Technology Development of Superconducting Magnet

Akira Ozaki
Nuclear Energy Systems & Services Division
Toshiba Corporation

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Magnet session
Toshiba’s Nuclear Activities

- Nuclear Plants Construction
- Maintenance & Services
- Nuclear Fuel Cycle
- Hydrogen Production/Accelerator applications
- Fast Reactor/Next Generation Reactor
- Nuclear Fusion
- Uranium/Fuel Manufacturing

BWR: ABWR
PWR: AP1000™

Developing Fusion as Energy System in Future

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SC Magnet for Fusion

- **CS Model Coil**
  - Conductor: Nb3Sn
  - Max. Field: 13T
  - Stored Energy: 640MJ

- **LHD Poloidal Coil**
  - Conductor: NbTi
  - Outer Dia.: 11m (OV coil)
  - Stored Energy: 251MJ

- **R&D for ITER TF coil**
  - Full scale Radial Plate
  - 1/3 scale Double Pancake
  - Coil Case segment

Images: Courtesy of Japan Atomic Energy Agency and National Institute for Fusion Science
SC Magnet for Accelerator

**ATLAS Central Solenoid**
- Inner Dia./Length: 2.5m/5.3m
- Field (at axis): 2T
- Conductor: NbTi/Cu/Al

**MQX**
- Inner Dia./Length: 70mm/6.6m
- Max. Field: 8.6T
- Conductor: NbTi
- Error field: <10^{-4}

Images: Courtesy of High Energy Accelerator Research Organization (KEK)
SC Magnet for Industry Application

- Magnets for single crystal silicon production

Field (at furnace center) 0.4-0.5 T
Conductor NbTi

![Diagram of SC Magnet for Industry Application](image)
Developing HTSC technology

Manufacturing Technology for YBCO coil
TOSHIBA has developed an auto-winding technology for 3D shape YBCO coil with high accuracy of winding position (<0.1mm)

Numerically controlled winding machine

Saddle-shaped YBCO coil for bending magnet of heavy ion radiotherapy
Issues in skill development & transfer

- Based On the real Job Training.
  - Continuing development is desirable
  - Fusion project is like a pulse load
  - Looking for various opportunities including accelerator, government R&D project, in-house R&D, etc.

- Superconducting magnet system is comprehensive technology.
  - Variety of skillsets are necessary; mechanical, electrical, material, cryogenic, ...
Thank you!