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LR F2384

Short Circuit Testing of Stainless Steel Cable Ties

Atle Lenes

September 2004

TEST REPORT

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TITLE

Short Circuit Testing of Stainless Steel Cable Ties

TEST CONDUCTED BY (AUTHOR(S))

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CLIENT(S)

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RESPONSIBLE

Rolf Hegerberg, Laboratory Manager

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TEST LOCATION

High Current Laboratory, SINTEF Energy Research

TEST OBJECT

Stainless steel ball-locking cable ties: Single loop MLT*SH-LP316 and double loop MLT*DSH-LP316. Cable ladder of stainless steel: Øgland OE100-300SS. Cables: RFOU 6/10 (12) kV P3 1*240 and RFOU 12/20 kV 1*300K-H16

TEST OBJECT RECEIVED

5. July 2004

TEST PROGRAM

Test for resistance to electromechanical forces during short circuit according to prEN 50368 "Cable cleats for electrical installations", chapter 9.4 (Prelimenary).

DATE OF TEST

6. -7. July 2004

SUMMARY

Testing of short-circuit stresses were performed on three installations of single core cables mounted in trefoil on a cable ladder. The cable ties were fastened to the rung at a distance of 0,6 m. The duration of each short-circuit was 0,1 second. The installation with copper conductor cross section of 300 mm^2 and double loop cable ties were tested with two short-circuits with maximum momentary value of 71,5 kA and 69,2 kA respectively. The installation with copper conductor cross section of 240 mm^2 and double loop cable ties were tested with one short-circuit with a maximum momentary value of 63,2 kA. The installation with copper conductor cross section of 240 mm^2 and single loop cable ties were tested with one short-circuit with a maximum momentary value of 53,0 kA.
The results from the tests showed that the trefoil cable runs did withstand the stresses without significant damages/deformations of the cable and ladder. Two of the cable ties were to some extent loose but not damaged.

The test results relate only to the items tested

KEYWORDS

SELECTED BY AUTHOR(S)		
	Short-circuit	Cable Ties
	Trefoil	Cables

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1 PURPOSE OF THE TEST

The purpose of the test was to examine the cables ties capability to withstand the stresses during short-circuit. The tests will also give information on visible damages/deformations on the cables after short-circuit.

2 TEST OBJECT

Single core cables mounted in trefoil on a cable ladder. The cable ladder of stainless steel was of make: Øglænd OE100-300SS with a length of 3 m and a width of 0,3 m. The cable ties were supplied with a cushion sleeving (black vinyl sleeving) that was mounted between the cable tie and the cables. Every cable tie was fastened to the rung by mounting the cable tie through the holes in the rung. An installation tool (RT1HT Ratchet style tool for high tension) was used to tighten the cable ties during installation. At the short-circuit busbar and at the supply busbar cord lashings were mounted to prevent rupture at the ends. The cable ties and spans close to the cord lasing will not be considered in this report due to end conditions. The cables were connected to a transformer with a voltage of 115 V and a frequency of 50 Hz.

2.1 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 300 MM^2 AND DOUBLE LOOP CABLE TIES

Figure 1 shows the installation with single core cables, RFOU 12/20 kV 1*300K – H16 mounted on the ladder. Double loop cable ties with cushion sleeving were used. Cable ties were mounted on every second rung with a distance of 0,6 m.

Figure 1: 300 mm^2 cable installations. Double loop cable ties with cushion sleeving mounted with a distance of 0,6 m.

2.2 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 240 MM^2 AND DOUBLE LOOP CABLE TIES

Figure 2 shows the installation with single core cables, RFOU 6/10 (12) kV P3 1*240 mounted on the ladder. Double loop cable ties with cushion sleeving were used. Cable ties were mounted with a distance of 0,6 m.

Figure 2: 300 mm^2 cable installations. Double loop cable ties with cushion sleeving mounted with a distance of 0,6 m.

2.3 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 240 MM^2 AND SINGLE LOOP CABLE TIES

Figure 3 shows the installation with single core cables, RFOU 6/10 (12) kV P3 1*240 mounted on the ladder. Single loop cable ties with cushion sleeving were used. Cable ties were mounted on with a distance of 0,6 m.

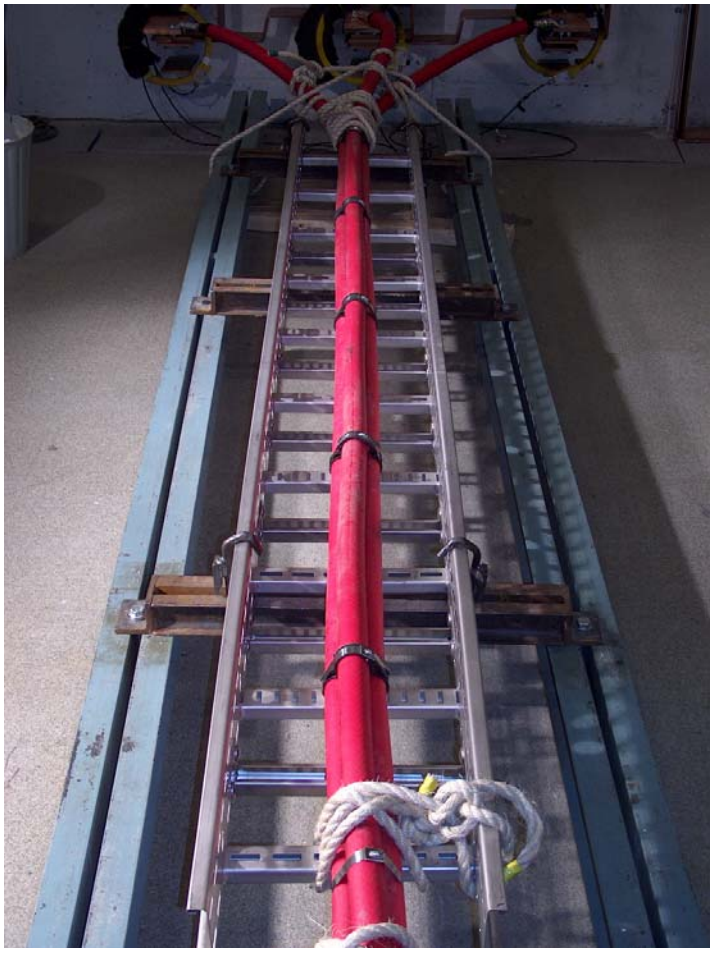

Figure 3: 240 mm^2 cable installation. Single loop cable ties with cushion sleeving mounted with a distance of 0,6 m.

3 TEST RESULTS

3.1 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 300 MM^2 AND DOUBLE LOOP CABLE TIES

Cables in trefoil configuration are subjected to three-phase short-circuit currents. A short-circuit with a maximum momentary value of 71,5 kA was performed on the installation. After inspection no significant damages/deformations were found. A second short-circuit with approximately the same maximum momentary value was performed on the installation. The result showed that the cable ties were capable to withstand two short-circuits without any adjustments on the cable ties. One of the cable ties was to some extent loose, but not damages. Figure 5 shows the installation after two shoots.
The test short-circuit currents are characterised by the maximum momentary value, i_p, the initial rms symmetrical current, I''_k and the steady state rms value, I_k. The calculations of the short-circuit current are based on IEC 609009-0. Characteristic values of the short-circuit currents for both shoots are shown in Table 1.

Table 1: The characteristic values of the short-circuit currents for 300mm^2 installation. Double loop cable ties with cushion sleeving.

Short-circuit no.	Distance between cleats [mm]	Max. momentary value, i_p [kA]	Initial RMS symmetrical current, I''_k [kA]			Steady state RMS current, I_k [kA]		
			R	S	T	R	S	T
1	600	71,5	41,4	35,0	42,4	37,2	33,0	40,0
2	600	69,2	40,7	33,5	40,6	36,9	32,4	38,9

Figure 4: 300 mm^2 cable installations after two short-circuit. Double loop cable ties with cushion sleeving mounted with a distance of 0,6m.

3.2 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 240 MM^2 AND DOUBLE LOOP CABLE TIES

Cables in trefoil configuration are subjected to three-phase short-circuit currents. A shoot with a maximum momentary value of 63,2 kA was performed on the installation. After inspection no significant damages/deformations were found. The results showed that the cable ties were capable to withstand one short-circuit. One of the cable ties was to some extent loose, but not damages. Figure 5 shows the installation after the shoot. Characteristic values of the short-circuit currents are shown in Table 1.

Table 2: The characteristic values of the short-circuit currents.

Short-circuit no.	Distance between cleats [mm]	Max. momentary value, i_p [kA]	Initial RMS symmetrical current, I''_k [kA]			Steady state RMS value, I_k [kA]		
			R	S	T	R	S	T
1	600	63,2	38,5	31,8	39,2	35,5	30,9	36,9

Figure 5: 300 mm^2 cable installations after one short-circuit. Double loop cable ties with cushion sleeving mounted with a distance of 0,6 m.

3.3 INSTALLATION OF CABLES WITH COPPER CONDUCTOR CROSS-SECTION OF 240 MM^2 AND SINGLE LOOP CABLE TIES

Cables in trefoil configuration are subjected to three-phase short-circuit currents. A shoot with a maximum momentary value of 53,0 kA was performed on the installation. After inspection no significant damages/deformations were found. The results showed that the cable ties were capable to withstand one short-circuit. Figure 5 shows the installation after the shoot. Characteristic values of the short-circuit currents for both shoots are shown in Table 3.

Table 3: The characteristic values of the short-circuit currents.

Short-circuit no.	Distance between cleats [mm]	Max. momentary value, i_p [kA]	Initial RMS symmetrical current, I''_k [kA]			Steady state RMS value, I_k [kA]		
			R	S	T	R	S	T
1	600	53,0	30,0	26,5	33,2	27,0	24,4	29,7

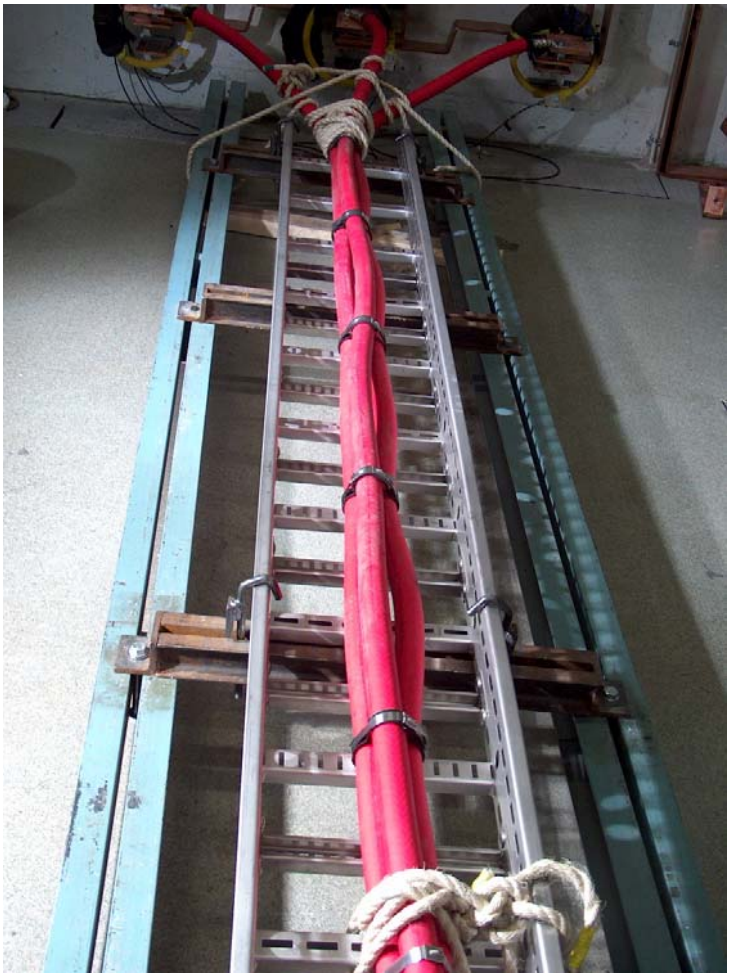

Figure 3: 240 mm^2 cable installations after one short-circuit. Single loop cable ties with cushion sleeving mounted with a distance of 0,6 m.

APPENDIX A1

RECORDING OF SHORT CIRCUIT CURRENTS

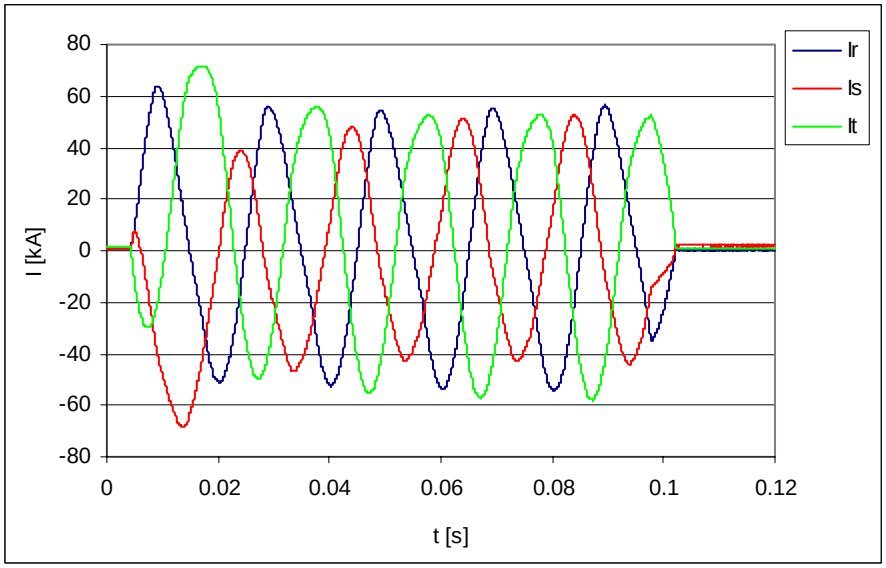

Figure A.1: Short circuit currents for installation of cables with copper conductor cross-section of 300 mm^2 and double loop cable ties. Short-circuit no.1.

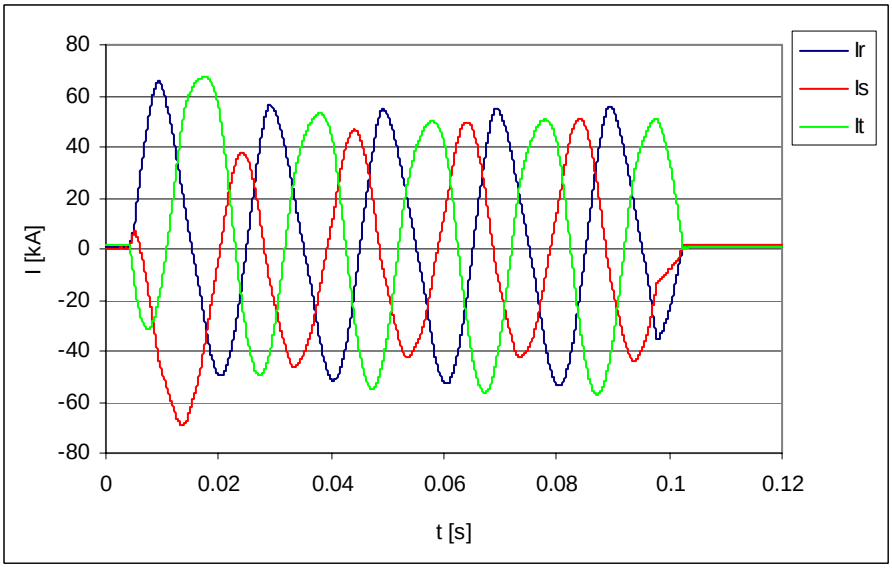

Figure A.2: Short circuit currents for installation of cables with copper conductor cross-section of 300 mm^2 and double loop cable ties. Short-circuit no.2.

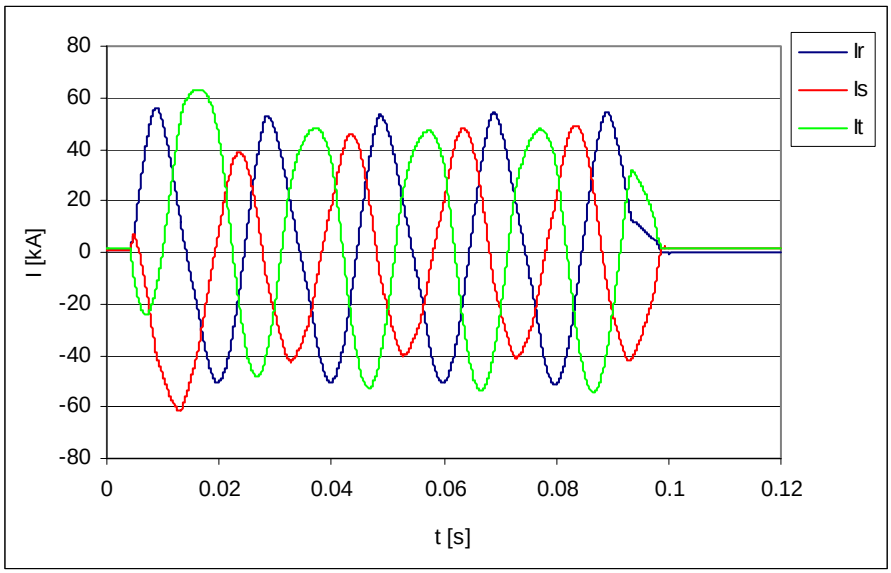

Figure A.3: Short circuit currents for installation of cables with copper conductor cross-section of 240 mm^2 and double loop cable ties.

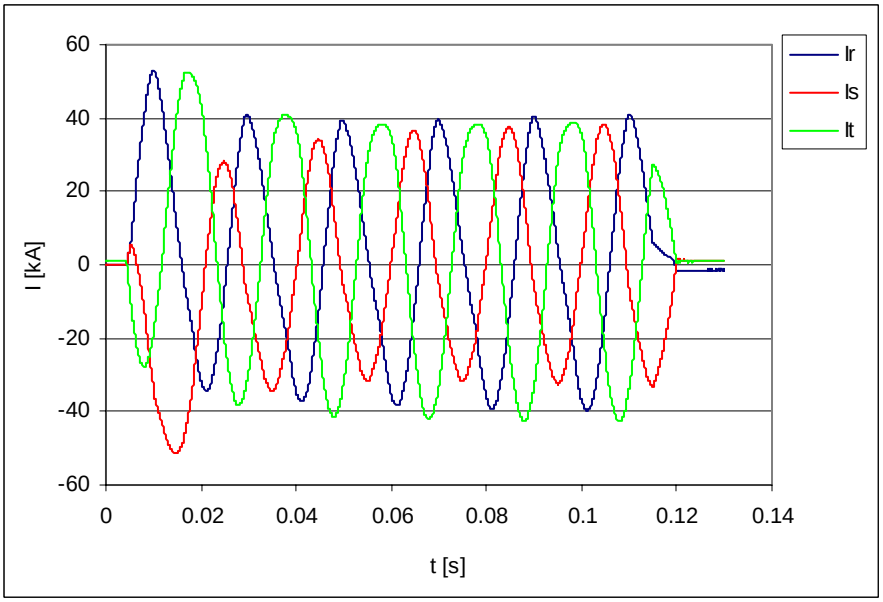

Figure A.4: Short circuit currents for installation of cables with copper conductor cross-section of 240 mm^2 and single loop cable ties.