Karlsruhe Institute of Technology

EUROfusion
POWER PLANT PHYSICS & TECHNOLOGY DEPARTMENT

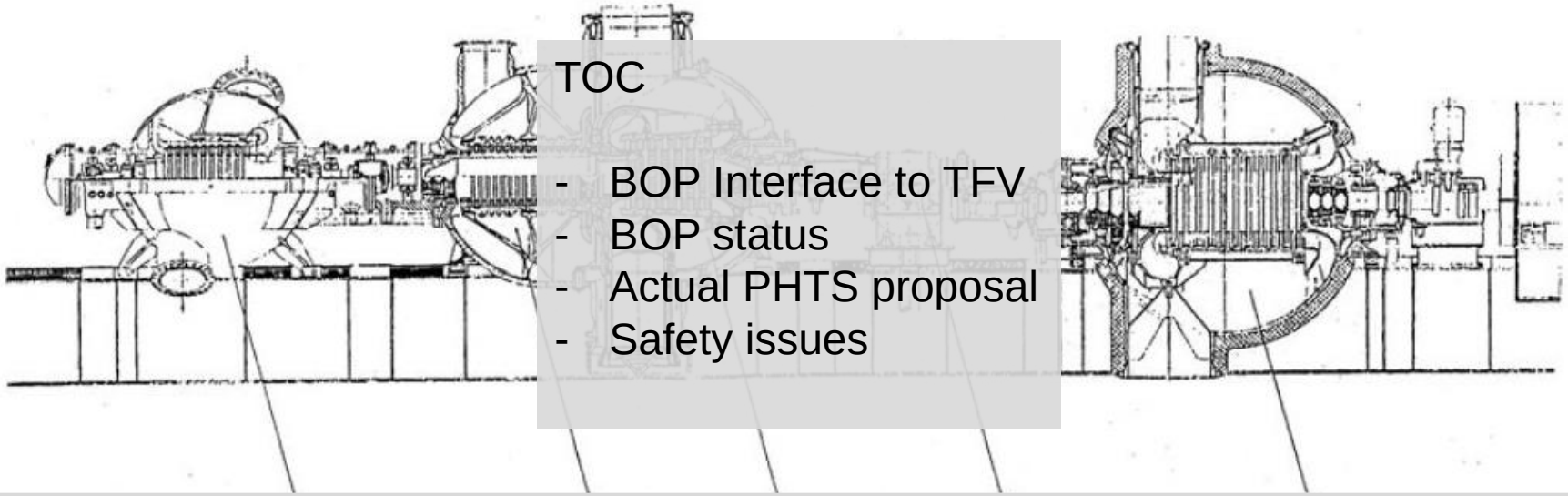
02.06.2016

Wolfgang Hering**,** Evaldas Bubelis, Sara Perez-Martin
presented by Sara Perez – Martin

BOP - PHTS: Interface to TFV

Working Meeting on T simulation and cross topics, June 13-15, 2016, Madrid

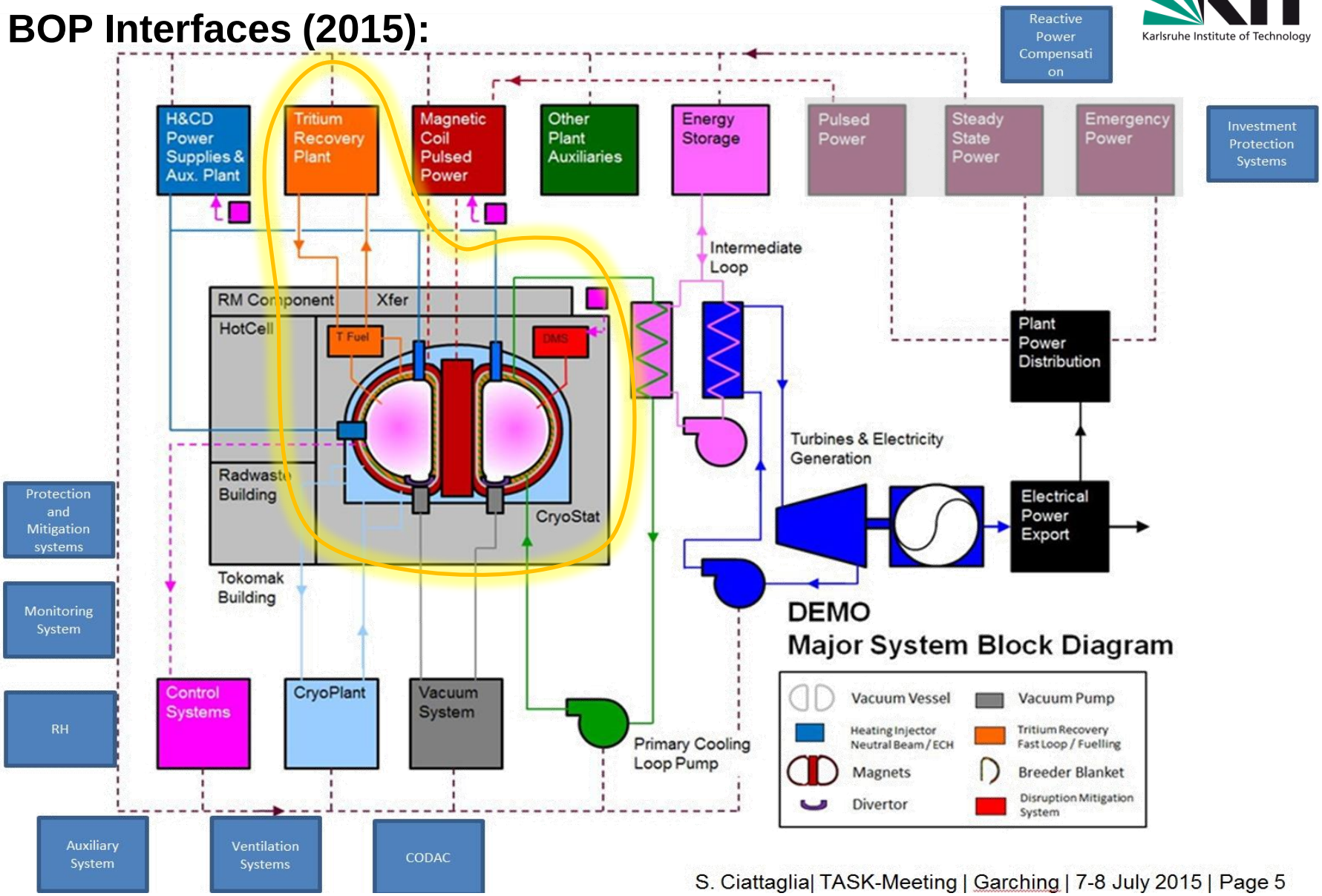
Institute for Neutron Physics and Reactor Technology



TOC

- BOP Interface to TFV
- BOP status
- Actual PHTS proposal
- Safety issues

BOP Interfaces (2015):



WPBOP status

- Heat transfer chain:
  1. PHTS → IHX → IHTS → Steam generator (SG) → PCS
  2. DIV, VV → IHX^2 → PCS – Feedwater train
- PHTS:
  1. Water → conventional design like PWR
  2. Helium → need of segmentation (e.g. 9 OB + 6 IB) to meet industrially available components, to reduce complexity and to allow for redundancy
- IHTS: heat transfer and storage system
  Transfers energy at ambient pressure to Energy Storage System (ESS) outside Tokamak building and to SG in PCS building
  Fluid: actually Solar- Salt from Concentrating Solar power
  (open issue: barrier to PCS, T contamination?)
  Volume incl. ESS: 8 Gg (He) … 50 Gg (Water) (t_{dwell} ~30 min, t_{pulse}: ~120min)
  → t_{dwell} *~10 min + EUR (European Utilities Requirements)* → *reduction by a factor 3!*
  (Presently under investigation: size of ESS to avoid fast aging of the PCS)
- Power Conversion System: Rankine Cycle (Water)

PHTS Design requirements

- Modular segmented structure:
  - Segmentation to avoid valves and large heat exchanger (scaling and space difficult)
  - Reduction of burden to VVPSS and to EV (expansion volume)
  - Cost benefits (serial production)
- Reduction of large and heavy collectors to distribute PHTS fluid
- Allow for inherent redundancy (50% flow assured in case of pump loss)
- Open issue: is water chemistry using LiOH feasible taking into account DEMO Neutron and γ-Flux densities
- Space allocation inside tokamak confinement may be easier due to smaller components.

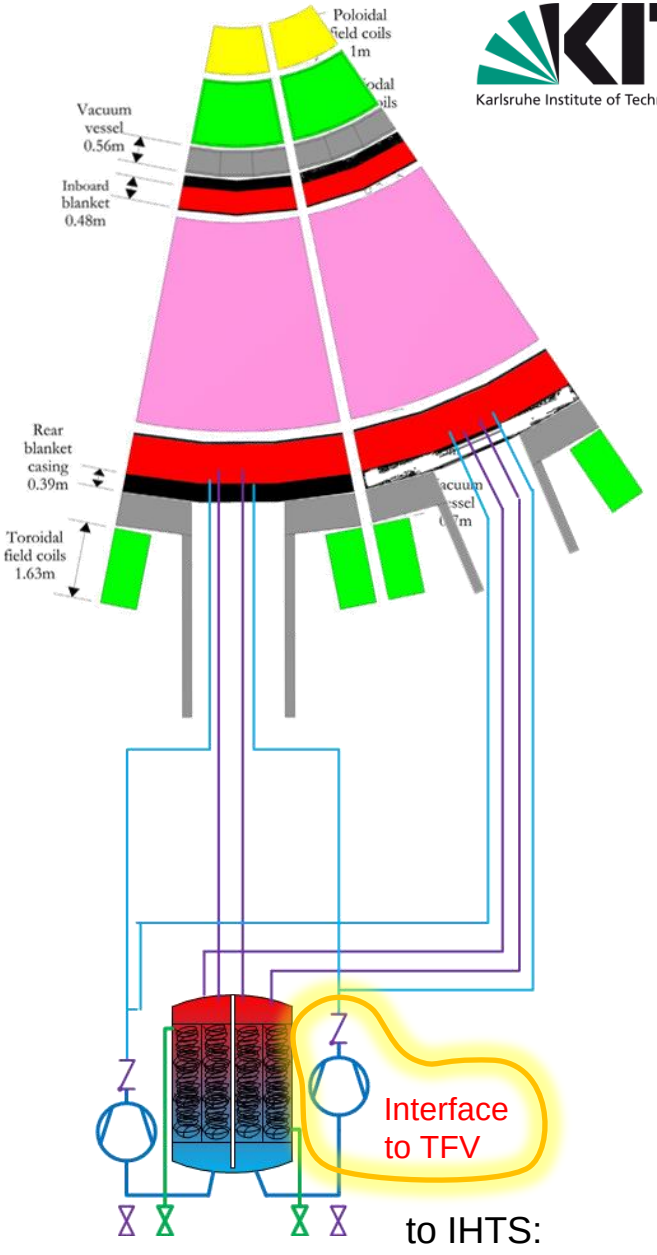
Realizable modularity of PHTS

Plus:

- Modular
- Less active components
- Size of components to be developed easily by industrial scale up
- No huge He collectors
- IHX in twin configuration (2 primary side, 1 secondary)
- Inherent redundancy
- Accidental consequences limited in case of in-vessel LOCA (except for the runaway electron accident which will destroy complete FW).

Minus:

- Helium mass released doubled under accidental conditions
- More complex connections to auxiliary systems



To be done:

In 2016 BoP WP priorities are to finalize a preliminary PHTS and PCS design for both He and H_2O PHTS and relevant PCS with first indication of allocation space mainly inside the tokamak confinement.

In detail:

- Consensus of modularity for He PHTS
- Separation between IB and OB (for the 18 sectors)
  (IB: less modules per sector)
- Component size to fit into tokamak building
- Design activity on:
  circulator, heat exchanger, pipe work, etc. for more reliable data for simulation
- Work ongoing in 2016 with industrial support

That's all for the moment…
Questions?