Capability of the UK Nuclear New Build Supply Chain
Delivering a Nuclear Future for the UK
December 2012

Capability Report.
Foreword to Capability Report by Lord Hutton

I am pleased to introduce this report by the NIA on the capability of the UK supply chain to deliver a new nuclear programme.

The NIA published a Capability Report in 2006, when new build was a policy option rather than a specific programme. This 2012 report comes as the programme is getting under way, with the developers setting out their plans for the supply chain and the first contracts being awarded.

As the report was being completed, the programme received a huge boost with the announcement by Hitachi that it is acquiring Horizon Nuclear Power. This represents a long term commitment to the UK and is a vote of confidence in the role of nuclear power and the UK supply chain.

The nuclear new build programme offers a massive opportunity for the UK economy, creating over 30,000 jobs at peak and contributing to the growth of low carbon power generation. This report demonstrates the potential for the UK supply chain and sets out recommendations for action to maximise the opportunities for UK companies.

The report has been prepared by a group of industry experts including contractors, developers and technology vendors. It speaks with the voice of industry and provides the most authoritative analysis made to date of the supply chain’s capability and the available opportunities. We are very grateful to the industry experts who have given their time and to their companies for supporting this important initiative on behalf of UK industry.
Executive Summary

The objective of this study is to assess the capability and capacity of UK industry to deliver a programme of new nuclear power stations in the UK over the next 15 to 20 years while continuing to support the existing, operating UK nuclear stations and to execute the UK Nuclear Decommissioning Authority’s decommissioning programme.

This report is intended to inform policy and decision makers in Government, local authorities, trades unions, skills and training organisations and industry of the current situation and to indicate where action should be taken to strengthen the UK nuclear supply chain and to enhance the prospects for successful delivery of the nuclear new build programme.

There are currently around 40,000 people working in the UK civil nuclear industry: 25,000 employed directly plus a further 15,000 in the supply chain with many additional indirect jobs supported by nuclear industry activity. The projected resource demand from the proposed new build programme of 16GWe will increase this to around 66,500 at the peak of the new build period. Beyond this, into the operational period, the numbers will reduce to 47,000 on the basis of the 16GWe programme, with further growth if the new build programme exceeds the initial 16GWe, as is likely to be the case.

It is recognised that development of UK resources necessary to support a UK programme will be inextricably linked to the broader opportunities for the UK to contribute to international nuclear programmes. Similarly, the resources required for the UK nuclear programme will be in demand for other major UK engineering programmes. This will create both opportunities and challenges.

The study has been carried out under the auspices of the NIA by a group of industry experts from the new build developers, nuclear system providers and major contractors, all directly involved in the nuclear new build programme and thus very familiar with UK nuclear capability. The group has been supported by the skills agencies, Government departments and other industry experts.

Since the last NIA Capability Reports in 2006 and 2008 there has been significant progress in preparing the way for a new nuclear programme and we are now on the threshold of the programme commencing:

- Government has implemented, and continues, a series of facilitative actions.
- Developers have laid out their plans for projects at five sites around the UK.
- At the time of writing, Hitachi has completed the acquisition of Horizon Nuclear Power.
- EDF Energy has submitted a planning application and initiated preliminary work for Hinkley Point C.
- The supply chain is tendering and preparing to execute contracts.
- Competition and partnerships with overseas companies are developing.

However, there are still uncertainties about the programme and the extent of UK content will depend on the supply chain’s capability and capacity to deliver.

There are no guarantees that UK companies will win contracts. Therefore UK supply chain companies need to be considering now their strategic actions and investments necessary to build their capabilities and capacity to compete effectively for the emerging opportunities.
EXECUTIVE SUMMARY

The study has examined UK industry's position in terms of:

- Are there sufficient facilities and skilled employees to deliver the major UK companies will be supported by many excellent smaller companies, particularly from industrial and business communities local to the nuclear sites, which are very familiar with the requirements of the programme. This sector is well resourced, but there will be a need for up-skilling and training to meet the new requirements of the new build programme, as more new build is implemented but others are still assessing when to commit.

- Can UK firms win orders against global competition?

- Does the UK have the facilities, skills and experience to deliver nuclear equipment and building new nuclear stations?

- To support site activities. Recruitment and training will be necessary to increase capacity by a multiplication factor of 4-6. Joint ventures are likely to create significant pinch points in certain areas and at certain times throughout the programme. Manpower estimates have been made for a 16GWe programme building to a peak of around 30,000 people and will then drop off into the operational phase.

- How will participants in the nuclear supply chain be able to manage the demands of delivering large-scale nuclear projects while maintaining existing business?

- What is UK capability and capacity as summarised in the UK?

UK capability and capacity have been summarised in the UK in terms of the UK's nuclear new build programme, the first phase of which is due to start in the late 2000s. The programme is expected to last for 30 years and will involve the construction of several new reactors, each designed to produce 1.6GW of electricity. The scale of the nuclear new build programme will substantially increase the demand for skills and industrial resources and is likely to create significant pinch points in certain areas and at certain times throughout the programme. Manpower estimates have been made for a 16GWe programme building to a peak of around 30,000 people and will then drop off into the operational phase.

The study has identified strengths in the UK supply chain, but has also identified areas requiring improvement. The report recommends actions in the short term to mitigate these, to assist in delivery of the new build programme, to achieve substantial input from UK companies, and to ensure that the UK is competitive and viable in the long term.

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Training
The Government and industry should re-examine the approach to training and put more funding into industry to ensure that industrial training is effective. Initially this should be aimed at new build but it will spin off to the benefit of UK industry in general. To attract young engineers into the industry the Government should consider subsidising tuition fees for university courses in engineering, not just for nuclear engineers, as is currently done for medical courses. Particular attention should be given by the Government and industry to the industrial phase of apprentice training as this is a bottleneck at present.

Business Support
Medium and small companies need more direct technical and financial support to improve their quality and business systems:

- Many need better direction as to where to go for advice.
- The Nuclear Advanced Manufacturing Research Centre (NAMRC) should continue to be supported in its role of assisting manufacturing companies to enter the nuclear market.
- The role of the Manufacturing Advisory Service (MAS) should be reviewed as it is not fulfilling its potential to help companies enter the nuclear market.
- Equipment qualification is an added cost and a barrier to firms wishing to enter the nuclear market. Additional resources and technical and financial assistance would help companies overcome this hurdle.
- Investment support for facilities, training and improvement of business systems should be made more easily available, via loans or grants.

Finance
Access to private finance through organisations that understand the sector is critical. Support needs to be provided quickly. The Government should actively promote private funding initiatives that will support the nuclear sector.

Supply Chain Preparation
Tier 1 contractors understand what is required and are developing their supply chains for their target market. Some of the smaller companies require technical and financial support to bring their facilities, processes and systems up to the standards required for nuclear new build.

Manufacturing
Capability and capacity for manufacture of some of the safety-critical, high precision equipment in the UK is limited and would benefit from investment in technology and machine tools to increase the competitiveness and potential scope of UK companies.

Client/Contractor Relationships
Successful delivery of major, complex and long term contracts is dependent on good contractual and industrial relationships. This is particularly so where there is a programme of projects that will be competing for resources. The NIA Programme Management Board should contribute to the development of strong client/contractor relationships and a common understanding of the challenges facing the new build programme.

The opportunities for the UK economy are enormous and with the actions described in this report, we believe that industry will be ready to play a significant part in delivering the new build programme in the UK whilst also positioning itself effectively to contribute to the global nuclear renaissance.
The New Build Programme

There are currently plans to build about 16GW of new nuclear capacity, replacing the current 8GW fleet of AGR and Magnox reactors, which are scheduled to reach the end of their lives in the period up to 2023, and the 1.2GW PWR at Sizewell B, due to close in 2035.

The NPS for new nuclear power stations was approved by Parliament in July 2011 and lists eight sites as suitable for new nuclear power stations. The sites are listed in appendix A.

Generic Design Assessment (GDA)

A process conducted jointly by the Office for Nuclear Regulation, part of the Health and Safety Executive, and the Environment Agency. The GDA allows the safety, security and environmental aspects of new reactor designs to be assessed before applications are made for licences and permits to build a particular design of reactor on a particular site.

The GDA process to date has examined the commissioned design, the EPR jointly developed by Areva and EDF and the Westinghouse AP1000, and it is anticipated that Hitachi’s ABWR design will enter the GDA process.

Developers and Project Definition

Three developers currently have plans to develop new nuclear plants in the UK:

- EDF Energy and Centrica
- Horizon Nuclear Power
- Hitachi

Further details are given in appendix B.

Projects in Further Detailed Stage

EDF’s plan for a twin reactor station at Hinkley Point is the most advanced project of the new build programme.

The independent Nuclear Liabilities Funding Allocation Board (NLFAB) was set up to ensure that operators fund decommissioning, waste management and disposal for new nuclear plants and that taxpayers, consumers and industry are protected against risks.

The Policy Context

The Government believes that new nuclear power stations could deliver a significant part of the low carbon electricity that the UK will need in the future in order to meet its carbon targets. New nuclear power stations could also help to secure the UK’s energy supplies and diversify the country’s energy sources.

A requirement under European law that the Government must establish that the benefits of any new nuclear activity outweigh the health risks.

One of the key elements of the reform was that EDF’s twin reactor design would be subject to a series of regulatory assessments before it could be licensed and permitted to build.

The Energy Act 2008 requires operators of new nuclear power stations to have secure financial arrangements in place to meet the full costs of decommissioning and their full share of waste management and disposal costs.

The Secretary of State published his justification decision in October 2010, and this was supported by a Parliamentary division with the largest supportive majority (520:27 for the EPR and 517:26 for the AP1000) since 1945 on any issue. Other modern reactor technologies would be expected to attract similar support.

Electricity Market Reform

Reforms to the UK’s electricity market are intended to give greater certainty to investors to develop low carbon sources of generation.

A carbon floor price is one of the key measures intended to encourage greater investment in low carbon technologies.

The Government has taken a number of facilitation actions to enable companies to make investment decisions. The principal actions that have been taken are:

- The Secretary of State has published indicative investment zones in the Financial Memorandum to Parliament.
- The Government has published guidance on the new nuclear process.
- The Secretary of State has published the Government’s (MDG) on low carbon nuclear investment.
- The Government has published the Nuclear Investment Framework, which sets out the Government’s approach to nuclear investment.
- The Government has published the Nuclear Investment Code, which sets out the Government’s approach to nuclear investment.
Supply Chain Support

The NIA's sc@nuclear programme has raised awareness and provided information directly to companies involved in the nuclear supply chain, including those in the construction sector, and helped companies understand the opportunities the new build programme presents. It has also offered guidance for supply chain companies, especially smaller companies, to assist them in preparing to compete for the work associated with new nuclear projects, and has helped ensure they have the necessary qualifications and experience for bidding. In particular, the supply chain support provided by the NIA has been important in maintaining and developing the UK's nuclear skills base.

Investing in Skills

The Nuclear Energy Skills Alliance (NESA) is a grouping of the key strategic skills bodies and state nuclear organisations to facilitate the development of essential skills for the nuclear industry. NESA aims to address the current and future skills needs of the UK nuclear programme and its members have agreed to work together to ensure an adequate and skilled supply of nuclear workers. Members of NESA have completed the online assessment of which 40 have completed the full F4N process and published two Essential Guides to Nuclear New Build.

At the time of writing the necessary legislation is due to be introduced to Parliament in the Energy Bill. It is also critical that the Government ensures that the other stakeholders take account of the requirements of the new build programme and specifically that National Grid connections are aligned with the timescales of new build projects.

Fukushima and the Weightman Report

The Fukushima disaster, whilst it has changed the views of governments in some countries such as Germany, has not affected the overall scale of the global nuclear renaissance. Policy with respect to civil nuclear power development has been reaffirmed in many countries. Public support for nuclear power in the UK has not changed and the political support remains strong. The construction of new plants on site are proceeding at the Hinkley Point C project and Sizewell C project.

Outstanding Policy and Regulatory Issues

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UK Capability

2.1 The UK has a strong history of developing and supplying civil nuclear programmes. Many of the skills that were developed to build previous generations of nuclear power stations are now being deployed in the decommissioning and clean-up programme. And the UK has successfully delivered major infrastructure programmes in energy and transport that demonstrate many of the construction skills that will be required in the new nuclear build programme.

2.2 The NIA’s previous report on UK Capability to deliver a New Nuclear Build Programme concluded that the UK supply chain could deliver the majority of the work packages required in a new nuclear programme and this study has confirmed that this remains the case.

2.3 The detailed Work Package Datasheets, listed in Appendix III, present assessments carried out by industrial experts of the capability of the UK supply chain to deliver work packages comprising a full power station. These Work Package Datasheets form the basis from which many of the conclusions of the report were developed.

2.4 An important consideration for the main suppliers of equipment and services is their knowledge of the codes to which these power plants are designed. The Westinghouse AP1000 plant is designed to the ASME codes with which many UK companies are very familiar. It is assumed that the Hitachi ABWR will also use ASME codes but at the time of writing this has yet to be confirmed. The AREVA/EDF EPR is designed to the French RCC codes which are less familiar to the UK industry. The major UK companies and specialist suppliers have, however, been training their staff in the application of these codes and the procurement strategy being implemented by EDF is encouraging the formation of UK-French joint ventures to address potential knowledge gaps in the short-term.

UK Capability by Discipline
Programme Management and Support to Owners

2.5 It is widely recognised that strong project and programme management capability, provided by a combination of the developer’s own in-house resources, those of main contractors and support from external consultancy advice will be critical to the successful delivery of the new build programme, bearing in mind the scale and complexity of the challenge.

2.6 The UK has demonstrated the capability to programme manage large infrastructure projects of a similar scale and complexity, most recently in the Channel Tunnel Rail Link, Heathrow Terminal 5, the Olympic programme and currently with Crossrail.

2.7 Currently no single UK company would be seen to be capable of managing the delivery of a programme of nuclear power stations. However, capability has been demonstrated to deliver large, complex projects through special project delivery vehicles with integrated management teams bringing together several organisations with strong international experience.

2.8 It is anticipated that such teams will be located in the UK and will incorporate UK companies that can provide project management and technical expertise support.

2.9 UK capability is summarised in the tables below in terms of industrial capability and specific skills.
In some cases, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.

Skills
Programme Management and Technical Services

Activities

<table>
<thead>
<tr>
<th>Programme Management</th>
<th>Project Management Services</th>
<th>Consents &amp; Planning</th>
<th>Safety &amp; Site Licensing</th>
<th>Technical Support</th>
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Cumulative Effect

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<thead>
<tr>
<th>Programme Managers</th>
<th>Safety Engineers</th>
<th>Civil Designers</th>
<th>Geotechnical Engineers</th>
<th>Quality Managers</th>
<th>Environmental Engineers</th>
<th>Commercial Advisers</th>
<th>QS &amp; Estimators</th>
<th>Project Planners</th>
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KEY

- **No capability**
- **Capacity can be grown with investment, recruitment, training**
- **Skills shortages, need special attention**

Skills
Programme Management and Technical Services

<table>
<thead>
<tr>
<th>Activities</th>
<th>Skills</th>
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Civil Engineering and Construction

2.10 There are several large UK civil engineering companies, operating internationally on major projects, with the capability to carry out much of the design work and most of the construction work for new nuclear power stations in the UK. It is anticipated that much of this work will be delivered through joint ventures involving both UK and international companies, as is common practice internationally in major infrastructure projects.

2.11 UK companies have experience of delivering very large scale and complex civil engineering and construction projects, including the Olympics, Heathrow Terminal 5, Channel Tunnel Rail Link (stage 2) and Crossrail. In many cases, including the examples mentioned, these entailed bringing large resources into logistically difficult locations.

2.12 Much of the work will be managed by UK/international partnerships and these are already being developed. However, most of the delivery of projects will be handled by resources from the UK companies in these partnerships. UK contractors have a strong track record of working successfully with trades unions. All of the onsite employment and most of the employment in the supply of materials (steel, cement, aggregates) will be in the UK.
In some cases, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.

### Skills

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<tr>
<th>Civil Engineering and Construction</th>
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<td>Skills</td>
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<td>Civil Engineering and Construction</td>
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<td>Site Supervisors</td>
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<td>Steel Fixers</td>
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<td>Steel Frame</td>
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<td>Site Labour</td>
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<td>Surveyors</td>
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<td>Quantity Surveyors</td>
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<td>Radiation Engineers</td>
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<td>Cladding</td>
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<td>Marine Works</td>
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<td>Site Erection</td>
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<td>Cladding</td>
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<td>Cladding</td>
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<td>Specialist Transport</td>
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<td>Heavy Lifting</td>
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<td>Heavy Lifting</td>
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**Cumulative Effect**

In some cases, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.

### Plant and Equipment – Supply

There is a small number of items for a nuclear project which can be manufactured by only a few companies in the world and for which there is no current UK capability. These are the reactor pressure vessel, main turbo-generator, reactor coolant pump, associated ultra-large forgings and large diesel engines. There are only a very few companies in the UK who could possibly develop this capability; the cost and timescales are very demanding and the business cases for investment are currently not attractive. These key items will therefore be supplied from the few companies in the world that have this capability. Although they are critical, these items represent a relatively small portion of the total requirement for a new nuclear plant.
### Industry Capabilities

#### Plant and Equipment Manufacture and Installation

<table>
<thead>
<tr>
<th>Component</th>
<th>Major Companies</th>
<th>Support Companies</th>
<th>Skills</th>
<th>Experience</th>
<th>Facilities</th>
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</thead>
<tbody>
<tr>
<td>Reactor Pressure Vessel</td>
<td>≥ 5 Companies</td>
<td>≥ 5 Companies</td>
<td>Sufficient</td>
<td>Sufficient capacity with some investment</td>
<td>Sufficient current capacity</td>
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<td>RPV Internals</td>
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<td>Reactor Integrated Head Package</td>
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<td>Steam Generator</td>
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<td>Primary Circuits</td>
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<td>Control Rods Drive Mechanism (CRDM)</td>
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<td>Reactor Containment Liner/Vessel</td>
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<td>Primary Circuit Auxiliaries</td>
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<tr>
<td>Tanks, Vessels, Heat Exchangers*</td>
<td>≤ 2 Companies</td>
<td>≤ 2 Companies</td>
<td>Skills shortages, need special attention</td>
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<td>Reactor Coolant Loop Pumps</td>
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<td>Pumps &amp; Valves</td>
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<td>Mechanical Equipment Modules</td>
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<td>Reactor Polar Crane</td>
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<td>Cranes (Excluding Polar)</td>
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<td>Primary Loop Pipework</td>
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<td>Safety Related Pipework</td>
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<td>Non-Safety Related Pipework</td>
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<td>HVAC</td>
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<td>Nuclear Island Installation</td>
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<td>Turbine/Generators</td>
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<td>Emergency Diesels</td>
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<td>Transmission &amp; Distribution</td>
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<td>Radwaste Plant</td>
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<td>Water Treatment Package</td>
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<td>General Site Electrics</td>
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<td>Security Equipment</td>
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<td>Mechanical Installation</td>
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*May be less capacity for safety related tanks etc.

#### Plant and Equipment – Installation

A key part of the capability required to deliver a new nuclear plant will be installing the equipment on site.

The UK has capability to provide much of the onsite installation of mechanical and electrical components, in some situations supplemented and backed by specialist engineering skills from the equipment suppliers. It is expected that increases in capacity and associated training will be required across the board.

The nuclear system provider is likely to use its own specialist engineering teams for installation of safety-critical components within the nuclear island but may utilise UK partners or specialist subcontractors. Most other installation can be provided by UK companies and is similar in scope to work currently being carried out by UK contractors on nuclear projects and in other infrastructure sectors such as oil and gas or safety-critical engineering sectors such as aerospace.
As for the civil works, the experience of developers and UK contractors in working with trades unions, including having effective site agreements and communications, will be important in avoiding costly disruption.

There will be a period of two to three years from initial contract award to start of site installation, but it is necessary that companies start early to develop their installation teams. This may have to include importing overseas skills which will require security clearance and could cause delays.

**Capability Summary**

UK companies cannot supply the reactor pressure vessel, steam generators, turbo-generators or reactor coolant pumps and currently have no plans to invest in these highly specialised manufacturing areas. However, the UK could supply almost all other equipment and services. There are also many smaller companies that can support the major contractors, including many small companies local to the proposed new build sites. Some of these are very good companies but most of them will need to improve their quality systems in line with nuclear industry requirements. The success of UK companies in winning orders will of course depend on their capacity and competitiveness, which is discussed in the following chapters.

**Skills**

Plant and Equipment Manufacture and Installation

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<td>Sup.</td>
<td>Welders</td>
<td>Designers</td>
<td>Test Technicians</td>
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<td>Key</td>
<td>Skills</td>
<td>Capacity</td>
<td>Skills shortages</td>
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In some areas, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.

**Cumulative Effect**

In some cases, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.
This section looks at the demands on resources that will be created by the new build programme and whether the UK supply chain has the capacity to meet this demand, bearing in mind the other demands that will compete with the new build programme for resources:

- Current and planned activities in the rest of the nuclear programme, including existing generation, decommissioning, fuel supply and reprocessing and defence programmes.
- Other developments in energy infrastructure including demand for gas and abated coal-fired generation, the growth of renewables and significant investment in transmission.
- Infrastructure developments in transport and other sectors.

The scale of the nuclear new build programme is very large compared with most other potential parallel projects, and will create huge demands for skills and industrial resources. However, this and other studies have shown that, given the right opportunities, the UK industry, supported where necessary by the global supply chain, is capable of meeting these demands. In our view the additional demands on the UK industry, although challenging, will not be a barrier to the new build programme being delivered successfully.

The resource requirement for the new build programme needs to be understood in the context of the total available pool of skilled resources and the demographic profile of the workforce. It will be necessary to recruit and train resources to offset the losses due to high retirement rates; in engineering construction for example these are currently running at approximately 11% per annum.

It will be critical to ensure that the supply chain, supported by Government where necessary, continues to invest in capacity and skills to address specific shortages, to meet the growth of demand and to cope with demographic changes. This will require clarity and confidence from Government on the policy direction and strong investment signals from developers. The phasing of orders will need to be sustained so that lead times will not put excessive strain on developers, regulators and the supply chain. With the commitment of Government and industry, there is every reason to believe that these conditions will be met.

Current Nuclear Capacity

The study examined the resource requirements across all of the current nuclear industry using projections of employment from Cogent, the NDA and NIA estimates: see figure 3.1.

Total direct employment in the civil nuclear industry is currently around 25,000 and in the defence programmes a further 15,000 people. The study shows a steady contraction in resource requirements for current generation as the existing AGR fleet comes to the end of its life and a transfer of resources into decommissioning as the retired stations enter the clean-up programme, which in turn declines as decommissioning passes its peak of activity. By 2025 the total figure, without the new build programme, is expected to fall to about 30,000.

Current Operations

3.7 Operation and maintenance of the existing fleet of AGRs and Sizewell B, together with fuel supply and reprocessing, currently employs around 7,500 people. With the exception of Sizewell B, these stations will reach the end of their current approved lifetimes by 2023. Subject to decisions about life extensions, which are likely to be considered, the workforce can be expected to decline steadily to around 5,900 by 2025.

Decommissioning and Clean-up

3.8 The current NDA estate, which includes the safe management of nuclear facilities and associated radioactive waste materials as well as the decommissioning programme, employs around 18,000 people. This will decline steadily to less than 10,000 by 2025. In addition to the NDAs own employees and agency workers, the NIA estimates there are approximately 3,500 people working for contractors on NDA sites and this will remain stable up to 2025.

The Defence Requirement

3.9 The study compared the new build requirement with resources for the defence programme which can create both competition for resources and a source of people with nuclear skills and experience. The skills profile is different from the civil programme; of the total workforce of around 13,000 people, 60% are Royal Navy personnel. Changes are largely driven by strategic policy decisions in Government but, on reasonable policy assumptions, the nuclear weapons programme is expected to decline somewhat, with a smaller reduction in nuclear facilities requirements. There will also be a requirement for the Submarine Dismantling Programme. Other than that, the demand is expected to be broadly stable up to 2025, so employment is projected to decline by approximately 1,000.

These figures do not take account of recent announcements on the Trident replacement programme, for which the initial assessment phase has now been announced, which will create further demand to offset this modest downturn. The programme will require design, manufacture and construction of nuclear equipment and facilities with very exacting quality standards.
3.11 So overall, the civil nuclear industry currently employs around 40,000 people, which will gradually reduce with time. The large majority of these resources will remain with their current employers and in their current locations, but a significant number, particularly the contractors’ employees, may be mobile, moving to where the jobs are and hence as the new build programme picks up could move into the new build work.

The 16GWe New Build Programme

3.12 For the purposes of this report, a set of working assumptions have been made about the programme of construction of 16GWe of capacity at the five sites currently planned by EDF Energy, Horizon and NuGeneration.

3.13 Beyond the first plants at Hinkley Point C, the timetables for the later stages of the programme are less certain but for the purposes of this study an assumption has been developed to allow for an assessment of the capacity of the supply chain to deliver multiple, phased projects. It does not reflect actual commitments to construction by the consortia that have made proposals for nuclear new build. Nor does it take account of any changes that may arise from Hitachi’s acquisition of Horizon. The timetable is set out below and is referred to as the NIA assumed programme:

### Manpower Estimates for 16GWe Programme

3.14 The study built up estimates from detailed work breakdown packages for a PWR of the resources required to deliver a single station. Further work will be required to assess the impact of deploying the ABWR technology. The manpower estimates were made by a group of industrial experts very familiar with such estimating for nuclear projects and close to the tendering work currently being done for Hinkley Point C. The estimates have, however, excluded those items that UK companies cannot manufacture: RPV, steam generators, main turbine and reactor coolant pumps. They have also excluded design work.

3.15 The breakdown of work based on these estimates is:
- Civil engineering and construction
- Manufacturing plant and equipment
- Mechanical installation
- Electrical, control and instrumentation supply and installation
- Commissioning

3.17 On the NIA assumed programme, the highest demand is in the period 2020 to 2023.

3.18 The civil engineering and construction onsite workforce required for the 16GWe programme will total approximately 11,000 at peak for the assumed phasing. Most of the workforce for the new build programme will not need specialist nuclear skills or knowledge, but will need to be suitably qualified and experienced for their particular role.

3.19 In addition, the mechanical and electrical onsite resources, comprising welding, plating, fitting, pipework, rigging, cabling and wiring will peak at 8,500 and 3,000 respectively.

3.20 This manpower analysis has been carried out in collaboration with Construction Skills/the Construction Industry Training Board (CITB) and the Engineering Construction Industry Training Board (ECITB), both of which have statutory roles in ensuring that training and skills are assured across their sectors, which together cover the major part of nuclear build requirements.

3.21 Both the CITB and ECITB have made their own estimates of nuclear new build requirements as part of their overall resource forecasts. Although these have been produced separately from the NIA’s work, they are broadly consistent.
The CITB survey of 2011 is in broad agreement with the current NIA findings in terms of peak levels of civil engineering and construction resources and in terms of skill category demands. The construction industry employs more than 2 million people. Although the nuclear new build requirements are only around 1-2% of projected national capacity for the construction industry, the regional demand around the new build sites will have greater impact. This will require additional training in safety and quality requirements to work on nuclear projects.

The ECITB's surveys suggest that the current registered engineering construction workforce of about 80,000 people will grow by 30% by 2023 overall, with an expected peak around 2018. The key drivers for this are energy-led; in addition to nuclear new build there is expected to be increased activity in oil and gas, including decommissioning, offshore wind, transmission infrastructure, biofuels and clean power generation. In addition to the ECITB registered workforce there is a similar number of unregistered workers in these sectors.

The manpower analysis gives a breakdown of construction and installation trade skills to identify the required numbers in the main skill categories and the demand profile over the construction phase. These are summarised in figure 3.4.

Estimates have also been made of the subdivision of resources by specific trade types which are presented in figures 3.5 to 3.7 below for civil, mechanical and electrical trades.

The bulk of the resource requirement is clearly onsite and therefore likely to be mainly UK resources provided by UK companies, often in partnership with overseas partners. Some designs have more modularisation than others and so less onsite fabrication. However significant levels of onsite work will be required for all designs. Some of the manufacturing resource will be supplied from overseas and the actual UK capacity build-up will depend on the target scope of UK companies and their success in winning the work.
In mechanical and electrical onsite installation, the UK has substantial capability and capacity and valuable experience of working under UK site conditions. Capacity will need to be increased by recruitment, up-skilling and transfer from non-nuclear sites and possibly by joint ventures.

For all onsite activities there will be a substantial amount of movement from project to project to follow the demand for skills, which will be attractive to many in the workforce. However, consideration will need to be given to the remoteness of some of the sites in terms of attractiveness to the workforce, accommodation, travel and employment conditions.

Where shortages of specific skills arise this could be resolved by importing labour from overseas; UK firms are experienced in employing and integrating foreign skilled labour.

The amount of labour required onsite, and therefore potentially moving from one project to another, will also be influenced by the extent of modularisation of equipment as opposed to onsite assembly.

The impact of the new build programme, based on the NIA assumed programme, on the total UK nuclear industry is shown in figure 3.8 where the new build resources for the build and operational phases are superimposed on the other nuclear work. There is a significant requirement for additional resources.

These data should prove to be very useful in assisting the skills bodies to formulate their strategies and provision of training. The information should also be very useful for companies intending to support the main contractors in these areas.

Some resources will move from one nuclear new build project to another around the UK, whilst others will be more project-specific. This will affect the need for training which may be greater for certain disciplines in order to maintain the skills of the non-itinerant workforce. This will also be significantly impacted by the competing demands from other infrastructure and industrial programmes.

An important feature of the resource analysis is the build-up and subsequent tail-off of the site workforce. The ECITB estimates that the nuclear new build programme requires a recruitment rate of approximately 2,000 people with engineering construction skills per year for around 10 years. Looking beyond the 16GW programme examined in this report, this will create a large, highly skilled workforce which will be a valuable resource, possibly in phase two of a nuclear new build-up to 2050 or deployment in other highly skilled major projects.

Overall:

- In manufacturing of plant and equipment, although companies may have the capability and a certain amount of capacity, they will need to judge whether to increase their capacity to target greater scope in the light of potential competition from overseas companies.

- In civil engineering and construction, UK companies have the capacity, skills and resources required to deliver the programme. Many of the workforce will need training in safety and requirements for working on nuclear sites. Also, there will be the need to build up resources in the areas around new build sites, through recruitment and training of local people and movement of resources into the area.

- The majority of the materials required for construction are readily available in the UK market.
The UK has significant capability to support the new build programme although there will be competing demands for capacity and, as in many major projects, support can be provided by overseas companies. Other disciplines may require some specialist knowledge from overseas to supplement their own expertise. For example, control and instrumentation requires expertise that is rare in the UK.

For many engineering disciplines such as mechanical and electrical trades it is expected that the UK has sufficient capability to support the programme although some specialist knowledge may be required. For the UK to be competitive in the context of available resources and competing overseas companies, the UK must be able to demonstrate that there will be very large increases required across all blue collar categories. Focused effort will be required to achieve these increases but with planning and confidence about projects proceeding they are manageable.

3.35 It is recommended that, as follow-on actions from this study, mitigation of these pinch points should be addressed as part of the Government’s Nuclear Supply Chain Action Plan. Apart from the nuclear-specific skills such as radiation protection, there are numerous pinch points, all with regard to staff and skill shortages. These are often exacerbated by inflexibility in the treatment of itinerant workers, a supply chain that is constrained by developments in other sectors of energy and infrastructure. Whilst the supply chain feels the pinch points, the requirements of the programme will ultimately apply the pressure. Without the delivery of the skills required by the developers and the main contractors to bring the rest of the supply chain onboard to ensure that all suppliers implement the appropriate health, safety and quality culture throughout the programme, it is considered by industry that the capacity required for a new build programme should be manageable in the context of available resources and competing overseas companies. Nuclear is a good place to start the recruitment and training required for the nuclear new build programme.

3.36 Training funding should be increased and put directly into industry to facilitate the essential industrial phase of apprenticeship training. There is currently a bottleneck in apprentice training due to the shortage of industrial placements, where this training needs to be delivered. The delivery of the training will be very dependent on the number of people who are able to ensure that this training is delivered. Even with the pinch points that are currently addressed, there will still be a large increase in the number of workers needed over the life of the programme. The Government’s Nuclear Supply Chain Action Plan will seek to address some of these pinch points. NESA to identify the manpower requirements shown above which will inform planning and delivery of skills provision for the build phase.

3.37 It is considered by industry that the capacity required for a new build programme should be manageable in the context of available resources and competing overseas companies. Nuclear is a good place to start the recruitment and training required for the nuclear new build programme. It is considered by industry that the capacity required for a new build programme should be manageable in the context of available resources and competing overseas companies. Nuclear is a good place to start the recruitment and training required for the nuclear new build programme.
The global renaissance in nuclear power will also create competing demands on capacity. Only a limited number of companies globally have the capability to manufacture some of the critical components of the Nuclear Steam Supply System and the main turbines. In practice, because of forward planning of orders to book capacity, this should not be a constraint on the ability to deliver the currently foresaw UK new build programme. However, it does place an increasing onus on Government and on vendors to take investment decisions associated with the procurement of long-lead items in a timely manner.

A number of UK companies are already making important contributions to overseas nuclear programmes. There are also many highly competitive UK companies competing in the international oil and gas, petrochemicals and other markets which could seize opportunities in the global nuclear renaissance. However, capitalising on these opportunities will depend on having a strong domestic market in which firms are able to develop and prove their expertise and competitiveness. So a sustained UK programme will be critical in ensuring the UK takes advantage of the global nuclear renaissance.

The absence of a UK-based reactor vendor has led to perceptions in many markets that the UK does not have nuclear capability. It will be important for the UK supply chain, supported by Government, to challenge this perception and to demonstrate the considerable capability that the UK has in nuclear infrastructure development, regulatory expertise, environmental and nuclear safety requirements and in equipment supply. Maximising the opportunity from the global market will therefore depend heavily on successful delivery of the multi-plant programme in the UK. If the UK demonstrates the capability to deliver a programme of plants on time and within budget, this will in itself be the most valuable commercial credentials to access for the global market, not just in terms of the technical and programme management skills that can be exported but also carrying with it the supply chain that delivers that programme.

It is recommended that further work should be initiated to establish the realistic opportunities for UK companies internationally and what facilitative actions would help to expand these and convert them into contracts.

The International Context

The UK new build programme is taking place in parallel with a global expansion of nuclear generation which will create opportunities for the UK supply chain.

The rise in demand for electricity due to population and economic growth, reinforced by the priority for safe, economic and low carbon baseload generation, means that nuclear is increasingly being considered within many countries’ energy mixes.

The potential growth of nuclear generation to 2030 is summarised in figure 4.1, based on lower case, reference case and upper case estimates by the World Nuclear Association. Based on the WNA reference case the global nuclear new build market to 2030 is expected to be approaching £1 trillion. Whilst much of this spending will be in the home markets, it is estimated that international orders for equipment could be worth around £20 billion per annum. How much of this is accessible to UK companies needs to be assessed.

Nuclear Power to 2030
Lessons Learned from Other Nuclear and Infrastructure Projects

5.1 A successful new build programme will have significant benefits:

[A] If project delivery is not on time and within budget there will be a delay in the delivery of electricity and in the opportunity for the UK economy to benefit from the new nuclear power stations.

[B] The benefits from the new nuclear power stations will be diverse, including the creation of jobs, the development of local economies, the enhancement of the competitive position of UK industry, and the contribution to a low-carbon transition. These are all important for the UK’s future prosperity.

[C] The nuclear power stations will provide a secure, sustainable, and low-carbon source of electricity, contributing to the UK’s energy security and reducing the carbon footprint of the UK economy.

[D] The nuclear power stations will also provide an opportunity for the UK to lead in the development of new technologies and to compete in the global nuclear market.

[E] The nuclear power stations will also provide an opportunity for the UK to lead in the development of new technologies and to compete in the global nuclear market.

[F] The nuclear power stations will also provide an opportunity for the UK to lead in the development of new technologies and to compete in the global nuclear market.

5.2 The reality is that companies which are already designing and building new nuclear power stations will win the design work and will have developed the supply chains. They will also be the companies that will have to repeat this preparatory work and incur the associated expenditure and should have learned from their past experience.

5.3 Developed with the lessons and experience from current new power station projects, the expertise and experience of companies already involved in building new stations.

5.4 UK companies have set up joint ventures with companies already involved in building new stations.

5.5 This is particularly challenging when overseas companies win the first contracts, which may only be a small part of the total programme.

5.6 It is also important to ensure that the UK companies are able to compete for the tendering work and that the UK industry is able to benefit from these opportunities.

5.7 It is also important to ensure that the UK companies are able to compete for the tendering work and that the UK industry is able to benefit from these opportunities.

5.8 It is also important to ensure that the UK companies are able to compete for the tendering work and that the UK industry is able to benefit from these opportunities.

5.9 Critical lessons to be learned from experience of international nuclear new build programmes:

[A] Lessons are learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

[B] Lessons are learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

[C] Lessons are learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

[D] Lessons are learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

[E] Lessons are learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

5.10 In addition, UK companies should be regarded as having the capability to deliver the programme, but it is important that they have the necessary experience and skills to deliver the project.

5.11 There are a number of lessons – both positive and negative – that have been learned in major infrastructure projects in nuclear new build internationally, including the current experience of Dungeness B and Flamanville 3, new plants in China, Japan and Korea, and successful infrastructure projects in the UK as demonstrated by Crossrail and Heathrow Terminal 5. These UK projects demonstrate that UK contractors are capable of adopting world-class standards of best practice to deliver large, complex projects on time and within budget. The lessons from these projects will be incorporated into future licensing applications.

5.12 The Olympic Games infrastructure development programme demonstrates how a programme can be delivered rapidly and with high standards of quality. Lessons learned over the course of a programme and will be incorporated into the licence application. It is essential to establish a process for rapid resolution of licensing and construction issues.

5.13 There are a number of lessons – both positive and negative – that have been learned in major infrastructure projects in nuclear new build internationally, including the current experience of Dungeness B and Flamanville 3, new plants in China, Japan and Korea, and successful infrastructure projects in the UK as demonstrated by Crossrail and Heathrow Terminal 5. These UK projects demonstrate that UK contractors are capable of adopting world-class standards of best practice to deliver large, complex projects on time and within budget. The lessons from these projects will be incorporated into future licensing applications.
There is a risk that new plants for different developers will overlap to a degree that their workforce is suitably qualified and experienced. Regular dialogue should therefore be maintained between developers, their principal contractors and the supply chain to exchange information about the expected pipeline of work.

5.14 There is a risk that new plants for different developers will overlap to a degree that their workforce is suitably qualified and experienced. Regular dialogue should therefore be maintained between developers, their principal contractors and the supply chain to exchange information about the expected pipeline of work.

5.15 Opportunities for collaborative working between clients and contractors should be maximised so as to secure productivity gains and to ensure effective project delivery.

5.16 Access to private market finance is critical for some companies, particularly SMEs, and support and initiatives need to be provided quickly by funding sources that understand the sector. For SMEs to increase their capability and/or capacity, access to a spectrum of open market financing options is desirable.
capital market funds have little knowledge of this sector and are not structured for these opportunities. The Government should actively support private funding initiatives to support the nuclear sector.

Raising Supply Chain Capacity

5.28 There are many UK companies that could have the capability to contribute to the new build programme and in many cases have demonstrated this in other markets with highly exacting requirements. Many of these firms would benefit from advice and support to assist them to prepare themselves for the nuclear new build market.

5.29 The Manufacturing Advisory Service (MAS) used to play a valuable role in providing advice for smaller firms wishing to enter the nuclear market and had an active nuclear workstream in its supply chain programme. MAS worked closely with the NIA in publicising the opportunities in the nuclear new build programme to many small firms through regional events and provided hands-on advice to individual firms to assist them to identify opportunities. Since the change in the delivery contract for MAS, there has been a significant gap in this area of provision to the detriment of SMEs aspiring to enter the nuclear market. It will be important for Government to consider how to fill this gap if the opportunities for small firms are to be maximised.

5.30 The NIA is working with Government to support the development of its Action Plan on Supply Chain and Skills including the establishment of a Nuclear Industry Council which covers current operations, decommissioning, waste management and export opportunities as well as UK new nuclear build.

International Partnerships

5.23 It is recognised that developers and vendors will find it advantageous to use the experience of the established supply chains they have used in previous or current projects overseas. One of the key benefits from the fact that the reactor technologies currently being considered for the UK are being delivered elsewhere is that the UK will be able to learn the lessons from international experience, including where things have gone wrong.

5.24 Even where UK firms have the capability to meet contract requirements and to make competitive offers, they are likely to face challenges competing against clients’ existing suppliers.

5.25 An important way for UK contractors to overcome this challenge, to the benefit of clients as well as themselves, is to develop partnerships with established supply chain companies. Both overseas and UK companies will find it attractive to form joint ventures:

- Overseas firms will bring design capability and existing experience of working relationships with their clients.
- UK partners will bring delivery capability and understanding of the UK regulatory, stakeholder and commercial environment.

5.26 Many joint ventures or partnerships have already been set up between UK companies and between UK and overseas companies. Some of these will be project-specific and others may extend over all or parts of the proposed new build programme. As new customers enter the UK market, so new partnerships will be set up.

5.27 UK Trade and Investment, working with the NIA and the developers, has already played an important role in assisting companies to develop international partnerships and this could be expanded further.

Industrial Relations

5.28 An important part of the contribution that UK firms will bring to international partnerships will be the experience of onsite working with clients, other contractors and trades unions to avoid costly delays arising from industrial disputes. Experience on major projects shows that it is vitally important to avoid disruption that may arise from poor industrial relations and failure to address workforce concerns.

5.29 Major UK civil engineering and engineering construction contractors have a strong track record of working successfully with trades unions to avoid disputes and to resolve issues that arise. Trades unions in turn are committed to working in partnership to promote stable, long term employment, safe working environments and successful delivery of projects.

Security

5.29 New legislation with respect to security of personnel is being introduced in the UK which will affect nuclear new build construction sites. First indications are that this will introduce an additional burden in the obligation to clear not only UK nationals to work on these sites but also any imported labour. This is an area that needs investigation by Government, developers and major site contractors.

Programme Management Board

5.30 The NIA has established a Programme Management Board (PMB) consisting of developers, technology vendors and major contractors together with government departments, the ONR, NDA, NESA, trades unions and other stakeholders to identify common issues affecting the new build programme. This study has identified a number of issues where the PMB could be ideally placed to take the lead in finding solutions, including:

- Ensuring effective delivery whilst at the same time maximising opportunities for UK industry.
- Developing collaboration between developers and main contractors:
  - Sharing information on the order pipeline to reduce costs arising from pinch points in capacity and also gaps in the build programme.
  - Effective engagement with suppliers to improve quality, performance and the readiness of the supply chain.
- Adaption of best practice across the new build programme.

Summary

5.31 Securing the twin objectives of successful delivery of projects on time and within budget and of maximising UK content will depend on the application of best practice principles to the new build programme. The UK has demonstrated that it is capable of adopting best practice in project delivery and it can be secured in the nuclear programme with shared commitment from Government, developers and the supply chain.
Conclusions

6.1 A Major Challenge

The delivery of a programme of new nuclear power stations is among the biggest construction projects expected to take place in Europe in the near future. It would represent a huge opportunity for jobs and economic activity in the UK, and can be expected to leave a legacy in terms of skills and infrastructure to the benefit of the economy for years to come. At the same time a single new station, let alone a programme of five such stations over a period of around 10 years, creates a major challenge to all parties. No one should underestimate the magnitude of this task. Each station is of the same magnitude as the Olympic park, but technically more demanding.

Although companies are preparing for the new build programme, they are seeking greater certainty that the programme will, in reality, go ahead as a multi-station programme and that it will proceed in a reasonable timescale without large gaps between stations. This will influence companies’ preparation plans and investment. However, the supply chain also needs to recognise that tendering is already under way for the early Hinkley Point C contracts and firms therefore need to tackle social and demographic changes such as a trend towards workers being less willing to move from one site to another.

There are many companies providing front end expert support to potential developers, but they are seeking assurance that the programme will go ahead and will proceed on a predictable timescale. This allows them to focus on delivering world class support for the new nuclear power plants. There is a strong business case for the programme, driven by the need to tackle social and demographic changes such as a trend towards workers being less willing to move from one site to another.

6.2 Uncertainty

At the time of writing, Hitachi has completed the acquisition of Horizon Nuclear Power which will be a major boost to confidence in the programme. The full impact of the deployment of the ABWR technology is not yet fully understood in the supply chain and there will need to be further work by Horizon Nuclear Power and the NIA’s sc@nuclear programme to raise awareness.

6.3 UK Capability

On the other hand, this study has confirmed that the UK has considerable capability to design, manufacture, supply, construct, install and commission the required nuclear power stations. The UK has a strong track record of delivering projects internationally and has the capability to deliver them to the highest standards.

The study also identified areas where the UK needs to improve its capability, such as in the areas of safety-critical equipment and in the provision of technical and other support services.

6.4 Capacity

With respect to capacity, the study has identified the need for additional nuclear power stations, with the potential requirement for up to five new stations across the planned UK sites, each with a capacity of around 1.6GW. The UK has the capability to deliver these projects, but it will require significant investment in infrastructure and skills development.

6.5 Front End Support to Developers

There are many companies providing front end expert support to potential developers, for example in nuclear technology, legal and financial advice. UK firms can also provide the architect, engineer and integrator roles, with support as necessary from the international supply chain.

6.6 General

It is clear that there must be a significant increase of resources in almost all areas to deal with the growth in demand but also the changing demographic profile of the workforce, high retirement rates and the challenge of attracting and training a new generation of engineers. The study has identified areas where the UK already has considerable capability but also where it needs to improve its capability. The UK also needs to ensure that it has the resources to deliver the required new nuclear power stations.
CONCLUSIONS

- Plant and Equipment Supply
  Excluding the areas identified earlier where there is no UK capability, UK companies could supply almost all of the other mechanical and electrical equipment including tanks, vessels, heat exchangers, HVAC equipment, pumps, valves, pipework, cranes, control and instrumentation, electricity and radioactive plant as well as components for the reactor, steam generators and turbines. The UK currently has substantial capacity, but, in some cases, dependent on target scope and volume of business, this may require additional investment and, whilst some of the larger companies have planned significant investment in new facilities or extension of existing capacity, they are assessing the volume of business, timing and certainty before committing. Such investments may be too late for the Hinkley Point C contracts. Further down the supply chain, there are many quite capable smaller companies. Some would benefit from financial and technical support to bring their quality and business systems in line with nuclear requirements. In the longer term, the contribution of the Nuclear Advanced Manufacturing Centre could improve productivity and costs.

- Plant and Equipment Installation
  There are several large UK companies expert in the installation of mechanical and electrical equipment into major power plants, including current thermal power plants, as well as other major infrastructure projects. These companies are very familiar with nuclear site requirements, UK regulator and industrial relations requirements and the supply chain required to support site activities. Dependent on the phasing of the build programme, this sector should not pose any capacity limitations, being able to cope with a multi-unit station with current resources plus enhancements, similar to those managed for normal outages. There will, however, be challenges due to retirement rates and the fact that workers are tending to be less keen to move from site to site. There will be a need for ongoing recruitment and training to cope with these trends. The specific skills of high-grade site welders and good quality on-site supervisors are key and require special attention. If a second multi-unit station overlaps an earlier multi-unit station significantly, there will be a strain on several skill types. Means of identifying and managing these potential pinch points will be required.

- Commissioning and operation
  Several of the installation companies are also experienced in commissioning equipment and systems and their people may transfer into the plant operational teams and maintenance as commissioning transitions towards operation.

6.7 Competition
UK contractors are well aware that they will be in a global competition for the new build programme particularly for the supply of equipment, but possibly in other areas. There will be a tendency for developers to rely on their experience and well-established commercial relations with existing suppliers to de-risk programmes so UK companies will need to demonstrate excellence in performance, equivalent experience and a competitive edge to overcome these challenges.

6.8 Joint Ventures
Many UK companies are forming joint ventures or partnerships with international companies currently involved in the new build projects internationally to make best use of the combined skills and experience and to avoid costs of repeating work already done such as many design activities. This is common practice in major infrastructure projects worldwide. Joint ventures can bring together complementary skills and provide additional resources to improve delivery prospects and reduce costs, but will inevitably involve a degree of work sharing.

6.9 Awareness
The study has found that the UK supply chain has improved its awareness of requirements of the nuclear market and its interest in the new build programme. Since the NIA Capability report in 2006 there has also been a general increased competitiveness of UK industry in high specification markets such as oil and gas, aerospace and petrochemicals as well as nuclear. Several UK companies previously not involved in the nuclear business have won business in the nuclear market in the last few years.

6.10 UK Exports
In several areas, such as professional services and supply of medium sized forgings, pumps and valves, UK companies are competing very successfully in the global nuclear market and in some cases have set up global manufacturing plants and supply chains together with international consortia to service these international markets. Some UK companies are carrying out specialised work on EDF’s French power stations and some have been invited by French companies to assist them to supplement their skills and resources for their business in France. Others are supplying equipment to nuclear projects in China.

6.11 Specific Pinch Points
As stated earlier it is necessary to increase capacity on almost all fronts. From the study, including discussions with NESA, developers and contractors, the following specific pinch points have been identified in addition to the general increase of onsite trades people:
  - Programme management
  - Project management
  - Project planners and controllers
  - HS&E regulators
  - HSE&E
  - High Grade Welders
  - Onsite supervisors
  - Safety case authors
  - Security regulators

6.12 Suitably Qualified and Experienced Personnel (SQEP)
In these and other areas there will be a need to increase the number ofSQEP resources. Steps have been taken to provide training at all levels but an important aspect of this requirement will be the need for relevant experience. Industry would benefit from introducing national standards for what clients and regulators mean by SQEP across the range of requirements.
Recommendations

For Government

The Government should maintain a clear and unequivocal commitment to leaving them to the market forces to operate.

Further work should be done to establish effective cross-departmental coordination so that all key Government bodies and departments are seen to be jointly committed to delivering the new build programme.

For Industry

The Government should use the findings of this study as the baseline for its to be jointly committed to delivering the new build programme.

The Government should complete the facilitative actions required to enable the private sector to be prepared for the nuclear generation opportunities and what facilitative actions would help to expand them and convert them into effective commercial and business arrangements.

Clients and contractors should develop their and skills to enable final investment decisions to be made particularly by continued progress on international partnerships.

Along with other major infrastructure programmes, there will be a huge requirement for young engineers to replace the ageing population of suitably qualified and experienced engineers. To attract more students to study engineering and encourage more graduates engineers to stay in the profession, the Government should consider subsidising tuition fees for university courses in engineering as is currently done for medical courses.

It is recommended that training funding should be increased and put directly into industry to create an industrial training facility in lieu of or to supplement the essential industrial phase of apprenticeship training. Consideration should be given to the introduction of a skills tax credit to encourage companies to invest more in training. The Government should also ensure that the Nuclear Decommissioning Authority encourages greater use of apprentices on decommissioning and waste management projects.

Companies should work closely with the Nuclear Decommissioning Authority to establish their skill and capacity requirements and to meet customer expectations.

Understanding of quality requirements should be improved across the supply chain through programmes of workshops. The NDA Stage 2 Essential Guide should be widely circulated and promoted by developers, technology providers, contractors, Government, NIA and training bodies.

The industrial phase of apprentice training is currently a bottleneck due to the shortage of industry placements. There is a need to address this issue by extending the essential industrial phase of apprenticeship training currently done by the Government.

The NDA’s Programme Management Board could be ideally placed to take the lead in addressing a number of the issues identified in this study including developing collaborative working at all levels of the supply chain.

For Supply Chain and Skills Action Plan

UK Trade and Investment should continue to assist UK companies to develop international partnerships.

The Government should actively support the creation of such mechanisms, but then leave them to the market forces to operate.

The Government should use the findings of this study as the baseline for its to be jointly committed to delivering the new build programme.

Further work should be done to establish effective cross-departmental coordination so that all key Government bodies and departments are seen to be jointly committed to delivering the new build programme.

The Government should complete the facilitative actions required to enable the private sector to be prepared for the nuclear generation opportunities and what facilitative actions would help to expand them and convert them into effective commercial and business arrangements.

For Supply Chain

The Government should maintain a clear and unequivocal commitment to leaving them to the market forces to operate.

Further work should be done to establish effective cross-departmental coordination so that all key Government bodies and departments are seen to be jointly committed to delivering the new build programme.

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The Government should complete the facilitative actions required to enable the private sector to be prepared for the nuclear generation opportunities and what facilitative actions would help to expand them and convert them into effective commercial and business arrangements.
To avoid disruption that may arise from poor industrial relations and failure to address workforce concerns, particularly onsite, developers, major contractors and trades unions should work together to set up the necessary site agreements, working practices and behaviours. These agreements will be greatly assisted by early contractor involvement and maximising the use of UK local labour but may have to encompass the use of itinerant international labour.

There is a trend for construction workers to be less willing to travel from site to site. This could have repercussions for some of the remote sites and it is important therefore to make these sites attractive places to work and live, even for temporary workers. On the other hand continuity of work over the build period of a multi-unit station and the opportunity to move from project to project could be quite attractive to many in the workforce.

To ensure that projects leave a sustainable legacy for the communities in which they are built, the developers and main contractors should work closely with the local councils and development agencies to use the growing local skill base to attract follow-on investment of appropriate industries.

**Conclusion**

This report has set out actions to be taken by Government, industry, skills bodies and other stakeholders to ensure that the new build programme is delivered successfully and that the opportunities for UK industry are maximised. The recommendations should inform the development of the Government’s Action Plan on Supply Chain and Skills and the work of the skills organisations. There is a shared commitment among all parties to meet these objectives and we believe there is every reason to be confident that the future of the nuclear renaissance in the UK can be secured.
Developers and Projects

Plans to build new nuclear power stations in the UK are currently being taken forward by three commercial developers, with plans to develop 10-13 new plants on five sites. The projects will be financed on a commercial basis through a combination of shareholders’ balance sheets and debt financing.

The Programme and Sites

Five of the eight sites identified in the National Policy Statement are currently subject to plans by development consortia.

The first of the plants is currently being planned at Hinkley Point C in Somerset. The planning application for this project has been submitted to the independent Planning Inspectorate and some pre-planning enabling works have been commenced. A final investment decision is planned by the developer, EDF Energy, around the end of 2012. Stage 1 of the Public Consultation for a further two EPRs at Sizewell C in Suffolk is under way.

Following completion of the acquisition by Hitachi, Horizon Nuclear Power is planning to proceed with the first of up to three plants at Wylfa.

Further on, there are plans by Horizon to develop a new station at Oldbury in Gloucestershire and by NuGen at its site in Moorside, West Cumbria (adjacent to Sellafield).
The ABWR is a Generation III+ advanced boiling water reactor. The standard ABWR plant design has a net output of about 1350MWe. The reactor type is operating in Japan. It will be undergoing UK GDA assessment and has already received licence certification in Japan, Taiwan, and the USA.

The EPR is a 3rd Generation EPR design with an electrical output of 1600MWe. The design is currently undergoing Generic Design Assessment for its UK licence. It has so far received its UK GDA and ISODA certification. The EPR is currently under construction in Finland, France, and China.

The Westinghouse AP1000 is a pressurized water reactor producing 1,117MWe. The design has so far received its ISDA and ISODA licence certification in the UK. Construction is ongoing of this design in China, and it has begun the application process for licence in the USA.
III. Work Package Data Sheets

For this study a nuclear power station was divided into 140 line items which were assessed by a group of industrial experts in terms of UK industry delivery capability and capacity. The line items were grouped into the Work Packages Data Sheets described in this Appendix and listed below.

The Data Sheets are too voluminous to include in the printed version of the Capability Report, but can be found at www.niauk.org/uk-capability.

Support to Owners

1.1 Project and Technical Support to Owners
1.1.1 Safety, Health, Environment, Quality
1.1.2 Consents
1.1.3 Site Licensing
1.1.4 Design Authority
1.1.5 Programme and Project management
1.1.6 Industrial Relations

Civil Engineering and Construction

2.1 Enabling Works
2.1.1 Bulk earthworks
2.1.2 Roads, Drainage, Power, Water
2.1.3 Marine works
2.1.4 Temporary facilities
2.2 Civil Engineering and Construction
2.2.1 Design
2.2.2 Piling and Diaphragm Walls
2.2.3 Superstructure
2.2.4 Containment Building
2.2.5 Materials and Services

Plant and Equipment

3.1 Reactor Pressure Vessels
3.2 Reactor Pressure Vessels Internals
3.3 Core Component Handling Equipment
3.4 Reactor Integrated Head Package
3.5 Steam Generators
3.6 Pressuriser
3.7 Pipework – Reactor Coolant Loop
3.8 Pipework – Main & Auxiliary
3.9 Pipework – Safety Related Systems
3.10 Tanks, Vessels, Heat Exchangers
3.11 Automated Inspection of Welds
3.12 Independent Third Party Inspection
3.13 Nuclear Island Installation
3.14 Turbine Island & BOP Mechanical Installation
3.15 Cranes & Lifting Equipment
3.16 Mechanical Equipment Modules
3.17 Electrical Installation

II. Skills Organisations

Nuclear Energy Skills Alliance (NESA) and Skills Bodies

The Nuclear Energy Skills Alliance is a grouping of the key strategic skills bodies and stakeholder organisations to facilitate the development of skills for the nuclear industry.

Cogent Sector Skills Council
Cogent is the employer-led Sector Skills Council that represents a range of the science-based industries, including nuclear, process manufacturing and life sciences. For the nuclear industry, Cogent’s main roles are as the standards setting body and the conduct of labour market intelligence research. Cogent responds to employer demand for skills programmes and develops employer- endorsed standards and qualifications including apprenticeship frameworks and foundation degrees.

CITB-ConstructionSkills
ConstructionSkills acts as an Industry Training Board, a Sector Skills Council and a National Skills Academy. It is responsible for developing labour market intelligence for the construction sector and providing tactical support to its in-scope companies. It works with partners in the alliance to provide solutions to the challenge of the nuclear renaissance.

ECITB
The Engineering Construction Industry Training Board provides the bridge between occupational standards, design of suitable training programmes and awarding qualifications, and the implementation of training required to meet the needs of the sector. The ECITB ensures that the training providers deliver training to around 70,000 people each year. Employers and providers are supported by an annual investment of £20–25 million in apprenticeship training, up-skilling and re-skilling programmes and project management and supervisory programmes.

National Skills Academy Nuclear
The National Skills Academy for Nuclear is an employer-led organisation established to ensure that the UK nuclear industry and its supply chain has the skilled, competent and safe workforce it needs. The vision of the National Skills Academy for Nuclear is to be the lead strategic body that represents the industry to stimulate, coordinate and enable excellence in skills to support the nuclear programme.

Semta
Semta is the employer-led Sector Skills Council for Science, Engineering and Manufacturing Technologies in the UK. Within NESA, Semta represents the interests of UK component and equipment manufacturers that fall within the sectors that either currently supply into, or are seeking to enter, the nuclear industry.
IV. Methodology of the Study

This study has been overseen by a Steering Group of 15 industry experts chaired by Bill Bryce, Chair of the NIA New Build Working Group. The Steering Group included representatives from the developers, reactor vendors, contractors, skills organisations and the NDA.

The approach adopted was to invite a group of Industry Leads to review capability in their specific areas of expertise. In addition to this bottom-up assessment there has been a top-down review to assess UK capacity against the resource requirements for a multi-plant new build programme, in the context of other demands on the supply chain from the existing nuclear industry (including the requirements to operate and maintain the existing nuclear fleet, the decommissioning programme and the defence programme) and wider demands on civil engineering, construction, engineering and manufacturing.

Work Package Datasheets

The Industry Leads were asked to provide their assessment of capability based on specific work packages and for this purpose the delivery of a new nuclear plant was broken down into approximately 140 work packages, covering:
- Support to Owners
- Nuclear Island
- Turbine Island
- Balance of Plant
- Fuel supply

Some of the packages were merged into the work packages presented in Appendix III of the Report.

To inform and support the work of the industry leads the NIA circulated a questionnaire to approximately 350 companies to identify current and expected future capability in specific work packages. These returns provided quantitative validation of the Industry Leads’ own knowledge of the industry, analysis of industrial data, and discussions with their industry peers.

For the manufacturing sections of the study, in addition to the reviews of work packages by Industry Leads, David Hall of the Nuclear Advanced Manufacturing Research Centre provided an overview of manufacturing capability.

Industry leads were asked to follow a common methodology for assessing capability in their areas of expertise including:
- Whether the UK has existing capability to deliver in each of the packages,
- Whether the UK has the potential to expand capacity to meet additional demand.
- The implications of scaling this up to two or three concurrent nuclear new build projects.
- The implications of demand from other nuclear and non-nuclear projects (in the UK and globally).
- Competitiveness of UK companies against global supply chain.
- What are the barriers are to expanding capacity and capability.

The reports by Industry Leads were subjected to a process of expert review by their industry peers.

3.18 Plant Control & Instrumentation
3.19 Reactor Control System
3.20 Reactor Protection Systems
3.21 Control Room Equipment
3.22 Mechanical Interlocks & Relays
3.23 HVAC
3.24 Sensors & Detectors
3.25 Pumps & Valves
3.26 Radwaste Plant
3.27 Fuel Transfer Tube
3.28 Turbine Generator
3.29 Turbine Island Deaerator & Moisture Separator
3.30 Emergency Diesel Generators
3.31 Forgings
3.32 Security
3.33 Scaffolding
3.34 Generator Circuit Breaker & Generator Connections
3.35 Generator & Unit Transformers
3.36 MV/LV Switchgear, Electrical/I&C Control & Distribution Panels
3.37 Engineering Computer System
3.38 Training Simulator
3.39 Thermal Insulation & Trace heating
3.40 Specialist Shield Doors
3.41 Fuel Supply
3.42 Fuel Pond Storage Racks
3.43 Spent Fuel Shipping Casks
3.44 Primary Circuit Supports and Restraints
3.45 Compressed Air Plant
Analysis of Manpower Requirements

The Steering Group examined the capacity of the UK supply chain in the context of its capacity to deliver a multi-plant programme. As a basis for this analysis, the group developed, in consultation with the developers:

- The construction profile for each plant including enabling works, civil works, mechanical and electrical installation, equipment supply and commissioning.
- An assumed programme with timelines for commencement for each plant.

With information provided by Industry Leads and others, the group established the resource requirements for each multi-reactor new nuclear plant and, combining this with the NIA Assumed Programme, established the overall manpower requirement for the 16GWe programme and the breakdown into skills categories.

The manpower analysis was conducted in close collaboration with the skills organisations especially ECITB and ConstructionSkills, and will contribute to the labour market intelligence work which is being coordinated by Cogent.

Expert Review

The report was also subjected to a expert review process by Lord Hutton of Furness, Terry Hill CBE and Dr Tim Stone CBE.
The Steering Group and the NIA are very grateful to the companies and to the individuals below for their assistance in this study:

- NG Bailey
- Studsvik
- Sheffield Forgemasters International Ltd
- Nuvia
- David Hall
- Engineering Construction Industry Training Board
- ConstructionSkills
- Cogent
- Department for Business Innovation and Skills
- Department for Energy and Climate Change
- Nuclear Advanced Manufacturing Research Centre

The following acted as Expert Reviewers for the report:

- Lord Hutton of Furness
- Terry Hill CBE
- Dr Tim Stone CBE
The Nuclear Industry Association (NIA) is the trade association and representative voice of the UK’s civil nuclear industry. We represent 63,000 UK nuclear workers across more than 260 member companies.

Nuclear Industry Association is a company limited by guarantee registered in England No. 2804518

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