


ATLAS Project Document No:	Page: <b>1 of 15</b>
<b>ATL - IC-ES-0002</b>	Rev. No.: 4 (date: 24/3/03)

	<b>SR1 Building preparation</b>  <b>SCT power cable specs for SR1 use</b>		
	ATLAS Project Document No:	Institute Document No.	Created: 08/07/02 Modified 24/3/03
<b>ATL-IC-ES-0002</b>		<b>349753</b>	Page: <b>1 of 15</b> Rev. No.: 4

## SR1 Building preparation

### Specifications for SCT power cables in SR1

*This document contains specifications for power cables to be used during the SCT macro assembly at the SCT macro assembly sites and in the Atlas SR1 integration building. They are used for powering up to 50% of the SCT during the integration test in SR1. This document specifies the routing of the cable, the position of the ID during final tests and the mapping to SCT barrel during the tests in SR1.*

<i>Prepared by[A1]:</i> <b>David Howell, Heinz Pernegger, Georg Viehhauser, Richard Fortin</b>	<i>Checked by:</i> <b>SCT steering group</b>	<i>Approved by:</i> <b>Marco Olcese            Andrea Catinaccio            Eric Perrin            Debbie Greenfield            Nigel Hessey            Alex Grillo, Richard Brenner            SCT steering group</b>
<i>Distribution List</i> <b>ID-SR1 working group, SCT steering group, ID steering group, TRT steering group</b>		

## 1. Description of the cable

This cable will supply the SCT modules during their test at the macro assembly site and during the SCT and SCT-TRT integration work at SR1. Given the basic layout of the SCT power supply distribution system (see [1]) we require one power supply cable per module. During the macro assembly we plan to power up to 2112 modules in the SR1 test area and 96 modules in the SR1 assembly area.

Initially 744 cables will be installed in the SR1 building to the test area and 48 cables to the assembly area, while the remaining cables will be distributed to the other SCT macro assembly sites (Oxford, KEK for barrel, Liverpool and NIKHEF for the endcaps) to cover their required number of power supply distribution channels. As the macro assembly progress those power supply cables will come back to CERN to cover the increasing need at the SR1 integration. The assembly and integration at SR1 requires the arrival of 1368 cables in addition to the initially installed cables in SR1 before the start of the SCT 4-barrel integration in June 2004. Those cables are the complete set of cables from Oxford and KEK plus 264 cables from Liverpool.

Due the large cable stock needed, we require a cost effective solution for this power cable which needs to address the following issues

- industrial termination to standard connectors
- Low cable stock price
- Sufficient number of lines to cover all supply and monitoring voltages (as outlined in reference [1])
- Sufficient line cross-section to limit voltage drop to the chip save limit (approximately 1.5V over voltage) for cables going to the SR1 test area.
- Shielded
- Compliance with Cern IS-23 guidelines

The power supply cable is based on a 30 lines (15 twisted pairs), shielded computer cable. Each line in a pair has a cross section according to AWG 24, all pairs are wrapped in the metal shield and the cable is inclosed in a halogen-free outer jacket.

The cable is distributed by Arrow Electronics as type "OS15P24-LSF". The specification sheets for the cable can be found in reference [2].

The cable will directly connect the SCTLV/HV crate power supply to the service cage of barrel and endcap. On the service cage a temporary patch panel and short interconnect serve as connection to the final PP1 patch panel already mounted to the detector.

The detailed description on the use of the cable, its connection schematic and connectors to be used can be found in reference [3].

## 2. Voltage drop

Four AWG 24 lines will be used in parallel for each power supply line (Vcc, Vdd, Agnd, Dgnd).

The resistance for each AWG24 is specified at 78.7 Ohm/km at room temperature [2].

Based on this value we estimate the voltage drops summarized in table 1 for the different cable lengths. The values given include the return path.

Cable length	Resistance [Ohm]	Vdrop at Icc nominal (1A) [V]	Vdrop at Imax =1.3A [V]
16m (minimal length)	0.624	0.624	0.8112
24m	0.936	0.936	1.2168
50m	1.95	1.95	2.535
74m (maximum length)	2.886	2.886	3.7518

Table 1: Calculated voltage drops for SCT power cables in SR1

Cable of length from 16m to 24m will be used in the SR1 test area. One 50m and one 24m cables will be daisy-chained to give up to 74m long cables for the assembly area. Between the two cables of this daisy-chain we required 1 PP3 per cable to limit the maximum over-voltage in case of current loss. Those temporary PP3s shall be installed in one rack in the assembly area.

### 3.) Safety requirements

The maximum currents used in these cables will be 1.3A on the power supply lines (sum of 4 lines).

The detector bias voltage (one line of the supply cable) is limited to 500V. The SCTHV power supply can provide a maximum current of 5mA, but we will implement a maximum current limitation of 1mA through the firmware of the power supply module. In addition to this current limit we plan to implement engineering controls and administrative procedures to prevent personnel from being able to come into direct contact with exposed conductive parts at voltages over 50V. The implementation is described in further detail in reference [3]. It shall be noted that, as additional safety, at SR1 the detector, when operated during the SCT barrel acceptance tests, will be sealed in a test container or thermal enclosure, which prevents any physical contact with the detector, the service cage and temporary patch panel on the service cage. The outer enclosure of this sealed container will be interlocked to the power supply system.

The cable is UL rate at 300V and several tests have been performed to verify the suitability of the cable for providing the detector bias (typically 100 to 300V, max. 500V). Samples of this cable have been extensively tested for several months at Oxford on a detector-bias test stand, showing no breakdowns or current leakage at 1500V [3].

The use of this cable has been discussed with the ATLAS Glimos and TIS and was found to be useable in SR1 with following recommendations:

"Date: Mon, 17 Jun 2002 11:23:26 +0200  
 From: Marc Tavlet <Marc.Tavlet@cern.ch>  
 To: Gianpaolo Benincasa <Gianpaolo.Benincasa@cern.ch>  
 Cc: Heinz Pernegger <Heinz.Pernegger@cern.ch>,  
 Wolfgang Weingarten <Wolfgang.Weingarten@cern.ch>  
 Subject: RE: Atlas SCT Computer cables

Gianpaolo,

Following our discussion this morning, after having read carefully

The related papers and specs, and considering that

- the proposed cable (PVC insulations, low-smoke 0-halogen sheath) present satisfactory fire resistance (BS4066) +UL certif.,
- the cables will be installed in SR1 surface building ; this bldg has several escape routes and is fire-protected,
- the installation will be temporary, for the time of testing,
- the price for the full 0-halogen version would be 6 times higher (~ 600'000 CHF in total)

I would have no objection for the temporary use of this cable (and that we sign an AOS), provided that these cables be installed on separate cable trays than power cables. Should these cables pass under the false floor, the volume will have to be equipped with fire/smoke detectors.

Regards,

Marc"

#### 4.) PP3

We do not plan to use PP3 patch panels on the short cables in the test area.

The 76m cable going to the assembly area will require 1 PP3 per cable (i.e. 100 PP3 total) between the 50m and 26m cable in order to limit the maximum over current. The production, tests and installation will be investigated with University of Melbourne.

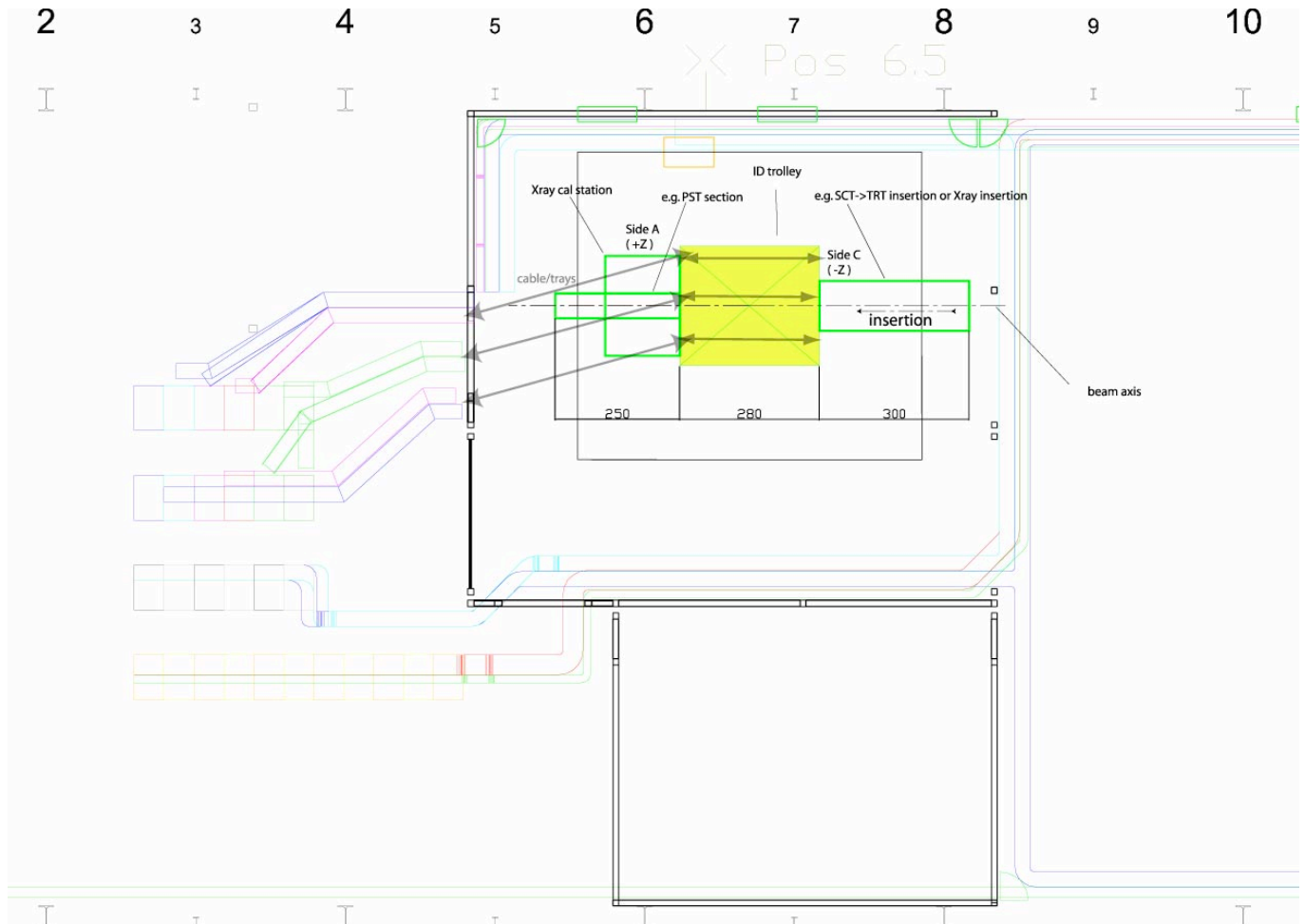
#### 5.) Cable routing in SR1

The cables will be installed in cable trays running above rack row 1 and 2 to a cable feed through in the wall from the rack room to the test area at approximately 3.2m height. Inside they will be distributed on cable trays running from the feed through to a service support structure above the ID trolley. The overall assumptions regarding positioning and orientation are shown schematically in drawing 1.

The cable routing is based on the following agreements

1. The ID trolley is positioned in the center of the platform in the test area
2. The axis of the barrel faces the wall to the rack room
3. The TRT will be setup in the ID trolley in the test area and cabled before the SCT is inserted
4. The endcaps will use the same services, same services support and distribution (with different mapping of existing cables)
5. We use a mapping of SCTLV power supply crates to the detector as described in the following section
6. All insertion in the barrel (e.g. SCT to TRT, Xray) will be done from Side C of the detector
7. Endcap SCT to TRT insertion will be done outside of the testarea on platform near control room in the assembly area.

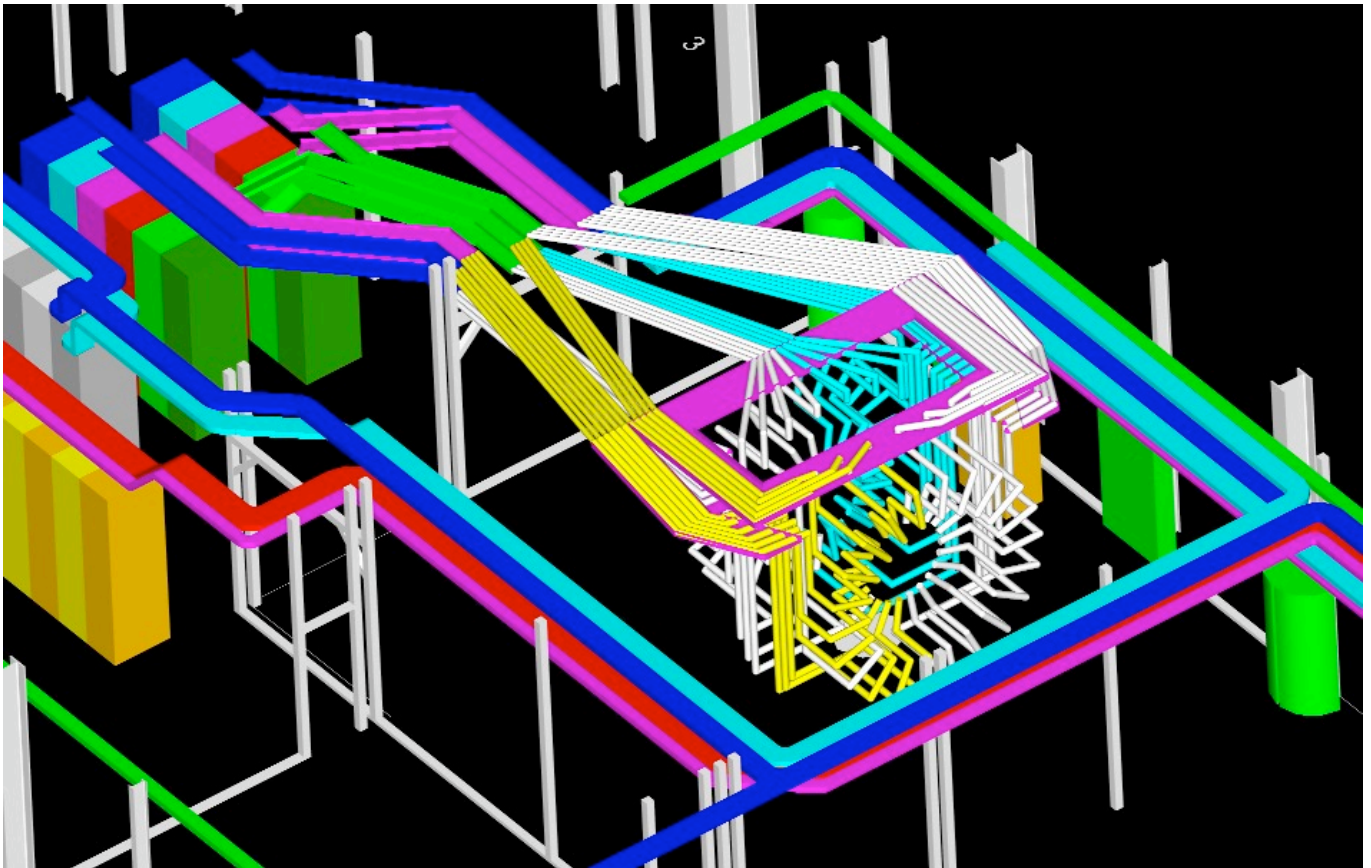
8. Connection will be made to temporary patch panels mounted close to the TRT ends inside the ID trolley on service extensions.



Drawing 1: Schematic illustration of cable trays and cable routing for SCT power cables. The outline of the ID trolley is shown with outlines of other equipment next to it.

The services will be distributed in bundles of 48 cables (all channels of one power supply crate). The bundles go from the crate to the cable trays, to the service support above the trolley and from there in a loop to either Side A or Side C of the trolley. There are 22 bunches of 48 cables on each side of the trolley (Side A and Side C). Each bunch connects to one PS crate. Excess cable length of up to 2m is stored in the rear of the PS rack.

The routing has been modelled in a 3D drawing. The drawing is available in Acad 2000 as attachment to this document. The drawing is also available in CDD (reference [7]). Drawing 2 shows a rendering of the 3D model routing from racks to the ID trolley on Side C.



Drawing 2: Rendering of cable bunch routing from racks to ID trolley on Side C of the ID barrel. (each “pipe” corresponds to a bunch of 48 cables). The bunches end at the outside radius of the barrel SCT.

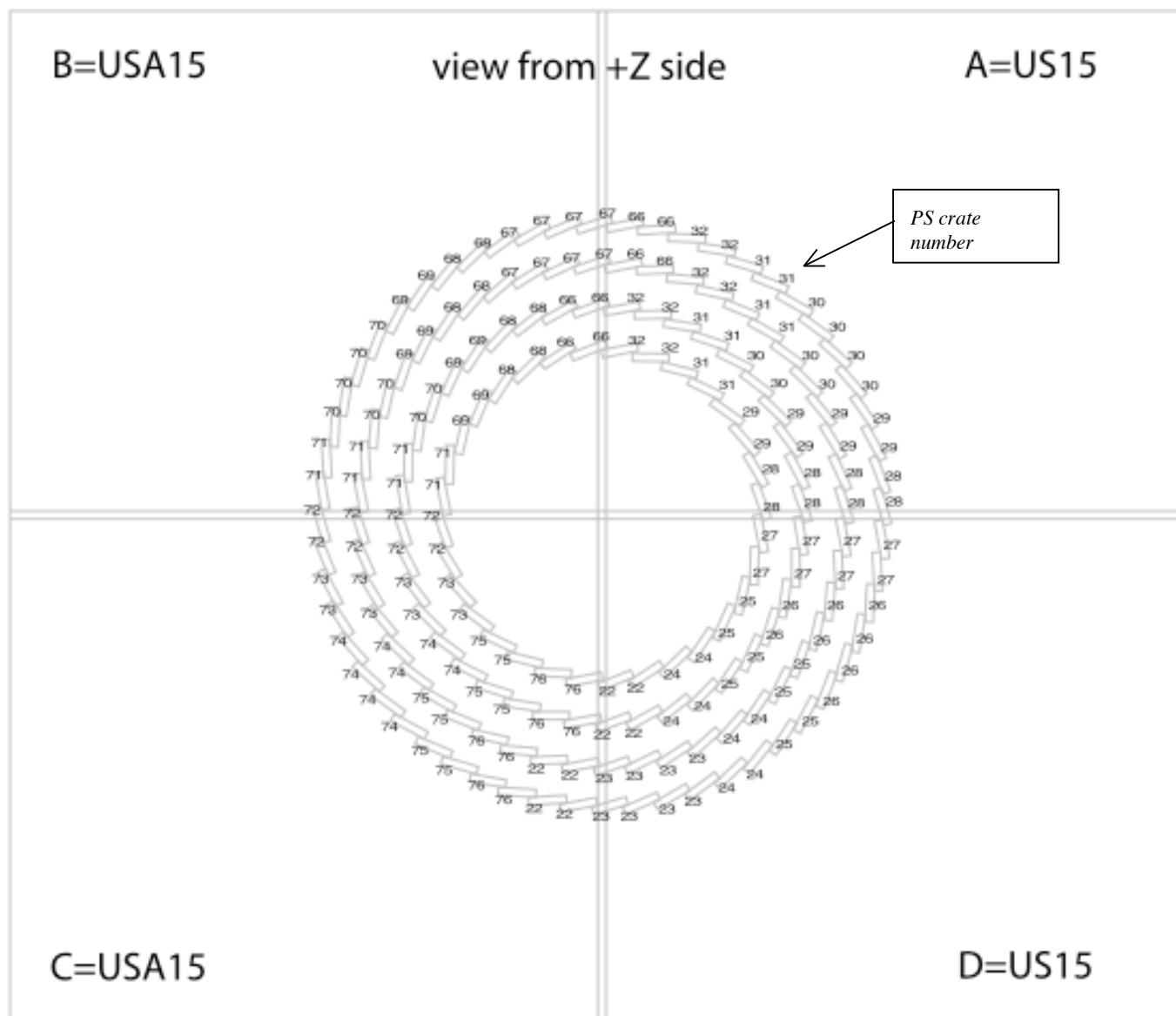
The weight of 1000 cables is estimated to be approximately 140kg/m.

Additionally 1 bundle of 48 power cables (74m max) will be routed from SCT power racks to the assembly area initially for a test of one quarter disk (33 modules required). This may later be upgraded to 132 cables to cover the SCT endcap acceptance. The cables will be routed from the rack area to the SCT section of the assembly area in the cable trays along the clean room walls. The layout of cable trays in SR1 is given in reference [6]. The 100 voltage limiters shall be installed in one rack in the assembly area from where the 24m cable connects to the detector.

## 6.) Mapping of power supply crates to SCT barrel module staves

The mapping of the power supply crate to module stave influences the routing and therefore cable length. We focussed on a cable bunch routing that minimizes crossovers between bunches.

For the determination of cable routing and length we used the routing used in the experiment. Drawing 3 shows the mapping of each half-stave (six modules) to a specific crate (identified by the number next to the half-stave) for Side A (“+z”).



Drawing 3: Mapping of power supply crate to module half-staves for SCT Barrel Side A (“+z”)

The detector is split vertically along the axis for the supply from rack row A (quadrant A and D) and rack row B (quadrant B and C) in SR1. This is similar to the experiment where quadrant A and D will be supplied from US15 and quadrant B and C from USA 15.

This gives the following power supply destination:

Rack row	Experiment destination	Crate number	Detector Side
A	USA15	66 to 76	Side A (“+z”)
A	USA15	55 to 65	Side C (“-z”)
B	US15	22 to 32	Side A (“+z”)
B	US15	33 to 43	Side C (“-z”)

**ATL - IC-ES-0002**

Rev. No.: 4 (date: 24/3/03)

The arrangement of racks in SR1 is described in reference [5]. Rack A10/B10 are the racks closest to the test area, Rack A5/B5 are the racks furthest away from the test area in rack rows A and B. Each SCT power supply rack in SR1 will hold 4 crates (labelled 1 to 4 from top to bottom of the rack)

The power supply crates are assigned to the following racks:

<i>rack-crate</i>	<i>crate #</i>	<i>rack-crate</i>	<i>crate #</i>
A10-1	74	B10-1	26
A10-2	69	B10-2	31
A10-3	68	B10-3	32
A10-4	67	B10-4	66
A9-1	85	B9-1	37
A9-2	78	B9-2	77
A9-3	79	B9-3	43
A9-4	80	B9-4	42
A8-1	72	B8-1	28
A8-2	71	B8-2	29
A8-3	70	B8-3	30
A8-4	Spare or AA	B8-4	Spare or AA
A7-1	33	B7-1	34
A7-2	87	B7-2	35
A7-3	86	B7-3	36
A7-4	81	B7-4	41
A6-1	22	B6-1	23
A6-2	76	B6-2	24
A6-3	75	B6-3	25
A6-4	73	B6-4	27
A5-1	84	B5-1	38
A5-2	83	B5-2	39
A5-3	82	B5-3	40
A5-4	Spare or AA	B5-4	Spare or AA

The tapes fold out in 4 large phi-section on the front face of the TRT corresponding to the quadrants, where the temporary patch panel boxes will be supported.

The following two tables details the precise mapping of SCT barrel layer ("B<sub>n</sub>")/half-stave ("s<sub>m</sub>") to power supply crate number for Side A and Side C of the detector. The numbering scheme for staves was provided by Janet Fraser for the SCT barrel.

*View from "+Z" side, read from bottom upwards, Side A*

End 'D', start 'A' Horizontal separation [+Z] lh								
	27-27	B	5s	48	B	6s	56	1
27	27-27	B	4s	40	B	6s	55	2
	27-27	B	3s	32	B	5s	47	3
	27-26	B	4s	39	B	6s	54	4
	27-26	B	3s	31	B	5s	46	5
28	26-26	B	4s	38	B	6s	53	6
	25-26	B	3s	30	B	5s	45	7
	26-26	B	4s	37	B	6s	52	8
	25-26	B	5s	44	B	6s	51	9
25	25-25	B	3s	29	B	4s	36	10
	25-25	B	5s	43	B	6s	50	11
	24-25	B	5s	42	B	6s	49	12
	24-25	B	3s	28	B	4s	35	13
24	24-24	B	5s	41	B	6s	48	14



## ATL - IC-ES-0002

Rev. No.: 4 (date: 24/3/03)

	24-24	B	4s	34	B	6s	47	15
	24-23	B	3s	27	B	5s	40	16
	24-23	B	4s	33	B	6s	46	17
	22-23	B	3s	26	B	5s	39	18
	22-23	B	4s	32	B	6s	45	19
	22-23	B	3s	25	B	5s	38	20
	22-23	B	4s	31	B	6s	44	21
23	23-23	B	5s	37	B	6s	43	22
Start quadrant 'D' Vertical separation [+Z] cw bottom>lh								
22	22-22	B	5s	36	B	6s	42	1
	76-22	B	4s	30	B	6s	41	2
	76-22	B	3s	24	B	5s	35	3
76	76-76	B	4s	29	B	6s	40	4
	76-76	B	3s	23	B	5s	34	5
	75-76	B	4s	28	B	6s	39	6
	75-76	B	3s	22	B	5s	33	7
75	75-75	B	4s	27	B	6s	38	8
	75-75	B	5s	32	B	6s	37	9
	75-74	B	3s	21	B	4s	26	10
	75-74	B	5s	31	B	6s	36	11
74	74-74	B	5s	30	B	6s	35	12
	73-74	B	3s	20	B	4s	25	13
	74-74	B	5s	29	B	6s	34	14
	73-74	B	4s	24	B	6s	33	15
73	73-73	B	3s	19	B	5s	28	16
	73-73	B	4s	23	B	6s	32	17
	72-73	B	3s	18	B	5s	27	18
	72-73	B	4s	22	B	6s	31	19
	72-72	B	3s	17	B	5s	26	20
72	72-72	B	4s	21	B	6s	30	21
	72-72	B	5s	25	B	6s	29	22
Start quadrant 'C' Horizontal separation [+Z] cw rh>bottom								
	71-71	B	5s	24	B	6s	28	1
71	71-71	B	4s	20	B	6s	27	2
	71-71	B	3s	16	B	5s	23	3
	71-70	B	4s	19	B	6s	26	4
	71-70	B	3s	15	B	5s	22	5
	70-70	B	4s	18	B	6s	25	6
	69-70	B	3s	14	B	5s	21	7
70	70-70	B	4s	17	B	6s	24	8
	69-70	B	5s	20	B	6s	23	9
69	69-69	B	3s	13	B	4s	16	10
	69-69	B	5s	19	B	6s	22	11
	68-69	B	5s	18	B	6s	21	12
	68-69	B	3s	12	B	4s	15	13
68	68-68	B	5s	17	B	6s	20	14
	68-68	B	4s	14	B	6s	19	15
	68-67	B	3s	11	B	5s	16	16
	68-67	B	4s	13	B	6s	18	17
	66-67	B	3s	10	B	5s	15	18
	66-67	B	4s	12	B	6s	17	19
	66-67	B	3s	9	B	5s	14	20
	66-67	B	4s	11	B	6s	16	21
67	67-67	B	5s	13	B	6s	15	22
Start quadrant 'B' Vertical separation [+Z] cw top>rh								
66	66-66	B	5s	12	B	6s	14	1
	32-66	B	4s	10	B	6s	13	2
	32-66	B	3s	8	B	5s	11	3
32	32-32	B	4s	9	B	6s	12	4

## ATL - IC-ES-0002

Rev. No.: 4 (date: 24/3/03)

	32-32	B	3s	7	B	5s	10	5
	31-32	B	4s	8	B	6s	11	6
	31-32	B	3s	6	B	5s	9	7
31	31-31	B	4s	7	B	6s	10	8
	31-31	B	5s	8	B	6s	9	9
	31-30	B	3s	5	B	4s	6	10
	31-30	B	5s	7	B	6s	8	11
30	30-30	B	5s	6	B	6s	7	12
	29-30	B	3s	4	B	4s	5	13
	30-30	B	5s	5	B	6s	6	14
	29-30	B	4s	4	B	6s	5	15
29	29-29	B	3s	3	B	5s	4	16
	29-29	B	4s	3	B	6s	4	17
	28-29	B	3s	2	B	5s	3	18
	28-29	B	4s	2	B	6s	3	19
28	28-28	B	3s	1	B	5s	2	20
	28-28	B	4s	1	B	6s	2	21
	28-28	B	5s	1	B	6s	1	22

Start quadrant 'A' Horizontal separation [+Z] cw lh&gt;top

View from "-Z" side, read from bottom upwards, Side C

End 'D', start 'A' Horizontal separation [-Z] rh								
	38-38	B	5s	48	B	6s	56	1
38	38-38	B	4s	40	B	6s	55	2
	38-38	B	3s	32	B	5s	47	3
	38-37	B	4s	39	B	6s	54	4
	38-37	B	3s	31	B	5s	46	5
37	37-37	B	4s	38	B	6s	53	6
	36-37	B	3s	30	B	5s	45	7
	37-37	B	4s	37	B	6s	52	8
	36-37	B	5s	44	B	6s	51	9
36	36-36	B	3s	29	B	4s	36	10
	36-36	B	5s	43	B	6s	50	11
	35-36	B	5s	42	B	6s	49	12
	35-36	B	3s	28	B	4s	35	13
35	35-35	B	5s	41	B	6s	48	14
	35-35	B	4s	34	B	6s	47	15
	35-35	B	3s	27	B	5s	40	16
	35-34	B	4s	33	B	6s	46	17
	33-34	B	3s	26	B	5s	39	18
	33-34	B	4s	32	B	6s	45	19
	33-34	B	3s	25	B	5s	38	20
	33-34	B	4s	31	B	6s	44	21
34	34-34	B	5s	37	B	6s	43	22

Start quadrant 'D' Vertical separation [-Z] ccw bottom&gt;rh

33	33-33	B	5s	36	B	6s	42	1
	87-33	B	4s	30	B	6s	41	2
	87-33	B	3s	24	B	5s	35	3
87	87-87	B	4s	29	B	6s	40	4
	87-87	B	3s	23	B	5s	34	5
	86-87	B	4s	28	B	6s	39	6
	86-87	B	3s	22	B	5s	33	7
86	86-86	B	4s	27	B	6s	38	8
	86-86	B	5s	32	B	6s	37	9
	86-85	B	3s	21	B	4s	26	10
	86-85	B	5s	31	B	6s	36	11
85	85-85	B	5s	30	B	6s	35	12

	84-85	B	3s	20	B	4s	25	13
	85-85	B	5s	29	B	6s	34	14
	84-85	B	4s	24	B	6s	33	15
84	84-84	B	3s	19	B	5s	28	16
	84-84	B	4s	23	B	6s	32	17
	83-84	B	3s	18	B	5s	27	18
	83-84	B	4s	22	B	6s	31	19
	83-83	B	3s	17	B	5s	26	20
83	83-83	B	4s	21	B	6s	30	21
	83-83	B	5s	25	B	6s	29	22
Start quadrant 'C' Horizontal separation [-Z] ccw lh>bottom								
	82-82	B	5s	24	B	6s	28	1
82	82-82	B	4s	20	B	6s	27	2
	82-82	B	3s	16	B	5s	23	3
	82-81	B	4s	19	B	6s	26	4
	82-81	B	3s	15	B	5s	22	5
	81-81	B	4s	18	B	6s	25	6
	80-81	B	3s	14	B	5s	21	7
81	81-81	B	4s	17	B	6s	24	8
	80-81	B	5s	20	B	6s	23	9
80	80-80	B	3s	13	B	4s	16	10
	80-80	B	5s	19	B	6s	22	11
	79-80	B	5s	18	B	6s	21	12
	79-80	B	3s	12	B	4s	15	13
79	79-79	B	5s	17	B	6s	20	14
	79-79	B	4s	14	B	6s	19	15
	79-78	B	3s	11	B	5s	16	16
	79-78	B	4s	13	B	6s	18	17
	77-78	B	3s	10	B	5s	15	18
	77-78	B	4s	12	B	6s	17	19
	77-78	B	3s	9	B	5s	14	20
	77-78	B	4s	11	B	6s	16	21
78	78-78	B	5s	13	B	6s	15	22
Start quadrant 'B' Vertical separation [-Z] ccw top>lh								
77	77-77	B	5s	12	B	6s	14	1
	43-77	B	4s	10	B	6s	13	2
	43-77	B	3s	8	B	5s	11	3
43	43-43	B	4s	9	B	6s	12	4
	43-43	B	3s	7	B	5s	10	5
	42-43	B	4s	8	B	6s	11	6
	42-43	B	3s	6	B	5s	9	7
42	42-42	B	4s	7	B	6s	10	8
	42-42	B	5s	8	B	6s	9	9
	42-41	B	3s	5	B	4s	6	10
	42-41	B	5s	7	B	6s	8	11
41	41-41	B	5s	6	B	6s	7	12
	40-41	B	3s	4	B	4s	5	13
	41-41	B	5s	5	B	6s	6	14
	40-41	B	4s	4	B	6s	5	15
40	40-40	B	3s	3	B	5s	4	16
	40-40	B	4s	3	B	6s	4	17
	39-40	B	3s	2	B	5s	3	18
	39-40	B	4s	2	B	6s	3	19
39	39-39	B	3s	1	B	5s	2	20
	39-39	B	4s	1	B	6s	2	21
	39-39	B	5s	1	B	6s	1	22
Start quadrant 'A' Horizontal separation [-Z] ccw rh>top								

## 7.) Required cable lengths

Based on the detailed location of power supply racks and crates we estimate the required cable lengths by taking into account.

- Location of the crate in the rack (“d1”)
- Termination bend into crate (“d2”)
- Location of rack (cable length on top of racks and trays up to clean room wall feed through “d3”)
- Routing from clean room wall feed through onto service support structure, bend around ID trolley frame, distance to barrel cylinder end, radial distance along TRT cylinder end (“d4”)
- A contingency of 2m (to be stored in the rear of the power supply racks in one bend)
- Rounding to the next closer cable length bins of 50cm.

Those numbers do NOT include termination losses. **Termination loss must be added to the numbers given below as they depend on the assembly process. The length given below are for a connector-to-connector length.**

Table 2 specifies the required minimum cable length as a function of crate location and rack location. Hatched fields mark crates that are cabled initially. The total resulting minimal cable length is denoted as “L” in table 2.

rack-crate	crate #	d1	d2	d3	d4(ID)	conting.	raw length	L
A10-1	74	58	50	362	1126	200	1796	1800
A10-2	69	93	50	362	890	200	1595	1600
A10-3	68	138	50	362	859	200	1609	1600
A10-4	67	173	50	362	857	200	1642	1650
A9-1	85	58	50	454	1349	200	2111	2100
A9-2	78	93	50	454	1262	200	2059	2050
A9-3	79	138	50	454	1205	200	2047	2050
A9-4	80	173	50	454	1131	200	2008	2000
A8-1	72	58	50	531	916	200	1755	1750
A8-2	71	93	50	531	846	200	1720	1700
A8-3	70	138	50	531	815	200	1734	1750
A8-4	0	0	0	0				
A7-1	33	58	50	604	1507	200	2419	2400
A7-2	87	93	50	604	1454	200	2401	2400
A7-3	86	138	50	604	1382	200	2374	2350
A7-4	81	173	50	604	1162	200	2189	2200
A6-1	22	58	50	643	1413	200	2364	2350
A6-2	76	93	50	643	1318	200	2304	2300
A6-3	75	138	50	643	1206	200	2237	2250
A6-4	73	173	50	643	1024	200	2090	2100
A5-1	84	58	50	724	1251	200	2283	2300
A5-2	83	93	50	724	1202	200	2269	2250
A5-3	82	138	50	724	1170	200	2282	2300
A5-4	0	0	0	0				
B10-1	26	58	50	452	1178	200	1938	1950

**ATL - IC-ES-0002**

Rev. No.: 4 (date: 24/3/03)

B10-2	31	93	50	452	892	200	1687	1700
B10-3	32	138	50	452	850	200	1690	1700
B10-4	66	173	50	452	827	200	1702	1700
B9-1	37	58	50	488	1223	200	2019	2000
B9-2	77	93	50	488	1169	200	2000	2000
B9-3	43	138	50	488	1105	200	1981	2000
B9-4	42	173	50	488	1051	200	1962	1950
B8-1	28	58	50	517	914	200	1739	1750
B8-2	29	93	50	517	832	200	1692	1700
B8-3	30	138	50	517	805	200	1710	1700
B8-4	0	0	0	0				
B7-1	34	58	50	609	1451	200	2368	2350
B7-2	35	93	50	609	1317	200	2269	2250
B7-3	36	138	50	609	1339	200	2336	2350
B7-4	41	173	50	609	1113	200	2145	2150
B6-1	23	58	50	662	1386	200	2356	2350
B6-2	24	93	50	662	1287	200	2292	2300
B6-3	25	138	50	662	1179	200	2229	2250
B6-4	27	173	50	662	996	200	2081	2100
B5-1	38	58	50	749	1198	200	2255	2250
B5-2	39	93	50	749	1145	200	2237	2250
B5-3	40	138	50	749	1108	200	2245	2250
B5-4	0	0	0	0				

Table 2: minimum length from power supply crate (1=bottom of rack, 4= top of rack) for each rack (5= furthest away from test area) and rack row (rack row a borders to the laser area). Each crate connects to 48 cables in one bunch.

Based on these numbers we propose to use cable lengths: ranging from 16m to 24m in increments of 0.5m for the test area and 50m long cables to the assembly area.

For the cable installation to the test area this would allow us to treat the installation in bundles of 48 cables (i.e. 1 crate). The total number of cables (including the cables to the assembly area) are summarized in table 3.

The following arrangement uses a total length of cable stock of 48.0 km. This does NOT include termination loss.

Length [cm]	bundles	cables	stock length [m]	location
1600	2	96	1536	test area
1650	1	48	792	test area
1700	6	288	4896	test area
1750	3	144	2520	test area
1800	1	48	864	test area
1850	0	0	0	
1900	0	0	0	
1950	2	96	1872	test area
2000	4	192	3840	test area
2050	2	96	1968	test area
2100	3	144	3024	test area
2150	1	48	1032	test area
2200	1	48	1056	test area
2250	7	336	7560	test area
2300	4	192	4416	test area
2350	5	240	5640	test area
2400	2	96	2304	test area
5000	1	48	2400	assembly
2400	1	48	1152	assembly
2400	1	48	1152	spare long
Total	<b>47</b>	<b>2256</b>	<b>48024</b>	

Table 3: Total number of cables required for test area and assembly area of SR1 (only 1 quarter disk in assembly area included). The list includes 1 bundle of spare cables to allow for an initial distribution between macro assembly sites and later installation in units of bundles.

## 7.) Initial distribution of cables between macro-assembly sites

Initially the cables will be distributed between the SCT macro assembly sites . Initially 744 cables are required for the SR1 test area and 1 cable bunch (48 modules, 1 bunch of 50m plus 1 bunch of 24m) to the assembly area. By June 2004 cables will be brought from the macro assembly sites to Cern. According to present schedules for the integration all 2112 cables in the test area are required in SR1 when the 4-barrel assembly starts by June 2004. Table 4 specifies the initial distribution of cables. This distribution foresees most likely shorter cables to be delivery to SR 1 initially as those cables are to be placed on the bottom of the cable stack in each tray and a later installation would be difficult. Note that the distribution of cable lengths to the different macro assembly sites will be fixed at a later time.

Note that NIKHEF is not included in this table as NIKHEF requires shorter cables and will finish their macro assembly only after those cables would be needed already for SR1 test area activities. The spare bundle will be shared between SR1 assembly area and Liverpool initially.

Assembly site	bundles	cables
SR1 test area	16	768
SR1 50m assembly area	1	48
SR1 24m assembly area	1	48
Oxford	18	864
Liverpool	6	288
KEK	5	240
<b>Total</b>	<b>47</b>	<b>2256</b>

Table 4: Initial distribution of power supply cables to SCT macro assembly sites.

## 8.) Procurement

Oxford leads the design and procurement of the power supply cable and interconnection piece to SCTLV0 crate. Procurement shall be done through Oxford.

The assembly shall be done industrially and shall include the testing of cables and adapter after assembly. The cables shall be labelled with unique serial numbers on both ends.

The purchase price of 64km of cable stock is 89.5 kCHF. . The termination cost for SR1 required cables is estimated to cost 25kCHF (parts and assembly).

## Reference

- [1] SCT power distribution scheme <http://edms.cern.ch/document/322442/3.3>
- [2] Specification for Arrow Electronics shielded computer cable OS15P24-LSF  
<https://edms.cern.ch/document/349753/4>
- [3] SCT Macro assembly - Test Cables, Connectors and Patch Panels, ATL-IC-ES0003
- [4] Installation de detection incendie Renovation Bat. SR1 LHC point 1, Contract HEKATRON B1133/ST
- [5] SR1 Rack Distribution, EDMS document ATL-IC-ES0001 Version 4
- [6] Installation of cable trays for SR1, CDD drawing reference LHCEIW\_\_1015
- [7] Routing of SCT power supply cables, CDD drawing reference **to be created at approval, 3D Acad drawing available at reference <https://edms.cern.ch/document/349753/4>**