Alcatel·Lucent

MARS

Load/Lay
Test Report

Global Sentinel
March 2007

CONTENTS

1. INTRODUCTION

The MARS system cable was loaded at the Cascade General Ship yard on Swan Island, Portland, Oregon.
The system cable consisted of three separate pieces of cable (to be jointed together onboard). Two lengths of spare cable were also loaded.

1.1 Scope of Document

This report details:

a) The test results obtained during the post load testing of the system cable and spare cable following its transfer onto the Global Sentinel
b) The test results obtained during system installation.
c) Jointing test results for i) On board joints. (See appendix)
ii) Final splice to TRF/CTA cable.

1.2 Test Equipment Lists

On Board Global Sentinel

Equipment type	Model No.	Serial No.	Calibration Due
Anritsu OTDR	MW9076B	SN 610004943	16 Jan 08
AVO Megger	BM11D	6410-729/010601/4533	13 Nov 07
JDS Optical switch	SC24B5-C2FA	JB004851	5 June 07

At Moss Landing Beach Station

Equipment type	Model No.	Serial No.	Calibration Due
Anritsu OTDR	MW9076B	6200048966	10 Dec 07
AVO Megger	BM11D	6410-792/990699/3458	13 Nov 07
Tinsley Submarine Cable Test Set	5910R	275389	19 Jul 07
JDS Optical switch	SC24B5-C2FA	1524	5 Dec 07

2. LOAD TEST RESULTS

2.1 3.655Km Length - Post load Electrical data sheet

Operator J.Roberts / G.Jones
Date 06-Mar-2007
Length 3.655 Km (OTDR)

Electrical measurements:

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	**> 30 GΩ**	**>100 000MΩ/ Km (=27 GΩ)**

2.1.1 3.655Km length - Post load OTDR Data Sheet

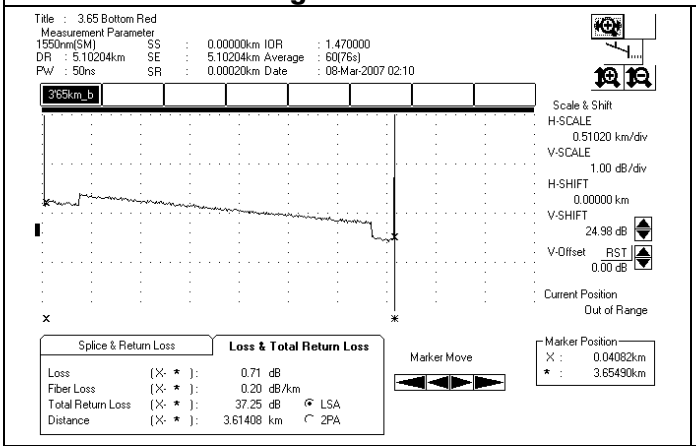
Operator J.Roberts / G.Jones
Date 06-Mar-2007
Length 3.655 Km (OTDR)

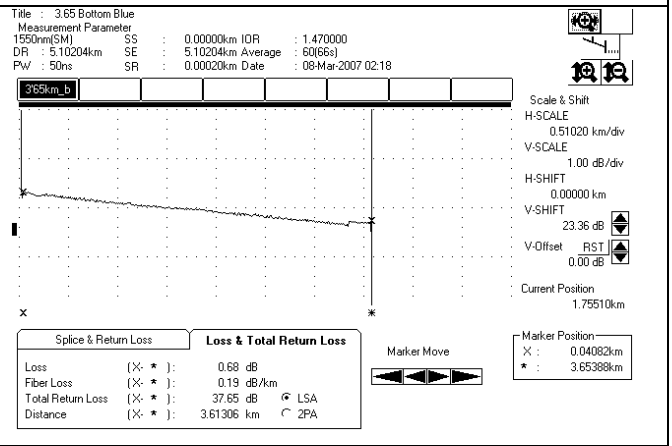
OTDR Parameters

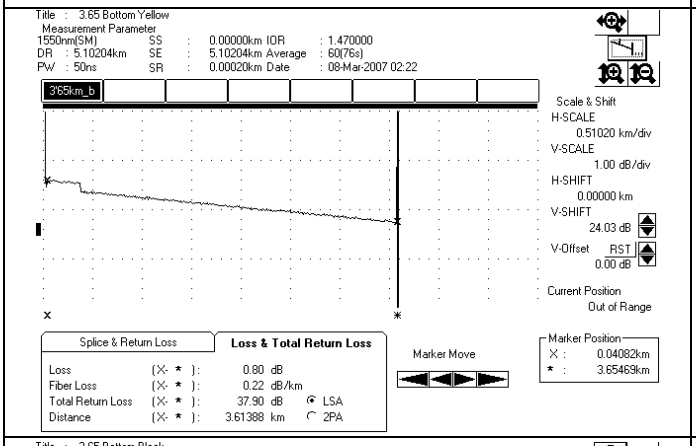
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	50 ns
Averaging	60 (76secs)

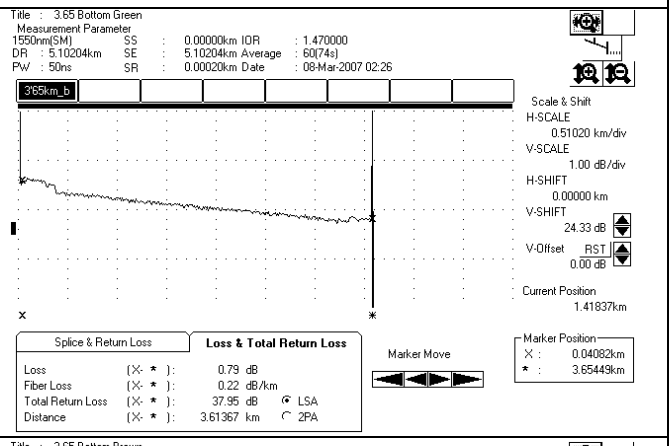
Fibre			Cursor Position /km		Attenuation	
No.	**Bottom**	Colour	C1	C2	dB	dB/km
1		Red	0.04082	3.65490	0.71	0.20
2		Blue	0.04082	3.65388	0.68	0.19
3		Yellow	0.04082	3.65469	0.80	0.22
4		Green	0.04082	3.65449	0.79	0.22
5		Black	0.04082	3.65571	0.76	0.21
6		Brown	0.04082	3.65429	0.69	0.19
7		Orange	0.04082	3.65408	0.67	0.19
8		Pink	0.04082	3.65388	0.76	0.21
	Top					
1		Red	0.04082	3.65510	0.81	0.22
2		Blue	0.04082	3.65408	0.82	0.23
3		Yellow	0.04082	3.65490	0.69	0.19
4		Green	0.04082	3.65449	0.70	0.19
5		Black	0.04082	3.65571	0.70	0.19
6		Brown	0.04082	3.65449	0.81	0.22
7		Orange	0.04082	3.65449	0.83	0.23
8		Pink	0.04082	3.65408	0.74	0.21

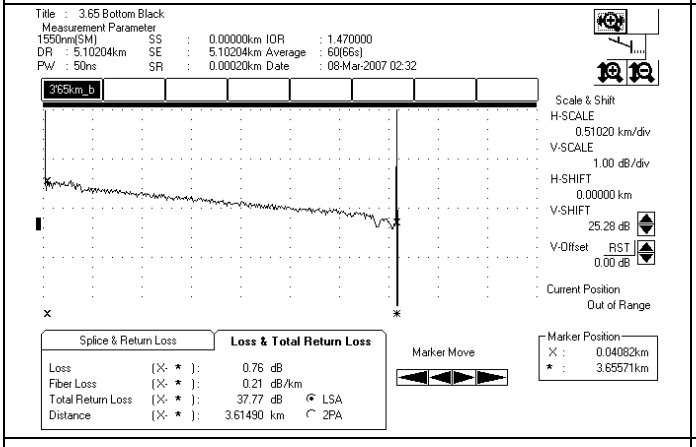
2.1.2 - 3.655Km Length Bottom. Post Load OTDR

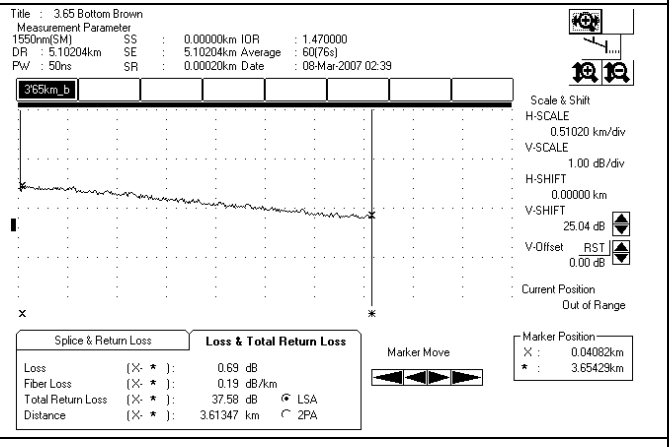


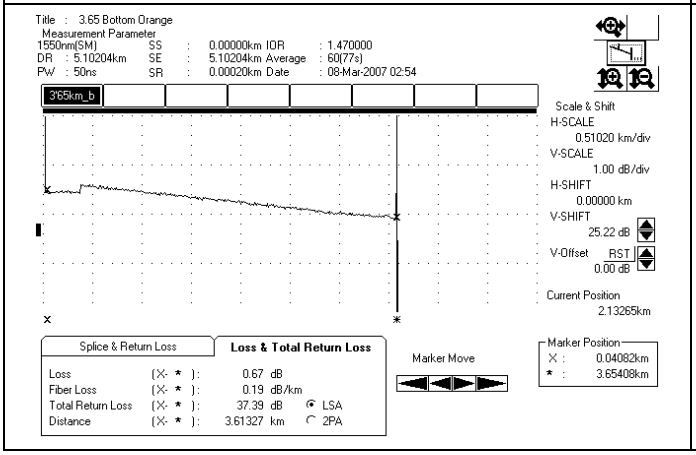


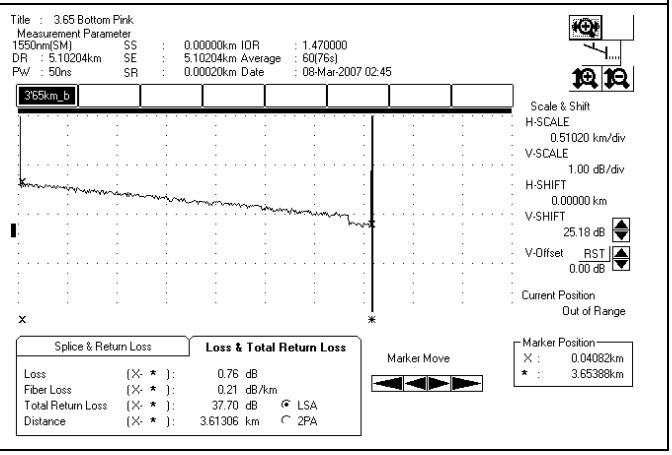




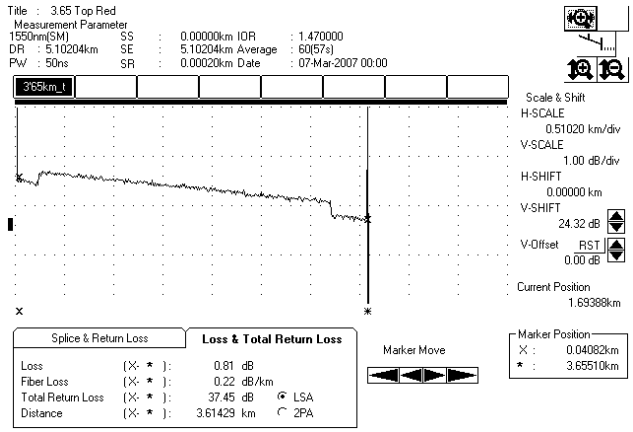


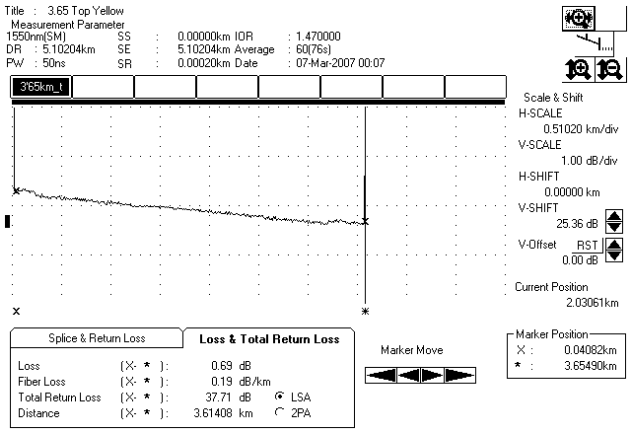


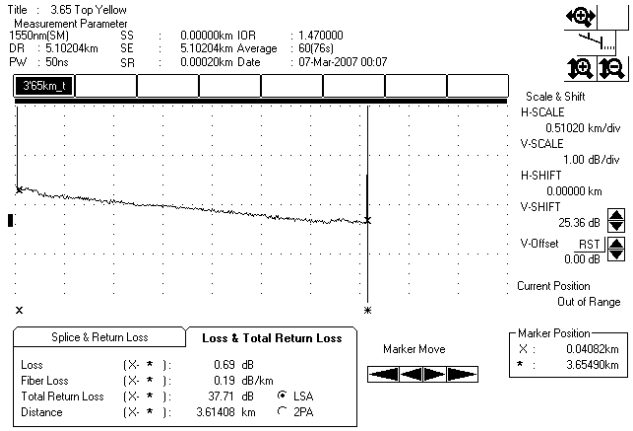


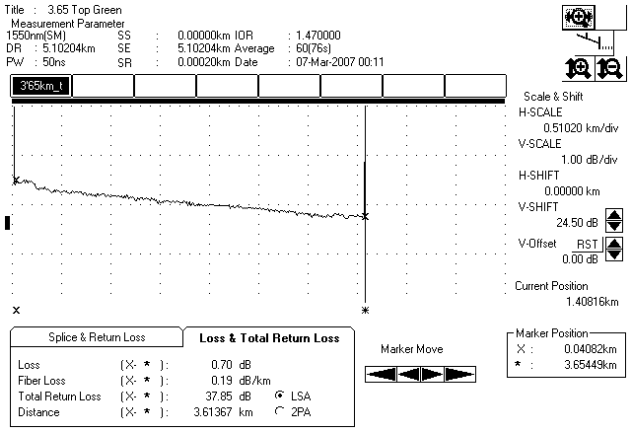


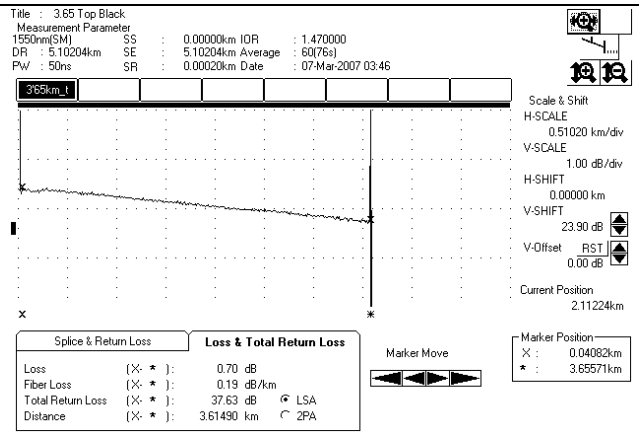
2.1.2 - 3.655Km Length Top. Post Load OTDR

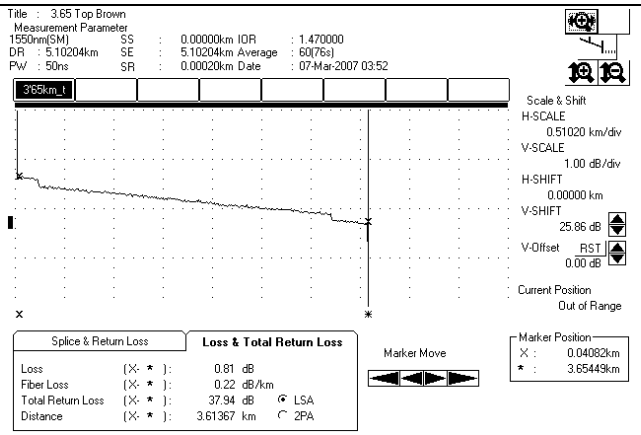


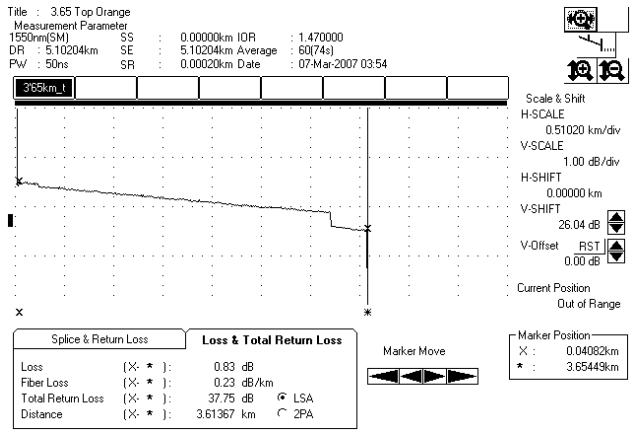


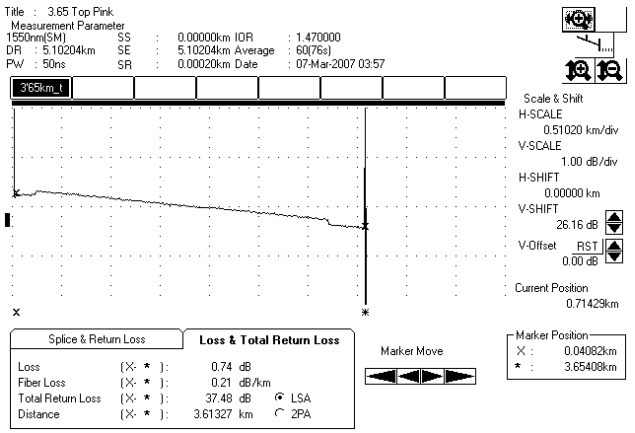












2.2 15.320Km Length. Post load Electrical data sheet

Operator J.Roberts / G.Jones
Date 6-Mar-2007

Length 15.320 Km (OTDR)

Electrical measurements

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	**> 15 GΩ**	**>100 000MΩ/Km (=6.5 GΩ)**

2.2.1 15.320Km Length. Post load OTDR Data Sheet

Operator J.Roberts / G.Jones
Date 6-Mar-2007

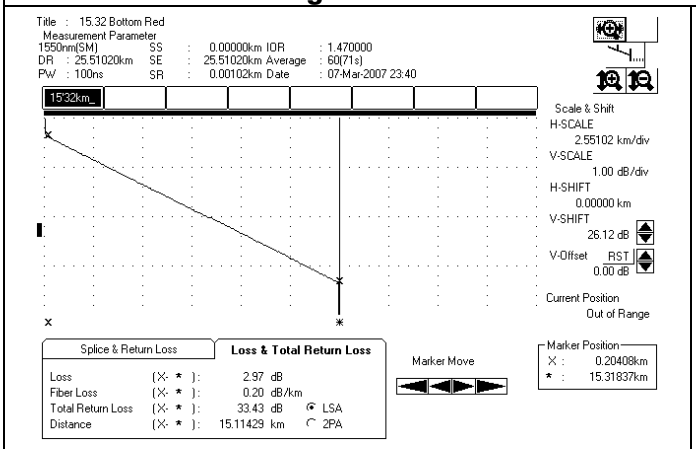
Length 15.320 Km (OTDR)

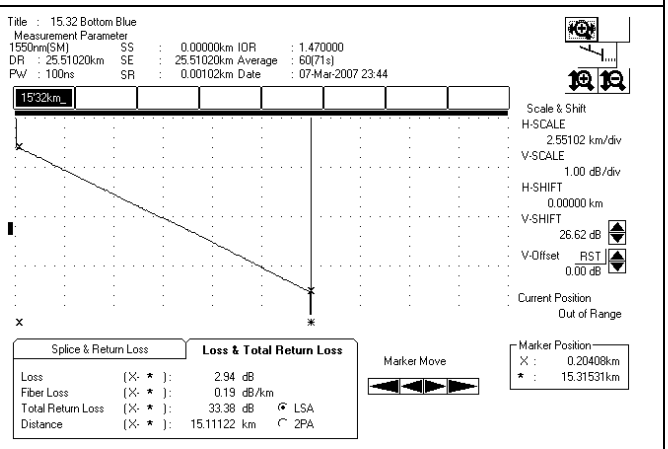
OTDR Parameters

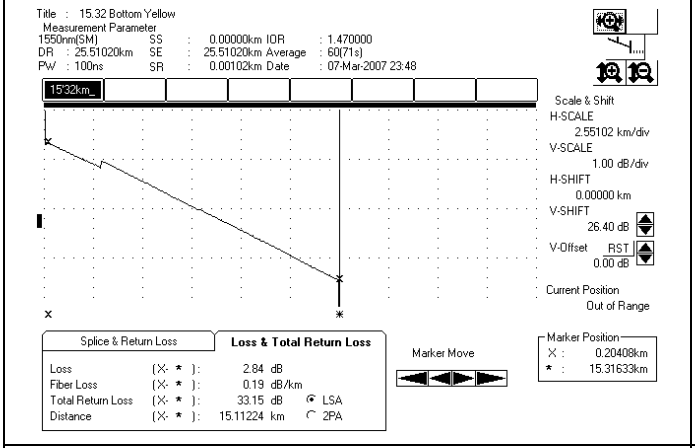
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	100 ns
Averaging	60 (71secs)

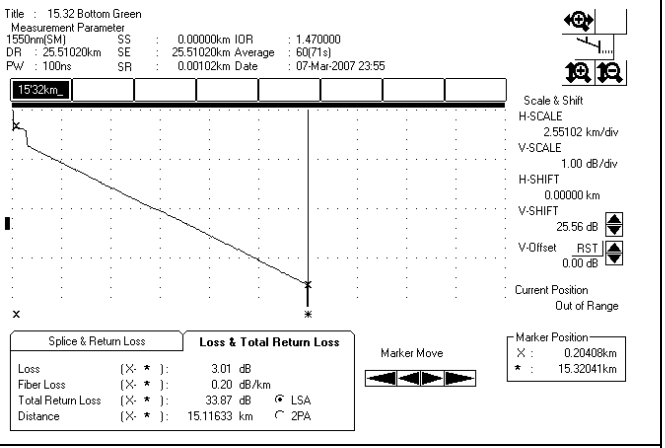
Fibre			Cursor Position /km		Attenuation	
No.	**Bottom**	Colour	C1	C2	dB	dB/km
1		Red	0.20408	15.31837	2.97	0.20
2		Blue	0.20408	15.31531	2.94	0.19
3		Yellow	0.20408	15.31633	2.84	0.19
4		Green	0.20408	15.32041	3.01	0.20
5		Black	0.20408	15.31939	3.01	0.20
6		Brown	0.20408	15.32251	3.21	0.21
7		Orange	0.20408	15.31633	3.02	0.20
8		Pink	0.20408	15.32041	3.01	0.20
	Top					
1		Red	0.20408	15.32143	2.90	0.19
2		Blue	0.20408	15.31837	2.93	0.19
3		Yellow	0.20408	15.31939	3.23	0.21
4		Green	0.20408	15.31837	2.91	0.19
5		Black	0.20408	15.32143	2.99	0.20
6		Brown	0.20408	15.32245	3.04	0.20
7		Orange	0.20408	15.31939	2.91	0.19
8		Pink	0.20408	15.32347	2.97	0.20

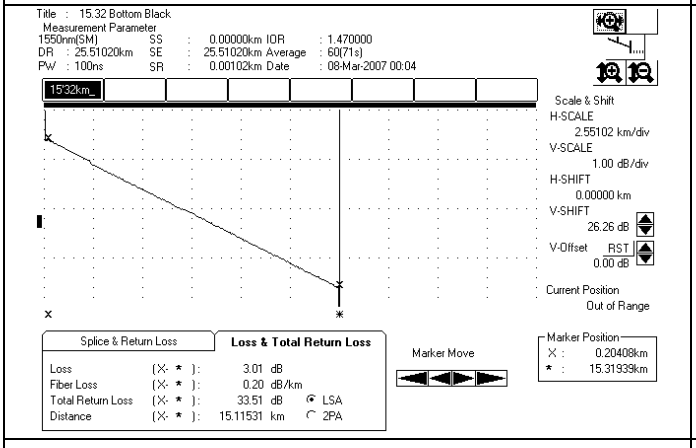
2.2.2 - 15.320Km Length Bottom. Post Load OTDR

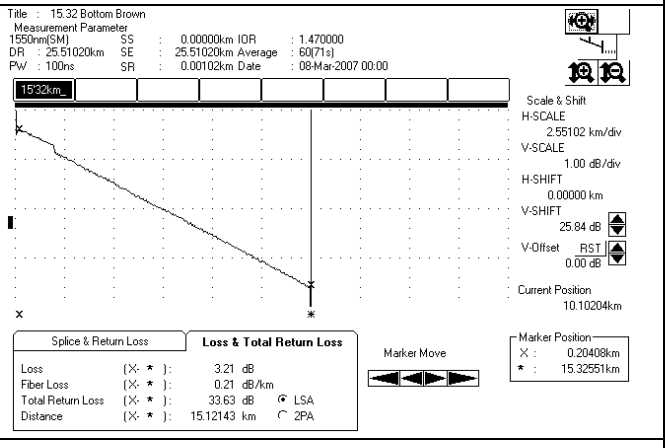


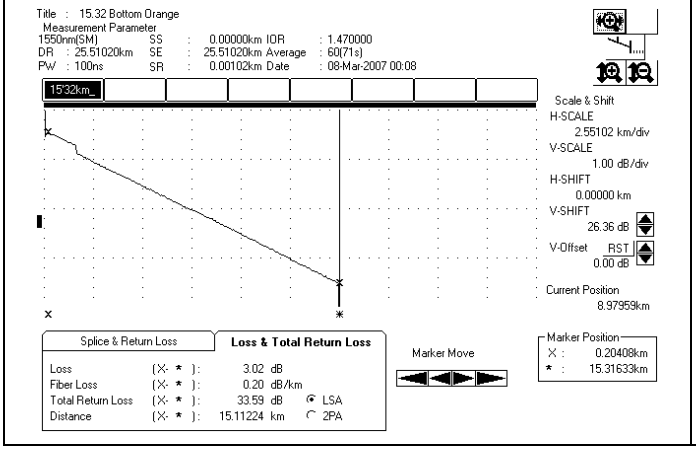


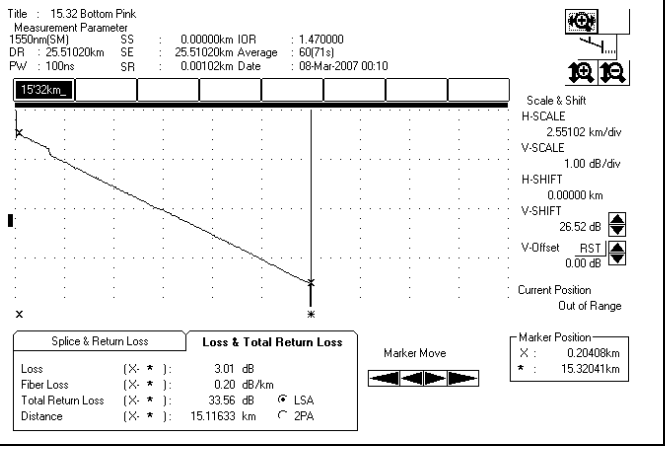




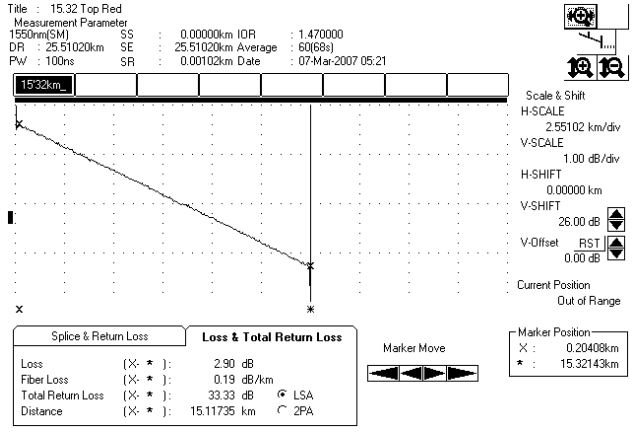


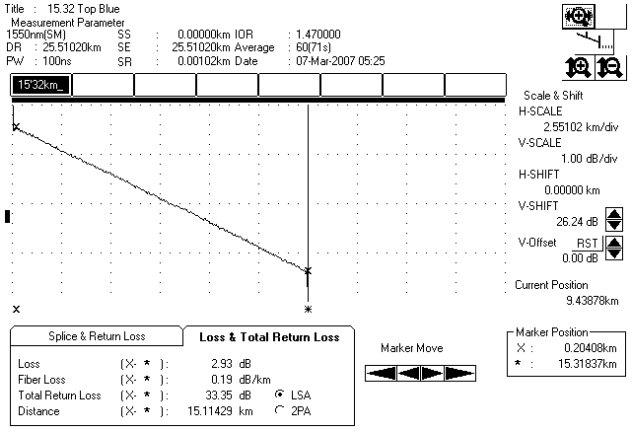


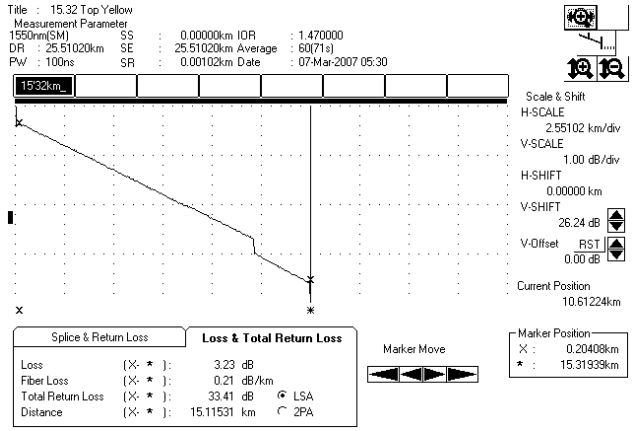


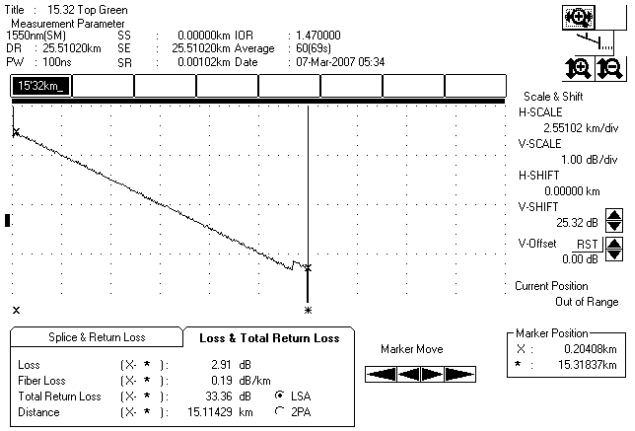


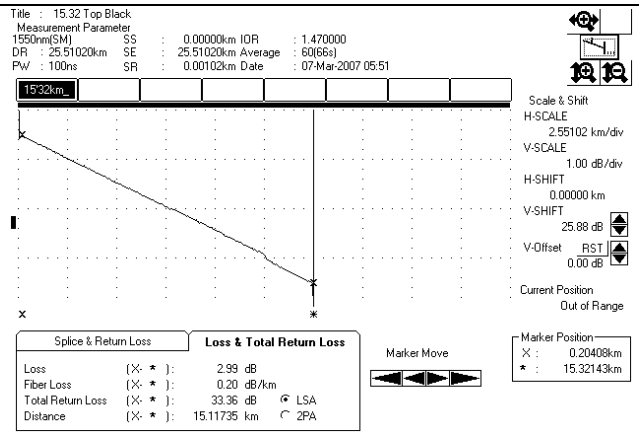
2.2.2 - 15.320Km Length Top. Post Load OTDR

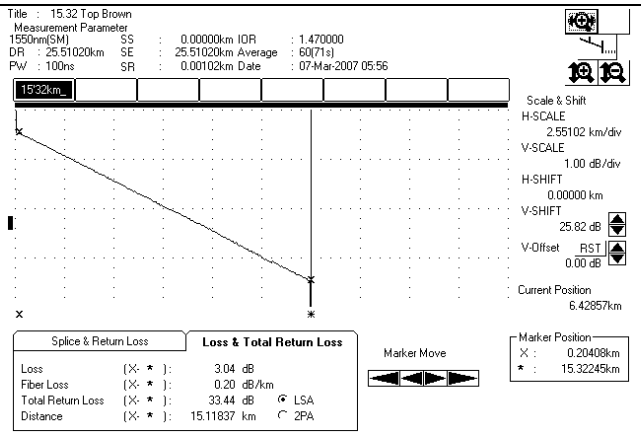


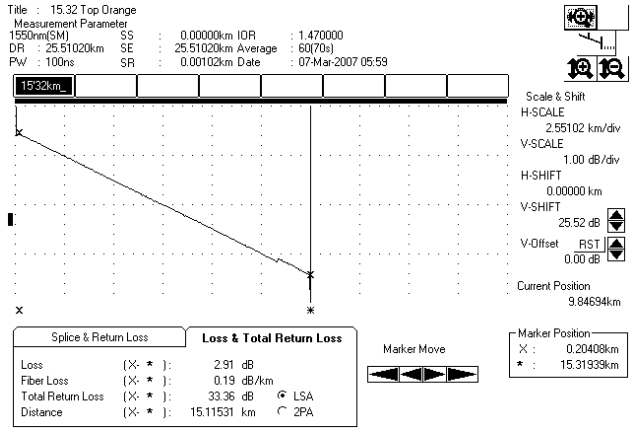


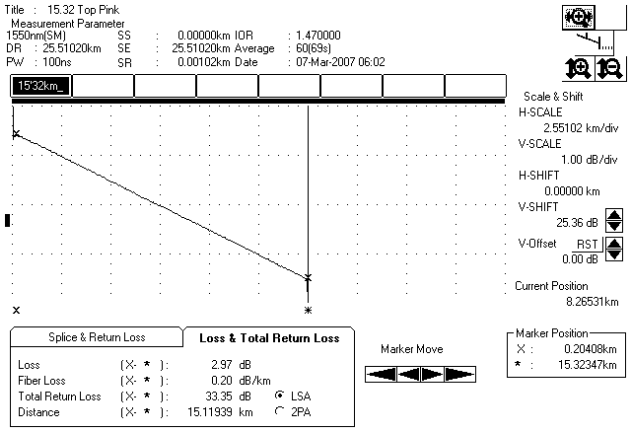












2.3 37.520Km length Post Load Electrical data sheet

Operator J.Roberts / G.Jones
Date 06-Mar-2007
Length 37.520Km (OTDR)

Electrical measurements

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	**> 50 GΩ**	**>100 000MΩ/Km (=2.67GΩ)**

2.3.1 37.520Km Length Post load OTDR Data Sheet

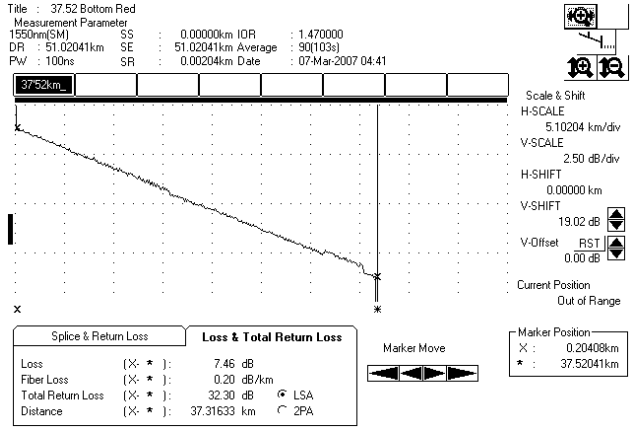
Operator J.Roberts / G.Jones
Date 6-Mar-2007
Length 37.520Km (OTDR)

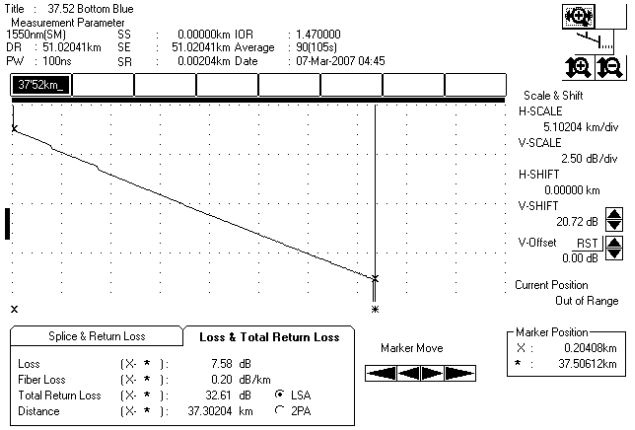
OTDR Parameters

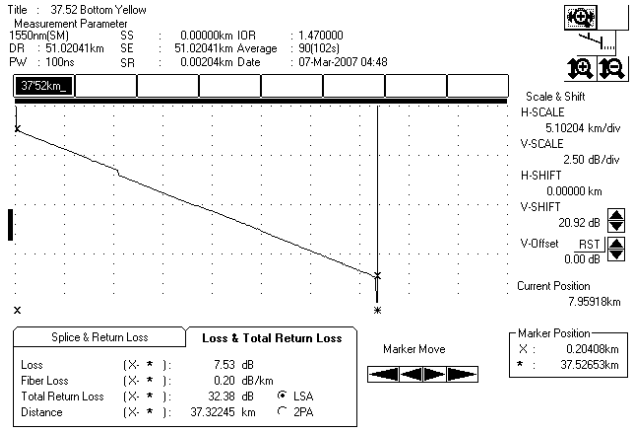
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	100 ns
Averaging	90 (103secs)

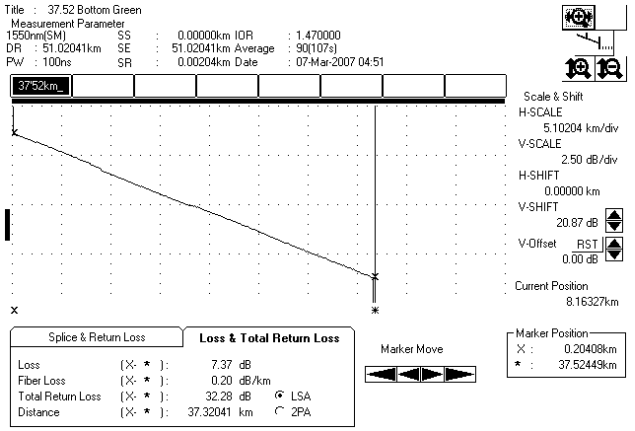
Fibre			Cursor Position /km		Attenuation	
No.	**Bottom**	Colour	C1	C2	dB	dB/km
1		Red	0.20408	37.52041	7.46	0.20
2		Blue	0.20408	37.50612	7.58	0.20
3		Yellow	0.20408	37.52653	7.53	0.20
4		Green	0.20408	37.52449	7.37	0.20
5		Black	0.20408	37.53469	7.25	0.19
6		Brown	0.20408	37.51837	7.79	0.21
7		Orange	0.20408	37.50816	7.64	0.20
8		Pink	0.20408	37.52245	7.62	0.20
	Top					
1		Red	0.20408	37.52041	7.60	0.20
2		Blue	0.20408	37.50612	7.48	0.20
3		Yellow	0.20408	37.52653	7.69	0.21
4		Green	0.20408	37.52449	7.62	0.20
5		Black	0.20408	37.53265	7.77	0.21
6		Brown	0.20408	37.51633	7.54	0.20
7		Orange	0.20408	37.51020	7.34	0.20
8		Pink	0.20408	37.52245	7.56	0.20

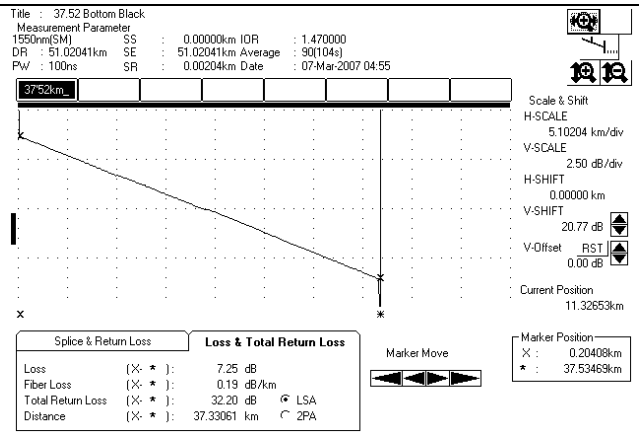
2.3.2 - 37.520Km Length Bottom. Post Load OTDR

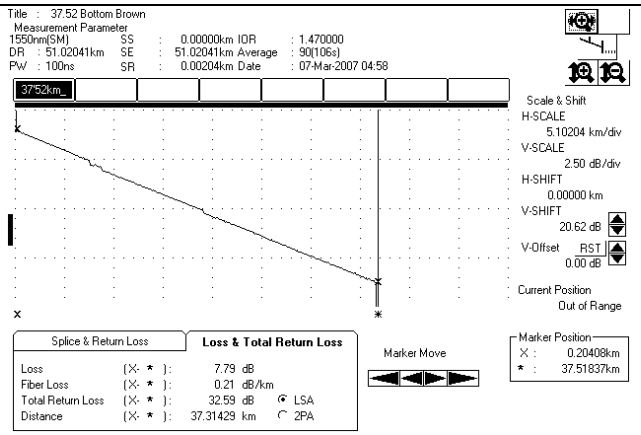


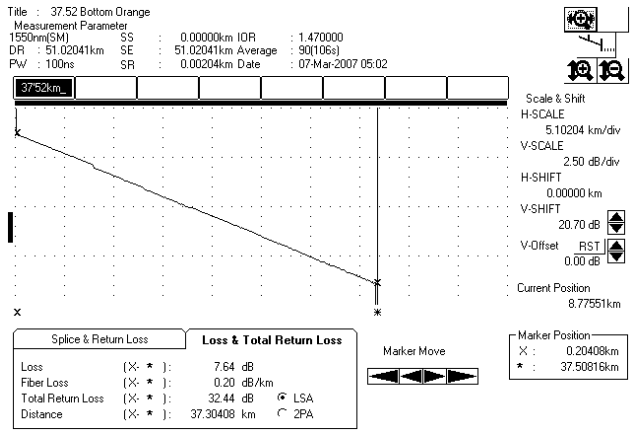


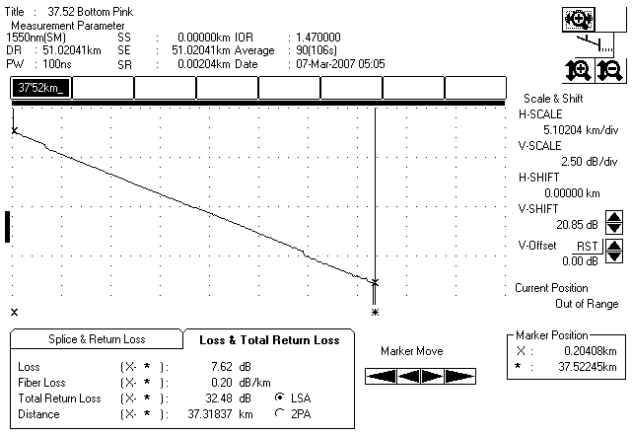




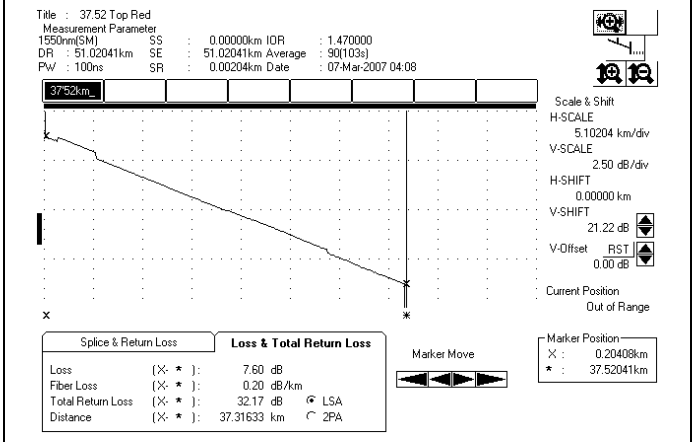


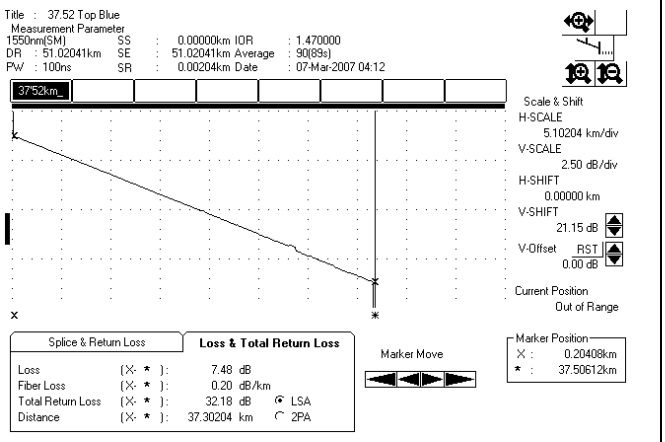


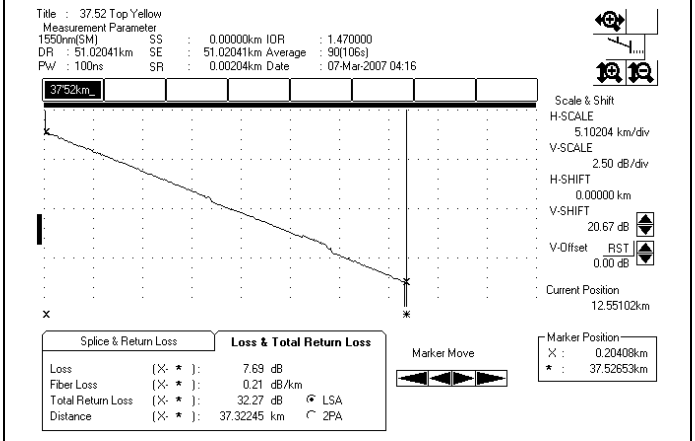


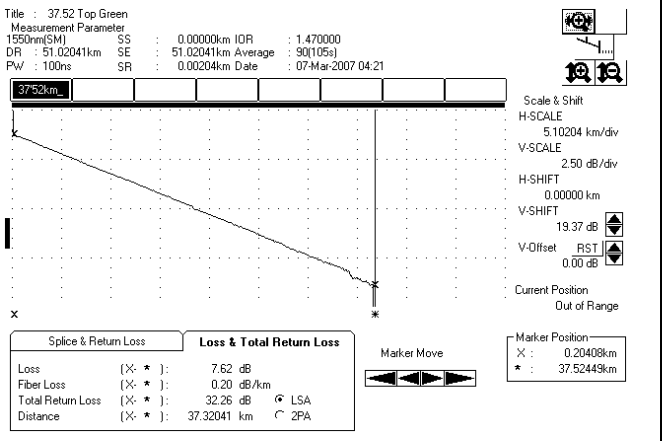


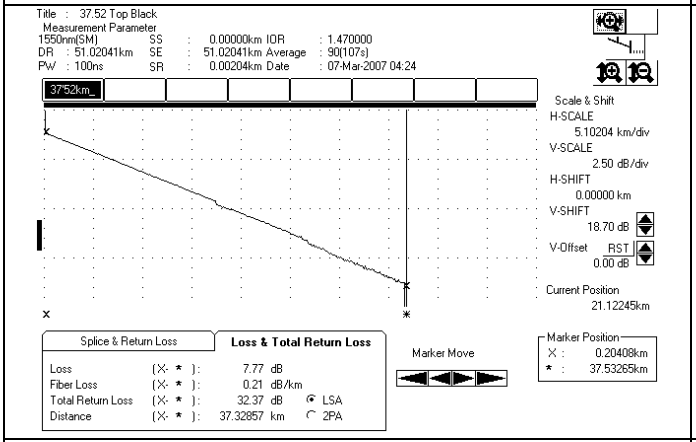
2.3.2 - 37.520Km Length Top. Post Load OTDR

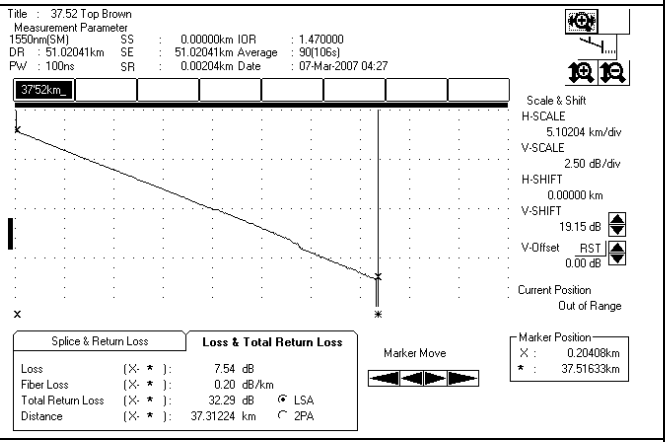


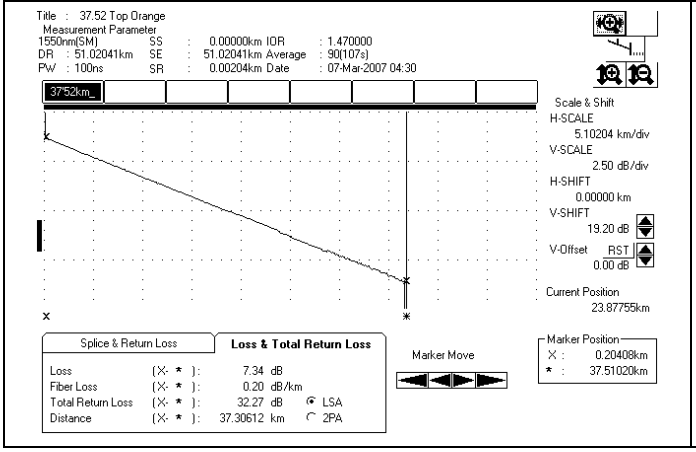


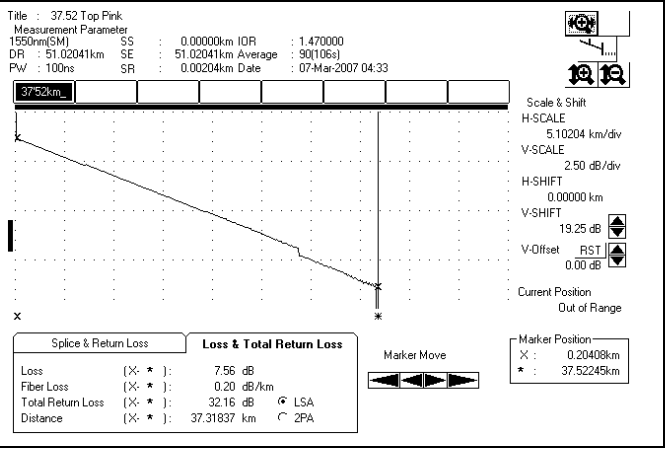












2.4 1.896Km Spare Cable Post load Electrical data sheet

Operator J.Roberts / G.Jones
Date 7-Mar-2007
Length 1.896Km (OTDR)

Electrical measurements

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**Ω**	**> 50 GΩ (Max Value Recordable)**	**>100 000MΩ/Km (= 53GΩ)**

2.4.1 1.896Km Spare Cable Post load OTDR Data Sheet

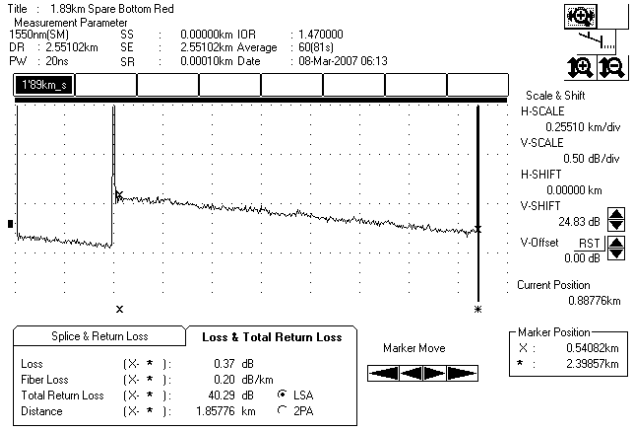
Operator J.Roberts / G.Jones
Date 7-Mar-2007
Length 1.896Km (OTDR)

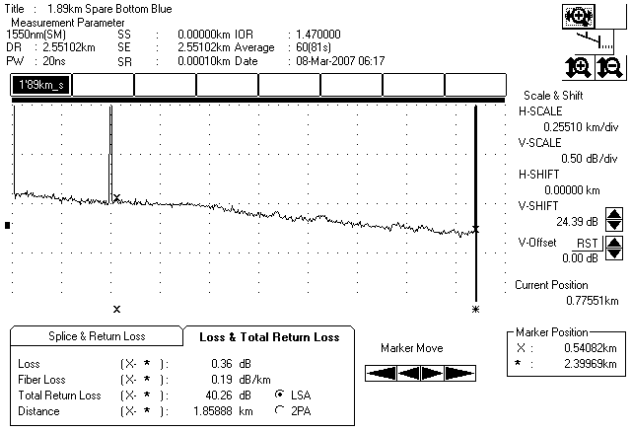
OTDR Parameters

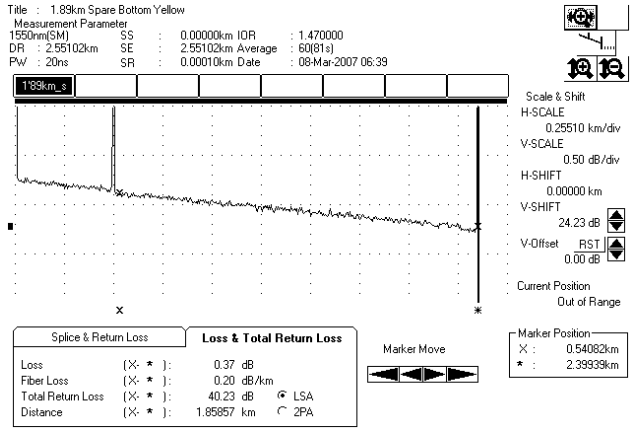
Equipment Anritsu MW9076B OTDR
Refractive index 1.470
Pulse Width 20 ns
Averaging 60 (81sec)

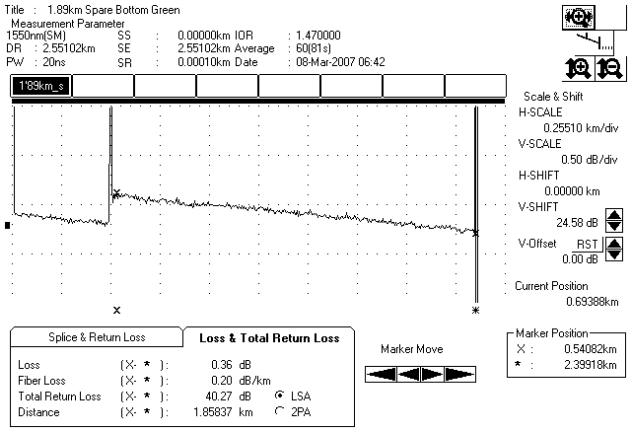
Fibre			Cursor Position /km		Attenuation	
No.	**Bottom**	Colour	C1	C2	dB	dB/km
1		Red	0.54082	2.39857	0.37	0.20
2		Blue	0.54082	2.39969	0.36	0.19
3		Yellow	0.54082	2.39939	0.37	0.20
4		Green	0.54082	2.39918	0.36	0.20
5		Black	0.54082	2.39918	0.36	0.19
6		Brown	0.54082	2.39918	0.37	0.20
7		Orange	0.54082	2.39908	0.36	0.19
8		Pink	0.54082	2.39918	0.36	0.19
	Top					
1		Red	0.54082	2.39918	0.36	0.19
2		Blue	0.54082	2.39959	0.35	0.19
3		Yellow	0.54082	2.39959	0.36	0.19
4		Green	0.54082	2.39990	0.36	0.19
5		Black	0.54082	2.39918	0.35	0.19
6		Brown	0.54082	2.39949	0.36	0.19
7		Orange	0.54082	2.39969	0.36	0.19
8		Pink	0.54082	2.39878	0.36	0.19

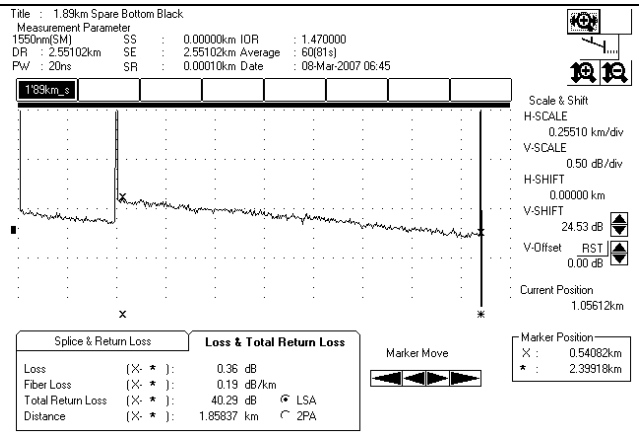
2.4.2 - 1.896Km Spare Cable Bottom. Post Load OTDR

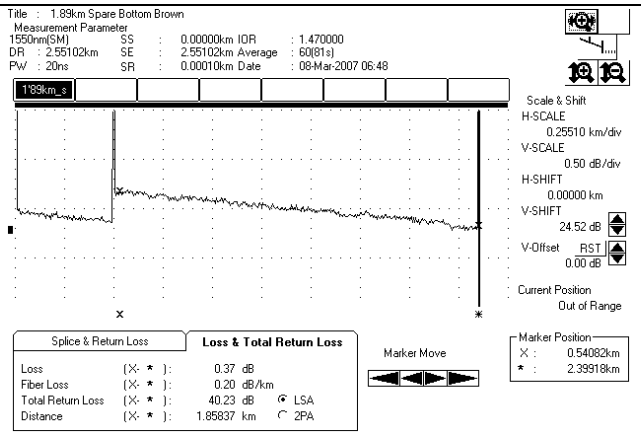


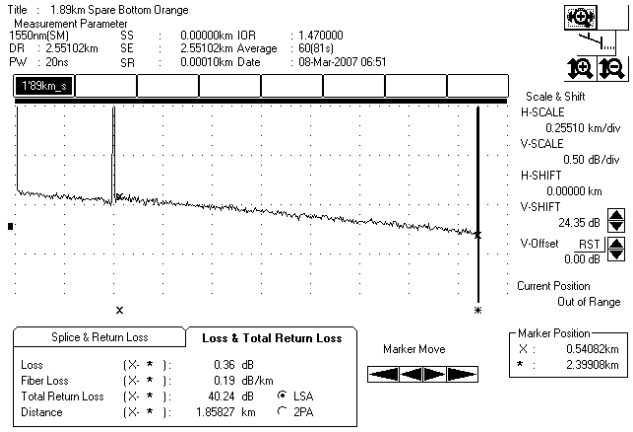


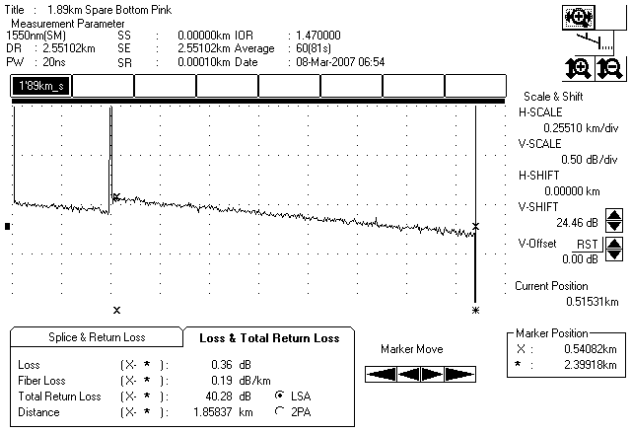




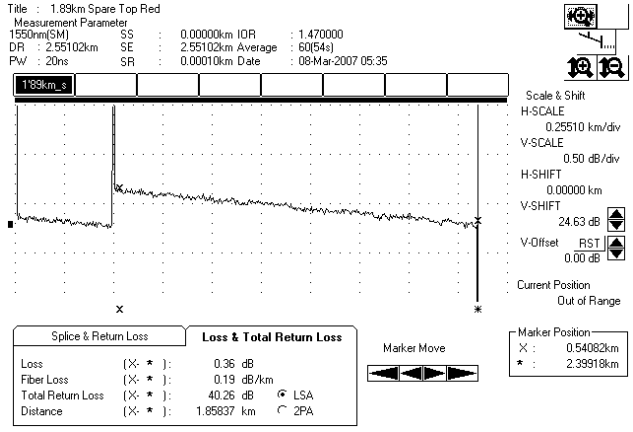


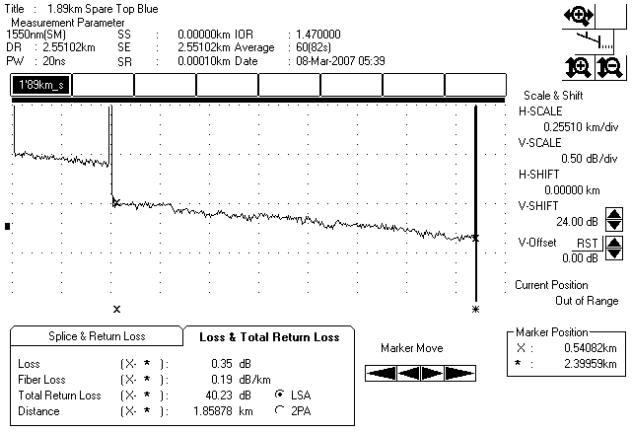


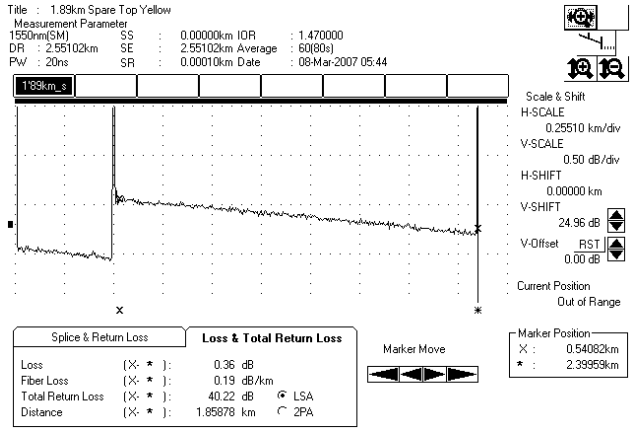


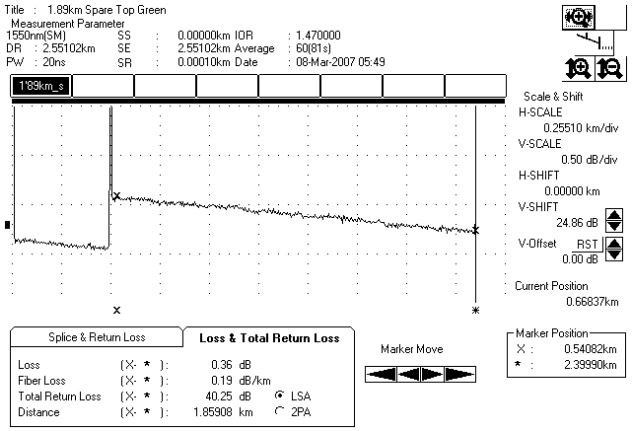


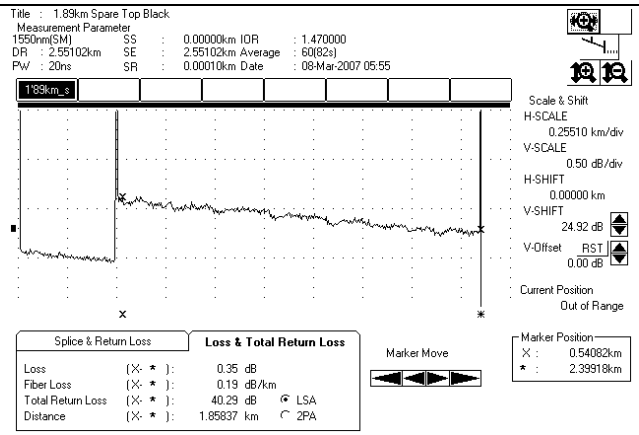
2.4.2 - 1.896Km Spare Cable Top. Post Load OTDR

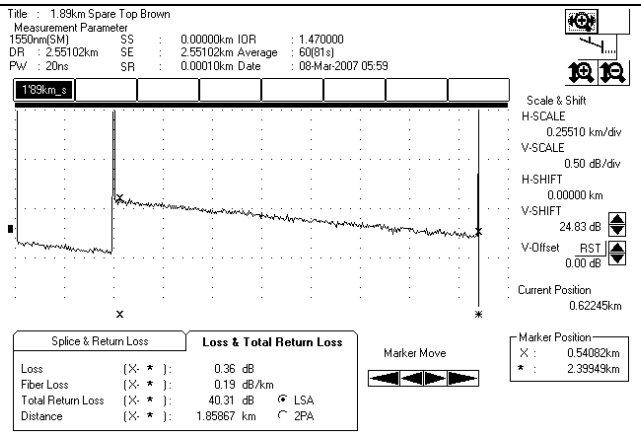


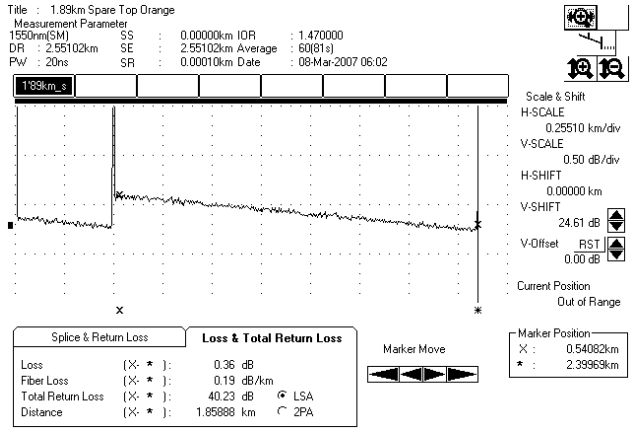


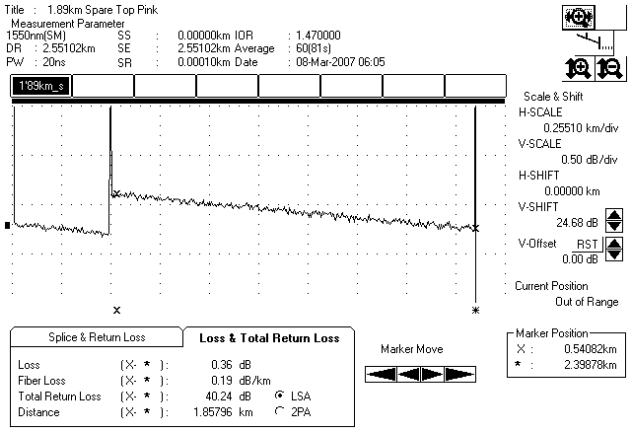












2.5 10.970Km Spare cable Post load Electrical data sheet

Operator J.Roberts / G.Jones
Date 7-Mar-2007
Length 10.970Km (OTDR)

ELECTRICAL MEASUREMENTS

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	**> 50 GΩ**	**>100 000MΩ/Km = 9.1 GΩ**

2.5.1 10.970Km Spare Cable Post load OTDR Data Sheet

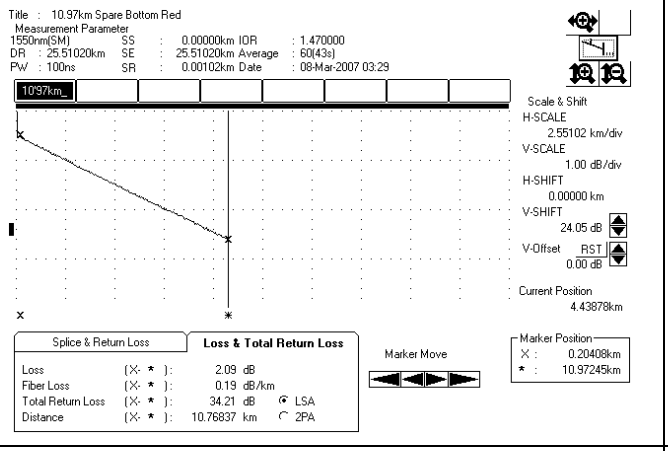
Operator J.Roberts / G.Jones
Date 7-Mar-2007
Length 10.970Km (OTDR)

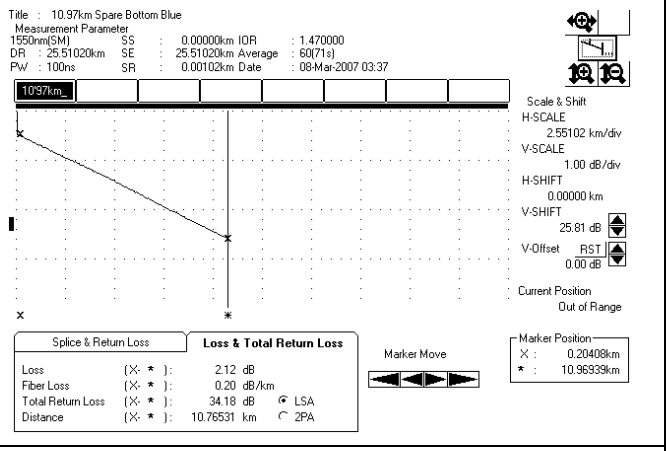
OTDR Parameters

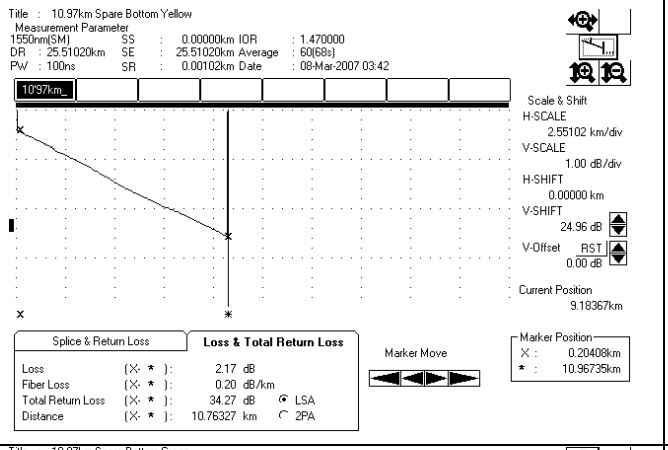
Equipment Anritsu MW9076B OTDR
Refractive index 1.470
Pulse Width 100 ns
Averaging 60 (43sec)

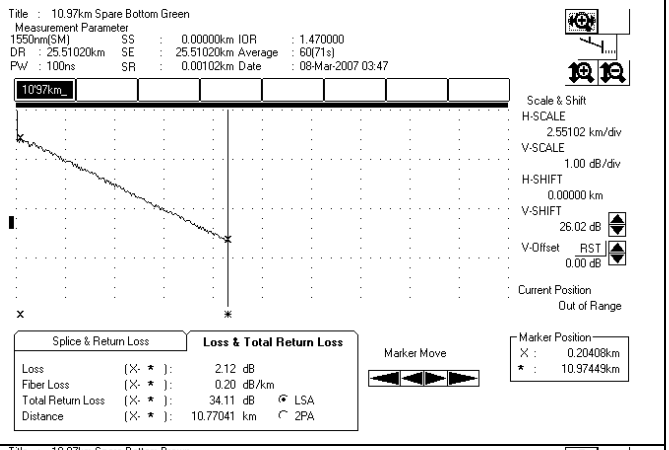
Fibre			Cursor Position /km		Attenuation	
No.	**Bottom**	Colour	C1	C2	dB	dB/km
1		Red	0.20408	10.97245	2.09	0.19
2		Blue	0.20408	10.96939	2.12	0.20
3		Yellow	0.20408	10.96735	2.17	0.20
4		Green	0.20408	10.97449	2.12	0.20
5		Black	0.20408	10.97245	2.21	0.21
6		Brown	0.20408	10.97449	2.18	0.20
7		Orange	0.20408	10.97347	2.05	0.19
8		Pink	0.20408	10.97449	2.11	0.20
	Top					
1		Red	0.20408	10.97245	2.11	0.20
2		Blue	0.20408	10.96939	2.10	0.20
3		Yellow	0.20408	10.96735	2.14	0.20
4		Green	0.20408	10.97449	2.23	0.21
5		Black	0.20408	10.97245	2.18	0.20
6		Brown	0.20408	10.97449	2.14	0.20
7		Orange	0.20408	10.97245	2.25	0.21
8		Pink	0.20408	10.97449	2.11	0.20

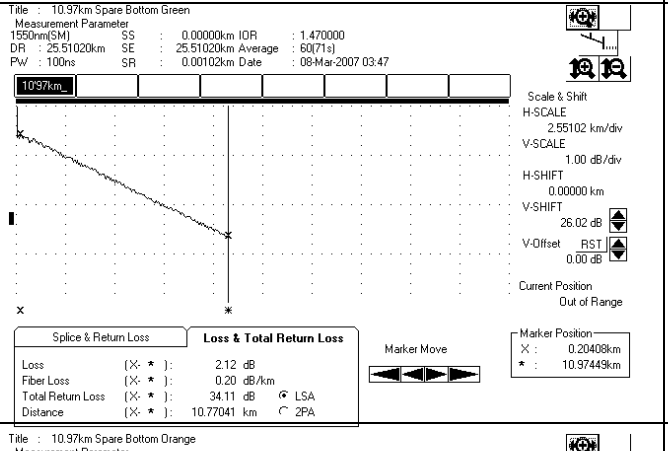
2.5.2 - 10.970Km Spare Cable Bottom. Post Load OTDR

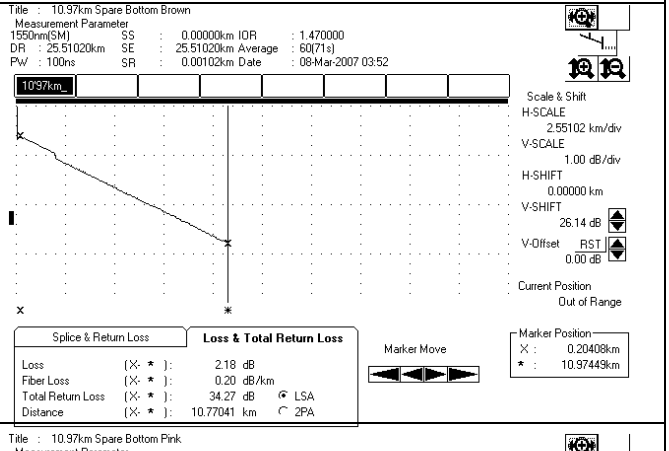


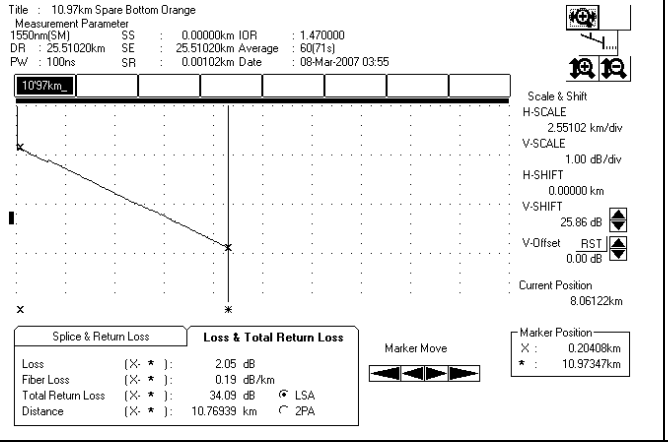


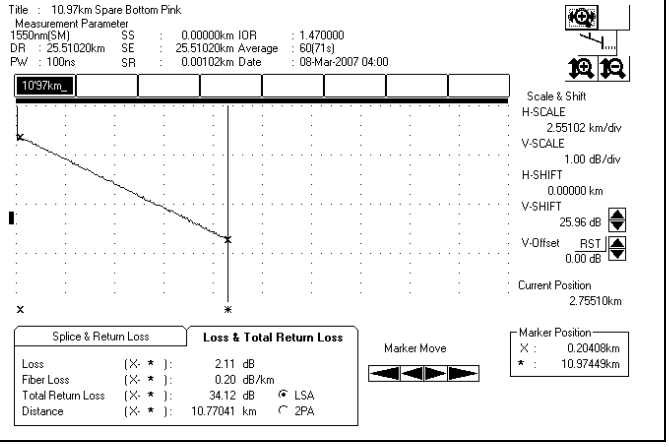




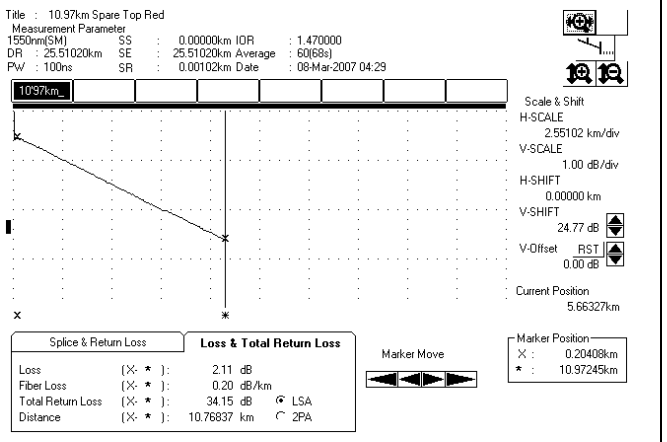


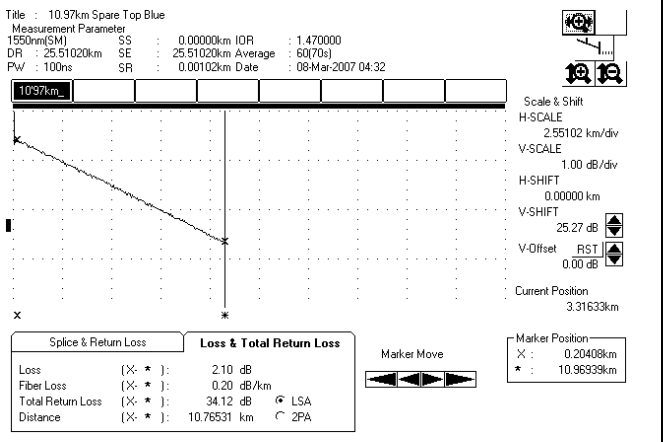


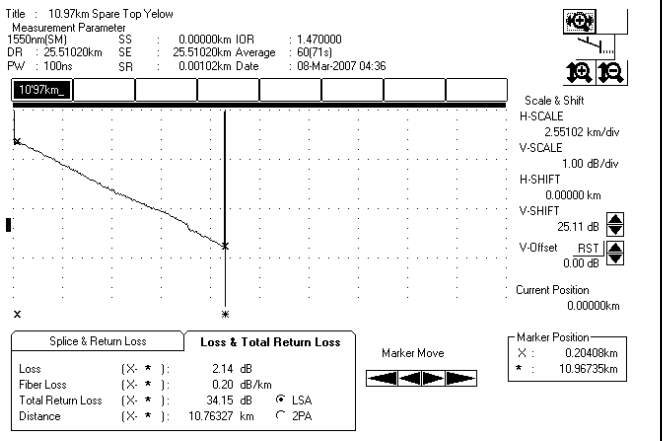


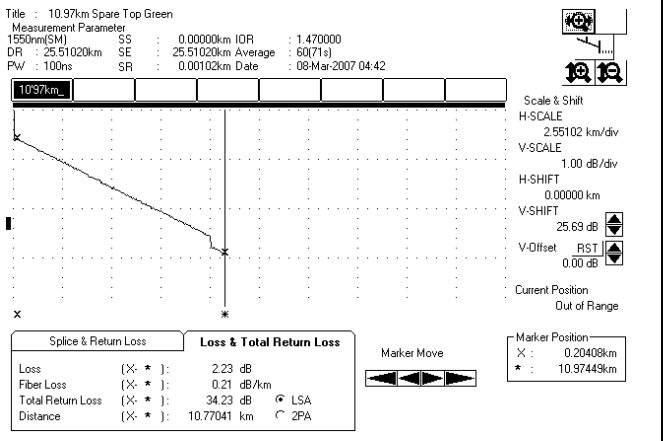


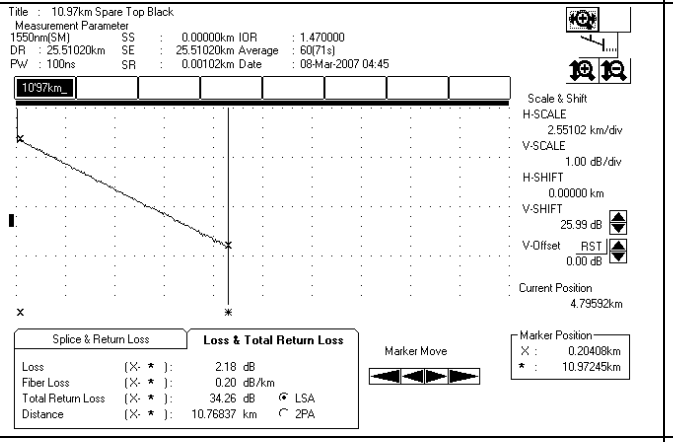
2.5.2 - 10.970Km Spare Cable Top. Post Load OTDR

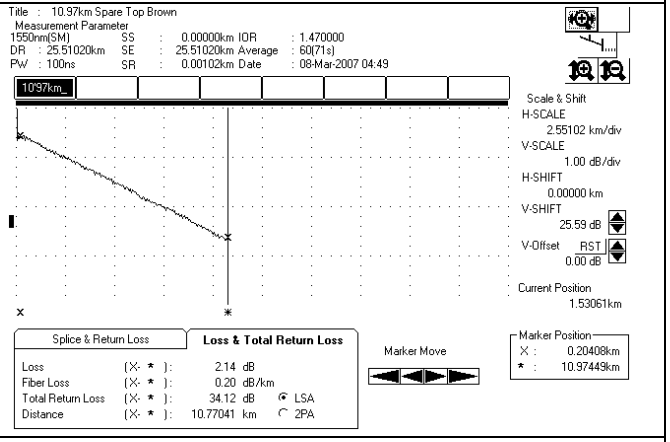


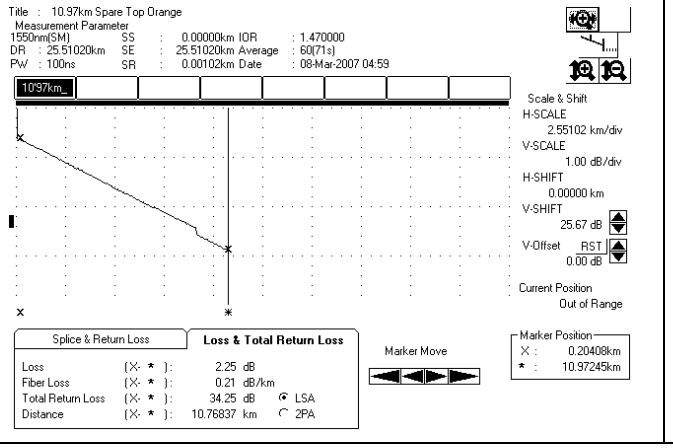


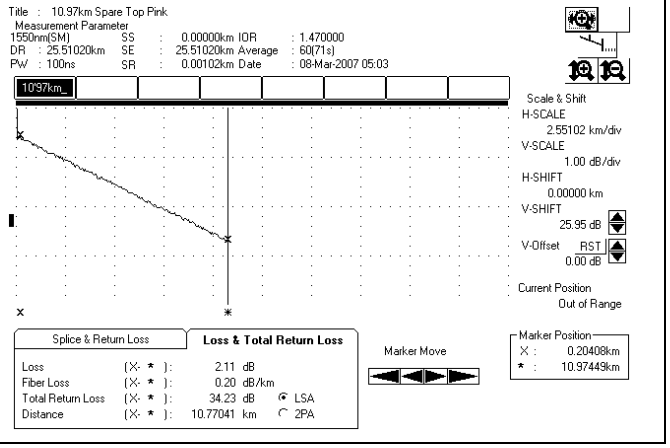












2.6 0.100Km TRF unit and tail Post load Electrical data sheet

Operator J. Roberts / G. Jones
Date 28-Mar-2007
Length 0.113Km (OTDR)

ELECTRICAL MEASUREMENTS

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	➢ **50GΩ (Max Value Recordable)**	**>100 000MΩ/Km**

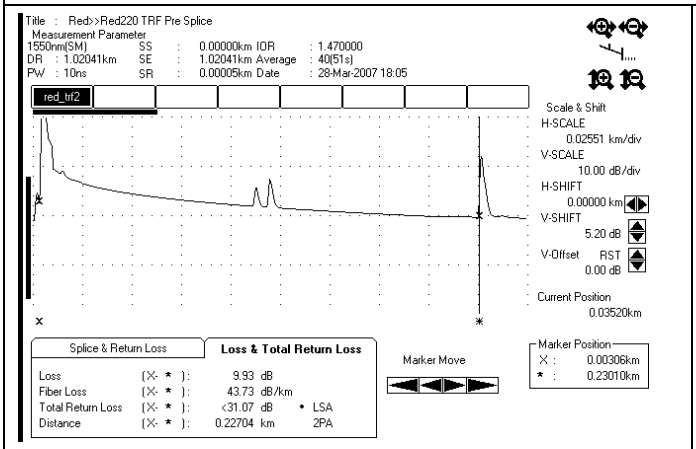
2.6.1 0.100Km TRF / CTA unit Post load OTDR Data Sheet

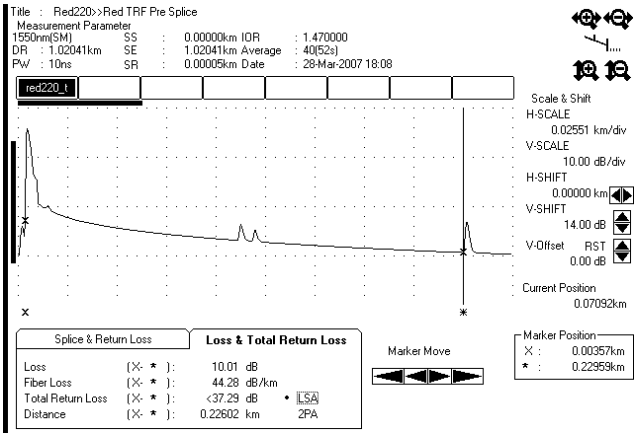
Operator G. Jones
Date 28-Mar-2007
Length 0.113Km (OTDR)

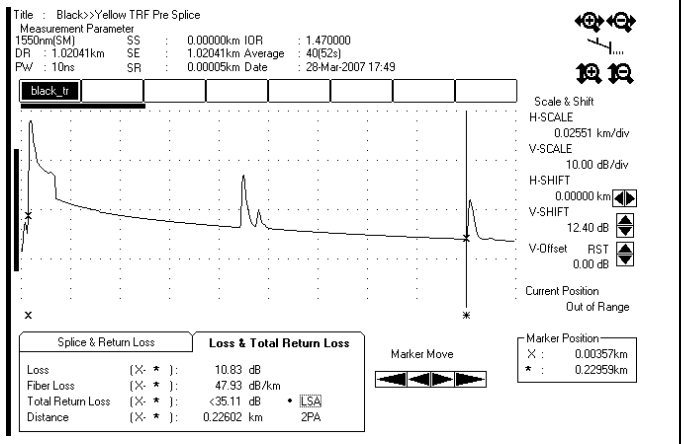
OTDR Parameters

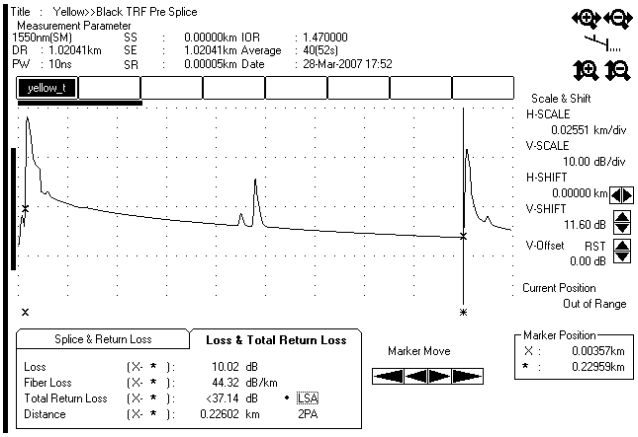
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	10 ns
Averaging	40 (52sec)

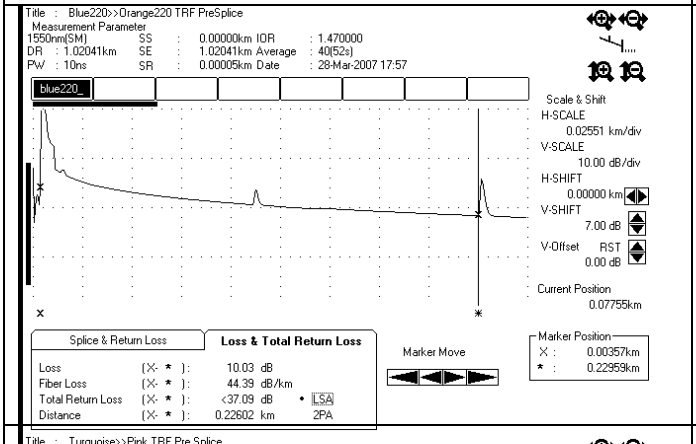
2.6.2 - 0.100km TRF / CTA Unit. Post Load OTDR

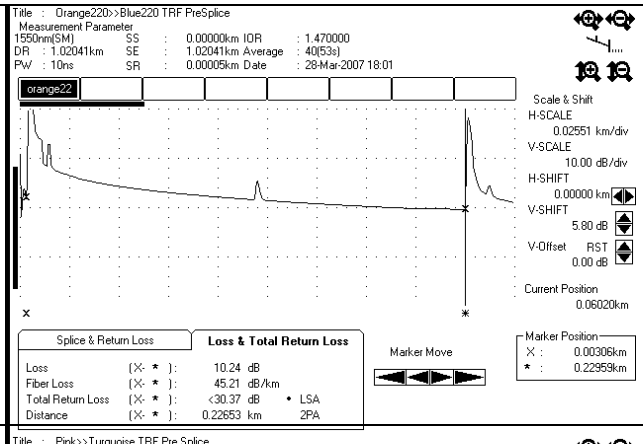


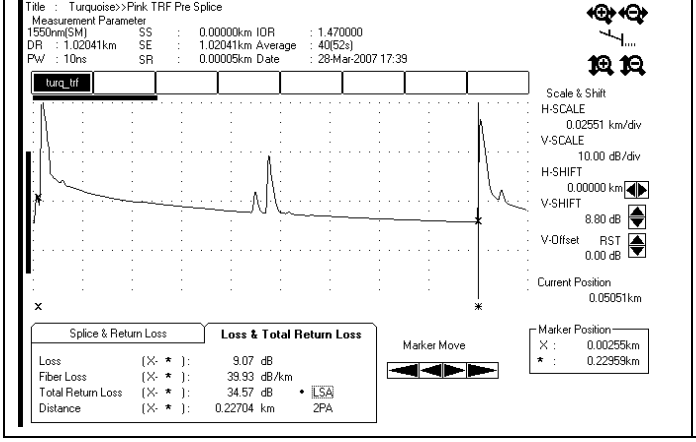


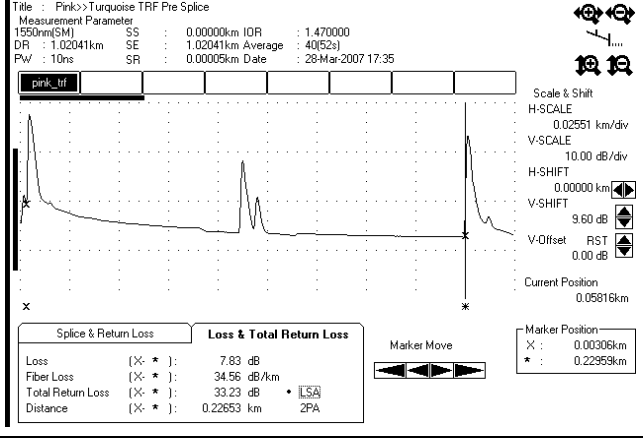












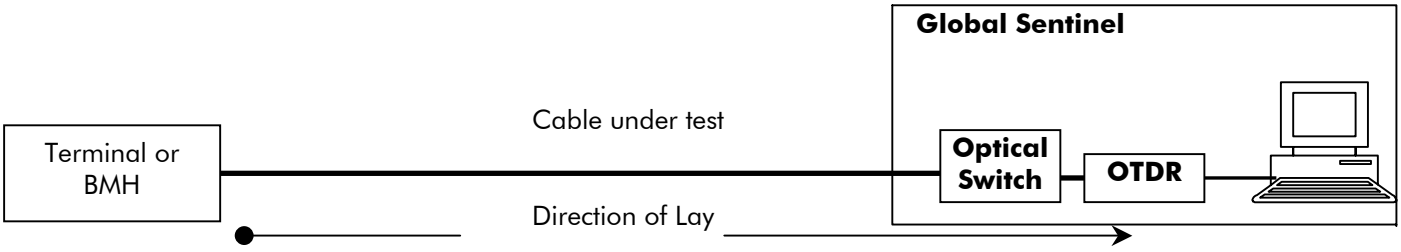
3. LAY TEST RESULTS

3.1 Test Methods during Lay operations.

The following test methods were used during the MARS cable lay.

OTDR Lay Monitor

All 8 fibres of the cable are connected to an optical switch in the test room aboard the lay vessel. The fibres are monitored sequentially by OTDR via the optical switch. The OTDR and optical switch are driven by a computer, which generates a spreadsheet and records the optical loss figure between two markers at either end of the trace displayed on the OTDR. The loss figure for each fibre is recorded approximately every 10 minutes depending on the averaging time set on the OTDR. Graphs were then plotted from the resultant data for each fibre and are provided in this report.



OTDR Monitor

Joint Testing:

Beach Manhole joints / Repair joints / Line Joints were tested by one or a combination of the following methods:

One way OTDR

The value of a splice loss is determined by OTDR back scattering from one direction only.

Two way OTDR

The value of a splice loss is determined by OTDR back scattering from both directions. The two results are then averaged to determine the true loss.

3.2 MARS OTDR Lay Monitor (Moss Landing to TRF/CTA Position)

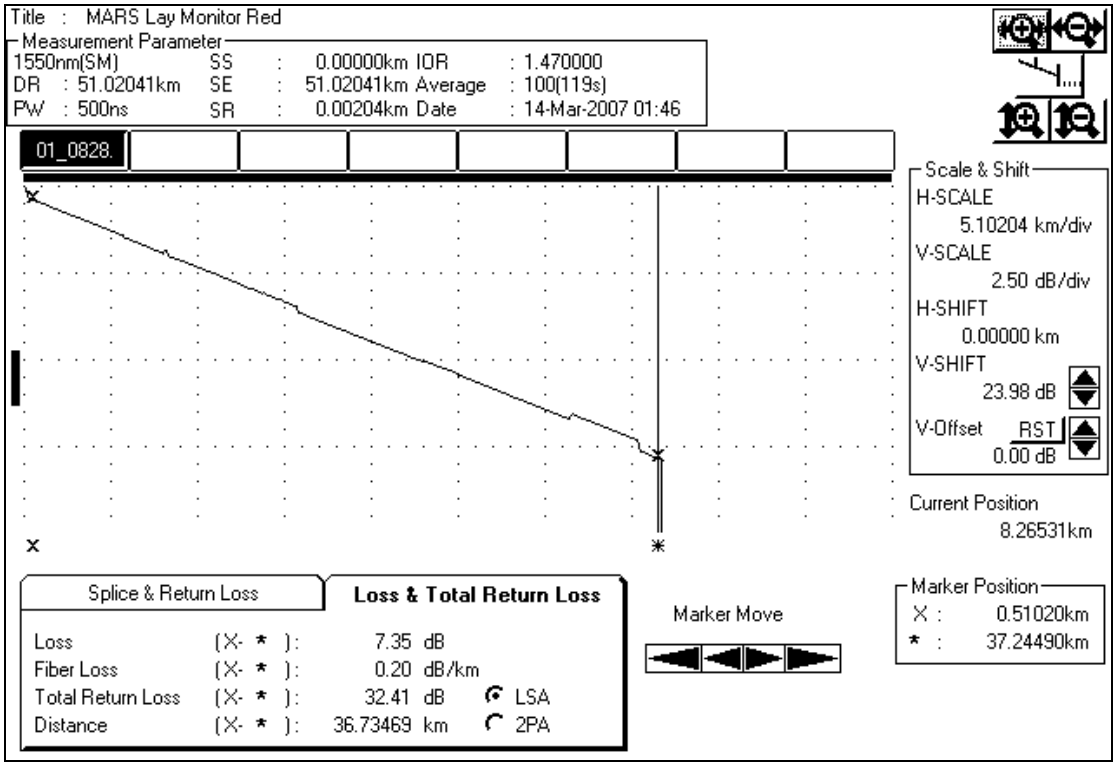
Tester J. Roberts / G. Jones

Date 14 March 2007 – 20 March 2007

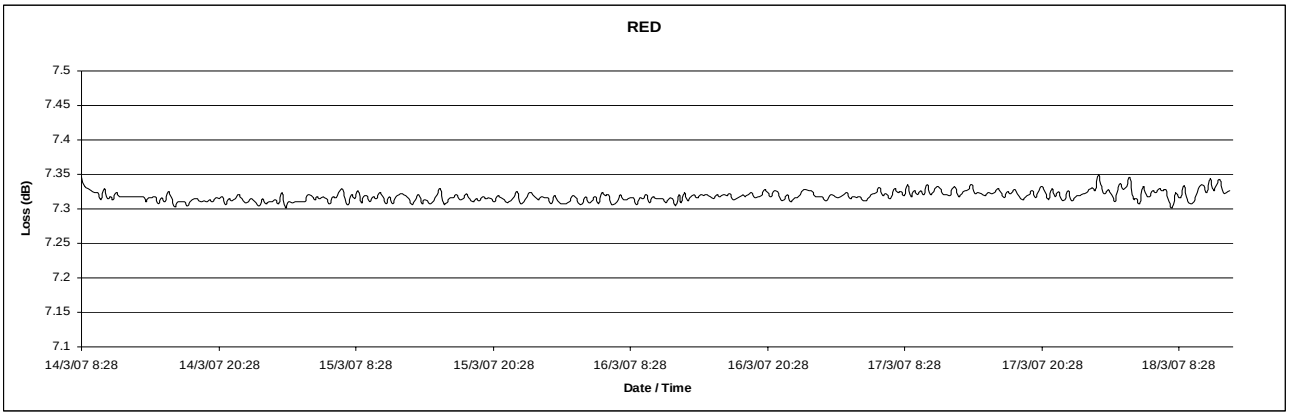
Remarks Lay monitor was started during shore end ops at Moss Landing, and monitored ≈33.52km of the system until the vessel reached the position to make joint SJ1 (which added the remaining ≈18.98km into the system). Following completion of SJ1, monitor was restarted and included the entire ≈52.5km until the lay ended at the TRF/CTA position.

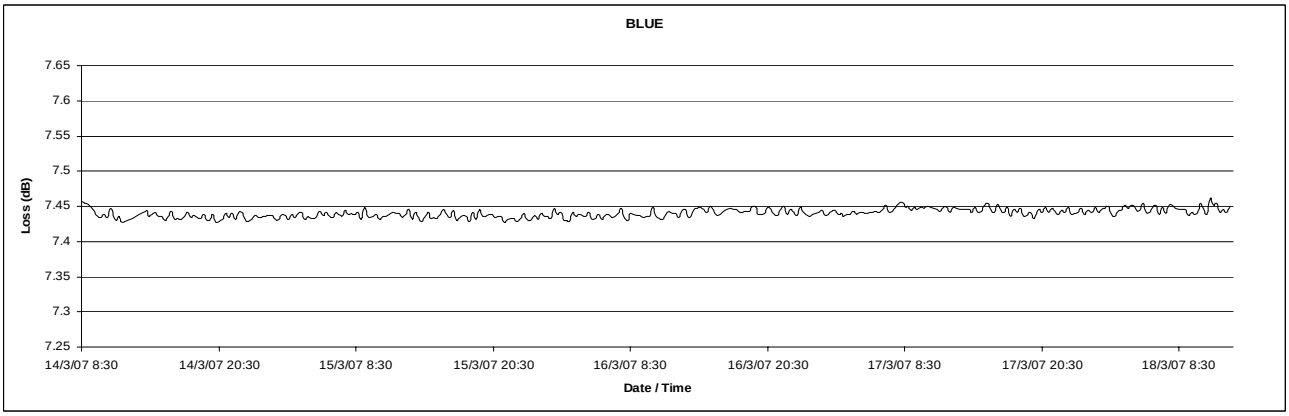
OTDR Parameters

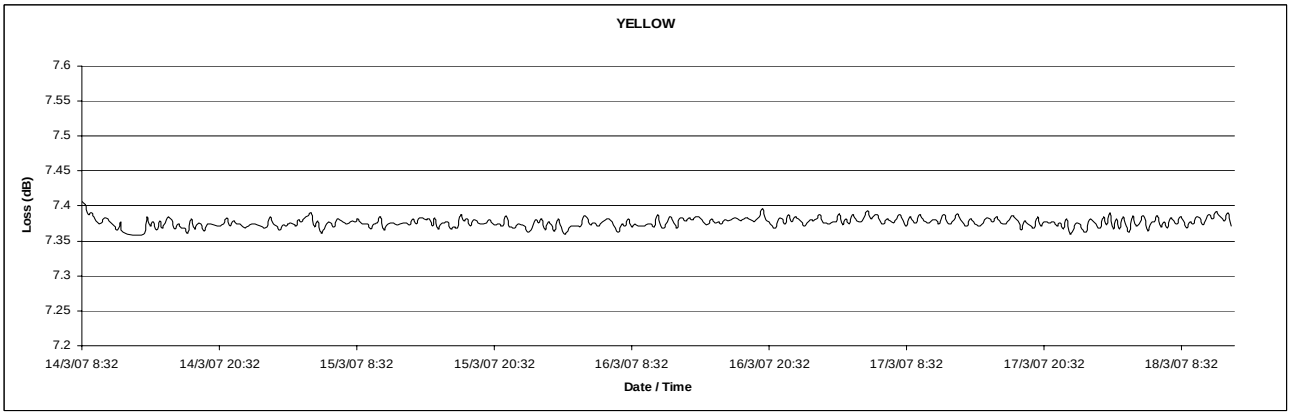
Global Sentinel	
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	500ns
Averaging	100(119s)

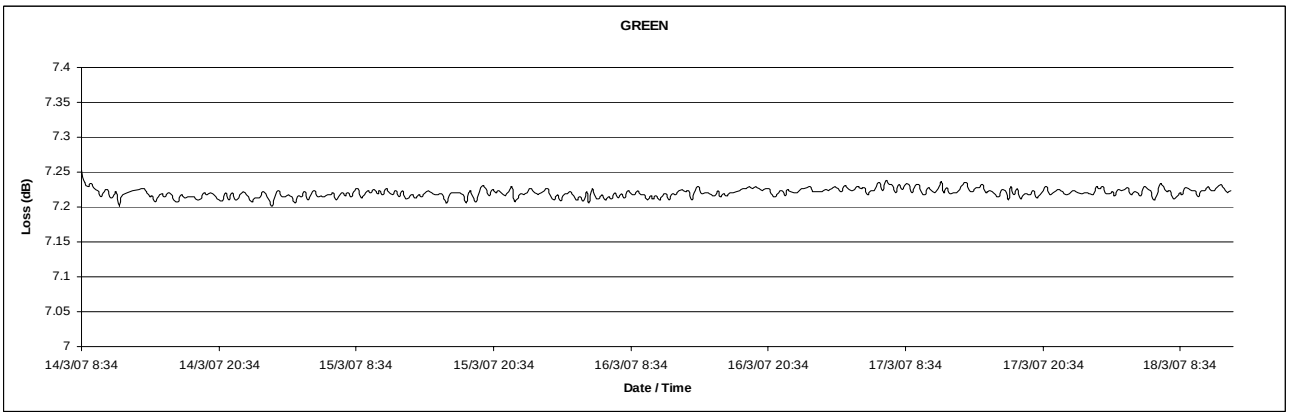


3.2.1 - MARS OTDR Lay Monitor (From Moss Landing to SJ1 position)

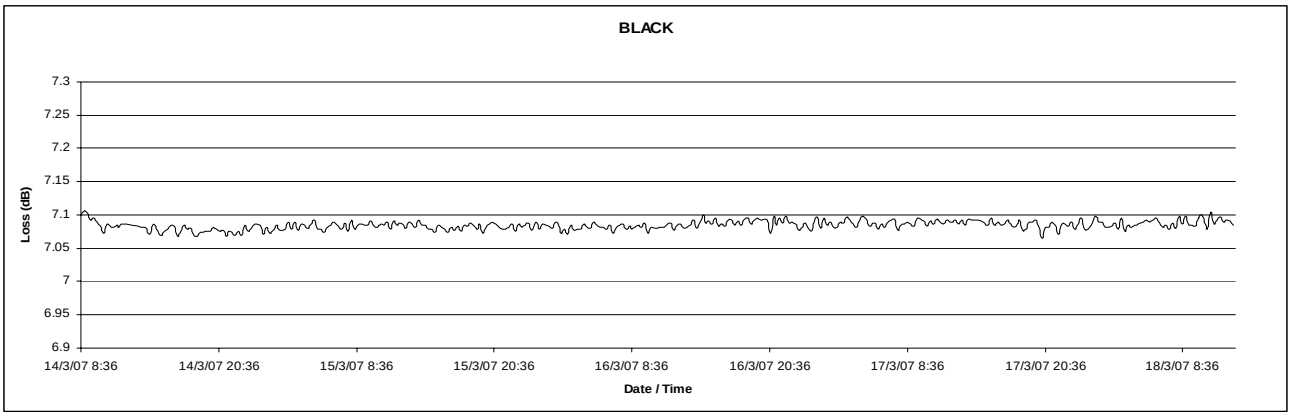


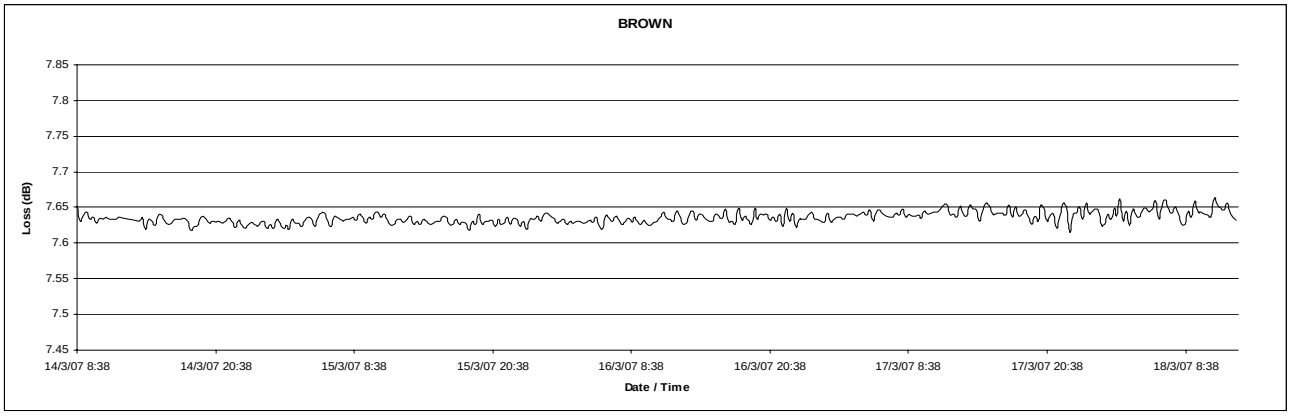


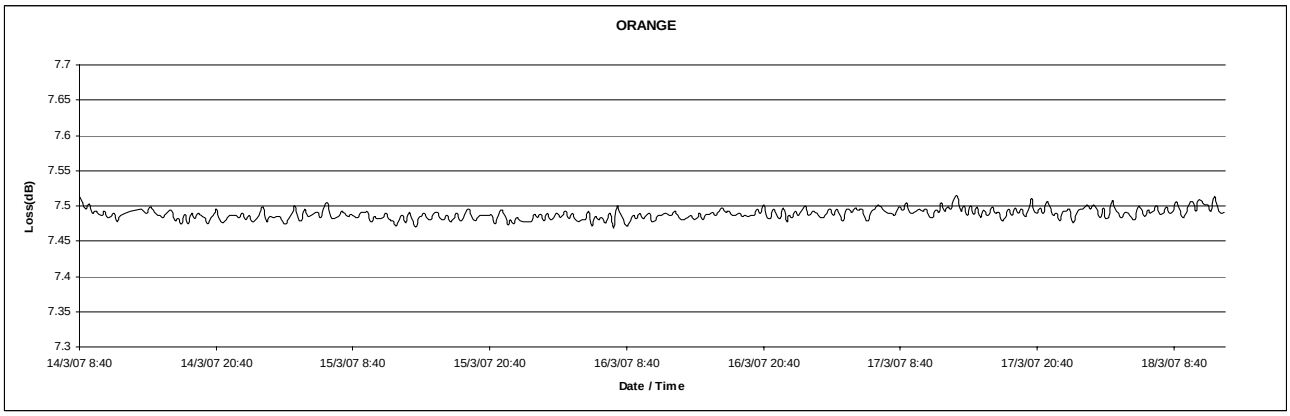


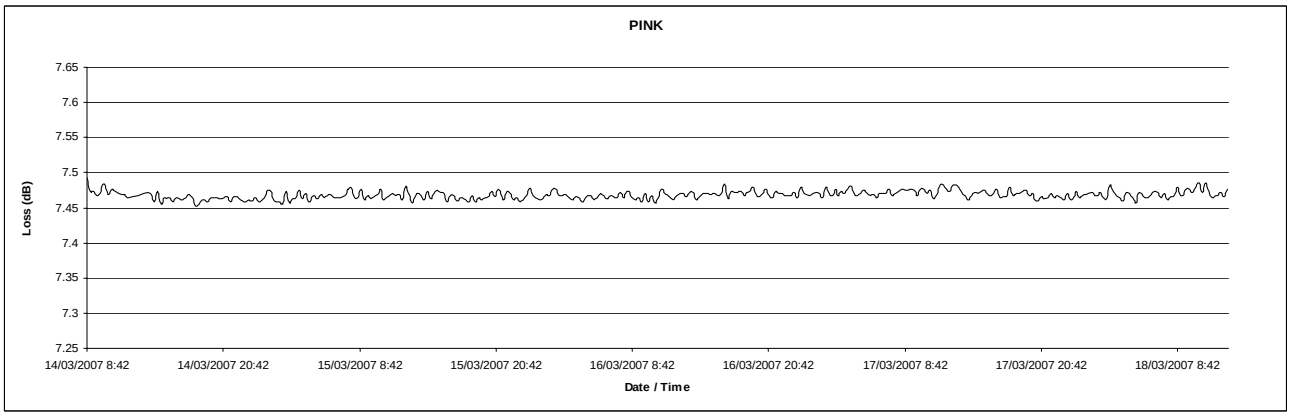


3.2.1 - MARS OTDR Lay Monitor (From Moss Landing to SJ1 position)

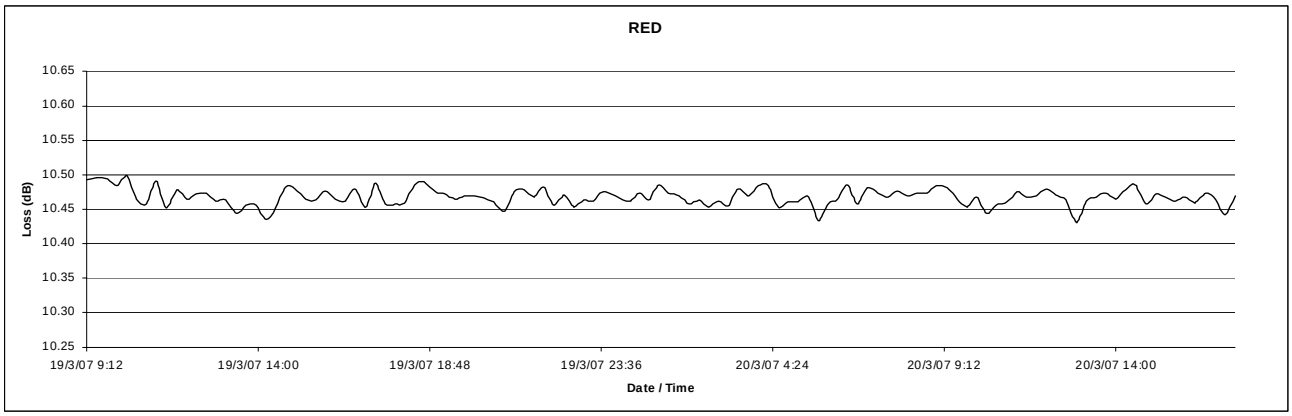


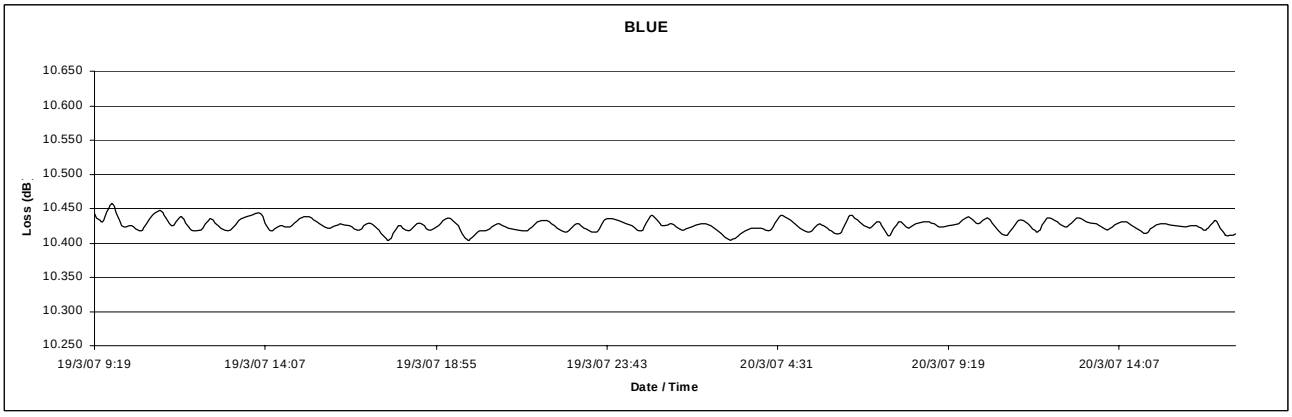


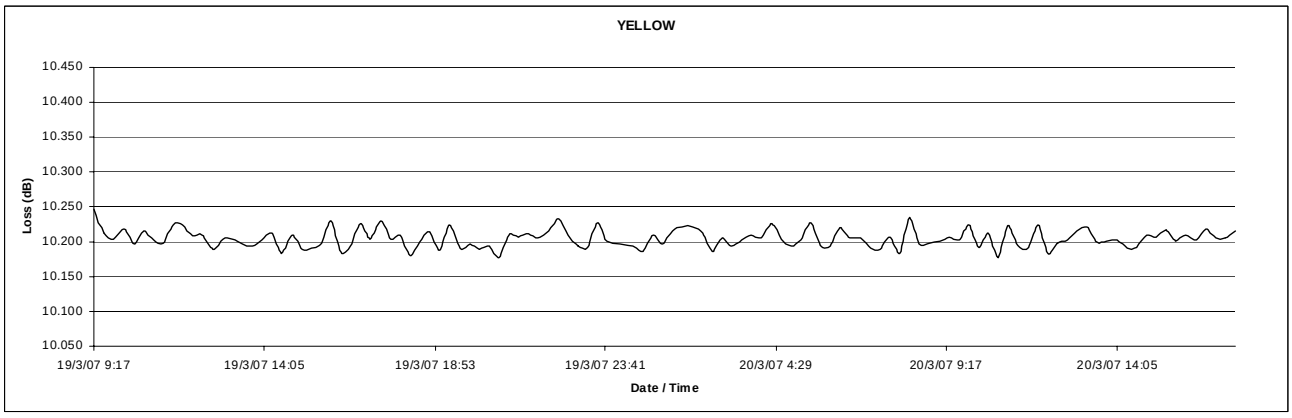


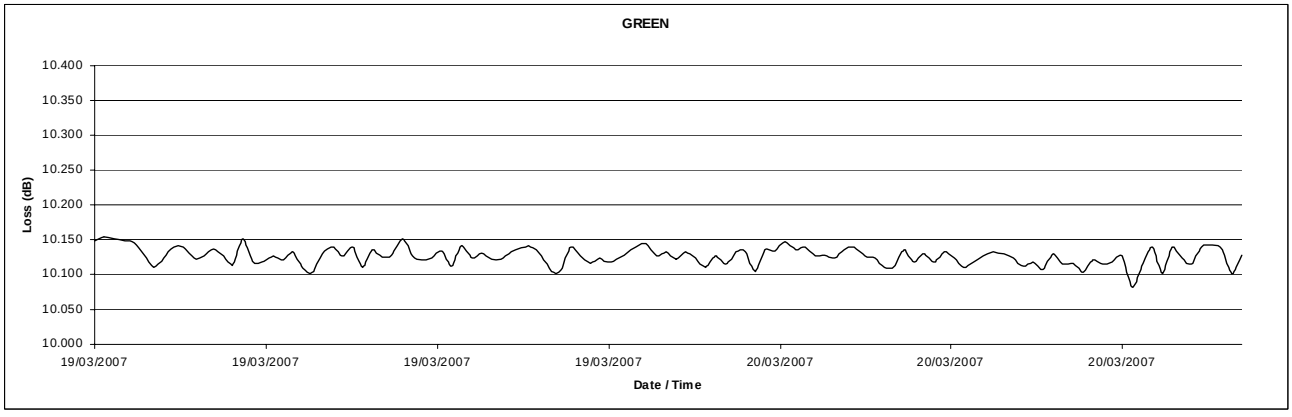


3.2.2 - MARS OTDR Lay Monitor (From SJ1 position to End of Lay)

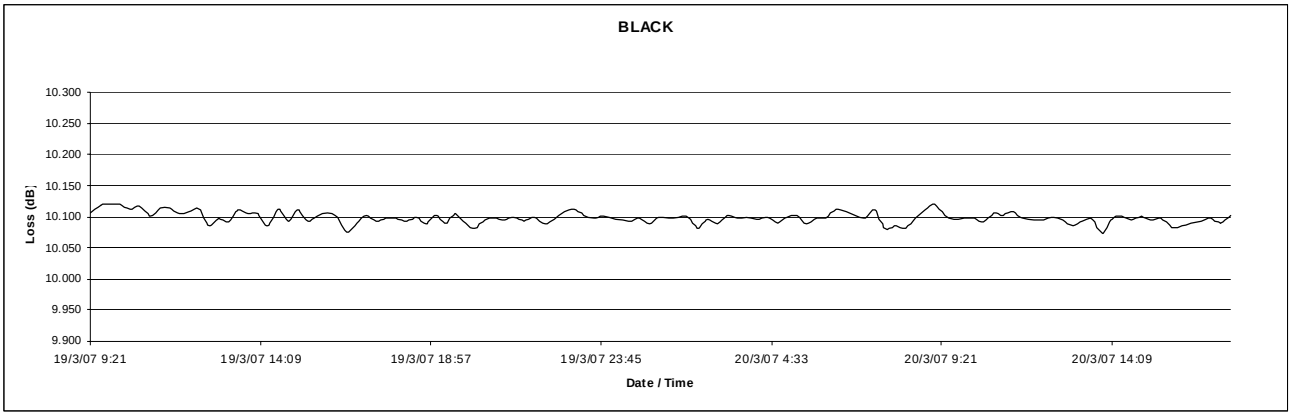


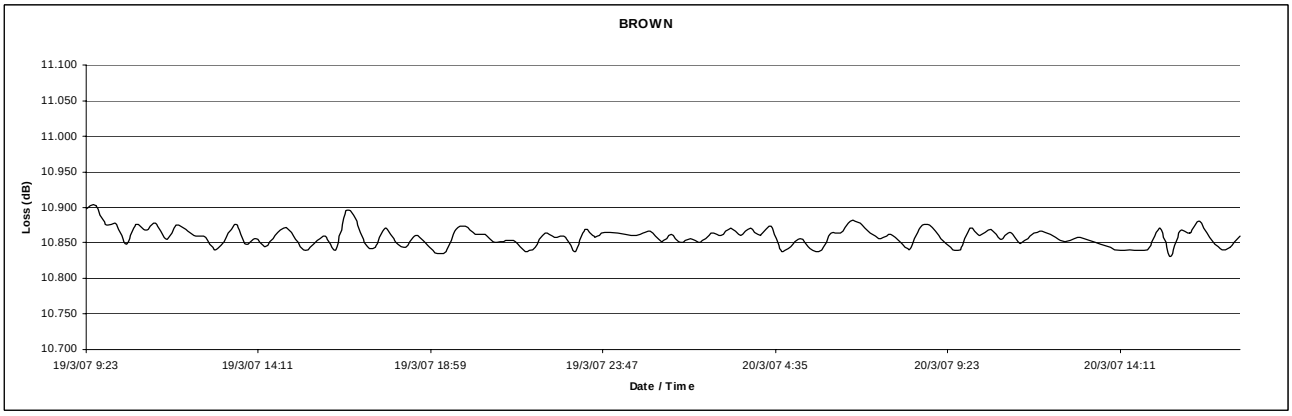


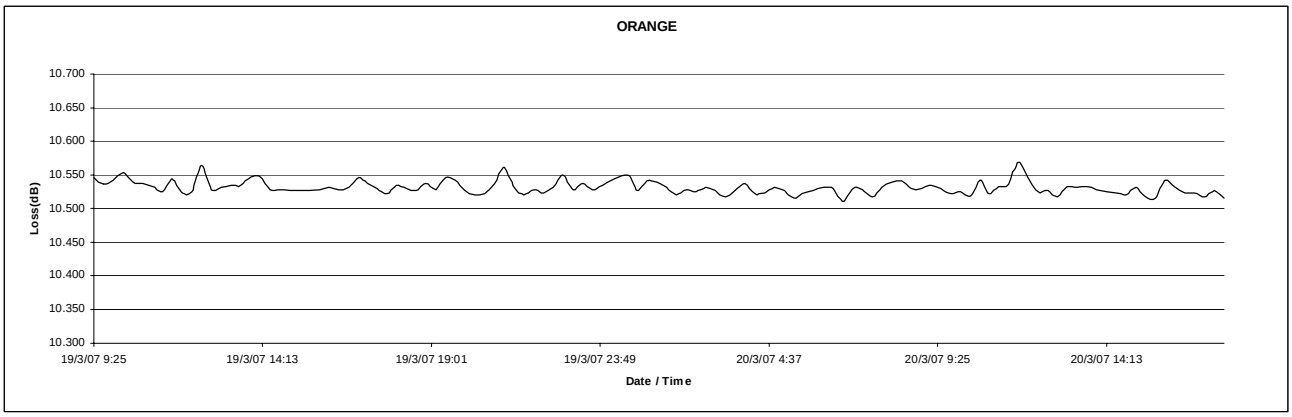


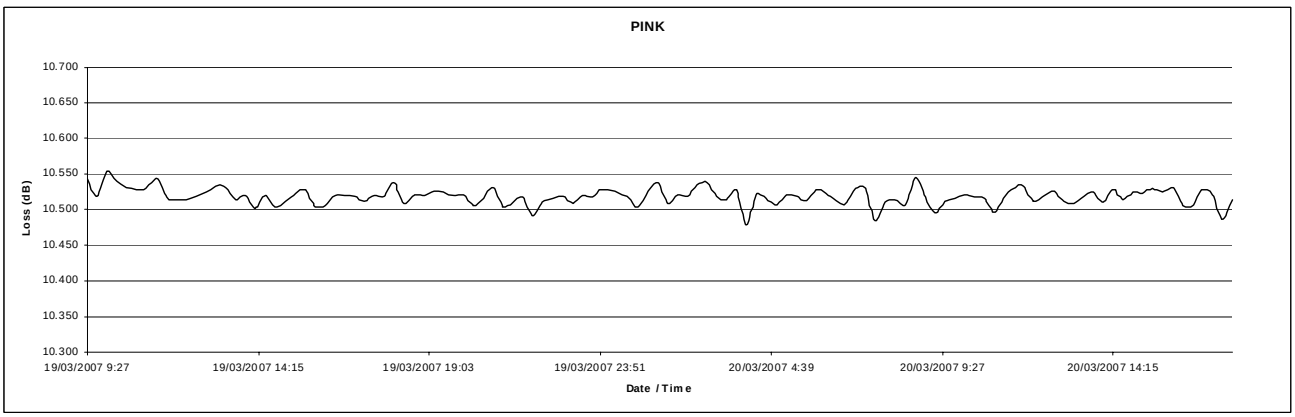


3.2.2 - MARS OTDR Lay Monitor (From SJ1 position to End of Lay)







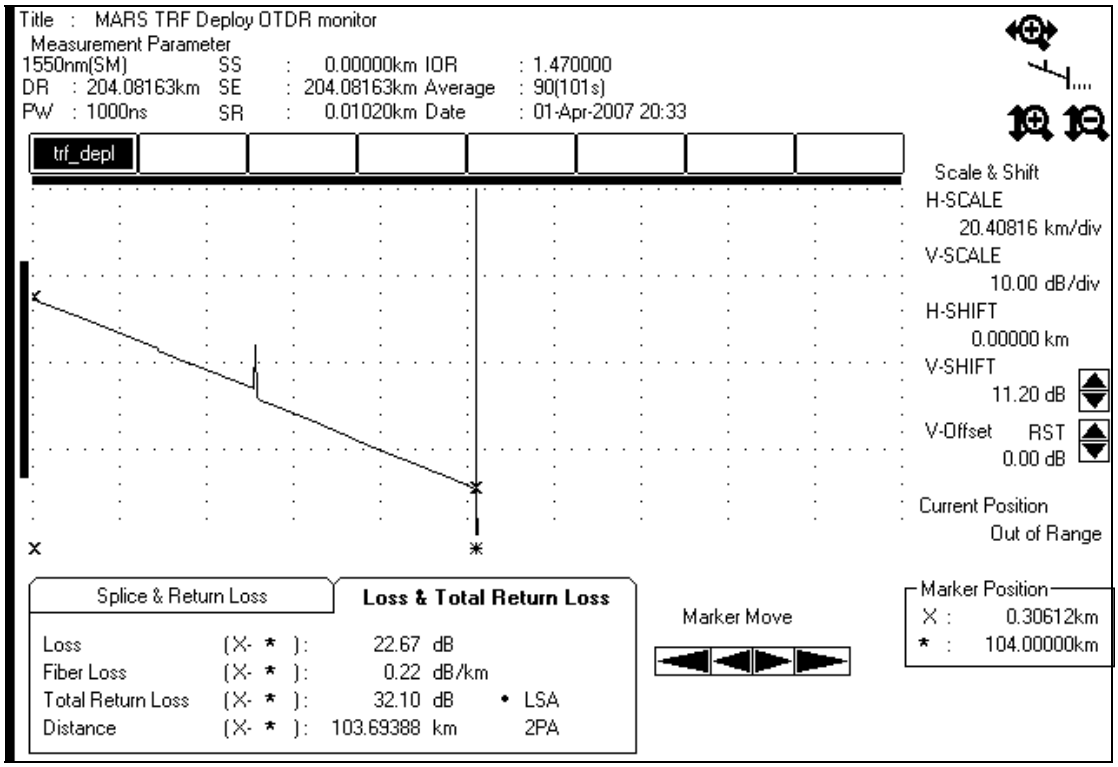


3.3 MARS OTDR Lay Monitor During TRF/CTA Deployment

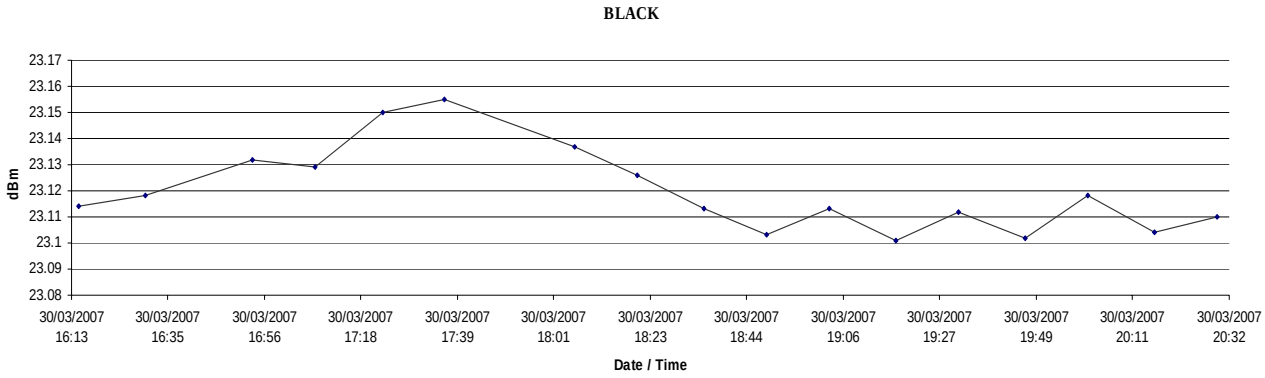
Tester J. Roberts
Date 30 March 2007

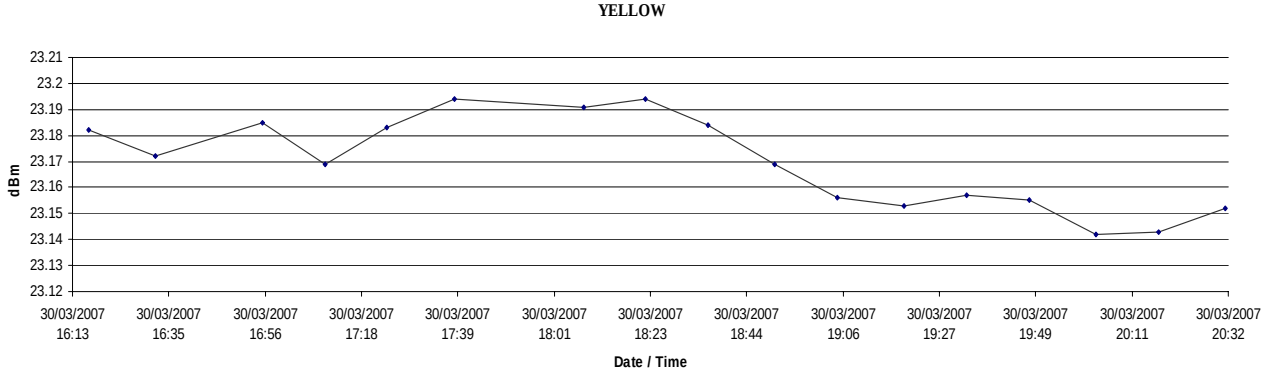
OTDR Parameters

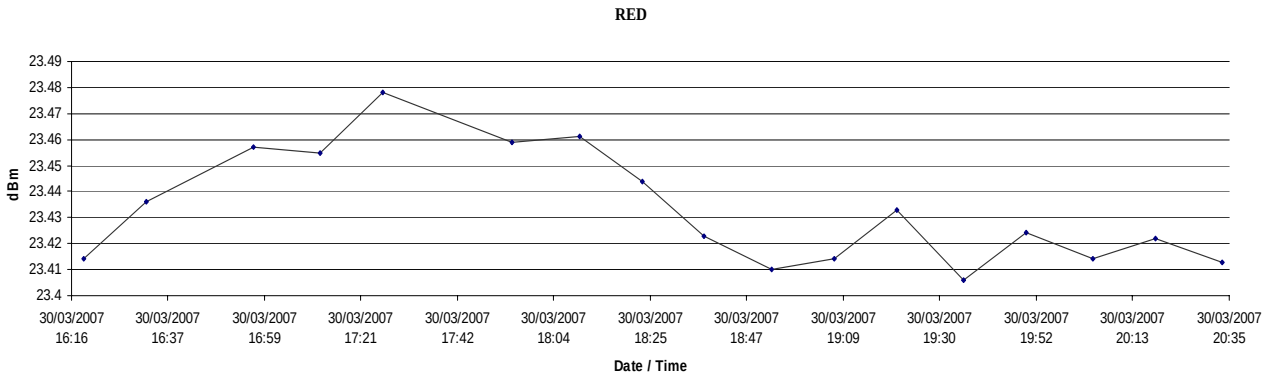
Global Sentinel	
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	1000ns
Averaging	90(101s)

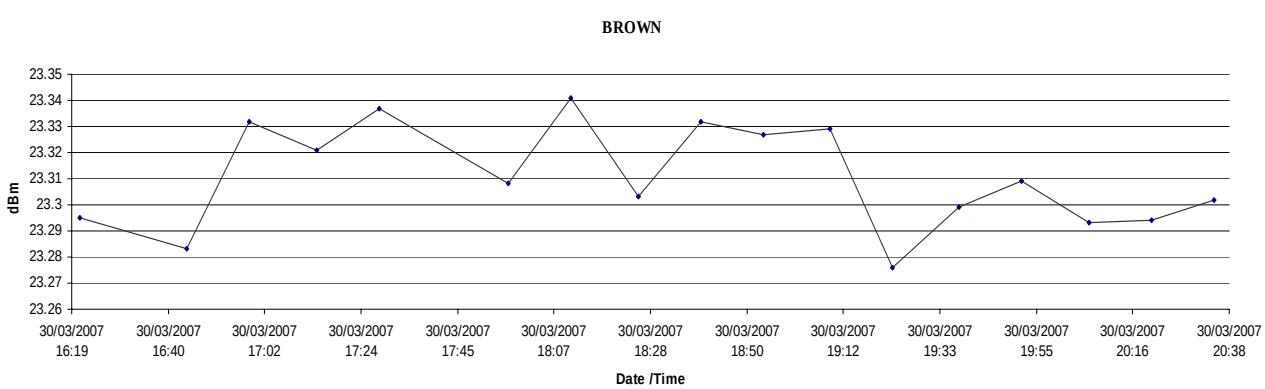


3.3.1 - OTDR Monitor (During deployment of TRF)



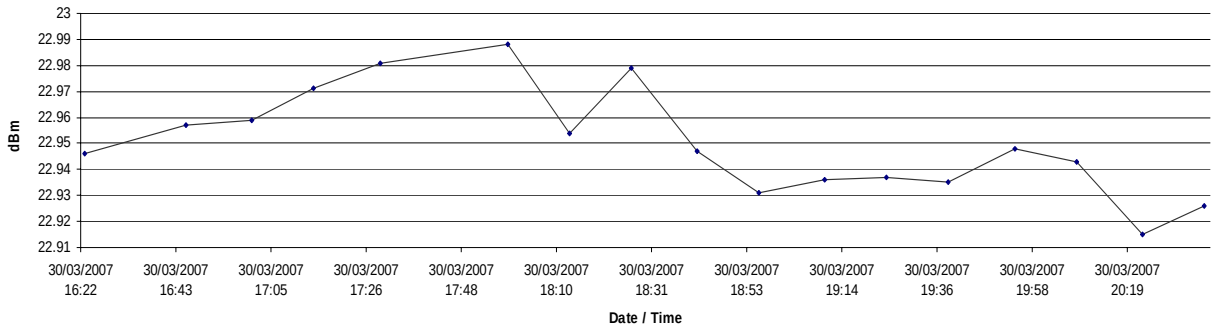




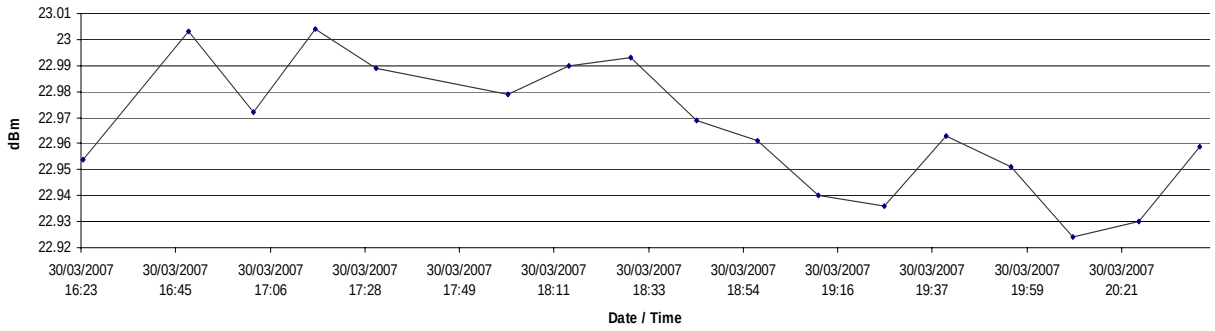


3.3.1 - OTDR Monitor (During deployment of TRF)

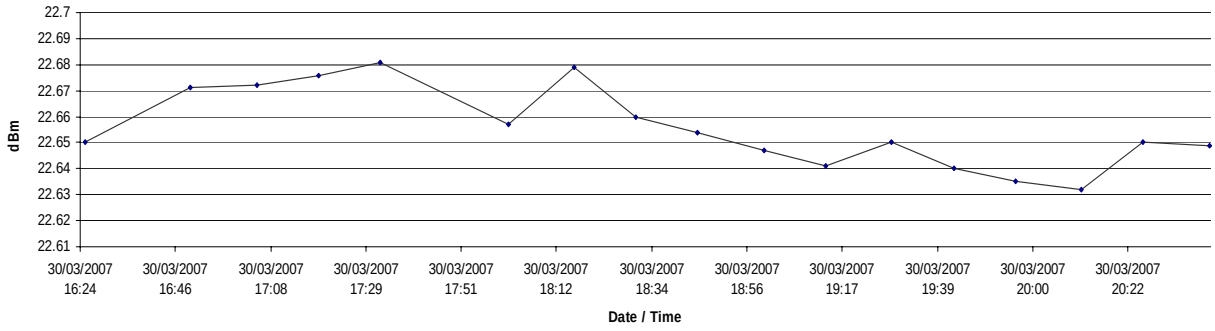
BLUE



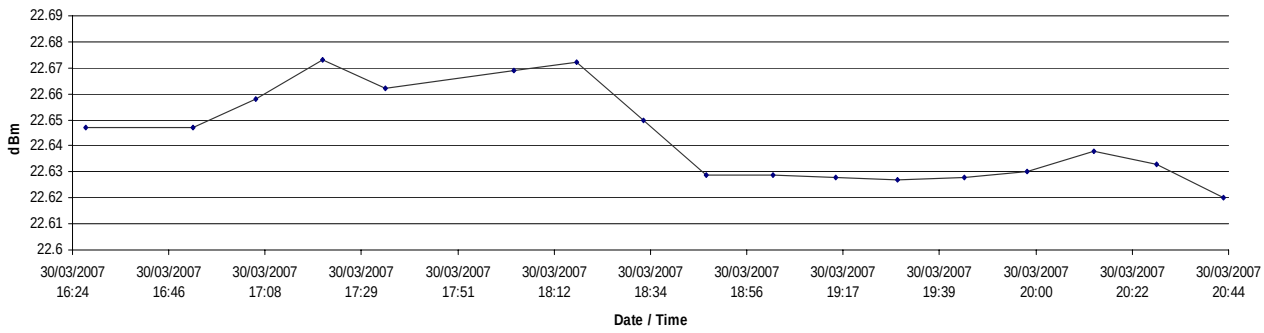
ORANGE



GREEN



PINK



3.4 MARS End of Lay OTDR from Global Sentinel

Tester G. Jones
Date 20th March 2007

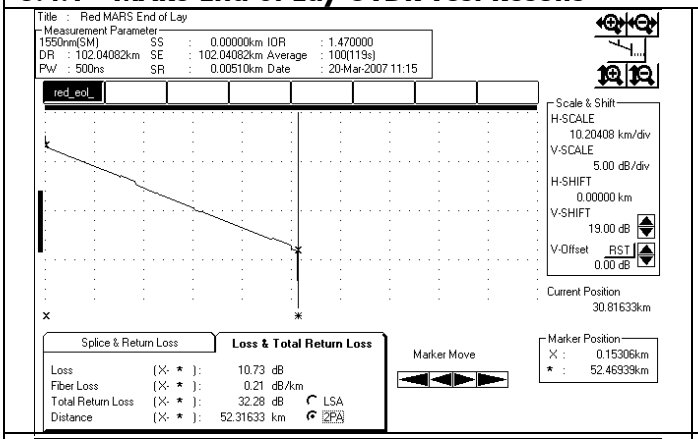
Test: One way OTDR (From vessel)

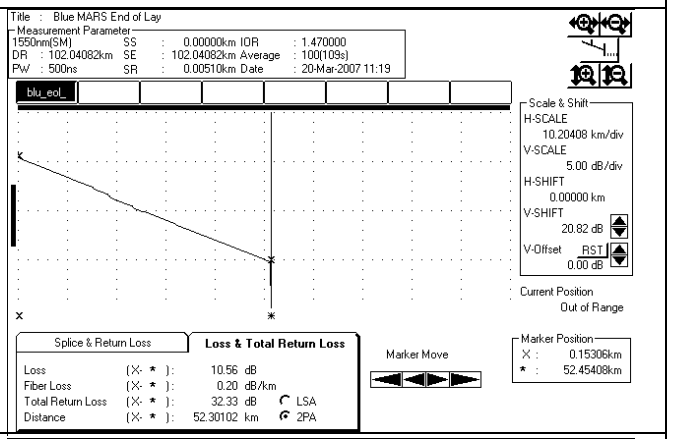
OTDR Parameters

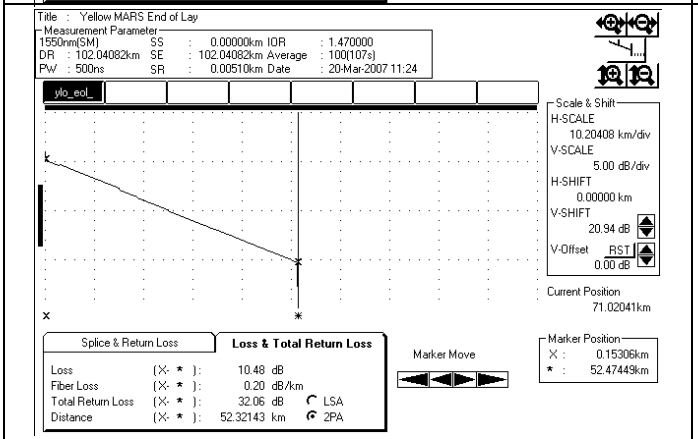
Global Sentinel	
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	500ns
Averaging	100(119s)

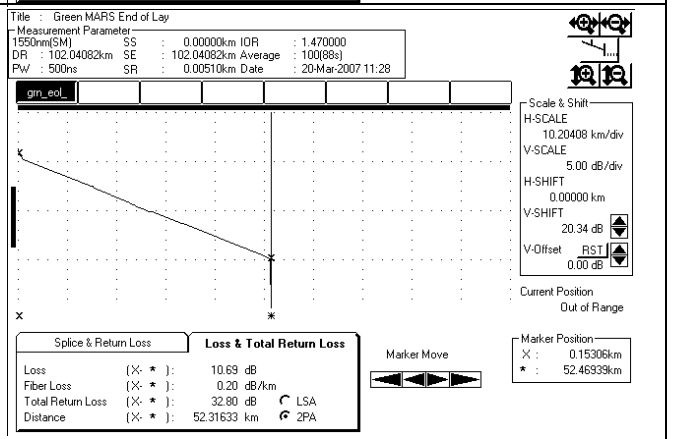
MARS End of Lay OTDR (from Global Sentinel)					
Fibre		**Cursor Position /Km**		**Attenuation**	
Number	Colour	C1	C2	dB	dB/Km
1	**Red**	0.153	52.469	**10.73**	**0.208**
2	**Yellow**	0.153	52.454	**10.56**	**0.202**
3	**Blue**	0.153	52.474	**10.48**	**0.200**
4	**Green**	0.153	52.469	**10.69**	**0.204**
5	**Black**	0.153	52.484	**10.39**	**0.199**
6	**Brown**	0.153	52.464	**11.12**	**0.213**
7	**Orange**	0.153	52.454	**10.83**	**0.207**
8	**Pink**	0.153	52.469	**10.79**	**0.206**

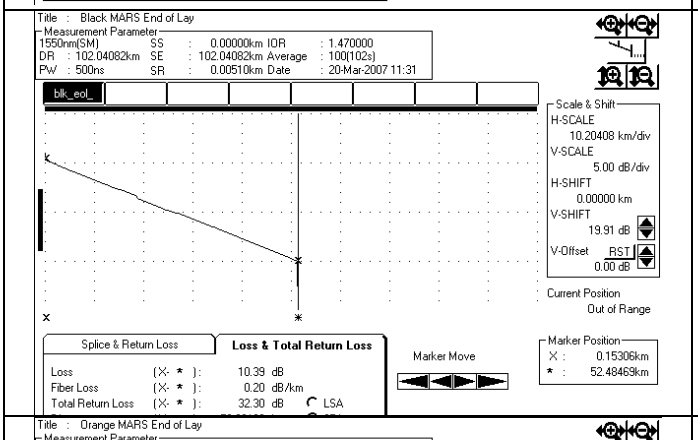
3.4.1 - MARS End of Lay OTDR Test Results

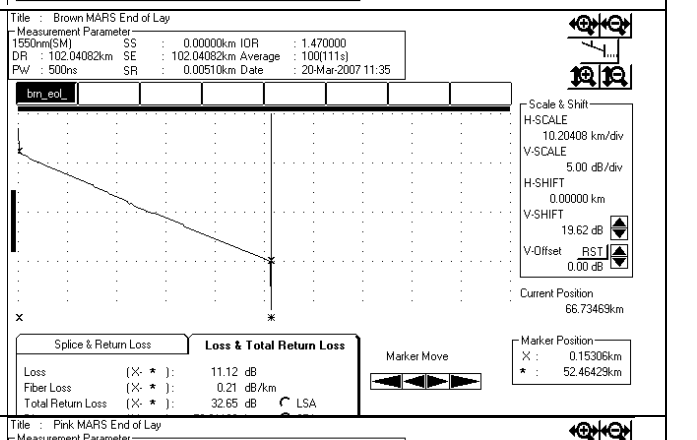


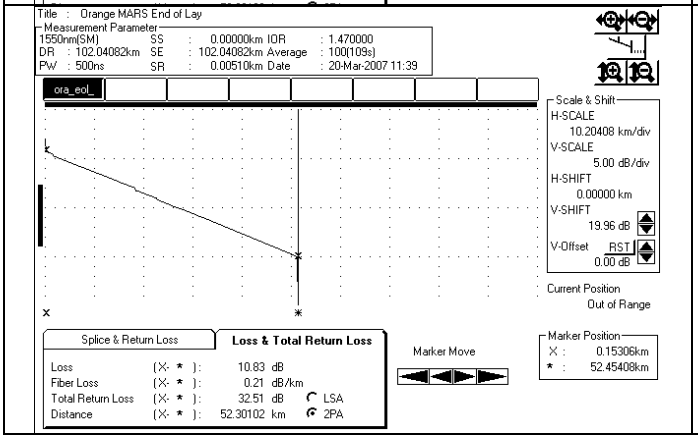


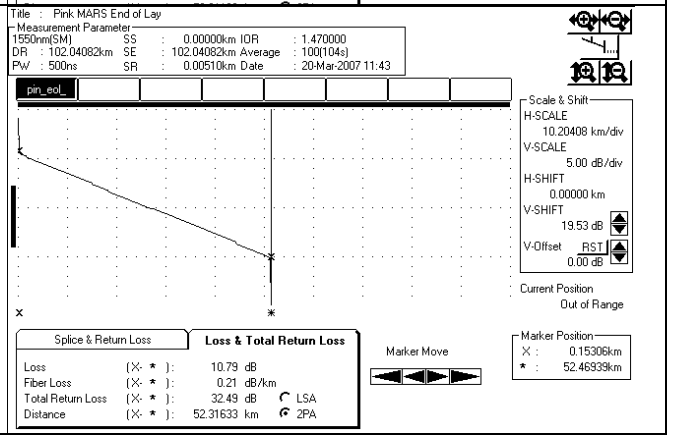












3.5 MARS Final Length OTDR (from cs Global Sentinel)

Tester G. Jones
Date 30th March 2007

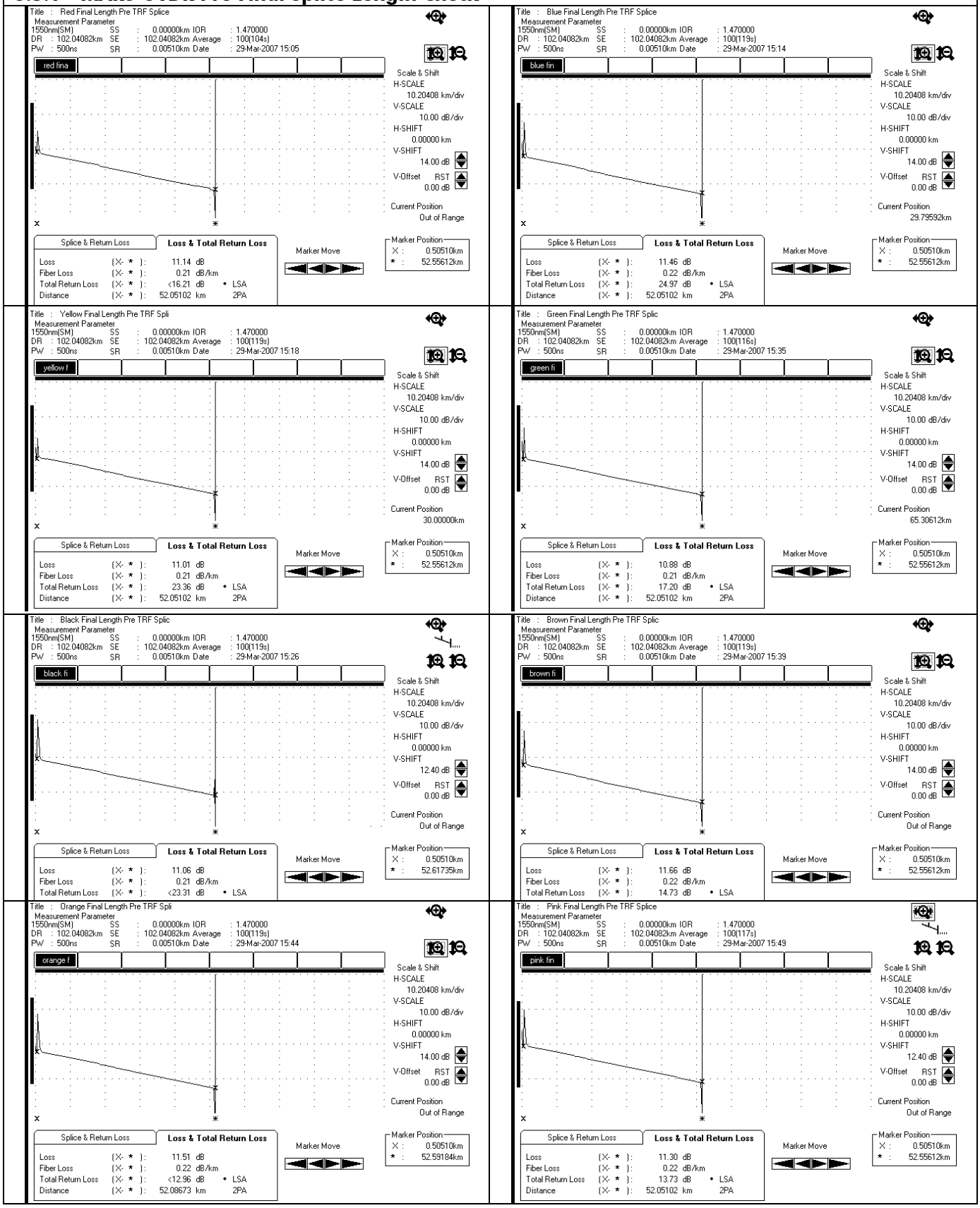
Test: One way OTDR From vessel to determine system length prior to Final Splice / CTA.

OTDR Parameters

Global Sentinel	
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	500ns
Averaging	100(119s)

MARS Final Length OTDR from Global Sentinel					
Fibre		**Cursor Position /Km**		**Attenuation**	
Number	Colour	C1	C2	dB	dB/Km
1	**Red**	0.505	52.556	**11.14**	**0.21**
2	**Yellow**	0.505	52.556	**11.01**	**0.21**
3	**Blue**	0.505	52.556	**11.46**	**0.22**
4	**Green**	0.505	52.556	**10.88**	**0.21**
5	**Black**	0.505	52.617	**11.06**	**0.21**
6	**Brown**	0.505	52.556	**11.66**	**0.22**
7	**Orange**	0.505	52.591	**11.51**	**0.22**
8	**Pink**	0.505	52.556	**11.30**	**0.22**

3.5.1 - MARS OTDR Pre Final Splice Length Check



4. JOINT TEST RESULTS

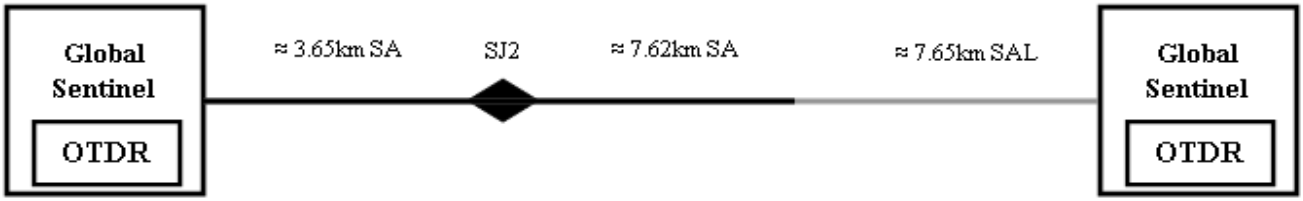
4.1 Joint SJ2

Operator J.Roberts / G.Jones

Date 10-March-2007

Test method Two way OTDR. (Both ends on board the Global Sentinel)

Remarks This joint was made during the transit from Portland to Monterey Bay.



Test set up Joint SJ2

OTDR Parameters

(3.65km SA end)

Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	100ns
Averaging	90 (104secs)

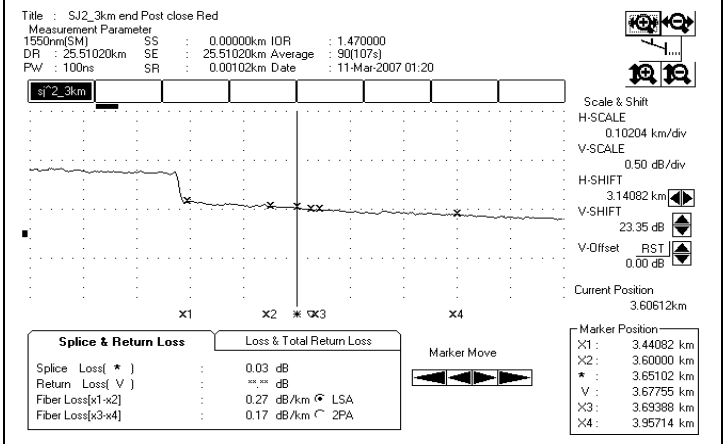
(7.65km SAL end)

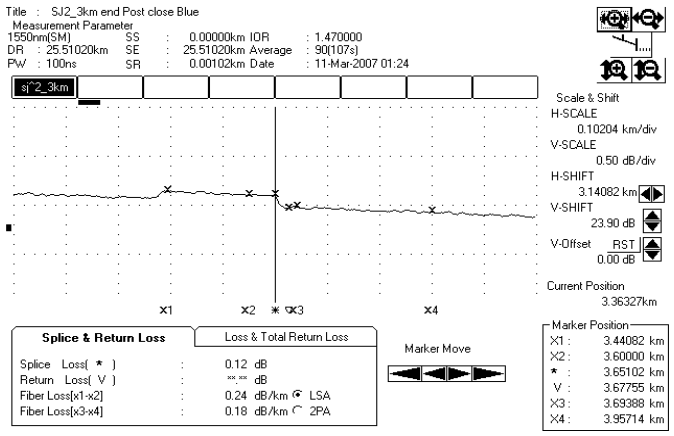
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	100ns
Averaging	90 (107secs)

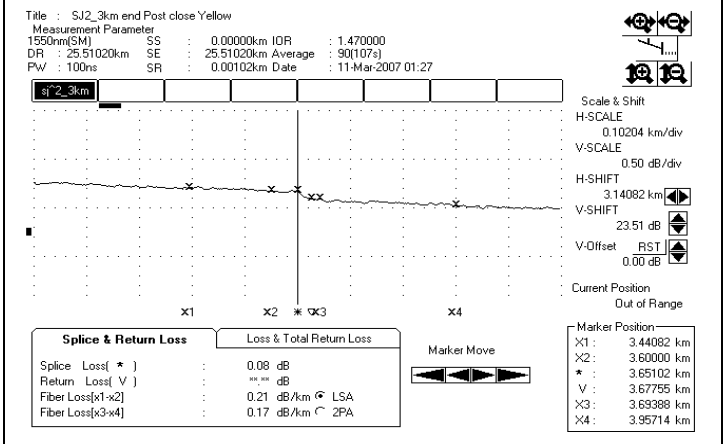
Splice loss OTDR measurement. Joint SJ2 (post close)

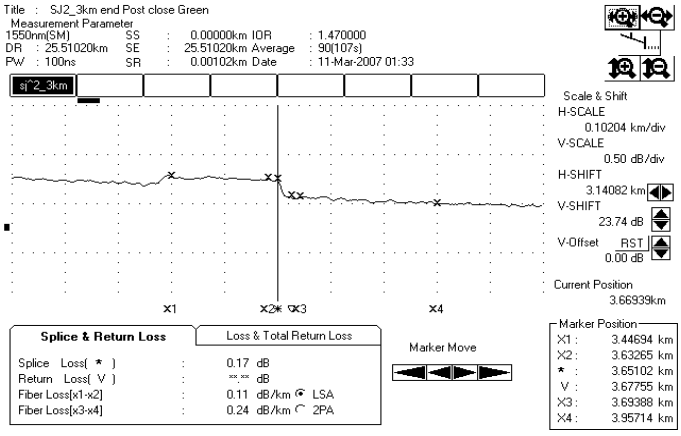
Fibre	From 3.65km SA end (dB)	From 7.65km SAL end (dB)	Average loss (dB)
Red	0.10	0.09	**0.10**
Blue	0.12	-0.08	**0.02**
Yellow	0.08	0.11	**0.10**
Green	0.17	-0.05	**0.06**
Black	0.16	-0.04	**0.06**
Brown	0.07	-0.01	**0.03**
Orange	0.12	-0.04	**0.04**
Pink	-0.09	0.17	**0.04**

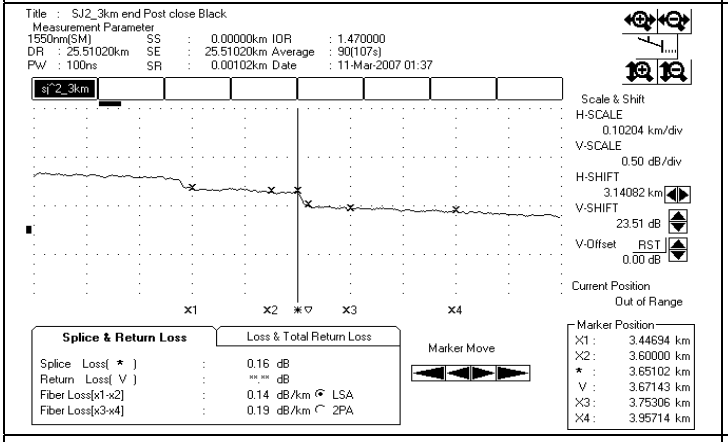
4.1 - Joint SJ2 Post close OTDR from 3.65km SA End

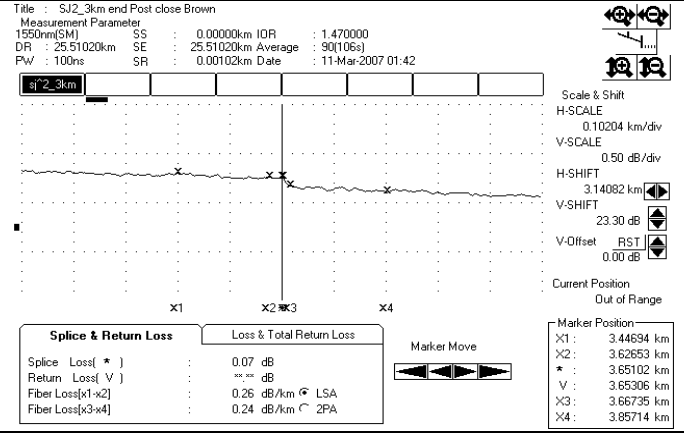


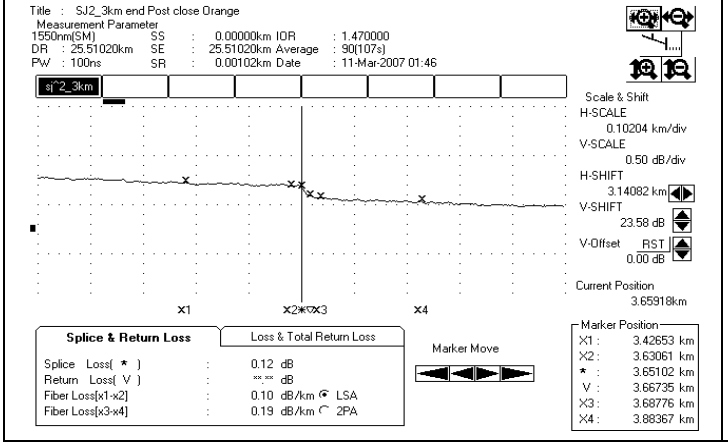


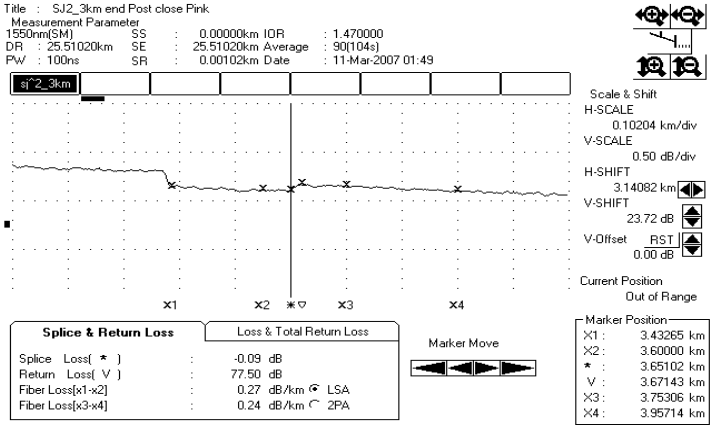




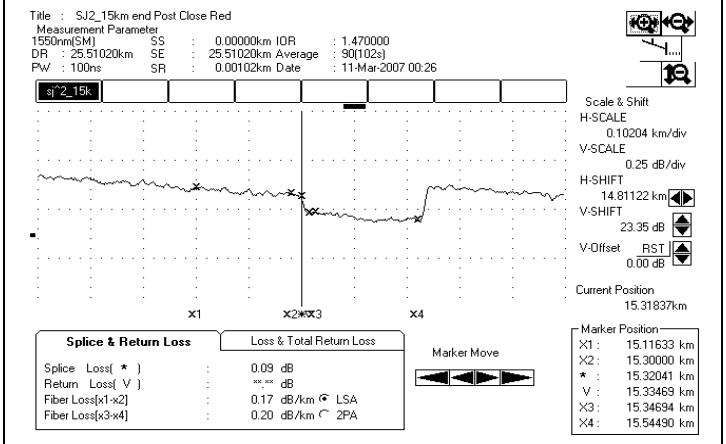


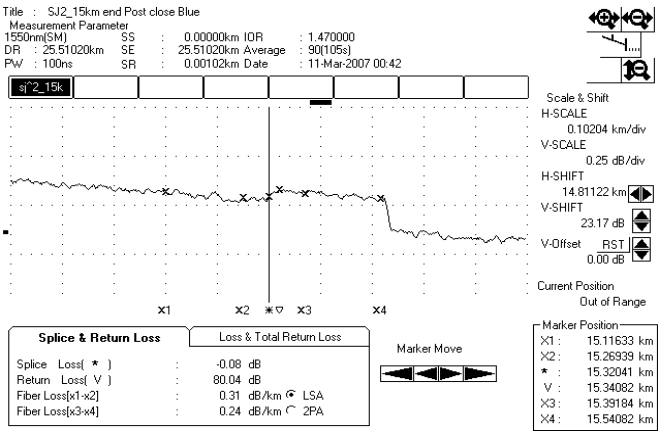


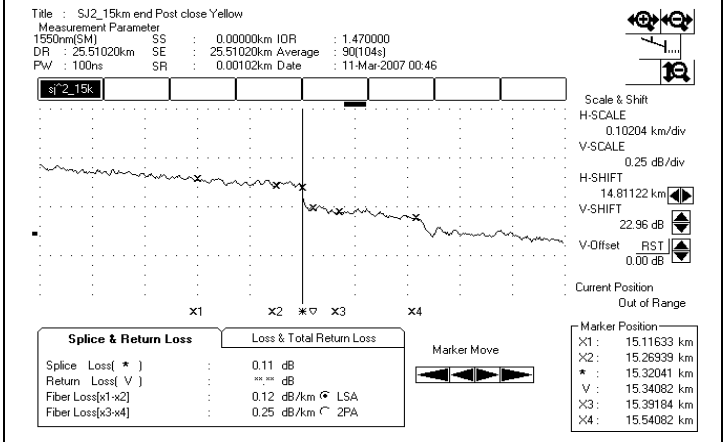


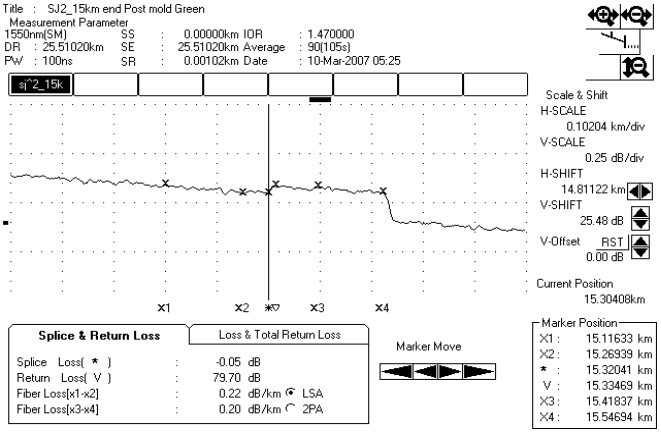


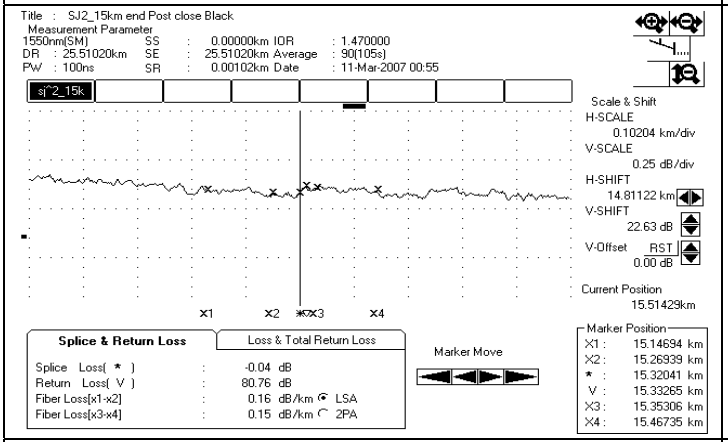
4.1 - Joint SJ2 Post close OTDR (from 7.65km SAL End)

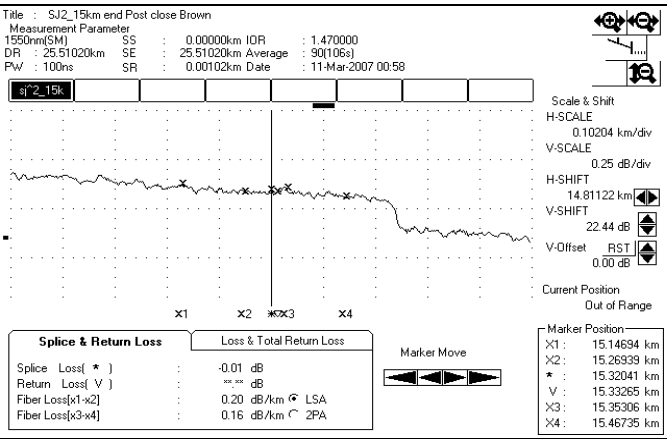


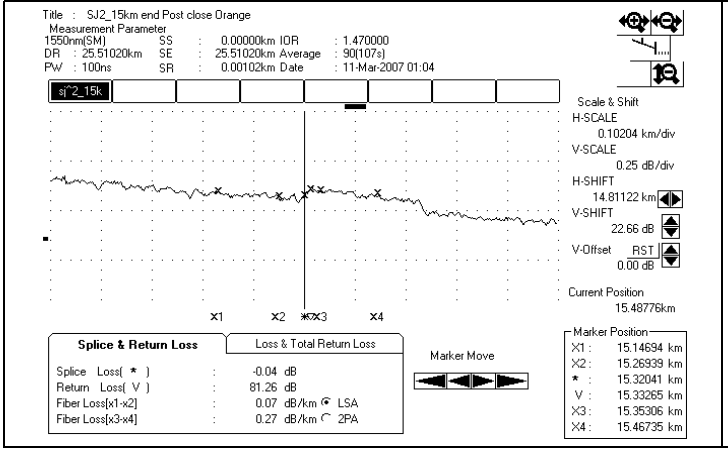


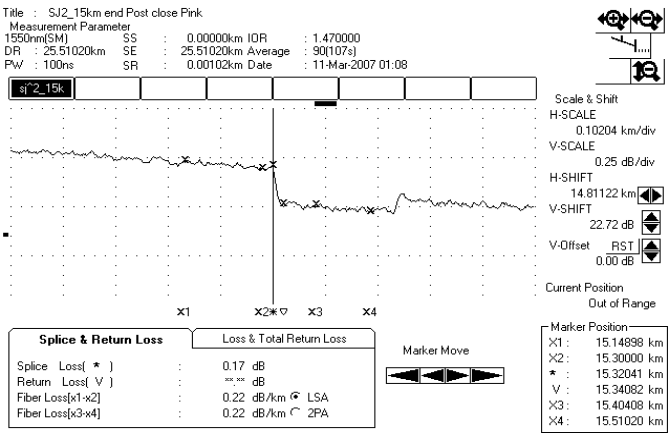












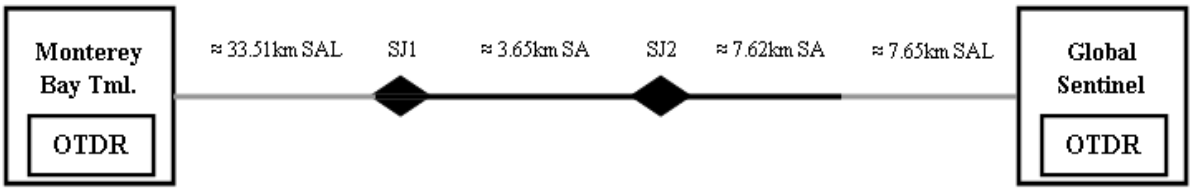
4.2 Joint SJ1 SA to SA

Operator J. Roberts / G. Jones

Date 19-March-2007

Test method Two way OTDR. (From Global Sentinel & Monterey Bay Terminal)

Remarks Joint was made after laying 33.51km**.**



Test set up Joint SJ1

OTDR Parameters

Global Sentinel

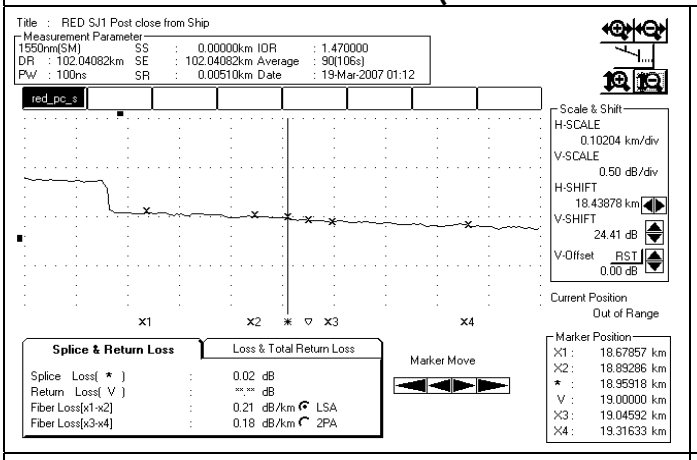
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	100ns
Averaging	90 (106secs)

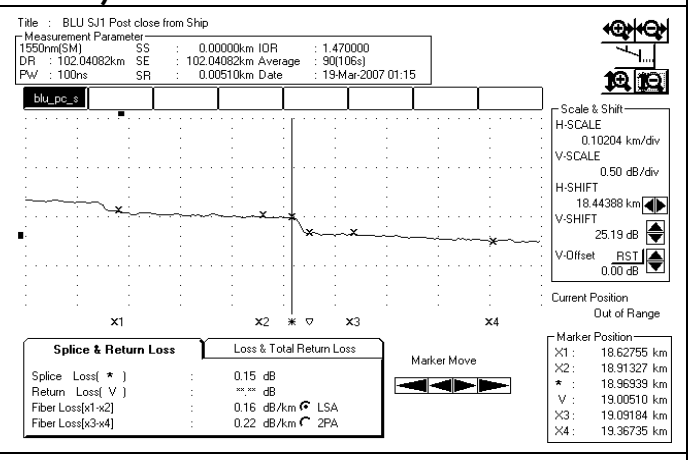
Monterey Bay Terminal

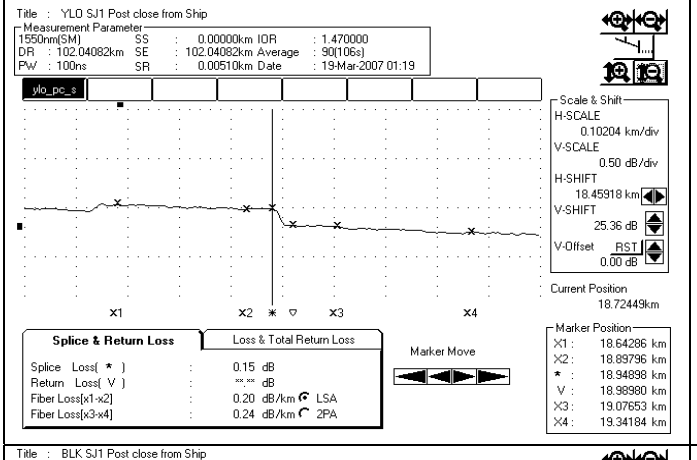
Equipment	Anritsu MW9076B OTDR
Refractive index	1.47
Pulse Width	500ns
Averaging	120 (140secs)

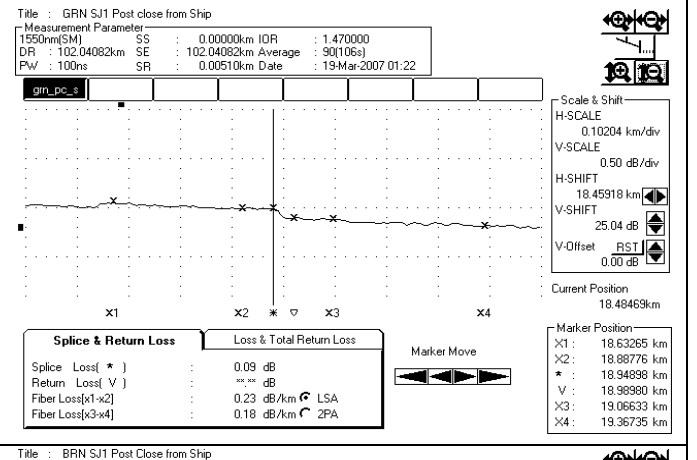
Fibre	From Global Sentinel (dB)	From Monterey Bay (dB)	Average loss (dB)
Red	0.02	0.01	**0.01**
Blue	0.15	0.15	**0.15**
Yellow	0.15	0.01	**0.08**
Green	0.09	0.04	**0.06**
Black	0.22	-0.15	**0.03**
Brown	-0.01	0.17	**0.08**
Orange	-0.08	0.24	**0.08**
Pink	0.03	0.04	**0.03**

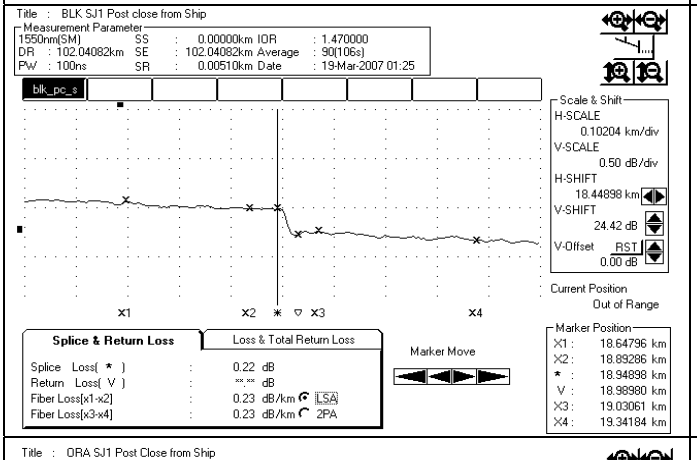
4.2 – Joint SJ1 Post close OTDR (From Global Sentinel End)

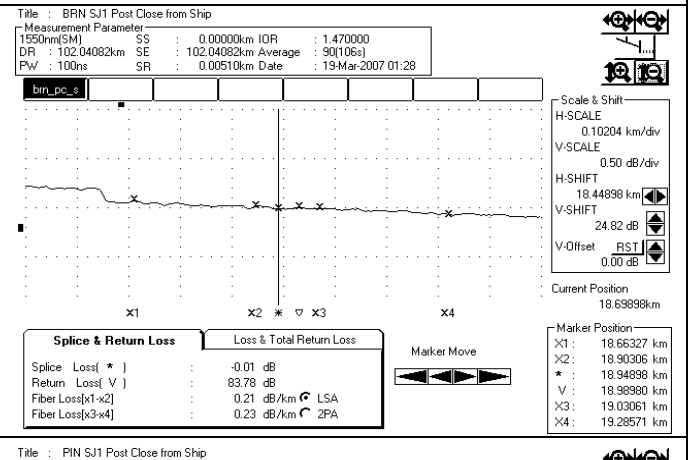


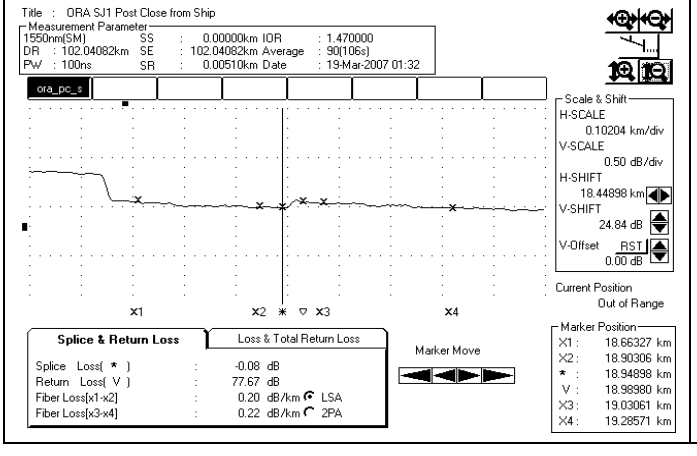


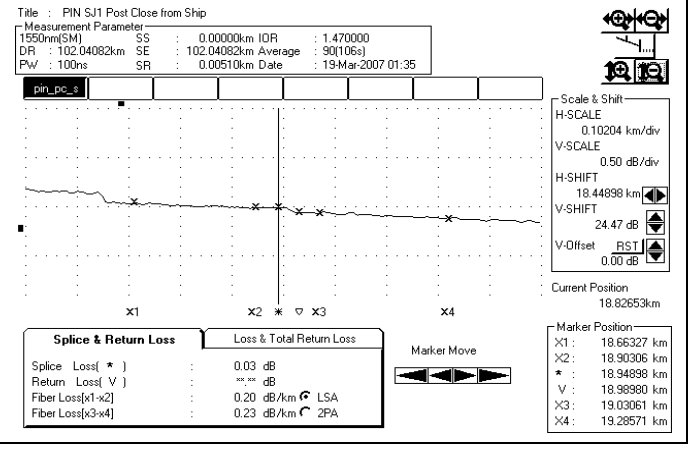




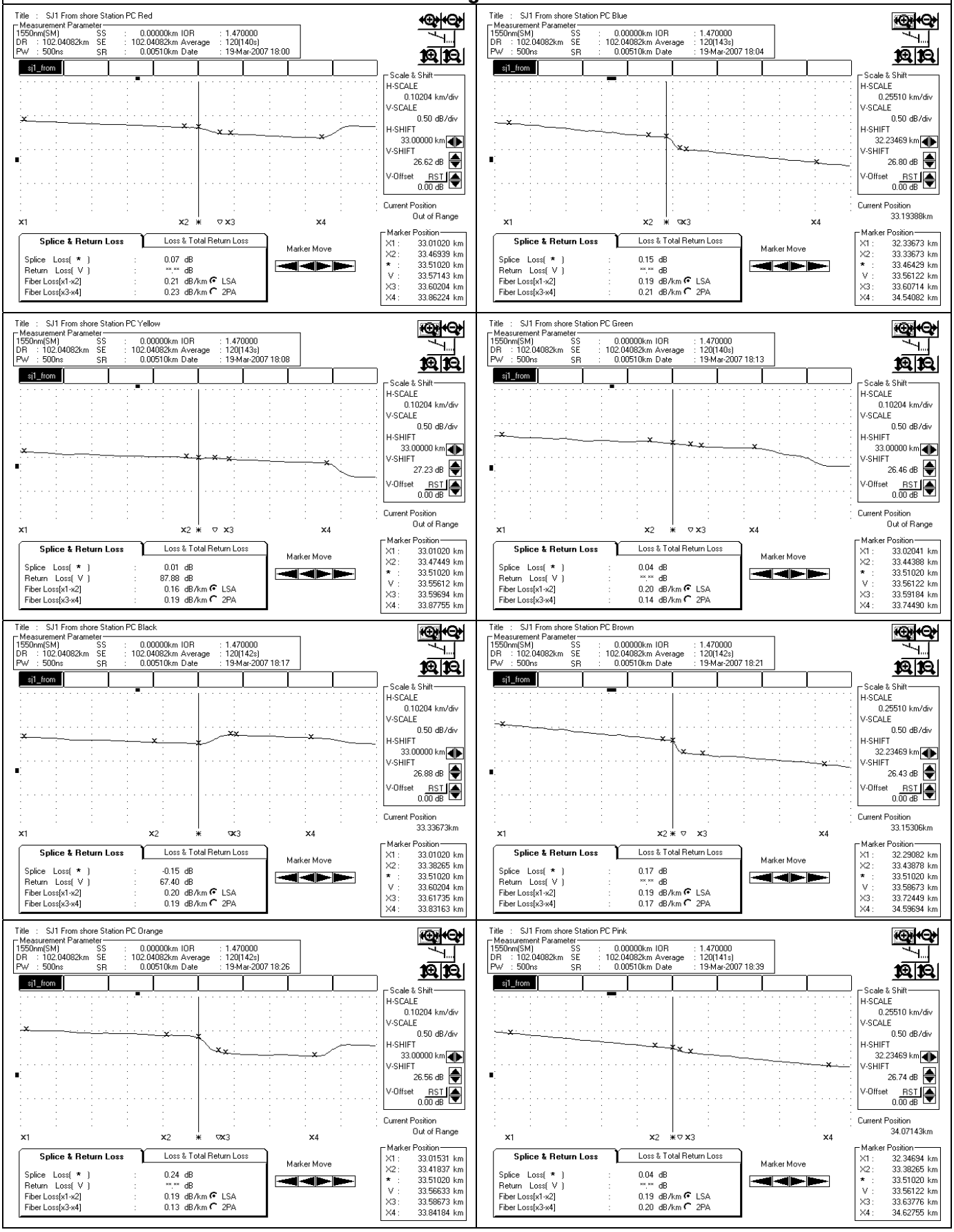








4.2 - Joint SJ1 Post close OTDR from Moss Landing End



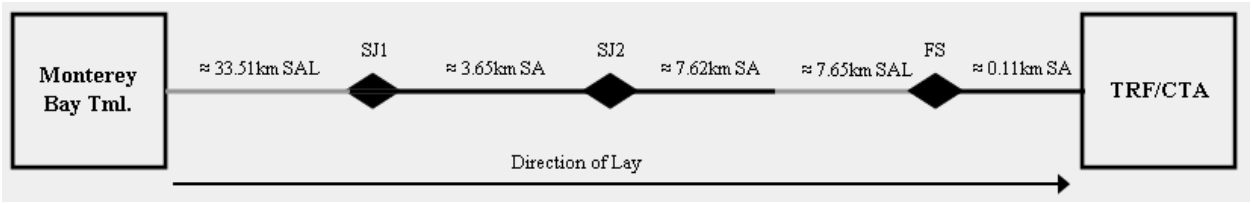
4.3 Final Splice

Operator J.Roberts / G.Jones

Date 31-March-2007

Test method Two way OTDR from terminal by means of loop-back terminations in the CTA.

Remarks Given the proximity of the FS to the end of the cable, OTDR traces here show losses that include the loop back termination at the CTA, as well as an existing splice in the CTA cable tail.



Test set up Joint FS

OTDR Parameters

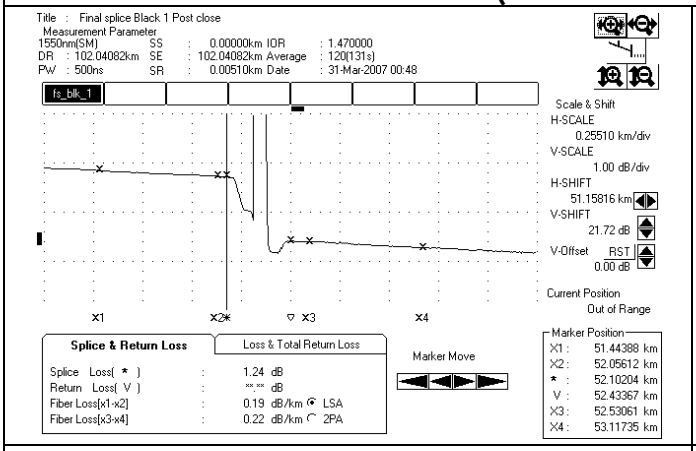
Equipment	Anritsu MW9076B OTDR
Refractive index	1.470
Pulse Width	500ns
Averaging	120 (138secs)

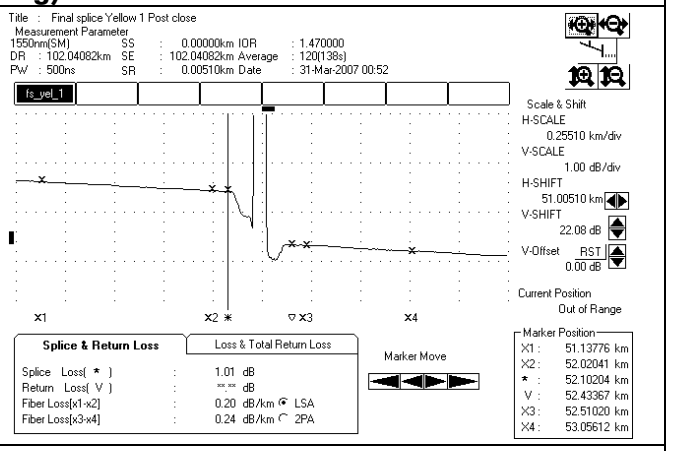
Splice loss OTDR measurement. FS (post close)

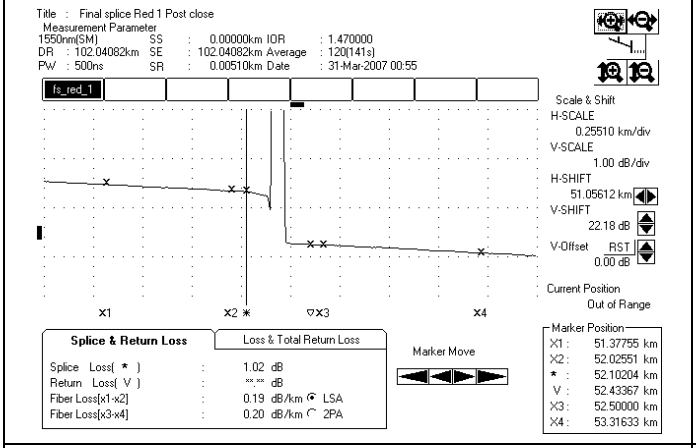
Fibre Colour		Loss A > B (dB)	Loss B > A (dB)	Average loss (dB)**
A	B			
Black	Yellow	1.24	1.01	**1.13**
Red	Brown	1.02	1.28	**1.15**
Blue	Orange	1.06	1.29	**1.18**
Green	Pink	0.96	0.77	**0.87**

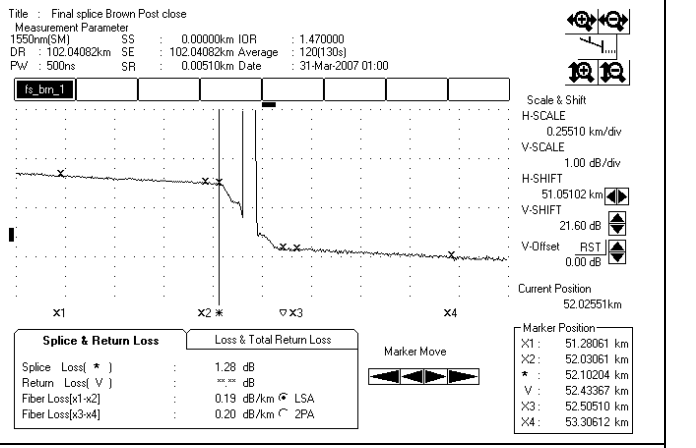
** See remarks above.

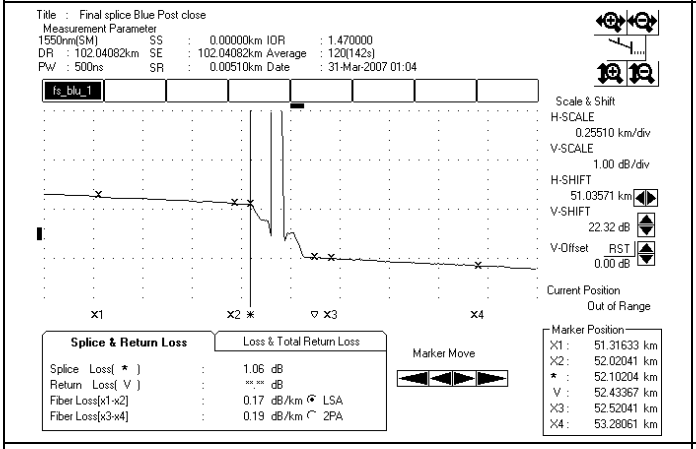
4.3 - FINAL SPLICE Post close OTDR (From Moss Landing)

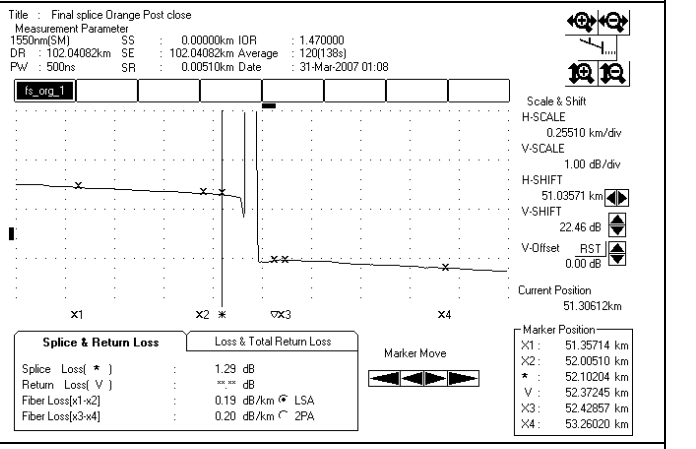


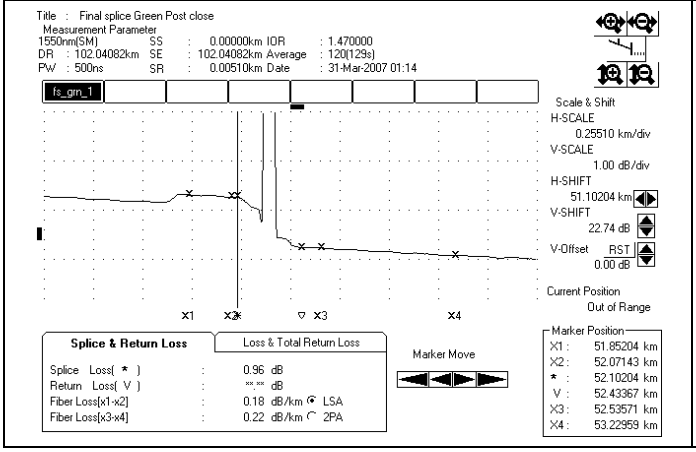


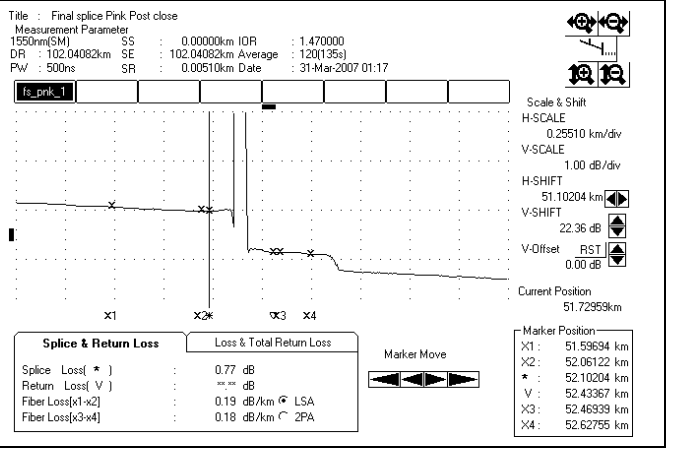












5. COMMISSIONING RESULTS

5.1 104.490Km System Cable Commissioning Electrical Data Sheet

Operator J.Roberts
Date 2-Apr-2007
Length 104.490Km (OTDR)

ELECTRICAL MEASUREMENTS

	Units	Post Load	Limits
Insulation Resistance @ 500V for 5 mins	**GΩ**	**> 30 GΩ**	**>100 000MΩ/Km**

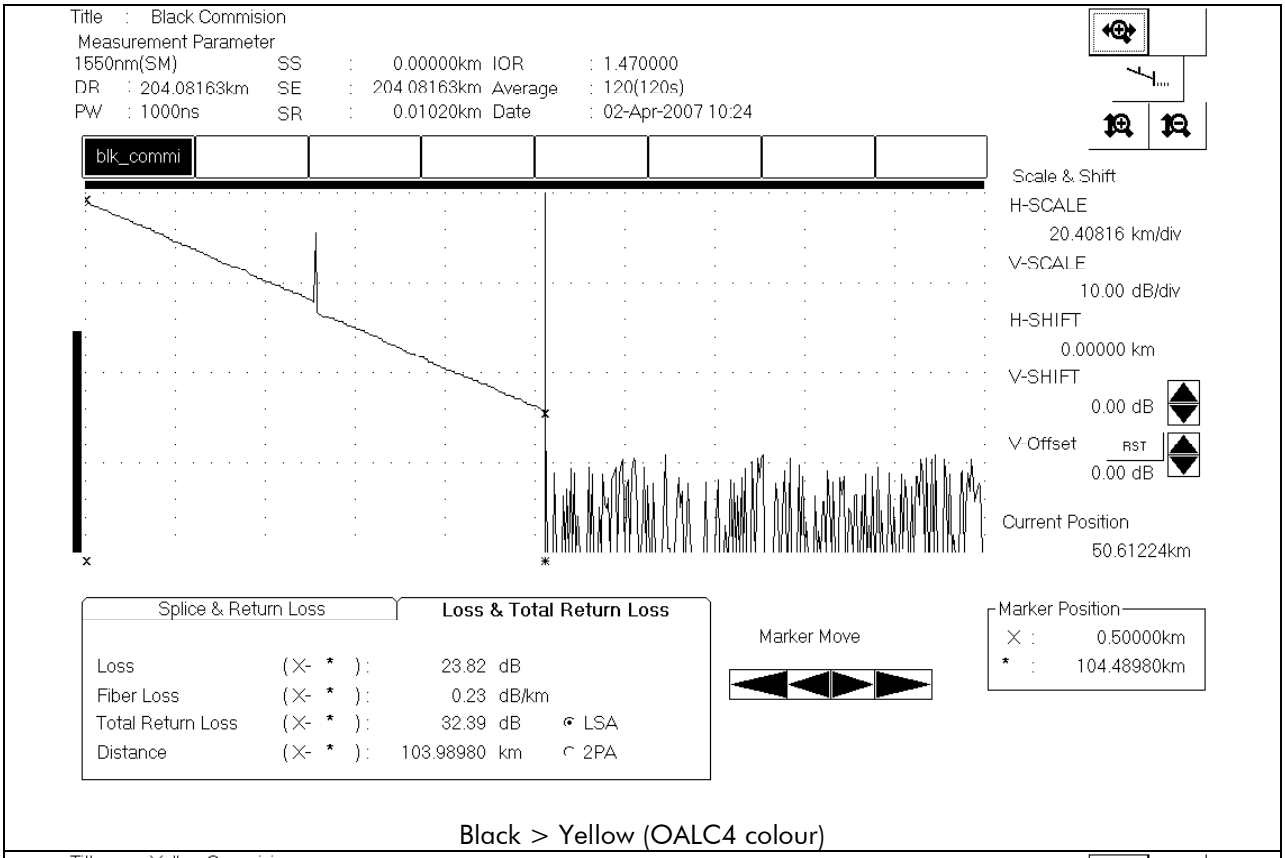
2.5.1 104.490Km System Cable Commissioning Electrical Data Sheet

Operator J.Roberts
Date 2-Apr-2007
Length 104.490Km (OTDR)

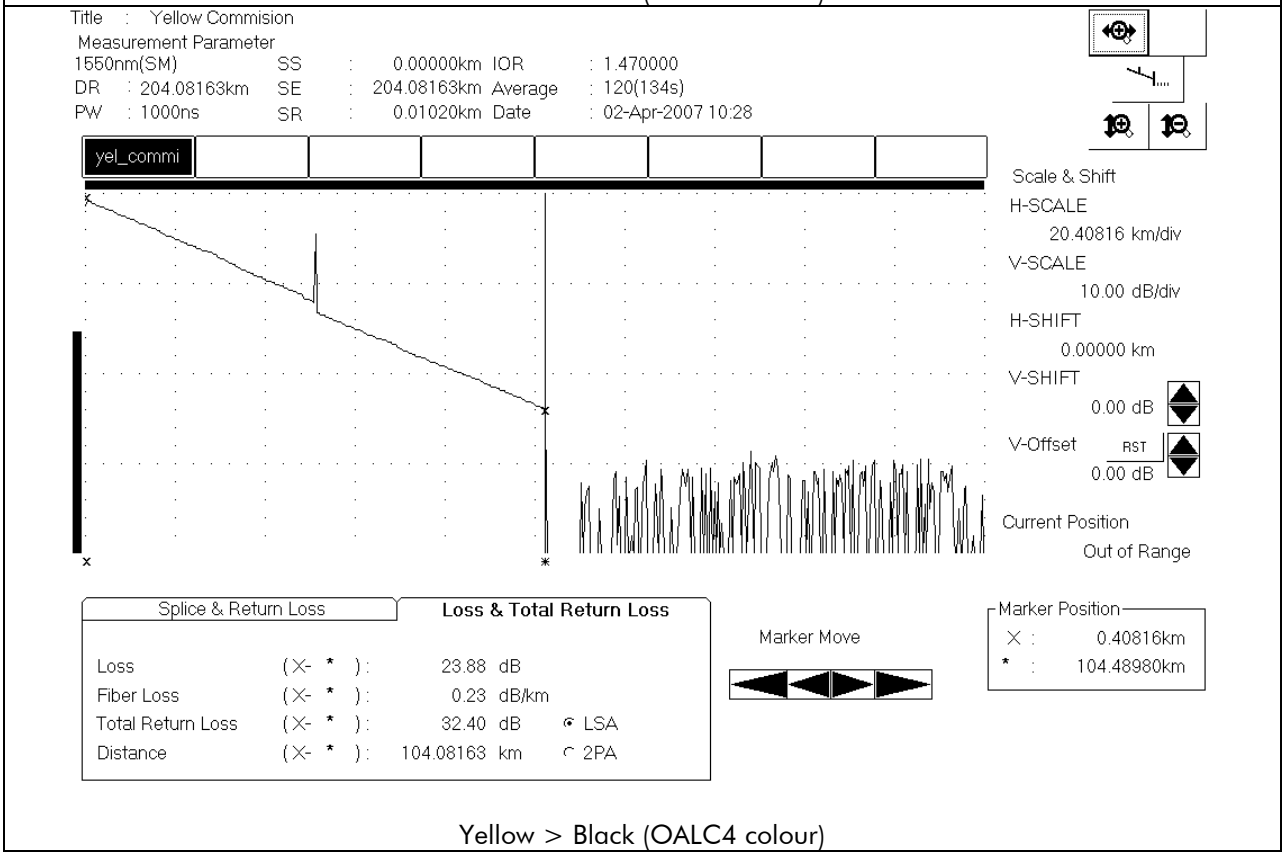
OTDR Parameters

Equipment Anritsu MW9076B OTDR
Refractive index 1.470
Pulse Width 100 ns
Averaging 60 (43sec)

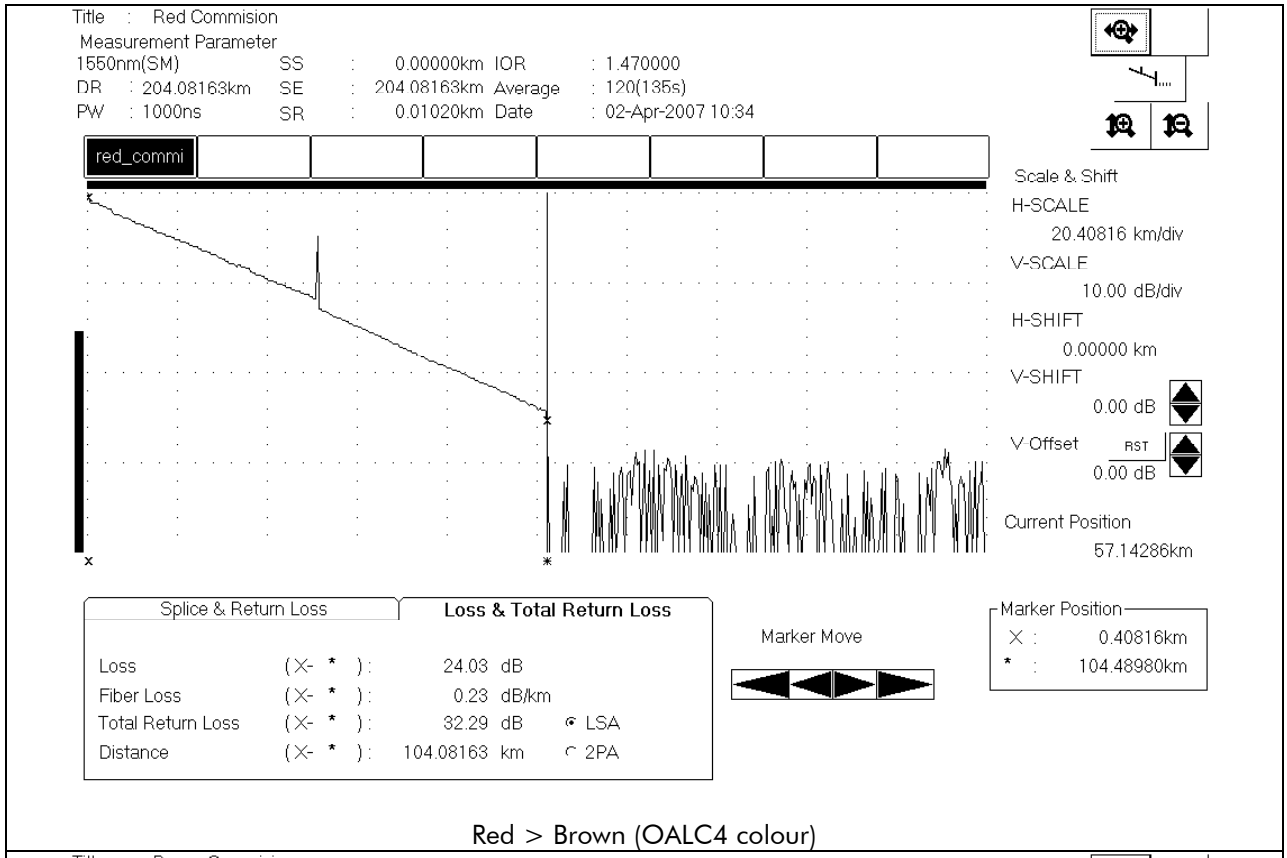
		Cursor Position /km		Attenuation	
No.	OALC4 Colour (Via CTA)	C1	C2	dB	dB/km
1	Black > Yellow	0.408	104.489	23.82	0.23
2	Yellow > Black	0.408	104.489	23.88	0.23
3	Red > Brown	0.408	104.489	24.03	0.23
4	Brown > Red	0.408	104.489	23.82	0.23
5	Blue > Orange	0.408	104.489	23.57	0.23
6	Orange > Blue	0.408	104.489	23.51	0.23
7	Green > Pink	0.408	104.489	23.11	0.22
8	Pink > Green	0.408	104.489	23.14	0.22



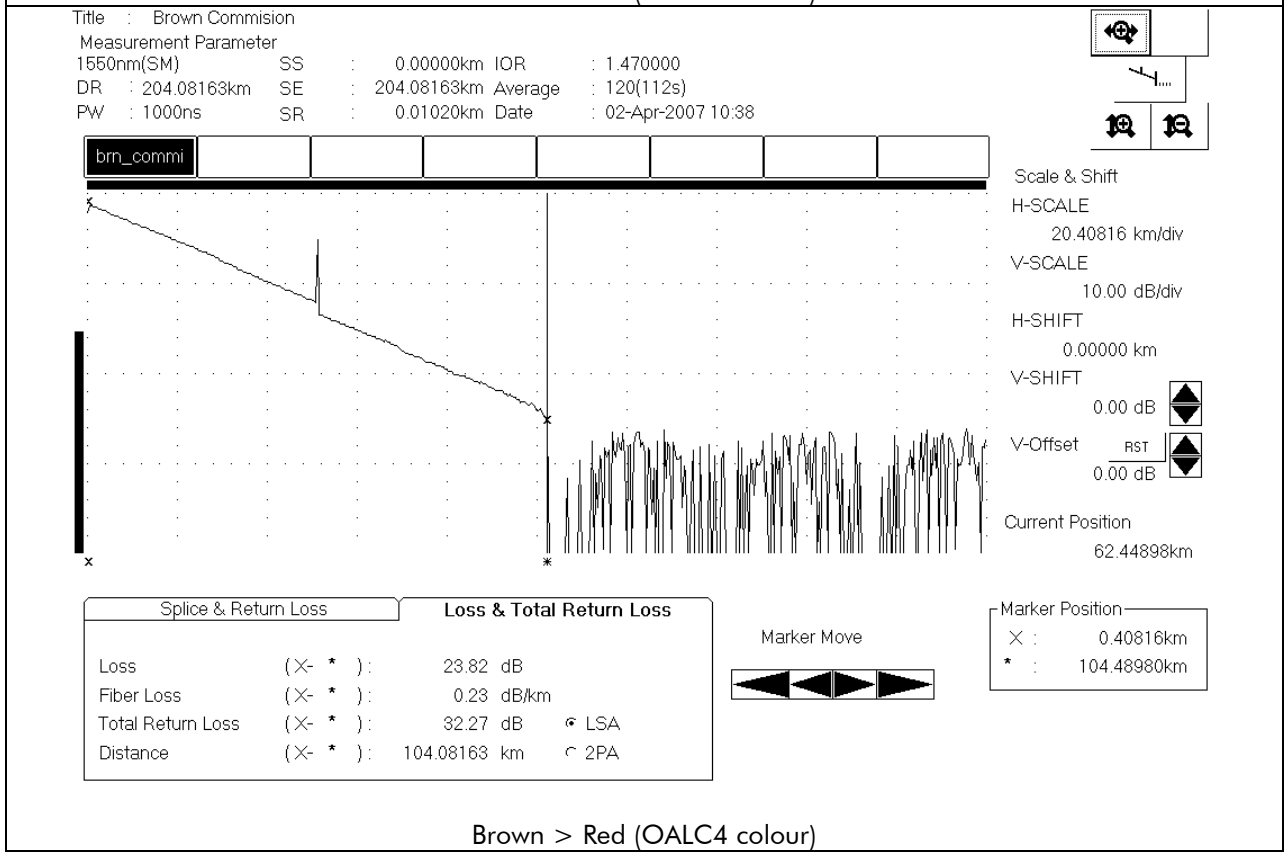
Black > Yellow (OALC4 colour)



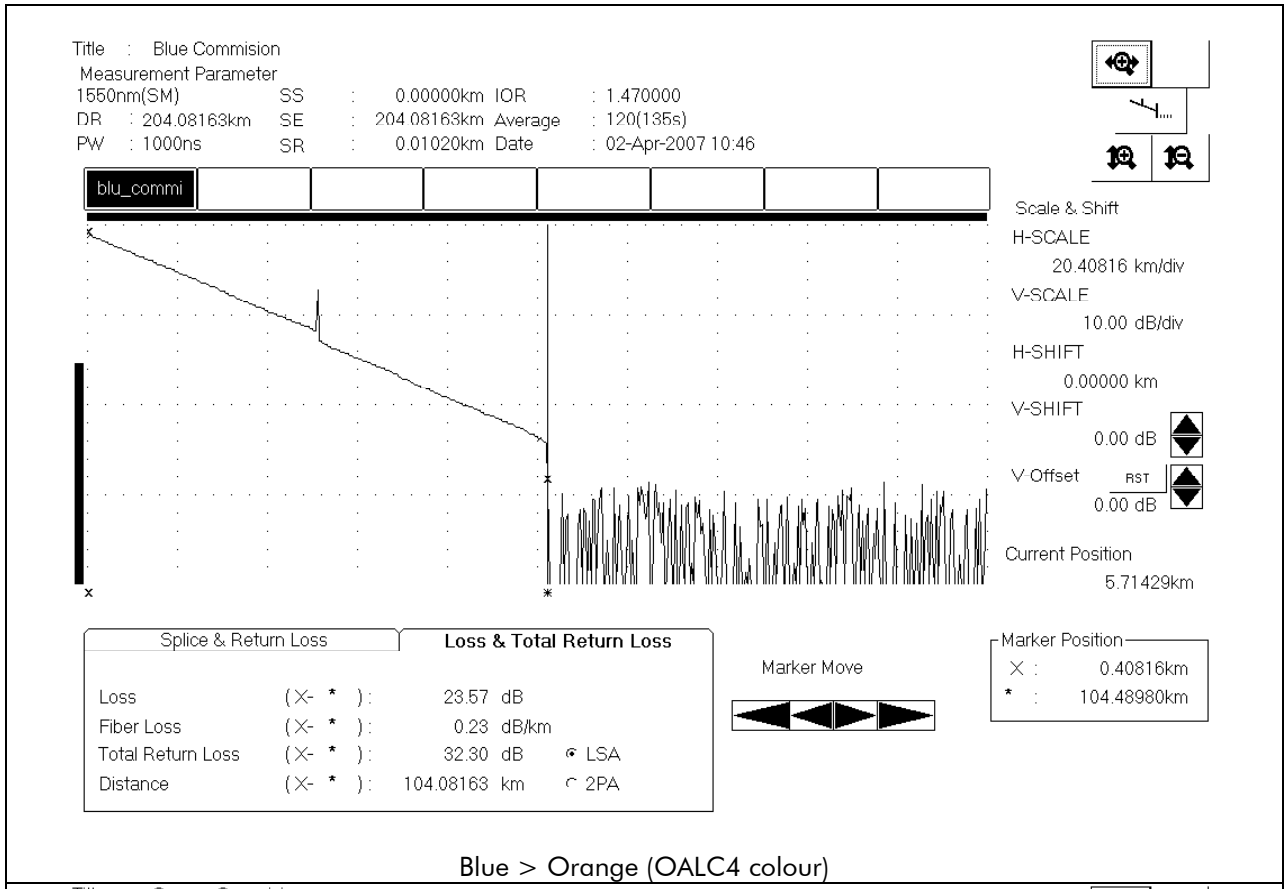
Yellow > Black (OALC4 colour)



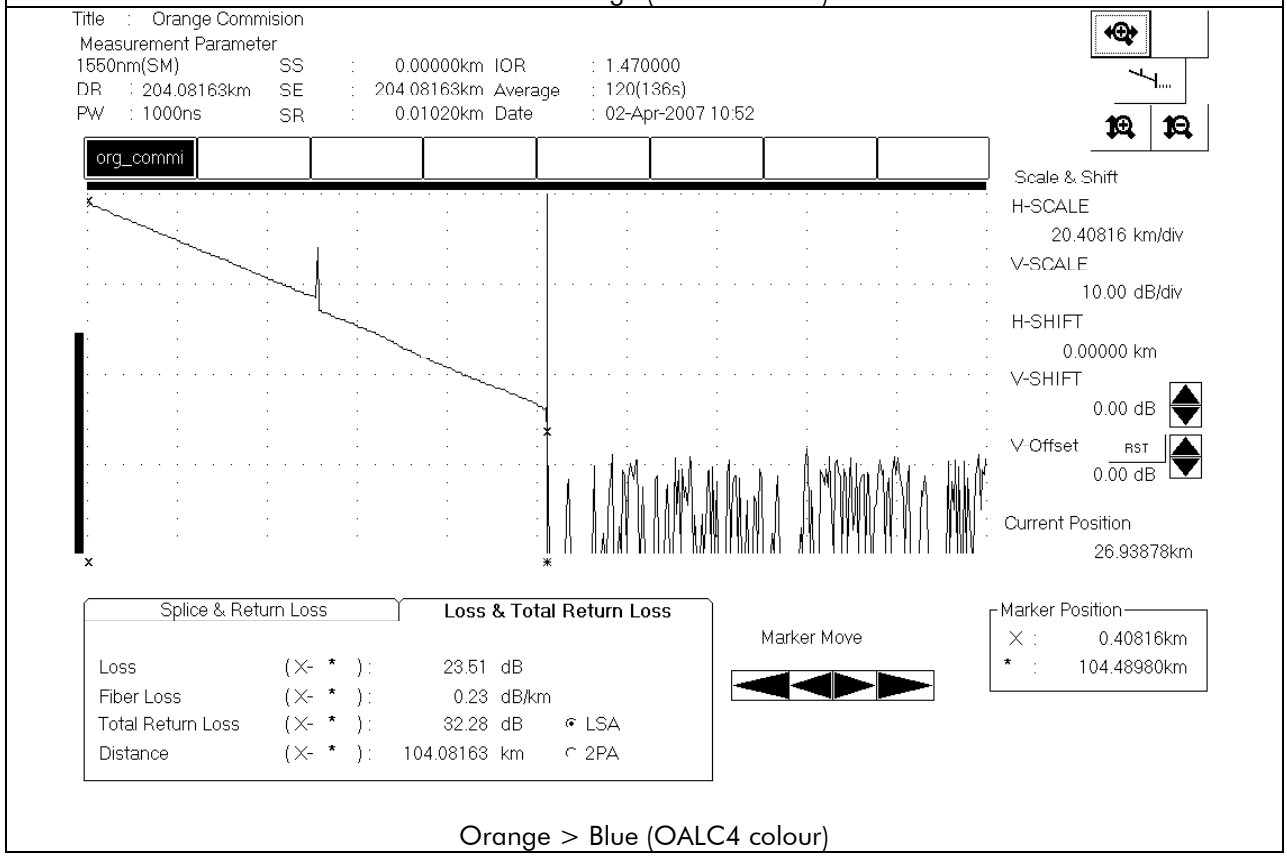
Red > Brown (OALC4 colour)



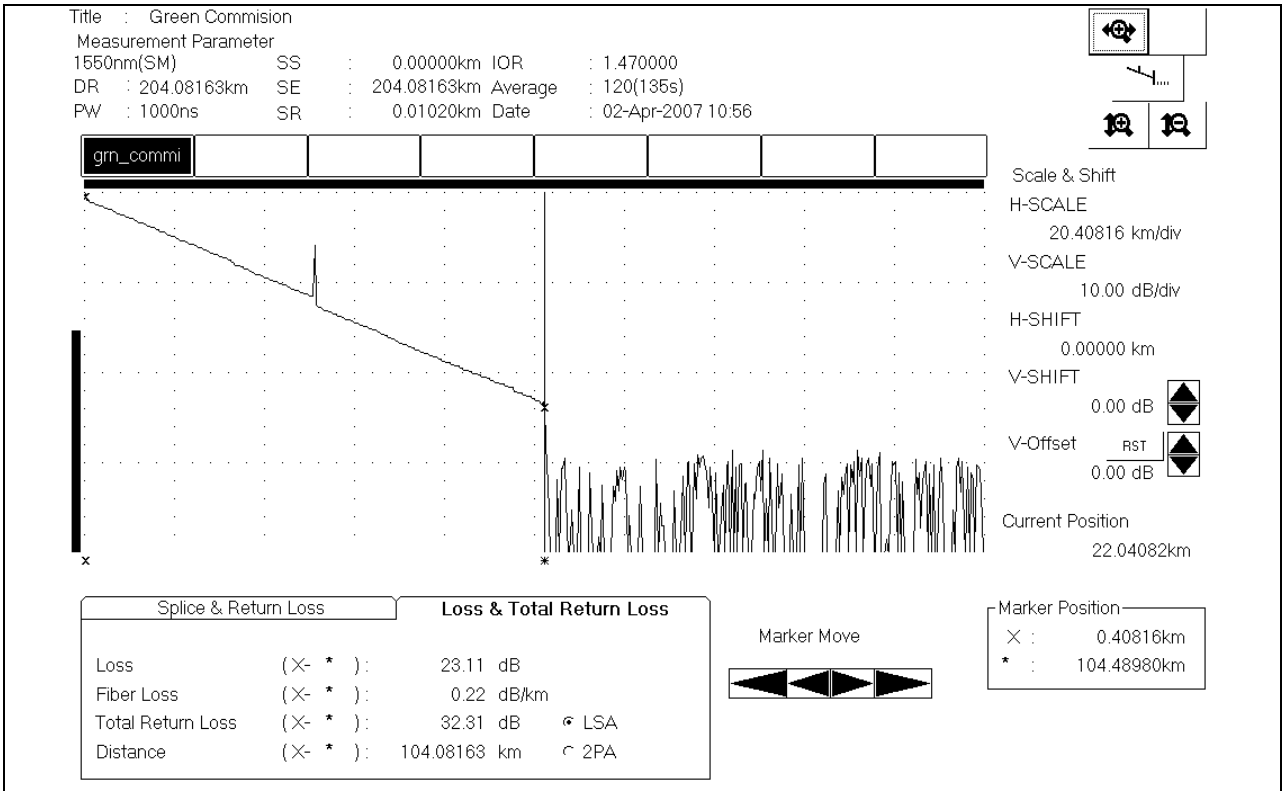
Brown > Red (OALC4 colour)



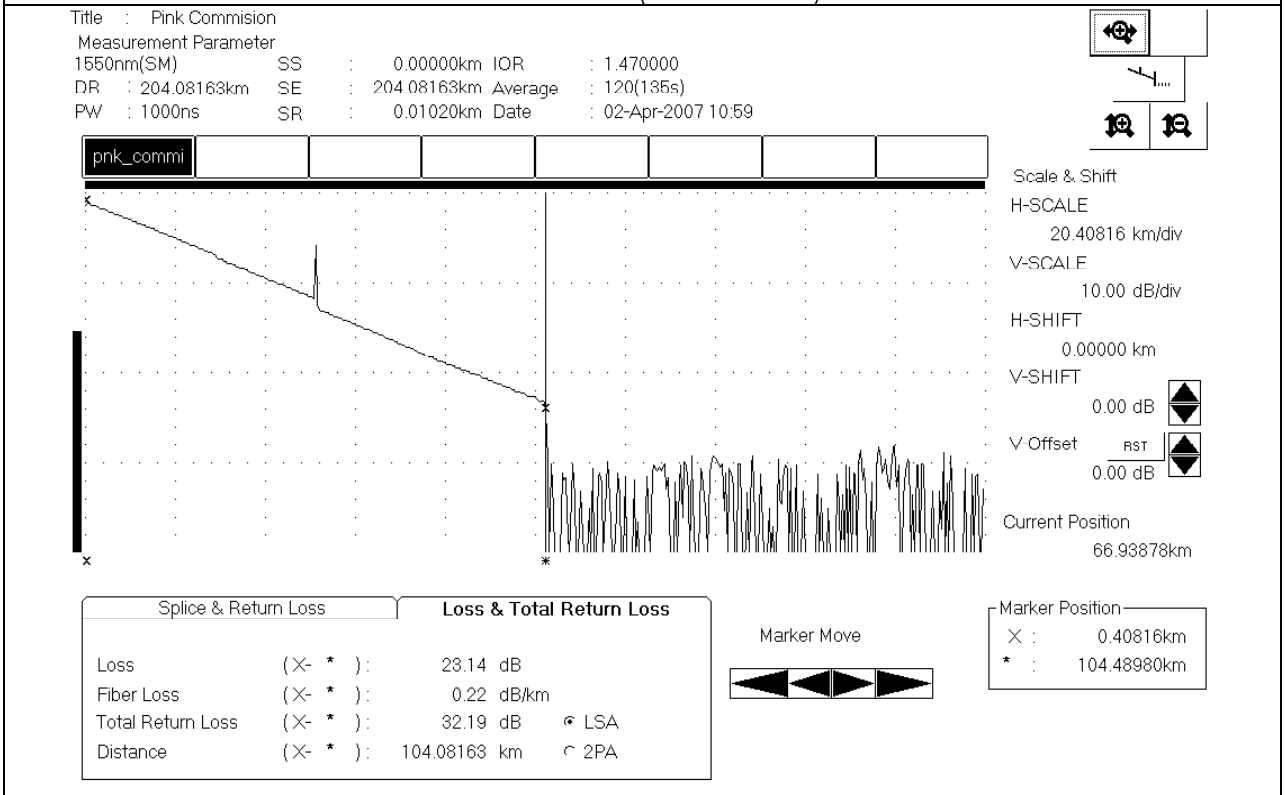
Blue > Orange (OALC4 colour)



Orange > Blue (OALC4 colour)



Green > Pink (OALC4 colour)



Pink > Green (OALC4 colour)

6. MOSS LANDING ODF FIBRE TRAY CONFIGURATION

ODF Position	OALC4 Fibre Colour	Pig Tail Fibre Colour
1	Black	Blue
2	Yellow	Orange
3	Red	Green
4	Brown	Brown
5	Blue	Blue
6	Orange	Orange
7	Green	Green
8	Pink	Brown

Fibre Tray at Moss Landing ODF: