International School on Fusion Reactors Technology

Name of the Course: Fundamentals of Magnetic Confinement Fusion Design (tbc)
Director of the School: Antonino Zichichi (Ettore Majorana Center)
Directors of the Course: Matteo Barbarino (IAEA), P. Batistoni (ENEA)

Dates: 7-12 June 2026

Sponsors: IAEA, ENEA, and other international partners
Location: Ettore Majorana Foundation and Centre for Scientific Culture, Erice, Italy
Expected Participants: 30
Registration Fee: TBD

Course Description

The International School on Fusion Reactors Technology provides a unique, advanced-level training program in fusion energy. This course integrates physics, cutting-edge technology, and engineering practices essential for the realization of fusion power plants. Participants will explore interdisciplinary approaches, addressing the challenges of plasma physics, magnetic confinement, material science, and power plant integration.

A particular emphasis is placed on understanding the intricate relationship between magnetic fields and machine size, a pivotal aspect of magnetic confinement fusion design. The curriculum delves into how magnets technology can influence engineering strategies and material selection, shaping the overall design of fusion power plants. Through lectures, interactive workshops, and case studies, participants will gain comprehensive insights into the future of fusion energy development.

Key focus areas include:

- Integration of plasma physics, materials science, and engineering principles.
- Magnetic field strength, scalability, and size in tokamaks.
- Tritium management and self-sufficiency strategies.
- Advances in divertor technology and power exhaust solutions.
- Regulatory, safety, and environmental considerations for commercialization.

Day 0 – Sunday, 7 June

Registration of participants, and coordination meetings with school directors, organizers and faculty

Day 1 – Monday, 8 June

08:00–09:00 – Breakfast

09:00–10:30 – Opening Session

- Welcome by Ettore Majorana Center
- Welcome by IAEA
- Welcome by ENEA (A. Dodaro)
- Welcome by School Directors (P. Batistoni, M. Barbarino, L. Zichichi)
- Introduction of faculty and participants (All)
- Overview of the School objectives and structure (P. Batistoni)

10:30–11:00 – Coffee Break

11:00–12:30 – Introduction to Fusion Energy

- The role of fusion in the global electricity outlook (M. Barbarino) (c)
- Historical progress and current technological landscape (H. Zohm) (c)

12:30–14:00 – Lunch

14:00–15:30 – Introduction to Fusion Energy (cont.)

- Enabling technologies for fusion and the EU fusion development strategy (G. Federici) (c)

15:30–16:00 – Coffee Break

16:00–17:30 – Roundtable

Fusion state of play
(M. Barbarino with P. Batistoni, G. Federici, J. Li, H. Zohm) (c)

20:00–22:00 – Welcome Dinner

Day 2 – Tuesday, 9 June

08:00–09:00 – Breakfast

09:00–10:30 – Plasma Physics, Magnetic Fields and Machine Size

- Tokamak operation basics, plasma stability, beta limits, magnetic fields (H. Zohm) (c)
- Field strength vs. power density, structural and thermal constraints, case studies BEST/CFEDR (J. Li) (c, virtual)

10:30–11:00 – Coffee Break

11:00–12:30 – Plasma Physics, Magnetic Fields and Machine Size (cont.)

- Stellarator operation basics, plasma stability, beta limits, magnetic fields (tbd, Renaissance Fusion) (c)
- Materials for magnets, scalability and industrialization (L. Muzzi) (c)

12:30–14:00 – Lunch

14:00–15:30 – Discussion Session

High-field vs. large-volume design philosophies
(P. Batistoni with L. Muzzi, H. Zohm) (c)

15:30–16:00 – Coffee Break

16:00–17:30 – Student Presentations (short talks)

Evening: Free time

Day 3 – Wednesday, 10 June

08:00–09:00 – Breakfast

09:00–10:30 – Power Exhaust and Divertor Technology

- Heat flux management challenges, scenarios development (M. Wischmeier) (c)
- Case study DTT (G. Polli) (c)

10:30–11:00 – Coffee Break

11:00–12:30 – Fusion Neutronics and Engineering

- Neutronics and nuclear aspects (R. Villari) (c)
- Neutronics tools and workflows (L. Packer) (c)

12:30–14:00 – Lunch

Afternoon: Free time

Day 4 – Thursday, 11 June

08:00–09:00 – Breakfast

09:00–10:30 – Extended Fuel Cycle Engineering

- Fuel cycle architecture, blanket integration, systems engineering (C. Day) (c)
- Breeding blanket case study (A. Spagnuolo) (c)

10:30–11:00 – Coffee Break

11:00–12:30 – Materials and Engineering

- Thermo-hydraulics and thermo-dynamics of reactor components (P.A. Di Maio) (c)
- Materials (C. Linsmeier) (tbc)

12:30–14:00 – Lunch

14:00–15:30 – Techno-Economic and Engineering Readiness

- Validation and qualification of components (C. Day) (c)
- Scaling, supply chain, grid integration (F. Ferrazza) (c)

15:30–16:00 – Coffee Break

16:00–17:30 – Discussion Session

Closing the gaps on fusion technology R&D
(P. Batistoni with C. Day, F. Ferrazza, A. Spagnuolo, R. Villari) (c)

20:00–22:00 – School Banquet

Day 5 – Friday, 12 June

08:00–09:00 – Breakfast

09:00–10:30 – Safety, Regulation and Waste Considerations

- Safety and regulation (B. Colling) (c)
- Environmental impacts, waste strategies (S. Diem) (c)

10:30–11:00 – Coffee Break

11:00–12:30 – Roundtable

Preparing the next generation of fusion workforce
(D. Cruz with P. Batistoni, B. Colling, S. Diem, F. Ferrazza) (c)

12:30–14:00 – Lunch

14:00–15:00 Closing Lecture

- ITER (tbc)

15:00–15:30 – Closing Remarks & Certificate Ceremony

16:00: Departures