Coal Combustion and Large Eddy Simulations

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**Introduction**

*EPSRC-E.ON OxyCap Tasks and Objectives:*

**TASK 2A**

**Large Eddy Simulations (LES) for pulverised coal combustion**

- Collaboration with Imperial College
- Model the new Oxy-fuel CTF at Leeds

**TASK 2B**

**Development and Validation of advanced sub-models for CFD**

- Collaboration with Imperial College
- Develop CFD submodels in oxy-combustion
- In-house LES Code
Why CCS?

- Carbon dioxide is believed to be the major cause of global warming.

- Approximately 60% of greenhouse gases are emitted from the energy sector [1]

Figure taken from Kone, A. et al (2010), Forecasting of CO2 emissions from fuel combustion using trend analysis, Renewable and Sustainable Energy Reviews, 15(9):2906-2915
CCS Technologies

Power Plant with post-combustion technology

Fuel

Air

CO₂ Capture, Compression and Sequestration
CCS Technologies

Power Plant with pre-combustion technology

Air Separation Unit

O₂

Fuel

Gasification & Water Gas Shift Reaction

H₂

CO₂ Capture, Compression and Sequestration
CCS Technologies

Power Plant with oxy-fuel technology

Air Separation Unit

Fuel

Recycled Flue Gas

CO₂ Capture, Compression and Sequestration
CCS Technologies

Power Plant with post-combustion technology
- Fuel
- Air Separation Unit
- Gasification & Water Gas Shift Reaction
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Power Plant with pre-combustion technology
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Power Plant with oxy-fuel technology
- Fuel
- Air Separation Unit
- O₂
- Gasification & Water Gas Shift Reaction
- Recycled Flue Gas
- CO₂ Capture, Compression and Sequestration
Turbulence plays a key role in the combustion process.
Turbulent Approach

\[ E(k) \]

Figure: Energy Spectrum

\( k_c \)

LES, Instantaneous Values

RANS, Time-Averaged Solution
## Combustion Modeling

### In house code – PsiPhi (Imperial College)

<table>
<thead>
<tr>
<th>Coal Combustion SubModels</th>
<th>Implemented</th>
<th>Imperial</th>
<th>Leeds</th>
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Acknowledgements

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References


Reynolds Averaging Numerical Simulation papers:


Reynolds Averaging Numerical Simulation and Large Eddy Simulation papers:
