Paris Session 2022

Irish expirience on Cable Systems accessories, lesson learned

SC B1 Insulated Cables – PS1 – Q6
Cable System accessories reliability and QA

Daniele Giustini, Ireland

Cable accessories reliability and weather effects

Are Terminations / Joint Bays weather immune?

- While cable systems are generally not affected by weather conditions it shall be acknowledged that water ingress is one of most common reasons for joint bays and terminations faults. Abundance of water presence around JBs and terminations is somehow linked to weather conditions.

- According to CIGRE TB 379 for XLPE cables 0.048 fault/yr-100 components is the Failure rate for JB and .0.5 is for Terminations.

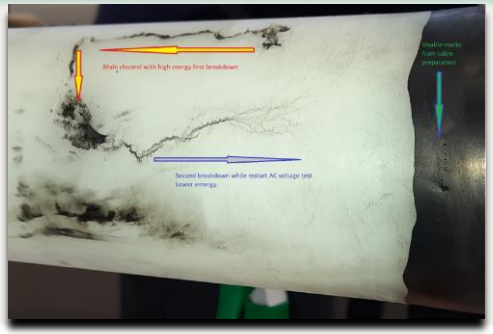
For a 50km 400kV cable system with JBs every 700m

Item	Failure Rate	Multiplier	Result	Comment
Cable	0.133	0.5	0.0665	50 km route, half of the 100 km failure rate
Joint	0.048	2.1429	**0.1029**	There are 214 Joints, FR*JBs/100
Termination	0.05	0.06	0.003	There are 6 sealing ends, FR*JBs/100

Table 11 Failure rates on the different types of AC land cable systems

		XLPE CABLES (AC)			SCOF CABLES (AC)		
A Failure Rate - Internal Origin Failures		60-219kV	220-500kV	ALL VOLTAGES	60-219kV	220-500kV	ALL VOLTAGES
Cable	Failure rate [fail./yr 100cct.km]	0.027	0.067	0.030	0.014	0.107	0.041
Joint	Failure rate [fail./yr 100 comp.]	0.005	0.026	0.005	0.002	0.010	0.004
Termination	Failure rate [fail./yr 100 comp.]	0.006	0.032	0.007	0.005	0.015	0.009
B. Failure Rate - External Origin Failures		60-219kV	220-500kV	ALL VOLTAGES	60-219kV	220-500kV	ALL VOLTAGES
Cable	Failure rate [fail./yr 100cct.km]	0.057	0.067	0.058	0.095	0.141	0.108
Joint	Failure rate [fail./yr 100 comp.]	0.002	0.022	0.003	0.002	0.004	0.002
Termination	Failure rate [fail./yr 100 comp.]	0.005	0.018	0.006	0.009	0.013	0.010
C. Failure Rate - All Failures		60-219kV	220-500kV	ALL VOLTAGES	60-219kV	220-500kV	ALL VOLTAGES
Cable	Failure rate [fail./yr 100cct.km]	0.085	0.133	0.088	0.109	0.248	0.149
Joint	Failure rate [fail./yr 100 comp.]	0.007	0.048	0.008	0.004	0.014	0.006
Termination	Failure rate [fail./yr 100 comp.]	0.011	0.050	0.013	0.014	0.028	0.019

Example



Possible reason from grinding with to high pressure so material melting and rubbed of.

Fault Repair and Installation Quality Assurance

Repair

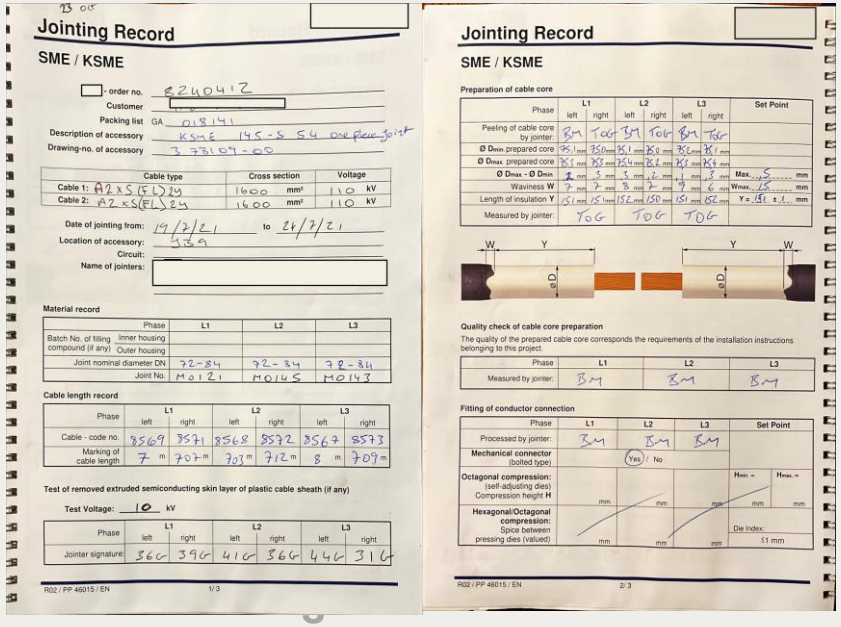
- A Joint Bay / Termination failure may lead to several weeks of unavailability of the circuit with consequential economical effects and system security issues. Civil works may be required to replace a joint depending on the joint bay design solution.
- Availability of qualified jointers and of replacing parts from the factory is the main reasons for the long repairing time.

QA

•A robust Quality Assurance process during manufacturing and installation reduces the probability of failures.

Irish requirements for jointing activity on transmission cables:

- Jointers to be certified by accessories manufacturers
- Jointer CV reviewed and accepted by TSO, min 5 years proven service
- Cable to be clamped for jointing
- Jointers to fill a QA report for every joint
- 10kV DC test on every joint with results recorded


Jointing Record

SME / KSME

Jointing Record

SME / KSME

Testing and Maintenance

Pre-Energisation tests

- Part of our commissioning procedure for transmission cables we perform an offline HV PD test on the entire cable system (connected end to end). Test is performed in accordance with IEC 60840 or IEC 62067 (test at 1.7 Uo at 50 Hz or 0.1 Hz. Results shall be within limits set by the cable manufacturer).
- we are introducing the LIRA test to our commissioning requirements.

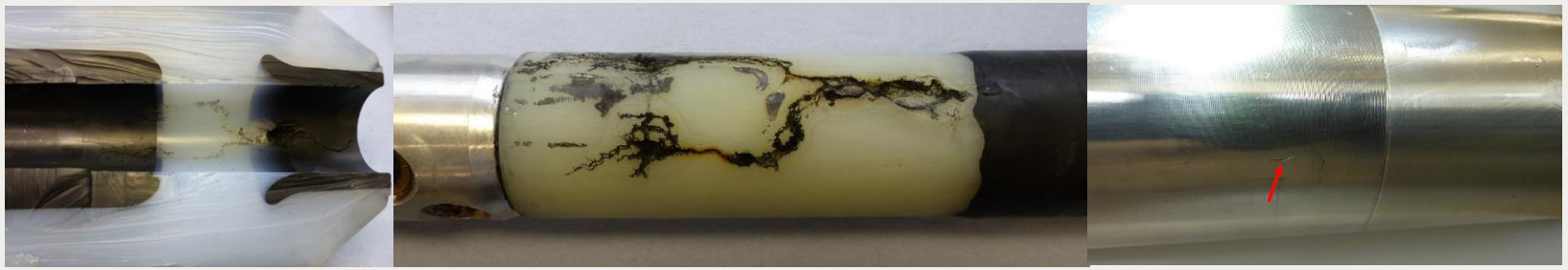
Operational Maintenance (recurring tests post Energisation)

- During Energisation we soak all cable for 24hrs with sat down settings for System security reasons. During this test we also perform an online HV PD test using the system voltage and recording PD activity for 24hrs.

The Online HV PD test is repeated every 3 years using the same test equipment. This provide a valuable health check for the cable system, especially for the Joint Bays and Terminations.

Suspicious PD activity would lead to repetition of the test with a shorter interval, if PD activity continue to increase with time the joint is replaced as a schedule task (preventing a potential catastrophic failure and reducing the time the circuit will be out of service).

Example ➡



The scratches in the insulation resulted from a sharp protrusion at a gouge in the conductor connector.