



Visualisation of Hinkley Point C - Image courtesy of EDF Energy

# The Role of Consultancies in the UK Nuclear Industry

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SYSTEMS AND ENGINEERING TECHNOLOGY

# Aims

- ▶ Give an understanding of:
  - ▶ The UK Nuclear Industry, and a broad overview of the key clients
  - ▶ The benefits and risks of consultancy to the client
  - ▶ The types of services provided by consultancies
  - ▶ Some key limitations to consultancy support
  - ▶ Some key industry partnerships
  - ▶ What work is completed



# Presentation Structure

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## The UK Nuclear Industry

Benefits & Risks

Services & Limitations

Key Industry Partnerships

Worked Examples

Summary

# The UK Nuclear Industry

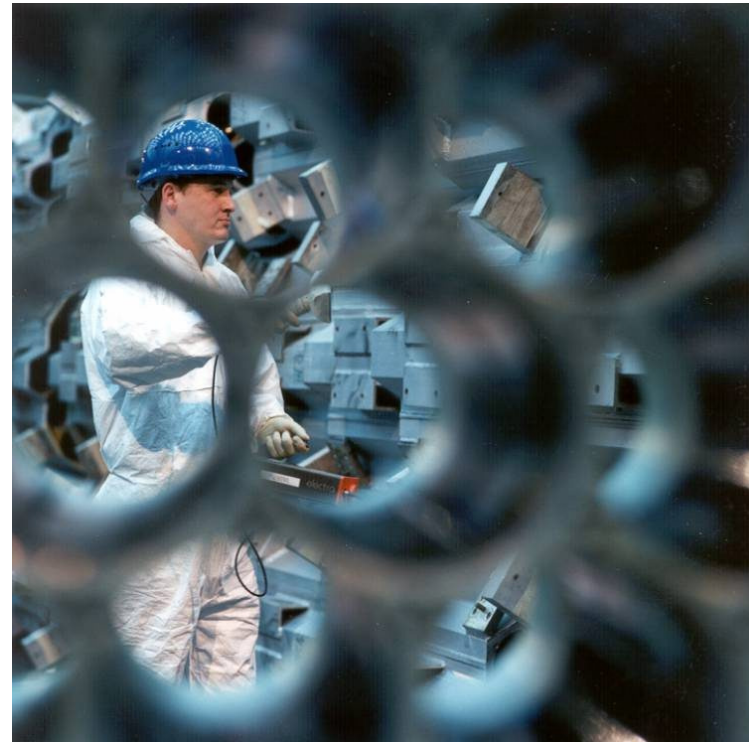
- ▶ Divided into 4 main areas:
  - ▶ Civil Nuclear Generation
  - ▶ Civil Nuclear New Build
  - ▶ Civil Nuclear Decommissioning
  - ▶ Defence Nuclear



- ▶ Nuclear Industry in the UK employs
  - ▶ ~50,000 people directly
  - ▶ >80,000 in linked jobs

# Civil Nuclear Generation

- ▶ Covers existing plant operators:
  - ▶ Magnox (now run by the NDA, and now only includes Wylfa as a generating reactor)
  - ▶ EDF Energy
- ▶ Nuclear Generation accounted for ~18% of the UK's supply in 2011 – 16 units, across 9 sites, supplying over 10 GWe



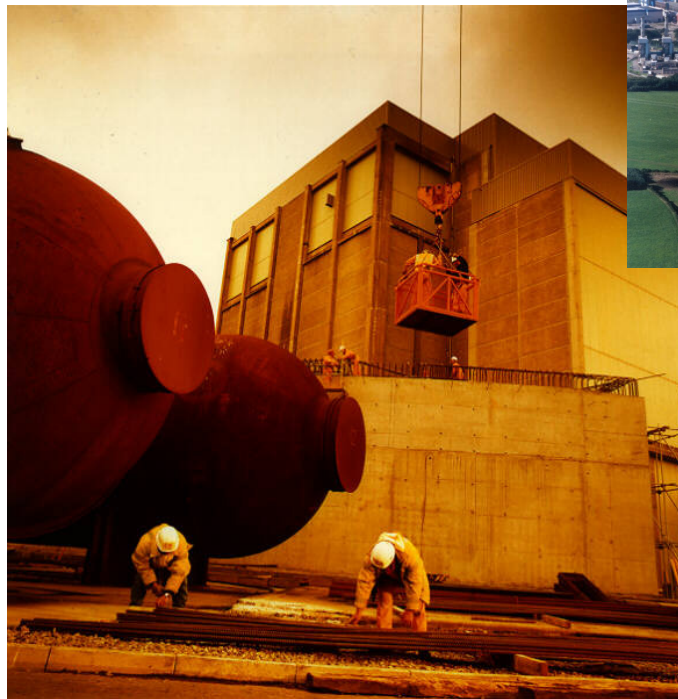
# Civil Nuclear New Build

- ▶ There are 3 main players in the UK new build market:
  - ▶ EDF Energy (under the guise of NNB GenCo)
    - ▶ Expected to need a peak workforce of ~1500 during commissioning
    - ▶ HPC expected first generation by 2020
  - ▶ Horizon  
(recently acquired by Hitachi)
  - ▶ NuGeneration  
(owned by GDF Suez and Iberdrola)



# Civil Nuclear Decommissioning

- ▶ Overseen by the NDA
- ▶ Covers the following sites/organisations:
  - ▶ **Sellafield**
  - ▶ **Magnox**
  - ▶ Dounreay
  - ▶ Harwell
  - ▶ Winfrith
  - ▶ LLWR
  - ▶ Springfields



# Defence Nuclear

(Translation: Nuclear Powered Submarines, and all that sail within them...)



- ▶ Rolls-Royce Naval Marine
  - ▶ Reactor Manufacturers and Design Authority
- ▶ BAE Systems
  - ▶ Boat Manufacturers and Design Authority
- ▶ AWE
  - ▶ The bit that goes bang...



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# Presentation Structure

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**The UK Nuclear Industry**

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**Summary**

# Consultancy - Benefits

- ▶ Expertise
  - ▶ Niche skills
- ▶ Independence
  - ▶ Verification
  - ▶ Independent Assessment
- ▶ Cost
  - ▶ Planned contracts with set budgets
- ▶ Availability/Resourcing
  - ▶ Workload balancing



# Consultancy – Challenges and Risks

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- ▶ Loss of in-house capability
  - ▶ Design Authority
  - ▶ Intelligent Customer
- ▶ Broadening of the competition
  - ▶ Not usually a problem due to different market roles (vendor/support)
- ▶ Loss of Control
  - ▶ Programme
  - ▶ Cost
  - ▶ Resource
- ▶ Maintenance of technical files
- ▶ Concern from permanent members of staff



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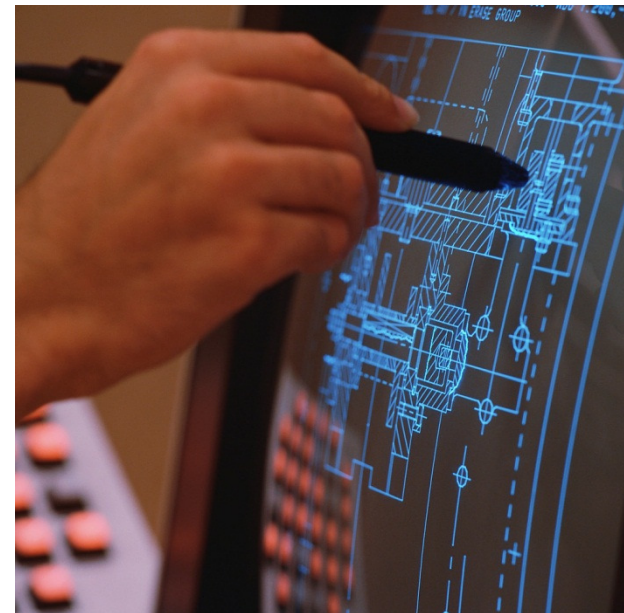
**Worked Examples**

**Summary**

# Services Provided (1)

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- ▶ Software
- ▶ Event Analysis/Investigation
  - ▶ Fault Studies
  - ▶ Post-incident Investigation / Justification for Continued Operation
- ▶ Engineering Analysis
  - ▶ Fluids
  - ▶ Structural Integrity
  - ▶ Thermal-Hydraulics
  - ▶ Electronics
  - ▶ Control & Instrumentation
- ▶ Lifetime Support



## Services Provided (2)

- ▶ Plant Modifications
- ▶ Safety Case Authorship
  - ▶ AV1/AV2
- ▶ Life Extension
- ▶ Obsolescence Management
- ▶ Project Management
- ▶ Research Management
- ▶ Independent Auditing



# Limitations

- ▶ Commercially Confidential information
  - ▶ Trading arrangements
- ▶ The Crown Jewels
  - ▶ Niche skills/expertise
- ▶ Design Authority
  - ▶ “Key” roles must be maintained by the DA
  - ▶ This includes Intelligent Customer role



# Presentation Structure

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# Key Industry Partnerships



- ▶ Generic Design Assessment
- ▶ EDF Energy
  - ▶ Technical Support Alliance
- ▶ Magnox/NDA
  - ▶ TESSA
- ▶ Sellafield
  - ▶ Design Services Alliance
- ▶ Naval Nuclear Defence



# Office of the Nuclear Regulator



- ▶ Generic Design Assessment
- ▶ Technical Support Framework supporting HSE
- ▶ Originally for EPR, AP1000 and ESBWR
- ▶ Various lots, now assigned to various bidders
  - ▶ Internal/External Hazards
  - ▶ Probabilistic/Deterministic Safety Analyses
  - ▶ Mechanical Engineering
  - ▶ Structural Integrity
  - ▶ Human Factors
  - ▶ Fuel Design
  - ▶ Reactor Chemistry
  - ▶ Control and Instrumentation



- ▶ The TSA comprises 3 Tier 1 companies
  - ▶ Atkins
  - ▶ AMEC (including what was SERCO)
  - ▶ Frazer-Nash Consultancy
  
- ▶ Discharges several £M worth of work each year covering
  - ▶ Civil Engineering
  - ▶ Electrical Engineering
  - ▶ Mechanical Engineering
  - ▶ Systems Engineering



- ▶ Engineering Framework Services
- ▶ Involves Astec, Frazer-Nash, Jacobs, SERCO (Now AMEC)
- ▶ Previously known as TESSA
- ▶ ~15 year history
- ▶ Significant impact on reactor lifetimes
  - ▶ Especially for Wylfa and Oldbury



- ▶ Covers Sellafield site
  
- ▶ Two Consortia
  - ▶ Axiom
    - ▶ Assystem, AMEC, Jacobs & Mott-McDonald
  - ▶ Progressive
    - ▶ Babcock (including Frazer-Nash), & URS
  
- ▶ 15 year contract
  - ▶ Worth ~£60M/year

# Presentation Structure

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# Japanese Earthquake Response



- ▶ Following Fukushima (Weightman report)
  - ▶ Stress tests on UK plant
  - ▶ Standard safety case concentrates on Design Basis
  - ▶ Concerns over Beyond Design Basis

- ▶ How to ensure risk is still ALARP
  - ▶ “Don’t touch” scenario
  - ▶ Off-site supplies
  - ▶ Test resilience of existing plant
  - ▶ Economic impact of accident less important
  - ▶ Significant success in proving safe operation outside reasonably expected events



# Hartlepool/Heysham Hotbox Dome

- ▶ Raised thermocouple readings on under-side of dome
  - ▶ Reduced operating power
  - ▶ Significant economic impact
- ▶ Large programme of work with 2 main aims
  - ▶ Restore lost output
  - ▶ Address issue to end of life

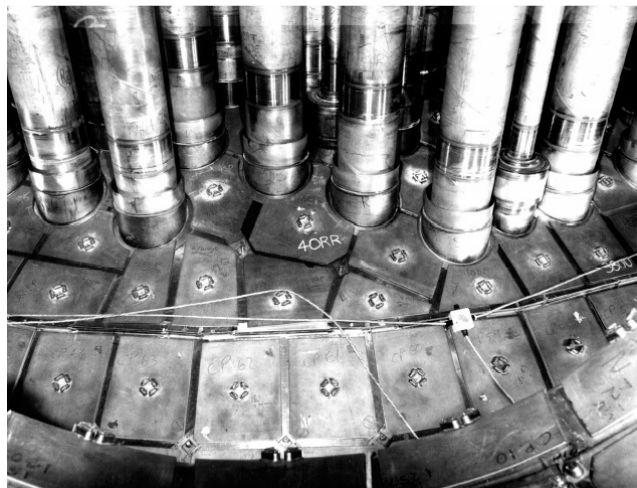
**TOP 30  
ENGINEERING  
PROJECTS 2012**

## **SHELF-LIFE SOLUTION**

- » EDF nuclear plant extensions, Hartlepool and Heysham
- » Cost: undisclosed

Extending the operating life of the 30-year-old nuclear stations at Hartlepool and Heysham 1 has always been a priority for EDF since it took control of them. But it was only last year that engineers overcame the technical problems that prevented the process.

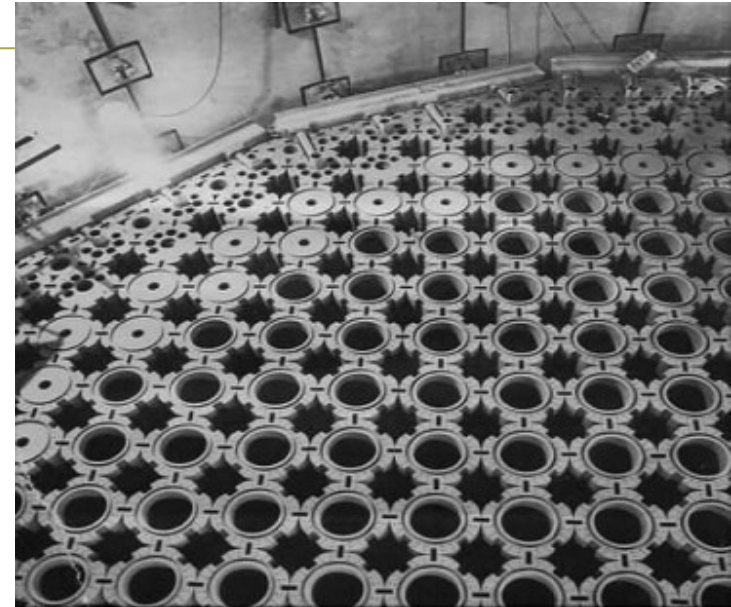
A design problem with the hot box dome, which separates cooler high-pressure gas from hot gas, meant output loads had to be reduced. At Heysham 1, the load on its second reactor was reduced to 80% in 2006 and by last year it was down to 70% of full load. The loads were cut to bring down the surface temperature on the hot



- ▶ Workstreams
  - ▶ Root-cause analysis
  - ▶ Thermal analysis
  - ▶ Reactor inspections
  - ▶ Physical mitigations
  - ▶ Safety case

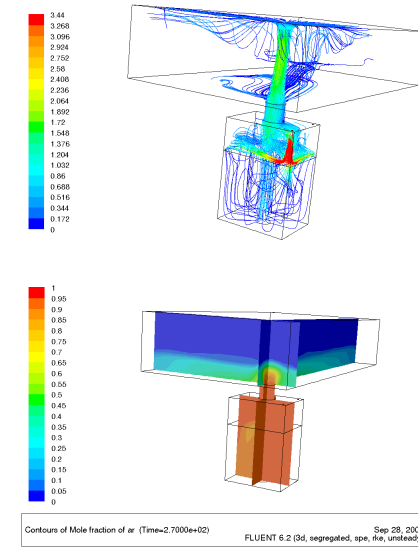
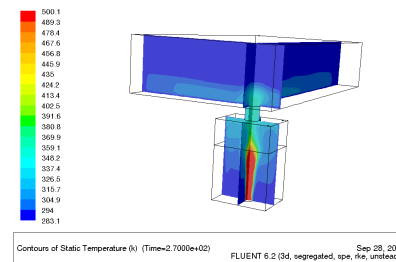
# Graphite Research

- ▶ Radiolytic Oxidation
  - ▶ Graphite Weight Loss (GWL)
- ▶ Issues
  - ▶ Decreased Moderator Performance
  - ▶ Altered Thermal Properties
  - ▶ Structural Integrity/Deformation
  - ▶ One of the key reasons behind closure of Magnox power stations
  - ▶ Expected to be life-limiting for AGRs as well
- ▶ Key Issue for EDF Energy to ensure continued generation
  - ▶ Large Research Program: Industry and Academia
  - ▶ Models – Weight Loss => Structural Properties => Crack models & Neutronics predictions

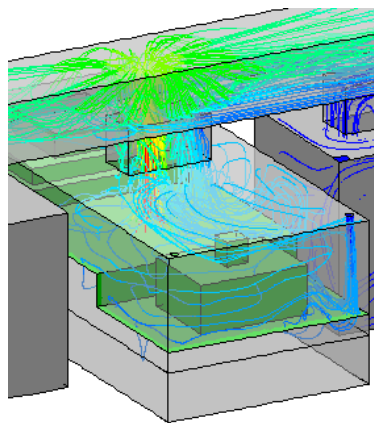


# Argon Fire Suppression Systems

- ▶ Magnox Fuel Element Debris in Waste Vaults
- ▶ Trawsfynydd
  - ▶ CFD Modelling to predict 92% argon timing
  - ▶ Closed system
  - ▶ Support to safety case
  - ▶ Thermal plume carries argon away from fire



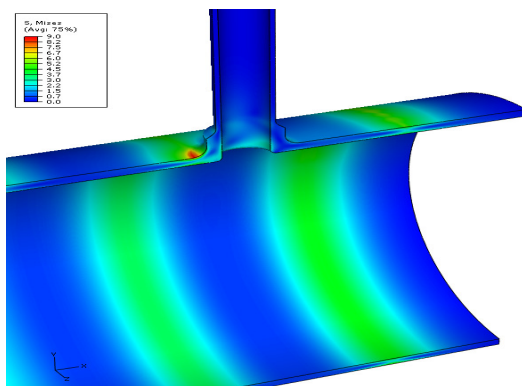
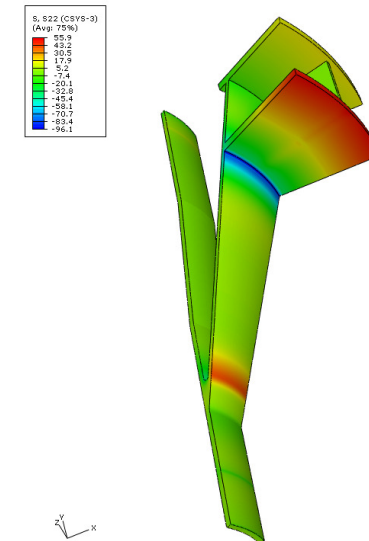
- ▶ Berkeley



- ▶ During decommissioning, system will be open
- ▶ Concern centred on fresh air flow driven by thermal plume
- ▶ Modelled fire strength: Argon effect vs Fire growth due to fuel heating
- ▶ Suggested modifications to allow effective use

# Reprocessing Vessel Assessment

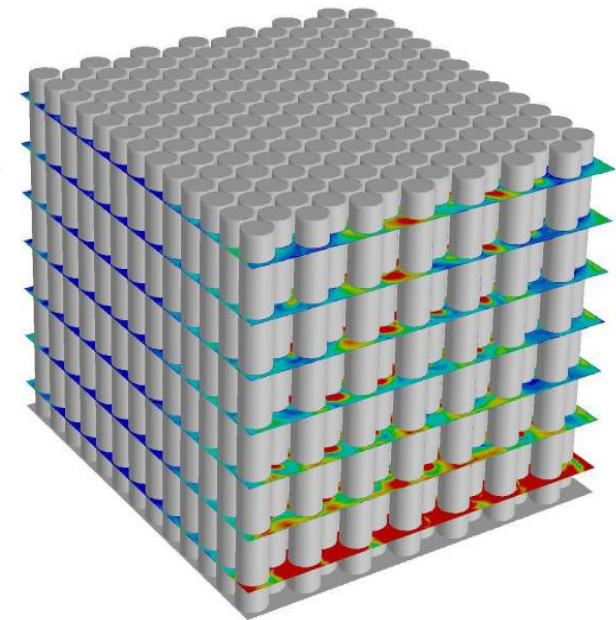
- ▶ High temperature reprocessing plant
- ▶ Creep rupture concern
- ▶ Assessment against BS7910
  - ▶ Finite Element and Heat Transfer assessments
  - ▶ Predicted most vulnerable areas
  - ▶ Able to target inspections



- ▶ Client Benefits
  - ▶ Reduction in operational downtime
  - ▶ Reduction in operator dose
  - ▶ Reduction in costs
  - ▶ Confidence in safe operation

# ILW Waste Store

- ▶ Dounreay waste handling and storage
- ▶ 8,000 drums of Intermediate Level Waste
- ▶ High drum integrity requirements
- ▶ Major concern was humidity levels
- ▶ CFD Model of individual bay
  - ▶ Water vapour from concrete
  - ▶ Assessed humidity and temperatures
- ▶ High temperatures found inside bay, as well as in roof crane area



- ▶ Found humidity fine, but high temperatures
  - ▶ Design now focussing on peak temperatures

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- ▶ UK Nuclear Industry draws heavily on consultancy support
- ▶ This strategy has both risks and benefits
- ▶ The total consultancy support in the industry is likely to increase with new build
- ▶ The range of skills, expertise and manpower that can be brought to bear at short notice through consultancy has repeatedly shown its value to the industry

# Questions?

[www.fnc.co.uk](http://www.fnc.co.uk)

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