WEF FORWARD DIARY – SECOND HALF OF SEASON 12:

March 11th – Demand Side & Consumer Markets, Clean Tech & Smart Energy
April 21st – Future International Gas Supply Security for the UK: RISK ASSESSMENT
May 14th – Annual Review of Renewables Policy & Deployment
Access to secure, affordable and diverse sources of natural gas is critical for the UK economy. Gas is a key requirement for the power generation, heat and transport sectors.

As the UK moves towards an era of gas import dependency, and declining UKCS production, a balanced UK energy mix that increasingly includes renewables, nuclear power, energy efficiency and indigenous, unconventional shale gas may help to reduce the UK’s strategic exposure to international gas imports.

In the meantime, however, a range of risks to strategic international gas supplies may represent a vulnerability to the UK’s national energy, and economic, security.
Certain key questions underpin the approach to the assessment process:

• How does industry currently perceive certain strategic risk issues that might affect the UK’s future gas import supply security? (or nuclear supply needs?)

• How might various risks compare relative to one another, and how dynamic does each risk appear to be?

• What gaps and uncertainties might exist in the current knowledge base, and what recommendations for further enquiry does this suggest?

• To what extent do policymakers assume correctly that strategic gas infrastructure and supply decisions will be committed to by industry, in a timely manner, in order to maintain adequate national energy security?

• Are there strategic opportunities for an agile UK in the context of an increasingly competitive and challenging international future, and how might these opportunities be best pursued?
Westminster Energy Forum:
February 2015

Liz Keenaghan-Clark
Current Nuclear Generation and Planned to 2030

- Nuclear capacity in the UK is 9.23GW. This is expected to decline substantially as plants’ ‘end of life’ approaches in mid-2020’s.

- 8 new nuclear designated sites contained within Nuclear National Policy Statement. Firm site development plans for Hinkley, Sizewell, Wylfa, Oldbury and Moorside.
New Nuclear Plans for UK

Subsidiary NNB GenCo intends to build four new EPR reactors (amounting to 6.4GW) at Hinkley Point and Sizewell. Currently under negotiation for CFD.

A wholly owned subsidiary of Hitachi Ltd. Plans to develop up to 7.8GW of new nuclear capacity at sites in Wylfa and Oldbury. Wylfa FID expected by 2018.

GDF and Westinghouse/Toshiba have begun site characterisation work on land which will be developed as part of plans to build up to 3.6GW of new nuclear capacity at Moorside near Sellafield.
Hinkley – on track

- Will power equivalent of nearly 6 million homes and replace old, polluting power plants; creating more than 25,000 jobs.
- UK companies could receive more than 50% of the work - thousands of jobs are expected to go to local people.
- During peak of construction, will put £100 million per year into local economy.
- 8th October – the Commission endorsed our view that the plans for Hinkley Point C provide a fair deal for both bill payers and investors.
- We agreed strengthened arrangements for benefits to be shared with consumers if the project comes in under budget or if the project’s return exceeds a certain level.
Hinkley - Head of Terms

- The duration of the payments - 35 years
- ‘Strike price’ of £89.50 per megawatt hour, fully indexed to CPI.
- Upfront reduction of £3 per megawatt hour - share ‘first of kind’ costs across the Hinkley Point C and Sizewell C.
- Strike price for Hinkley £92.50 if no Sizewell C FID.
- Competitive with other low-carbon technologies, including onshore wind, the cheapest large scale renewable.
- Includes gain share arrangements and operational cost reviews.
- Compensation if shut down due to a political decision.
- Developers required to put money aside in a protected clean-up fund to pay for decommissioning and share the waste management costs.
Potential opportunities - Small Modular Reactors

– Recognise that there may be long-term value in SMR technology:
  • potential for shorter delivery times;
  • potential cost reduction; and
  • value for UK firms.
– Feasibility study launched by the Government, published Dec 2014 - confirmed that there could be potential benefits for the UK energy market, and commercial opportunities, from SMRs.
– Phase 2 work underway.
– But HMG’s priority is the conventional new nuclear build programme.
Short and long term waste management

- Waste is managed safely and securely now, either at a specially licensed repository or at the nuclear site where it was first produced.
- Nuclear Decommissioning Authority manages the clean-up of nuclear sites with an annual budget of approx. £3.2bn.
- But we need a long term plan - the best option is Geological disposal.
- White Paper at the end of July - still committed to working with communities to find a suitable site.
- Discussions will happen from 2016 after we’ve provided more information on geology, decision making and planning.
There is more support than opposition for Hinkley Point C

In October 2013, the government gave the go-ahead to build the Hinkley Point C plant in Somerset. To what extent do you support or oppose the plans to build a new nuclear power station at Hinkley Point C?
Public support – comparison to other energy sources

If the UK is aiming to create long-term energy price stability and limit future price rises, which, if any, of the following energy sources do you believe would help achieve that aim?

- Increasing the use of renewables: 2013 (59%), 2012 (60%)
- Increasing the use of nuclear: 2013 (46%), 2012 (43%)
- Increasing the use of coal: 2013 (14%), 2012 (9%)
- Increasing the use of gas: 2013 (11%), 2012 (7%)
- Increasing the use of oil: 2013 (2%), 2012 (6%)

Source: YouGov Nov 2013
Challenges for new nuclear in the UK

- Third party financing needed for all consortia.
- Maximising UK economic benefit (localisation).
- Building to time and budget (cost reduction).
- Meeting the skills demand.
- Progress on long-term waste disposal.
Nuclear New Build

Stephen Livingstone
HPC Delivery Director

5 February 2015
Proposed Development: Hinkley Point C
HPC significant progress

**2011**
- Planning permission for site preparation works

**2012**
- Agreement with local authorities on measures to address impacts of HPC development (Section 106)
  - Nuclear site licence
  - Generic Design Assessment of EPR design

**2011-2012**
- Three main environmental permits
- Full planning consent
- Marine licence
- Contract for Difference (CfD) heads of terms announced
- Public confirmation of Infrastructure UK (IUK) Guarantee eligibility
- Equity Partners letters of intent signed
- Industrial Relations agreements achieved with main trade unions
- Top four suppliers contract terms & conditions agreed

**2013**
- European Commission approves the CfD and IUK Guarantee
- Safety Case, Design & Engineering development ongoing in line with the Project’s schedule.
- Early Contractor Involvement with key industrial partners
- Preparatory works underway on site
- Procurement of long lead items continues
Next steps to the Final Investment Decision

- **Contract for Difference (CfD):** agreement with the UK Government of the full contract

- **Funded Decommissioning Programme (FDP):** agreement with the UK Government on the full contract

- **IUK guarantee:** agreement of the full terms for debt funding with the UK Government

- **Equity investors:** finalisation of agreements with industrial and financial partners

- **Approvals:** final approvals from EDF and the UK Government
The HPC industrial delivery team

Our Nuclear New Build

Values

- HUMILITY: Recognising there is always opportunity to learn from others and improve
- RESPECT: Valuing people, safety, the environment, and the rules under which we operate
- SOLIDARITY: Being one team, working closely together and helping each other
- POSITIVITY: Being an ‘enabler’ and focusing on solutions when faced with challenges
- CLARITY: Knowing how far we’ve come, how far we’ve got to go and how we’re going to get there

Technology Systems:

- Responsible Designer
- EDF

Mechanical, Electrical & HVAC Erection:

- AREVA
- ALSTOM
- cavendish boccard Nuclear
- ACTAN
- Balfour Beatty
- NG Bailey

Civil Engineering:

- BOUYGUES
- COSTAIN
- LAING O’ROURKE
- KIER
- BAM

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NOT PROTECTIVELY MARKED
Activity on site
Horizon Overview

- Established 2009, acquired 2 of the 8 UK sites designated for new nuclear
- Acquired by Hitachi November 2012
- Provide at least 5.4GW of new capacity across two sites
- Deploy Hitachi-GE UK ABWRs – two at Wylfa, decisions to follow on Oldbury
- Expect first unit at Wylfa to be operating in the first half of the 2020s
- c.£20billion investment in the UK
- Per site – up to 1,000 jobs once operational, c.20,000 roles during construction
- Up to 60% of project value could be spent in UK
- Over 270 staff at Gloucester HQ, office on Anglesey growing

Pictures: Existing Magnox stations at Wylfa (Top) and Oldbury (Bottom), adjacent to our sites
Delivering Wylfa Newydd

- Regulatory Justification – Complete
- GDA – Q4 2017
- Planning – 1st round of public consultation complete, DCO 2018
- Nuclear Site Licence – 2018
- Power station construction – commence 2019/2020
- COD – 1st unit, 1st half of the 2020s
Organisational Development

Developer

Intelligent Customer

Site Licence Company

Operator / Utility
Business Development

Horizon Nuclear Power

Investors

Hitachi, Ltd.

Infrastructure Guarantee
HM Treasury

Lenders
Export Credit Agencies

Counterparty Body

CfD

Power Sales

DECC

Horizon Nuclear Power

HGNE

EPC Prime Contractor

Operations Partner

Power Suppliers

Power Sales

Sub-Contractors

Supply Chain Companies

GEH

GNF

Construction Company

Supply Chain Companies

HM Treasury

Infrastructure Guarantee

EPC Prime Contractor

Operations Partner

Sub-Contractors

Power Suppliers
HORIZON MISSION

Our mission is to build a new, leading, UK nuclear utility company, successfully developing, constructing and operating the UK Advanced Boiling Water Reactor at Wylfa on Anglesey and Oldbury-on-Severn in South Gloucestershire.
Update briefing – Radioactive waste management

Adam Dawson
Adviser GDF Siting

Date: 05/02/2015
“Implementing Geological Disposal”

• Published July 2014

• Sets out the UK Government’s framework for disposal of higher activity radioactive waste

• Updates and replaces 2008 MRWS White Paper

• An ‘enabling’ document which addresses many issues that stakeholders have raised

• Sets out a clear plan and timescales to address some remaining questions and help communities participate
Geological disposal – 2014 White Paper overview

Geological disposal: making it happen

Making it safe: Office for Nuclear Regulation and environment agencies - independent bodies that will only authorise construction and operation of any facility if the developer can demonstrate that it will be safe, secure and the environment will be protected.

Engagement: Communities can talk to Government and the developer at any time, although formal discussions will only begin in 2016. There will be open dialogue throughout the entire process and a test of public support will be carried out before construction of a geological disposal facility can begin.

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Policy framework and Initial Actions

• Based on willingness of local communities to participate

• Recognises importance of providing upfront information on issues such as geology, socio-economic impacts and community investment

• Initial Actions :
  – Amendments to national land-use planning arrangements for GDF and boreholes
  – Providing greater clarity on how DECC/RWM intend to work with communities
  – A national geological screening exercise

• Other significant activities
  – Developer-led communications and stakeholder engagement
  – Providing the ONR with the legal vires to license a GDF
Initial Action: National land use planning

- DECC-led activity

- Define GDF and boreholes as Nationally Significant Infrastructure Project (NSIP)
  - Statutory Instrument to Amend 2008 Planning Act

- Produce Generic National Policy Statement (NPS) supported by Appraisal of Sustainability (AoS)
  - Consult on scope of AoS
  - Draft NPS and undertake AoS
  - Consult on draft NPS and AoS report
  - NPS designated by DECC Secretary of State
Initial Action: Working with communities

• DECC-led activity

• Key issues
  – Community representation
  – Community investment
  – Test of public support, etc

• Community Representation Working Group
  – Working group has been established
  – Group met for the first time in January
  – GDF Siting Director represents RWM
Initial Action: National geological screening

• The objective of the National Geological Screening exercise is to provide authoritative information that can be used in discussions with communities and may help RWM focus its engagement activities

• Screening will:
  – focus on long-term environmental safety of a GDF
  – draw on the requirements in the existing Disposal System Safety Case
  – consider existing geological information only

• Screening will not:
  – definitively rule all areas as either ‘suitable’ or ‘unsuitable’
  – target individual sites
  – select sites
  – replace statutory processes
Summary

• Progress is being made - All Initial Actions on track

• National geological screening
  • Stakeholder events being held
  • Consultation in Summer

• Land-use planning
  • Statutory Instrument laid before Parliament
  • Consultation in Summer

• Working with Communities
  • Working Group established
  • Consultation next year

• RWM still provides packaging advice to ensure waste suitable for disposal
Thank you

Subscribe for updates on our website:

www.nda.gov.uk/rwm/
AGENDA

Introduction

UK Fleet of Advanced Gas Cooled Reactors (AGR)

Expected Plant Life

Achieving Life Extension

The Impact of Life Extension

Case Study: Typical Servicing of a Nuclear Power Plant
INTRODUCTION – DOOSAN BABCOCK

Built on more than a century of innovation, Doosan Babcock is a specialist providing asset support, maintenance, repair, modernisation and upgrade services.

Doosan Group
A Forbes Global 2000 Company
Employees 43,000

Doosan Heavy Industries & Construction
A global leader in power and water
Employees 19,000

Doosan Babcock
A pioneering technology and service provider in global energy.
Employees 5,000

Thermal Power
Servicing and Optimising Plant Output

Nuclear Power
New Build, Servicing, Optimising Plant Output & Decom

Oil, Gas, Petrochem and Pharmaceutical Servicing and Optimising Plant Output

Doosan Babcock key dates

Doosan Babcock world firsts

1891 Babcock & Wilcox established

1956 World First Steam-raising plant for world’s first commercial nuclear power station

1957 World First HRSG/Waste heat boiler

1960 World First Platen Superheater

2003 World First Low mass flux positive flow once through boiler

2003 World First Largest operating down shot boiler for anthracite

2006 Mitsui Babcock acquired by Doosan to become Doosan Babcock

2007 World First Low mass flux positive flow downshot supercritical boiler

2013 Signed the Lifetime Enterprise Agreement with EDF Energy to support operations of the company’s seven UK Advanced Gas Cooled Reactor (AGR) nuclear power stations
Doosan Babcock are a key supplier in delivering the UK’s nuclear fleet.

Babcock has over 60 years of OEM supply of nuclear plant and equipment.

Design, manufacture, installation of 1st commercial nuclear plant in the world

Key supplier in UK nuclear fleet providing through life service support since construction

Supplied Steam Generators, Primary Pipework spools, and High Integrity Pipework as well as through life service support since construction

- Calderhall 1953
- Wylfa 1953 - 1971
- Torness 1964 - 1988
- Sizewell B 1980 – 2016
The AGR’s share the same basic concept, designed and built by different Companies

1976
- Hinkley and Hunterston
  Designed and built by TNPG
  Operational 1976

1983
- Hartlepool and Heysham 1
  Designed and built by BNDC
  Operational 1983

- Dungeness B
  Designed and built by APC / completed by CEGB
  Operational 1983

1988
- Torness and Heysham 2
  Designed and built by NNC (successor to TNPG)
  Operational 1988

CEGB – Central Electricity Generating Board
BNDC – British Nuclear Design and Construction
NNC – National Nuclear Corporation
APC – Atomic Power Construction
TNPG – The Nuclear Power Group
8.9GW Nuclear Generation capacity operational in the UK

<table>
<thead>
<tr>
<th>Station</th>
<th>Reactor Type</th>
<th>NET Capacity (MW)</th>
<th>Commission Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hunterston B</td>
<td>AGR</td>
<td>965</td>
<td>1976</td>
</tr>
<tr>
<td>Hinkley Point B</td>
<td>AGR</td>
<td>955</td>
<td>1976</td>
</tr>
<tr>
<td>Hartlepool</td>
<td>AGR</td>
<td>1,180</td>
<td>1983</td>
</tr>
<tr>
<td>Heysham 1</td>
<td>AGR</td>
<td>1,155</td>
<td>1983</td>
</tr>
<tr>
<td>Dungeness B</td>
<td>AGR</td>
<td>1,050</td>
<td>1983</td>
</tr>
<tr>
<td>Heysham 2</td>
<td>AGR</td>
<td>1,230</td>
<td>1988</td>
</tr>
<tr>
<td>Torness</td>
<td>AGR</td>
<td>1,185</td>
<td>1988</td>
</tr>
<tr>
<td>Sizewell B</td>
<td>PWR</td>
<td>1,198</td>
<td>1995</td>
</tr>
</tbody>
</table>

14 AGRs, 7 Sites
Commissioned 1976-1988
1 PWR, 1 Site
Commissioned 1995

PWR – Pressurised Water Reactor
AGR – Advanced Gas Cooled Reactor
Historic approach to lifetime planning was short-term / incremental

<table>
<thead>
<tr>
<th>Station</th>
<th>MW</th>
<th>Start of Generation</th>
<th>Original Accounting Lives</th>
<th>Life Extension Already Declared</th>
<th>Total Operating Life / yrs</th>
<th>Scheduled Closure Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sizewell B</td>
<td>1,198</td>
<td>Feb-95</td>
<td>40</td>
<td>0 N/A</td>
<td>40</td>
<td>2035</td>
</tr>
</tbody>
</table>
Engineering Asset Management of Irreplaceable components is key to Life Extension

• AGR reactors comprise of large steel lined, pre-stressed concrete pressure vessels, containing a graphite core moderator, numerous penetrations, linked to a number of in-built boilers – these components are considered irreplaceable

• Irreplaceable components are subject to high temperatures, pressures and radiation which leads to a number of ageing and degradation mechanisms

• EDF Energy have conducted assessments of plant condition, and ageing mechanisms associated with these components

• Lifetime expectations are determined by an engineering assessment of the life limiting components

• Graphite core and boilers are judged to be life limiting components
Life Extension of the existing UK Nuclear Fleet brings significant benefits

• Benefits of Extending the Life of the UK Nuclear Fleet:
  - **Energy Affordability** - the most affordable, large-scale, low-carbon source of electricity in the UK
  - **Security of Energy Supply** - Life extensions will play a role in keeping the lights on as aged thermal plant retire
  - **Decarbonisation** – Nuclear Power Generation is a large scale, low carbon source of electricity – supporting UK CO₂ reduction targets
  - **Impact to UK Economy** – EDF Energy directly employ over 15,000* people in the UK and spend £650m per year in the supply chain - 90% of which across ~300 UK companies
  - **Maintain UK Nuclear Competence** – UK’s New Build ambition will require tens of thousands of additional, mainly highly-skilled jobs

• Life Extension does not change the need or **urgency** of the **new nuclear build programme**

*Correct as of ‘EDF Energy Annual Sustainability Report 2013’*
The impact of life extension – why life extend? (2/2)

Life Extension does not change the need or urgency of the new nuclear build programme

- Estimated phased closure of existing UK AGR fleet until 2028*
- Sizewell B will be the only remaining existing station from 2028, estimated closure 2035 (with 20 year expected extension)
- New build phasing based on EDF Energy’s current estimated dates for 2xEPR’s at Hinkley Point C and Sizewell C
- Nuclear New Build still subject to a Final Investment Decision which is expected 2015

*Based on current declared dates
• As stations approach end of life, the need for longer-term planning to realistic dates was recognised

• Lifetime Programme implemented to ‘seek life extensions for all nuclear power stations where it is safe and commercially viable’

• An extensive review of the potential AGR lifetimes was conducted utilising predictive models of degradation

• This allowed experts to provide a judgement on appropriate planning dates for the fleet

• Early engagement with key supply chain partners and external stakeholders has been crucial to the success
  - Adopting a different approach enabled activities and resources to be prioritised
  - EDF Energy formed a Strategic Partnership for Lifetime with; Amec Foster Wheeler, Atkins, Cavendish Nuclear and Doosan Babcock
  - The supply chain approach has created a strong sense of leadership and shared responsibility
### CASE STUDY: SERVICING AN AGR – HUNTERSTON B

**Nuclear Plant switched off periodically for planned maintenance and inspection**

<table>
<thead>
<tr>
<th><strong>Client</strong></th>
<th>EDF Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Site Location</strong></td>
<td>Hunterston B</td>
</tr>
</tbody>
</table>
| **Project Amount**| ~£20m investment by EDF Energy  
~750 people involved |
| **Project Period**| July – September 2014 |
| **Work Scope** | Statutory outage and plant inspections |

**Project Overview**

- During a Statutory Outage, the Power Plant is taken off line to open and inspect components and carry out work that cannot be inspected when on line
  - Statutory Inspections of Tanks, Pipes, Vessels, Instruments, Pumps and Valves
  - Equipment Maintenance
  - Plant improvement or upgrade projects
  - In-reactor inspections
CASE STUDY – SERVICING AN AGR

Skilled nuclear resource, focused preparation & planning, predictable delivery
Supplier collaboration key to supporting EDF Energy for Outages and Life Extension

Event Characteristics
- Unexpected inspection test results
- Potential nuclear safety implications across the fleet
- Unique first of a kind engineering challenge
- Significant operational and commercial impact

Response Characteristics
- Key supply partners instrumental in developing solutions
- Over 90 suppliers engaged in the project
- >£70m spent across supply base
- 12 weeks from inception to delivery
SUMMARY

Extending life of the AGRs secures safe, reliable, low carbon generation for the future

- EDF Energy reviewed lifetime potential and updated the market on the expectation of an average life extension of 8 years for AGRs and 20 years for Sizewell B (PWR)

- January 2015 - EDF Energy announced a 10 year life extension for Dungeness B in line with this expectation

- The previous shorter-term planning approach was no longer sufficient

- Longer-term planning, based on a reasonable expectation of lifetime, is necessary and is already showing clear value and benefits

- Planning dates are underpinned with robust strategies and plans involving key UK suppliers and stakeholders

PWR – Pressurised Water Reactor
AGR – Advanced Gas Cooled Reactor
THANK YOU
END OF DOCUMENT