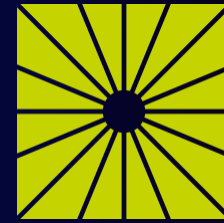


STEP



FUSION
CDT

HTS CABLES AND FUSION MAGNETS

STUART WIMBUSH

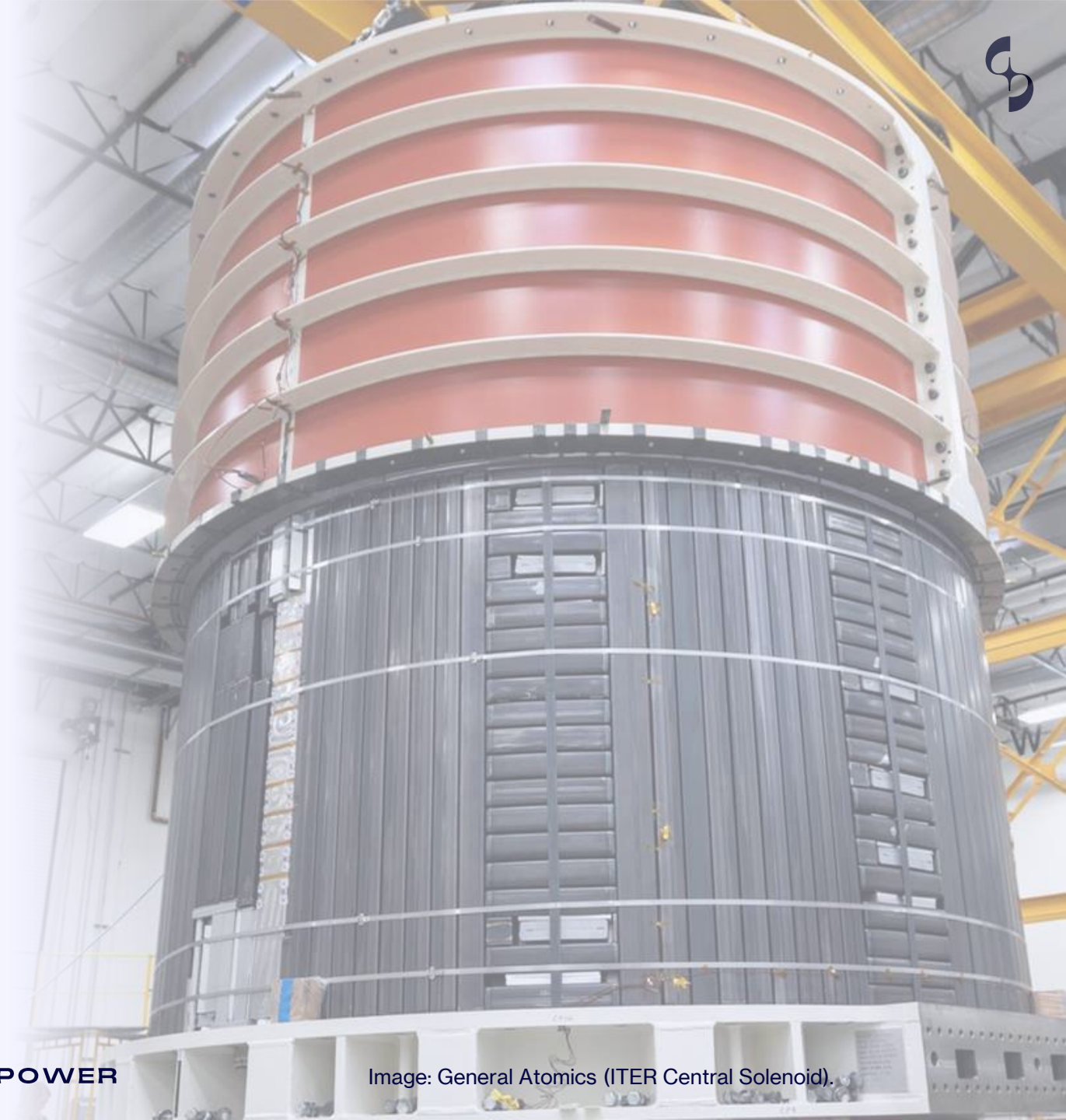
Principal Magnets Engineer for STEP / UKIFS

EPSRC CENTRE FOR DOCTORAL TRAINING IN FUSION POWER



OUTLINE

1. A quick survey of magnetic fusion devices.
2. Why are cables needed?
3. Hierarchy of tape – cable – coil – magnet.
4. Types of REBCO cable.
5. Assembly of cables into conductors.
6. Cable testing.
7. Types of fusion magnet.
8. Magnet testing.
9. Case study – STEP magnet systems.
10. Post-lecture discussion.





DISCUSSION QUESTIONS

- 1) Name some different **types** of magnetic confinement fusion device. If you can, name some specific **examples** of those types. Also, for completeness, identify some fusion concepts that **don't** rely on magnetic confinement.
- 2) Why are superconducting **cables** needed for fusion reactor magnets?
- 3) List some prominent **designs** of superconducting cable, and – if you can – identify the primary advantage and disadvantage of each.
- 4) Name the primary **tokamak magnet systems** and identify the principal challenge with each. What are some other challenges that apply across multiple systems?

This week's practical work has focussed on **performance characterisation** (critical current measurement) of **HTS tape**.

- 5) Based on what you have learned in the lab, discuss the challenges for **quality control** of the hundreds of thousands of kilometres of HTS tape required for typical magnetic confinement fusion reactor designs. What are the requirements? How might this be implemented? What experimental developments are required? How is this being approached at the present time? What developments might be hoped for in the future?
- 6) Moving from tape to **cables**, what sort of tests are required, and what sort of apparatus is needed to deliver them? What might a future UK HTS cable test facility look like, in order to make it as useful as possible to as wide a range of stakeholders as possible?
- 7) Consider the full suite of test facilities required to cover tape, cables, coils and **magnets**. What opportunities exist to combine or genericise these facilities? What would you build?