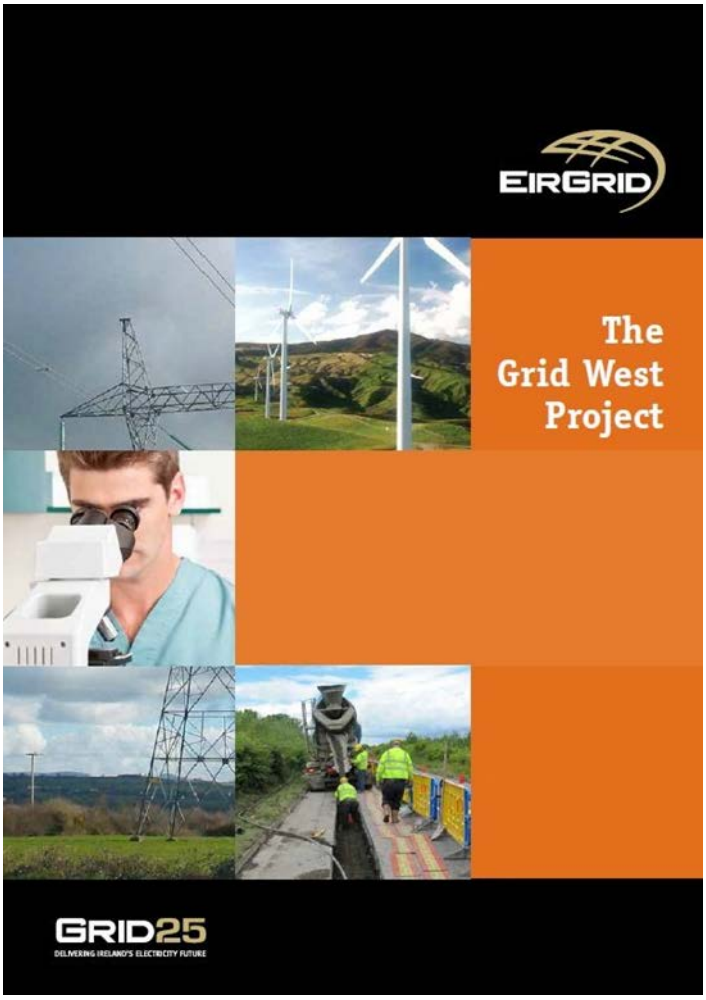
EirGrid

10344 – PSP0019 - CABLE STUDIES FOR GRID WEST

Partial AC Underground Solution



Appendix B – 120 km 220 kV Cable Option

17/12/2014

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REPORT AUTHORISATION SHEET

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Contents

1 REACTIVE POWER STUDIES

The reactive power requirements of the cable were determined under steady state conditions using PSS/E 32.

1.1 Cable reactive power

The steady state reactive power requirements of the cable have been determined as follows, cable was energised from the Flagford busbar at 220 kV and disconnected from the North Mayo busbar to determine worst case reactive power requirements.

Length of cable (% of 120 km)	Reactive power requirements at Flagford
100% (120 km)	782.90 MVar
90% (108 km)	664.80 MVar
80% (96 km)	559.80 MVar
70% (84 km)	467.00 MVar
60% (72 km)	383.80 MVar
50% (60 km)	308.00 MVar
40% (48 km)	237.10 MVar
30% (36 km)	172.10 MVar
20% (24 km)	110.60 MVar
10% (12 km)	53.40 MVar

In the case of the 120 km 220 kV Cable length, reactors are recommended, 300 MVar at Flagford and 250MVAr at North Mayo, which compensates the cable to around 70%.

Verification was carried out for the Winter Peak A, with a voltage level of 1.05pu and the Summer Valley A with a voltage level of 1.00pu, details should below.

Winter Peak A – WPA – 1.05 pu

Length of Cable (% of 120 km)	Flagford		North Mayo	
	Voltage (pu)	Reactive power absorbed (MVars)	Voltage (pu)	Reactive power absorbed (MVars)
100% (120 km)	1.04727	219.4	1.04330	272.1
90% (108 km)	1.06659	170.6	1.07728	230.6
80% (96 km)	1.04828	164.8	1.04568	218.7
70% (84 km)	1.06743	113.9	1.07623	173.7
60% (72 km)	1.04922	110.1	1.04778	164.7
50% (60 km)	1.06835	57.1	1.07496	115.6
40% (48 km)	1.0777	58.1	1.07777	58.1
30% (36 km)	1.05083	55.2	1.0545	55.6
20% (24 km)	1.06987	0.0	1.07552	0.0
10% (12 km)	1.05314	0.0	1.05180	0.0

Summer Valley A – SVA – 1.00 pu

Length of Cable (% of 120 km)	Flagford		North Mayo	
	Voltage (pu)	Reactive power absorbed (MVars)	Voltage (pu)	Reactive power absorbed (MVars)
100% (120 km)	0.99039	245.2	0.98663	243.4
90% (108 km)	1.00628	202.5	1.01504	206.1
80% (96 km)	0.9913	196.5	0.9889	195.6
70% (84 km)	1.00718	152.2	1.01453	154.4
60% (72 km)	0.99221	147.7	0.99085	147.3
50% (60 km)	1.0080	101.6	1.01371	102.8
40% (48 km)	0.9931	98.6	0.99252	98.5
30% (36 km)	1.01258	51.3	1.0089	50.9
20% (24 km)	1.00987	0.0	1.0115	0.0
10% (12 km)	1.00987	0.0	1.01115	0.0

The results verified that the reactors have a suitable rating for the 100% cable length and give reactive power requirement for all the other lengths.

2 RESULTS

Impedance scans and time domain simulations for a total of 120 km of 220 kV cable with sized reactors at both Flagford and North Mayo. The entire Grid West circuit will be 220 kV underground cable. It should be noted that the actual cable route is assumed to be approximately 112.5 km in length but this has been rounded up to the nearest 10 km for contingency purposes in the event the final cable length is extended beyond this.

This appendix will cover the 220 kV fully underground cable option with the circuit length at 120 km. This case has failed due to a high resonance point below the 3rd harmonic of above 1000 Ohms, induced transformation saturation at Flagford 220 kV station and has also failed due to TOVs exceeding the allowable limits.[1]

[1] For the purposes of clarity , in the Time Domain Simulations shown in all the Appendices, the term 'N-2' shown in the graphical figure descriptions refer to an 'N-1-1' trip-maintenance situation.

2.1 Impedance Scans - Length 120 km – Winter Peak A – Case 1

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 1: (N) Normal Operating Condition

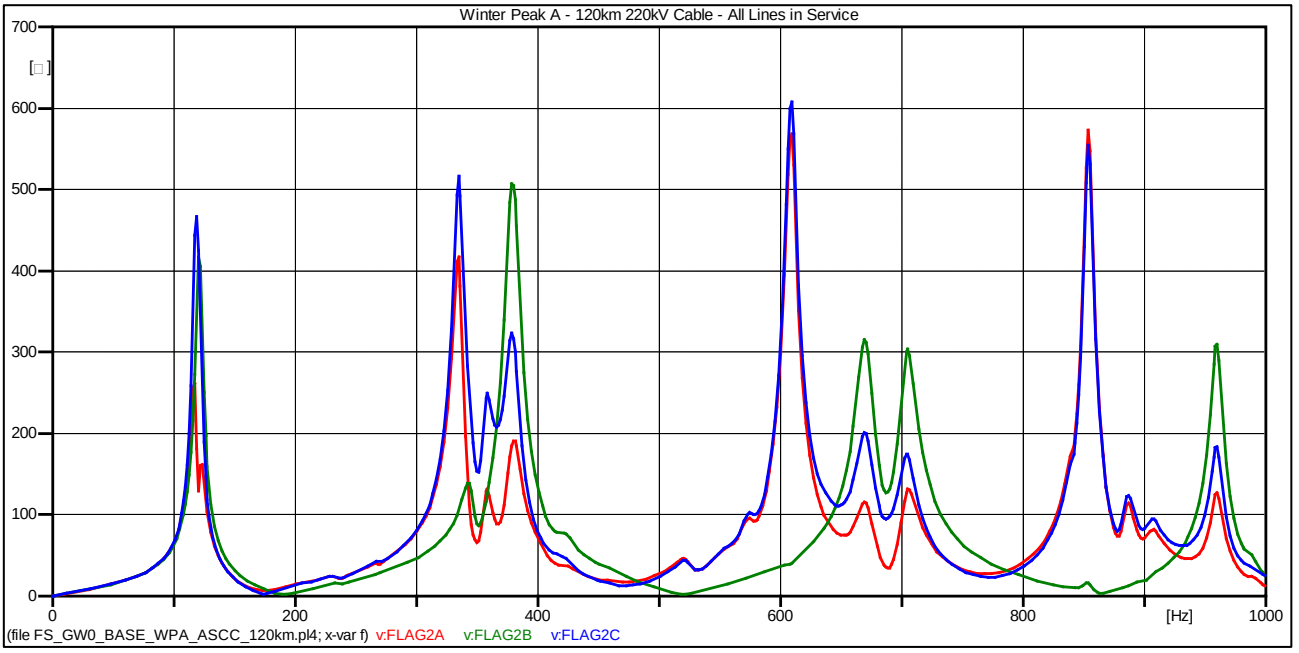

Figure 1: WPA - Length 120 km - (N) Normal Operating Condition

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
120.1	425.35
336.01	491.95
376.51	505.32
609.01	607.04
670.51	312.37
705.01	174.17
853.51	554.57
960.01	310.06

2.2 Impedance Scans - Length 120 km – Winter Peak A – Case 2

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 2: (N-1) Flagford-Louth 220 kV Line Out

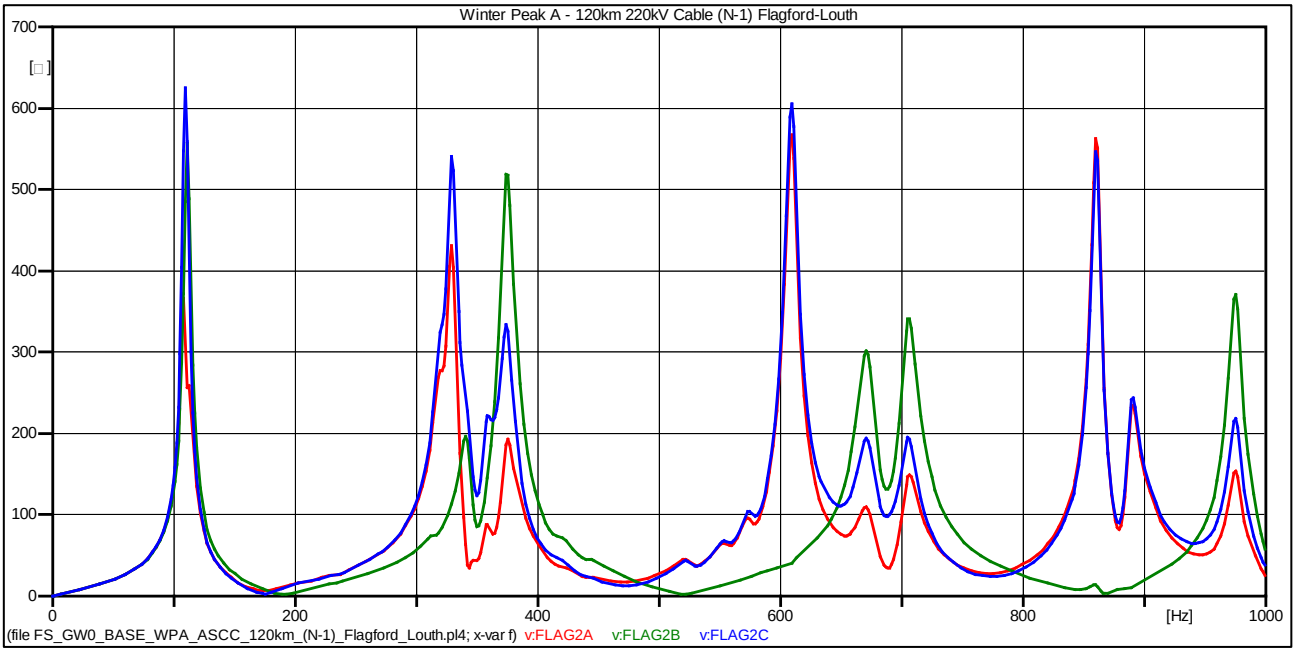

Figure 2: WPA - Length 120 km – Flagford-Louth Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
109.51	624.79
328.51	540.76
375.01	517.61
609.01	605.65
672.01	296.43
706.51	340.87
861.01	536.50
975.01	371.37
975.01	214.97

2.3 Time Domain Simulation - Length 120 km – Winter Peak A – Case 2

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 2: (N-1) – Autoreclose of the Flagford-Louth line

System Conditions:

1. Fault on Flagford side of Flagford-Louth line applied at 0.5s, removed at 0.575s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closure at 90°.

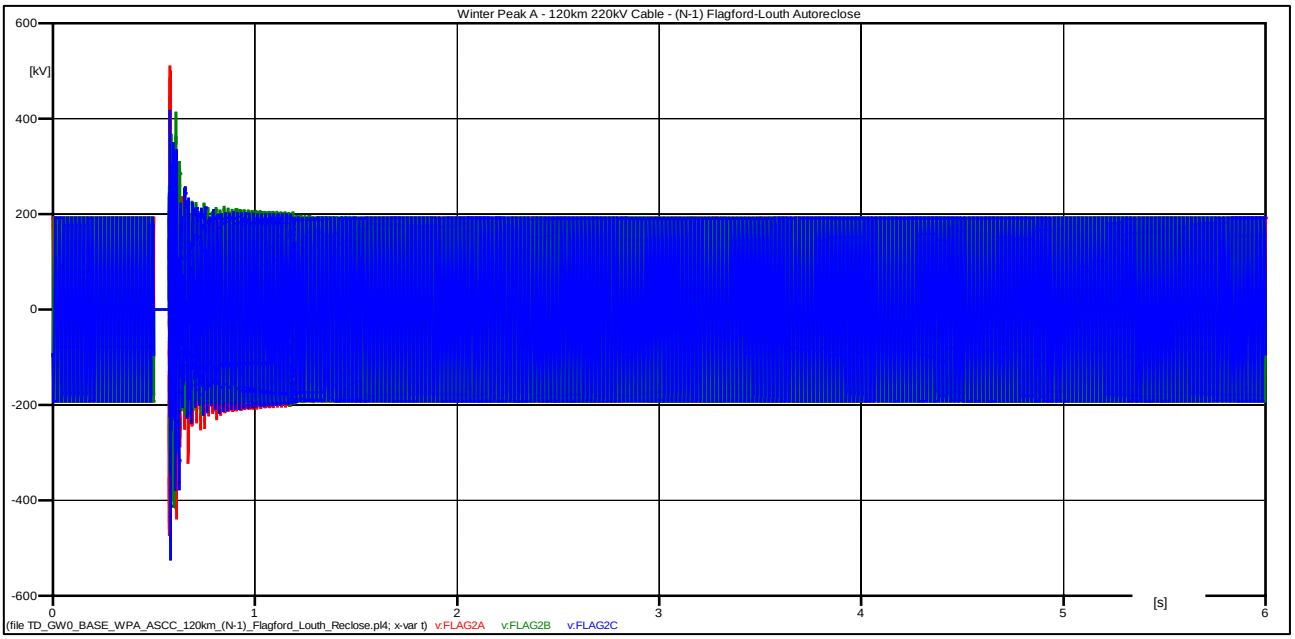

Figure 3: WPA - Length 120 km – Flagford – (N-1) – Autoreclose of the Flagford/Louth line (0-6s)

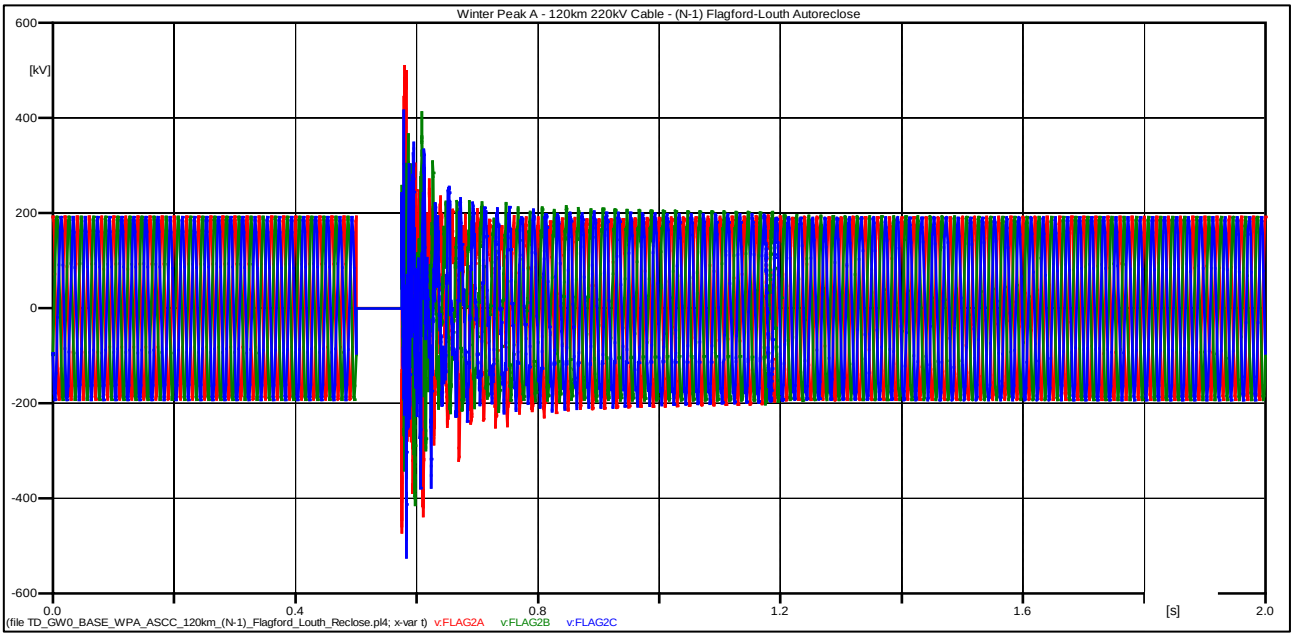

Figure 4: WPA - Length 120 km – Flagford – (N-1) – Autoreclose of the Flagford-Louth line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	483.73 kV (2.6931 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	403.52 kV (2.2481 pu)	287.32 kV(1.6pu)	Fail

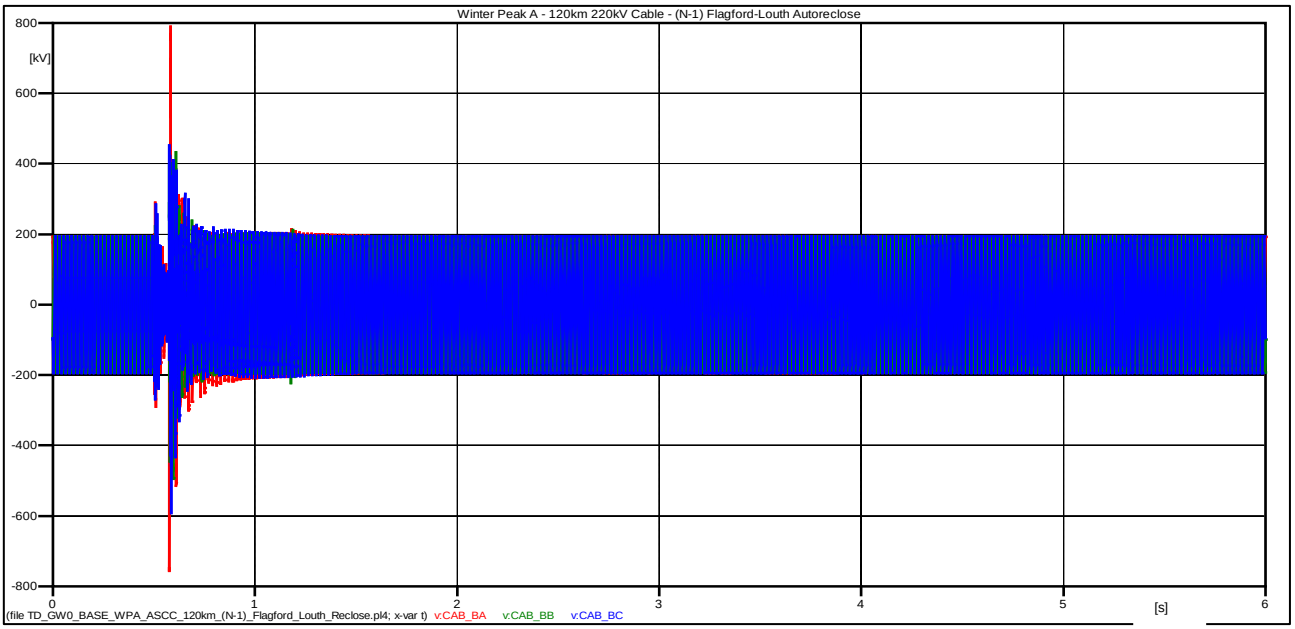

Figure 5: WPA - Length 120 km – North Mayo – (N-1) – Autoreclose of the Flagford-Louth line (0-6s)

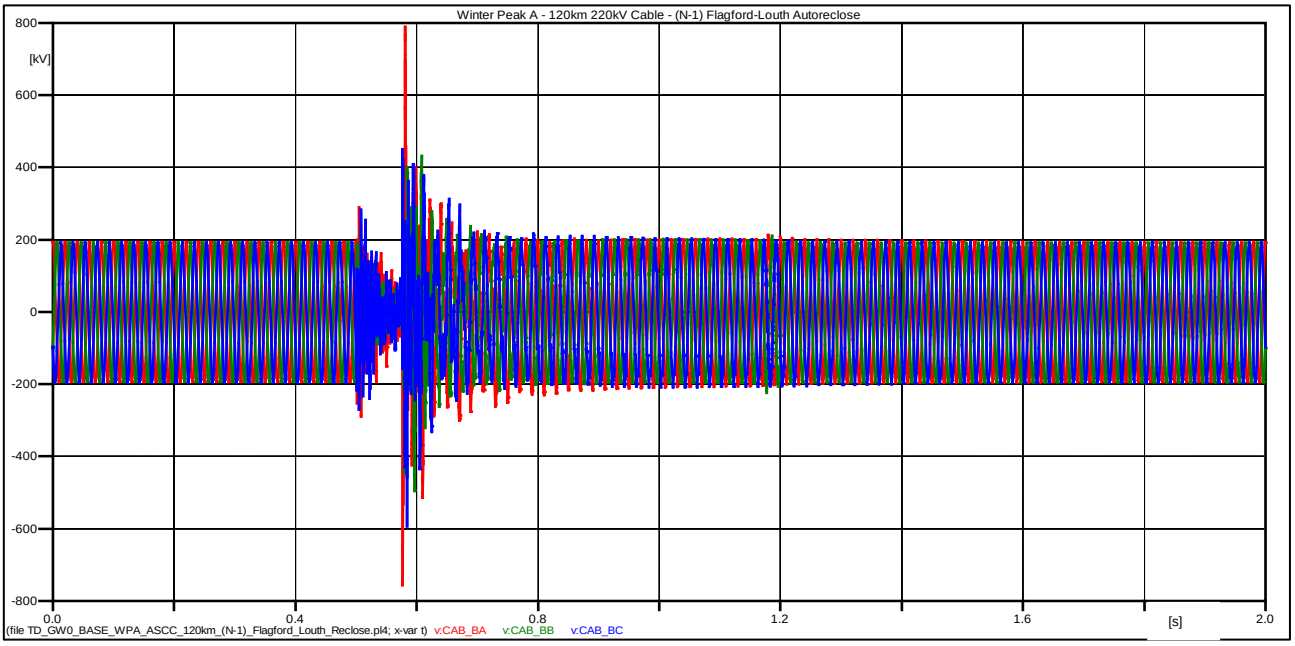

Figure 6: WPA - Length 120 km – North Mayo – (N-1) – Autoreclose of the Flagford-Louth line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	785.33 kV (4.3731 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	410.00 kV (2.2831 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.4 Impedance Scans - Length 120 km – Winter Peak A – Case 3

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 3: (N-1) Flagford-Cashla 220 kV Line Out

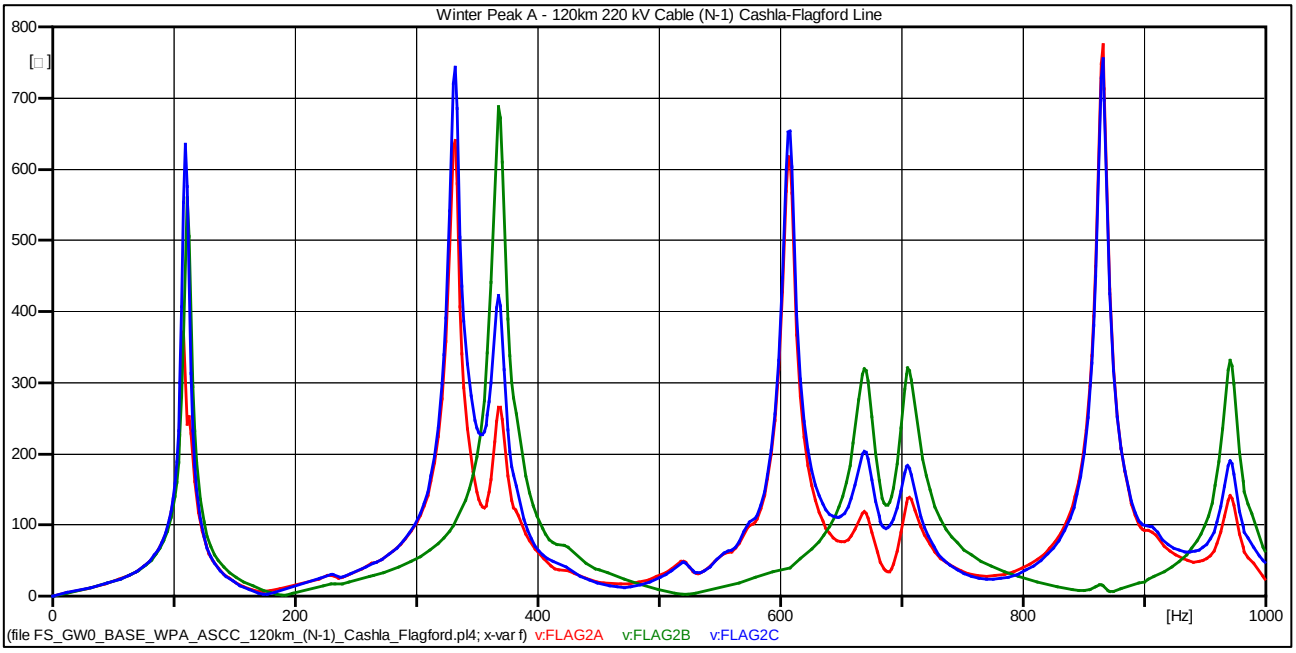

Figure 7: WPA - Length 120 km – Flagford-Cashla Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
109.51	635.40
331.51	742.67
367.51	687.28
607.51	653.78
670.51	316.89
706.51	320.25
865.51	697.55

2.5 Time Domain Simulation - Length 120 km – Winter Peak A – Case 3

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 3: (N-1) – Autoreclose of the Cashla-Flagford line

System Conditions:

1. Fault on Flagford side of Cashla-Flagford line, applied at 0.5s, removed at 0.575s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.

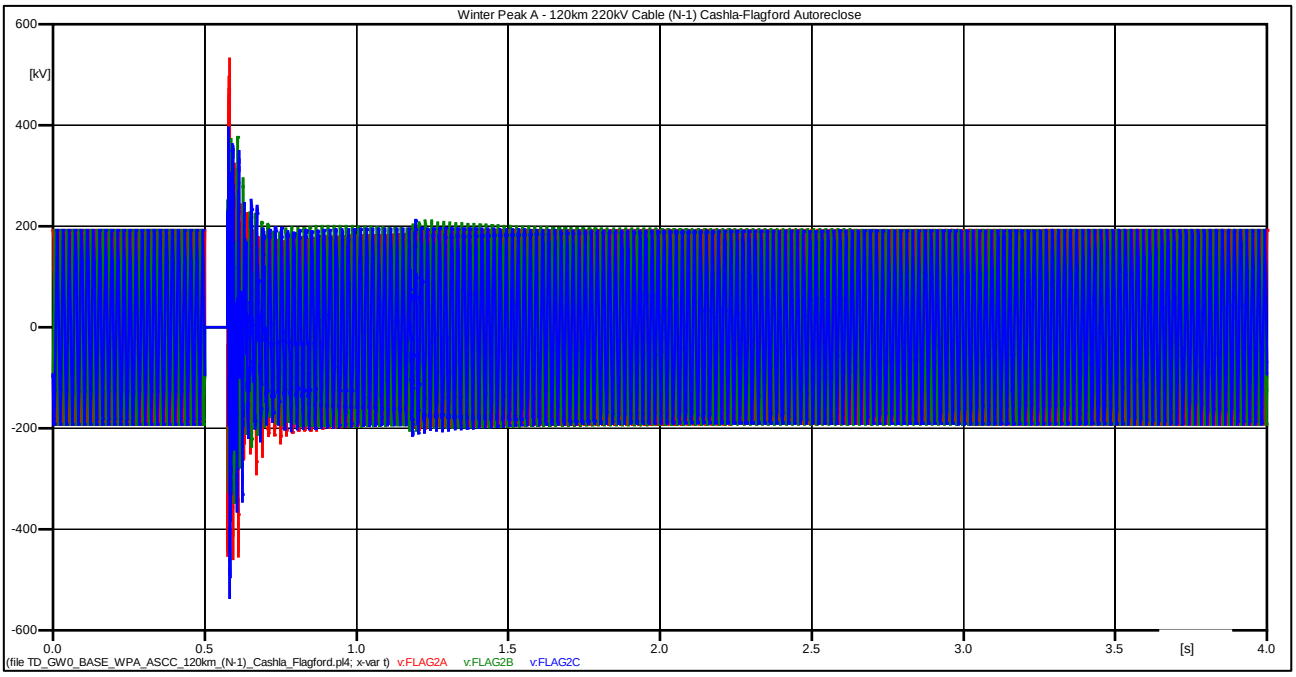

Figure 8: WPA - Length 120 km – Flagford – (N-1) Autoreclose Cashla-Flagford Line (0-4s)

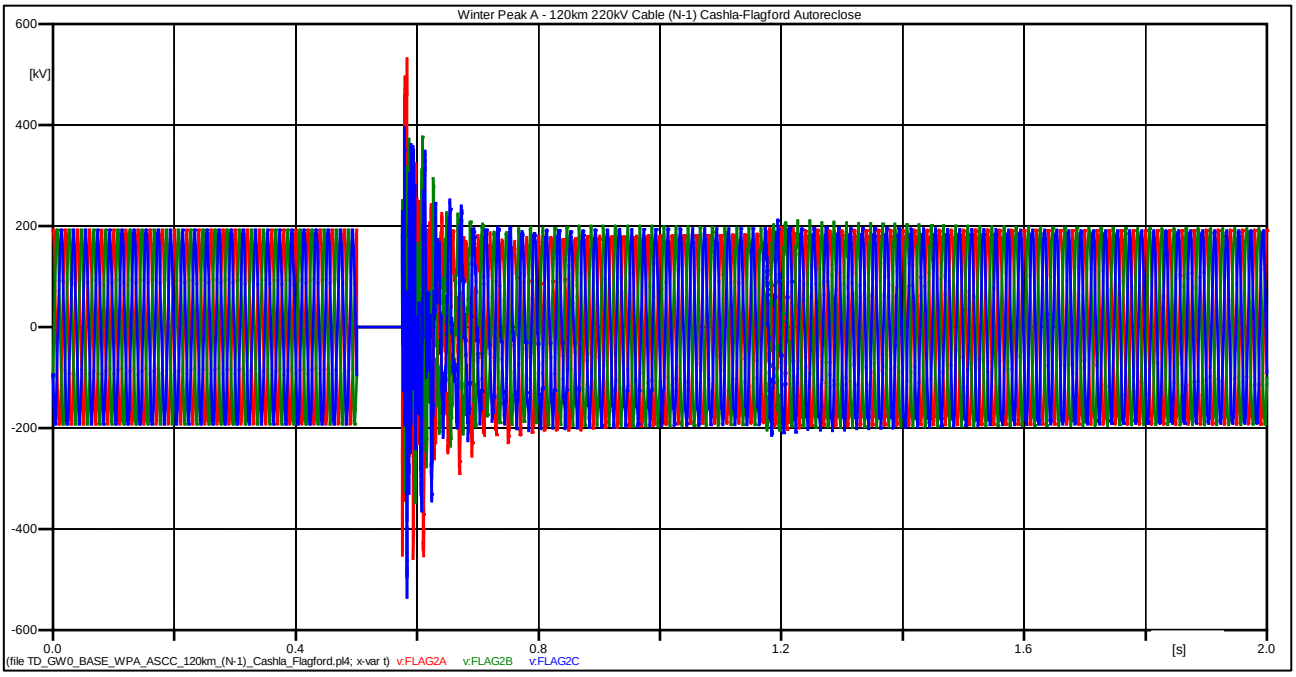

Figure 9: WPA - Length 120 km – Flagford – (N-1) Autoreclose Cashla-Flagford Line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	459.39 kV (2.5581 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	365.5 kV (2.0353 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

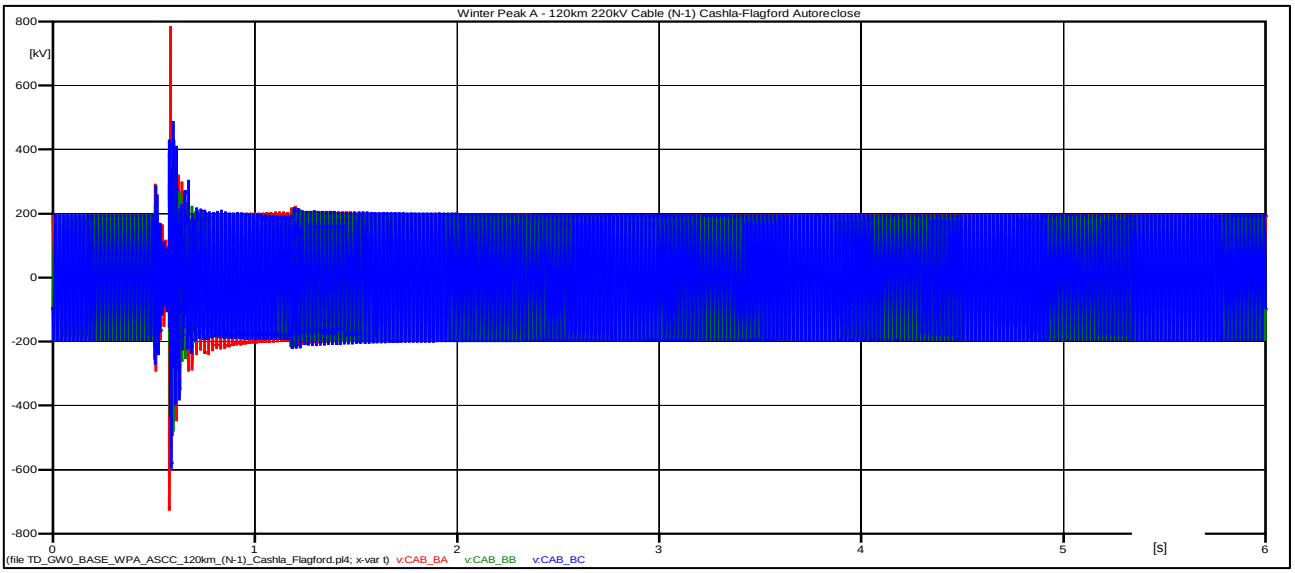

Figure 10: WPA - Length 120 km – North Mayo – (N-1) Autoreclose Cashla-Flagford Line (0-6s)

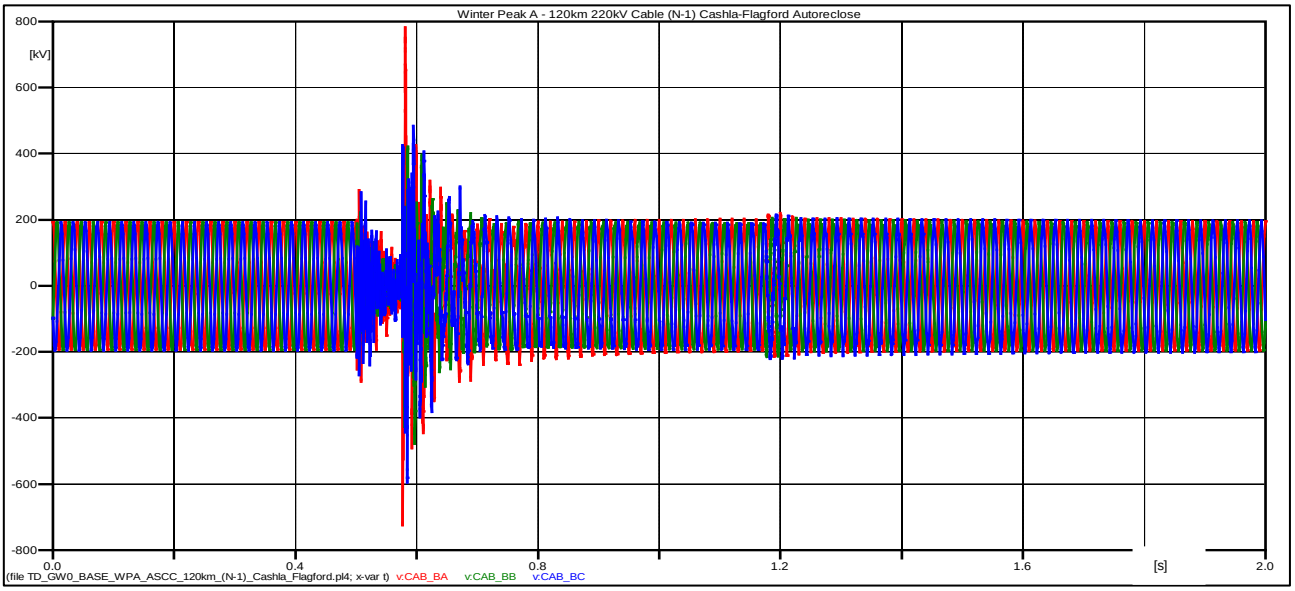

Figure 11: WPA - Length 120 km – North Mayo – (N-1) Autoreclose Cashla-Flagford Line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	777.33 kV (4.3286 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	454.46 kV (2.5305 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.6 Impedance Scans - Length 120 km – Winter Peak A – Case 4

Conditions for impedance scan:

4. Winter Peak A Network
5. North Mayo to Flagford Circuit – 120 km 220 kV Cable
6. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 4: (N-1) Flagford-Srananagh 220 kV Line Out

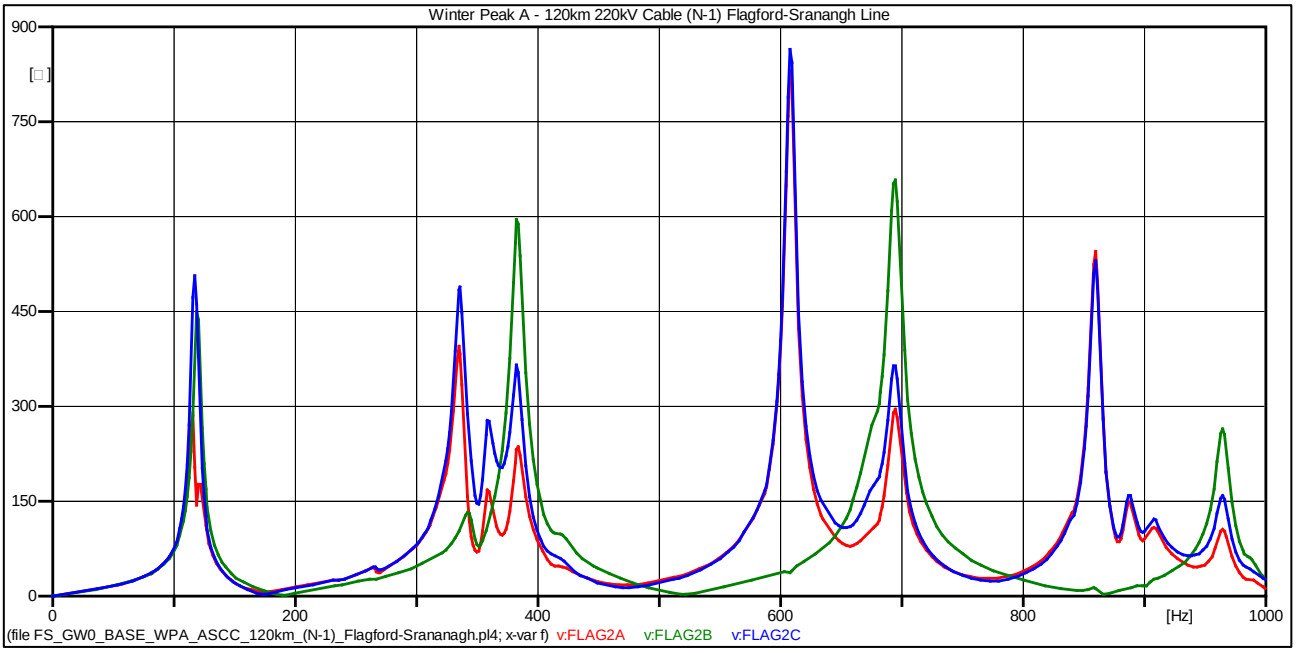

Figure 12: WPA - Length 120 km – Flagford_Srananagh line – Out of service

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
118.51	461.92
336.01	487.98
384.01	587.65
609.01	844.25
696.01	623.01
859.51	529.54
964.51	264.78

2.7 Time Domain Simulation - Length 120 km – Winter Peak A – Case 4

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 4: (N-1) – Autoreclose of the Flagford-Srananagh line

System Conditions:

1. Fault at edge of Flagford-Srananagh Line, applied at 0.5s, removed at 0.575s.
2. Reclose sequence at 0.575s, dead time 0.7s, circuit breaker closes 1.275s, point on wave closure at 90°.

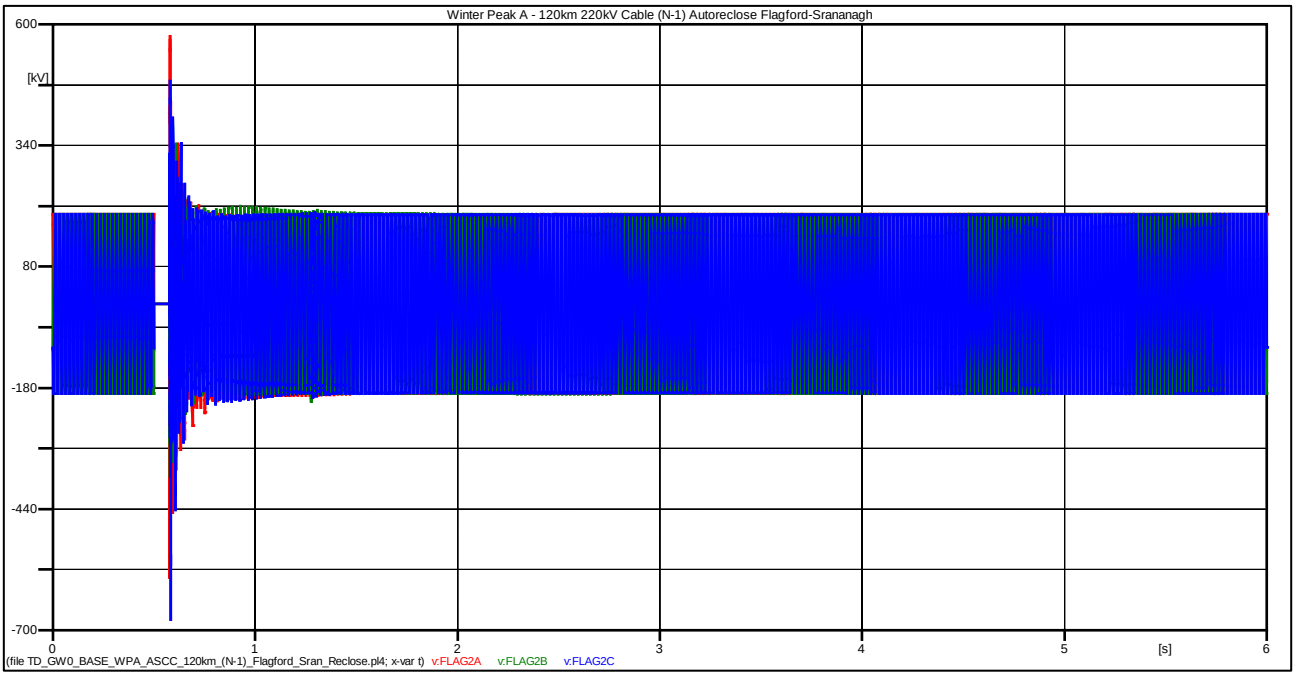

Figure 13: WPA - Length 120 km – Flagford – (N-1) – Autoreclose of the Flagford-Srananagh (0-6s)

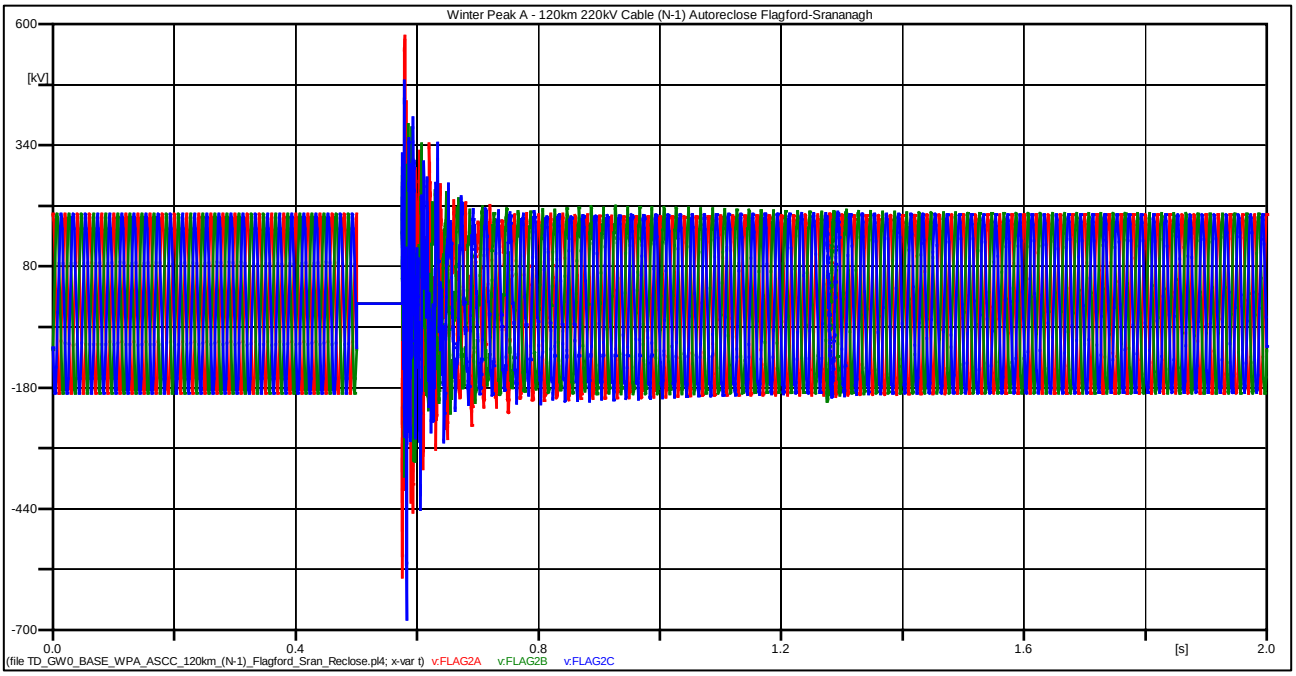

Figure 14: WPA - Length 120 km – Flagford – (N-1) – Autoreclose of the Flagford- Srananagh (0-2s)

Condition	Maximum Value	Limit	Result
Switching	580.23 kV (3.2310 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	340.99 kV (1.8988 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

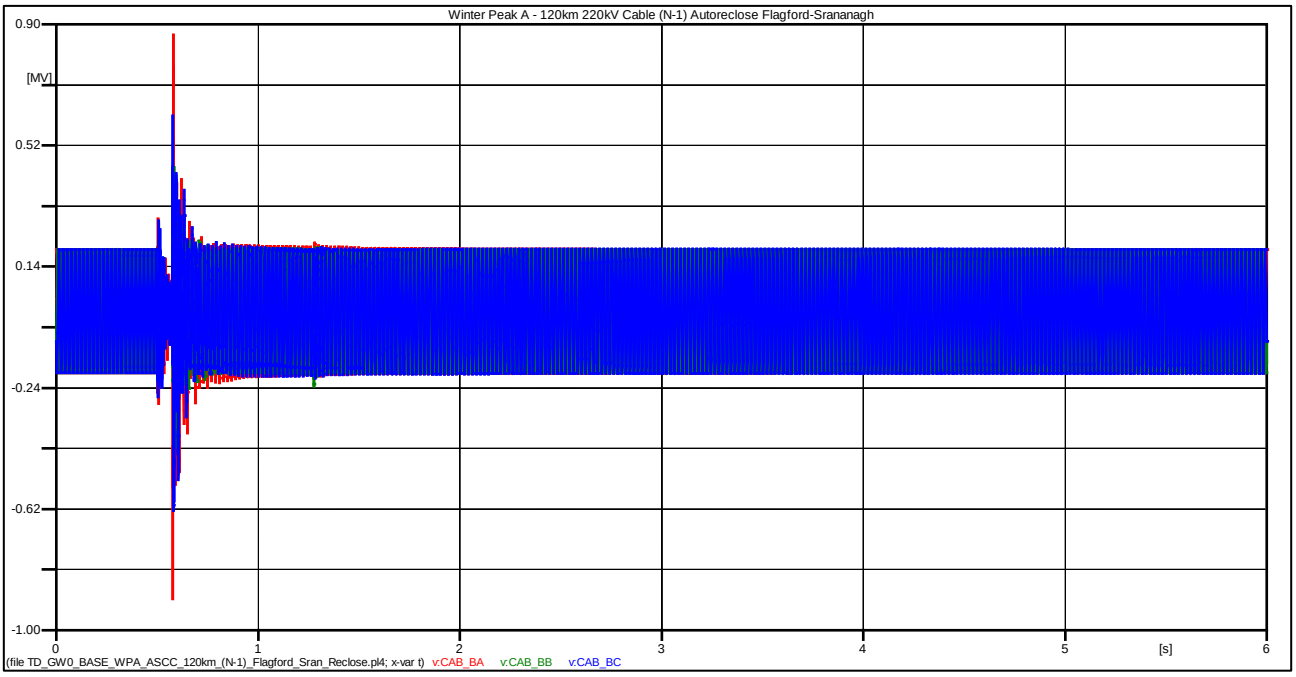

Figure 15: WPA - Length 120 km – North Mayo – (N-1) – Autoreclose of the Flagford-Srananagh (0-6s)

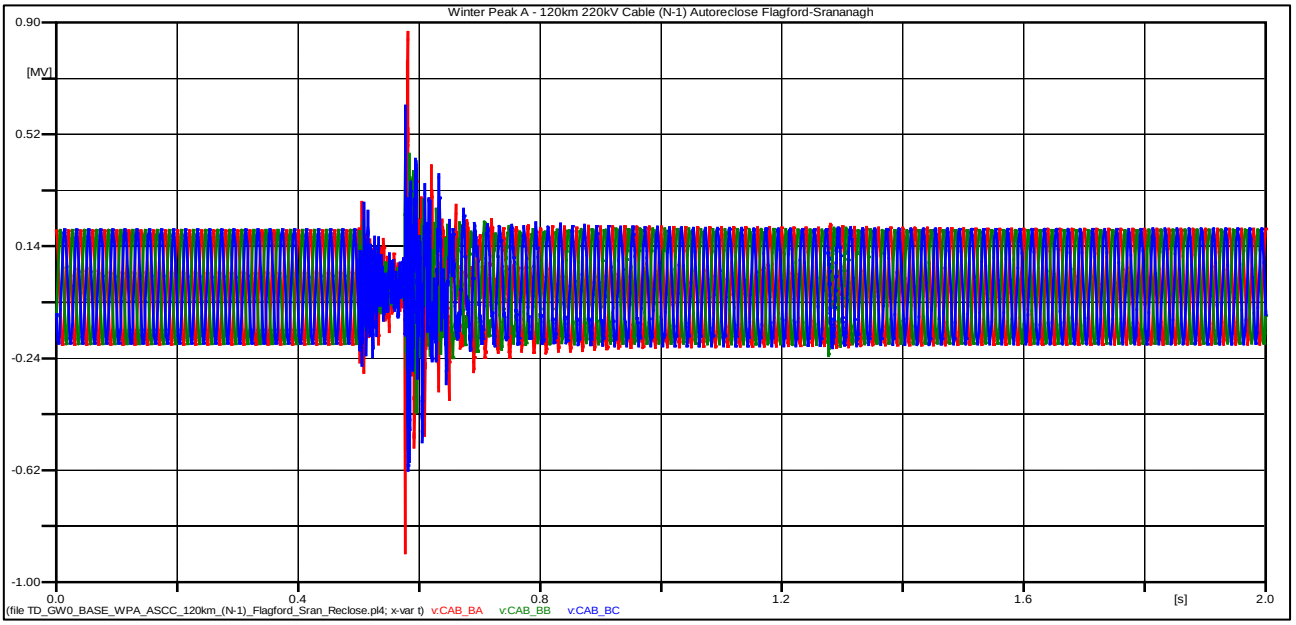

Figure 16: WPA - Length 120 km – North Mayo – (N-1) – Autoreclose of the Flagford-Srananagh Line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	793.17 kV (4.4168 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	345.35 kV (1.923 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.8 Impedance Scans - Length 120 km – Winter Peak A – Case 5

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

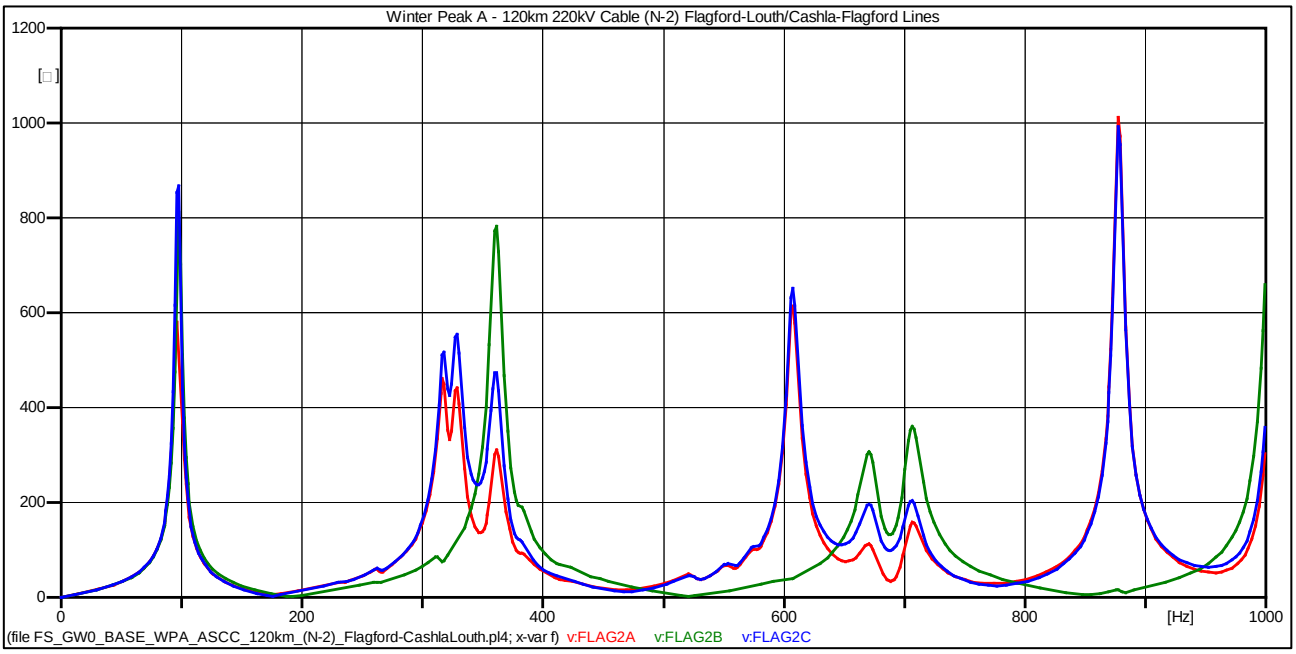

Figure 17: WPA - Length 120 km – (N-2) Flagford-Louth/Cashla-Flagford lines – Out of service

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
97.51	867.28
328.51	554.46
361.51	782.96
607.51	650.96
708.01	354.09
879.01	954.28

2.9 Time Domain Simulation - Length 120 km – Winter Peak A – Case 5

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 5: (N-2) Condition – Flagford/Louth Disconnected - Autoreclose of the Cashla-Flagford line

System Conditions:

1. Fault on Flagford side of Cashla-Flagford line, applied at 0.5s, removed at 0.575s
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closure at 90°.

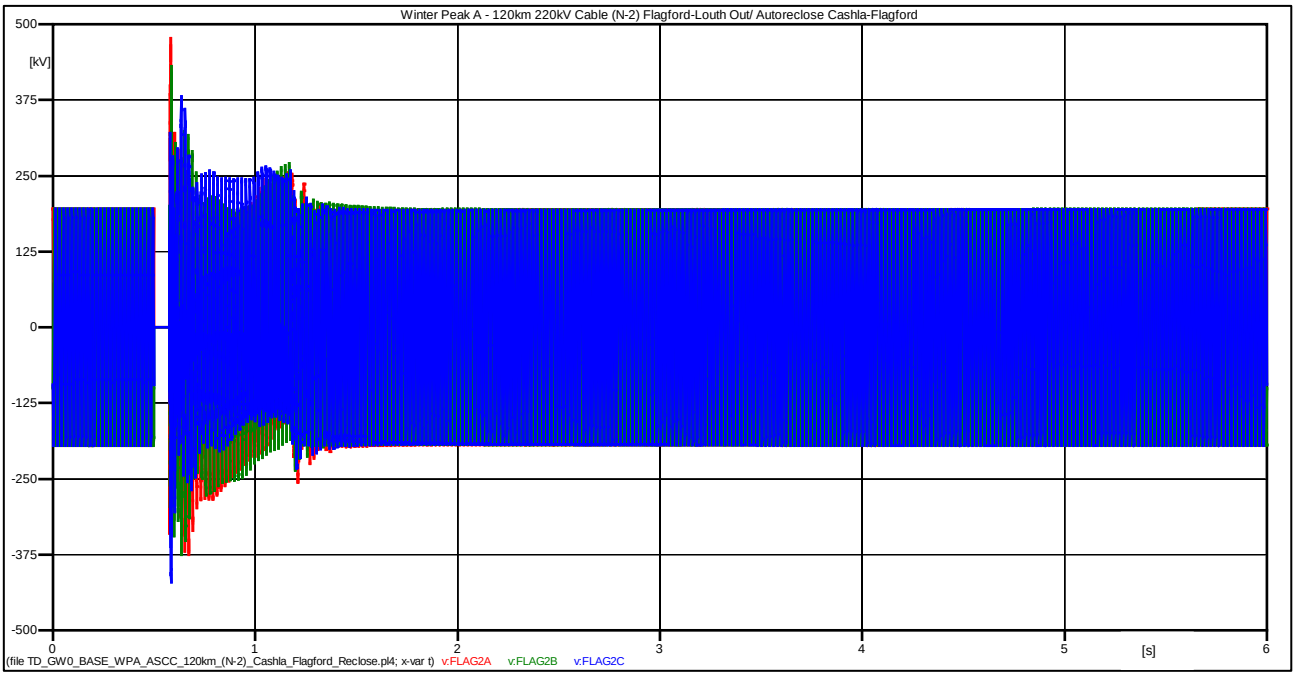

Figure 18: WPA - Length 120 km – Flagford – (N-2) Flagford-Louth Out - Autoreclose Cashla-Flagford Line (0-6s)

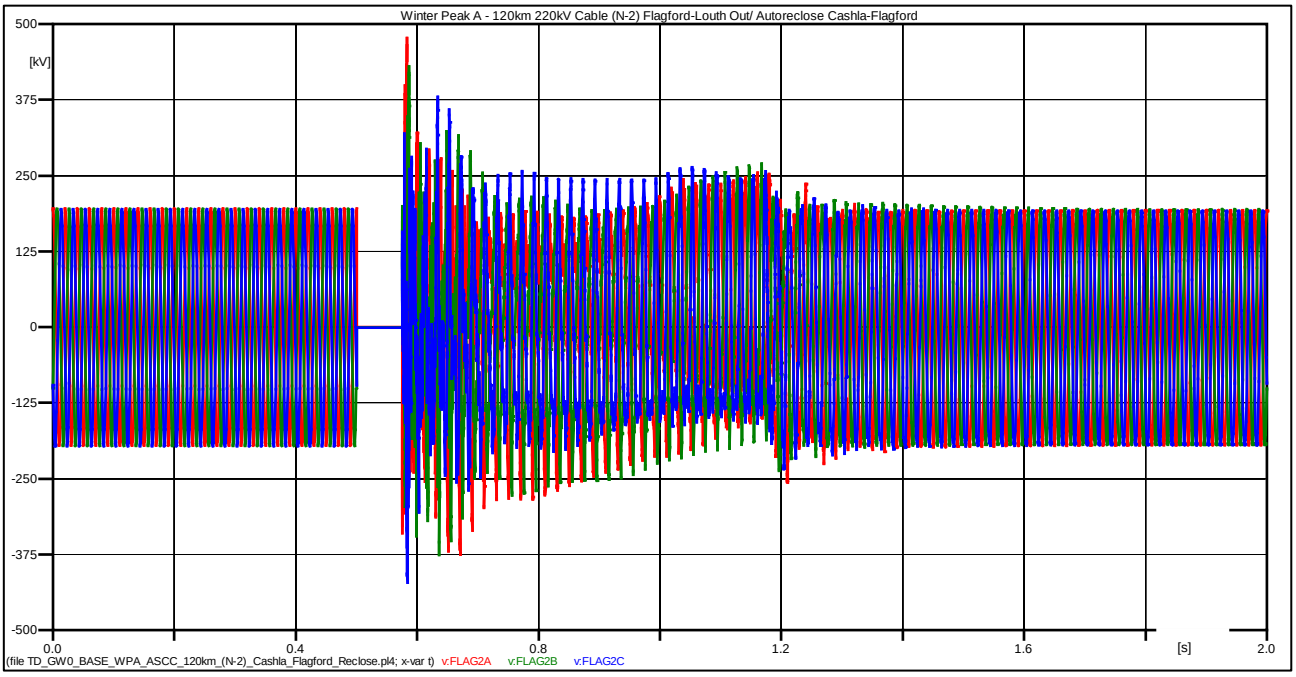

Figure 19: WPA - Length 120 km – Flagford – (N-2) Flagford-Louth Out - Autoreclose Cashla-Flagford Line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	463.12 kV (2.5789 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	376.66 kV (2.097 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

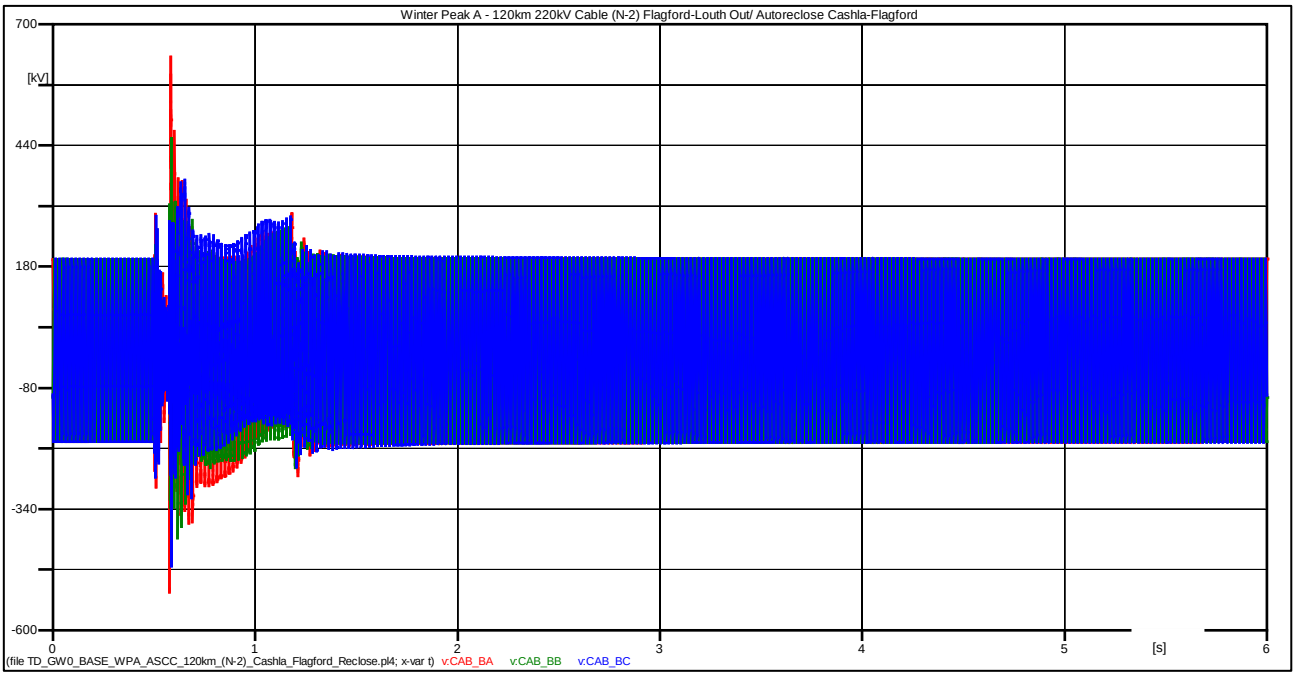

Figure 20: WPA - Length 120 km – North Mayo – (N-2) Flagford-Louth Out - Autoreclose Cashla-Flagford Line (0-6s)

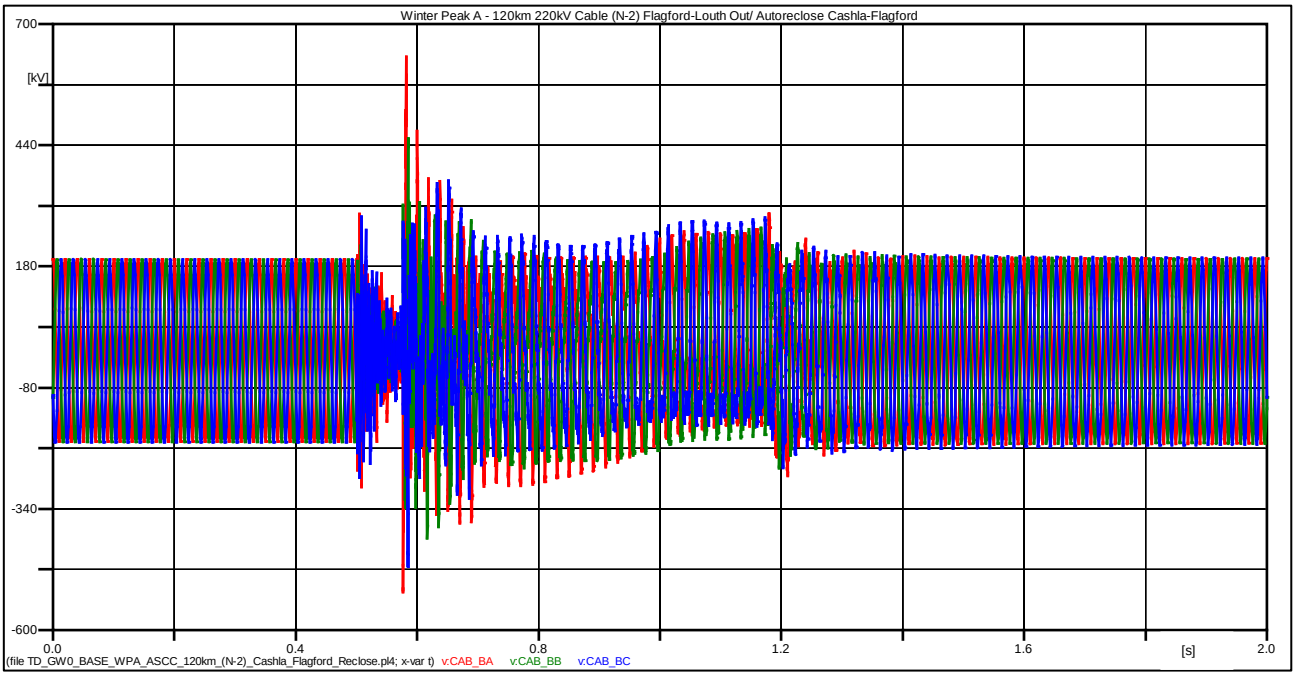

Figure 21: WPA - Length 120 km – North Mayo – (N-2) Flagford-Louth Out - Autoreclose Cashla-Flagford Line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	510.22 kV (2.8411 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	328.66 kV (1.8301 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.10 Impedance Scans - Length 120 km – Winter Peak A – Case 6

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

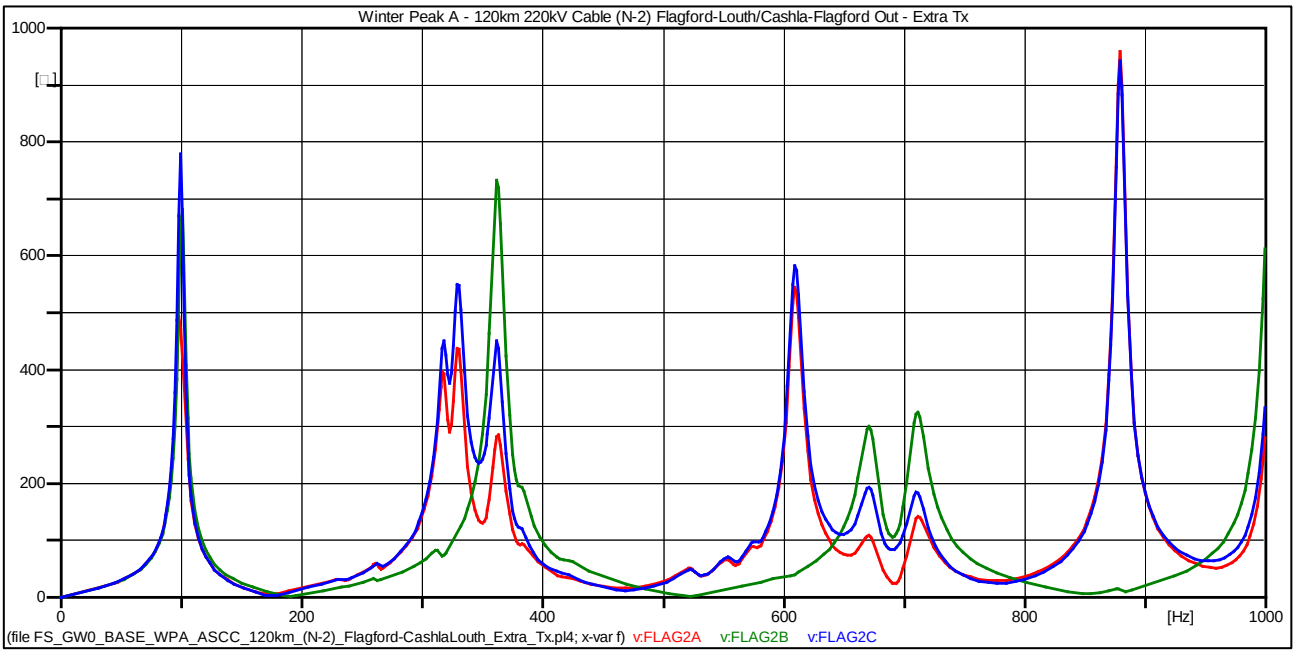

Figure 22: WPA - Length 120 km – (N-2) Flagford-Louth/Cashla-Flagford lines – Extra Tx at Flagford

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
100.51	664.1
330.01	548.06
361.51	732.58
609.01	583.01
670.51	294.25
711.01	324.34
879.01	942.29

2.11 Time Domain Simulation - Length 120 km – Winter Peak A – Case 7

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 7: Energisation of the 220 kV 120 km cable from Flagford

System Conditions:

1. Energisation the cable from Flagford (North mayo disconnected).
2. Circuit breaker closes at a point on wave of 90°.

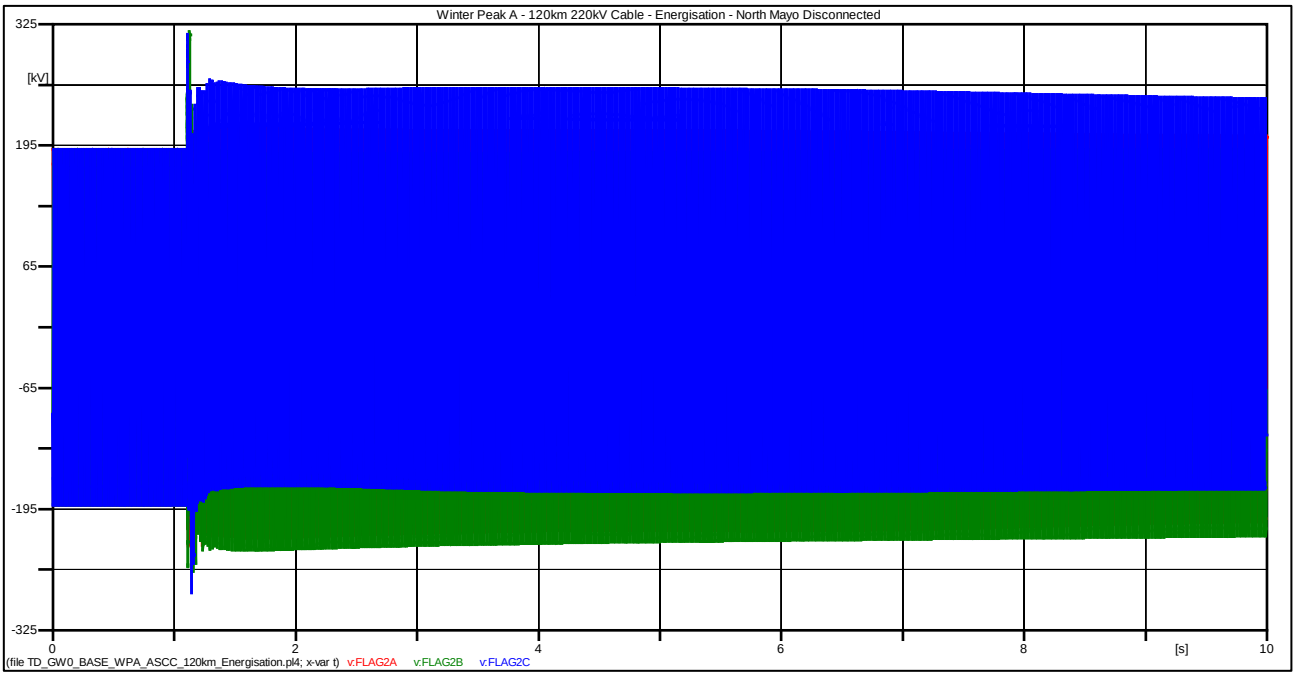

Figure 23: WPA - Length 120 km - Flagford – Energisation of the cable (0-10s)

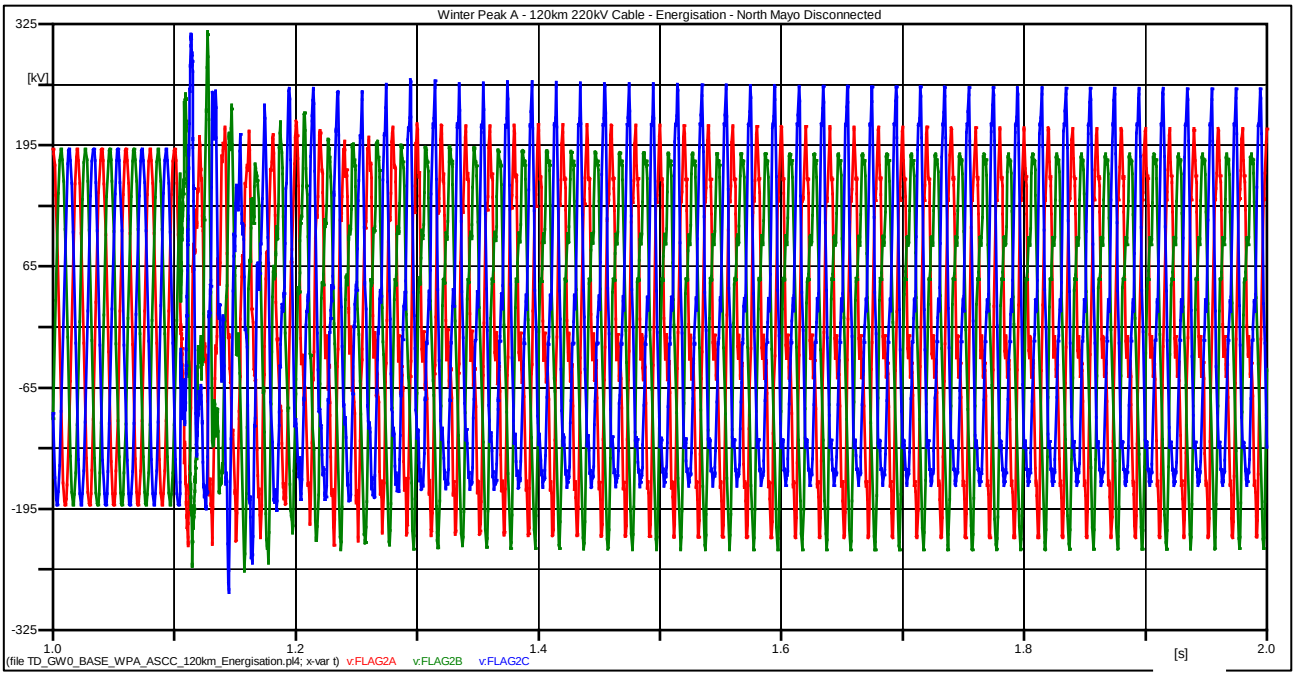

Figure 24: WPA - Length 120 km – Flagford – Energisation of the cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	320.1 kV (1.7824 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	256.86 kV (1.4300 pu)	287.32 kV(1.6pu)	Pass

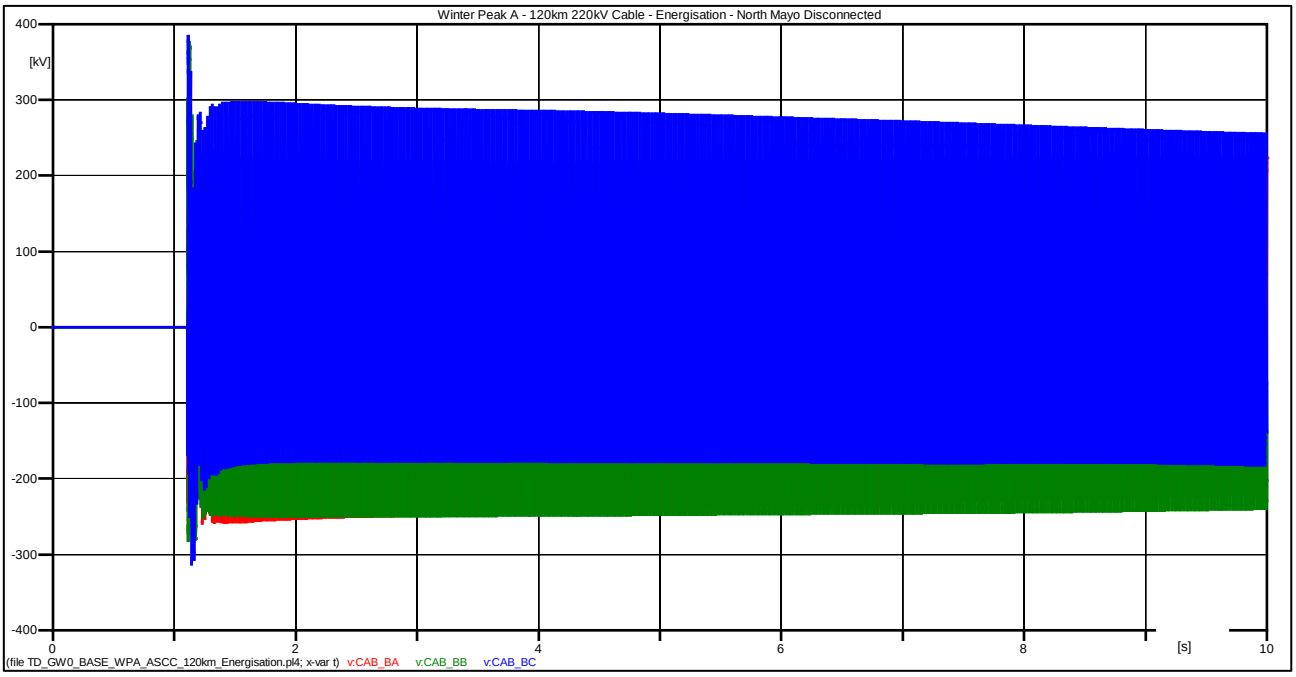

Figure 25: WPA - Length 120 km – North Mayo – Energisation of the cable (0-10s)

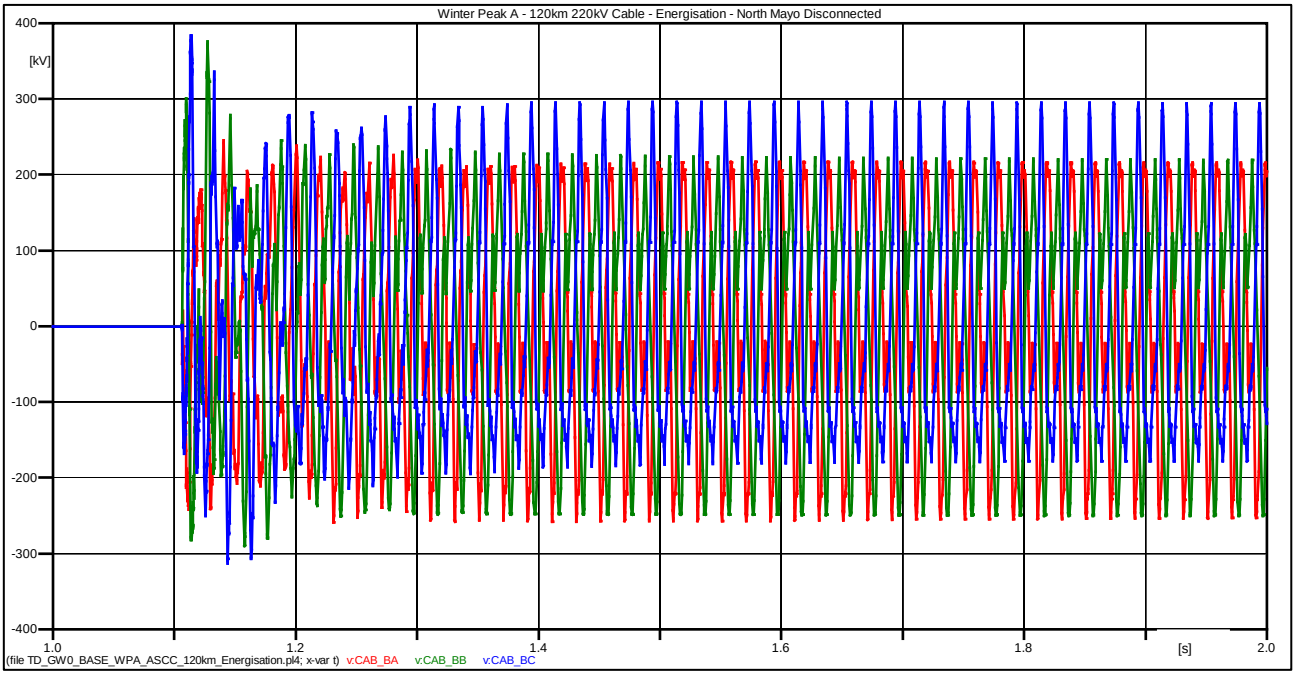

Figure 26: WPA - Length 120 km – North Mayo – Energisation of the cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	378.1 kV (2.1054 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	295.2 kV (1.6438 pu)	287.32 kV(1.6pu)	Fail

2.12 Impedance Scans - Length 120 km – Summer Valley B – Case 1

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 1: All lines in service

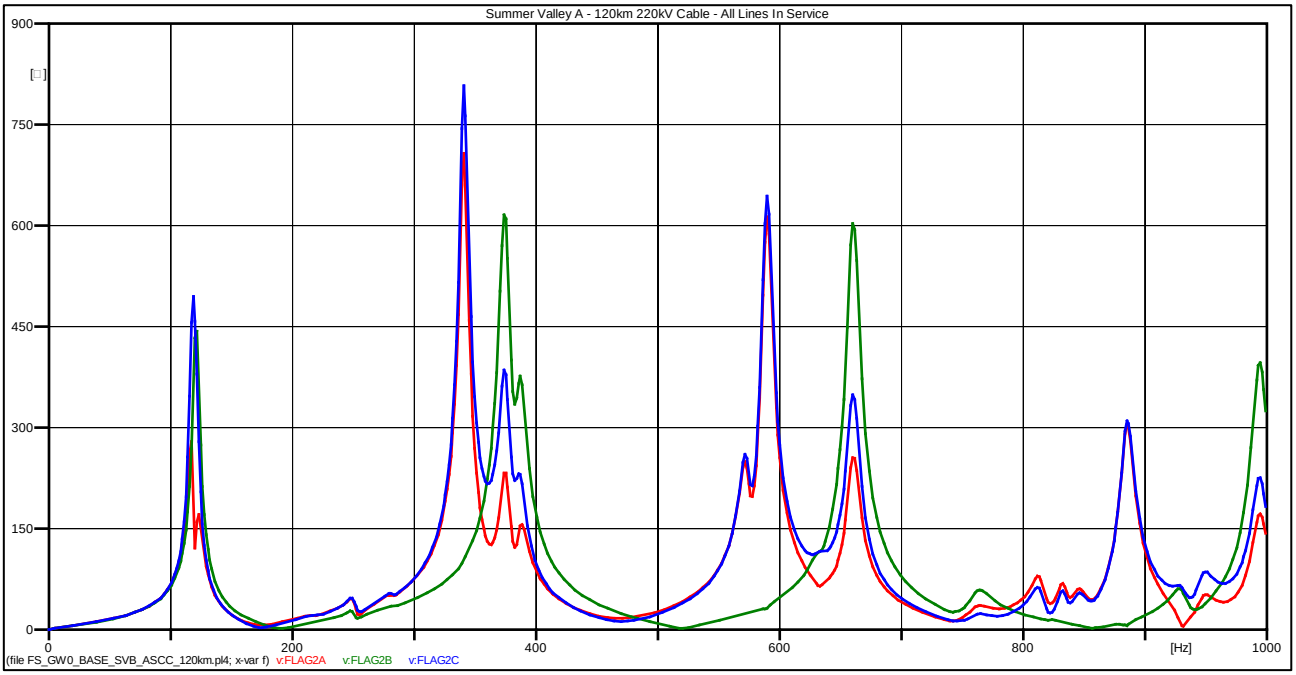

Figure 27: SVB - Length 120 km - All lines in service

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
118.51	494.89
340.51	807.51
373.51	610.31
589.51	643.36
660.01	603.28
886.51	310.10
994.51	402.10

2.13 Impedance Scans - Length 120 km – Summer Valley B – Case 2

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 2: (N-1) Flagford-Louth 220 kV Line Out

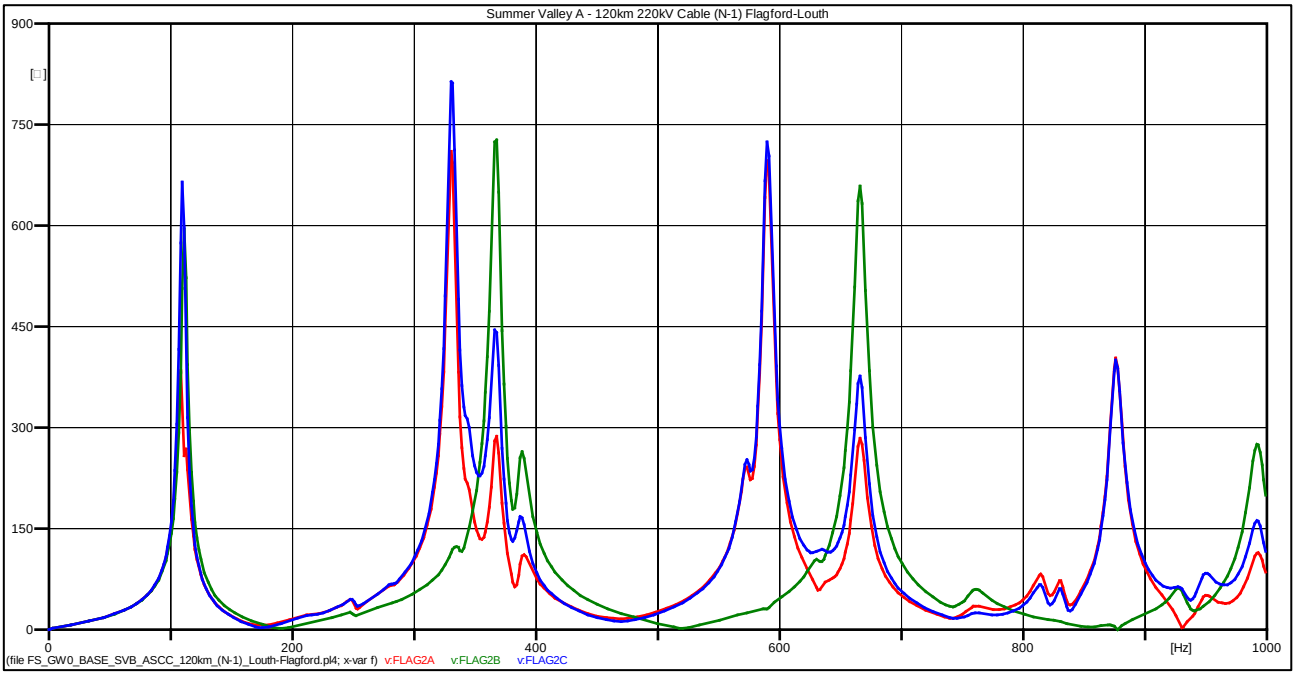

Figure 28: SVB - Length 120 km – (N-1) Flagford-Louth Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
109.51	664.56
331.51	811.10
366.01	724.31
589.51	724.52
660.01	658.18
876.01	400.62
993.01	273.92

2.14 Time Domain Simulation - Length 120 km – Summer Valley B – Case 2

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 2: (N-1) – Autoreclose of the Flagford-Louth line

1. Fault on Flagford side of Flagford-Louth line, applied at 0.5s, removed at 0.575s
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.

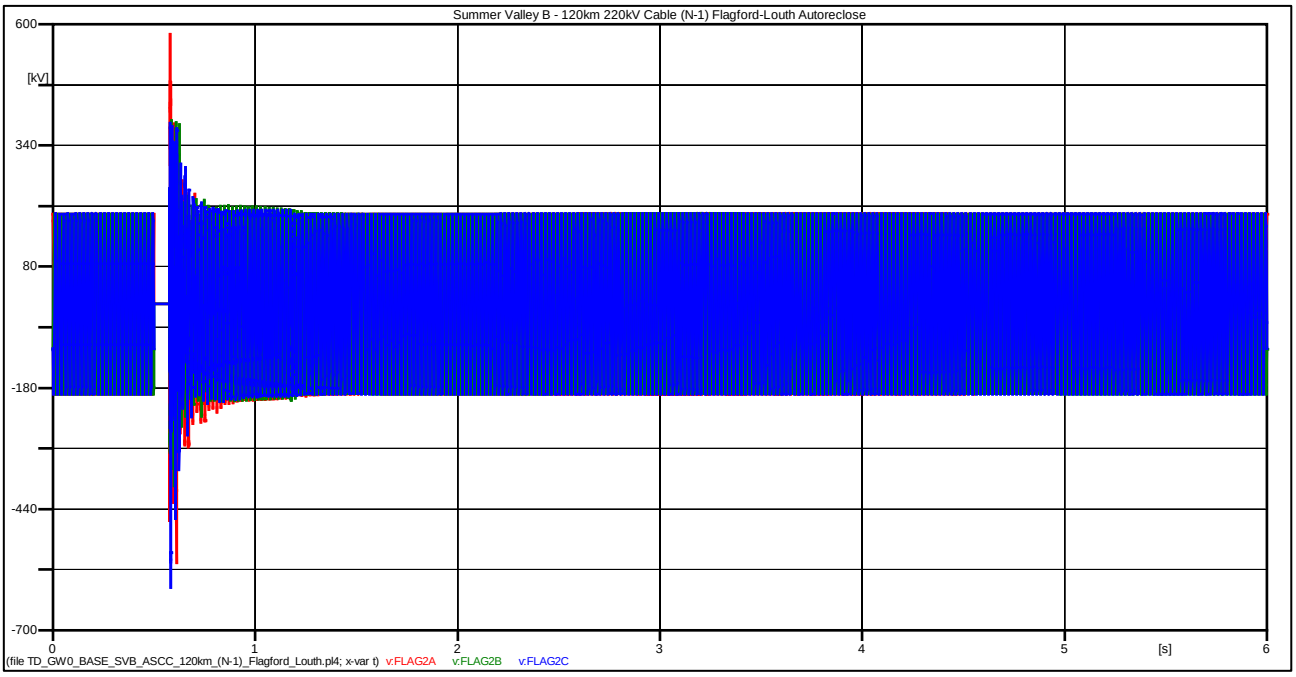

Figure 29: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Flagford-Louth line (0-6s)

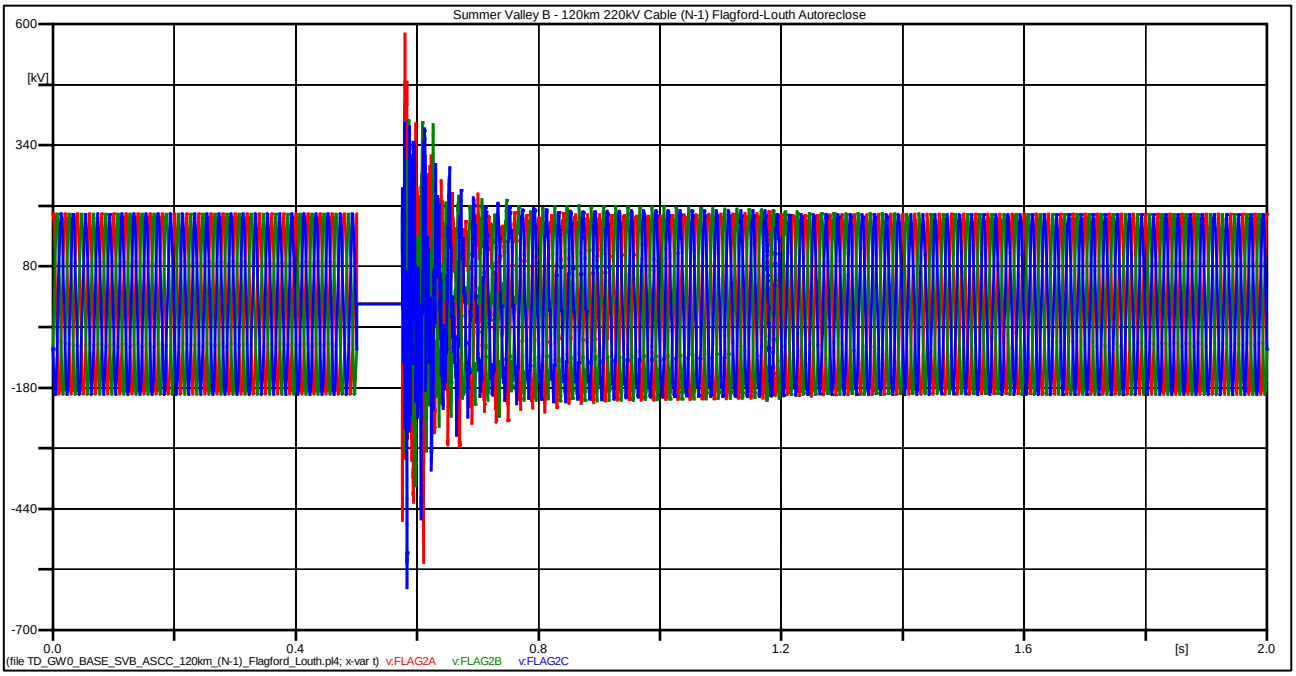

Figure 30: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Flagford-Louth line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	568.23 kV (3.1642 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	378.045 kV (2.1057 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

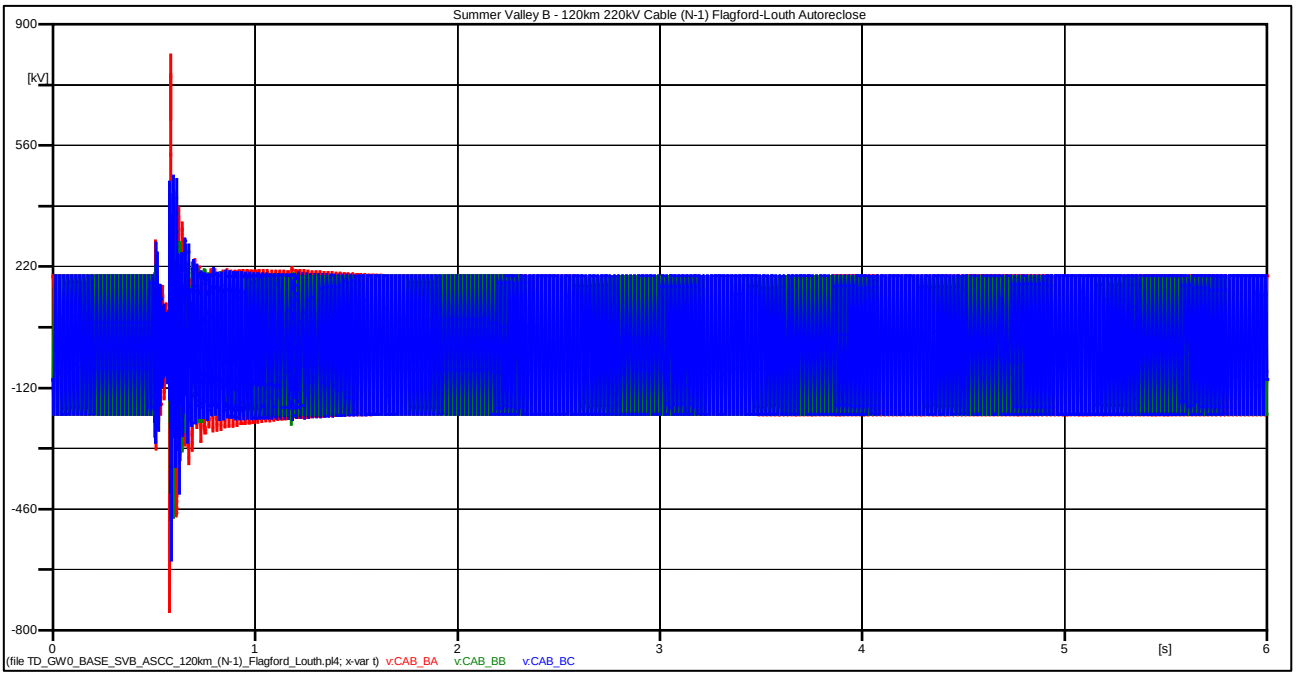

Figure 31: SVB - Length 120 km –North Mayo – (N-1) Autoreclose of the Flagford-Louth line (0-6s)

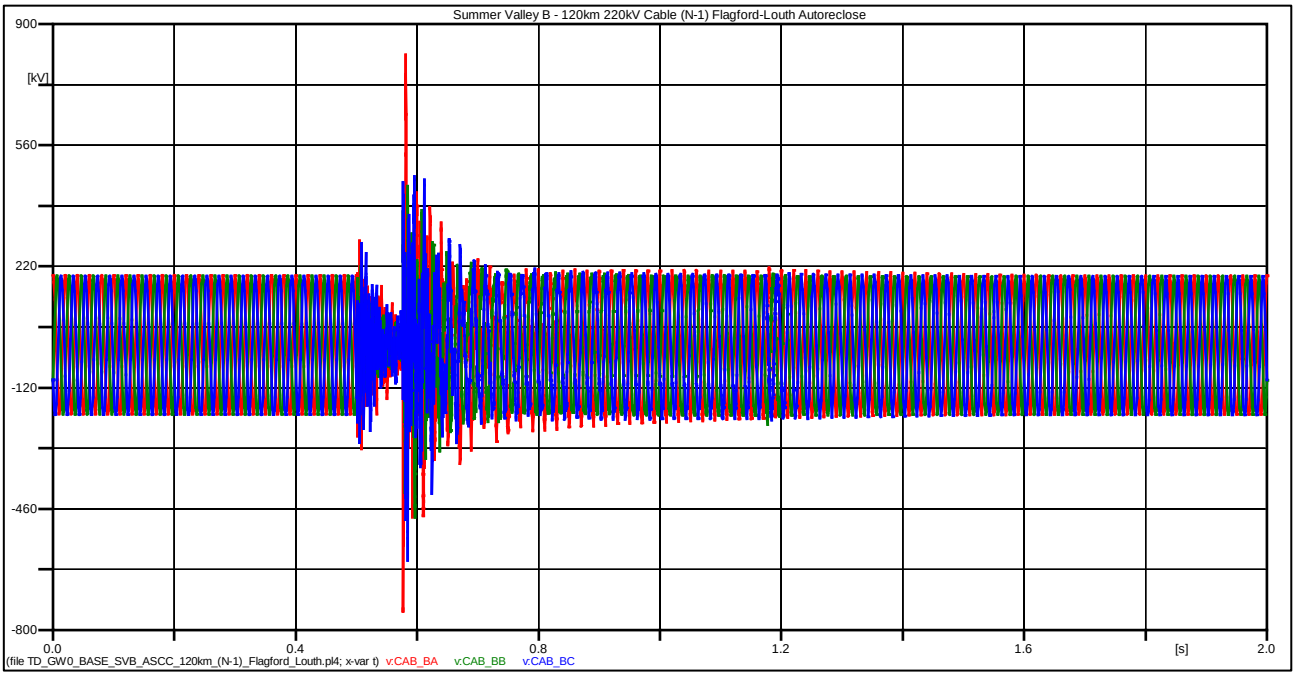

Figure 32: SVB - Length 120 km –North Mayo – (N-1) Autoreclose of the Flagford-Louth line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	703.48 kV (3.9173 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	417.094 kV (2.322)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.15 Impedance Scans - Length 120 km – Summer Valley B – Case 3

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 3: (N-1) Cashla-Flagford 220 kV Line Out

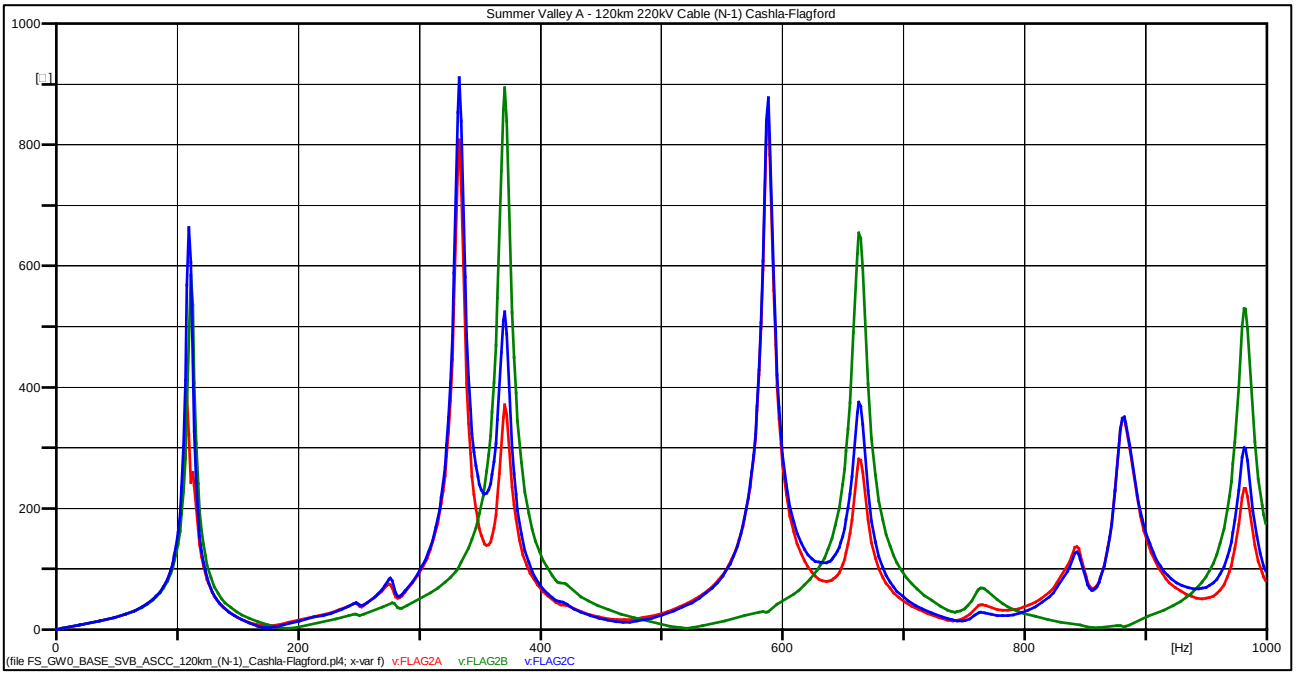

Figure 33: SVB - Length 120 km – (N-1) Cashla-Flagford Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
109.51	663.61
333.01	910.96
370.51	894.43
588.01	877.14
663.01	655.06
882.01	351.34
982.51	528.37

2.16 Time Domain Simulation - Length 120 km – Summer Valley B – Case 3

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 3: (N-1) – Autoreclose of the Cashla-Flagford line

1. Fault on Flagford side of Cashla-Flagford line, applied at 0.5s, removed at 0.575s
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.

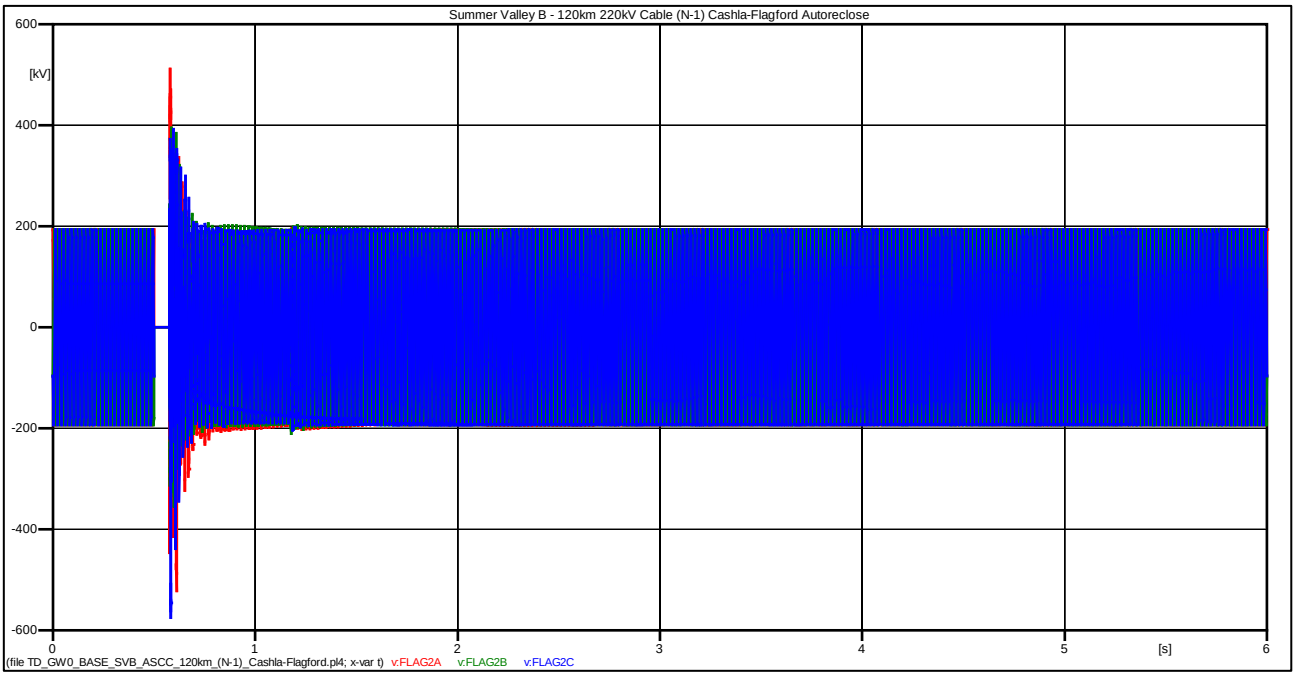

Figure 34: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Cashla-Flagford line (0-6s)

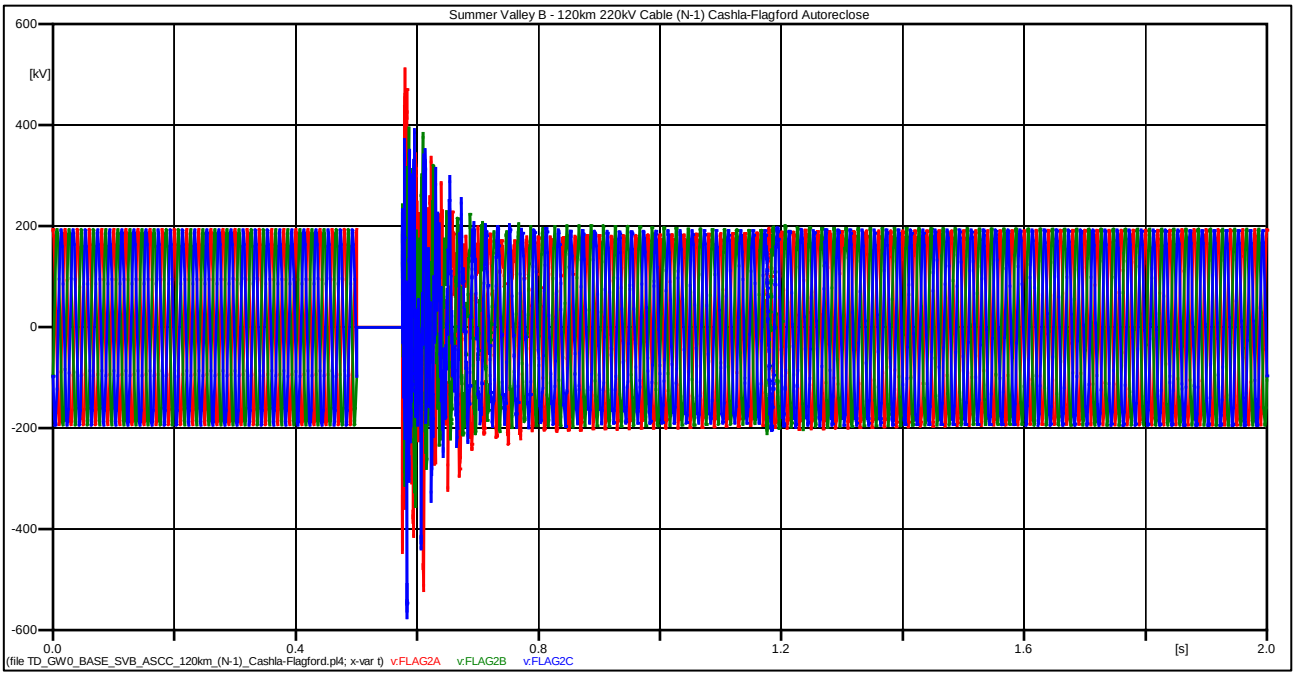

Figure 35: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Cashla-Flagford line (0-6s)

Condition	Maximum Value	Limit	Result
Switching	369.59 kV (2.0580 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	409.29 kV (2.279 pu)	287.32 kV(1.6pu)	Fail

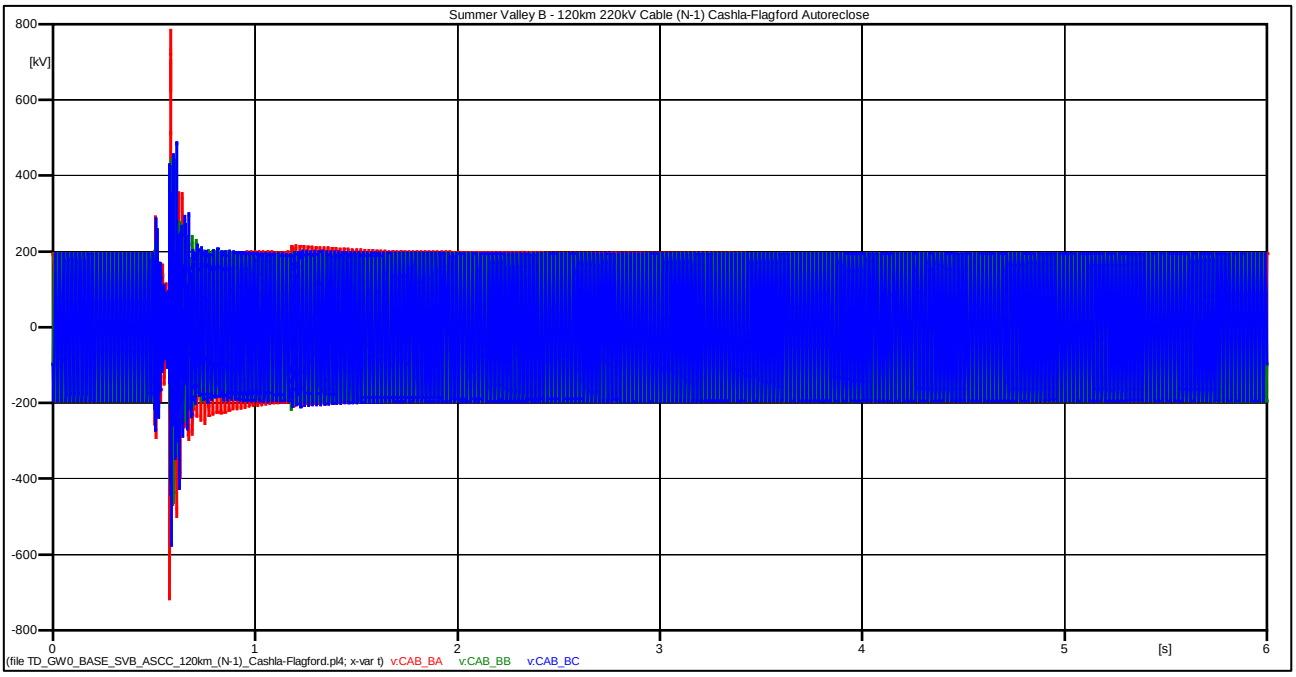

Figure 36: SVB - Length 120 km – North Mayo – (N-1) Autoreclose of the Cashla-Flagford line (0-6s)

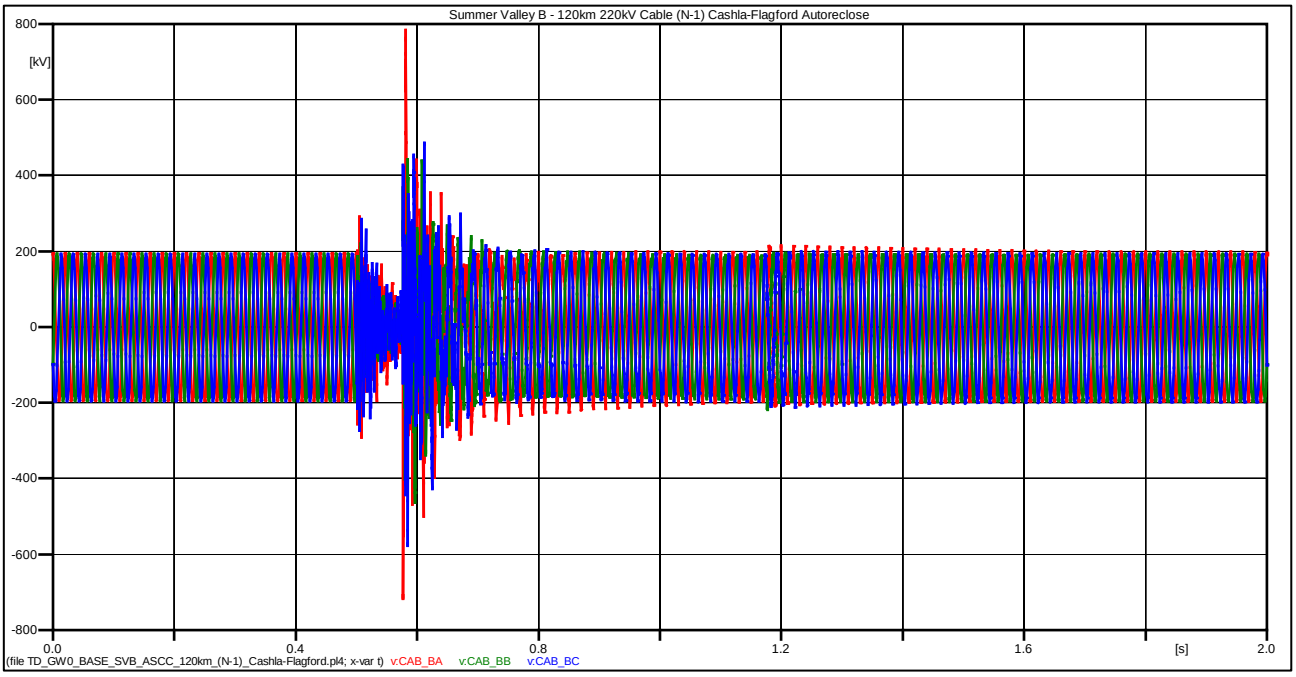

Figure 37: SVB - Length 120 km – North Mayo – (N-1) Autoreclose of the Cashla-Flagford line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	785.265 kV (4.372 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	353.100 kV (1.9662 pu)	287.32 kV(1.6pu)	Fail

2.17 Impedance Scans - Length 120 km – Summer Valley B – Case 4

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 4: (N-2) Cashla-Flagford & Flagford-Louth 220 kV lines out

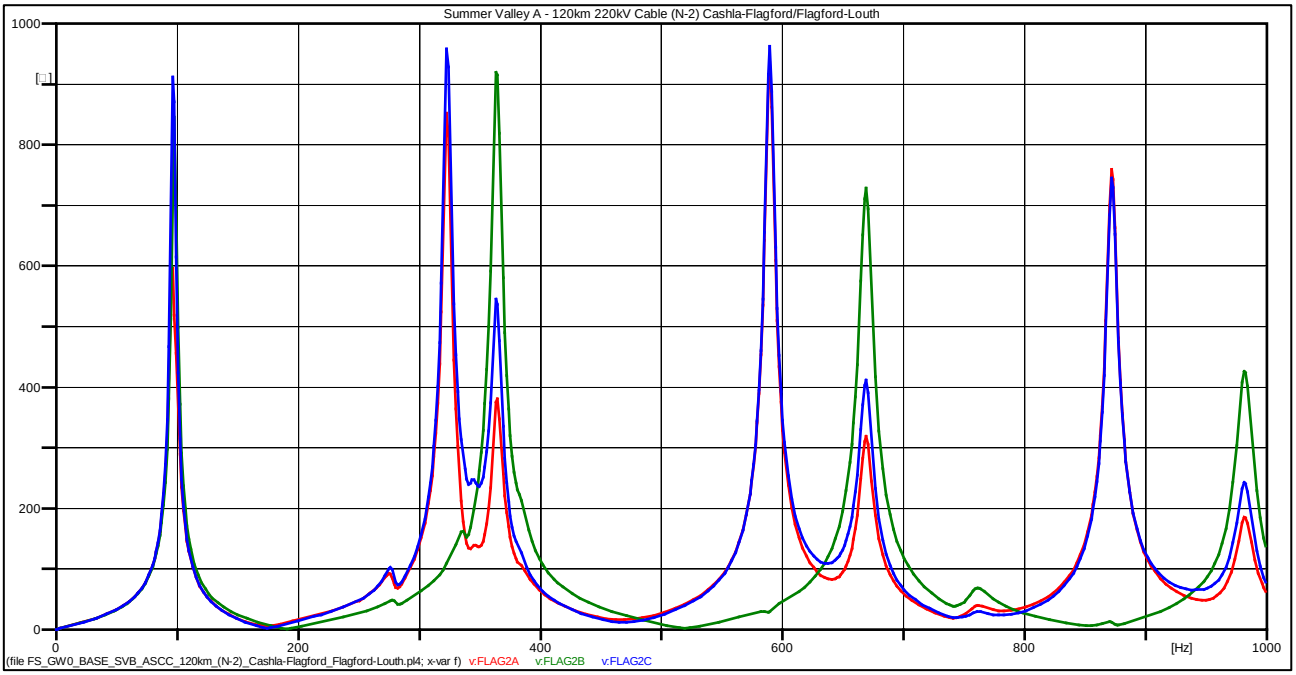

Figure 38: SVB - Length 120 km – (N-2) Flagford-Louth & Cashla-Flagford Lines Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
96.01	912.19
322.51	957.68
364.51	915.22
589.51	962.08
669.01	728.37
871.51	759.82
982.51	424.32

2.18 Time Domain Simulation - Length 120 km – Summer Valley B – Case 4

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 4: (N-2) Condition – Flagford/Louth Disconnected - Autoreclose of the Cashla-Flagford line

1. Fault on Flagford side of Cashla-Flagford line, applied at 0.5s, removed at 0.575s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.

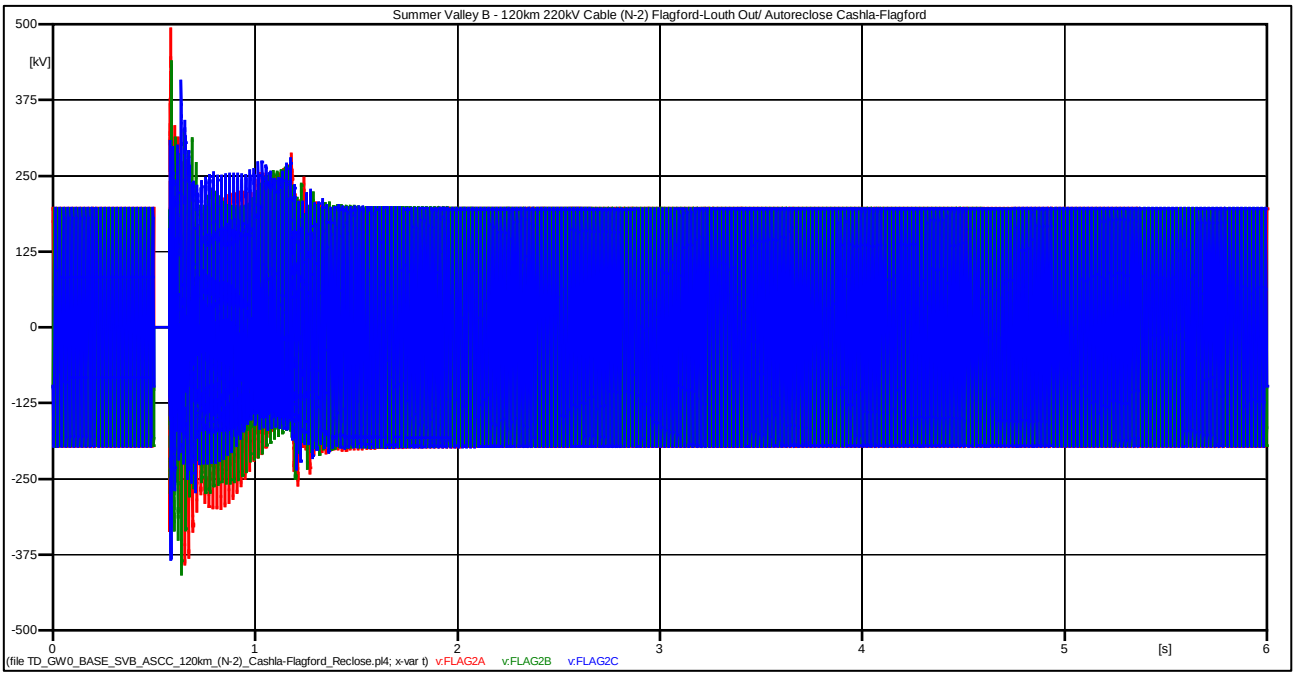

Figure 39: SVB - Length 120 km – Flagford – (N-2) Autoreclose of the Cashla-Flagford line - Flagford/Louth Disconnected (0-6s)

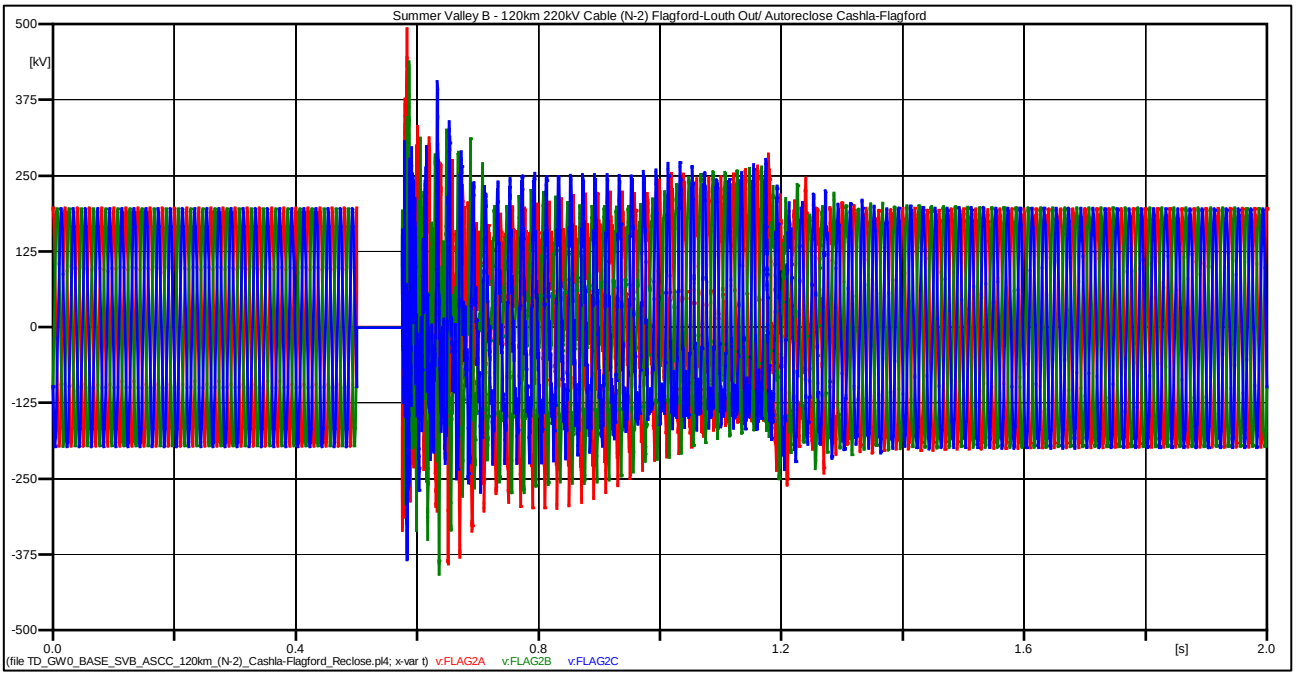

Figure 40: SVB - Length 120 km – Flagford – (N-2) Autoreclose of the Cashla-Flagford line - Flagford/Louth Disconnected (0-2s)

Condition	Maximum Value	Limit	Result
Switching	490.01 kV (2.7286 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	385.23 kV (2.145 pu)	287.32 kV(1.6pu)	Fail

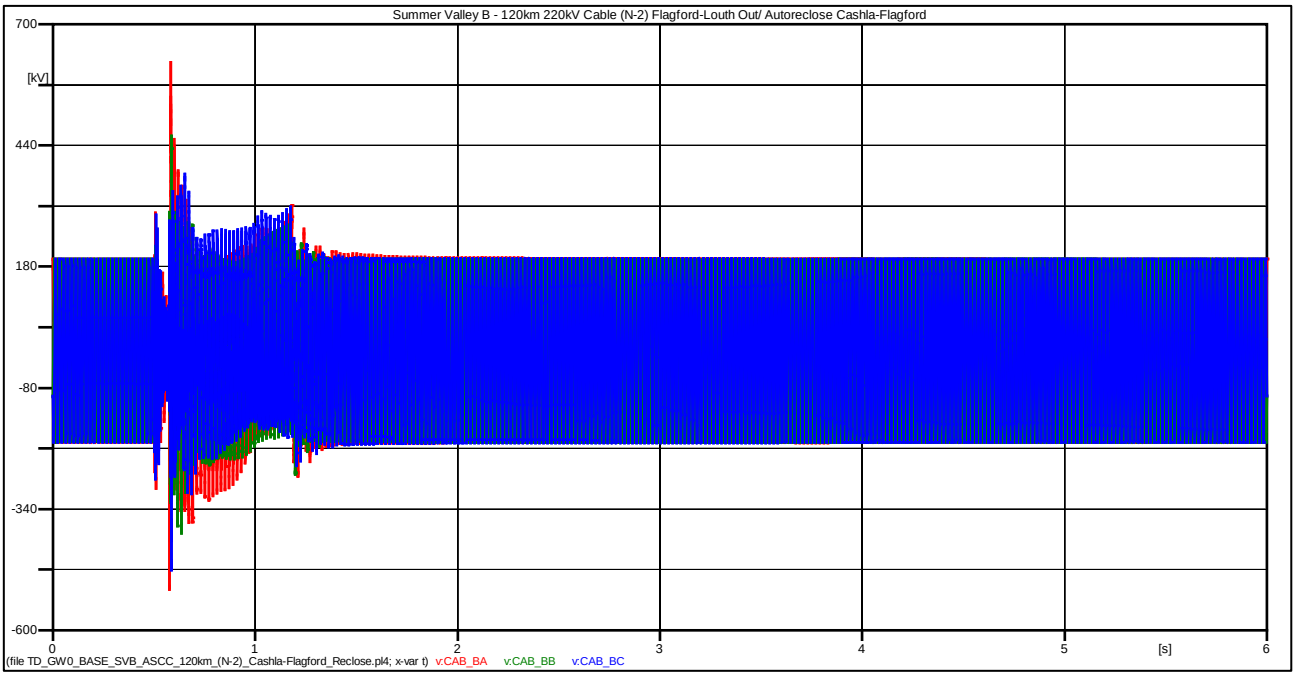

Figure 41: SVB - Length 120 km – North Mayo – (N-2) Autoreclose of the Cashla-Flagford line - Flagford/Louth Disconnected (0-6s)

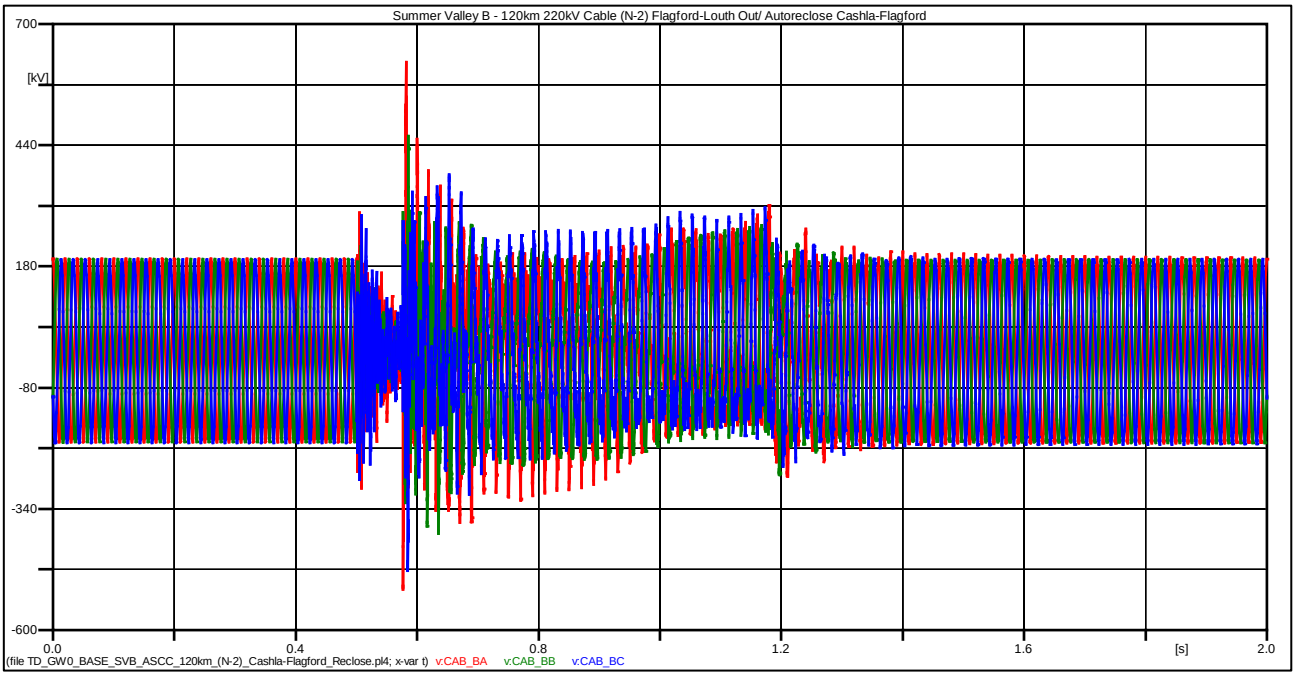

Figure 42: SVB - Length 120 km – North Mayo – (N-2) Autoreclose of the Cashla-Flagford line - Flagford/Louth Disconnected (0-2s)

Condition	Maximum Value	Limit	Result
Switching	610.01 kV (3.3968 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	370.05 kV (2.0606 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.19 Impedance Scans - Length 120 km – Summer Valley B – Case 5

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 5: (N-2) Cashla-Flagford & Flagford_Louth 220 kV lines out – Extra Flagford transformer

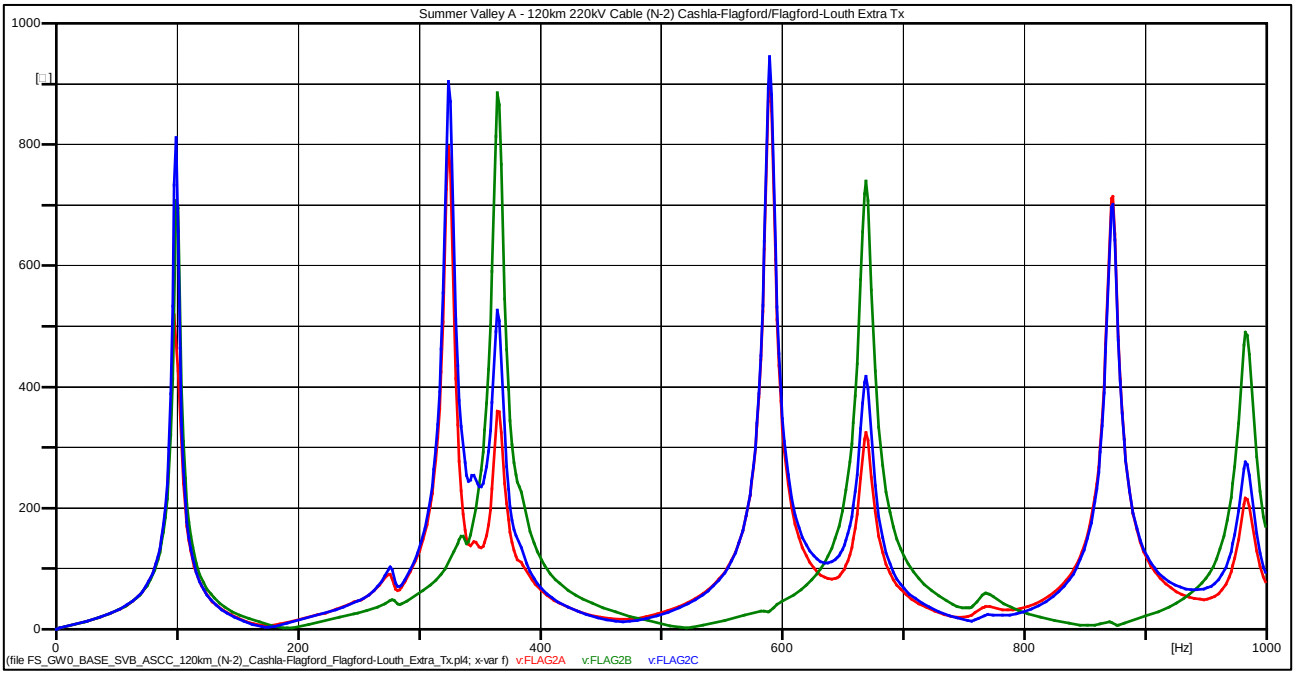

Figure 43: SVB - Length 120 km – (N-2) Flagford-Louth Line Out/Cashla-Flagford Out & Extra Tx

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
99.01	811.46
324.01	903.51
364.51	884.98
589.51	944.83
669.01	739.70
873.01	713.94
982.51	490.56

2.20 Time Domain Simulation - Length 120 km – Winter Peak A – Case 5

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 5: (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford – Extra transformer at Flagford

1. Fault on Flagford side of Cashla-Flagford line applied at 0.5s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.
3. Breaker opens at again at 1.25s.

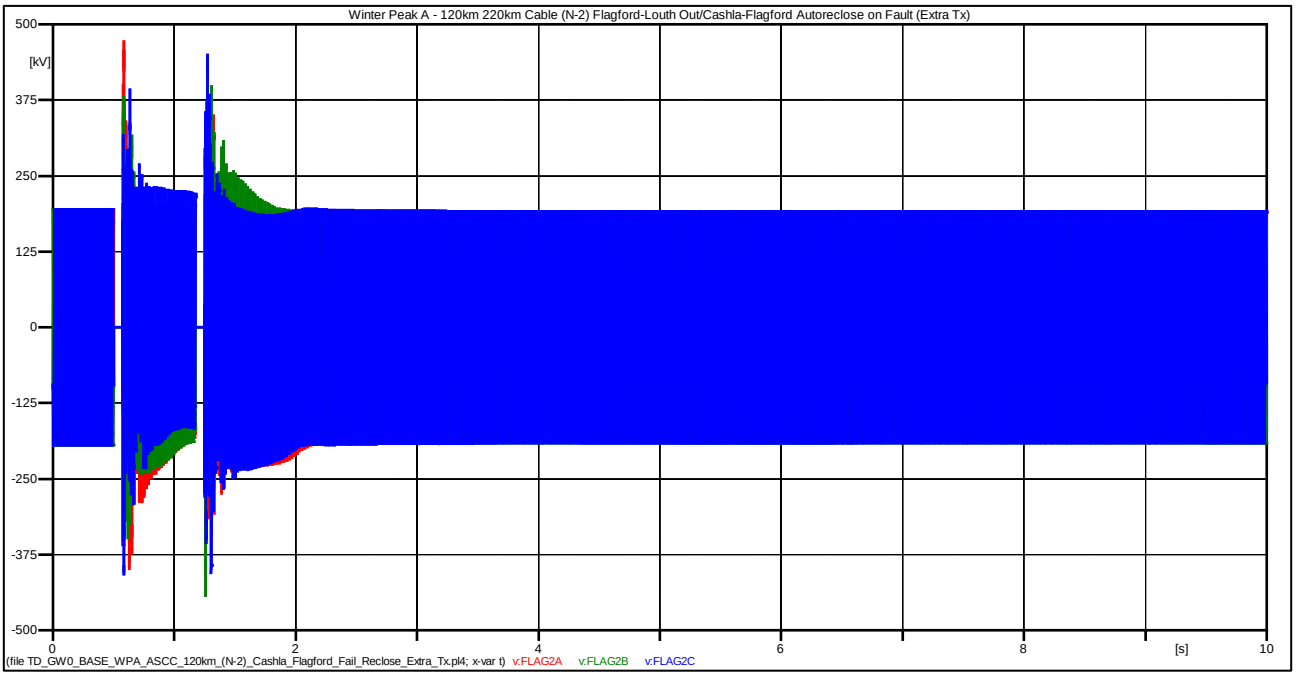

Figure 44: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-10s) – Extra Tx added at Flagford

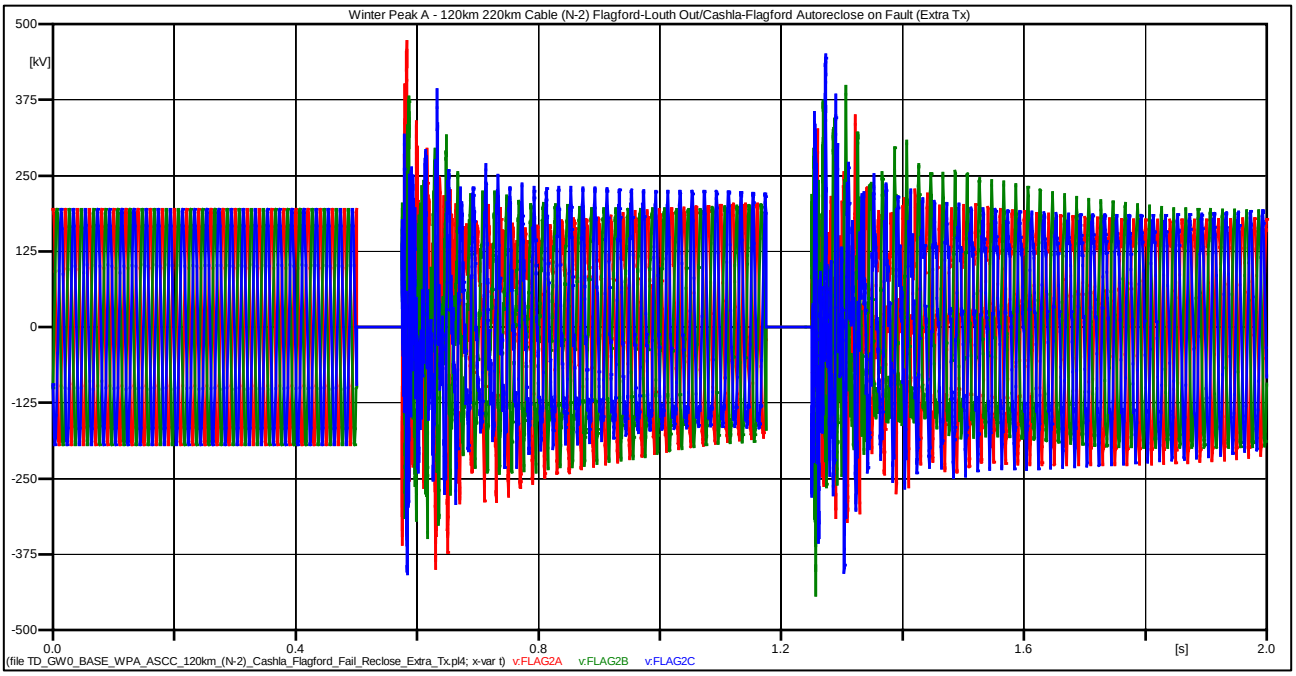

Figure 45: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-2s) – Extra Tx added at Flagford

Condition	Maximum Value	Limit	Result
Switching	475.56 kV (2.6481 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	382.50 kV (2.1299 pu)	287.32 kV(1.6pu)	Fail

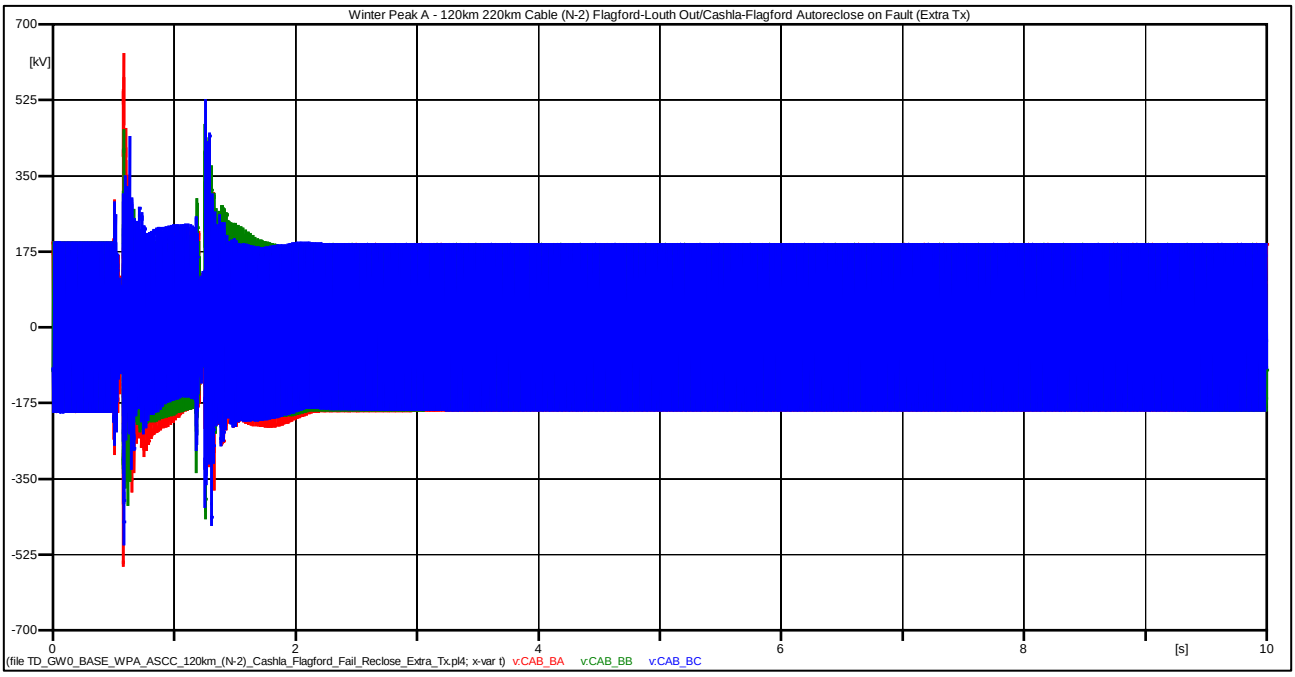

Figure 46: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford - No fault removal (0-10s) – Extra Tx added at Flagford

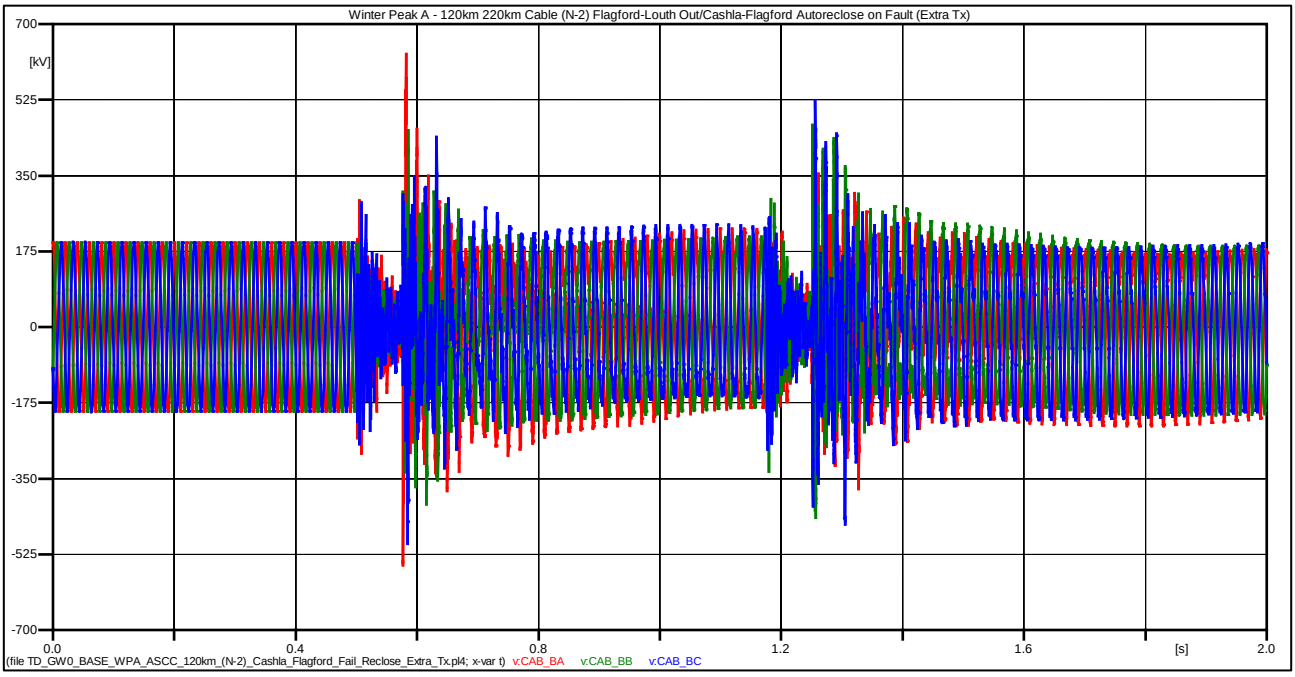

Figure 47: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-2s) – Extra Tx added at Flagford

Condition	Maximum Value	Limit	Result
Switching	601.05 kV (3.346 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	420.1 kV (2.339 pu)	310.76 kV (1.73 pu)	Fail

*Pass can be achieved with surge arrestors

2.21 Impedance Scans - Length 120 km – Summer Valley B – Case 6

Conditions for impedance scan:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 6: (N-1) Flagford-Srananagh 220 kV Line Out

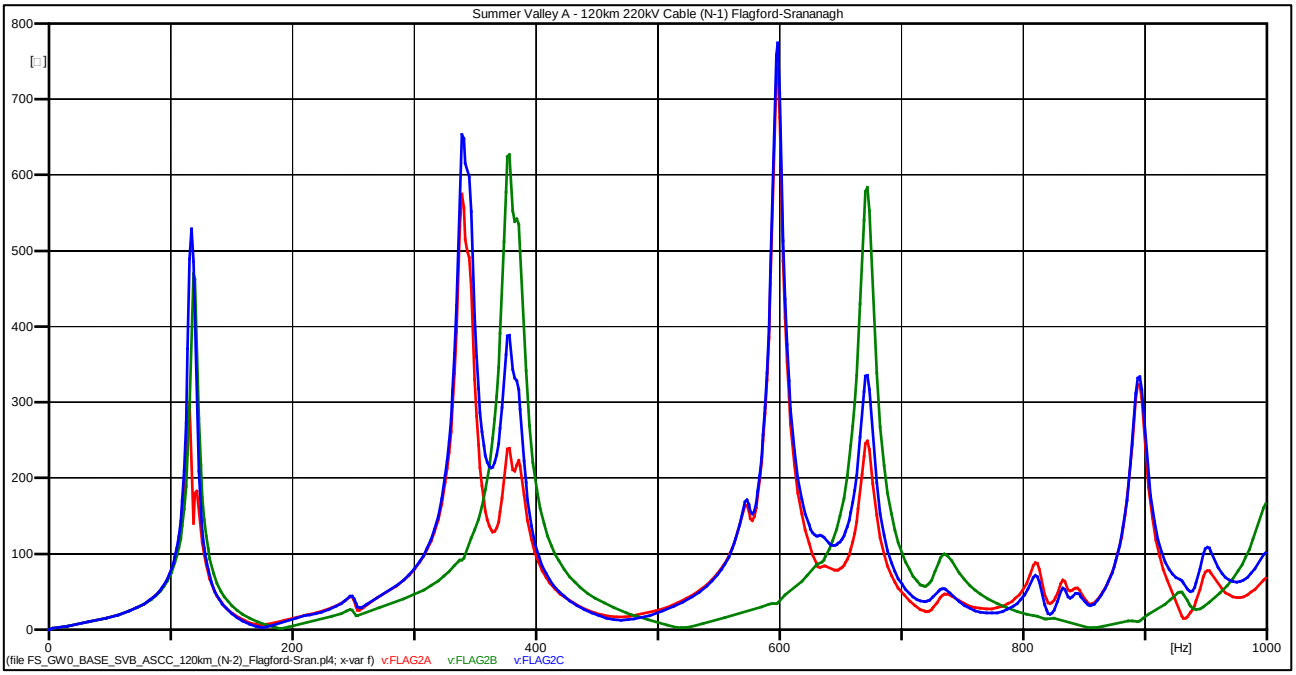

Figure 48: SVB - Length 120 km – (N-1) Flagford-Srananagh Line Out

Frequency (Hz)	Impedance (Ω)
117.01	529.29
339.01	652.99
378.01	626.55
598.51	774.79
672.01	583.31
895.51	333.66

2.22 Time Domain Simulation - Length 120 km – Summer Valley B – Case 6

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 6: (N-1)- Autoreclose of the Flagford/Srananagh Line

1. Fault on Flagford side of Flagford-Srananagh line, applied at 0.5s, removed at 0.575s
2. Reclose sequence at 0.575s, dead time 0.7s, circuit breaker closes 1.275s, point on wave closes at 90°.

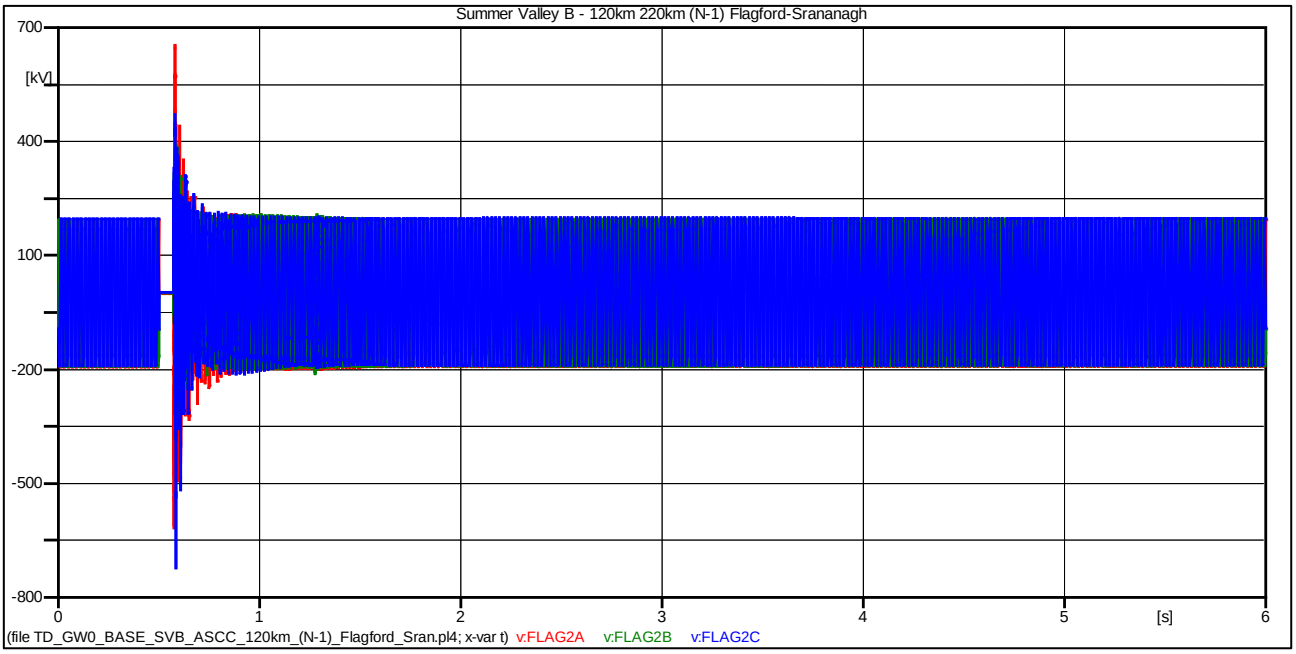

Figure 49: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Flagford-Srananagh line (0-6s)

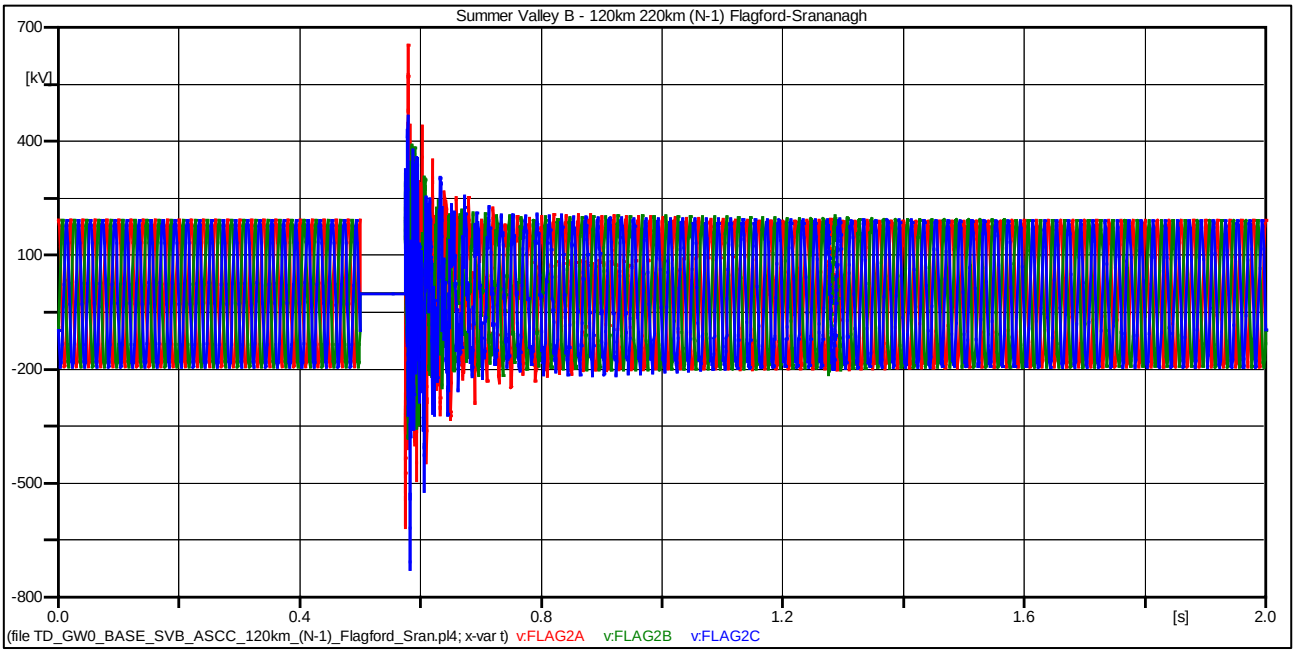

Figure 50: SVB - Length 120 km – Flagford – (N-1) Autoreclose of the Flagford-Srananagh line (0-2s)

Condition	Maximum Value	Limit	Result
Switching	610 kV (3.3968pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	410.05 kV (2.283pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

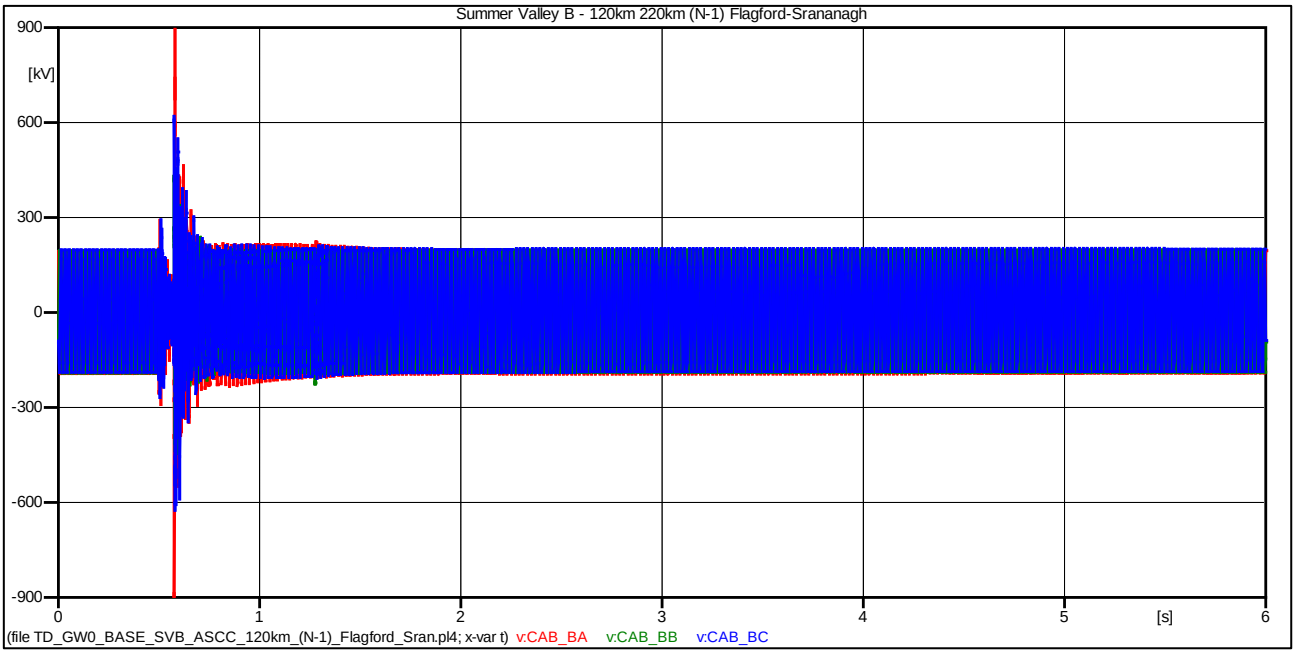

Figure 51: SVB - Length 120 km – North Mayo – (N-1) Autoreclose of the Flagford-Srananagh line (0-6s)

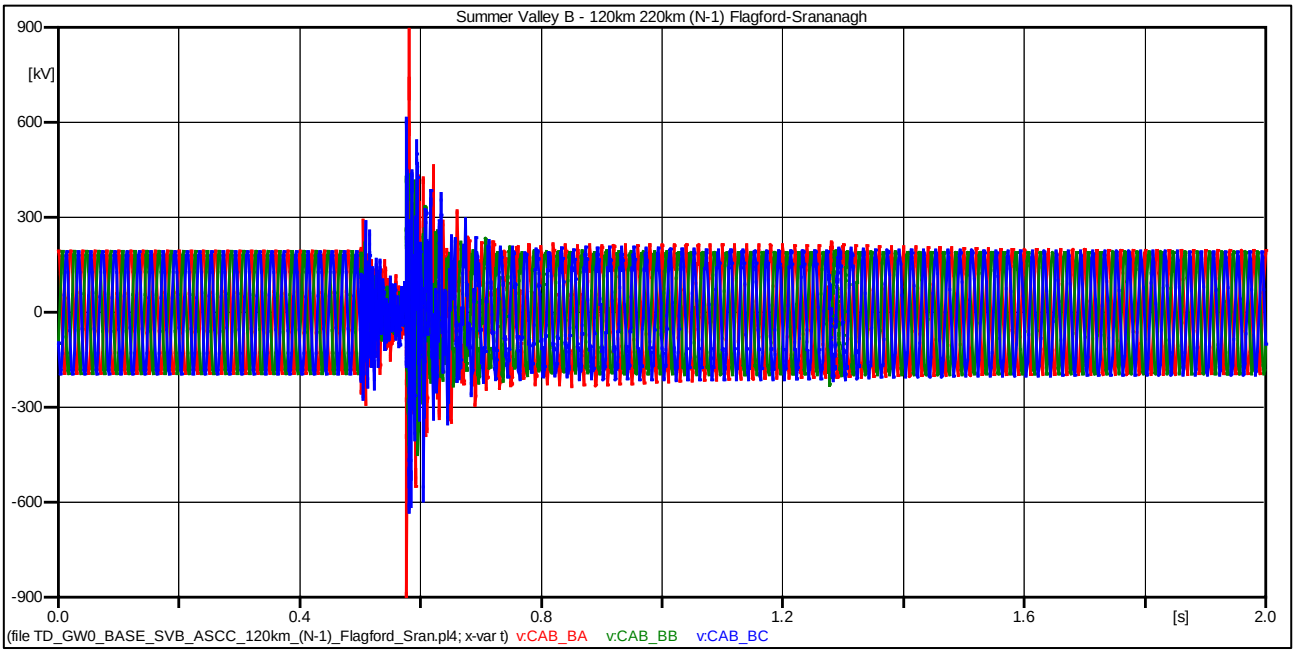

Figure 52: SVB - Length 120 km – North Mayo – (N-1) Autoreclose of the Flagford-Srananagh line (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	900 kV (5.0116pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	430.03 kV (2.3946pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with surge arrestors

2.23 Time Domain Simulation - Length 120 km – Summer Valley B – Case 7

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 7: Energisation of the Cable

System Conditions:

1. Energisation the cable from Flagford at 1.105s (North mayo disconnected).
2. Circuit breaker closes at a point on wave of 90°.

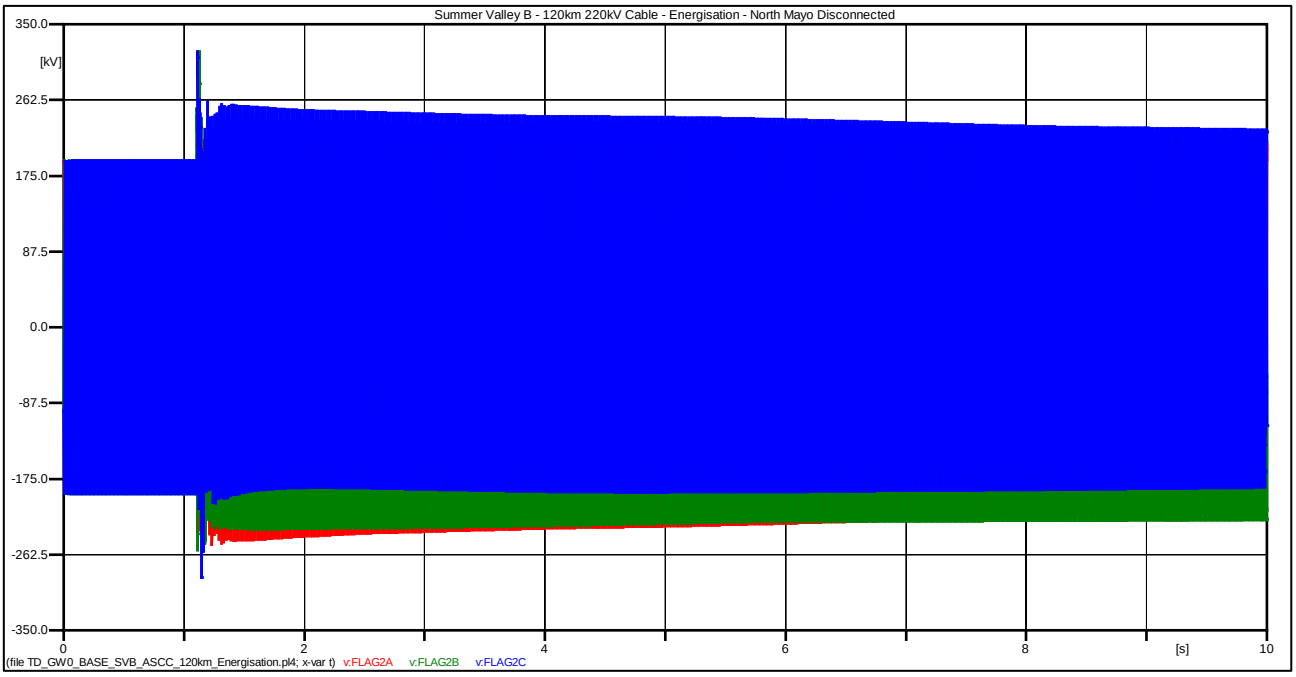

Figure 53: SVB - Length 120 km - Flagford – Energisation of the cable (0-10s)

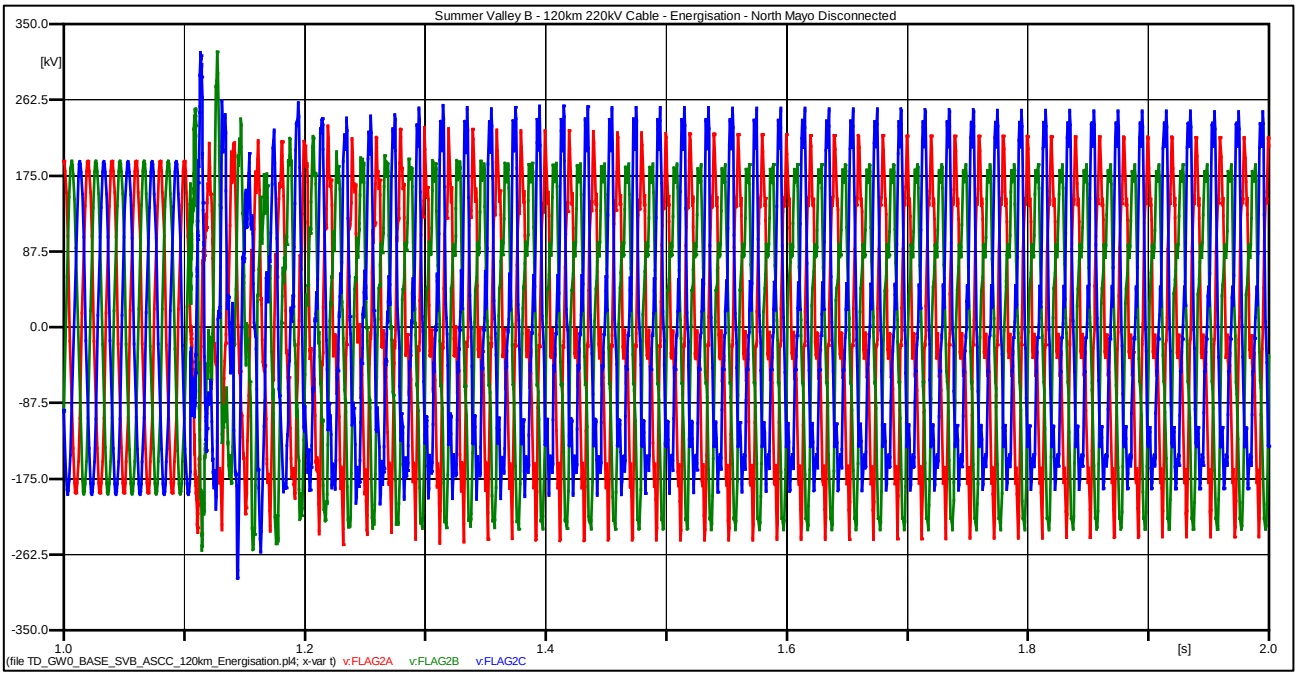

Figure 54: SVB - Length 120 km - Flagford – Energisation of the cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	793.17 kV (4.4168 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	305.35 kV (1.7003 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

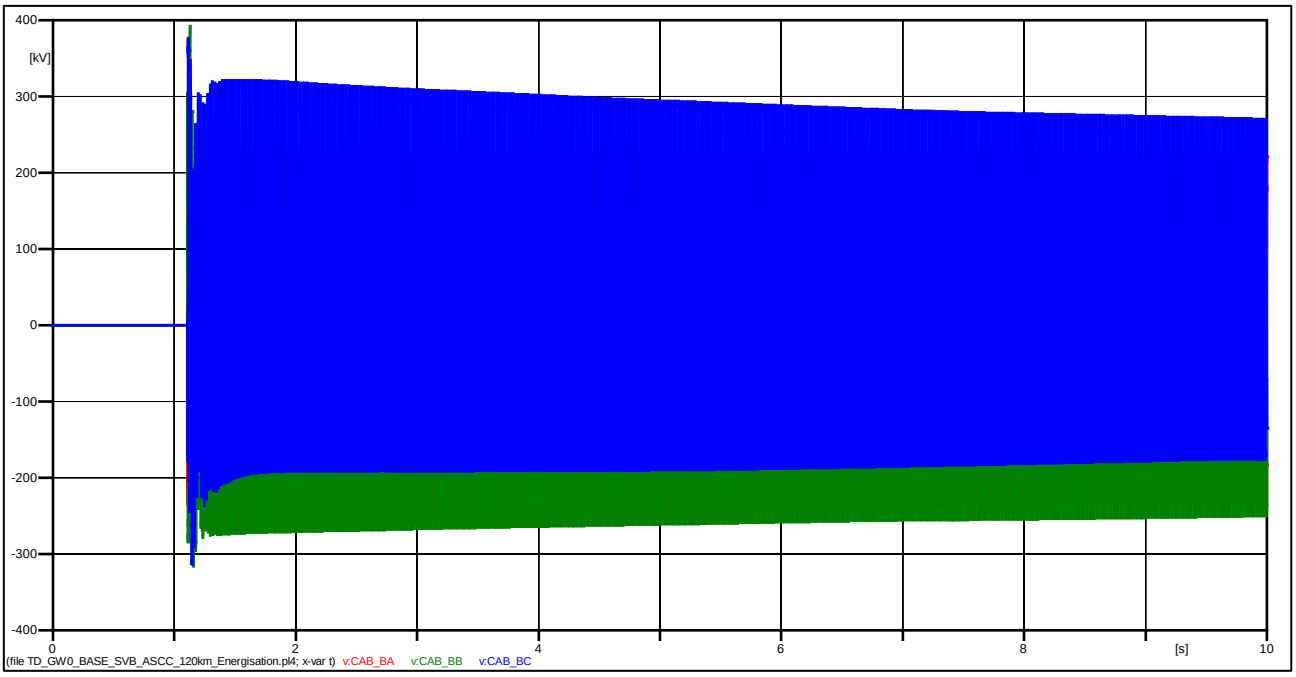

Figure 55: SVB - Length 120 km – North Mayo – Energisation of the cable (0-10s)

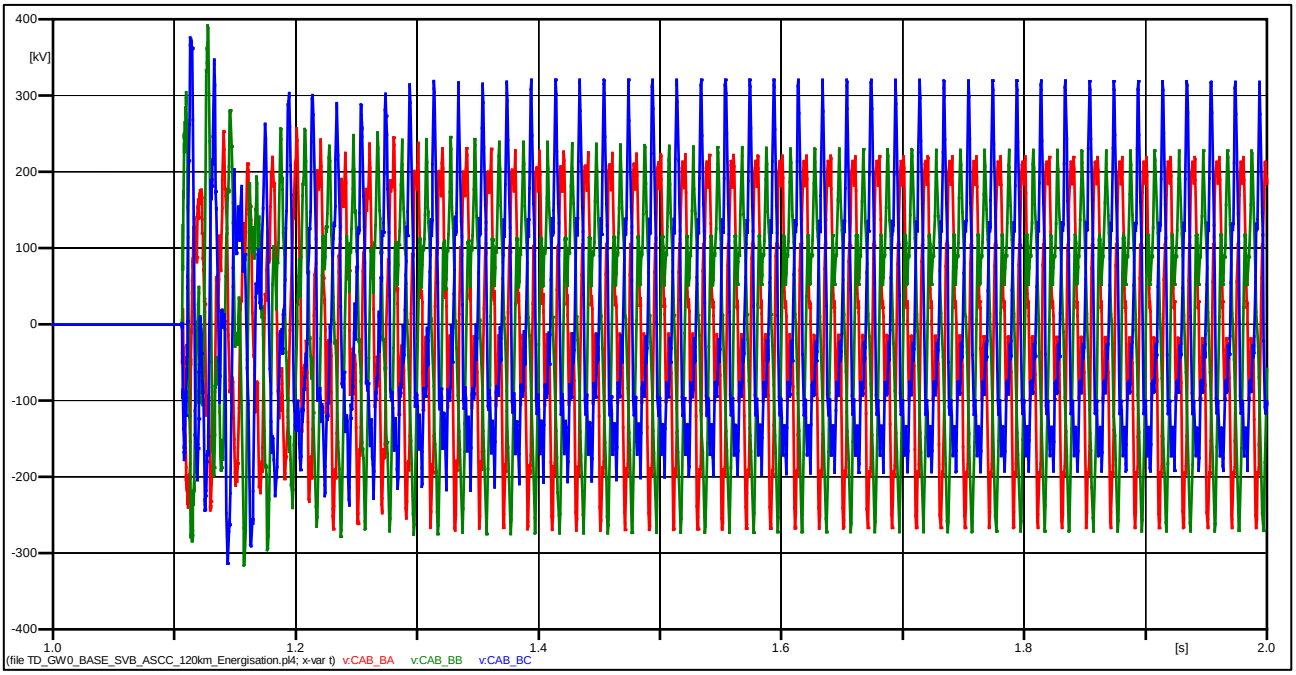

Figure 56: SVB - Length 120 km – North Mayo – Energisation of the cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	369.59 kV (2.058 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	313.53 kV (1.745 pu)	287.32 kV(1.6pu)	Fail

2.24 Time Domain Simulation - Length 120 km – Winter Peak A – Case 8

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 8: (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford (Stuck breaker)

1. Fault on Flagford side of Flagford-Cashla line, applied at 0.5s, removed at 0.575s
2. Reclose sequence at 0.575s, dead time 600ms, circuit tries to reclose but is stuck.

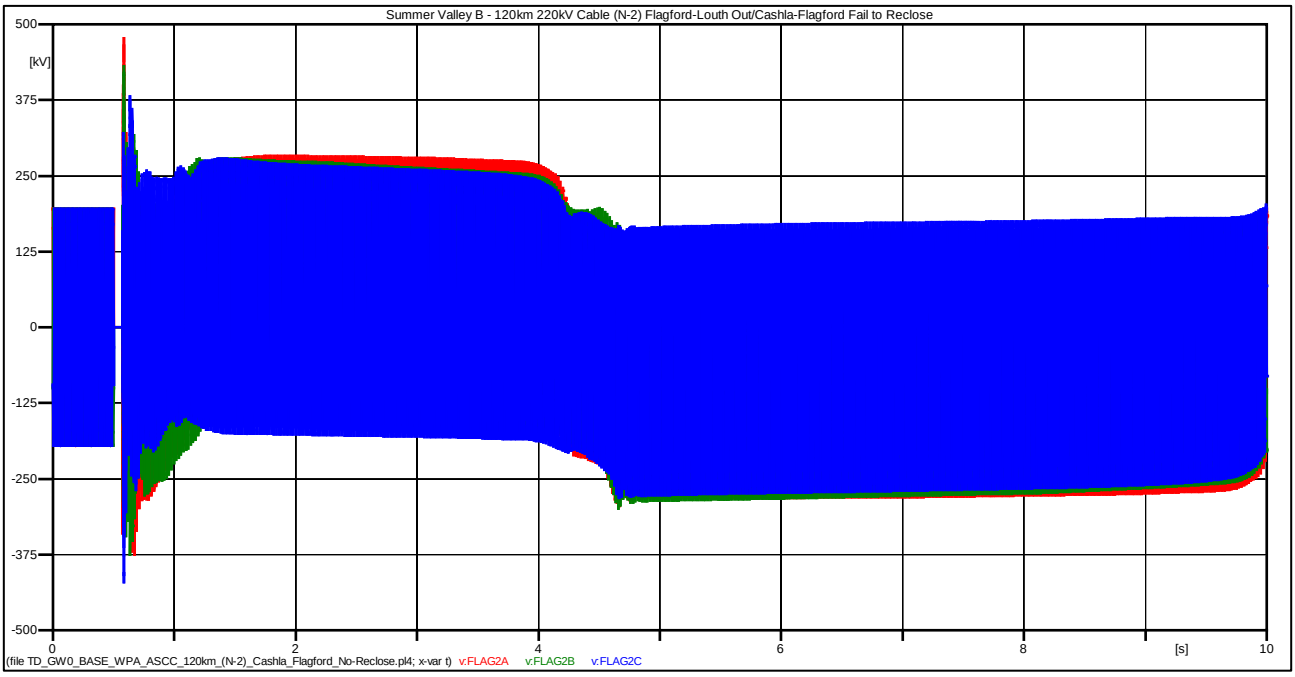

Figure 57: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line [Stuck breaker] (0-10s)

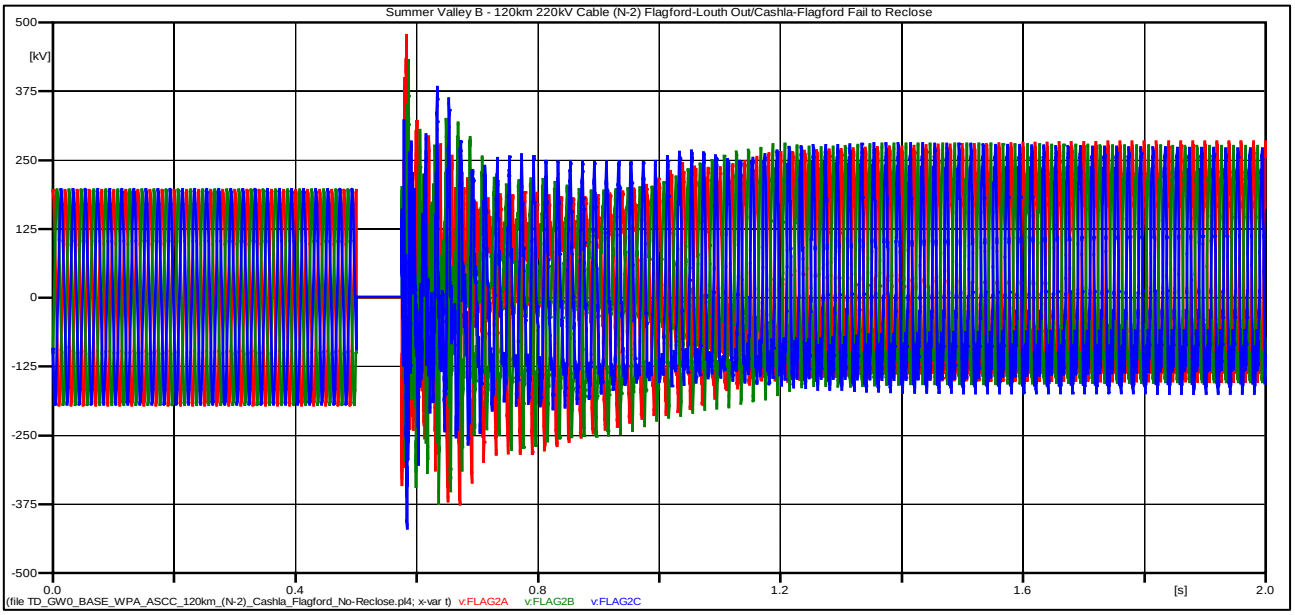

Figure 58: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line [Stuck breaker] (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	480.12 kV (2.6735 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	375.12 kV (2.088 pu)	287.32 kV(1.6pu)	Fail
Note: Significant transformer saturation - Fail			

*Pass can be achieved with surge arrestors

Figure 59: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line [Stuck breaker] (0-10s)

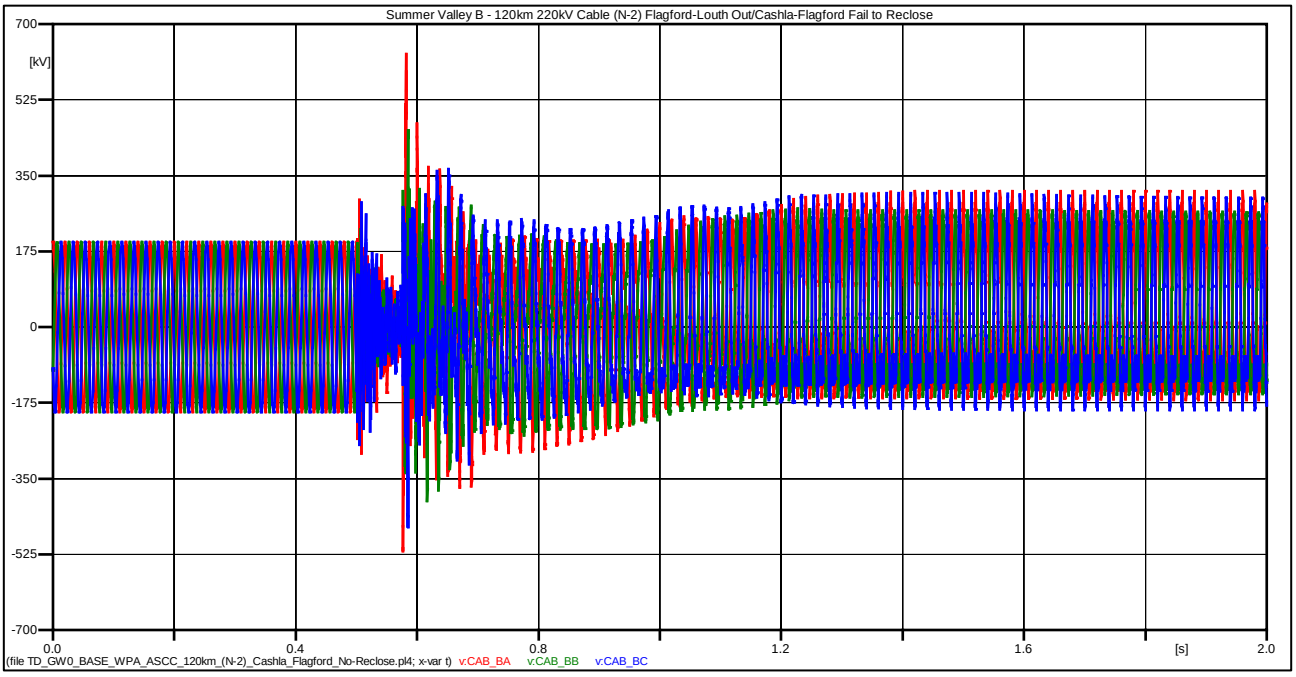

Figure 60: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla-Flagford Line [Stuck breaker] (0-10s)

Condition	Maximum Value	Limit	Result
Switching	650.12 kV (3.6202 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	370.25 kV (2.0617 pu)	287.32 kV(1.6pu)	Fail
Note: Significant transformer saturation - Fail			

2.25 Time Domain Simulation - Length 120 km – Winter Peak A – Case 9

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 9: (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford on fault

1. Fault on Flagford side of Flagford-Cashla line, applied at 0.5s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.
3. Breaker opens at again at 1.25s.

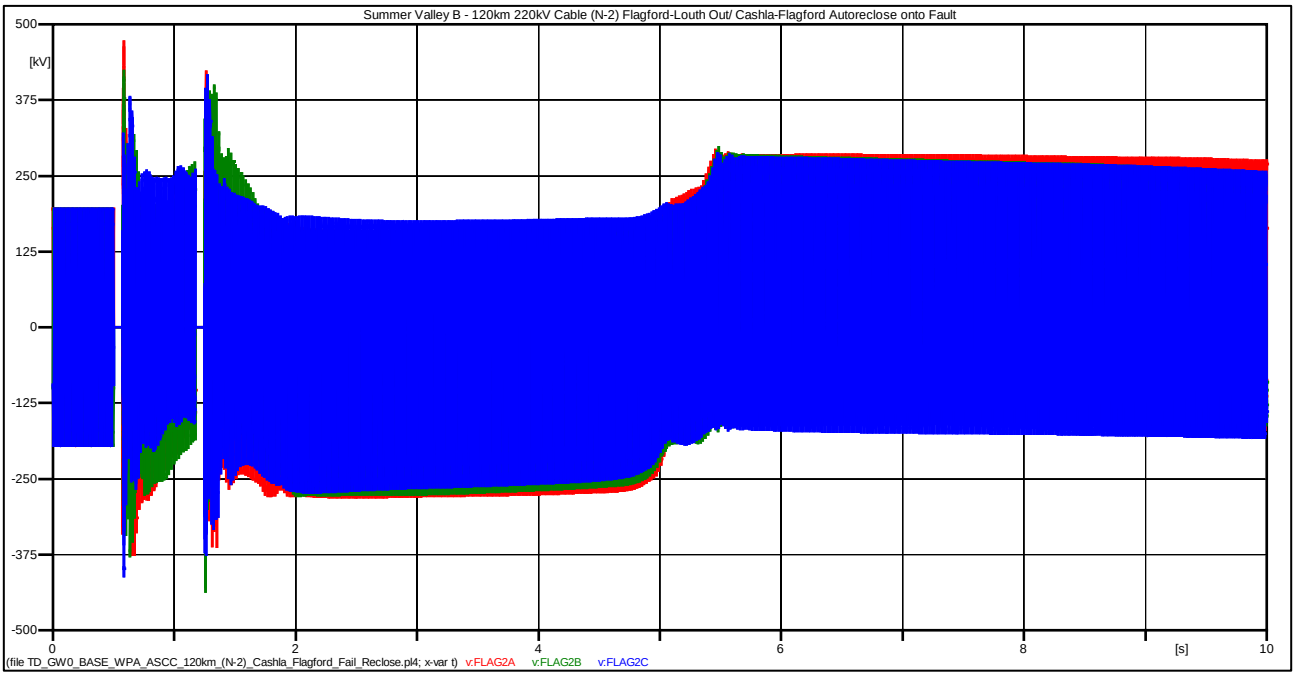

Figure 61: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line - No fault removal (0-10s)

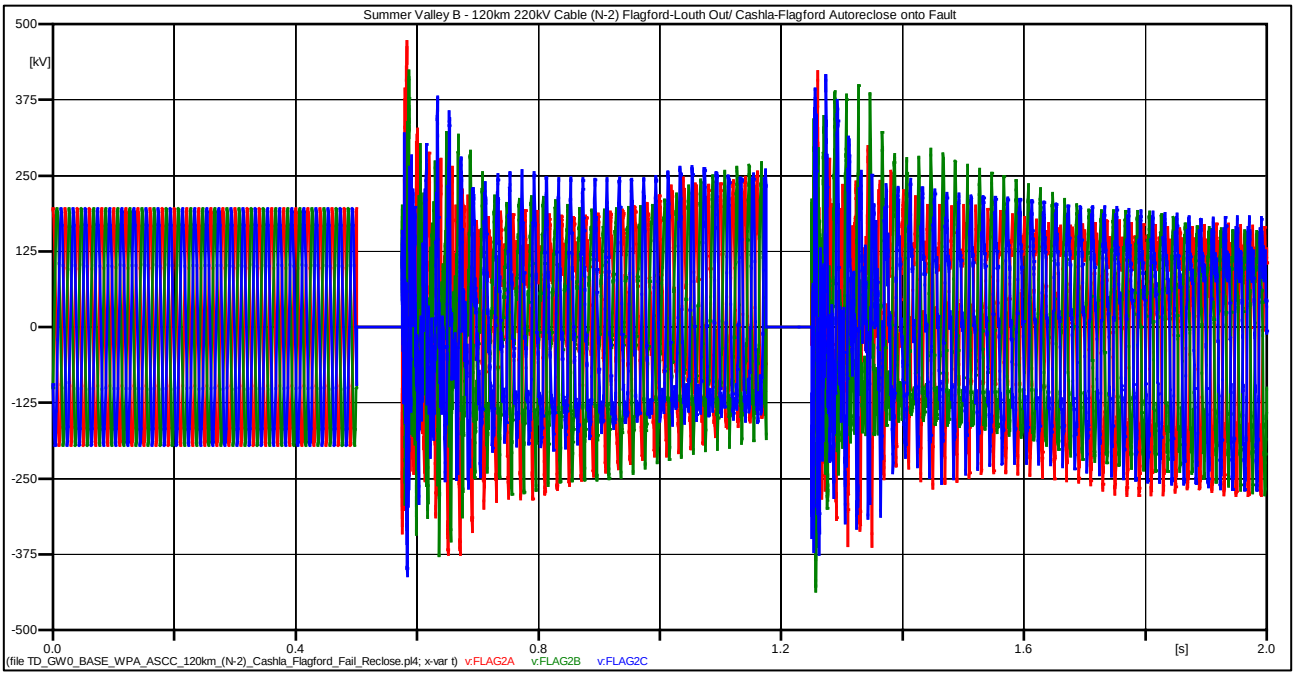

Figure 62: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line - No fault removal (0-2s)

Condition	Maximum Value	Limit	Result
Switching	475.21 kV (2.6462 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	380.21 kV (2.1172 pu)	287.32 kV(1.6pu)	Fail
Note: Significant transformer saturation - Fail			

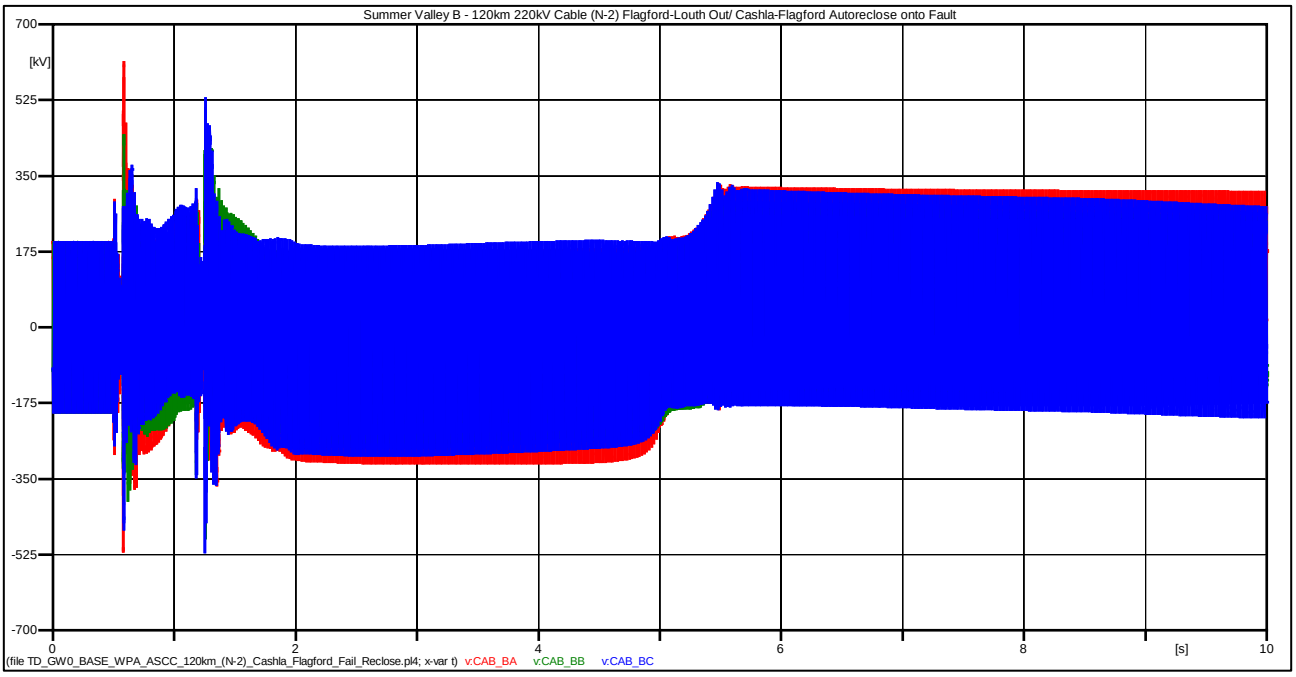

Figure 63: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-10s)

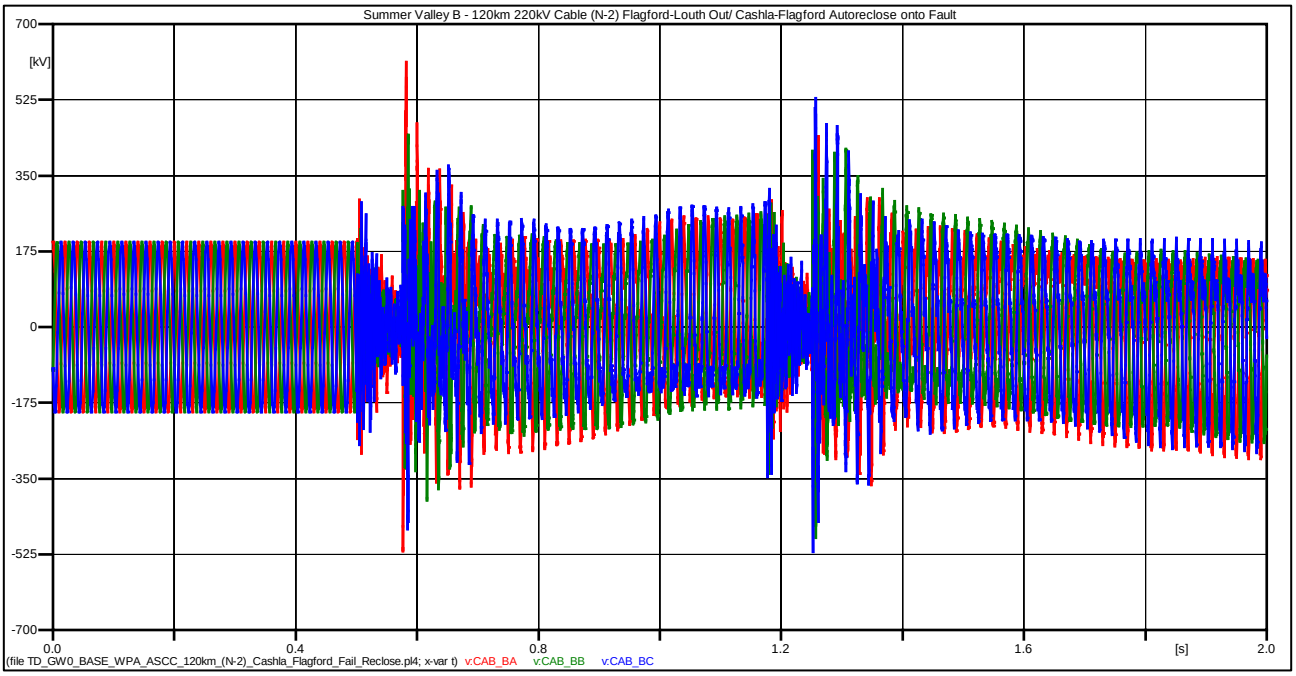

Figure 64: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-2s)

Condition	Maximum Value	Limit	Result
Switching	615.12 kV (3.4253 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	360.1 kV (2.0052 pu)	287.32 kV(1.6pu)	Fail

2.26 Time Domain Simulation - Length 120 km – Winter Peak A – Case 10

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 10: (N-2) Condition – Cashla/Flagford Line Out – Fault on North Mayo transformer

Conditions:

1. Cashla-Flagford Line Out.
2. Fault on the North Mayo 220 kV/110kV Transformer.

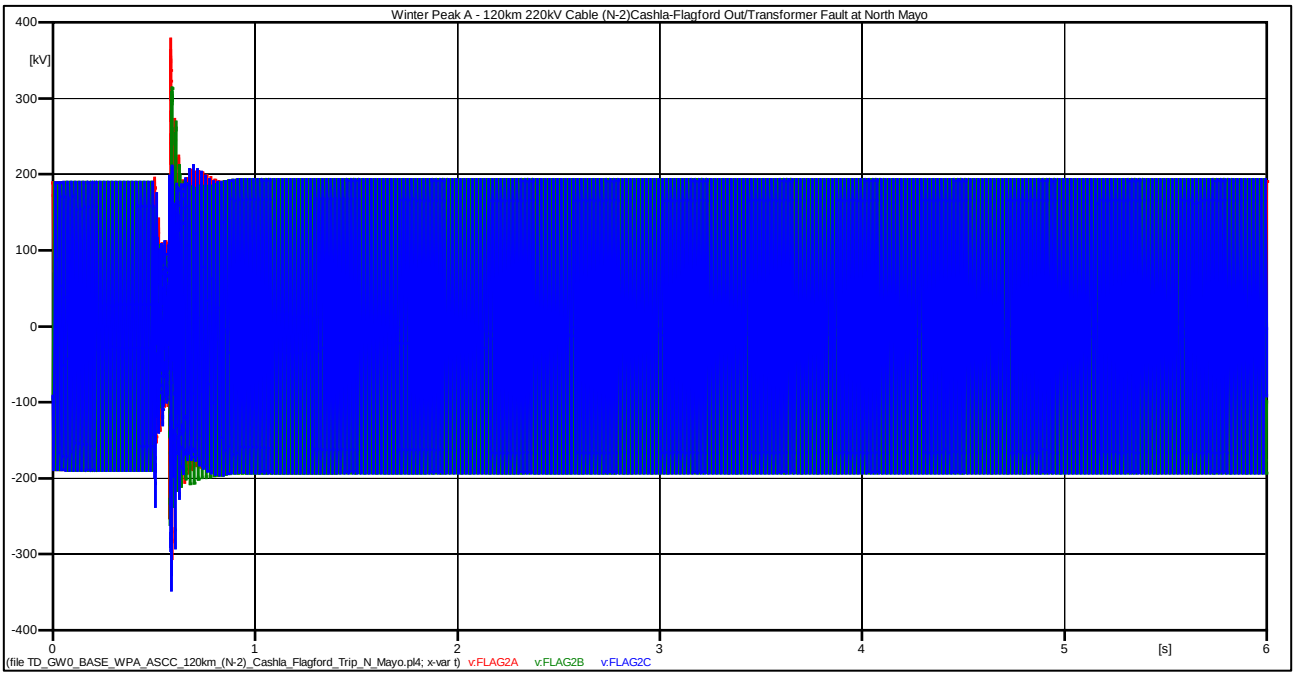

Figure 65: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-6s)

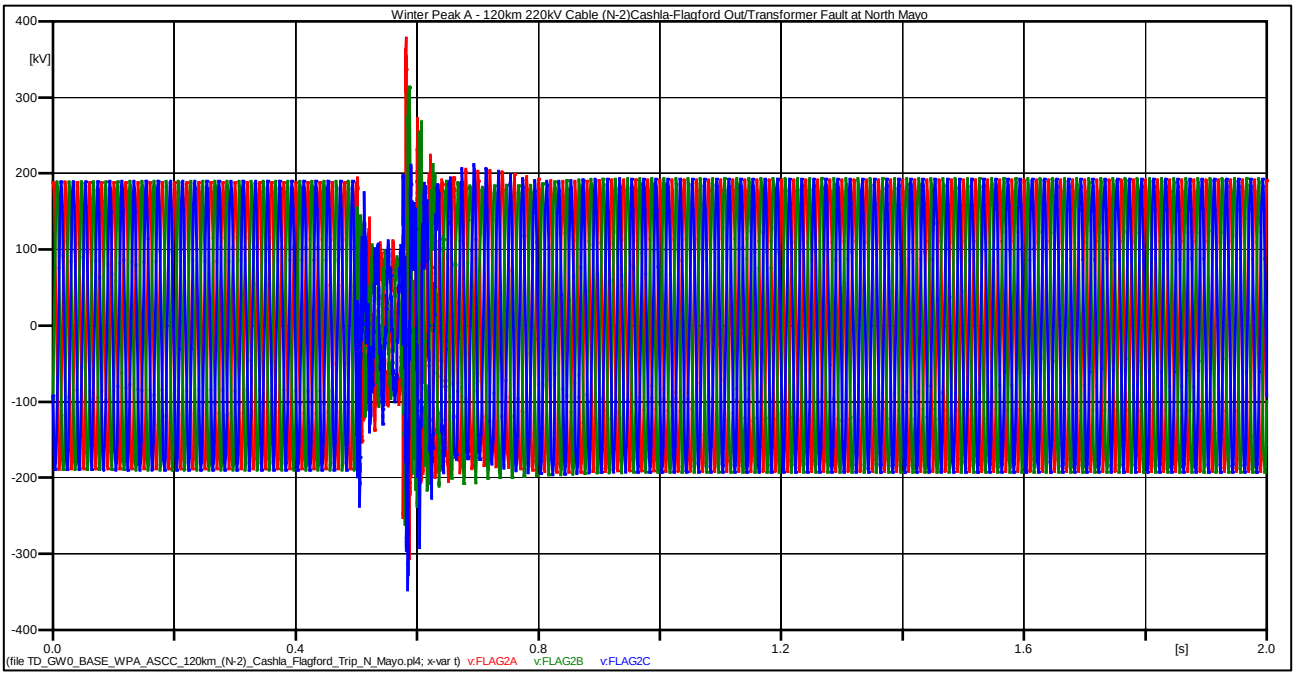

Figure 66: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-2s)

Condition	Maximum Value	Limit	Result
Switching	376.20 kV (2.094 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	210.2 kV (1.1705 pu for 80 ms)	287.32 kV(1.6pu)	Pass

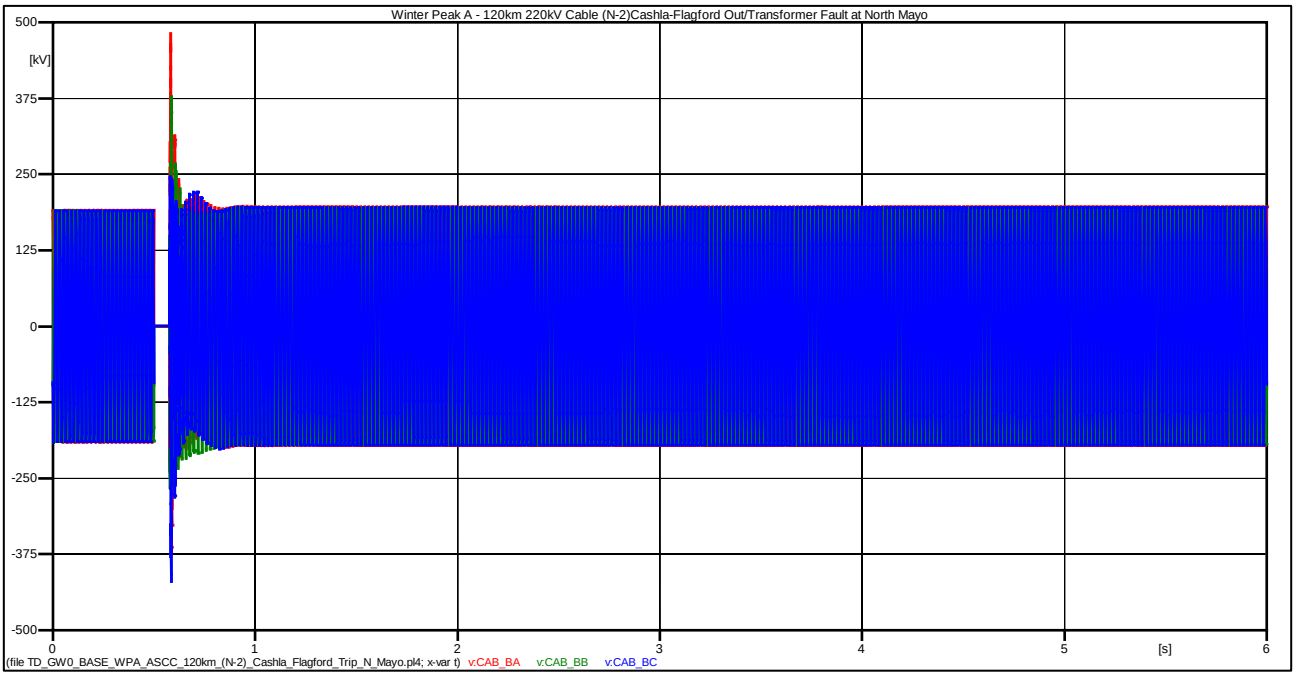

Figure 67: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-6s)

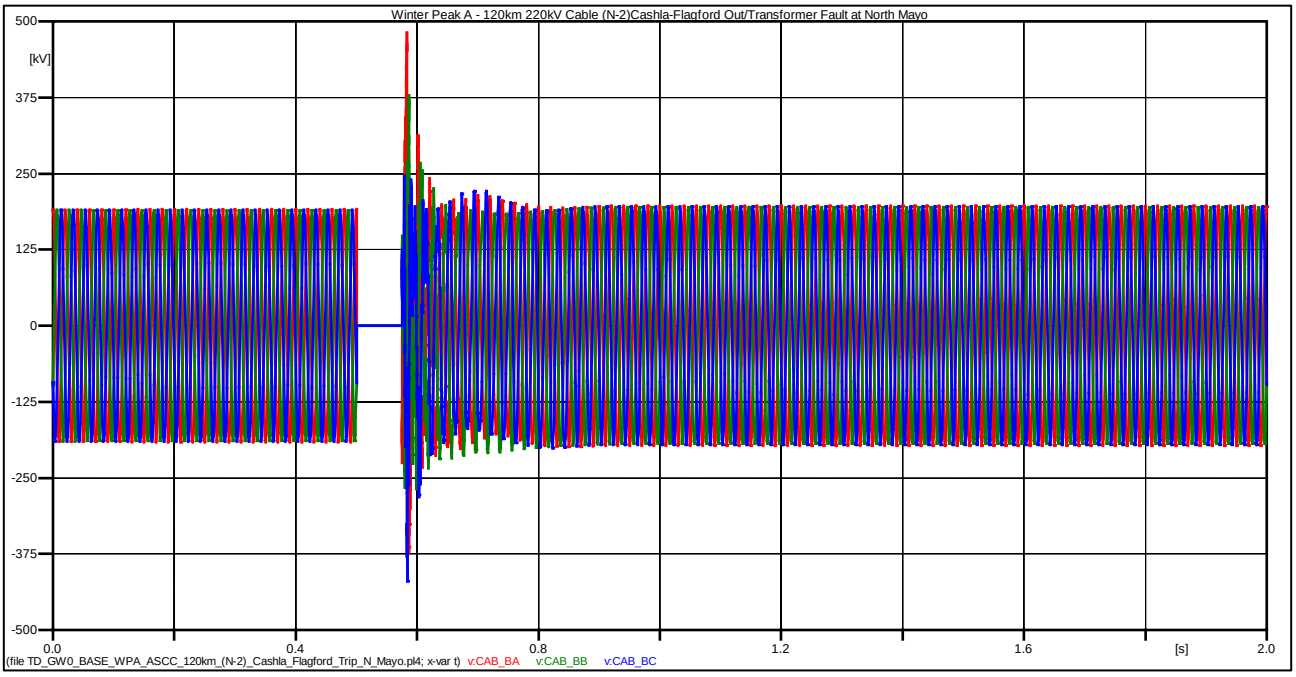

Figure 68: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-2s)

Condition	Maximum Value	Limit	Result
Switching	481.67 kV (2.6822 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	225.23 kV (1.254 pu)	287.32 kV(1.6pu)	Pass

***Pass can be achieved with the application of surge arrestors

2.27 Time Domain Simulation - Length 120 km – Winter Peak A – Case 11

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 11: (N-2) Condition – Cashla/Flagford Line Out – Fault half way along cable

Conditions:

1. Cashla-Flagford Line Out
2. Fault half way along the 220 kV Cable

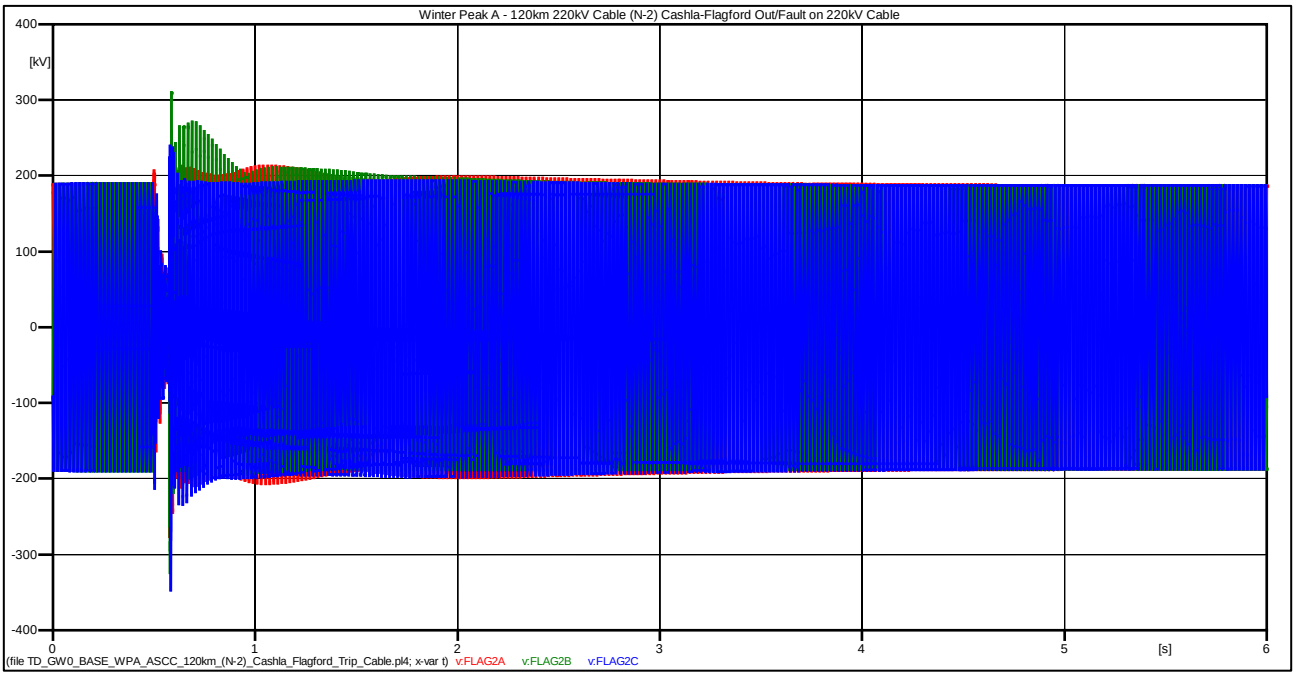

Figure 69: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-6s)

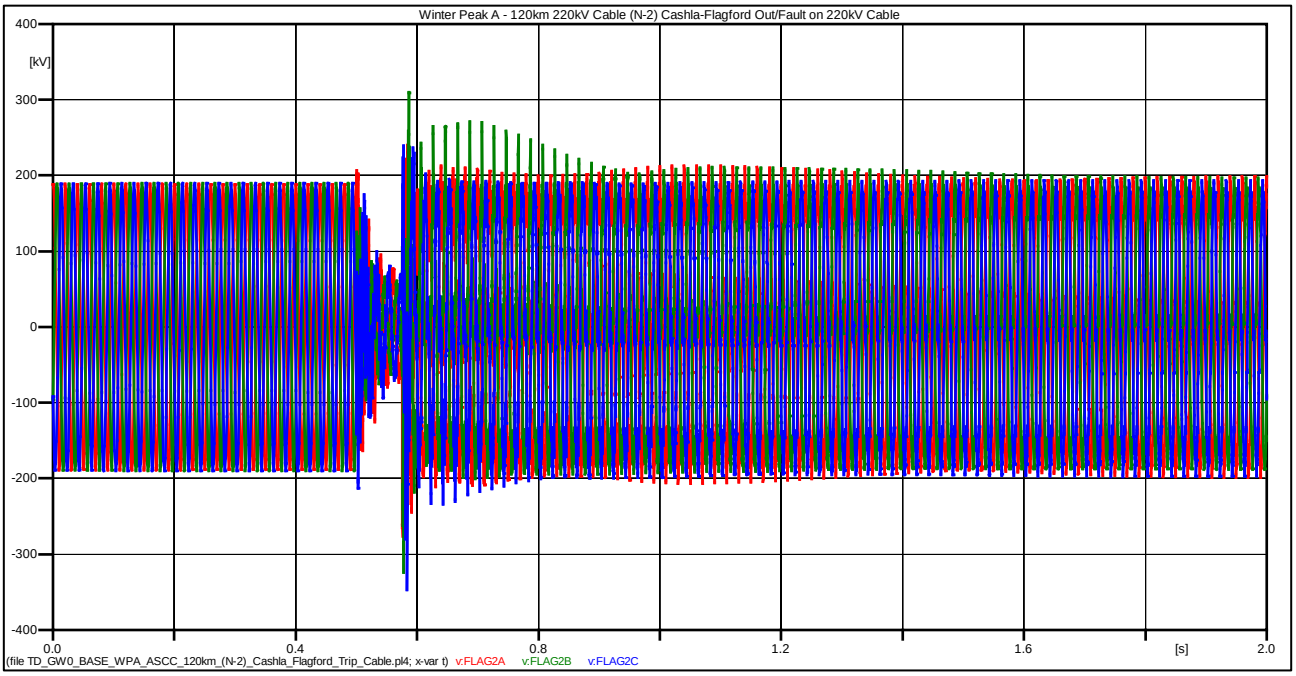

Figure 70: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	315.56 kV (1.7572 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	270.23 kV (1.5047 pu)	287.32 kV(1.6pu)	Pass

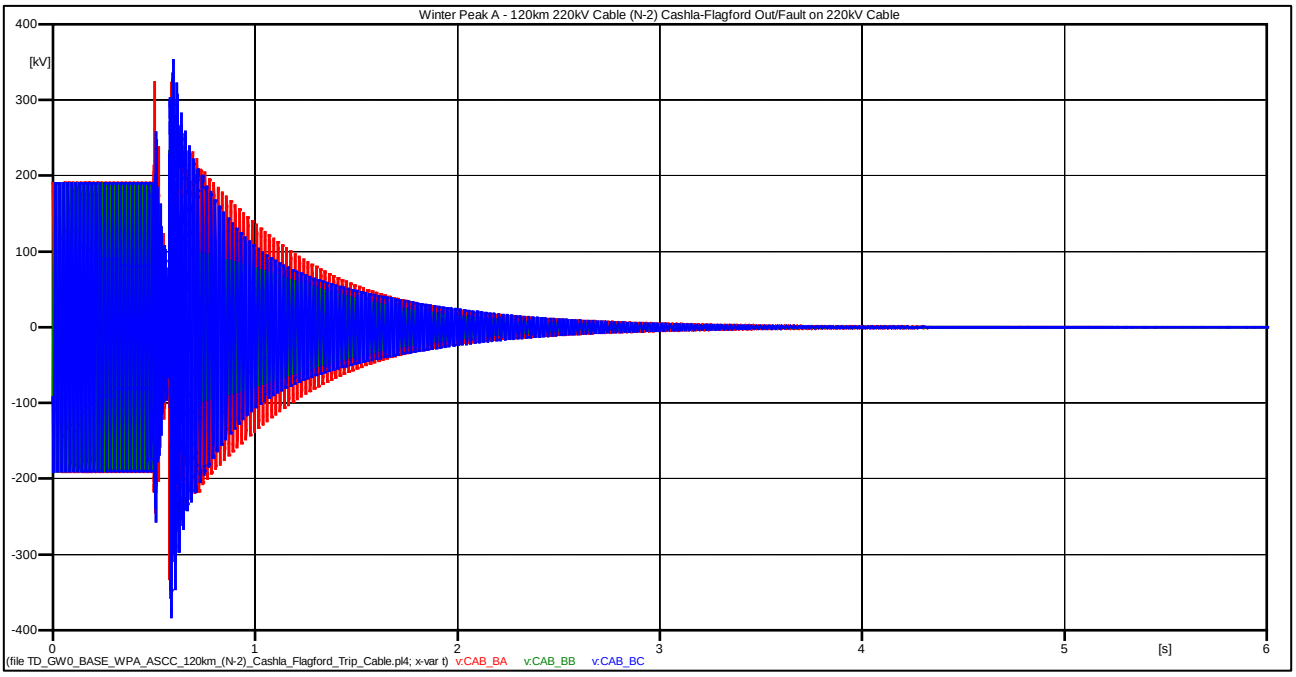

Figure 71: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-6s)

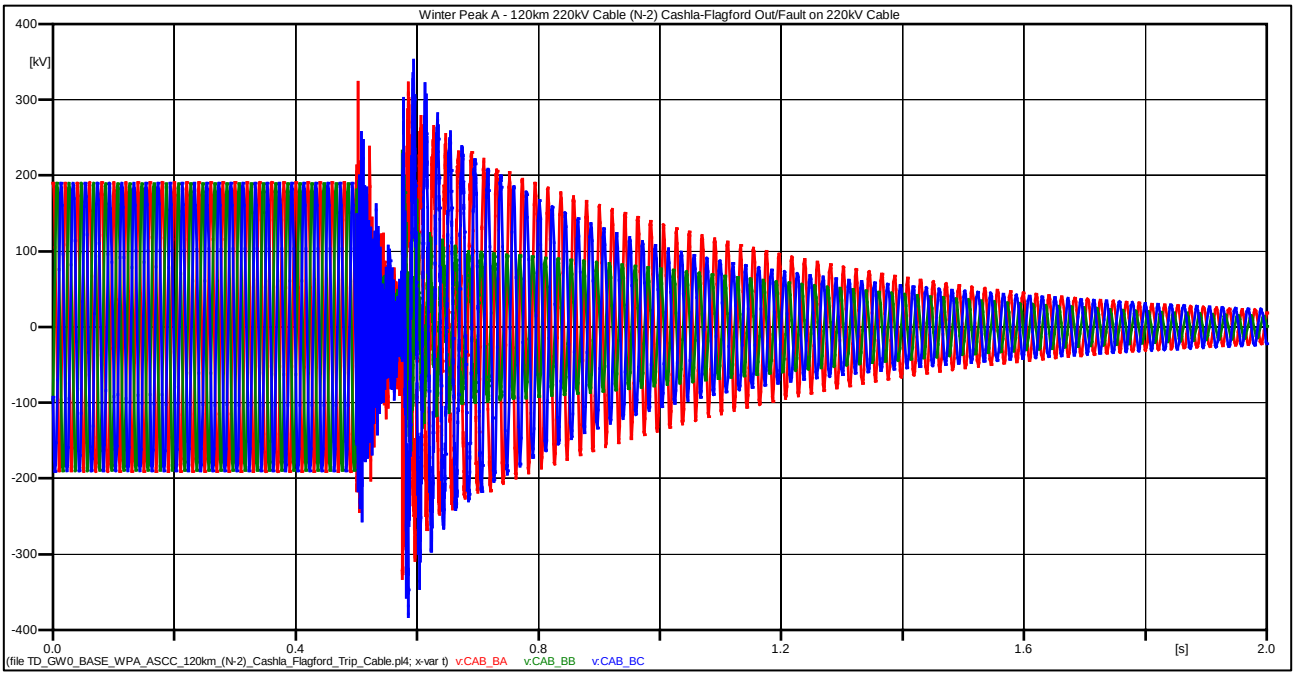

Figure 72: WPA - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	348.23 kV (1.9391 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	284.1 kV (1.5820 pu)	287.32 kV(1.6pu)	Pass

2.28 Time Domain Simulation - Length 120 km – Summer Valley B – Case 12

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 12: (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Stuck breaker

Conditions:

1. Flagford-Louth Line Out.
2. Stuck breaker at the Flagford side of the Cashla-Flagford Line.

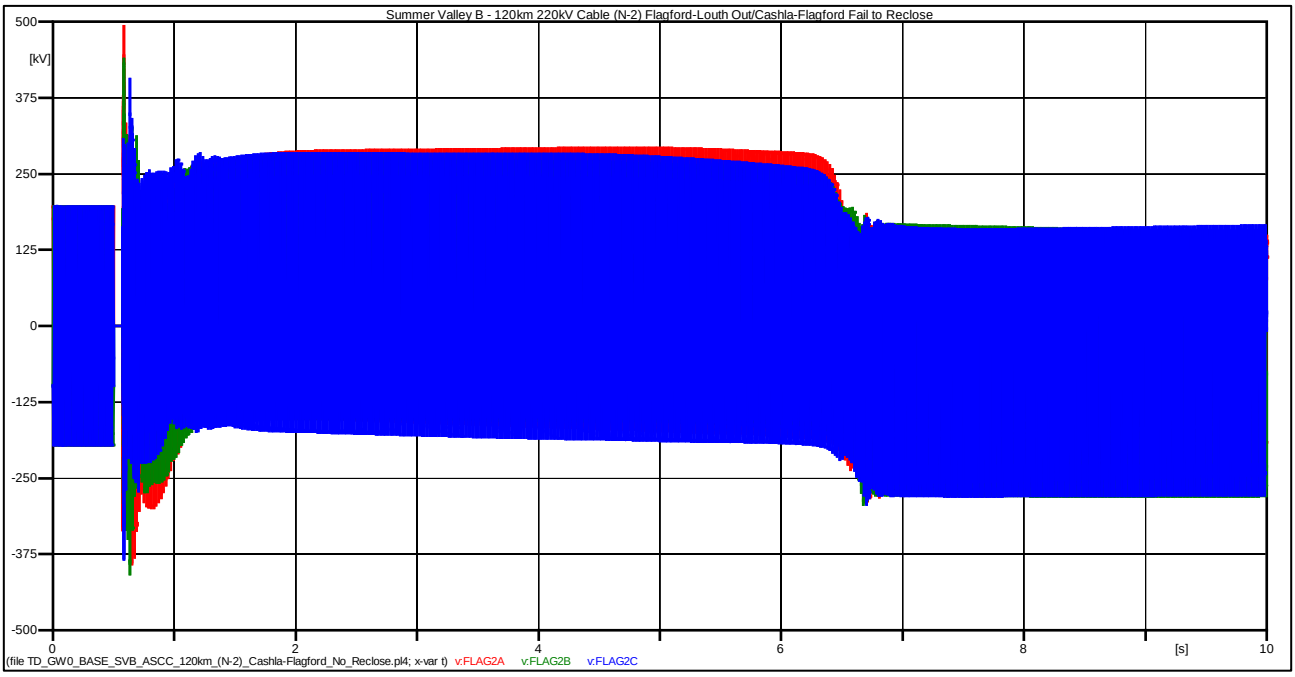

Figure 73: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out – Autoreclose Cashla/Flagford (0-6s) – Stuck breaker

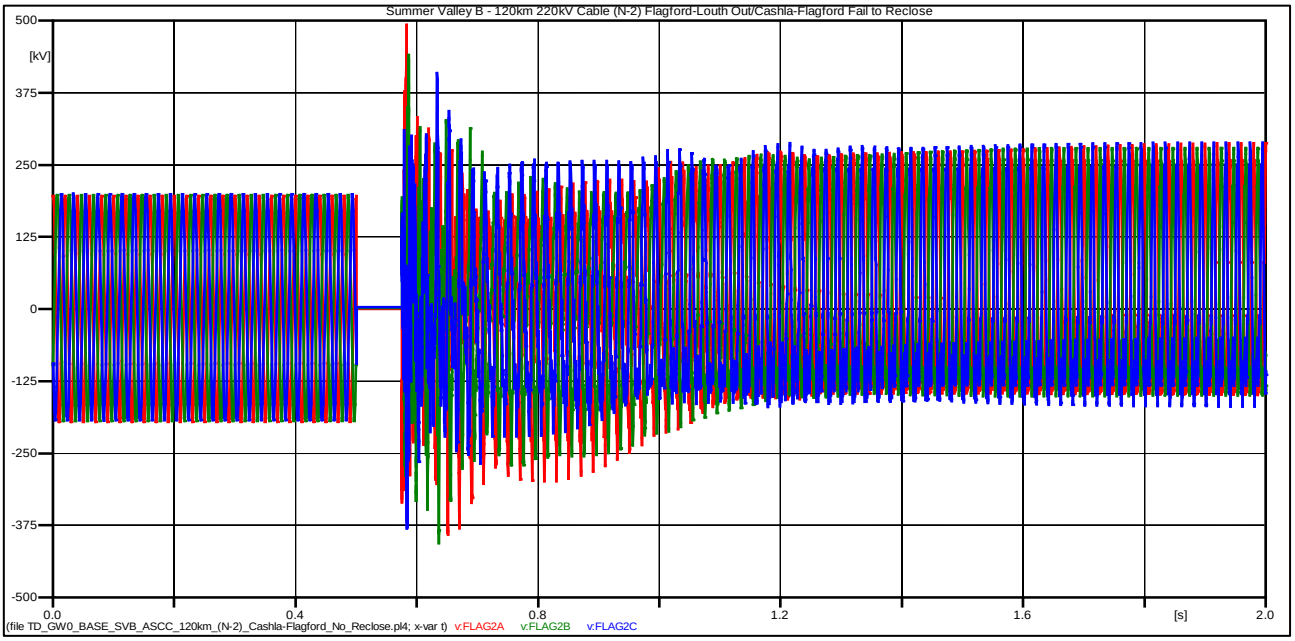

Figure 74: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford-Louth Line Out – Autoreclose Cashla/Flagford (0-6s) – Stuck breaker

Condition	Maximum Value	Limit	Result
Switching	493.25 kV (2.7625 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	301.25 kV (1.6872 pu)	287.32 kV(1.6pu)	Pass
Note: Significant transformer saturation			

*Pass can be achieved with surge arrestors.

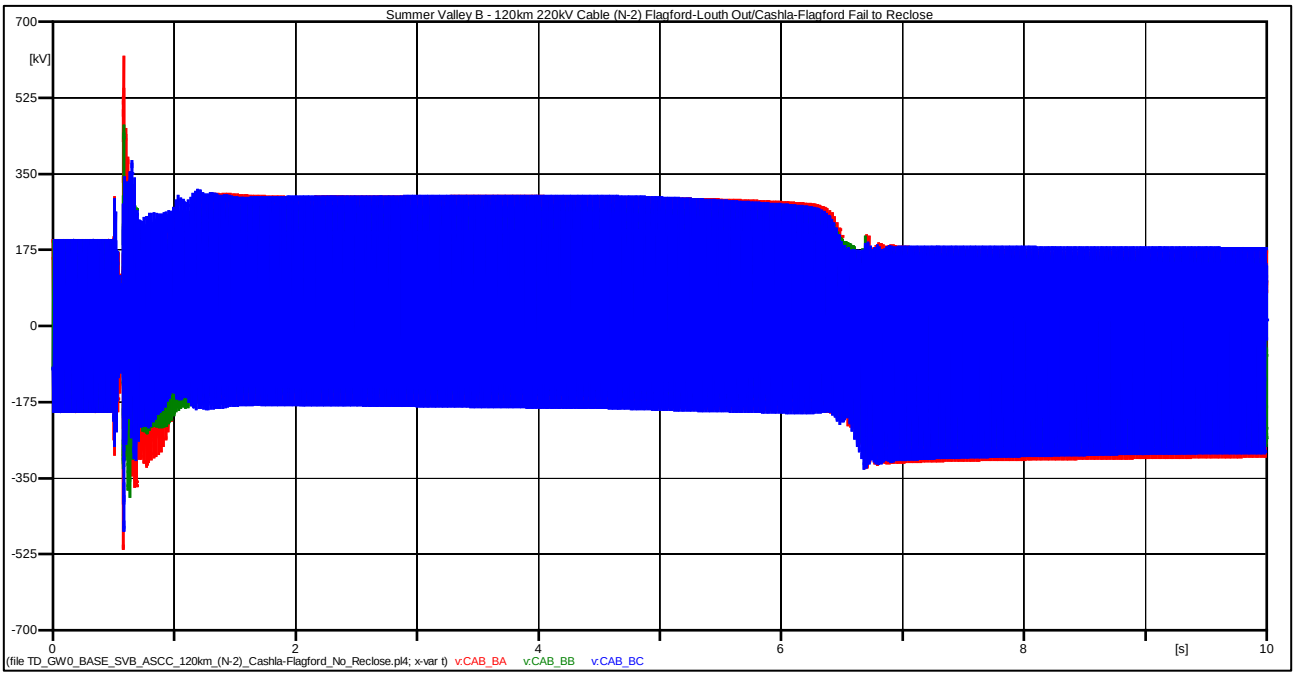

Figure 75: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out – Autoreclose Cashla/Flagford (0-6s) – Stuck breaker

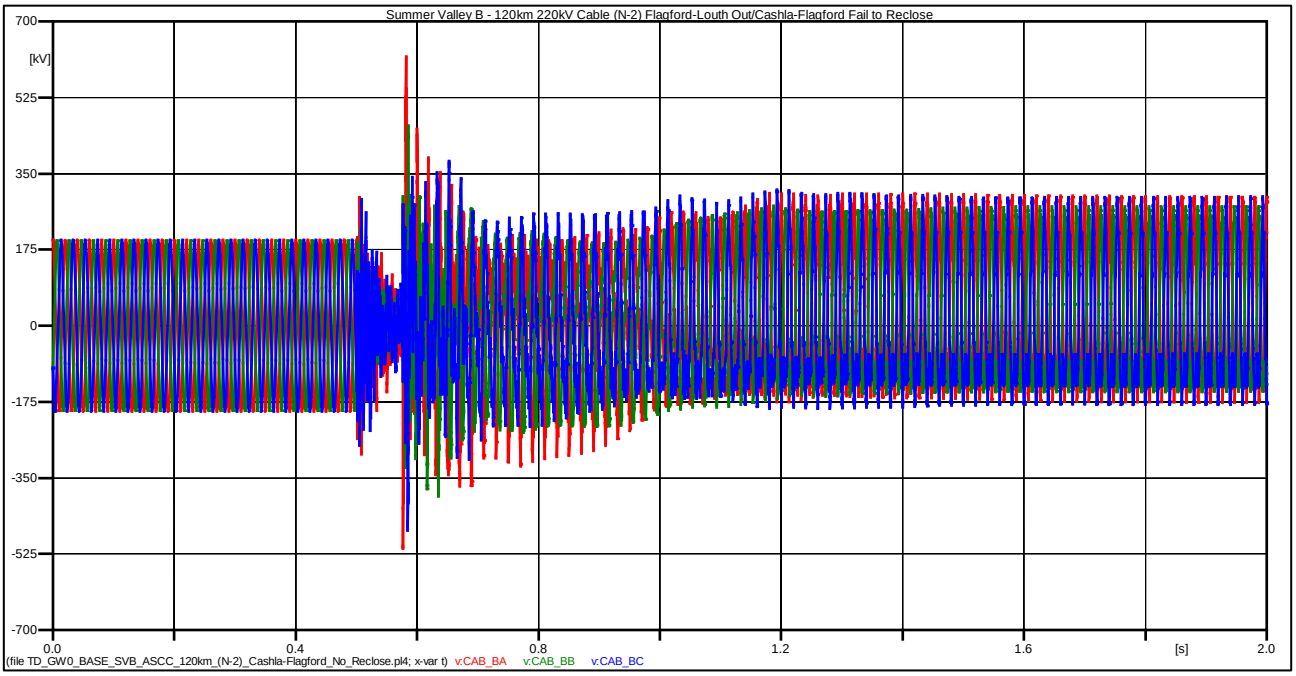

Figure 76: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford-Louth Line Out – Autoreclose Cashla-Flagford (0-2s) – Stuck breaker

Condition	Maximum Value	Limit	Result
Switching	605.23 kV (3.3702 pu)	449.07 kV (2.5 pu)	Fail
Temporary Overvoltage	354.56 kV (1.974 pu)	287.32 kV(1.6pu)	Fail

2.29 Time Domain Simulation - Length 120 km – Summer Valley B – Case 13

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 13: (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford – Fault not removed.

1. Fault on Flagford side of Flagford-Cashla line, applied at 0.5s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.
3. Breaker opens at again at 1.25s.

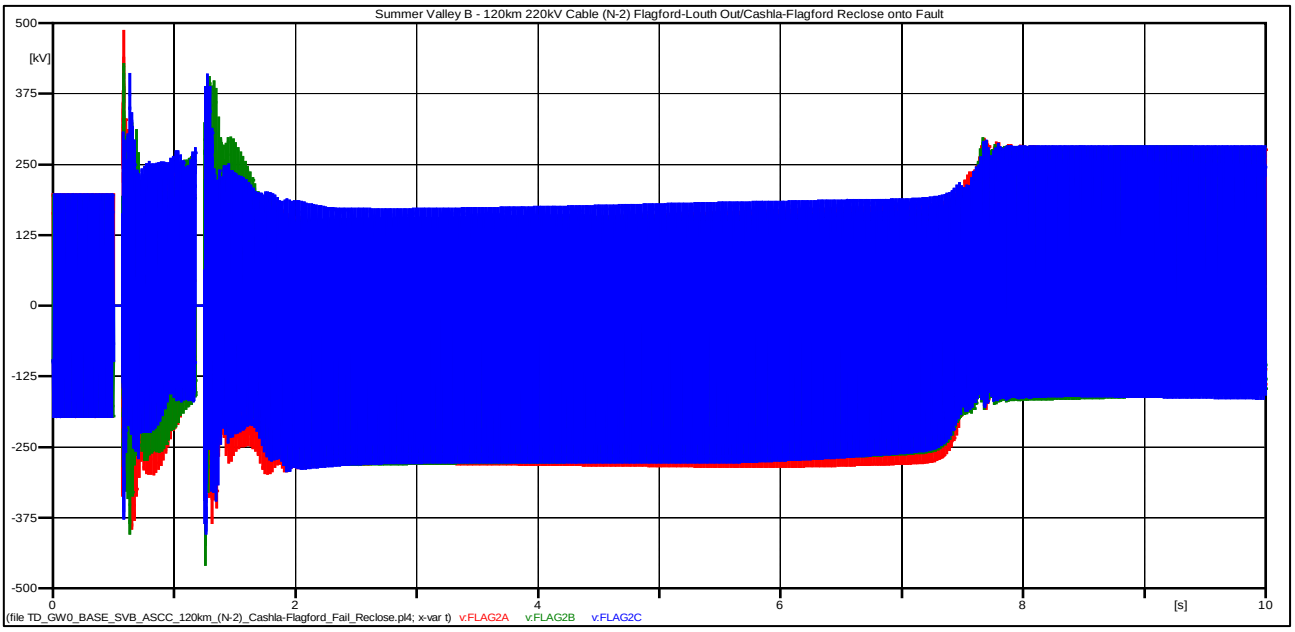

Figure 77: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford Line - No fault removal (0-10s)

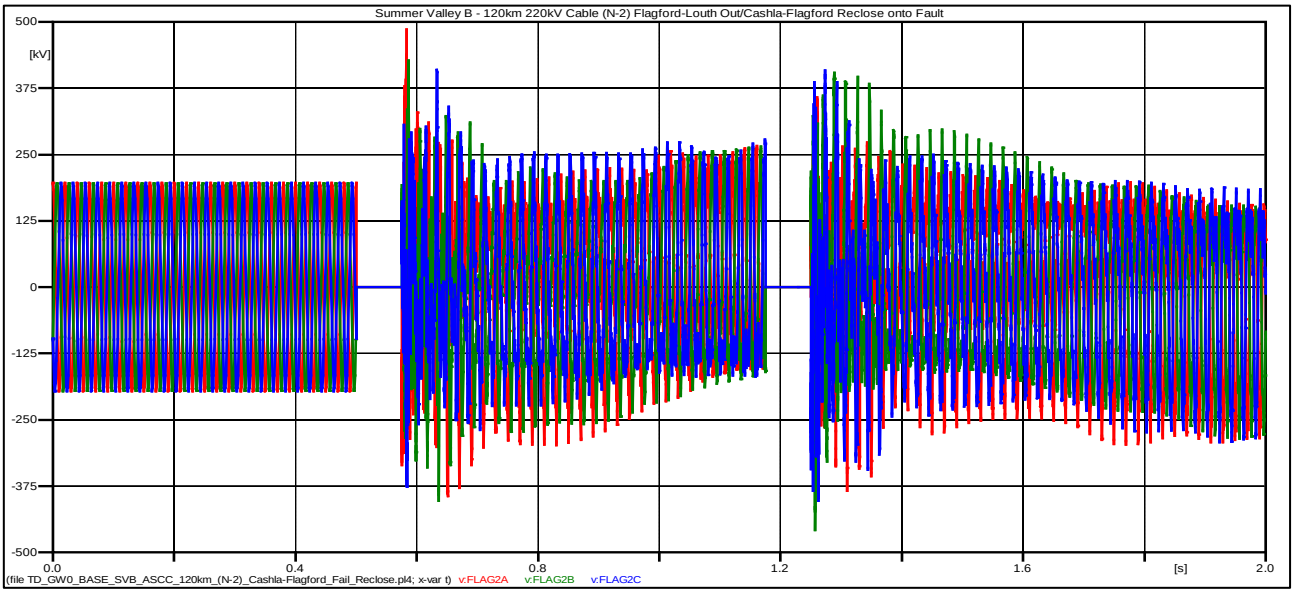

Figure 78: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford Line - No fault removal (0-2s)

Condition	Maximum Value	Limit	Result
Switching	482.79 kV (2.6884 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	381.29 kV (2.123 pu)	287.32 kV(1.6pu)	Fail
Note: Significant transformer saturation			

*Can be achieved with the application of surge arrestors

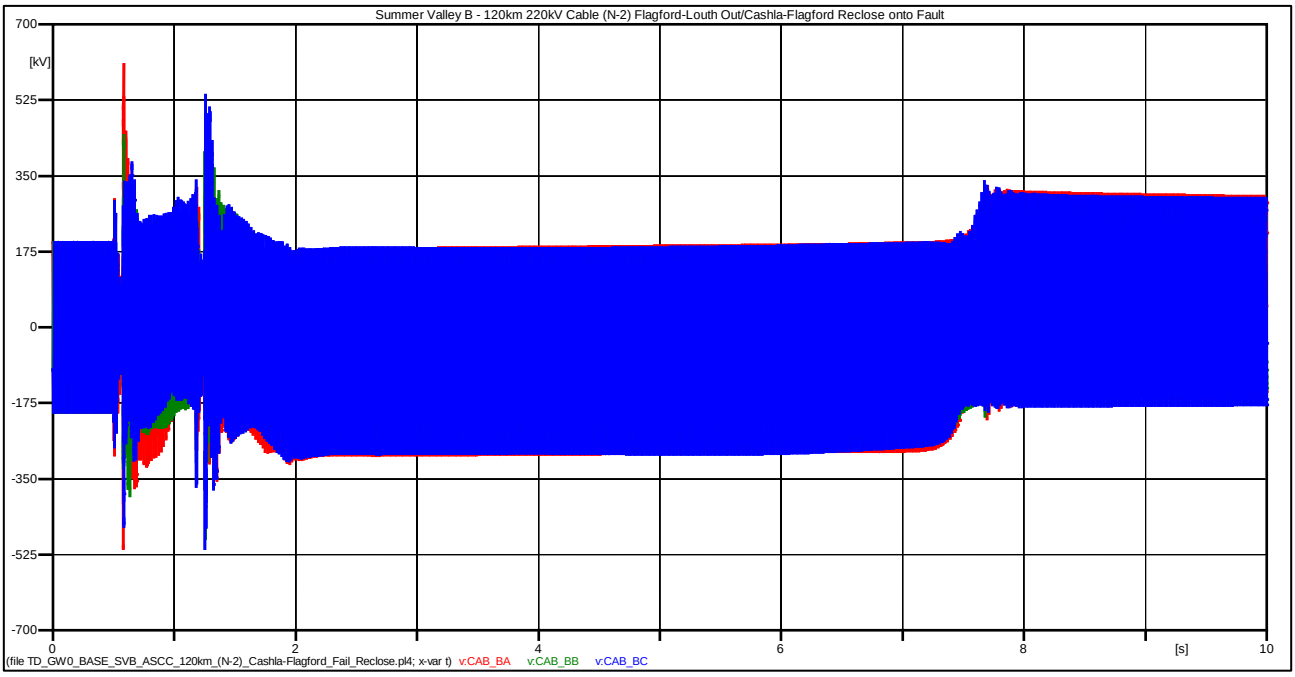

Figure 79: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-10s)

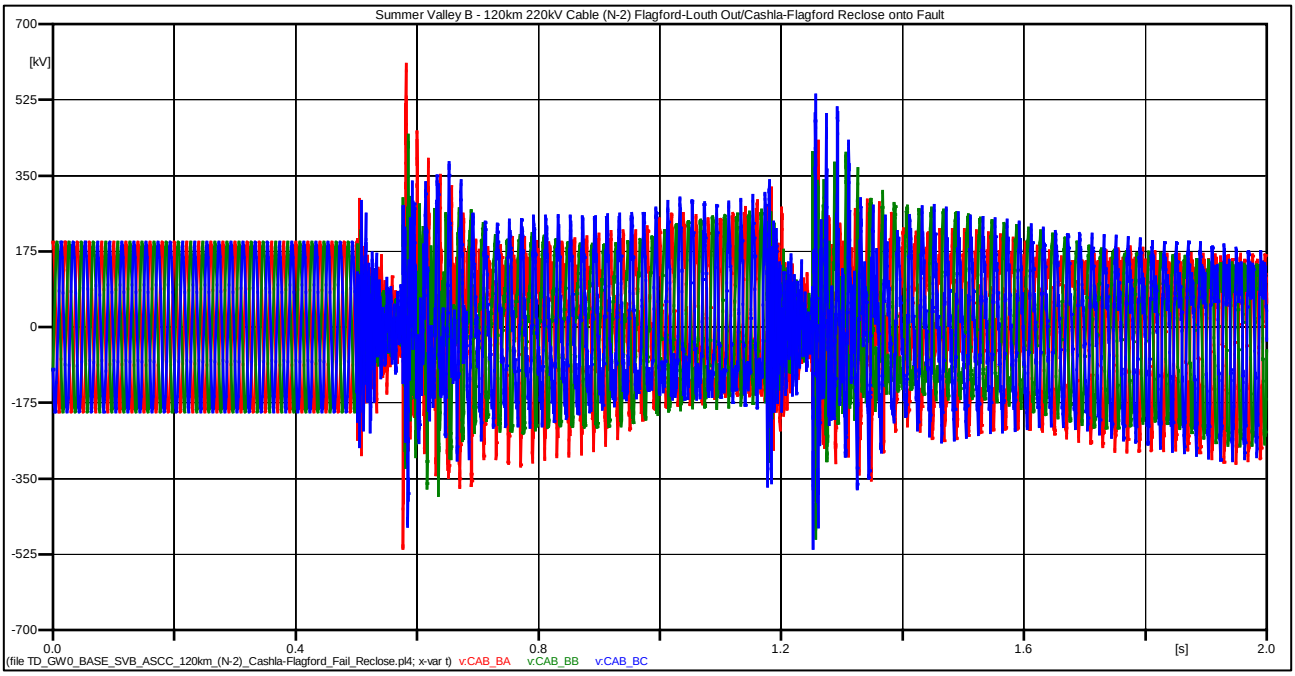

Figure 80: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford - No fault removal (0-2s)

Condition	Maximum Value	Limit	Result
Switching	580 kV (3.2297 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	348.0 kV (1.9494 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with the application of surge arrestors.

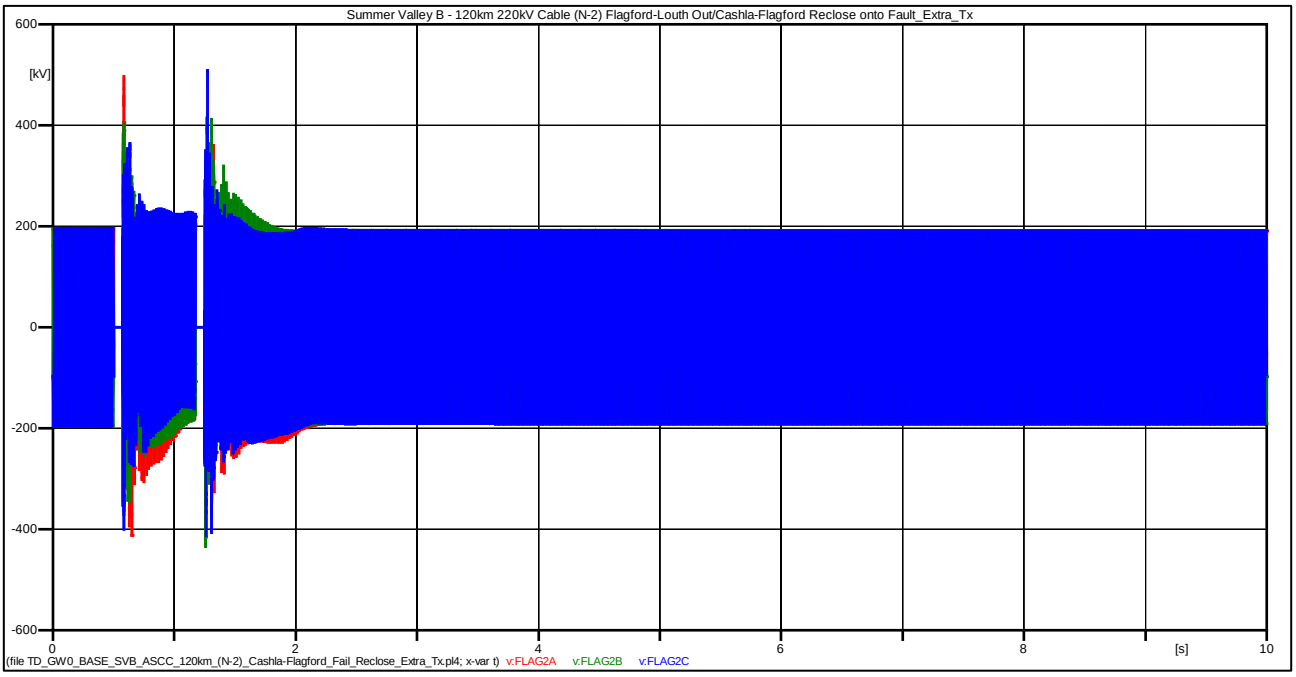

Figure 81: (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford – fault not removed (0-10s) – Extra Tx added at Flagford

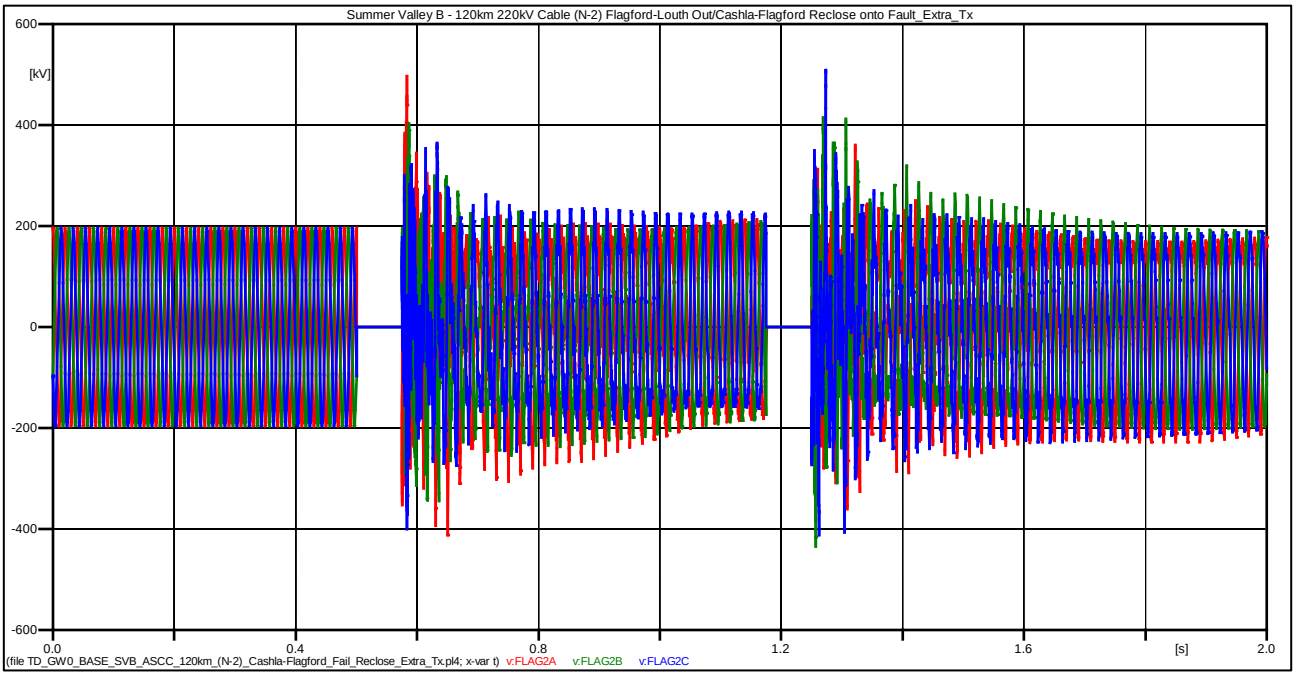

Figure 82: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford - No fault removal (0-2s) – Extra Tx added at Flagford

Condition	Maximum Value	Limit	Result
Switching	501.23 kV (2.7911 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	370 kV (2.0603 pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with the application of surge arrestors.

2.30 Time Domain Simulation - Length 120 km – Summer Valley B – Case 14

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 14: (N-2) Condition – Flagford-Louth Line Out - Autoreclose of the Cashla-Flagford – Fault not removed.

1. Fault on Flagford side of Flagford-Cashla line, applied at 0.5s.
2. Reclose sequence at 0.575s, dead time 0.6s, circuit breaker closes 1.175s, point on wave closes at 90°.
3. Breaker opens at again at 1.25s.

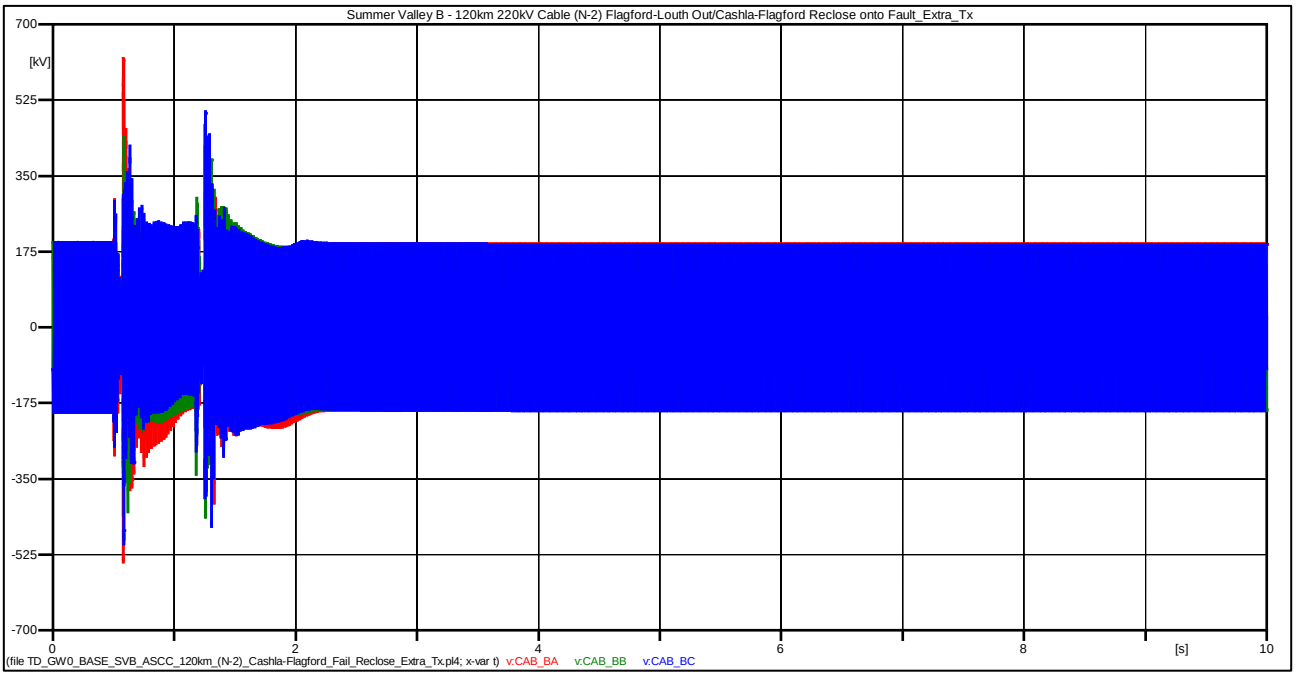

Figure 83: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-10s) – Extra Tx added at Flagford

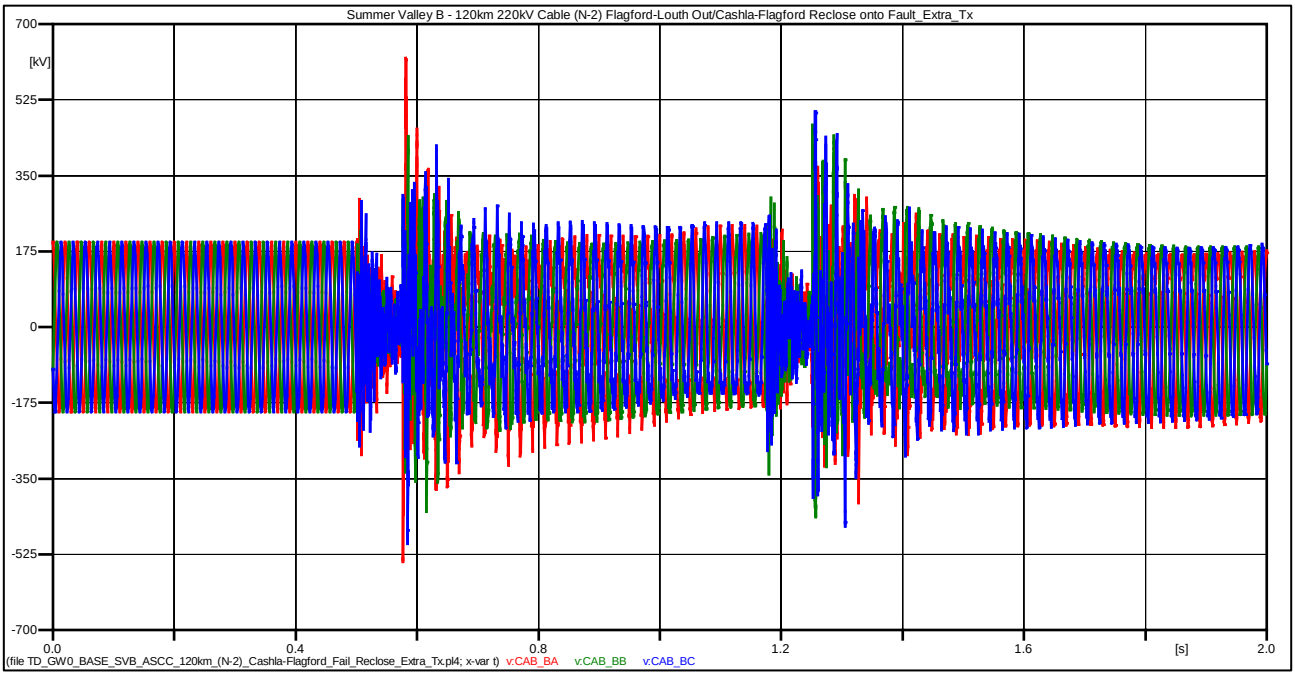

Figure 84: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Louth Line Out - Autoreclose of the Cashla/Flagford - No fault removal (0-10s) – Extra Tx added at Flagford

Condition	Maximum Value	Limit	Result
Switching	590.78 kV (3.2897 pu)	449.07 kV (2.5 pu)	*Fail
Temporary Overvoltage	350.23 kV (1.9502pu)	287.32 kV(1.6pu)	Fail

*Pass can be achieved with the application of surge arrestors.

2.31 Time Domain Simulation - Length 120 km – Summer Valley B – Case 15

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 15: (N-2) Condition – Cashla/Flagford Line Out – Fault on North Mayo transformer

Conditions:

1. Flagford-Cashla Line Out.
2. Fault on the high voltage side of the 220 kV/110kV transformer at 0.5s.

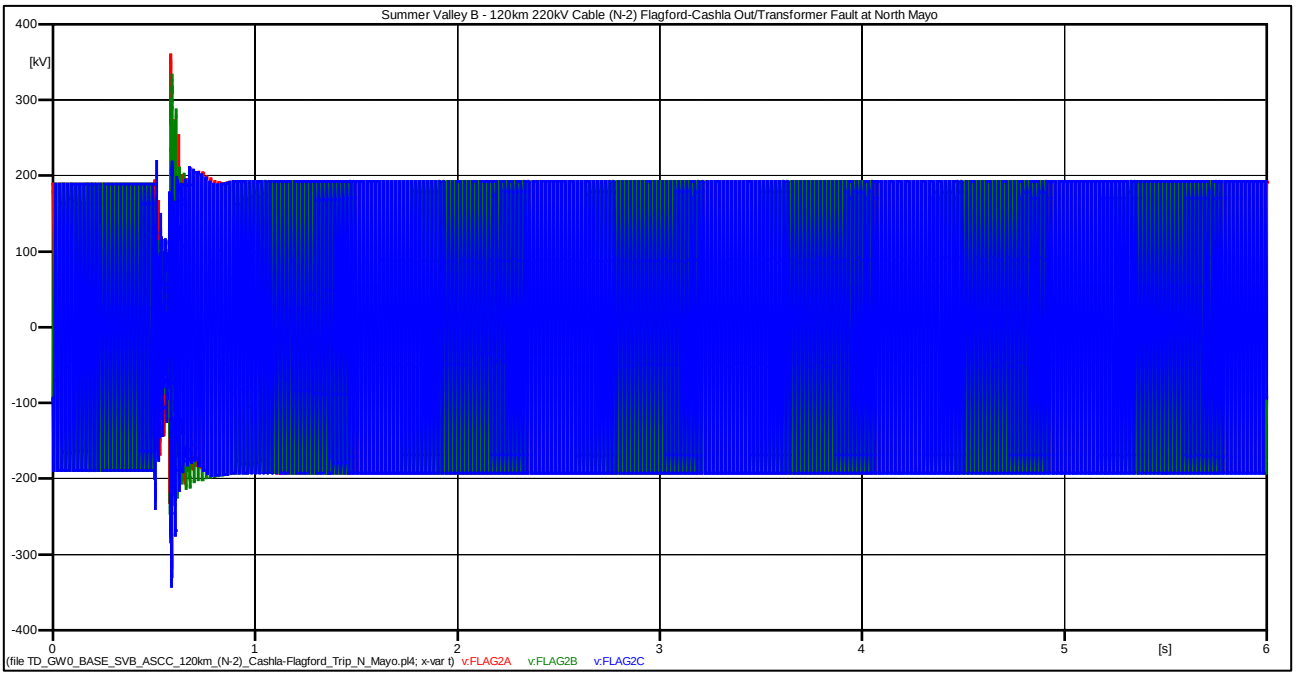

Figure 85: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-6s)

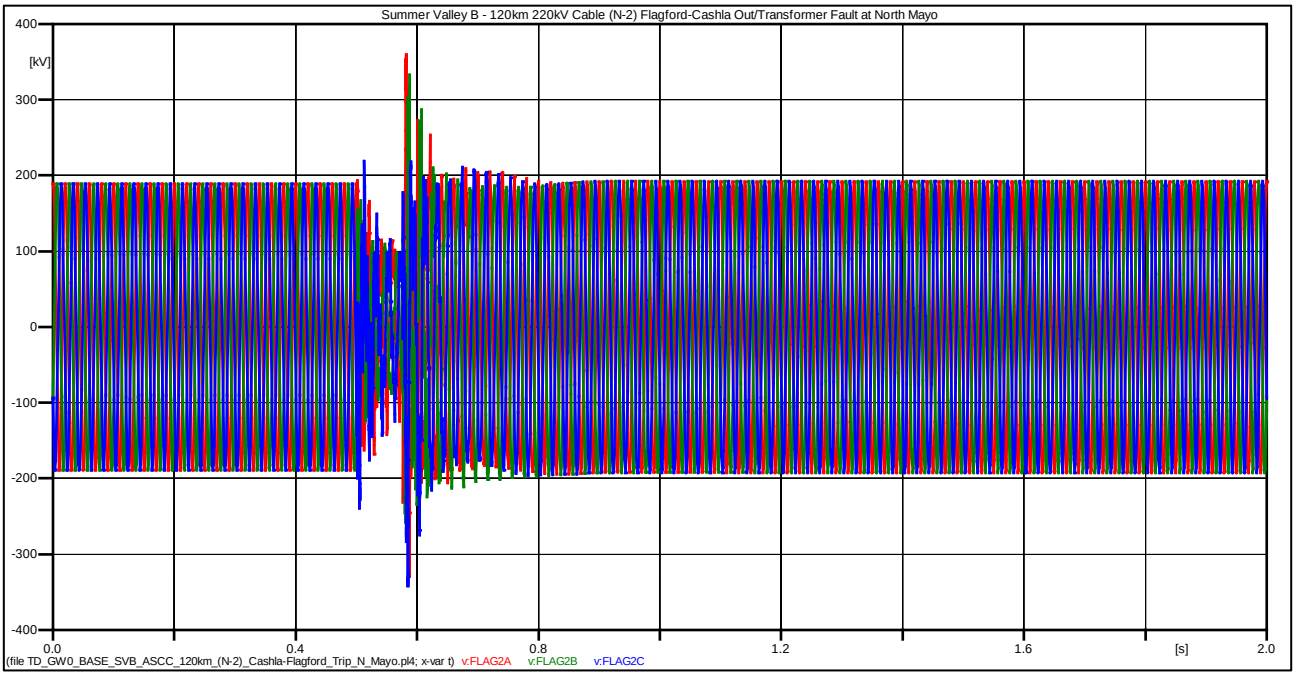

Figure 86: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-2s)

Condition	Maximum Value	Limit	Result
Switching	350.12 kV (1.9496 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	240.53 kV (1.3394 pu)	287.32 kV(1.6pu)	Pass

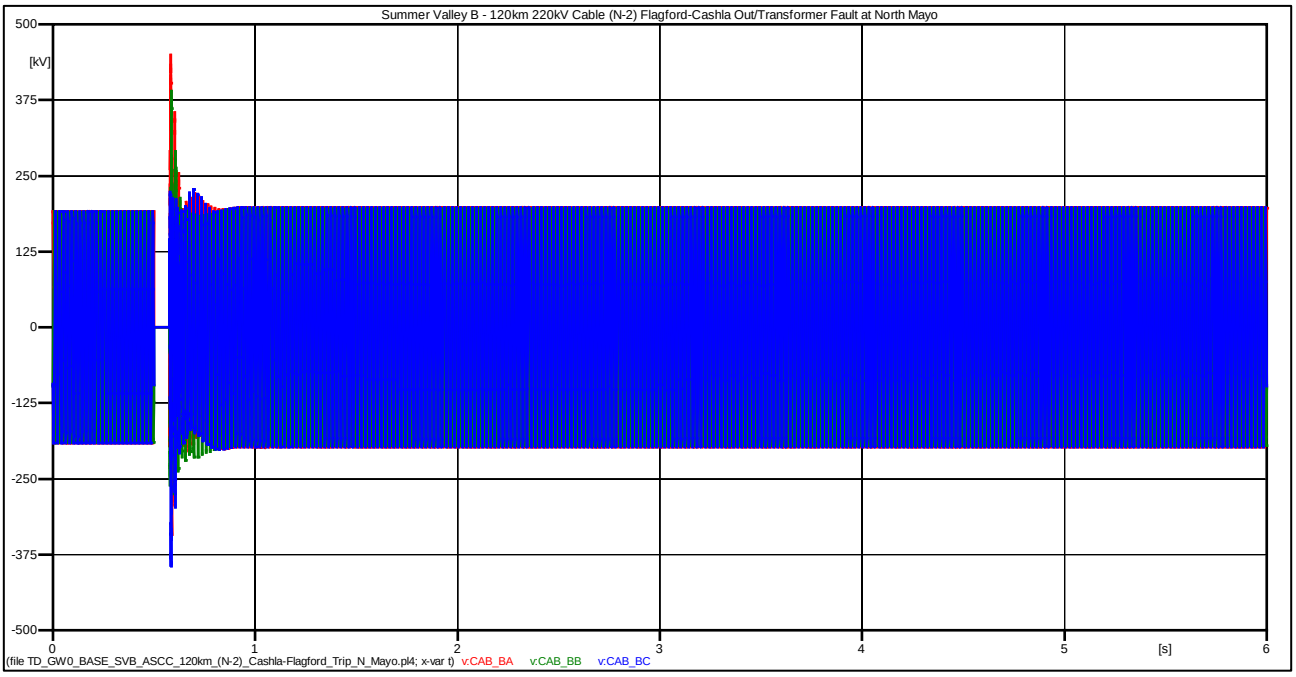

Figure 87: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-6s)

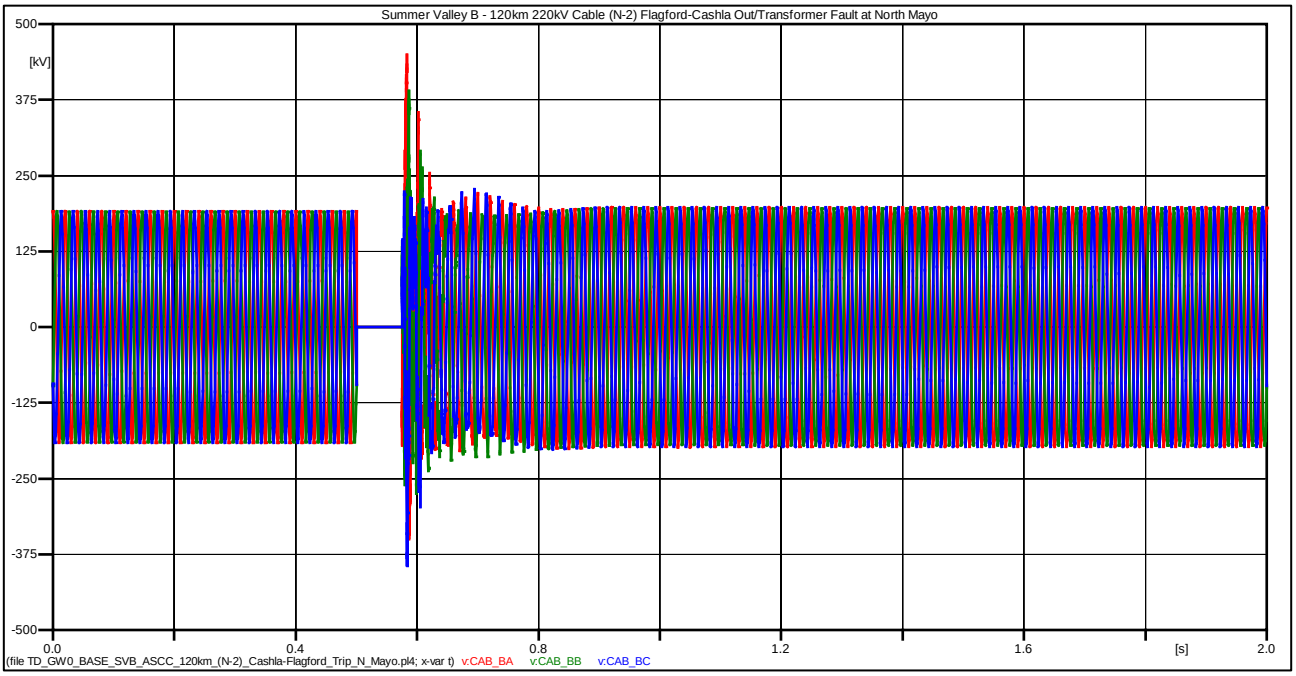

Figure 88: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault at North Mayo (0-2s)

Condition	Maximum Value	Limit	Result
Switching	440.23 kV (2.4514 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	220.01 kV (1.2251 pu)	287.32 kV(1.6pu)	Pass

2.32 Time Domain Simulation - Length 120 km – Summer Valley B – Case 16

Conditions for time domain simulation:

1. Summer Valley B Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 16: (N-2) Condition – Cashla/Flagford Line Out – Fault half way along cable

Conditions:

1. Flagford-Cashla Line Out.
2. Fault half way along cable at 0.5s.

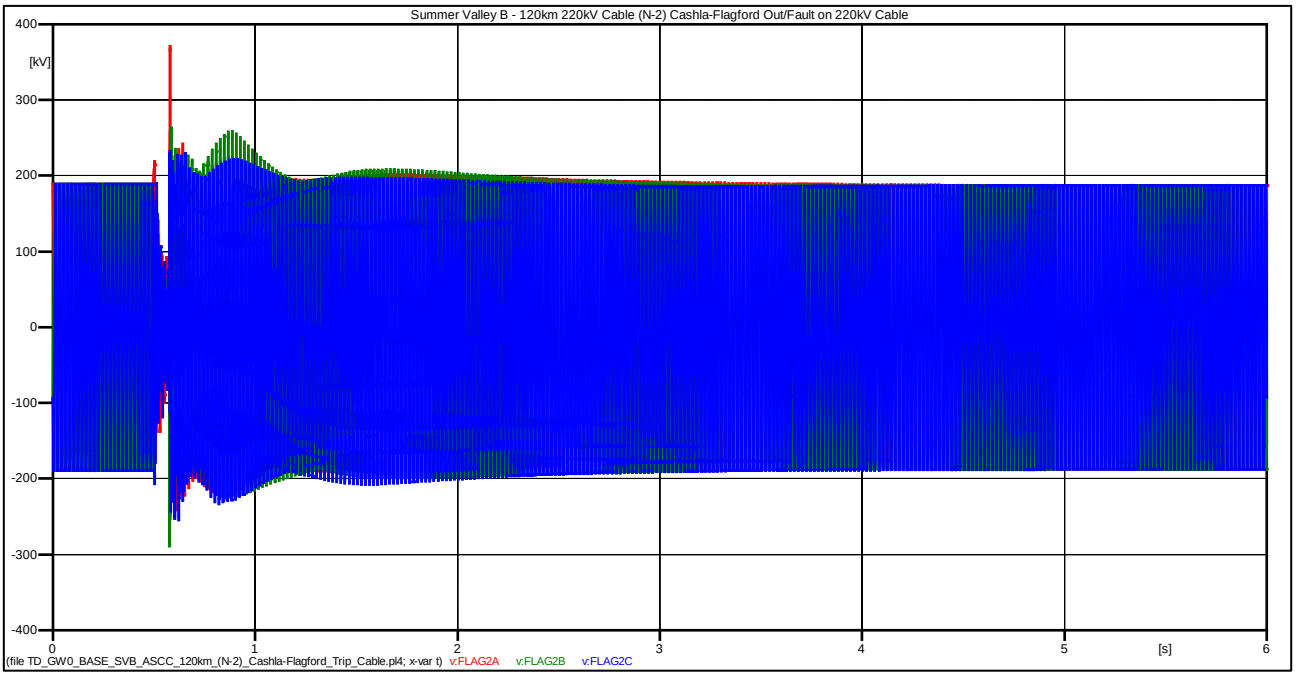

Figure 89: SVB - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-6s)

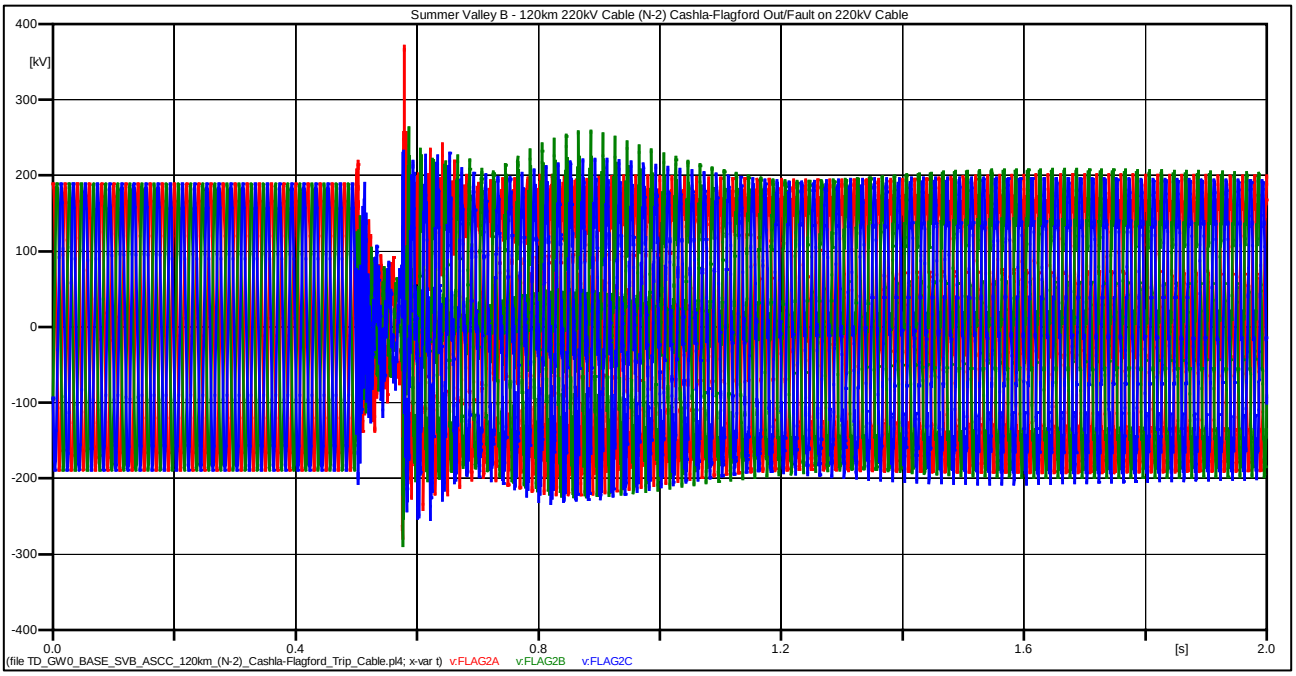

Figure 90: WPA - Length 120 km – Flagford – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	360.56 kV (2.0077 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	245.56 kV (1.3674 pu)	310.76 kV (1.73 pu)	Pass

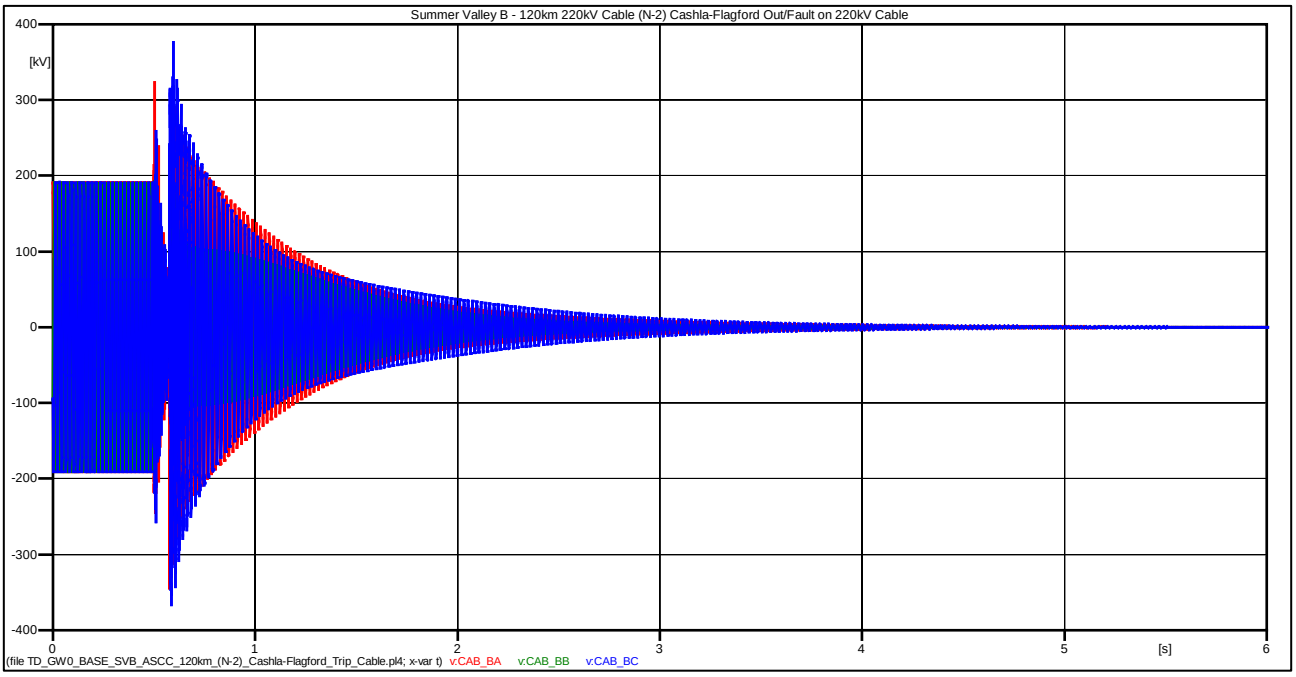

Figure 91: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-6s)

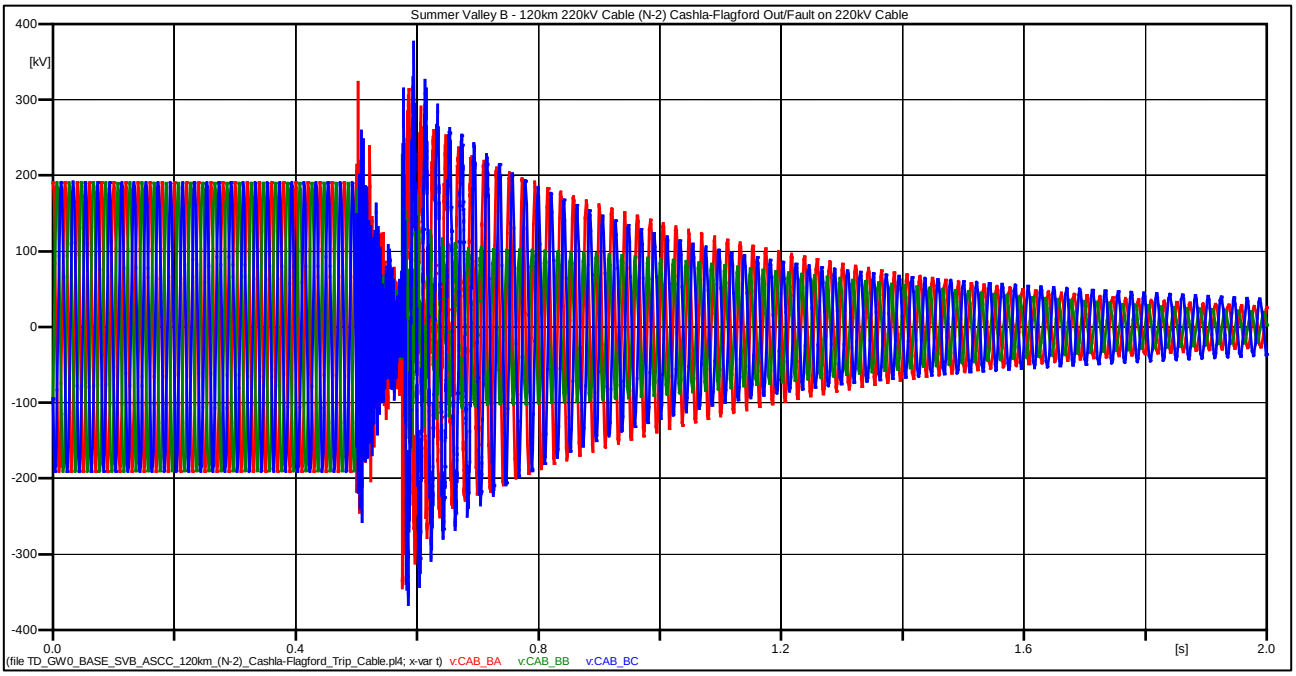

Figure 92: SVB - Length 120 km – North Mayo – (N-2) Condition – Flagford/Cashla Line Out – Fault, Half Way along Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	379.58 kV (2.1137 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	281.02 kV (1.5648 pu)	287.32 kV(1.6pu)	Pass

2.33 Time Domain Simulation - Length 120 km – Winter Peak A – Case 17

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 120 km 220 kV Cable
3. Reactors – North Mayo 250 Mvar/Flagford 300 Mvar

Case 17: (N-2) Condition – Louth-Flagford Line Out – Autoreclose Flagford-Cashla permanent fault

Conditions:

1. Louth-Flagford Line Out.
2. Autoreclose Cashla-Flagford onto permanent fault.

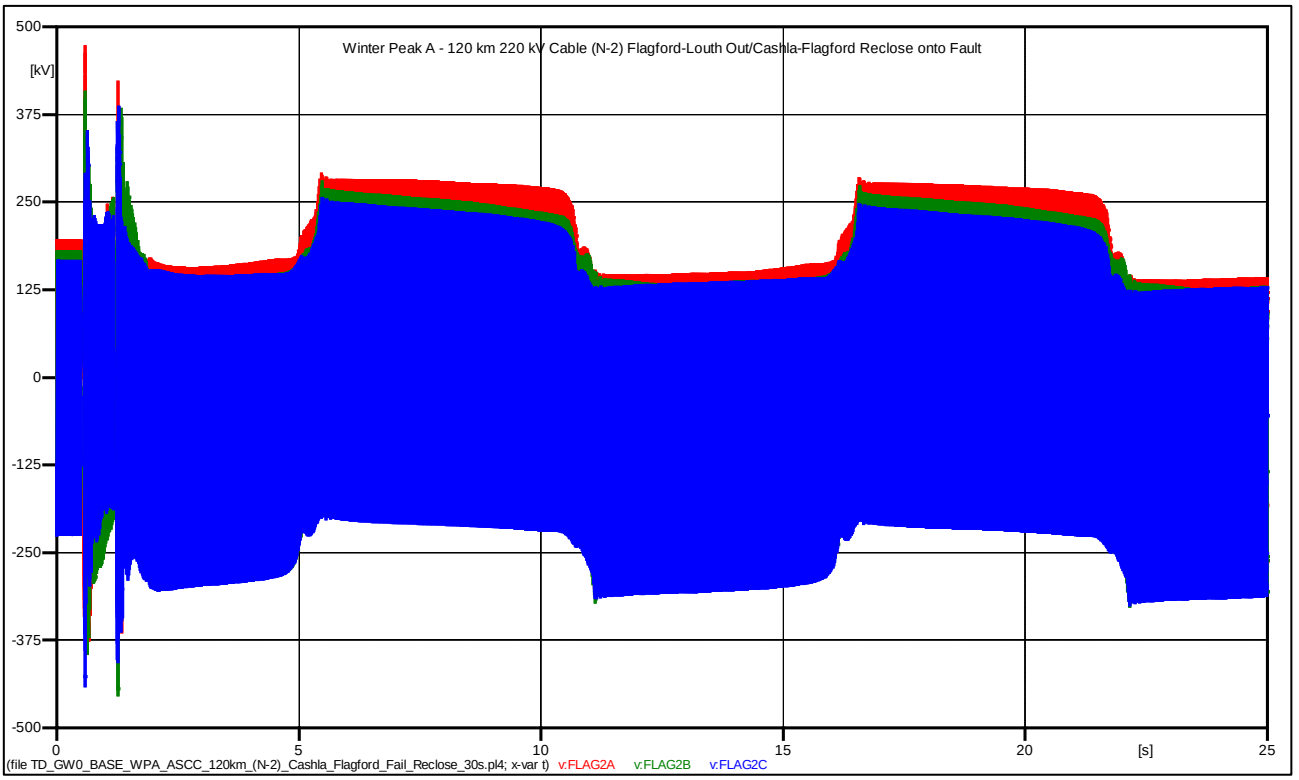

Figure 93: WPA - Length 120 km – Flagford – (N-2) Condition – Autoreclose Flagford-Cashla permanent fault (0-25s)

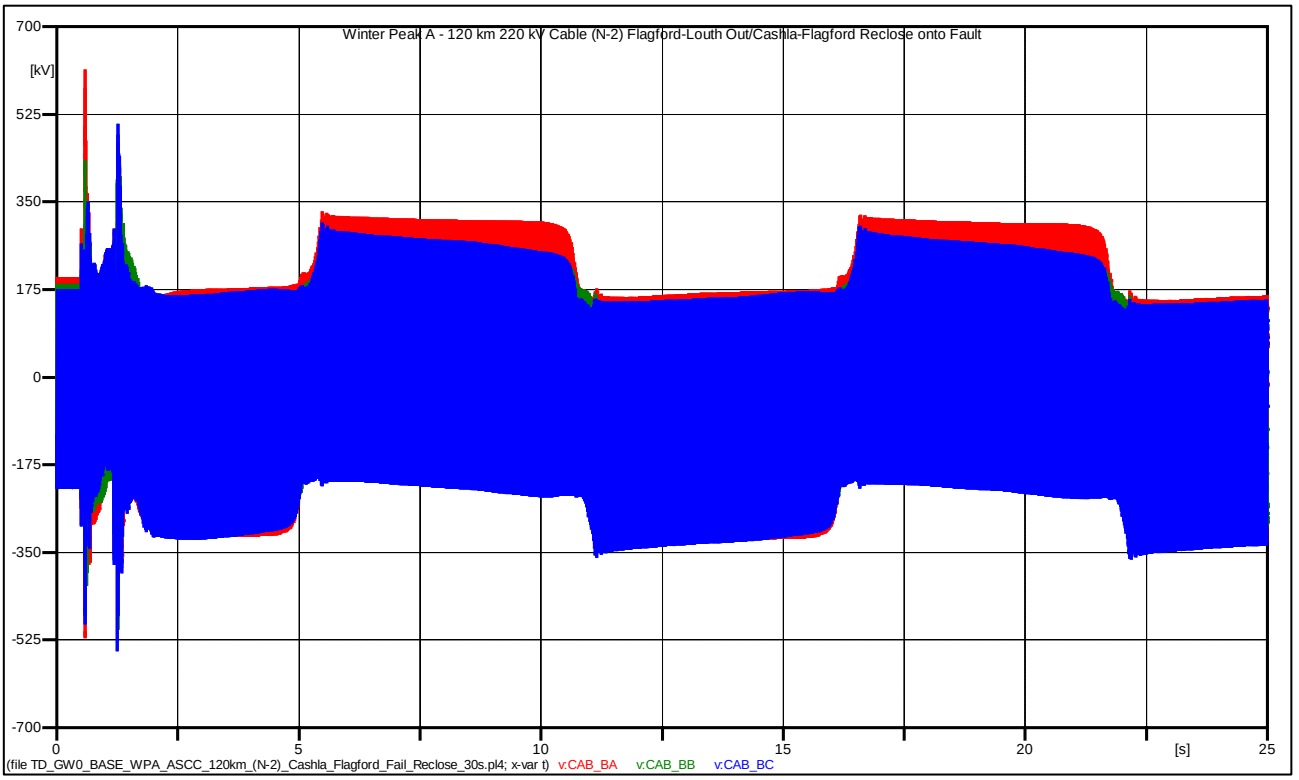

Figure 94: WPA - Length 120 km – North Mayo – (N-2) Condition – Autoreclose Flagford-Cashla permanent fault (0-25s)

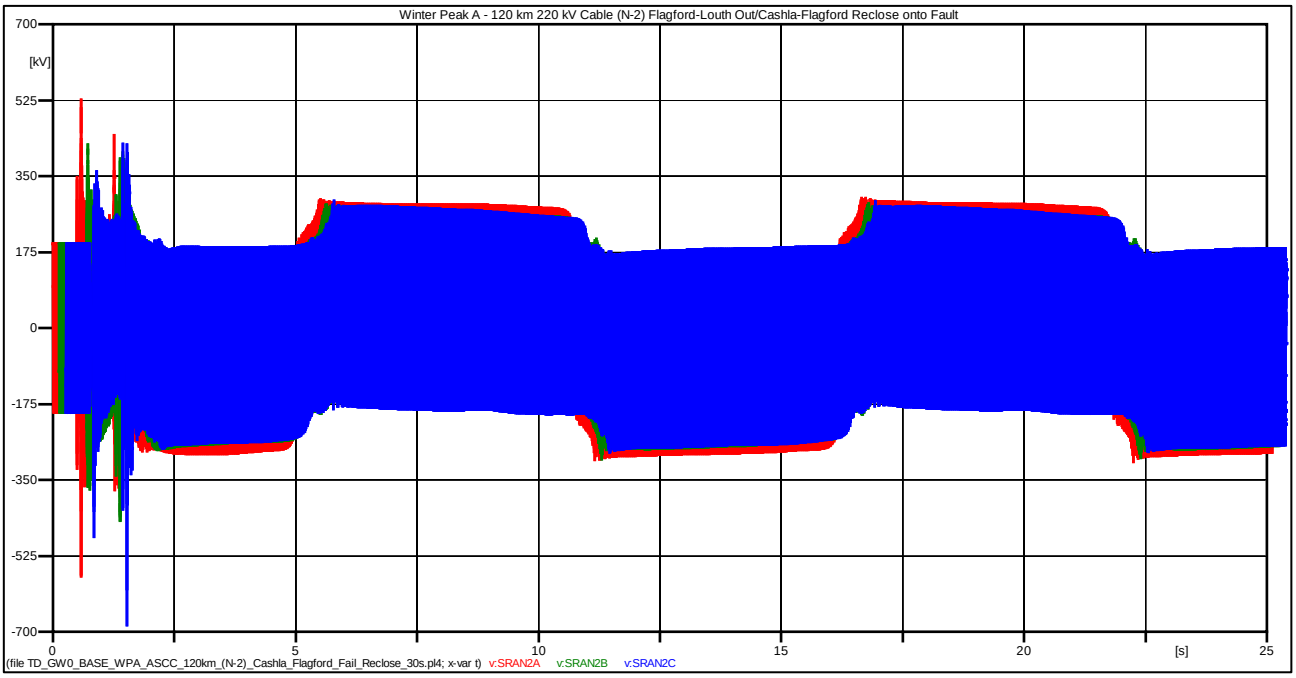

Figure 95: WPA - Length 120 km – Srananagh – (N-2) Condition – Autoreclose Flagford-Cashla permanent fault (0-25s)