
GIS Manager

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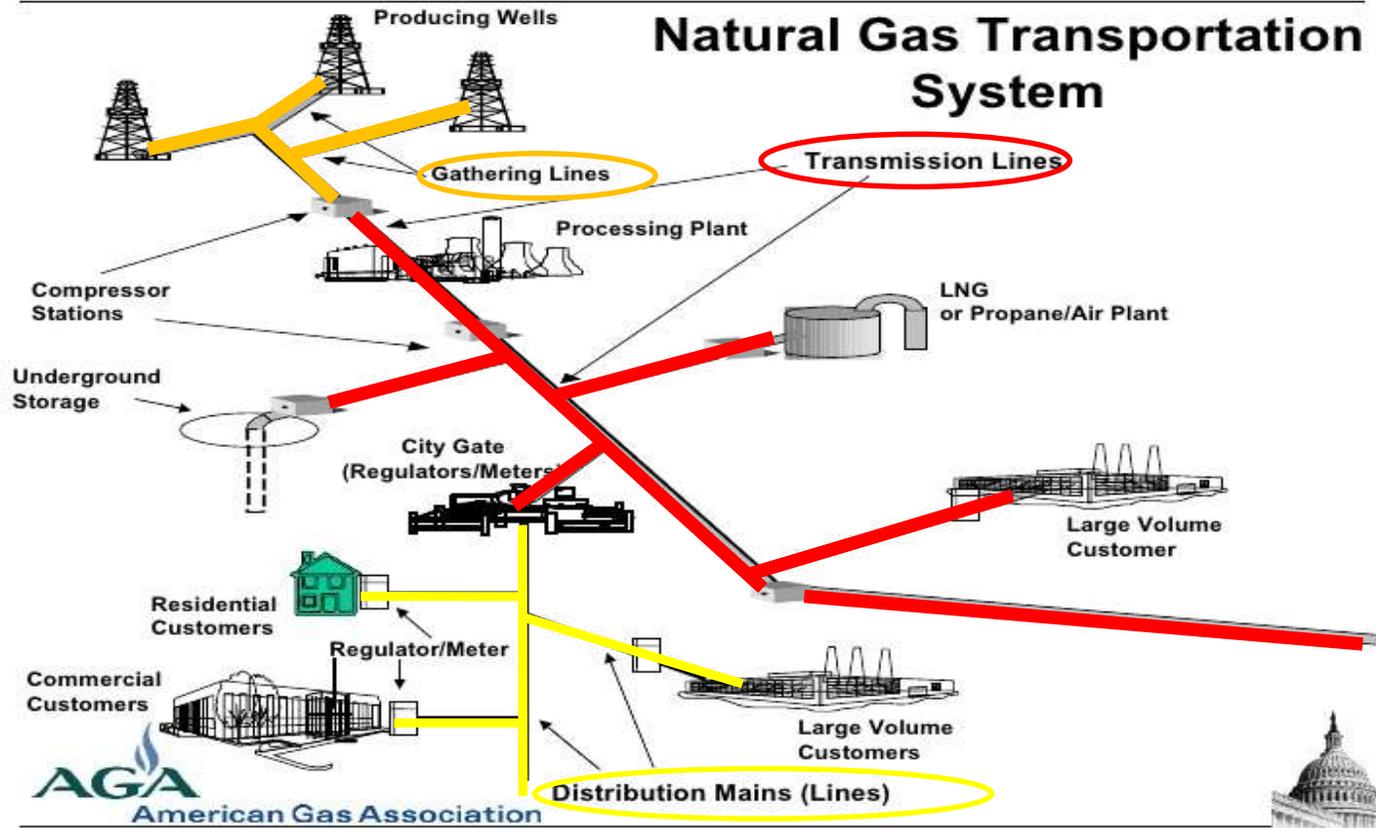


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- with high pressures of 50-75 bars

- through steel pipes of 8-48 inches in diameter

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- provides natural gas to 77 out of 81 provinces in Turkey

- operating nearly 14,000 kilometers natural gas transmission pipeline

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Technical and environmental safety in natural gas transmission pipelines

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Risks related to safety in natural gas pipelines

Anomalies

Natural

- Fault lines
- Landslide sites
- Erosion zones



Manmade

- Buildings
- Mine areas
- Sand or gravel pit
- Highway, road & railways crossing pipeline
- Power transmission lines crossing pipeline
- River & channels crossing pipeline
- Other pipelines crossing natural gas pipeline



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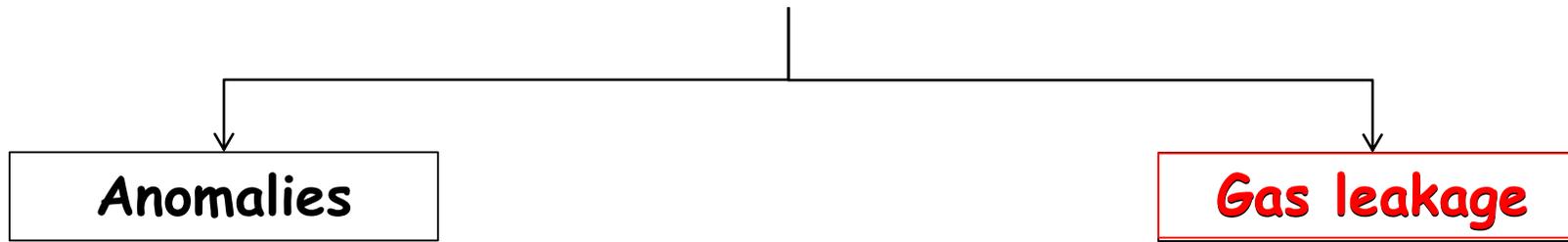


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Risks related to safety in natural gas pipelines



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Before pilot project;

- Anomaly checks and gas leak inspection are **periodically performed** by BOTAŞ.
- The controls are made using **terrestrial methods by land vehicles or walking** along the pipeline route and in the station area.



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In 2016 BOTAŞ decided a pilot project
along 1200 km pipeline **by aerial vehicles.**

It was aimed that;

- Saving time
- Less workload
- More precise results
- Utilize the high technology



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Scope of the project is

1200 km of natural gas transmission pipeline route and

Stations on route such as;

- Line Vanes Stations,
- Pig Stations,
- Regulator / Meter Stations (RMS),
- Compressor Stations,
- Take-off Vane Stations.



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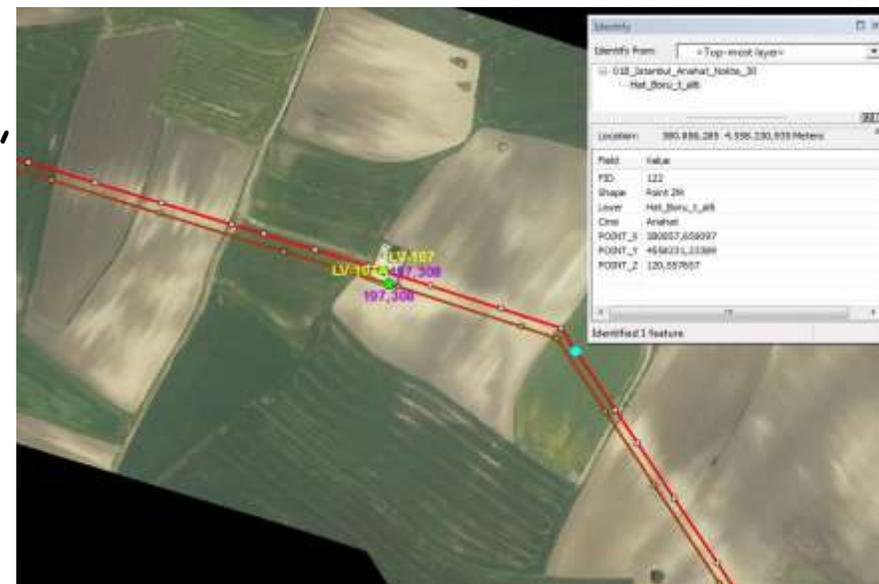
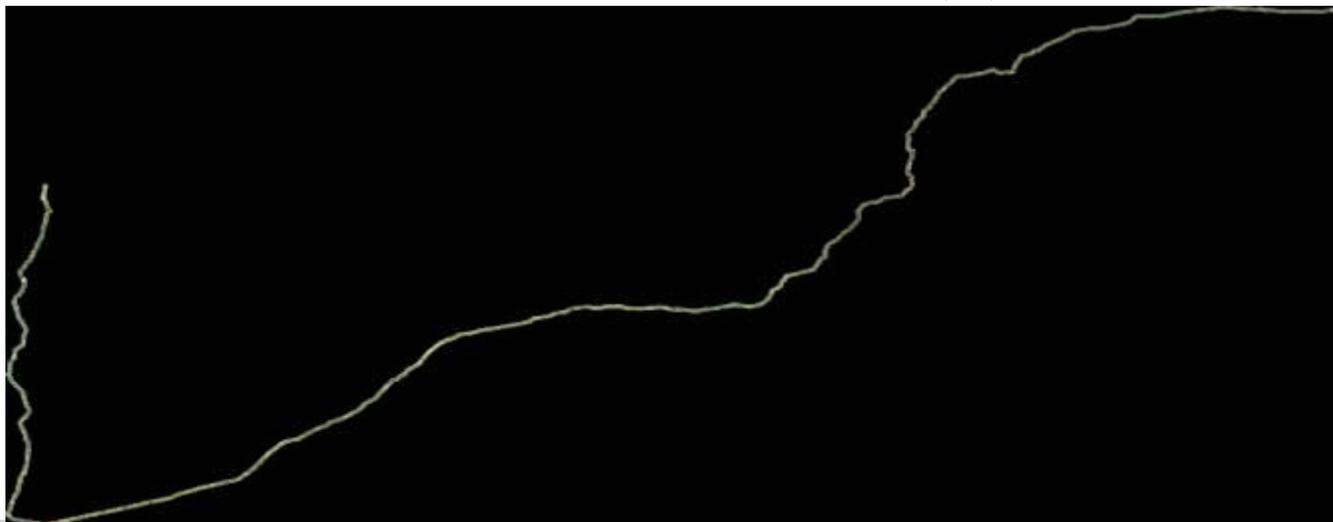
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The geospatial data set for the goal contains;

- **Orthophoto** mosaic image
 - ✓ with 10 cm GSD,
 - ✓ along 1200 km long and 400 m wide,
- **DSM and DTM,**
- **Vector data and coordinate list** of pipelines and stations,



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- Anomalies in vector data structure;

- ✓ **Landslide zones** and their natural gas pipeline catch points.
- ✓ **Erosion zones** and their natural gas pipeline catch points
- ✓ **Fault lines** (The data obtained from General Directorate of Mineral Research and Exploration- MTA was used)
- ✓ **Highway, main road, village road** and pipeline crossings,
- ✓ **Railway system** (railway, subway etc.) and pipeline crossings,
- ✓ **Power transmission lines** and pipeline crossings
- ✓ **Rivers, streams, irrigation canals** and pipeline crossings,
- ✓ **Mines, stone and sand quarries,**
- ✓ **Housing** (all kinds of buildings, facilities and human structure objects),

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- Video recording of flight animation along pipeline route in 3D environment





What we need to start the production is a KML file of pipeline route and stations provided by BOTAŞ

KML

Flight planning



GCP planning



Flight operation

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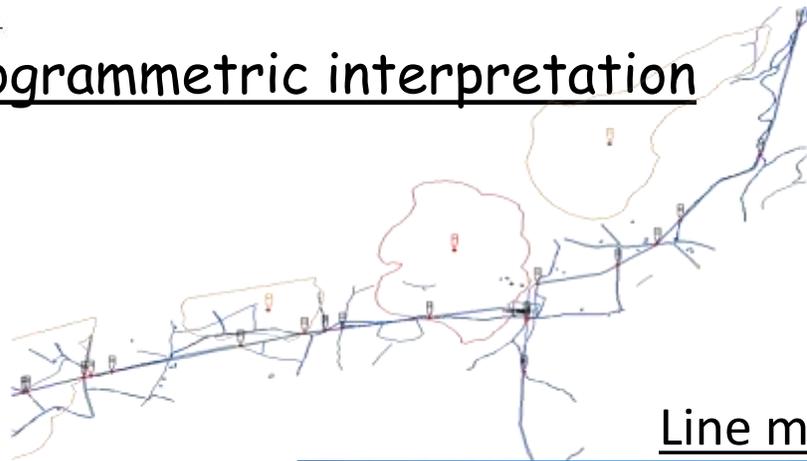


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Photogrammetric interpretation



Visually controlling of pipeline route

& By taking advantage of

Line markers

pipeline trace on orthophoto image



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Defining cross points using GIS location analyses such as



intersect, buffer analyze, contain, point in polygon etc.

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and reports

**BURSA ŞUBE MÜDÜRLÜĞÜ
BORU HATTI GEÇİŞ NOKTALARI**

DİLİM NO	İŞLETME/ŞUBE MÜDÜRLÜĞÜ	GEÇİŞ TÜRÜ	BORU HATTI / TESİS ADI	Kp	X (m)	Y (m)	Z (m)	İMAJ-1	İMAJ-2
30	Bursa Şube Müdürlüğü	Karayolu gecis noktası	Hersek Vana İstasyonu, LV-112	322,106	456271,490	4509345,660	0,850	322,106 A.png	322,106 B.png
30	Bursa Şube Müdürlüğü	Karayolu gecis noktası	Hersek Vana İstasyonu, LV-112	322,887	455840,070	4508712,490	1,350	322,887 A.png	322,887 B.png

**BURSA ŞUBE MÜDÜRLÜĞÜ
JEOLÖJİK ANOMALİLER**

DİLİM NO	İŞLETME ŞUBE/MÜDÜRLÜĞÜ	ANOMALİ TÜRÜ	BORU HATTI/ TESİS ADI	Kp	X (m)	Y (m)	Z (m)	BORU HATTINA MESAFE	İMAJ-1	İMAJ-2
30	Bursa Şube Müdürlüğü	Boru hattının holosen fayı kestigi nokta	Hersek Vana İstasyonu, LV-112	320,681	457539,663	4510005,048	1,115	Boru hattı üzerinde	320,681 A.png	320,681 B.png
30	Bursa Şube Müdürlüğü	Boru hattının fay hattını kestigi nokta	Hersek Vana İstasyonu, LV-112	321,434	456832,894	4509717,118	1,350	Boru hattı üzerinde	321,434 A.png	321,434 B.png
30	Bursa Şube Müdürlüğü	Eski heyelan bölgesi	Hersek Vana İstasyonu, LV-112	326,557	455104,633	4505284,981	62,261	277 m.	326,557 A.png	326,557 B.png
30	Bursa Şube Müdürlüğü	Boru hattının holosen fayı kestigi nokta	Hersek Vana İstasyonu, LV-112	326,600	455056,566	4505255,025	71,850	Boru hattı üzerinde	326,600 A.png	326,600 B.png

**BURSA ŞUBE MÜDÜRLÜĞÜ
YAPILAŞMA - MADEN, KUM, KİREÇ VE TAŞ OCAKLARI**

DİLİM NO	İŞLETME ŞUBE/MÜDÜRLÜĞÜ	YAPILAŞMA TÜRÜ	BORU HATTI/ TESİS ADI	Kp	X (m)	Y (m)	Z (m)	BORU HATTINA MESAFE	İMAJ-1	İMAJ-2
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-112, LV-113 İlyasköy	326,914	455212,180	4504996,724	108,500	70.56 m	326,914 A.png	326,914 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-112, LV-113 İlyasköy	327,309	455290,092	4504626,929	184,750	67.54 m	327,309 A.png	327,309 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-114, Orhangazi RMS TOV	357,193	442175,673	4482725,519	99,057	106.30 m	357,193 A.png	357,193 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-114, Orhangazi RMS TOV	357,306	442122,468	4482627,272	99,057	103.92 m	357,306 A.png	357,306 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Orhangazi RMS TOV, Yumurtatepe 24 inch Anahat Vanası	365,377	436312,889	4477253,870	76,003	573.56 m	365,377 A.png	365,377 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Orhangazi RMS TOV, Yumurtatepe 24 inch Anahat Vanası	365,637	436077,074	4477140,124	78,253	643.48 m	365,637 A.png	365,637 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	383,710	429909,771	4464125,935	485,271	383.22 m	383,710 A.png	383,710 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	383,863	429795,485	4464024,901	531,271	332 m	383,863 A.png	383,863 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	388,370	429279,870	4460202,194	236,000	168.5 m	388,370 A.png	388,370 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	388,557	429220,175	4460021,458	229,000	240.73 m	388,557 A.png	388,557 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	388,991	429361,182	4459651,805	159,500	379 m	388,991 A.png	388,991 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	Seğköy Pig İstasyonu, LV-115	389,131	429356,232	4459511,317	124,750	433 m	389,131 A.png	389,131 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-115, CS4 Turanköy Vana İstasyonu	404,548	441655,270	4452954,904	144,250	174.97 m	404,548 A.png	404,548 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	LV-115, CS4 Turanköy Vana İstasyonu	404,590	441579,918	4452920,780	148,000	147.1 m	404,590 A.png	404,590 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	CS4 Turanköy Vana İstasyonu, İngaz OSB RMS 6 inch TOV	419,789	451744,822	4445489,305	507,760	841.17 m	419,789 A.png	419,789 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	CS4 Turanköy Vana İstasyonu, İngaz OSB RMS 6 inch TOV	420,050	451870,661	4445259,030	462,010	991.02 m	420,050 A.png	420,050 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	CS4 Turanköy Vana İstasyonu, İngaz OSB RMS 6 inch TOV	420,246	451985,279	4445087,822	421,510	303.15 m	420,246 A.png	420,246 B.png
30	Bursa Şube Müdürlüğü	Kum Kirec Tas Ocagi	CS4 Turanköy Vana İstasyonu, İngaz OSB RMS 6 inch TOV	420,446	452061,777	4444913,211	416,260	380.47 m	420,446 A.png	420,446 B.png

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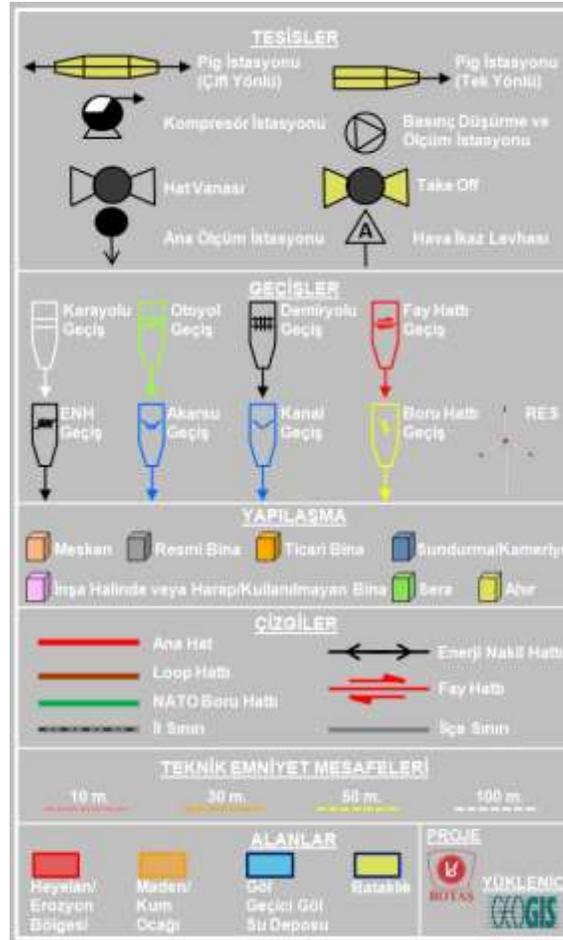
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Symbology used for video records

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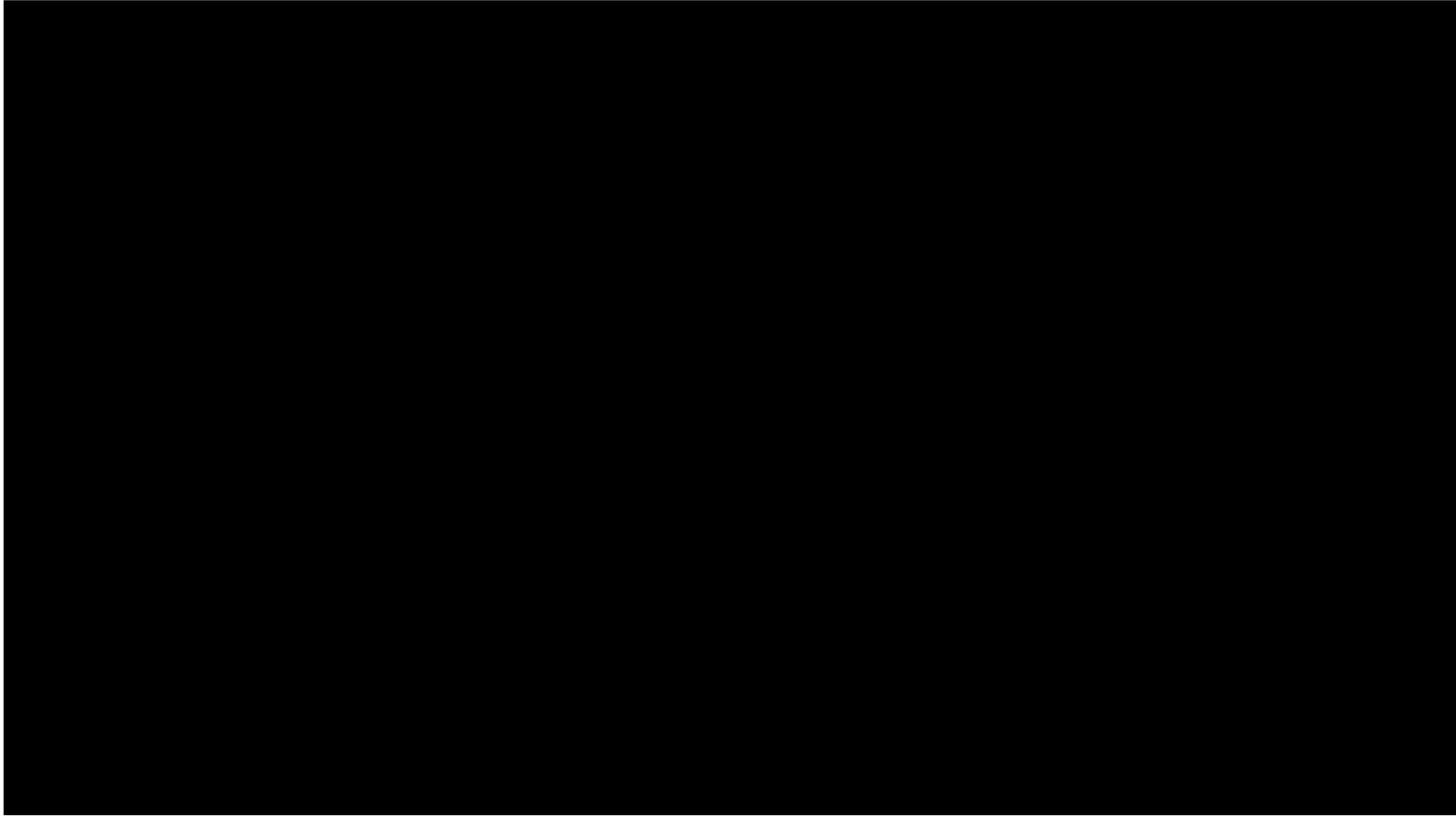




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Video recording of flight animation on the pipeline route



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Gas leak inspection

with ALMA G2 (Airborne Laser Methane Assessment) mounted to Bell 206 Jet Ranger helicopter



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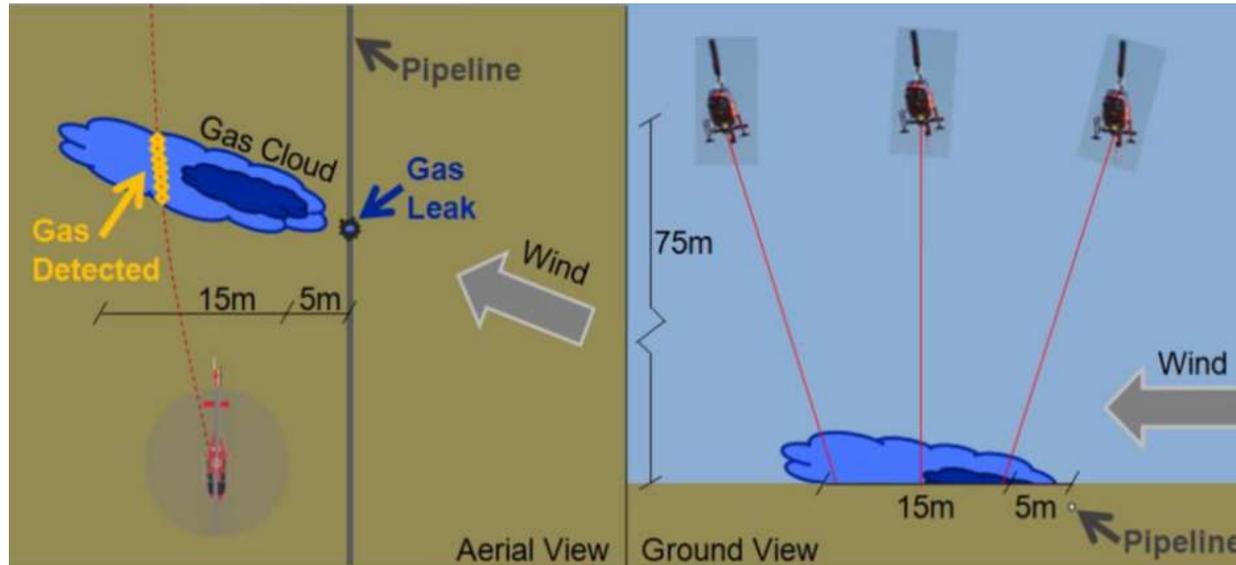




The ALMA system uses a technology based on the **measurement of the amount of infrared laser light** having a radioactive wavelength of 1650 nm **absorbed by methane gas**.

The laser beam is emitted from the Optical Unit of the system and strikes objects such as soil, grass, wood, concrete, and asphalt on the ground surface.

The **system analyzes the reflected laser beam** and calculates how much is absorbed by the **possible methane**.



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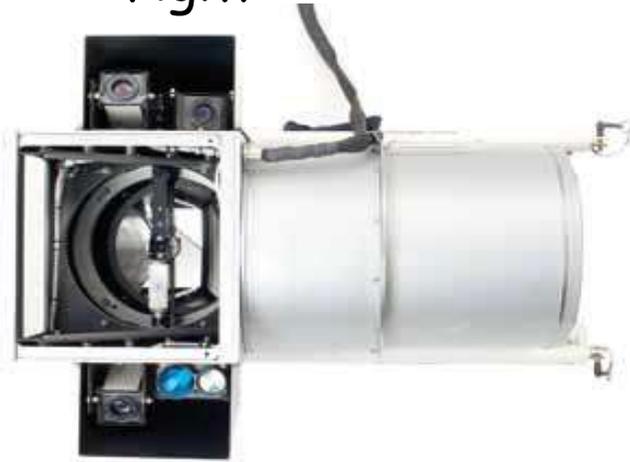


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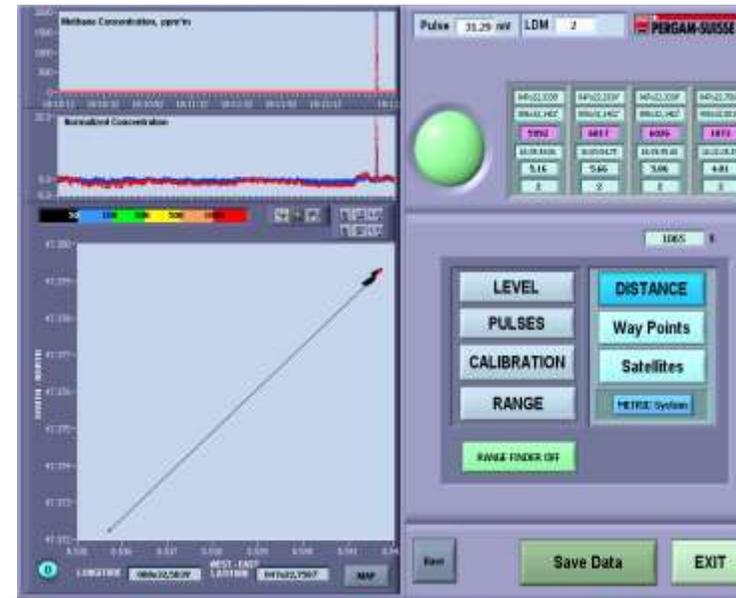




Optic unit has 3 cameras
- pilot
- left
- right



When gas leakage is detected,
the graphic will make a pig as seen.
And system records all related data as a leak point.



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Detection #	Date	Time	Latitude	Longitude	Methane Concent. (ppm*m)	Altitude (m)
1	18.10.16	16:51:21.40	41.1506400	28.5790750	46.37	29.7



Left camera image



Right camera image



Pilot camera image



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Conclusion

The data sets produced by geographical analysis in this pilot project have enabled the identification and reporting of anomalies that have big importance in terms of the safety of natural gas transmission lines.

In addition, video recordings prepared in 3D environment using actual aerial photographs facilitated analyzes and evaluations made by BOTAS managers and engineers within the scope of control / maintenance / repair works for pipelines.

Airborne inspection of gas leaks has enabled effective control, reporting and evaluation in a large area and has allowed the pipeline operating units to repair gas leaks as soon as possible.

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