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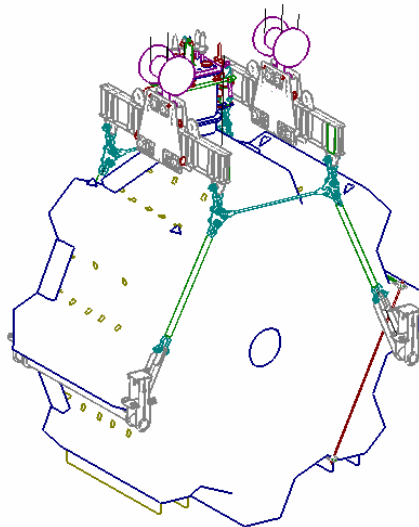
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ATLAS – EC Toroid Installation

REPORT

of Dynamical Conflict Checking



Done by: Georgian CAD/CAM Engineering Center

Platform: Dassault System CATIA V5R12

PRECONDITIONS

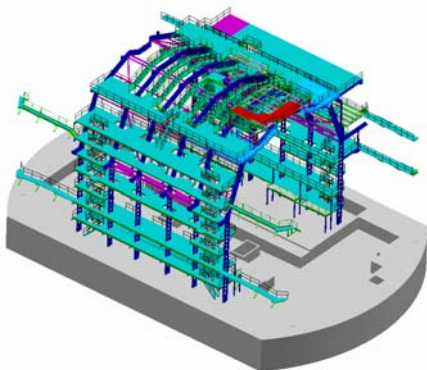
1. Dynamical Conflict Checking Strategy

- Two type of conflicts where considering - Clashes and Clearances
- Dynamical conflict checking is carrying out separately for each segment of EC toroid (ECT) lifting path
- Cases, when the clearance between the moving ECT and the estimated environment around, was less than 80mm was not considered in detailed

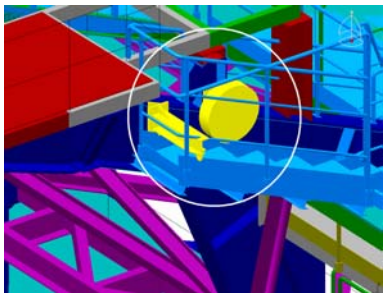
2. Environment

Environment for checking was chosen according to close location of objects to assumed path of ECT lifting.

1.



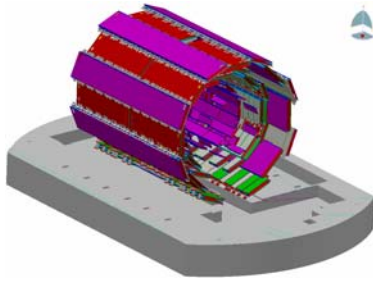
HS Structure + Civil Engineering



Cryolink support was also added while it is going bit more forward from HS stairs

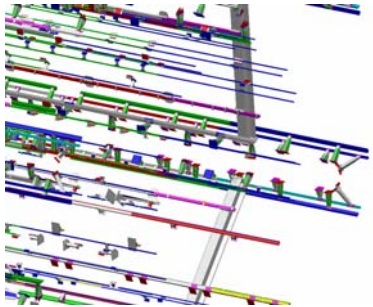
Representation was checked in cavern and it fully corresponds to reality.

2.



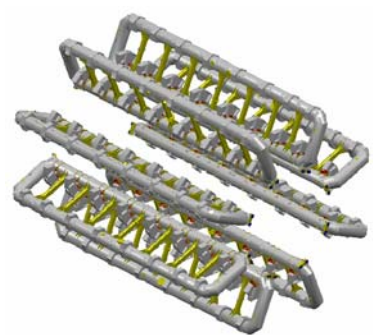
Muon Chambers

3.



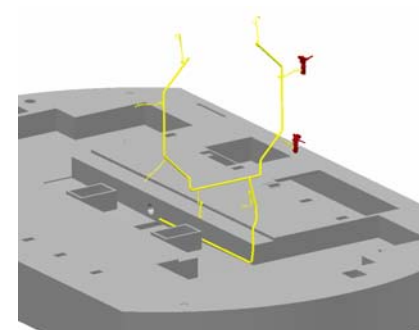
Muon Brackets

4.



Vacuum Vessels

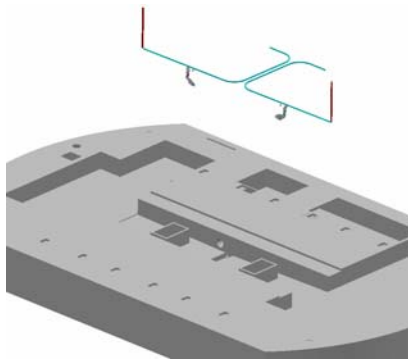
5.



BT Vacuum pipe

Representation was checked in cavern and it fully corresponds to reality.

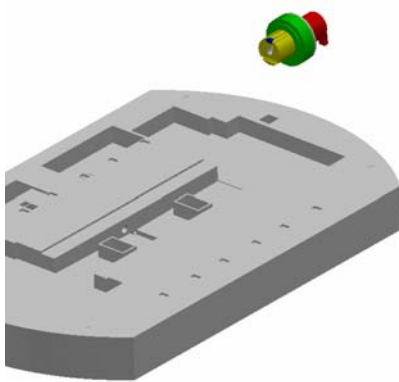
6.



Rail and Support

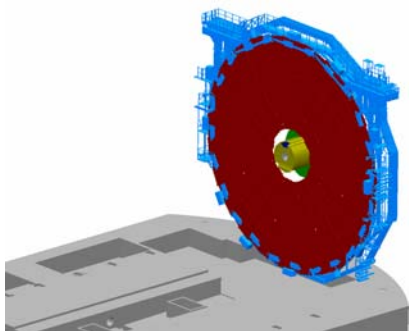
Representation was checked in cavern and it fully corresponds to reality.

7.



TX1S Shielding

8.

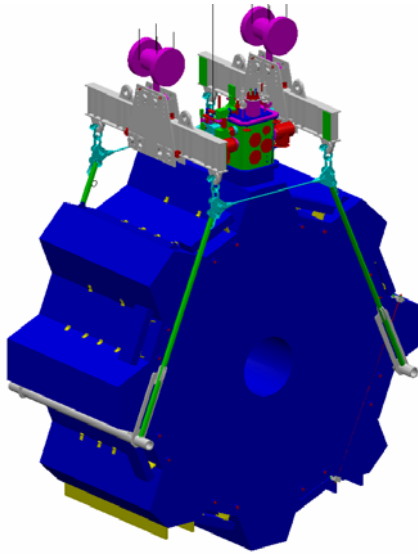


TGC3 Chambers + BW Assembly

TGC3 chambers are positioned on $Z=19'497\text{mm}$ from Z_0 . Representation was checked in cavern and it fully corresponds to reality.

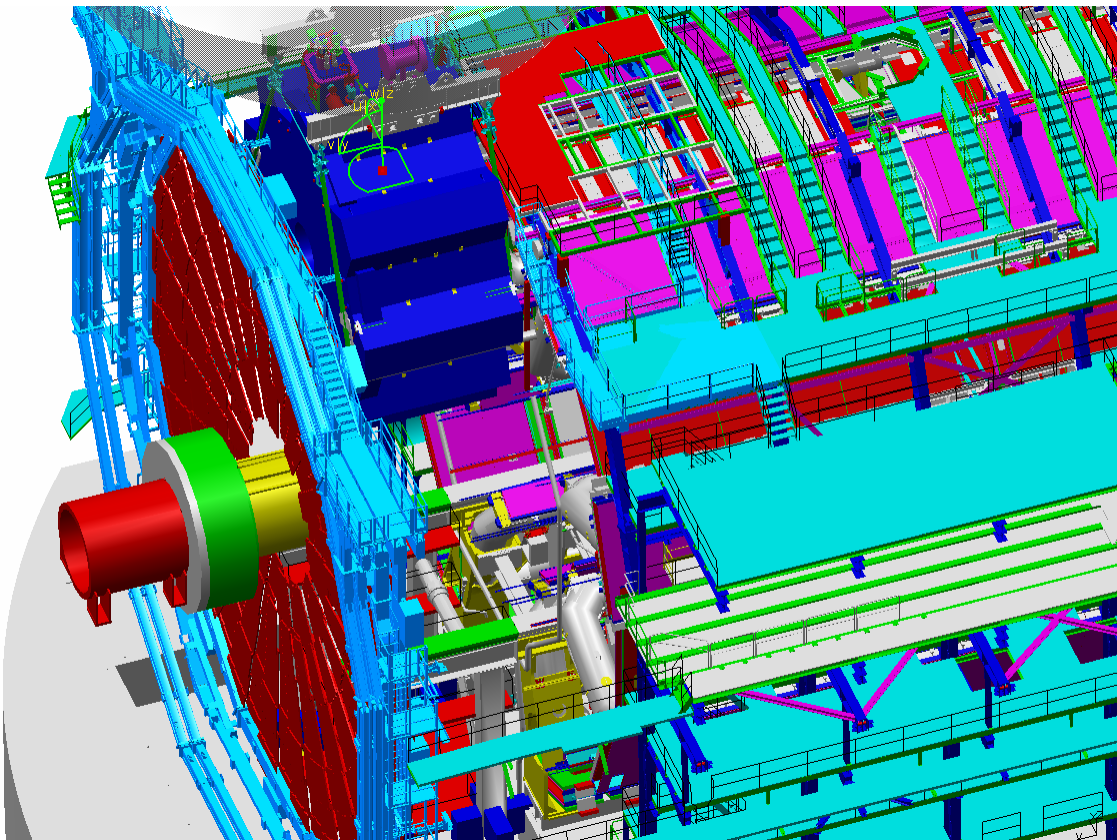
9.

End-Cap Toroid



Dimensions of fasteners and supports was measured on ECT side A and adopted for calculations

Final environment for checking looks like above,



3. Predefined Path of ECT Lifting

5 segments have been separated. On the 1st segment ECT is moving down starting from the on ground surface. In this point altitude is 0 and ECT central point is coincidence with SCX1 ground floor. Movement is going on along the Z axis and finished on the altitude = 60.3m of ECT central point. Further vertical movement of ECT is restricted by the big wheel supports (figure 1). Clearance

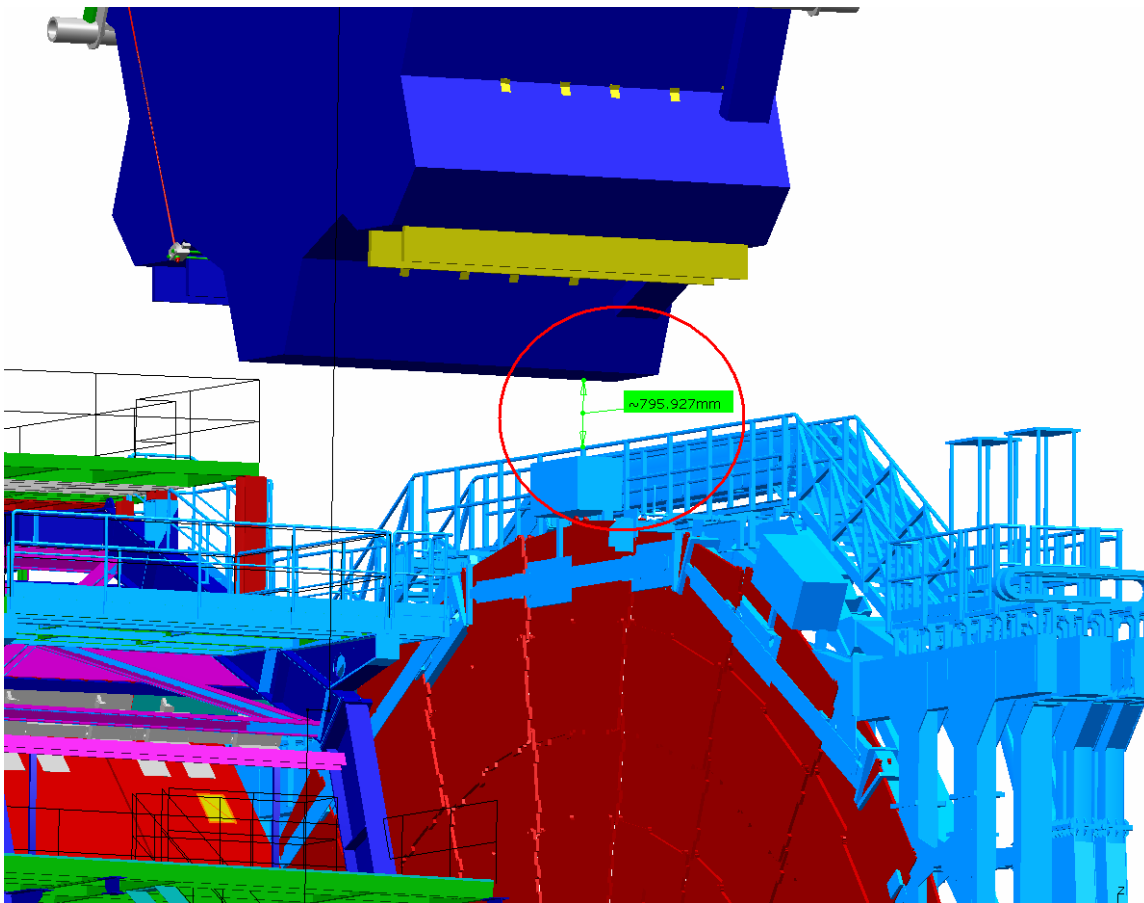


Figure 1

between ECT and handrails above the boxes is ~800mm. Next movement has to be done along the Y axis to Z0 direction on 1'520mm. This length makes possible to set the clearance >100mm during the further vertical movement of ECT on segment #3.

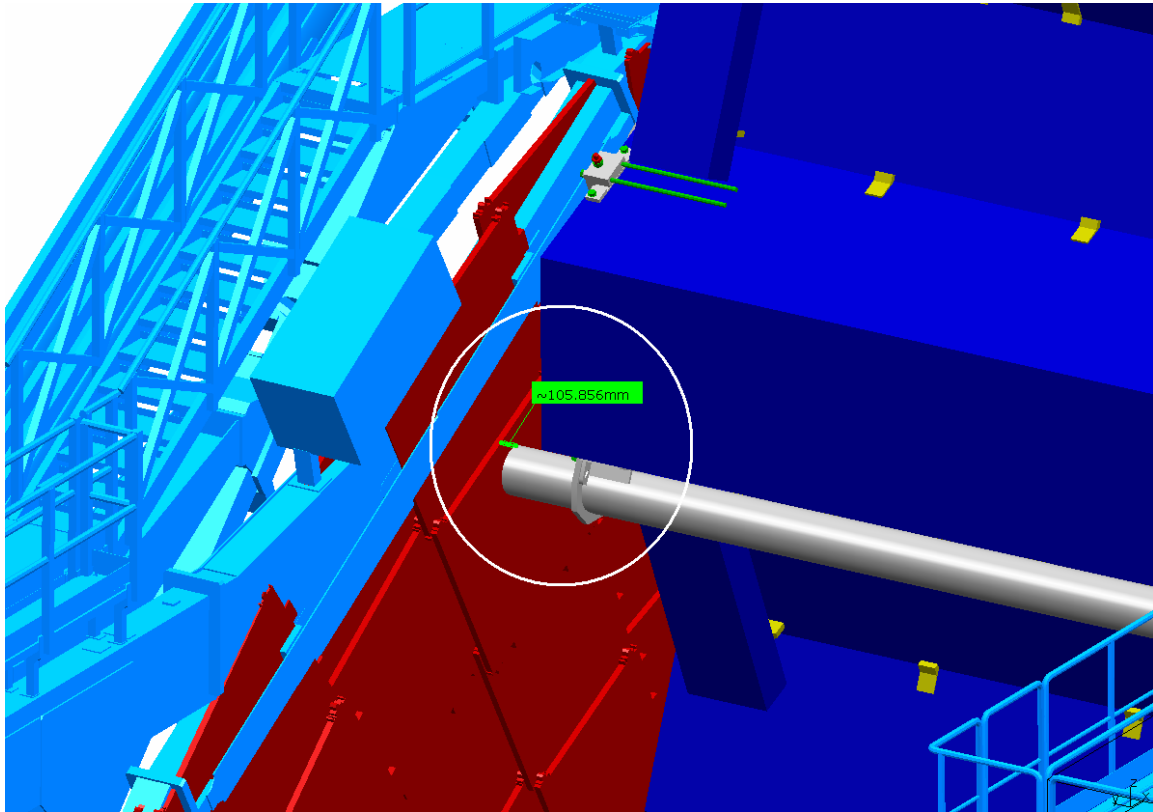


Figure 2

Movement on segment #3 is starting on altitude 60.3m and finishing on altitude 72.3m. Minimum clearance from the cavern walls side is 105mm with big wheel chambers on the altitude 68.8m (figure 2). From the opposite side of ECT minimum clearance is 121mm on the altitude 67.8m with the frame of stairs of HS structure (figure 3). It is assumed that handrails on stairs will be removed while with the handrails, clearance will be 75mm. Further vertical movement of ECT is restricted by the TX1S shielding having the clearance with ECT 246mm (figure 4). Reducing above clearance will bring no further simplification.

Next movement has to be done along the Y axis to Z0 direction. This is segment #4. Length of movement is 296mm. This value guaranteeing 100mm clearance between ECT and TX1S shielding during the further vertical movement of ECT up to final position.

Last is the segment #5 where ECT is moving down from the altitude 72.3m up to 80.2m which is its final position.

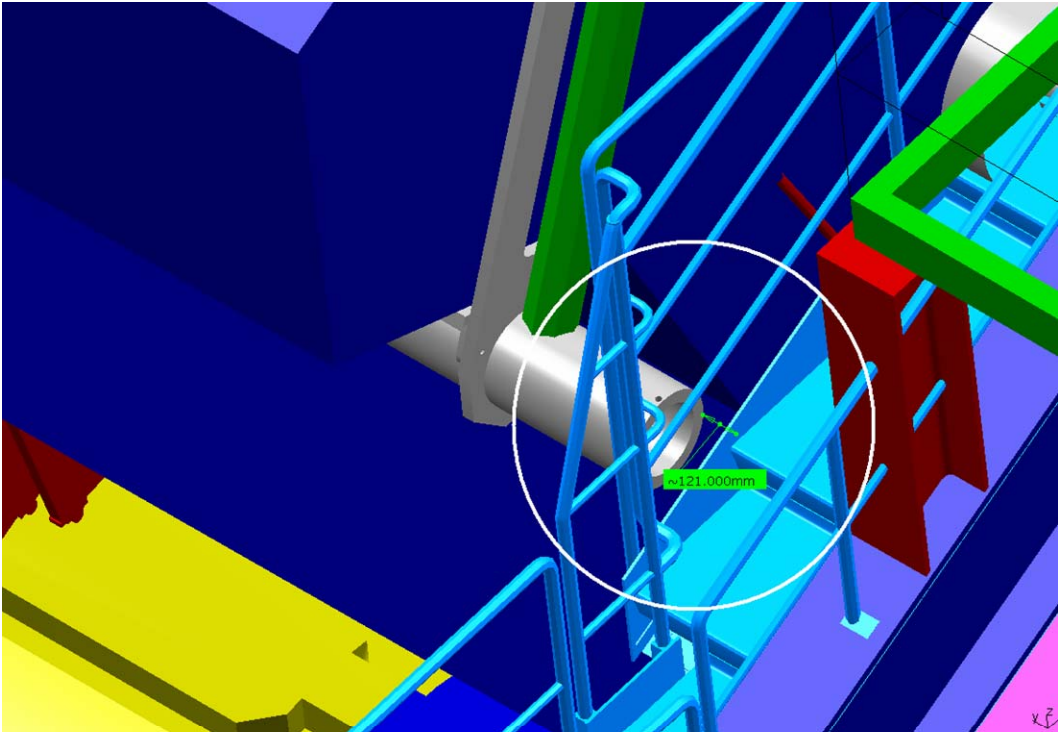


Figure 3

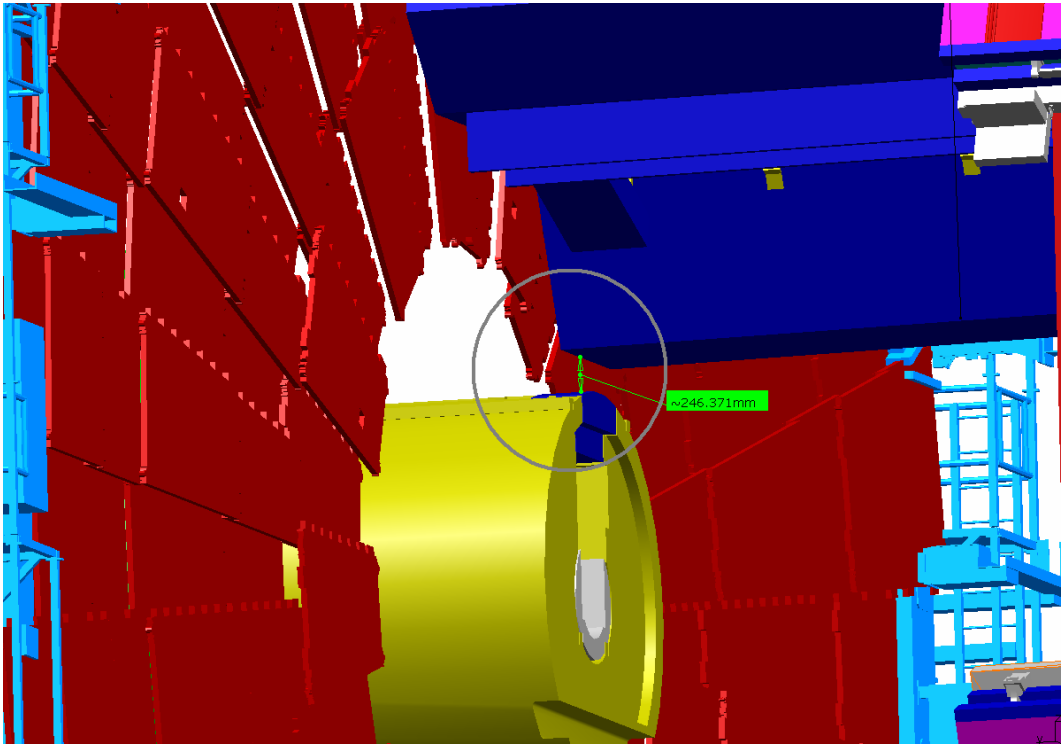


Figure 4

Thus, final path will be as follow,

All dimensions are given in meter

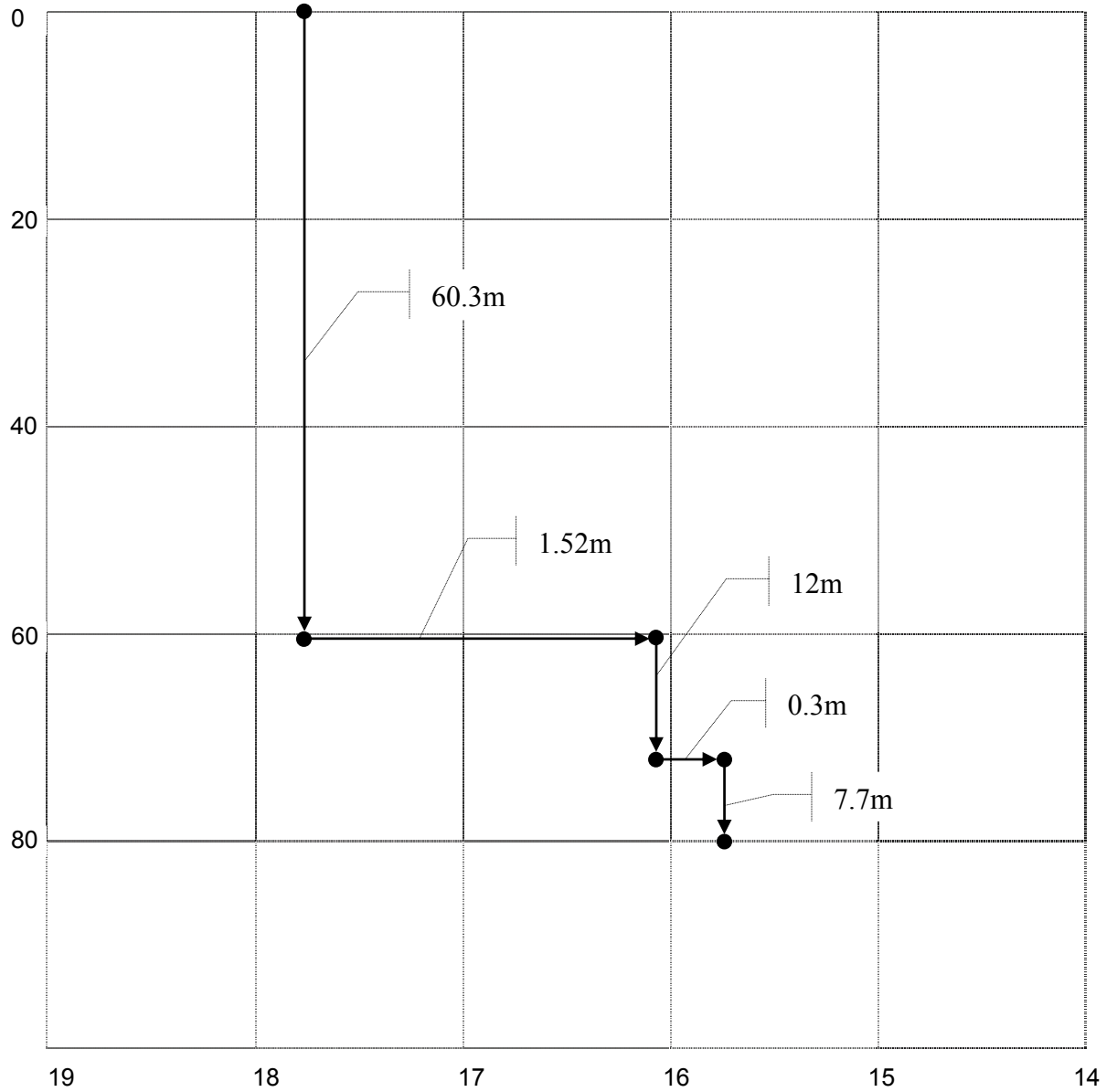


Figure 5

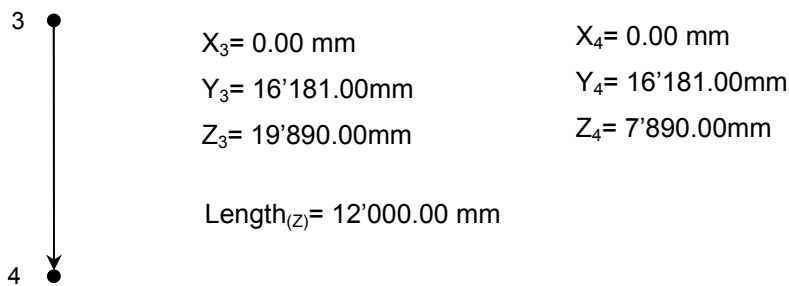
Coordinates in Z0 of support points of ECT Lifting path are presented in table.

Points	X	Y	Z
1	0mm	17'700.00mm	80'211.00mm
2	0mm	17'700.00mm	19'890.00mm
3	0mm	16'181.00mm	19'890.00mm
4	0mm	16'181.00mm	7'890.00mm
5	0mm	15'876.00mm	7'890.00mm
6	0mm	15'876.00mm	190.00mm

DYNAMICAL CONFLICT CHECKING RESULTS

For Segments #1, #2 and #4 no critical zones have been detected.

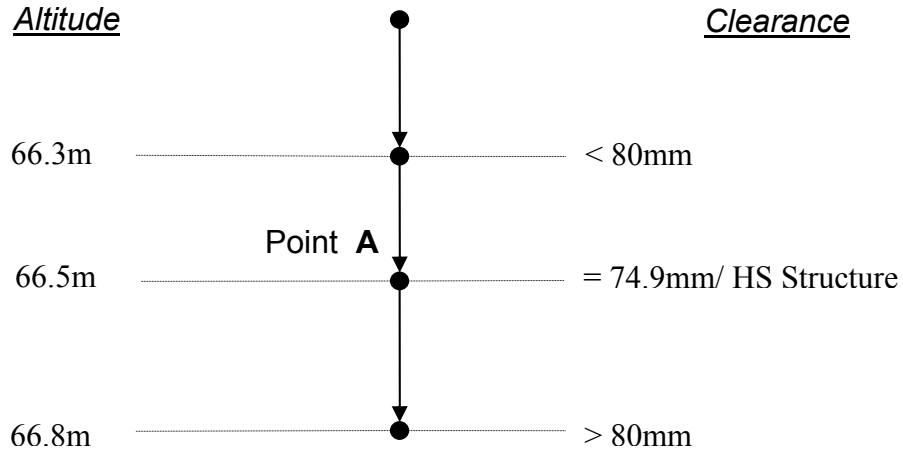
Segment #3: Movement from point 3 to point 4



Grouping Environment by the Clearance			
More than 80mm		Less than 80mm	
Environment	Clearance (mm)	Environment	Clearance (mm)
		<ul style="list-style-type: none"> HS Structure (JUX150019) 	74.9

Segment #3: Movement from point 3 to point 4

Conflicts Summary

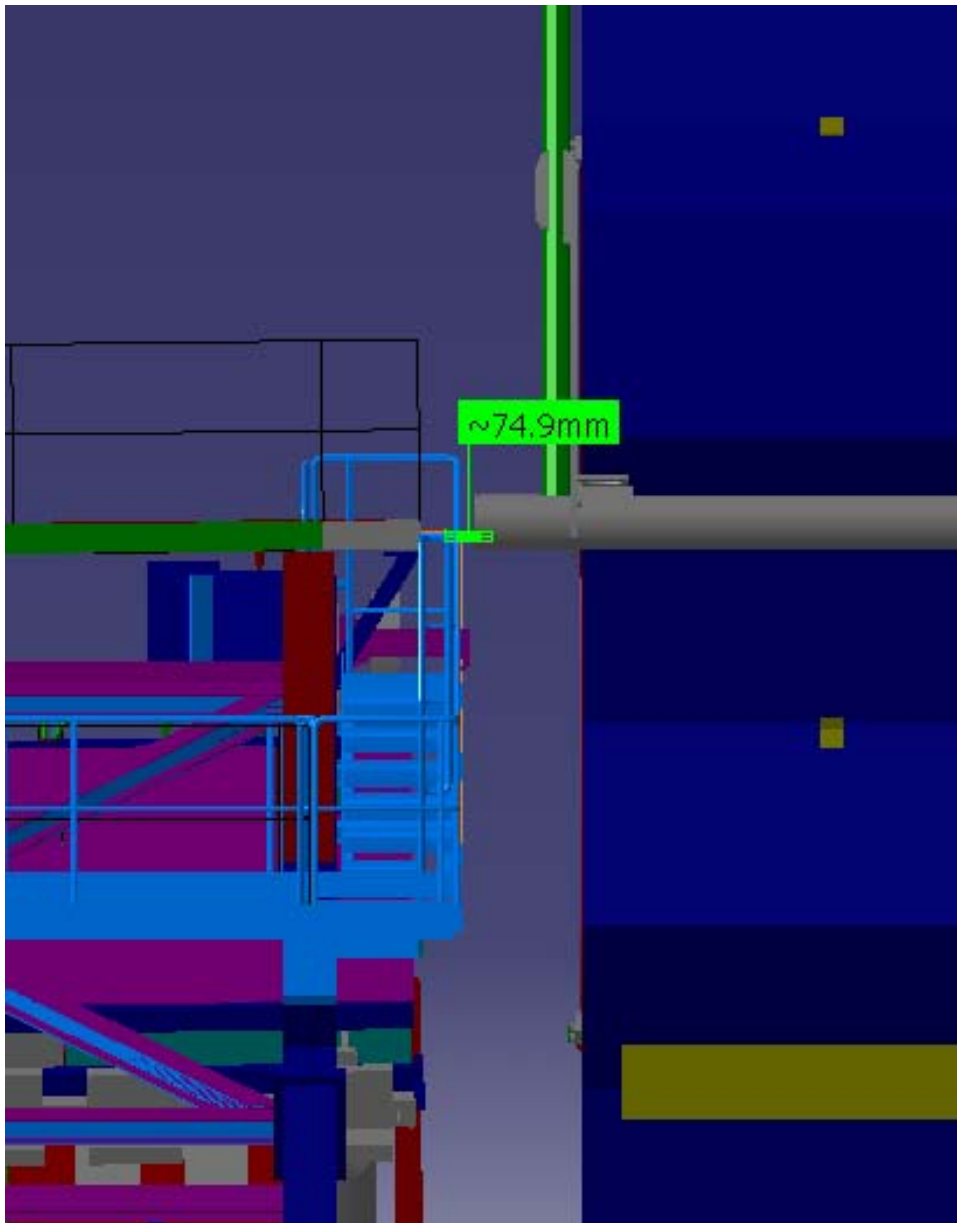


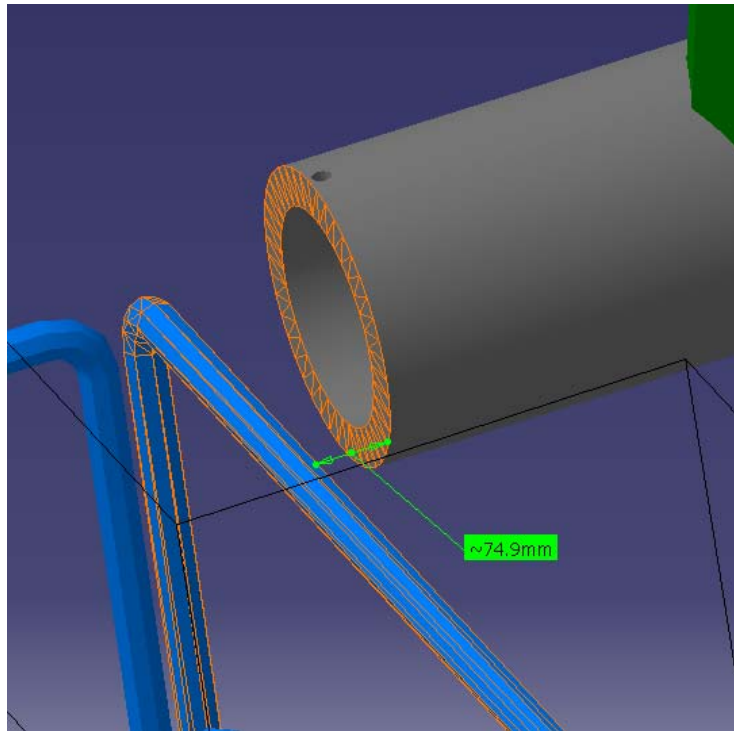
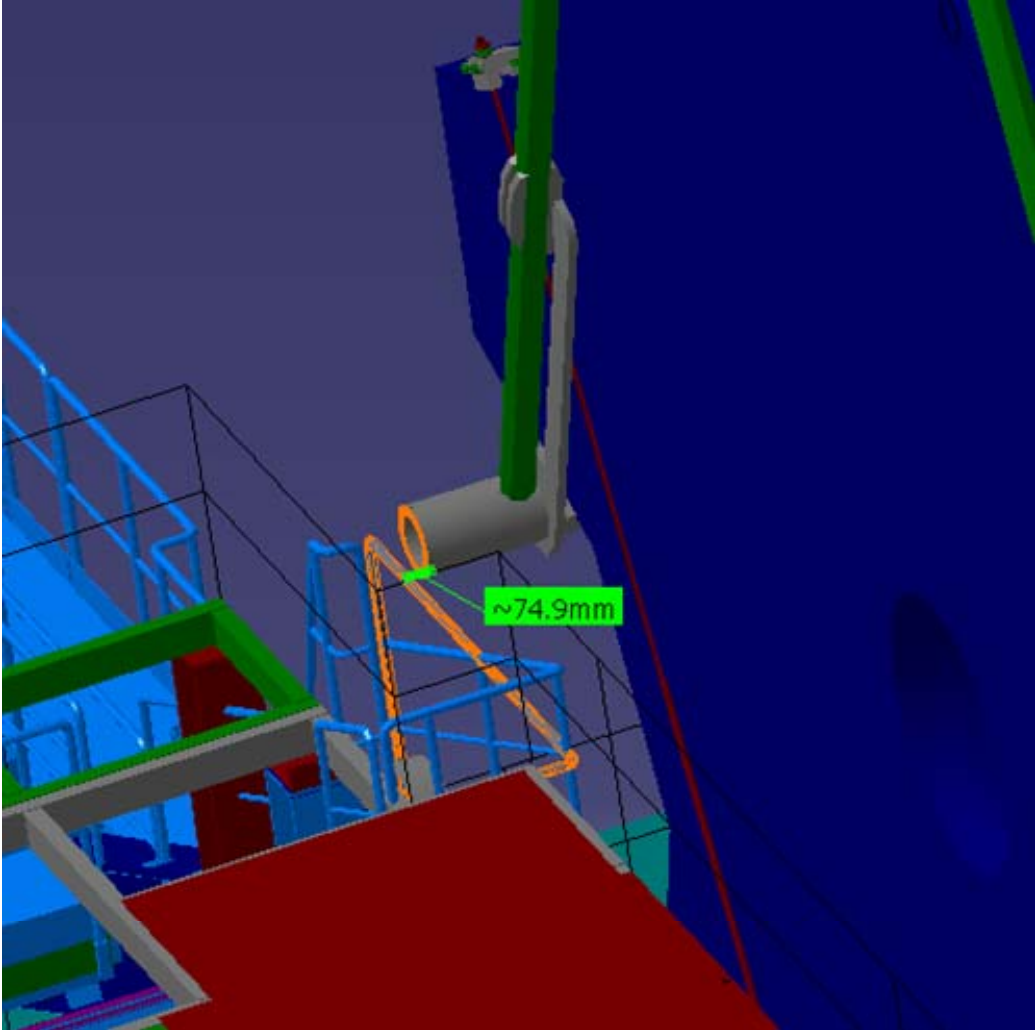
Segment #3: Movement from point 3 to point 4

Point A: Altitude 66.5m Side C /

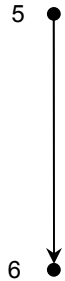
<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	HS Structure	74.9mm	Not Considered

X=0.00mm
Y=16'511.00mm
Z=13'790.00mm





Segment #5: Movement from point 5 to point 6



$X_5 = 0.00 \text{ mm}$

$Y_5 = 15'885.00 \text{ mm}$

$Z_5 = 7'890.00 \text{ mm}$

$\text{Length}_{(Z)} = 7'700.00 \text{ mm}$

$X_6 = 0.00 \text{ mm}$

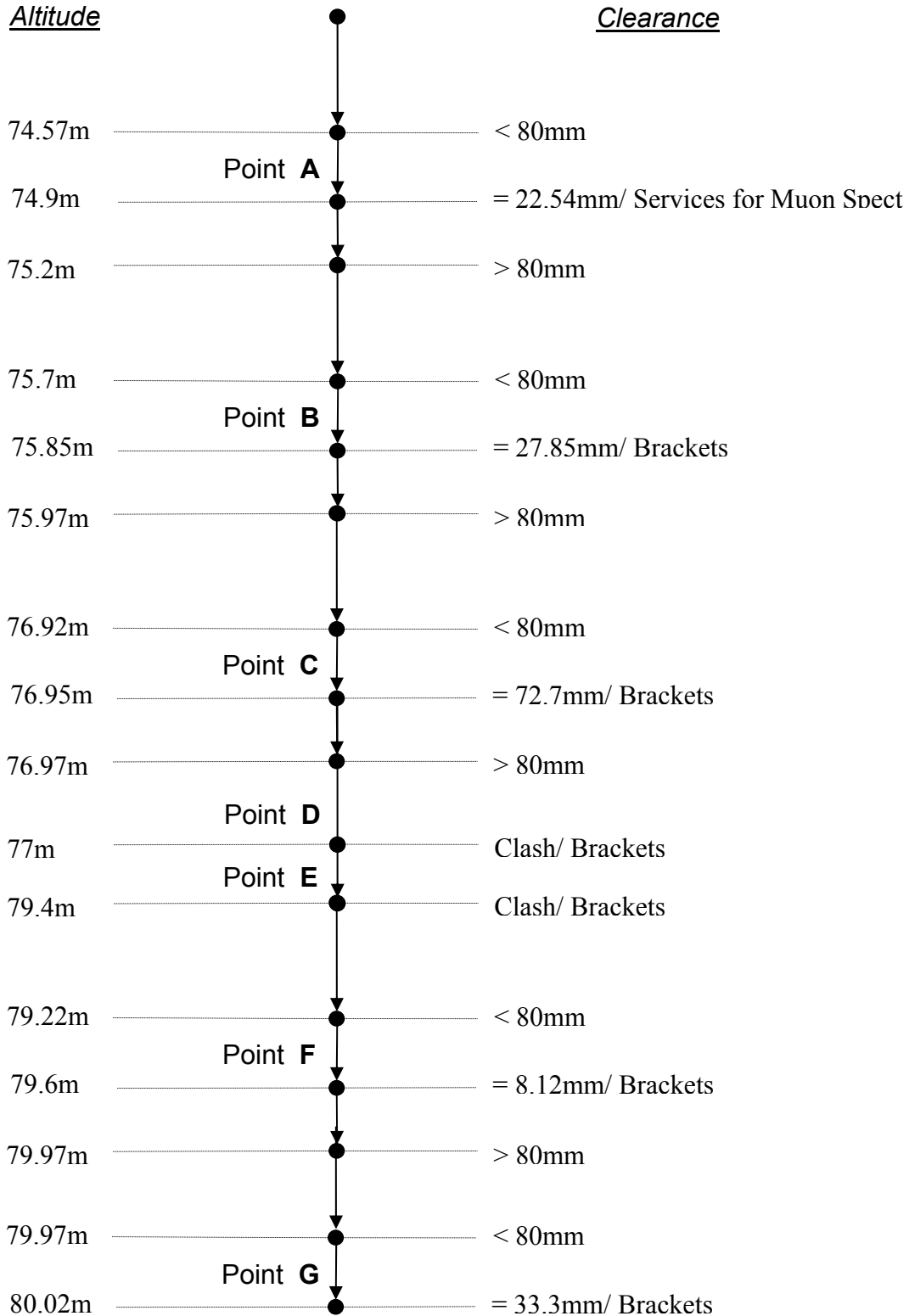
$Y_6 = 15'885.00 \text{ mm}$

$Z_6 = 190.00 \text{ mm}$

Grouping Environment by the Clearance			
More than 80mm		Less than 80mm	
Environment	Clearance (mm)	Environment	Clearance (mm)
		<ul style="list-style-type: none"> Vacuum pipe (QQ212200MQ) 	22.54
		<ul style="list-style-type: none"> Brackets (AT612367MQ) 	27.85
		<ul style="list-style-type: none"> Brackets (AT612369MQ) 	72.7
		<ul style="list-style-type: none"> Brackets (AT612361MQ) 	8.12
		<ul style="list-style-type: none"> Brackets (AT612362MQ) (AT612363MQ) 	Clash
		<ul style="list-style-type: none"> Brackets (AT612364MQ) (AT612365MQ) 	Clash
		<ul style="list-style-type: none"> Brackets (AT612358MQ) 	33.3

Segment #5: Movement from point 5 to point 6

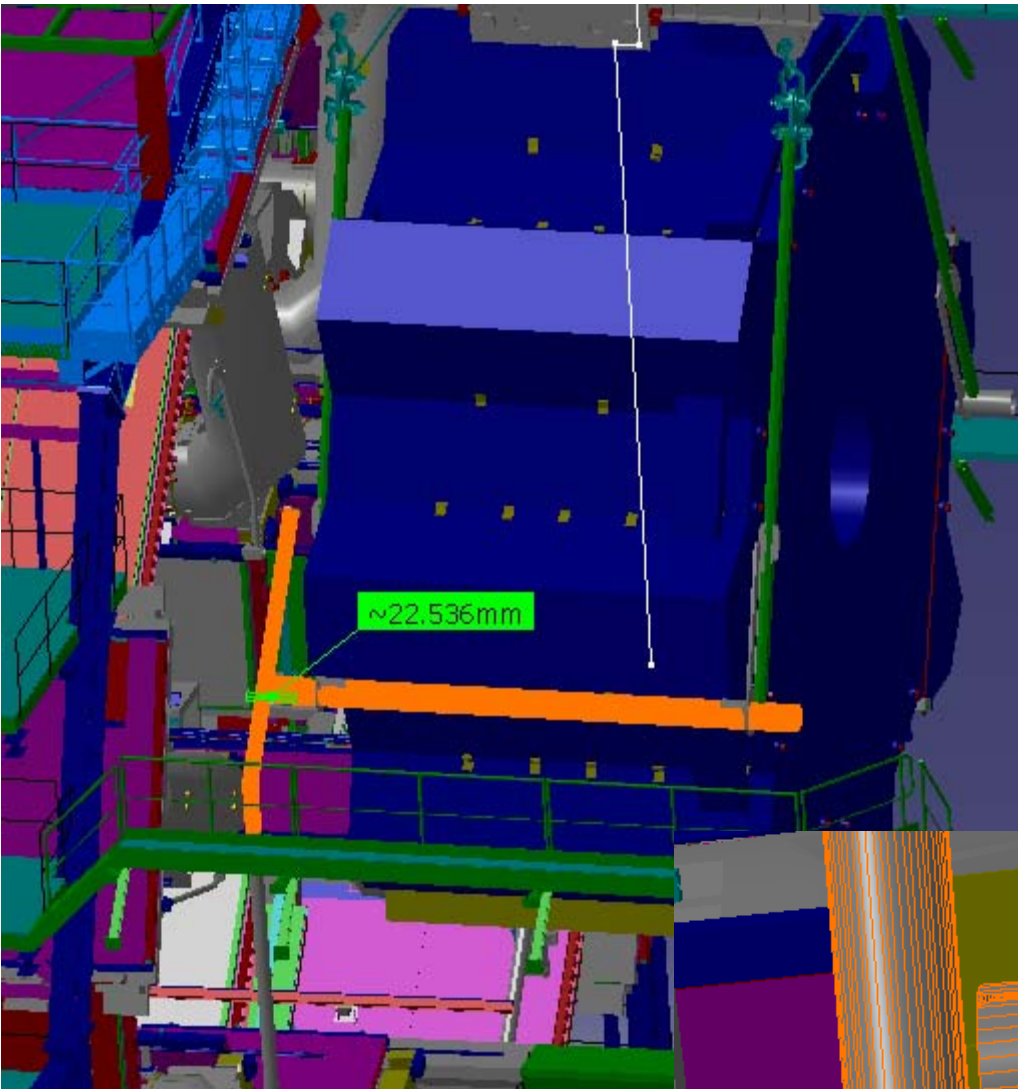
Conflicts Summary



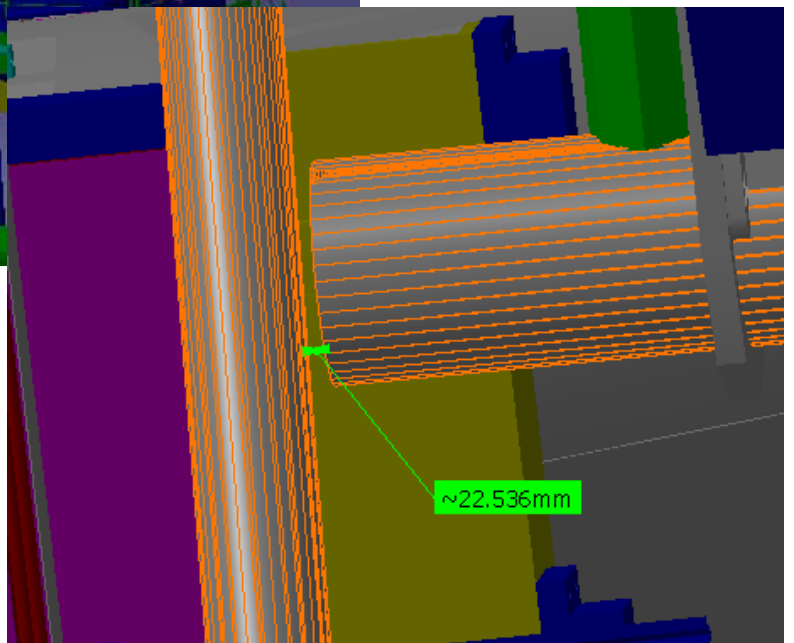
Segment #5: Movement from point 5 to point 6

Point A: Altitude 74.9m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	Vacuum pipe, sect. 7	22.54mm	Not Considered



X=0.00mm
Y=15'885.00mm
Z=5'290.00mm

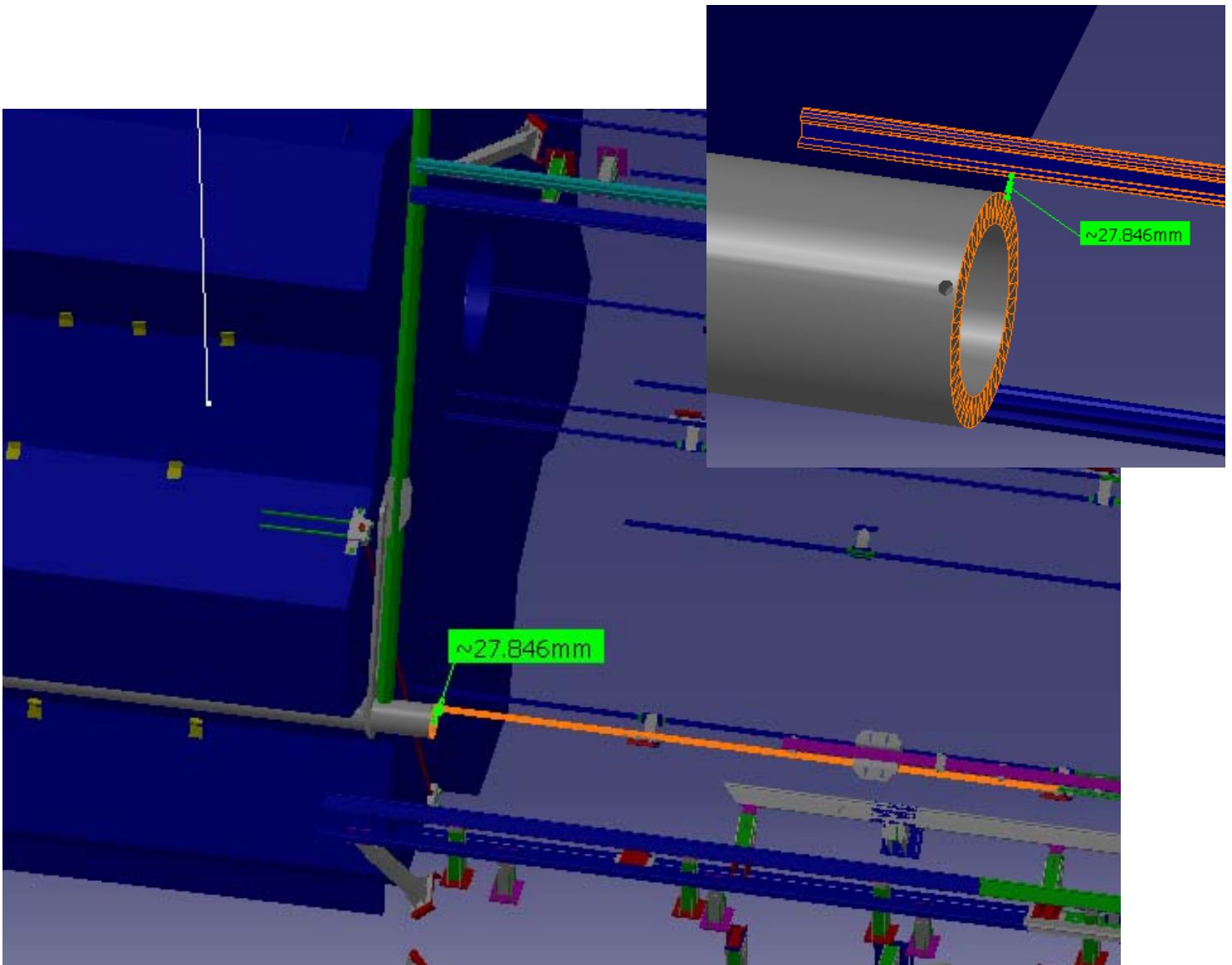


Segment #5: Movement from point 5 to point 6

Point B: Altitude 75.85m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 7	27.8mm	Not Considered

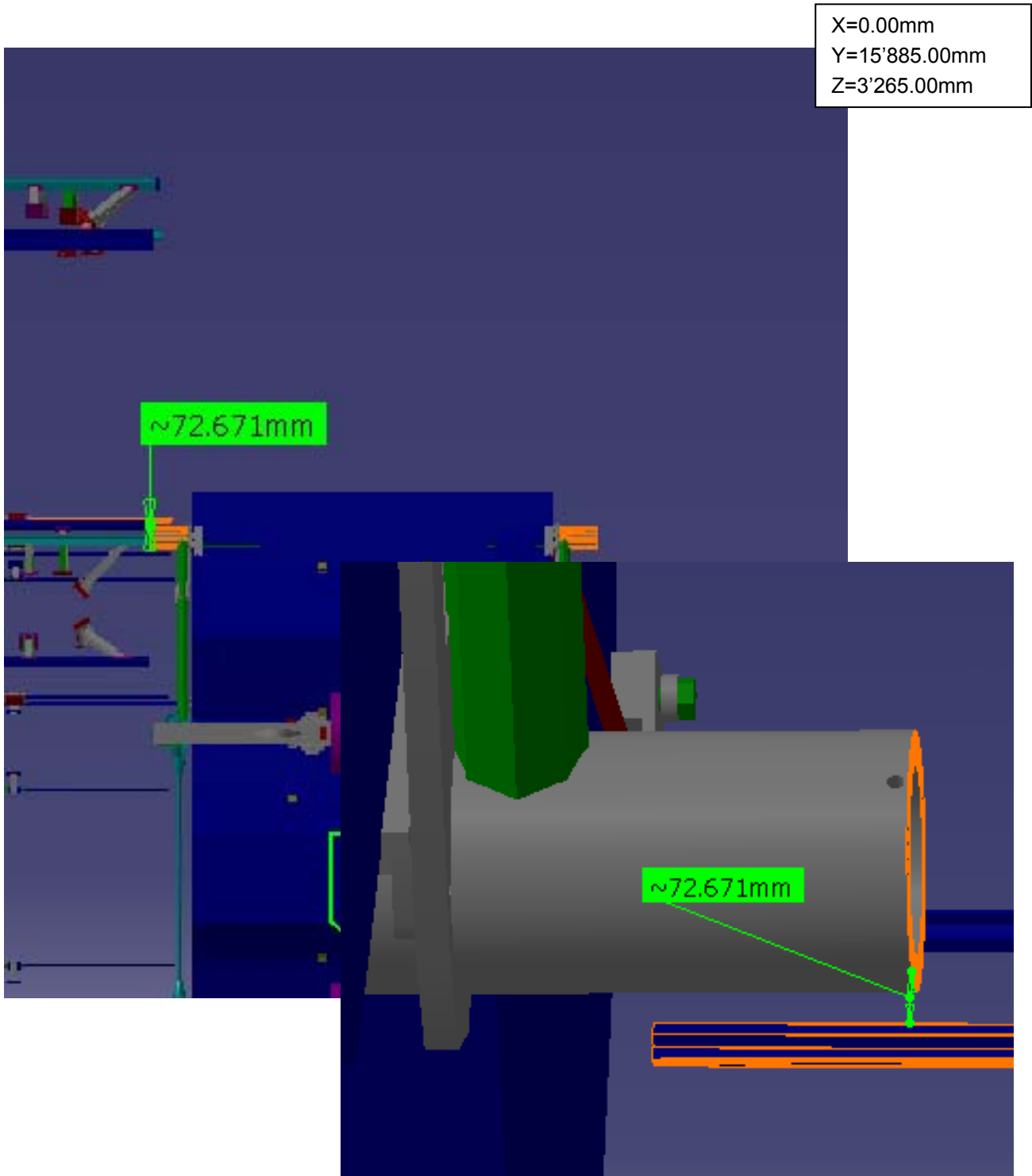
X=0.00mm
Y=15'885.00mm
Z=4'365.00mm



Segment #5: Movement from point 5 to point 6

Point C: Altitude 76.95.9m Side C / US15

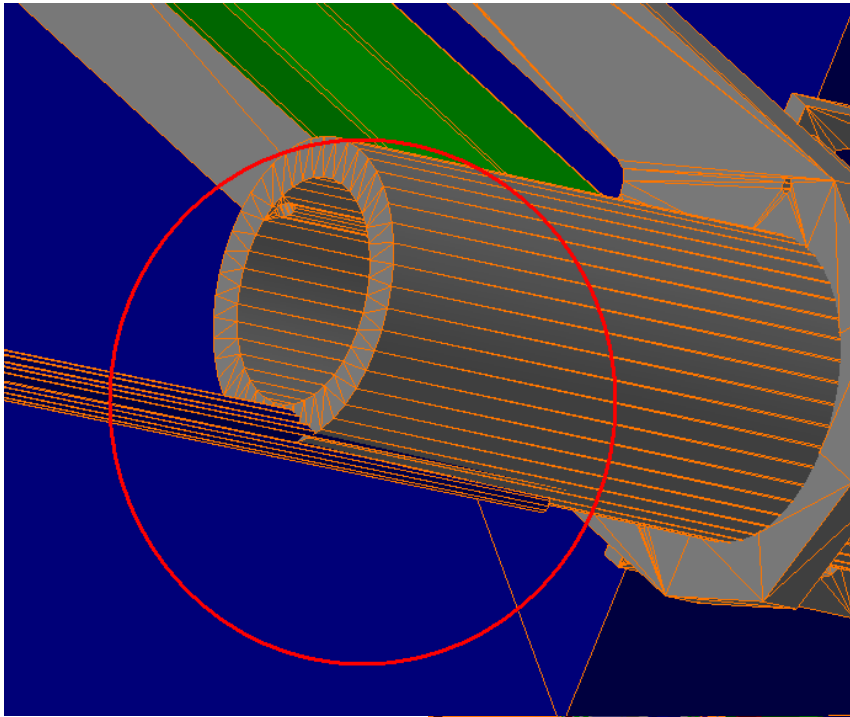
<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 9	72.6mm	Not Considered



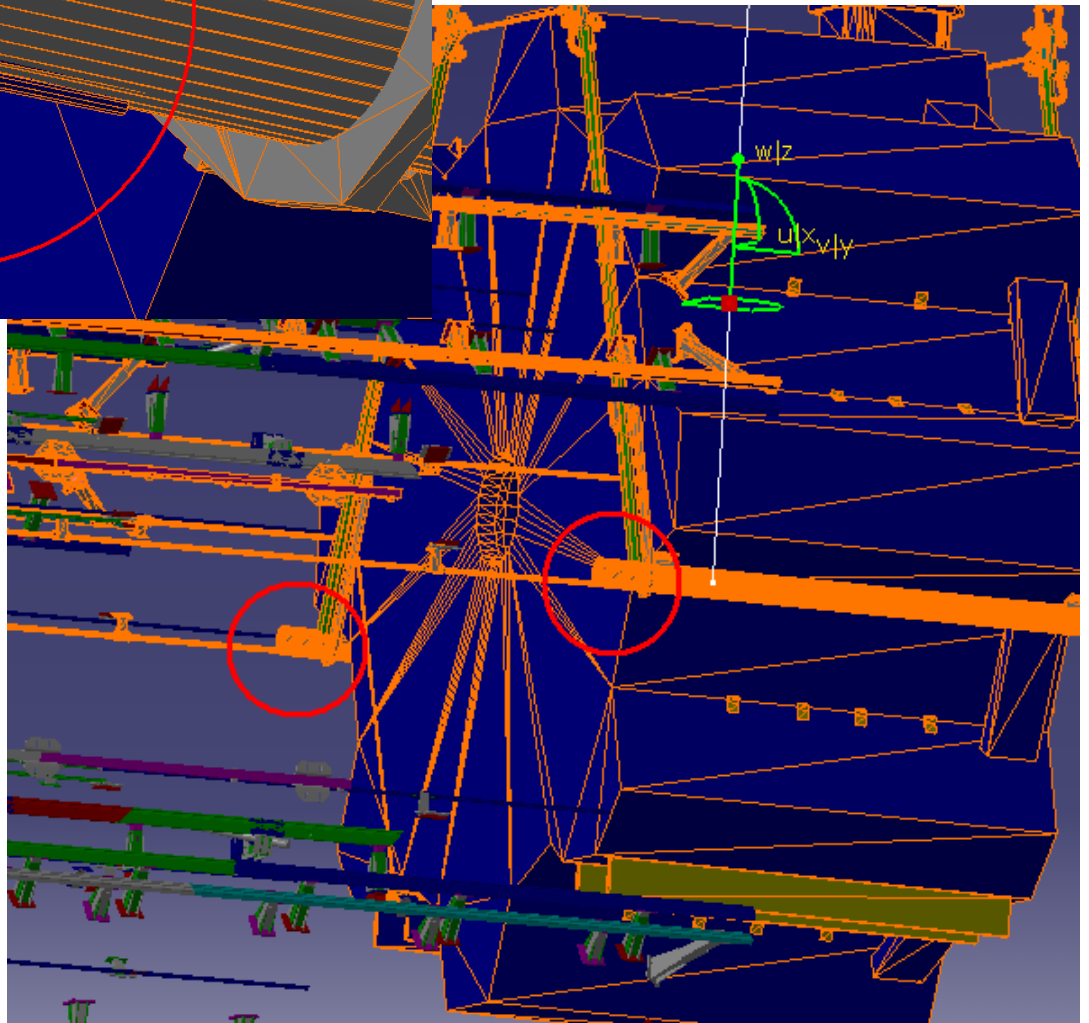
Segment #5: Movement from point 5 to point 6

Point D: Altitude 77m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clash</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 2, 8	-	Not Considered



X=0.00mm
Y=15'885.00mm
Z=3'190.00mm

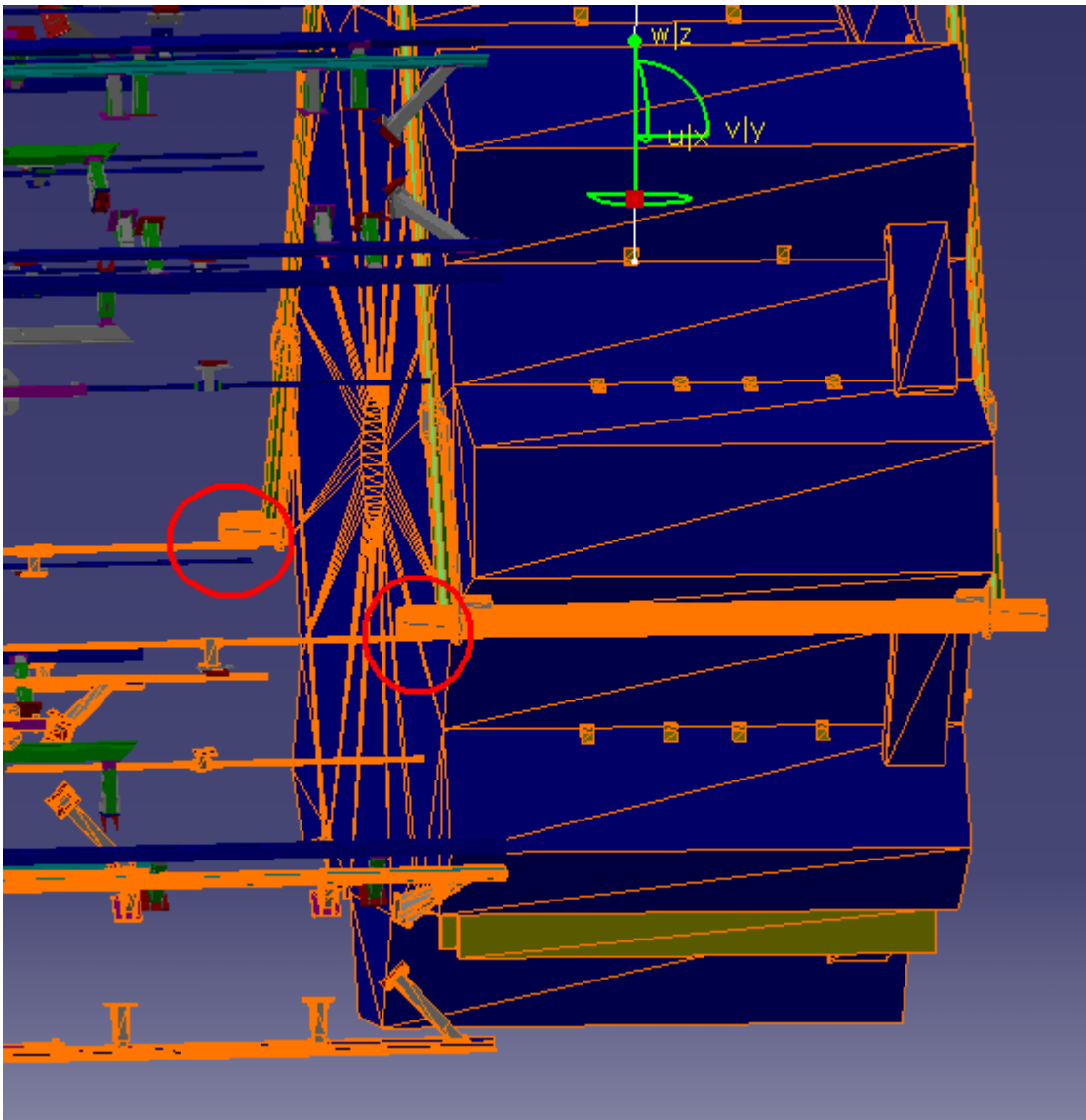


Segment #5: Movement from point 5 to point 6

Point E: Altitude 79.4m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clash</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 10, 16	-	Not Considered

X=0.00mm
Y=15'885.00mm
Z=790.00mm

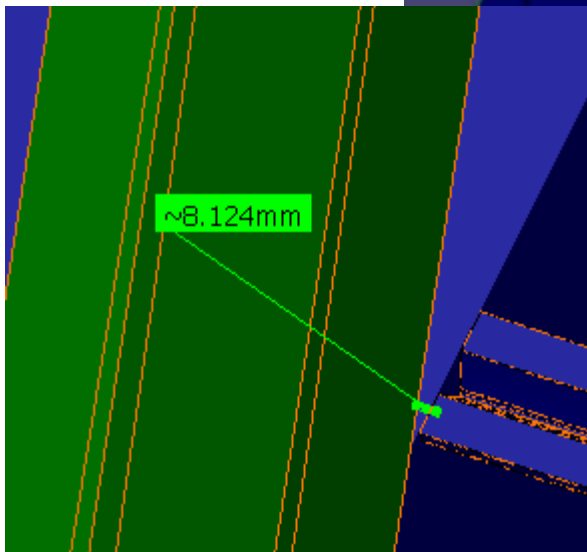
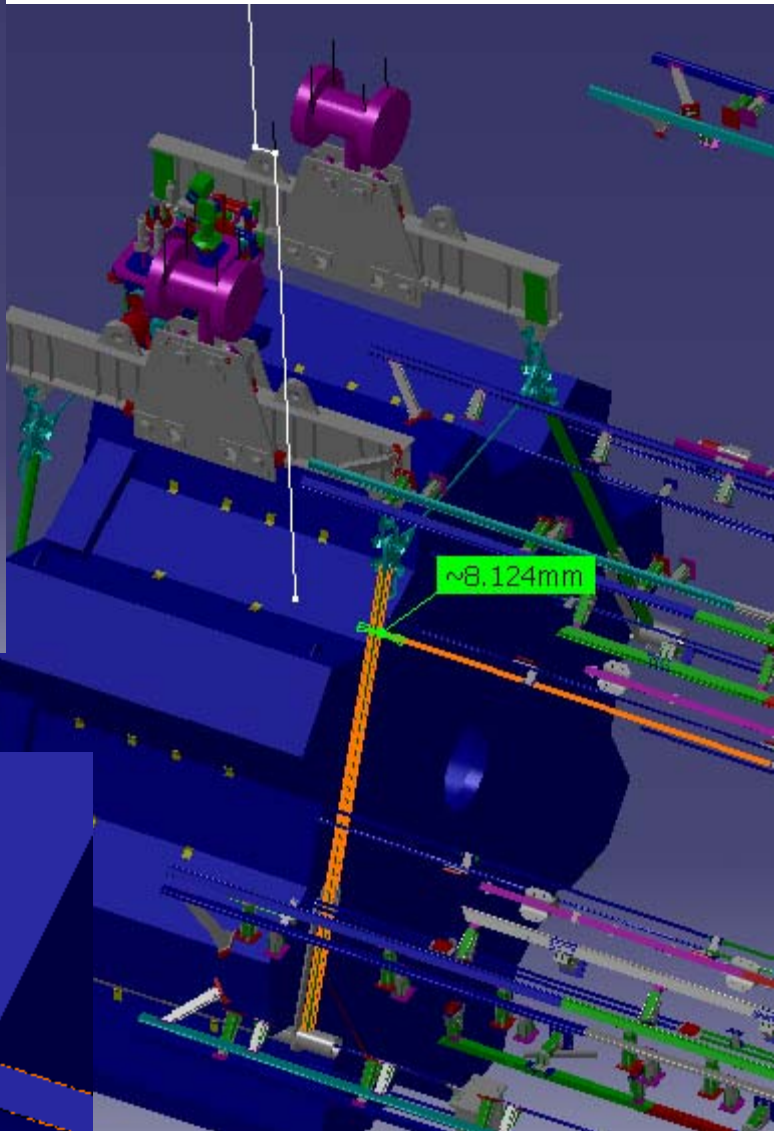
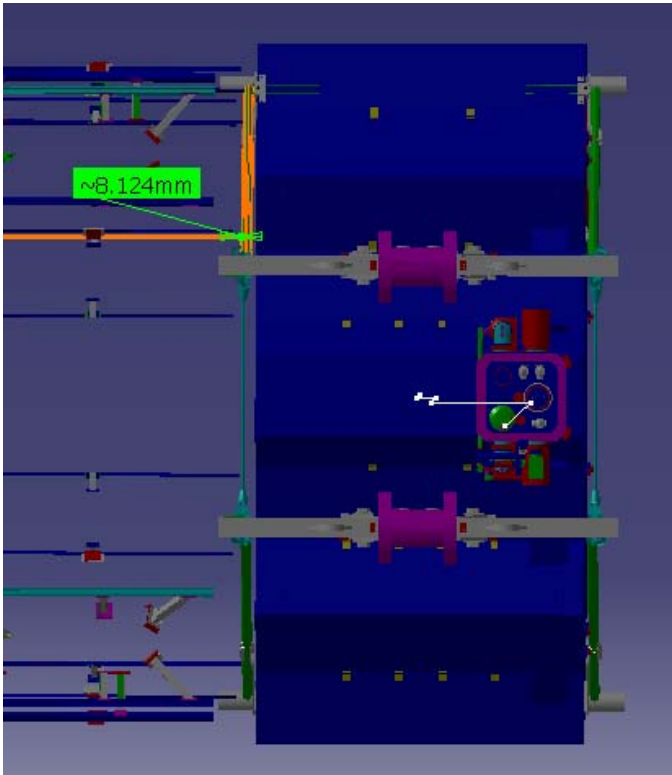


Segment #5: Movement from point 5 to point 6

Point F: Altitude 79.52m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 6	8.12mm	Not Considered

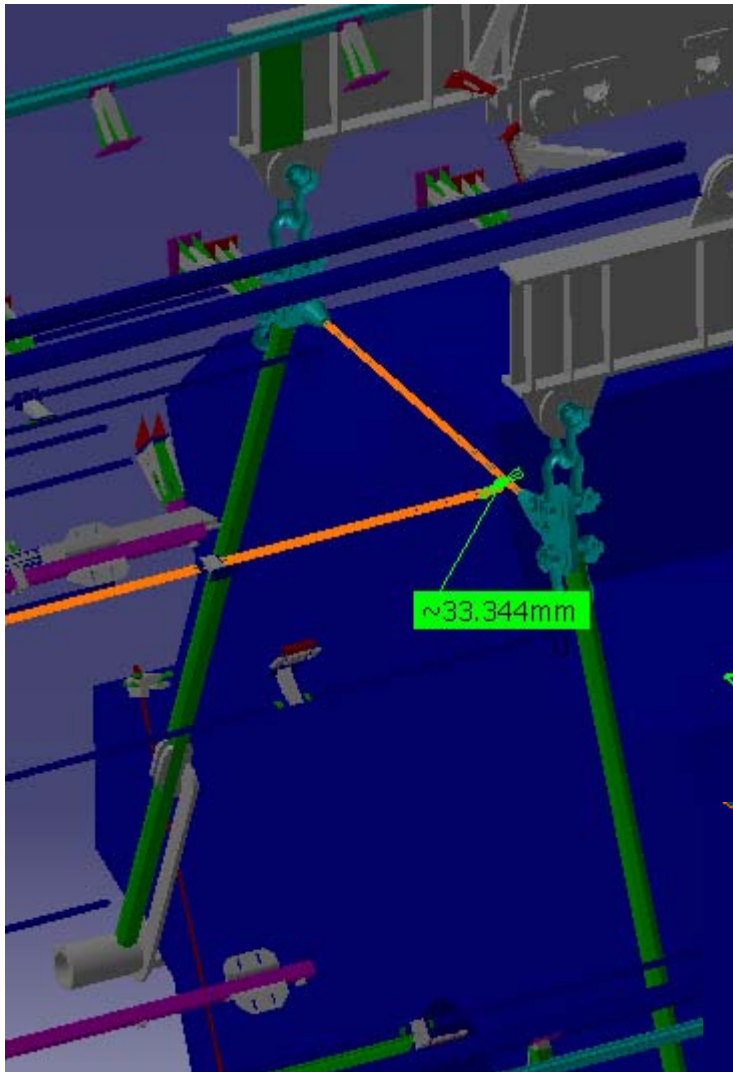
X=0.00mm
Y=15'885.00mm
Z=690.00mm



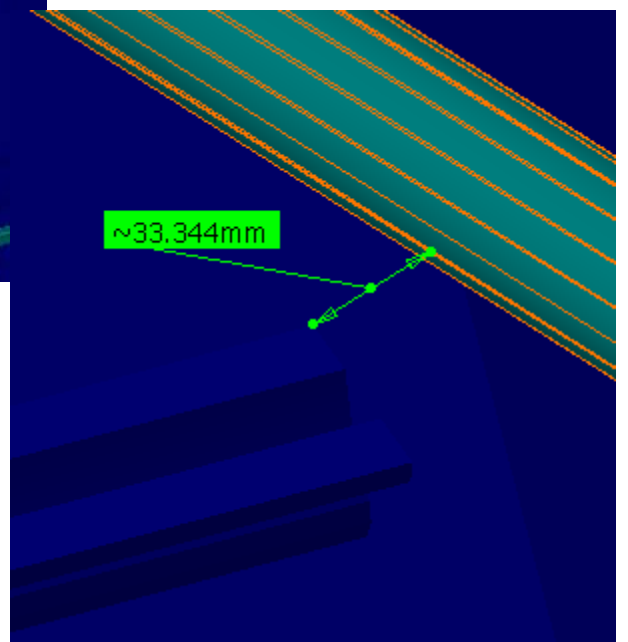
Segment #5: Movement from point 5 to point 6

Point G: Altitude 80m Side C / US15

<i>Moving Object</i>	<i>Environment</i>	<i>Clearance</i>	<i>Status</i>
EC Troid	Muon brackets, sect. 4	33.4mm	Not Considered



X=0.00mm
Y=15'885.00mm
Z=215.00mm



CONCLUSIONS

ECT lifting down can be realized according to suggested path of movement in case of removal of following structures:

1. Handrails from HS Structure stairs in sector 4 and sector 6 (*pp. 12, 13*)
2. Vacuum pipe for services of muon spectrometer in sector 3 and sector 7 (*pp. 16*)
3. Muon brackets in sectors 1, 2, 3, 4, 6, 7, 8, 9, 10, 16 (*pp. 17-22*)