Capability of the UK Nuclear New Build Supply Chain

Delivering a Nuclear Future for the UK

December 2012
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.
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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.
The study has examined UK industry’s position in terms of:

- **Capability**: does the UK have the facilities, skills and experience to deliver particular work packages?
- **Capacity**: are there sufficient facilities and skilled employees to deliver the programme as it expands and in the light of demands in other areas, both in the existing nuclear industry and in the rest of the economy?
- **Competitiveness and challenges**: can UK firms win orders against global competition, particularly against those companies currently supplying equipment and building new nuclear stations?

The study has confirmed that the UK has substantial capability across a wide range of new build activities, but capacity will clearly need to be increased to meet the requirements of the new build programme. However, companies cannot afford to carry excess capacity in the hope that projects will be forthcoming. Many UK companies have been planning their capacity requirements for some time and some plans are now being implemented but others are still assessing when to commit.

Clarity in project timing is therefore extremely important in terms of build-up of facilities and resources and maintaining these should there be large gaps between projects.

UK capability and capacity can be summarised as follows:

- **Support to Owners**
  This area is well resourced for UK and international projects in areas of regulation, planning, safety, environmental, legal and financial matters. Some specialists could be attracted overseas.

- **Civil Engineering and Construction**
  There are several large UK civil engineering companies competing successfully in international markets and able to carry out design and construction for nuclear power stations as they are currently doing for new nuclear facilities associated with clean up and decommissioning. As is common practice, these companies are likely to operate in joint ventures with UK and overseas companies to deliver new nuclear build in the UK. These large companies are supported by many small 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 in quality and safety issues for people transferring from non-nuclear sites.

- **Plant and Equipment Supply**
  The UK currently does not have the capability to supply the key items of reactor pressure vessel, steam generators, turbine generators, ultra-large forgings and reactor coolant pumps. There are only a very few companies in the UK who could possibly develop this capability, but 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.

  However, the UK could supply almost all other mechanical and electrical equipment, including tanks, vessels, heat exchangers, pumps, valves, pipework, cranes, control and instrumentation, nuclear HVAC (Heating, Ventilation and Air Conditioning) systems, electrical panelling and radwaste plant as well as...
components for the reactor, steam generators and turbines. This comprises a very large quantity of high quality manufacturing. Dependent on target scope and volume, some investment in manufacturing facilities may be required. In those areas where the UK does have capability, the equipment can also be sourced globally and therefore competition is likely to be strong. UK suppliers will need to have the necessary quality and capacity and be competitive.

The major UK companies will be supported by many excellent smaller manufacturing companies, but these companies would benefit from support to meet nuclear requirements, including accreditation to bring their overall quality and business systems into line with nuclear industry norms.

Plant and Equipment Installation and Commissioning
There are several large UK companies with expertise in the installation of mechanical and electrical equipment on nuclear and other complex infrastructure projects. These companies are very familiar with UK industrial relations requirements while also having experience of the supply chain required to support site activities.

Recruitment and training will be necessary to increase capacity for a multi-station programme, the numbers being dependent on phasing of the new stations. Here again, joint ventures will be formed to combine expertise and experience, to share risks and to reduce costs. Installation of safety-critical components within the nuclear steam supply system will require specialist engineering teams from the nuclear system provider, but possibly working with UK partners or specialist subcontractors.

Some of the personnel installing equipment will make the transition to commissioning and can become a very valuable supplement to the existing commissioning and operational resources.

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 as part of this study for various multi-station scenarios. They indicate that total resources for a 16GWe programme will build to a peak at around 30,000 people and will then drop off into the operational phase.

The development and maintenance of these resources is a major challenge, in view of the demographic profile of the existing workforce, the need to attract sufficient skilled people into the industry and competing demands from other sectors. These challenges are being addressed but will need additional funding for the resource requirement to be successfully delivered. The data developed in this study will be of assistance to Government, training providers, developers and suppliers in their forward planning of resources.

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 to the current wave of new build and to grow the UK nuclear industry into an influential and strong force in the international market:

Programme Confidence
The Government should maintain a clear and unequivocal commitment to nuclear power and developers should give confidence that the programme will proceed without long gaps between stations. Otherwise there is a danger that suppliers will not invest or will need to seek business in other sectors. Many companies, large and small, are waiting to see developments before committing.
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 when 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.
Progress Since 2006 Report

The New Build Programme

1.1 After more than two decades since the last nuclear power station was built in the UK, the UK now faces one of the largest programmes of new nuclear build in the world.

1.2 There are currently plans to build about 16GW of new 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.

1.3 There is no Government policy limit on the amount of nuclear capacity that could be built. The Government has said that it would like to see 60GW of low carbon capacity being constructed by 2050, of which it expects 35GW to come from renewable sources. The Government has indicated that new nuclear could provide a large part of the remaining 25GW of low carbon capacity. Some scenarios in the Government’s 2050 pathway suggest a contribution from nuclear of over 75GW.

Developers and Project Definition

1.4 Three developers currently have plans to develop new nuclear plants in the UK:
   - EDF Energy and Centrica
   - Horizon Nuclear Power
   - NuGeneration
   Further details are given in appendix I.

1.5 Whilst the three developers are operating to different timelines, they have made significant progress in acquiring land, developing dialogue with local communities and assessing the viability of their respective sites. These have required significant investments and have enabled them to progress towards final investment decisions. EDF’s plan for a twin reactor station at Hinkley Point is the most advanced project of the new build programme.

1.6 At the time of writing, Hitachi has completed its acquisition of Horizon Nuclear Power.

The Policy Context

1.7 The Government believes that new nuclear power stations could deliver a significant part of the low carbon electricity that it wishes to see developed in the UK and that it should take active steps to facilitate companies making the necessary investments, subject to there being no Government subsidies.

1.8 The Government has therefore taken a series of facilitative actions to enable companies to make investment decisions. The principal actions have been:

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

   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.
National Policy Statements (NPS)
Statements of strategic need for development which will form the basis for the decision-making processes of the independent Planning Inspectorate (formerly the Infrastructure Planning Commission). Once adopted, the statements mean that questions about the strategic need for a certain type of development do not need to be further considered in the planning process.

In the case of nuclear, the statement included a strategic siting assessment which set out the strategic locations that would be suitable for development of the first phase of new nuclear power stations.

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 I.

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 generic safety, security and environmental aspects of new nuclear 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 two candidate designs, the EPR jointly developed by Areva and EDF and the Westinghouse AP1000. It is anticipated that Hitachi’s ABWR design will enter the GDA process.

In December 2011 the regulators granted interim Design Acceptance Confirmations (iDACs) and interim Statements of Design Acceptability (iSoDAs) for the UK EPR and the AP1000 reactor designs.

Funded Decommissioning Programme (FDP)
The Energy Act 2008 requires operators of new nuclear power stations to have secure financing arrangements in place to meet the full costs of decommissioning and their full share of waste management and disposal costs.

This means that operators must submit an FDP for approval before construction commences. In December 2011 the Government published guidance setting out the principles that the Secretary of State will expect to see satisfied in the FDP.

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.

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.

The principal elements of the reform are:
• A carbon floor price, to provide greater certainty about the future price of carbon in the EU Emissions Trading Scheme.
• Implementation of feed-in tariffs with contracts for differences.
• Introduction of a capacity mechanism.
• Emission performance standards.
At the time of writing the necessary legislation is due to be introduced to Parliament in the Energy Bill.

1.9 Taken together, these facilitative actions will be important in creating the conditions to allow developers to make investment decisions to enable the programme to proceed. The Generic Design Assessment process has been particularly important from the point of view of delivery of the programme as it has allowed emerging issues to be identified by the regulators and to be addressed by the reactor technology companies and developers before construction commences.

1.10 The Government’s facilitative actions, and the strong cross-party political support that these have enjoyed, are welcome. Nevertheless, further progress with policy, especially in relation to electricity market reform, needs to be made before investment decisions will be made, which in turn affects the willingness of the supply chain to make their own necessary investments. The Government should therefore make an unambiguous commitment to the benefits of nuclear power in terms of energy security, economic and employment growth and low carbon generation and to delivering its requirements with respect to planning consent, spent fuel and waste disposal and electricity market reform.

1.11 In particular the Government should make clear that policy instruments that are intended to support low carbon generation, including the benefits of rates retention by local communities and measures to assist the supply chain to access loans and financial support, should explicitly apply to nuclear.

1.12 It is also critical that Government ensures that other stakeholders take account fully 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

1.13 Following the earthquake and tsunami in Japan in March 2011 and the accident at the Fukushima Daiichi plant, the UK Government asked UK Chief Nuclear Inspector Dr Mike Weightman to provide a report on the implications of the accident and the lessons to be learned for the UK nuclear industry.

1.14 Dr Weightman’s final report was published in October 2011 and identified a number of lessons for the UK nuclear industry but it did not find any reason to curtail the operation of existing nuclear operations or the new build programme.

Specifically, as regards new build, it confirmed there was no reason to change:

- The selection of sites identified in the National Policy Statement as suitable for new nuclear plants.
- The construction of multiple plants as proposed by the developers on these sites.

1.15 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 in fact increased to an all time high following a drop immediately after the Fukushima disaster.
Supply Chain Support

1.16 The NIAs sc@nuclear programme has raised awareness and provided information and guidance for supply chain companies, especially smaller companies, to assist them in preparing for new build opportunities. It has organised and supported events around the country, maintained a website and online updates by email, and published two Essential Guides to Nuclear New Build.

1.17 The Government created the Nuclear Advanced Manufacturing Research Centre (NAMRC), based at Rotherham, to improve and develop new manufacturing processes and to assist firms with experience in other advanced technology sectors to enter the nuclear market. The NAMRC, in addition to its preparations for developing advanced manufacture processes, has created the Fit4Nuclear programme to assess manufacturing companies’ preparedness for working in the nuclear sector through a questionnaire and interview process. This applies mainly to smaller companies, but also to larger companies that may be considering entering the nuclear market. To date around 100 mechanical/material supply companies have completed the online assessment; 50 of these have been through the on-site assessment, of which 40 have completed the full F4N process.

1.18 The developer consortia and the reactor technology vendors have also held a series of supply chain events to brief companies on the opportunities and the expectations for the programme.

Investing in Skills

1.19 The Nuclear Energy Skills Alliance (NESA) is a grouping of the key strategic skills bodies and stakeholder organisations to facilitate the development of skills for the nuclear industry. The skills bodies are Cogent Sector Skills Council, Construction Skills (CITB), the Engineering Construction Industry Training Board (ECITB), the National Skills Academy Nuclear and SEMTA (Science, Engineering and Manufacturing Technologies Sector Skills Council), see appendix II

1.20 NESA works to address the current and future skills needs of the UK nuclear programme and its members have agreed to work together to ensure an agreed frame of reference regarding nuclear skills and to minimise duplication and overlap of work. Members agree to leverage their collective resources and expertise to address the training issues identified and to maximise the opportunities for job creation in the UK.

Outstanding Policy and Regulatory Issues

1.21 Very considerable progress has been made towards initiating a new build programme, but there are still some outstanding issues to be resolved to ensure the programme proceeds:
- Completion of the electricity market reform package including setting the strike price for the first contracts for differences.
- Completion of the GDA process, and obtaining Nuclear Site Licences.
- Consideration of development consent applications by the Planning Inspectorate and approval by the Secretary of State.
- Development of National Grid infrastructure aligned with new build project timelines.
- Agreeing terms with Government for funded decommissioning programmes.
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 nuclear new build programme.

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.

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.

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.

It is widely recognised that strong project and programme management capability, provided by a combination of the developers’ 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.

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.

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.

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.

UK capability is summarised in the tables below in terms of industrial capability and specific skills.
## Industry Capabilities

*Programme Management and Technical Support Services*

<table>
<thead>
<tr>
<th>Programme Management</th>
<th>Major Companies</th>
<th>Support Companies</th>
<th>Skills</th>
<th>Experience</th>
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<tbody>
<tr>
<td>Project Management Services</td>
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<td>3 Companies</td>
<td>Capacity available with some investment</td>
<td>Skills shortages, need special attention</td>
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<tr>
<td>Architect Engineer</td>
<td>5 Companies</td>
<td>3 Companies</td>
<td>Sufficient available skills capacity</td>
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<tr>
<td>Safety &amp; Site Licensing</td>
<td>5 Companies</td>
<td>3 Companies</td>
<td>Current experience of nuclear markets</td>
<td></td>
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<tr>
<td>Consents &amp; Planning</td>
<td>5 Companies</td>
<td>3 Companies</td>
<td>Some experience of nuclear or related markets</td>
<td></td>
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<tr>
<td>Technical Support</td>
<td>5 Companies</td>
<td>3 Companies</td>
<td>Sufficient current capacity</td>
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<td>Commercial Support</td>
<td>5 Companies</td>
<td>3 Companies</td>
<td>Capacity available with some investment</td>
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### KEY

- **Major Companies**: 5 Companies → 5 Companies ← 2 Companies
- **Support Companies**: 5 Companies → 5 Companies ← 2 Companies
- **Skills**: Sufficient available skills capacity
- **Experience**: Current experience of nuclear markets
- **Facilities**: Sufficient current capacity
- **Capacity available with some investment**: Skills shortages, need special attention
- **Some experience of nuclear or related markets**: Lack of experience, needs special attention
- **Capacity available with some investment**: Shortage of capacity without significant new investment
In some cases, although there is sufficient capacity for individual areas, the cumulative effect can put a strain on capacity.

**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.
## Industry Capabilities
### Civil Engineering and Construction

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<thead>
<tr>
<th>Enabling Works</th>
<th>Tunnelling/Cooling Water Works</th>
<th>Piling &amp; Diaphragm Walls</th>
<th>Aggregate &amp; Cement Supply</th>
<th>Civil Engineering Design</th>
<th>Architectural Design</th>
<th>Stressing</th>
<th>Site Erection</th>
<th>Cladding</th>
<th>Structural Steelwork</th>
<th>Marine Works</th>
<th>Specialist Transport</th>
<th>Heavy Lifting</th>
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<td>Major Companies</td>
<td>Support Companies</td>
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<td>Facilities</td>
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<td>Sufficient available skills capacity</td>
<td>Capacity available with some investment</td>
<td>Skills shortages, need special attention</td>
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<tr>
<td>Current experience of nuclear markets</td>
<td>Some experience of nuclear or related markets</td>
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<td>Sufficient current capacity</td>
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Skills

**Civil Engineering and Construction**

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<th>Specialist Transport</th>
<th>Heavy Lifting</th>
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**Cumulative Effect**

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<th>Site Supervisors</th>
<th>Steel Erectors</th>
<th>Steel Fixers</th>
<th>Civil Site Labour</th>
<th>Surveyors</th>
<th>Scaffolders</th>
<th>Civil/Architectural Designers</th>
<th>Quantity Surveyors</th>
<th>HS&amp;E Engineers</th>
<th>Cladders</th>
<th>Groundwork Specialists</th>
<th>Prestressing Specialists</th>
<th>Plant Operators</th>
<th>Site Engineers</th>
<th>Formwork Joiners</th>
<th>Concreters</th>
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</table>

**KEY**

- **Skills**
  - Sufficient available skills capacity, training in nuclear safety/culture required
  - Capacity can be grown with investment, recruitment, training
  - Skills shortages, need special attention
  - No capability

**Plant and Equipment – Supply**

2.13 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, steam 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></th>
<th>Major Companies</th>
<th>Support Companies</th>
<th>Skills</th>
<th>Experience</th>
<th>Facilities</th>
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<tbody>
<tr>
<td>Reactor Pressure Vessel</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>Pressuriser</td>
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<td>Control Rods Drive Mechanism (CRDM)</td>
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<tr>
<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>
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<tr>
<td>Reactor Coolant Loop Pumps</td>
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<td>Pumps &amp; Valves</td>
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<tr>
<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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<tr>
<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>Non-safety Related EC&amp;I</td>
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<td>HVAC</td>
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<tr>
<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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<tr>
<td>Forgings (Excluding Ultra-large)</td>
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<tr>
<td>Mechanical Installation</td>
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<tr>
<td>Electrical Installation</td>
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</tbody>
</table>

*May be less capacity for safety related tanks etc

### KEY

- **Major Companies**: 5 Companies
- **Support Companies**: 5 Companies
- **Skills**: Sufficient available skills capacity
- **Experience**: Current experience of nuclear markets
- **Facilities**: Sufficient current capacity
The UK does have the capability to supply most of the remainder of the manufactured components for a new nuclear plant including pumps and valves, pipework, vessels, tanks, heat exchangers, HVAC, radwaste plant, control, instrumentation and electrical equipment and forgings.

Many of the UK companies that are capable of manufacturing these items are already supplying similar equipment to the global new build market, as well as to the existing nuclear industry in the UK and to other highly technically demanding sectors such as the oil and gas, chemical and other process industries.

It is expected that some of the equipment, even where the UK does have capability, will come from JVs of UK companies with international partners, with the latter providing experience of design and codes and standards, as well as involvement in existing international supply chains, whilst UK partners will provide delivery capability and understanding of the UK commercial, regulatory and stakeholder environment.

As UK companies extend their experience and demonstrate their capability to supply the new build market, the opportunity for UK content may increase over the timescale of the programme. Equally, though, companies winning contracts for the first projects (which may contain options for subsequent projects) will be in a favoured position to win follow on contracts so the potential for growing UK content may therefore be limited.

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.
Skills

Plant and Equipment Manufacture and Installation

|------------------------|---------------|-------------------------------|----------------|------------|-------------------------------------|-------------------|---------------------------------|-----------------------------|-----------------------------|--------------------|-----------------------------|------------------------------|-------------------------|-------------------------|-----------------------------|-----------------------------|-----------------------------|----------------|-----------------------------|----------------|----------------|-----------------------------|----------------|-----------------------------|----------------|----------------|-----------------------------|----------------|-----------------------------|

Cumulative Effect

<table>
<thead>
<tr>
<th>Supervisors</th>
<th>Welders</th>
<th>Platers</th>
<th>Electrical Technicians</th>
<th>Instrument Technicians</th>
<th>Riggers</th>
<th>Site Engineers</th>
<th>Manufacturing Engineers</th>
<th>Manufacturing Trades</th>
<th>H&amp;S&amp;E Engineers</th>
<th>NDE Engineers</th>
<th>Mechanical Fitters</th>
</tr>
</thead>
</table>

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

**KEY**

<table>
<thead>
<tr>
<th>Skills</th>
<th>Sufficient available skills capacity, training in nuclear safety/culture required</th>
<th>Capacity can be grown with investment, recruitment, training</th>
<th>Skills shortages, need special attention</th>
<th>No capability</th>
</tr>
</thead>
</table>
2.21 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.

2.22 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**

2.23 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.
3.1 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.

3.2 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.

3.3 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.

3.4 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

3.5 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.

3.6 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 5,500 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 NDA’s 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 15,000 people, 40% 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.

3.10 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.
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

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.

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

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.

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
Service trades (laggers, painters, scaffolders etc)

Project management and technical support services

Using the requirement for a single station as the building block, the requirements for the 16GWe programme, based on the NIA assumed programme, are shown in figure 3.3. These estimates are based on a common assumption of requirements across each of the projects and have not taken into account any savings due to efficiency improvement through the programme.

Workforce Projection NIA Assumed Programme

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

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.

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.

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.

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.

### Manpower by Trades

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<thead>
<tr>
<th>Year</th>
<th>Civil</th>
<th>Mechanical</th>
<th>Electrical</th>
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<td>2027</td>
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</table>
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 work force. 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 16GWe 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.
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.

The operational resources in the various sectors are likely to remain in their sectors but there will be a movement of the contracting resources to follow the work, with a possible movement from decommissioning work to new build and then back to decommissioning when the new build programme is completed. There will of course be an increase in the new build operational staff and in the contractors' workforce maintaining and servicing the new stations. There will also need to be an increase in regulatory resources for both the new build period and the subsequent operational lives of the new plants.
Interaction with Activities in Other Energy Sectors

3.31 The nuclear new build programme will take place against the background of other energy and infrastructure developments. The suite of National Policy Statements published by the Government in July 2011 included, in addition to the nuclear statement, NPSs on fossil fuels, renewables, gas supply/pipelines, and electricity networks. These will all require significant investment and will compete for some of the resources required for the nuclear programme, which will need to be taken into account when assessing total recruitment and training requirements. Resources will be required whichever electricity generation technologies are pursued which means that, in broad terms, uptake in one type of electricity generation technology will be balanced by lower uptake in another technology.

3.32 Provided there is a clear programme with continuity of work over the anticipated build period of 15 to 20 years and conditions are created that will attract contractors, staff and labour, the nuclear new build programme should not be constrained by developments in other sectors of energy and infrastructure. Whilst the requirements of the programme will undoubtedly be very large, the delivery of the 16GWe of capacity will be manageable. However, it will need commitment and leadership from the developers and the main contractors to bring the rest of the supply chain on board and to ensure that all suppliers implement the appropriate safety and quality culture required in the nuclear sector.

3.33 For many engineering disciplines such as mechanical and electrical trades it is expected that the UK has sufficient capability to support the 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, in control and instrumentation, the UK has sufficient general capability but there is limited capability and capacity for the high safety grade nuclear element. In all areas the lessons, good and bad, from recent international experience of nuclear new build will be valuable to owners to de-risk the programme.

3.34 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 demands. That said, the detailed analysis of manpower requirements, supported by the Work Package Datasheets, identifies in addition to the general increase in onsite resources, specific pinch points and shortages that will need to be addressed, notably for:

- **Programme management** – this requires strong individual leadership, which is a scarce resource, plus a strong multi-skilled support team.
- **Project management** – these are managers of parts of the overall programme and managers within the supplier companies; good ones are scarce.
- **Project planners and controllers** – these people schedule, monitor, progress the work and identify early warnings/actions. Once again, good ones are scarce.
- **H&S&E regulators** – as more applications to build are forthcoming there will be a need to increase the resources of regulators. This will be particularly important if new designs/technologies are introduced. The regulators will need to determine their specific requirements in terms of skill types and timing.
- **HQS&E controllers** – during the build programme there will be an increasing demand on HQS&E controllers and this will continue through the operational phase of the programme.
High grade welders – this applies to the onsite phase but also to offsite manufacturing work.

Onsite supervisors – these are key people for all civil, mechanical and electrical activities.

Safety case authors

Security regulators

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 safety case authors, these pinch points relate to broad skills required across industry in general so mitigating them will have wider benefits to UK industry. Obviously, the longer it takes to overcome them, the more severe the problem will become.

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 is normally done. The NIA has been working closely with the skills organisations, primarily ECITB and Construction Skills/CITB (which together cover most of the skills requirements for the new build programme) through NESA to identify the manpower requirements shown above which will inform the planning and delivery of skills provision by the skills bodies.

3.37 The manpower estimates and the split across trades summarised above 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.

3.38 The tax treatment of itinerant workers needs to be addressed so that it is geared to the reality of the nuclear programme. Many workers on new build projects will be working and staying away from home, with the duration of the construction works being at least seven years. On current rules, after two years, the travel, subsistence and accommodation expenses payable to these workers will become taxable. To avoid unnecessary churn arising from workers relocating to other sites the tax regime should reflect the nature of employment on major projects such that project workers are assigned to jobs for the project duration and expenses remain exempt from tax liability for the lifetime of the project.

Summary

3.39 The new build programme will take place against a background of high retirement rates in the industry and competing demands for skilled workers from other sectors. There will be a requirement for significant increases in capacity and skills across the industry through training, re-skilling and improvements in recruitment and retention rates. Whilst industry should be able to ramp up capacity with the support of Government and with forward planning, the scale of the challenge should not be underestimated.
The International Context

4.1 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.

4.2 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.

4.3 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**

4.4 In addition to new build, there will be opportunities in decommissioning and in the upgrade of plants resulting from greater scrutiny of quality and safety standards following the Fukushima accident. These are both areas where the UK has significant strengths. Having been one of the first countries to develop civil nuclear power, the UK has acquired a wealth of experience and now has well-established decommissioning expertise employed directly and in the supply chain. UK companies have already secured major overseas contracts in these areas.

4.5 The market for nuclear technology, which has historically been dominated by national champions, reinforced by regulatory and commercial barriers to entry, has in recent years become more globally competitive. There are nine consolidated reactor vendors offering their technology and services over much of the full nuclear fuel cycle and to most if not all regions of the world. At the same time the trend towards localisation of component manufacture creates competition and opportunities for new specialist suppliers to develop.
4.6 The global renaissance in nuclear power will also of course 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 foreseen 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.

4.7 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.

4.8 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.

4.9 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.
5.1 A successful new build programme will have significant benefits:
  - For the UK as a whole in terms of secure, economical and low carbon energy
  - For developers in terms of delivery of projects on time and within budget and
  - For UK industry in terms of maximising opportunities for UK jobs and economic content.

5.2 However these benefits will only be achieved if the projects can be delivered in a competitive way. The goal of maximising UK content will only be achieved if Government, developers and contractors are jointly able to ensure that risks to project delivery are minimised. This chapter considers the twin challenges that will be faced of successful delivery and maximising UK content.

Throughout this report we refer to UK content as economic activity in the UK and employment created in the UK.

5.3 The reality is that companies which are already designing and building new nuclear power stations will have done the design work and will have developed their supply chains. This means that they will not have to repeat this preparatory work and incur the associated expenditure and should have learned from their past experience.

5.4 UK companies will therefore need to demonstrate at the pre-qualification or tendering stage excellence in performance, equivalent experience and a competitive edge to overcome this challenge. This could be through innovative manufacturing technologies, innovative construction and installation methods, high productivity levels and competitive pricing.

5.5 Developers wish to ensure lessons and experience from current new power station projects are fully absorbed into their projects in the UK. Hence a major challenge will be to combine the capabilities and experience of the UK industry with that of companies already involved in building new stations.

5.6 Several UK companies have set up joint ventures with companies already supplying into the current new build projects so as to make best use of the combined skills and experience and to avoid costs of repeating work already done. In some areas these partnerships will enhance the supply chain, and collaboration and benchmarking with international experts can support knowledge transfer and development of UK expertise. It should also de-risk the projects and reduce costs. On the other hand it inevitably involves work sharing and reduces the potential UK content.

5.7 This is particularly challenging where overseas suppliers win the first contracts (which may contain options for follow-on contracts) and thus will be in a strong position to win the contracts for subsequent stations. Whilst it is understandable that many companies in the supply chain are waiting for greater clarity in the programme, it is important that they are preparing now to compete for tenders. There is a danger that many firms will not make the necessary commitments in the early stages of the programme and will then find they have missed out on subsequent opportunities.

5.8 In addition, UK supply could be disadvantaged where overseas suppliers benefit from export credit finance from their home countries that is more favourable and is easier to obtain than UK companies can achieve.
Lessons Learned from Other Nuclear and Infrastructure Projects

5.9 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 Olkiluoto 3 and Flamanville 3, new plants in China, Japan and Korea, and in successful infrastructure projects in the UK in non-nuclear sectors, including:

- The Olympic Games infrastructure development programme
- Heathrow Terminal 5
- Channel Tunnel Rail Link (stage 2)
- Crossrail

5.10 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 are well understood by leading UK contractors and have been applied successfully in other projects. They have been documented in authoritative reports including the Infrastructure UK Cost Review and the Engineering the Future Nuclear Lessons Learned reports. Ensuring that they are applied in the nuclear new build programme, as well as learning lessons from projects that have not been successful, will require effective collaboration between clients and contractors based on a shared commitment to reduce project risks and a mutual interest in successful delivery.

5.11 Critical lessons to be learned from experience of international nuclear and other major projects are:

[A] A clear Government commitment to nuclear power with strong cross-party support and a willingness to recognise its requirements with respect to planning consent, the National Grid, market stability and spent fuel/waste disposal, are essential to attract the necessary private capital investment.

[B] Lessons are learned over the course of a programme and will be incorporated into common practices and processes through the supply chain; in the case of nuclear new build this means that follow-on Nth-of-a-kind stations should be delivered at lower cost and in shorter timescales than first-of-a-kind.

[C] Many delays and cost increases occur as a result of incomplete designs or subsequent changes. New stations should be based on a high level of design completion in advance of construction, and the licensing basis for the plant must be secure before commitment to construct. All stations using the same reactor technology should be as near identical as possible, subject to site-specific considerations, to maximise the value of lessons learned, and to allow comparability for both normal operations and when issues arise.

[D] It is also important to have a detailed work plan for construction and installation, prepared in advance of the work commencing and with a minimum of subsequent changes.

[E] It is essential to establish a process for rapid resolution of licensing and regulatory issues throughout the build programme, continuing the positive experience of the GDA process, to ensure that any emerging issues are resolved before they impact on the construction programme.

[F] A highly-qualified integrated team should be established to develop the design, secure the safety case and to plan the procurement and build
schedule in detail in collaboration with main contractors. Ideally the integrated project team should have a clear identity and be located in one place in close proximity to the site. It is also essential to have clear lines of responsibilities, communication and authority, between the client and the delivery team.

Early contractor engagement should be undertaken to ensure comprehensive integration of the design with the construction approach.

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

A robust supply chain is needed with the necessary skills and experience, systems and processes, competitive strengths and capacity to deliver to time, cost, quality and safety standards. Prior to receiving any contract, contractors and their sub-contractors must demonstrate:
- that their quality systems are suitable
- that their workforce is suitably qualified and experienced
- that they understand the contract specification and are committed to work to it including safety, quality, traceability and documentation requirements.

Rigorous quality assurance is essential throughout the design process and must seamlessly integrate with the manufacturing, construction management and quality assurance processes.

Good communications with the local community must be established from the start and maintained throughout the programme. There must be open engagement but it must also be conducted in a structured and formally managed way.

There will necessarily be differences in the forms of contracts used by different developers. Equally, there are advantages in achieving a high level of standardisation of contracting practices. From the contractors’ viewpoint, use of a common contracting framework over the new build programme could lead to more effective delivery and take costs out of the programme. This would avoid having to set up different conditions for different projects and would focus attention more on project delivery and less on variations in contract conditions. It is appreciated that we are operating in a competitive commercial environment but in view of the potential gains some consideration should be given to this possibility.

The New Build Order Pipeline

Developers have invested time and effort into engaging with the supply chain to provide information to potential suppliers on their timetables, scope of procurement and their expectations of supply chain partners. This is valued by supply chain companies.

This process of engagement needs to be continued and to be deepened, to the benefit of both developers and their suppliers. If companies are going to undertake the investments that are required to meet the new build programme they will need clarity over the new order pipeline and confidence that there will be repeat orders for which they will be able to compete.
There is a risk that new plants for different developers will overlap to a degree that would require very large numbers of people with particular skills for short periods of time. This would prove difficult and expensive to accommodate. It is therefore important to identify both pinch points and gaps in the programme that could lead to higher costs and delays and to work out the best solutions to mitigate them.

Regular dialogue should therefore be maintained between developers, their principal contractors and the supply chain to exchange information about the expected pipeline of orders.

Supporting Investment

With increased clarity and confidence in the new order pipeline, there should be clear market signals for firms to make the investments in capacity and skills that will be required.

However, the investments need to be made in advance of winning contracts, otherwise they are likely to be too late. Many companies are not in the position to take such risks and would benefit from assistance. Specific areas where support would be beneficial are listed below. These have been identified in the nuclear context, but would benefit companies in their general business.

Training
- Additional financial support to companies to employ and train more apprentices.
- Create facilities for industrial phase of apprentice training, in lieu of on-project training.
- Additional financial support for graduate training.
- Additional financial support to up-skill staff and labour.
- Additional financial support for training of onsite supervisors.
- A longer term review of training methods.
- Mitigation of pinch points identified in this and other studies.

Equipment Qualification
- Assistance to companies for equipment qualification.
- Common facilities for equipment qualification and accreditation.

Quality Systems
- Assist companies to set up and apply appropriate quality systems.

There will still be a need, however, for larger scale investments in some parts of the industry, especially if the UK is to develop capability in some of the areas of equipment supply where none exists at the moment. Given the long term nature of these investments, and the need to make a return over several projects with different timescales and clients, these investments will be difficult to finance through conventional market instruments. These long term investments could nevertheless make a positive return for the UK economy as well as the firms concerned. The Government should therefore consider mechanisms to provide or underwrite loans on a commercial basis to support specific investment requirements.

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. Traditional
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

5.20 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.

5.21 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.

5.22 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.
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

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.

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

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

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.
  - Adoption of best practice across the new build programme.

Summary

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 next few years. 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 to 20 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.

6.2 Uncertainty
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 engage actively if they wish to avoid missing out on opportunities.

6.3 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.

6.4 Areas with no UK Capability
There are elements of a nuclear plant that can be supplied by only a few companies in the world and where the UK has no, or very limited, capability. This applies particularly to manufacture of reactor pressure vessels, steam generators, large turbines, ultra-large forgings and reactor coolant pumps. To enter such markets requires an international strategy with a robust business plan and confidence in global demand. Even with that, it would take a new entrant many years to develop and achieve customer and regulatory approval. For the few UK companies that could possibly tackle these items the business cases are currently not strong enough for investment.

6.5 UK Capability
On the other hand, this study has confirmed that the UK has considerable capability to design, manufacture, supply, construct, install and commission both safety-critical and general equipment for new nuclear power plants. Much of the work on a nuclear plant and therefore the capability required will be non-nuclear. This area of capability can be delivered in parallel with supply of support services to the existing UK operating stations and execution of the NDA-funded decommissioning and waste management programmes.

6.6 Capacity
With respect to capacity, the study has quantified the different types of resource required to deliver a single, twin or triple reactor unit plant and multiple plants across the planned UK sites for various assumed building schedules. These requirements have been compared with the demands from the existing nuclear programme and with available capacity, with the following conclusions:

- 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 a skilled workforce. It is therefore necessary to have substantial recruitment, training and up-skilling at graduate, trade and labour levels and throughout the civil, mechanical, electrical, quality and project management sectors. The largest increases will be in the blue collar sector for onsite construction and installation. The magnitude of the increases will obviously depend on the phasing of the new build programme and the potential competition for resources which may attract resources away from nuclear to other sectors.

- **Front End Support to Developers**
  There are many companies providing front end expert support to potential developers at home and internationally, for example in nuclear technology, international regulation, planning, safety and environmental requirements, legal and financial advice. UK firms can also provide the architect engineer and integrator roles, with support as necessary from the international supply chain. This is a global market in people and skills and there could be a movement of expertise into and out of the UK.

- **Civil Engineering and Construction**
  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. Much of this work is likely to be delivered through joint ventures involving both UK and international companies, as is common practice internationally in major infrastructure projects. The large companies would be supported by the very many small and medium sized UK construction companies. This sector is well resourced by engineers, technicians, skilled and semi-skilled labour and is not expected to be a constraint in terms of capacity. There will, however, still need to be some up-skilling and training in the quality and safety requirements for personnel transferring from conventional work to working on nuclear projects and the need to tackle social and demographic changes such as a trend towards workers being less willing to move from one site to another.
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, electrics and radwaste 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 this challenge.

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
- HQS&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 of SQEP 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

7.1 The Government should maintain a clear and unequivocal commitment to nuclear power, on the grounds of energy security, economic growth and low carbon generation and ensure that there is effective cross-departmental coordination so that all key Government bodies and departments are seen to be jointly committed to delivering the new build programme.

7.2 The Government should complete the facilitative actions required to enable final investment decisions to be made, particularly by continued progress on the process of Electricity Market Reform.

7.3 The Government should simplify and improve the training provisions for manufacturing, construction and erection skills and apprenticeships. Work is underway through the creation of the Nuclear Energy Skills Alliance but this must progress rapidly and successfully to assist the supply chain in strengthening its resources. The situation is still confusing for many companies and Government has an important role to play in ensuring there is clarity of roles and objectives.

7.4 In particular, there should be facilitative actions supported by the Government to address the key skill shortages identified by industry in this study and by NESA which may involve funded training programmes. The Government may need to identify appropriate additional funding to ensure that a sufficient number of the right skilled resources are available at the right time through facilitation of close liaison between the developers, training agencies and industry. One specific concern is the tax treatment of itinerant workers which should be addressed to reflect the longevity of nuclear projects.

7.5 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.

7.6 The industrial phase of apprentice training is currently a bottleneck due to the shortage of industrial placements, where this training is normally done. 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 NDA encourage greater use of apprentices on decommissioning and waste management projects.

7.7 The Government should consider mechanisms to provide funding or underwrite loans on a commercial basis to support specific investment requirements in the supply chain for nuclear alongside other low carbon technologies.

7.8 To help maximise opportunities for small firms wishing to enter the nuclear market, Government should improve advice and direct assistance services to small firms. The change to the Manufacturing Assistance Service (MAS) in England and Wales does not appear to be helping firms enter the nuclear sector. It is particularly important that companies fully appreciate the quality requirements of working in the nuclear industry and specific practical assistance should be made available in this area.
7.9 The establishment and active support of private funding initiatives for this sector spanning equity to debt with innovative finance mechanisms is required and Government should actively support the creation of such mechanisms, but then leave them to the market forces to operate.

7.10 The Government should use the findings of this study as the baseline for its Supply Chain and Skills Action Plan.

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

7.12 Further work should be initiated to establish the realistic international opportunities and what facilitative actions would help to expand them and convert them into effective commercial and business arrangements.

For Industry

7.13 Clients and contractors should develop more effective collaboration to ensure best practices are applied at an early stage to the new build programme based on a shared commitment to reduce project risks and a mutual interest in successful delivery. The nuclear regulators will need to play an important role to ensure that appropriate safety and quality checks are in place without stifling efficient delivery. Developers also need to ensure that their own quality assurance processes do not duplicate work carried out by the contractors or the ONR.

7.14 Regular dialogue should be maintained between developers and the supply chain to exchange information about the expected pipeline of orders and the required safety, quality and performance standards. This can be difficult due to uncertainties particularly in timing and the competitive tendering process for both main contracts and subsequent subcontracts, but it would greatly assist the supply chain to prepare. Early contractor involvement from both the main contractors and their subcontractors will help to secure productivity gains and to ensure effective project delivery.

7.15 The NIA’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.

7.16 Companies should work closely with NESA to coordinate training across the industry.

7.17 Supply chain companies should be clear about their aspirations, raise their profile and actively seek dialogue with the developers and key industry players to assist them to establish their skill and capacity requirements and to meet customer expectations.

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

7.19 Companies should actively explore partnerships with established global supply chain players. This will provide an important way for UK contractors to enter the supply chains of developers, bringing benefits to the clients themselves as well as to both the UK and international partners. Companies should seek assistance from UKTI in establishing these 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.
I. Sites and Developers

National Policy Statement – Nuclear Sites

The National Policy Statement identified the following eight sites as suitable for development of new nuclear power stations before 2030.

1. Bradwell, Essex, EDF Energy
2. Hartlepool, Durham, EDF Energy
3. Heysham, Lancashire, EDF Energy
4. Hinkley Point, Somerset, EDF Energy
5. Oldbury, Gloucestershire, Horizon Nuclear Power
6. Sellafield, Cumbria (Moorside), NuGeneration
7. Sizewell, Suffolk, EDF Energy
8. Wylfa, Anglesey, Horizon Nuclear Power
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.

EDF Energy (80%)/Centrica (20%) Joint Venture
2 x 1600 MW EPRs for Hinkley Point
2 x 1600 MW EPRs for Sizewell

HORIZON NUCLEAR POWER
Up to 7,800 MW
Plans for ABWRs at Wylfa and Oldbury to be confirmed following completion of the acquisition by Hitachi

IBERDROLA/GDF Suez Joint Venture
Up to 3600MW operating by 2025
Technology to be decided

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 NuGeneration at its site in Moorside, West Cumbria (adjacent to Sellafield).
European Pressurised Reactor
3rd Generation EPR design with an electrical output of 1,600MWe. The design is currently undergoing Generic Design Assessment for its UK licence. It has so far received its UK IDAC and ISODA certification. The EPR is currently under construction in Finland, France and China.

AP1000
The Westinghouse AP1000 is a pressurised water reactor producing 1,117MWe. The design has received its IDAC and ISODA licence certification in the UK. Construction is ongoing in China, and it has begun the application process for licence in the USA.
Advanced Boiling Water Reactor
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.
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.

Terms of Reference and further details at DECC website www.decc.gov.uk/en/content/cms/meeting_energy/nuclear/new/supply_skills/nesa/nesa.aspx

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 mapped to employer needs. The ECITB-approved and-licensed training provider network delivers 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 supervisor 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.
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
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</table>
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 PackageDatasheets

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.
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 an expert review process by Lord Hutton of Furness, Terry Hill CBE and Dr Tim Stone CBE.
### Steering Group Membership

<table>
<thead>
<tr>
<th>Name</th>
<th>Organization</th>
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<tbody>
<tr>
<td>Bill Bryce</td>
<td>Doosan Power Systems Chair of Steering Group</td>
</tr>
<tr>
<td>Terry Gilbert</td>
<td>AMEC</td>
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<tr>
<td>Chris Squires</td>
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<td>Rafael Jimenez</td>
<td>NuGeneration</td>
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<td>Morgan Powell</td>
<td>Horizon Nuclear Power</td>
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<tr>
<td>Roger Hull</td>
<td>Sir Robert McAlpine Ltd</td>
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<tr>
<td>John Molyneux</td>
<td>Rolls Royce Plc</td>
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<tr>
<td>Alastair Pollock/ Jon Halladay</td>
<td>Weir Group</td>
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<tr>
<td>Clive Smith</td>
<td>NESA</td>
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<tr>
<td>Robert Davies/ Helen Higgs</td>
<td>AREVA</td>
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<tr>
<td>Alistair Smith</td>
<td>Costain</td>
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<tr>
<td>Ron Gorham</td>
<td>Nuclear Decommissioning Authority</td>
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<tr>
<td>Glen Little</td>
<td>Doosan Power Systems</td>
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<tr>
<td>Adrian Bull/Simon Marshall</td>
<td>Westinghouse</td>
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<tr>
<td>Chris Savage</td>
<td>NIA, Project Manager</td>
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<tr>
<td>Alastair Evans</td>
<td>NIA, Secretary</td>
</tr>
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</table>
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