



# LONG-LENGTH SUPERCONDUCTING CABLES



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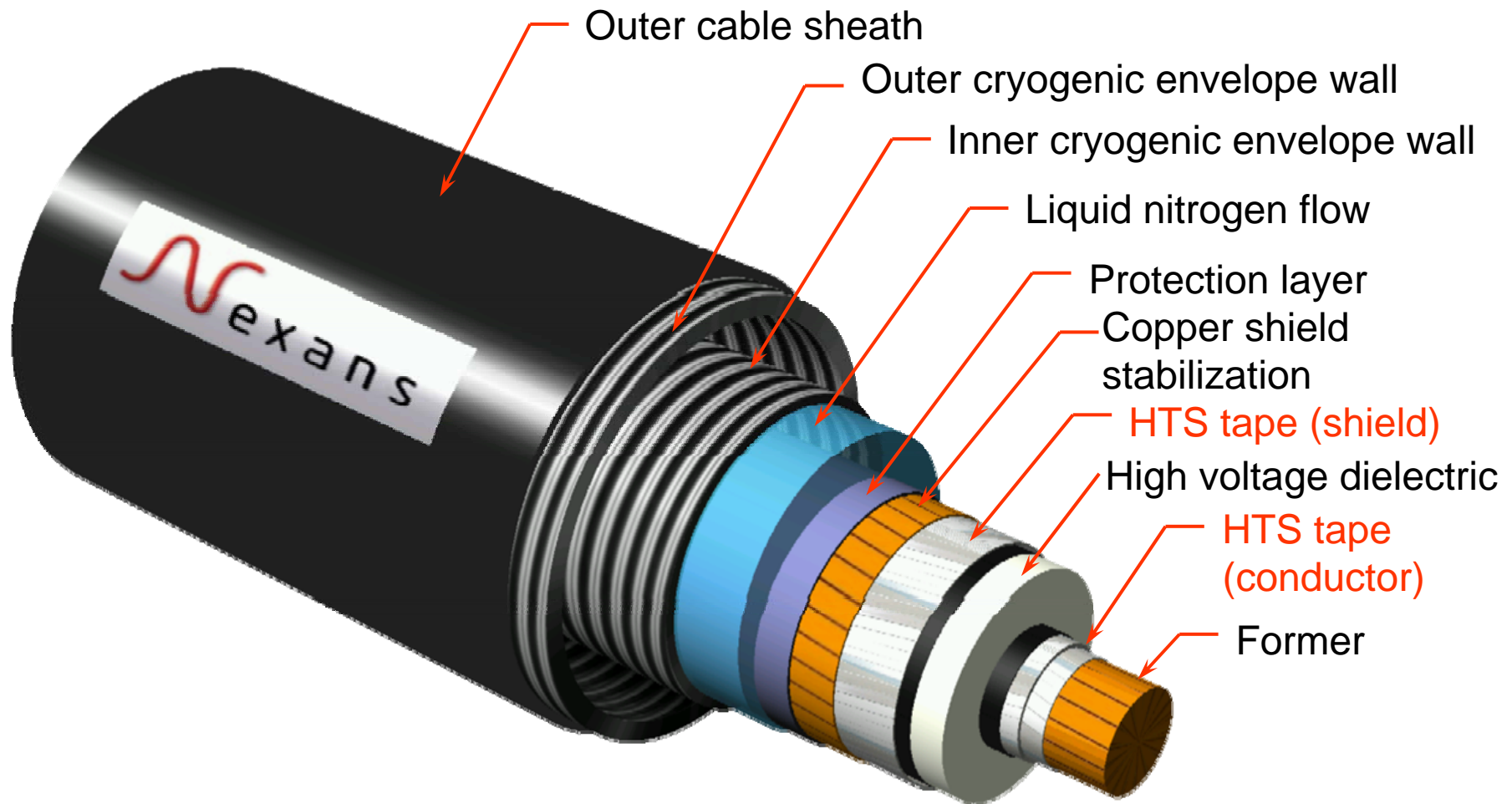
**WETS'07, Paris-La Défense, FRANCE**



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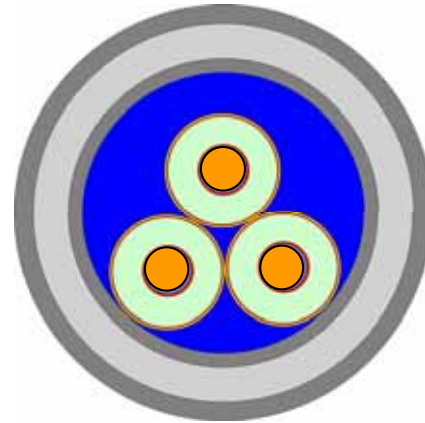
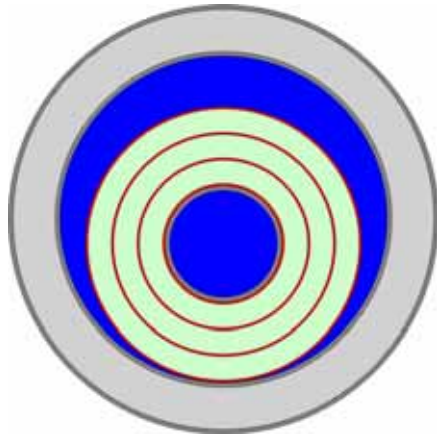
STATUS

## Low temperature dielectric inside cryogenic envelope



## 3 phases in one cryogenic envelope



### Concentric phases (triaxial design)



### 3 separate phases

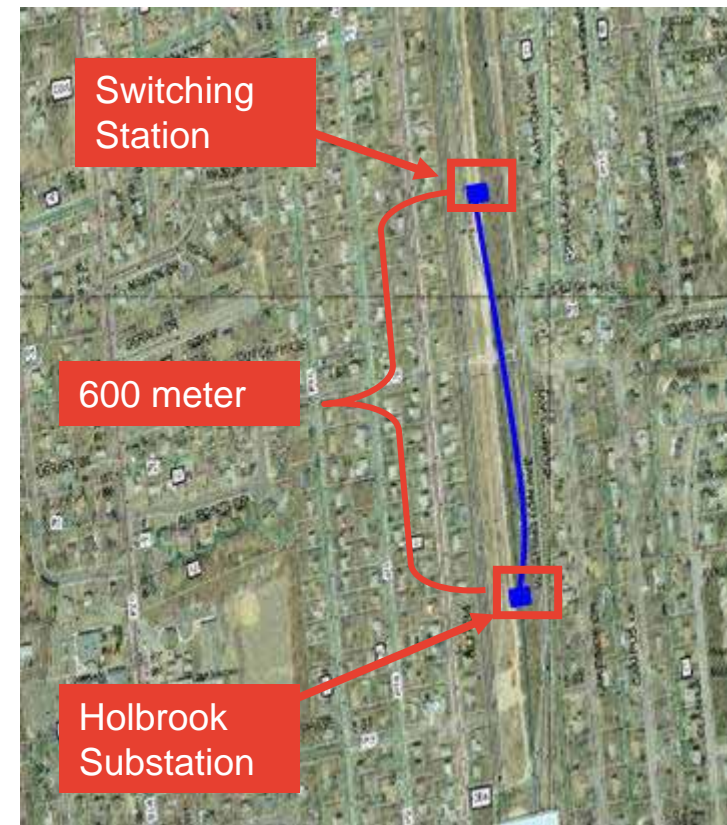
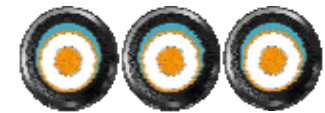
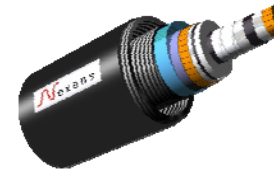


**Three major HTS AC cable projects in the United States**

Cable design	Cable maker	Location	Utility	Cable characteristics	Cable in operation
	Southwire (Ultera)	Columbus (OH)	AEP	200 m / 13.2 kV / 3 kA / <b>69 MVA</b>	August 2006
	Sumitomo	Albany (NY)	Niagara Mohawk	350 m / 34.5 kV / 0.8 kA / <b>48 MVA</b>	July 2006
	Nexans	Long Island (NY)	LIPA	600 m / 138 kV / 2.4 kA / <b>574 MVA</b>	2007

### World's first installation of a transmission voltage HTS cable


- 600-meter cable
- 155 km of superconducting tape
- Electrical operating characteristics:
  - ◆ 138 kV, 2.4 kA, 574 MVA
  - ◆ Design fault current: 51 kA during 200ms
  - ◆ Cable operating through low level faults
- Cable accessories:
  - ◆ Six 138 kV outdoor terminations
- Liquid nitrogen refrigeration system
- Commissioning: 2007






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EXPECTATIONS


Cable parameter	Value
Voltage	50 kV
3-phase current	2900 A rms
Transmitted power	250 MVA
Total length	6 km
Cable core unit length	2 km
Cable design	Cold dielectric, triaxial (concentric phases) 
Cooling fluid	Liquid nitrogen
Number of cooling stations	2 (one at both ends)

[1] Presented by Nuon, NKT Cables and Praxair at JICABLE 2007



Cable parameter	Value
Voltage	138 kV
3-phase current	2400 A rms
Transmitted power	574 MVA
Total length	10 km
Phase unit length	≥ 500 m
Cable design	Cold dielectric, one cryostat per phase 
Quantity of HTS tape	2400 km
Cooling fluid	Liquid nitrogen
Number of cooling stations	3 (one at both ends and one intermediate)

[2] Envisioned by Nexans, American Superconductor and Air Liquide for LIPA

- Perfect application for HTS materials (no electrical loss)
- Cable design similar to the one of the LIPA cable (terminations to be adapted) 
- The HTS shield would be used as return conductor, eliminating any external magnetic field
- We could envision:
  - 20-kilometer between liquid nitrogen cooling stations
  - 2 DC cables in parallel (or a return line for the liquid nitrogen)



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CONCLUSION

- Projects in Columbus, Albany and Long Island are paving the way for multi-kilometer HTS AC cables
- A 6-kilometer HTS AC cable project at 50 kV has been presented at JICABLE 2007
- A 10-kilometer HTS AC cable project at 138 kV is envisioned
- Very long HTS DC cables can be foreseen