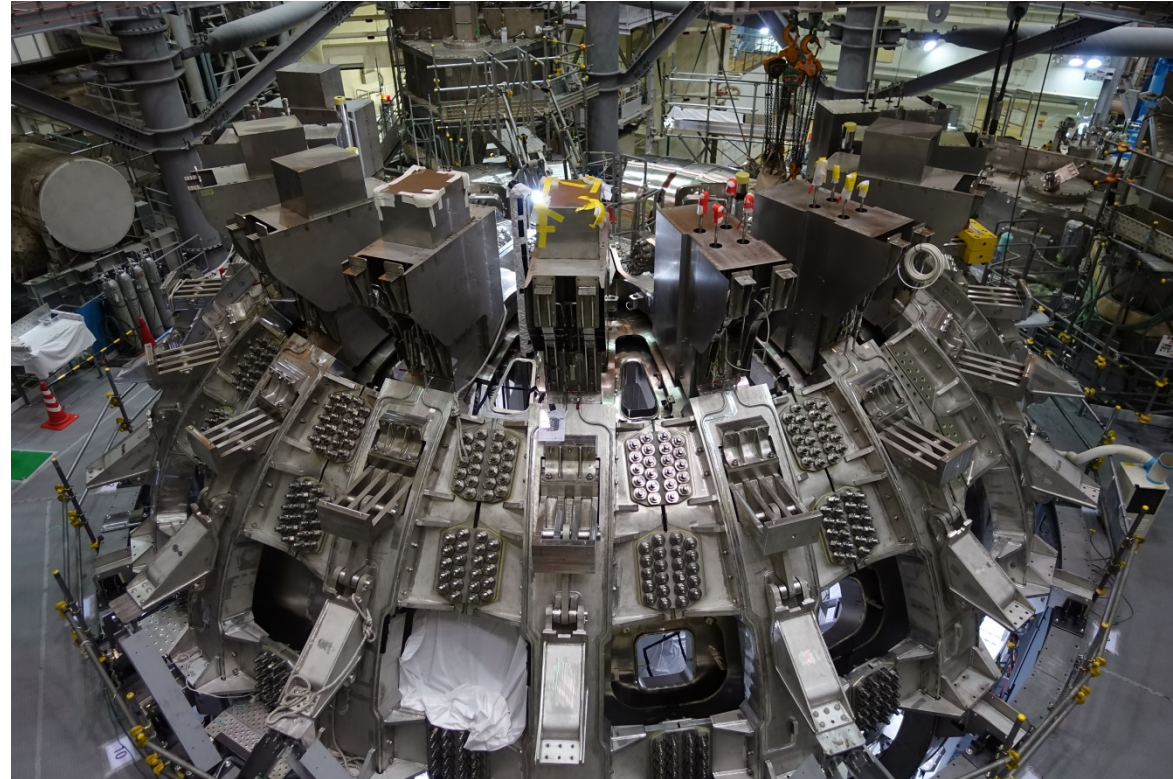


JT-60SA Magnet System Status

Sam Davis
28th August 2017

S. Davis, W. Abdel Maksoud, P. Barabaschi, A. Cucchiaro, P. Decool, E. Di Pietro, G. Disset, N. Hajnal, K. Kizu, C. Mayri, K. Masaki, J.L. Marechal, H. Murakami, G.M. Polli, P. Rossi, V. Tomarchio, K. Tsuchiya, D. Tsuru, M. Verrecchia, M. Wanner

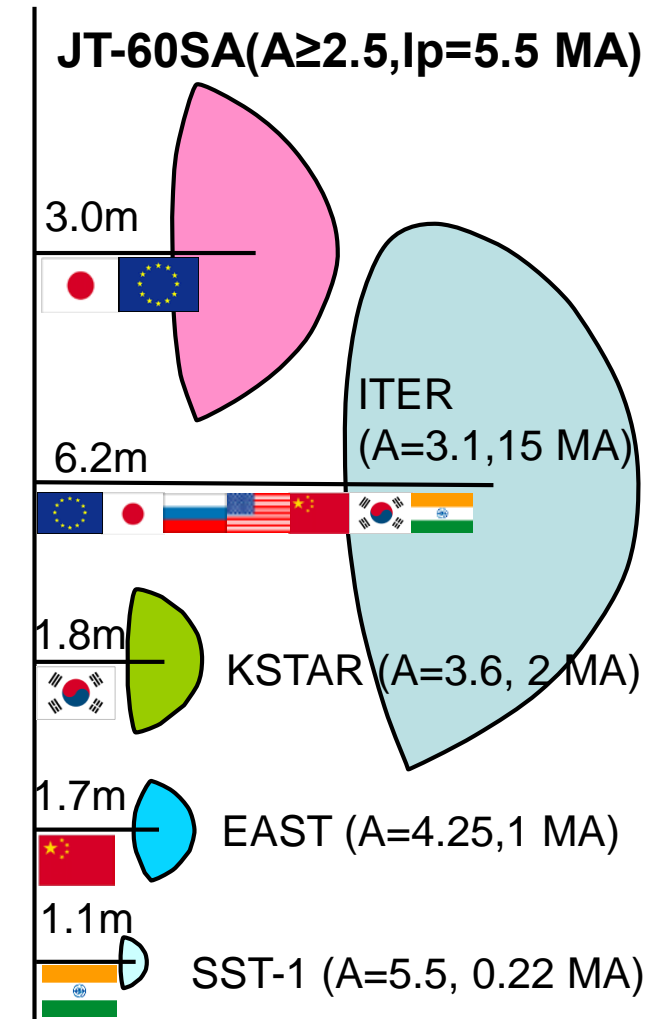
- What is JT-60SA?
- Magnet system overview
- Coil design and manufacturing
- Electrical testing
- Installation



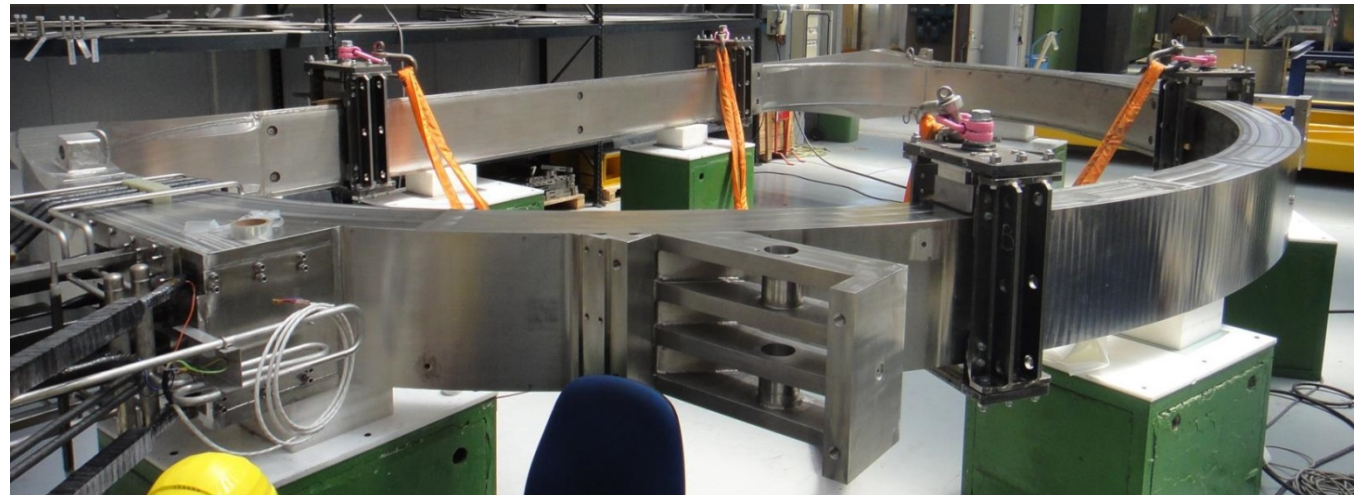
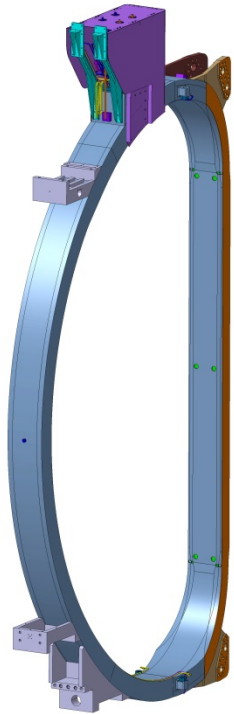
What is JT-60SA?

- Fully superconducting JET-sized tokamak using existing JT-60U infrastructure at Naka, in particular the beams and the building
- Focused on developing “advanced” plasma scenarios relevant to achieving fusion conditions in a power plant, i.e. operational modes in which
 - plasma current is driven by means other than induction
 - the ratio between plasma pressure and the confining toroidal field is high
 - plasma conditions and plasma-wall interactions are achieved for durations relevant to steady-state operation.

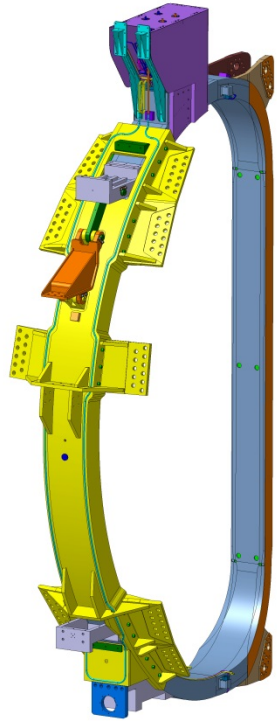
	JET	JT-60SA	ITER
Major radius	2.96 m	2.96 m	6.21 m
Minor radius	1.25 m	1.18 m	2 m
Plasma current	4.8 MA	5.5 MA	15 MA
Plasma volume	100m ³	135 m³	840 m ³
Toroidal field	4 T	2.25 T	6 T
Plasma	Now	2020	2025
Flat top	20s	100 s	3000 s
H&CD power	44 MW	41 MW	73 MW



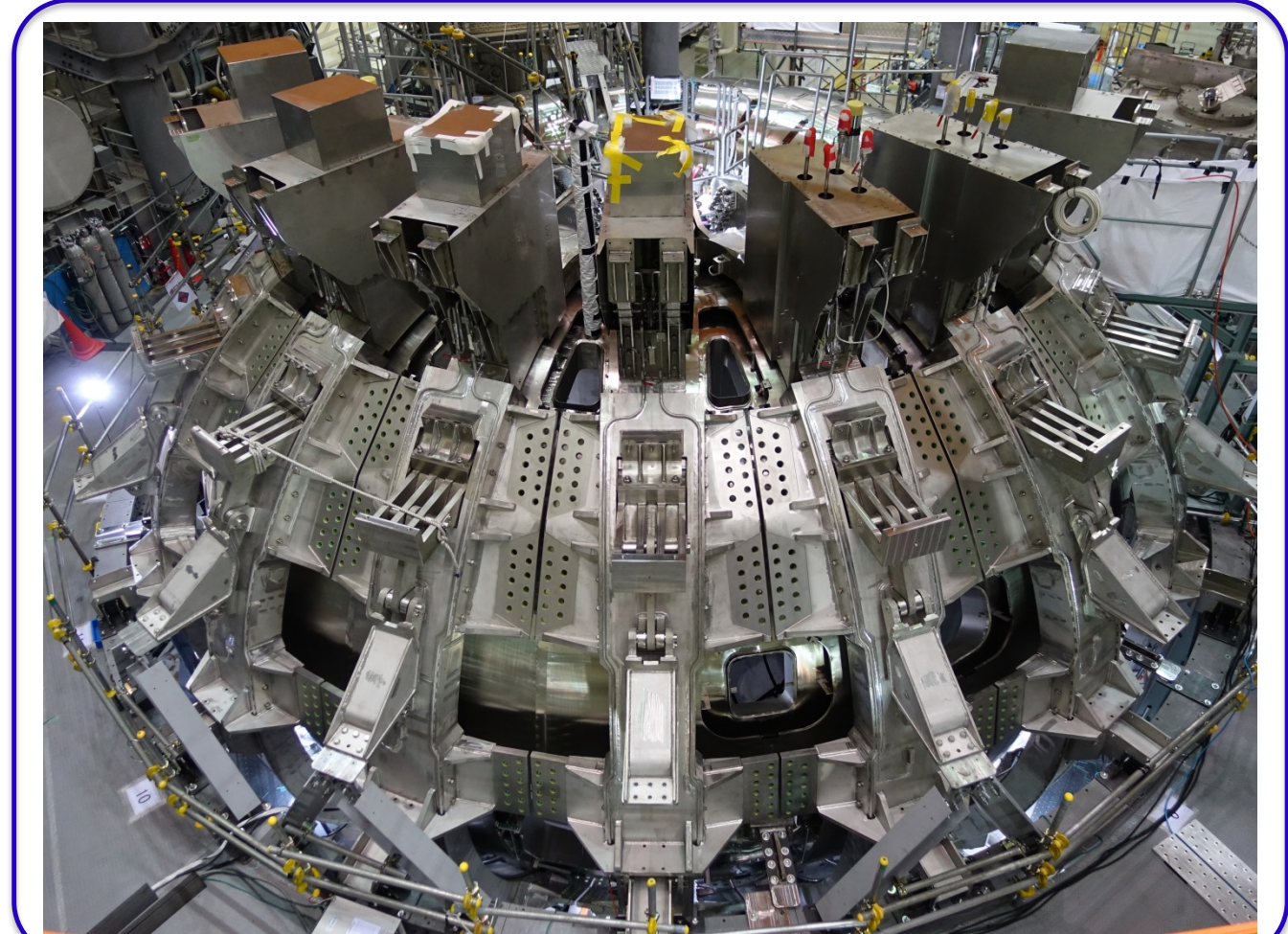
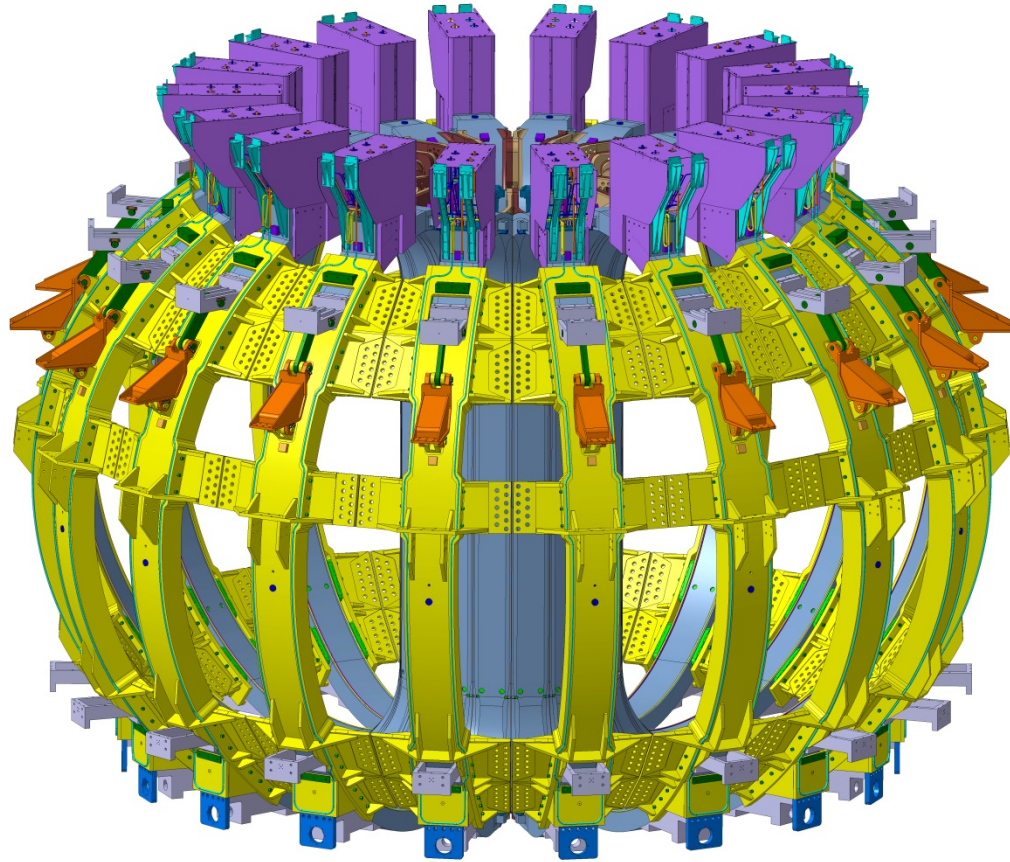
A single Toroidal Field (TF) coil



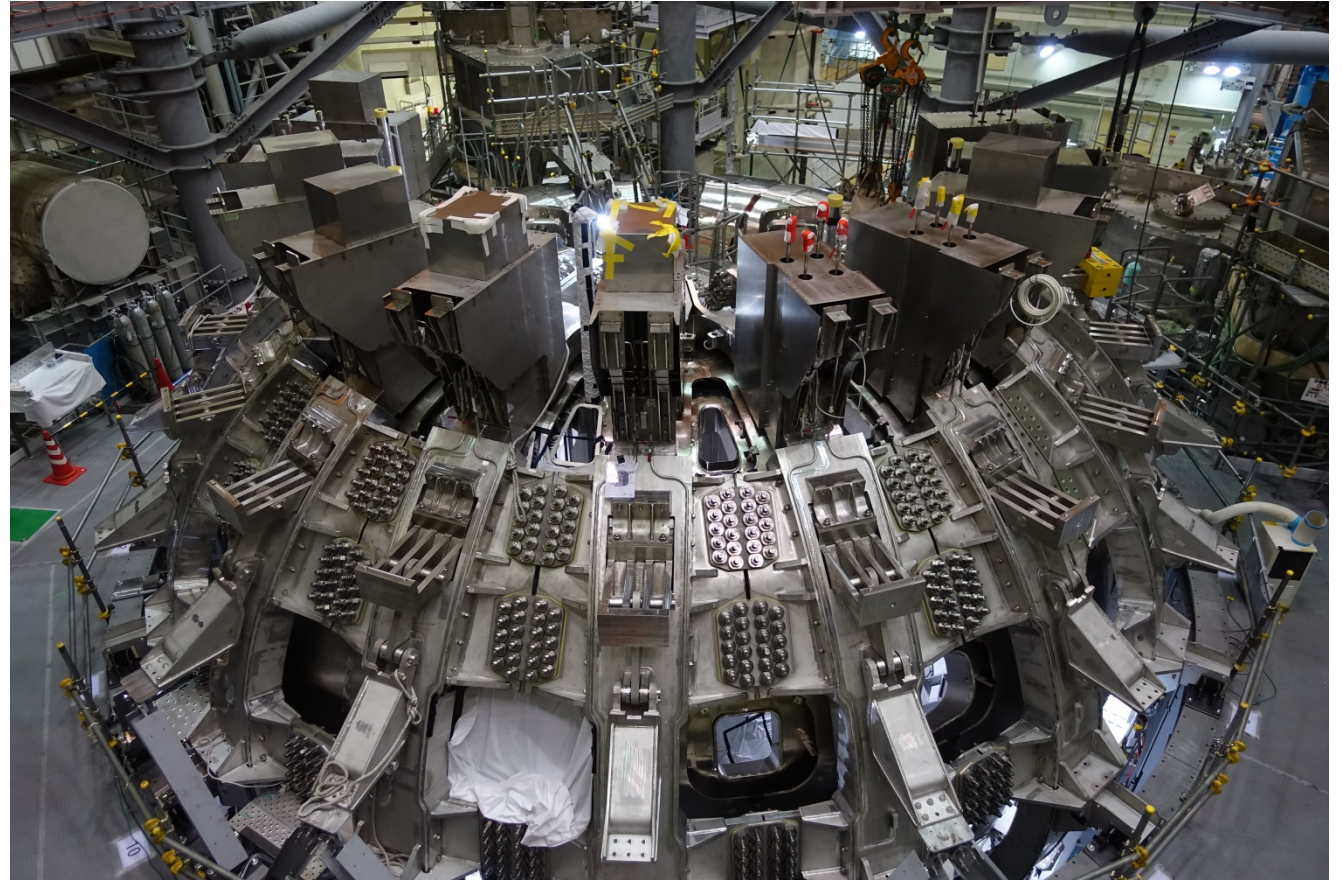
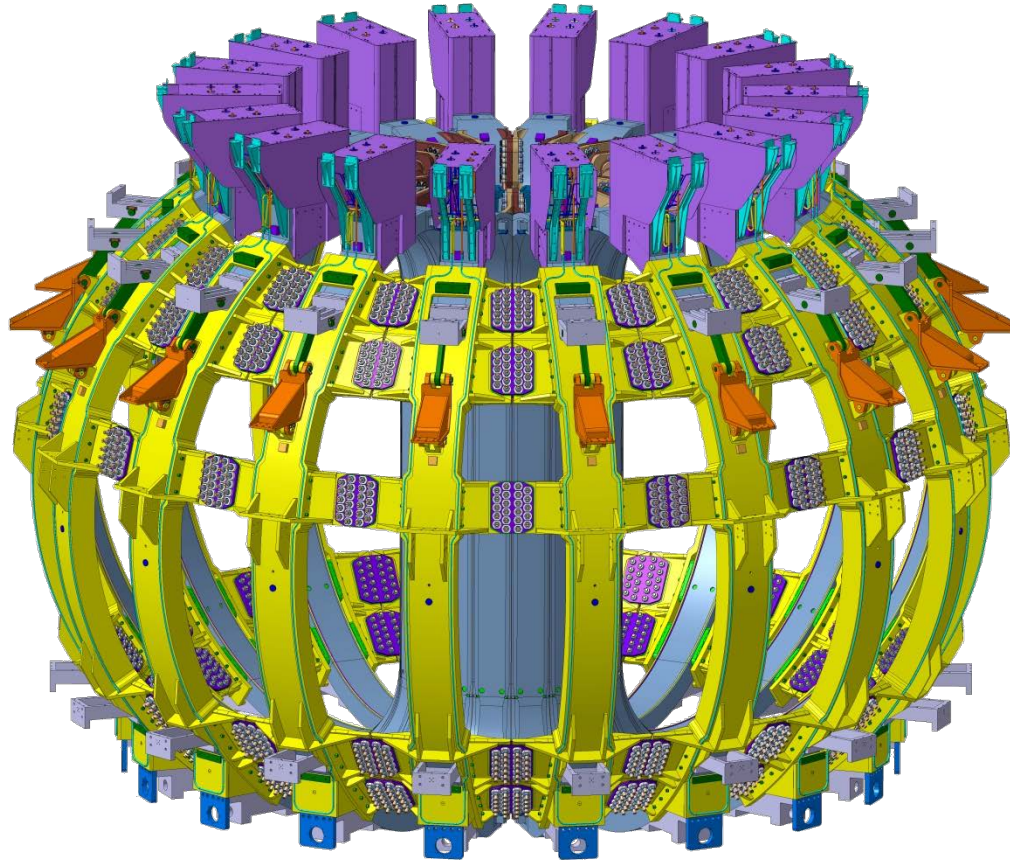
TF coil with Outer Intercoil Structure (OIS)



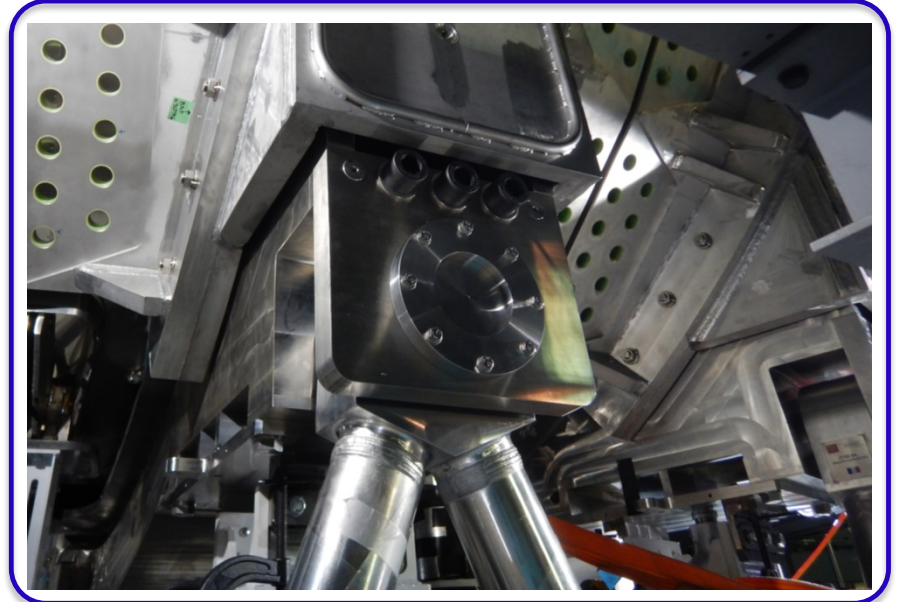
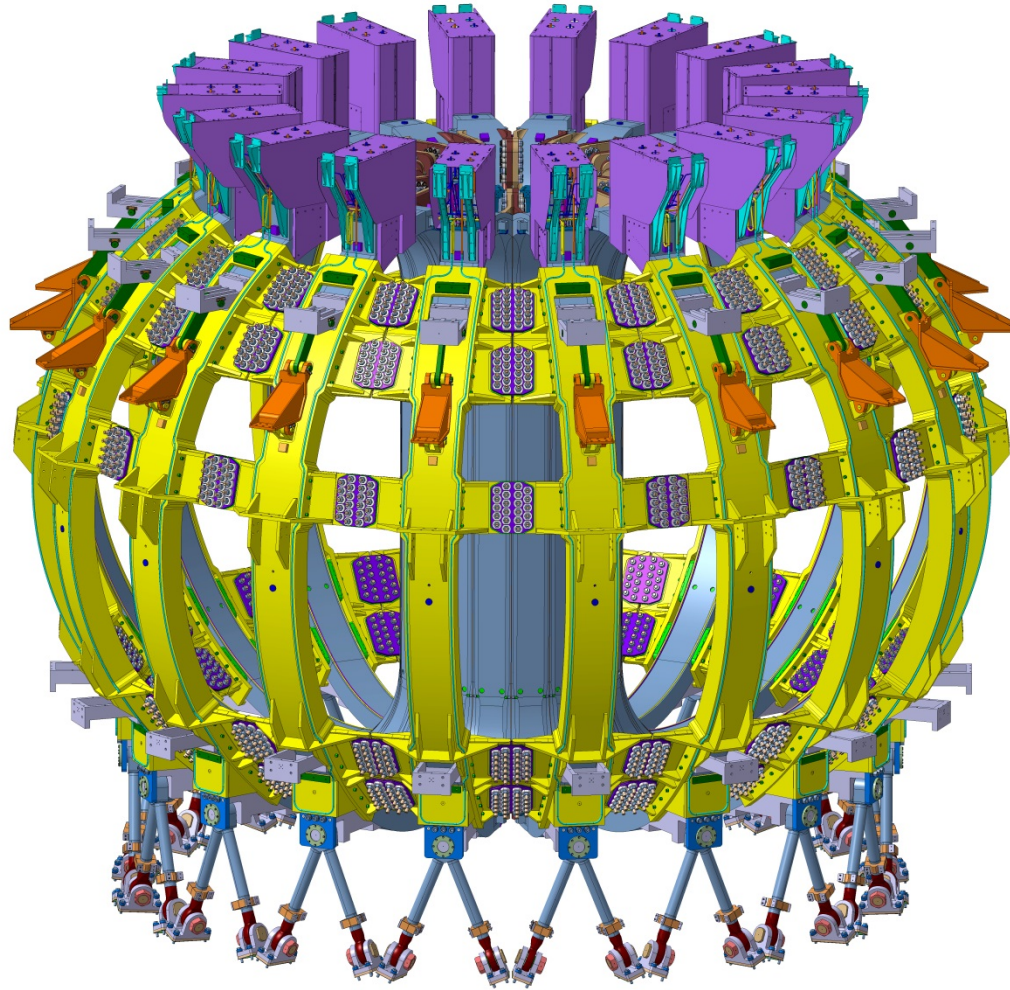
18 TF coils and OISs



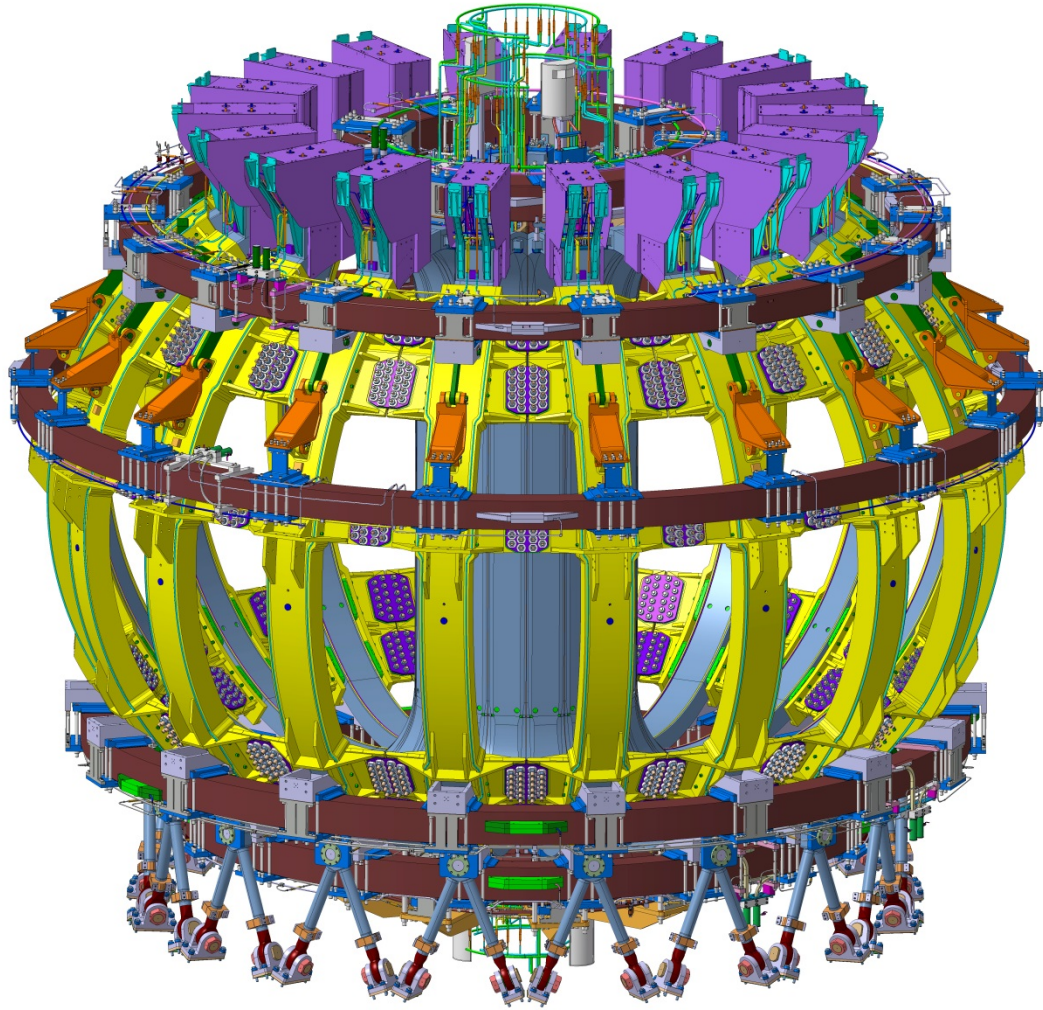
TF magnet with bolts and pins



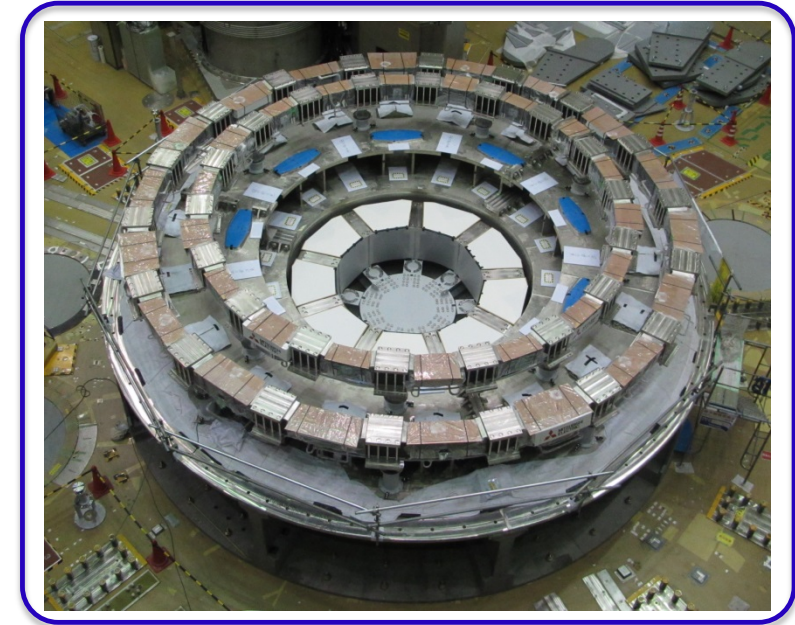
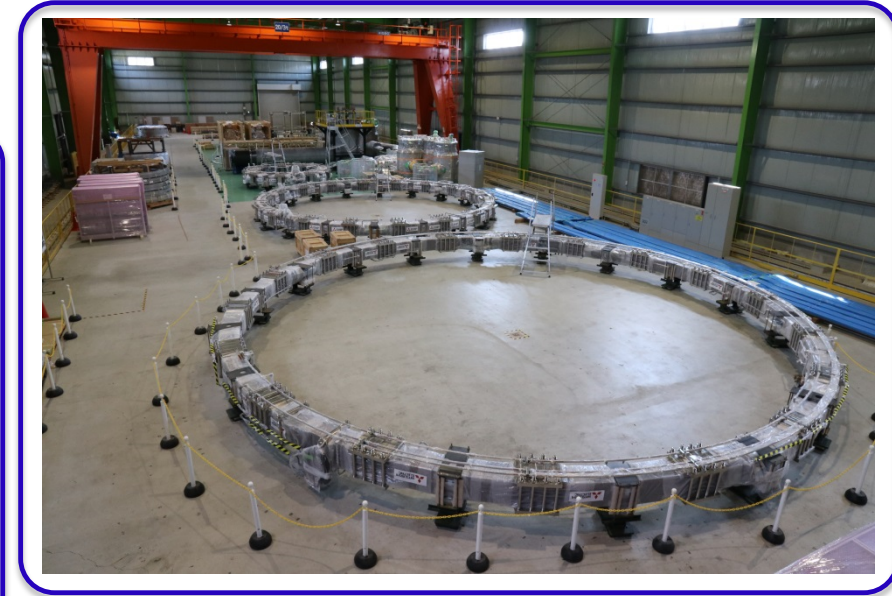
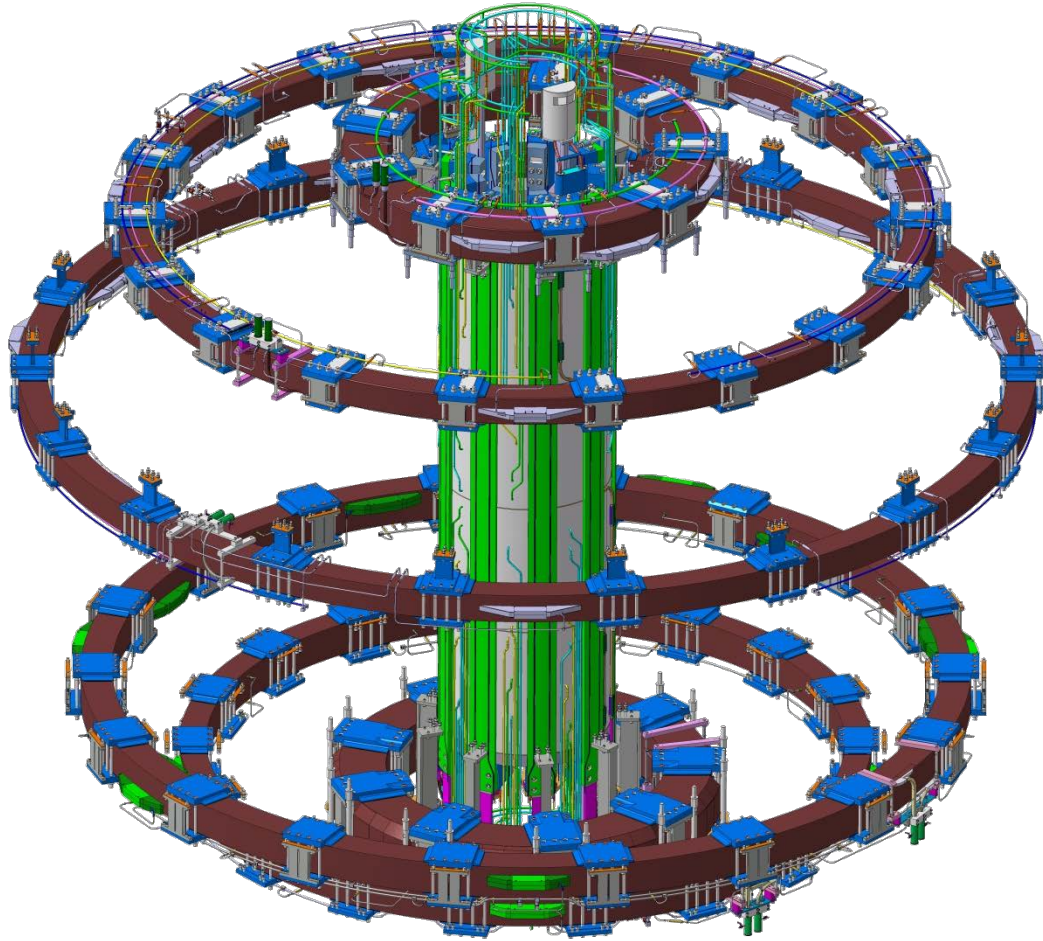
TF magnet with gravity supports



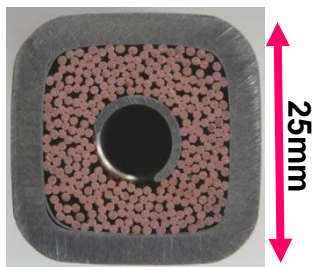
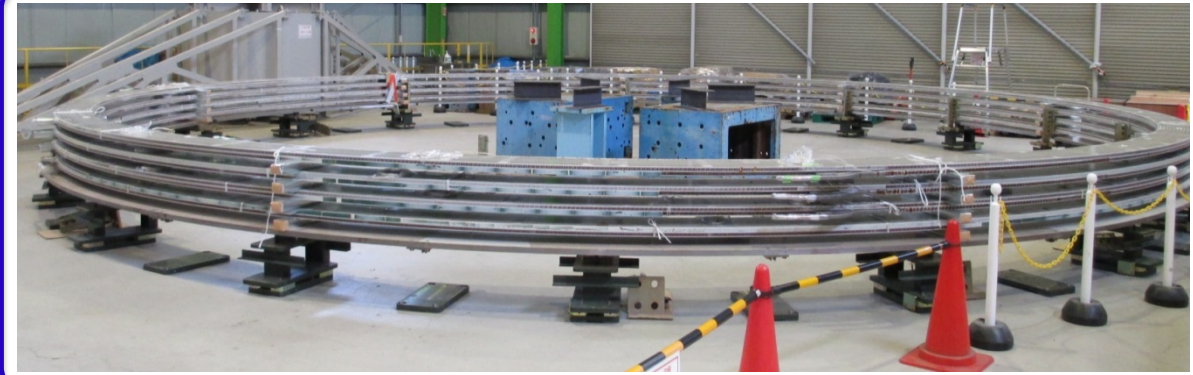
TF magnet with Equilibrium Field coils and Central Solenoid



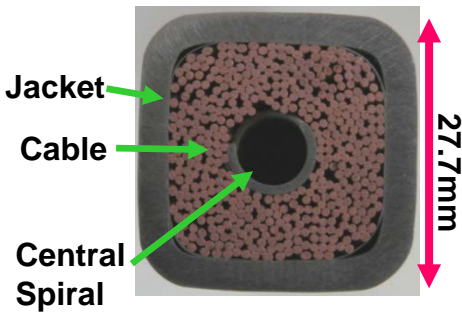
Equilibrium Field coils and Central Solenoid



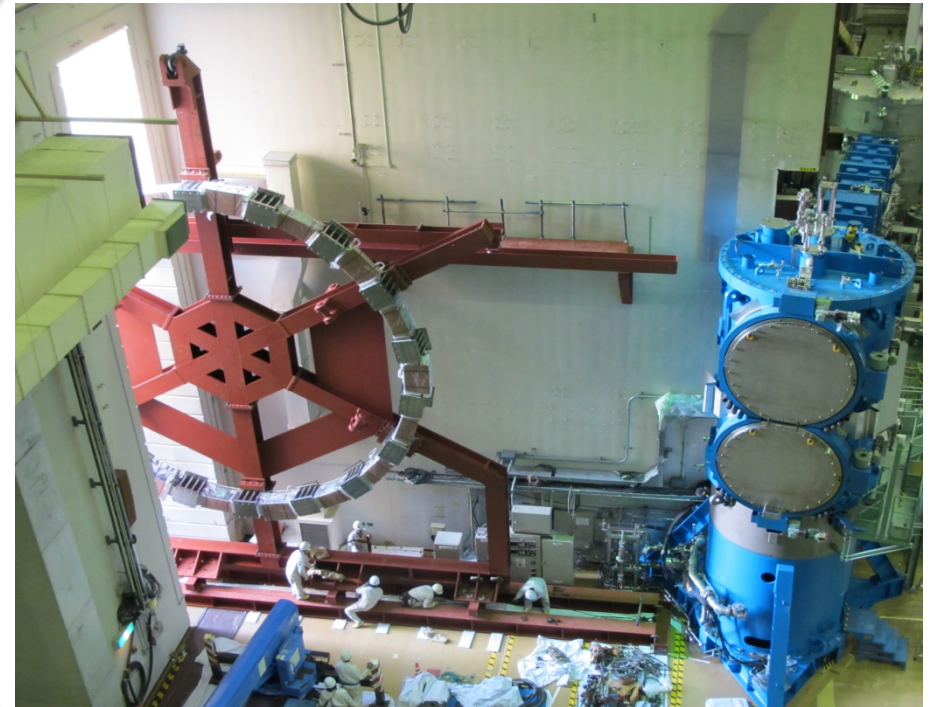
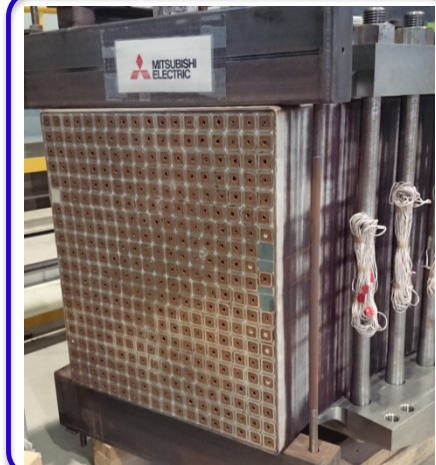
EF coil manufacturing and installation



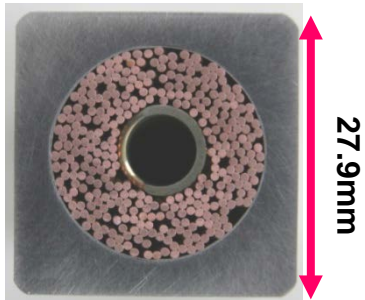
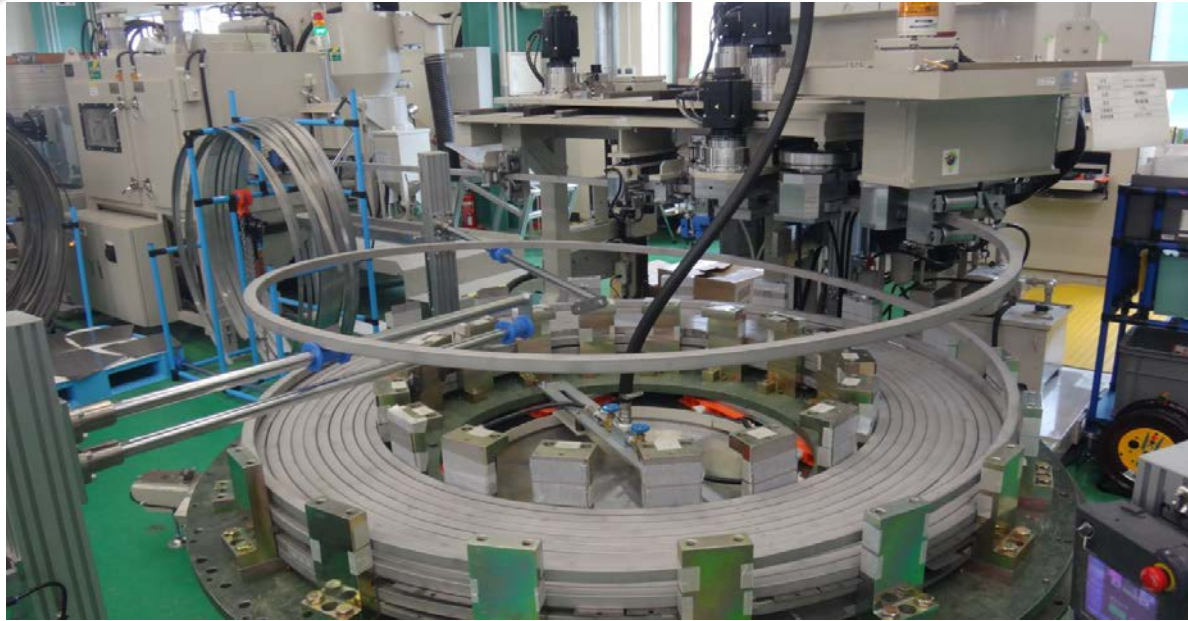
EF 1, 2, 5 & 6
NbTi, 20kA
Peak field 4.8T



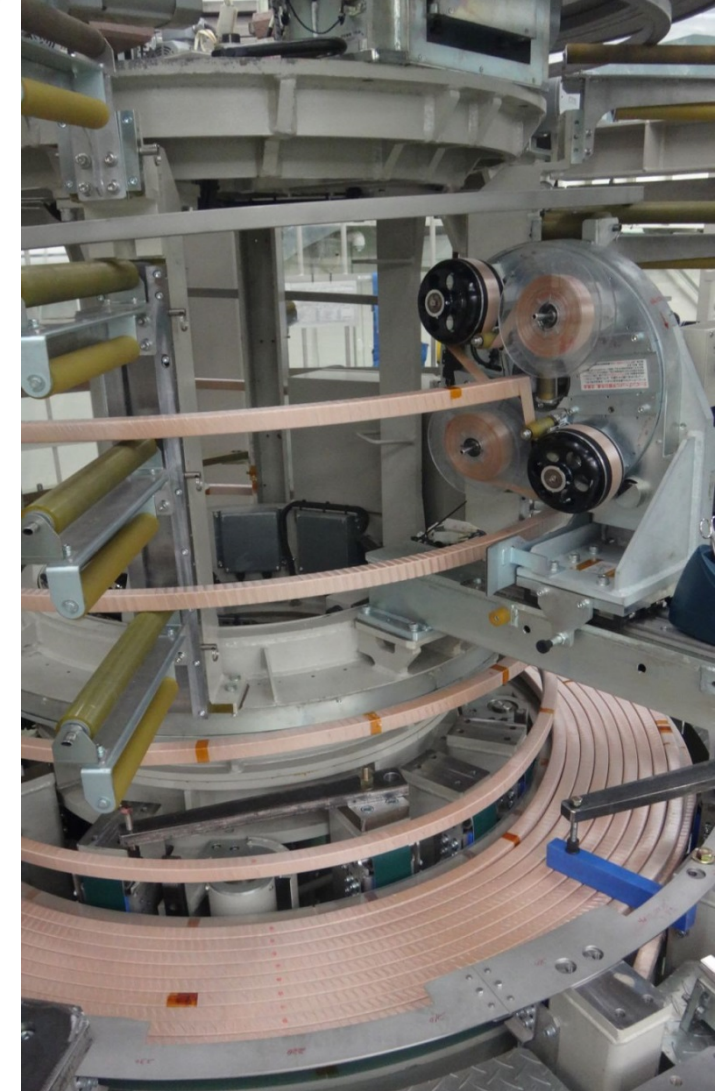
EF 3 & 4
NbTi, 20kA
Peak field 6.2T



CS manufacturing: wind & react

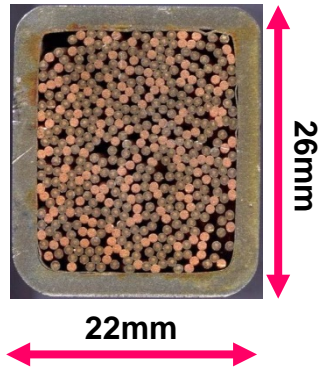
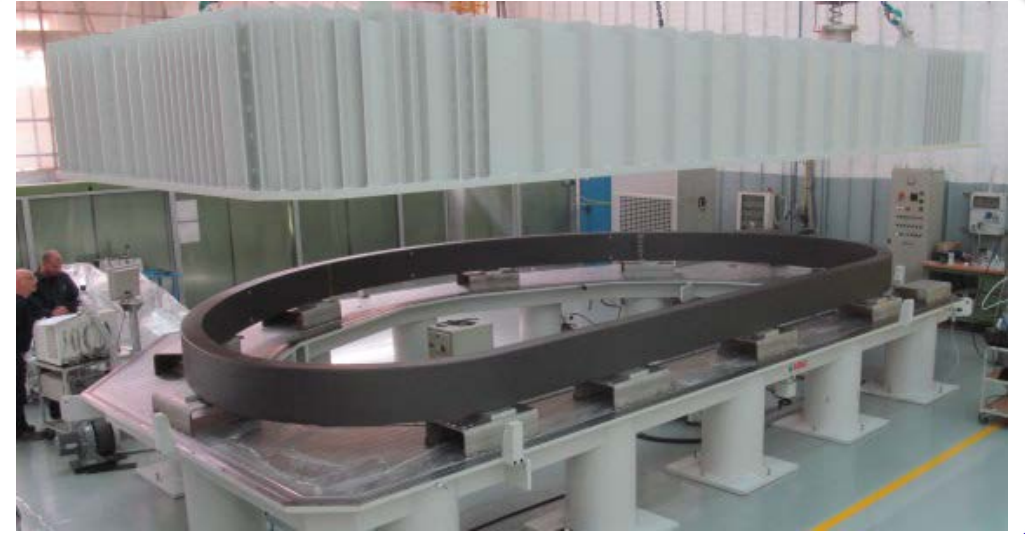
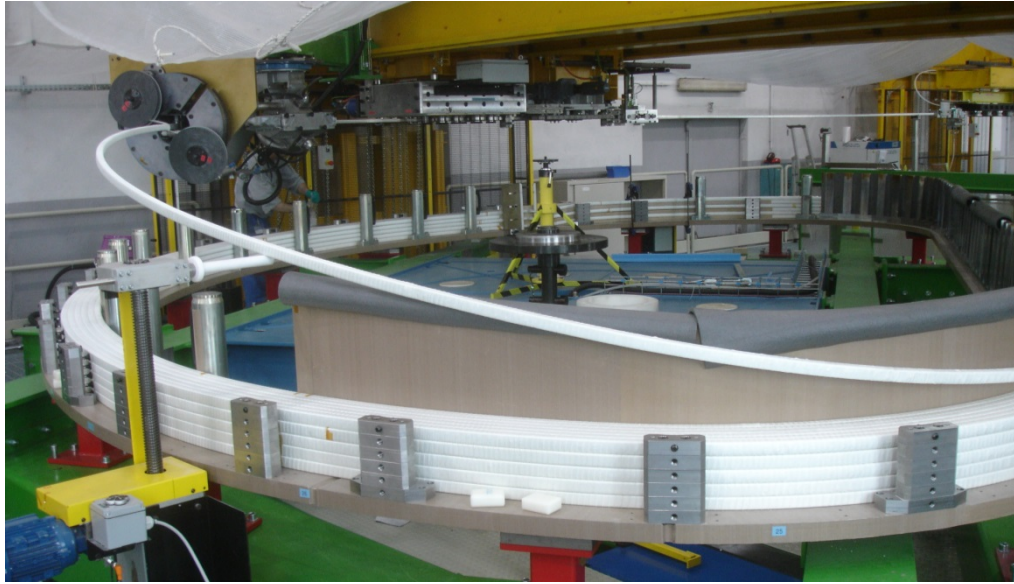


CS modules 1 - 4
Nb₃Sn, 20kA
Peak field 8.9T

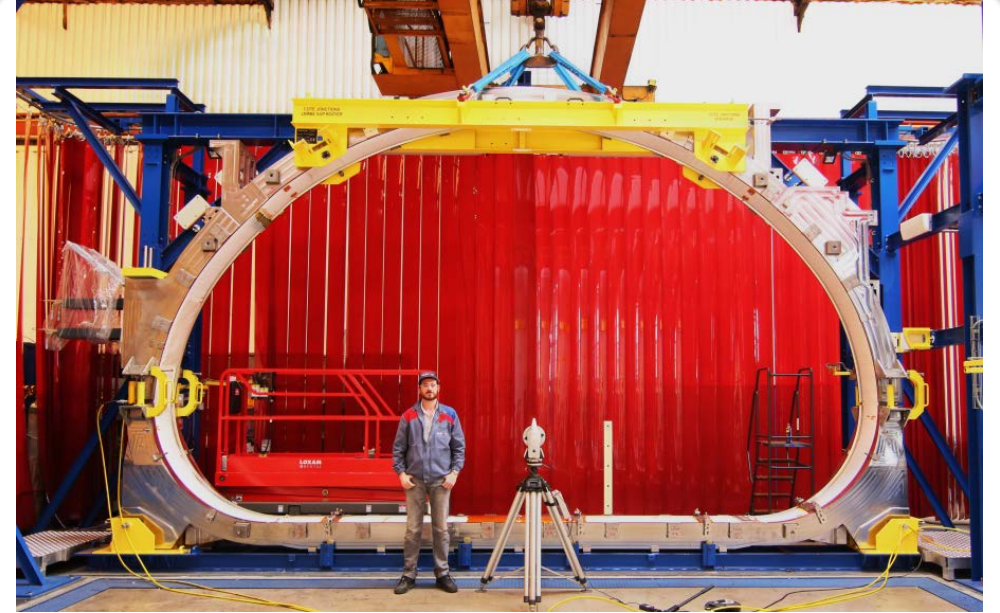




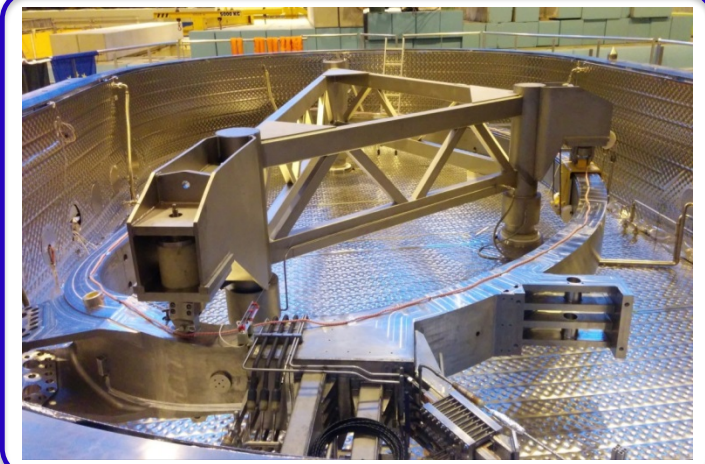
TF coil manufacturing



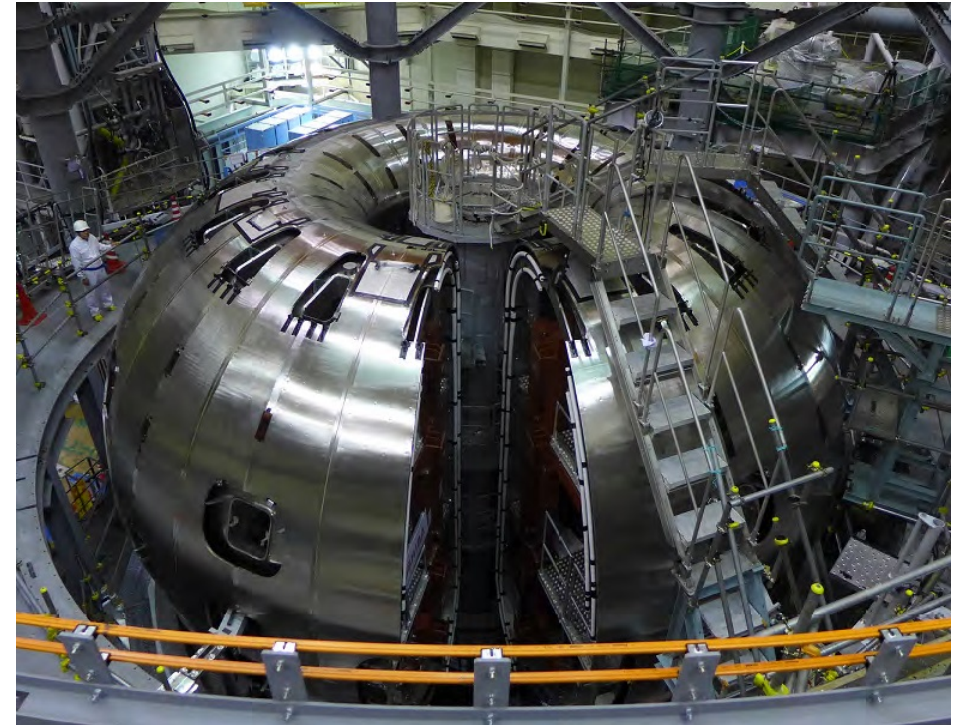
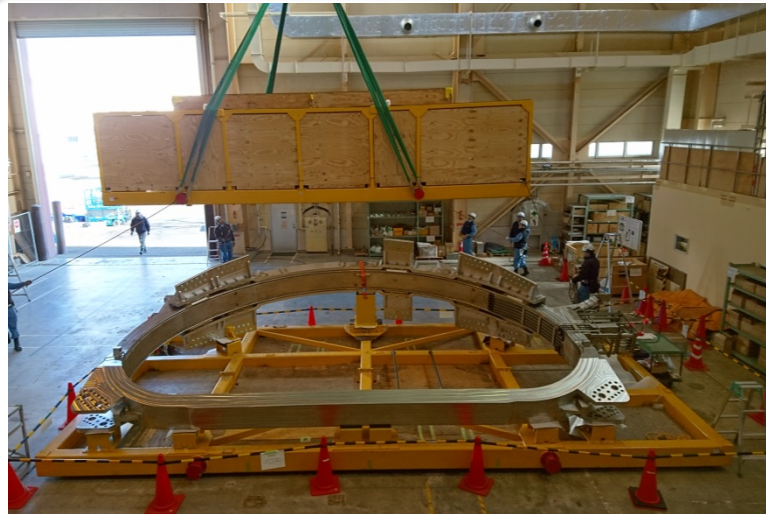
18 TF coils
NbTi, 25.7kA
Peak field 5.65T



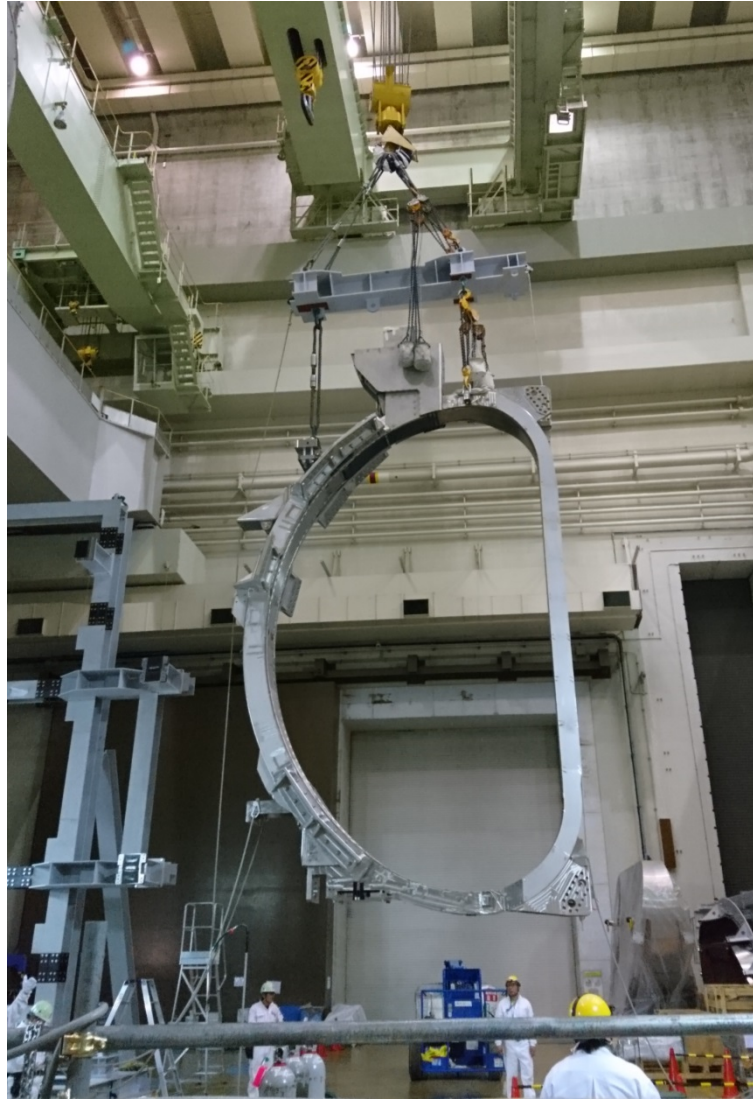
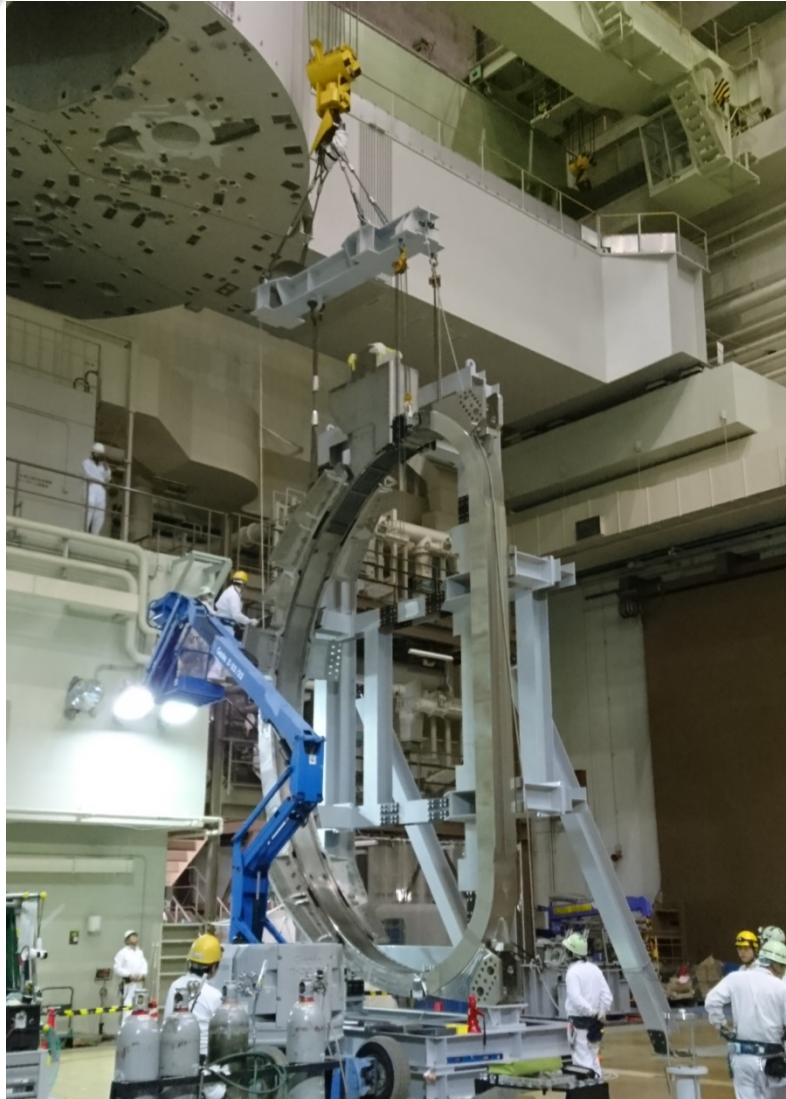
TF coil test facility



TF coil transport and assembly



TF magnet assembly



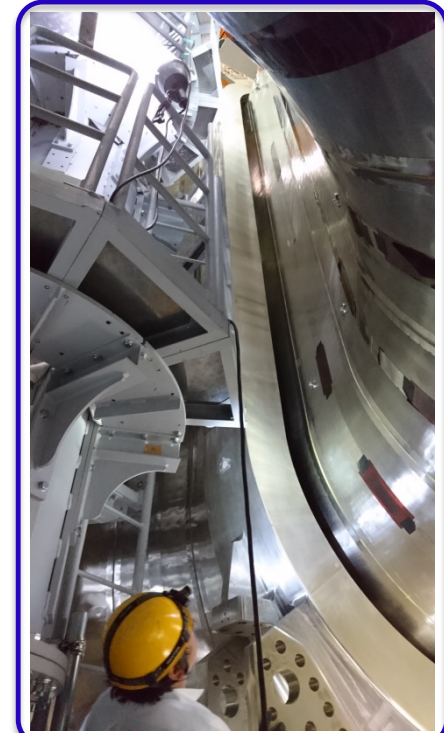
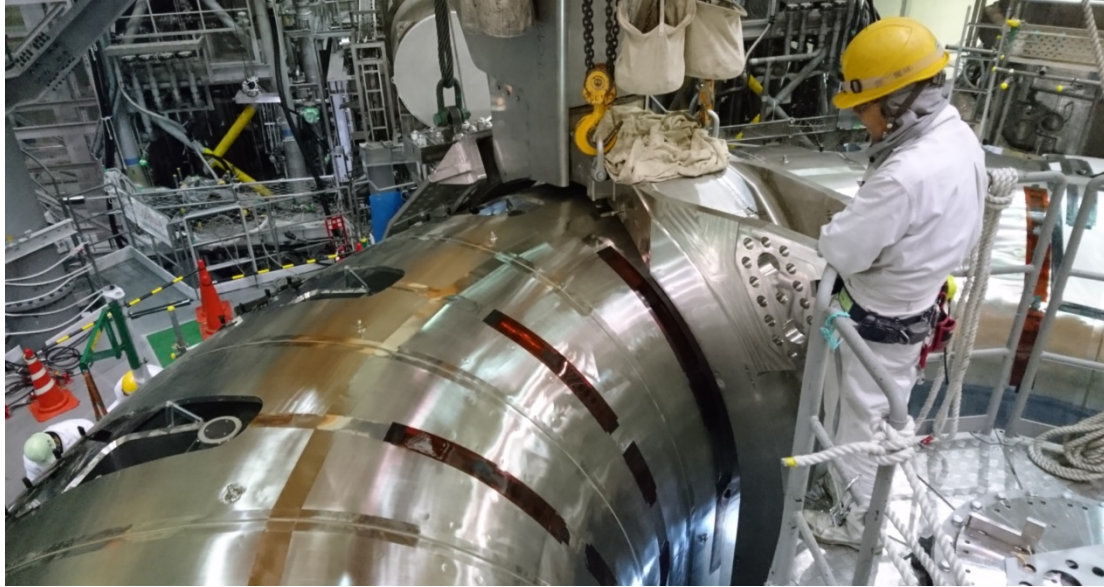
TF magnet assembly



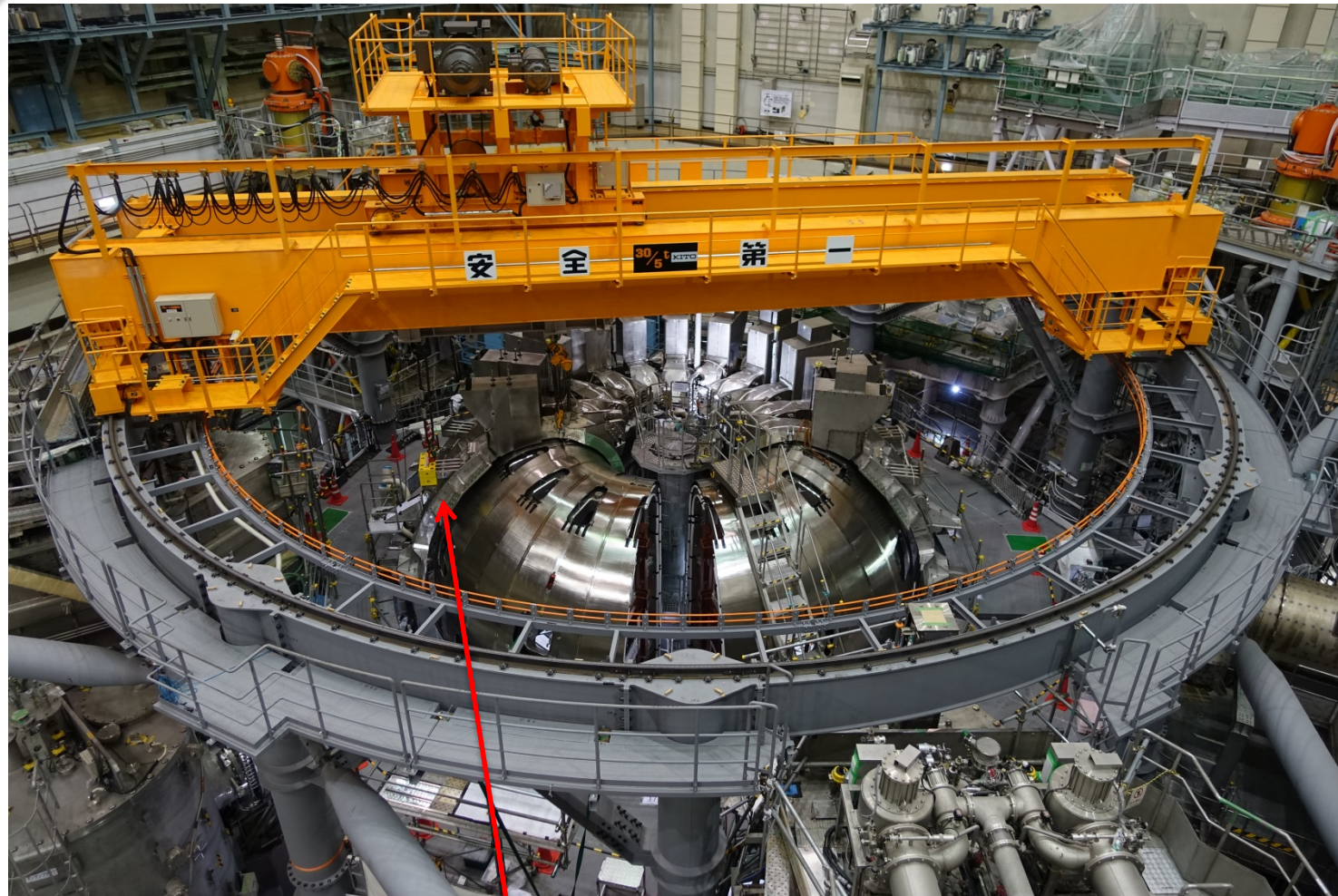
TF magnet assembly



TF magnet assembly

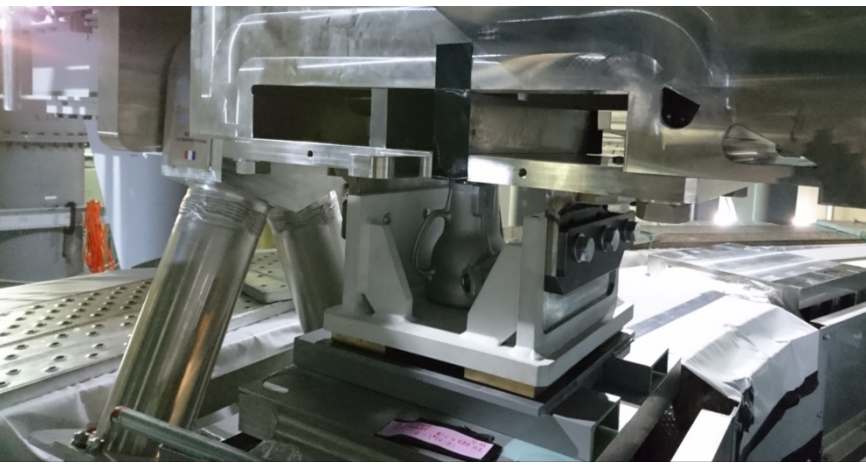
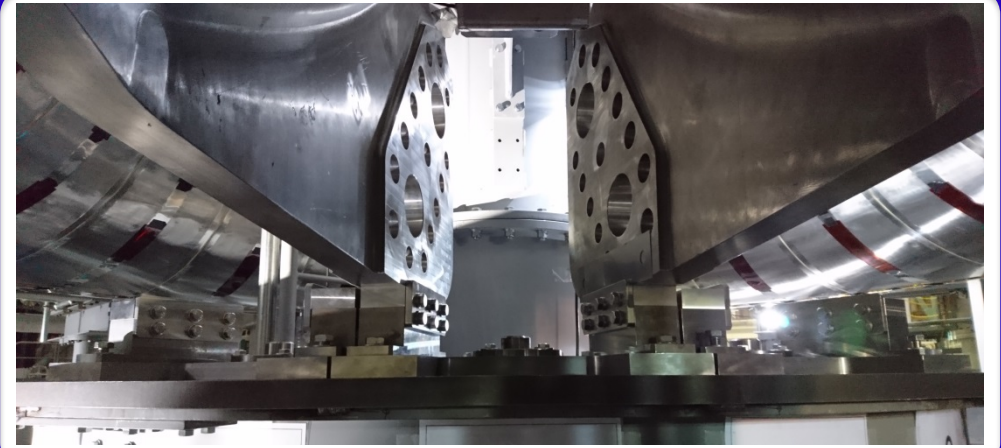
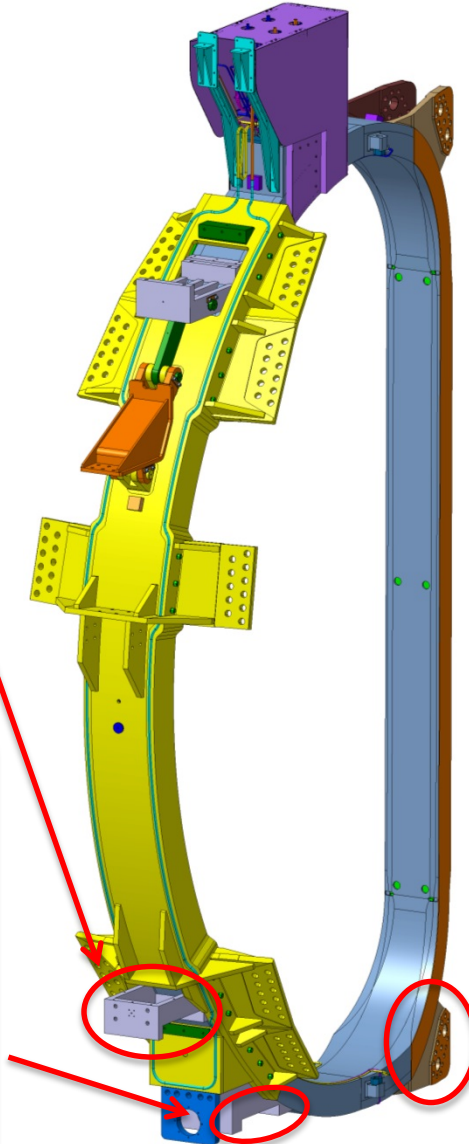


11 TF coils assembled so far

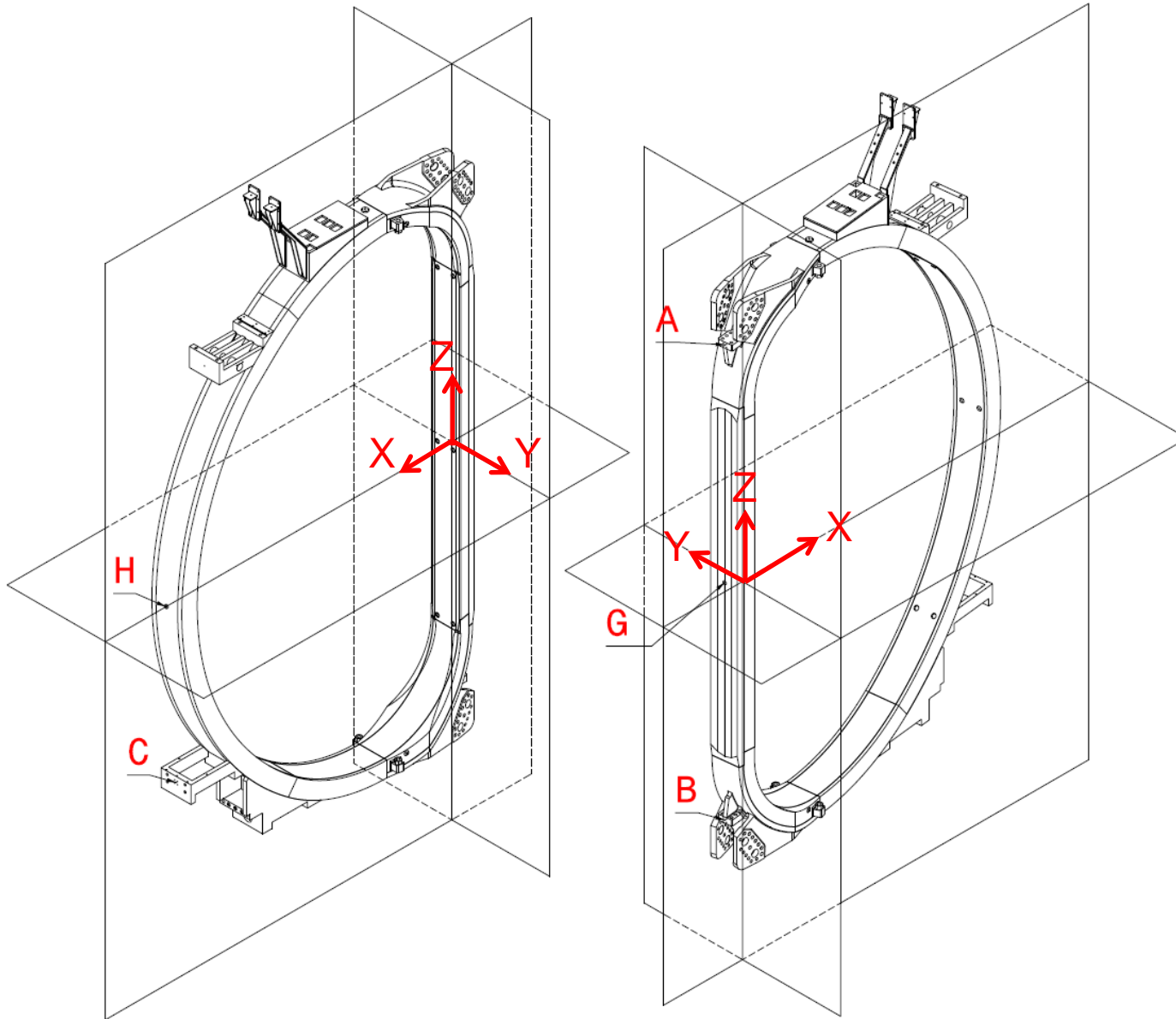


11th coil: "Yasuda"
8th coil: "Yasuda"
5th coil: "Eleonora"
1st coil: "Flora"
3rd coil: "Roberta"
4th coil: "Cécile"
6th coil: "Gisèle"
7th coil: "Emmanuelle"

TF coil positioning

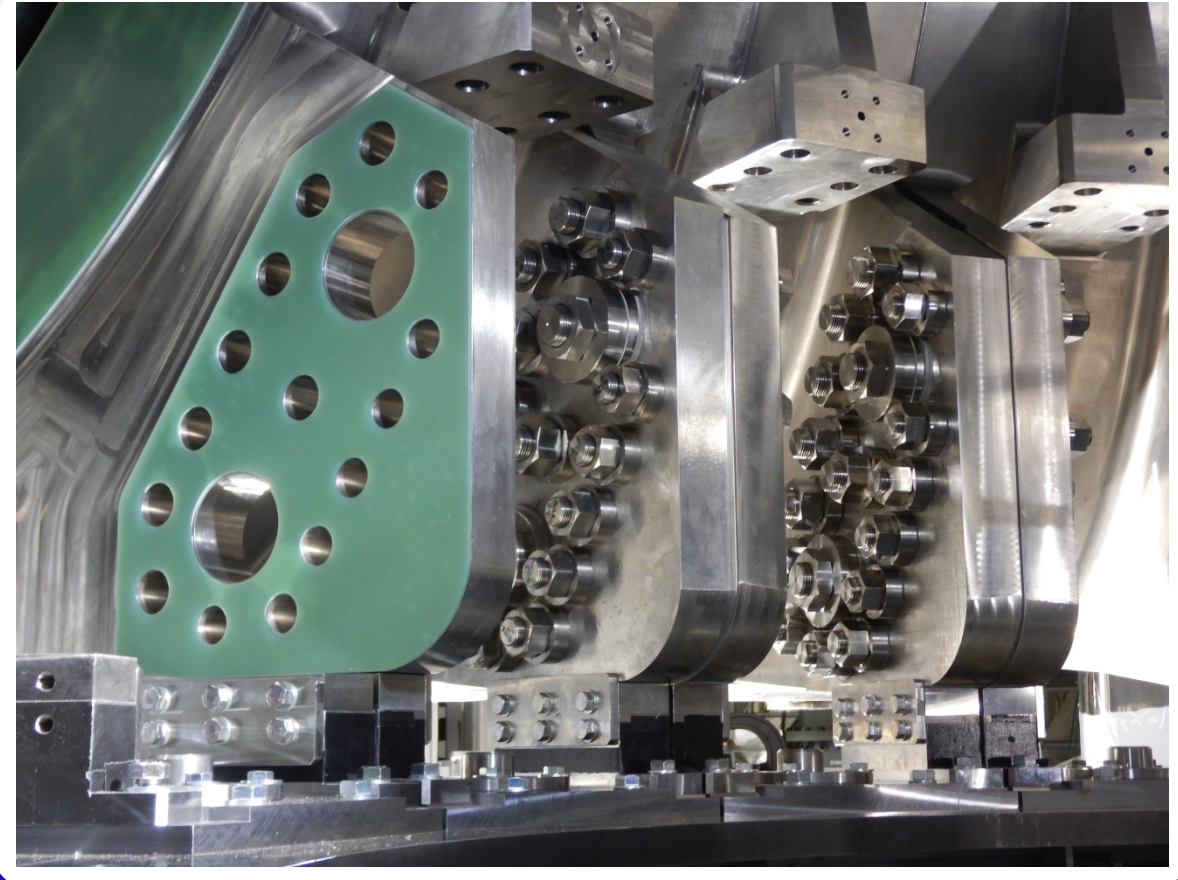


TF coil positioning

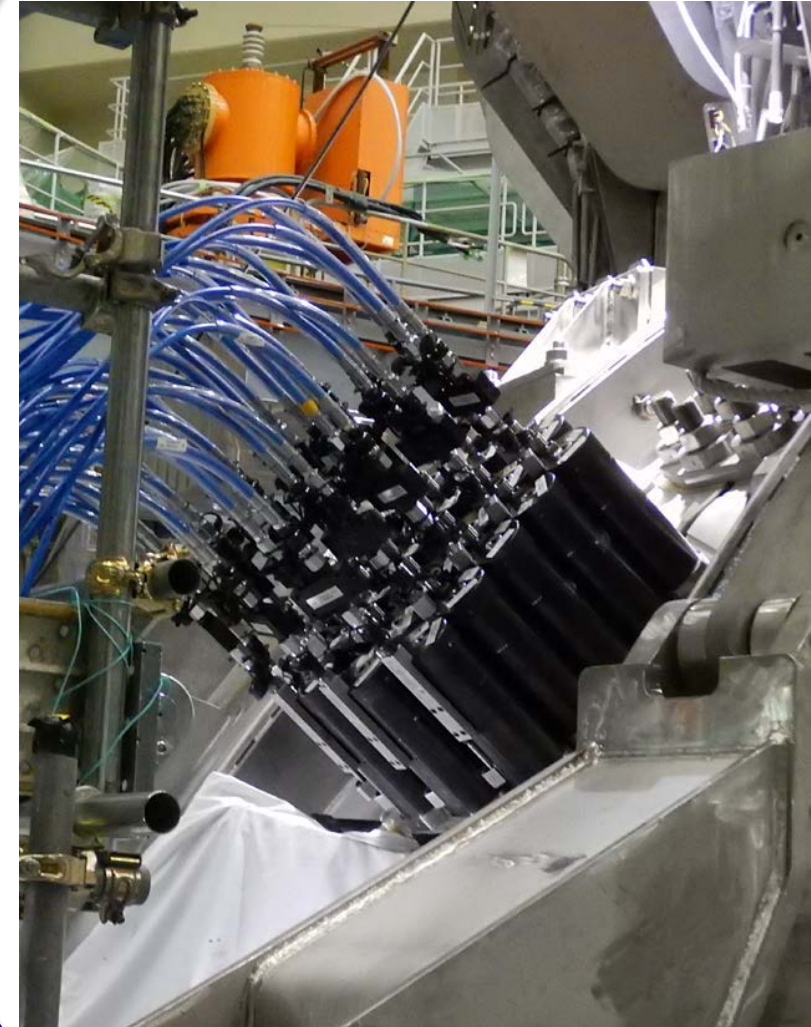
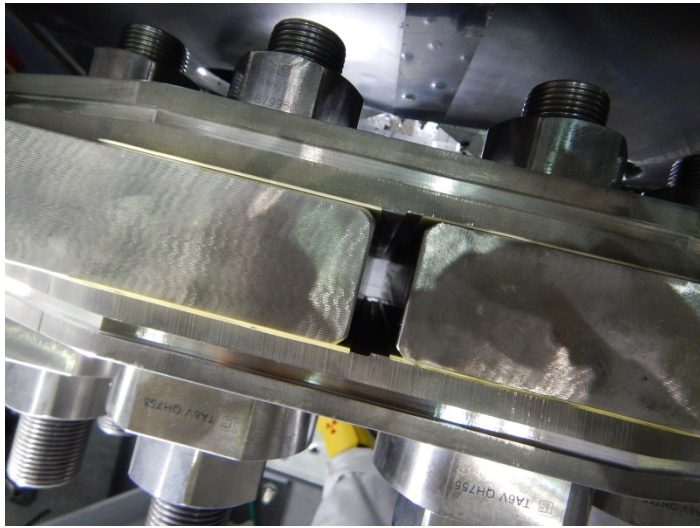


Casing tracking point		B	A	G	H	C
Coil position 3 (11th installed, no. 6)	x	0.1	-0.2	-1	2.3	1.1
	y	0.1	0.4	0	0.5	0.6
	z	0.8	0.9	0.5	1.4	1.6
Coil position 4 (9th installed, no. 5)	x	0.1	-0.1	-1.0	2.0	0.7
	y	-0.4	0.0	-0.3	0.7	0.5
	z	-0.1	0.1	0.1	0.6	0.9
Coil position 5 (7th installed, no. 14)	x	0.4	-0.6	-1.3	1.3	0.3
	y	-0.6	-0.5	-0.1	-0.3	-0.3
	z	0.3	0.2	0.1	1.5	1.6
Coil position 6 (4th installed, no. 3)	x	0.8	0.7	-0.3	2.4	1.2
	y	-0.2	0.8	0.3	0.1	0.0
	z	0.4	0.7	0.6	1.5	1.8
Coil position 7 (3rd installed, no. 1)	x	0.0	0.3	-0.4	1.8	0.3
	y	-0.4	0.4	-0.1	-0.4	0.3
	z	0.1	0.5	0.3	0.5	0.9
Coil position 8 (1st installed, no. 10)	x	0.5	0.5	-0.9	2.8	1.1
	y	0.0	0.6	0.0	-0.3	-0.4
	z	-0.4	0.5	0.1	0.9	1.3
Coil position 9 (2nd installed, no. 11)	x	0.2	0.4	-1.0	2.0	0.6
	y	0.1	0.2	0.0	0.2	-0.2
	z	0.2	0.2	0.1	0.5	0.6
Coil position 10 (5th installed, no. 12)	x	0.3	1.1	-0.8	2.8	1.1
	y	0.0	0.6	-0.1	-0.4	-0.2
	z	0.2	-0.4	0.5	0.8	1.0
Coil position 11 (6th installed, no. 13)	x	0.3	0.2	-1.2	2.1	0.8
	y	0.3	0.3	0.1	1.0	0.2
	z	1.0	0.4	0.5	1.3	1.7
Coil position 12 (8th installed, no. 4)	x	0.3	0.6	-0.2	2.1	0.8
	y	0.2	-0.1	0.2	-0.6	0.8
	z	0.5	0.7	0.6	1.4	1.3
Coil position 13 (10th installed, no. 15)	x	-0.1	0.1	-1.3	2.8	1.4
	y	0.6	0.4	-0.5	0.2	-0.1
	z	-0.9	0.5	0.8	1.0	1.1

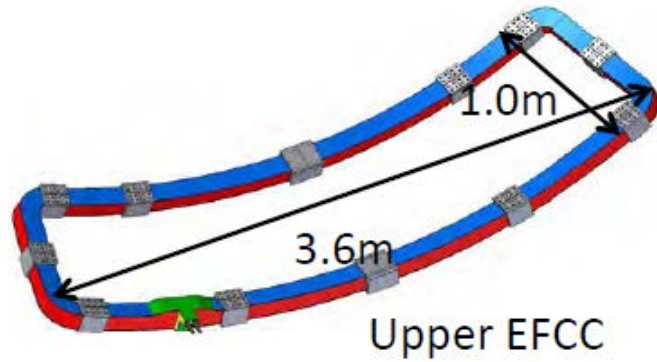
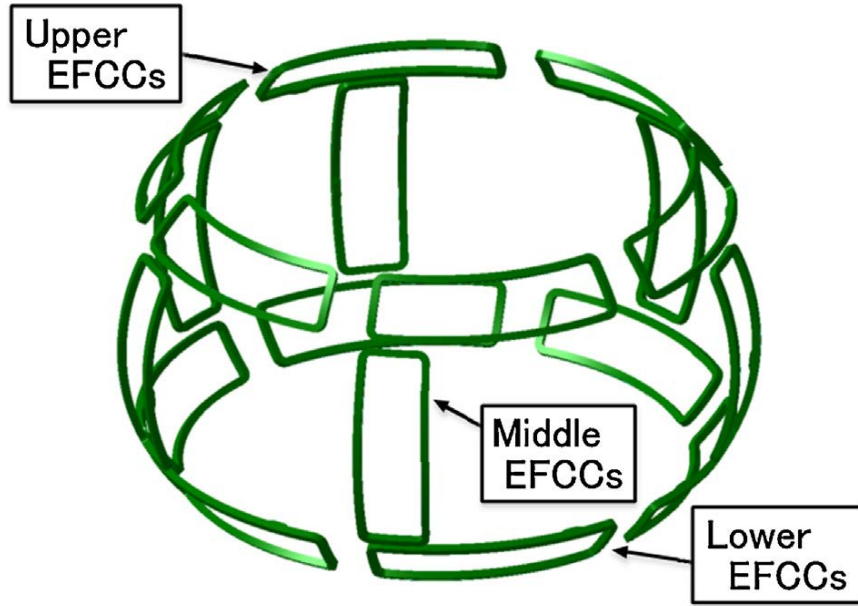
Inner Intercoil Structures (IIS)



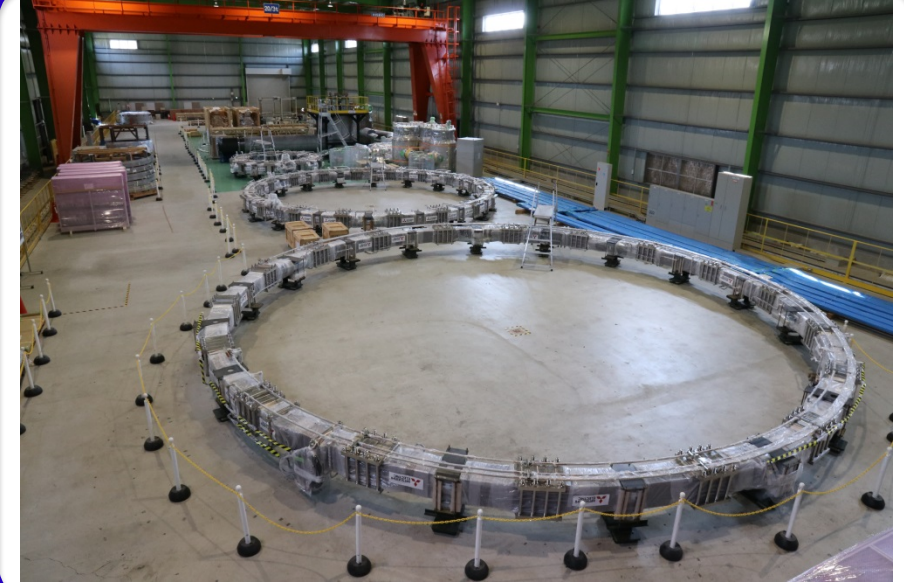
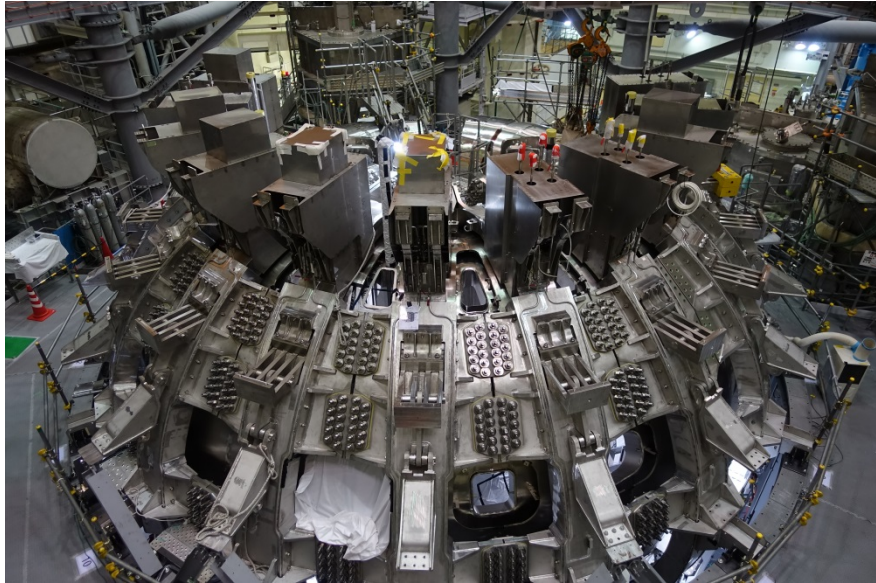
OIS splice plate installation



Error field correction coils



Conclusion



- Manufacturing of the equilibrium field coils and the error field correction coils is complete
- Manufacturing of the toroidal field coils and the central solenoid is well advanced.
- Assembly of the TF magnet is underway and will be completed in the first half of 2018.

See also in this conference

W. Abdel-Maksoud	Progress of the JT-60 SA Toroidal Field coils tests in the Cold Test Facility	Mon-Af-Or4
H. Murakami	Vacuum Pressure Impregnation for Central Solenoid of JT-60SA	
G. M. Polli	Completion of ENEA's procurement for 9 TF coils of JT-60SA tokamak	
R. Heller	Overview of JT-60SA HTS current lead manufacture and testing	Mon-Af-Po1.09
F. Bonne	Dynamical Cryodistribution Model of the JT-60SA Toroidal Field Coil in Cold Test Facility	Tue-Af-Po2.03
D. Ciazynski	Analyses of early quench development in JT-60SA toroidal field coils tested in the cold test facility	
S. Fujiyama	Evaluation of Voltage between Conductors for Resonance Phenomenon and Transient Response in JT-60SA Central Solenoid	
P. Decool	Completion of the French JT-60SA Toroidal Field Magnet Contribution	Wed-Af-Po3.02
S. Nicollet	Parametric analyses of JT-60SA TF coil in cold test facility with SUPERMAGNET code	Thu-Af-Po4.02
V. Tomarchio	On a full 3D thermal structural Finite Element Model of the JT-60SA toroidal field coils	
Y. Huang	Numerical modelling of the quench propagation phase in the JT-60SA TF coils tested in CTF	