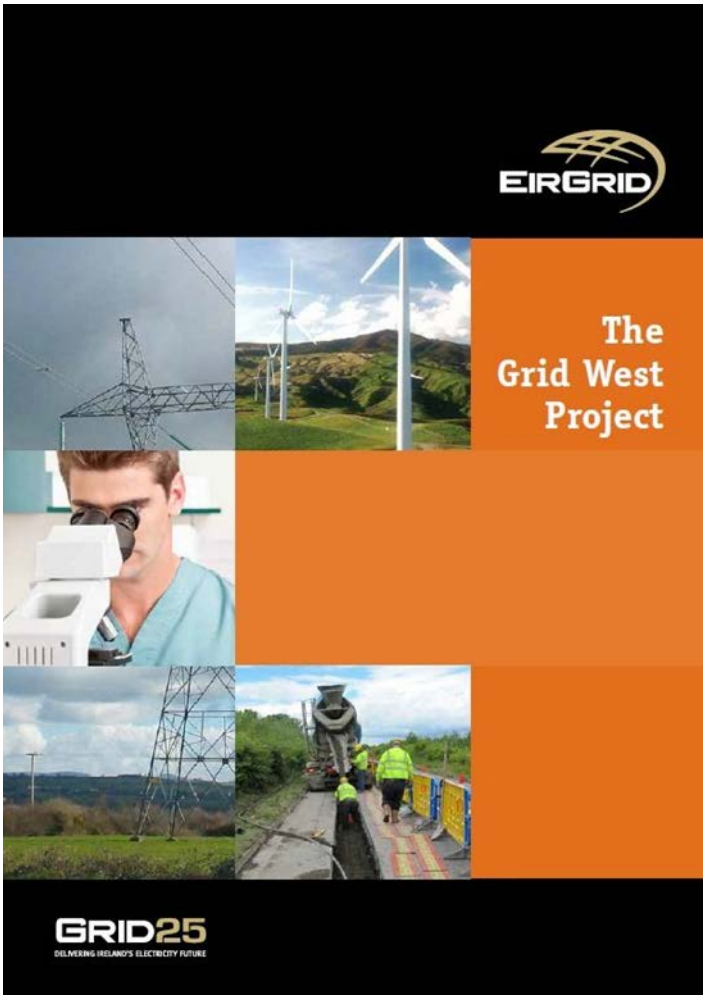
EirGrid

10344 - PSP019 - CABLE STUDIES FOR GRID WEST

Partial AC Underground Solution



Appendix H – 30 km Split 220kV Cable Solution -

Winter Peak A Cases

17/12/2014

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REPORT AUTHORISATION SHEET

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Contents

1 RESULTS

Impedance scans and time domain simulations for a total of 30 km of 220 kV cable with sized reactors at both Flagford and North Mayo. The Grid West circuit configuration is as follows: Flagford to North Mayo – 2 km 220 kV Cable/11 km OHL/20 km 220 kV Cable/72 km OHL/2 km Double OHL and in addition to this the Flagford – Srananagh 220 kV circuit is as follows: Flagford to Srananagh – 8 km 220 kV Cable/45 km OHL.[1]

This Appendix will give results for the Winter Peak A scenario and will show there are no technical issues with this solution.

Steady state voltages were recorded, for a reactor size of 100 Mvar at North Mayo and 50 Mvar at Flagford.

Location	Voltage (kV)	Voltage (pu)
Flagford	192.57	1.0723
North Mayo	189.11	1.0530

Steady state voltages were recorded, for a reactor size of 75 Mvar at North Mayo and 25 Mvar at Flagford.

Location	Voltage (kV)	Voltage (pu)
Flagford	195.38	1.0879
North Mayo	194.30	1.0819

Use the combination of 100 Mvar at North Mayo and 50 Mvar at Flagford.

[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.

The case results are presented as follows:

- Case 1: (N) Normal Operating Condition
- Case 2: (N-1) Cashla-Flagford Autoreclose onto Fault
- Case 3: (N-1) Flagford-Louth Line Autoreclose onto Fault
- Case 4: (N-1) Flagford-Srananagh Line Trip
- Case 5: (N-1) Trip Grid West Cable
- Case 6: (N-2) Cashla-Flagford Autoreclose onto fault/Flagford-Louth Lines out
- Case 7: (N-2) Cashla-Flagford Line Autoreclose onto Fault/Flagford-Srananagh Cable/Line Out
- Case 8: (N-2) Flagford-Louth Line Autoreclose onto Fault/Flagford-Srananagh Cable/Line Out
- Case 9: (N+1) Energise Grid West Cable

The naming convention from ATP for the Grid West circuit sections are given in Figure 1, these indicate where on the circuit the readings are being taken from:

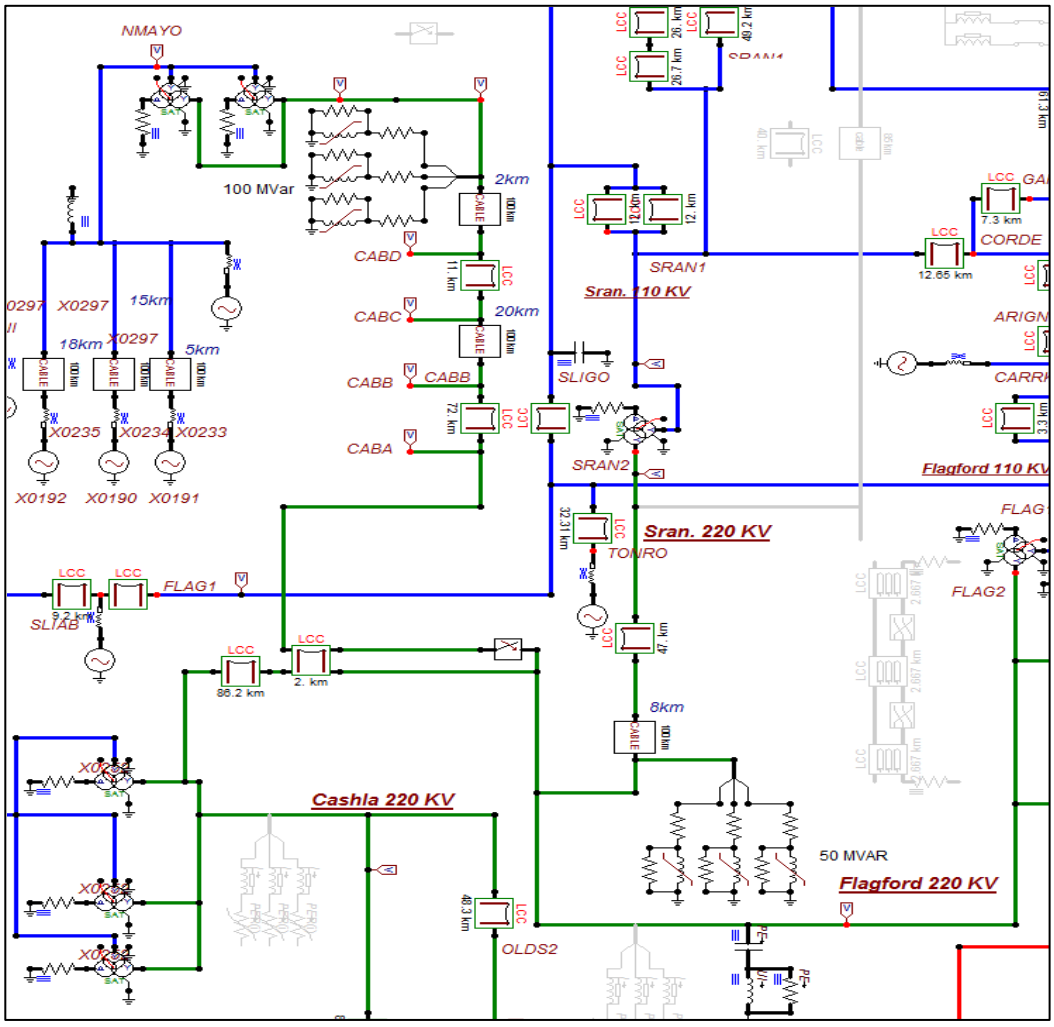

Figure 1: ATP Diagram showing node names and locations

1.1 Impedance Scans - Length 30 km – Winter Peak A – Case 1

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 1: (N) Normal Operating Condition

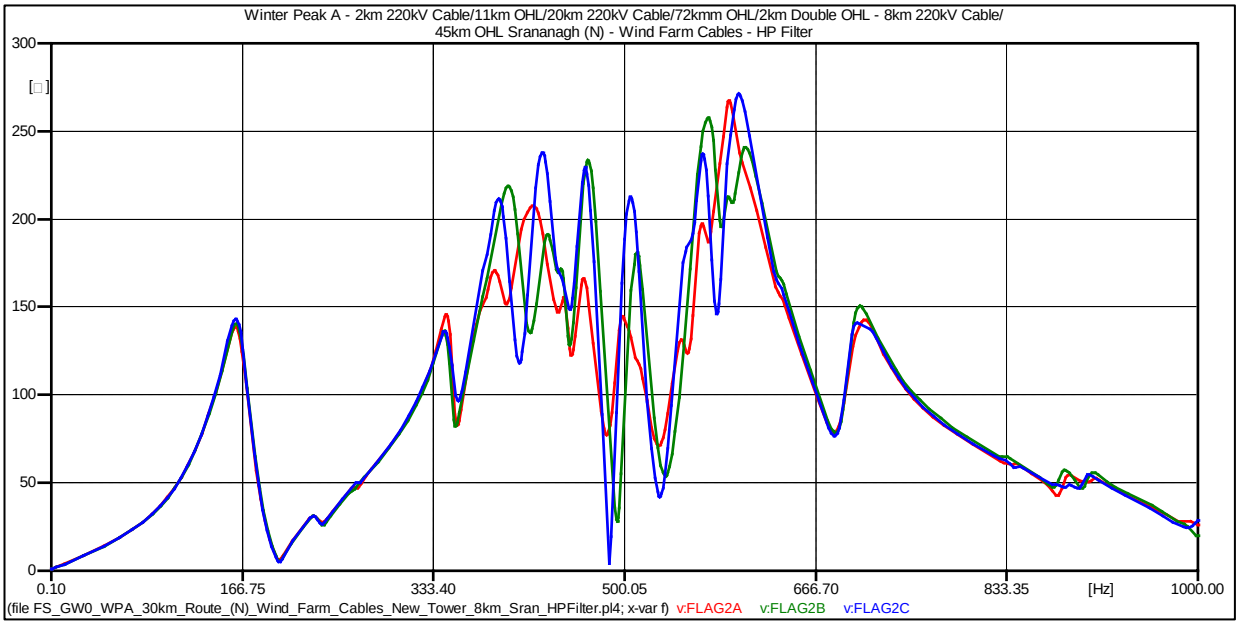

Figure 2: WPA - Length 30 km - (N) Normal Operating Condition

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
160.60	143.13
344.80	133.01
429.40	237.27
467.80	224.60
600.40	270.96
705.40	105.64

1.2 Impedance Scans - Length 30 km – Winter Peak A – Case 2

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 2: (N-1) Cashla-Flagford Line Out

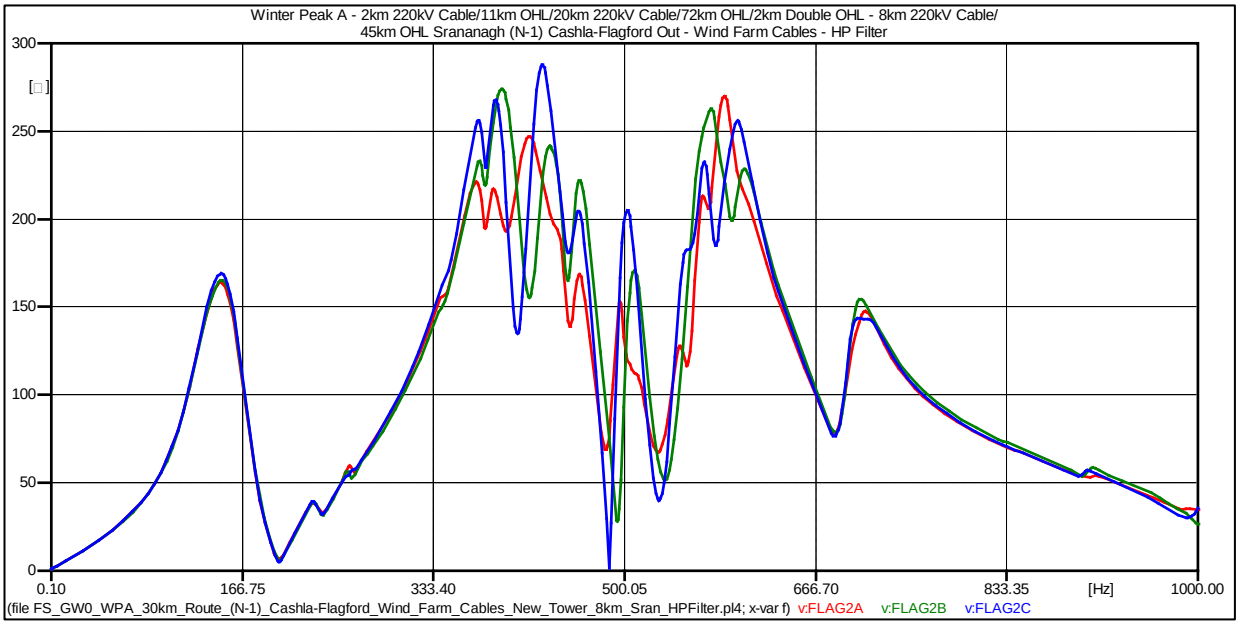

Figure 3: WPA - Length 30 km - (N-2) Cashla-Flagford Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
148.90	168.94
392.80	247.55
428.80	287.61
588.70	268.48
706.00	154.58

1.3 Time Domain Simulation - Length 30 km – Winter Peak A – Case 2

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 2: (N-1) Cashla-Flagford Auto Reclose onto Fault

System Conditions:

1. Fault applied 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.

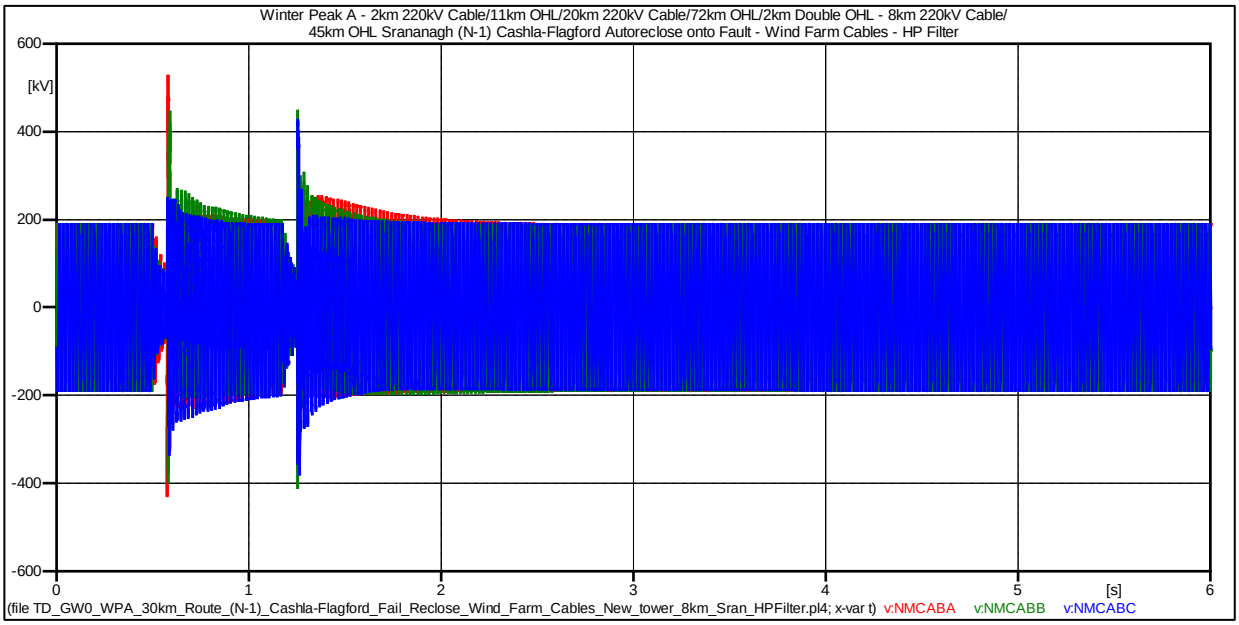

Figure 4: WPA - Length 30 km – North Mayo – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

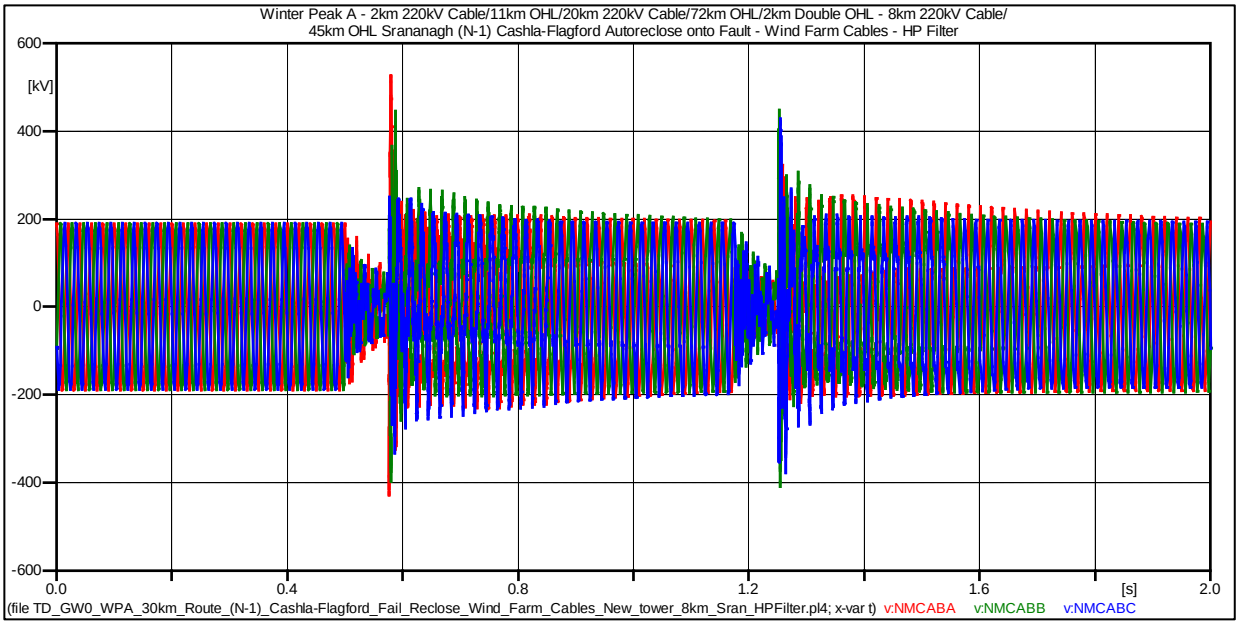

Figure 5: WPA - Length 30 km – North Mayo – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	507.89 kV (2.8282 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	250.89 kV (1.3970 pu)	287.32 kV (1.6pu)	Pass

*Pass can be achieved with surge arrestors

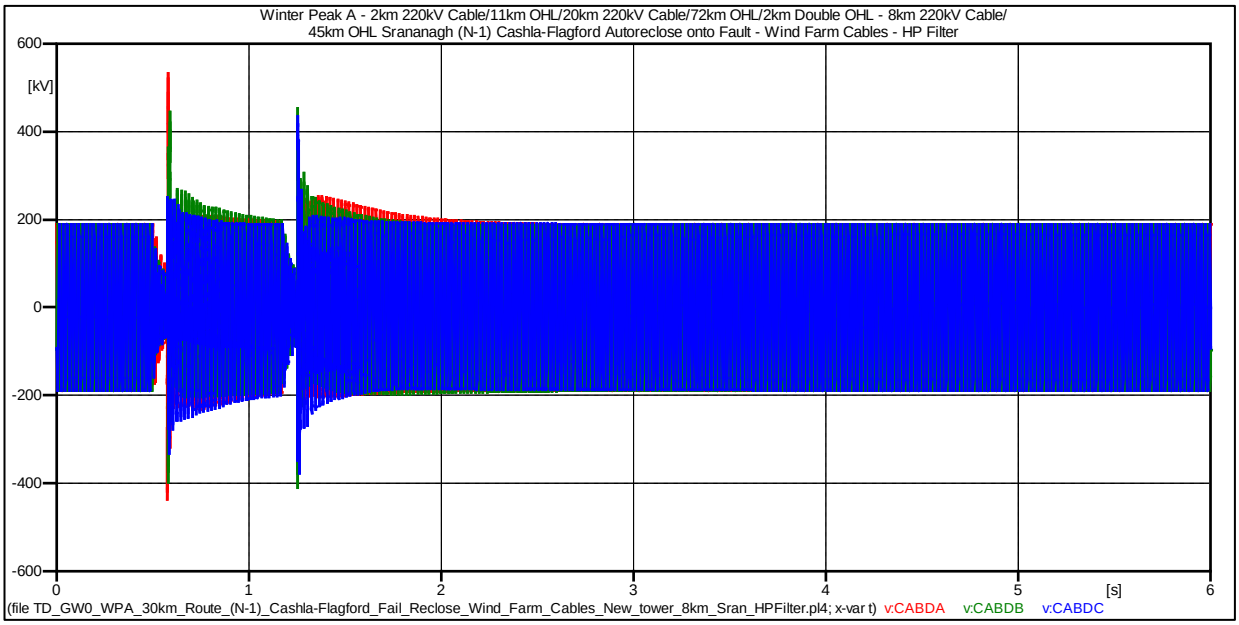

Figure 6: WPA - Length 30 km – Cable End D – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

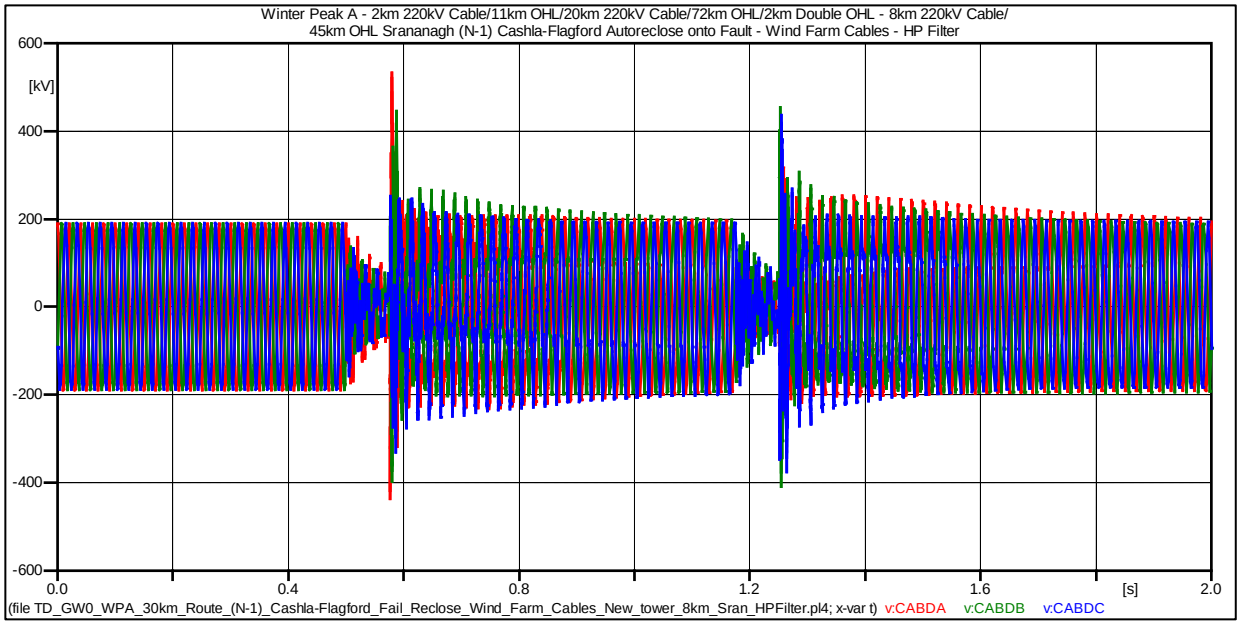

Figure 7: WPA - Length 30 km – Cable End D – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	530.78 kV (2.9556 pu)	449.07 kV (2.5 pu)	Fail*
Transient Overvoltage	266.69 kV (1.4851 pu)	311.12 kV(1.73 pu)	Pass

*Pass can be achieved with surge arrestors

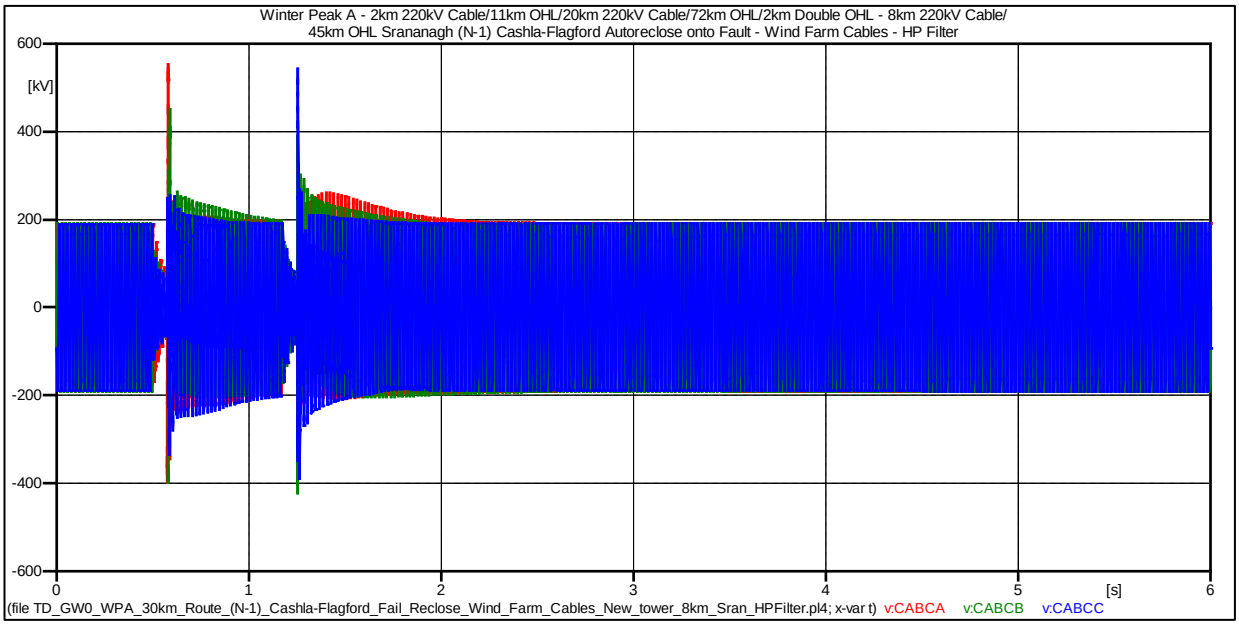

Figure 8: WPA - Length 30 km – Cable End C – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

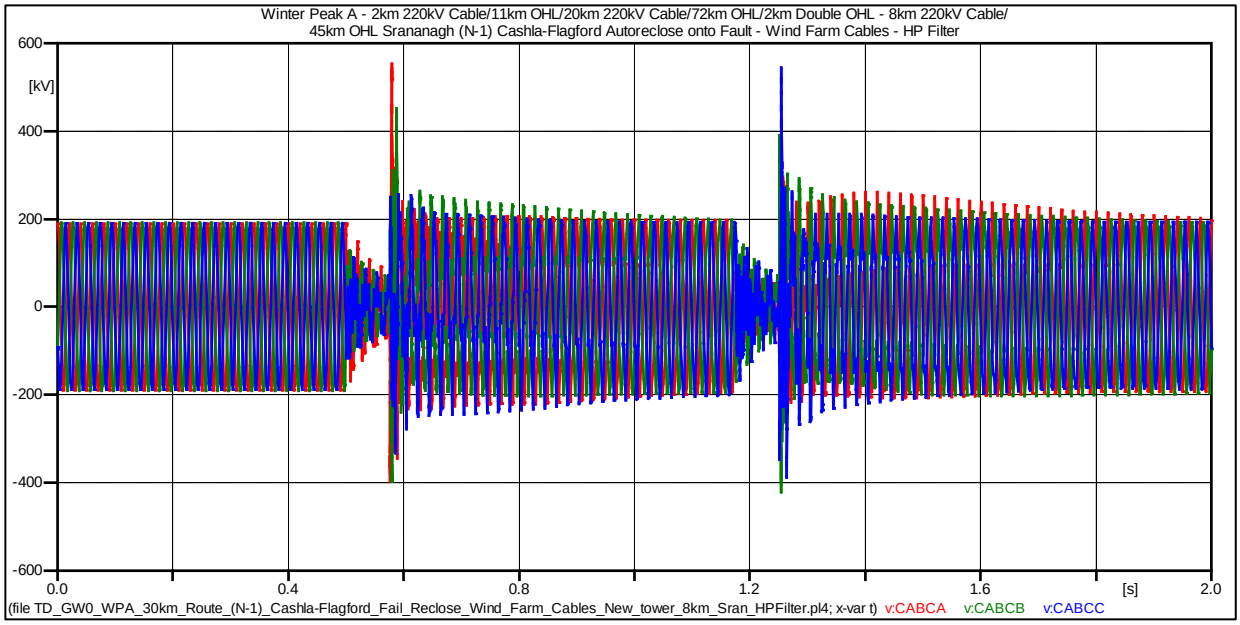

Figure 9: WPA - Length 30 km – Cable End C – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	552.34 kV (3.075 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	248.64 kV (1.3846 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

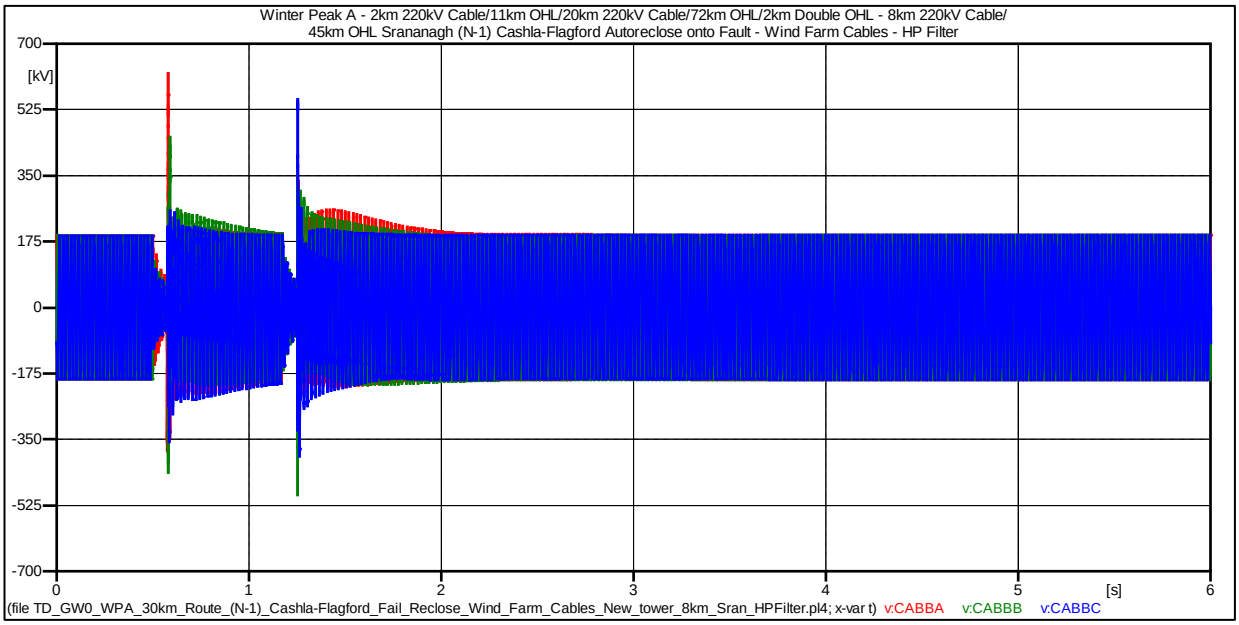

Figure 10: WPA - Length 30 km – Cable End B – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

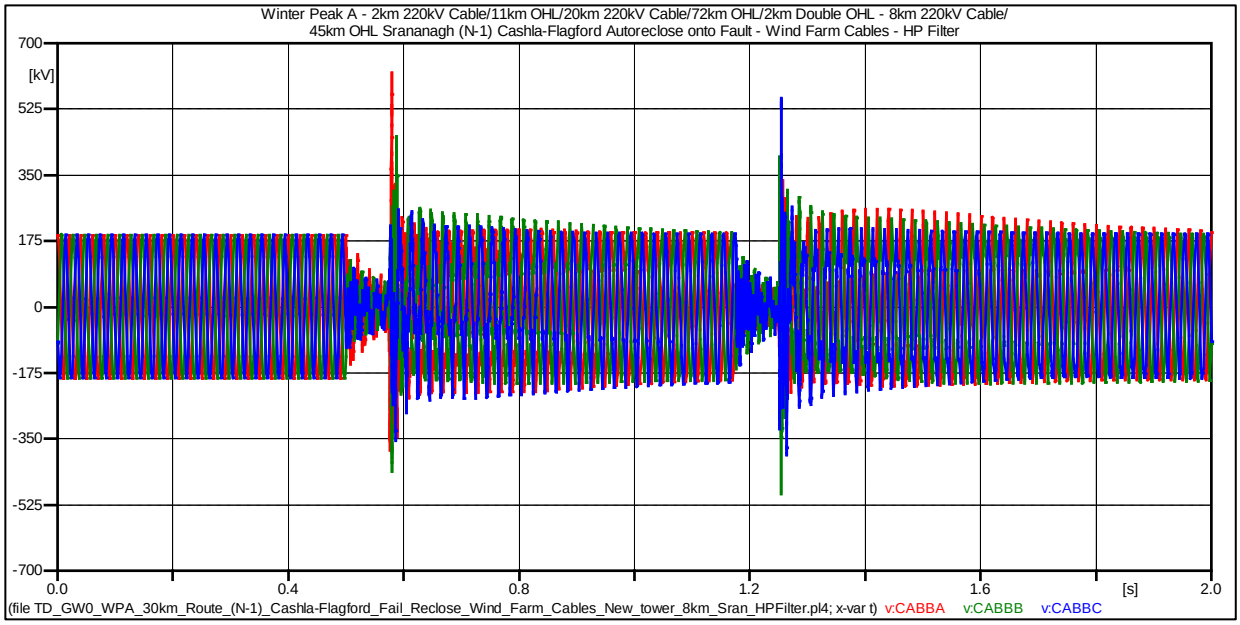

Figure 11: WPA - Length 30 km – Cable End B – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	548.41 kV (3.0538 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	257.27 kV (1.4043 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

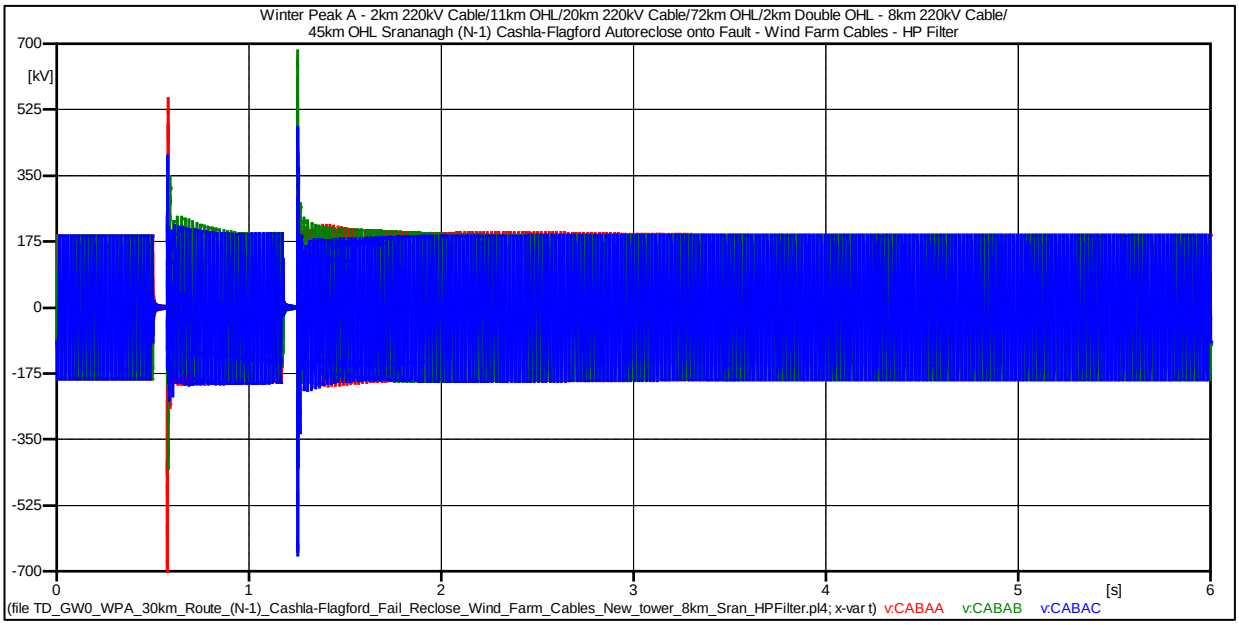

Figure 12: WPA - Length 30 km – Cable End A – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

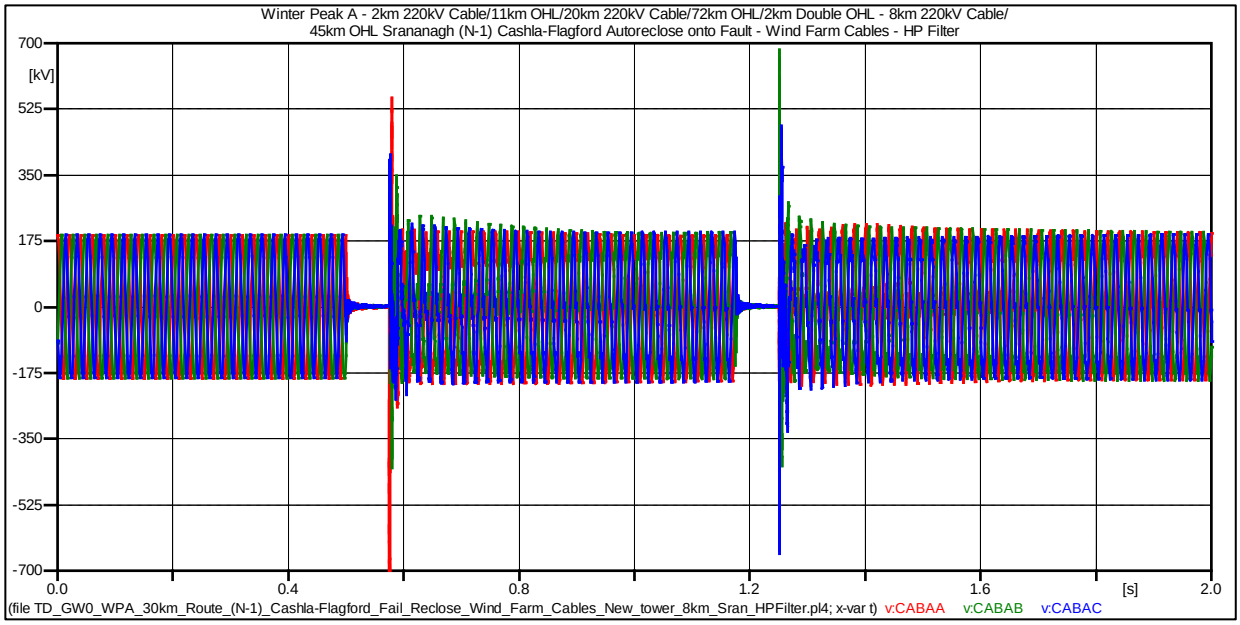

Figure 13: WPA - Length 30 km – Cable End A – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	800.17 kV (3.8989 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	234.06 kV (1.3033 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

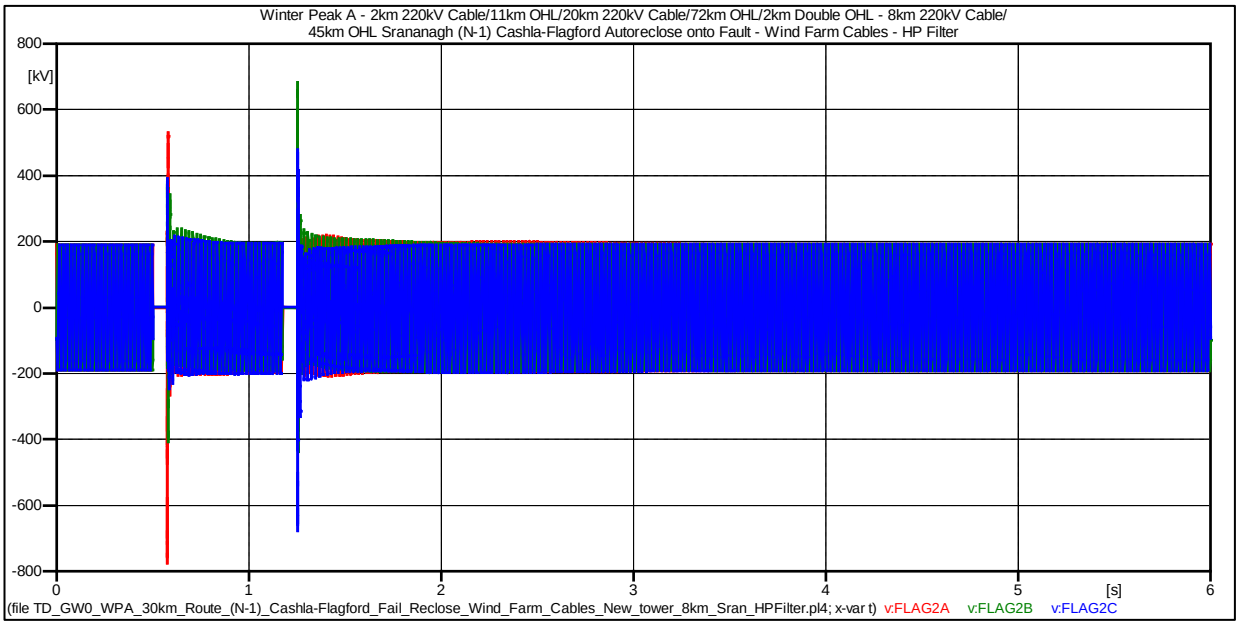

Figure 14: WPA - Length 30 km – Flagford – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

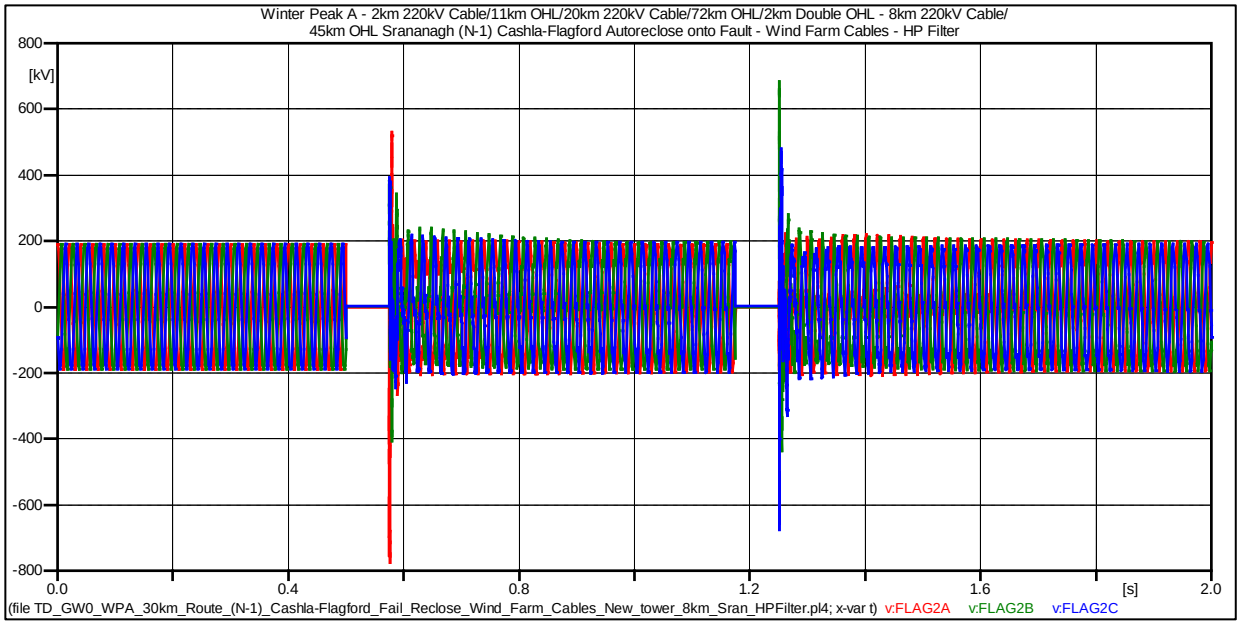

Figure 15: WPA - Length 30 km –Flagford – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	756.10 kV (4.2103 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	235.12 kV (1.3092 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

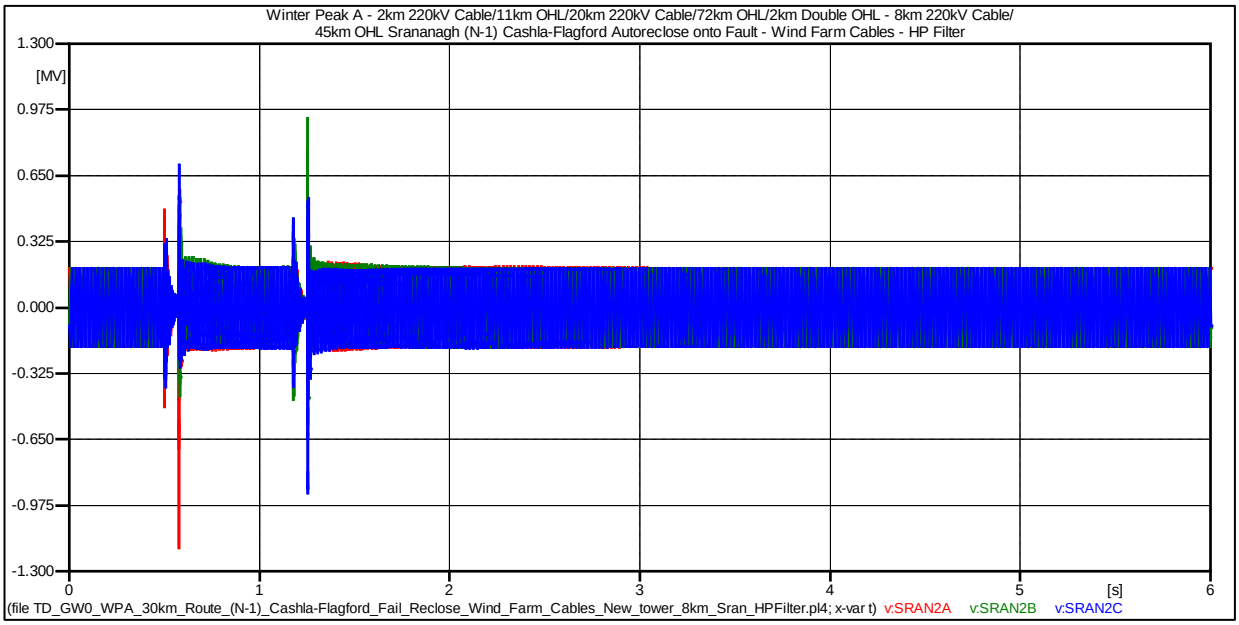

Figure 16: WPA - Length 30 km –Srananagh – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-6s)

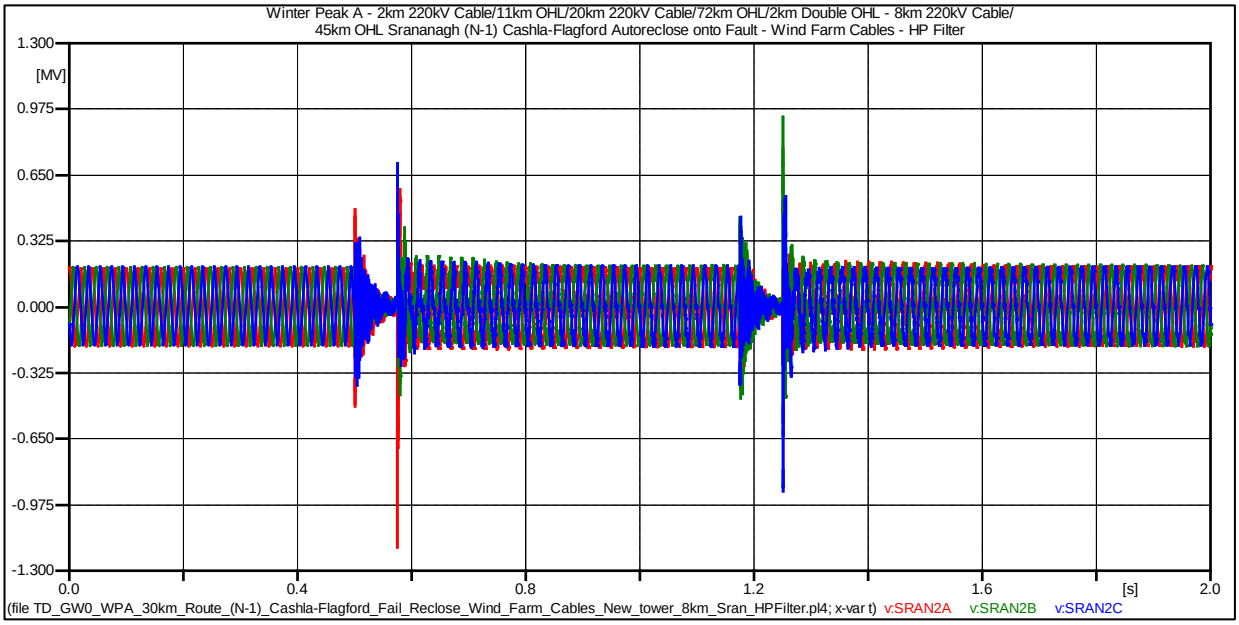

Figure 17: SVB - Length 30 km –Srananagh – (N-1) Cashla-Flagford Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	1.18 MV (6.5708 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	200.00 kV (1.1137 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

1.4 Impedance Scans - Length 30 km – Winter Peak A – Case 3

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 3: (N-1) Flagford-Louth Line Out

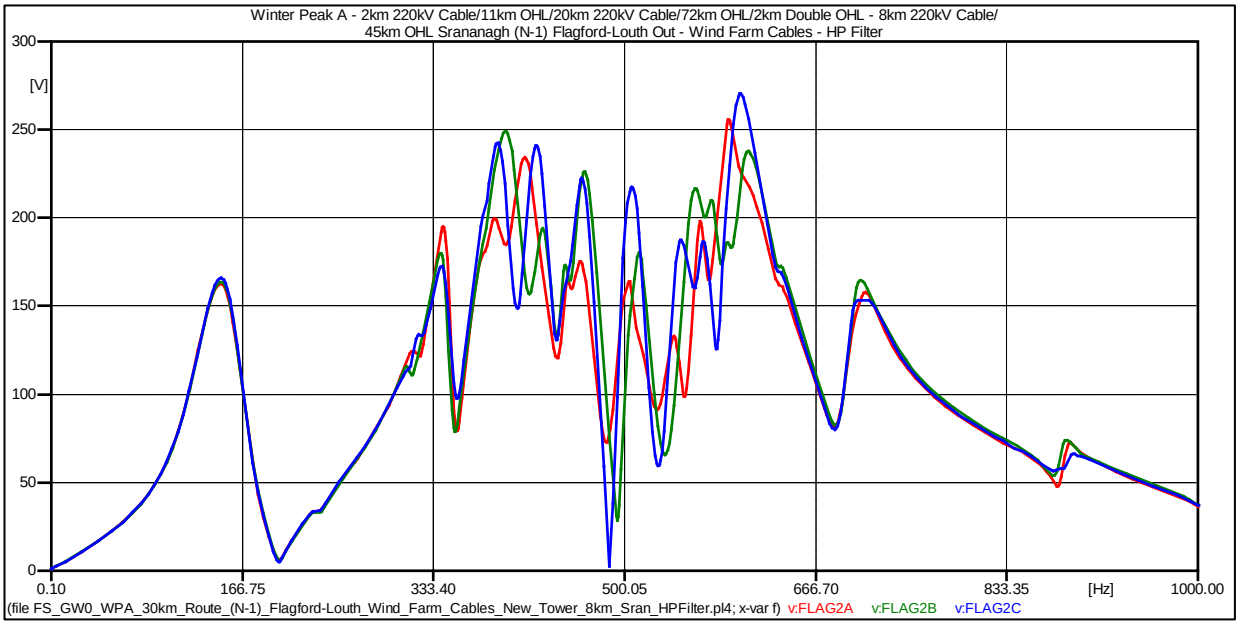

Figure 18: WPA - Length 30 km - (N-2) Cashla-Flagford Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
148.30	165.91
397.30	248.79
342.40	194.39
424.00	240.43
463.30	222.23
504.70	215.22
600.40	270.30
707.80	163.99

1.5 Time Domain Simulation - Length 30 km – Winter Peak A – Case 3

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 3: (N-1) Flagford-Louth Line Autoreclose onto Fault

System Conditions:

1. Fault applied on Flagford side of Flagford-Louth 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.

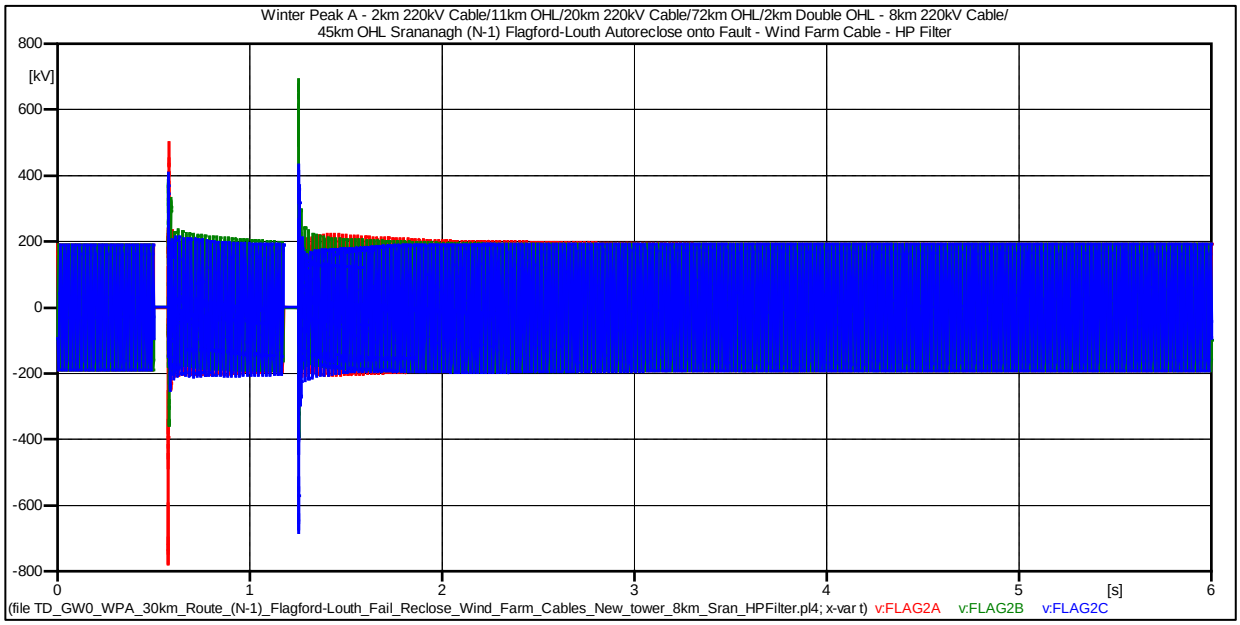

Figure 19: WPA - Length 30 km – Flagford – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

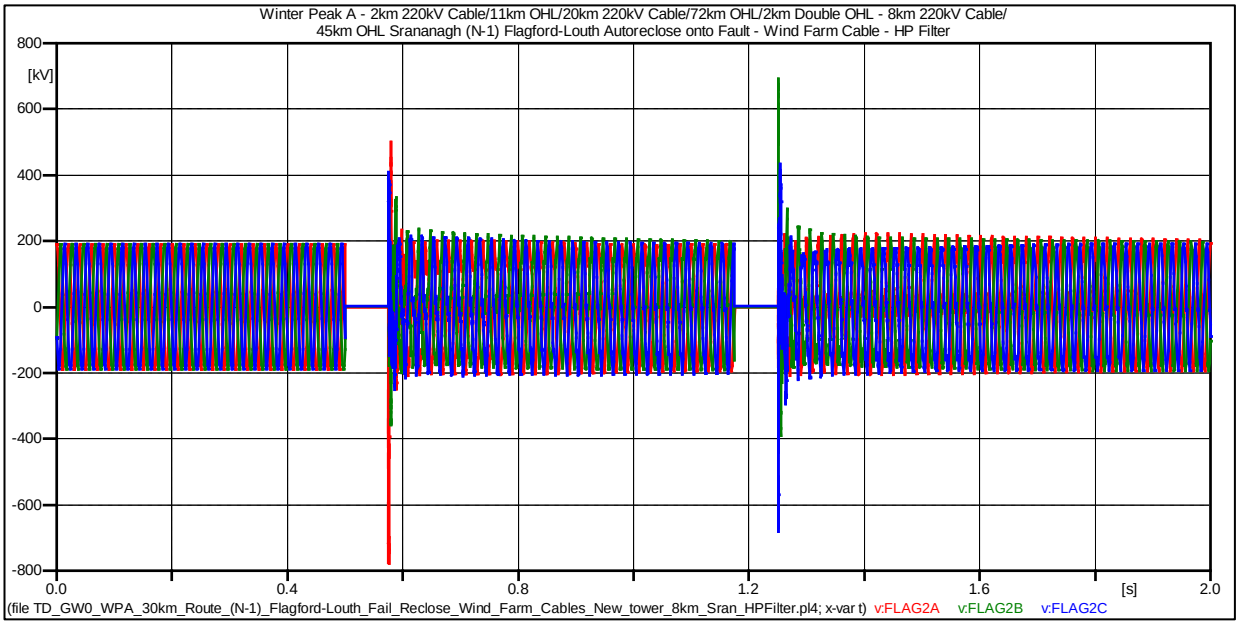

Figure 20: WPA - Length 30 km – Flagford – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

Condition	Maximum Value	Limit	Result
Switching	715.89 kV (3.9864 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	240.15 kV (1.3372 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

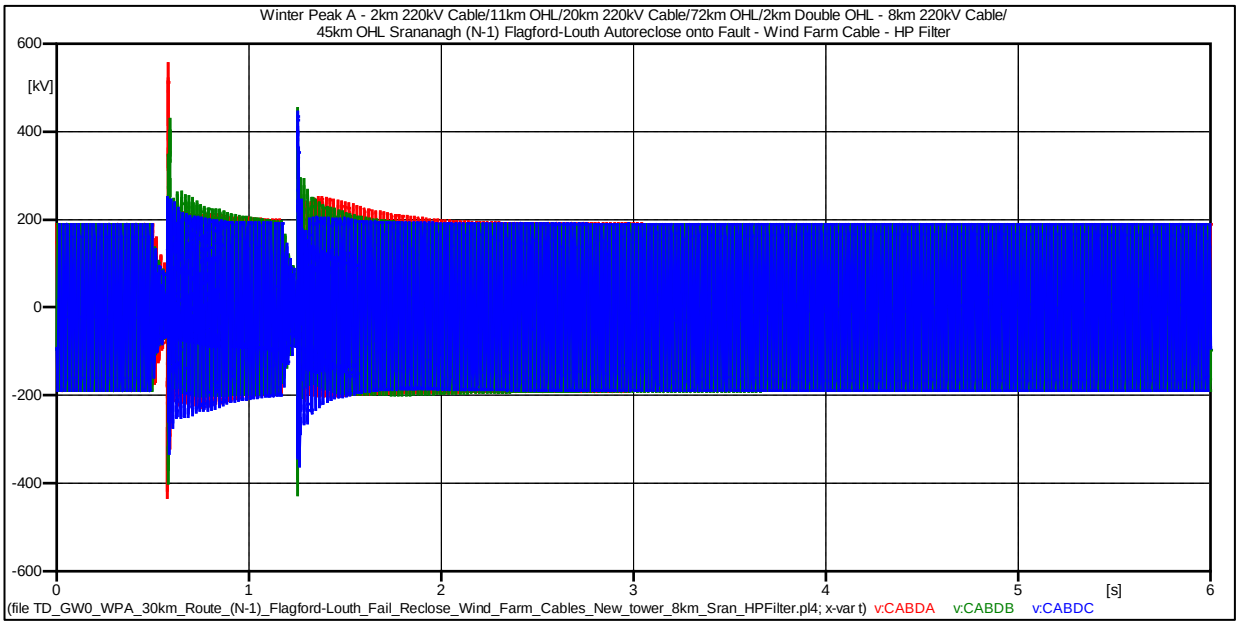

Figure 21: WPA - Length 30 km – Cable End D – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

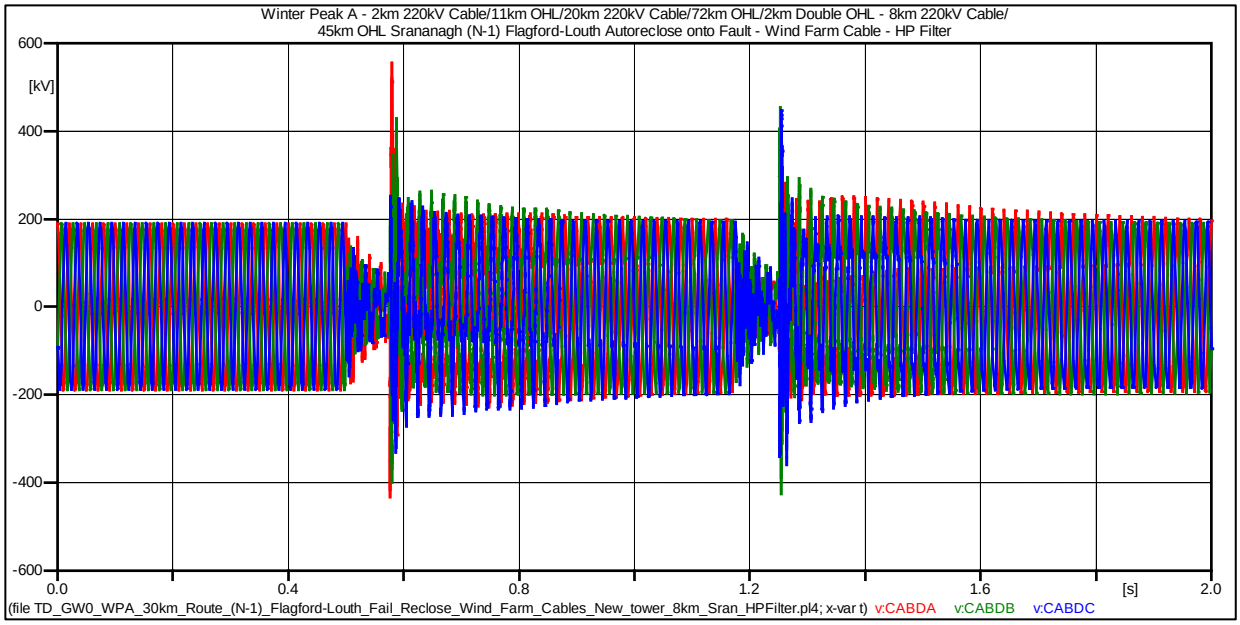

Figure 22: WPA - Length 30 km – Cable End D – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	537.84 kV (2.9949 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	251.79 kV (1.4021 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

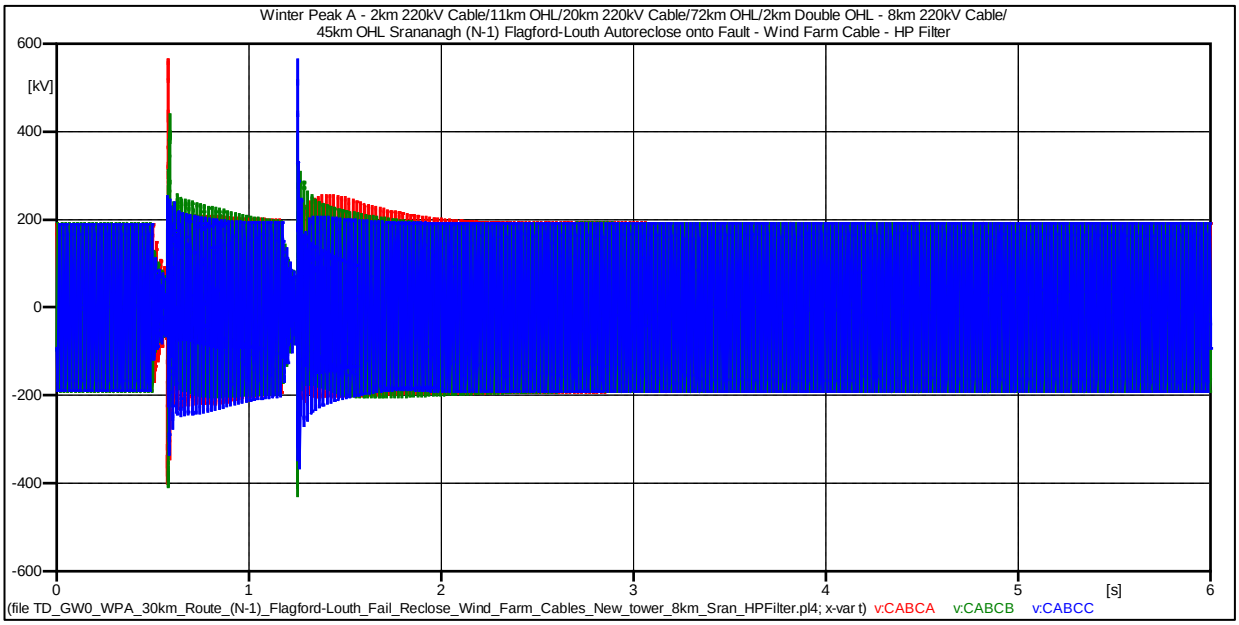

Figure 23: WPA - Length 30 km – Cable End C – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

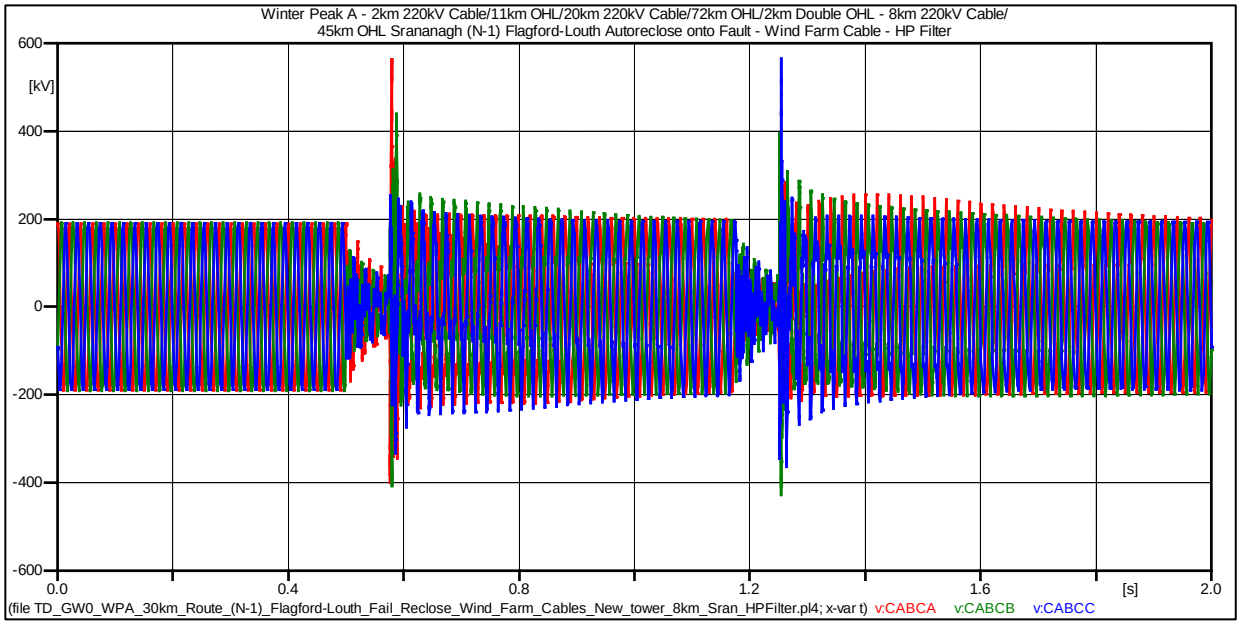

Figure 24: WPA - Length 30 km – Cable End C – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	561.88 kV (3.1288 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	247.57 kV (1.3786 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

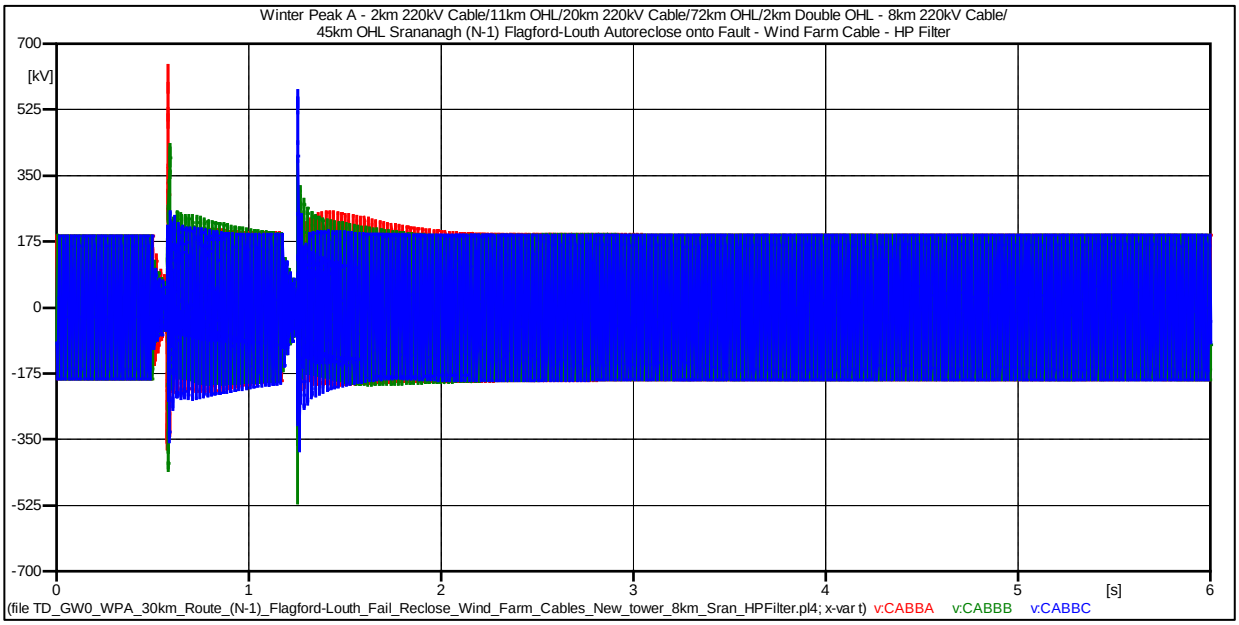

Figure 25: WPA - Length 30 km – Cable End B – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

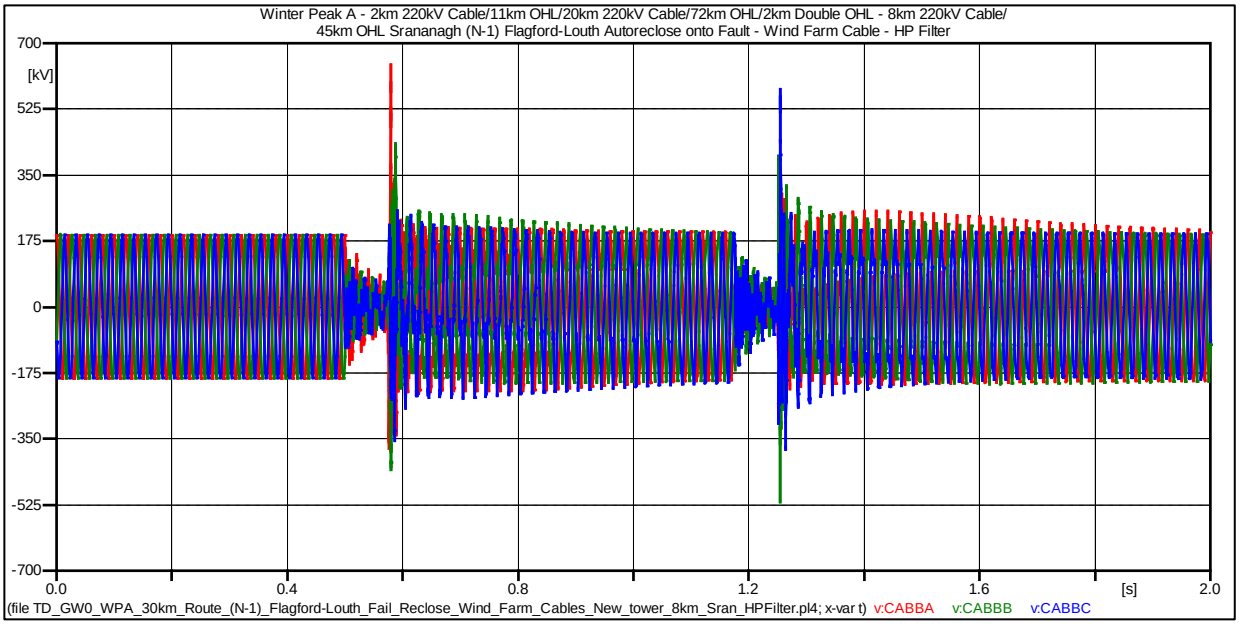

Figure 26: WPA - Length 30 km – Cable End B – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	584.73 kV (3.2506 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	253.65 kV (1.4124 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

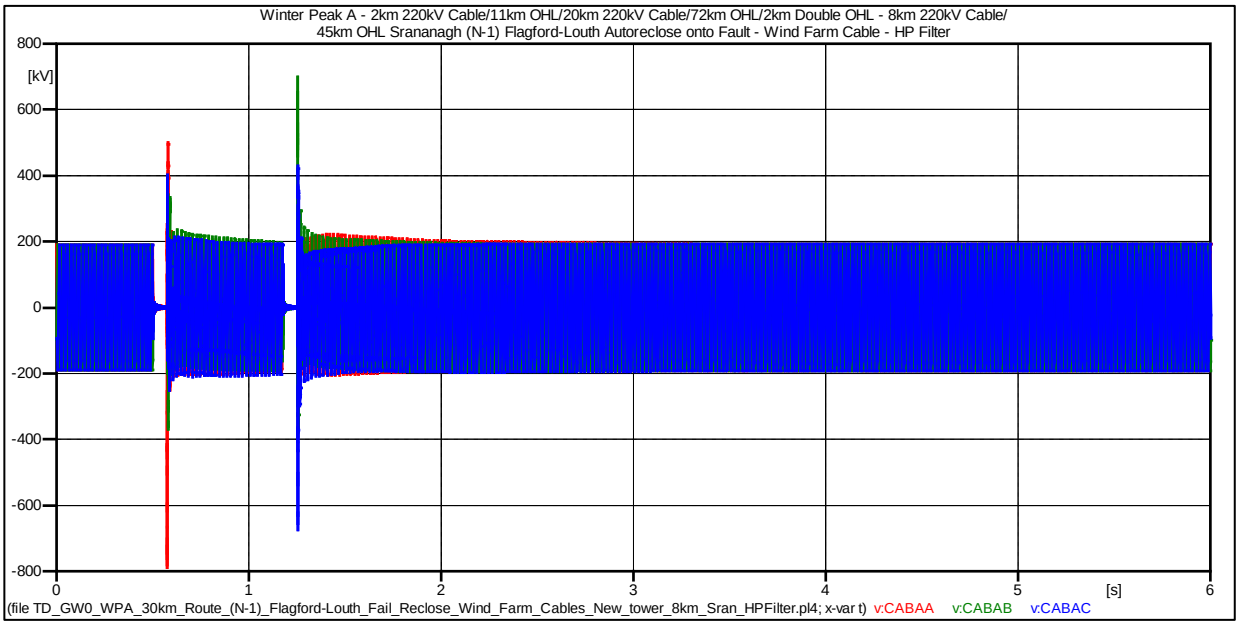

Figure 27: WPA - Length 30 km – Cable End A – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

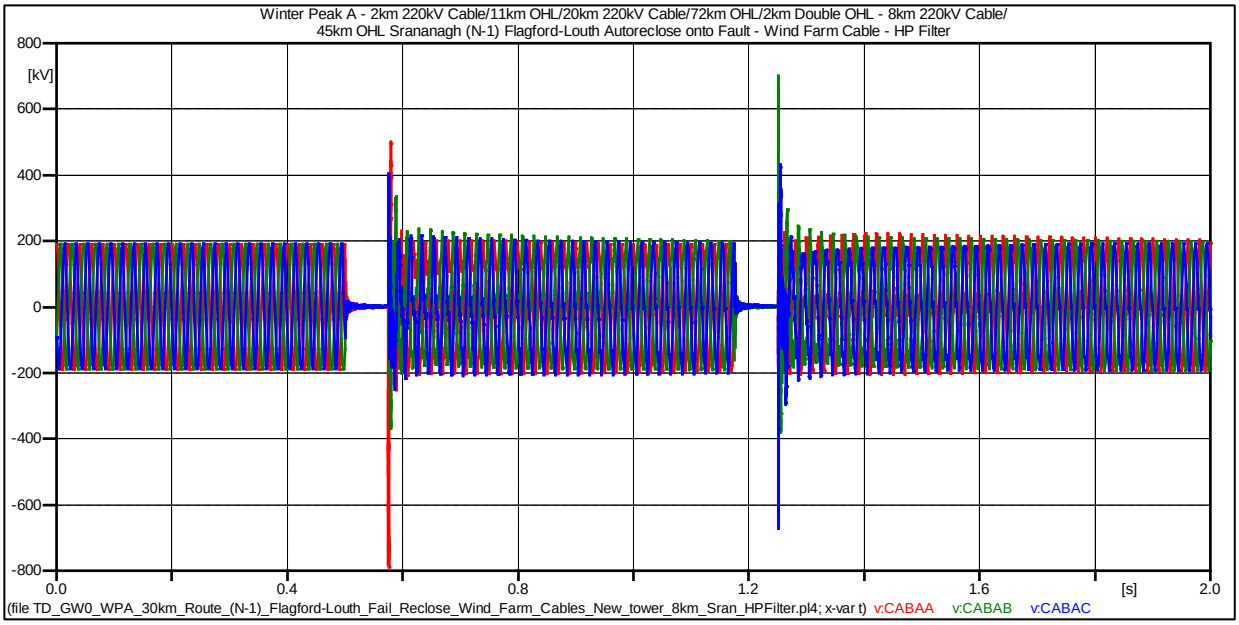

Figure 28: WPA - Length 30 km – Cable End A – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	795.12 kV (4.4276 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	232.95 kV (1.2971 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

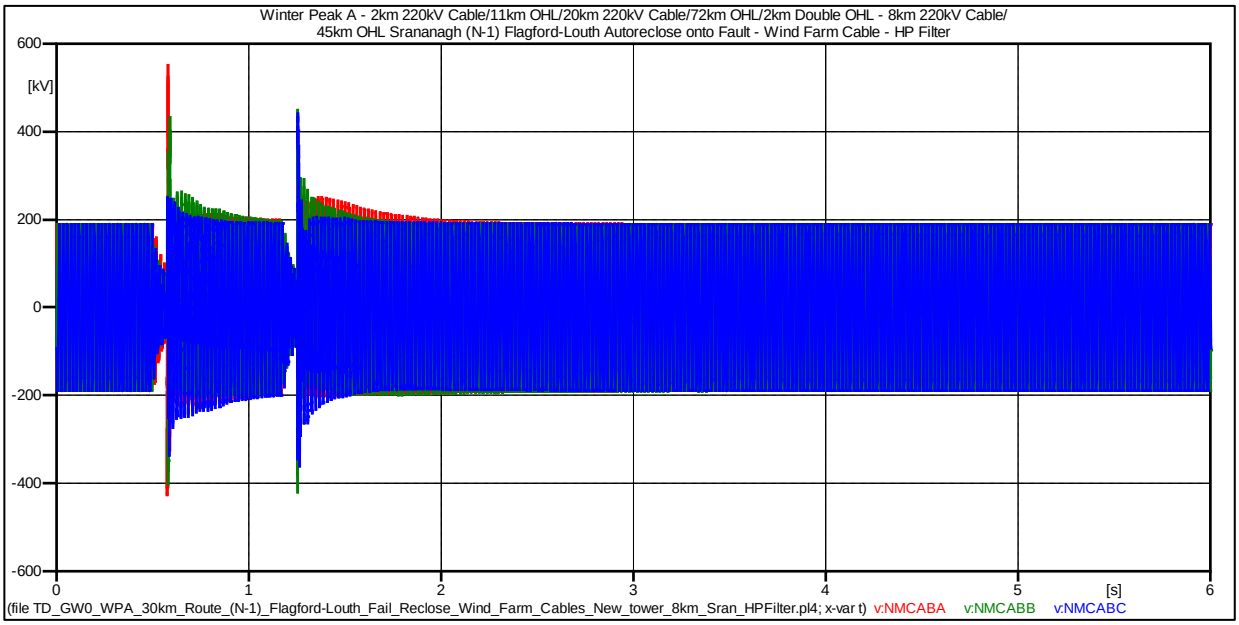

Figure 29: WPA - Length 30 km – North Mayo – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

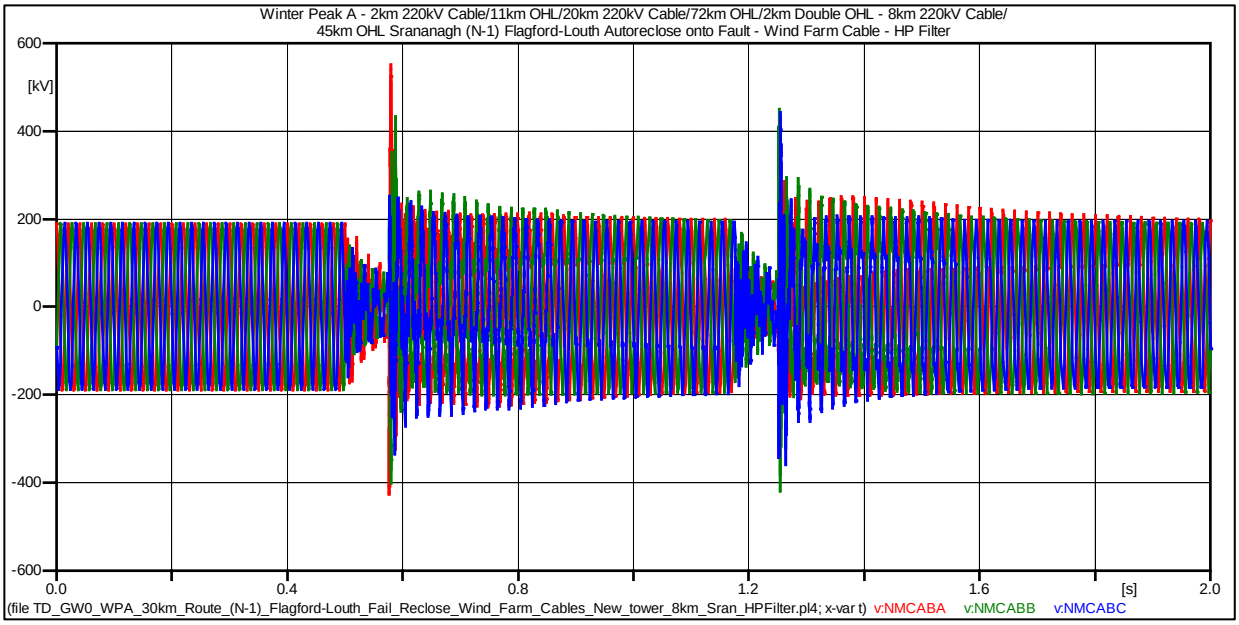

Figure 30: WPA - Length 30 km – North Mayo – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	584.73 kV (3.2561 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	253.65 kV (1.4124 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

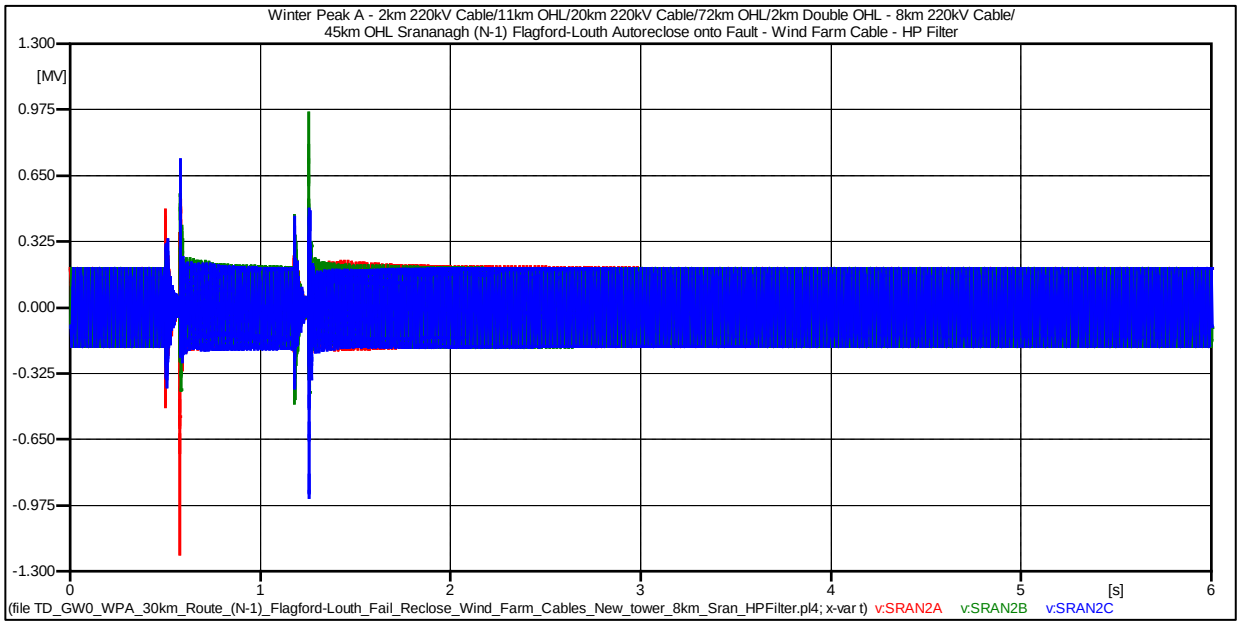

Figure 31: WPA - Length 30 km – Srananagh – (N-1) Flagford-Louth Auto Reclose onto Fault (0-6s)

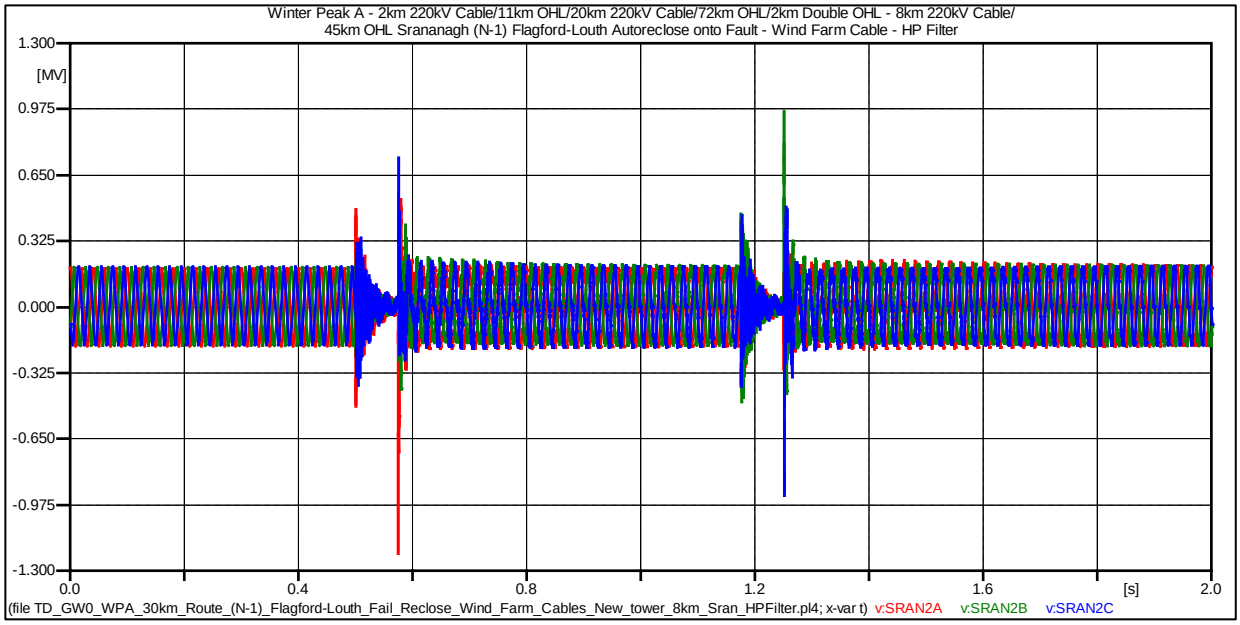

Figure 32: WPA - Length 30 km – Srananagh – (N-1) Flagford-Louth Auto Reclose onto Fault (0-2s)

Condition	Maximum Value	Limit	Result
Switching	1.271 MV (7.0776 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	240.15 kV (1.3372 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

1.6 Impedance Scans - Length 30 km – Winter Peak A – Case 4

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 4: (N-1) Flagford-Srananagh Cable/Line Out

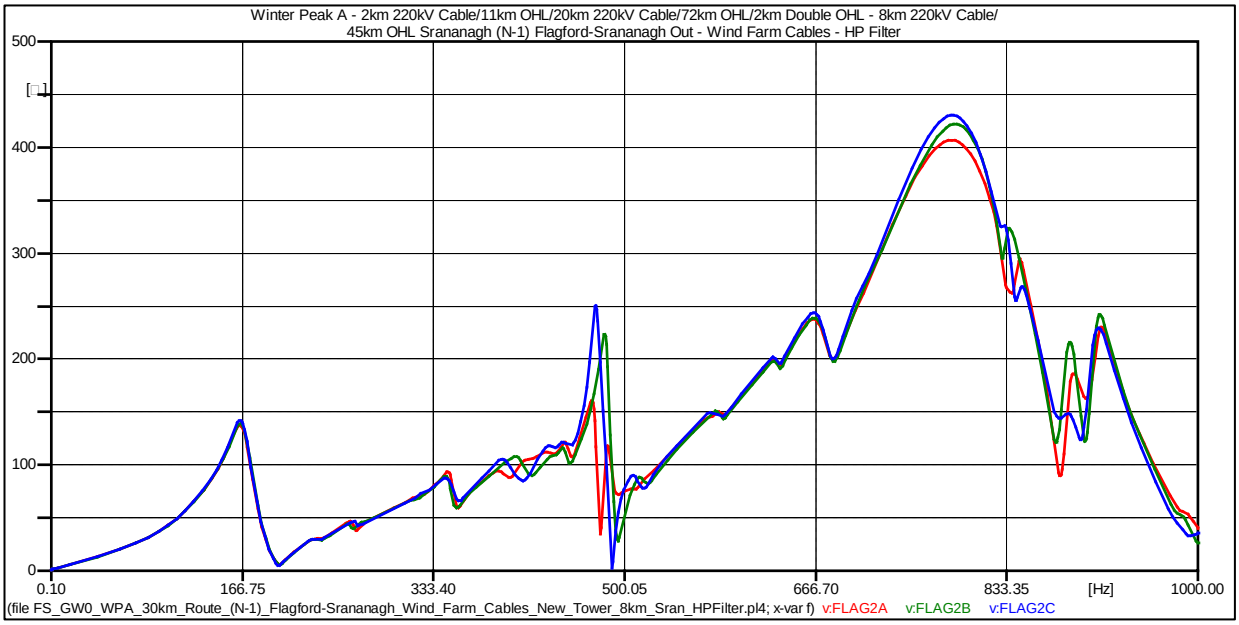

Figure 33: WPA - Length 30 km - (N-1) Flagford-Srananagh Cable/Line Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
164.80	142.11
345.70	93.36
475.00	249.90
785.20	430.31
913.90	242.07

1.7 Time Domain Simulation - Length 30 km – Winter Peak A – Case 4

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 4: (N-1) Flagford-Srananagh Line Trip

System Conditions:

1. Fault in between the 8km cable and the Flagford-Srananagh line applied at 0.5s, removed at 0.575s.

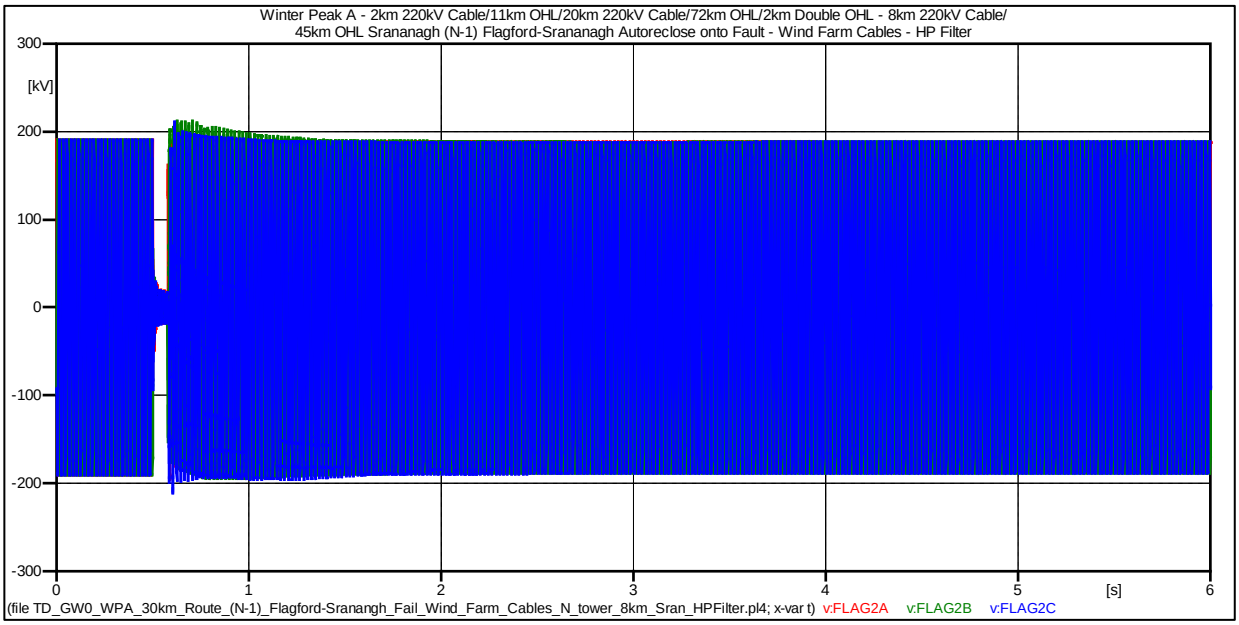

Figure 34: WPA - Length 30 km – Flagford – (N-1) Flagford-Sranangh Line Trip (0-6s)

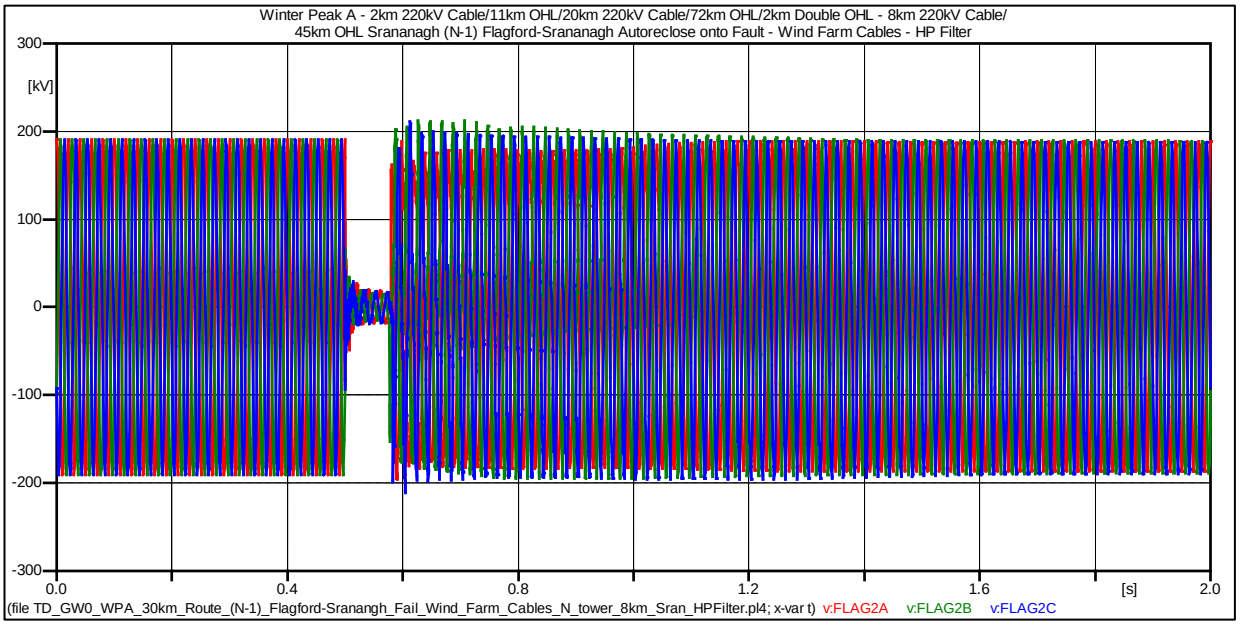

Figure 35: WPA - Length 30 km – Flagford – (N-1) Flagford-Sranangh Line Trip (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	201.59 kV (1.1225 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	210.64 kV (1.1729 pu)	287.32 kV(1.6pu)	Pass

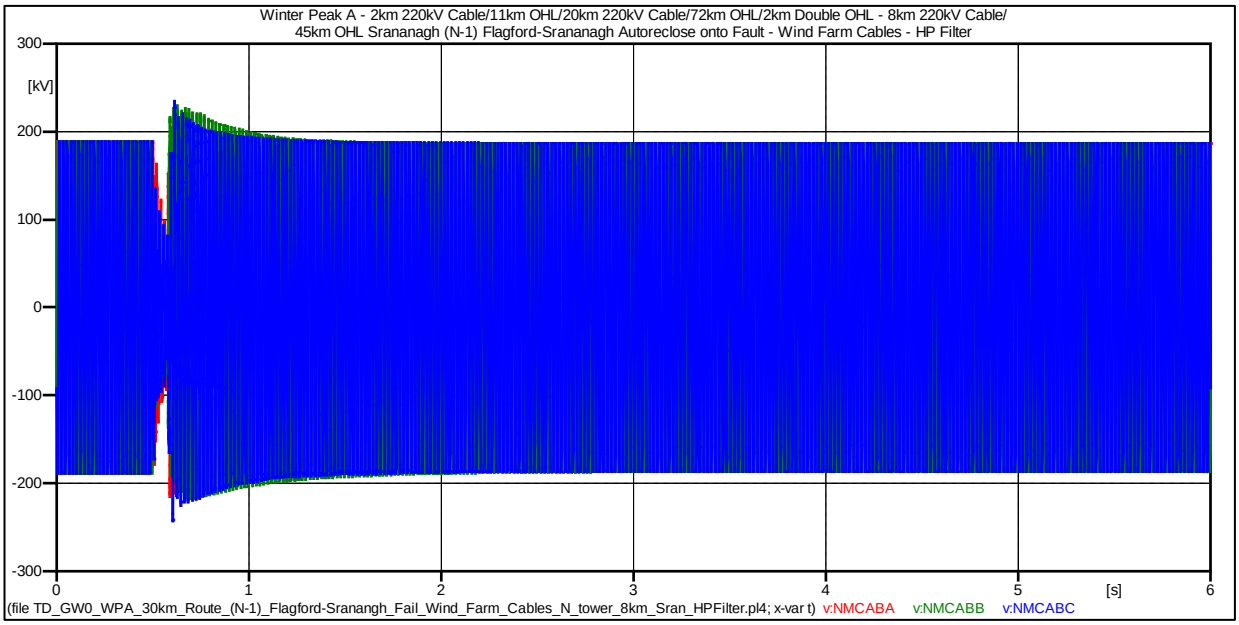

Figure 36: WPA - Length 30 km – North Mayo – (N-1) Flagford-Srananagh Line Trip (0-6s)

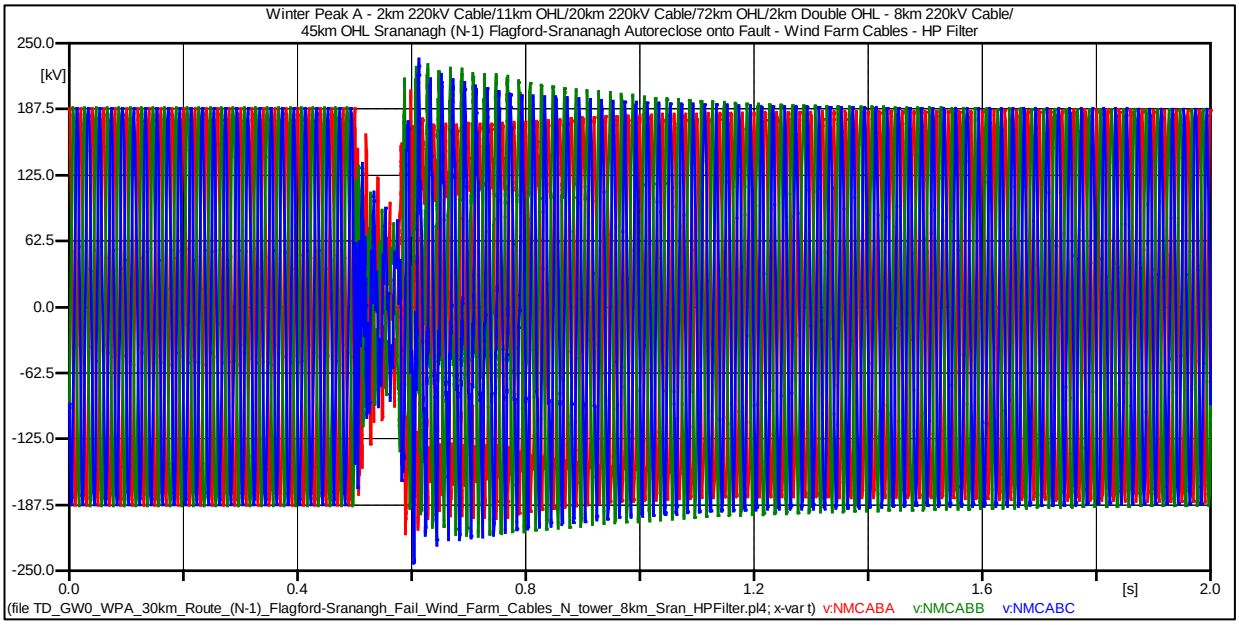

Figure 37: WPA - Length 30 km – North Mayo – (N-1) Flagford-Srananagh Line Trip (0-2s)

Condition	Maximum Value	Limit	Result
Switching	213.89 kV (1.1910 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	217.97 kV (1.2137 pu)	287.32 kV(1.6pu)	Pass

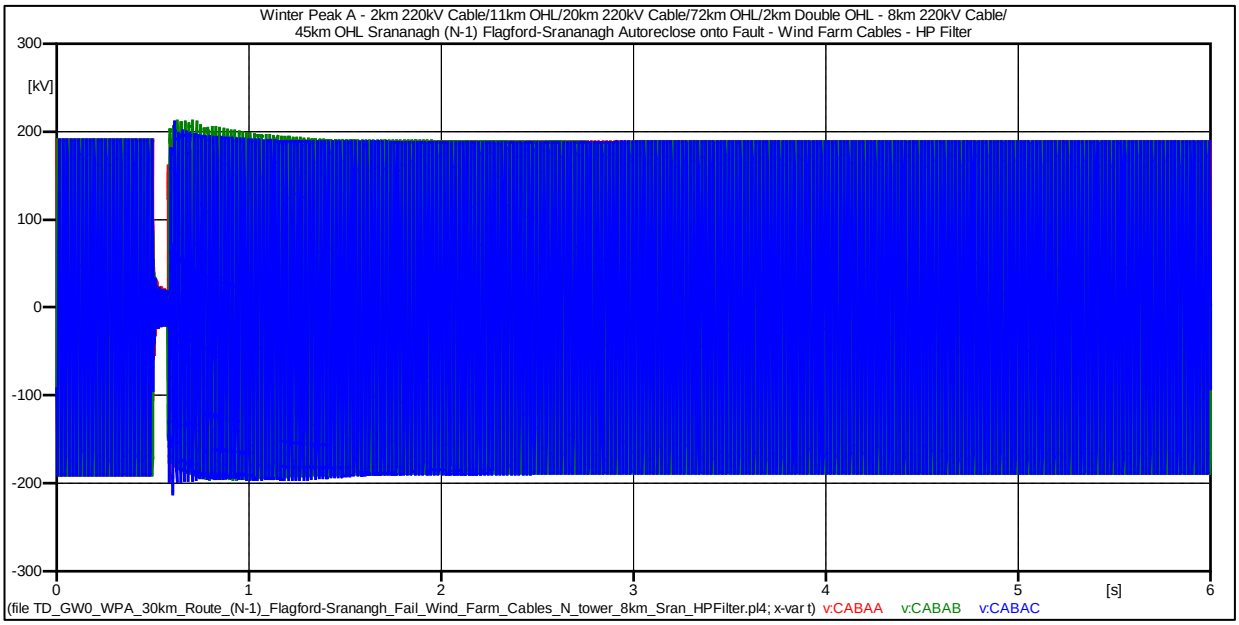

Figure 38: WPA - Length 30 km – Cable End A – (N-1) Flagford-Srananagh Line Trip (0-6s)

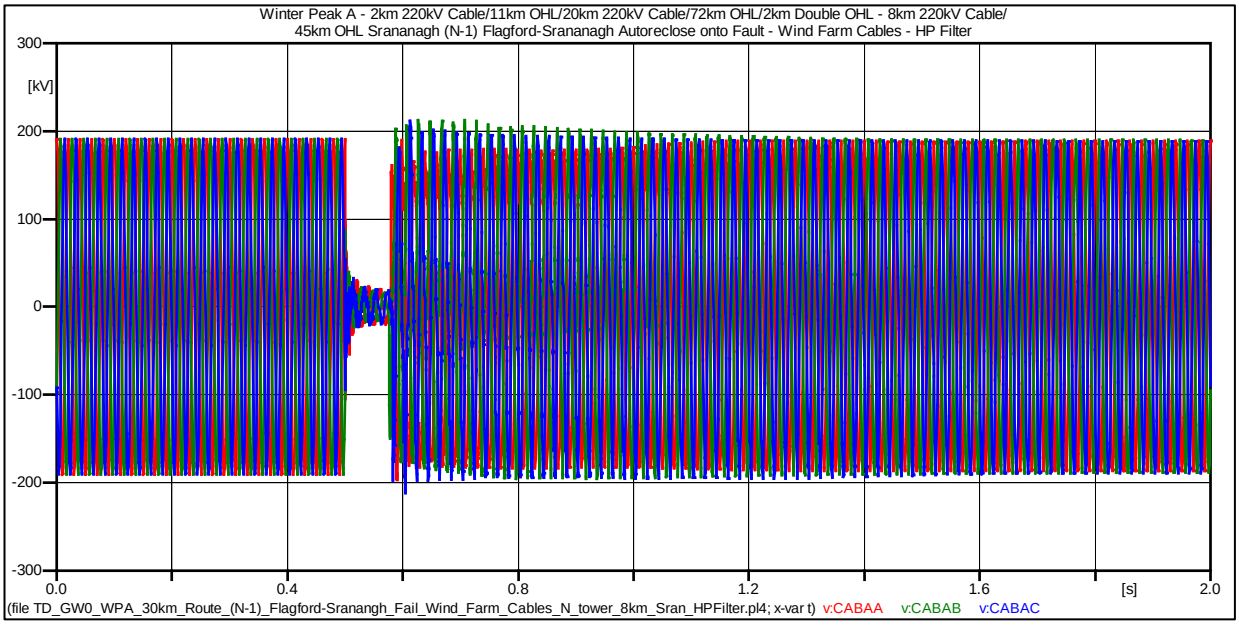

Figure 39: WPA - Length 30 km – Cable End A – (N-1) Flagford-Srananagh Line Trip (0-2s)

Condition	Maximum Value	Limit	Result
Switching	208.12 kV (1.1589 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	210.58 kV (1.1726 pu)	287.32 kV(1.6pu)	Pass

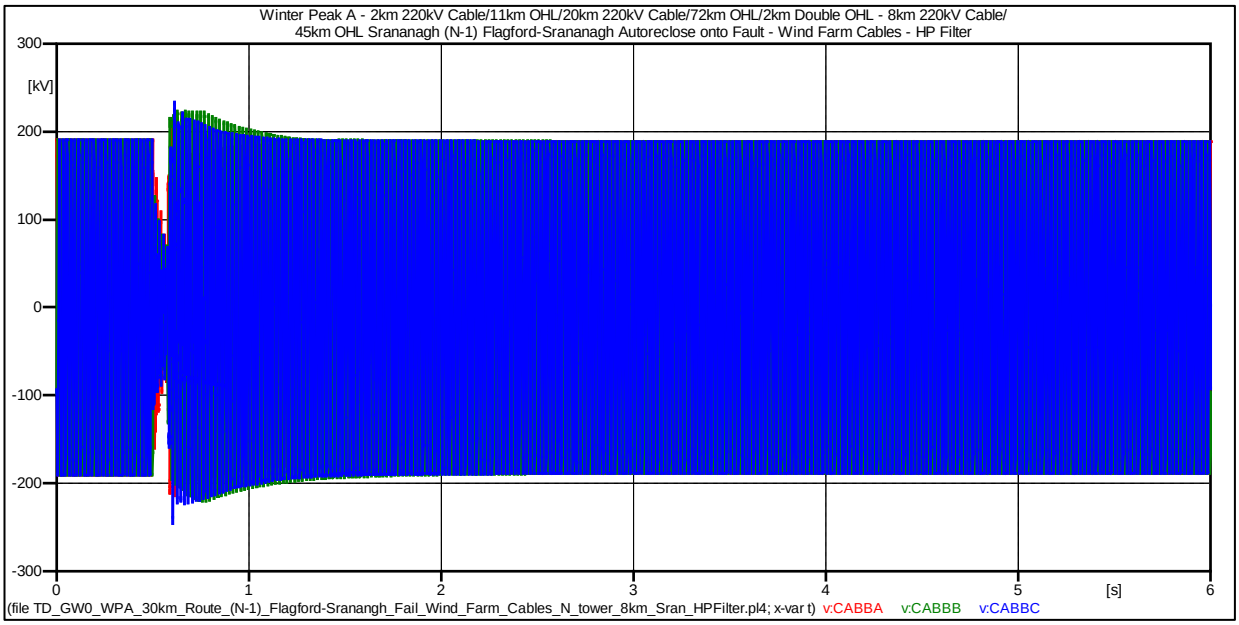

Figure 40: WPA - Length 30 km – Cable End B – (N-1) Flagford-Srananagh Line Trip (0-6s)

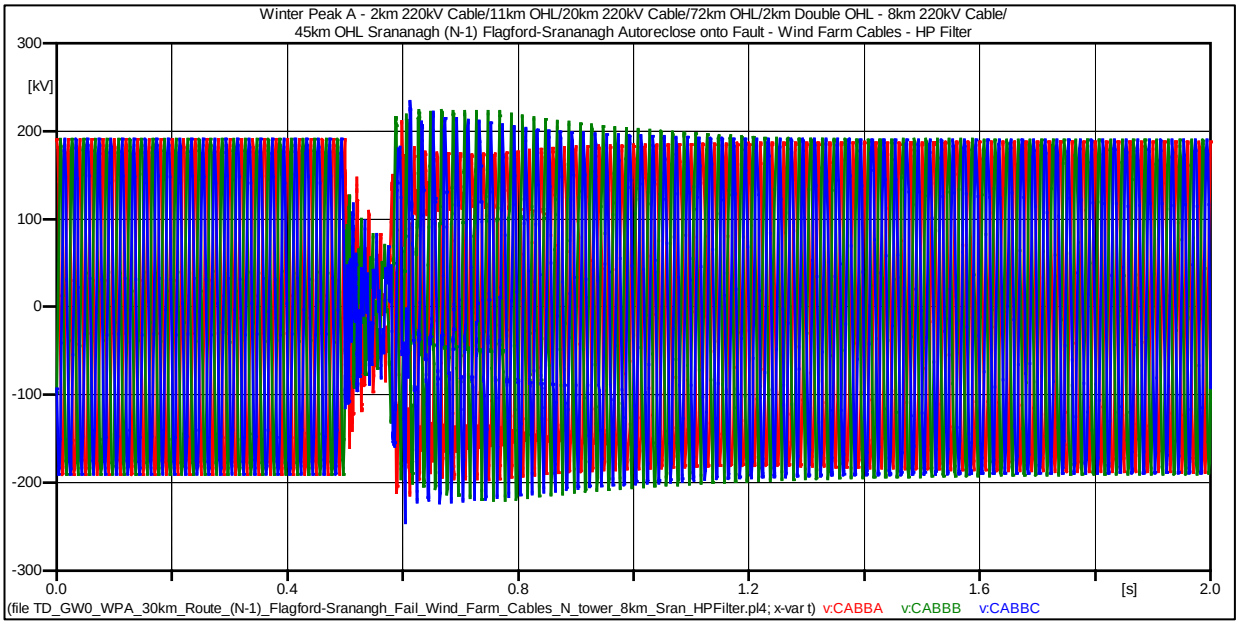

Figure 41: - Length 30 km – Cable End B – (N-1) Flagford-Srananagh Line Trip (0-2s)

Condition	Maximum Value	Limit	Result
Switching	245.66 kV (1.3679 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	217.33 kV (1.2102 pu)	287.32 kV(1.6pu)	Pass

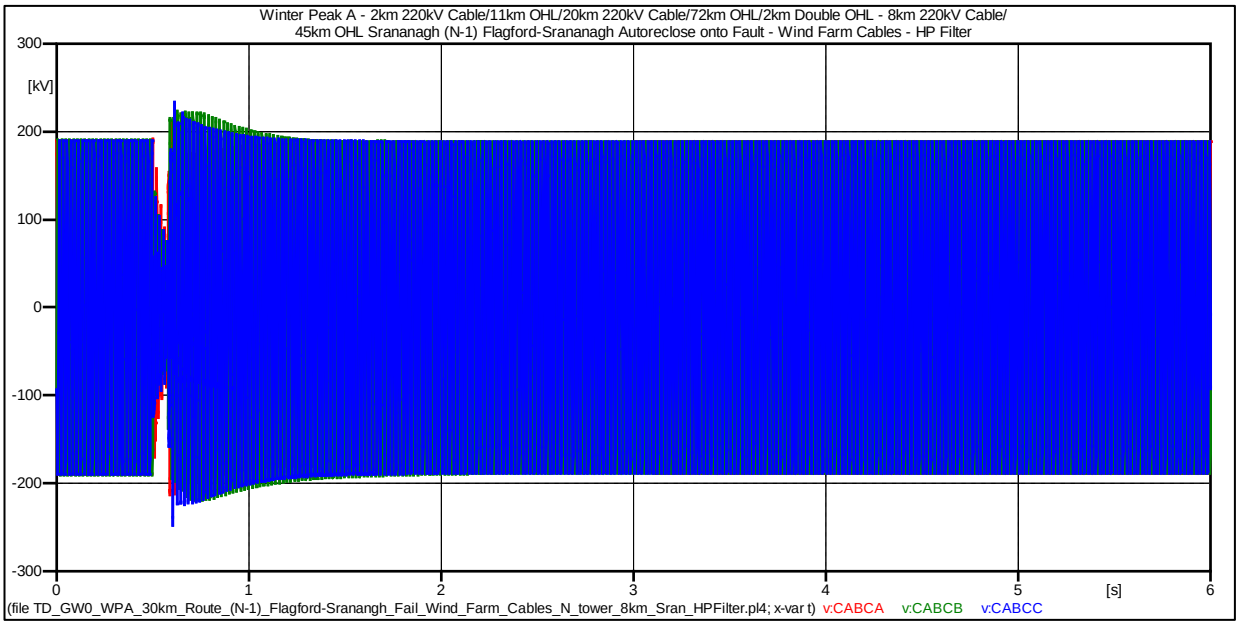

Figure 42: WPA - Length 30 km – Cable End C – (N-1) Flagford-Srananagh Line Trip (0-6s)

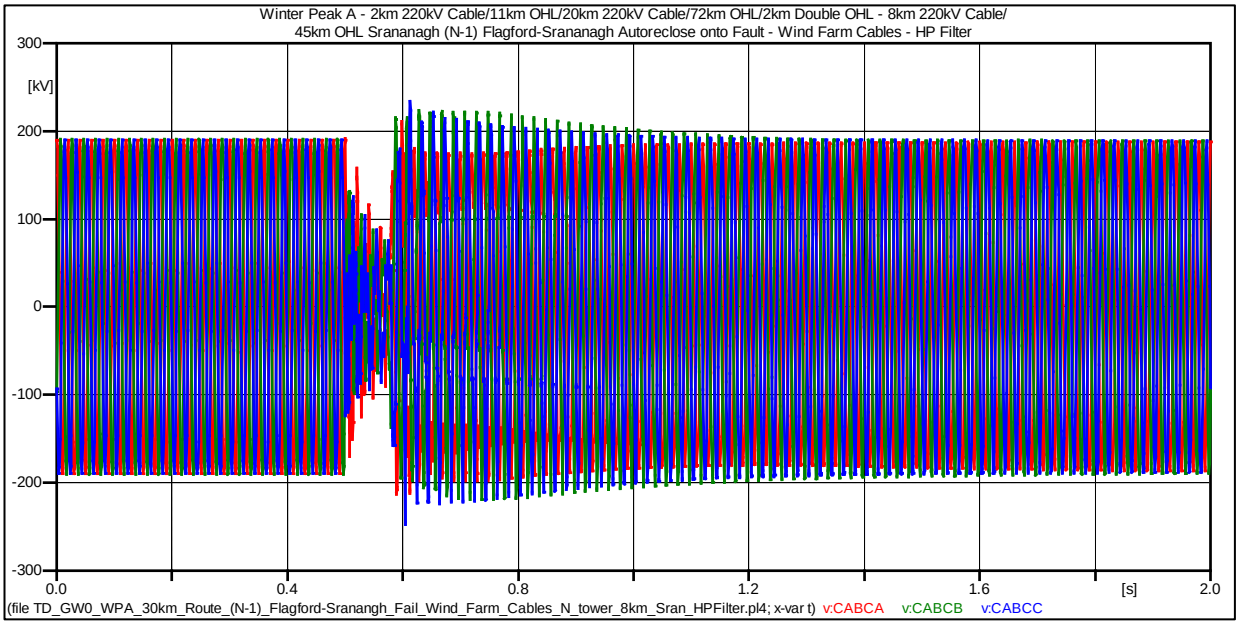

Figure 43: WPA - Length 30 km – Cable End C – (N-1) Flagford-Srananagh Line Trip (0-2s)

Condition	Maximum Value	Limit	Result
Switching	243.87 kV (1.3580 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	214.92 kV (1.1967 pu)	287.32 kV(1.6pu)	Pass

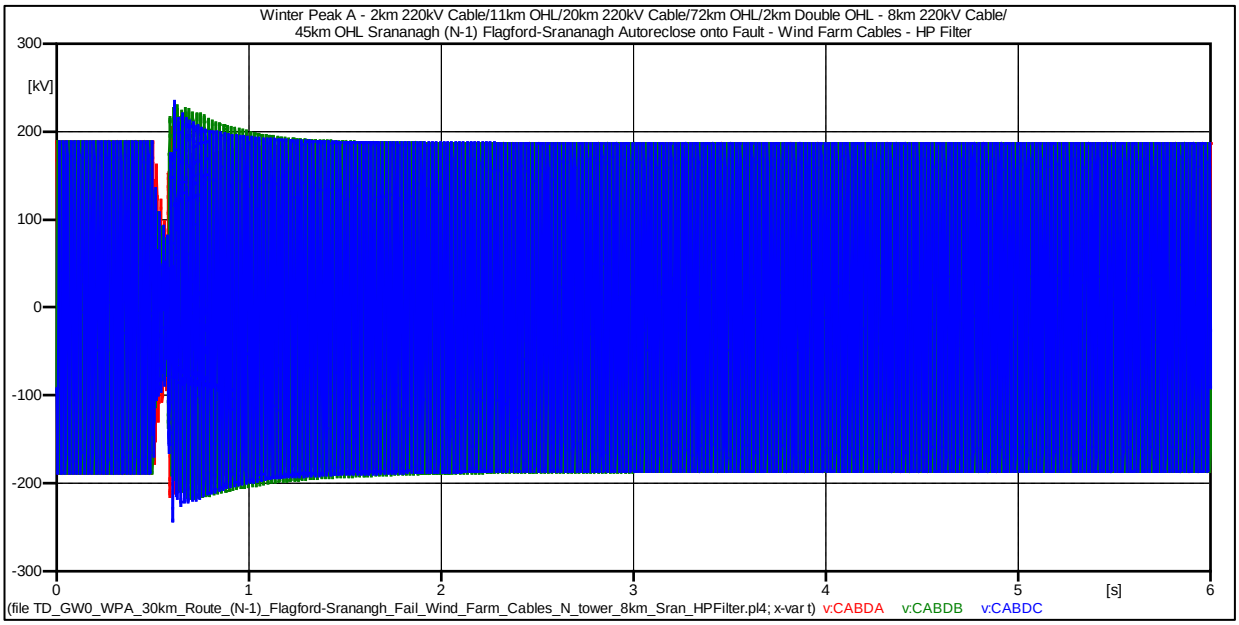

Figure 44: WPA - Length 30 km – Cable End D – (N-1) Flagford-Sranangh Line Trip (0-6s)

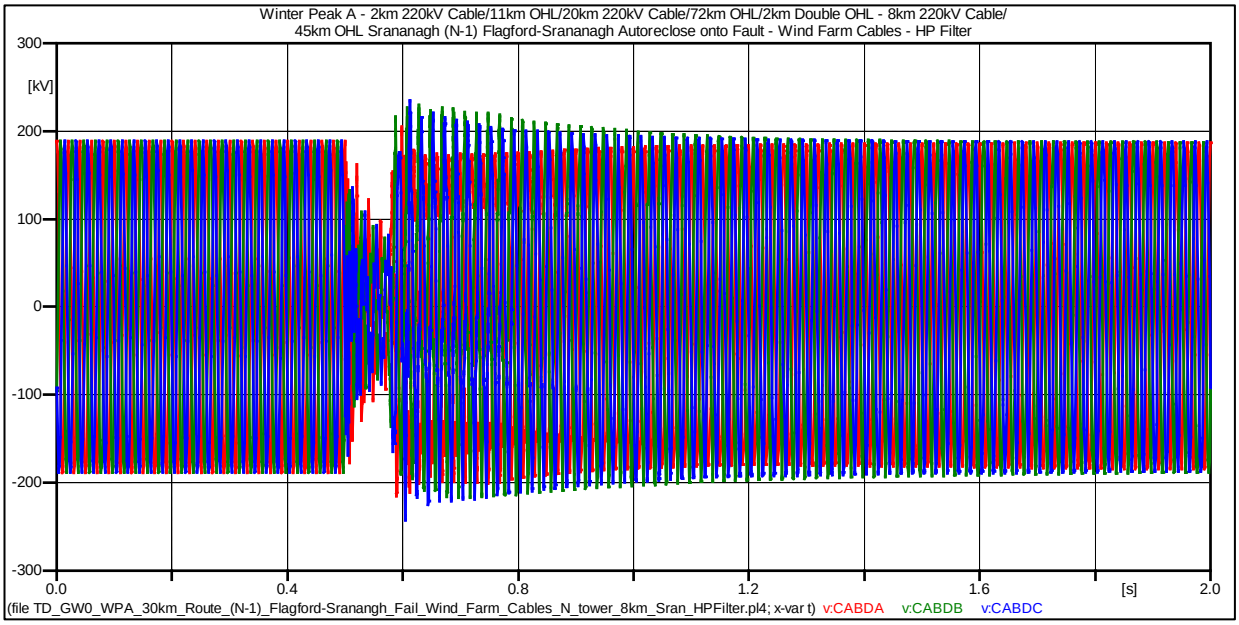

Figure 45: WPA - Length 30 km – Cable End D – (N-1) Flagford-Sranangh Line Trip (0-2s)

Condition	Maximum Value	Limit	Result
Switching	242.37 kV (1.3496 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	223.33 kV (1.2436 pu)	287.32 kV(1.6pu)	Pass

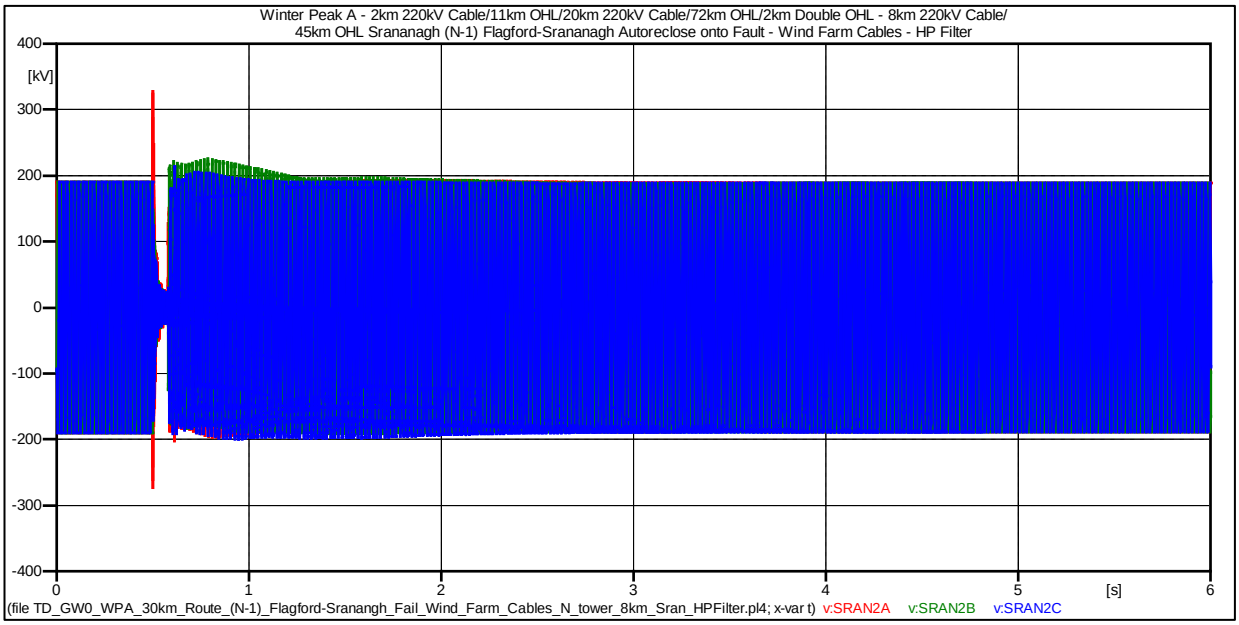

Figure 46: WPA - Length 30 km – Srananagh – (N-1) Flagford-Srananagh Line Trip (0-6s)

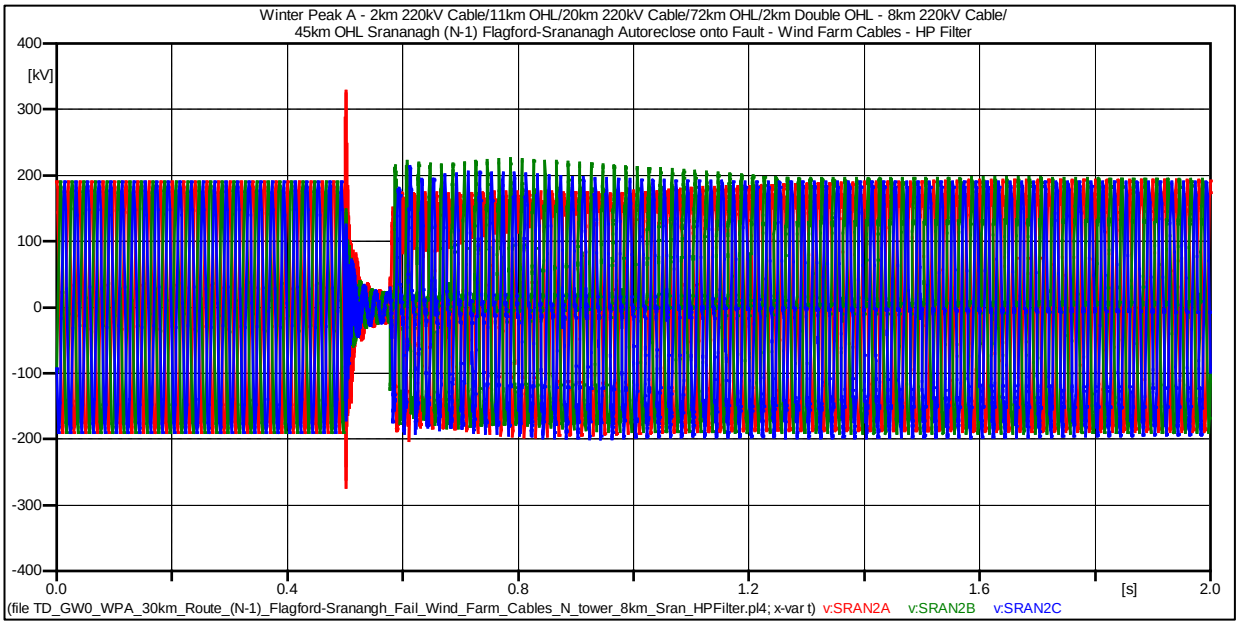

Figure 47: WPA - Length 30 km – Srananagh – (N-1) Flagford-Srananagh Line Trip (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	327.10 kV (1.8217 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	186.27 kV (1.037 pu)	287.32 kV(1.6pu)	Pass

1.8 Impedance Scans - Length 30 km – Winter Peak A – Case 5

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 5: (N-1) Trip Grid West Cable

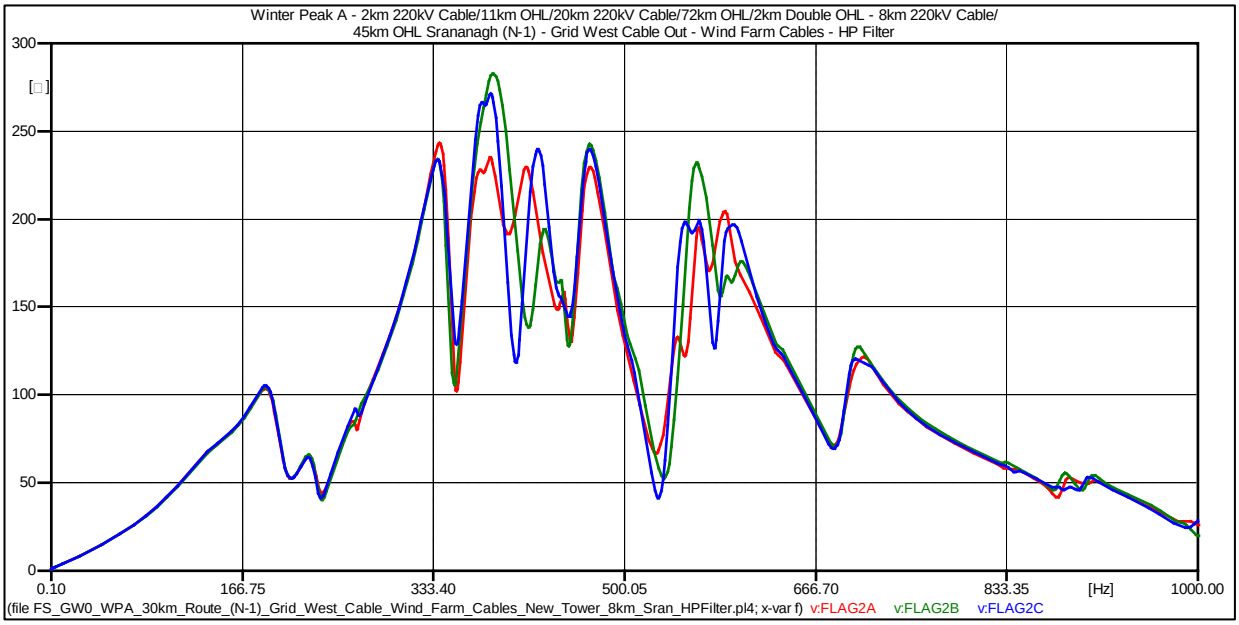

Figure 48: WPA - Length 30 km - (N-1) Trip Grid West Cable

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
186.70	105.21
384.10	282.06
469.60	242.58
562.60	231.87
704.50	127.35

1.9 Time Domain Simulation - Length 30 km – Winter Peak A – Case 5

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 5: (N-1) Trip Grid West Cable

System Conditions:

1. Fault on CABC side of Grid West Cable, applied at 0.5s, cable tripped at 0.575s.

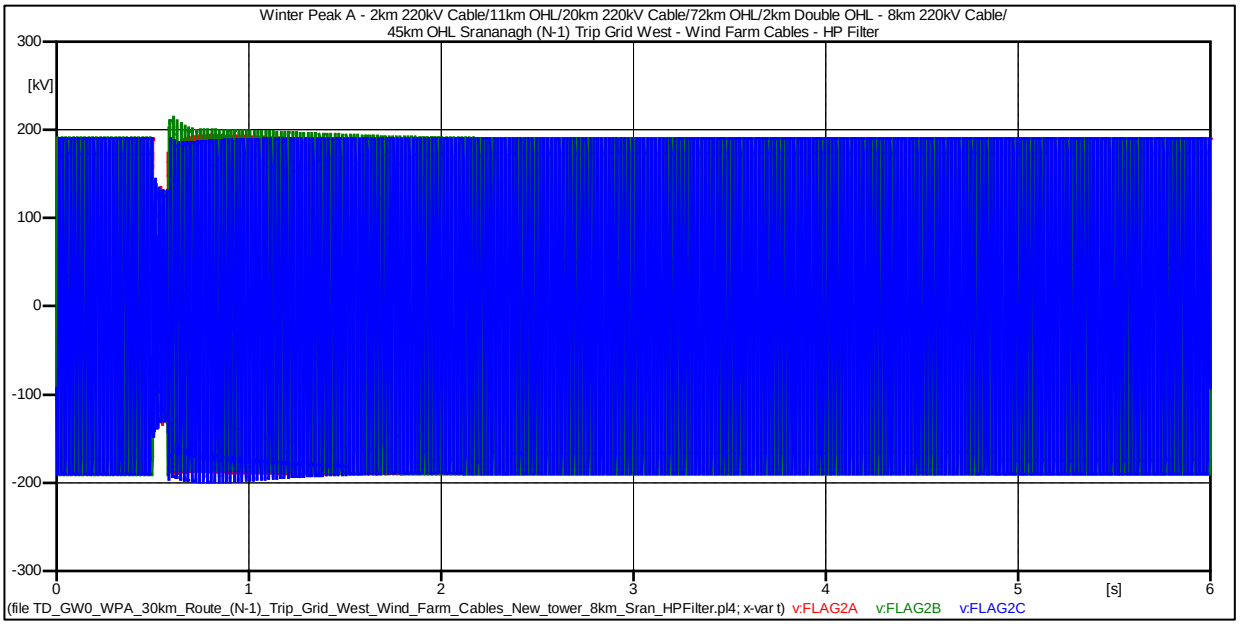

Figure 49: WPA - Length 30 km – Flagford – (N-1) Trip Grid West Cable (0-6s)

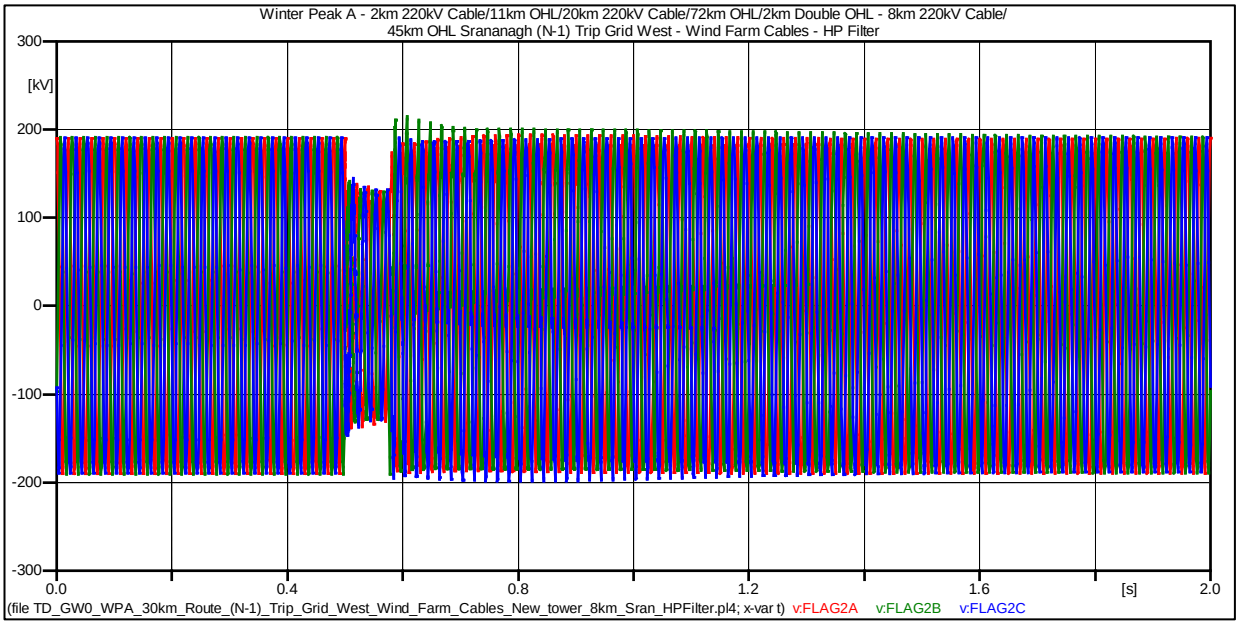

Figure 50: WPA - Length 30 km – Flagford – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	N/A	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	214.23 kV (1.1929 pu)	287.32 kV(1.6pu)	Pass

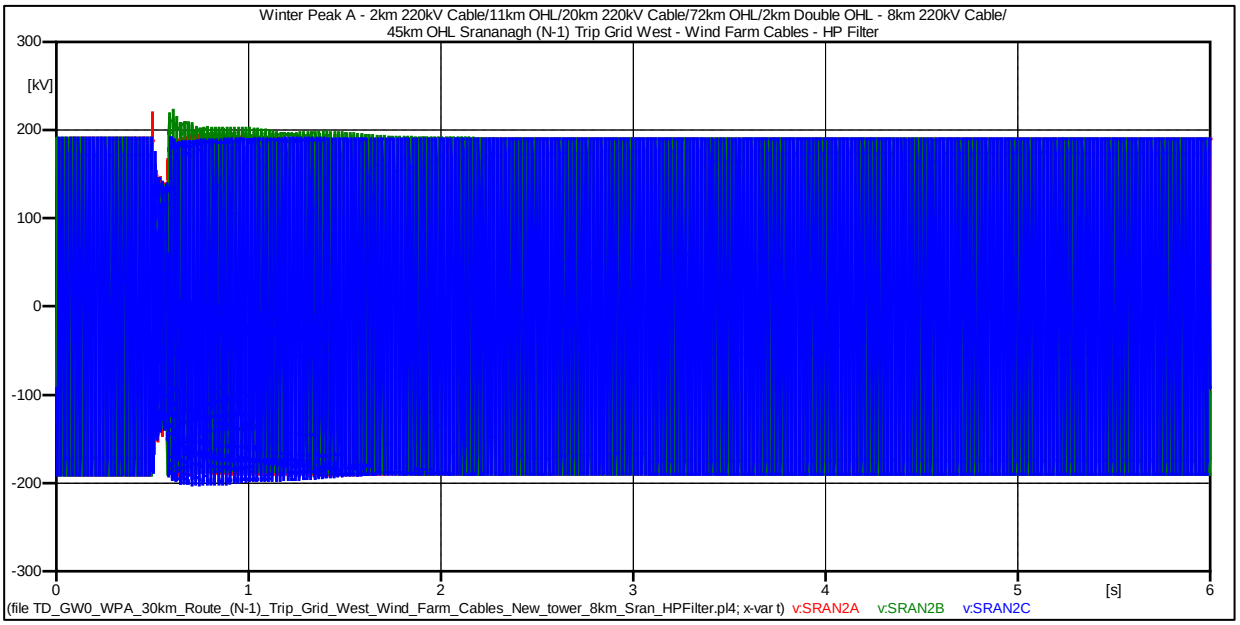

Figure 51: WPA - Length 30 km – Srananagh – (N-1) Trip Grid West Cable (0-6s)

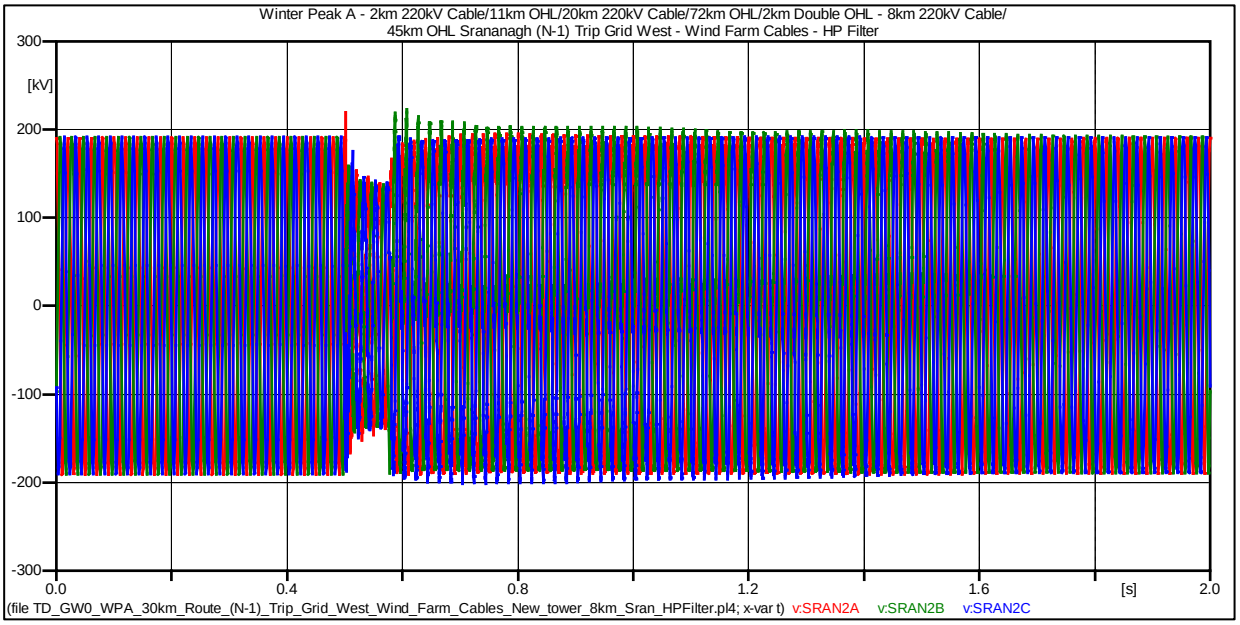

Figure 52: WPA - Length 30 km – Srananagh – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	217.23 kV (1.2096 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	218.78 kV (1.2182 pu)	287.32 kV(1.6pu)	Pass

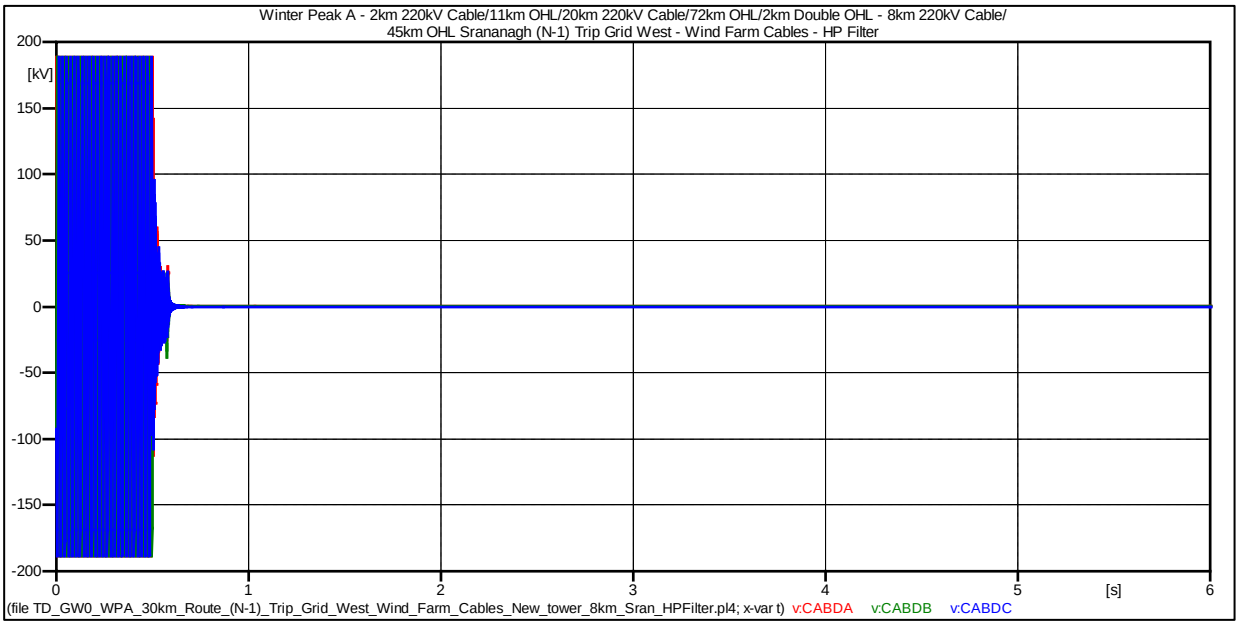

Figure 53: WPA - Length 30 km – Cable End D – (N-1) Trip Grid West Cable (0-6s)

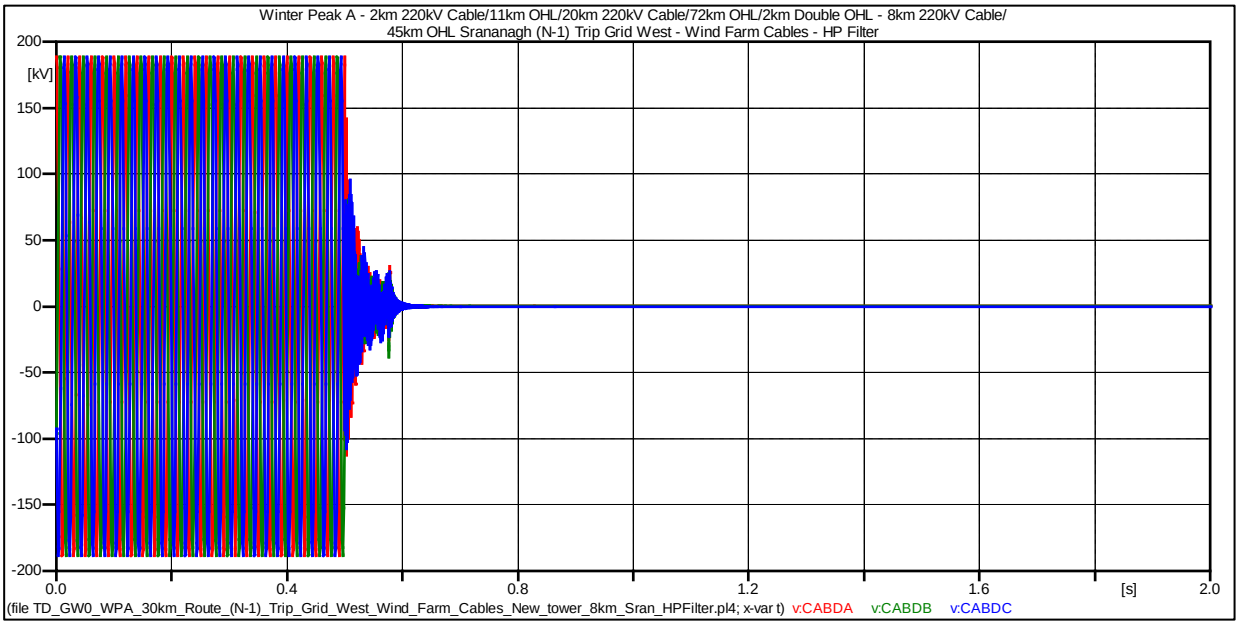

Figure 54: WPA - Length 30 km – Cable End D – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	N/A	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

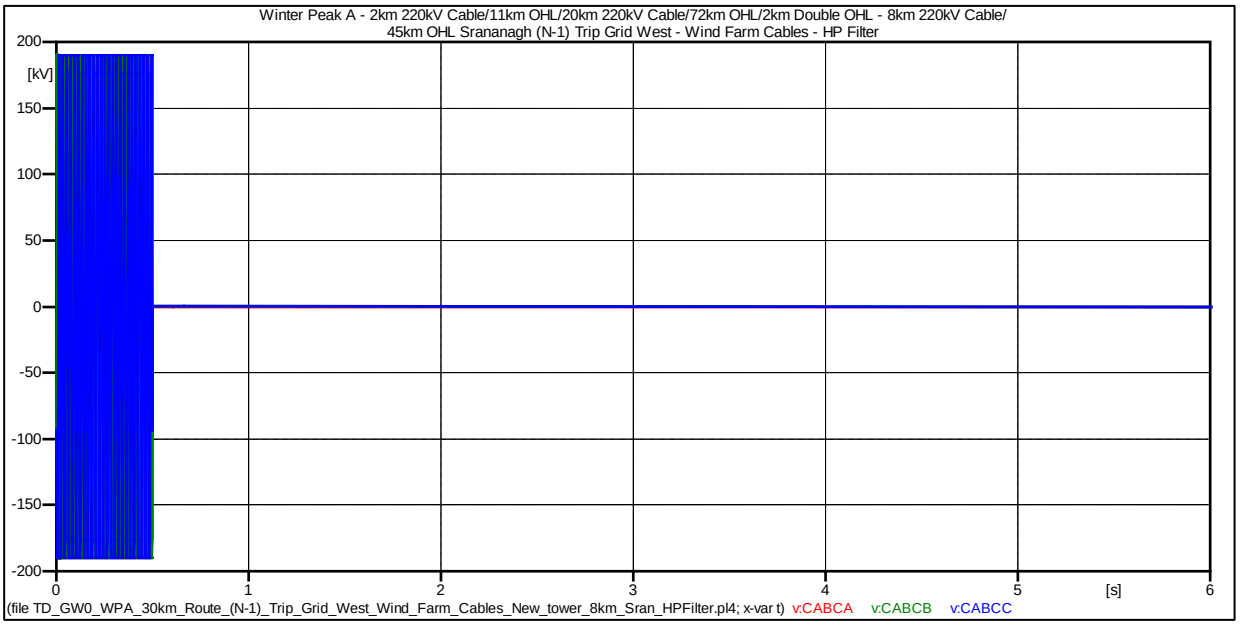

Figure 55: WPA - Length 30 km – Cable End C – (N-1) Trip Grid West Cable (0-6s)

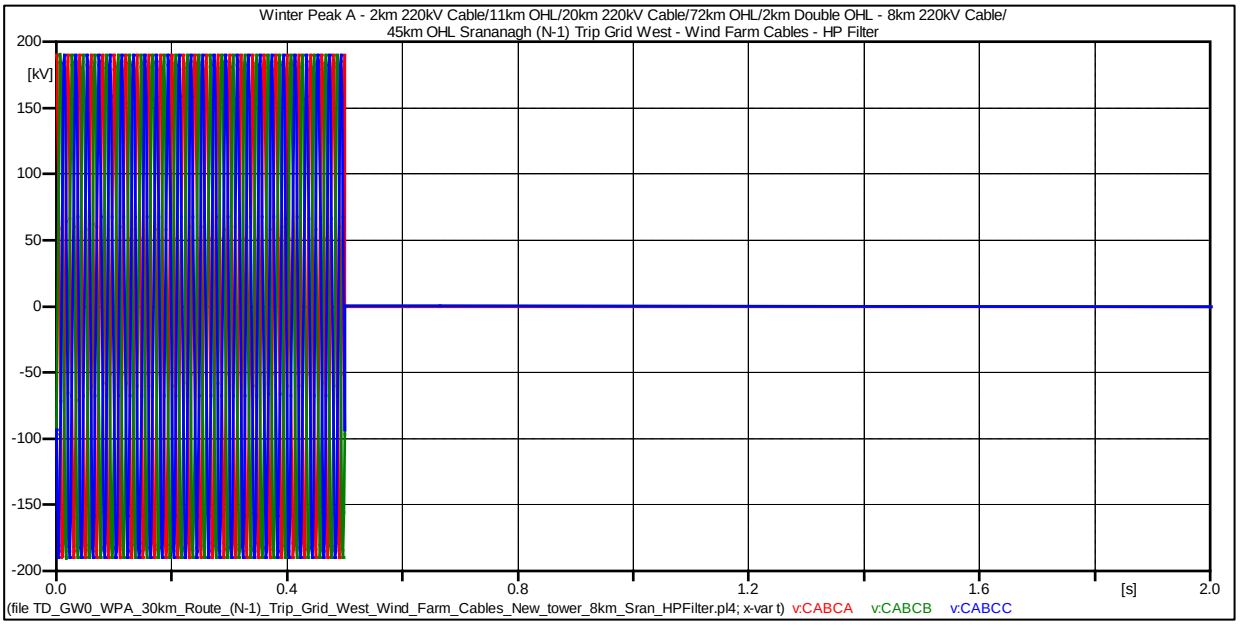

Figure 56: WPA - Length 30 km – Cable End C – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	N/A	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

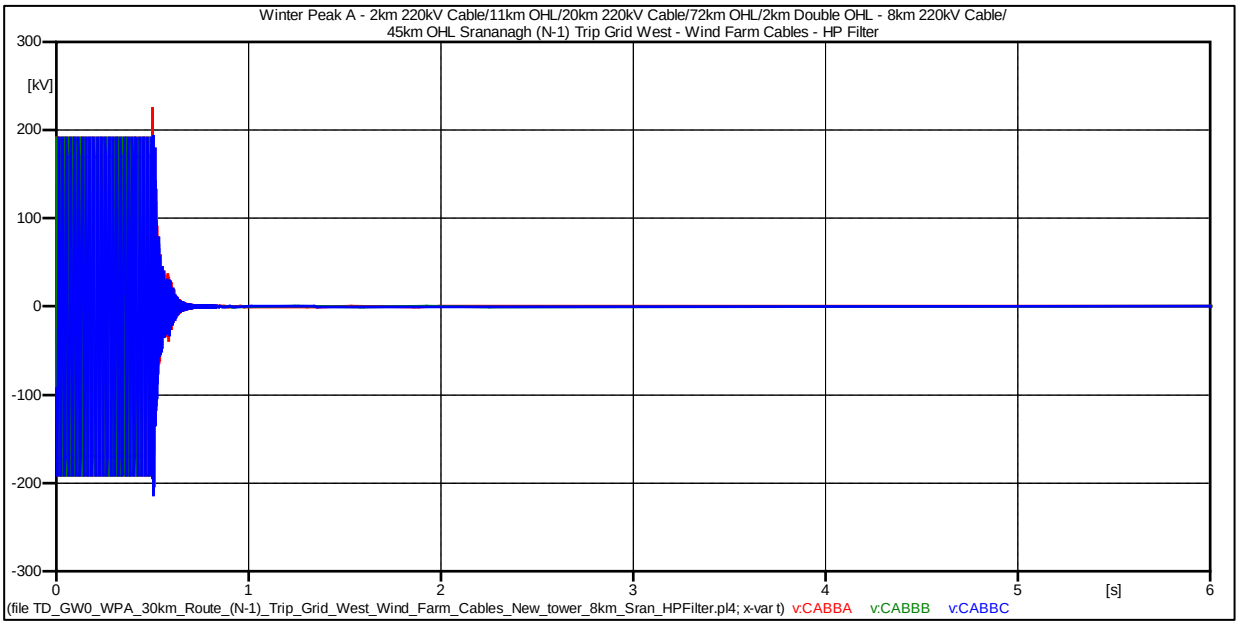

Figure 57: WPA - Length 30 km – Cable End B – (N-1) Trip Grid West Cable (0-6s)

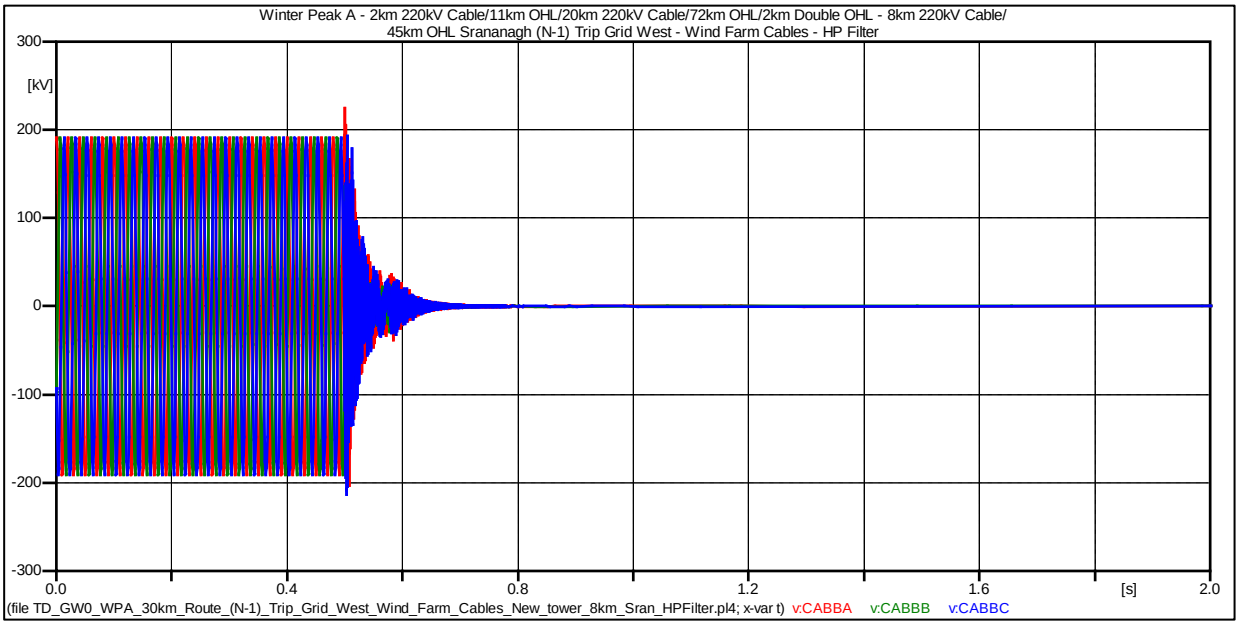

Figure 58: WPA - Length 30 km – Cable End B – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	224.56 kV (1.2504 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

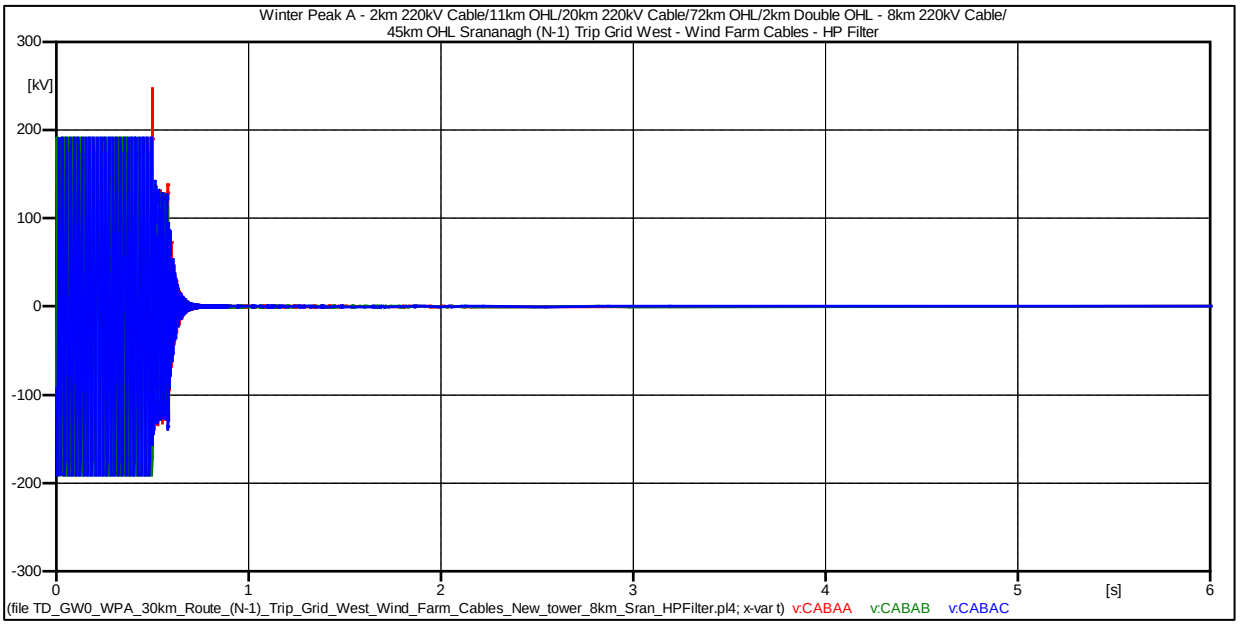

Figure 59: WPA - Length 30 km – Cable End A – (N-1) Trip Grid West Cable (0-6s)

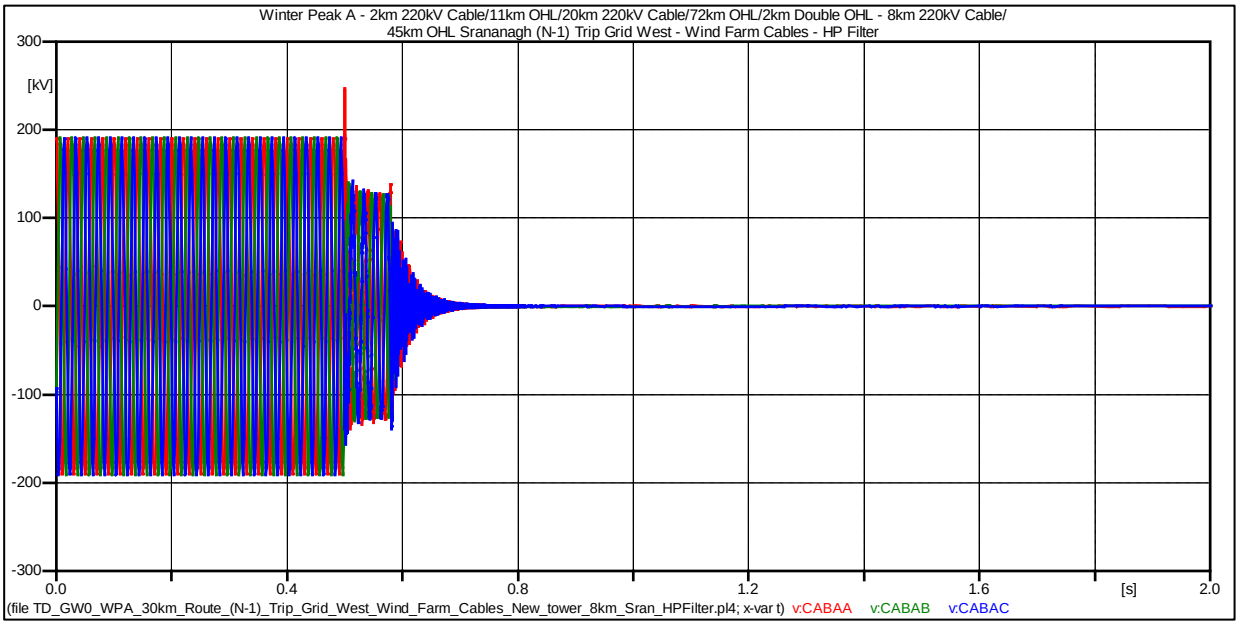

Figure 60: WPA - Length 30 km – Cable End A – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	247.89 kV (1.3803 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

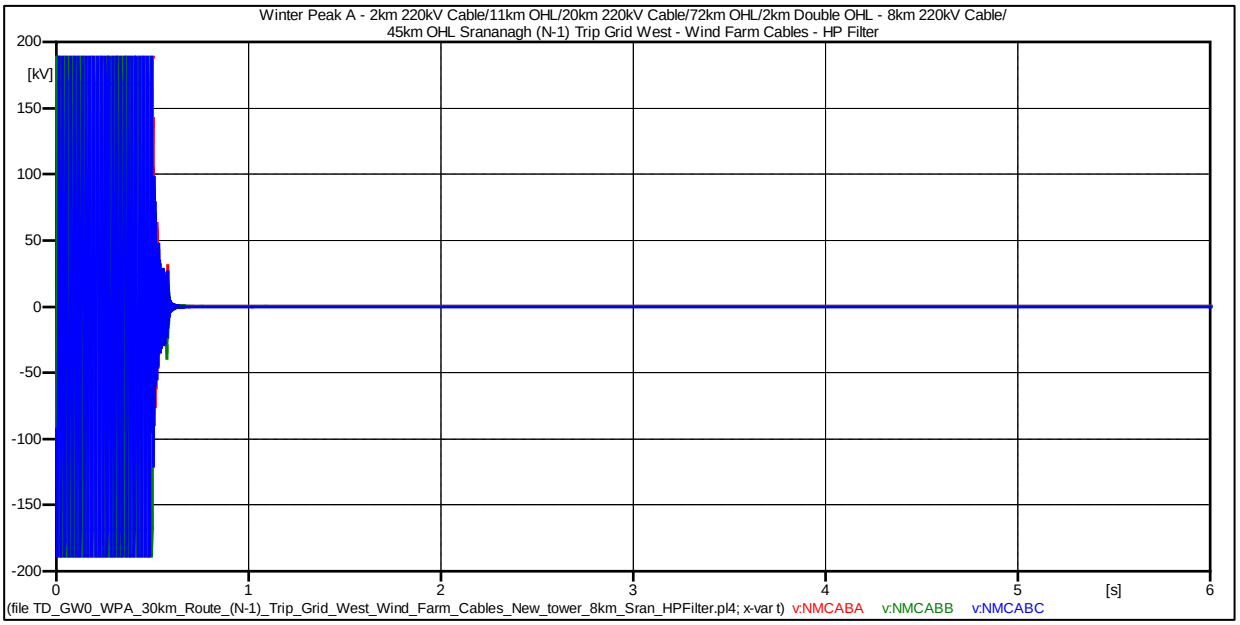

Figure 61: WPA - Length 30 km – Cable End North Mayo – (N-1) Trip Grid West Cable (0-6s)

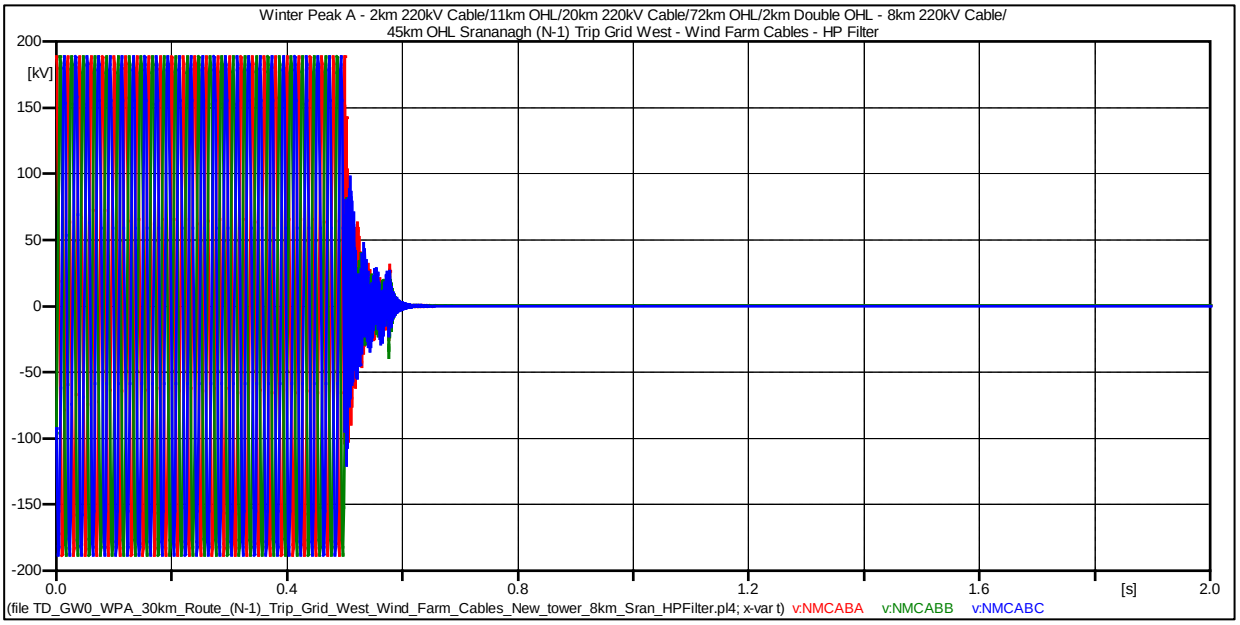

Figure 62: WPA - Length 30 km – Cable End North Mayo – (N-1) Trip Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	N/A	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

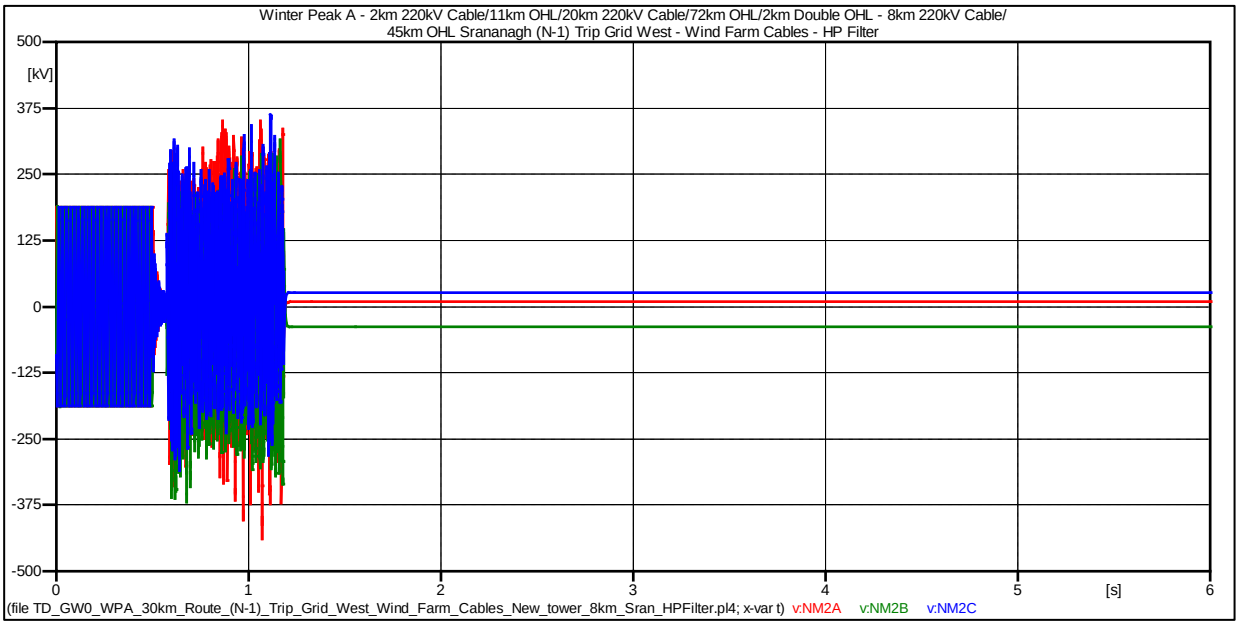

Figure 63: WPA - Length 30 km – North Mayo – (N-1) Trip Grid West Cable (0-6s)

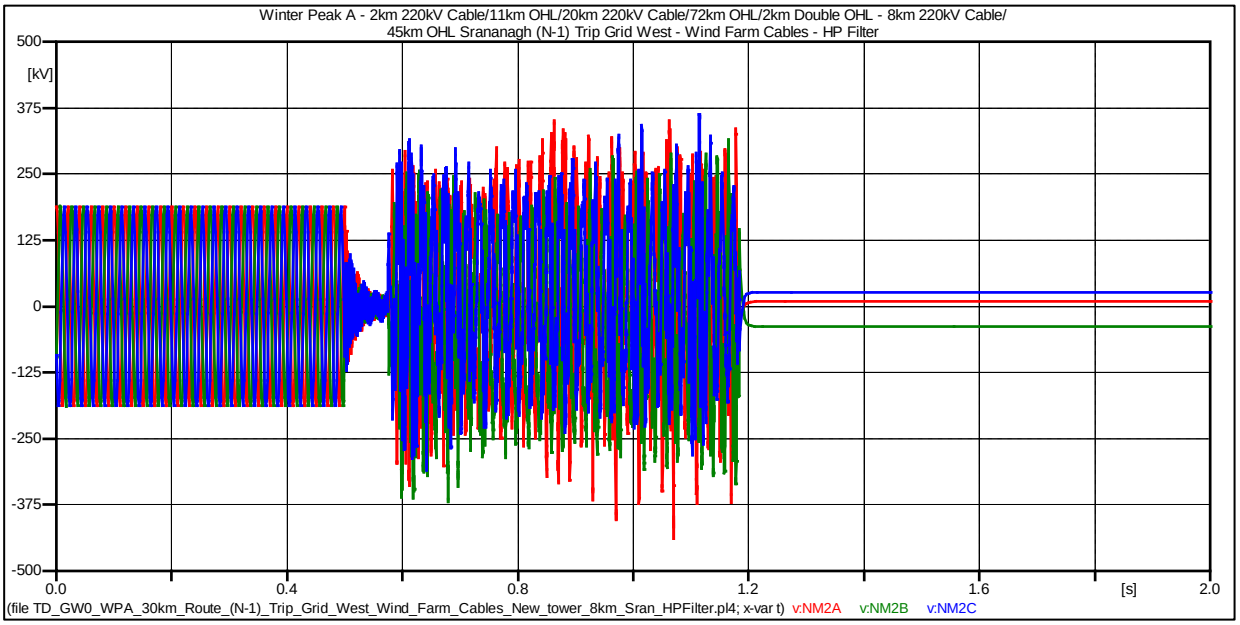

Figure 64: WPA - Length 30 km – North Mayo – (N-1) Trip Grid West Cable (0-2s)

The above transients are produced by the unloaded transformer. In a practical scenario, wind farms would trip on islanding or overvoltage protection. Therefore, this has been simulated by opening a circuit breaker at North Mayo after 500 ms.

1.10 Impedance Scans - Length 30 km – Winter Peak A – Case 6

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit – 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 6: (N-2) Cashla-Flagford/Flagford-Louth Lines Out

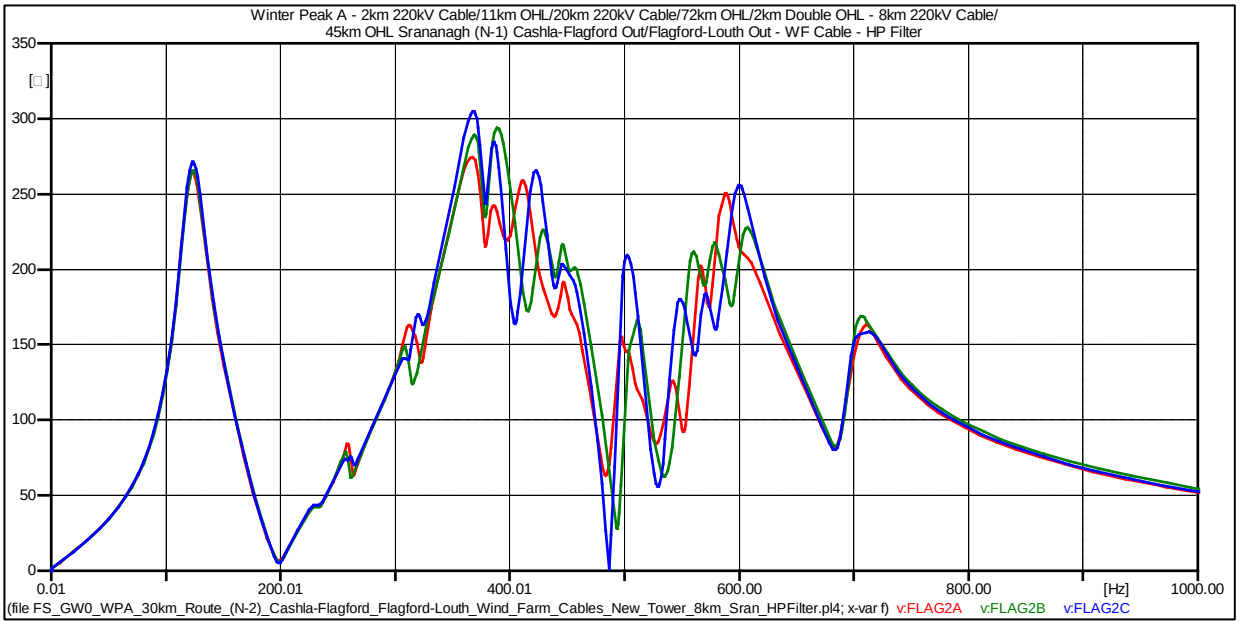

Figure 65: WPA - Length 30 km - (N-2) Cashla-Flagford/Flagford-Louth Lines Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
123.91	271.12
369.91	303.12
502.21	209.25
601.81	254.91
709.21	167.69

1.11 Time Domain Simulation - Length 30 km – Winter Peak A – Case 6

Conditions for time domain simulation:

1. Winter Peak Network A
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29uF, 372mH, 500 Ω

Case 6: (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Lines Out

System Conditions:

1. The Flagford – Louth 220 kV line is on an outage. Fault applied 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.

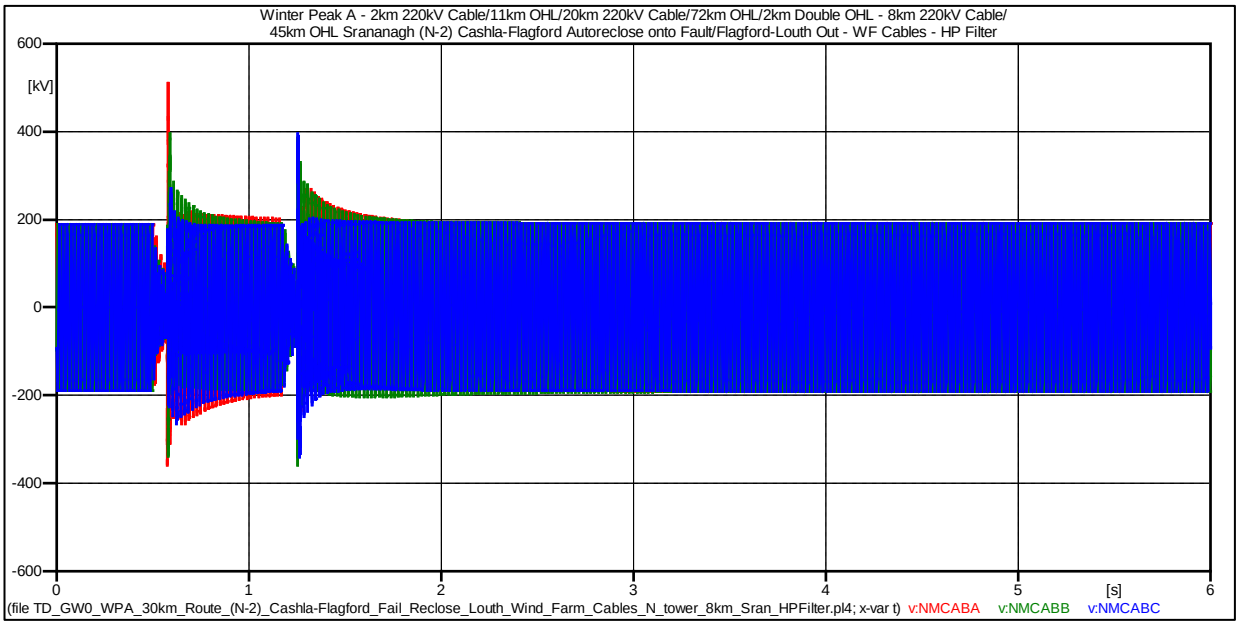

Figure 66: WPA - Length 30 km – North Mayo – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

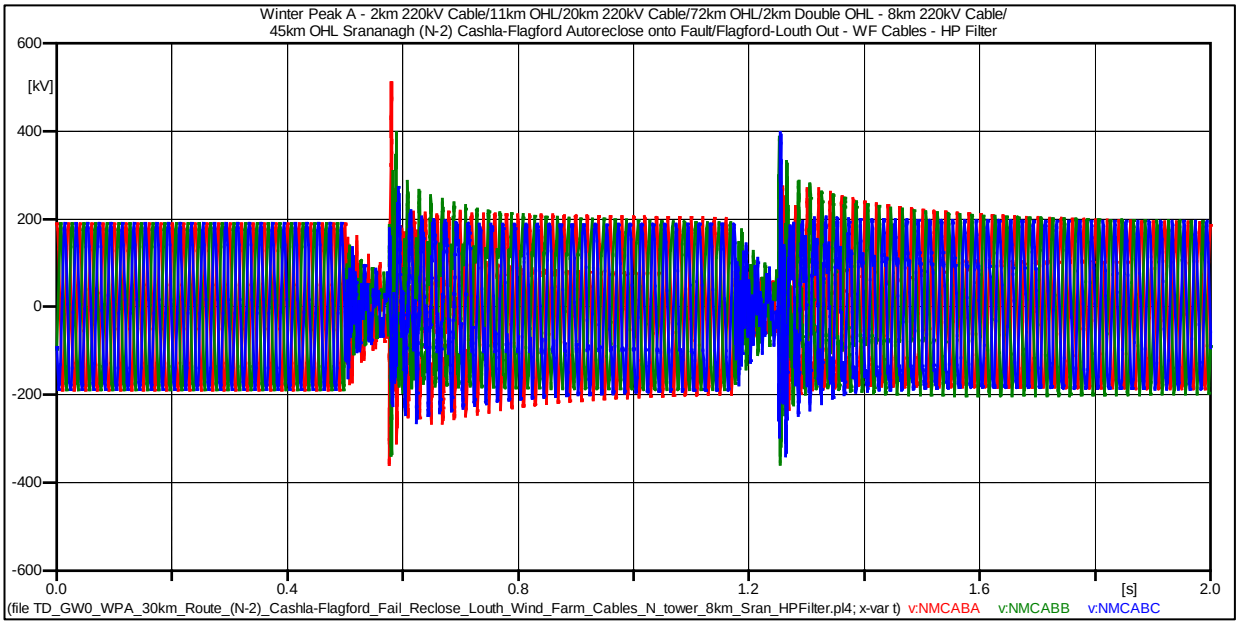

Figure 67: WPA - Length 30 km – North Mayo – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	487.69 kV (2.7157 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	270.97 kV (1.5089 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

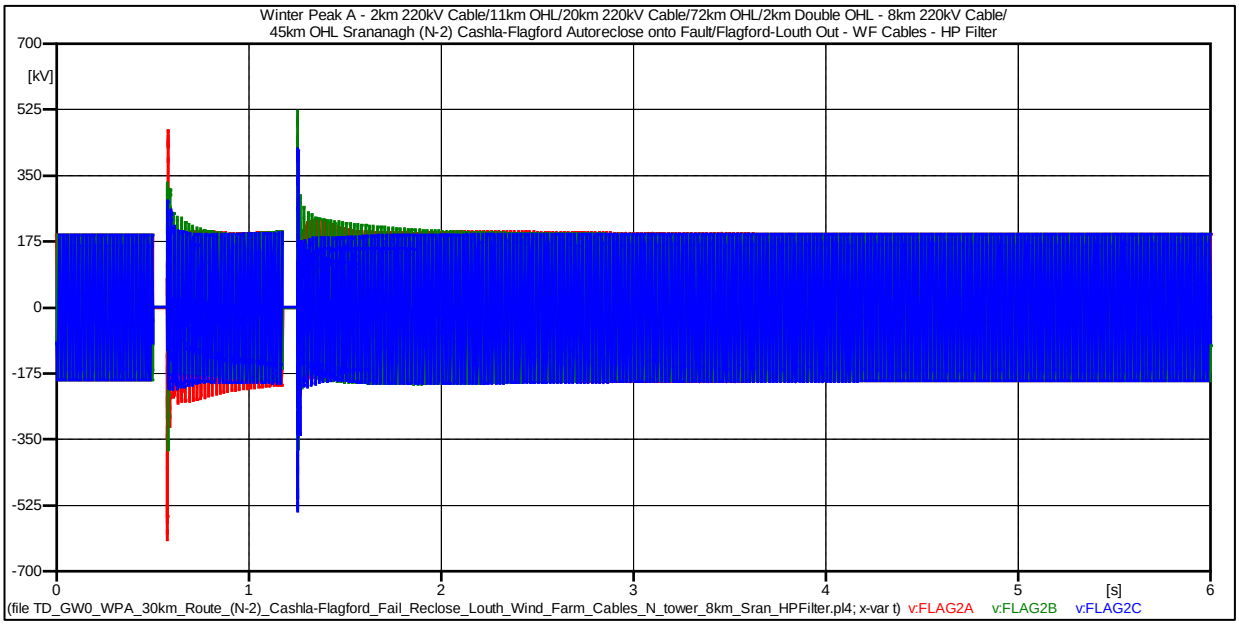

Figure 68: WPA - Length 30 km – Flagford – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

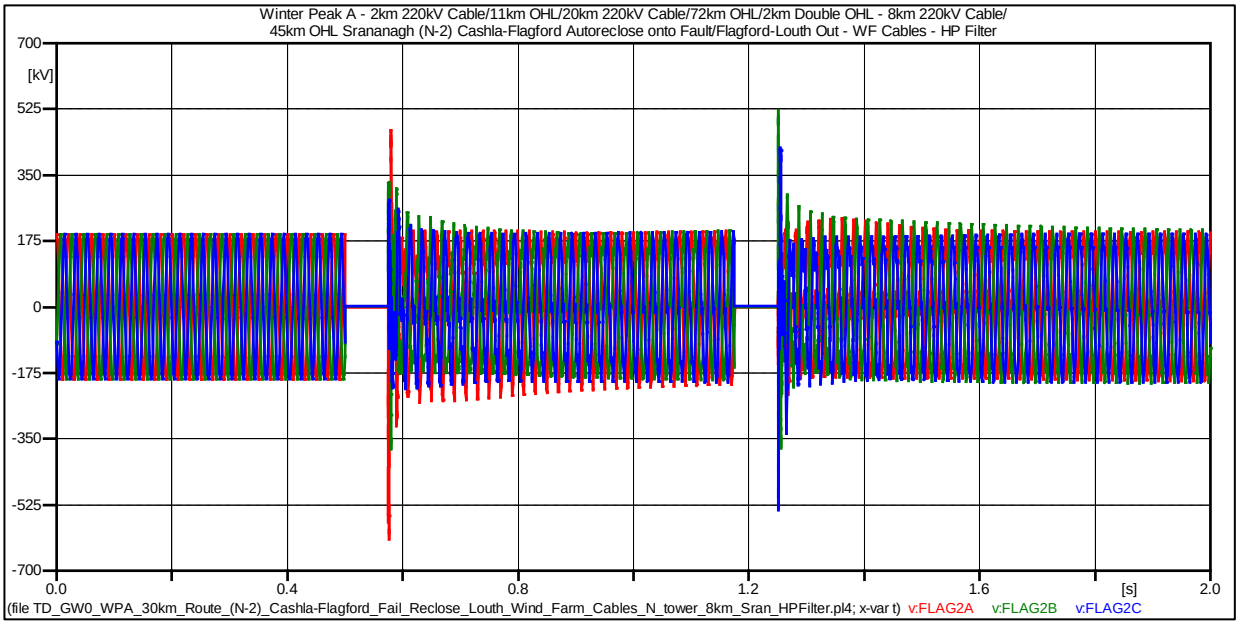

Figure 69: WPA - Length 30 km – Flagford – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	329.99 kV (1.8375 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	259.22 kV (1.4434 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

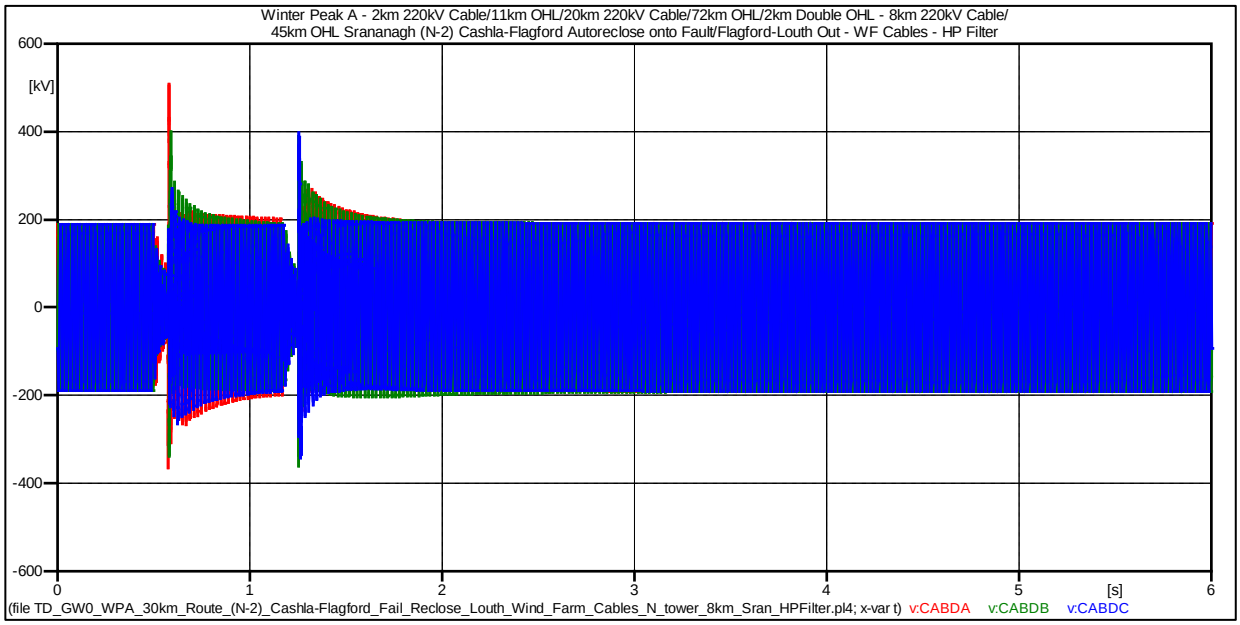

Figure 70: WPA - Length 30 km – Cable Mid-Point D – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

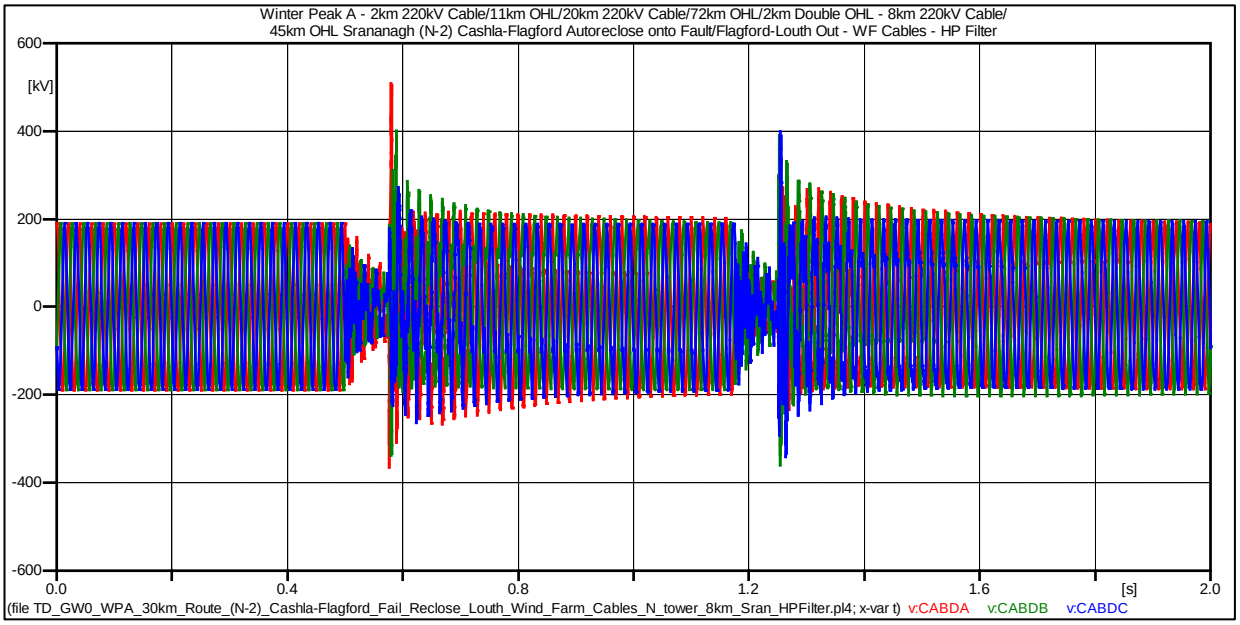

Figure 71: WPA - Length 30 km – Cable Mid-Point D – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	500.12 kV (2.7849 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	266.64 kV (1.4847 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

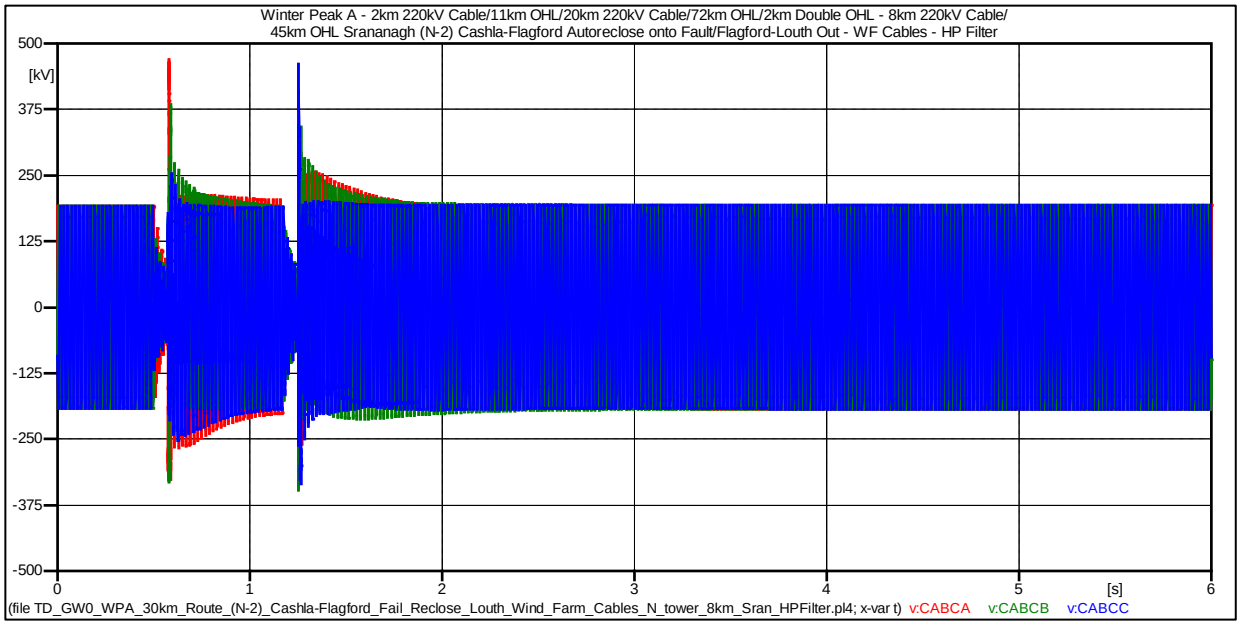

Figure 72: WPA - Length 30 km – Cable Mid-Point C – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

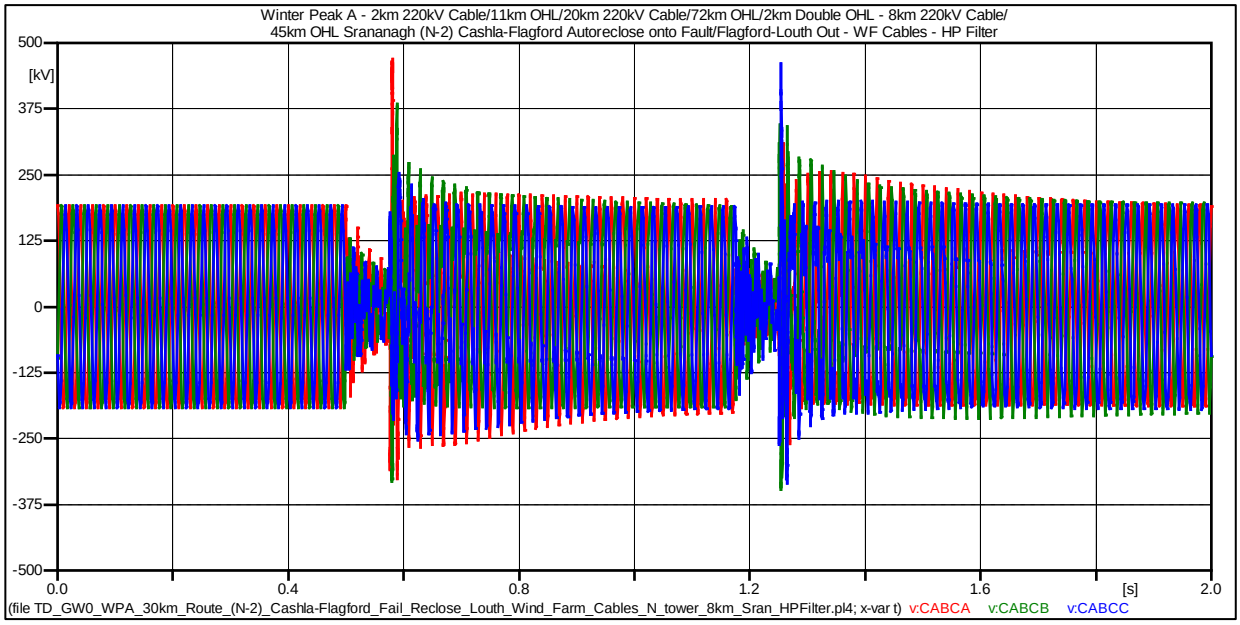

Figure 73: WPA - Length 30 km – Cable Mid-Point C – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	456.04 kV (2.5349 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	274.75 kV (1.5299 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

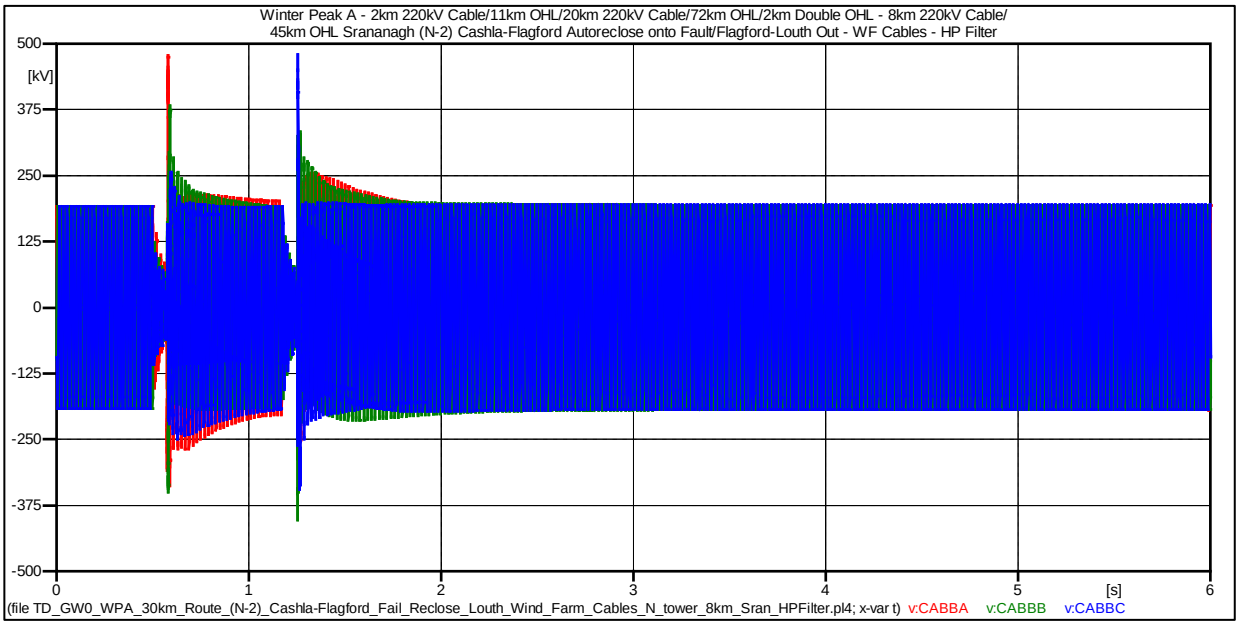

Figure 74: WPA - Length 30 km – Cable Mid-Point B – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

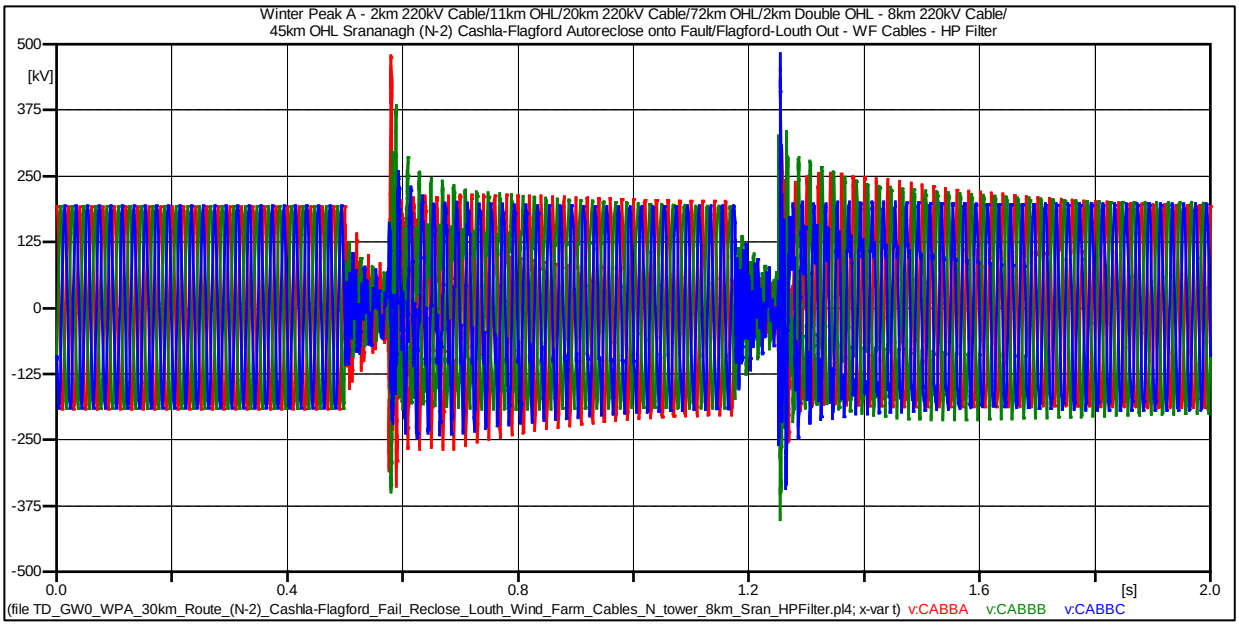

Figure 75: WPA - Length 30 km – Cable Mid-Point B – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	493.40 kV (2.7469 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	277.64 kV (1.5460 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

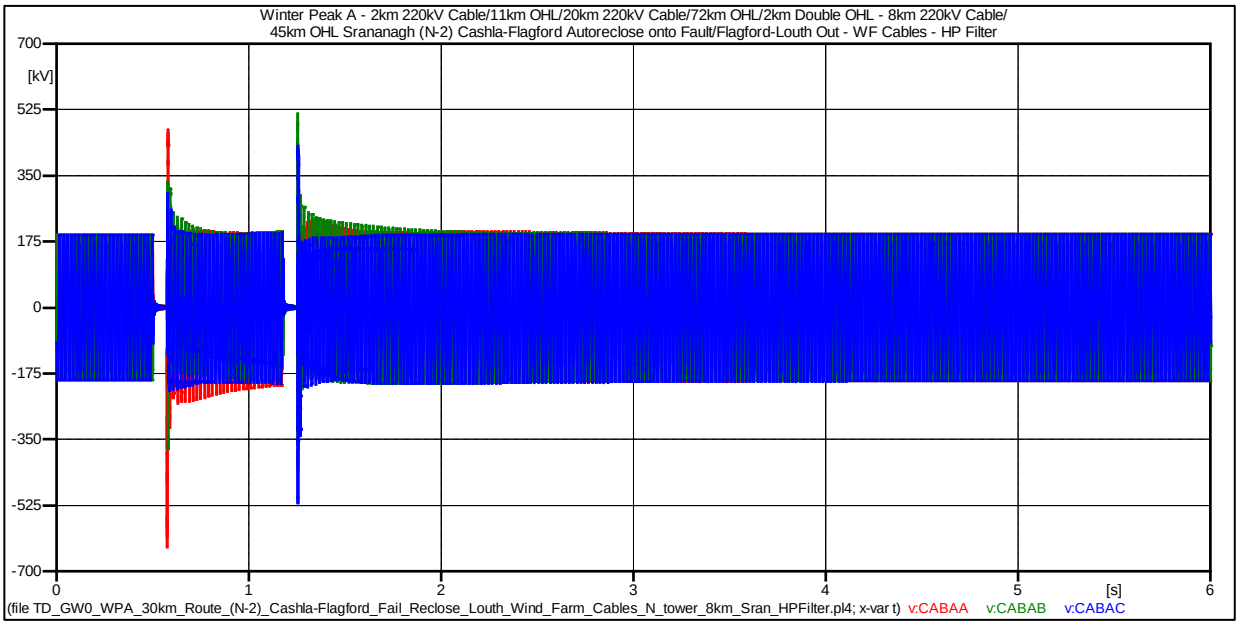

Figure 76: WPA - Length 30 km – Cable Mid-Point A – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

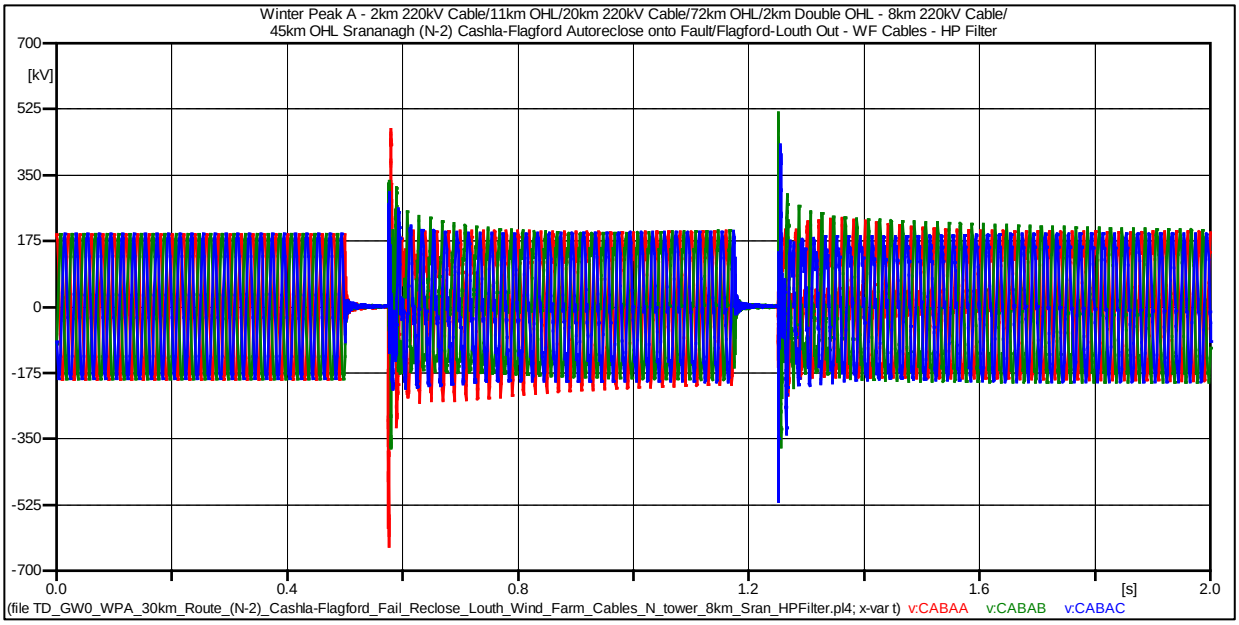

Figure 77: WPA - Length 30 km – Cable Mid-Point A – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	636.26 kV (3.5430 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	247.51 kV (1.4156 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

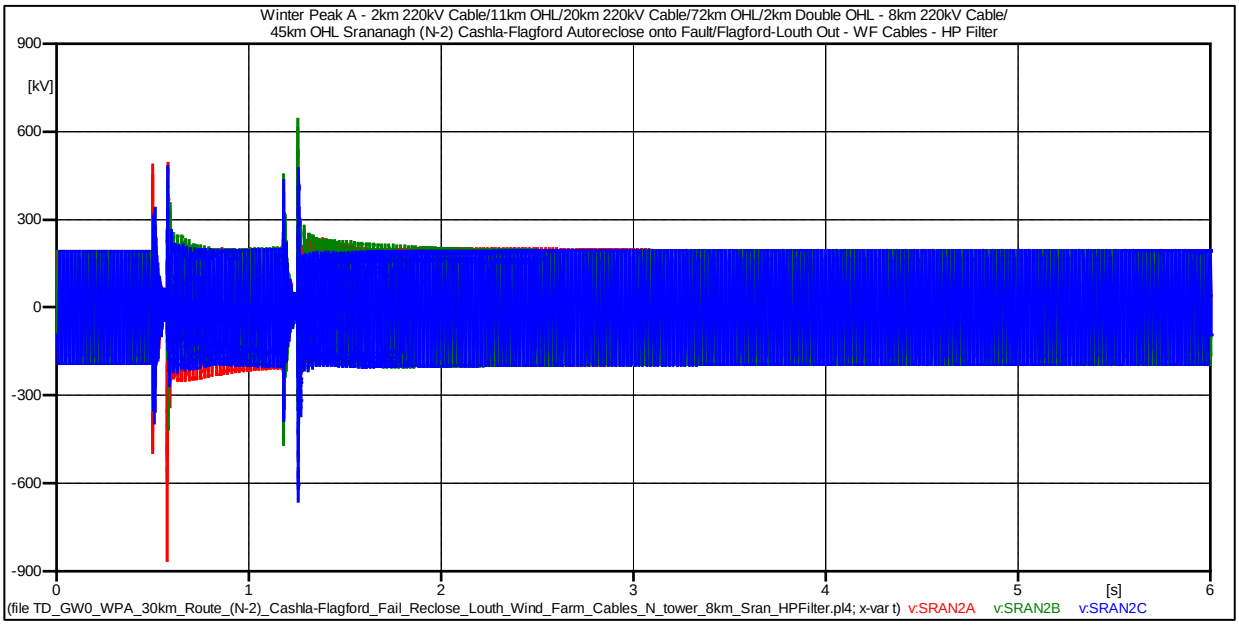

Figure 78: WPA - Length 30 km – Srananagh – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-6s)

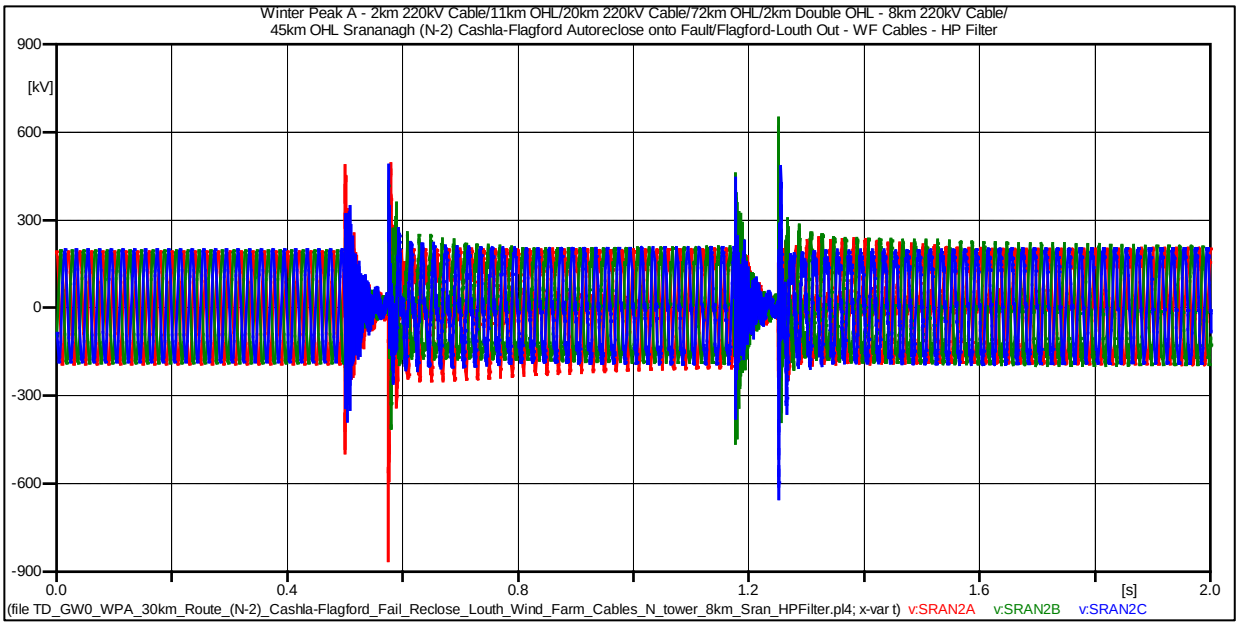

Figure 79: WPA - Length 30 km – Srananagh – (N-2) Cashla-Flagford Auto Reclose onto Fault/Flagford-Louth Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	726.06 kV (4.043 pu)	449.07 kV (2.5 pu)	Fail*
Temporary Overvoltage	273.06 kV (1.5205 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

1.12 Impedance Scans - Length 30 km – Winter Peak A – Case 7

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 7: (N-2) Cashla-Flagford/Flagford-Srananagh Cable/Line Out

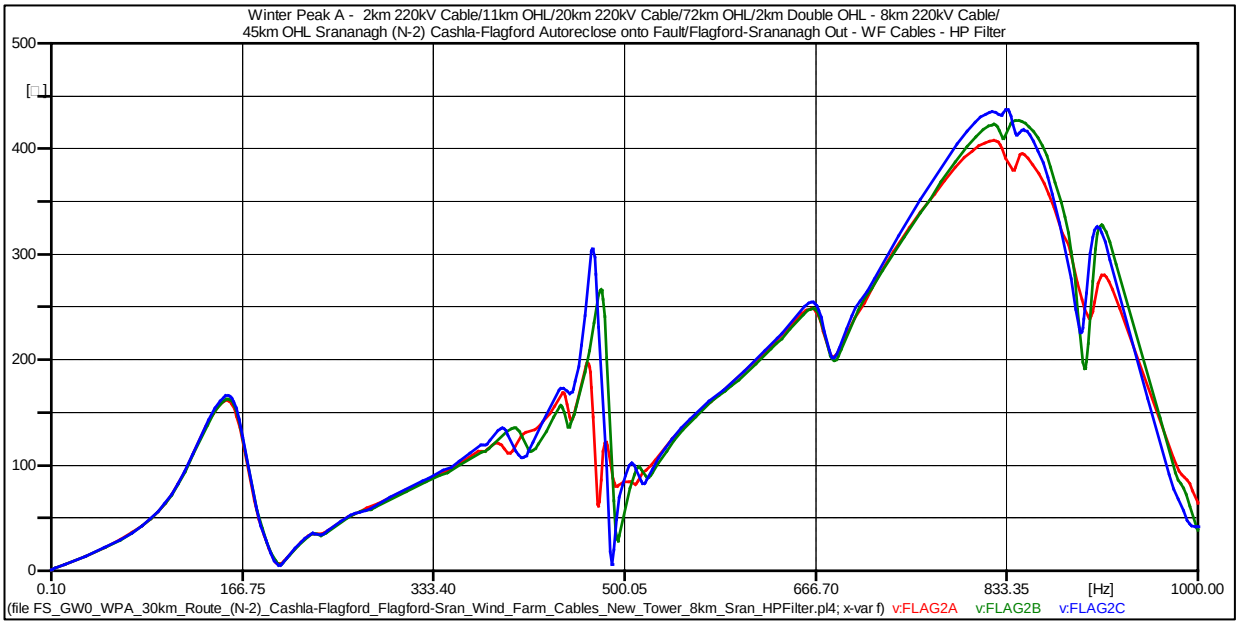

Figure 80: WPA - Length 30 km - (N-2) Cashla-Flagford/Flagford-Srananagh Lines Out

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
152.80	166.04
472.60	304.57
833.80	437.27
911.50	325.11

1.13 Time Domain Simulation - Length 30 km – Winter Peak A – Case 7

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 7: (N-2) Cashla-Flagford Line Autoreclose onto Fault/Flagford-Srananagh Cable/Line Out

System Conditions:

1. The Flagford – Srananagh 220 kV circuit is on an outage. Fault applied 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.

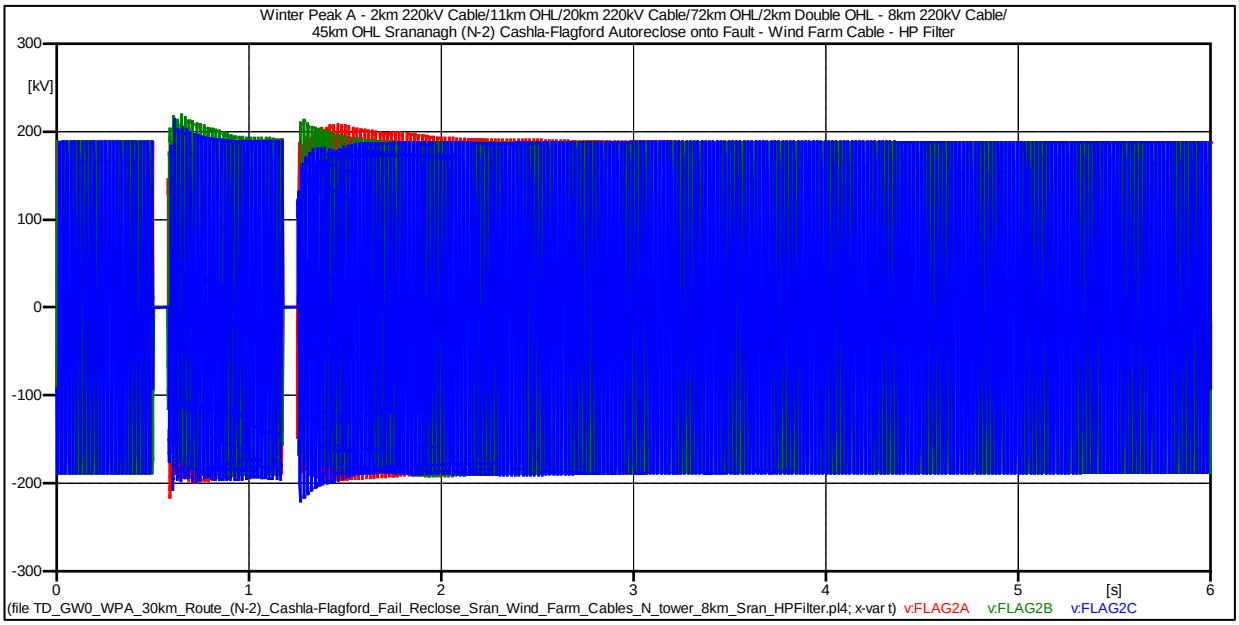

Figure 81: WPA - Length 30 km – Flagford – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

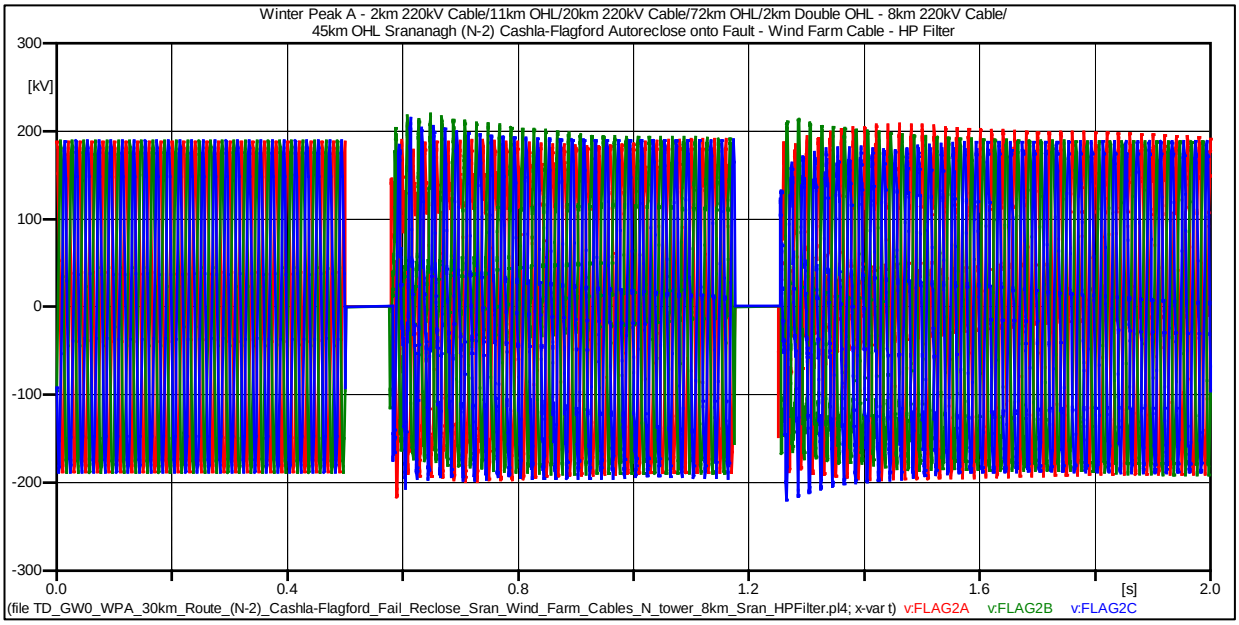

Figure 82: WPA - Length 30 km – Flagford – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	216.12 kV (1.2034 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	218.23 kV (1.2152 pu)	287.32 kV(1.6pu)	Pass

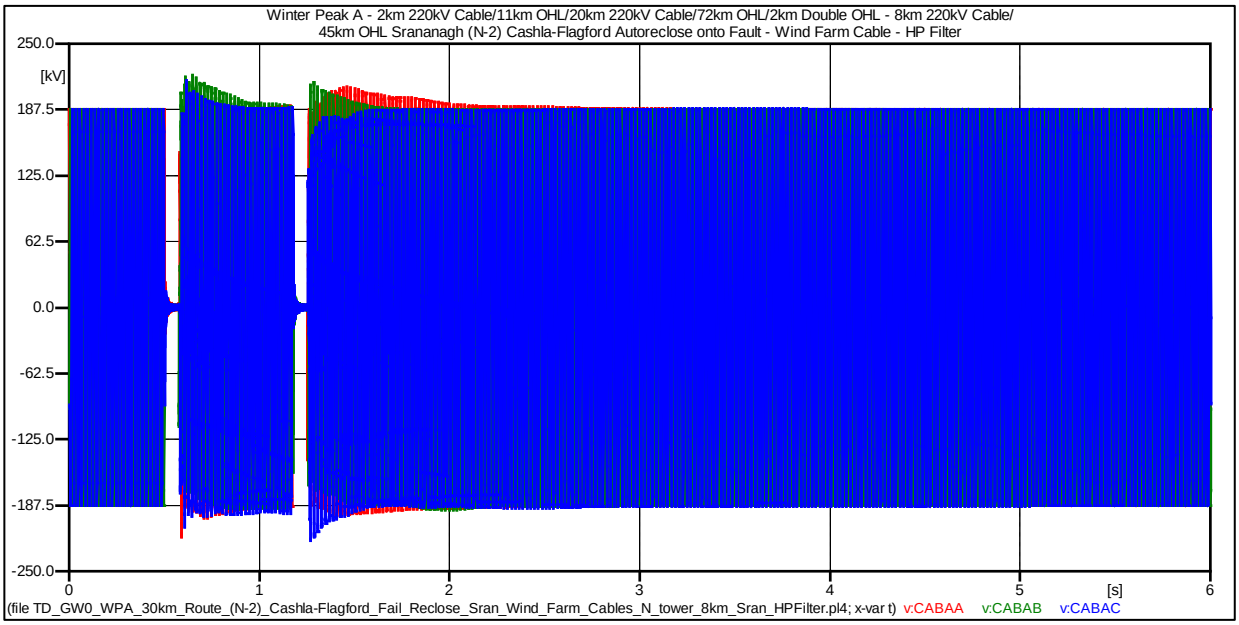

Figure 83: WPA - Length 30 km – Cable End A – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

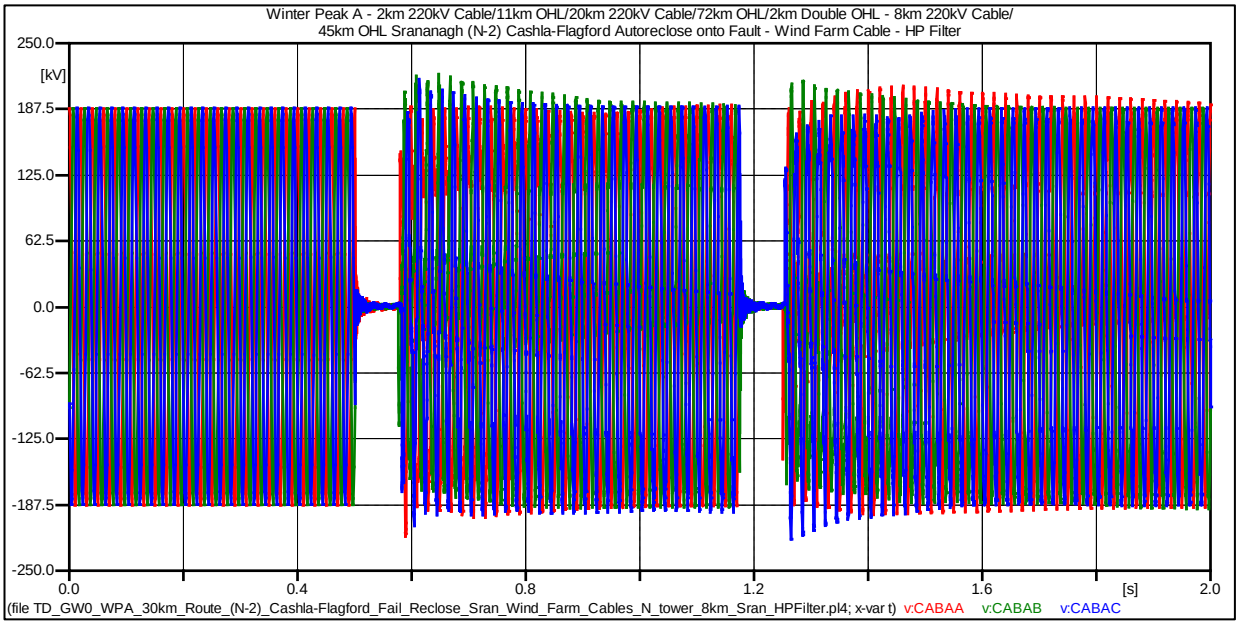

Figure 84: WPA - Length 30 km – Cable End A – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	216.12 kV (1.2034 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	214.90 kV (1.1966 pu)	287.32 kV(1.6pu)	Pass

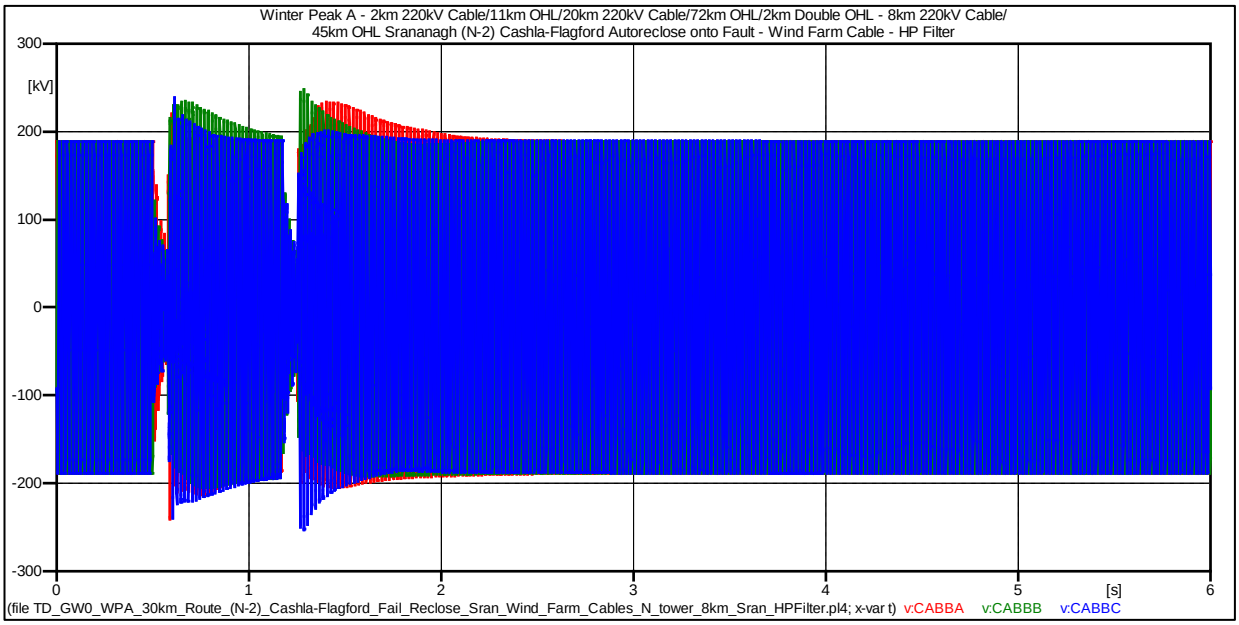

Figure 85: WPA - Length 30 km – Cable End B – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

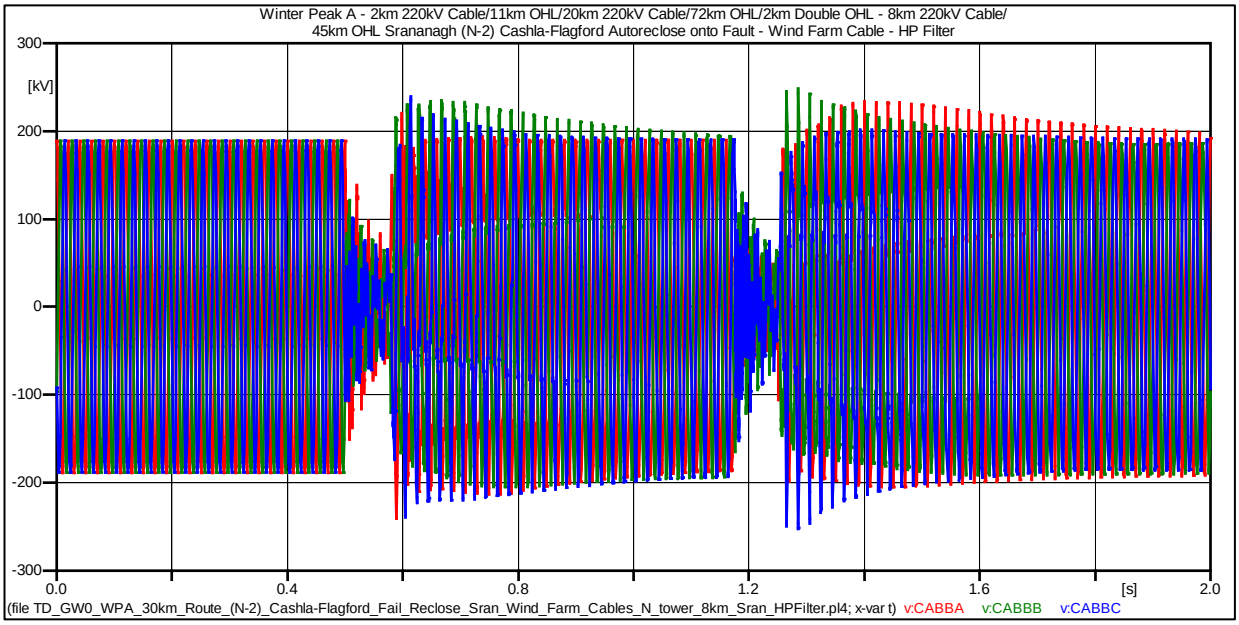

Figure 86: WPA - Length 30 km – Cable End B – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	249.58 kV (1.3897 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	229.89 kV (1.2801 pu)	287.32 kV(1.6pu)	Pass

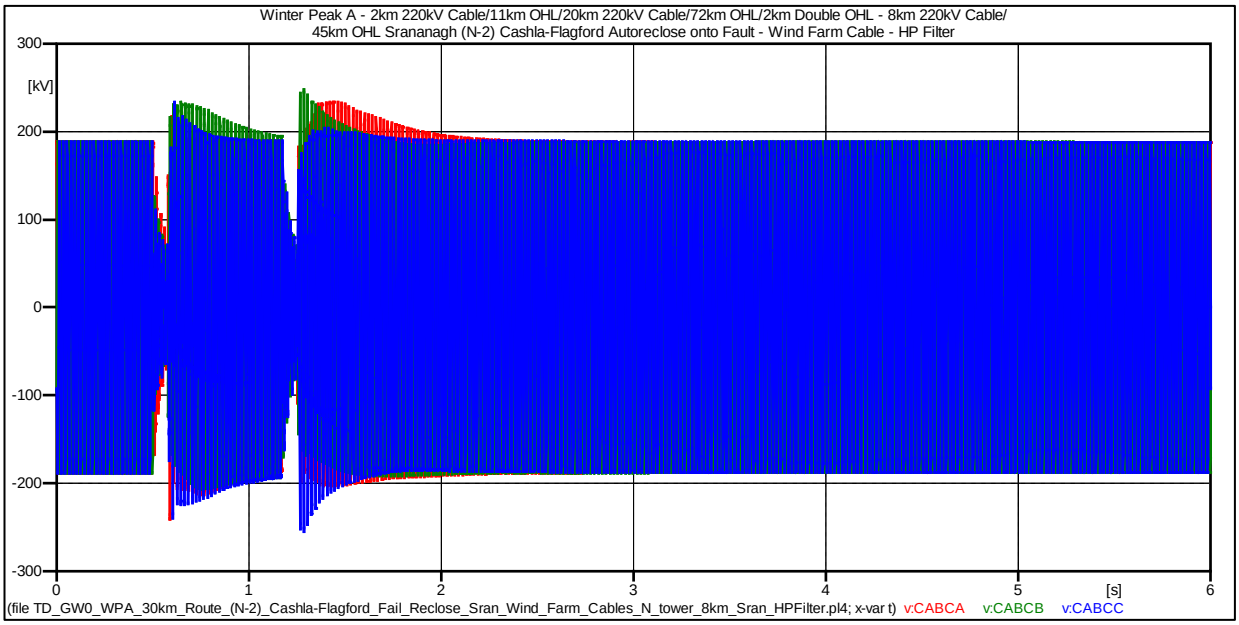

Figure 87: WPA - Length 30 km – Cable End C – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

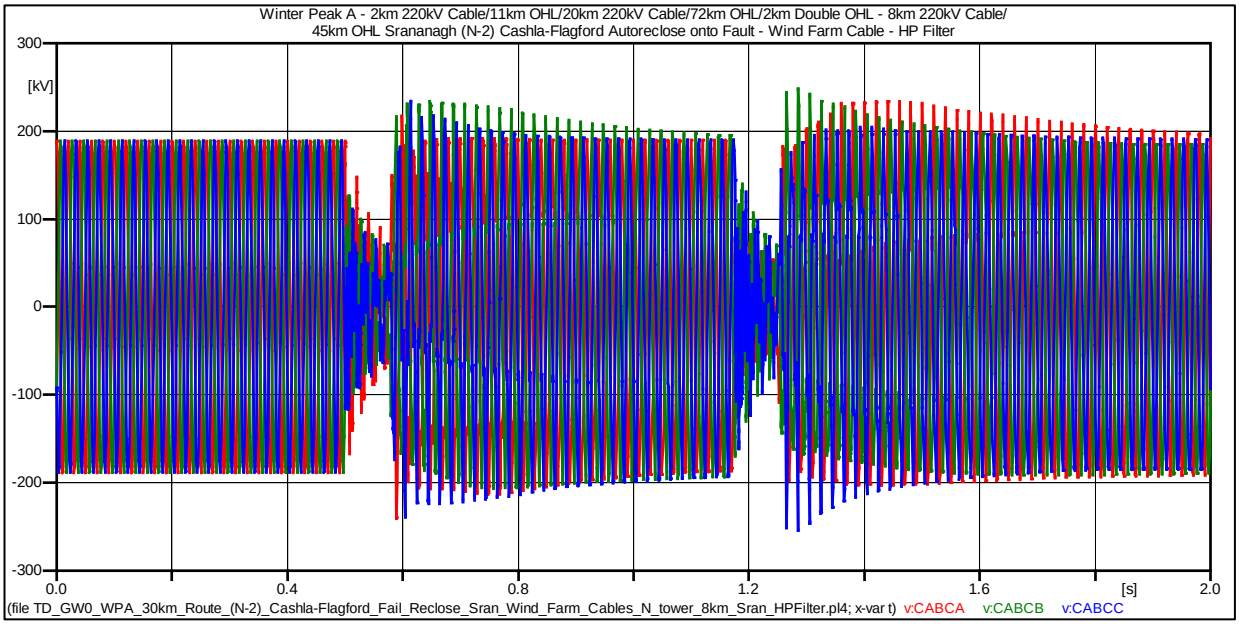

Figure 88: WPA - Length 30 km – Cable End C – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	251.89 kV (1.4026 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	232.59 kV (1.2951 pu)	287.32 kV(1.6pu)	Pass

*Pass can be achieved with surge arrestors

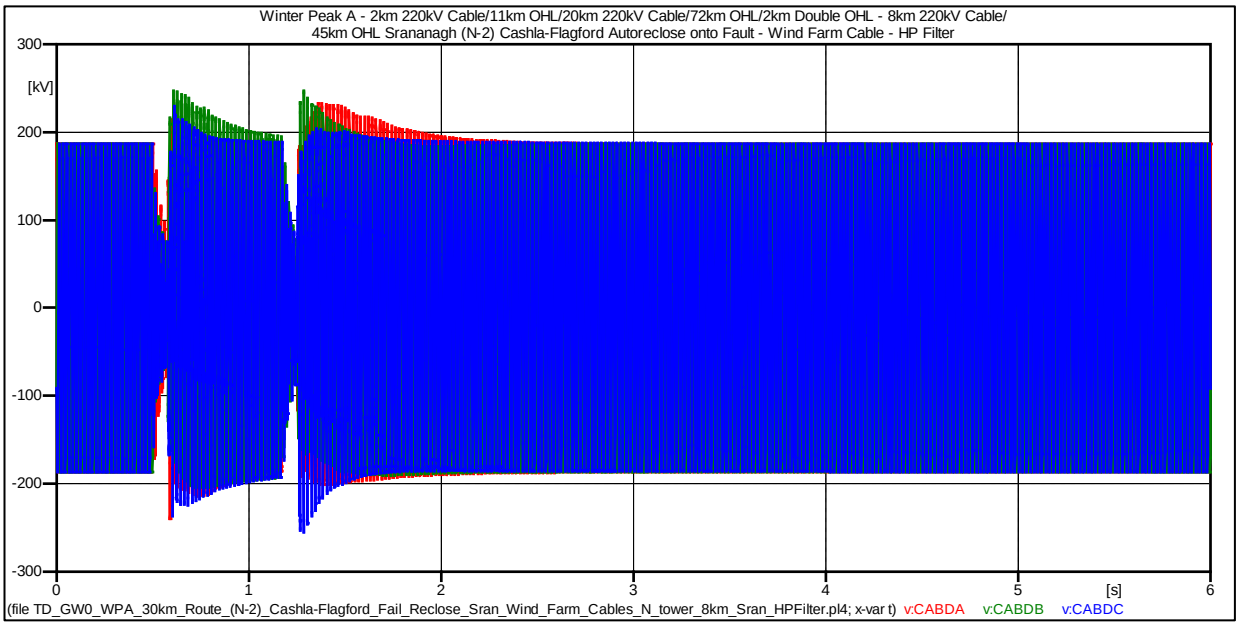

Figure 89: WPA - Length 30 km – Cable End D – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

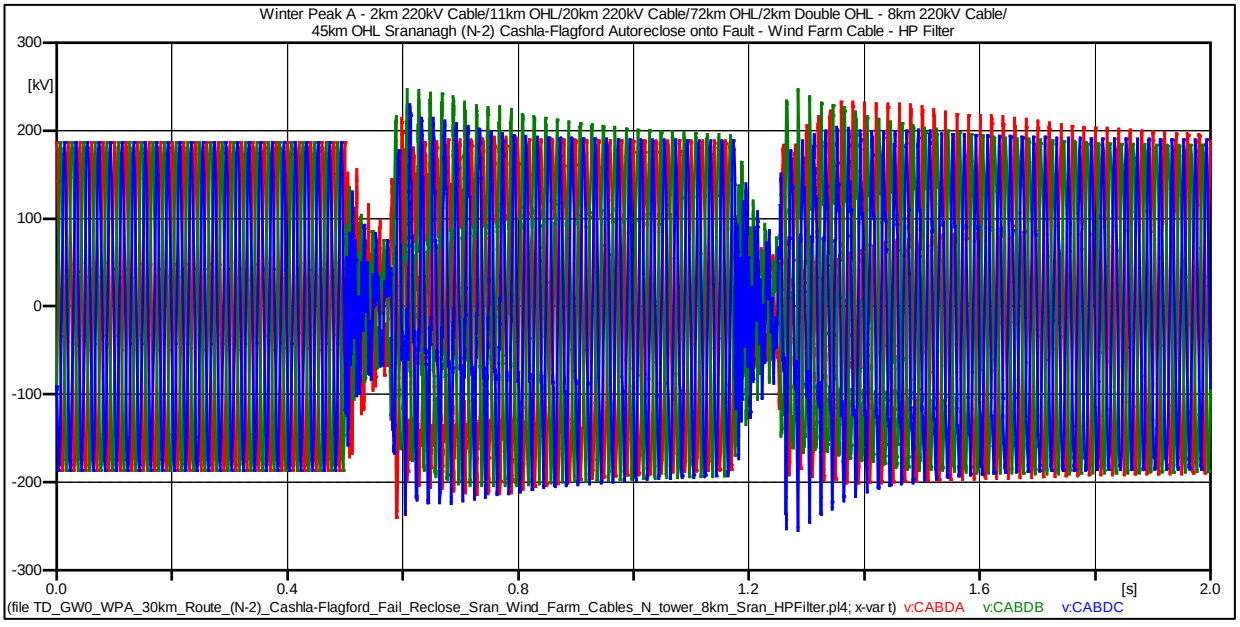

Figure 90: WPA - Length 30 km – Cable End D – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	240.18 kV (1.3374 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	238.89 kV (1.3302 pu)	287.32 kV(1.6pu)	Pass

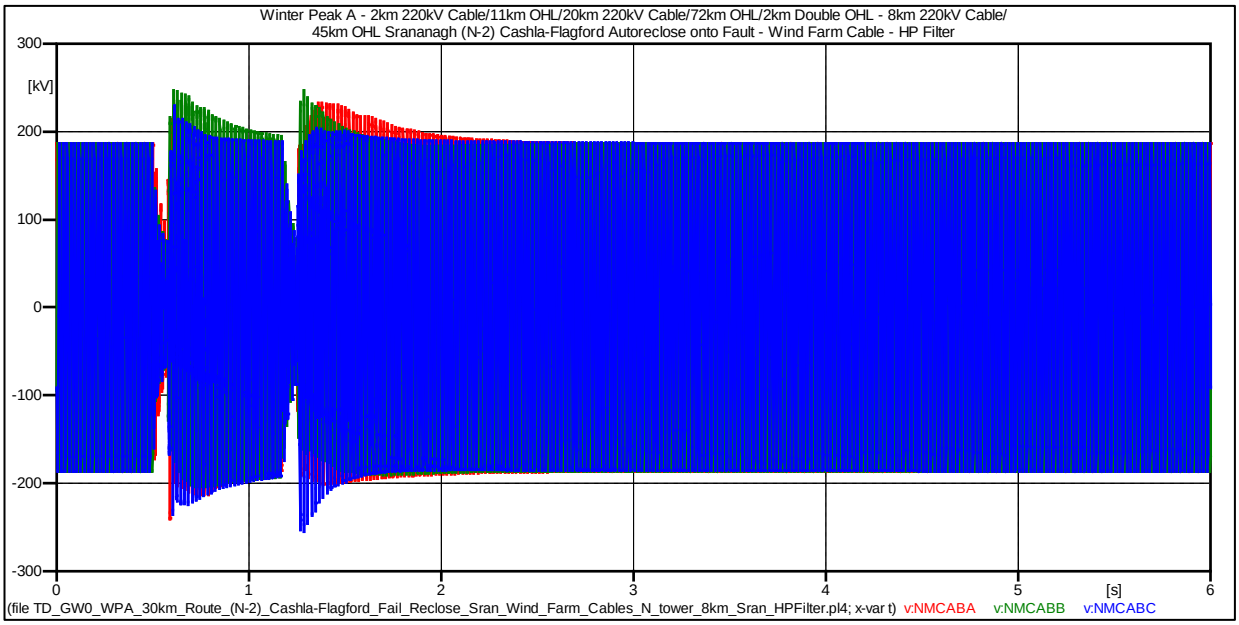

Figure 91: WPA - Length 30 km – North Mayo – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

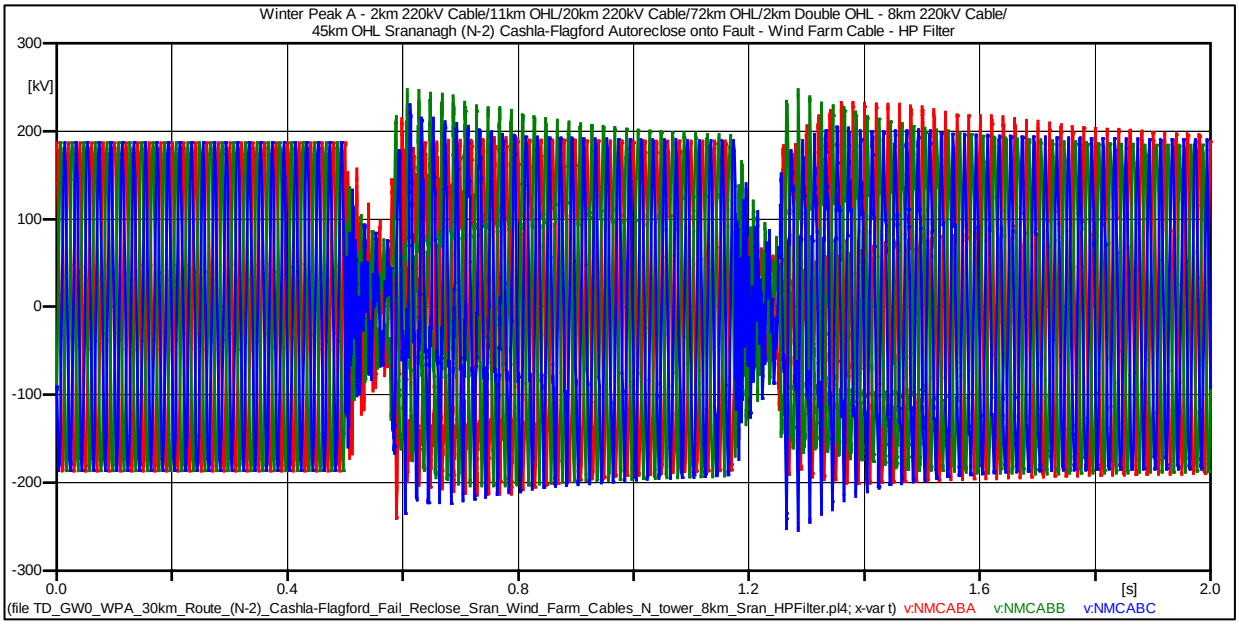

Figure 92: WPA - Length 30 km – North Mayo – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	253.65 kV (1.4124 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	236.12 kV (1.3148 pu)	287.32 kV(1.6pu)	Pass

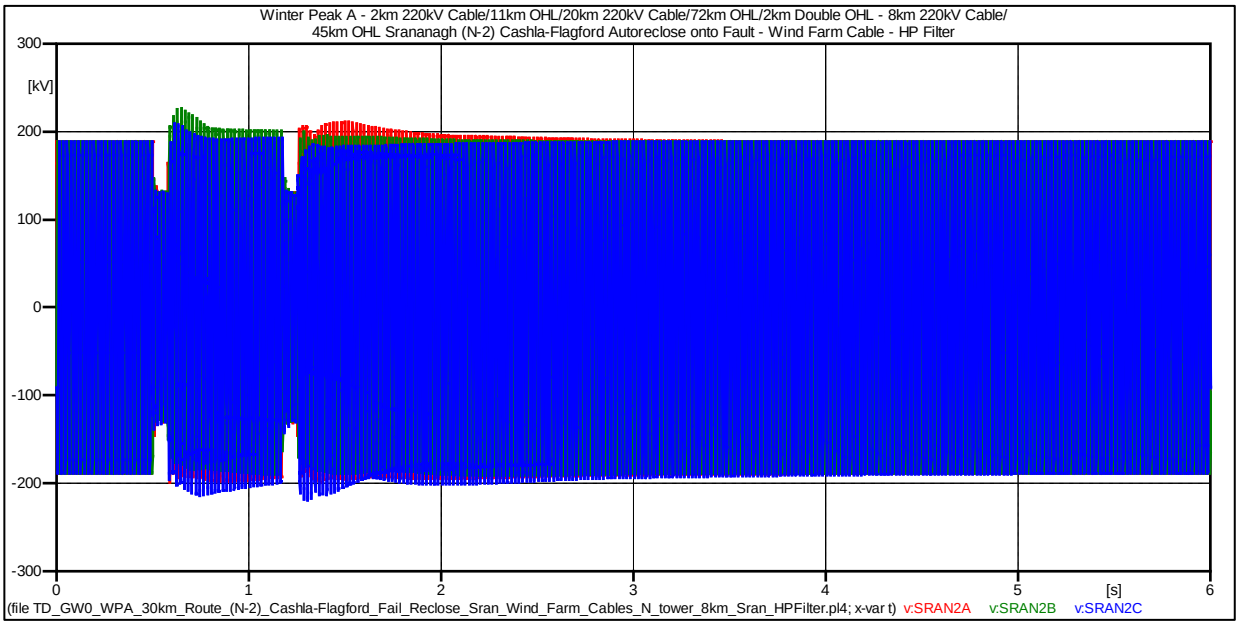

Figure 93: WPA - Length 30 km – Srananagh – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

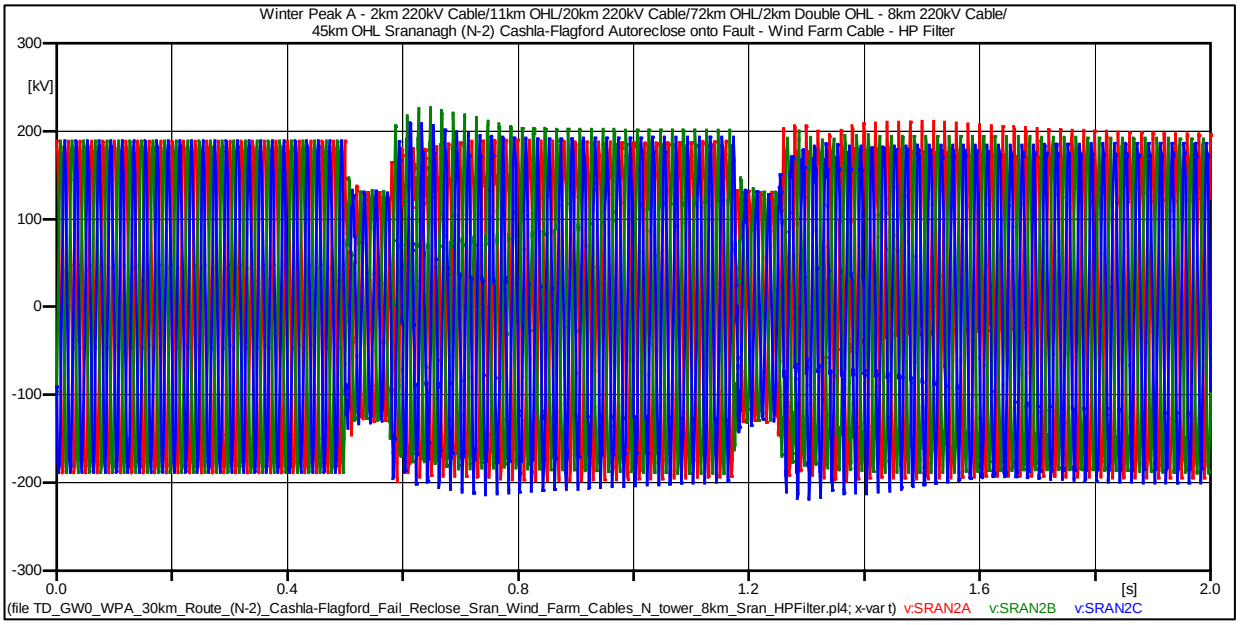

Figure 94: WPA - Length 30 km – Srananagh – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	221.59 kV (1.2339 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	226.39 kV (1.2606 pu)	287.32 kV(1.6pu)	Pass

1.14 Impedance Scans - Length 30 km – Winter Peak A – Case 8

Conditions for impedance scan:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 8: (N-2) Flagford-Louth/Flagford-Srananagh Cable/Line Out

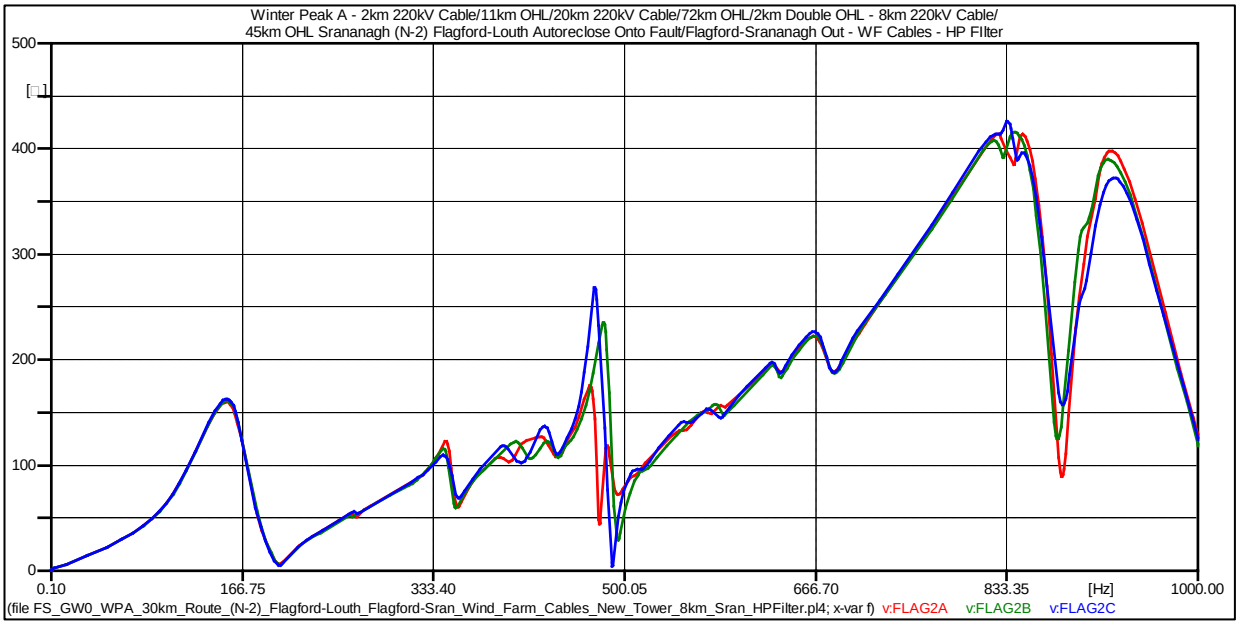

Figure 95: WPA - Length 30 km - (N-2) Cashla-Louth/Flagford-Srananagh

Impedance Scan - Resonance points

Frequency (Hz)	Impedance (Ω)
152.2	162.82
344.80	122.69
474.10	268.55
666.10	425.88
924.70	398.10

1.15 Time Domain Simulation - Length 30 km – Winter Peak A – Case 8

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 8: (N-2) Flagford-Louth Line Autoreclose onto Fault/Flagford-Srananagh Cable/Line Out

System Conditions:

1. The Flagford – Srananagh 220 kV circuit is on an outage. Fault applied 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.

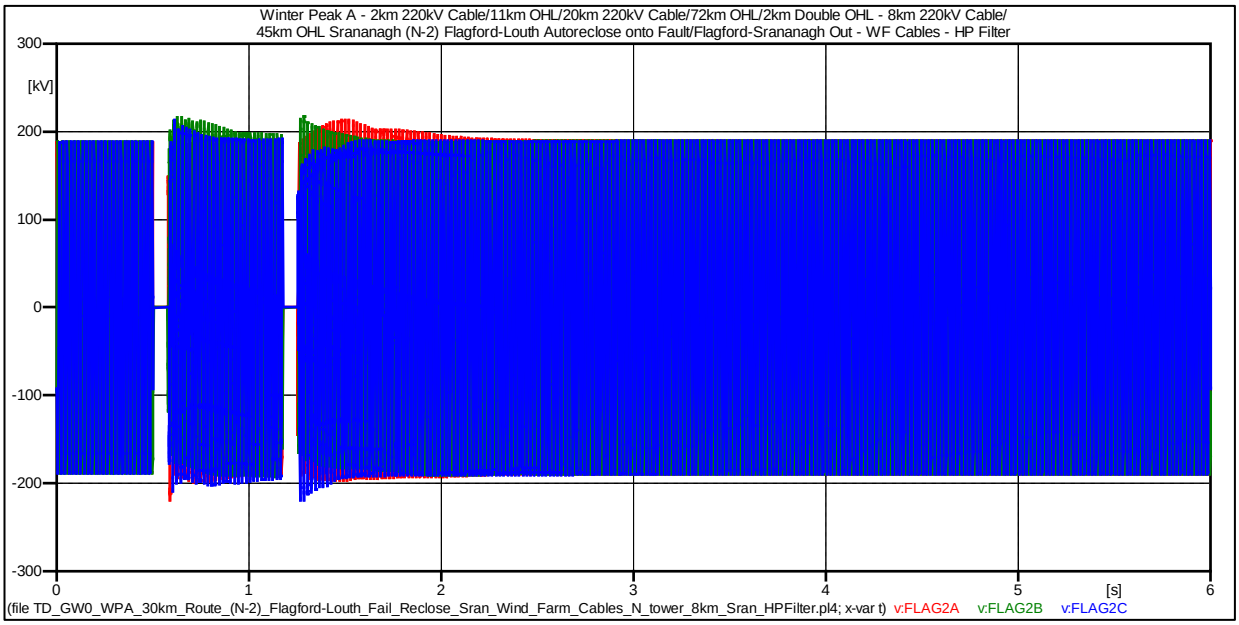

Figure 96: WPA - Length 30 km – Flagford – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

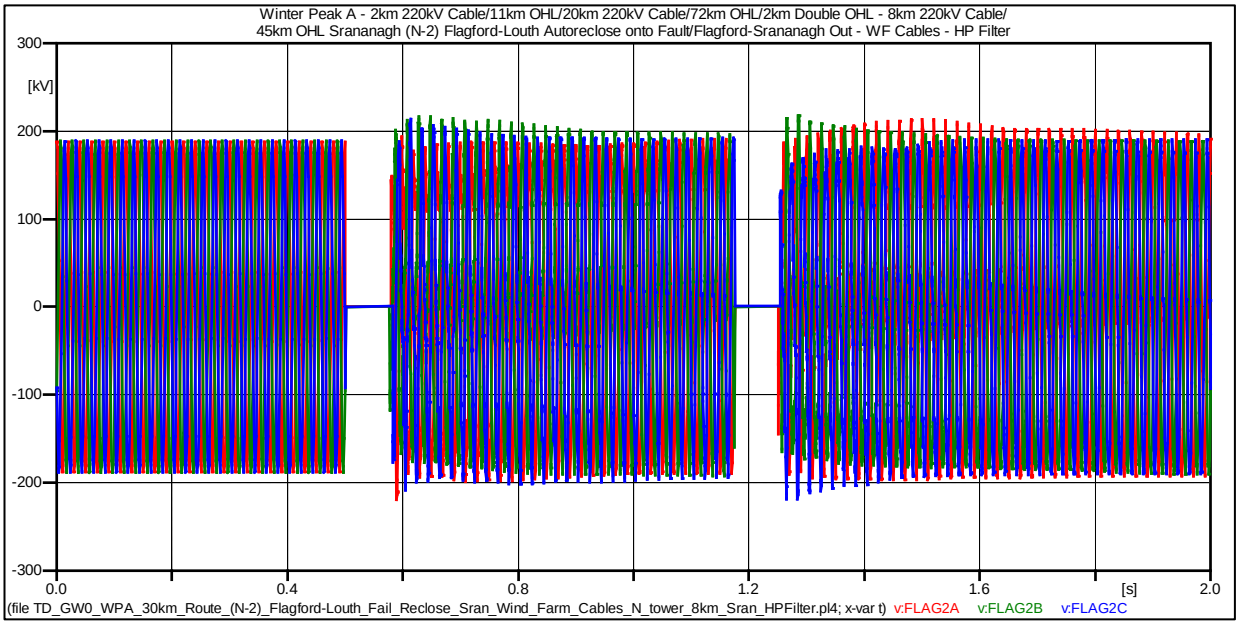

Figure 97: WPA - Length 30 km – Flagford – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	215.87 kV (1.2020 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	218.57 kV (1.2171 pu)	287.32 kV(1.6pu)	Pass

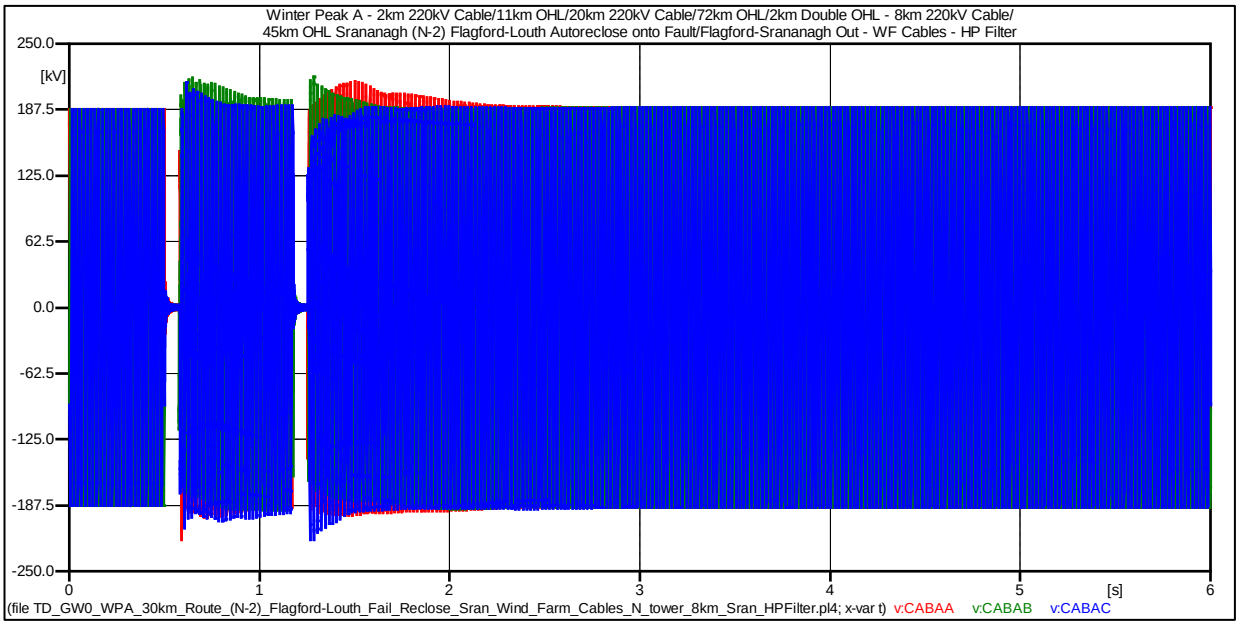

Figure 98: WPA - Length 30 km – Cable End A – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

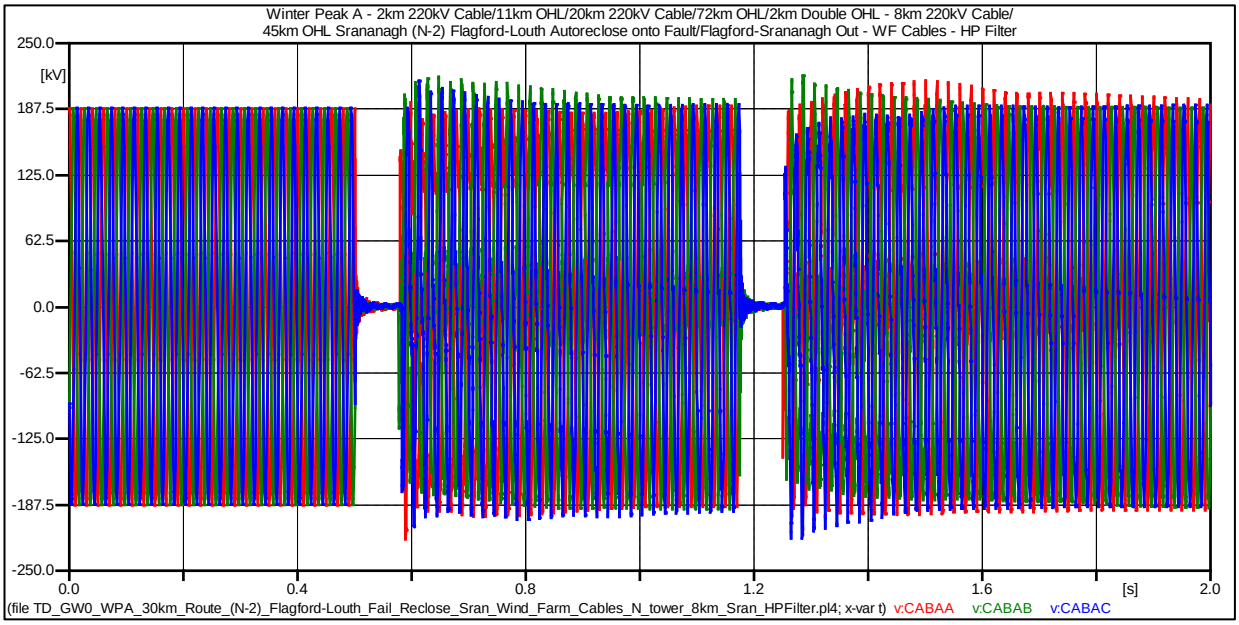

Figure 99: WPA - Length 30 km – Cable End A – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	218.86 kV (1.2187 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	218.86 kV (1.2187 pu for 300 ms)	287.32 kV(1.6pu)	Pass

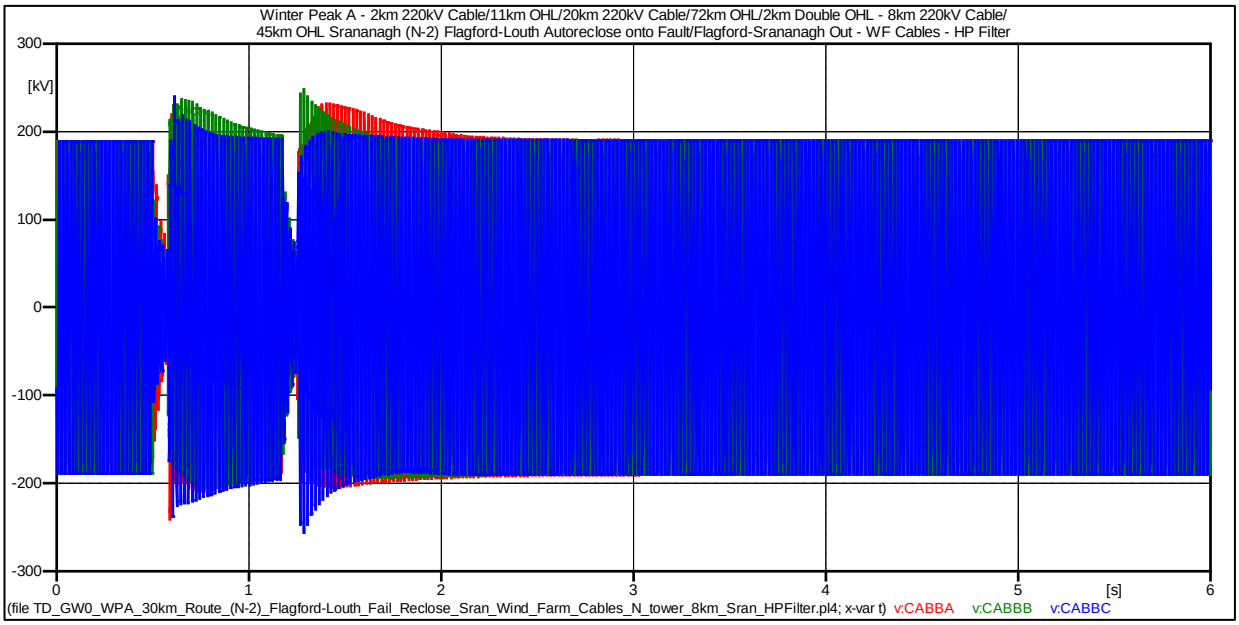

Figure 100: WPA - Length 30 km – Cable End B – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

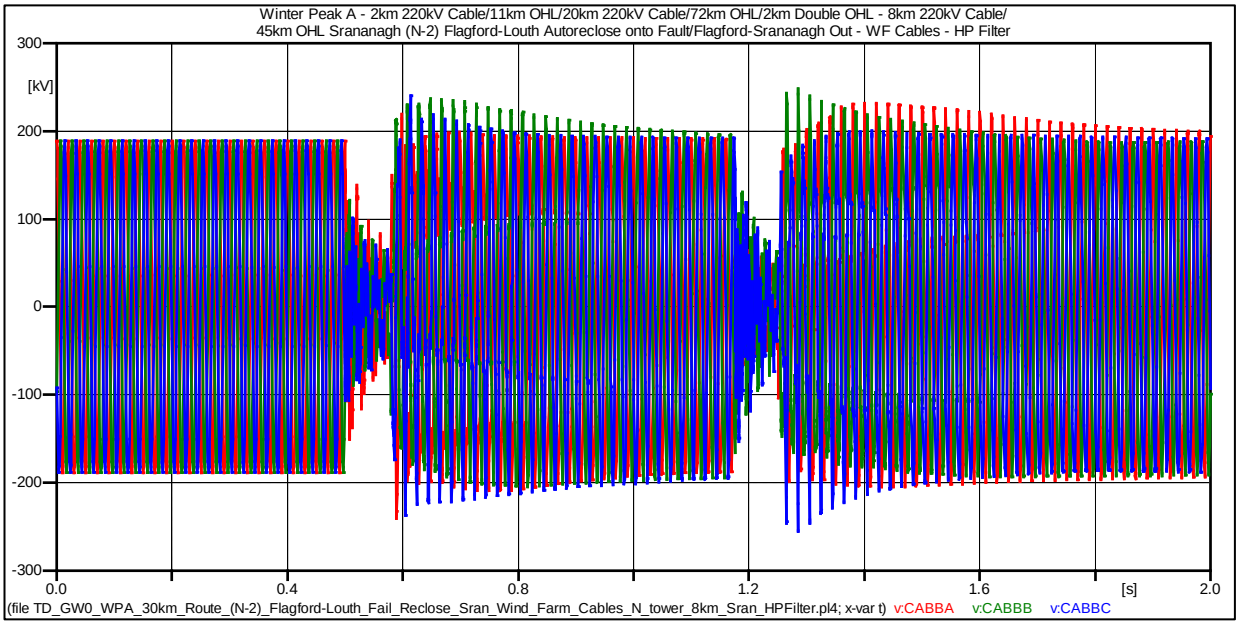

Figure 101: WPA - Length 30 km – Cable End B – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	255.59 kV (1.4232 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	230.94 kV (1.2860 pu for 300 ms)	287.32 kV(1.6pu)	Pass

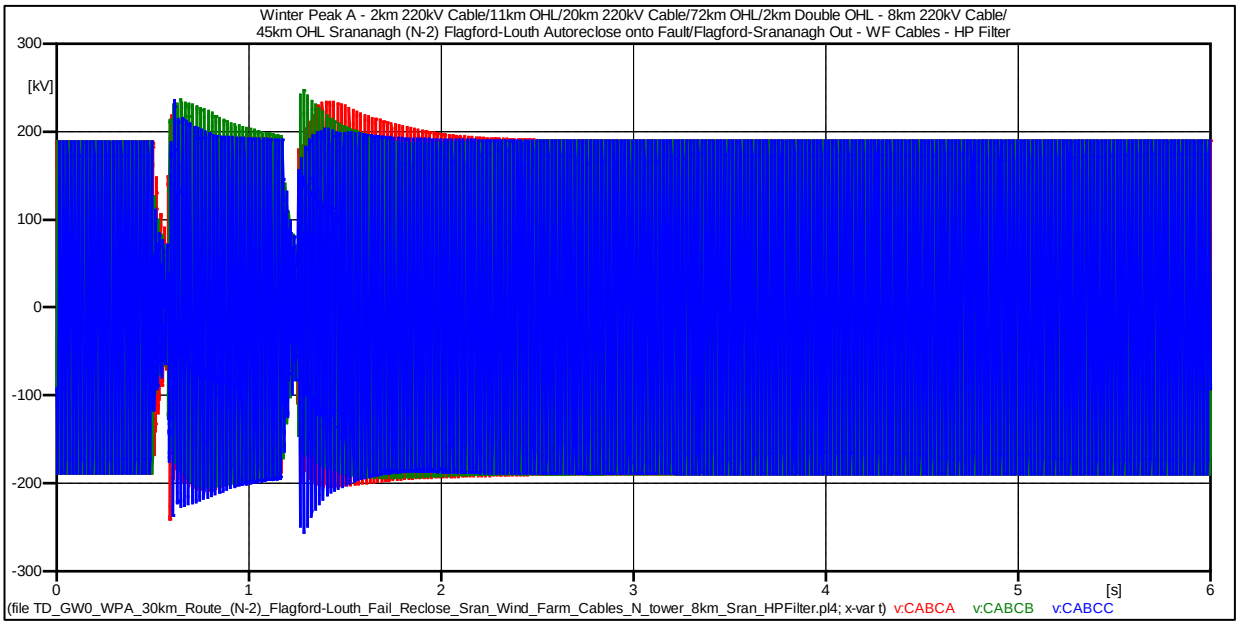

Figure 102: WPA - Length 30 km – Cable End C – (N-2) Flagford-Louth Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

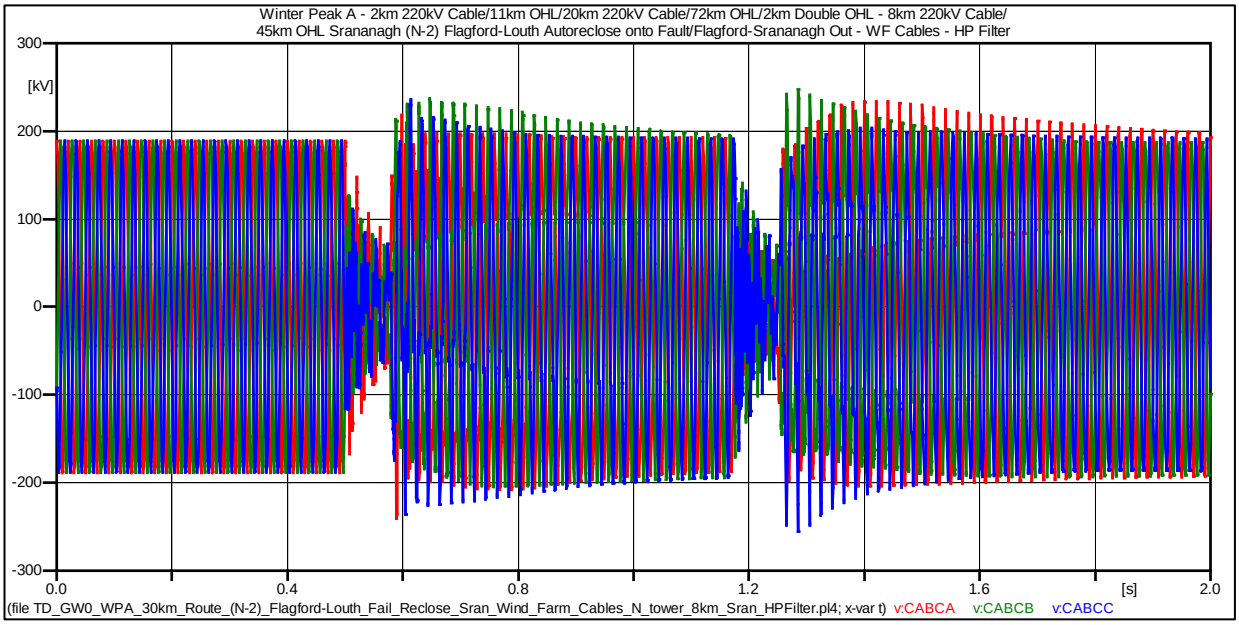

Figure 103: WPA - Length 30 km – Cable End C – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	255.77 kV (1.4242 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	238.86 kV (1.3301 pu)	287.32 kV(1.6pu)	Pass

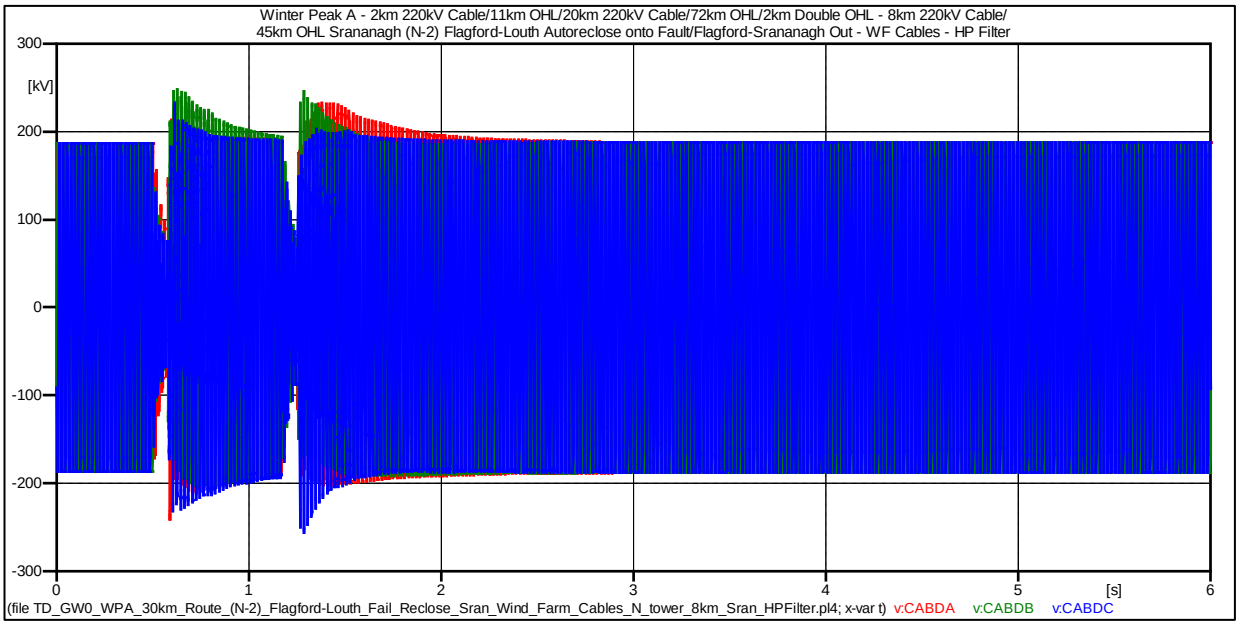

Figure 104: WPA - Length 30 km – Cable End D – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

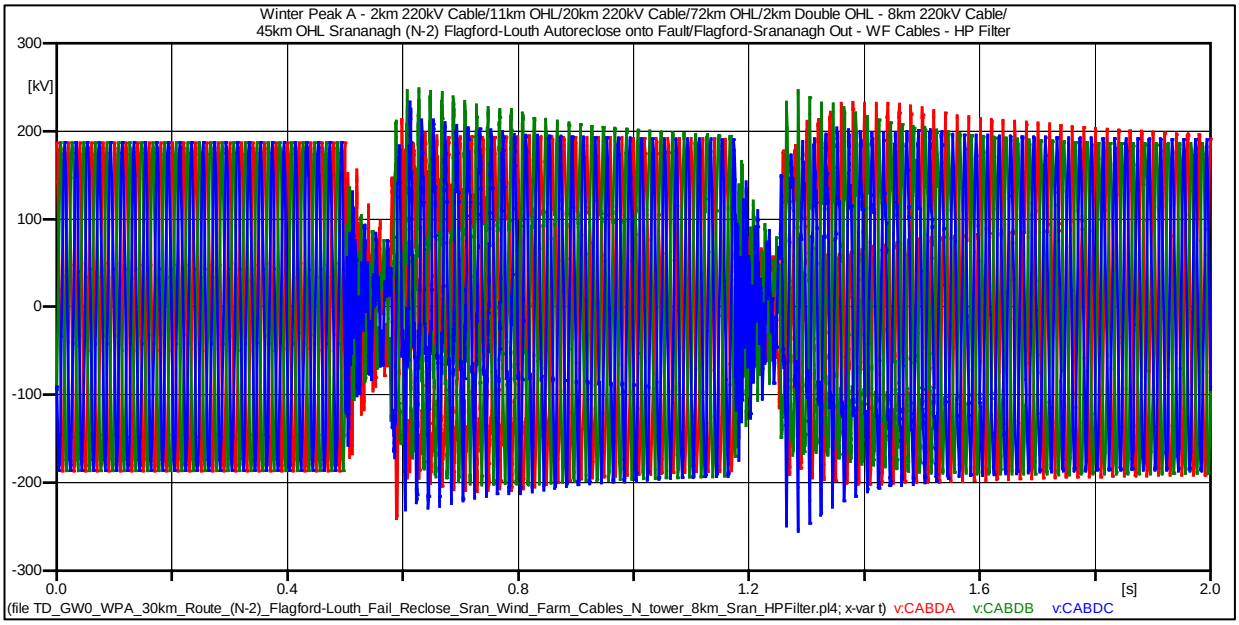

Figure 105: WPA - Length 30 km – Cable End D – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	254.87 kV (1.4192 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	238.89 kV (1.3302 pu)	287.32 kV(1.6pu)	Pass

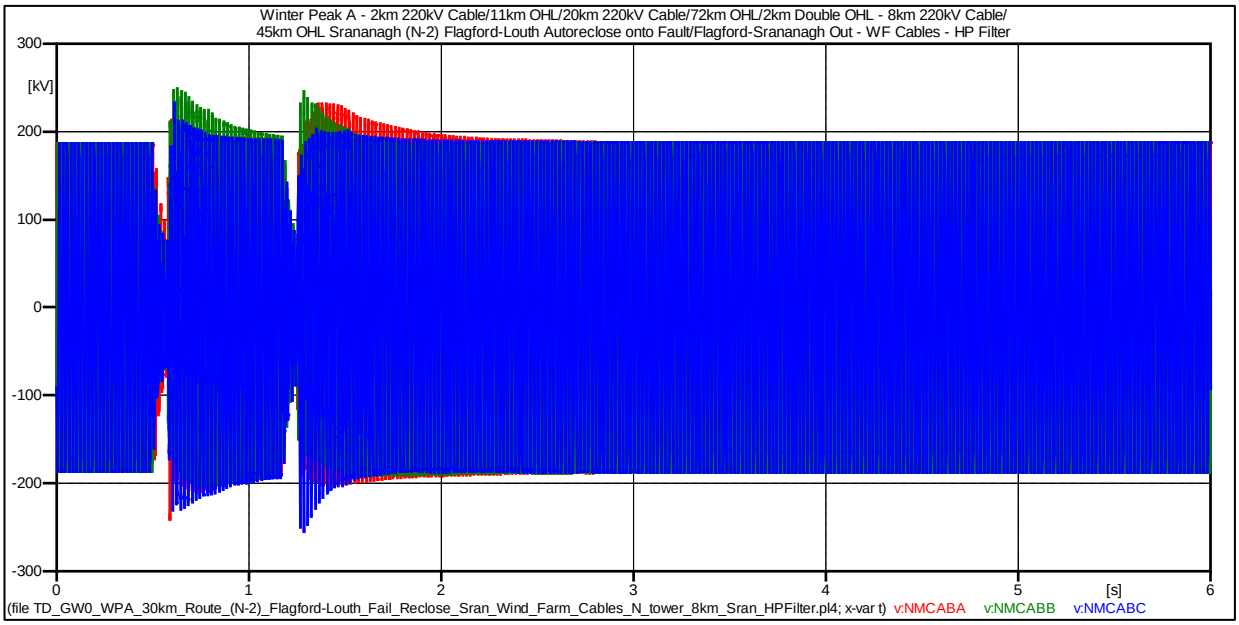

Figure 106: WPA - Length 30 km – Cable End - North Mayo – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

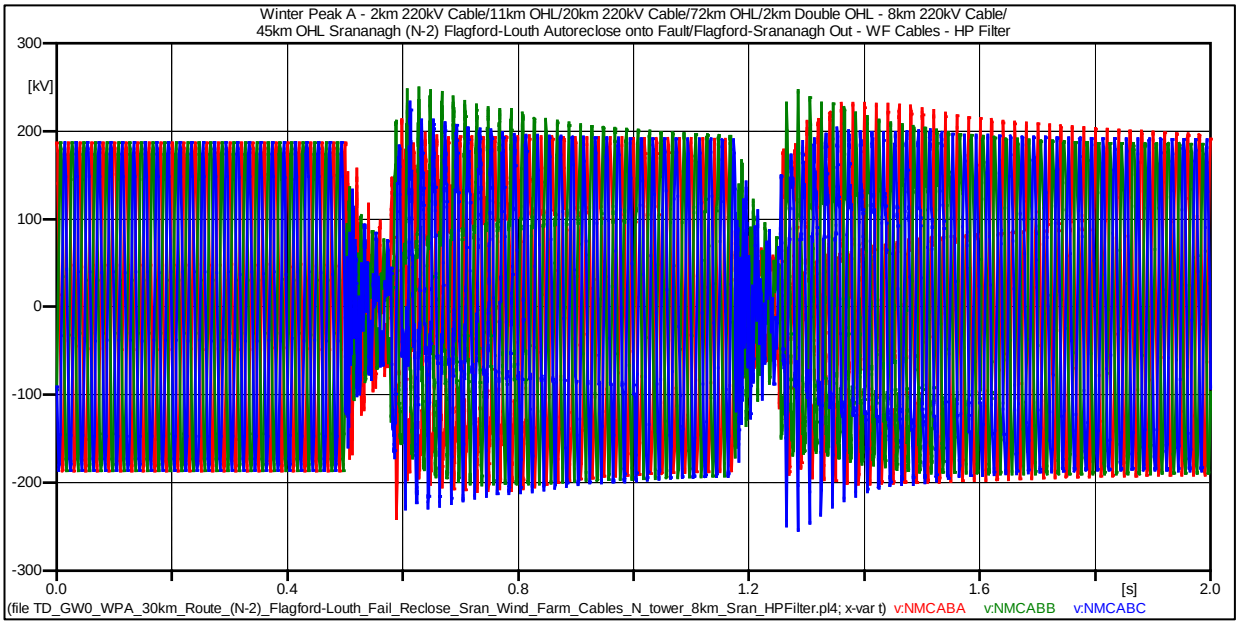

Figure 107: WPA - Length 30 km – North Mayo – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	255.49 kV (1.4227 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	230.94kV (1.2860 pu)	287.32 kV(1.6pu)	Pass

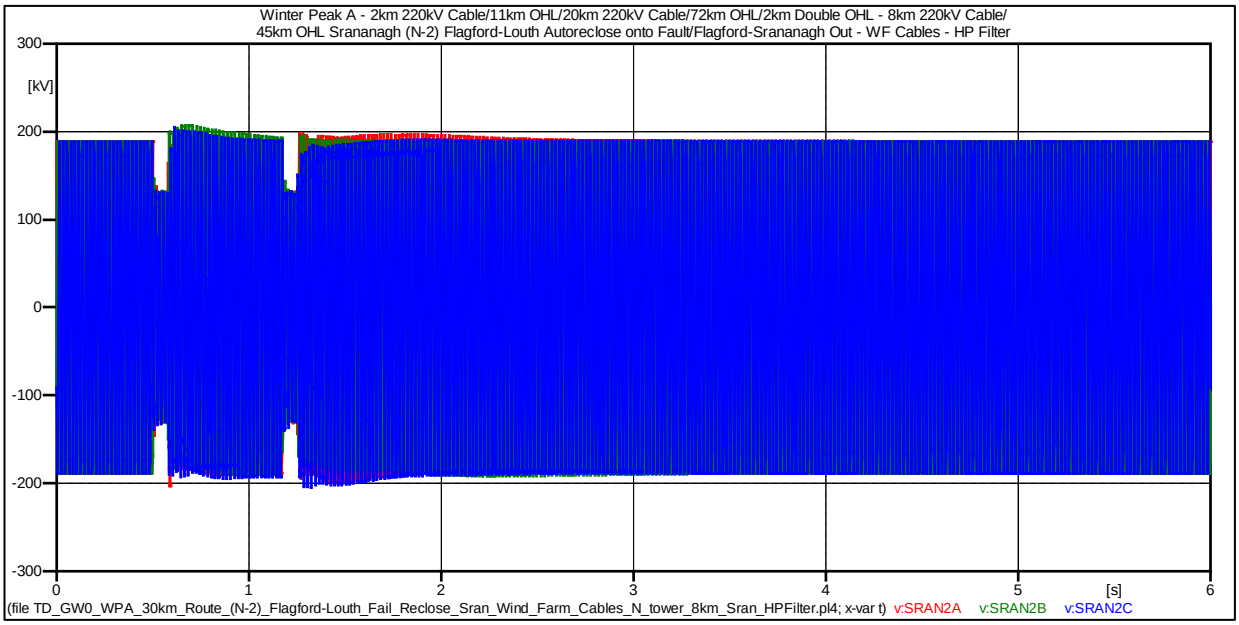

Figure 108: WPA - Length 30 km – Srananagh – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-6s)

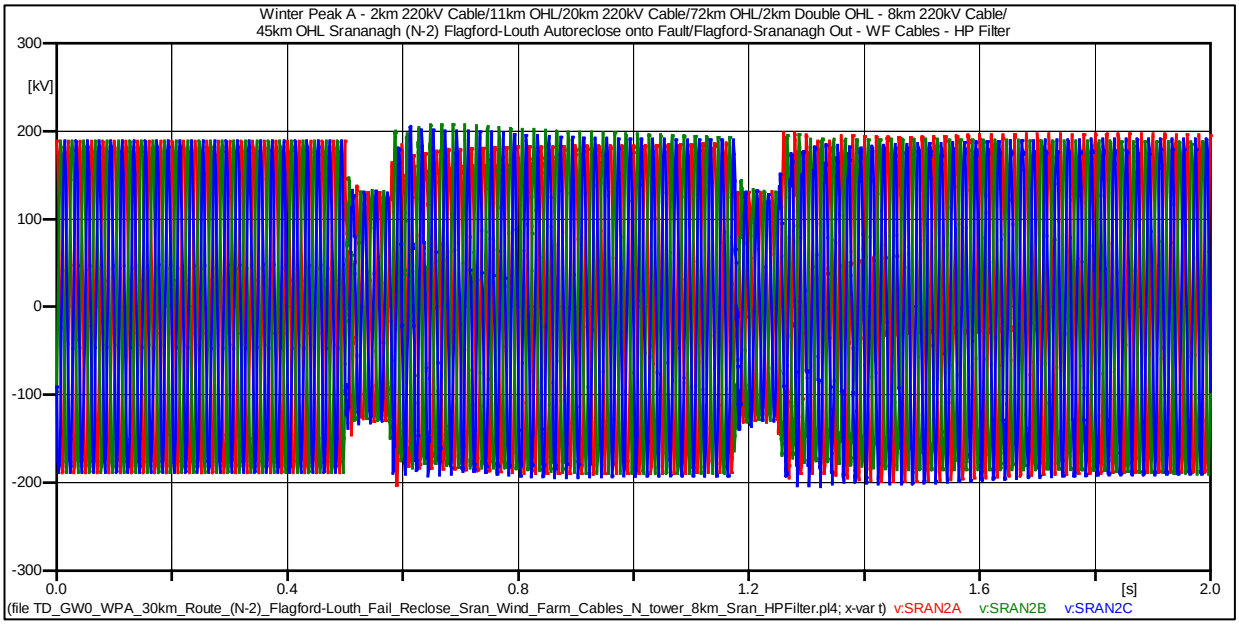

Figure 109: WPA - Length 30 km – Srananagh – (N-2) Flagford-Cashla Auto Reclose onto Fault – Flagford-Srananagh Line Out (0-2s)

Condition	Maximum Value	Limit	Result
Switching	204.49 kV (1.1387 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	201.59kV (1.1225 pu)	287.32 kV(1.6pu)	Pass

1.16 Time Domain Simulation - Length 30 km – Winter Peak A – Case 9

Conditions for time domain simulation:

1. Winter Peak A Network
2. North Mayo to Flagford Circuit - 2 km Cable/11 km OHL/20 km Cable/72 km OHL/2 km Double Circuit OHL
3. Srananagh to Flagford Circuit – 8 km Cable/45 km OHL
4. Reactors – North Mayo 100 Mvar/Flagford 50 Mvar
5. Filter – High Pass Filter – 3.29 uF, 372 mH, 500 Ω

Case 9: Energise Grid West Cable

System Conditions:

1. Energise the Grid West Cable from Flagford at 1s.

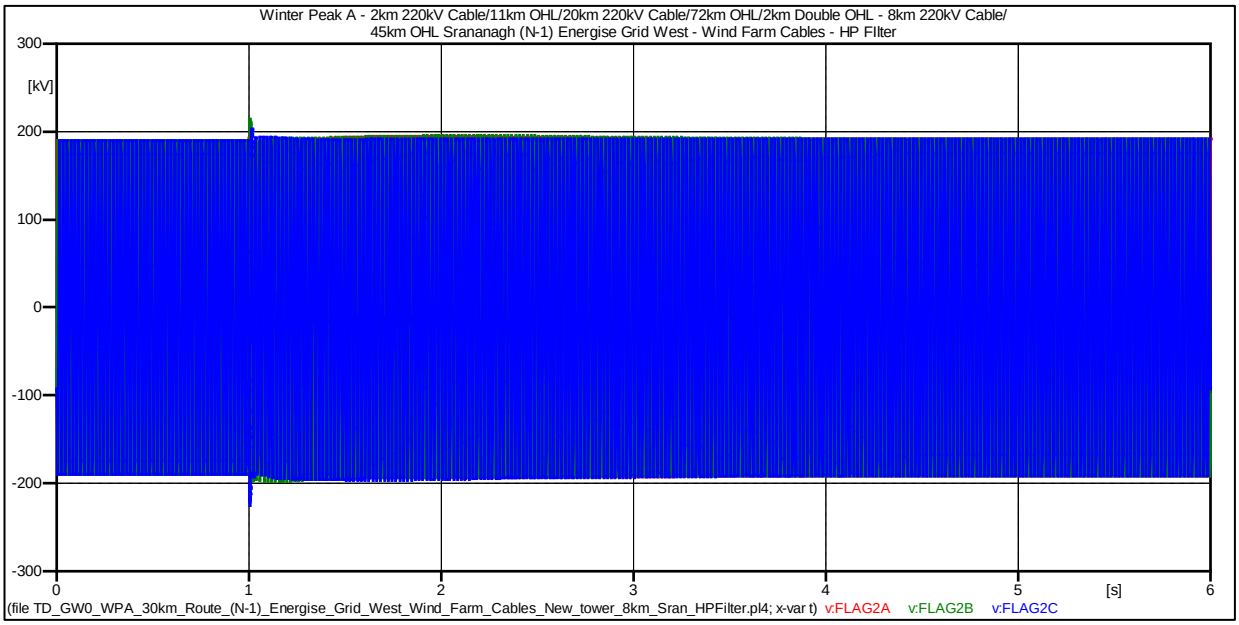

Figure 110: WPA - Length 30 km – Flagford – Energise Grid West Cable (0-6s)

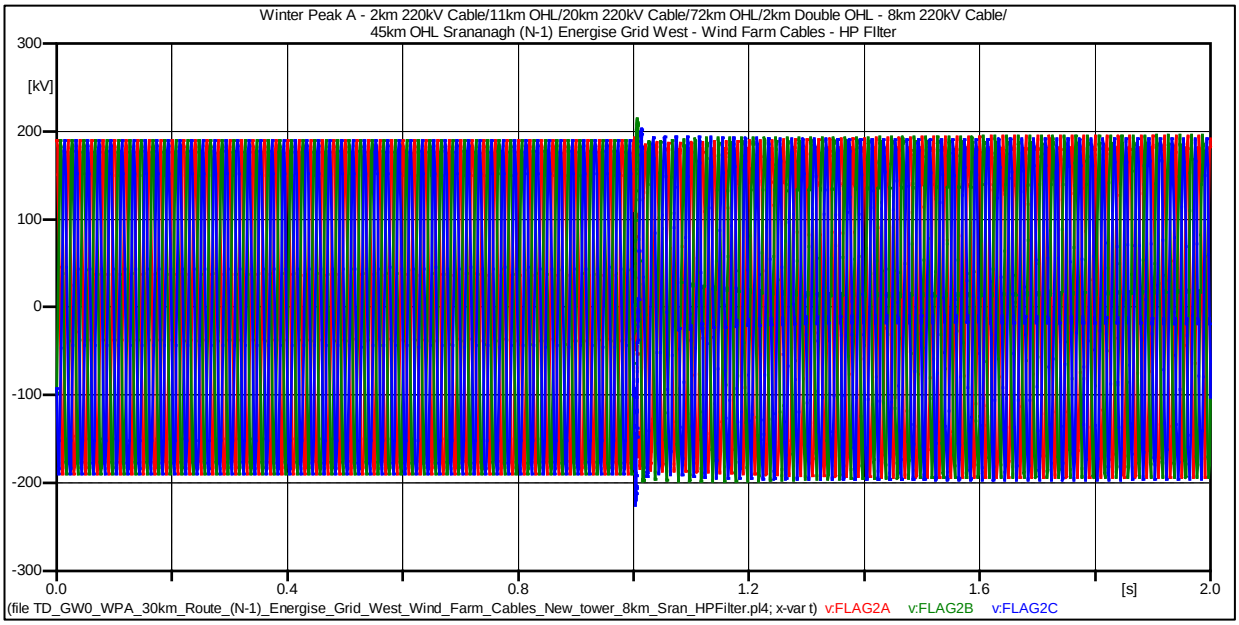

Figure 111: WPA - Length 30 km – Flagford – Energise Grid West Cable (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	218.59 kV (1.2172 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	205.12 kV (1.1422 pu)	287.32 kV(1.6pu)	Pass

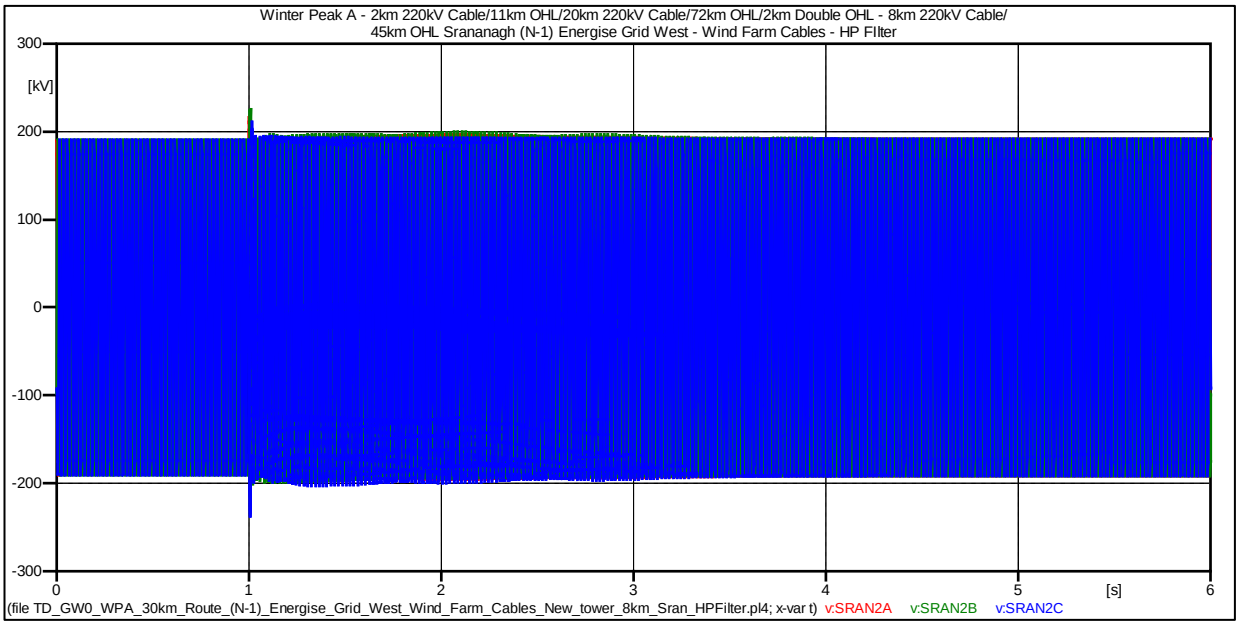

Figure 112: WPA- Length 30 km – Srananagh – Energise Grid West Cable (0-6s)

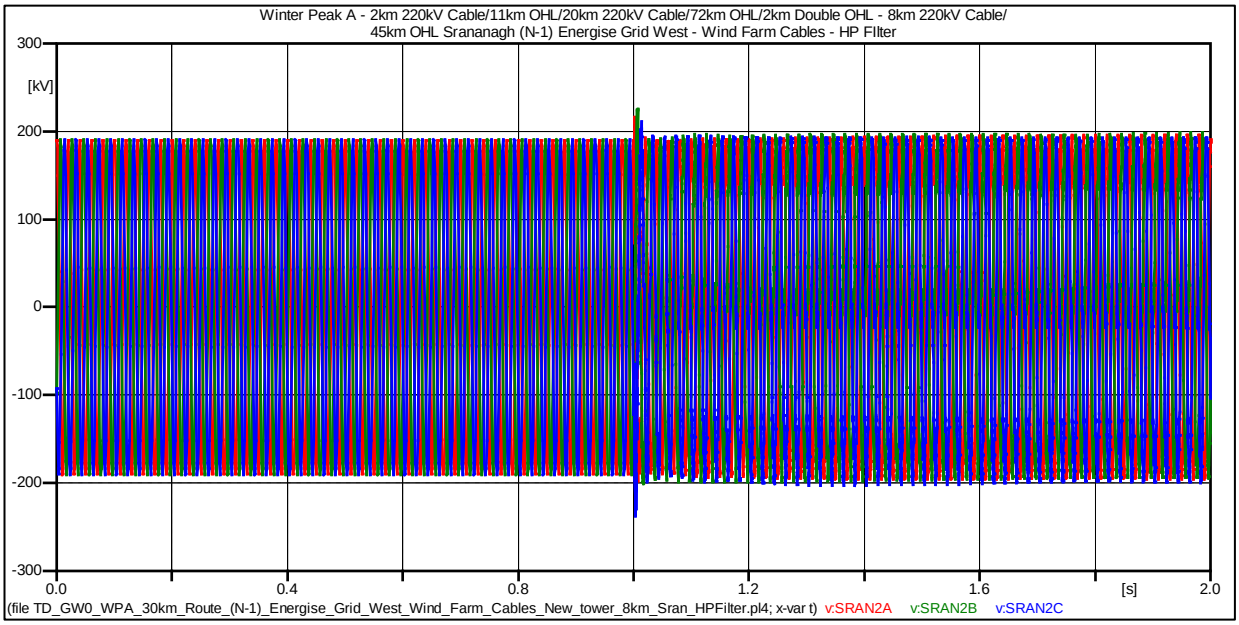

Figure 113: WPA - Length 30 km – Srananagh – Energise Grid West Cable (0-2s)

Condition	**Maximum Value**	**Limit**	**Result**
Switching	234.23kV (1.3043 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	201.01 kV (1.1193 pu)	287.32 kV(1.6pu)	Pass

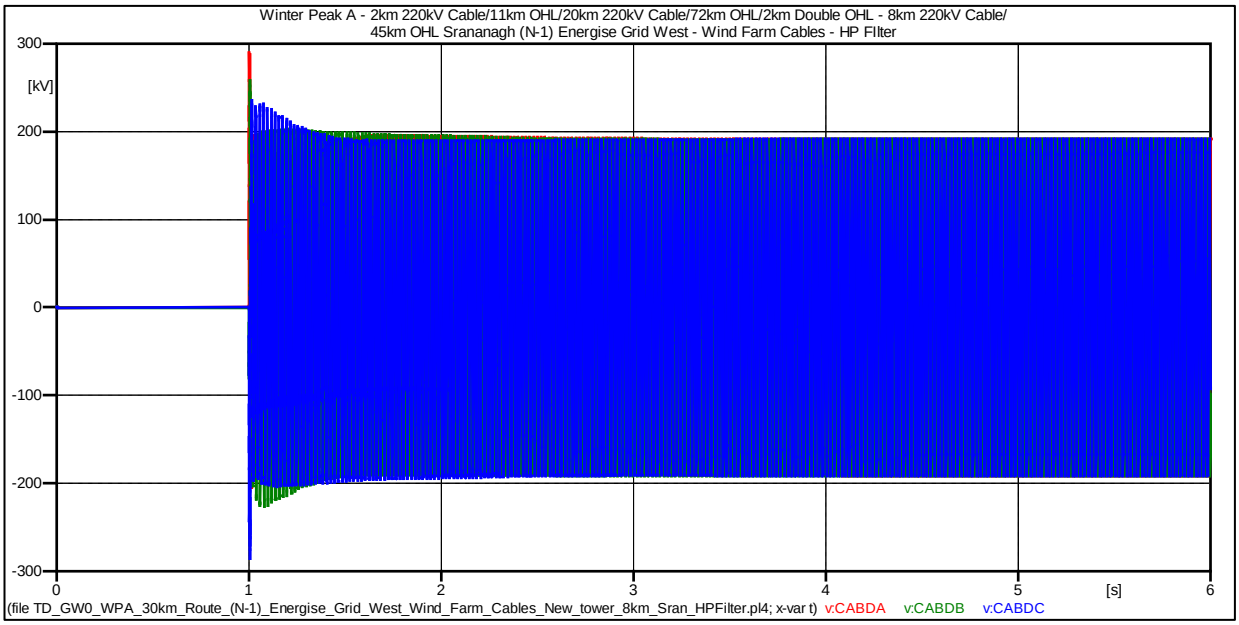

Figure 114: WPA - Length 30 km – Cable End D – Energise Grid West Cable (0-6s)

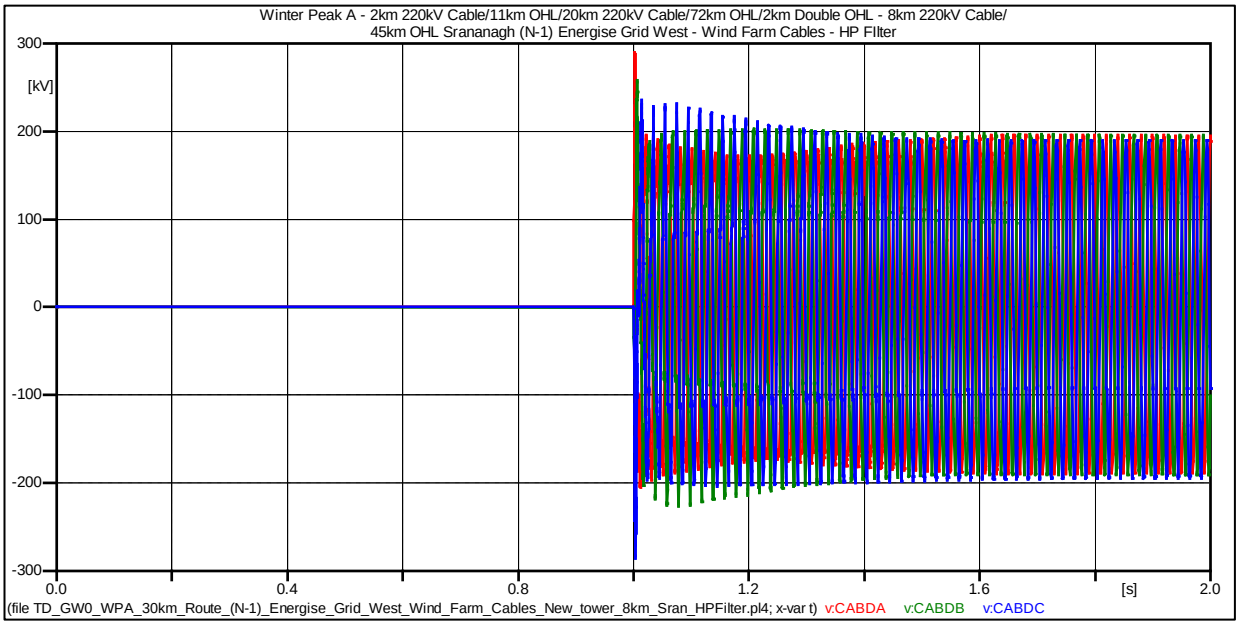

Figure 115: WPA - Length 30 km – Cable End D – Energise Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	271.89 (1.5140 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	229.89 (1.2801 pu)	287.32 kV(1.6pu)	Pass

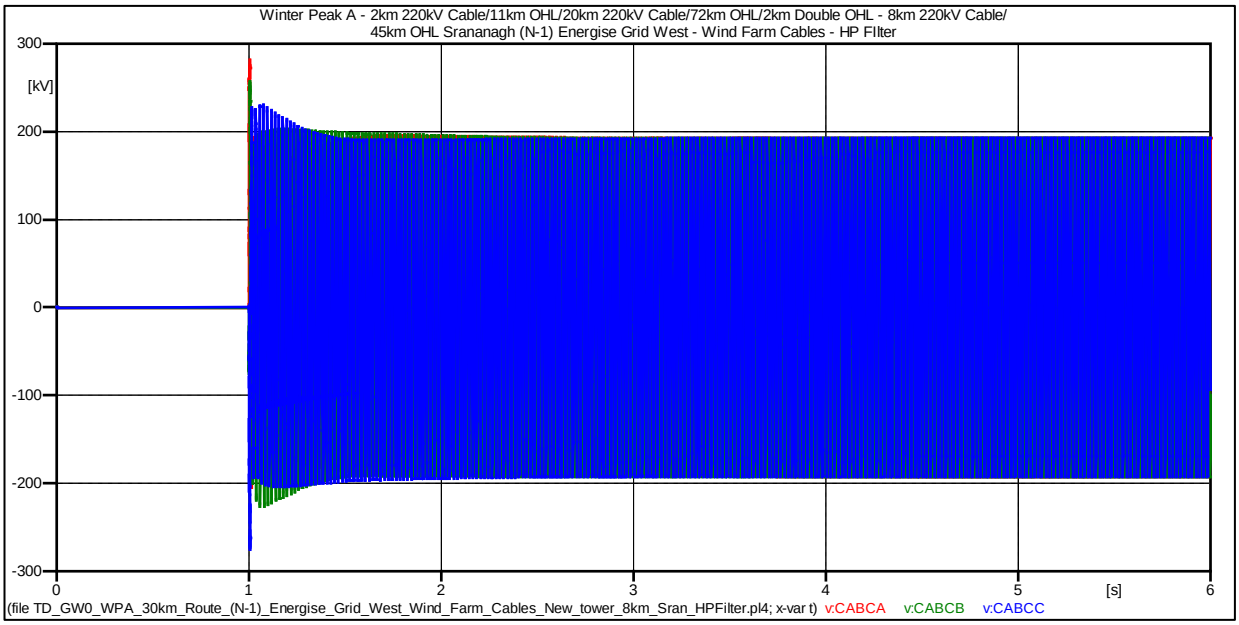

Figure 116: WPA - Length 30 km – Cable End C – Energise Grid West Cable (0-6s)

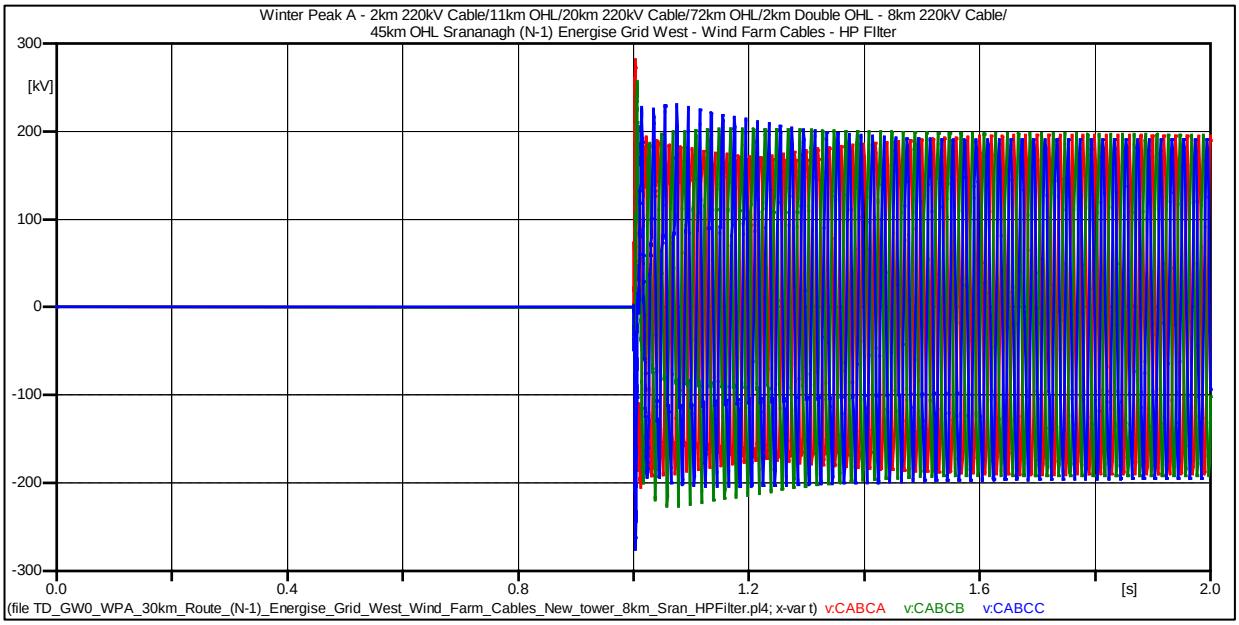

Figure 117: WPA - Length 30 km – Cable End C – Energise Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	274.63 kV (1.5292 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	226.89 kV (1.2634 pu)	287.32 kV(1.6pu)	Pass

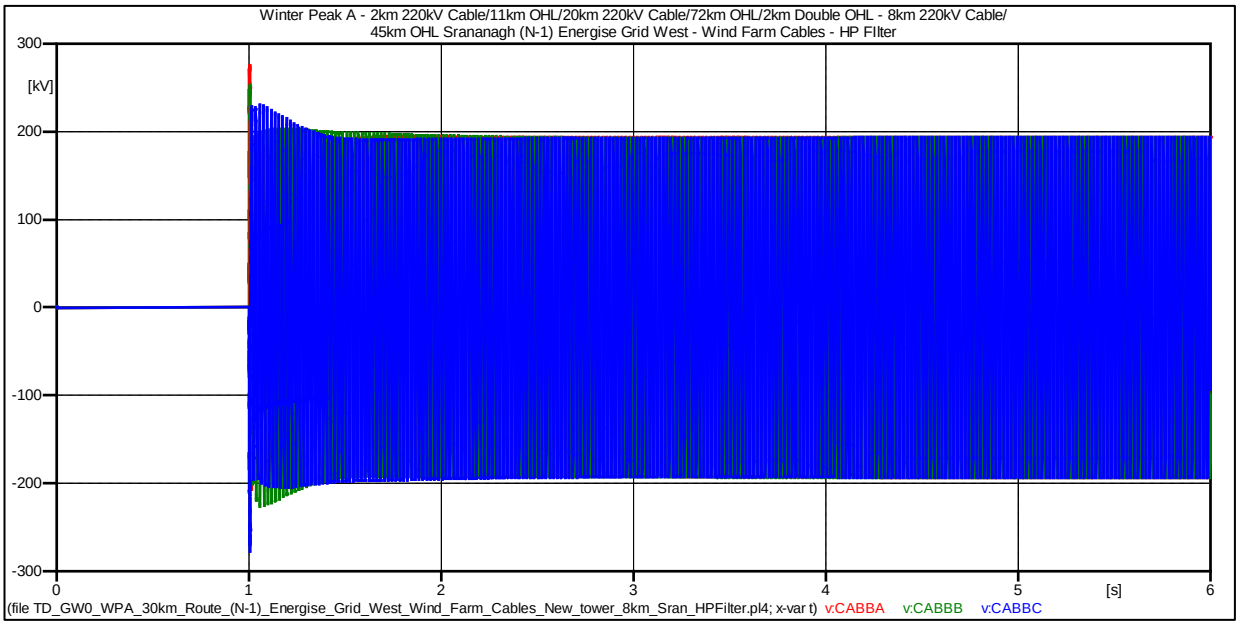

Figure 118: WPA - Length 30 km – Cable End B – Energise Grid West Cable (0-6s)

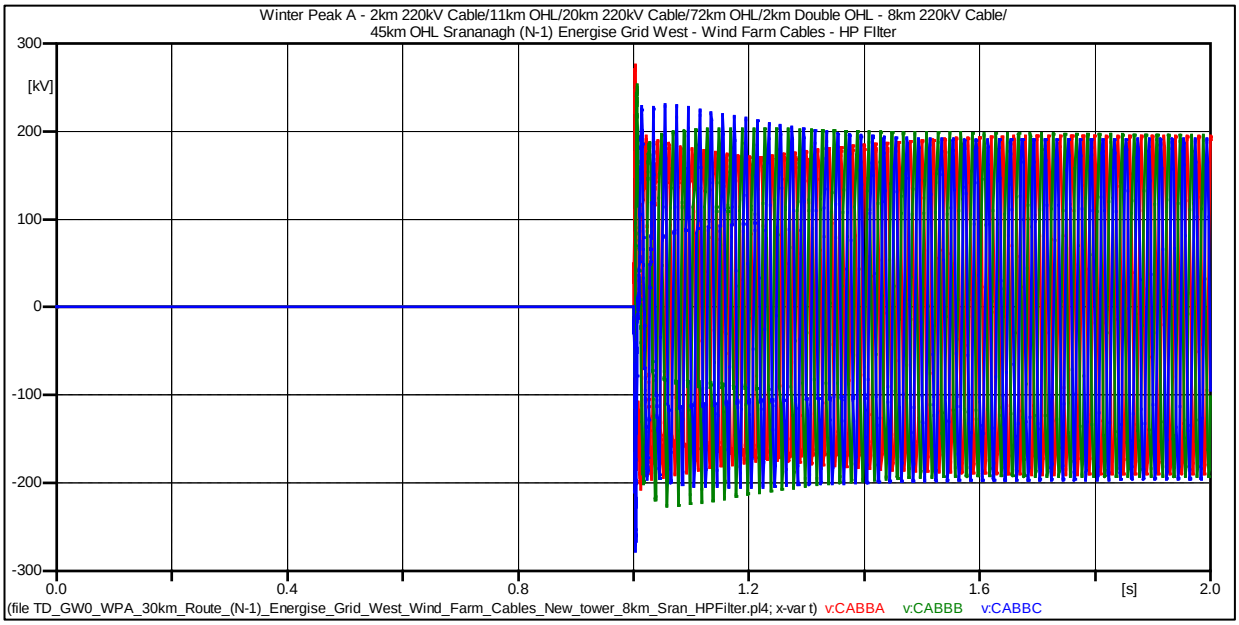

Figure 119: WPA - Length 30 km – Cable End B – Energise Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	276.65 kV (1.5405 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	228.67 kV (1.2733 pu)	287.32 kV(1.6pu)	Pass

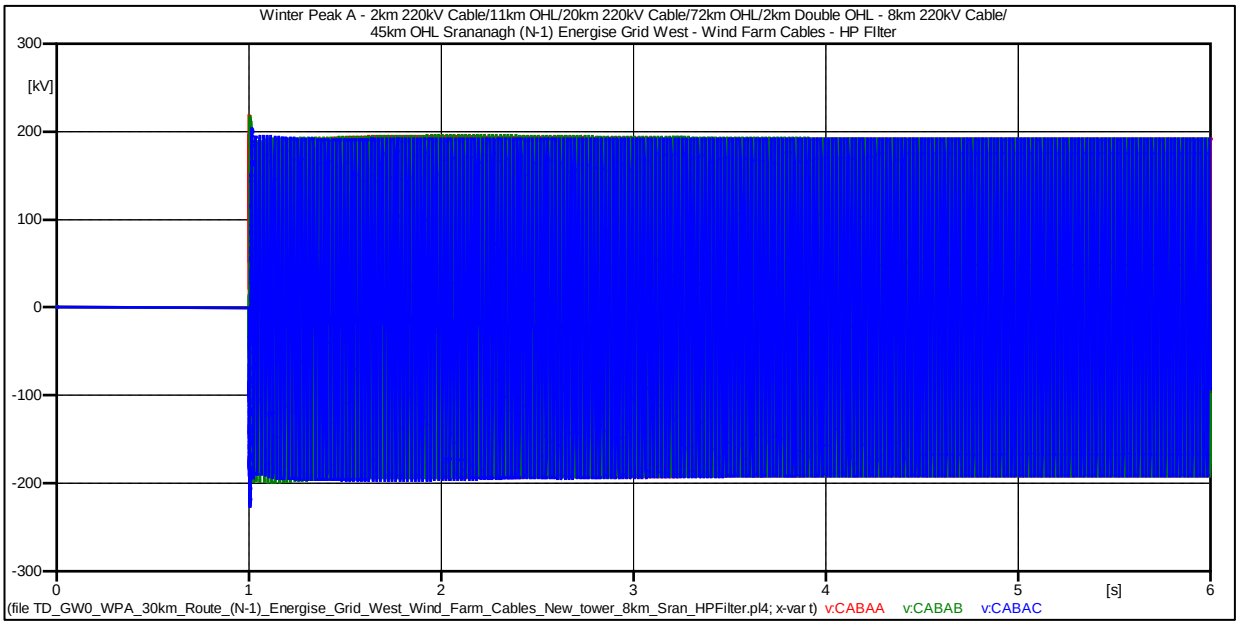

Figure 120: WPA - Length 30 km – Cable End A – Energise Grid West Cable (0-6s)

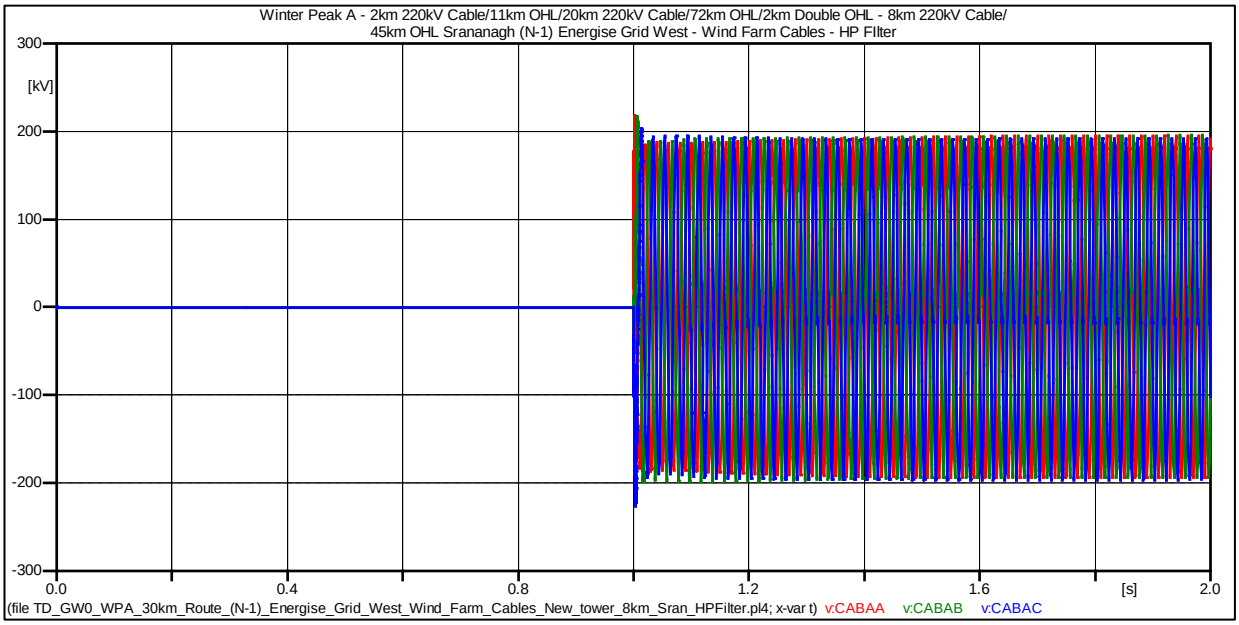

Figure 121: WPA - Length 30 km – Cable End A – Energise Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	219.78 kV (1.2238 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	N/A	287.32 kV(1.6pu)	Pass

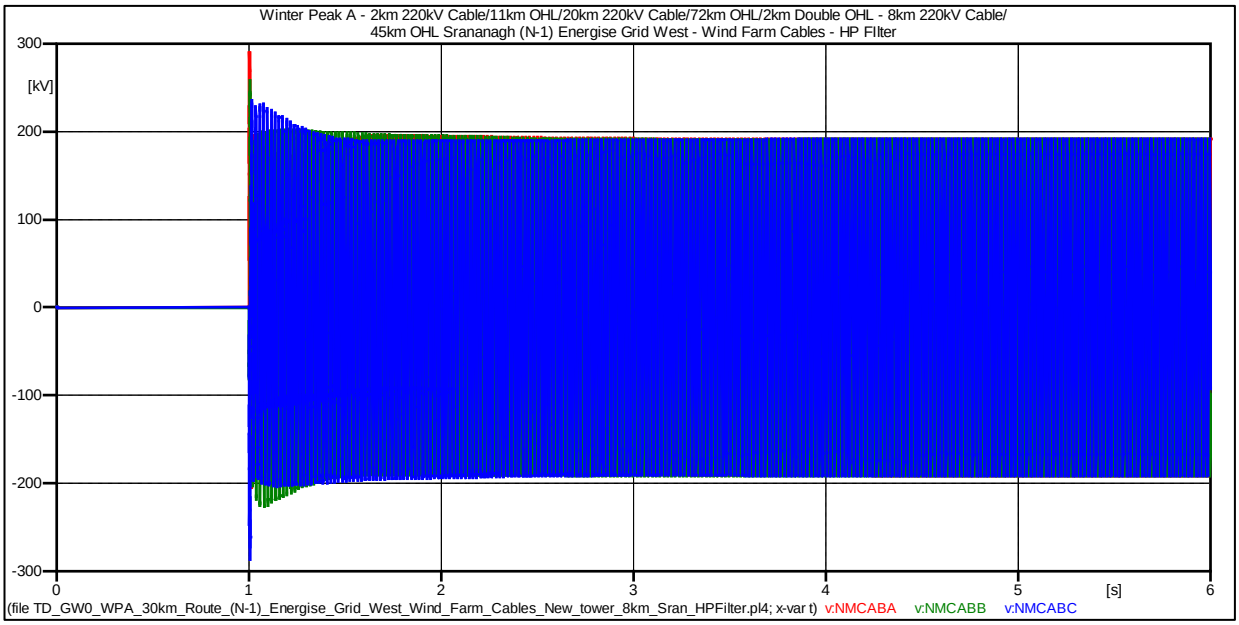

Figure 122: WPA - Length 30 km – North Mayo – Energise Grid West Cable (0-6s)

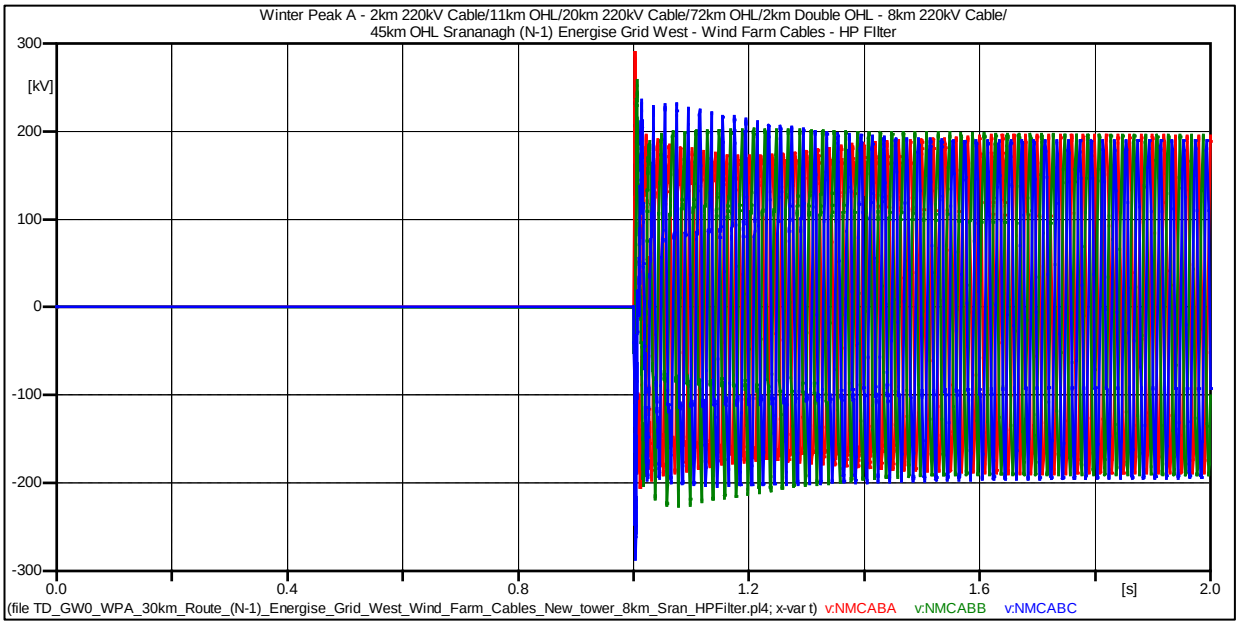

Figure 123: WPA - Length 30 km – North Mayo – Energise Grid West Cable (0-2s)

Condition	Maximum Value	Limit	Result
Switching	284.56 kV (1.5845 pu)	449.07 kV (2.5 pu)	Pass
Temporary Overvoltage	223.89 kV (1.2467 pu)	287.32 kV(1.6pu)	Pass