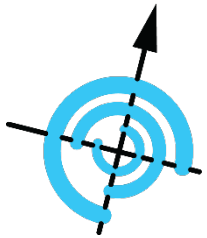
DRILLGUIDE RADAR INTERSECT TECHNOLOGY

Brownline

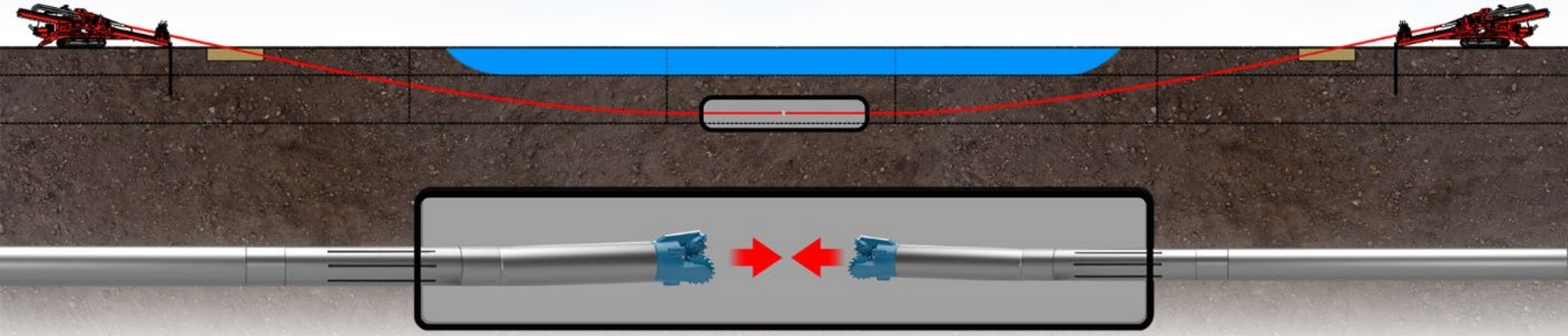


Drillguide

GYRO STEERING TECHNOLOGY

HDD INTERSECT CROSSINGS

- HDD crossings evolved into intersects
- Intersect HDDs commonplace in industry
- Also, for shorter crossings



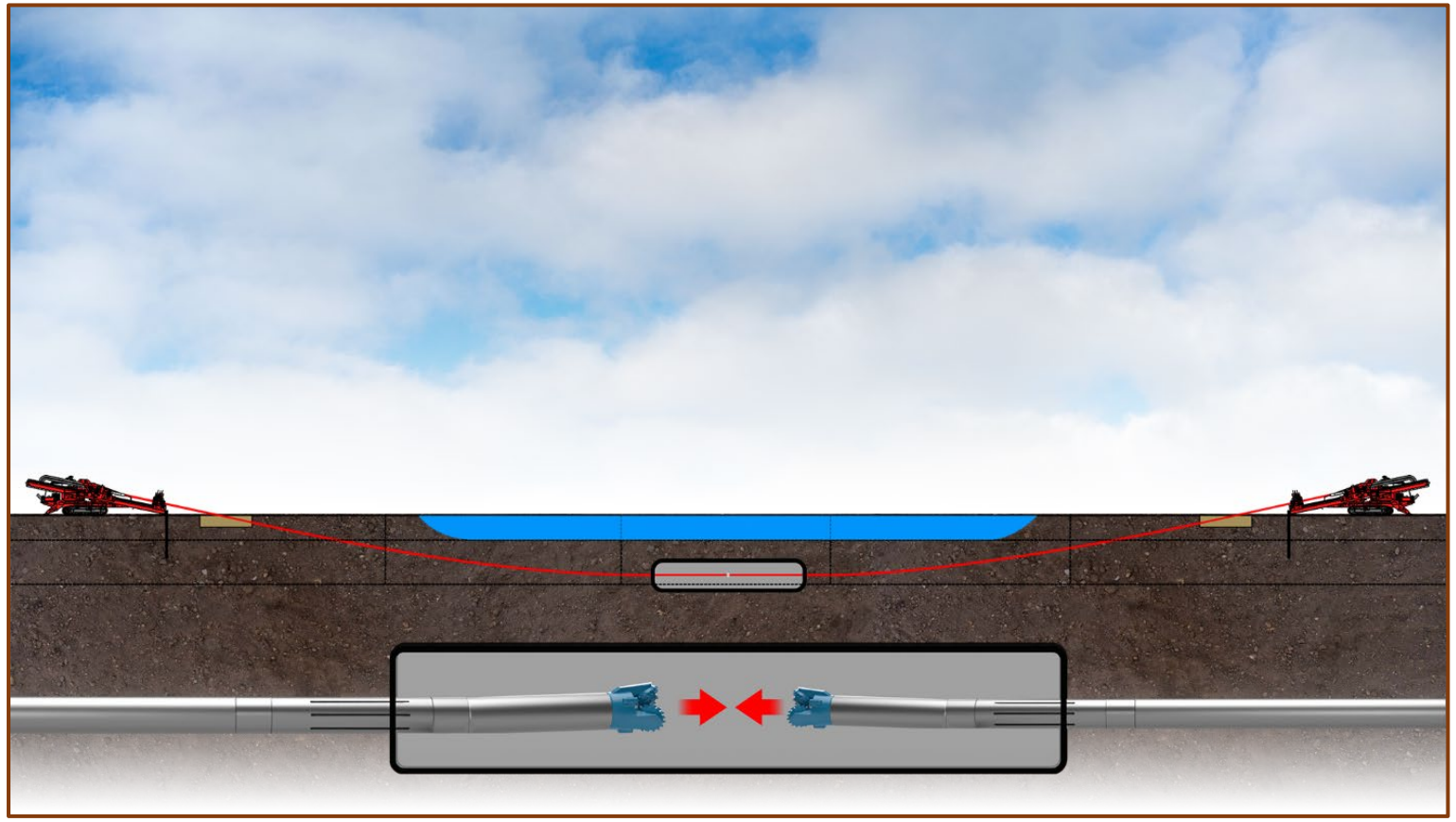
INTERSECT CHALLENGES

- Extremely long
- No surface access
- Accuracy compromised
- Mitigating downhole annular pressures

SOLUTION

- **Steering system not reliant on surface tracking, not susceptible to magnetic interferences**
- **Drillguide Radar Intersect: add-on technology to GST**
- **Highly accurate**

HOW IT WORKS



- Contained in GST housing
- Pilot hole to intersect point
- Downhole assemblies in proximity
- Radar activated
- Radar data collection
- Bore path design adjusted


MODE
Drilling
Project:
MT FT
Brownline
Guidance
Reporting
Graph
Monitoring
Calibration
Mud Pressure
Radar
Drilling
Tools
Report
Data
Help
Start Wizard
Show 1 last result(s)
Internet is available
Communication Lost
COMMUNICATION STATUS
Side A
Side B
1 2 3 4 5 6 7 8 9
Info
Turn chat on
Clear chat box
Drillguide
by Brownline
Event
Azimuth
Inclination
Inclination
Radar
INTERSECT TOOL
by Brownline
CURRENT DATA
Side A
Side B
X
Y
Z
REAL POSITION
CLOSER 3.41 (ft)
LEFT 1.95 (ft)
ABOVE 0.27 (ft)
Communication with Box lost
www.drillguide.com
Key Status

Latitude
48.115862°
Longitude
-103.092544°

ENTRY

EXIT

SPECIFICATIONS

- AZI .04°
- INC/Pitch .01°
- AP Sensor position 8’
- 590’ Minimum radius

V1.4

Drillguide GST

8-1/2” - 215 mm Gyro Steering Tool specifications

Tool OD	8-1/2” – 215 mm
Tool length (shoulder/shoulder)	8,7’ – 265 cm
Thread connection pin/box	6-5/8” FH
Recommended make-up torque	6-5/8” FH 57,000 ftlb – 77 kNm
	GST collar 42,000 ftlb – 57 kNm
Sensor(s) Accuracy	Azimuth 0.04° / Pitch 0.01° / Toolface 0.02°
Shoulder to sensor distance	27,6” – 70 cm
Net weight	1125/1200 lbs – 510/545 kg
Hole/drill bit size	10-5/8” / 12-1/4” – 250 - 300 mm
Minimum bending radius	590’ – 180 mtr
Maximum flow rate	780 gl/min – 3000 ltr/min
Annular pressure sensor position (distance from pin shoulder)	8’ – 248 cm
Annular pressure sensor range	0 to 870 psi – 6000 kPa – 60 bar
Maximum allowed inner mud pressure	1150 psi – 8000 kPa – 80 bar
Inner mud pressure sensor range	0 to 2175 psi – 0 to 15000 kPa – 0 to 150 bar
Maximum allowed torque (on tool housing)	42,000 ftlb – 57 kNm
Maximum allowed push/pull (on tool housing)	110.000 lb – 50 t
Maximum allowed temperature (on tool)	158° f – 70° c
Maximum allowed vibration (on tool)	20 g up to 200 Hz
Electric power (input on surface)	230V-50Hz / 110V-60Hzz
Electric power (output to downhole tool)	56 Volt DC
Recommended downhole wireline	10 to 8 AWG – 6 or 10 mm^2

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Latitude
48.115862°
Longitude
-103.092544°

ENTRY

EXIT

SPECIFICATIONS

- 1,150 P.S.I. Mud pressure
- 590’ Minimum bend radius

V1.4

Radar

8-1/2” 215 mm Radar Tool specifications

Tool OD	8-1/2” – 215 mm
Tool length (shoulder/shoulder)	8,7’ – 265 cm
Thread connection pin/box	6-5/8” FH
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	GST collar 42,000 ftlb – 57 kNm
Net weight	1200/1350 lbs – 550/600 kg
Hole/drill bit size	10-5/8” – 12-1/4” – 250 - 300 mm
Minimum bending radius	590’– 180 mtr
Maximum flow rate	780 gl/min – 3000 ltr/min
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Electric power (input on surface)	230V-50Hz / 110V-60Hz
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Recommended downhole wireline	10 to 8 AWG - 6 or 10 mm^2

Radar Tool can only be used in combination with Drillguide GST

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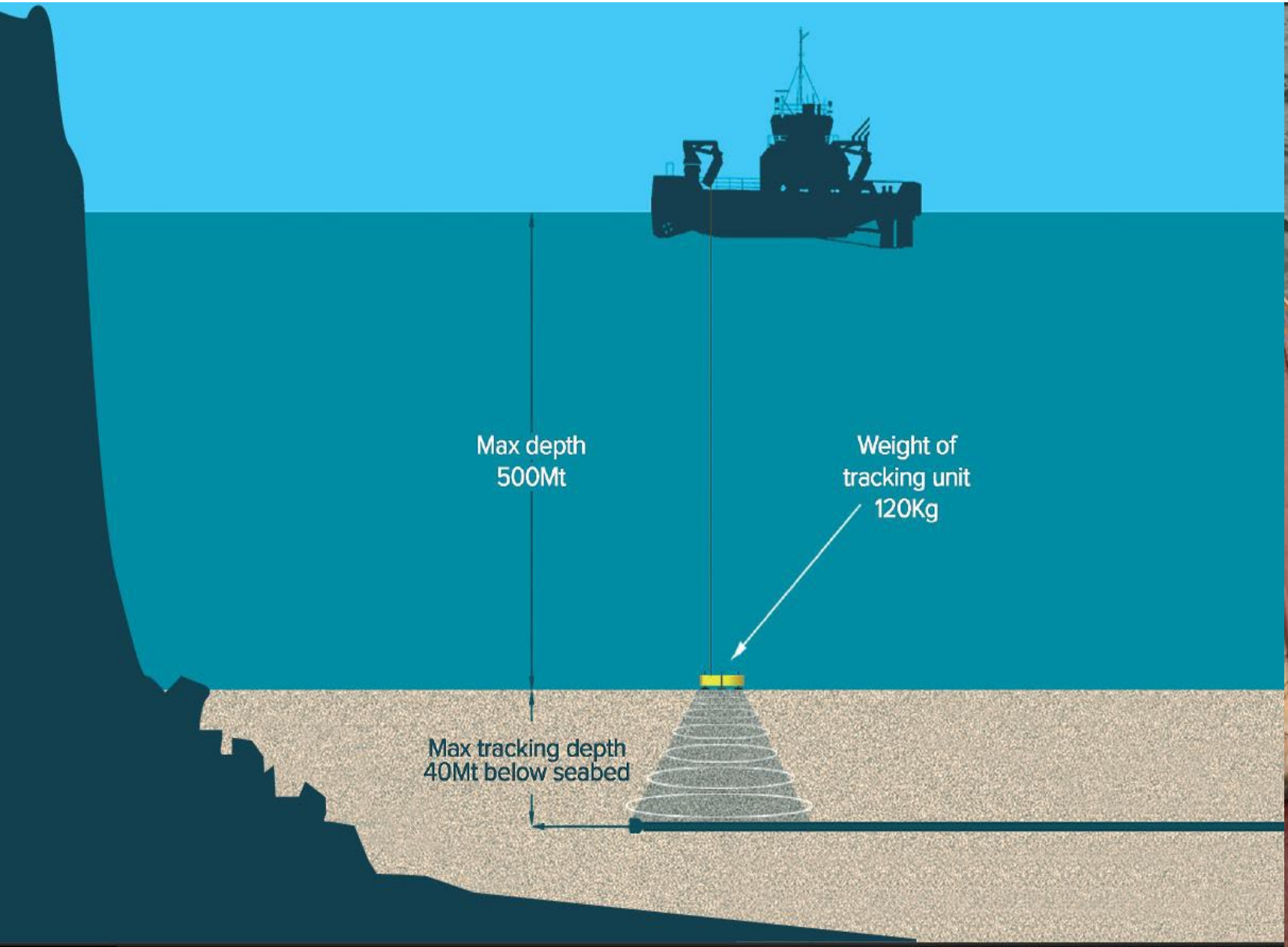
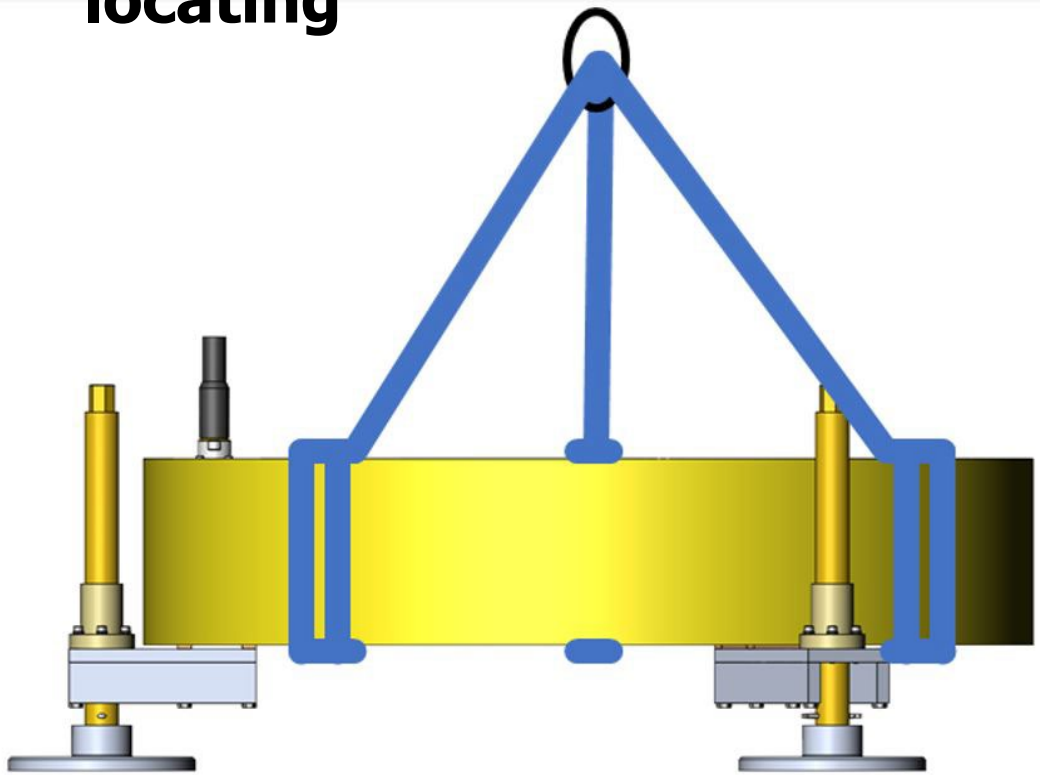
GPS TRACK AQUA

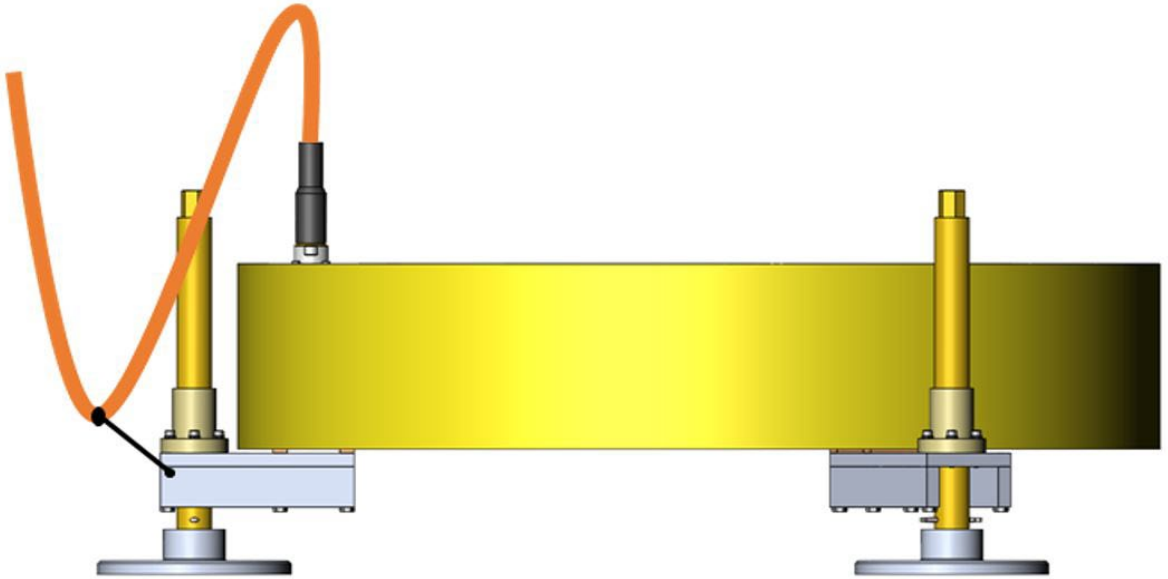


GPS TRACK AQUA

- **Installed & adjusted by divers**
- **Position determined by geo-locating**



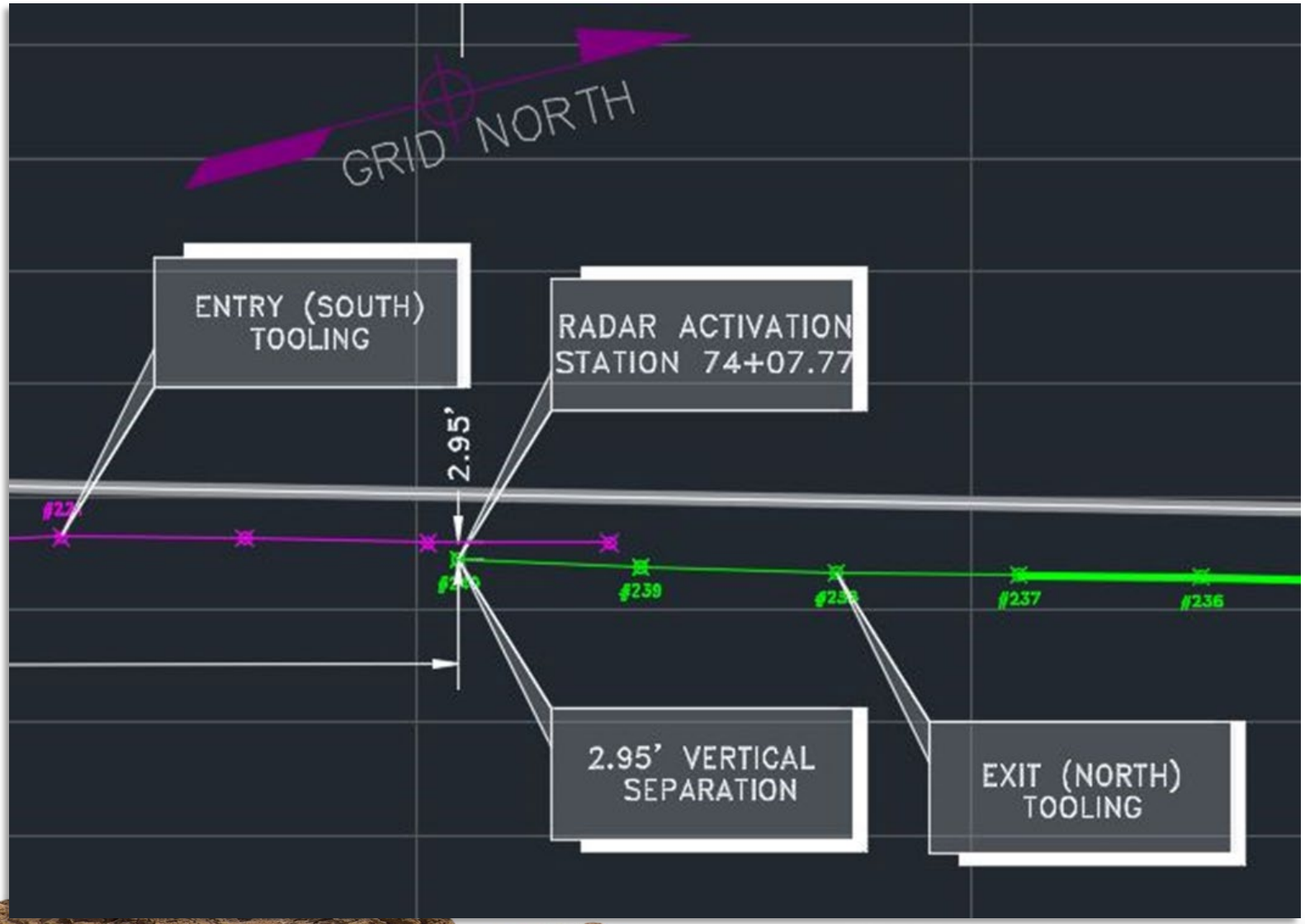
- **Additional data & accuracy source**
- **Stand-alone unit**



CASE STUDY: LAKE SAKAKAWEA, ND

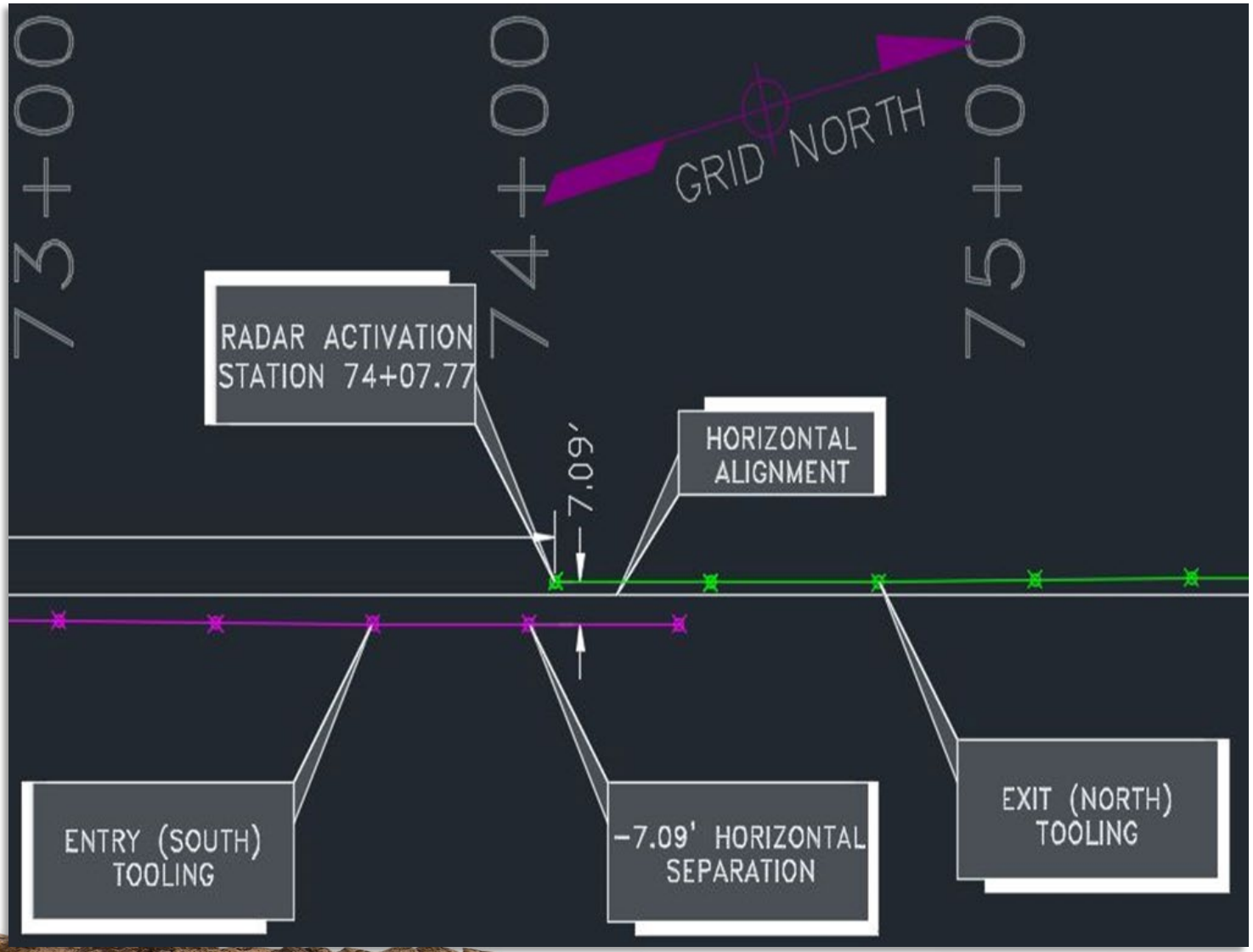
- 15,426’ HDD
- Install 24” natural gas pipeline
- Intersect method
- 12,470’ water distance

VERTICAL ALIGNMENT



- **South operation: 7475.85'**
- **North operation: 7977.42'**
- **2.95' vertical separation**

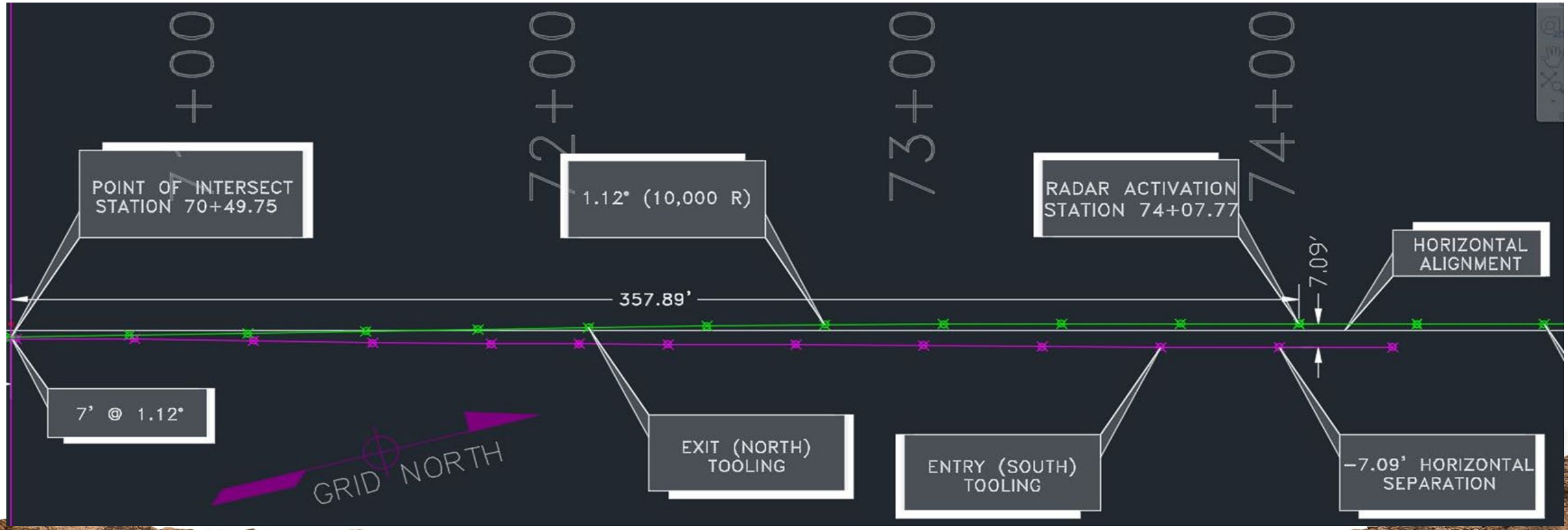
HORIZONTAL ALIGNMENT



- South tooling=magenta
- North tooling=green
- Radar activated station 74+07.77
- Results: 7.09’ horizontal separation

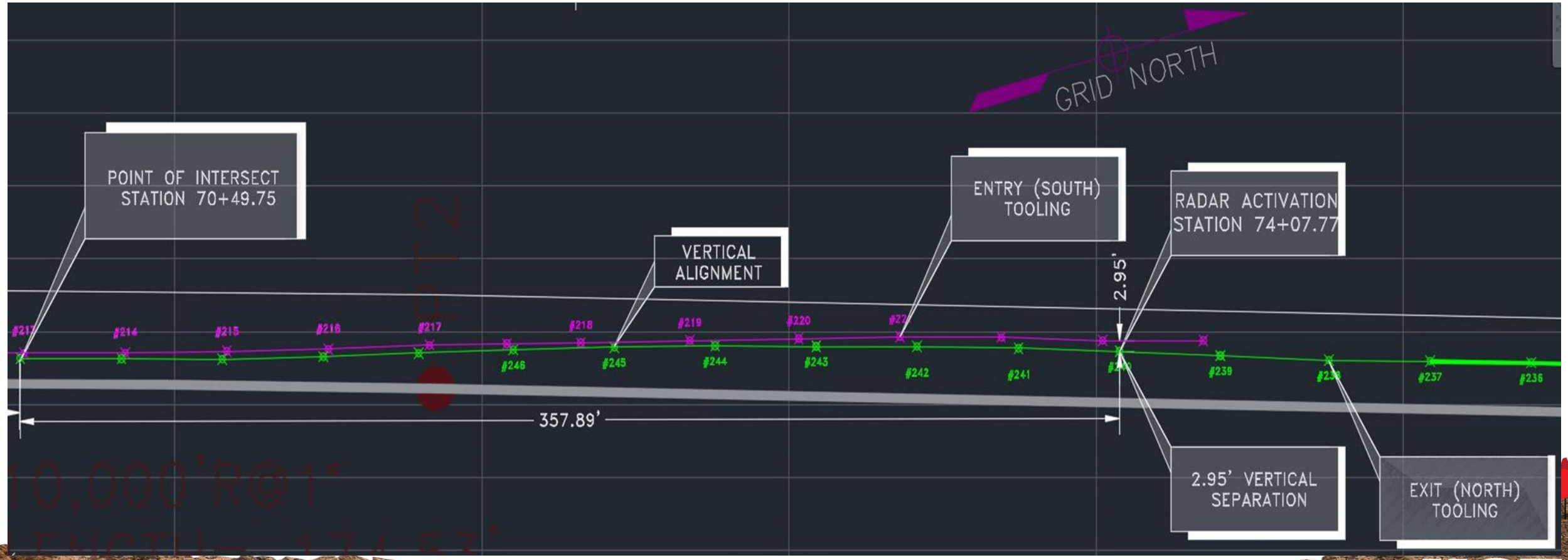
HORIZONTAL ADJUSTMENT

- The north operation continued drilling south while the south operation began retrieval
- The AZI was adjusted 1.12° in 197’ to the east for the north operation
- This 1.12° AZI adjustment calculated the north trajectory to shift to the east 7’ in a total forward distance of 358’ to the planned intersect point at station 70+49.75
- Calculated radius is at 10,000’



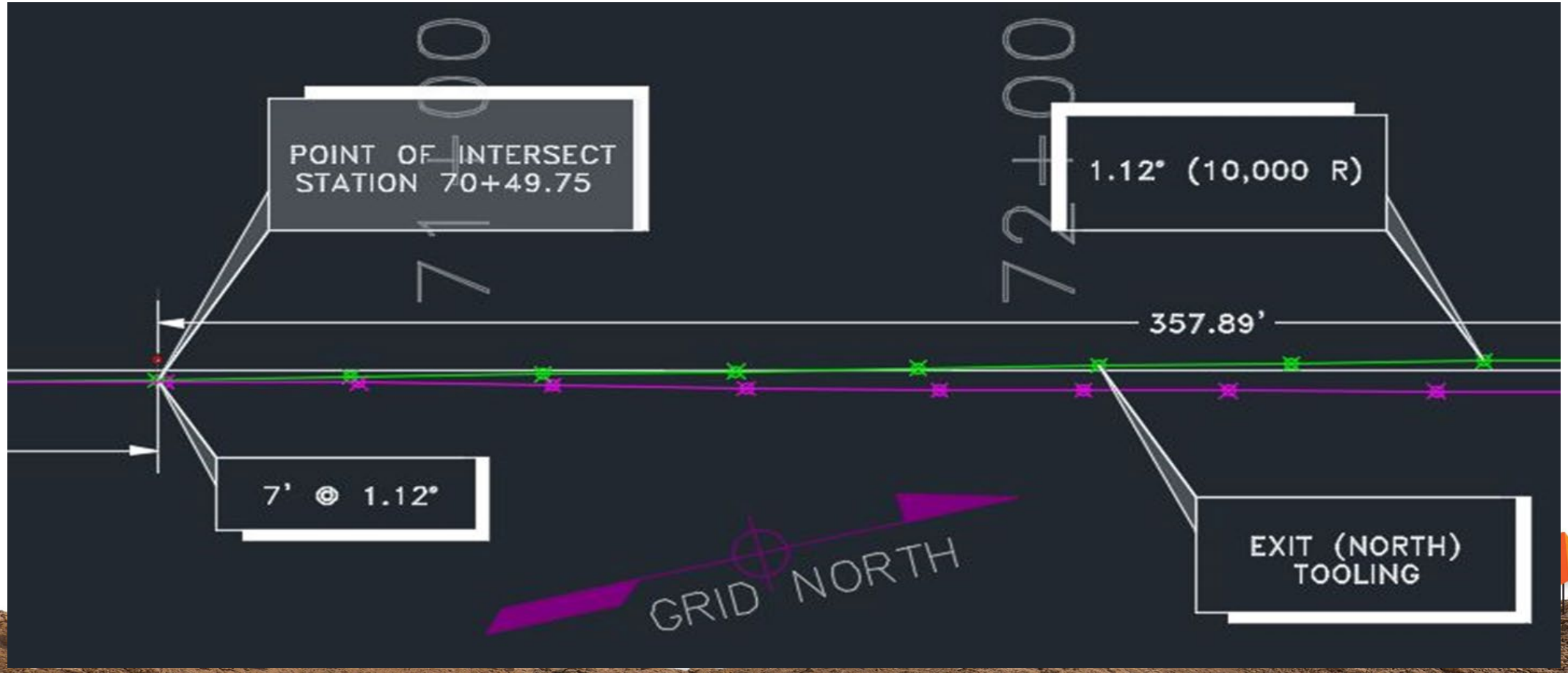
VERTICAL ADJUSTMENT

- North BHA INC is at 1.4° or 91.4°
- Designed a .94° decrease in 358’ to the north BHA
- Continue advancing to the designated intersect point at station 70+49.75



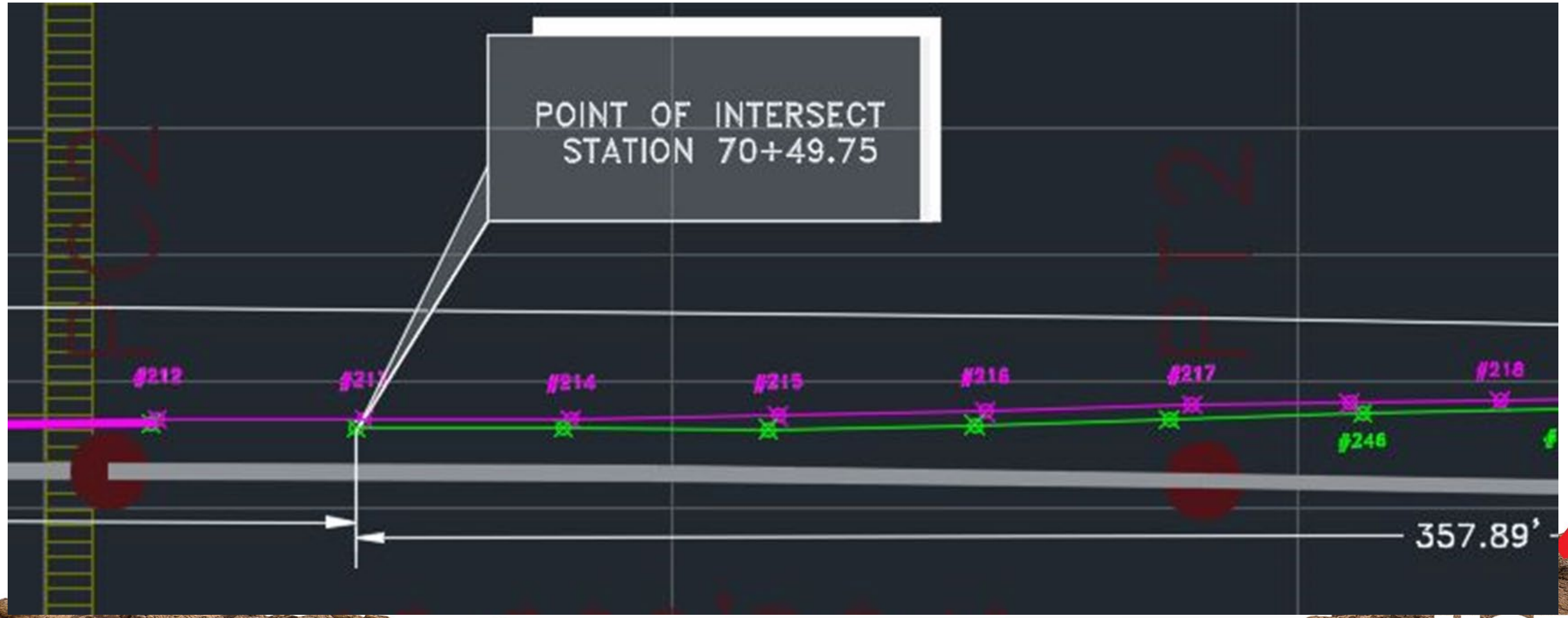
HORIZONTAL RESULTS

- North operation successfully made the AZI adjustment and entered the south bore hole at the planned station.
- The HZ angle as the BHA intersect the south borehole was .29° at a 6263’ radius



VERTICAL RESULTS

- The north operation successfully made the vertical angle adjustment to the trajectory and intersected the south borehole at the planned station of 70+49.75
- The vertical angle as the north operation entered the south borehole was at .17° with a 10,683’ radius



SUMMARY

Questions?

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Drillguide
GYRO STEERING TECHNOLOGY

Radar

UNDERGROUND CONSTRUCTION TECHNOLOGY

THE UNDERGROUND UTILITIES EVENT | February 7-9, 2023 | Orlando, FL

UCT

1. Introduction

Thank you all for coming today. My name is Tom Forconi I am the business development manager for Brownline USA and with me today is Jim Cloud, President Brownline U.S.A

2. Slide 2 – HDD Intersect Crossings

Today we will be discussing HDD intersect crossings and look at a case study of Lake Sakakawea.

As most of us know, an HDD Intersect typically is defined as 2 opposing drill rigs drilling towards each other along a pre-designed bore path to a pre-determined point of intersect usually meeting in the middle of the crossing.

HDD crossings evolved into intersects to increase the success of extremely long drills and have now become common place in the HDD Trenchless industry.

You may ask…Why Intersect? Well, there are many reasons for intersecting some of which are:

- Reduced annular pressures to mitigate the risk of inadvertent releases of fluid to the surface.
- Reduced torque and drag on the down hole tooling and drill pipe.
- HDD Intersects provide a high success rate for extremely long drills.

3. Slide 3 – Intersect Challenges

The accuracy or precision of an intersect drill is dependent on the accuracy of the down hole steering tool, bore design, and geologic conditions.

In most cases there is no surface access between the entry points to install a surface coil for tracking a magnetic tool to increase the accuracy and circumvent any magnetic interference.

Adhering to an annular pressure plan while maintain acceptable limits.

4. Slide 4 – Solution

One solution is to utilize a steering system that is not reliant on a surface coil for accurate positional verification and is not susceptible to magnetic interferences.

The Radar equipped GST is a stand-alone steering tool that achieves accuracy and precision without relying on a surface coil for tracking and is not affected by magnetic interference from down hole or surface anomalies.

The down hole pressure module equipped to the GST is an extremely robust and accurate tool to ensure the limits of the annular pressure plan can be adhered to.

5. Slide 5 – How It Works

- The Drillguide Radar is system is attached to the GST and is contained with the GST housing.
- Pilot hole operations begin at the drill entry points on each side of the crossing and drill towards one another to the designated intersect point.
- When the bottom hole assemblies are in proximity, the Radar is activated to determine the positions of each down hole assembly relative to each other within tenths of an inch.
- The Radar data collection process takes seconds to complete with the resulting data being instantaneous requiring no interpretation or adjustment.
- The bore path design will be adjusted withing the parameters of the design and pilot hole operations will continue drilling on the adjusted path until one assembly has intersected the drilled path.

6. Slide 6 – GST Software Radar Screenshot

Here we have a screenshot of the guidance engineer's screen as he has activated the radar which shows the resulting data:

- The blue bit represents the radar equipped assembly and the green bit represents the opposing assembly.
- Results showing the opposing assembly to be 3.41' to the right and .27' above.

7. Slide 7 – GST Specifications

The GST specifications are shown here with the

- AZI being accurate to .04°
- The inclination or pitch at .01°
- The annular pressure sensor position is 8' to the rearward of the bit connection
- The minimum radius for the 8" housing is 590.'

8. Slide 8 – Radar Tool Specifications

- 1,150 P.S.I. Recommended maximum internal mud pressure.
- 590' Minimum bend radius

9. Slide 9 – GPS Track Aqua

Brownline has introduced the GPS Track Aqua secondary tracking system for long HDD intersect crossings to provide secondary/redundant tracking beneath water bodies.

10. Slide 10 – GPS Track Aqua Installation

- The unit is placed on the sea bottom by marine equipment and divers to a maximum depth of 500 meters.
- It is then adjusted to level and its position is determined by geolocation.
- The unit is capable of a maximum tracking depth of 40 meters below the sea bottom.
- Acts as an additional data source to improve precision.
- Stand alone unit with communications to the surface via the attached cable.

11. Slide 11 – Case Study: Lake Sakakawea, ND

Lake Sakakawea is part of the Missouri River system located approximately 25 miles to the east of Williston, ND. The drill was designed as an intersect and completed utilizing the Drillguide GST and Radar Intersect Technology. The purpose of the 24" installation was to establish a connection under Lake Sakakawea to increase the amount of natural gas that can be transported from the Bakken and Three Forks shale fields in North Dakota.

- Total length of 15,426'
- An approximate distance of 12,470' across the water body with no access.
- Chosen as the Trenchless Technologies 2022 Project of the Year.

12. Slide 12 Vertical Alignment

- South operation drilled to 7475.85.'
- North operation to 7977.42', and at this point the tooling was overlapped and the Drillguide Radar system was activated.
- Radar data showed a vertical separation of 2.95'.

13. Slide 13 Horizontal Alignment

- Radar data showed a horizontal separation of 7.09'.

14. Slide 14 Horizontal Adjustment

- The north operation continued drilling south while the south operation began retrieval.
- The AZI was adjusted 1.12° in 197' to the east for the north operation.
- This 1.12° AZI adjustment calculated the north trajectory to shift to the east 7' in a total forward distance of 358' to the planned intersect point at station 70+49.75
- Calculated radius is at 10,000'.

15. Slide 15 Vertical Adjustment

- North BHA INC is at 1.4° or 91.4°
- Designed a .94° decrease in 358' to the north BHA
- Continue advancing to the designated intersect point at station 70+49.75

16. Slide 16 Horizontal Results

- North operation successfully made the AZI adjustment and entered the south bore hole at the planned station.
- The HZ angle as the BHA intersected the south borehole was .29° at a 6263' radius.

17. Slide 17 Vertical Results

- The north operation successfully made the vertical angle adjustment to the trajectory and intersected the south borehole at the planned station of 70+49.75
- The vertical angle as the north operation entered the south borehole was at .17° with a 10,683' radius.
- Now that the intersect was complete, the south drilling operation began retrieving the tooling to the surface while the north operation advanced southward through the existing borehole to the south entry point.

18. Slide 18 Summary

- HDD Intersect technology has vastly increased the lengths that can be completed accurately and successfully while mitigating, IRs, adverse geology, and decreased down hole pressures on the tooling.
- The GST Radar Technology is utilized whereas there is no access to the surface.
- Is not susceptible to magnetic interference.
- The results of the GST Radar data require no interpretation with the data collection process taking only seconds.

- The accuracy and precision of the calculations leading up to the point of intersect ensures a smooth transition at the point of intersect.

19. QUESTIONS?

END

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