ZDC additional signal cables cabling study

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Prepared by: *Marco CIAPETTI*	*Checked by:* *Giulio AVONI* *Gianluca CANALE* *Michel RAYMOND* *Peter Alan STEINBERG*		*Approved by:* *Ludovico PONTECORVO*

DOCUMENT REVISIONS

1. Document initial release
2. Modified path after discussion with BE-EA-AS
3. Patch panel proposal has been added
4. Modified path including survey galleries and removed patch panels

Introduction

8x Ø28mm air-core cables (4 cables from ZDC Point 1-2 and 4 cables from ZDC Point 1-8) shall be routed from the ZDC detector in the LHC tunnel to USA15.

From the ZDC detectors (TAN is around 141m far from IP), the cables are routed along the tunnel and enter into the survey galleries (UPS14 and UPS16). Then passing into UX15 and into the technical gallery (TE16), they arrive in USA15 up to Y.30-11.A1.

The air-core cables will be routed by BE-EA-AS from a splicing point located max 2m far from the TAN face to a splicing point in proximity of the rack in USA15 (below the fake floor at about 6m from the bottom of the rack).

From splicing point in the tunnel to ZDC as well as from splicing point in USA15 to the rack, CC50 cables will be installed by ZDC group

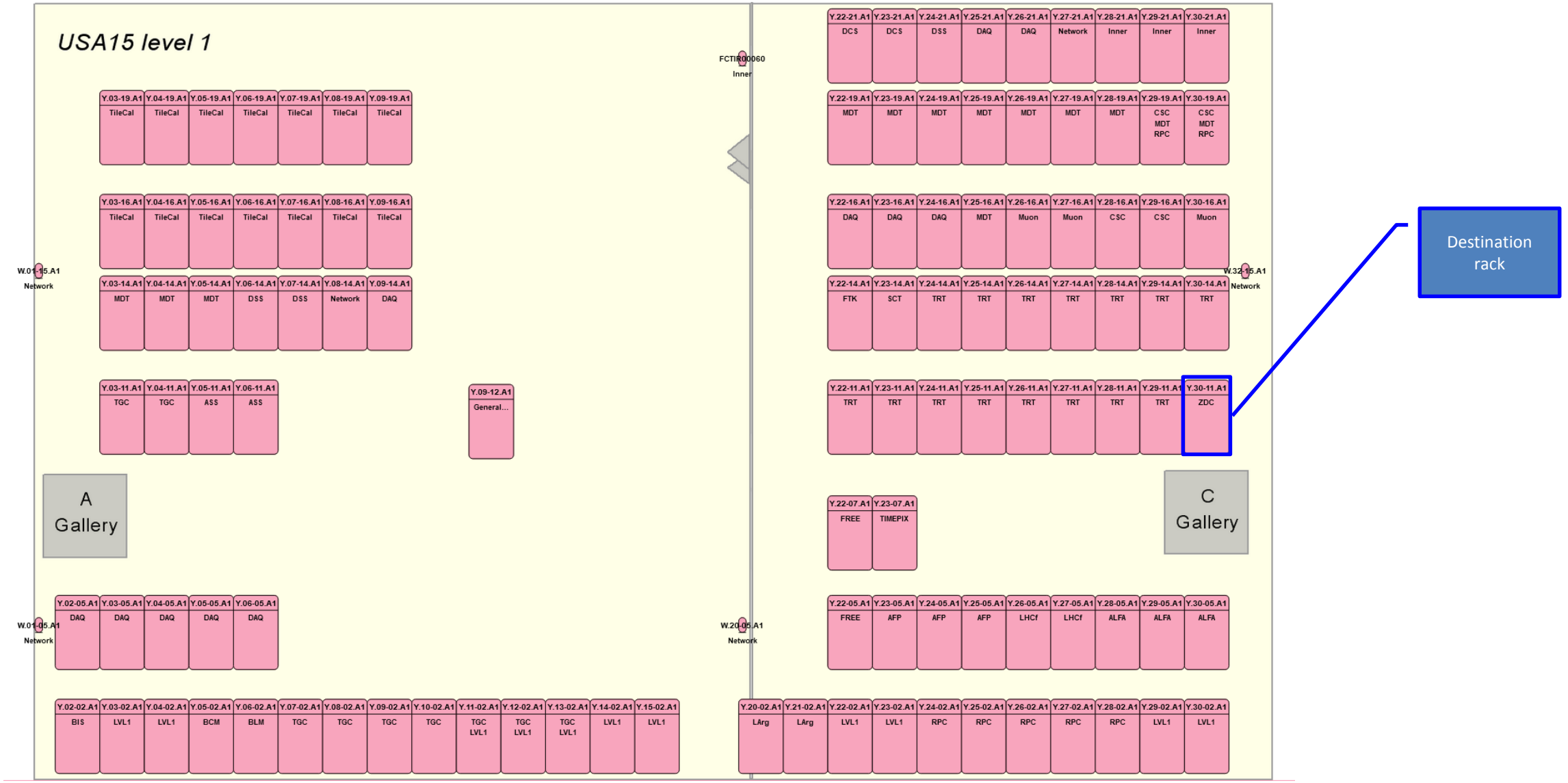
During LS3, the part of air-core cables running into the tunnel will have to be removed (most probably) to allow the foreseen civil engineering works.

Furthermore, in LS3 the TAN will be replaced with TAXN that will move toward IP by about 14m, hence a distance from IP of 127m.

The air-core cables will be pulled in one single piece. However, the cables must be cut into two parts before LS3, to allow the removal and replacement of the tunnel part (see previous point).

The foreseen installation period is fall 2021 (indicatively October 2021). However, the exact schedule is constrained by LHC schedule.

Racks layout in USA15 Level 1



Proposed layout for additional signal cables

Side A

Total cross section with packing factor 2 (≈50 cm^2 per side)

Help assembly: ST1210318_01

Estimated length from CAD: ≈199m (between 2 splicing points without contingency)

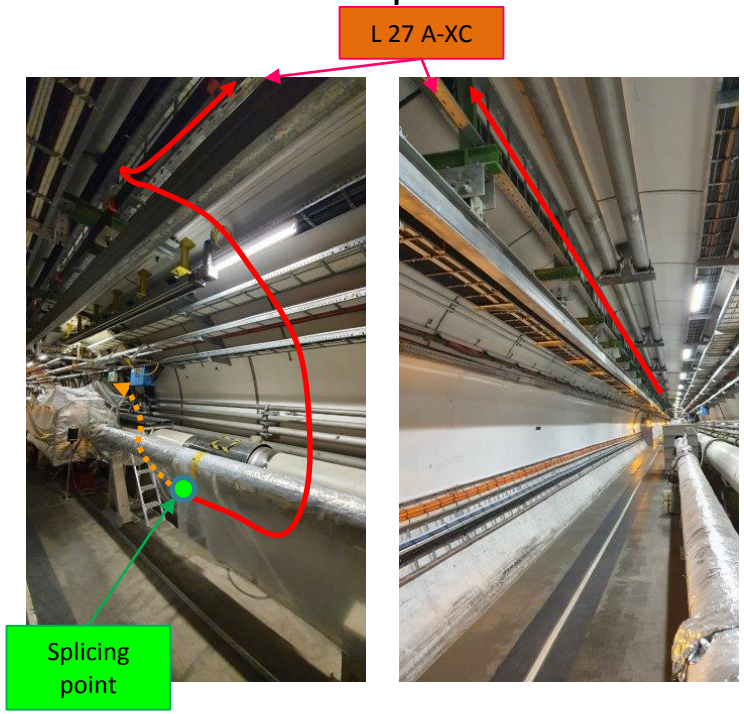
From ZDC side A to UPS14 – Option 1

ZDC side A is located around 140m far from ATLAS IP, in the portion of LHC tunnel between point 1 and point 8.

From the splicing point* (located on the back wall, close to the floor at about 1m in Z from the face of the TAN) the cables will be routed along the vertical tray that arrives to the longitudinal ceiling tray (L 27 A-XC). On this tray the cables run towards ATLAS. Once they arrive to the larger part of the tunnel, they jump into a perpendicular tray that follows the wall making a left turn and then a right one running along the wall up to the red door of UPS14 (survey gallery).

The cables are routed on the floor of the survey gallery.

* For a more precise view of the proposed splicing point, see back-up slides



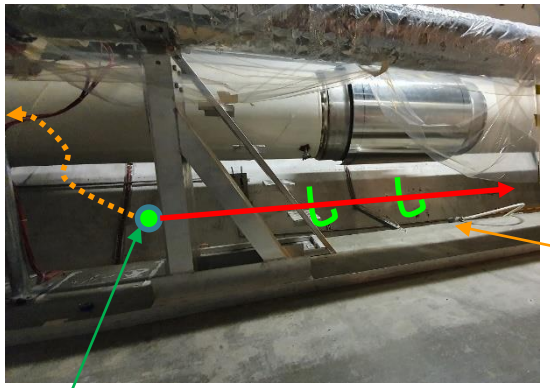
From ZDC side A to UPS14 – Option 2

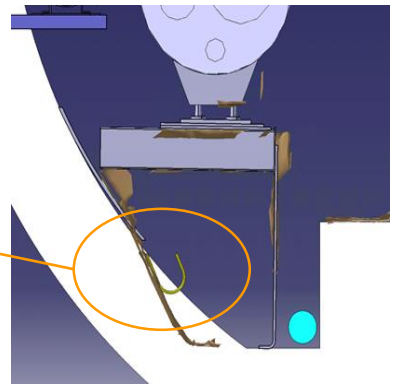
A second option is to route the cables from the splicing point into the drain channel below the QRL (cryogenic line behind the beam line), using "**J supports**" attached to the curved wall.

Once they arrive to the larger part of the tunnel, they are routed up into the "**J supports**" attached to the lower cable tray up to the red door of UPS14 (survey gallery).

The cables are routed on the floor of the survey gallery.

This option, which has been already presented to LHC integration and to EN-EL, would ease the installation process and also the removal foreseen in LS3.





From UPS14 to TE16

Just before entering in UX15 the cable will go up and once inside UX15 they enter in the“**J supports**” attached to the longitudinal tray (CT/X.W.H.1:80-30.X4/6L) running over the Level 4 platform.

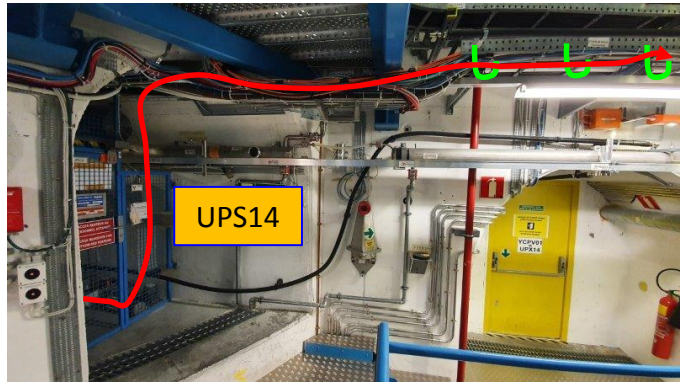
They go towards side C. Once arrived around Z0 the cables jump into a **new tray** (to be installed) running vertically on the wall beside the existing CT/X.W.V.50-30.X2:X5/3L.

In this tray the 4 cables join the other 4 cables arriving from side C.

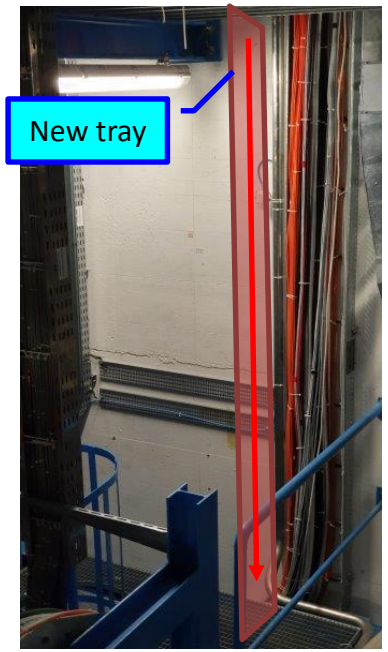
All cables go down in this newly installed tray, arriving to the top of the technical gallery TE16.

J supports and new trays will be installed by BE-EA-AS

Lights will be displaced by ATLAS TC



Lights to be displaced!



From TE16 to USA15

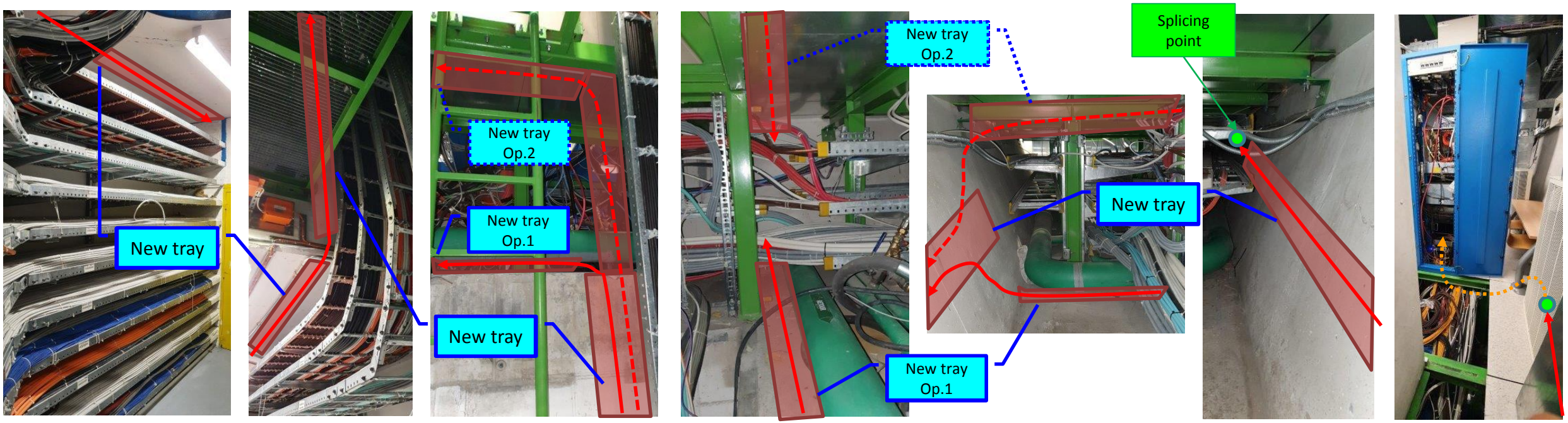
All cables enter in TE16 on the left side (side A). A dedicated **new cable tray** (to be installed) will run attached to the ceiling of the gallery so that the air-core cable will keep free the access to the existing trays.

At the end of the gallery the cables go up along the wall in a dedicated **new cable tray** (to be installed).

Once arrived in USA15 level 1, the cables make a 90° left turn passing either on the concrete floor (option 1) or below the false floor tiles (option 2) in a dedicated **new cable tray** (to be installed).

When the cables reach the side wall of USA15, they run along the wall up to the splicing point.

From the splicing point to the rack Y.30-11.A1, CC50 cables will be installed by TC under the supervision of ZDC group



Proposed layout for additional signal cables

Side C

Total cross section with packing factor 2 (≈50 cm^2 per side)

Help assembly: ST1210318_01

Estimated length from CAD: ≈193m (between 2 splicing points without contingency)

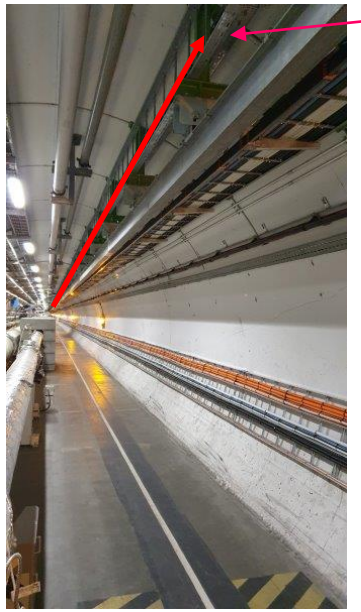
From ZDC side C to UPS16 – Option 1

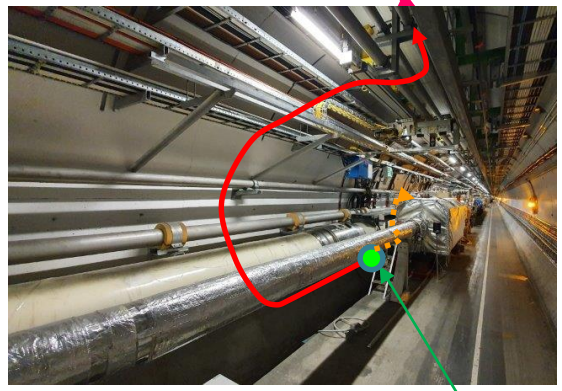
ZDC side C is located around 140m far from ATLAS IP, in the portion of LHC tunnel between point 1 and point 2.

From the splicing point* (located on the back wall, close to the floor at about 1m in Z from the face of the TAN) the cables will be routed along the vertical tray that arrives to the longitudinal ceiling tray (L 27 A-XC). On this tray the cables run towards ATLAS. Once they arrive to the larger part of the tunnel, they jump into a perpendicular tray that follows the wall making a right turn and then a left one running along the wall up to the red door of UPS1C (survey gallery).

The cables are routed on the floor of the survey gallery.

* For a more precise view of the proposed splicing point, see back-up slides





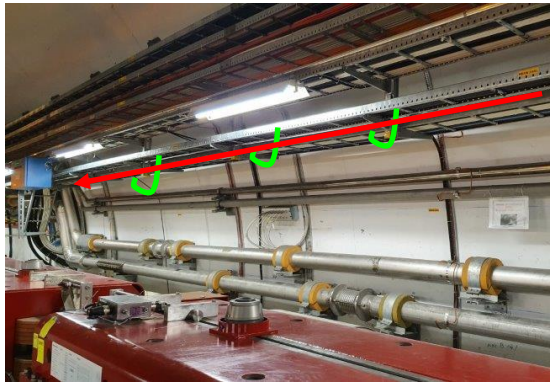
From ZDC side C to UPS16 – Option 2

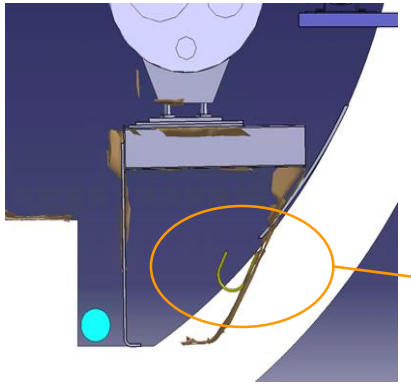
A second option is to route the cables from the splicing point into the drain channel below the QRL (cryogenic line behind the beam line), using "**J supports**" attached to the curved wall.

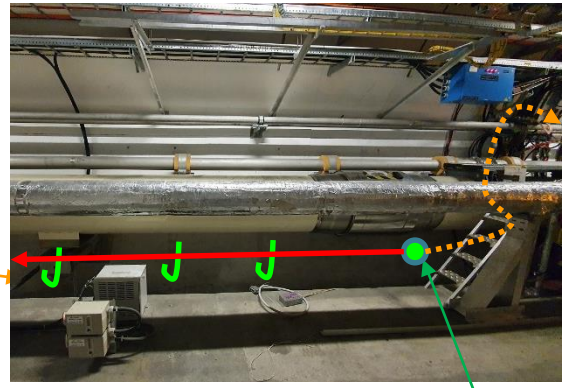
Once they arrive to the larger part of the tunnel, they are routed up into the "**J supports**" attached to the lower cable tray up to the red door of UPS16 (survey gallery).

The cables are routed on the floor of the survey gallery.

This option, which has been already presented to LHC integration and to EN-EL, would ease the installation process and also the removal foreseen in LS3.







From UPS16 to TE16

Just before entering in UX15 the cable will go up and once inside UX15 they enter in the "**J supports**" attached to the longitudinal tray (CT/X.W.H.1:80-30.X4/6L) running over the Level 4 platform.

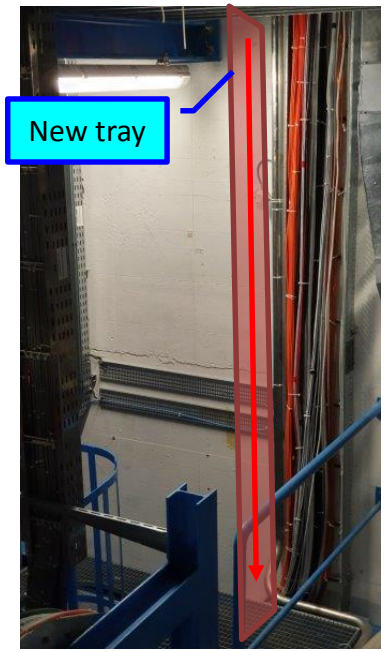
They go towards side A. Once arrived around Z0 the cables jump into a **new tray** (to be installed) running vertically on the wall beside the existing CT/X.W.V.50-30.X2:X5/3L.

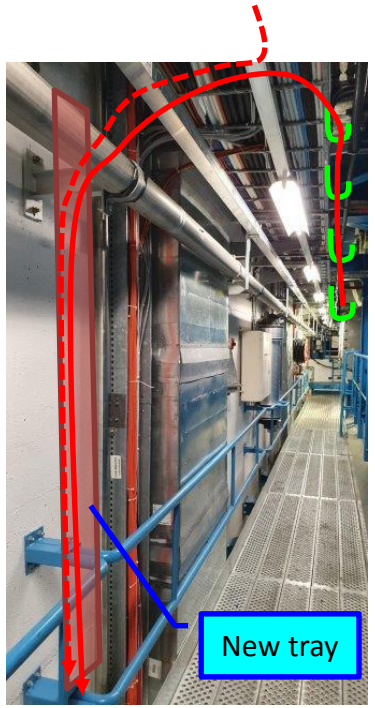
In this tray the 4 cables join the other 4 cables arriving from side A.

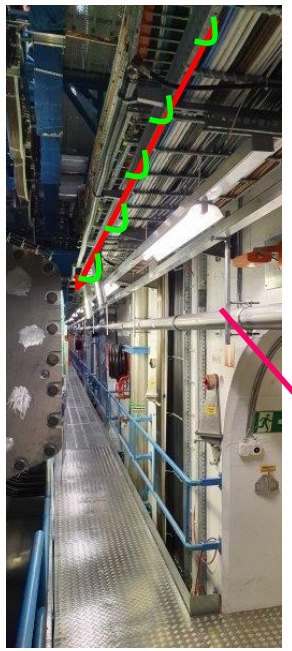
All cables go down in this newly installed tray, arriving to the top of the technical gallery TE16.

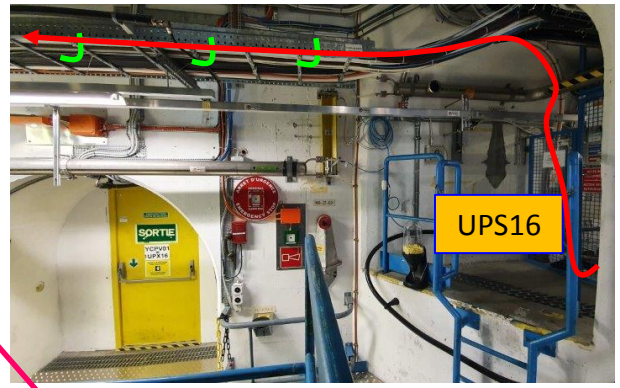
J supports and new trays will be installed by BE-EA-AS

Lights will be displaced by ATLAS TC









Lights to be displaced!

From TE16 to USA15

Same path of the cables for ZDC side A

Back-up slides

Product Data Sheet **HCA78-50JFN**

7/8" HELIFLEX® Air-Dielectric Coaxial Cable, flame retardant/ halogen free jacket

Product Description

HELIFLEX® 7/8" low loss air dielectric cable

Application: UHF, VHF

7/8" HELIFLEX® Air Dielectric Coaxial Cable

Features/Benefits

- **Low Attenuation**
  The low attenuation of HELIFLEX® coaxial cable results in highly efficient signal transfer in your RF system.
- **Complete Shielding**
  The solid outer conductor of HELIFLEX® coaxial cable creates a continuous RFI/EMI shield that minimizes system interference.
- **Low VSWR**
  Special low VSWR versions of HELIFLEX® coaxial cables contribute to low system noise.
- **Outstanding Intermodulation Performance**
  HELIFLEX® coaxial cable's solid inner and outer conductors virtually eliminate intermods. Intermodulation performance is also confirmed with state-of-the-art equipment at the RFS factory.
- **High Power Rating**
  Due to their low attenuation, outstanding heat transfer properties and temperature stabilized dielectric materials, HELIFLEX® cable provides safe long term operating life at high transmit power levels.
- **Wide Range of Application**
  Typical areas of application are: feedlines for broadcast and terrestrial microwave antennas, wireless cellular, PCS and ESMR base stations, cabling of antenna arrays, and radio equipment interconnects.

Technical Features

Structure

Inner conductor:	Copper Tube	[mm (in)]	9 (0.35)
Dielectric:	Helical Polyethylene Spacer	[mm (in)]	20.2 (0.79)
Outer conductor:	Corrugated Copper	[mm (in)]	25.5 (1)
Jacket:	Polyethylene, PE, Metalhydroxite Filling	[mm (in)]	28 (1.103)

Mechanical Properties

Weight, approximately	[kg/m (lb/ft)]	0.68 (0.46)
Minimum bending radius, single bending	[mm (in)]	100 (4)
Minimum bending radius, repeated bending	[mm (in)]	250 (10)
Bending moment	[Nm (lb-ft)]	27 (20)
Max. tensile force	[N (lb)]	1600 (360)
Recommended / maximum clamp spacing	[m (ft)]	0.5 / 0.9 (1.8 / 3)

Electrical Properties

Characteristic impedance	[Ω]	50 +/- 0.5
Relative propagation velocity	[%]	93
Capacitance	[pF/m (pF/ft)]	71 (21.6)
Inductance	[µH/m (µH/ft)]	0.178 (0.054)
Max. operating frequency	[GHz]	3
Jacket spark test RMS	[V]	8000
Peak power rating	[kW]	73
RF Peak voltage rating	[V]	2700
DC-resistance inner conductor	[Ω/km (Ω/1000ft)]	1.1 (0.34)
DC-resistance outer conductor	[Ω/km (Ω/1000ft)]	0.88 (0.27)

Recommended Temperature Range

Storage temperature	[°C (°F)]	-70 to 85 (-94 to 185)
Installation temperature	[°C (°F)]	-40 to 60 (-40 to 140)
Operation temperature	[°C (°F)]	-50 to 85 (-58 to 185)

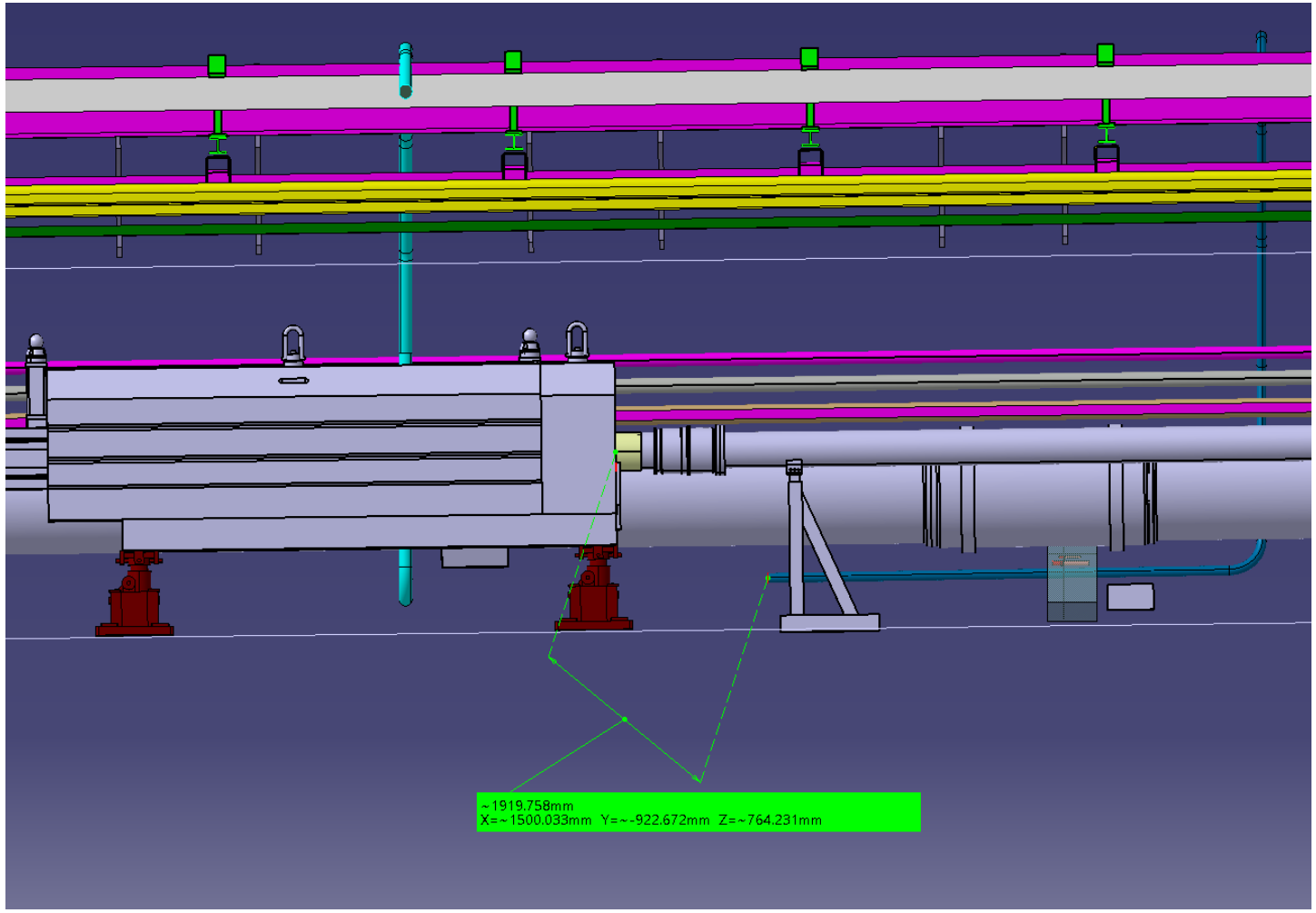
Other Characteristics

Fire Performance:	Flame Retardant, LS0H	
VSWR Performance:	Standard	Typical 20.8dB (1.2 VSWR) or better within the operation bands of most global frequency ranges. Premium also available. Contact factory for options in your specific frequency band.
Other Options:	Phase stabilized and phase matched cables and assemblies are available upon request.	

Frequency	Attenuation		Power
[MHz]	[dB/100m]	[dB/100ft]	[kW]
0.5	0.0813	0.0248	73.0
1.0	0.115	0.0351	73.0
1.5	0.141	0.0430	70.9
2.0	0.163	0.0497	61.4
10	0.366	0.112	27.3
20	0.520	0.158	19.2
30	0.638	0.194	15.7
50	0.827	0.252	12.1
88	1.10	0.337	9.11
100	1.18	0.359	8.49
108	1.23	0.374	8.15
150	1.45	0.443	6.92
174	1.57	0.478	6.39
200	1.69	0.514	5.94
300	2.08	0.634	4.84
400	2.42	0.738	4.17
450	2.57	0.785	3.93
500	2.72	0.830	3.71
512	2.76	0.840	3.66
600	3.0	0.914	3.37
700	3.25	0.992	3.12
800	3.49	1.07	2.91
824	3.55	1.08	2.86
894	3.71	1.13	2.74
900	3.72	1.13	2.74
925	3.78	1.15	2.69
960	3.85	1.17	2.65
1000	3.94	1.20	2.59
1250	4.45	1.36	2.30
1500	4.91	1.50	2.10
1700	5.26	1.60	1.97
1800	5.43	1.65	1.91
2000	5.75	1.75	1.81
2200	6.07	1.85	1.72
2300	6.22	1.90	1.68
3000	7.22	2.20	1.47

Attenuation at 20°C (68°F) cable temperature
Mean power rating at 40°C (104°F) ambient temperature

Splicing point in tunnel 1-8 (side A)



Splicing point in tunnel 1-2 (side C)