

## 150 kV gas pressure cable systems in the Netherlands: Experienced systems

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In the Netherlands the majority of 150 kV external gas pressure cables were installed during the 70 ties and the early 80 ties. The current total amount of gas pressure cable is 160 km. Nowadays some systems are more over 40 years of age and still in service.

For a few years ago a national survey was conducted with respect to gas pressure cables; addressed topics:

- Historical events
- Quality aspects
- Current rating
- Grid operating aspects
- Remaining life time

Besides the paper study also a pilot retro-fitting project of gas pressure cables was executed. In this retro-fitting project, the first 150 kV three core plastic type cable was pulled into the existing steel pipe. This 'new circuit in an old jacket' is now in service over 4 years with good behavior. The proof of principle is delivered and retro-fitting with plastic cable is a good alternative to re-use the existing steel pipes with much higher loading capabilities. Furthermore a lot of civil construction experience was gained with respect to pull forces, flexibility, side wall pressure and arrangement of joint bays.

Recently unscheduled outages of gas pressure cable occurred which ignited the internal discussion "Are we encountering the end-of-life-time' of the matured gas pressure cable systems?". Since the 150 kV cable grid is developed for [N-2] the unscheduled outages do not lead to black-outs of the grid. During the repair a failure investigation was conducted in order to determine the cause of failure and to stipulate knowledge rules for the future use of the cable systems. In the failure analysis each cable phase was described layer-by-layer, the quality of paper, the quality of the impregnate oil, the grain structure of the lead sheath and tandelta was observed. Some interested things could be concluded.

In the paper all aspects from above will be described in detail for the whole population of external gas pressure cable and two case studies with respect to retro-fitting and failure analysis.