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EUROPEAN TECHNOLOGY AND INNOVATION PLATFORM
SMART NETWORKS FOR ENERGY TRANSITION

Session: "Flexible Power Generation"

Flexibilisation of power plants through thermal energy storage (FLEXI-TES)

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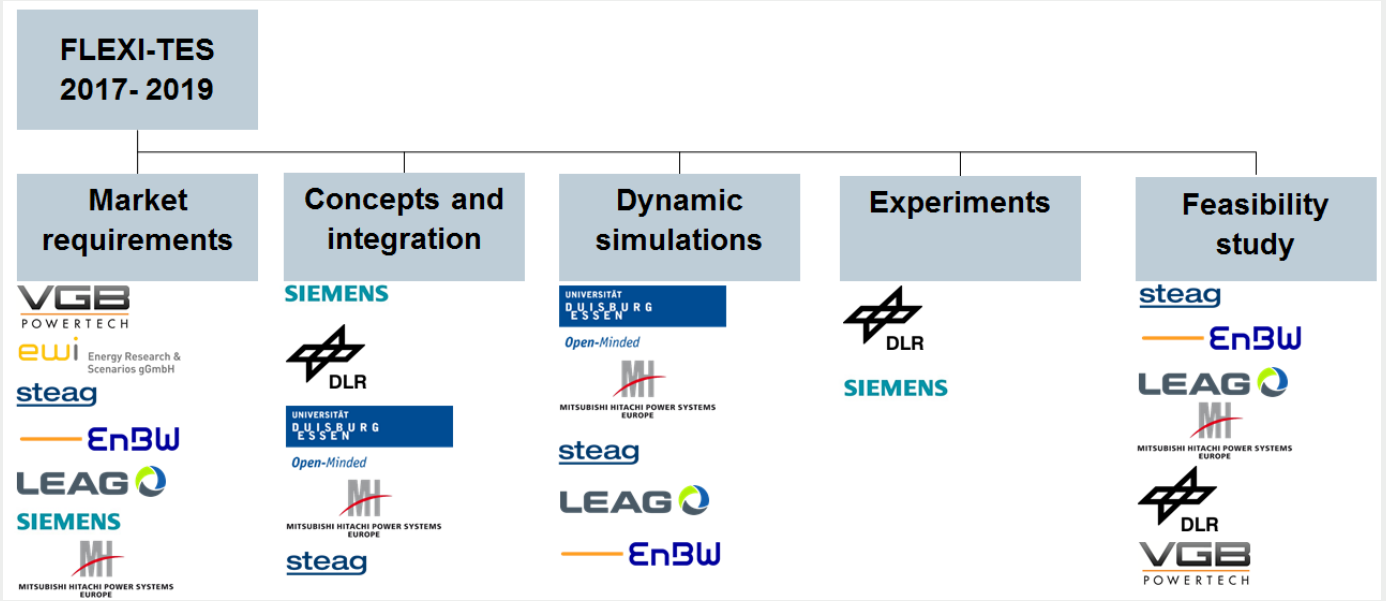
Short presentation of the project

- **Project**: FLEXI-TES, "Flexibilisation of coal power plants through thermal energy storage", National project (FKZ 03ET7055)
- **Consortium**: 9 partners from Electric utilities, OEMs, Science (STEAG, EnBW, LEAG, MHPS, Siemens, VGB, ewi, LUAT, DLR)
- **Budget**: 3.5 M€, 2.4 M€ funding share
- **Runtime**: 01.2017-12.2019
- **Contact**: stefan.zunft@dlr.de

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag



Short presentation of the project

Overarching objectives

- Support grid integration of RE through a more flexible operation of remaining conventional power generation
- Improve contributions of coal to grid stabilisation

Technical objectives

- improve load gradients
- reduce minimal loads to avoid cold starts
- capability to participate in reserve, intraday, day-ahead markets
- Assess different TES technologies, assess different TES integration points

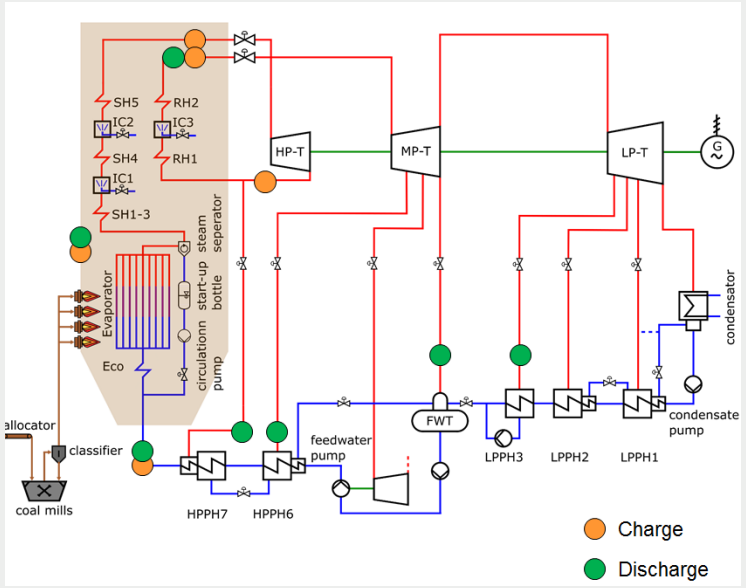
Focus is on

- modern plants (800 MW class)
- retrofit of hard coal plants (lignite phase out in Germany)

Short presentation of the project

Scope of work

- Elaboration of 15 concepts for TES integration, differing
- … in TES integration point
- … in TES technology
- Design studies
- Adaptation of storage technologies
- Assessment (QFD analysis) of concepts w.r.t.
- … investment costs
- … technical risks
- … economic assessment based on scenarios
- Case study for a selected concept to specify the integration measures in more detail

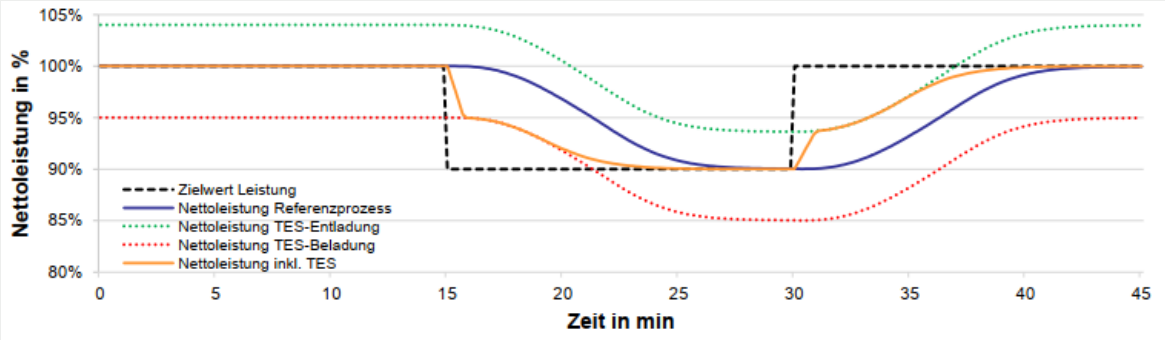


FLEXI-TES 2017- 2019

Market requirements	Concepts and integration	Dynamic simulations	Experiments	Feasibility study
VGB POWERTECH	SIEMENS	UNIVERSITÄT DUISBURG ESSEN	DLR	steag
ewi Energy Research & Scenarios gGmbH	DLR	Open-Minded	SIEMENS	EnBW
steag	UNIVERSITÄT DUISBURG ESSEN	MITSUBISHI HITACHI POWER SYSTEMS EUROPE		LEAG
EnBW	Open-Minded	steag		MITSUBISHI HITACHI POWER SYSTEMS EUROPE
LEAG	MITSUBISHI HITACHI POWER SYSTEMS EUROPE	LEAG		DLR
SIEMENS	steag	EnBW		VGB POWERTECH
MITSUBISHI HITACHI POWER SYSTEMS EUROPE				

Key exploitable results addressing energy system integration

- Integration of TES
  - reduces minimal load by up to -40 MW_el (-6% of nom. load)
  - clearly improves load gradients during charge/discharge periods



- Achievable flexibilisation window of the power range is limited to ~ 65 MW_el_net for retrofit installations
- Round trip efficiency: 40-70% depending on TES integration concept
- Investment cost of viable solutions (in terms of €/kWh_installed) are clearly below competing storage technologies (starting from 100 €/kWh_el_inst)

Lessons learned and barriers to innovation deployment

- TES-extension of coal power plants is a effective means to improved operational flexiblity
- ... can be implemented as a plant retrofit
- ... at competitive costs
- Short-term solutions are viable with existing TES technologies (solid media, molten salt, PCM), through carefully adapted designs
- "High exergy solutions" are performing best w.r.t. investment costs, efficiency, flexibilations range, but have higher technical challenges
- Molten salt hat storage is favourable solution for integration into the steam cycle, offers viable retrofit solutions, with low investment costs (but moderate efficiency 40%)
- Solid media storage is an appropriate solution for integration into the flue gas path, viable for greenfield implementations only, with high efficiency (70%)

Barriers

- profitability lacking today
- Germany: limited lifetime of coal-fire power plants in Germany

Deployment prospects of the most promising solutions

Deployment opportunities are anticipated in the mid-term

- on intraday and day-ahead market
- on secondary and primary control reserve market
- for greenfield & retrofit installations

strongly dependent on

- regulation
- volatility of electricity prices

Needs for future R&I activities coming out of the project

- further optimisation of storage solutions (capacity, dynamics)
- further elaboration of market opportunities
- pilot demonstration

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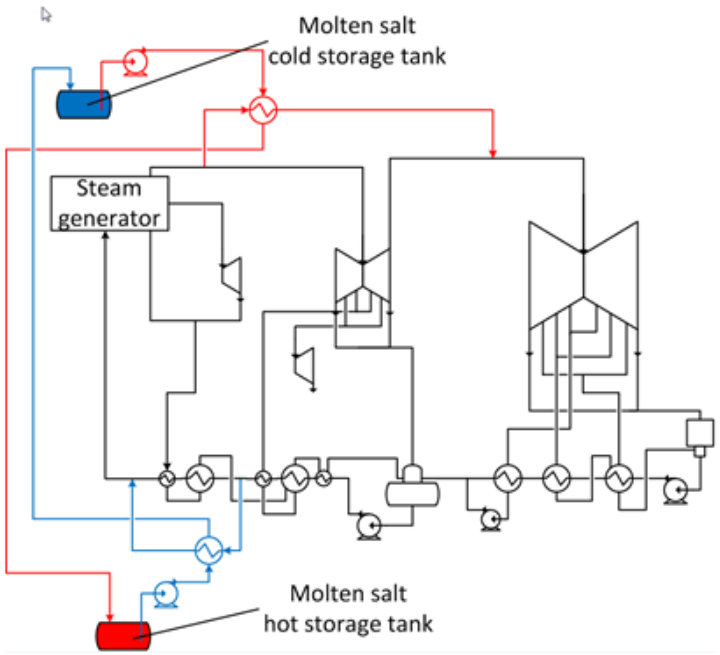
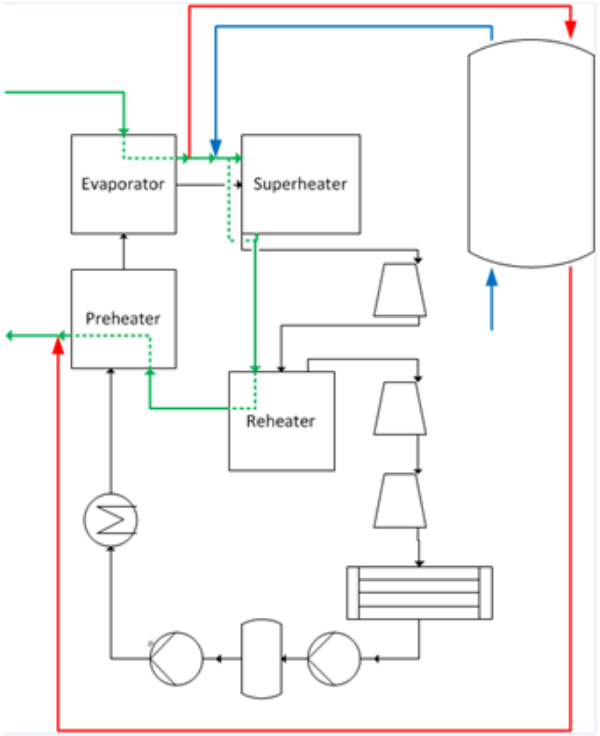
Backup

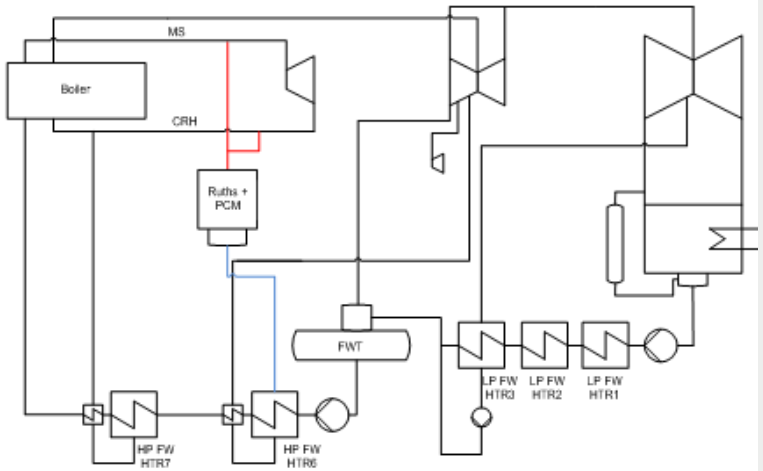
Concept 2:
HRH-HP FW HTR7_indirect, molten salt



Concept 6:
Flue gas-Air_indirect, solid material



Concept 4:
MS/CRH-HP FW HTR6_direct, Ruths + PCM



Backup

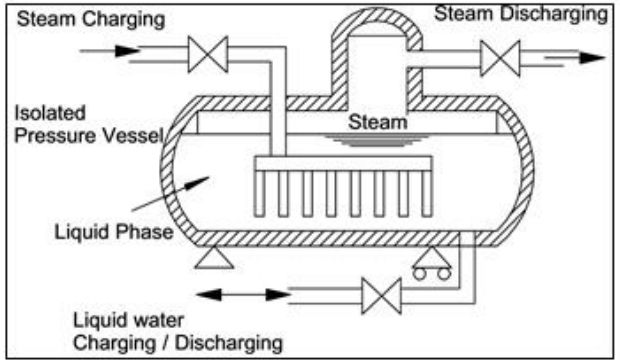
Molten salt

- indirect storage system
- cost competetive and state of the art solution
- for medium temperature application
- for long term application (> 1 h)

Solid media

- indirect storage system
- cost competitive storage material and storage material options
- for high temperature application
- for long term application (> 1 h)

Ruths + PCM



- direct storage system
- fast dynamic response
- heat capacity increased by capsuled PCM

- for short term application (< 1 h)