Future Developments at Drax Power Station, (Oxyfuel and Biomass)

Richard Dean

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we are shaping the future ALSTOM

Agenda

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What triggered the Drax biomass project

Strategic decision to embark on a CO2 reduction programme

- Included turbine retrofit
- Biomass co-firing

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Biomass Co-firing: Potential to Reduce CO2 Emissions

World largest co-firing

project - 1.5 million tonnes/year biomass co-firing at 10% heat input

400 MWe of green power

2 million tonnes/year CO2 avoided

Process works commissioned early 2010



- Phase 1, 4 month Design Study, Drax engaged at all stages of project development, inc HAZOP
- Phase 2, (EPC) Engineer contract, design, supply and installation of equipments associated with the main processing works (road unloading, storage & biomass milling) inc civils, mechanical & electrical

Potential to retrofit existing power plant Utilising existing assets - Quick solution to meet renewable energy targets

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Drax Challenges

Largest co-firing project in the world

Throughput and processing requirements

Biomass fuels challenges:

- Spontaneous combustion
- ATEX/DSEAR (local directives)
- Dust emissions

Retrofit project

- Existing footprint
- Live Plant- constructability
- Health and Safety

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Alstom's European experience



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Performance

- No interruption of existing plant performance or operation during construction and commissioning
- Plant fully commissioned and operational since April 2010
- CO2 savings per year = > 2million tonnes (based on 100% capacity)
- Green House Gases reduction of >70% v coal
- Plant consistently delivers rated output
- Capable of processing 40 tonnes of biomass per hour on each of the six boiler units, alongside some 230 tonnes per hour of coal.
- Multiple fuels (being received, stored, processed, sampled and fired
 - Forestry residues
 - Agricultural by-products
 - Energy group (including LIK grown)

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Site Overview



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Drax



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Road Unloading



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Drax





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Conclusion - Drax Biomass Co-firing

- Successful project delivered safely, on time and on budget.
- Forms the basis for further (increased) biomass firing
- Makes a significant contribution to the UK renewables target
- An economic means of CO2 reduction

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What triggered the CCS project

- Alstom has a global ambition to develop CCS technology
- Drax has a long term vision that is focussed around low carbon electricity generation
- Retrofitting an existing coal plant with CCS is unlikely to deliver a competitive power plant in the UK market

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Project Snapshot

- A new modern supercritical 426MWe Gross Oxy-fuel Power Plant
- Clean power generation with the entire flue gas treated to capture 2 Million t/y CO₂
- Biomass co-firing leading to zero (or negative!) CO₂ emissions
- Located at the Drax Power Station Site, Selby, North Yorkshire
- Associated with National Grid's (NG) regional CO₂ transport & offshore storage network
- Project development activities on-going
- NER funding application under EC evaluation.
- UK Demo funding application planned

Largest Oxy-fuel CCS Demonstration Project Worldwide

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PRODUCT VALIDATION PLAN Oxy-Roadmap Overview



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Alstom activity on CO2 capture Oxy-Combustion



Total Lacq France - 30 MWth



Vattenfall Schwarze Pumpe Germany - 30 MWth

Status

- Currently tested at
 - Schwarze Pumpe (30MWth, Germany)
 - Alstom Boiler Simulation Facility Windsor (15MWth, US)
 - Lacq (30MWth, France)



Alstom BSF Windsor US - 15 MWth



Vattenfall Jänschwalde Germany - 250 MWe



Invited by the Commission to negotiate award agreements for EEPR funding



- Jänschwalde (250MWe, Germany),
 - -pre-selected by EU Commission,
 - -Alstom did the feasibility study
- Drax (300MWe net, UK)
 - -Application for NER 300 funds 2010

-Application for DECC funds 2012

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Project Promoters





- Produces more renewable power than any other UK facility
- Committed to reducing Drax and UK power generation carbon footprint
- A global leader in the world of power generation, power transmission and rail infrastructure
- A pioneer in large-scale and efficient CCS technologies
- The largest provider of industrial gases in UK
- A member of the Linde group, a world leading gases and industrial company
- An international electricity and gas company and one of the largest investor-owned energy companies in the world.
- Expert in running high pressure natural gas system in a safe, reliably and efficient manner.

A strong consortium

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Partner Roles



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Oxy Technology nationalgrid Drax Member of The Linde Group



- Fuel Flexibility: applicable for all types of boilers, firing systems and fuels
- Scale-up: no constraints anticipated for larger commercial units
- ◎ ALST Emissions: No new chemicals introduced to the power plant.

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Plant 3D Model



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CO₂ Transport and Storage Solution

Storage Development

Regional assessment completed

- All Southern North Sea (SNS) gas fields and saline formations
- Petroleum Geo-Services SNS Megasurvey 3D seismic (25,000 sq. km)
- Supplemented by Western Geco 3D & 2D seismic for in-fill of gaps

Assessed 257 wells in target area (full database setup and selected petrophysics)

Key sites short-listed

Technical programme to identify prime target (2 front runners) developed

Developing appraisal plan; to include formation drilling

Transport Development

R&D programme:

- Vapour phase programme completed
- Dense phase programme underway

Onshore route planning - public consultation started

Offshore route planning ongoing

On- & Off-shore operational options prepared

Offshore facilities options prepared



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UK Oxy CCS Demo



national**grid**

THE POWER OF ACTION



- 426 MWe gross output / 390MW in air mode / 304MW in full Oxy-mode
- Gross efficiency 44 46%, net efficiency 35-36%
- CO2 Capture 90%
- Steam quality 260bar / 600C / 620C
- As a demonstration project it is expensive on a /MW basis but has significantly less risk when scaled up to commercial size

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Conclusion – CCS Oxy project



- An exciting technology
- A lot of hurdles to get over before it happens but with...
- A solid group of companies supporting it..
- And Government backing CCS it provides..
- Excellent opportunity to demonstrate that coal can be used for clean power generation for years to come

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