North Auckland and Northland 220kv cable project - Managing thermo-mechanical forces in large conductor XLPE cable circuits

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This paper describes the thermo-mechanical design aspects of the North Auckland and Northland (NAaN) 37 km long, 220kV cable project to provide security of supply to Auckland, the largest city in New Zealand. The city occupies a narrow isthmus between the Manukau Harbour on the Tasman Sea to the southwest and the Waitemata Harbour on the Pacific Ocean to the east. The cable route is geographically challenging as it passes between North and South Auckland, which are connected by the Auckland Harbour Bridge.

The cable route comprises four sections of 220kV underground circuits of large conductor XLPE insulated cables that link existing and new substations. The project installation work commenced in 2005. Commissioning was completed in February 2014.

The NAaN cable project will be of interest to utilities and cable designers worldwide as its route combines major section lengths of each type of thermo-mechanical installation design and the transition sections that connect them:

1. 16.4 circuit km of 2,500 mm^2 cable installed semi-flexibly in unfilled ducts laid beneath a public transport busway.
2. 1.4 circuit km of 1,600 mm^2 cable installed flexibly underneath Auckland Harbour Road Bridge.
3. 9.0 circuit km of 2,500 mm^2 cable installed both flexibly and rigidly in a shared, ventilated cable tunnel underneath the Central Business District.
4. 9.0 circuit km of 2,500 mm^2 of cable installed semi-flexibly in unfilled ducts, but including two cable bridges

In view of the large conductor sizes, and the range of flexible and fixed installation methods, the transmission utility, Transpower, required that the thermo-mechanical forces generated by the cables be adequately evaluated and mitigated by sound installation engineering.

The paper describes:

1. Engineering approaches taken to manage the thermo mechanical forces and movements, from the initial design phase through to final commissioning.
2. Techniques to measure the cable parameters, to FEA model the thermo-mechanical installations and to prove the installation designs.

Key words: XLPE cables; Thermo-mechanical Forces;