Nuclear Power in the UK Energy Mix

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Minerals 2014
Kegworth; Thursday 15 May 2014
Outline

- Background to nuclear energy in the UK
- Current prospects for new nuclear stations
- The Nuclear Industrial Strategy
- The role of the UK’s National Nuclear Laboratory
How a Nuclear Reactor Works

Source: Nuclear Industry Association
UK Nuclear Industry

- Pioneer in nuclear generation
- Full fuel cycle capability
- Highly skilled workforce
- Mature and flexible supply chain
- Exemplary safety record
- World leader in decommissioning nuclear reactors and associated facilities
- At forefront of global nuclear renaissance
The UK electricity mix

- Nuclear: 19%
- Gas: 28%
- Coal: 39%
- Renewables: 9.8%
- Hydro: 1.5%
- Other: 1.6%

Source: DECC, 2013 Digest of UK Energy Statistics
• The UK nuclear industry employs around 62,000 people

• Around half of these are in the North West of England, in particular Cheshire and Cumbria

• A programme of nuclear reactor new build could generate up to 40,000 additional jobs at its peak
Nuclear Generates Very Low Greenhouse Gas Emissions

Electricity Emissions Factors (kg CO₂e/kWh)

- Lignite: 1.21
- Coal: 0.91
- Oil: 0.77
- Natural Gas: 0.51
- Solar PV: 0.05
- Wind: 0.03
- Biomass: 0.03
- Nuclear: 0.02
- Geothermal: 0.02
- Hydro: 0.01

Source: World Energy Council 2004
• There’s plenty of uranium in the world, in countries like Canada and Australia

Total: 3,537 thousand tonnes

Sources: WEC, OECD, 2003

“Reasonably Assured Resources” and “Class I Estimated Additional Resources” - all in thousands of tU (<$80/kg)
There’s plenty of uranium in the world, in countries like Canada and Australia.

If supplies are disrupted, it doesn’t matter for a long time.

We can afford to pay a bit more for the uranium.

Nuclear plants run around the clock, whatever the weather.
Closure Dates for AGR and PWR Fleet

- Hunterston B: 2023
- Heysham 1: 2019
- Heysham 2: 2023
- Torness: 2023
- Hartlepool: 2019
- Sizewell B: 2035
- Dungeness B: 2018
- Hinkley Point B: 2023
- Wylfa: 2014
“By 2025, if current policy is unchanged, there will be a dramatic gap on our targets to reduce CO2 emissions;

…we will become heavily dependent on gas; and at the same time move from being 80/90% self-reliant in gas to 80/90% dependent on foreign imports,

These facts put the replacement of nuclear power stations, a big push on renewables and a step-change on energy efficiency, engaging both business and consumers, back on the agenda with a vengeance.”

Former Prime Minister, Tony Blair 16 May 2006, CBI Annual Dinner
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• Background to nuclear energy in the UK

• **Current prospects for new nuclear stations**

• The Nuclear Industrial Strategy

• The role of the UK’s National Nuclear Laboratory
• “Nuclear power has a key role to play as part of the UK’s energy mix”

• Energy companies allowed to build

• Government to take forward:
  • Strategic Siting Assessment
  • Strategic Environmental Assessment
  • EU Justification
  • Pre-licensing (including ensuring the NII have adequate resources)
  • Funding framework for waste and decommissioning liabilities
  • A National Policy Statement to ensure effective passage through planning process

Published 10 January 2008
Cross Party Consensus (since October 2013)
More of the Same?

• UK has had 19 nuclear power stations (of which 9 are still running), but 15 different designs
  • 11 Magnox stations
  • 7 AGR stations
  • 1 PWR

• France has 58 nuclear power stations, but essentially just 3 designs
  • 34 similar 900 MW plants
  • 20 similar 1300 MW plants
  • 4 identical N4 plants
Wastes from New Stations Would Add Little to Existing Stocks

- **High and Intermediate Level Waste**
  - 216,000 m$^3$
  - 23,000 m$^3$ (10%)

- **Low Level Waste**
  - 2,750,000 m$^3$
  - 80,000 m$^3$ (3%)

From 60 years operation of 10 AP1000 reactors.
‘Designated’ Nuclear Sites

- Moorside, Cumbria
  to be developed by NuGeneration Ltd

- Heysham, Lancashire
  EDF Energy has no plans yet

- Wylfa, Anglesey
  to be developed by Horizon Nuclear Power

- Oldbury, Gloucestershire
  to be developed by Horizon Nuclear Power

- Hartlepool, County Durham
  EDF Energy has no plans yet

- Sizewell, Suffolk
  to be developed by EDF Energy

- Bradwell, Essex
  EDF Energy has no plans yet

- Hinkley, Somerset
  to be developed by EDF Energy
New Build Plans for UK

EDF Energy UK
2 x 1600MW Areva EPRs for Hinkley Point
2 x 1600MW Areva EPRs for Sizewell
EU State Aid decision expected mid-2014
Final investment approval expected late 2014 / early 2015

Horizon Nuclear Power Ltd
(Owned by Hitachi)
2 x GE-Hitachi ABWRs at both Wylfa and Oldbury

NuGeneration Ltd
(Set to become a Toshiba-Westinghouse/GDF Suez Joint Venture)
3 x 1100MW AP1000s at Moorside, near Sellafield
Hinkley Point C
Where are we now?

- **Generic Design Assessment:**
  Completed End 2012

- **Site Licence:**
  Awarded November 2012

- **Planning:**
  Approved 19 March 2013

- **Electricity Market Reform:**
  Energy Bill – End 2013

- **“Strike Price”:**
  Agreed in October 2013 as £92.50 per MWh
  (£89.50 if EDF Energy proceed with Sizewell C)
Electricity Market Reform

- Carbon Floor Price
- Capacity Markets
- Contracts for Difference

![Diagram showing electricity market reform](image-url)
Public Opinion has Survived the “Fukushima Dip”

To what extent would you support or oppose the building of new nuclear power stations in Britain to REPLACE those that are being phased out over the next few years? This would ensure the same proportion of nuclear energy is retained (Net: support; Net: oppose)

Net: support
Net: oppose

Tracking adjustment for method change: Support (+5%); Oppose (+4%). Based on comparable question on favourability.
Base: Online survey (2,009)
Source: YouGov Dec 2012
In an uncertain world, one thing is very important to potential investors in nuclear: Certainty

- ...in the ability to licence the design
- ...in the availability of supply chain and skills
- ...the build schedule and cost
- ...in the plant running costs – fuel, operations & maintenance
- ...in the plant’s operational performance
- ...in the ability to finance projects
- ...in the ability to secure planning approvals
- ...in the revenue from long-term stability in energy prices
- ...in knowing their liabilities for spent fuel and decommissioning
- ...in the underpinning political landscape

Industry responsibility

Government responsibility
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UK Public Sector Fission R&D Funding

Funding £M

• Establish long-term nuclear energy strategy
• DECC to lead long term R&D roadmap
• Establish Nuclear R&D Board with funding
• National strategic R&D programmes on Generation IV reactors and advanced fuel cycles
• Broaden role of NNL
Nuclear Industry Strategy
March 2013

HOUSE OF LORDS
Select Committee on Science and Technology
3rd Report of Session 2010–12

Nuclear Research and Development Capabilities

Ordered to be printed 15 November 2011 and published 22 November 2011

Published by the Authority of the House of Lords
London: The Stationery Office Limited

H.I. Paper 221

The UK’s Nuclear Future

Industrial strategy: government and industry in partnership
The Vision in the wider context: Nuclear Industrial Strategy

Nuclear Industrial Vision

Nuclear Supply Chain Action Plan

Nuclear R&D Roadmap

Nuclear Landscape Review

NIA Nuclear Industry Current Capability Report

Sir John Beddington Review

Nuclear Industrial Strategy

Nuclear Energy Strategy
Key messages

• Nuclear strategy supporting long term Government energy policy, ongoing programmes and industrial exploitation

• Nuclear Innovation Research Advisory Board (NIRAB) to be established to advise Government.

• Nuclear Innovation Research Office (NIRO) to be established to deliver NIRAB strategy – NNL to host.

• Government to implement long term R&D programmes based on advice from NIRAB.

• NNL mission to be restated to give emphasis to supporting UK national programmes.

• NNL to stay in Government ownership, but current management contract will not be replaced.
Ownership and Management (GOGO)

- National Laboratory for both UK Government and Industry
- Support to national R&D programmes
- Host and lead NIRO

From 2013
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DECC Objectives

1. Place NNL on a sound commercial footing
2. Safeguard the UK's strategic nuclear skills
3. Develop NNL's customer base beyond its historic nuclear markets
4. Optimise the utilisation of NNL facilities
5. Enable the use of NNL facilities by others; and
6. Provide support for the West Cumbrian master plan
• Around 800 staff
  - Over 60% of whom have science or engineering degrees / PhDs
• Key customers
  – Sellafield Ltd, EdF Energy, NDA, Magnox, Cavendish Nuclear, MoD, Westinghouse, UK Government, Regulators
• Annual turnover of around £90M
• We operate as a commercial business
  - No direct funding grant from HMG
6 Locations Across the UK

- Sellafield
  - Central Laboratory
  - Windscale Laboratory
- Workington Laboratory
- Springfields
  - Preston Laboratory
- Risley
- Stonehouse
- Harwell
The Role of the National Nuclear Laboratory

Universities

**Basic Science**
- Proof of principle
- Small scale
- Low radiation
- Surrogate materials
- Non-licensed

NNL

**Research, Development and Testing**
- Convert why (science) to how (technology)
- Independent and authoritative
- Establish practicality
- Scale up
- Actual materials
- Licensed facilities

Industry

**Technology Deployment**
- Application of product
- Full scale
- Solution to problem
- Marketable

Technology maturity
NNL supports all nuclear programmes

- Continued operation of existing reactors & fuel cycle facilities (fuel fabrication, reprocessing)
- Legacy waste management / decommissioning
- New nuclear build
- Geological disposal
- Plutonium stockpile disposition
- Naval propulsion support
- Advanced reactor & fuel cycles
- Space energy systems
- Security, non-proliferation & safeguards

Between them, NNL employees have over 10,000 man-years of nuclear industry experience
Summary

• The UK’s nuclear industry is already a major contribution to meeting UK energy needs

• Plans for new nuclear build in the UK are very much alive

• The next important steps are the EU decision on the State Aid issue for Hinkley Point C, and EDF Energy’s Final Investment Decision to proceed.

• The National Nuclear Laboratory is uniquely placed to support the industry – owned by UK Government, but run commercially and returning a profit