Milestone 7.2.1 Report: Fiber Optic Installation, Well 16B

Organization: University of Utah

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Project Title: Fiber-Optic Geophysical Monitoring of Reservoir Evolution at the Utah FORGE Milford Site

Project Period: 10/01/2021 – 09/30/2024

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Milestone 7.2.1 Report: Fiber-Optic Installation

This report documents the successful installation of the FOGMORE fiber-optic cable in well 16B(78)-32 which occurred during the summer of 2023, in fulfillment of Milestone 7.2.1. This cable was intended to be one of the primary monitoring tools utilized by the project. The goal of Milestone 7.2.1, as laid out in the project SOPO, was to install the system, including the fiber, fiber-optic interrogator units, and telemetry systems and verify functioning by recording at least 7 days of data using all DFOS modalities. This milestone is the primary endpoint of subtask 7.2, *"Installation of fiber optic cable in production well"* which was originally scheduled for the end of Q3/Yr 2. The completion of the milestone was delayed due to the delays in drilling and completion of the 16B. For reference, we include below the text of the milestone

Milestone 7.2.1: *Production well fiber-optics systems installed and commissioned*: Milestone 7.2.1 is the completion of the production well fiber-optic system installation and commissioning of the monitoring infrastructure including IUs and compute components. This milestone is contingent on the FORGE drilling schedule. This milestone is linked to task 7.2 and will be managed by Silixa (Coleman) (Q3, Yr3). The milestone will be completed if the primary measurement IUs can successfully record 7 days of DTS, DSS, and DAS data on the installed cable system, cross-validated against available reference data.

The primary installation was conducted in mid-July 2024 (7/8-7/15) during the drilling and completion of well 16B with a second visit to arrange for a permanent connection to our recording container, also located on the 16 well pad. We considered this milestone completed by September 2024 when 7 uninterrupted days of DFOS data became available. This memo is to document completion and provide archival information for the project.

Attached to this memo you will find a detailed installation report from Silixa LLC, the primary fiber contractor detailing (a) cable specifications including fiber, protection, termination, and wellhead details, (b) mobilization/preparation description, (c) details of the installation procedure including termination and RiH, and wellhead completion, (d) description of the final enclosure and surface run installation, and (e) QC information on the fiber after connection. This provides archival information on the fiber installation procedure.

One issue we observed were higher then expected optical losses on the cable, likely due to manufacturing defects in the cable that led to microbends in the FIMT assembly. While this did not impact early measurements relevant to this milestone, we intend to develop a follow-on report detailing observations of fiber health over time, an on-going challenge at the site. Pre-travel and as-installed OTDR traces are included in the installation report to document this issue (pg. 40-47).

FIELD INSTALLATION REPORT

Project: FORGE 16B(78)-32
Client: RICE University

Client Representative:	Jonathan Ajo-Franklin	Engineer (1):	Ben Broman
Site Representative:	John Mclennan	Engineer (2):	Matt Derosier
Site Location:	FORGE EGS, Milford, UT, USA	Engineer (3):	
Date:	07/24/2023 Rev 1	Engineer (4):	
Completed by:	Ben Broman Matt Derosier		

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1 List of Acronyms

CCUS: Carbon Capture, Utilization and Storage

CF: Constellation™ Fiber

DAS: Distributed Acoustic Sensing

DFOS: Distributed Fiber Optic Sensor

DSS: Distributed Strain Sensing

DTS: Distributed Temperature Sensing

EDU: Electrical Distribution Unit

EOF: End of Fiber

FAT: Factory Acceptance Test

FOC: Fiber Optic Cable

GPS: Global Positioning System

ICI: Incoming Inspection

ITP: Inspection Test Plan

IU: Interrogator Unit

KVM: Keyboard Video Mouse

LER: Local Equipment Room

MM: Multimode Fiber

MMV: Monitoring, Measurement and Verification

MRB: Manufacturers Record Book

ODU: Optical Distribution Unit

OFS: Optical Feedthrough System

OTDR: Optical Time Domain Reflectometer

RAID: Redundant Array of Independent Disks

RIH: Run-in-Hole

RTPU: Real-time Processing Unit

SCM: Subsea Controls Module

SEM: Subsea Electronics Module

SIT: System Integration Test

SMF: Singlemode Fiber

SNR: Signal to Noise Ratio

TDMS: Technical Data Management System

UTA: Umbilical Termination Assembly

VSP: Vertical Seismic Profiling

WHO: Wellhead Outlet

2 Executive Summary

This document presents Silixa's summary of the permanent fiber optic cable installation in the deviated geothermal production well 16B(78)-32 located in the Utah FORGE underground geothermal laboratory situated near Milford, UT, USA.

A downhole fiber optic cable was installed outside the 7" production casing with well dimensions and fiber optic cable hardware outline below:

Well Details:

- Measured Depth = 10,208.40 ft
- Production casing: 7" 38# P110EC VAM TOP HT
  7" 38# P110MS VAM TOP HT
- Open hole: 9.5"
- KB: 31 ft

Permanent Hardware:

- Downhole A825 fiber optic cable with 5 FIMT fibers/ one impregnated strain fiber in belting
- A825 Bottom Hole Assembly (BHA) with steel clamp
- Surface enclosure with emergency shutoff valve and surface cable terminated with E2000/APC connectors

Cabling RIH started on July 10th and was completed on July 12th. The cable was tested every 20 joints passing QA/QC at each test. Before landing the casing hanger, cable was wrapped around the hanger neck 3 times on the rig floor, then another 2 times prior to exiting through the adapter. On a prior visit to site, Silixa engineers installed an instrumentation cabinet (the "edge monitoring system") to acquire data during operations and future phases of the project. A Silixa XT-DTS™, Carina™, and iDSS™ were used to monitor cementation and circulation testing, and the cable was temporarily terminated in a NEMA 4 aluminum junction box with surface cable and E2000/APC connectors. Just after wellhead repairs were performed on August 30th, an in-line splice repair was also performed in the cellar due to breakage of the cable during wellhead removal. During final system commissioning, a permanent NEMA 4/IP66 junction box was installed near the well cellar and spliced into a surface cable running to the Rice University/Silixa acquisition trailer. Silixa engineers left after ensuring the edge monitoring system was operating as expected, with optical fibers connected to each IU in the acquisition trailer.

3 Scope of Work

Silixa was contracted to provide cable, components, and installation services for an installation at 16B well located at the FORGE site near Milford, UT, USA. The cable fiber count included 2 multimode, 2 singlemode, 1 Constellation, and 1 strain fiber. Cable and all ancillary components were specified by Silixa. The scope of Silixa's services were to provide personnel and equipment required to attach the cable to casing as the casing was run in hole. A field team of three personnel and equipment including truck, powered spooler, sheave, cable clamp tools, fiber splicing and test instruments, and hand and power tools were required. Design specifications for the installation and equipment are below.

An additional scope of work, completed later during the week of August 28th, was performed to trench and install the downhole cable into buried conduit and connect via a tactical surface FOC to the acquisition trailer.

3.1 Downhole Design Specifications

3.1.1 Well Completion Design

The completion design for well 16B is presented in Figure 1.

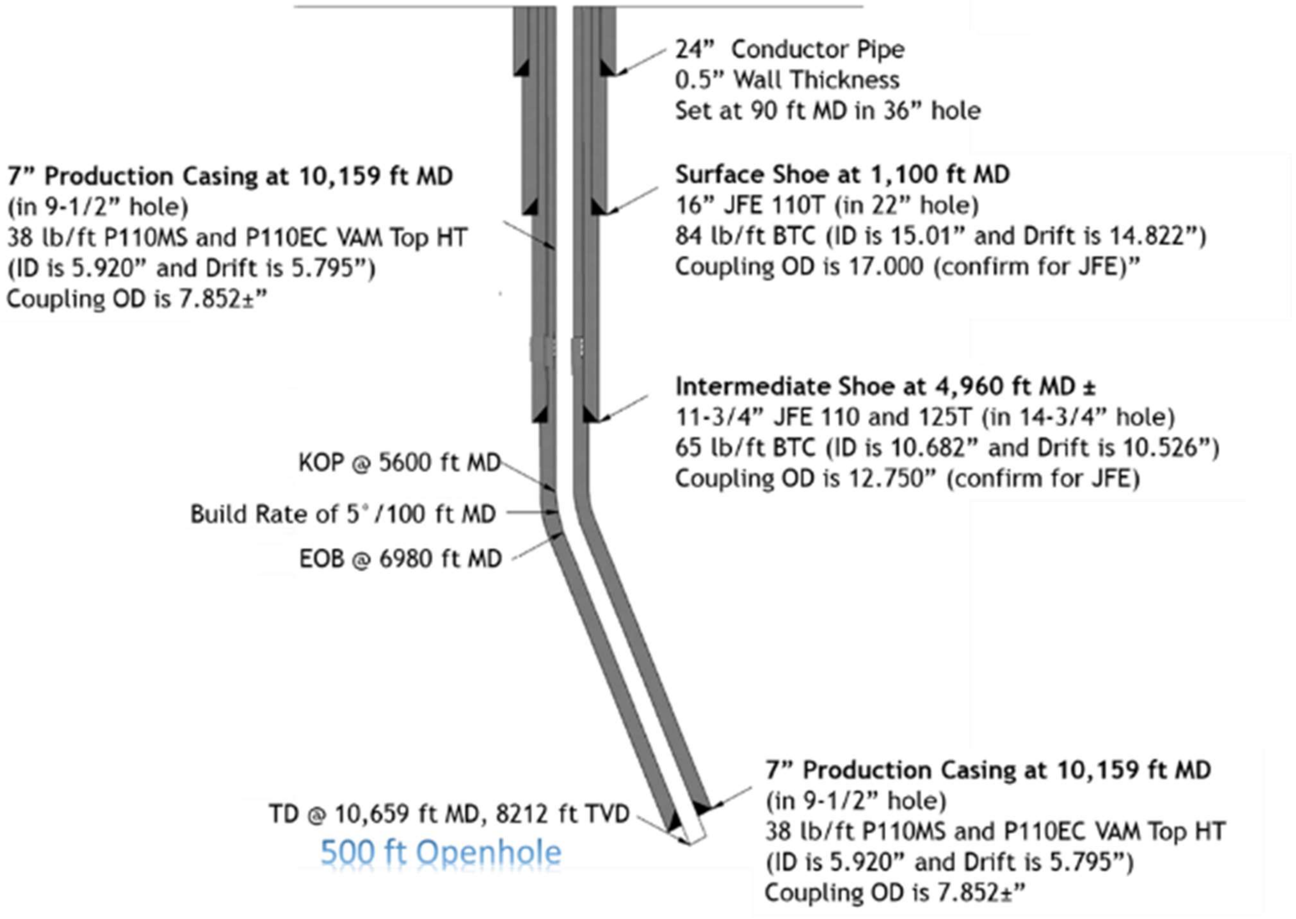


Figure 1. Well completion diagram from 16B(78)-32 planning phase.

3.1.2 Casing Specifications

Details are provided in the Casing Tally Run Report presented in Appendix C: Casing Tally.

- Length: 46' nominal
- Production casing: 7" 38# P110EC VAM TOP HT, optimal torque 23,150 ft.lbs.
  7" 38# P110MS VAM TOP HT, optimal torque 23,150 ft.lbs.
- Open hole: 9.5" ID

3.1.3 Fiber Optic Cable Specifications

The installed cable included two multimode fibers, two singlemode fibers, and one Silixa engineered Constellation fiber incorporated in a 1.8 MM FIMT. A belting layer encapsulated the strain fiber, FIMT, and a bare ¼" O.D. A825 outer tube served as the primary physical protection layer.

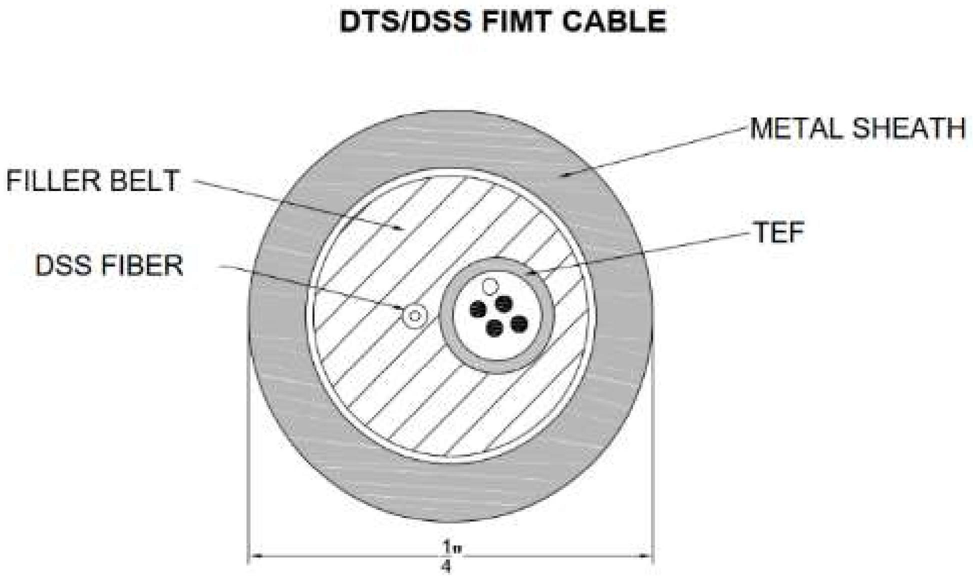


Figure 2: ¼" OD A825 alloy tube downhole cable with belting and 1/8" OD FIMT.

The proposed cable designs provide multiple layers of hydrogen protection. The hydrogen barriers include a carbon hermetic coating layer to resist hydrogen darkening, and the fibers sit in hydrogen scavenging gel within the inner metal tube.

Parameter	Specification
Outer tube diameter	6.35 mm (0.250")
Outer tube material	Incoloy A825
Outer tube wall thickness	0.889 mm (0.035")
Belting	4.45mm OD PFA
Inner tube diameter	1.8 mm
Inner tube material	Stainless Steel 316L
Number of multimode fibers	2
Number of singlemode fibers	3
Number of Constellation fibers	1
Temperature rating	260 °C
Static bend radius	159 mm (6.26")
Dynamic bend radius	635 mm (25.0")
Approximate weight	167 kg/km (112 lb/kft)
External Collapse Pressure	275,790 kpa (40,000 psi)

Table 1: Fiber optic cable specification.

3.2 Bottom Hole Assembly and Protector Specifications

An A825 Silixa high pressure 1” OD bottom hole assembly (BHA) seals the end of the cable and houses optical fiber turnarounds (Figure 3). The BHA was attached to the casing with a custom designed steel protector and clamp. Protector clamp schematics and running OD are presented in Figure 4 and Figure 5. The BHA was installed on a 20 ft pup joint to allow for a centralizer to be installed below the adjacent downhole collar and provide additional protection for the BHA.

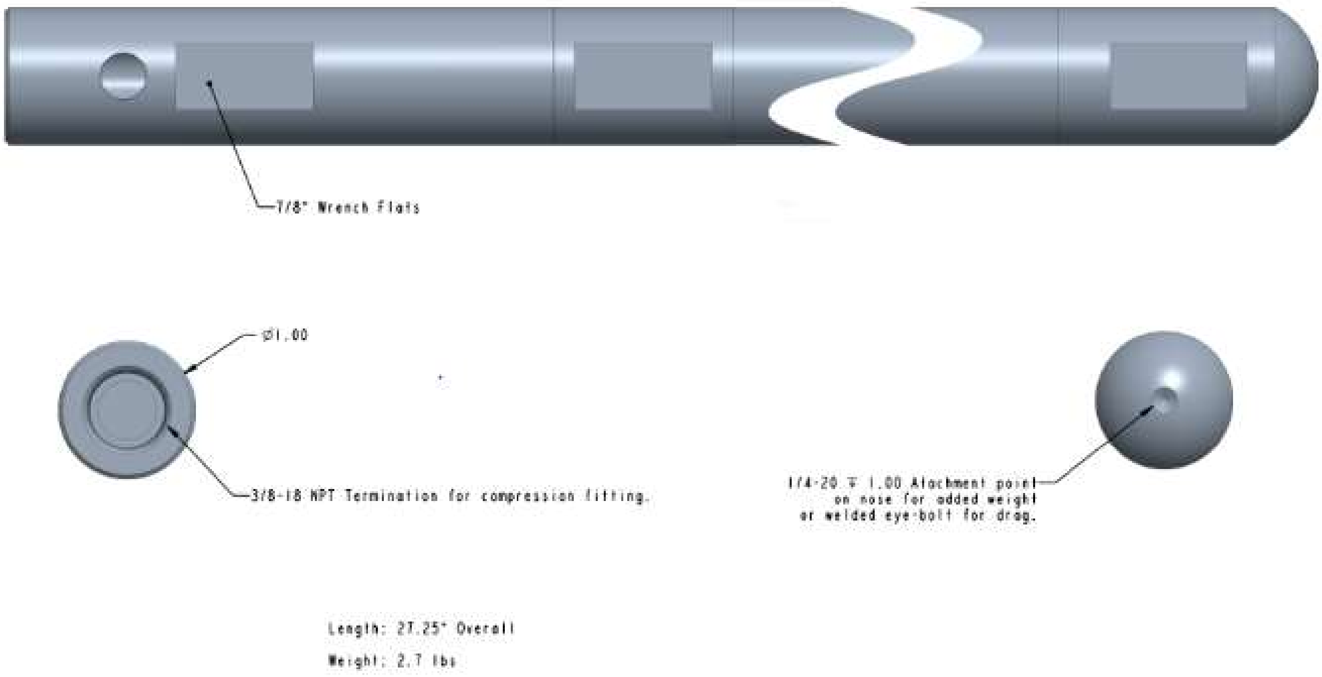


Figure 3: Silixa’s high-pressure bottom hole assembly (BHA).

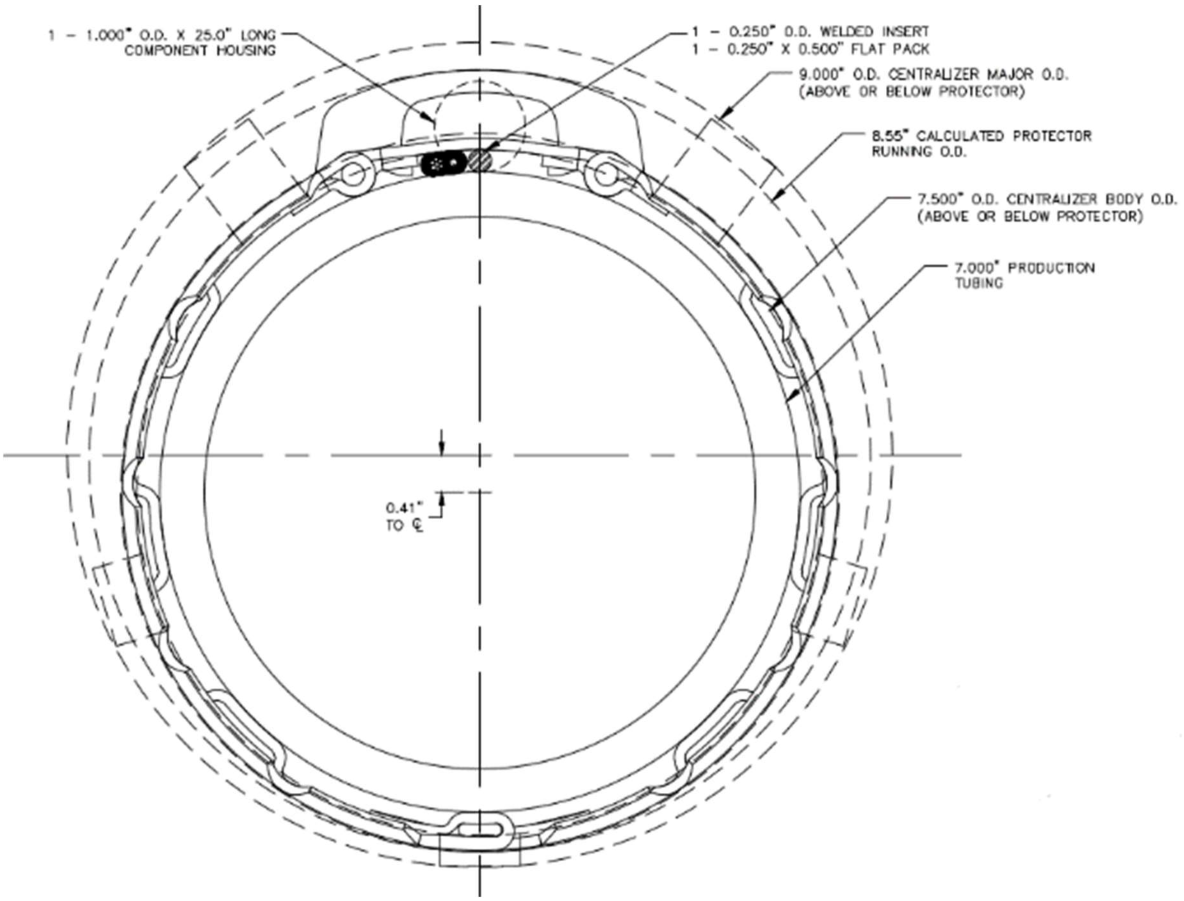


Figure 4: Cross section of example BHA Clamp

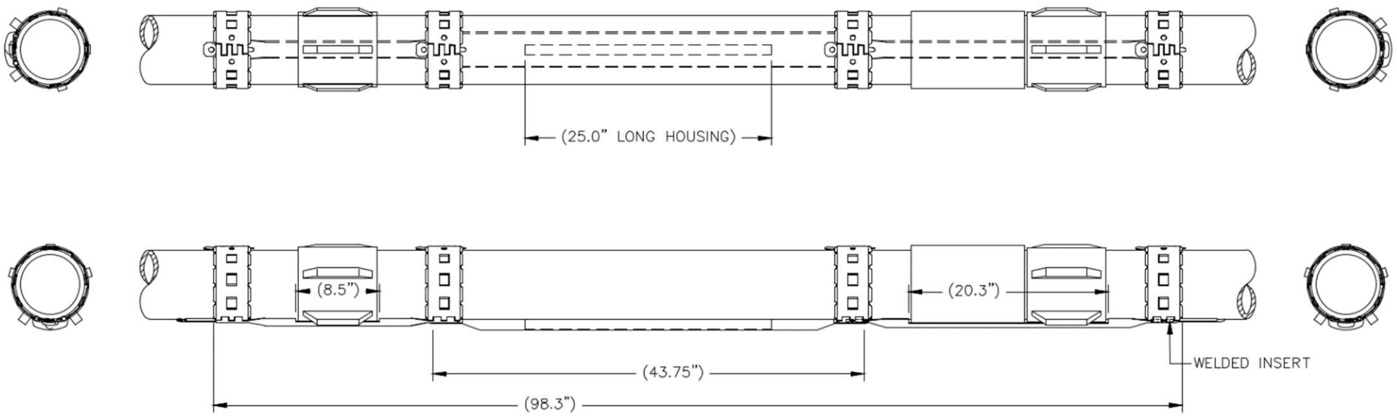


Figure 5: Side view of BHA clamp.

3.3 Cross-coupling Protector with Centralizers

A cross-coupling fiber optic cable clamp protector with solid body centralizers fixed the cable to the casing. This also provided protection against abrasion with the borehole wall during deployment, in contrast to simple band clamp or mid-joint style designs. This notched design (Figure 6 and Figure 7) locks over each collar preventing vertical movement, while set screws prevent rotational migration to reduce the risk of failure during installation. These components were used at every coupling in the open hole section of the well.

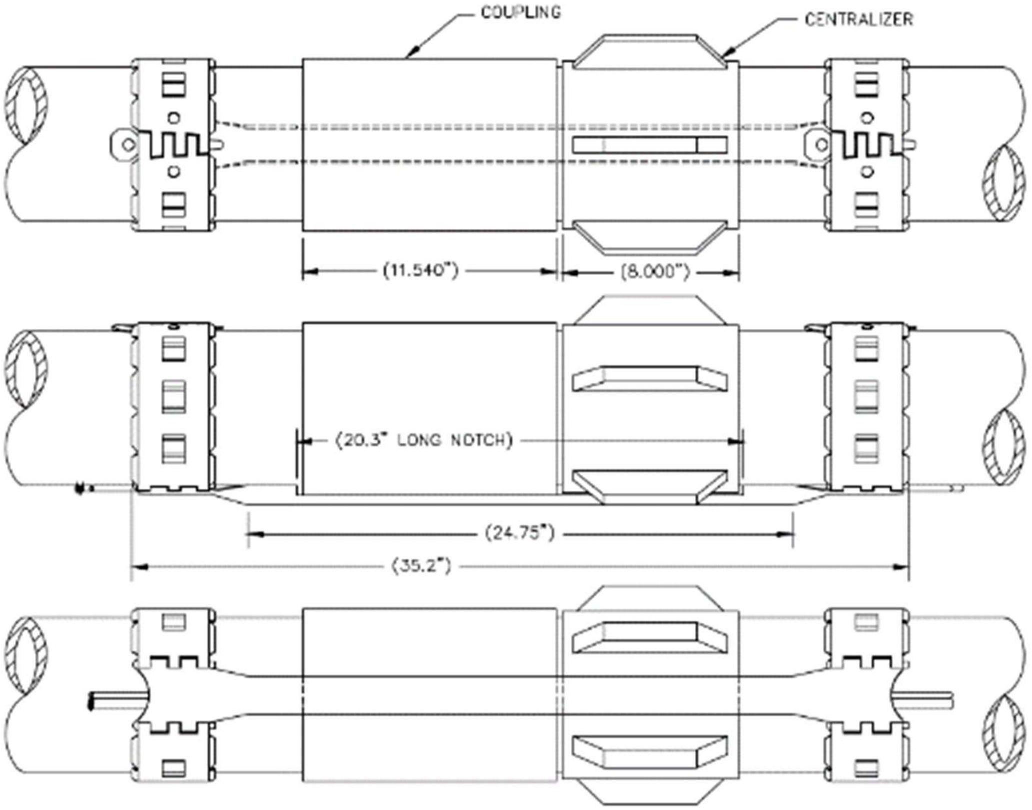


Figure 6: Notched clamp over collar and solid body centralizer.

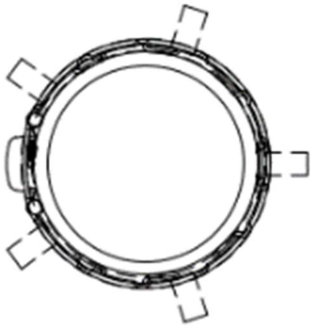


Figure 7: Solid body centralizer.

3.4 Surface Completion

A custom-designed wellhead system was implemented, incorporating high-temperature-resistant components to withstand the extreme conditions associated with geothermal drilling. The 1/4" stainless steel cable was routed through the wellhead, passed through an autoclave assembly and Swagelok fitting to ensure proper pressure sealing. At the surface, the cable was protected and cleanliness was maintained by enclosing it within ~10 feet of 1" Sealtite conduit, providing both rigid and flexible protection with PVC coating.

The surface enclosure process involved initial cable routing outside the cellar to monitor cementing and the circulation test, respectively. Subsequently, the cable was secured around the wellhead and later cut, wrapped, and further secured. Field engineers returned for final cable routing on August 30th. Cables were spliced into an enclosure after necessary wellhead maintenance procedures, including a lift to redo the wellhead seals and pass the pressure test again. During disassembly, a damaged section of the 1/4" cable required an inline splice with a Silixa minisaddle splice assembly. This splice allowed for the connection of the fiber optic cable to the strut rack, supporting the junction box that housed the shutoff valve assembly. The cable was then spliced onto a surface tactical cable. This cable ran into the acquisition trailer where interrogator units were housed, which were responsible for measuring temperature, acoustic, and strain data.

3.4.1 Wellhead

The wellhead schematic is presented in Figure 8 below.

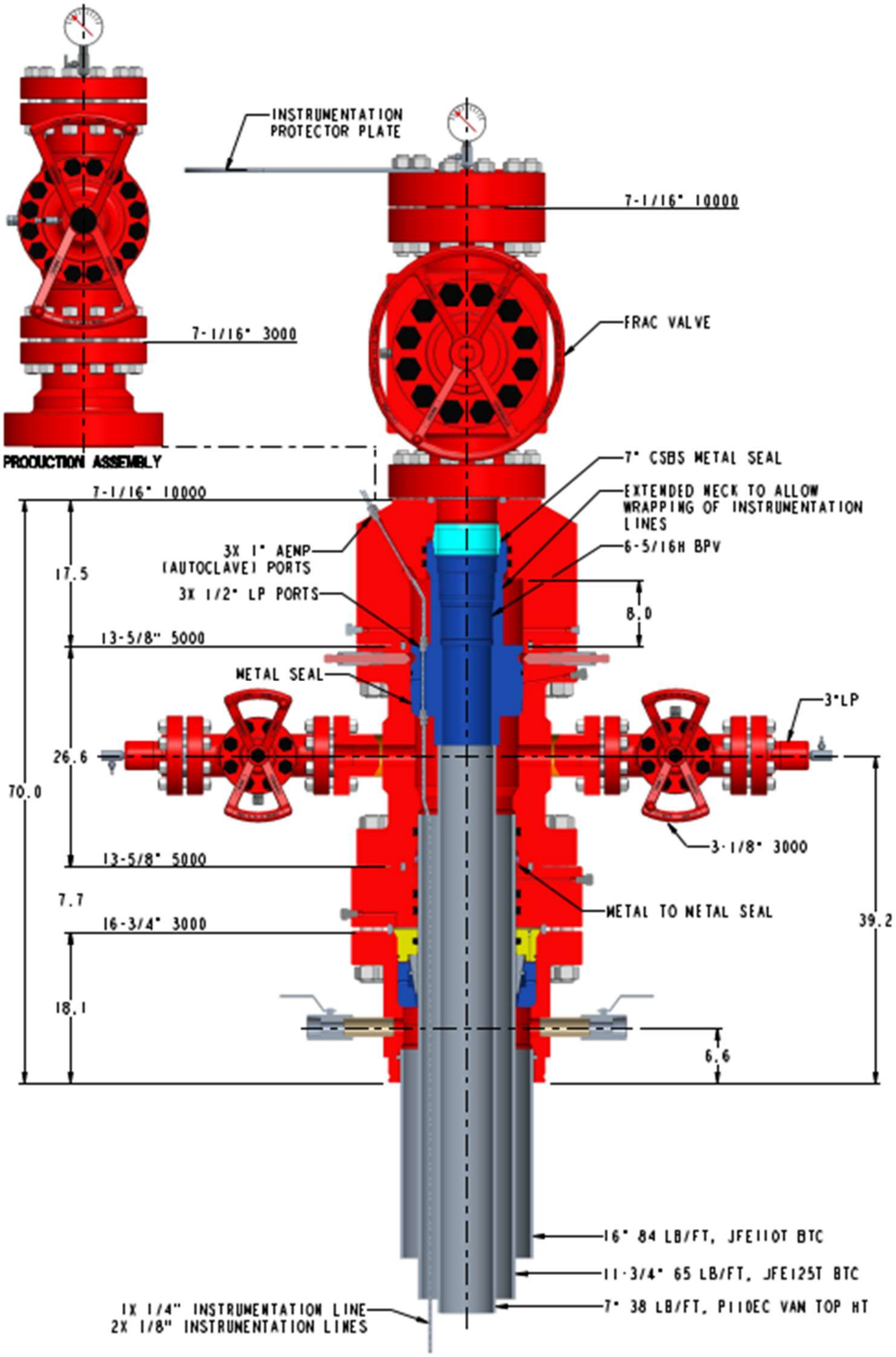


Figure 8. Streamflo Wellhead Schematic.

4 Mobilization and Preparation

4.1 Pre-mobilization Component and Equipment QA/QC

Prior to mobilization of the equipment, rigorous QA/QC checks were carried out to ensure the quantity and integrity of all components including conformance to optical and physical specifications, form/fit, and compliance with the completion plan. Installation equipment parts were tested to verify functionality. A summary is presented in Appendix A: Pre-Mobilization Checklist.

4.2 Pre-mobilization BHA Termination

OTDR tests were conducted on the cable to ensure the integrity of all fibers. The cable was terminated with an A825 BHA, which was pressure tested for 30 min at 6000 psi. The cable was fitted with temporary E2000/APC connectors to facilitate testing prior to, during, and post installation. OTDR traces are presented in Appendix D: OTDR Traces. A schematic of BHA splicing and resultant fiber configuration is presented in Figure 9.

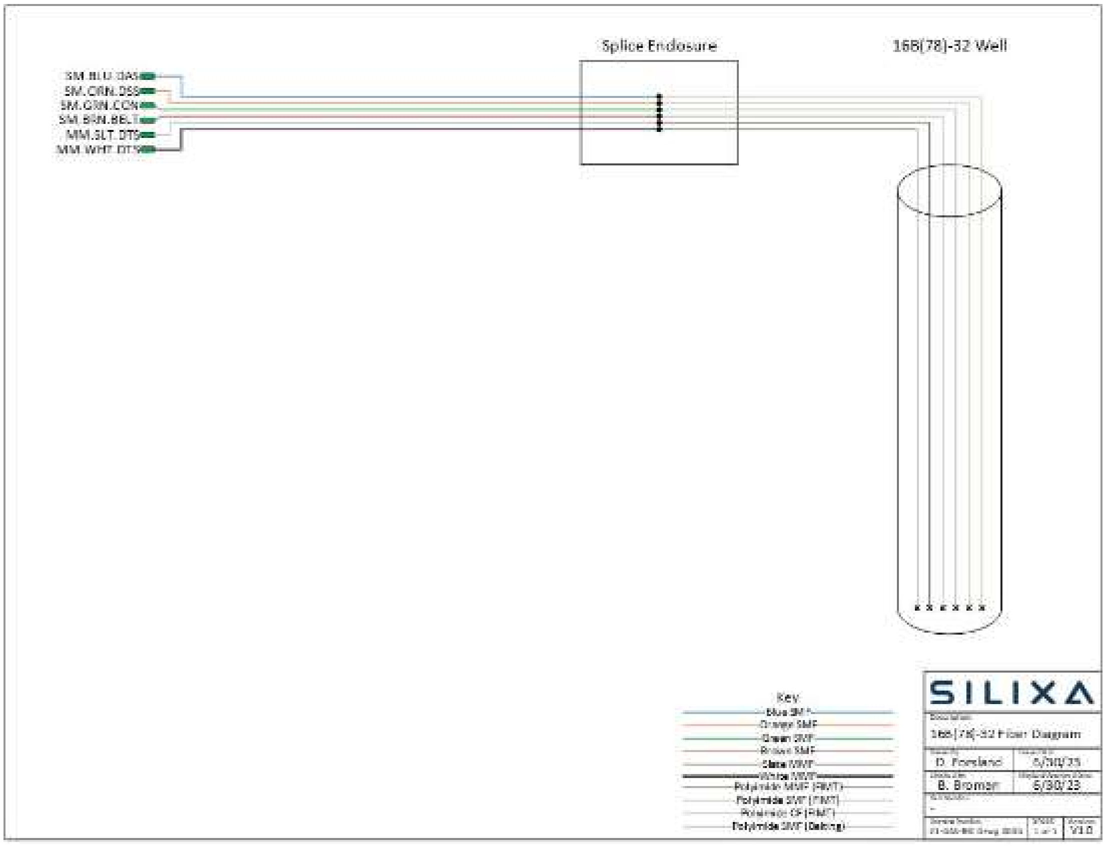


Figure 9: Fiber Splice Diagram for RIH.

4.3 Mobilization

The field team mobilized on July 7th, 2023, from Missoula, Montana to Milford, UT with all required equipment. Immediately upon arriving onsite, the Silixa field engineers tested the cable, DTS unit, and all equipment before RIH operations started.

Figure 10. Silixa site mobilization.

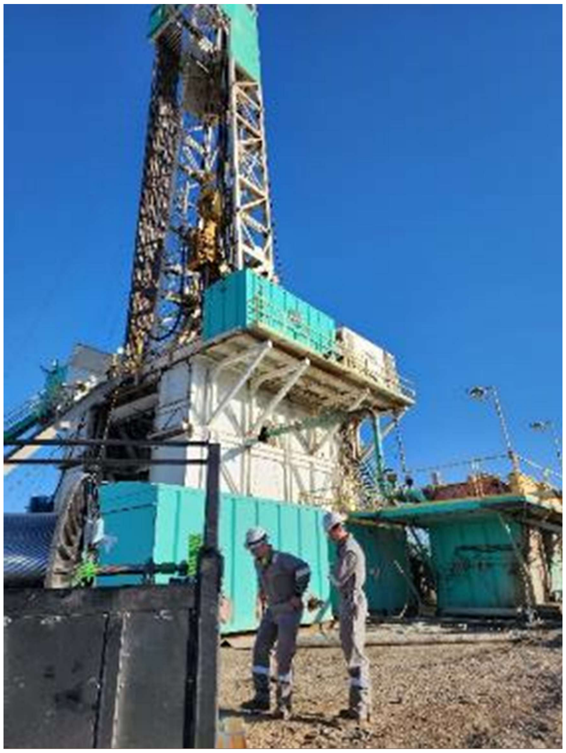


Figure 11. Silixa site mobilization.

5 Installation Execution

5.1 Rig Up

Setting up for the installation required coordination and precision, from both Silixa and Baker Hughes engineers. The crucial step of positioning the sheaves and spreader bar was executed with attention to detail. A forklift was used to maneuver the sheave into place, and once secured each FOC was carefully threaded through it. Throughout this phase, engineers from Silixa and Baker Hughes worked together ensuring control over the movement of the spreader bar as another team member acted as a tag line. From the rig floor a member of the drilling crew operated the crane to lift the spreader bar to the monkey boards' designated location. This collaborative effort guaranteed an efficient deployment of both BHAs and cable.

Rigging up the BHA went smoothly and according to procedure. Despite the site conditions with winds, a busy and challenging environment, the BHAs were secured by Baker Hughes and Silixa on the rig floor as a measure to ensure access and quick deployment once the appropriate casing joint was available on deck.

Figure 12. Sheave and spreader bar.

Figure 13. Spooler with Fiber Optic Cable.

5.2 BHA Installation

The fiber optic BHA was installed using a clamp protector assembly to ensure protection of the BHA during RIH. The location of the BHA was on Pup Joint A with the final fiber turnaround location placed at a measured depth of 9999.89ft.

Figure 14. Installation of fiber optic cable BHA.

5.3 RIH Completion Program

Silixa's BHA and protector clamp were installed per specifications with a Silixa field engineer present to ensure proper delivery. Baker Hughes had one gauge installed approximately 61 casing joints later. The FOC management was excellent and there were no issues or interference with Silixa's equipment.

5.4 RIH Integrity Testing

Cable integrity tests were performed using an optical time domain reflectometer (OTDR) at all critical moments and on a regular interval during run in hole. Integrity tests were also taken before and after cementation. Traces were taken:

1) On site upon arrival

2) After rig-up

3) Every 10 casing joints

4) After reaching TD

OTDR traces taken after RIH was completed are shown in Appendix D: OTDR Traces.

5.5 Wellhead Completion

The fiber optic cable installation was successfully completed. Three fiber wraps were placed around the casing hanger on the rig floor. A temporary junction box was installed for cement monitoring with a surface cable spliced on with E2000/APC connectors. Later on the cable was cut prior to nipple down operations. Two more wraps were made during wellhead termination, so the fiber passed through in the correct direction based on the wellhead orientation. This yielded a total of 5 wraps. This changed later during trenching and junction box install to 2 remaining wraps.

Table 2. Completion of FOC through the wellhead.

5.6 Cementation Monitoring

Monitoring during cementing operations was carried out using a Silixa XT-DTS ruggedized distributed temperature sensor. Cementation was carried out in 1 stage with operations commencing on July 13th at 5am. DTS acquisition ceased at July 14th at 11:28am. Field depth calibration was carried out using the control points in Table 3, Table 4, and Table 5 and determined from interrogator spray test and optical data. 'Cementing configuration' refers to the optical layout prior to pumping cement and after cutting the cable from the spool. 'Circulation configuration' refers to the optical layout after the cable had been passed through the wellhead and re-terminated. 'Final configuration' refers to the optical layout after wellhead repairs and junction box splicing were completed.

Control Point	Fiber Color in Trailer/Downhole Fiber Type	Fiber Distance (m/ft KB)	Measured Depth (m/ft)
KB (Cementing configuration)	Green, CF	172.60 / 566.28	0
BHA (Cementing configuration)		3237.00 / 10620.08	3047.97 / 9999.89
KB (Circulation configuration)	White, MMF	179.71 / 589.61	0
BHA (Circulation configuration)		3237.00 / 10620.08	3047.97 / 9999.89
KB (Final configuration)	Slate, MMF	171.91 / 564.00	0
BHA (Final configuration)		3231.00 / 10600.39	3047.97 / 9999.89

Table 3. Depth Calibration for Carina DAS interrogator. KB rig floor height is 31ft.

Control Point	Fiber Color in Trailer/Downhole Fiber Type	Fiber Distance (m/ft KB)	Measured Depth (m/ft)
KB (Cementing configuration)	White, MMF	174.65 / 573.00	0
BHA (Cementing configuration)		3223.75 / 10576.61	3047.97 / 9999.89
KB (Circulation configuration)	Slate, MMF	178.14 / 584.44	0
BHA (Circulation configuration)		3223.30 / 10575.13	3047.97 / 9999.89
KB (Final configuration)	White, MMF	172.25 / 565.11	0
BHA (Final configuration)		3218.00 / 10557.74	3047.97 / 9999.89

Table 4. Depth Calibration for XT-DTS interrogator. KB rig floor height is 31ft.

Control Point	Fiber Color in Trailer/Downhole Fiber Type	Fiber Distance (m/ft KB)	Measured Depth (m/ft)
KB (Cementing configuration)	Blue, SMF	174.38 / 572.11	0
BHA (Cementing configuration)		3242.00 / 10636.48	3047.97 / 9999.89
KB (Circulation configuration)	Blue, SMF	177.93 / 583.76	0
BHA (Circulation configuration)		3241.00 / 10633.20	3047.97 / 9999.89
KB (Final configuration)	Orange, SMF	172.01 / 564.34	0
BHA (Final configuration)		3237.10 / 10620.41	3047.97 / 9999.89

Table 5. Depth Calibration for iDSS interrogator. KB rig floor height is 31ft.

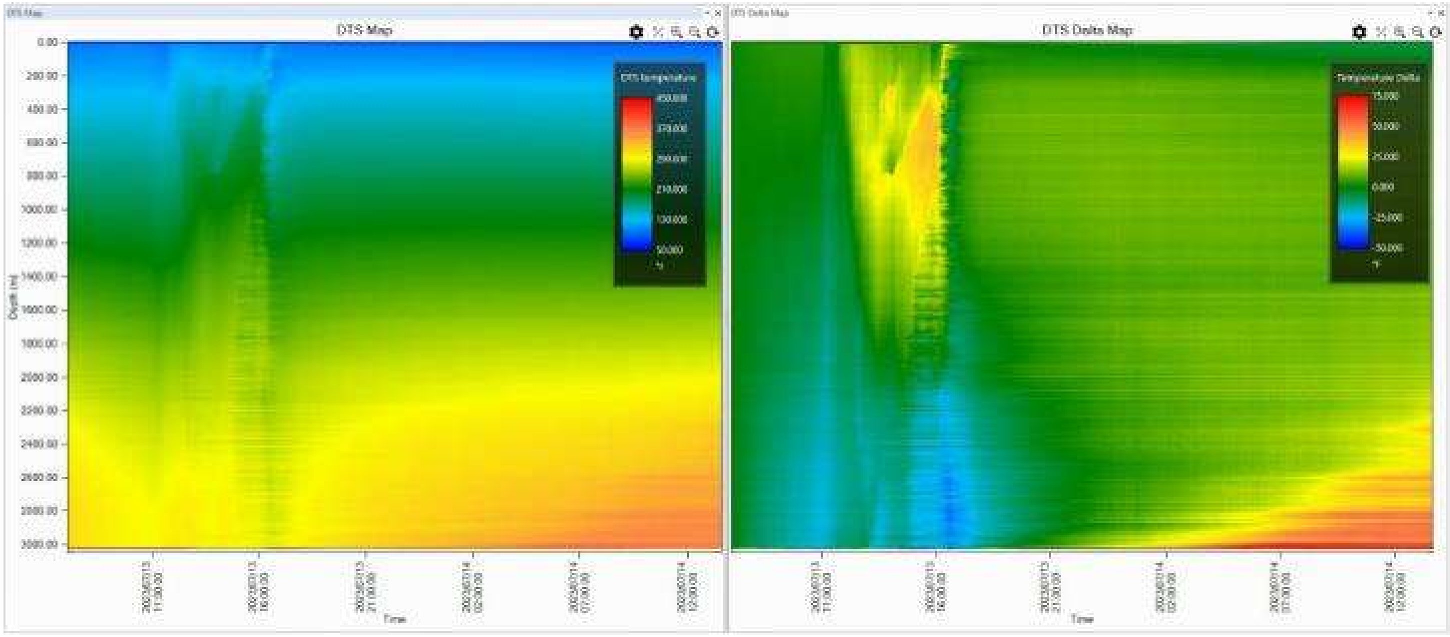


Figure 15. Thermal plot during cementing operations.

5.7 Final Surface Enclosure Installation and FOC Routing/Splicing

A stainless steel surface enclosure was installed on the 16B(78)-32 pad to connect the Silixa ¼" downhole cable to more flexible tactical surface cable. This surface cable routed directly to the Silixa instrumentation in the Rice University acquisition trailer. See Figure 22 for the final physical fiber schematic.

5.7.1 Physical Fiber Layout

The Silixa and Baker Hughes/Shell downhole fiber optic cables were protected from damage during future site operations by burying them in 2" PVC conduit. This scope of work was performed in conjunction with a wellhead repair operation, from August 30th to September 3rd. A Unistrut frame was erected away from the cellar (to mount the surface enclosure), and conduit was run both from the frame towards the well cellar and away to the acquisition trailers (located on the North side of the sump; see Figure 16). Flexible surface fiber optic cables were pulled through the conduit from the trailers to the enclosure Unistrut frame. The downhole cables were routed from the well cellar into conduit that penetrated the cellar wall, where it then ran to the enclosure Unistrut frame. Cables in the cellar were protected with 1" Sealtite conduit.

Figure 16. Conduit trenching from enclosure frame to acquisition trailer.

Figure 17. Conduit routing for fiber optic cable into Silixa acquisition trailer.

Figure 18. Silixa acquisition trailer after trench has been backfilled.

Figure 19. Trenching for permanent trailer electrical supply.

Figure 20. Fiber optic cables after Silixa removed three wraps (during wellhead repair).

Figure 21. Cables exiting Wellhead Outlets after the wellhead adapter was replaced.

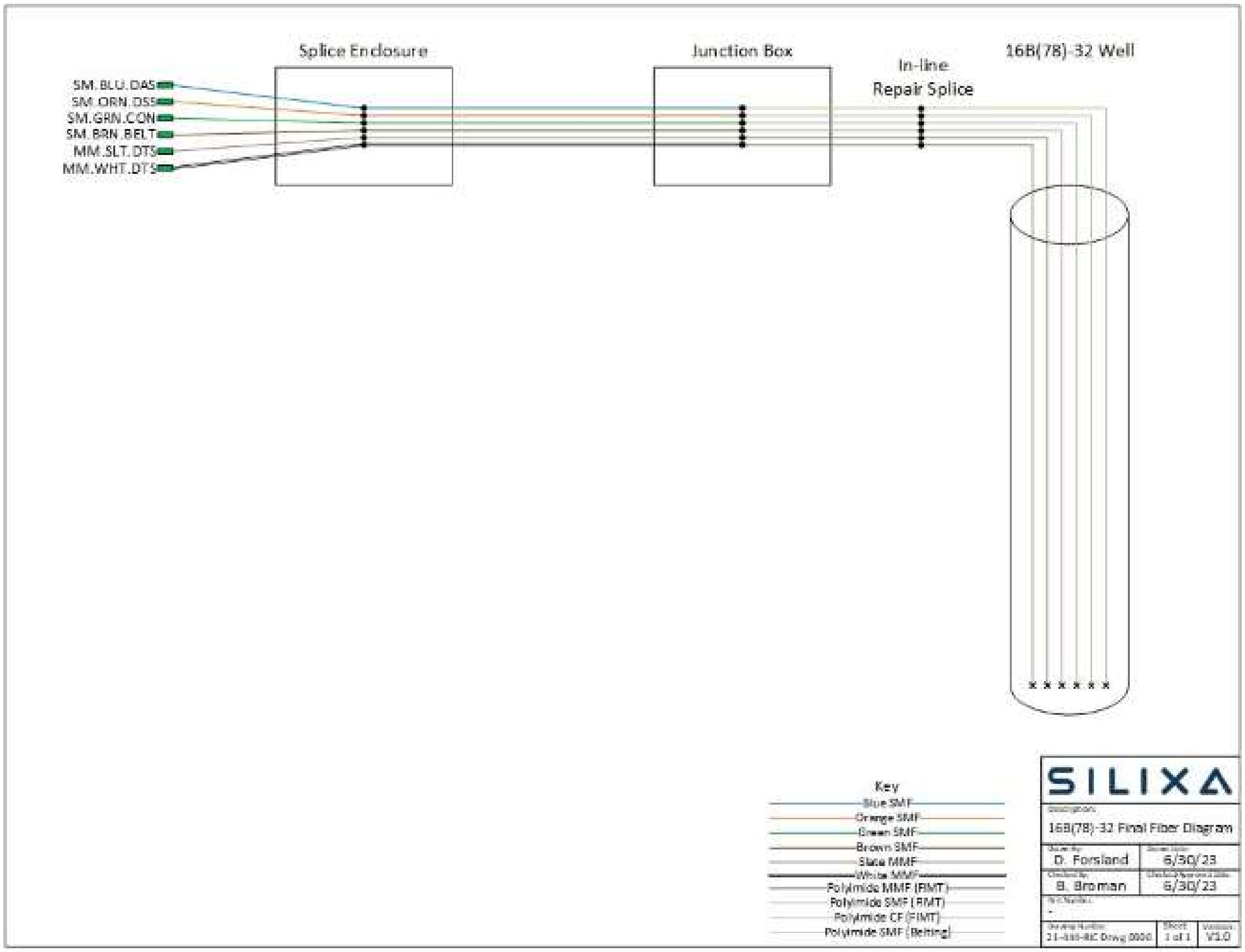


Figure 22. Final fiber splice arrangement.

5.7.1 Silixa FOC Repair Splice

During wellhead repair operations on August 30th, a Swagelok fitting seized on the Silixa downhole cable while removing it. The cable was damaged during efforts to remove the fitting. To proceed with wellhead repair operations, the cable was cut at the fitting and wraps were removed from the wellhead to facilitate an in-line repair splice. The wraps were removed during the wellhead repair process and did not affect the Shell FOCs.

After the wellhead repair was successfully completed and Unistrut frame was erected (see Figure 24), the repair splice was installed on the cable (see Figure 23). All repair fiber splices were acceptable, and the in-line splice box was mounted to a bar extending from the cellar wall. The cellar grate was replaced around the wellhead after repairs were completed.

Figure 23. In-line repair splice located underneath 16B cellar grating.

Figure 24. Final installation with Silixa/Baker Hughes enclosures on the Unistrut frame.

Figure 25. Excess Silixa fiber optic service loops stored on the back of the frame.

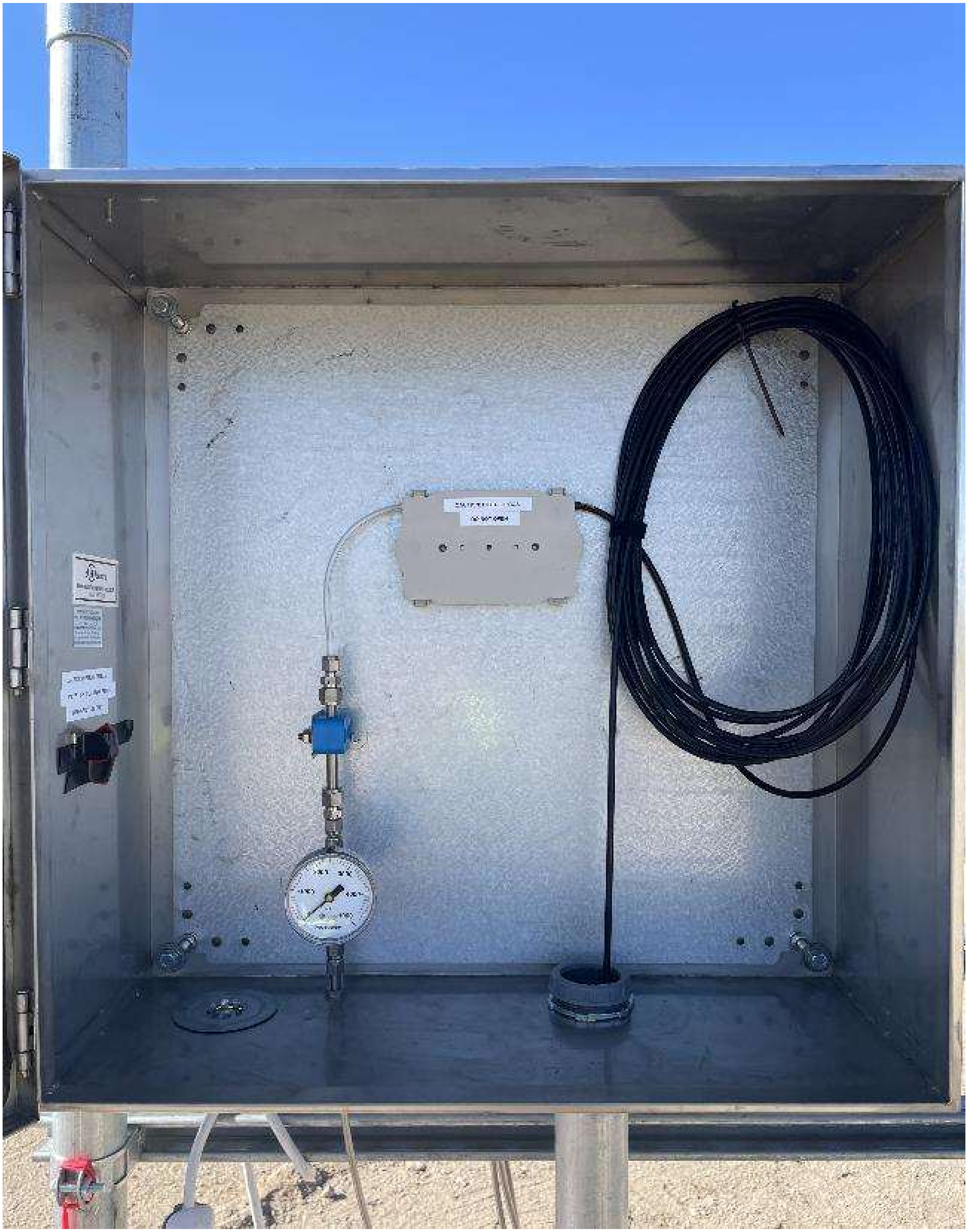


Figure 26. Surface enclosure interior with valve assembly shutoff.

6 Final Remarks

The fiber optic cable installation for the 16B(78)-32 well, although faced with fiber attenuation issues from the manufacturer, was successfully run to the planned depth. Silixa's precaution of having spare FOC on hand, though unnecessary, underscored our commitment to project success.

Careful planning during cable installation facilitated smoother decision-making during the RIH process, particularly concerning the tactical cable route from the RICE trailer to the rig floor. Edge system cabinet installation and surface cable splicing in advance of the FOC installation also facilitated setup of the systems (before cementing operations) when time was short. Although an acquisition issue occurred with the DSS during cement pumping, the other two interrogators captured the cementing process and all three were acquiring during the circulation test. Additionally, Silixa provided an online dashboard for remote parties to view the livestream of the data, which several parties successfully accessed during operations. The edge monitoring system was left operating and intact at the conclusion of system commissioning, with optical fibers plugged into each interrogator for remote operation. The system is operating as expected.

Notably, the project benefitted from strong communication and teamwork among all parties. Alan Reynolds from Baker Hughes and the Silixa team cooperated effectively, resulting in a safe installation without any damage during RIH. This collaborative effort enhanced project efficiency and safety.

Considering future projects with this client, maintaining communication and collaboration among stakeholders remains essential. Vigilance regarding cable quality, length, and attenuation mitigation remains a priority. Our detailed preplanning processes during cabinet installation should serve as a blueprint for future projects, ensuring more efficient field operations.

Figure 27. Edge monitoring system cabinet.

Figure 28. Rice/Silixa acquisition trailer.

Appendix A: Pre-Mobilization Checklist

- ✓ Backup DTS
- ✓ Backup DAS
- ✓ Field Processing Laptop
- ✓ Fusion Splicer Kit
- ✓ AFL FS300 OTDR
- ✓ 2 x Multimode launch cables
- ✓ 2 x Singlemode Launch cables
- ✓ 2 x Multimode patch cables
- ✓ 2 x Singlemode patch cables
- ✓ Hydraulic clamping tools
- ✓ Manual clamping tools
- ✓ Cannon taper pins
- ✓ 150m 2MM/4SM tactical cable
- ✓ Splice boxes
- ✓ Splice trays
- ✓ Silixa Window Maker
- ✓ Backup 825 BHA
- ✓ Backup BHA protector clamps
- ✓ 2 x 825 mini saddle kit
- ✓ Mini saddle protector clamps
- ✓ Assortment of Swagelok parts
- ✓ 4 x wellhead outlet 1” autoclave assembly
- ✓ 4 x 1” NPT to sealtite adapter
- ✓ 60ft of 1” sealtite
- ✓ 2 x Silixa Half Moon bending cap
- ✓ 24” x 24” Junction box for shutoff valve assembly
- ✓ Cable bender
- ✓ Cable straightener
- ✓ Hydraulic pressure tester kit
- ✓ Wrench set
- ✓ Drill set
- ✓ PPE – hard hat, gloves, safety toe boots, glasses, ear plugs

Appendix B: Daily Activity Reports

Saturday 7/8
1130 – Matt and Ben arrived onsite and checked in with Leroy
1145 - unloaded spooler
1230 - unloaded truck and trailer into RICE trailer
1330 - parked trailer at upper pad
1400 - FET tools on rig floor
1430 - Hydessco spool moved to NE corner of pad
1500 - OTDR traces taken and uploaded
1530 - installed TeamViewer remote access on server for cementing operations
1600 - setup external backup drives
1615 - checked in with Leroy and John M
1645 – Both left site. Headed to Milford

Sunday 7/9
1730 - all 3 arrived onsite, checked in
1745 - quick tour for Joey
1800 - moved spooler into location
1830 - touched base with Alan, John M, Baker Hughes
1840 - left site. All 3 Headed to hotel

Monday 7/10
0520 - Matt and Joey arrived onsite
0530 - safety meeting
0550 - Silixa internal safety meeting
0600 - OTDR traces on spool

1100 – Start RIH

1340 – Silixa BHA on
1730 - Ben onsite. Matt and Joey leave

Tuesday 7/11
0530 - Matt and Joey arrived onsite. Ben leaves
1730 - Ben onsite. Matt and Joey leave

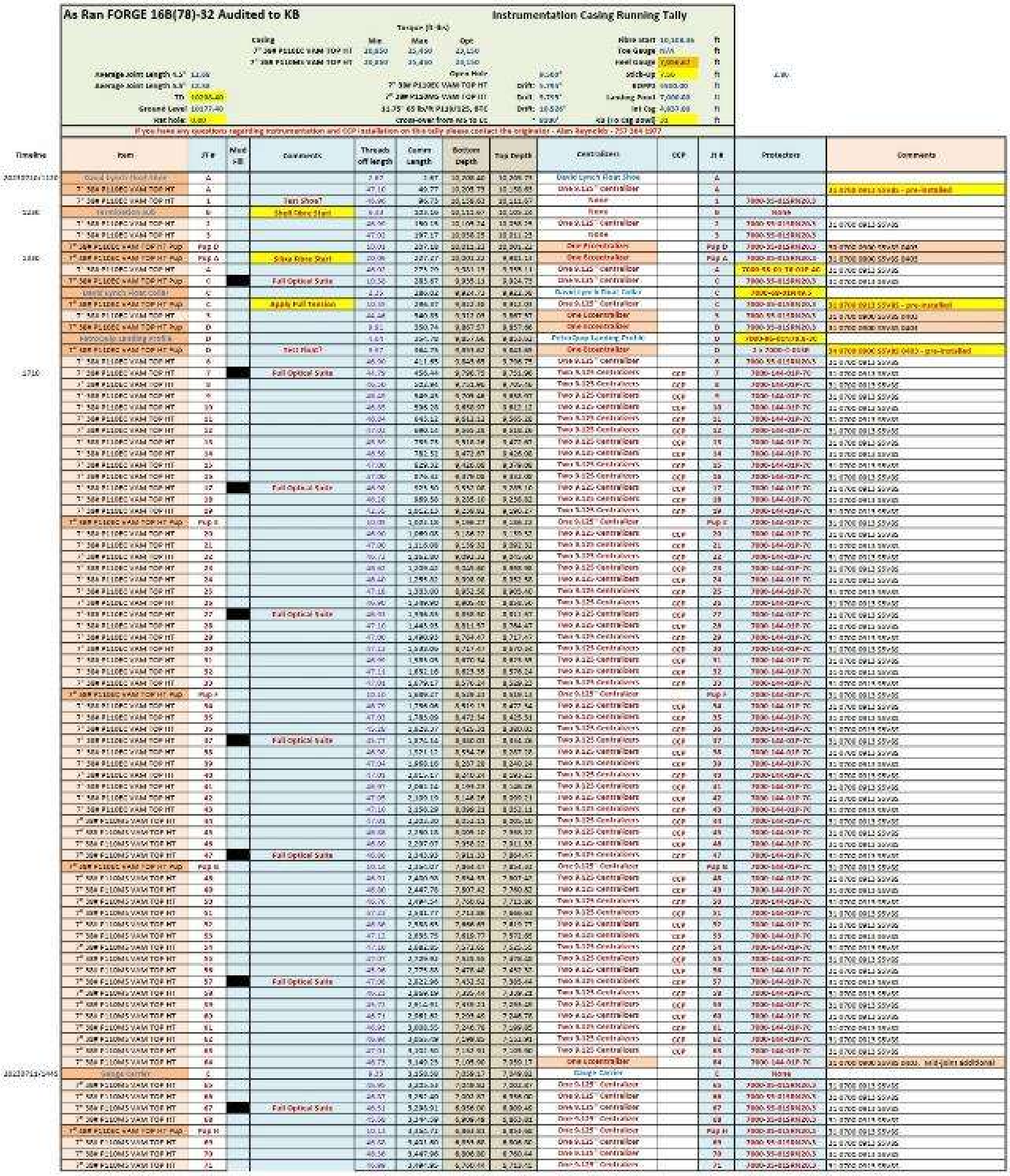
Wednesday 7/12
0530 - Matt and Joey onsite. Ben leaves
1200 - Ben onsite
1300 - rope attached to Silixa fiber
1500 - BH starts setting up cable to pass through hanger
1800 - Silixa starts setting up cable to pass through hanger
1900 - Silixa hanger pressure test
1930 - Silixa wraps
2000 - landing joint
2100 - Silixa starts splicing
2330 - done splicing. Continue config

Thursday 7/13
0000 - Matt leaves site
0030 - spray mapping on DTS and DSS
0102 - started DTS acquisition
0104 - started DSS acquisition
0109 - started DAS acquisition
0118 - started tap test
0200 - setup Aquidash
0330 - setup remote access for DSM and clients
0345 - Ben and Joey left site
1530 - all 3 arrived onsite. Started Mosaic depth correction
1600 - Joey talk with Alan Reynolds and Peter Meier
1800 - spooler loaded on trailer
1845 - dropped off trailer. Left site

Friday 7/14
0700 - all 3 arrived onsite
0715 - small gradient adjustment to Aquidash
0800 - plotting cementation on Mosaic
0830 - checked in with Dana from Neubrex
0900 - looking for top of cement in Mosaic
1000 - dry fit autoclave fitting on wellhead termination
1123 - stopped aquiring on all units
1200 - cut cable
1230 - Ben leaves site
1300 - started nipple down
1500 - completed nipple down
1700 - well head landed. Silixa and BH fibers OK. Still needs torqued down
1800 - Silixa well head auto clave and fittings done
1845 - Ben arrives onsite
1930 - temp splicing starts
2215 - done splicing. Take traces
2300 - all 3 left site to hotel

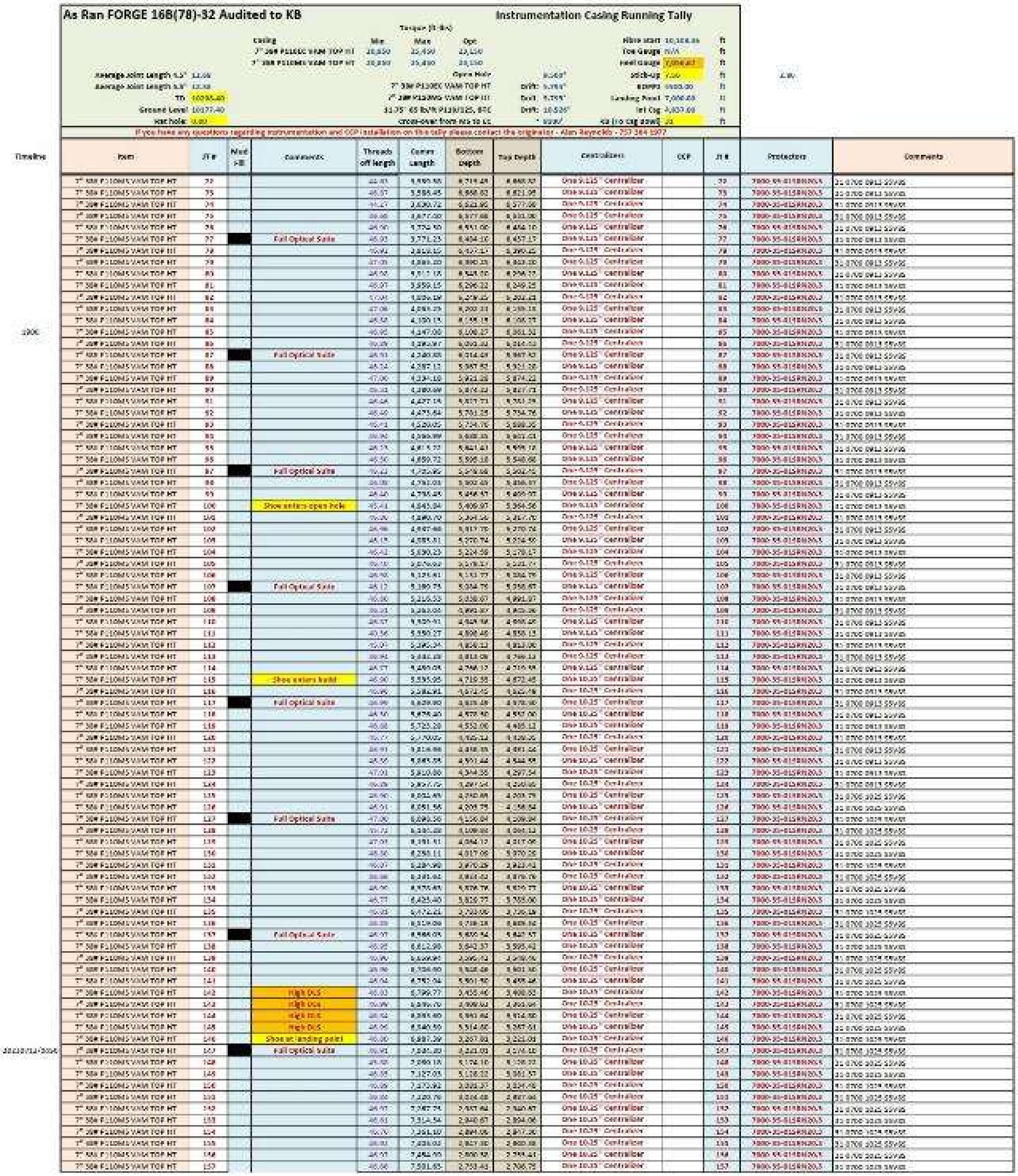
Saturday 7/15
0930 - hardware store
1000 - all 3 onsite. Starting on setup
1100 - noise check and assigned fibers
1200 - configuration of DTS, DAS, and DSS
1300 - spray and tap test
1400 - depth correction math
1430 - Aquidash config
1600 - hooked up trailer and loaded
1745 - all 3 left site. To hotel

Appendix C: Casing Tally



As Ran FORGE 16B(78)-32 Audited to KB

Instrumentation Casing Running Tally



As Ran FORGE 16B(78)-32 Audited to KB

Instrumentation Casing Running Tally

Timeline	Item	JT #	Mud Fill	Comments	Threads off length	Comm Length	Bottom Depth	Top Depth	Centralizers	CCP	JT #	Protectors	Comments

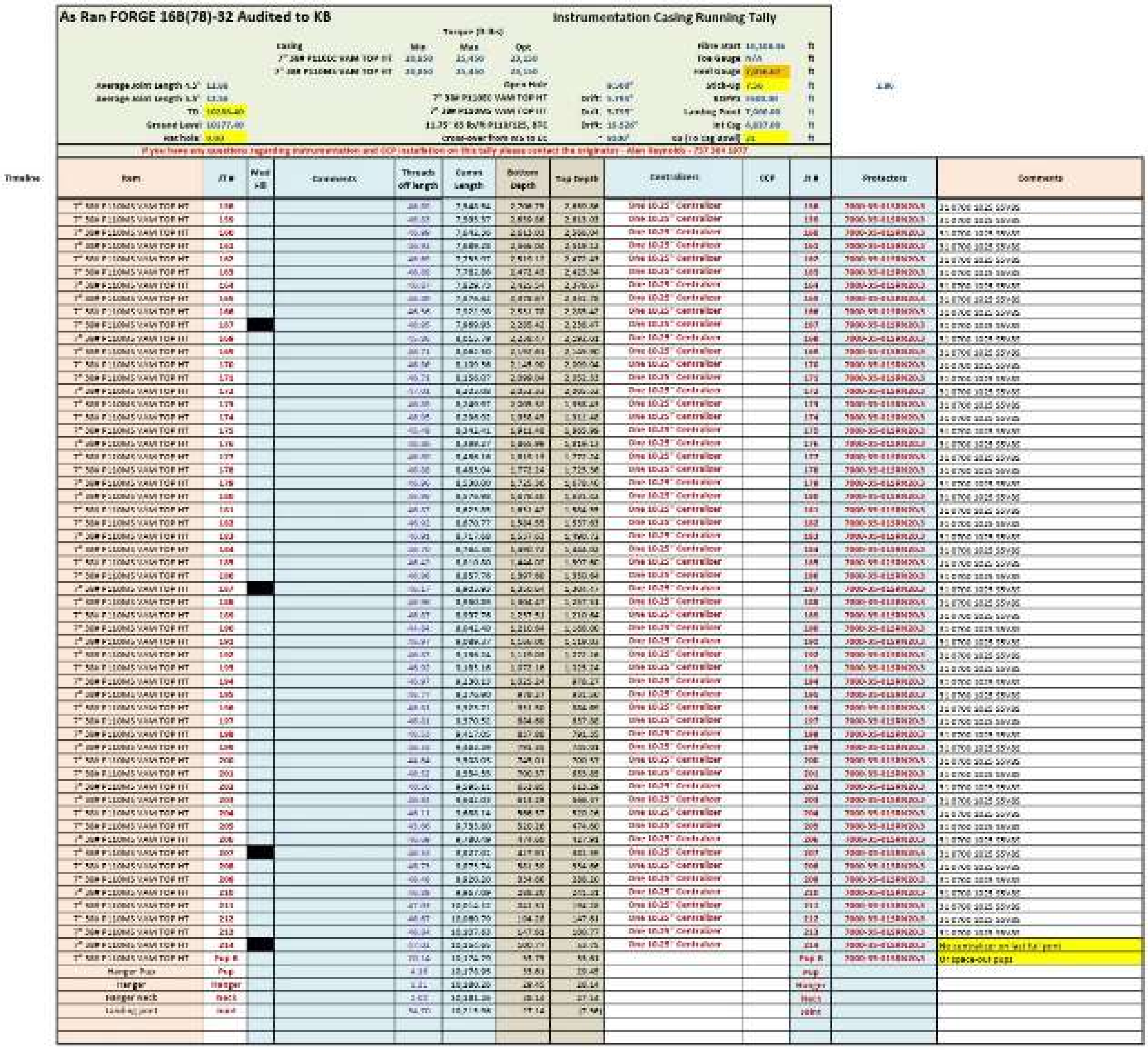
Full Optical Suite

Shoe enters open hole

Shoe enters build

High DLS

Shoe at landing point



As Ran FORGE 16B(78)-32 Audited to KB

Instrumentation Casing Running Tally

Timeline	Item	JT #	Wait KB	Comments	Threads off length	Cumm Length	Bottom Depth	Top Depth	Centralizers	CCP	JT #	Protectors	Comments

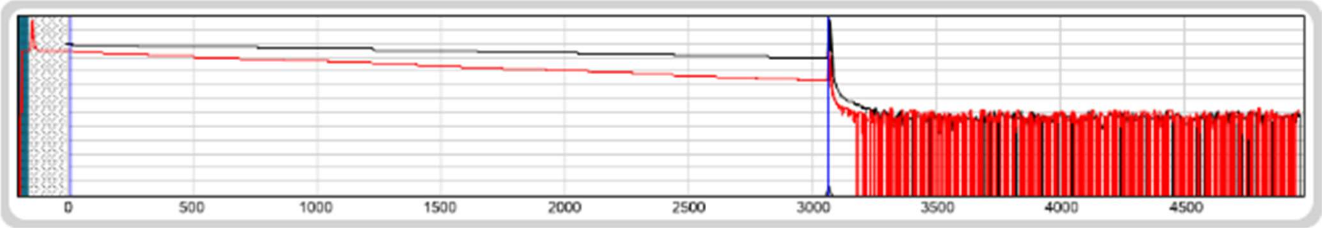
Appendix D: OTDR Traces

6.1 Pre-Travel Check

6.1.1 Multimode Fiber 1

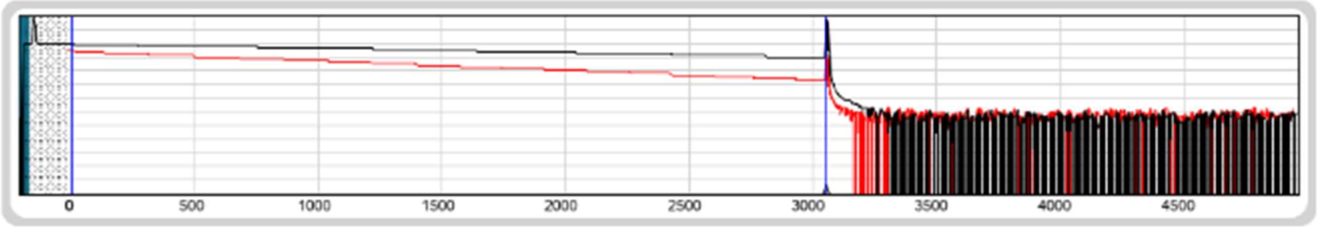
OTDR Results Wavelength : 850 nm

END100-END200-MM1_004_M85



OTDR Results Wavelength : 1300 nm

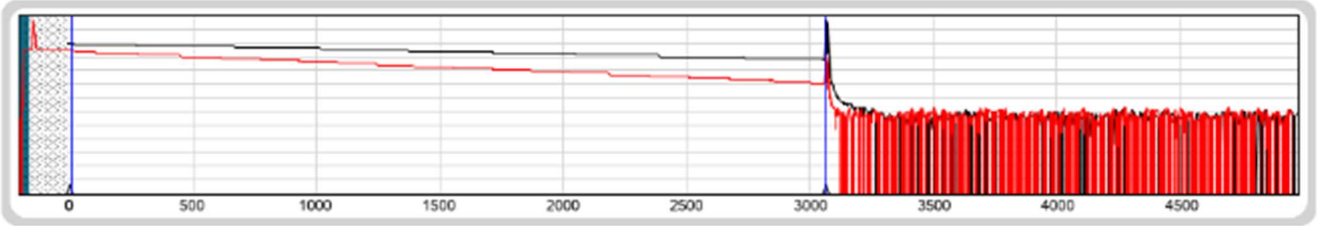
END100-END200-MM1_004_M13



6.1.2 Multimode Fiber 2

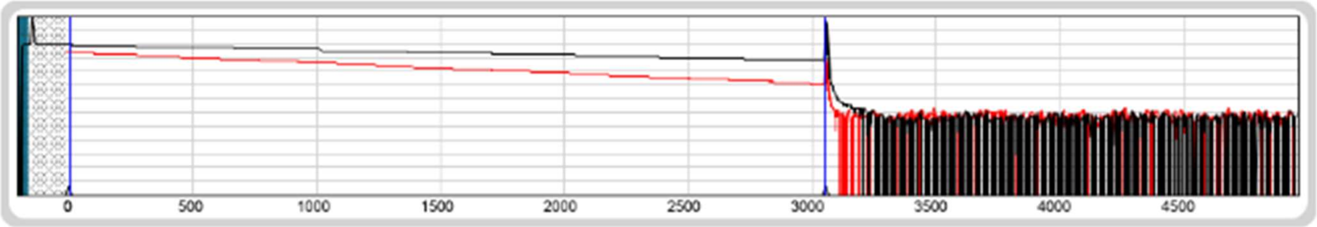
OTDR Results Wavelength : 850 nm

END100-END200-MM2_005_M85

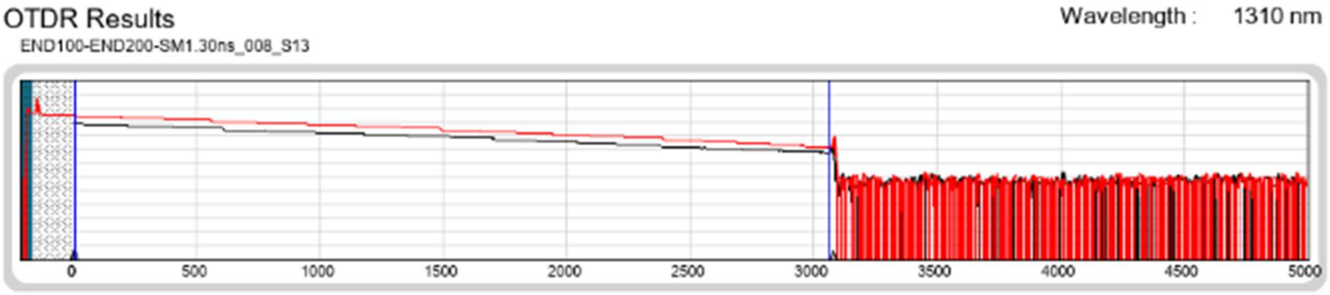


OTDR Results Wavelength : 1300 nm

END100-END200-MM2_005_M13



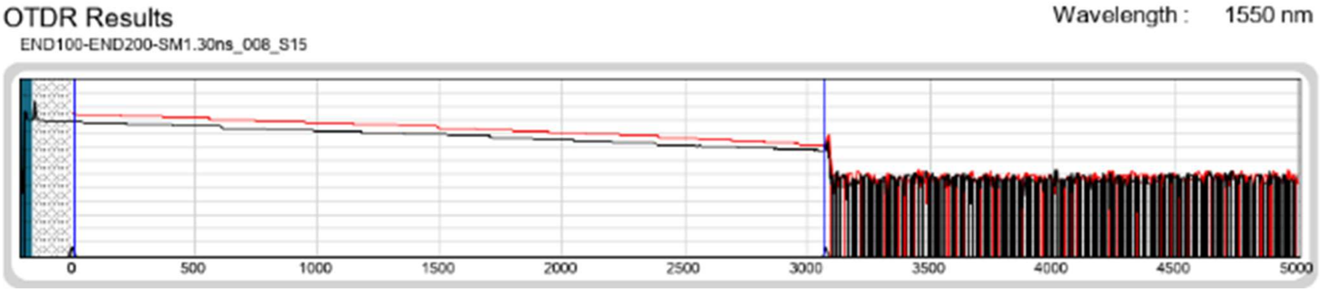
6.1.3 Singlemode Fiber 1



OTDR Results

END100-END200-SM1.30ns_008_S13

Wavelength : 1310 nm

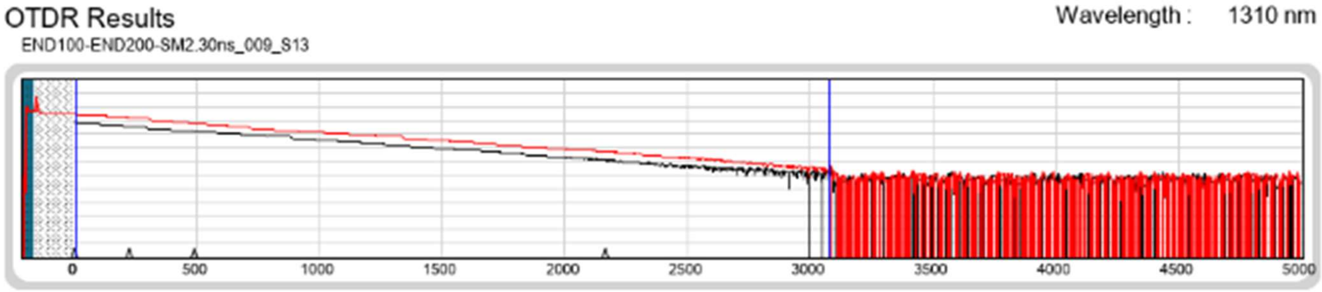


OTDR Results

END100-END200-SM1.30ns_008_S15

Wavelength : 1550 nm

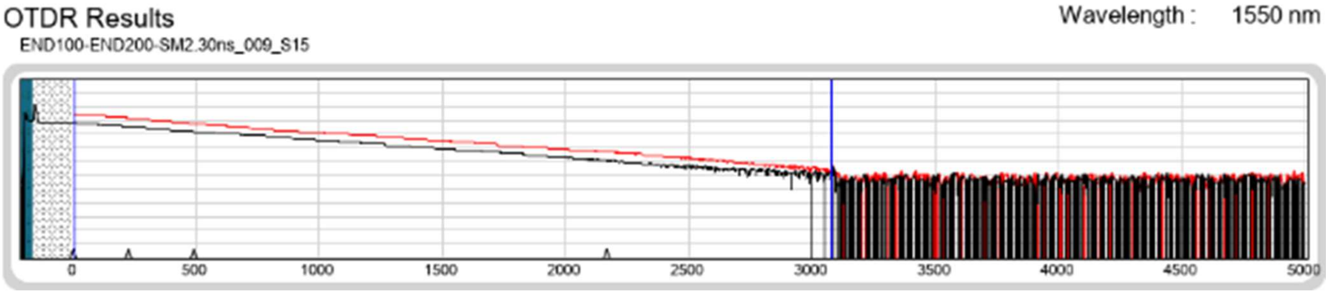
6.1.4 Singlemode Fiber 2



OTDR Results

END100-END200-SM2.30ns_009_S13

Wavelength : 1310 nm

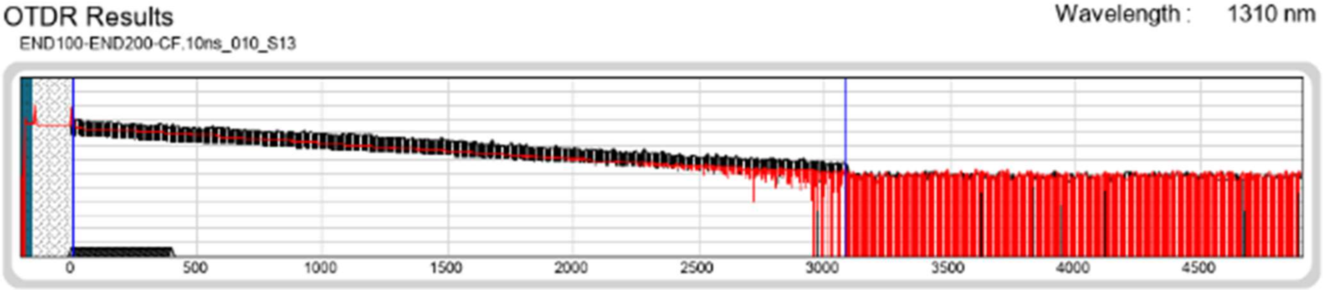


OTDR Results

END100-END200-SM2.30ns_009_S15

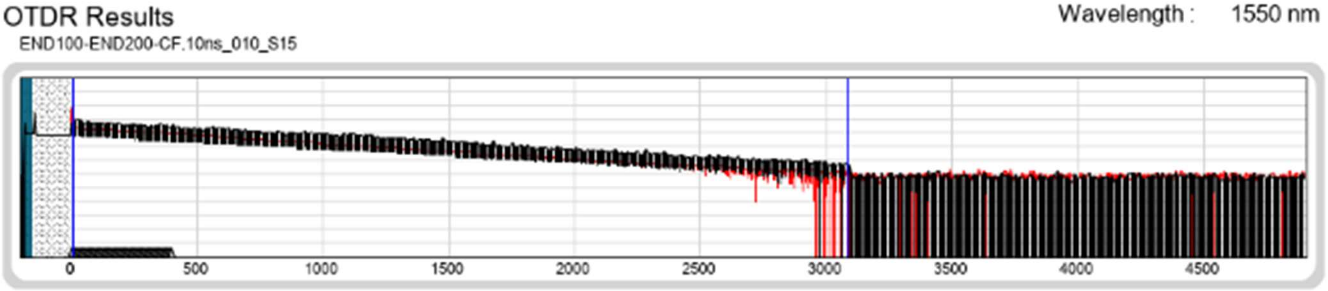
Wavelength : 1550 nm

6.1.5 Constellation Fiber


OTDR Results

END100-END200-CF.10ns_010_S13

Wavelength : 1310 nm

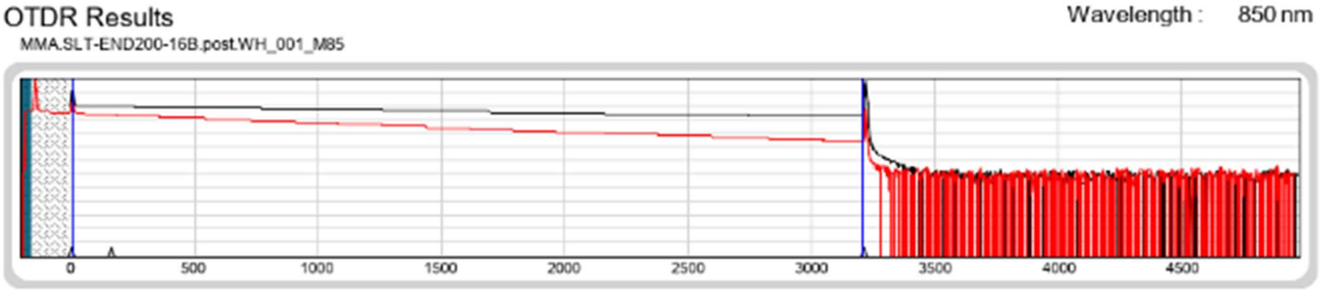

OTDR Results

END100-END200-CF.10ns_010_S15

Wavelength : 1550 nm

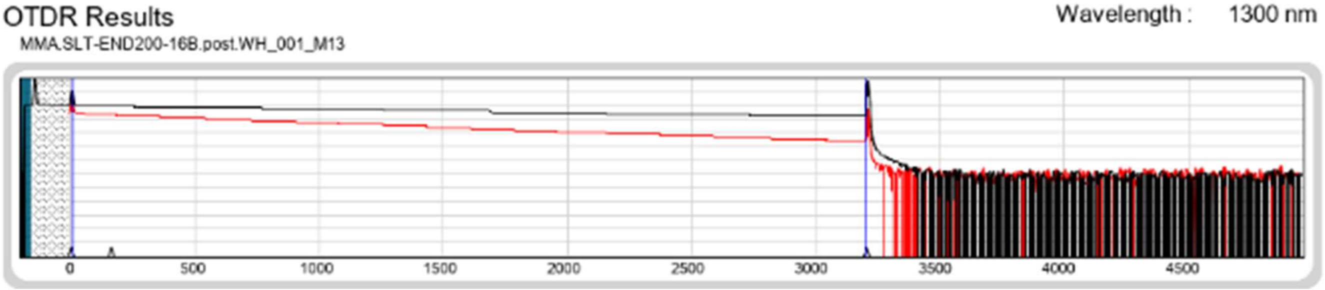
6.2 Post Wellhead Check

6.2.1 Multimode Fiber A


OTDR Results

MMA.SLT-END200-16B.post.WH_001_M85

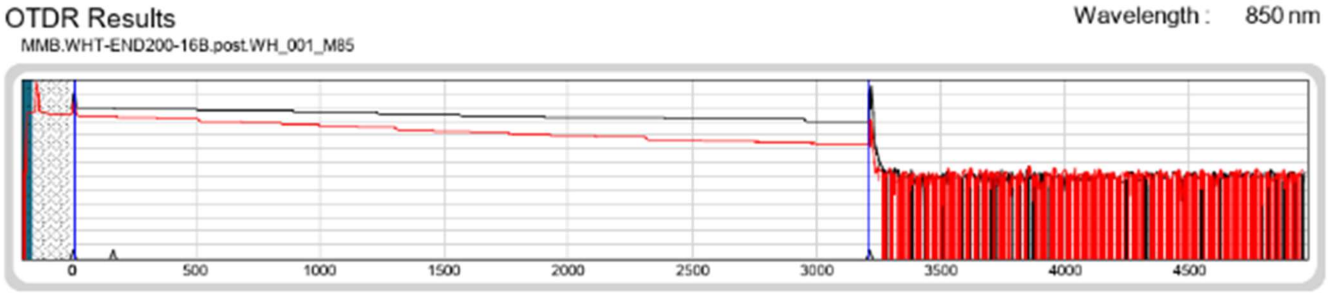
Wavelength : 850 nm


OTDR Results

MMA.SLT-END200-16B.post.WH_001_M13

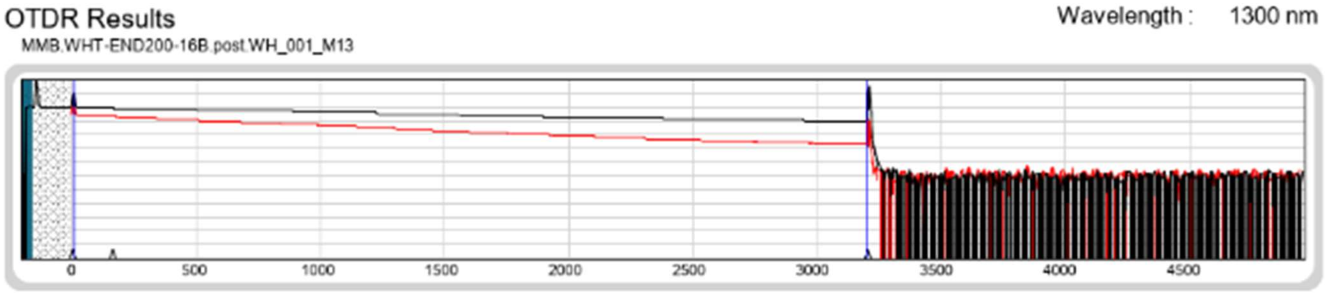
Wavelength : 1300 nm

6.2.2 Multimode Fiber B


OTDR Results

MMB.WHT-END200-16B.post.WH_001_M85

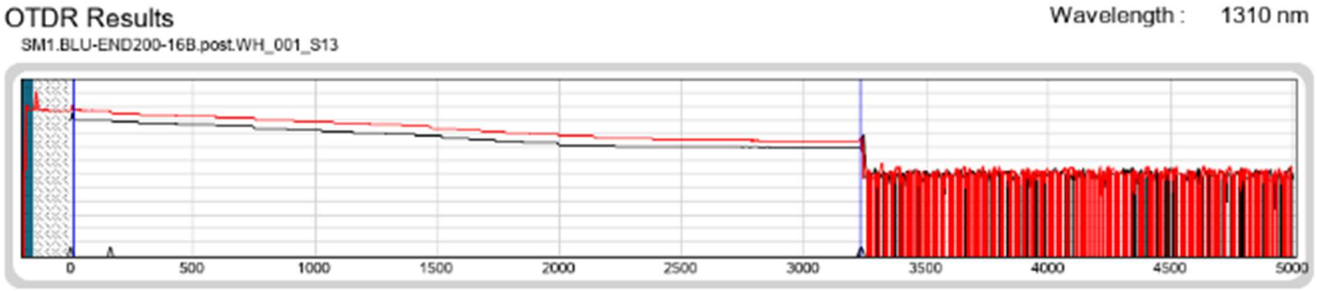
Wavelength : 850 nm


OTDR Results

MMB.WHT-END200-16B.post.WH_001_M13

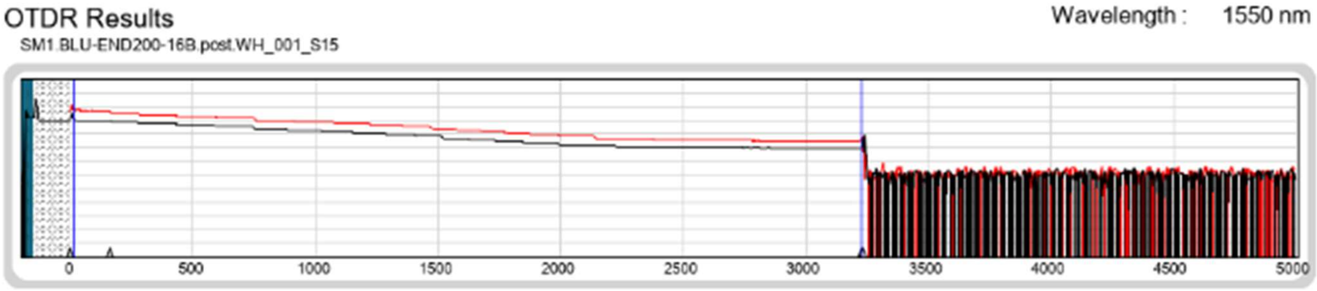
Wavelength : 1300 nm

6.2.3 Singlemode Fiber 1


OTDR Results

SM1.BLU-END200-16B.post.WH_001_S13

Wavelength : 1310 nm


OTDR Results

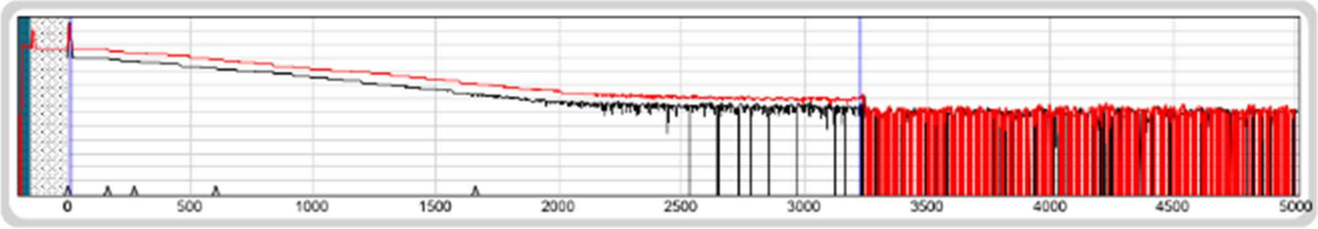
SM1.BLU-END200-16B.post.WH_001_S15

Wavelength : 1550 nm

6.2.4 Singlemode Fiber 2

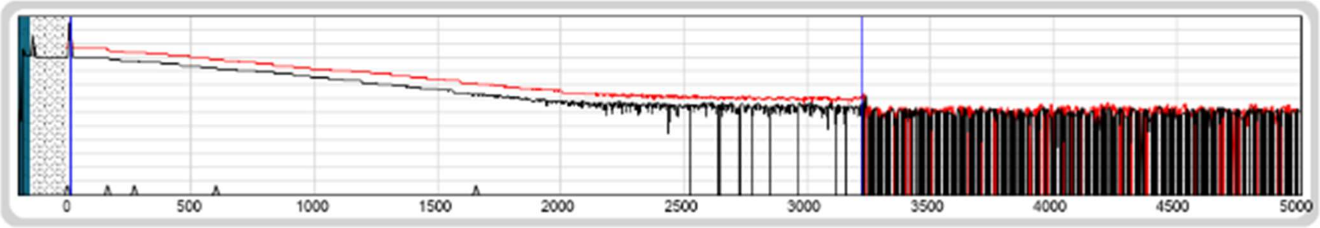
OTDR Results Wavelength : 1310 nm

SM2.ORG-END200-16B.post.WH_001_S13



OTDR Results Wavelength : 1550 nm

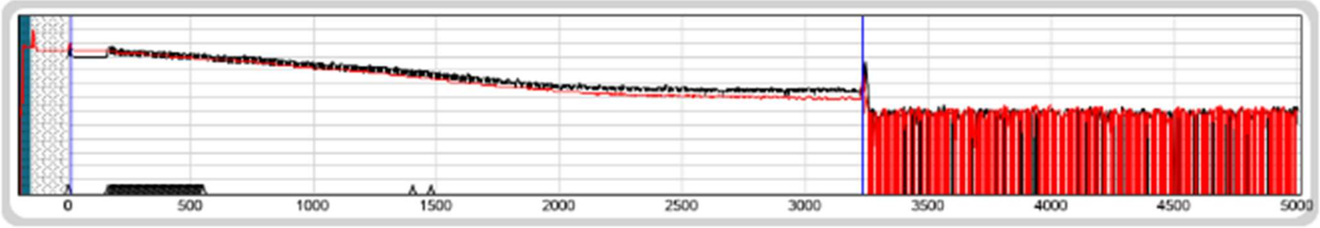
SM2.ORG-END200-16B.post.WH_001_S15



6.2.5 Constellation Fiber

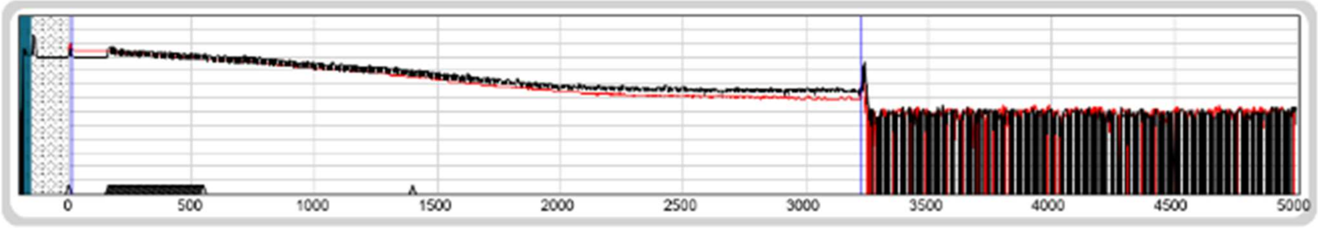
OTDR Results Wavelength : 1310 nm

CF.GRN-END200-16B.post.WH_001_S13



OTDR Results Wavelength : 1550 nm

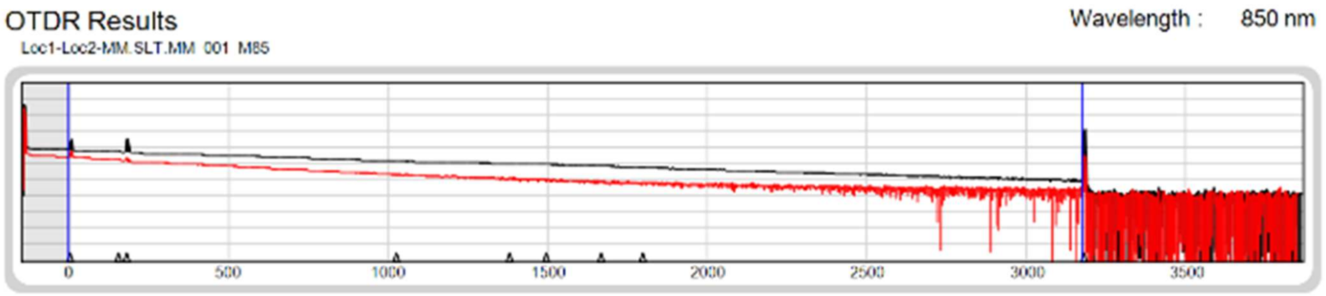
CF.GRN-END200-16B.post.WH_001_S15

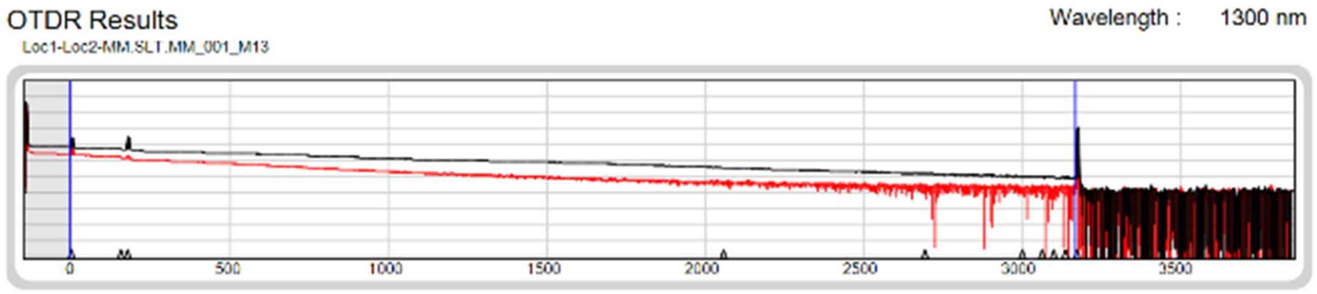


6.3 Final fiber array Commissioning Check

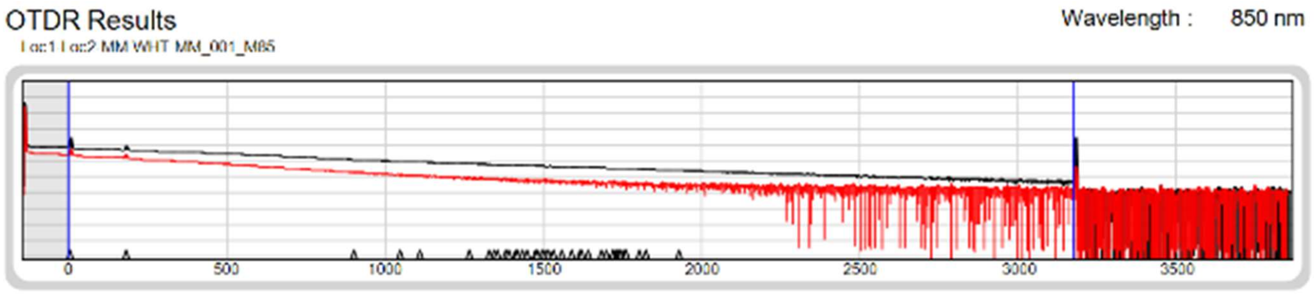
***Note:** The DSS strain fiber inside the belting was not included in trace results, as it was rendered unusable/”dark” due to fiber failure from the manufacturer.

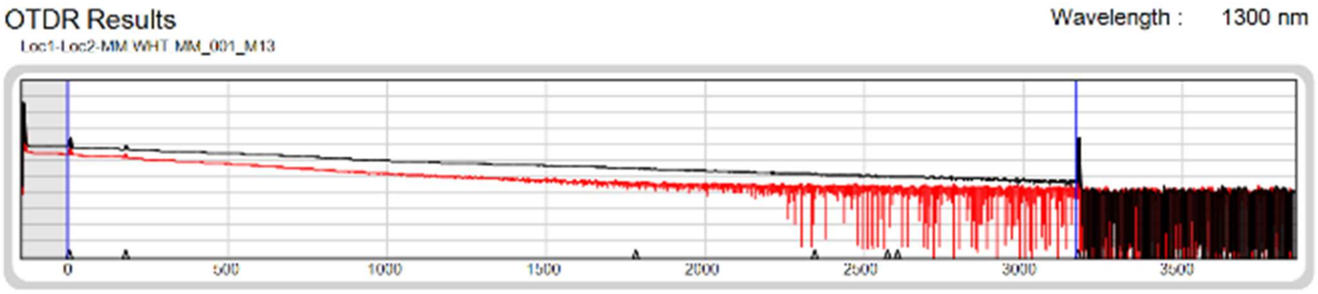
6.3.1 Multimode Fiber Slate



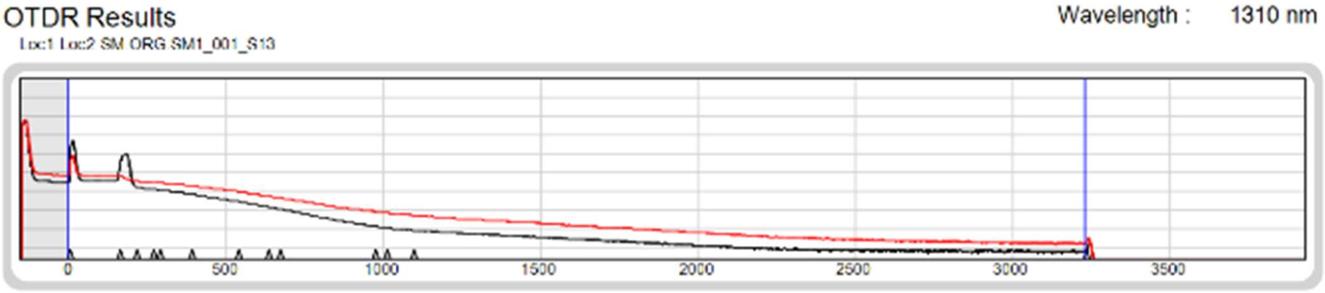


6.3.2 Multimode Fiber White



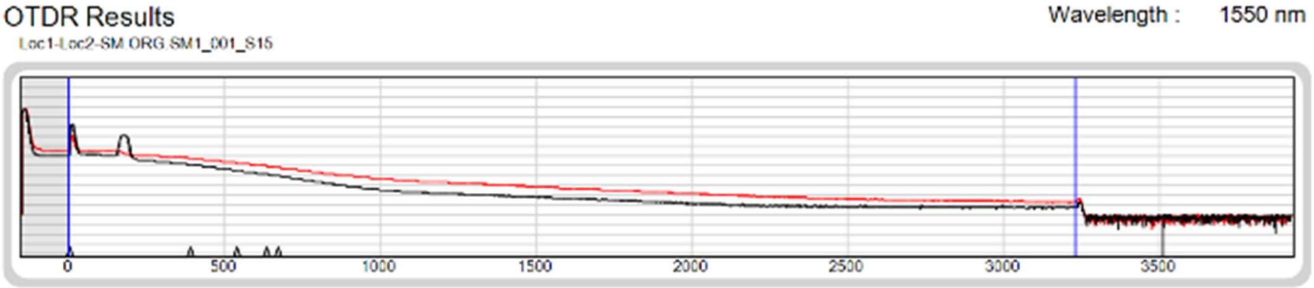


6.3.3 Singlemode Fiber 1- Orange


OTDR Results

Loc1-Loc2-SM.ORG.SM1_001_S13

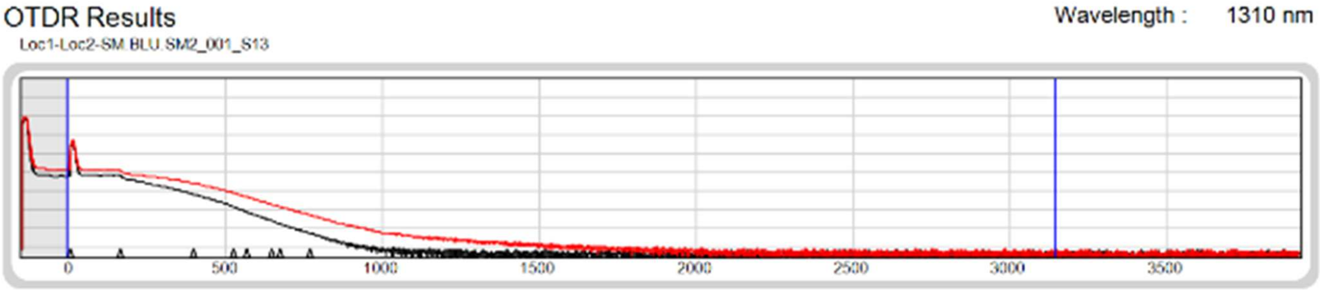
Wavelength : 1310 nm


OTDR Results

Loc1-Loc2-SM.ORG.SM1_001_S15

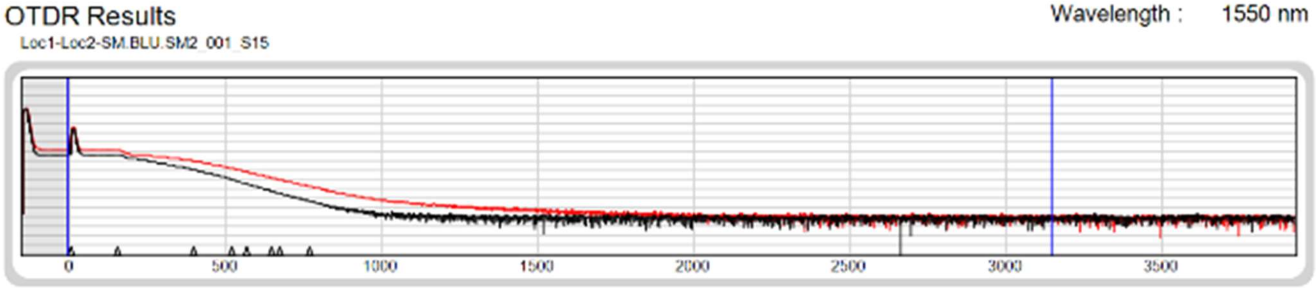
Wavelength : 1550 nm

6.3.4 Singlemode Fiber 2- Blue


OTDR Results

Loc1-Loc2-SM.BLU.SM2_001_S13

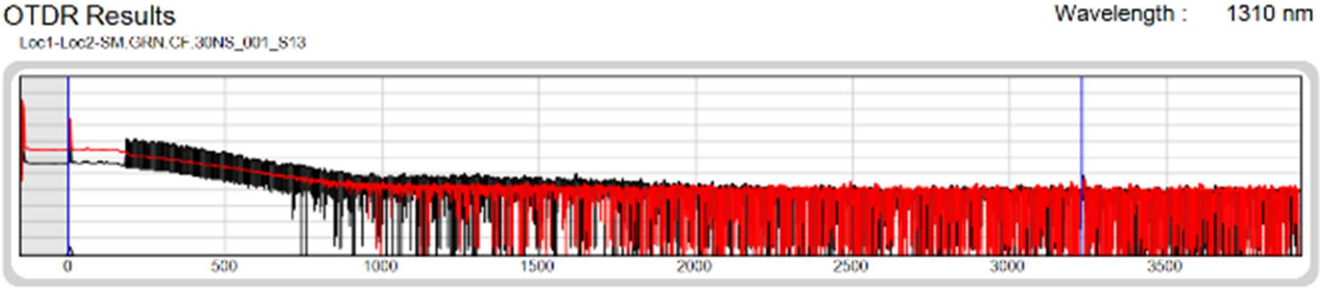
Wavelength : 1310 nm


OTDR Results

Loc1-Loc2-SM.BLU.SM2_001_S15

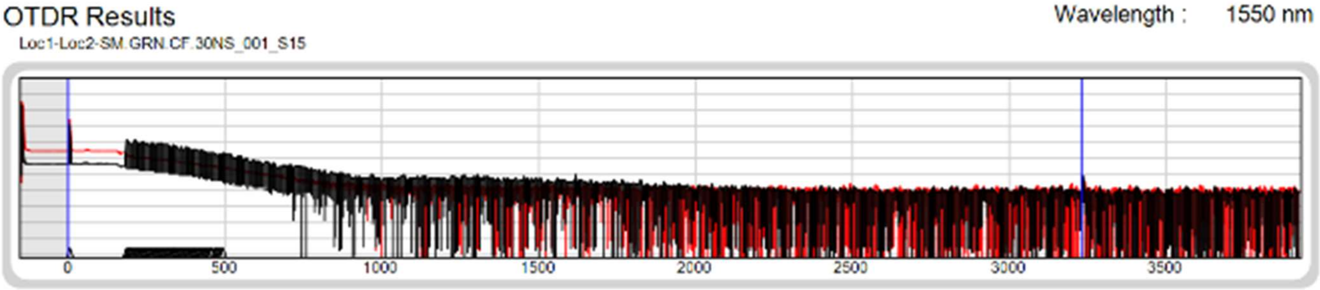
Wavelength : 1550 nm

6.3.5 Constellation Fiber


OTDR Results

Loc1-Loc2-SM.GRN.CF.30NS_001_S13

Wavelength : 1310 nm


OTDR Results

Loc1-Loc2-SM.GRN.CF.30NS_001_S15

Wavelength : 1550 nm