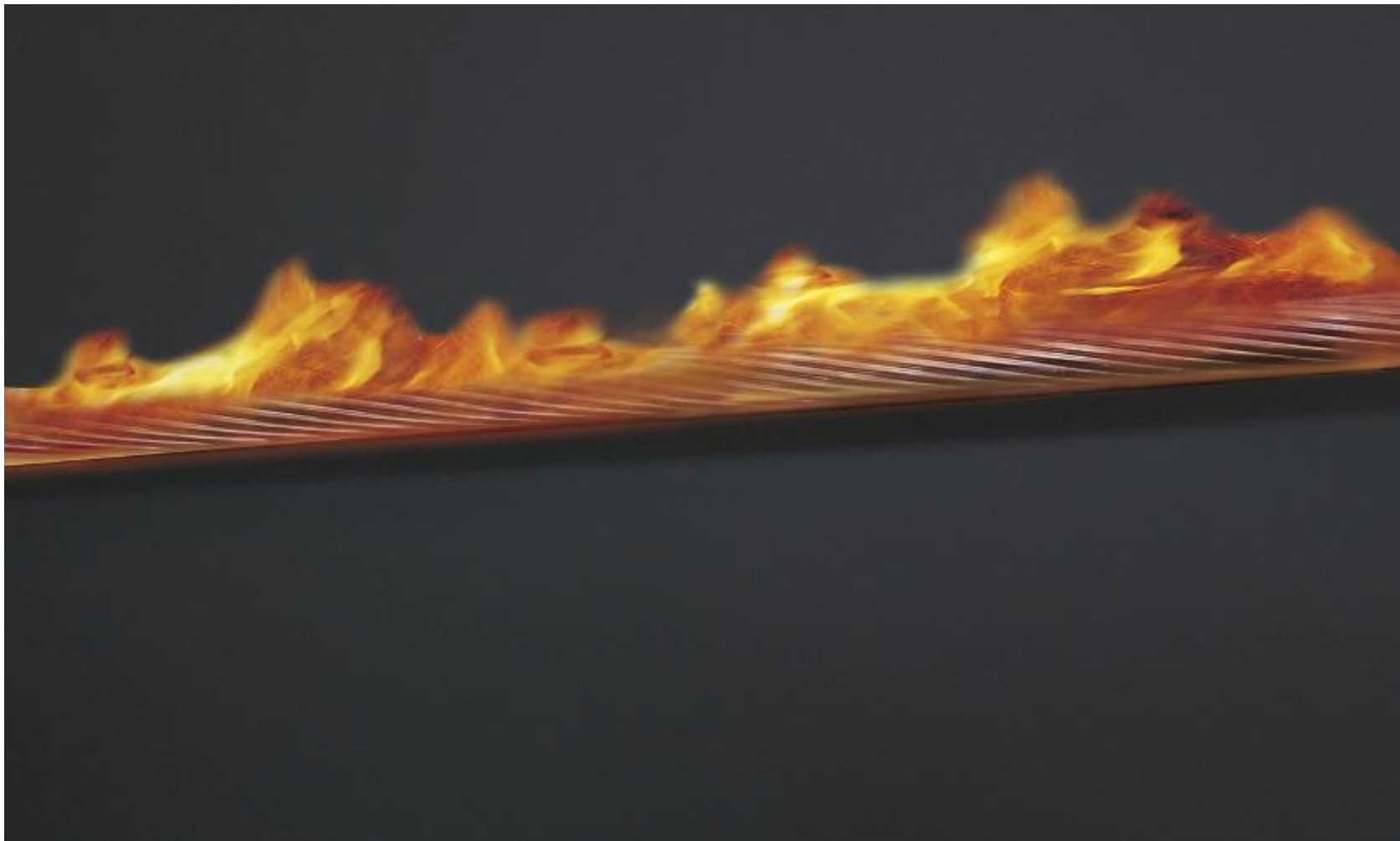




## Pilot project - high temperature low sag conductors

Stockholm 21 may 2010 Steffen Kupke

hot conductors, the future?



## Pilot project high temperature low sag conductor – definition of the project

- transmission capacity of the existing line should be doubled.
- sag should not be increased.
- towers may not be overloaded statically.
- same diameter as the existing conductor.
- system should be reliable and economic.
- line section should be accessibly, but without crossroads.

## Pilot project high temperature low sag conductor

- 110-kV-line Heide – Ostermoor/West
- line section tower 104 – portal Ostermoor/West
- length of line section circa 1 km
- existing conductor 2 systems Al/St 230/30 (ACSR) – max. ampacity 630 A
- replace northern system with ACCR conductor by 3M
- replace southern system with ACCR conductor by CTC/Lamifil



# 3M ACCR installations worldwide

abstract reference  
list

3M ACCR Installations	Application	kV	Conductor Size	
			(kcmil)	(mm <sup>2</sup> )
<a href="#">TATA Power</a>	Mumbai, India Load growth Dense population	110	300	150
<a href="#">Xcel Energy</a>	Minneapolis, Minnesota Installation validation	115	477	238
<a href="#">Hawaiian Electric Company</a>	Oahu, Hawaii Corrosive environment	46	477	238
<a href="#">Western Area Power Administration</a>	Fargo, North Dakota Heavy ice and wind loads	230	795	418
<a href="#">Bonneville Power Administration</a>	Washington State High temperature operation	115	675-TW	322-TW
<a href="#">Western Area Power Administration</a>	Phoenix, Arizona Installation validation	230	1272	642
<a href="#">Salt River Project</a>	Phoenix, Arizona High current operation	69	795	418
<a href="#">Pacific Gas &amp; Electric</a>	Santa Clara, California High temperature operation	115	477	238
<a href="#">San Diego Gas &amp; Electric</a>	San Diego, California EPRI test	69	795	418
<a href="#">Xcel Energy</a>	Minneapolis, Minnesota Environmentally sensitive area River crossing	115	795	418
<a href="#">Arizona Public Service</a>	Phoenix, Arizona Dense population Underbuilds	230	1272	642
<a href="#">Western Area Power Administration</a>	Arizona/California Border High growth	230	795	418
<a href="#">Shanghai Electric</a>	Shanghai, China Cost and time savings	115	795	418
<a href="#">Platte River Power Authority</a>	Fort Collins, Colorado Increased reliability	230	954	490
<a href="#">Aha Macay Power Services</a>	Needles, California Increased reliability	69	300	150
<a href="#">Allegheny Power</a>	West Virginia Underbuilt facilities Cost and time savings	138	1033	525
<a href="#">British Columbia Transmission Company (BC Hydro)</a>	British Columbia River Crossing	230	788	400
<a href="#">Alabama Power</a>	Birmingham, Alabama Underbuilt facilities Load growth	230	680	346
<a href="#">Silicon Valley Power</a>	City of Santa Clara, CA Environmental and aesthetics Reliability	60	715	365
<a href="#">Chongqing</a>	Chongqing, China Load growth Time savings	220	680	346

Since 2002 about 1175 km of conductor were installed in 8 countries

# CTC ACCC installations worldwide

## abstract reference list



reference list - ACCC overhead conductors

year	type	designation	al section	number of strands		quantity		customer	end user	country
			[mm <sup>2</sup> ]	core	aluminium	[tonne]	[km]			
2007	ACCC	Brussels	430	1	20	453	355	CTC Cable Corp	CTC Cable Corp	United States
2007	ACCC	Amsterdam	380	1	20	119	107	CTC Cable Corp	CTC Cable Corp	United States
2007	ACCC	Lisbon	325	1	16	332	347	CTC Cable Corp	CTC Cable Corp	South Africa
2007	ACCC	Copenhagen	230	1	16	54	81	CTC Cable Corp	CTC Cable Corp	United States
2008	ACCC	Dublin	540	1	22	10	6	CTC Cable Corp	PacifiCorp	United States
2008	ACCC	Amsterdam	380	1	20	61	57	Neo Energia	not known	Spain
2009	ACCC	Vienna	650	1	36	17	9	CTC Cable Corp	Entergy	United States
2009	ACCC	Lisbon	325	1	16	207	217	CTC Cable Corp	Citypower	South Africa
2009	ACCC	Dublin	540	1	22	90	58	CTC Cable Corp	NV Energy	United States
2009	ACCC	Dublin	540	1	22	123	77	CTC Cable Corp	STEC	United States
2009	ACCC	Stockholm	470	1	36	35	25	CTC Cable Corp	PSE	Poland
2009	ACCC	Amsterdam	380	1	20	5	4	edp	edp	Portugal
2009	ACCC	Lisbon	325	1	16	124	130	Ella	Ella	Belgium
2009	ACCC	Oslo	325	1	20	11	11	Confidential	Confidential	European Union
2009	ACCC	Glasgow	245	1	16	2	3	Confidential	Confidential	European Union
2009	ACCC	Helsinki	160	1	16	1	1	Confidential	Confidential	European Union

producers of aluminium conductors for overhead lines since 1959

Lamifil nv

Since 2004 about 8700 km of conductor were installed in 13 countries

## Pilot project, final inspection 3M in USA

- Spiral accessories of PLP were checked in August 2009 in Cleveland (Ohio) in the PLP lab.
- Connectors of ACA were checked together with 3M conductor in 3M lab in St Paul (Minnesota)
- All accessories and the conductor have passed tests.



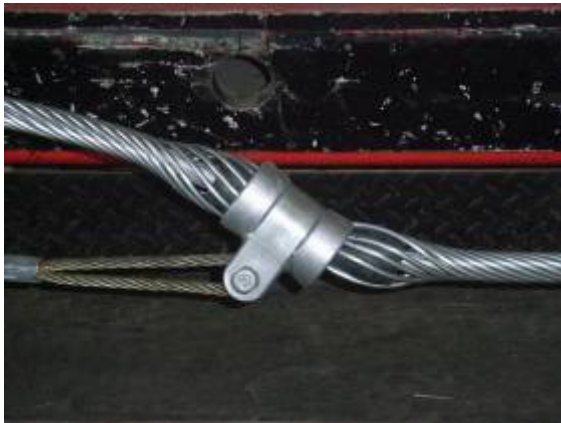
Test of spiral accessories



Test of connector

## Pilot project, final inspection CTC/Lamifil in Belgium

- Spiral accessories of PLP and connectors of Burndy were checked in September 2009 in an external lab in Mennens under the responsibility of Lamifil.
- Tests of single wires were done by Lamifil in Hemiksem.
- All components and the conductor have passed tests.



Test of spiral accessories



Test of connector

## Pilot project, installation of HTLS conductors

- the installation started in December 2009
- Ahead of the installation trainings of the involved assembly personell have been carried out by Lamifil/CTC as well as 3M.
- Installation was supervised by Lamifil/CTC and 3M on the construction site.



## Pilot project, cost comparison

conductor type	Al/St 230/30 (ACSR)	HTL Glasgow Lamifil/CTC	HTL Hawk 3M
transmission capacity [MVA]	120	210	240
cost system/ transmission capacity	1	4 - times	8 - times

- HTL Glasgow of Lamifil/CTC approx. 75% more capacity and around factor 4 more expensive than standard Al/St 230/30 (ACSR) conductor
- HTL Hawk of 3M approx. 100% more capacity and around factor 8 more expensive than standard Al/St 230/30 (ACSR) conductor
- Due to low sag behavior of conductors raising of towers was not necessary
- Cost factors are valid for the specific project definition and the price of aluminium at that time

## Pilot project, monitoring conductor temperature

- measuring the conductor temperature directly at the conductor
- transmit the temperature via radio communication to a central station
- Analysis of measurements
- application of two different temperature monitoring systems in each case on both transmission systems
- comparison with the E.ON Netz weather stations and real time monitoring system



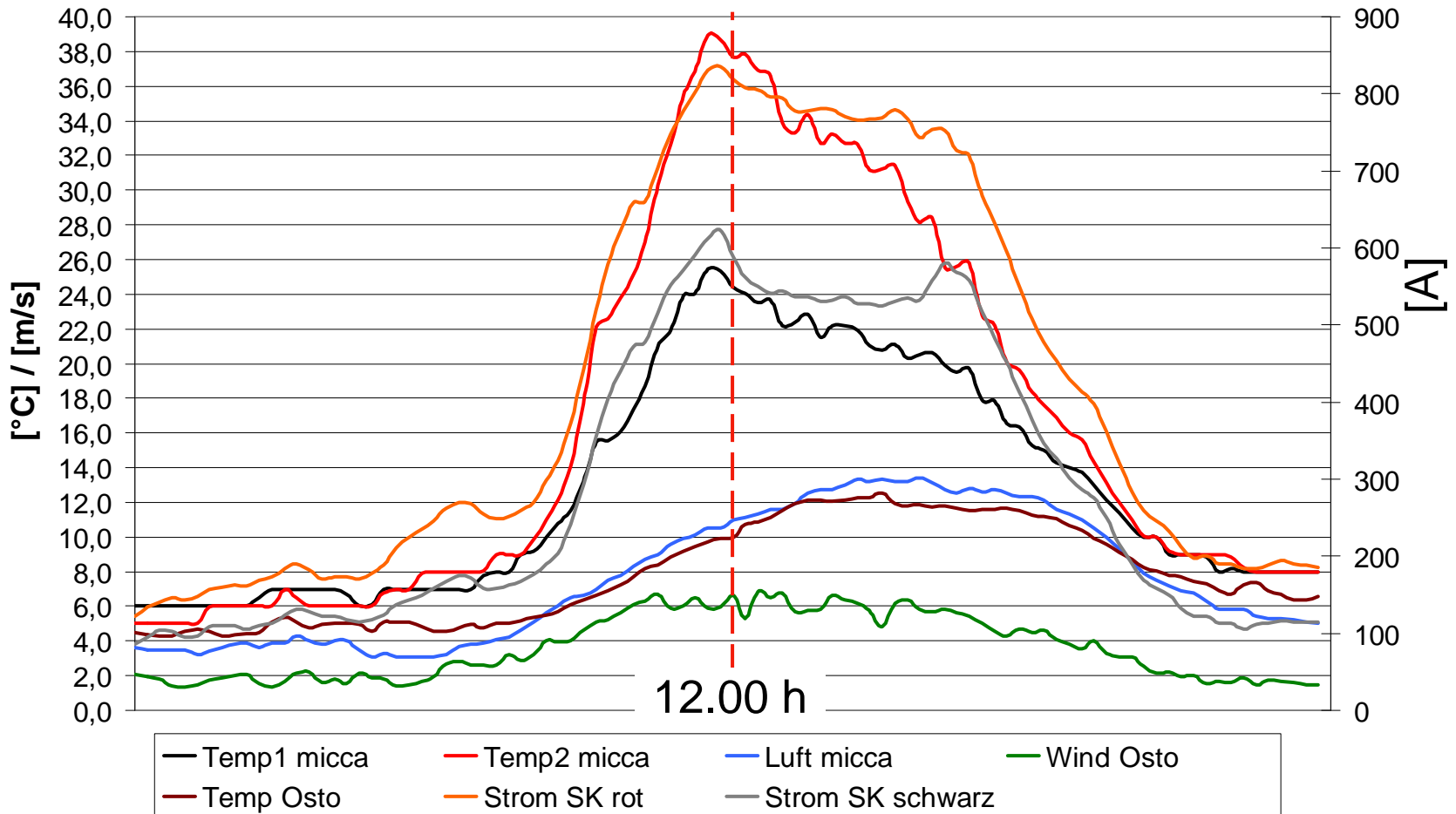
- emo-system by Micca
- measuring range up to 210 °C



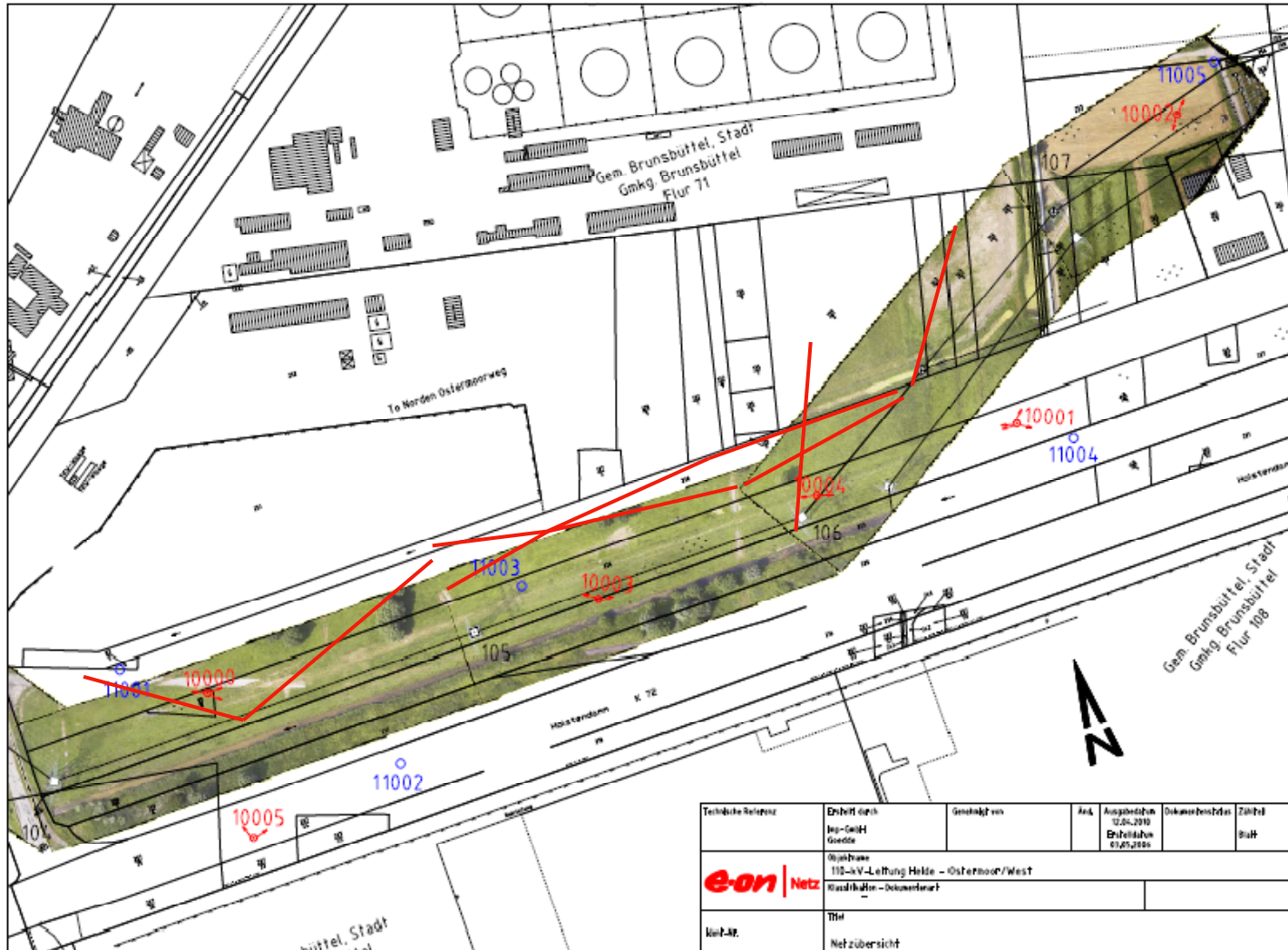
- I-Button-system by Dallas Semiconductors
- measuring range up to 150 °C

# Pilot project, monitoring conductor temperature

Conductor temperature and climate data from 17 th april 2010



# Pilot project, monitoring the sag



## Pilot project, look-out

- Pilot project continues for 3 years
- Long term studies (ecologically, technically, financially) go along with the pilot project
- standardization for the new core materials necessary
- expected prize reduction by new competitive situation
- Accessories should be available from a higher number of manufacturers
- adaptation of the calculation software used in Germany (knee-point)
- HTLS conductors can be technical solution for highly loaded lines



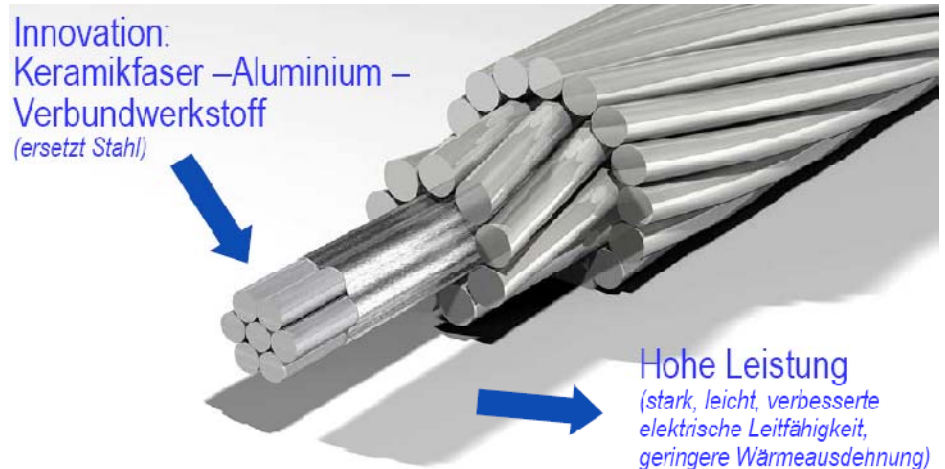
Thank you for your  
attention!

Backup

## Pilot project, HTLS – conductor by 3M – Typ Hawk -

### ACCR

- **ACCR** - Aluminium Conductor Composite Reinforced
- Spezieller Verbundwerkstoffkern (Keramikfaser-Al-Matrix) aus verseilten Einzeldrähten
- Wärmebeständige
- Geringere Durchhangzunahme bei höheren Temperaturen auf Grund des niedrigen Temperatur-Koeffizienten
- Geringeres Gewicht wegen speziellem Kernmaterial
- Übertragungsfähigkeit von ca. 1290 A bei 210°C



## Pilot project, HTLS – conductor by Lamifil/CTC – Typ Glasgow ACCC

- **ACCC** - Aluminium Conductor Carbon Core
- Unverseilter Kern aus Kohlenfasern in Polymermatrix mit Glasfaserumhüllung
- Weichgeglühte Al-Drähte in der Hülle
- Geringe Durchgangszunahme bei höheren Temperaturen auf Grund niedrigen Temperatur-Koeffizienten
- Geringeres Gewicht wegen speziellem Kernmaterial
- Höhere Übertragungsfähigkeit durch trapezförmige Al-Drähte
- Übertragungsfähigkeit von ca. 1115 A bei 175 °C

