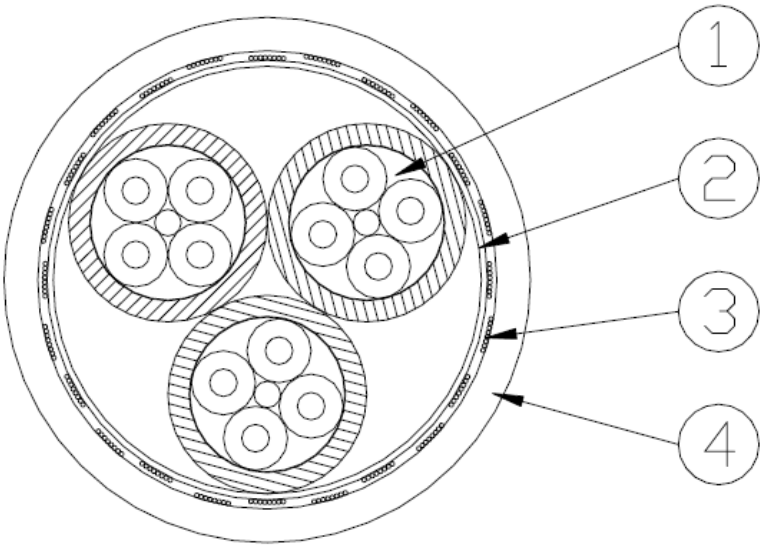
Bob Morse 05.27.2010

The 1.8 km IceRay Testbed Cable Plan as of 2007

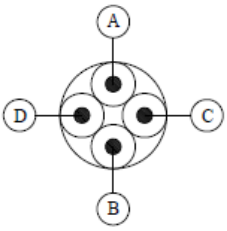
Below is presented the plan that was envisioned for the IceRay Testbed Cable installation in 2007. It needs revisiting and updating.



The IceRay Testbed cable is about 1.8 km in length and consists of 3 twisted-quad cables as shown above. The overall cable is also shielded and has a separate drain-wire.

Positioning and colours within quads

Pair 1 is: *A-core* and *B-core*
Pair 2 is: *C-core* and *D-core*



Construction

1. Quads 3 units (quads equal to IceCube Surface to Dom cables)

Description	Material	Diameter	Unit
Conductor	Solid copper	0.9	mm
Insulation	PE, solid	2.1	mm
	Pair Colour		
	1 white, blue		
	2 turquoise, violet		
Filler	PE-Thread	0.9	mm
Sheath	PE-LLD ,Colour black, thickness=0.5 mm	6.5	mm

Cable-Hookup
The cable was designed to carry signals and DC power to and from the remotely located IceRay Testbed to either a Surface Junction Box (SJB) or the IceCube Lab (ICL).

Mother Board Power and Signals
It was planned that a single twisted-pair of a twisted-quad should carry the signals and power (+/- 48 VDC) to the DOM-MB (Digital Optical Module—Mother Board) from the DOR (Digital Optical Receiver) cards located at the ICL counting house. The DOR card also provides the +/- 48 VDC needed to power the DOM-MB.

TestBed Electronics Power (+12 and +5 volts)
The other 5 twisted-pair combinations, 10 wires, 5 parallel pairs were designated to carry the power to the Testbed electronics. It was estimated that about 60-70 watts would be required at about 100 volts to run the 12 volt and 5 volt DC-to DC converters.

Cable Power Losses
Each single wire has about 45-50 ohms resistance, so that the effective loop resistance is about 18-20 ohms for the 5-conductor parallel arrangement, so we would expect voltage drops of about 12-15 volts, and power loss of about 7-10 watts. It was planned to provide this power with a 120 V, 1-2 Amp DC supply at the ICL.

Isolation and Grounds
If we establish the chassis of the Testbed electronics as the ground and connect the cable braid to this Testbed ground then we must isolate the power and braids from the ICL grounds, that is, we must float the DC power at the ICL, however being sure to provide a good AC ground using low-inductive capacitors! We could have as much as 6-8 volts DC offset between IceRay ground and the ICL ground.

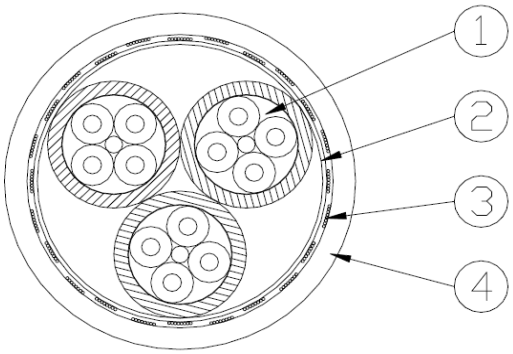
Grounds at South Pole?
AMANDA and IceCube experience indicates that AC or signal grounds can be achieved by making good low-inductive connections to large hunks of metal like an array of equipment racks that have been lashed together with copper straps. Using Q=CV if you have enough C then you can sink lots of Q without raising V (noise) too much. It seems to work.

Signal Transfer
This signal transfer occurs over a 1.8 km twisted pair cable with an impedance of 145 ohms. The exact attenuation levels can be found in the Ericsson Cable Specifications. This system is pretty similar to how the IceCube digital signals get routed from an optical modules at 2500 meters depth to the surface and then along the surface to ICL. The Testbed transfer appears to less of a distance challenge though it does have more surface exposure.

Cable Documentation (Ericsson Specifications
See complete Ericsson Cable Specifications presented below.

Technical Description

Prepared	Date	Rev	Document no
HL/ECA/T/TK Jan Nilsson	2007-07-13	PA1	TD 91 080
Approved			File/reference
ECA/T/TK (Mattias Andersson)			HL 36
Title			
Ice Cube AURA cable			



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Finished cable

	Description	Material	Diameter	Unit
2.	Shield	Copper tape thickness =0.1 mm 50% overlap	15	mm
3.	Braid (otional)	Tinned copper braid 60% coverage		
4.	Sheath	TPE-U , Colour black, thickness = 1.0 mm	17	mm

General

Temperature range handling	-40 to + 80	°C
Temperature range operation	-70 to + 80	°C
Temperature range storage	-80 to + 80	°C

Mechanical Characteristics at -70 to +40 C°

Parameter	Value		Unit
Cable diameter	nom	17	mm
Cable mass	nom	0.3	kg/m
Minimum static bend radius complete cable		100	mm
Minimum static bend radius individual quad		80	mm

Electrical Characteristics Maximum 800 m end to end at 20 C° (According to IEC 61156-1)

Quads

Parameter	Value		Unit
Loop resistance	max	60	ohm/km
Insulation resistance	min	5000	Mohm
Impedance at 1 MHz	145 ±10		ohm
Attenuation at 1 MHz	max	8	dB/km
Near End Crosstalk at 2 MHz	min	50	dB
Equal Level Far End Crosstalk at 2 MHz	min	35	dB
Operating Voltage	max	400	V DC
Operating Voltage	max	280	V AC
Operating Current *	max	5	A DC
Operating Current *	max	5	A AC

* Limiting value for maximum 5 quads at the same time.

Operating Current	max	140	mA AC

Positioning and colours within quads

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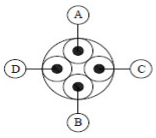

Delivery drum

Delivery drum will be of the same design as drum for IceCube surface cables with an inner flange to cover inner end of cable.
Size of drum will be K16, 1600mm diameter and a center hole of 105mm.
Details and drawings of drum will be discussed with customer.