

Manufacturing of Superconducting Magnet

Superconducting Detector Magnet Workshop 2022

2022/09/13

MITSUBISHI ELECTRIC CORPORATION

ENERGY SYSTEMS CENTER

Nuclear Power Department

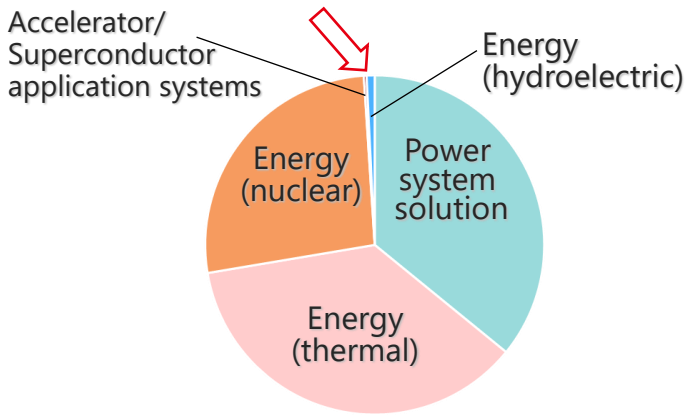
Radiation Monitoring Instrumentation Section

Hiroyuki Horii

- 1 What is MITSUBISHI ELECTRIC?
- 2 Topics of Superconducting magnets and coils
- 3 Continuous automatic winding CICC
- 4 Summary

Energy Systems Center(ESC)

Sales ratio by business field



ESC

Nagasaki

- ▶ Electrical Motor



Kobe

- ▶ Plant Engineering
- ▶ Generator (Thermal, Hydro, Nuclear)
- ▶ Instrument & Control System
- ▶ Electrical grid control & monitoring system
- ▶ Accelerator/Superconductor application



Yokohama

- ▶ Power information & communication system



Pick up several types of SC-magnets and coils

NbTi

(a) SC Combined Function Magnet For Neutrino beam line @J-PARC



◆ Rutherford cable

(b) Final focus SC Magnet, QCS-L/R @SuperKEKB

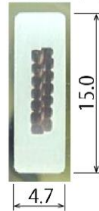


◆ Rutherford cable SC monolith

(c) Pion Capture Solenoid @COMET



CS Cold mass

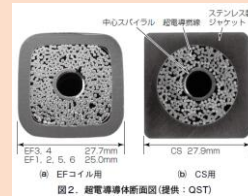


(d) VENUS@TRISTAN



◆ Al-stabilized conductor

(d) EF1~EF6 @JT-60SA



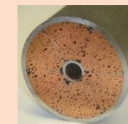
◆ CIC (Cable-in-Conduit) conductor

Nb3Sn

(e) CS @JT-60SA



(f) TF WP @ITER



For Fusion



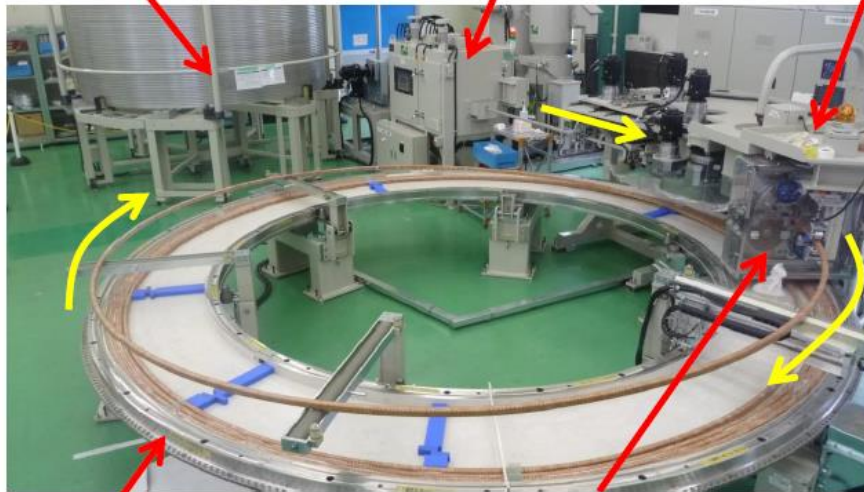
ITER/BA 成果報告会 2016

3. Manufacturing Techniques

3-3. Continuous automatic winding

We developed the winding simulation code, which sets parameters of the devices for the designed winding configuration.

Uncoiler
(Straightening of the supplied conductor)
Blast device
(Surface roughening)
Winding head
(Bending)



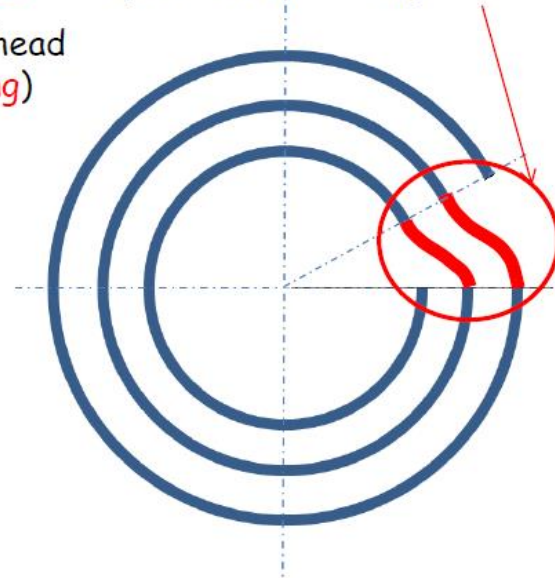
Cure vessel

Taping head
(Wrapping of insulation tape)

Winding device for EF coils
(Photo: EF4 winding in 2009)

Prepreg tape, previously impregnated with resin

Turn transition area:
where a turn shifts to a next turn
(out -> in, in -> out)



Continuous winding in constant R and turn transition areas is MELCO's specialty.
(JT-60SA EF/CS, ITER TF)

Summary

- Mitsubishi Electric manufactures SC-magnets and SC-coils from 1980's

For example,

SC-Combined Function magnets for Neutrino Beam Line at J-PARC

Final Focus SC-magnets, QCS-R/L, for SuperKEKB

Pion Capture Solenoid for COMET (just going)

Poloidal Field SC-coils, EF and CS, for JT-60SA

Winding Pack of Toroidal Field coils for ITER

- Mitsubishi Electric have developed Continuous automatic winding CICC techniques

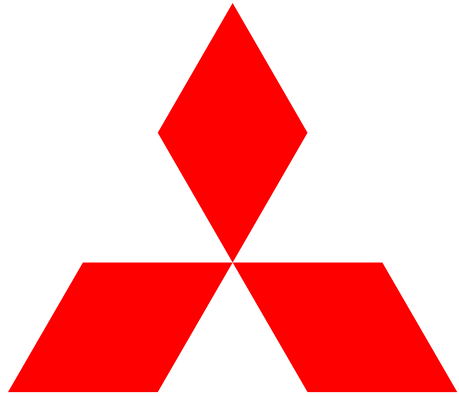
If you interest, check the following.

["https://www.giho.mitsubishielectric.co.jp/giho/pdf/2019/1911113.pdf"](https://www.giho.mitsubishielectric.co.jp/giho/pdf/2019/1911113.pdf)

(written in Japanese only, sorry)

Thank you for your attention

Question or Comment, Please !



**MITSUBISHI
ELECTRIC**

Changes for the Better