

Engineering Integration of the Double- Double Bend Achromat (DDBA) into the Diamond storage ring

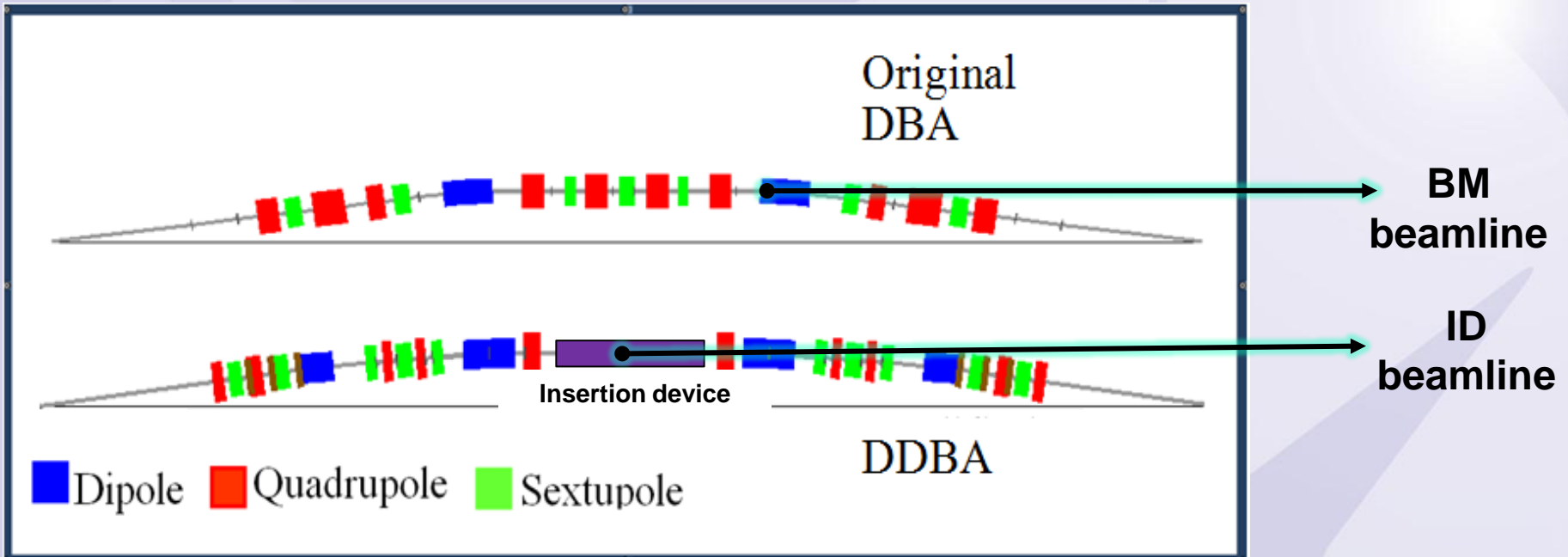
**Jim Kay
Diamond Light Source**

**Low emittance ring 2013
workshop**



The Concept

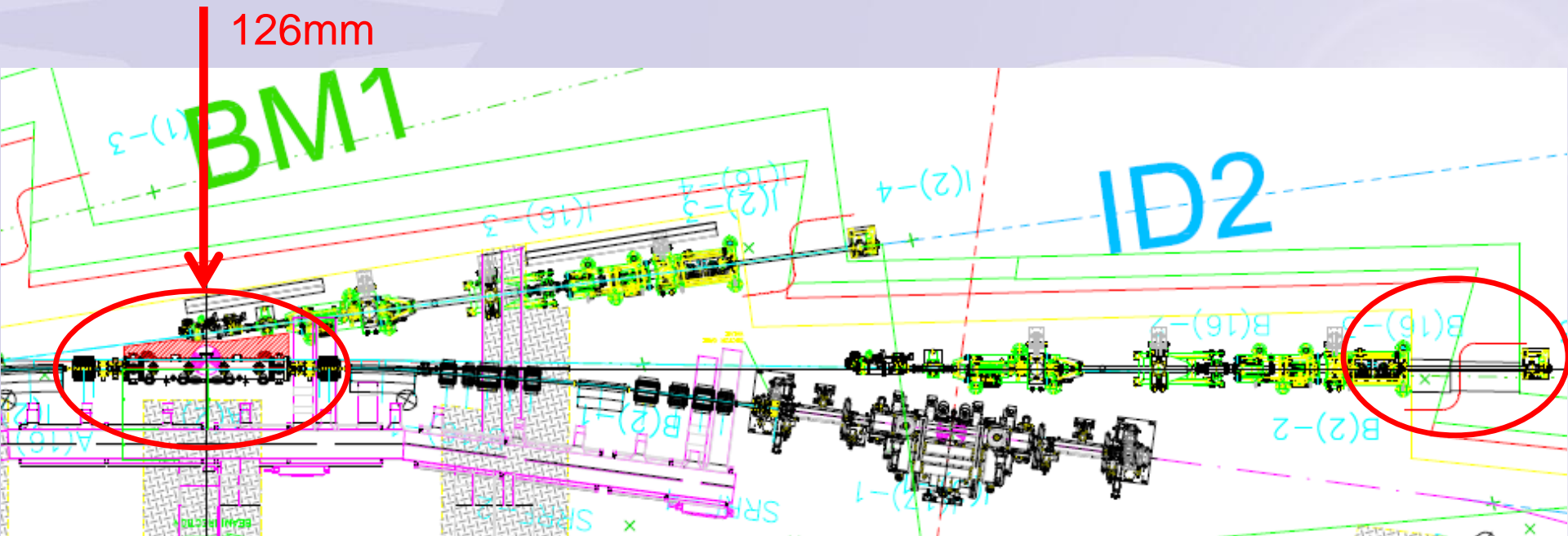
Replace each bending magnet in the Double Bend Achromat (DBA) lattice with a pair of dipoles each forming a DBA i.e. a double- DBA or DDBA, with a new straight section between them to host an Insertion Device, thus converting a BM beamline into an ID beamline.



Development of technology needed for a future major upgrade: Diamond-II

Fitting DDBA into a working SR

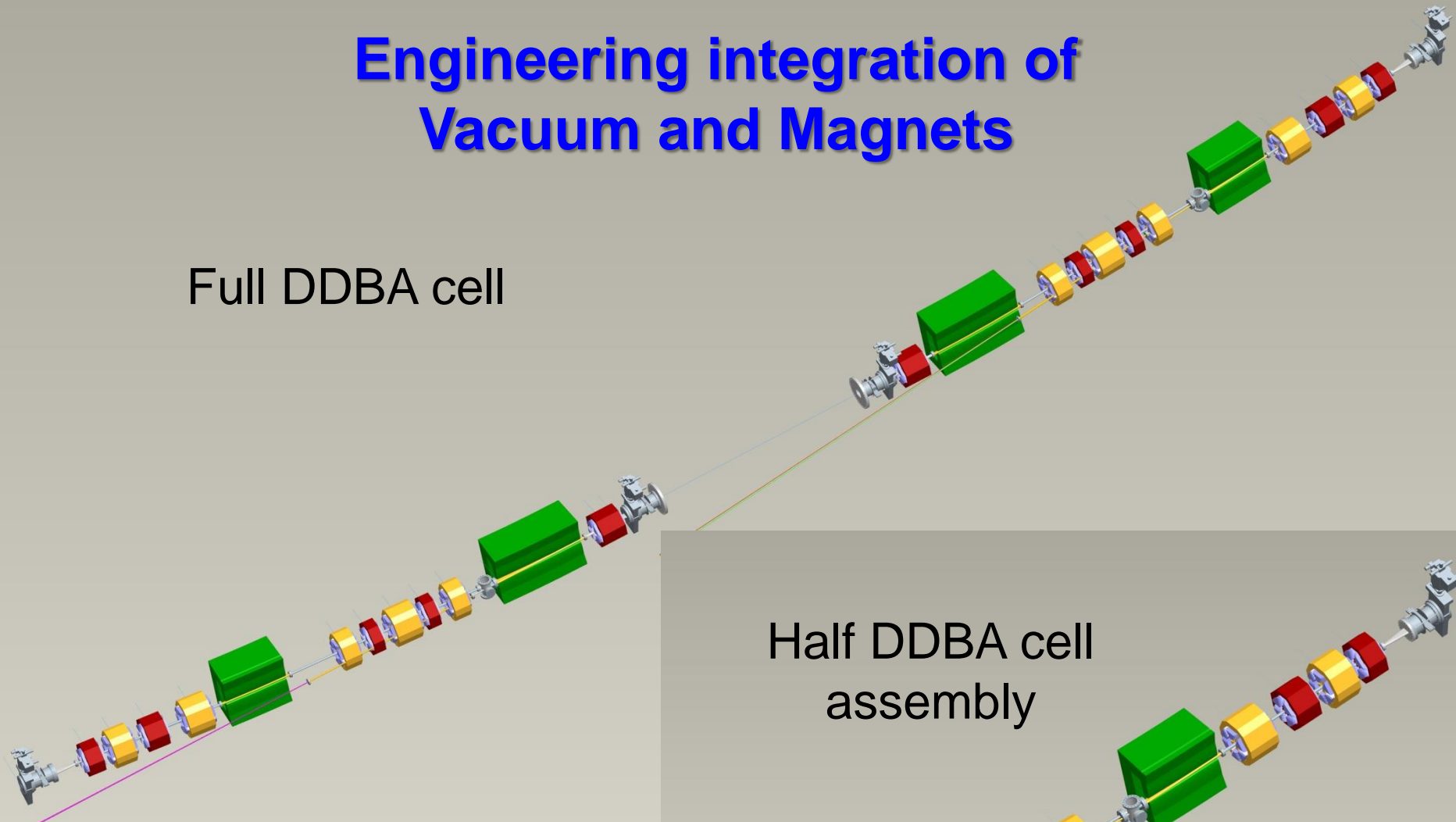
2.5 cm Shorter path length aligns new straight with BM ports
RF frequency increases 22kHz per DDBA cell



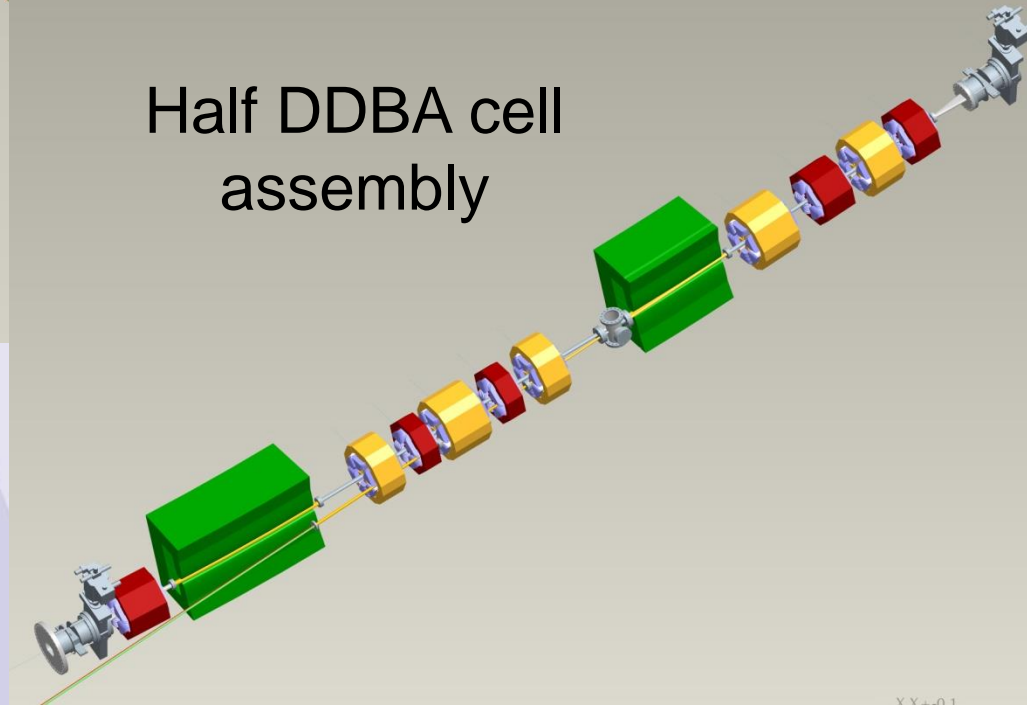
Sector gate valves in identical location as existing
Existing ID straights and front ends unchanged
A new 3m straight created suitable for ID

Engineering integration of Vacuum and Magnets

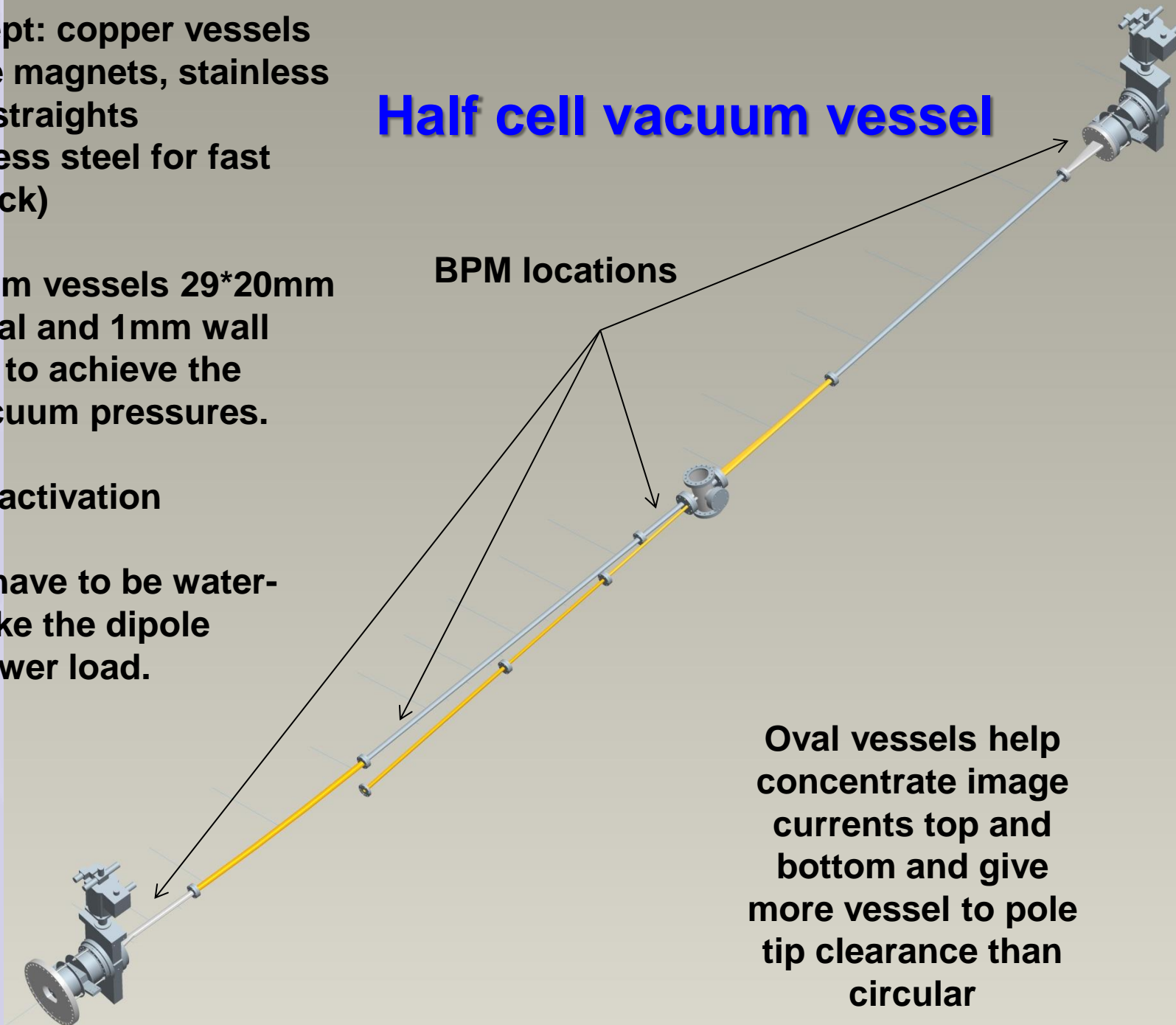
Full DDBA cell



Half DDBA cell assembly



Half cell vacuum vessel



Basic concept: copper vessels in the dipole magnets, stainless steel in the straights (need stainless steel for fast orbit feedback)

Small vacuum vessels 29*20mm (H*V) external and 1mm wall NEG coated to achieve the required vacuum pressures.

In-situ NEG activation

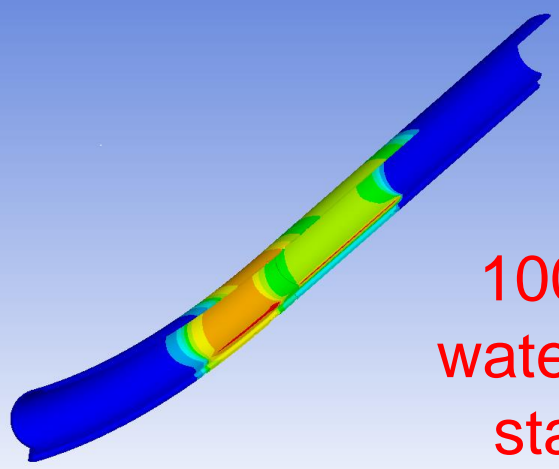
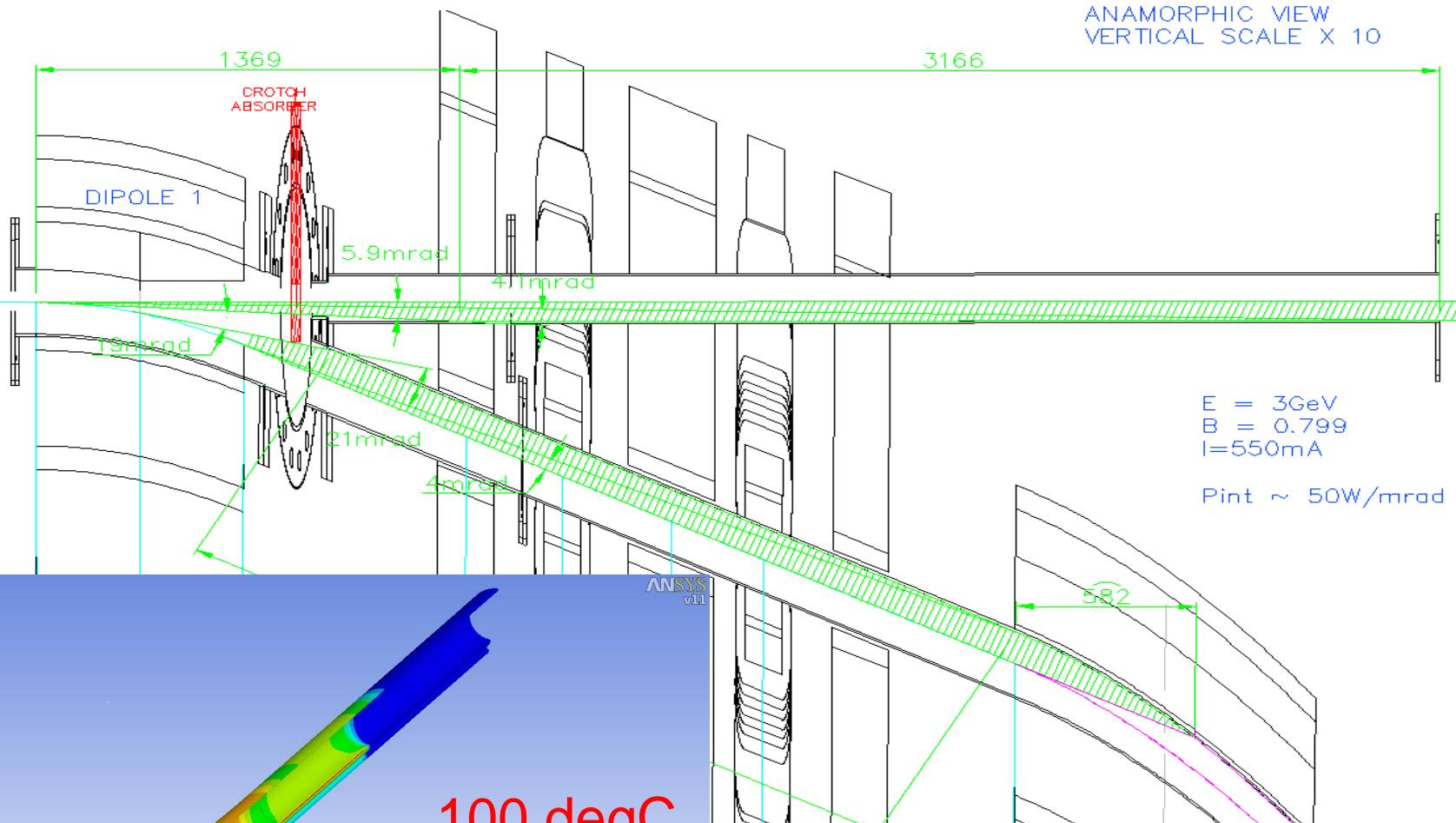
All vessels have to be water-cooled to take the dipole radiation power load.

BPM locations

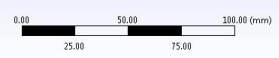
Oval vessels help concentrate image currents top and bottom and give more vessel to pole tip clearance than circular

Dipole Ray Tracing and FEA

.. where the radiation goes, and can the vessel be cooled adequately ...

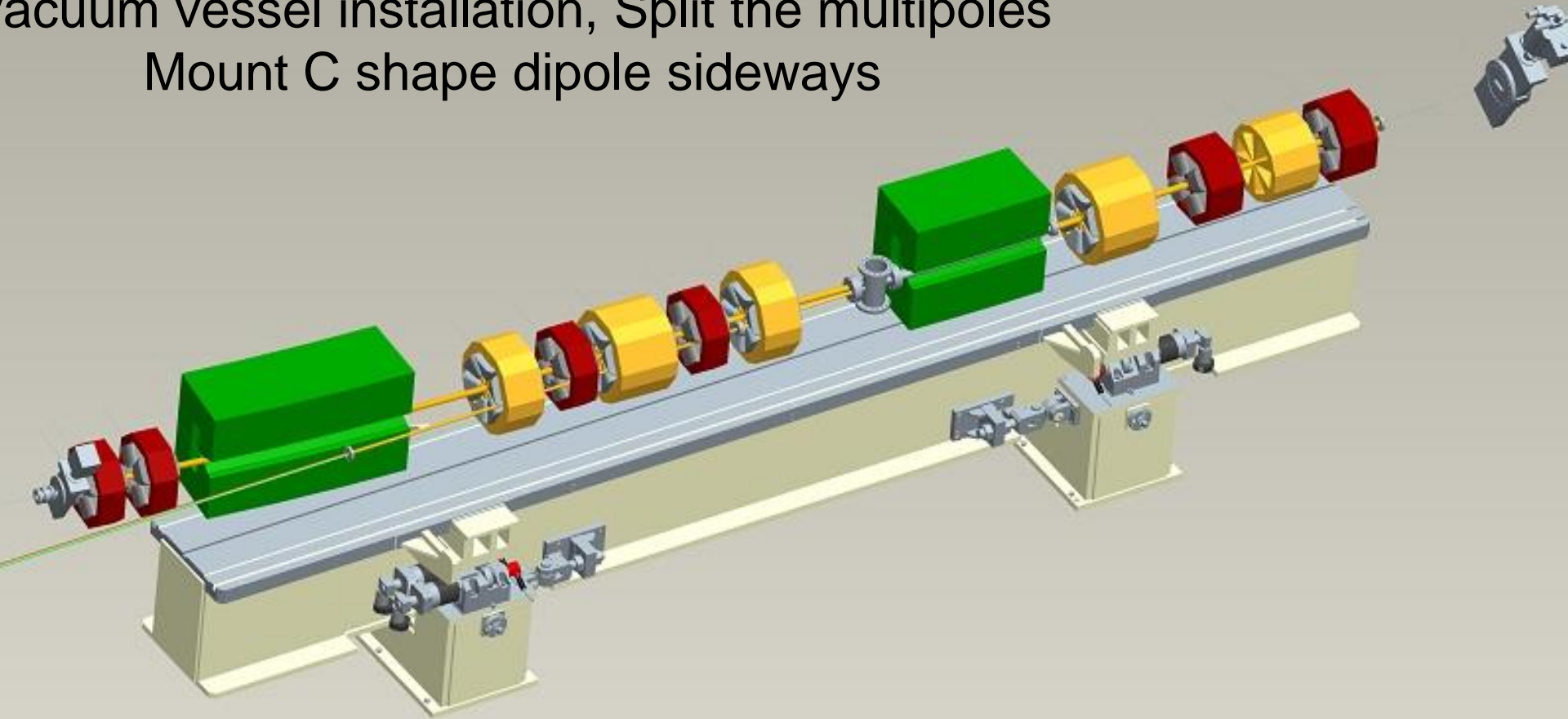


100 degC
water cooled
stainless



DDBA Assembly and Alignment

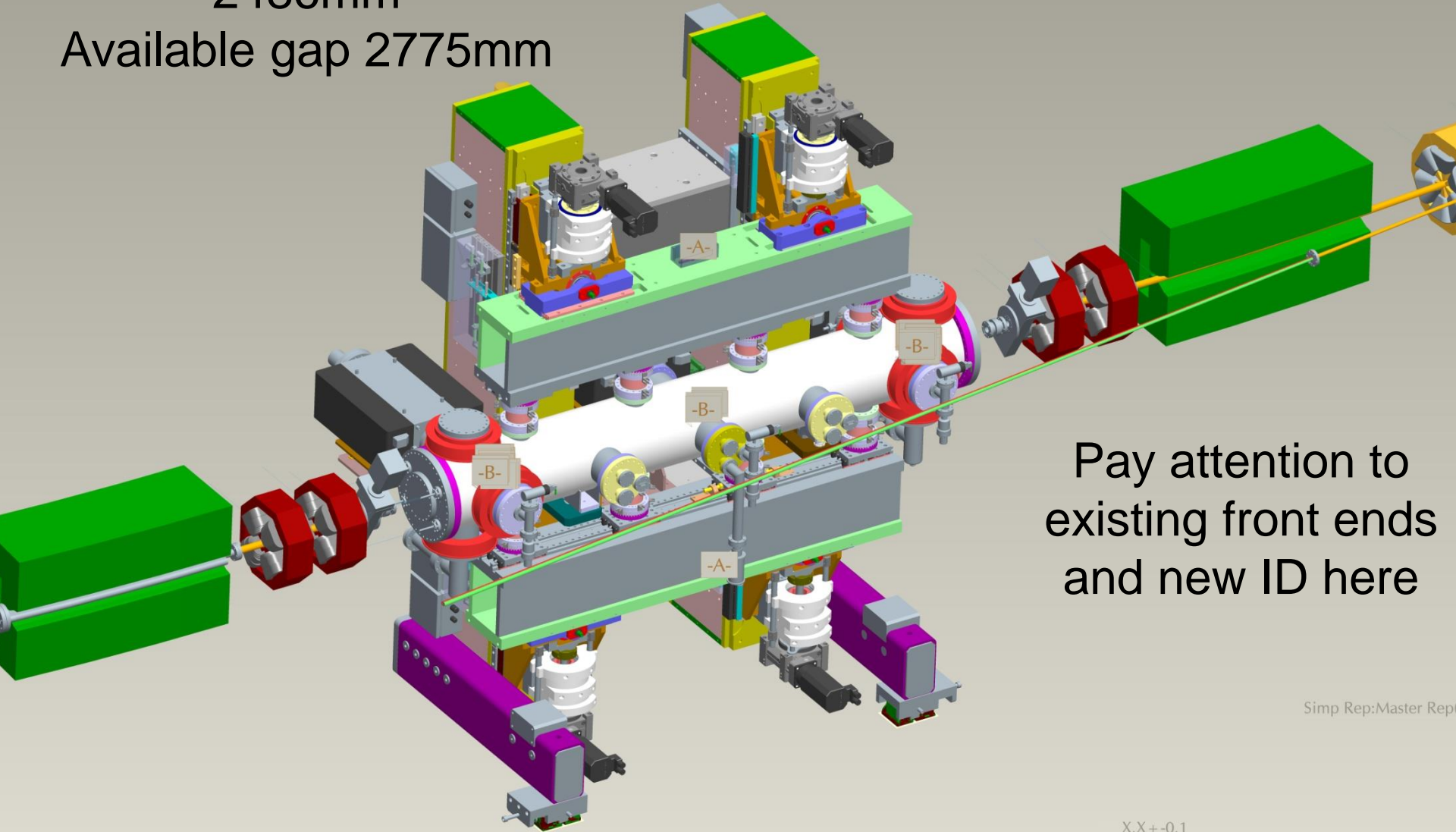
Each half of the DDBA fits on a 7m girder
The girder pedestals and motorised alignment system
Vacuum vessel installation, Split the multipoles
Mount C shape dipole sideways



X.X+0.1
X.XX+0.01

Existing 2m In-Vac length
2486mm
Available gap 2775mm

New Insertion Device location

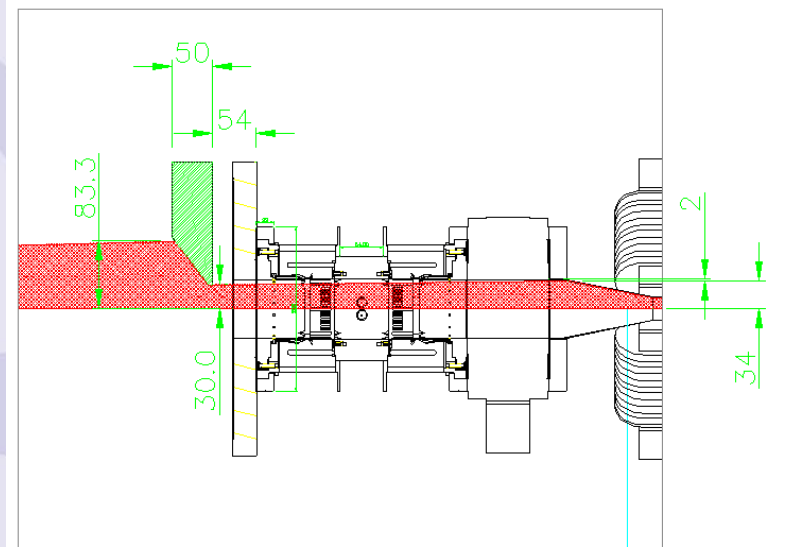
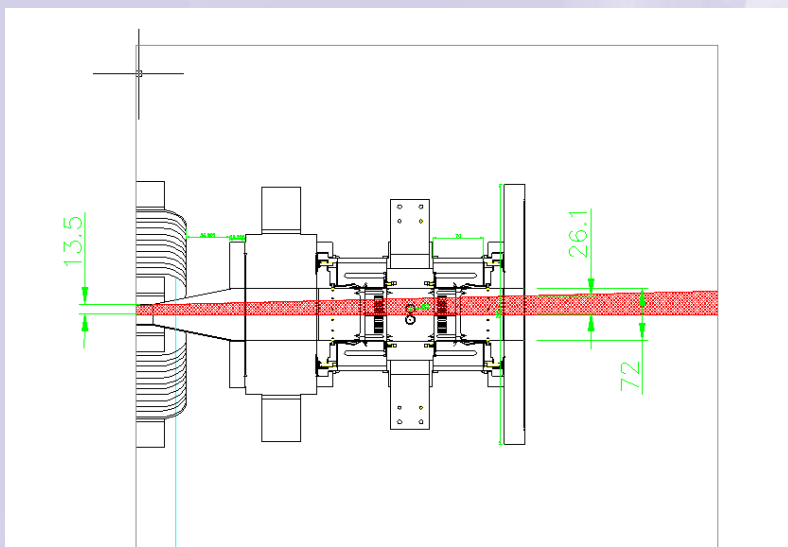
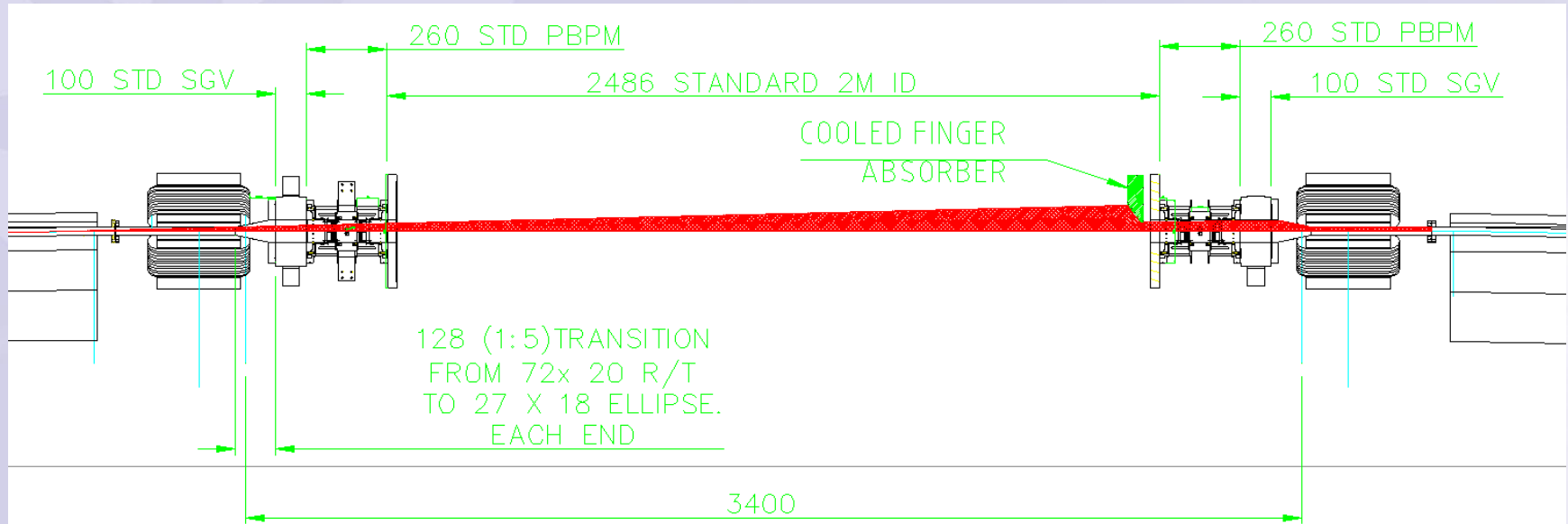


Pay attention to
existing front ends
and new ID here

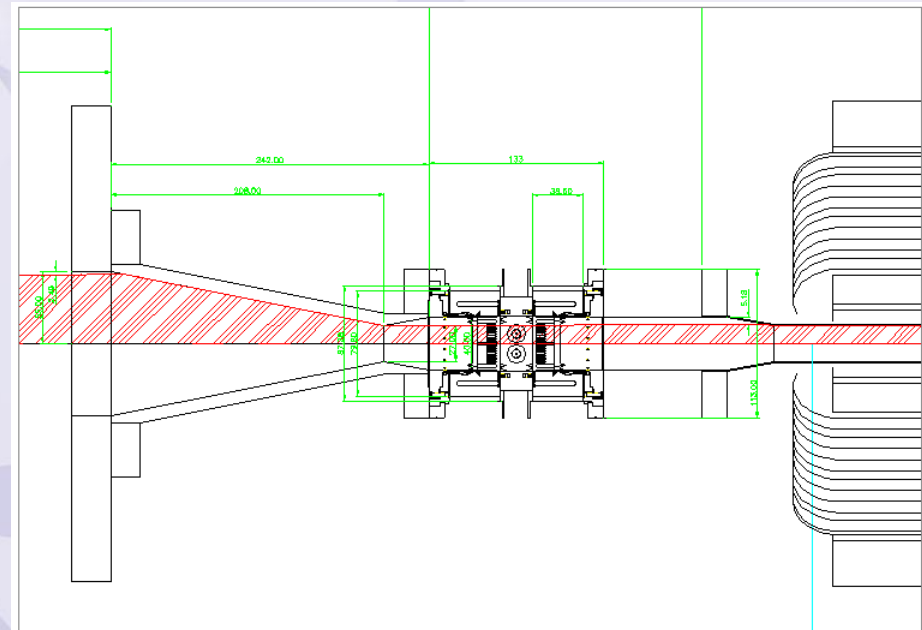
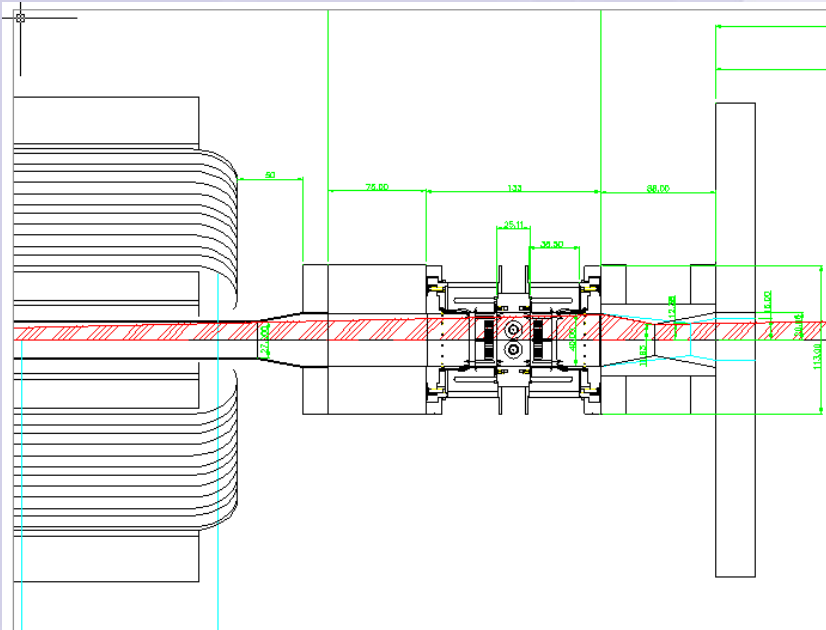
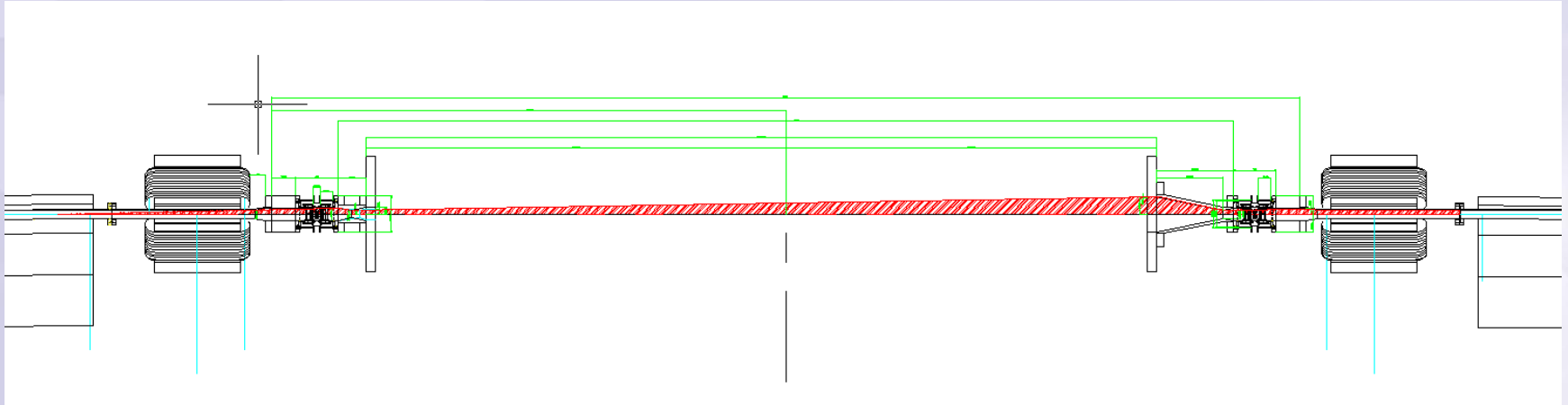
Simp Rep:Master Rep

X.X+0.1
X.XX+0.01
X.XXX+0.001
ANG.+0.5

ID Ray-trace First Configuration (with Finger Absorber)



ID Ray-trace Second Configuration (light passes through ID)



Mid straight assembly

Insertion
Device

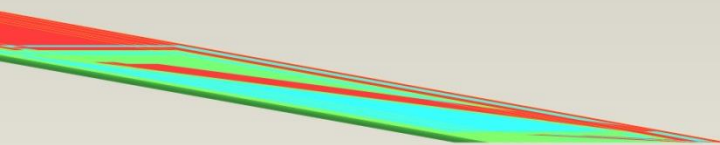
Cooled
Taper

BPM
between
bellows

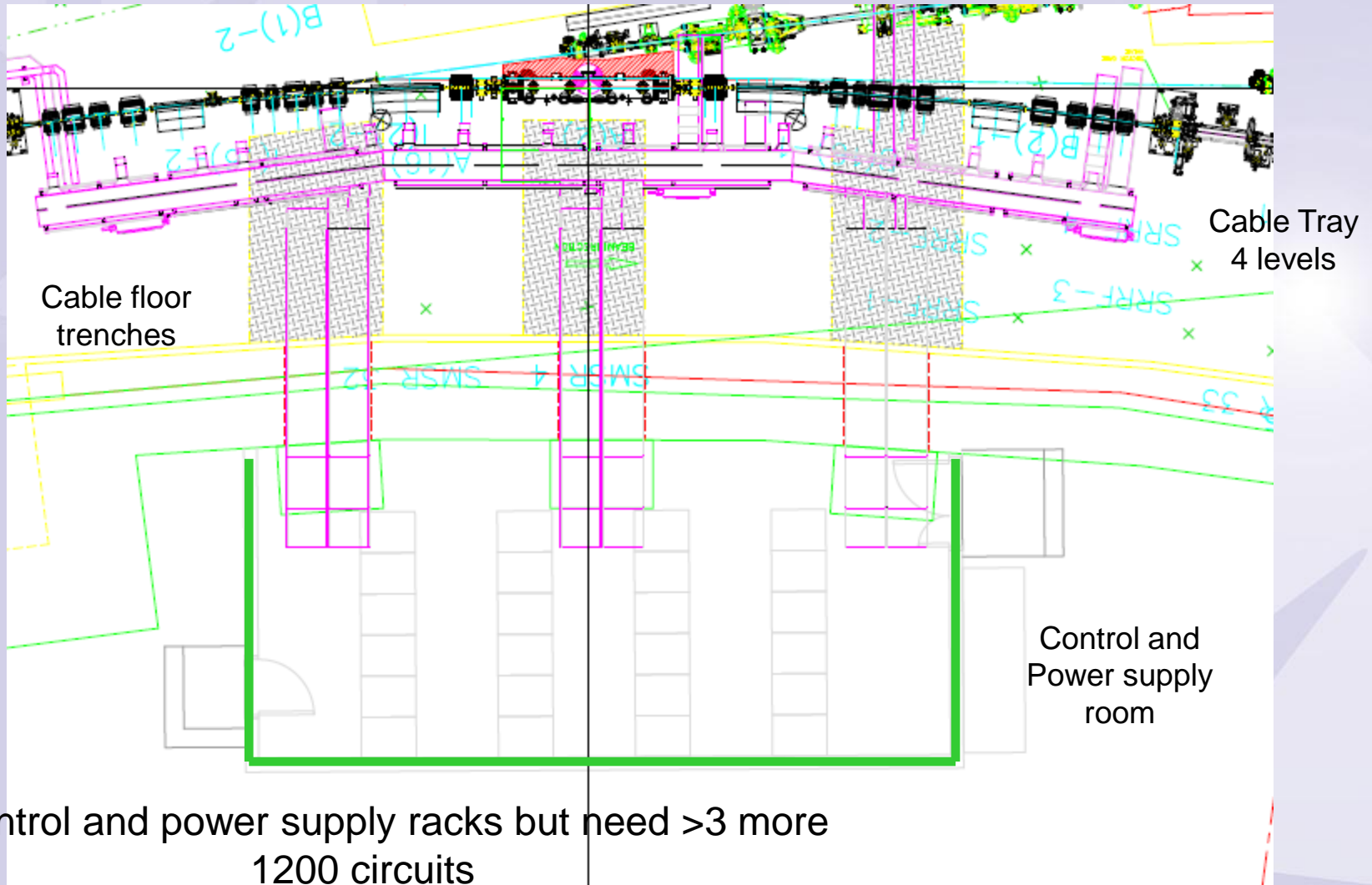
DN63 Valve

Clipping State:X

X.X+-0.1
X.XX+-0.01
X.XXX+-0.001
ANG.+-0.5



Electrical Engineering



Cabling dictates length of shutdown at 2 months

Re-use cables where possible

Match new magnets to existing power supplies

Engineering Integration summary

Done:

- engineering layout which matches the lattice and magnet design
- vacuum vessel solution looks feasible
- NEG coating feasible and in discussion with CERN
- feasible to accommodate full length in-vacuum ID in the new straight section
- solutions exist for dealing with the radiation power in the new ID straight

In progress:

- finalise copper and stainless steel vessels
- engineering of BPMs, vacuum vessel supports
- shielding of BPMS and flanges from synchrotron radiation
- new design for primary BPMs and bellows
- Flange and RF/Vacuum gasket detail design
- new girder design, cooling water distribution etc.

Programme dates:

- Design review Nov 2013
- Installation June 2016

Thanks

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