Conventional Generation Scoping Workshop

15th April 2014

Crowne Plaza, NEC Birmingham

In this event we addressed the following question:

What are the research needs associated with conventional power generation through to 2050?

Participants discussed with their tables areas which either:

- Are not met by the current research landscape
- Or areas which are being met but may benefit from further inputs and development of next generation technologies

Tables were then asked, in the context of their previous discussion, to identify their top 5 research needs in conventional power generation:

- Adapting existing conventional plants to deliver low cost electricity
    - Life extension, flexible operation, RAMO, fuel flexibility
- Conventional plant developments to enable CCS integration
    - International collaboration, fuel aspects
- Increased flexibility of steam and gas turbines
    - Quick start, part loads
- Innovative design concepts for power plant components
- Coping with the variability of gas supplies
    - Shale gas, biogas, LNG
- Biomass
    - Variability of fuel, slagging/fouling, co-firing, impact on emissions
- Emission control technologies for flexible fuels
- Advance in-situ diagnostics
- Projects to deliver step change efficiency improvements
    - Coal/gas/bio/syngas, heat use integration, international collaboration
- Materials challenges for flexible operation
- High temperature materials
    - Increased efficiency plant
- Novel power cycles
- Advanced virtual power plant dynamic simulation
- Intelligent management and design of complex energy systems
- Optimising heat storage: integration with renewables

    - More efficient start-ups, ramp rates
- Thermal energy storage for improved integration
- Chemical energy storage and conversion
- Underground gasification linked to carbon capture
- The social, economic, behavioural, market aspects of conventional power generation
- Societal engagement for future conventional power
    - Demand side management
    - Public acceptability of fuels

The above research needs were then clustered into three higher level research challenges:

- Step change in new plant design
- Integration of conventional plants with future technologies
- Optimisation of existing plants

The following cross-cutting issues were also identified:

- Fuel variability
- Environmental issues/emissions
- Materials/engineering – novel design
- Social/economic/behavioural aspects
- Sensors
- Energy storage (thermal)

Participants self-organised into groups and discussed how the research challenges could be addressed; bearing in mind the cross-cutting issues that had been identified.

The Challenge: **Step change in new plant design**
1. How will this aid the conventional power generation sector up to 2050? • Improved efficiency, lower cost of electricity • Flexibility of power supply • Aid integration with CCS • Allow the plant to make the most of varied (cost effective) fuel sources
2. What research is required to meet this challenge/need? • Advanced steam cycles + materials (manufacturing and design) • Advanced sensors and diagnostics • Advanced steam and gas turbine technologies/novel cycles • Production and use of alternative fuels • Fuel analysis and impact of fuel on process • Turbine seal materials technology – low thermal mass
3. What disciplines are required to tackle this challenge? • Materials sciences/engineering –Thermodynamics/heat transfer/fluid mechanics • Instrumentation • Combustion • Fuel analysis/pollutant analysis (zero emission plants)
4. What access to facilities is needed to help address this challenge? Are they currently available and where? • Pilot scale test facilities – combustion/advanced pollution control • Computer modelling • Sensor development capabilities • International Collaboration

The Challenge:

Integration of conventional plants with future technologies

1. How will this aid the conventional power generation sector up to 2050?

- Increased efficiency and flexibility of plant
- Enables operation with intermittent renewables (optimise)
- Integration/interface with CCS – "CCS Ready"
- Storage
  - Reduces demands for flexibility (longer term link to liquid transport fuels)
  - Interface with thermal storage and distributed electrical storage

2. What research is required to meet this challenge/need?

- Steam cycle integration
- Bring heat/thermal storage to power generation cycle
- Higher-H_2 gas turbines
- H_2 in natural gas supply
- On-line monitoring techniques
- Sensors (optical and high speed)
- System modelling – include power plants (new/old) and distributed storage
- Bio-CCS

3. What disciplines are required to tackle this challenge?

- Electrical and mechanical engineering
- Materials
- Chemistry/Chemical engineering
- Civil engineering
- Social/economic/behavioural aspects

4. What access to facilities is needed to help address this challenge? Are they currently available and where?

- Large scale/pilot facilities (combustion testing/simulation)
- Collaboration with utilities
- International collaboration (e.g. with renewables)
- Utilise existing software/programmes

The Challenge: **Optimisation of existing plants**
1. How will this aid the conventional power generation sector up to 2050? • Improved efficiency • Reduced emissions • Cost reduction • Flexibility • Use of existing assets • Fuel optionality at a national level
2. What research is required to meet this challenge/need? • Turbine seal materials/design • Sensor technologies – online monitoring and diagnosis • Materials for reduced thermal mass • Improved transient control methodologies (start and load change) • Fuel variability – impact on deposition, emission and their control • Efficiency <-> flexibility trade off • Combustion stability in gas turbines
3. What disciplines are required to tackle this challenge? • Materials • Engineering
4. What access to facilities is needed to help address this challenge? Are they currently available and where? • Pilot plants • PACT • International collaboration where it adds value (e.g. with USA)

Participants were also given an opportunity to identify other issues which they felt were important:

- "Materials" issues should be focussed on novel challenges for flexible operation
- Life cycle analysis, including economic aspects (level playing field)
- Fuel storage safety – biomass (handling, storage, effective mitigation)
- International collaboration – added value, greater reach and impact
    - E.g. integration with renewables (US experience)