Summary

Table 3-12. Summary of Nexans Lo-Sag CFCC conductor's performance

Composite	Test temp	Endurance test	Breaking Load test	Tg and Bending mechanical test
Nexans (2011)	180±5°C	Pass	Pass (UTS equal to 129.4% RBS)	Pass Tg(final)-Tg(initial) ~1°C

Mercury Cable HVCRC (2010)

In this test, the conductor HVCRC was installed and subjected to the same thermal and mechanical stresses as CTC conductor. It was the first qualification test undertaken on the Mercury cable conductor. The technical specifications of the conductor are provided below.

Table 3-13. Technical specifications for Mercury cable conductors

Conductor	Type	Core	Aluminum	Overall Diameter	Kcmil	Core Diameter	RBS (lbf)	Connectors
Mercury Cable / GC	HVCRC/ TW	Single composite glass and fiber core	Two layers of 22 fully annealed trapezoidal AL alloy strands	1.108 inch (28.15 mm)	1020	9.53 mm	41,000	FCI/Burndy

Endurance Test

The HVCRC/TW test assembly completed 100 thermo-mechanical cycles. The HVCRC/TW test conductor had about 7-10°C lower steady-state temperature (190-193 °C) then the ACCC/TW conductor. This might be since HVCRC/TW conductor had loose strands in the outer layer because of forward crimping compression dead-ends. During tensioning the HVCRC/TW test assembly to 70% RBS (28,700 lbf), the test tension dropped suddenly to zero. The HVCRC/TW conductor was not pulled apart, but a cracking sound was noticed at the south compression dead-end along with carbon fiber odor. It was suspected that the composite core slipped in the south dead-end. After this, this test assembly was removed from the test program, and it was dissected.

Photo showing the HVCRC/TW conductor and core condition taken after 100 thermo-mechanical cycles is given in Figure 3-22. No bird caging was noticed during the first 100 thermo-mechanical cycles. The core was not broken or cracked between compression dead-ends. The color of the core did not change significantly (like the core in new condition) after being exposed to 100 thermo-mechanical cycles.

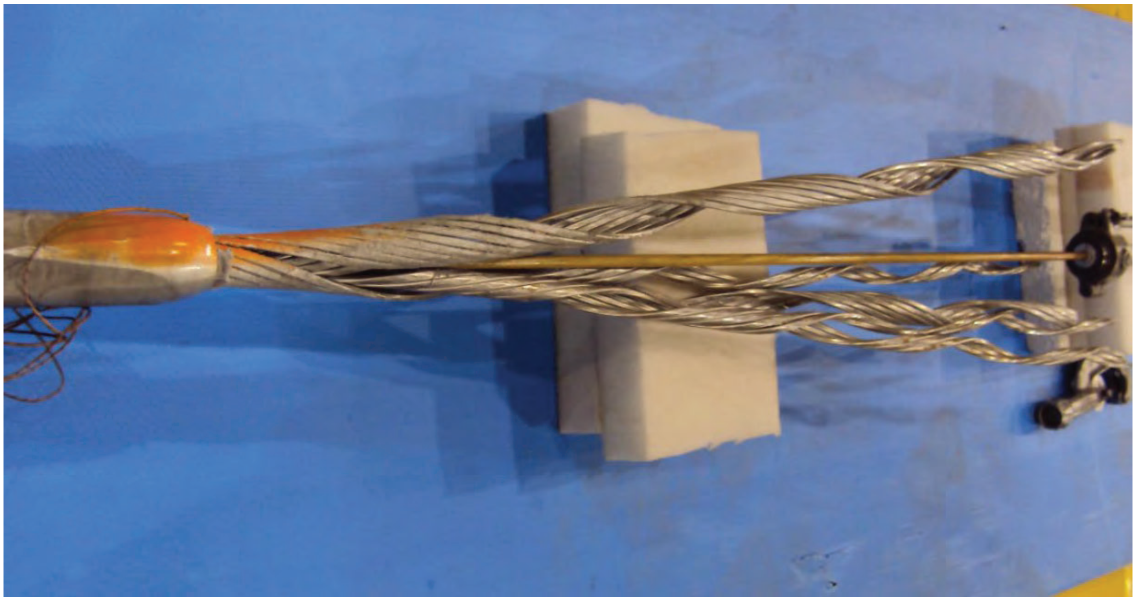

Figure 3-19. Core of HVCRC/TW test conductor near south dead-end after failure

The overall temperature measurements taken from the compression connectors used in the test show that the dead-end pad and eyebolt crimp had very similar temperatures as the connecting jumper terminal during testing. The temperature of dead-end connector pad, eyebolt crimp and connecting jumper connector was in the range of ~43-51 °C. This is lower than the box temperature since the jumper connector and terminal pad of the dead-end were located outside the box. The entrance (mouth) of the dead-end connector had the highest temperature along the length of the connector and was in range of 72-78 °C. This represents a thermally stable connector, considering that the temperature variations are also influenced by changes in the ambient temperature. The connector temperature at the electrical crimp was in range of 62-70 °C during the first 100 thermo-mechanical cycles. After 100 thermo-mechanical cycles, the connector showed some slippage at the south dead-end based on the orange marking paint. This may not represent the total slippage experienced by the composite core.

Initial and Final Characterization of the Composite Core – Diagnostic Tests

Two tests were done in the case of Mercury cable conductors during 2010. Tg measurement and bending mechanical test to analyze the limit to the practical operating temperature and mechanical performance of the HVCRC/TW conductors.

T_g Test

Table 3-14 shows both initial and final DMA results of Mercury cable core. An increase of about 12°C occurred in the Tg results from the initial value. This last result can be assumed from an annealing of the resin during the endurance test, contributing to an increase of the Tg.

Table 3-14. DMA Results for the Mercury Cable Core

Section	Tg (°C)
Initial	148.7±0.1
Center	164.5±0.8
North of Center	162.8±0.6
South of Center	160.5±2.3

Bending Mechanical Test

The result of the initial and final bending mechanical test of Mercury cable sample is shown in Table 3-15. The overall results of mechanical measurements indicate there is no change in the properties of the HVCRC/TW conductor, taking the experimental tolerance into consideration.

Table 3-15. Mercury Cable HVCRC/TW bending mechanical test results

Section	Max α (MPa)	Max Deflection (mm)	E (Gpa)
Initial	624.08 ± 24.9	1.9 ± 0.1	46.9 ± 1.0
Center	636.7 ± 30.6	2.0 ± 0.2	48.0 ± 1.5
North of Center	589.6 ± 77.5	1.8 ± 0.4	46.8 ± 1.9
South of Center	628.5 ± 47.1	1.8 ± 0.3	48.8 ± 1.9

Summary

Table 3-16. Summary of Mercury cable HVCRC/TW conductor performance

Composite	Test temp	Endurance test	Breaking Load test	Tg and Bending mechanical test
Mercury cable (2010)	180±5 °C	Fail (Core failed at 100 cycles. Mechanical failure due to the slippage of the conductor out of the deadend joint)	N/A	Pass Tg(final)-Tg(initial) ~12°C

TS Conductor (@160C)

This chapter describes the qualification test conducted on a TS carbon fiber composite core conductor. The technical specification of the TS CFCC conductor is provided in Table 3-17. The specialty of this conductor is the aluminum encapsulation around the core which acts as a barrier.