787 CROWN REDESIGN SUPPORT. GENERAL INFORMATION

Reason:

Enabler to support Mid-body rate at 14/month. Additional savings associated with reduction of stick build of 787 crown:

- Part count and cost reduction – reduce number of parts;
- Transport element routing – optimize routing to reduce non-straight elements;
- Ergo/Safety improvement – reduce over head work.

General description and main changes:

Air Distribution architecture redesign and material changes to facilitate significant part cost & flow reduction:

- Mixing of Recirculation. Air and Conditioned Pack Air will occur in existing ducts under the floor (zones A & B) and in individual risers (zone C) to enable the elimination of large crown mixing ducts and cross-over ducts in sections 41, 43 & 44;
- Risers will connect directly to the left & right outboard manifold ducts.

ICS tubing routing optimization in the crown of sections 43, 44, 46 & 47.

Modularize Crown Systems - ducts, ICS, Electrical, CRN, Vertical Panels in Sec 43, 44, 46.

Maximize feeder line assembly and test.

Project stages:

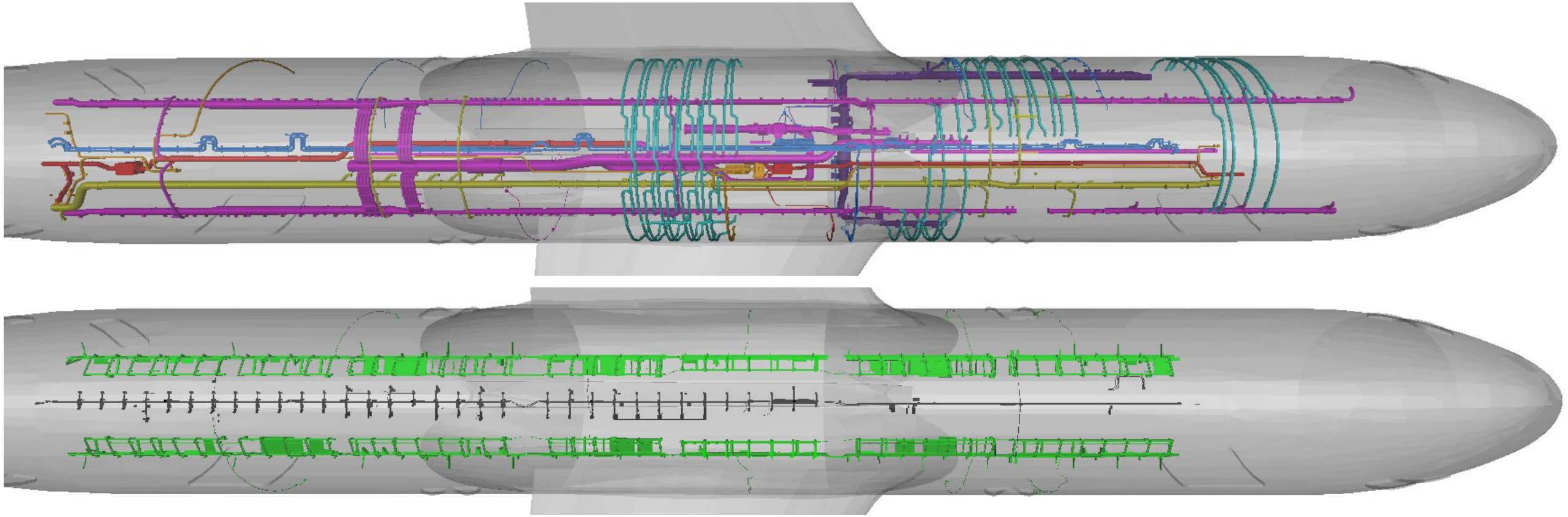
Conceptual Layout Review (August 2016 – March 2017): create, work and close conceptual LOs. Coordinate design with mating teams, impacting parties and Partners; Create and prepare ICMs for Partners PIDDs.

Approval Layout Review (April 2017 – September 2017): create, work and close approval LOs. Coordinate design with mating teams, impacting parties and Partners; get responsibility for 75% of project IPLs (not part of original WS), promote thru the process for publishing; update ICMs per latest design for Partners FIDDs.

Release (MBDs, IRMs) (October 2017 – November 2017): start release process for all MBDs.

BRI RESPONSIBILITY

- Main Air Distribution, PAO, Upper Recirculation
- Risers
- Crew Rest (OFCR/OACR)
- Moisture Control
- ICS (Integrated cooling system)
- Lavatory & Galley Ventilation
- Mix Bay, Lower Lobe, Flight Deck Air Distribution, Injectors



- CM, CRN Extrusions, CRN Cables
- Vertical Panels

PROJECT STAFFING*

US team

Manager:
Annika Carden
Emily Bryan
Anthony Kania (PM)

Leads:
Nicholas Sullivan (ECS)
Anthony Hunt (ICS)
Jason Murphy (VP)
Manuel Rivera (CM, CRN)

Design Engineers:
Jesse Tibayan (ECS)
Carlos Lindner (CM)
Stephen Cooley (CM)

Spatial Integration:
Michael Ackerman (ALL)

BRI team

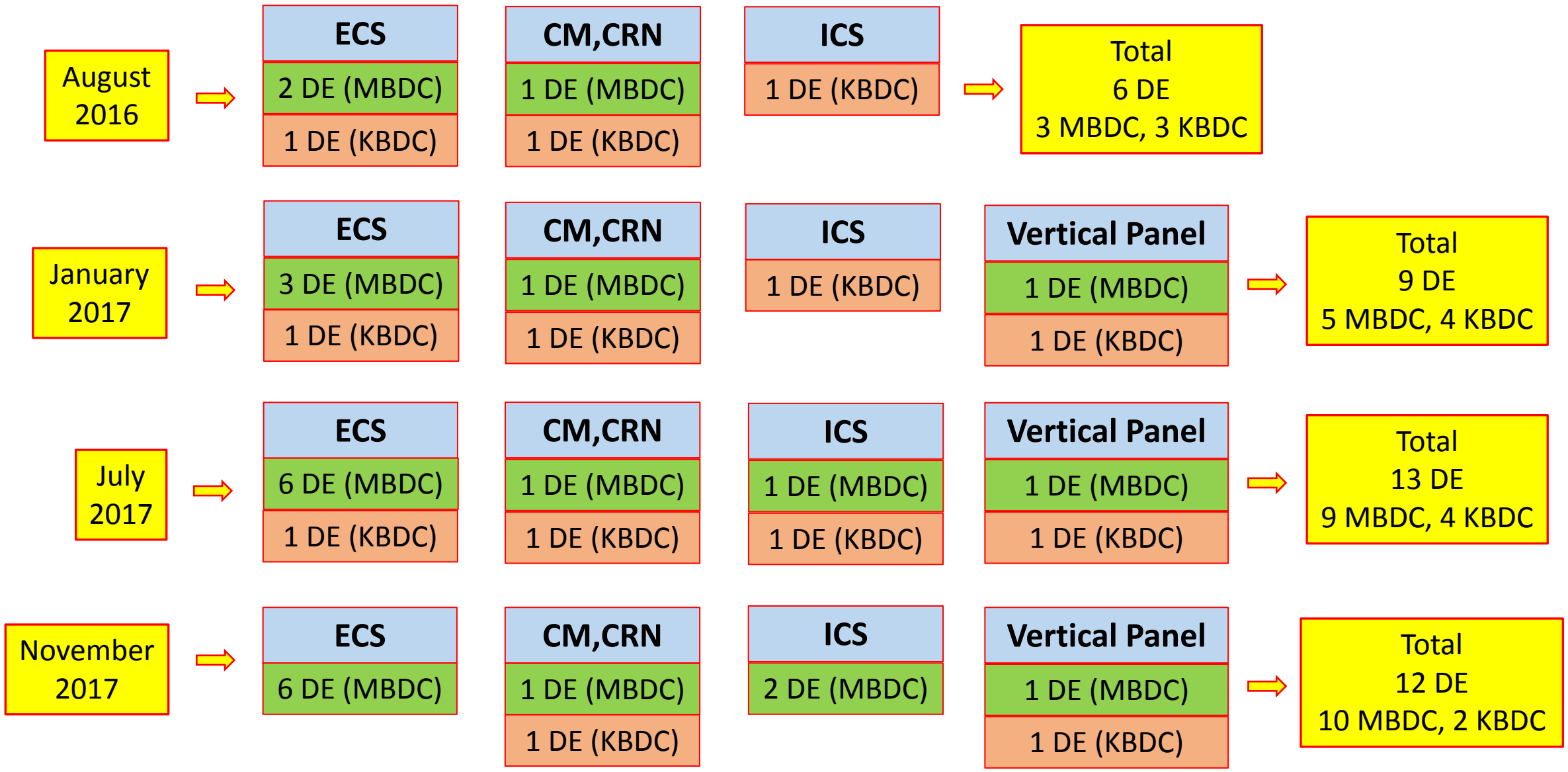
Manager:
Stanislav Kussev (Moscow)

Leads:
Dmitry Solodovnikov (Moscow)
Ivan Mitloshuk (Kyiv)

Design Engineers:
Elena Agafonova (ECS) (Moscow)
Natalia Andreeva (VP) (Moscow)
Alexander Gartvig (ICS) (Moscow)
Dmytro Korotchuk (VP) (Kyiv)
Oleksandr Kurlovych (ICS, ECS) (Kyiv)
Sergii Lashko (CM, CRN) (Kyiv)
Sergey Malakhevich (VP, CM) (Moscow)
Vitalii Nelepov (ECS) (Kyiv)
Elena Pavlova (CM, CRN) (Moscow)
Alexander Ratnikov (ECS) (Moscow)
Sergey Usachev (ECS) (Moscow)
Vladimir Vorobiev (ICS) (Moscow)
Maxim Yashin (ECS) (Moscow)

* Not included - Systems Stress (BRI, BSC, PS), Structure DE (BRI, BSC, PS), Wiring BSC and Labinal, ME

PROJECT DEVELOPMENT



PROJECT DEVELOPMENT

August-September'16

*40 LO's (**34%** of total 116)*
- *ECS: 24 LO's (**30%** of total 78)*
- *ICS: 6 LO's (**27%** of total 22)*
- *WEM: 2 LO's (**25%** of total 8)*
- *VP: 8 (**100%** of total 8)*

*0 IPL's (**0** at that time)*

*0 ICM's (**0** at that time)*

November'17

*96 LO's (**8**[illegible]f total 120)*
- *ECS: 72 LO's (**92%** of total 78)*
- *ICS: 10 LO's (**45%** of total 22)*
- *WEM: 6 LO's (**50%** of total 12)*
- *VP: 8 (**100%** of total 8)*

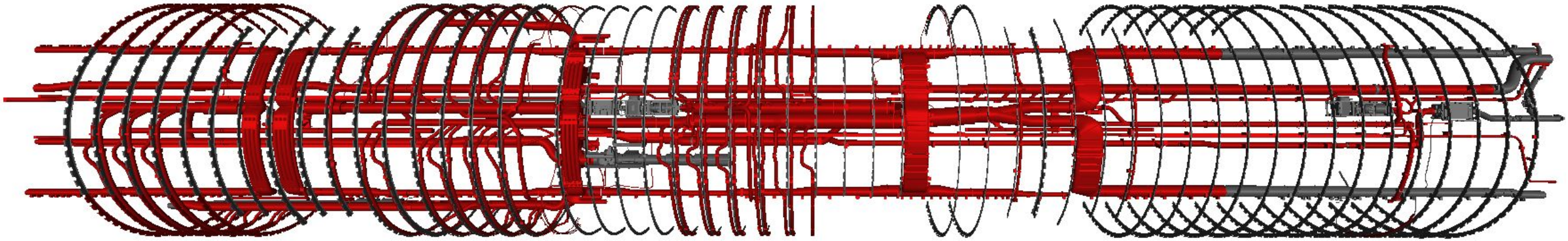
*9 IPL's (**75%** o[illegible]l 12)*

28 ICM's ([illegible] of total 31)

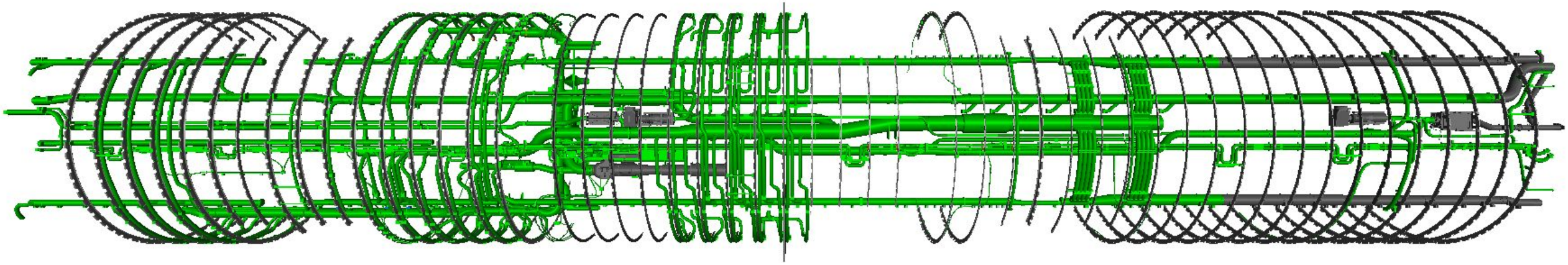
Created by today:
ECS: 1500 new MBDs with 1900 new instances;
ICS: 475 new MBDs with 850 new instances;
CM, CRN: 198 new MBDs with 1300 new instances;
VP: 137 new MBDs with 800 new instances.

TYPICAL CHANGES

Original (baseline) design

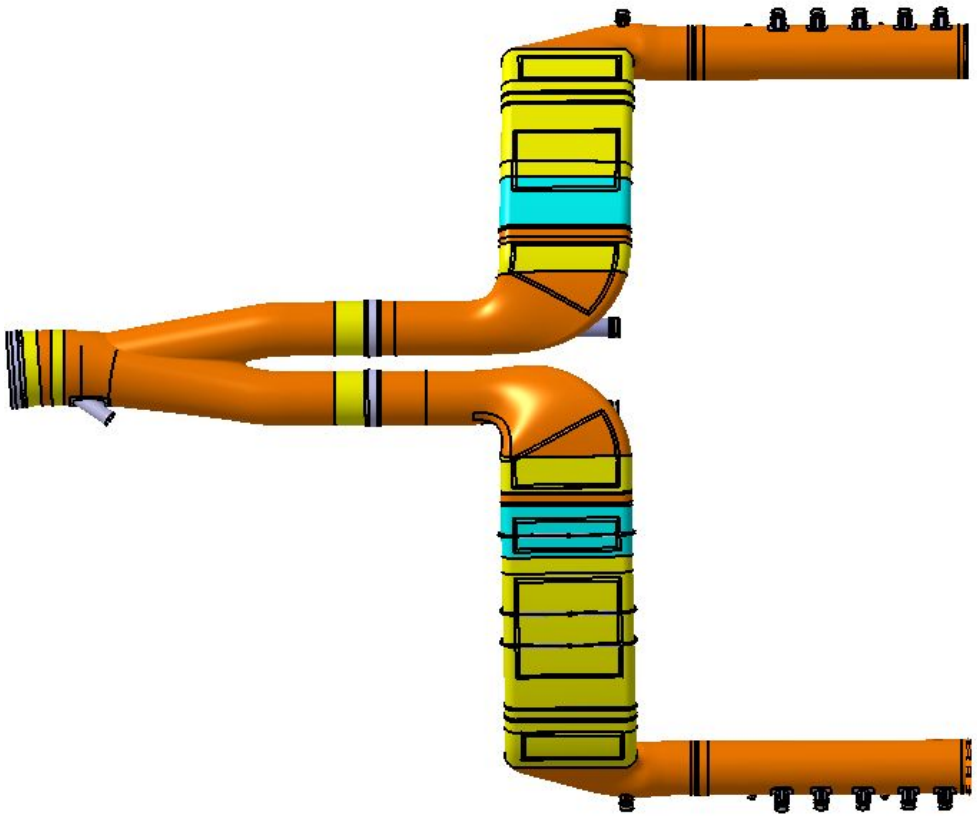


New design



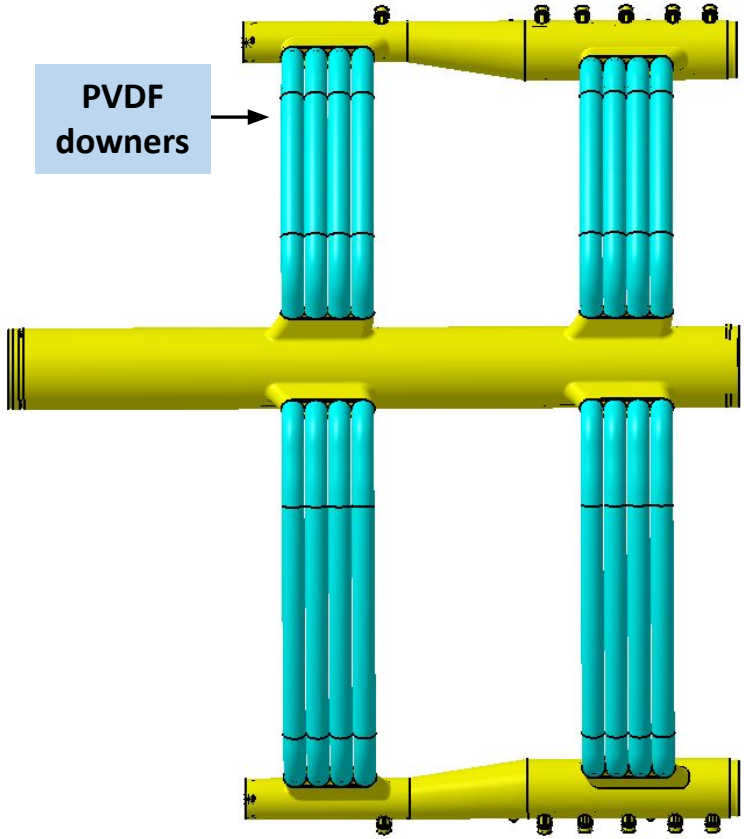
COORDINATION PROCESS BETWEEN CHARLESTON AND BRI TEAMS. MAIN AIR DISTRIBUTION. TYPICAL PROPOSALS

Original design



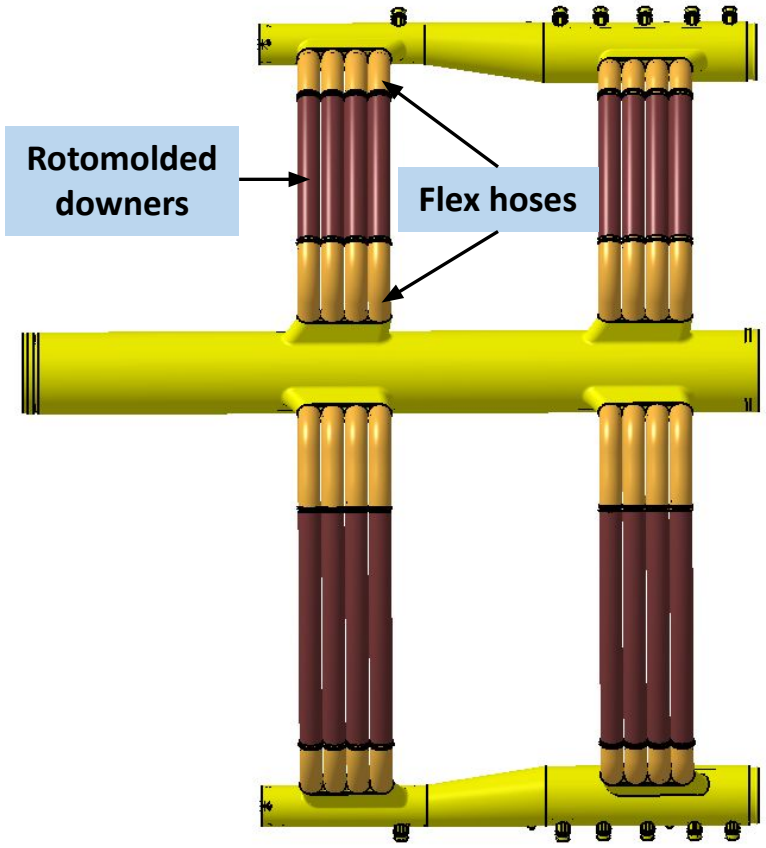
PVDF downers:

+ maintainability; easier to install and remove; flex hose and insulation elimination - reduced P/N quantity; installation and assembly procedures reduction; better separation with surrounding structure; weight saving; ducts cost saving.
- curved complex spud (if no flex hoses); temperature expansion and transfer additional loads to structure need to resolve; anchors is required.



Rotomolded downers:

+ straight simple spud; no issue with temperature expansion.
- cost; weight; hard to remove; may require partial removal of Vertical Panel assembly; more part numbers consuming.

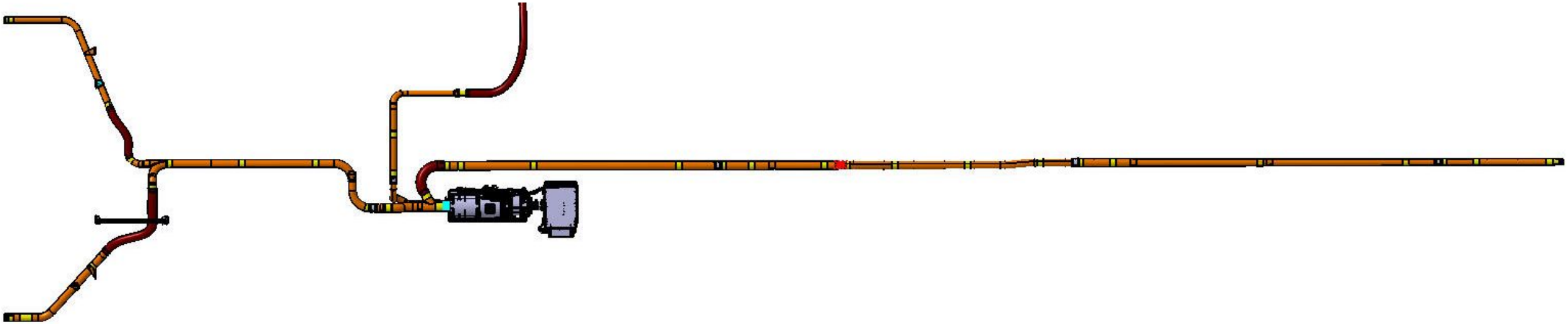


COORDINATION PROCESS BETWEEN CHARLESTON AND BRI TEAMS. MOISTURE CONTROL. TYPICAL PROPOSALS

Original design

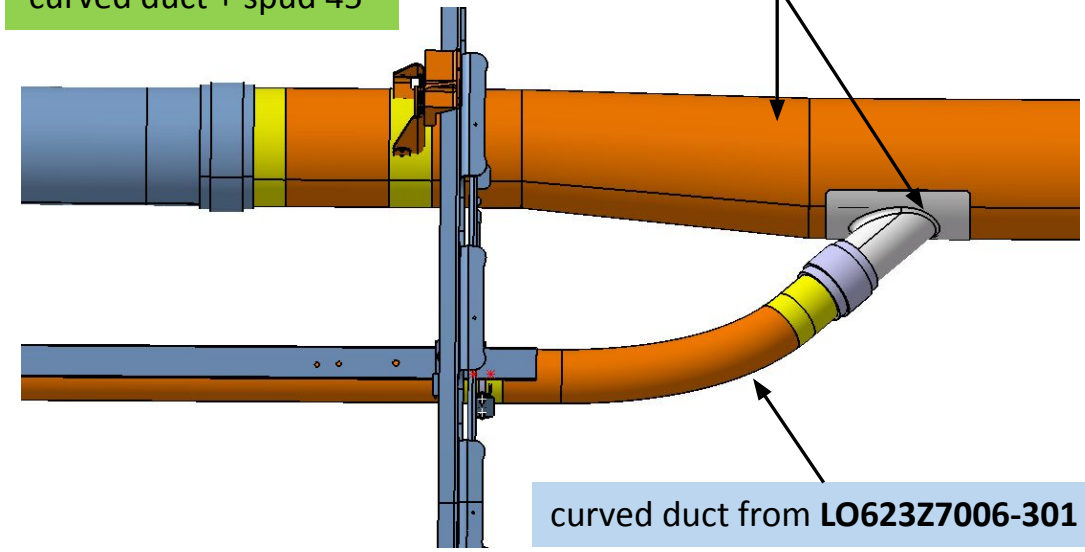
New design:

- New strategy to have single MoCo routing in SEC. 46;
- All MoCo ducts are Kevlar but for the downer;
- New Design will be supported mostly by WEM brackets but for the section joint (SEC. 44-46);
- One MoCo duct uses OFCR as a support by means of back-to-back saddle installation;
- New silicone duct downer is now placed in SEC46.

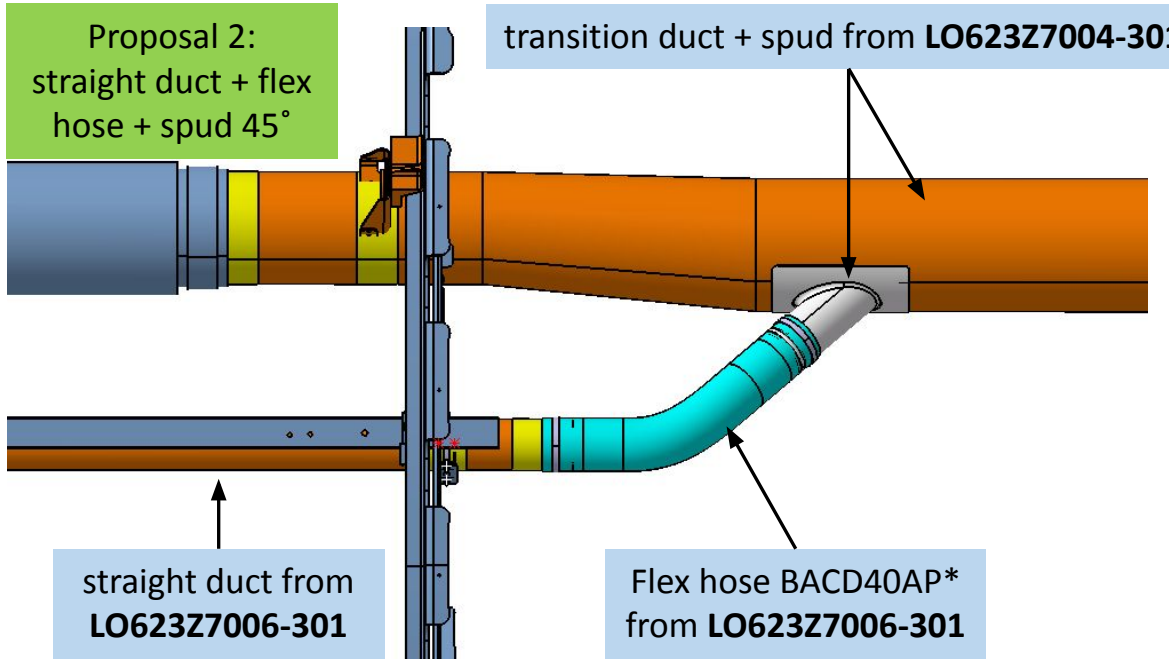


COORDINATION PROCESS BETWEEN CHARLESTON AND BRI TEAMS. PAO. TYPICAL PROPOSALS

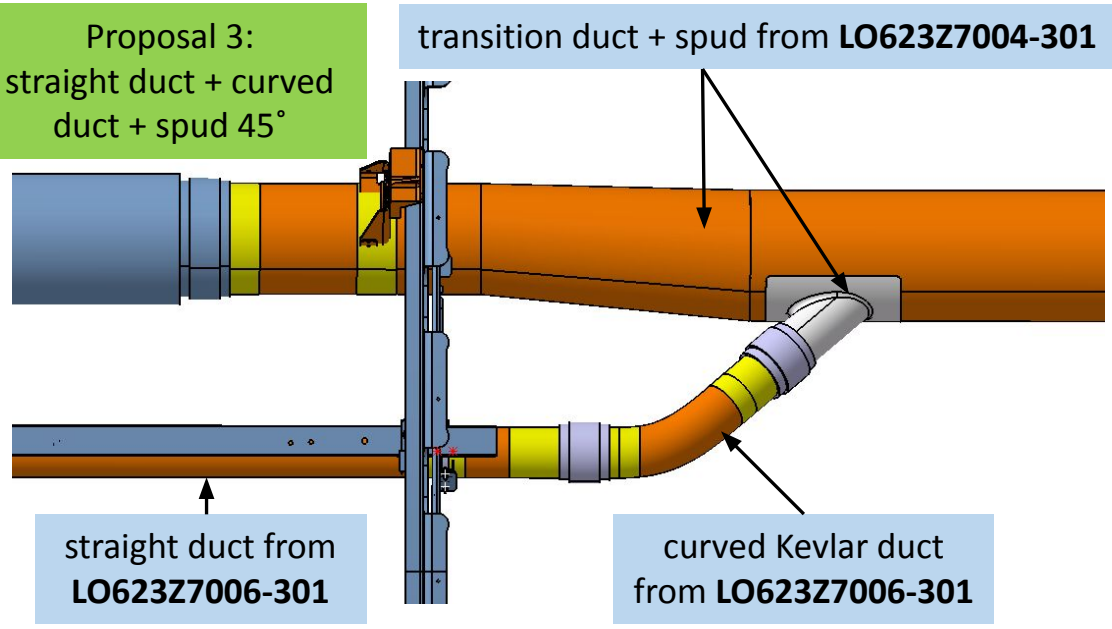
Proposal 1:
curved duct + spud 45˚



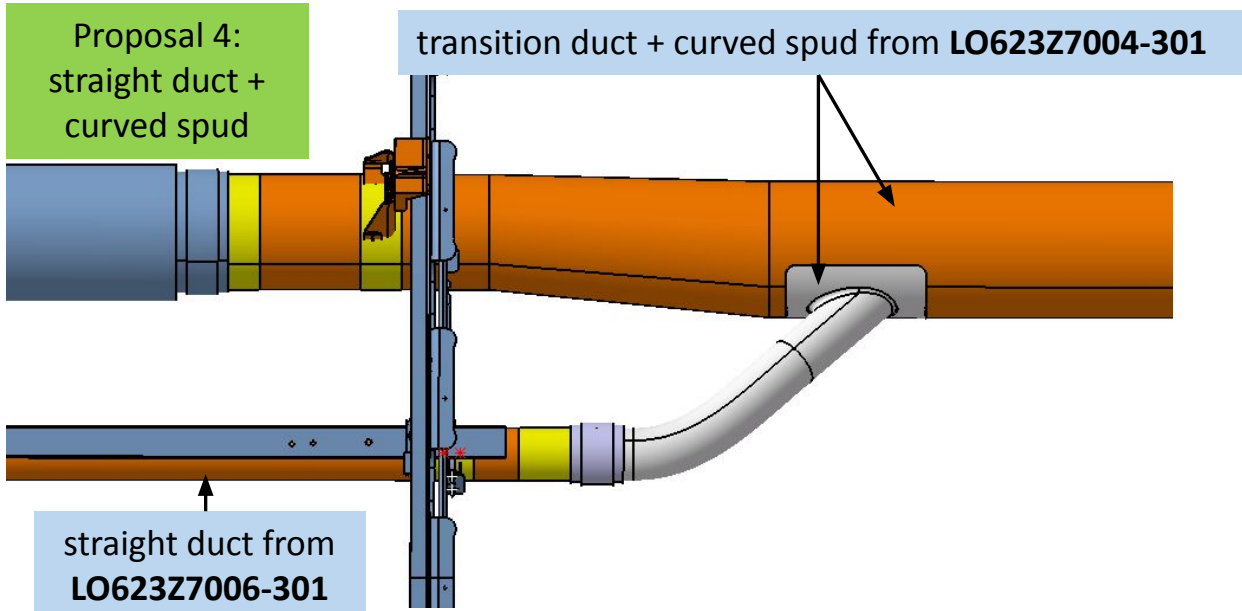
Proposal 2:
straight duct + flex hose + spud 45˚



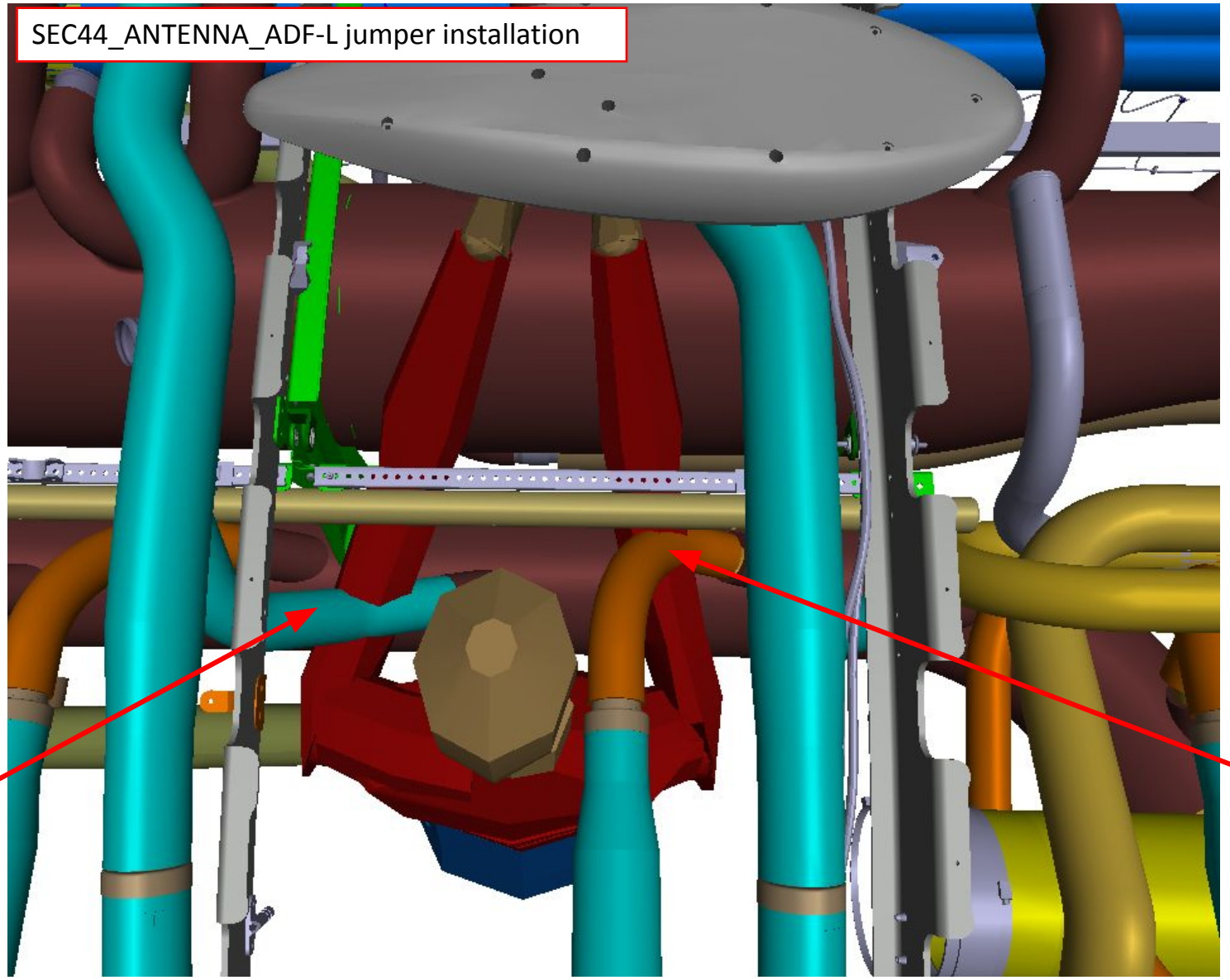
Proposal 3:
straight duct + curved duct + spud 45˚



Proposal 4:
straight duct + curved spud

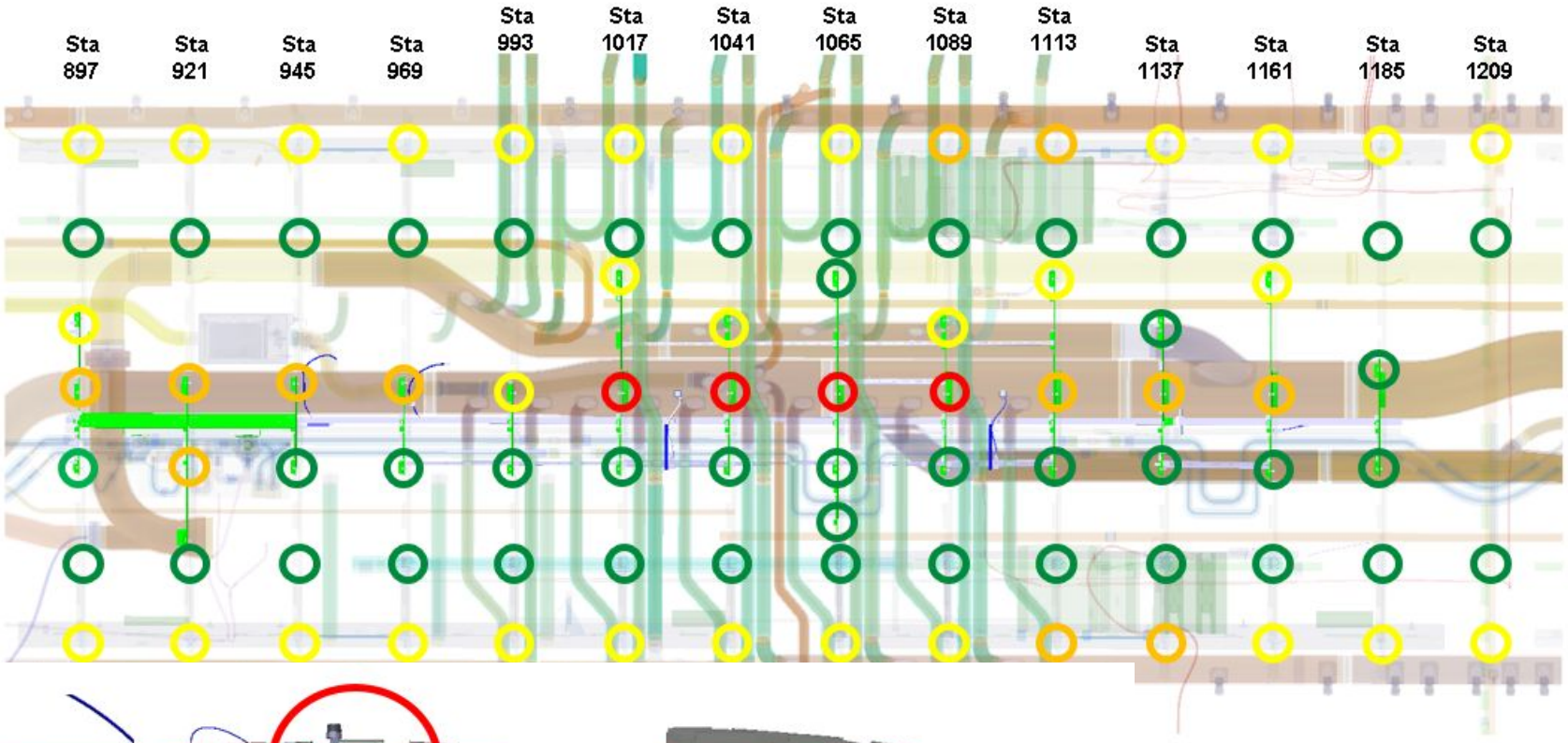


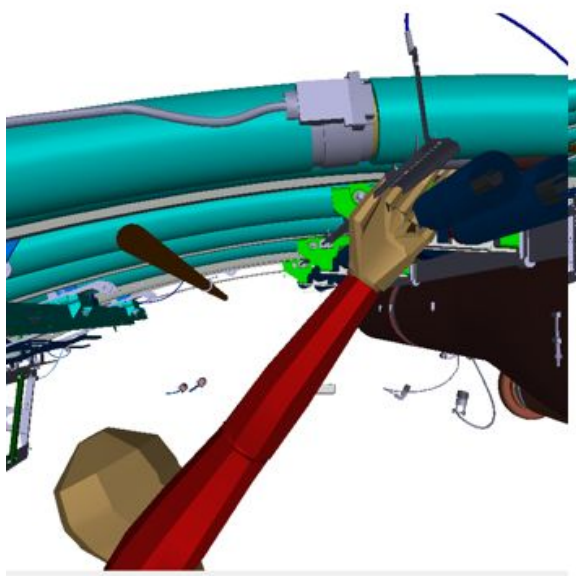
TYPICAL PARTS INSTALLATION

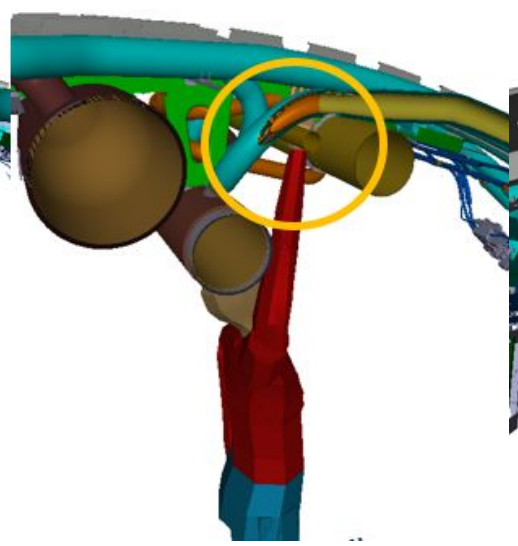


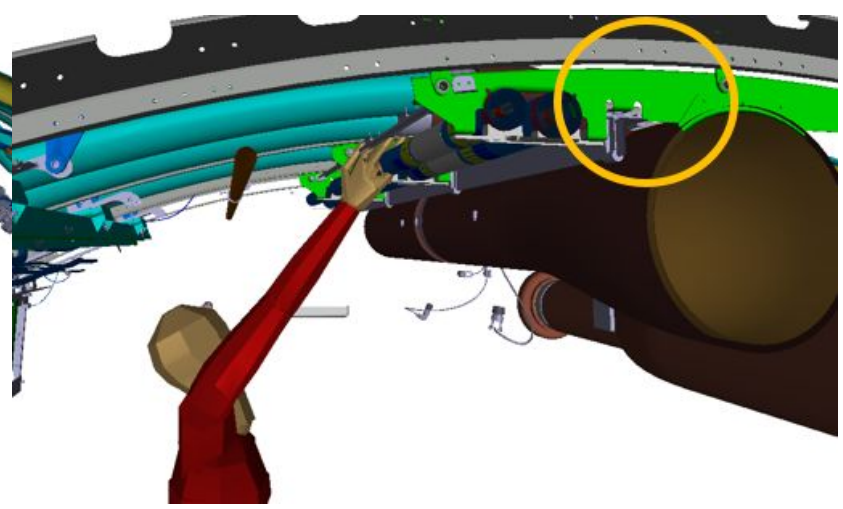
ECS, ICS AND ELECTRICAL MODULAR INSTALLATION. ACCESS MAP

- Easy
- Moderate
- Difficult
- Study in progress









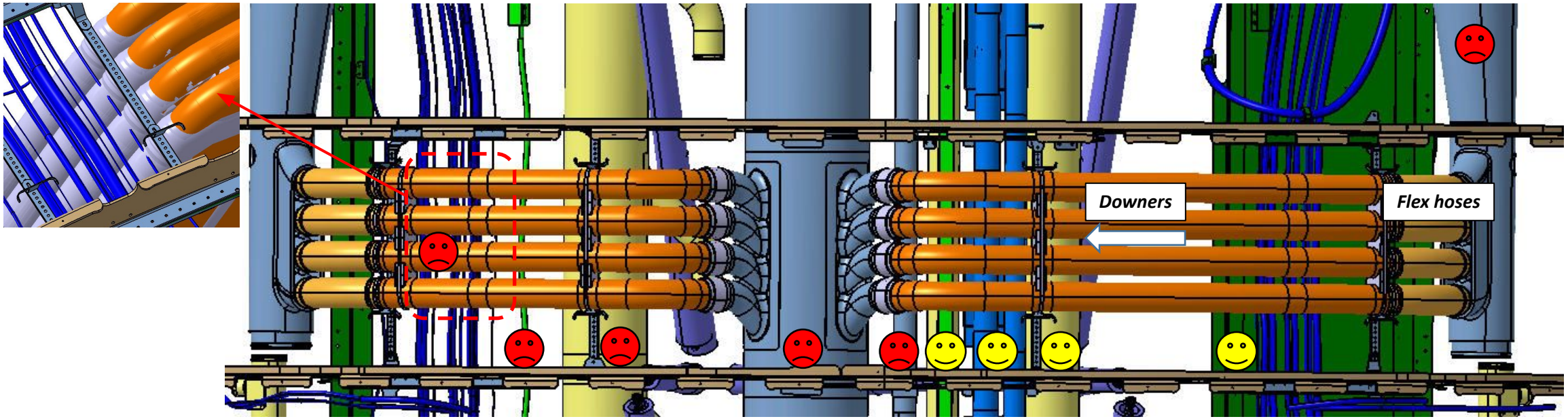
TYPICAL REMOVAL PARTS

happy mechanic (no removal required)

sad and angry mechanic (system removal required)

Removal: *thru central area*
Design: *downer – single piece downer, 1st end of pack – sleeve, 2nd end of pack – flex hose, supports per pack – 2*

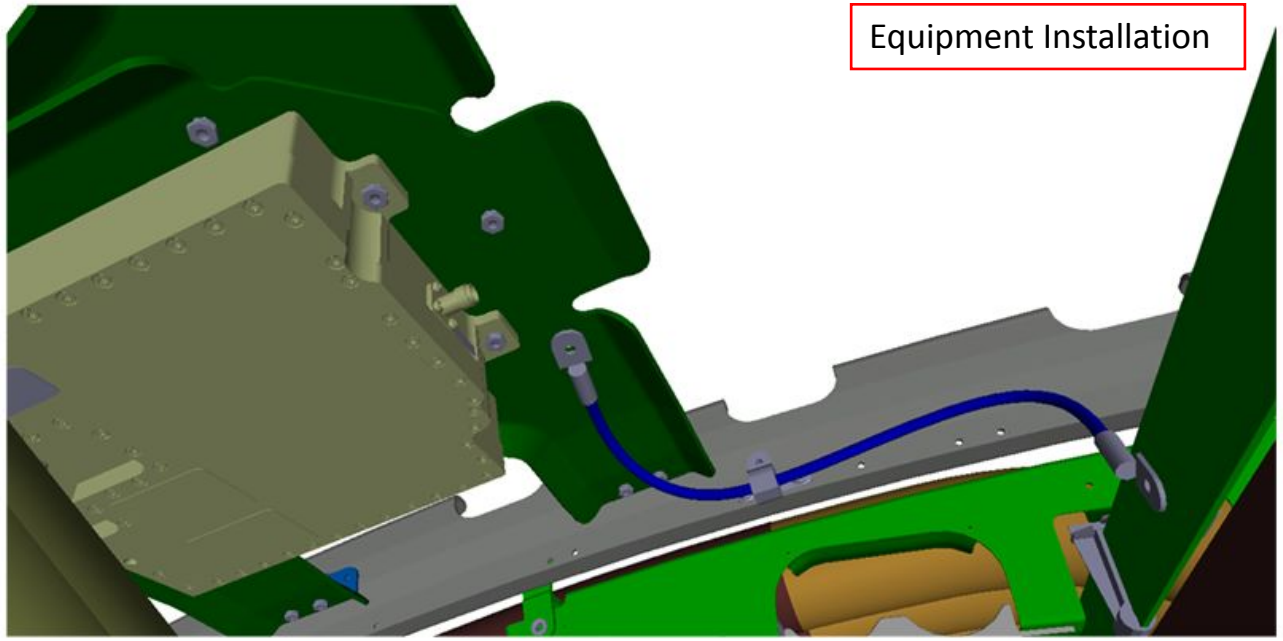
Systems to remove: *LH OUTBD manifold, MOC duct (for access to sleeves between central duct and downers), Central Air duct, RH downers pack, LGV, CRN cable*

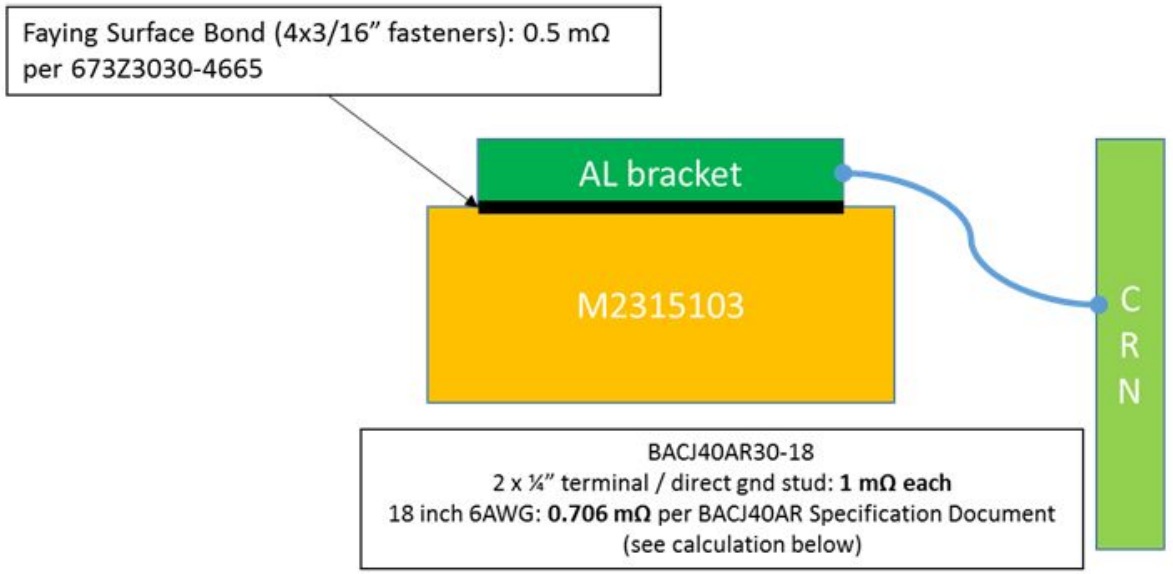


Disadvantages: *Requires to remove central duct e.a. disconnect of all 4 downer packs; Requires to remove opposite RH sided downers and related system elements – LGV and CRN cable*

Advantages: *Less cost design. Total 2 supports per pack. No need to have additional 8 ducts, 8 sleeves, 8 brackets, 2 spanner bars, 6 close outs, 2 insulation details on LH side like on two-piece-downer design; No need to disconnect downers from 3rd support, no need to remove drip shield with electrical equipment*

BONDING AND GROUNDING LRU ANALYSIS PACKAGE





Calculations:

Resistance from LRU to CRN:

a) Bond Jumper BACJ40AR30-18 Resistance:
0.037 mΩ * 12 + .262 mΩ = 0.706 mΩ per BACJ40AR Specification Document

b) ¼" Terminal lug (BAC5117-4) + Bond Jumper + ¼" Terminal lug (BAC5117-4) = 1 mΩ + 0.706 mΩ + 1 mΩ = 2.706 mΩ

c) Faying Surface Bond (BAC5117-6) + BACJ40AR30-18 = 0.5 mΩ + 2.706 mΩ = 3.206mΩ

Voltage between LRU and CRN:

AC Fault Current * Path Resistance = 209 A * 0.003206 Ω = 0.670 Vac

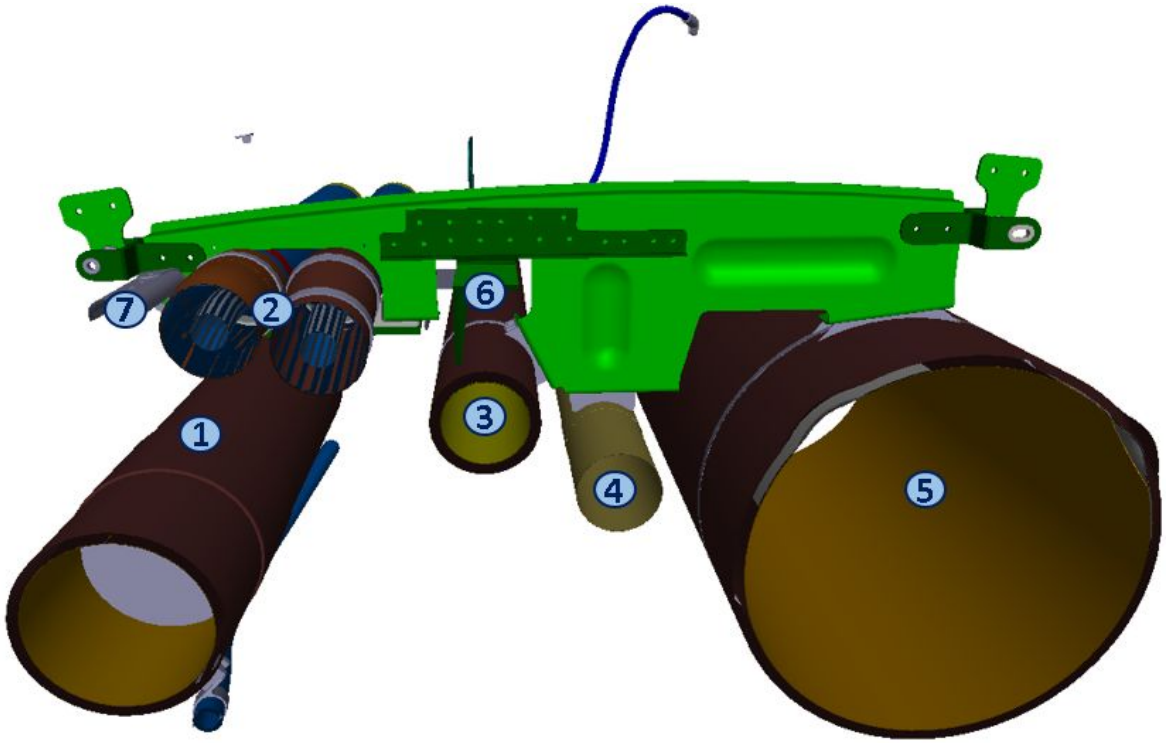
Hardware Fault Current Capability:

Bond Jumper BACJ40AR30-18:
6AWG Jumper capable of 400A per BACJ40AR Specification Document
Each ¼" Terminal Lug capable of 400A per EDMP

Faying Surface Bond:
3/16" fasteners capable of 112A per EDMP.
112*4 = 448A of capability.

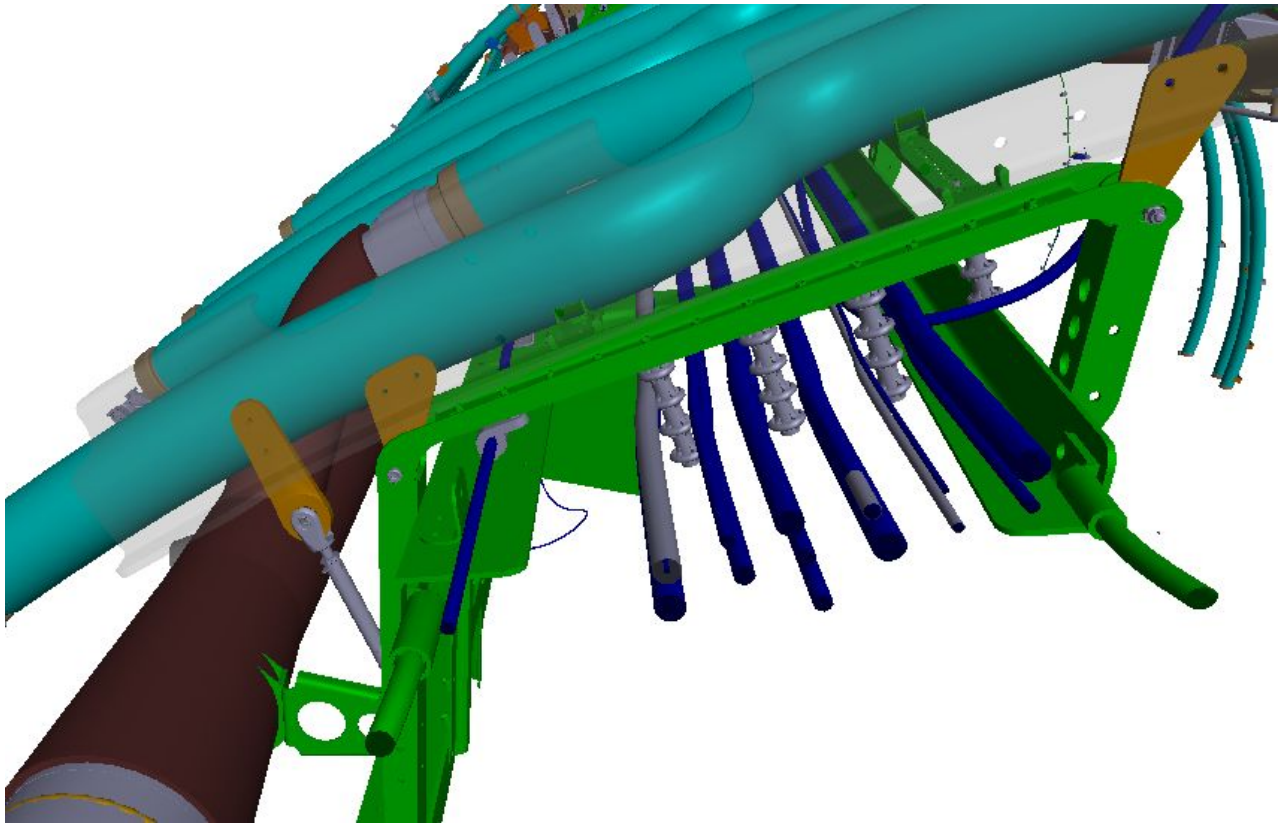
CROWN MODULARIZATION TO MOVE ASSEMBLY WORK OFF THE AIRPLANE

Create Pallet brackets (one on each STA) for central assembly module to support different Systems and assemble them off the AP.



1. OACR
2. ICS
3. PAO
4. MoCo
5. Main Air Distribution
6. CRN extrusion
7. Wire Supports

Redesign Vertical Panels to accommodate wire bundles, ECS ducts and risers to one common module.



ICS. 3D PRINTING