

Mode Analysis of Single Spoke Resonator Type-2 (SSR2) for RISP

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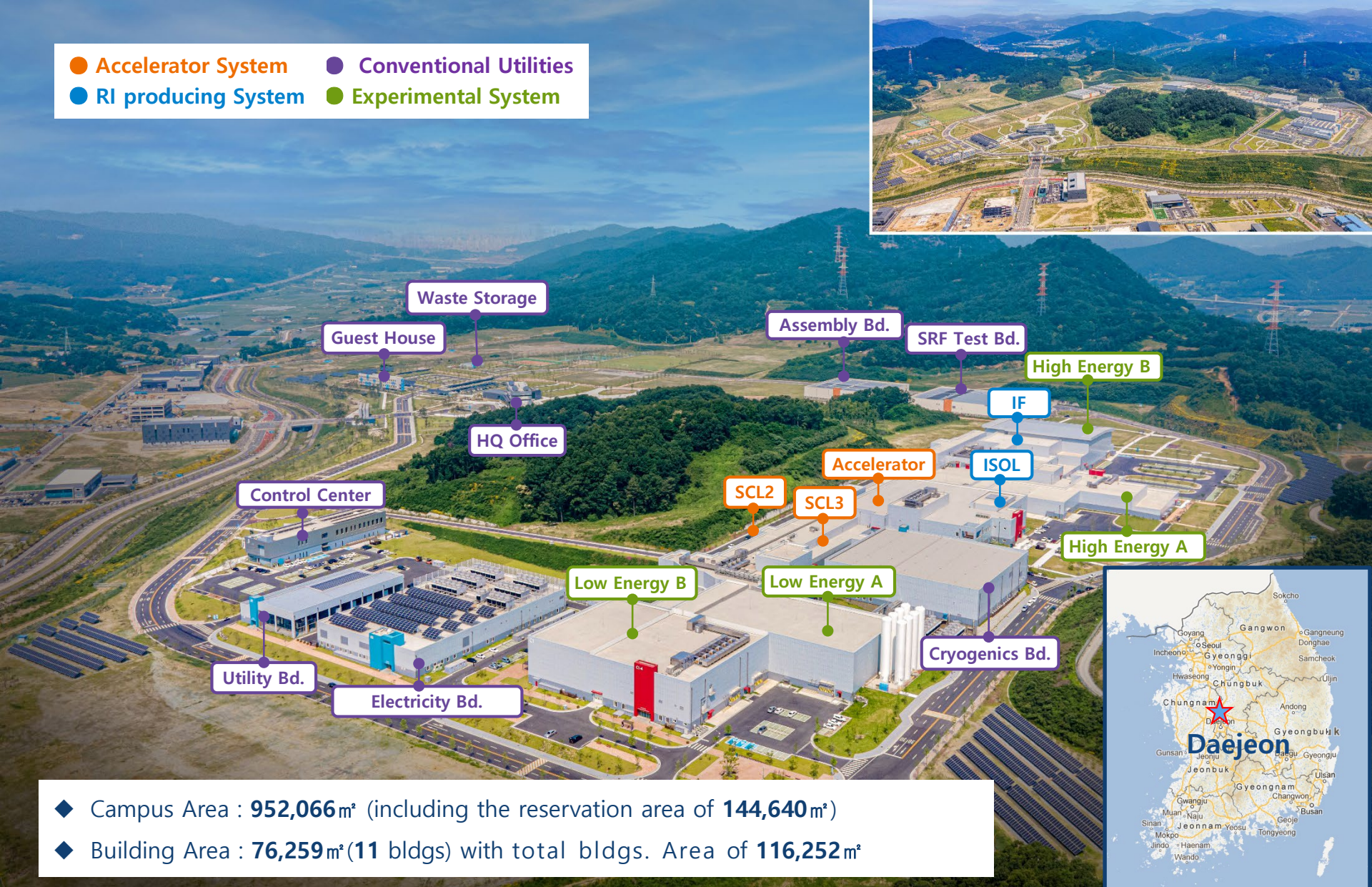
July 1th, 2022

RISP / IBS / South Korea



RAON Layout

- Accelerator System
- RI producing System
- Conventional Utilities
- Experimental System



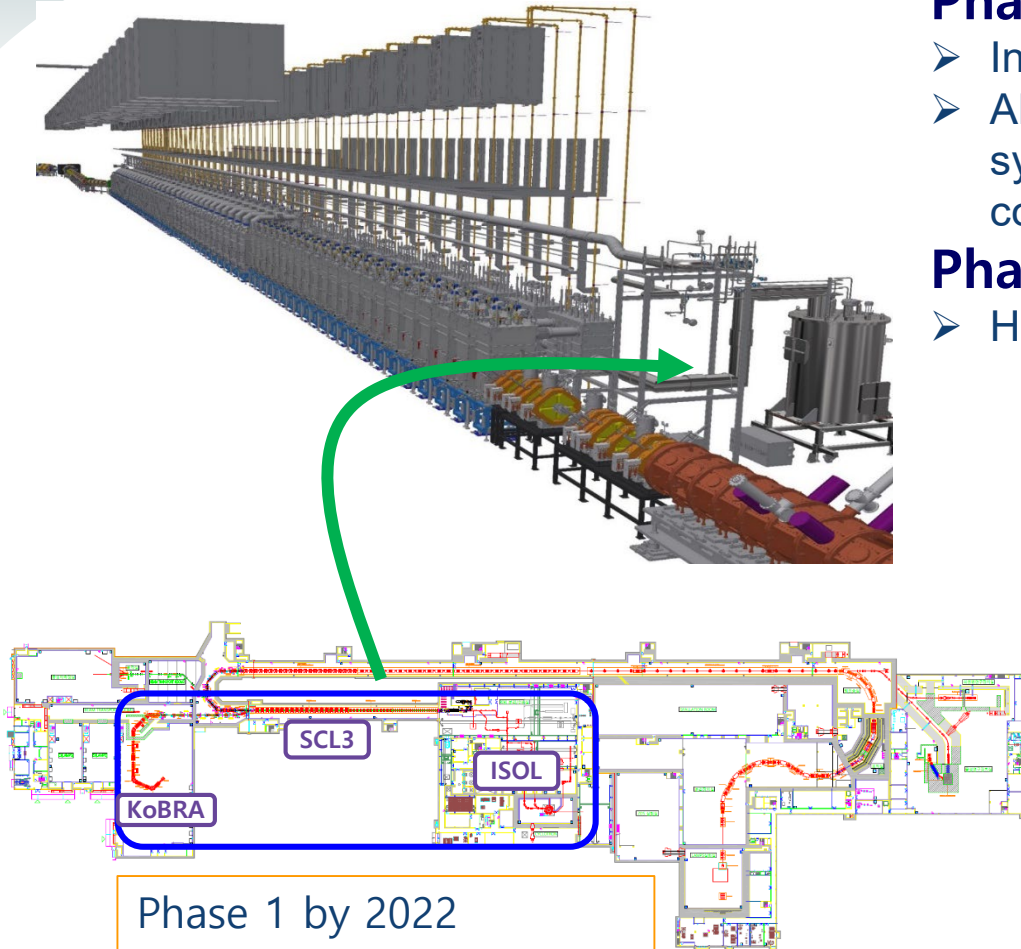
- ◆ Campus Area : **952,066m²** (including the reservation area of **144,640m²**)
- ◆ Building Area : **76,259m²**(11 bldgs) with total bldgs. Area of **116,252m²**

Phase 1 (~2022)

- Injector, SCL3, ISOL beam commissioned
- All the experimental systems including IF system to be installed and machine commissioned

Phase 2 (~2030)

- High energy Linac, SCL2



SCL3 → installation done on 2021 & commissioning on Oct 2022

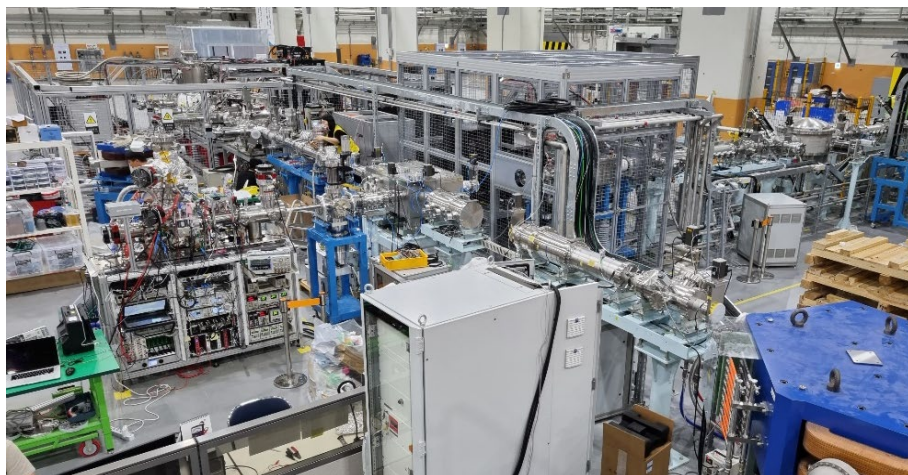
Low-Energy Linac (QWR/HWR) Status



Injector



SCL3(QWR & HWR Cryomodule)



ISOL Beam Line



CM/Cryogenic Control Rack and SSPA

- Injector and ISOL beam line are under commissioning.
- Commissioning of superconducting linac(SCL3) will start in October, 2022.

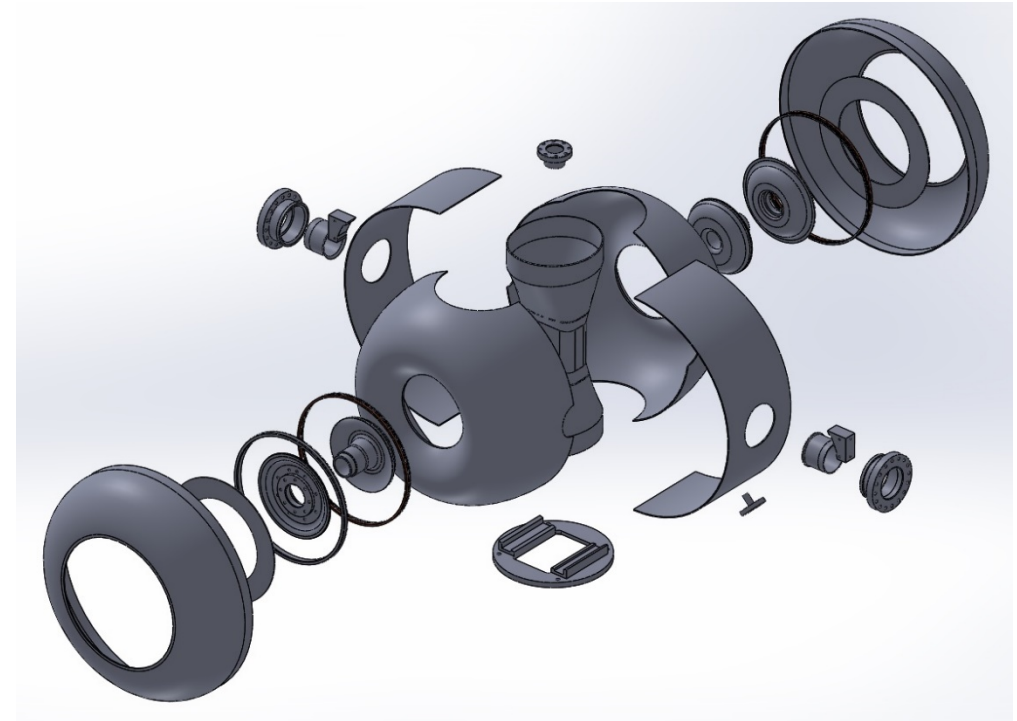
SC Cavity Specifications in RISP



Parameters	Unit	QWR	HWR	SSR1	SSR2
β_g	-	0.047	0.12	0.30	0.51
F	MHz	81.25	162.5	325	325
Aperture	mm	40	40	50	50
G	Ohm	22	42	94	112
R/Q	Ohm	468	310	233	290
V_{acc}	MV	1.1	1.4	2.5	4.1
E_{peak}	MV/m	35	35	35	35
B_{peak}	mT	57	55	55	67
$Q_{calc}/10^9$	-	0.24	1.45	>5	>5
Temp.	K	4.5	2.05	2.05	2.05



SSR2 Bare Cavity



SSR2 Exploded View

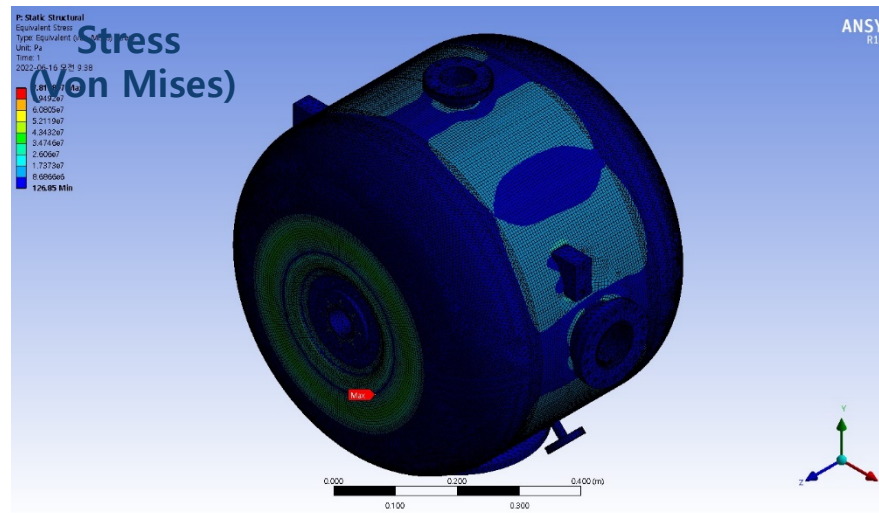
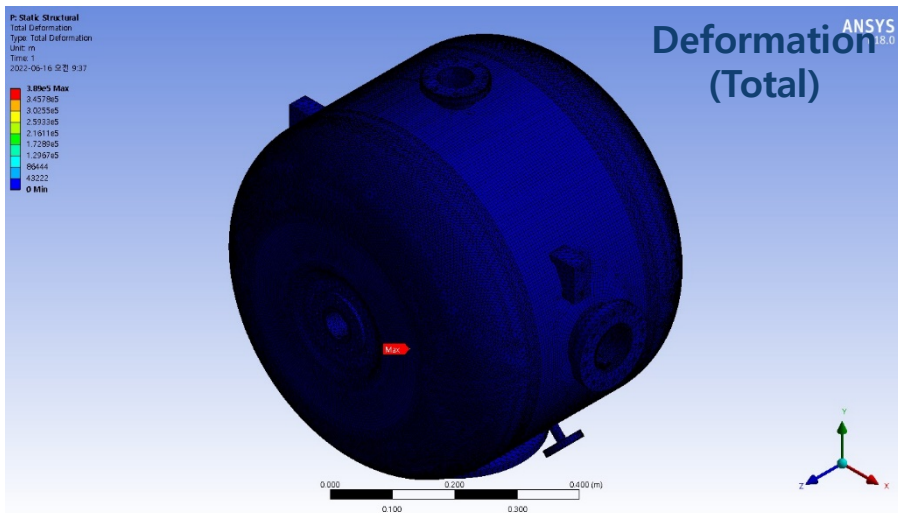
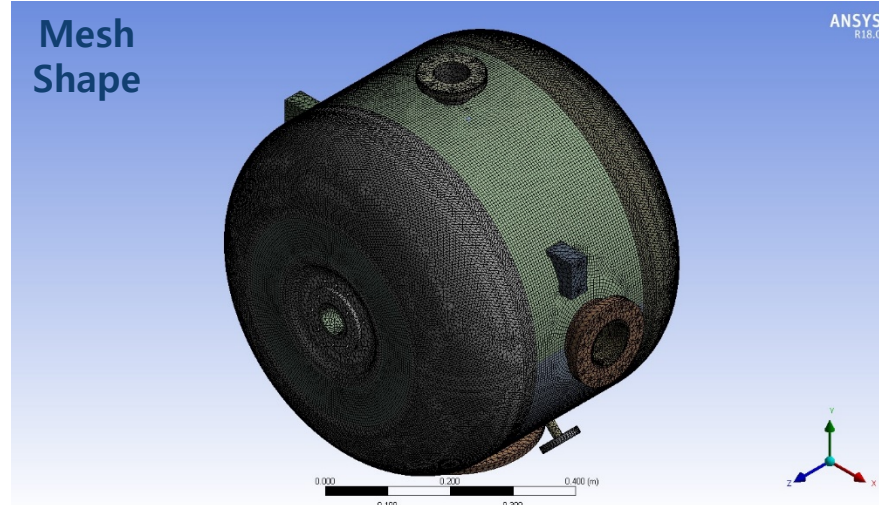
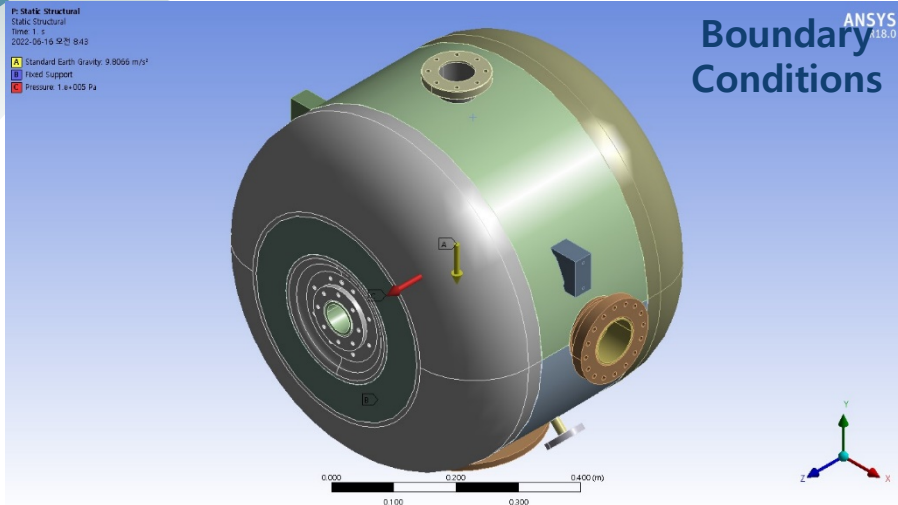
❖ SSR2 Superconducting Cavity

- Cavity : 3T pure niobium (RRR 300 grade), single spoke, 0.51 beta, 325MHz, bulk machining beam port, stiffening ring and spoke stiffener for structural reinforcement, vacuum braze at every ports and flanges, EBW for weldment attach, beam port trimming for frequency adjustment
- Jacket : 3T STS316L, 1.3 bar pressure vessel design (ASME Section-2 Part-D Subpart-1) , liquid helium volume 51.32L (33.05L for SSR1), GTAW for weldment attach, transition ring for stiffening ring interface

SSR2 Cavity Prototype Fabrication

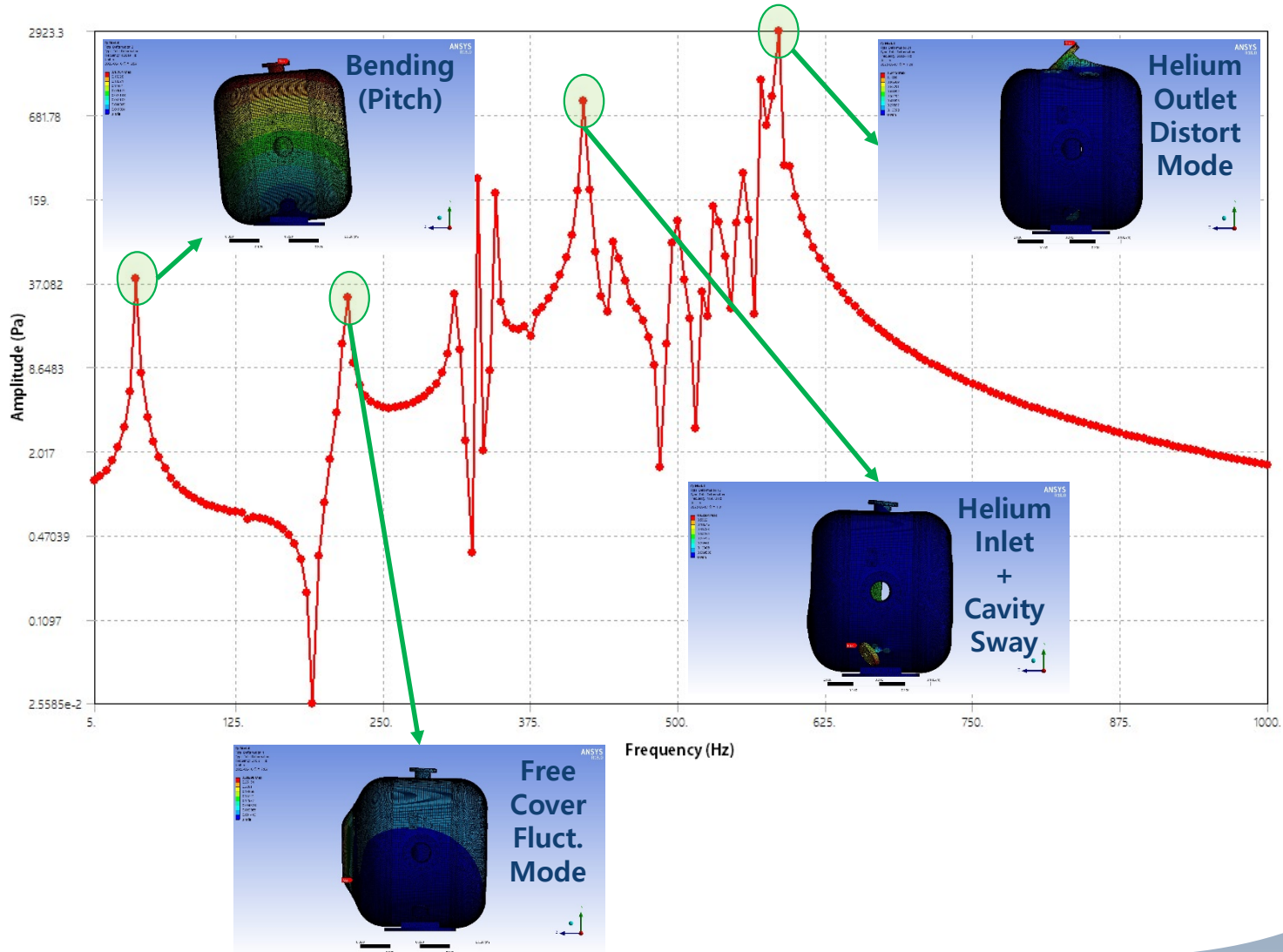


SSR2 Cavity Mode Analysis



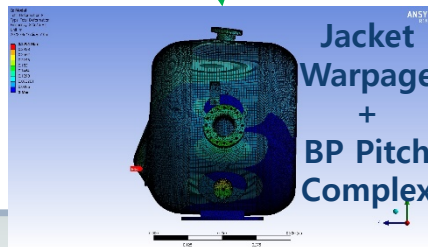
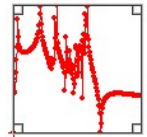
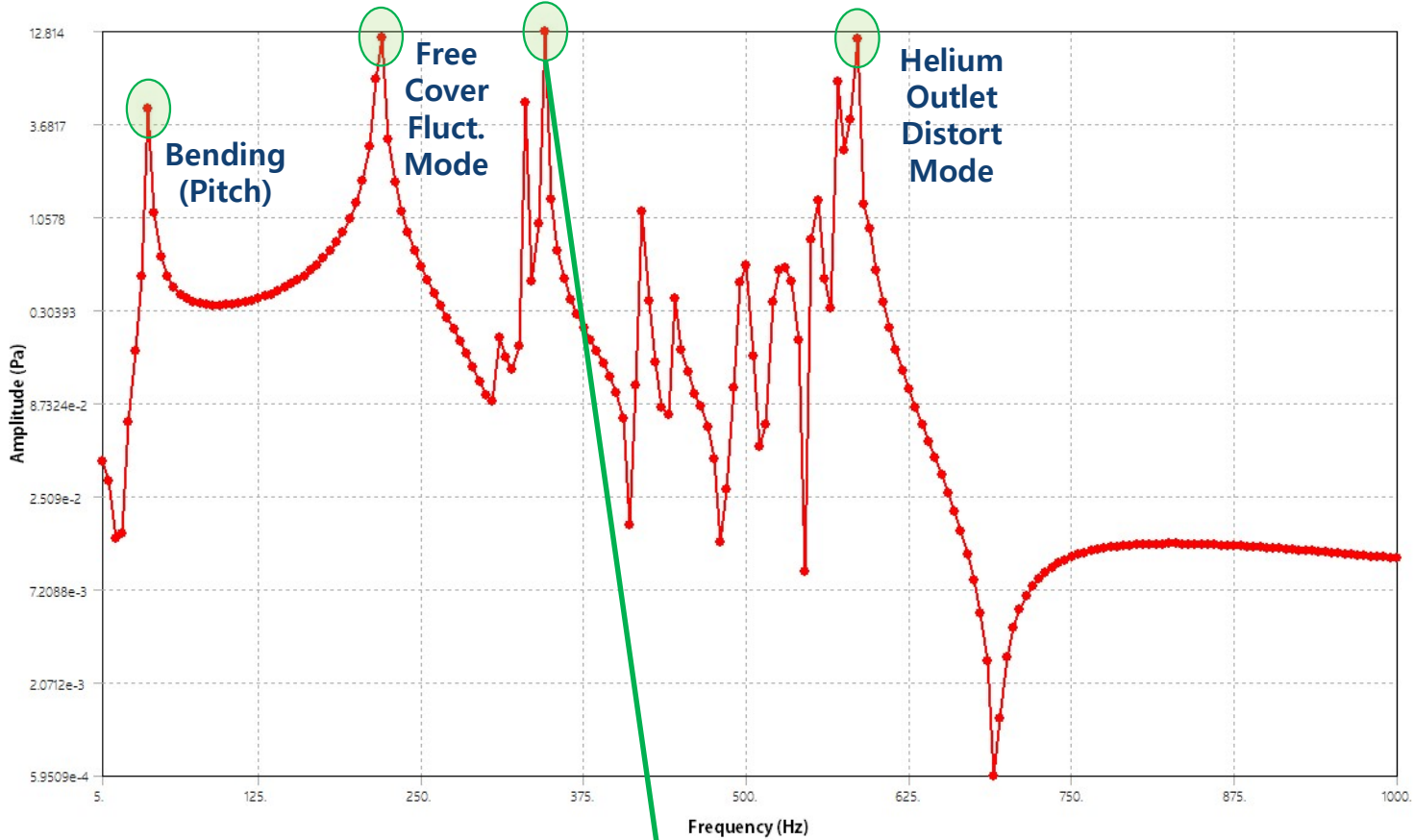
SSR2 Harmonic Response – Spoke Center

Frequency Response



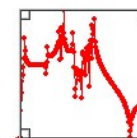
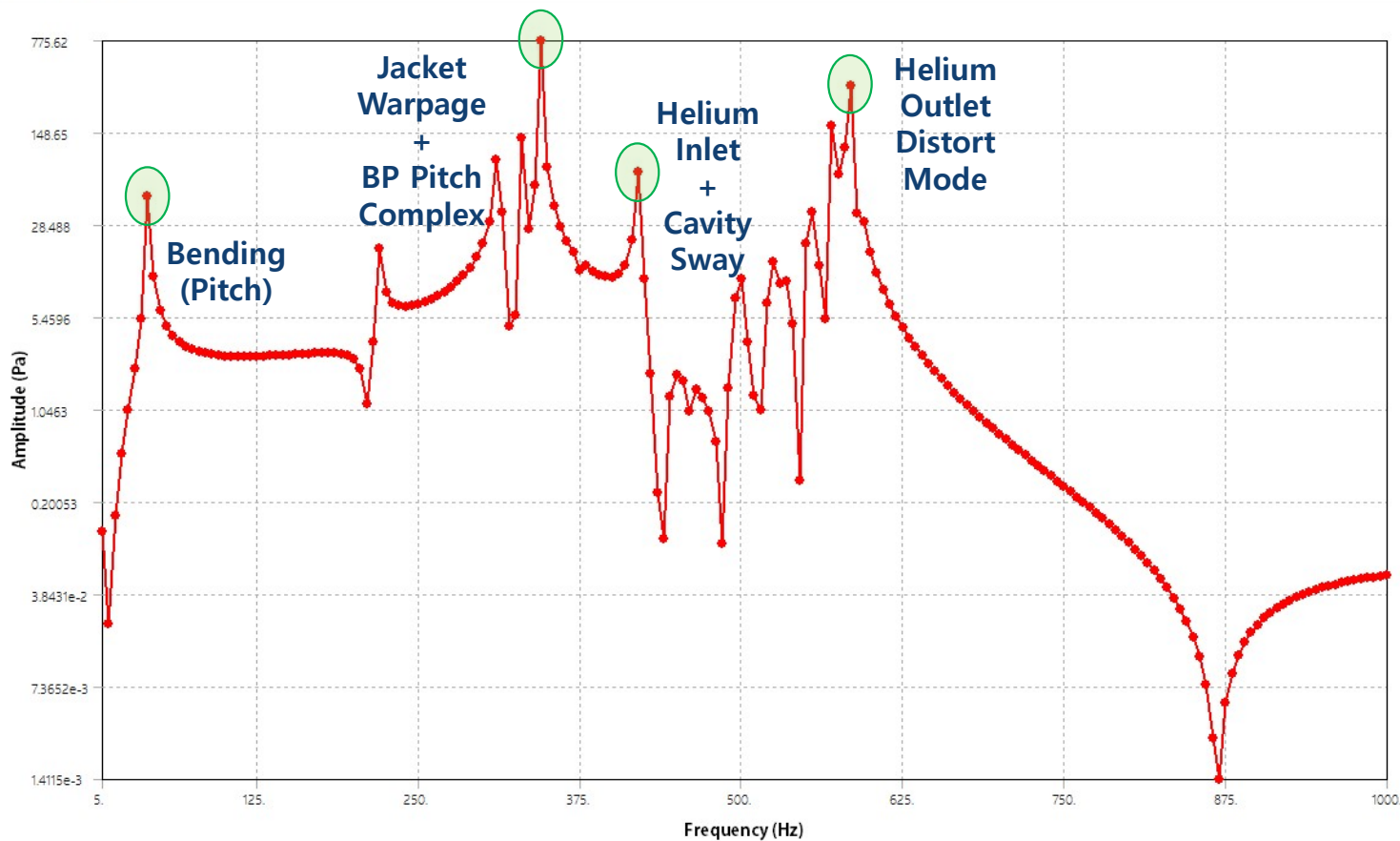
SSR2 Harmonic Response – Free Cover

Frequency Response 2



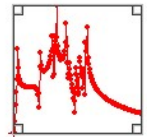
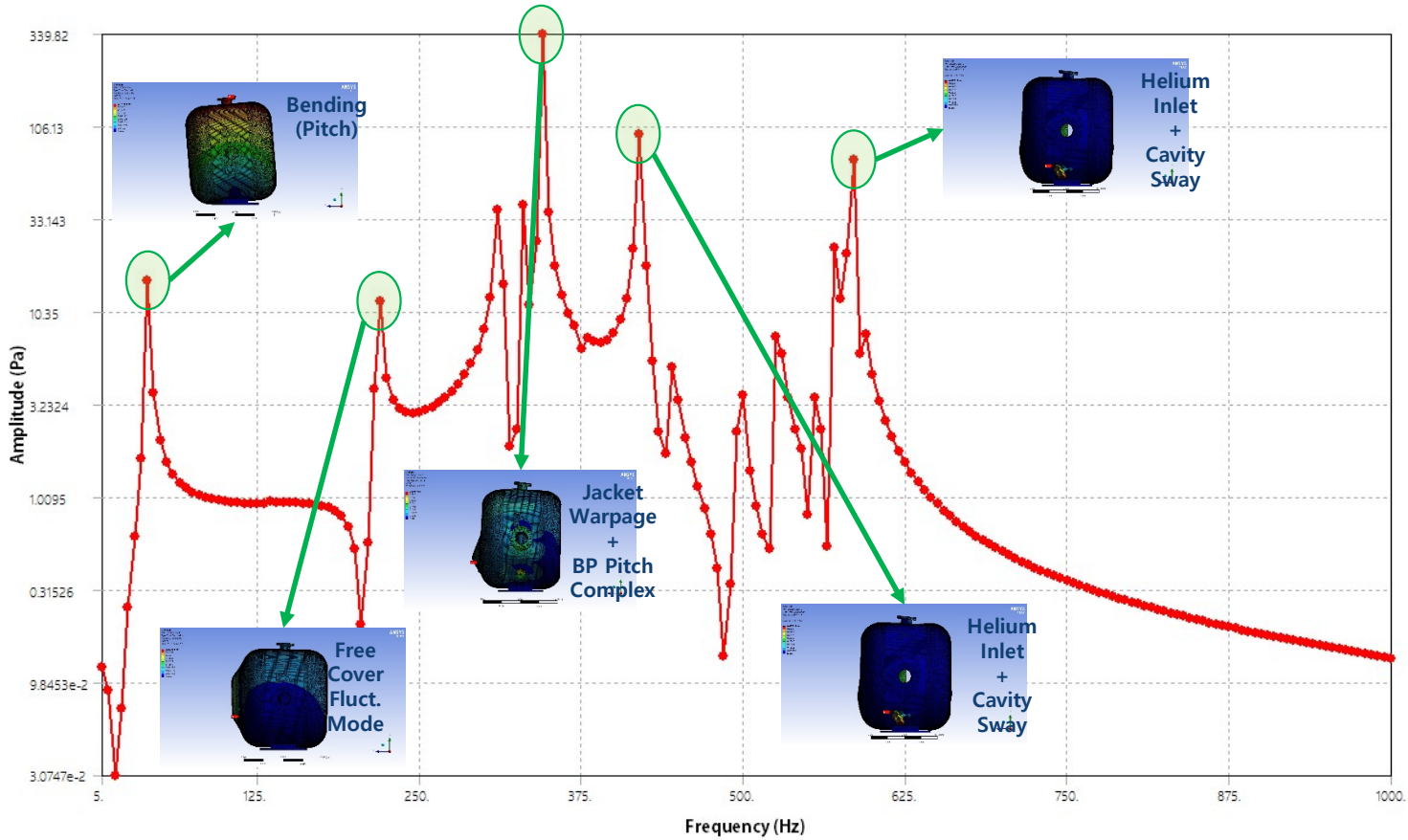
SSR2 Harmonic Response – Fixed Cover

Frequency Response 3



SSR2 Harmonic Response – Combined

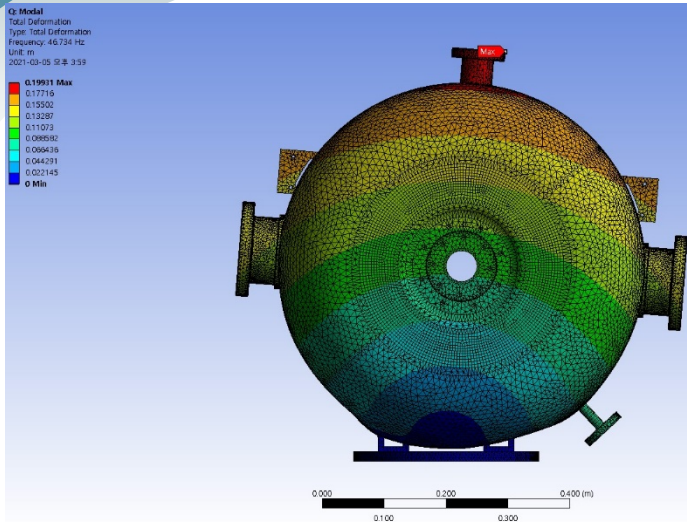
Frequency Response 7



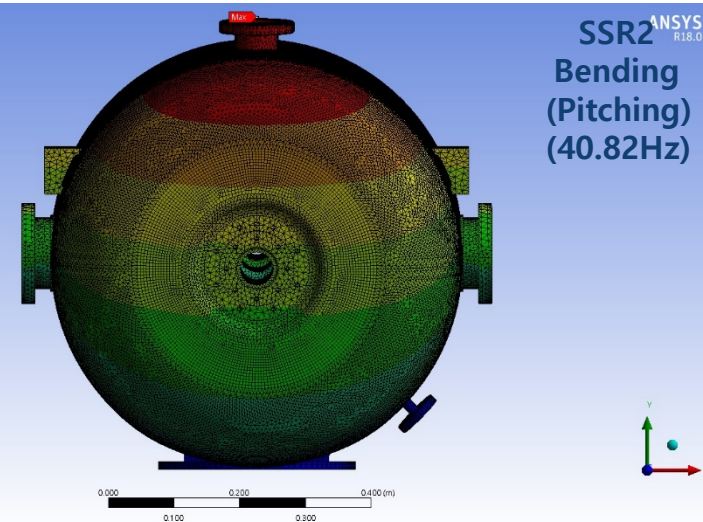
SSR1/SSR2 Cavity Mode Comparison

	SSR2 Mode	SSR2 Mode Estimation	SSR1 Mode	SSR1 Mode Estimation
1st	40.82Hz	Simply Bending (Pitching)	46.73Hz	Simply Bending (Rolling)
2nd	218.21Hz	Free Cover Fluctuation	240.77Hz	Free Cover Fluctuation
3rd	-	-	265.54Hz	Helium Inlet Bending
4th	345.45Hz	Free Cover Torsion (Warpage)	349.38Hz	Free Cover Torsion (Fluctuate)
5th	419.18Hz	Helium Inlet Bending	-	-
6th	583.97Hz	Helium Outlet Bending	579.55Hz	Helium Outlet Bending
7th	-	-	710.06Hz	Complex

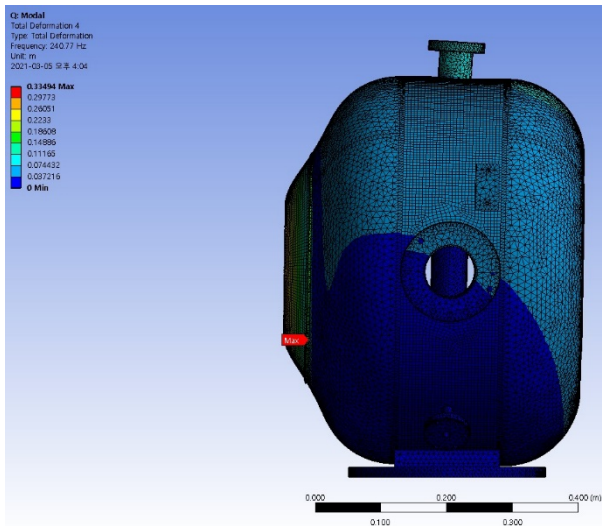
SSR1/SSR2 Cavity Mode Comparison



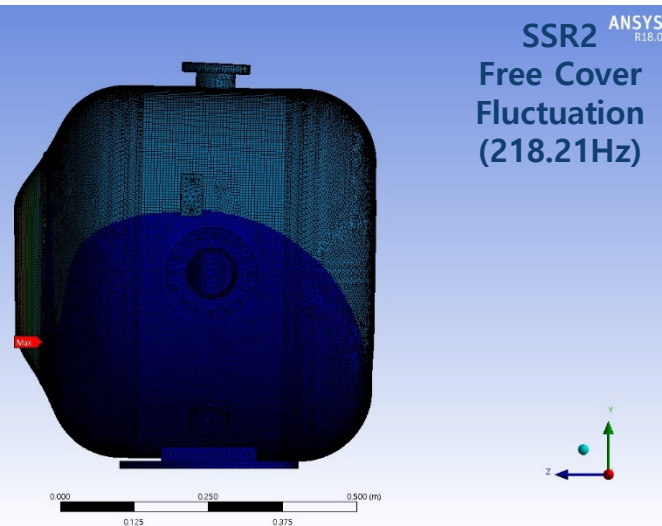
SSR1 ANSYS R18.0
Bending (Rolling)
(46.73Hz)



SSR2 ANSYS R18.0
Bending (Pitching)
(40.82Hz)



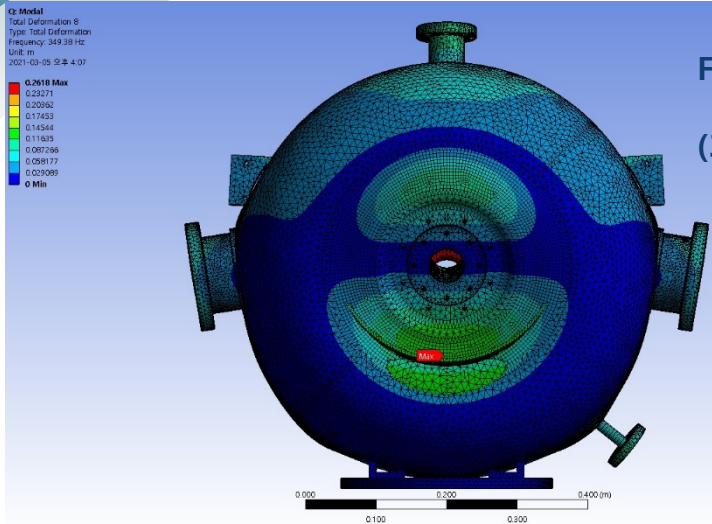
SSR1 ANSYS R18.0
Free Cover Fluctuation
(240.77Hz)



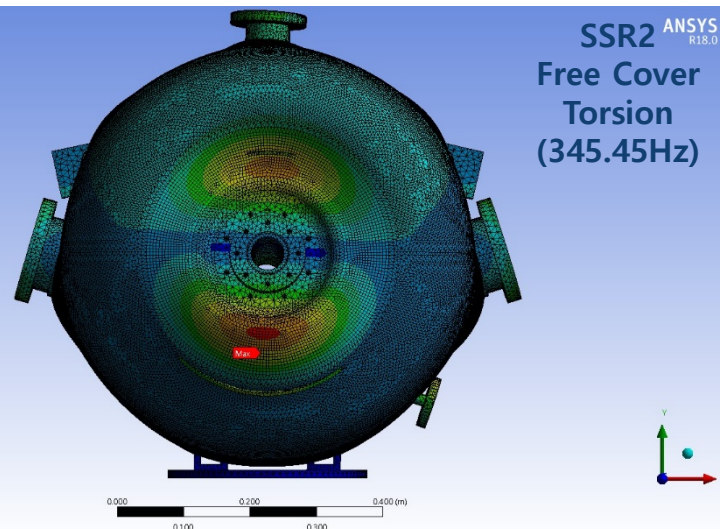
SSR2 ANSYS R18.0
Free Cover Fluctuation
(218.21Hz)



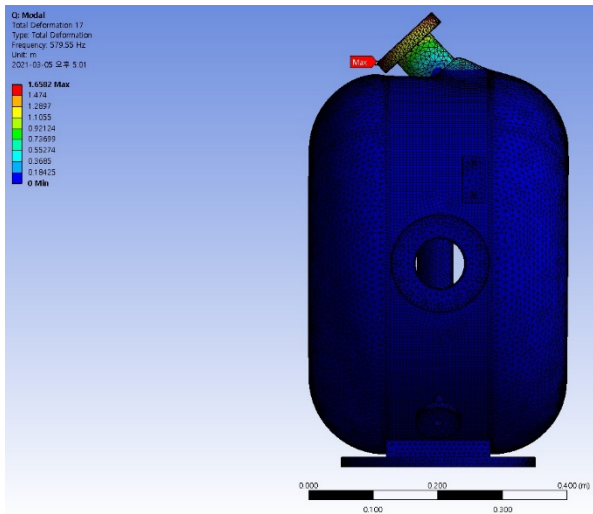
SSR1/SSR2 Cavity Mode Comparison



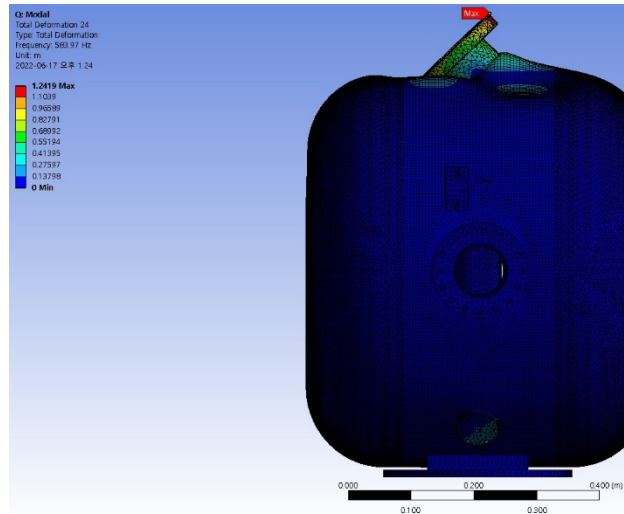
SSR1 ANSYS
Free Cover
Torsion
(349.38Hz)



SSR2 ANSYS
Free Cover
Torsion
(345.45Hz)



SSR1 ANSYS
Helium Outlet
Bending
(579.55Hz)



SSR2 ANSYS
Helium Outlet
Bending
(583.97Hz)

- Through this study, we can see that SSR2 mode is very similar to SSR1. ANSYS analysis method is verified through previous studies – QWR/SSR1 mode analysis, but we must proceed the vibration test of SSR2 SC cavity for proving our analysis. We will proceed the vibration test for SSR2 dressed cavity after all fabrication and cold test are finished.
- Currently 4 SSR2 bare cavities are made and ready for cold test, and 2 bare cavities are in the post-processing. RISP are now preparing for the next step, pre-production of SCL2 which has a plan for fabrication of modified SSR1 and SSR2 models. For entering next stage, RISP will finish the current SSR1 and SSR2 prototyping within this year.

Thank you!
Vielen Dank!