The Sector Skills Council for
Chemicals, Nuclear, Oil and Gas,
Petroleum and Polymers

cogent

A Gap Analysis for the
Nuclear Industry

An investigation into gaps in provision based on current and predicted future skills needs.

May 2006

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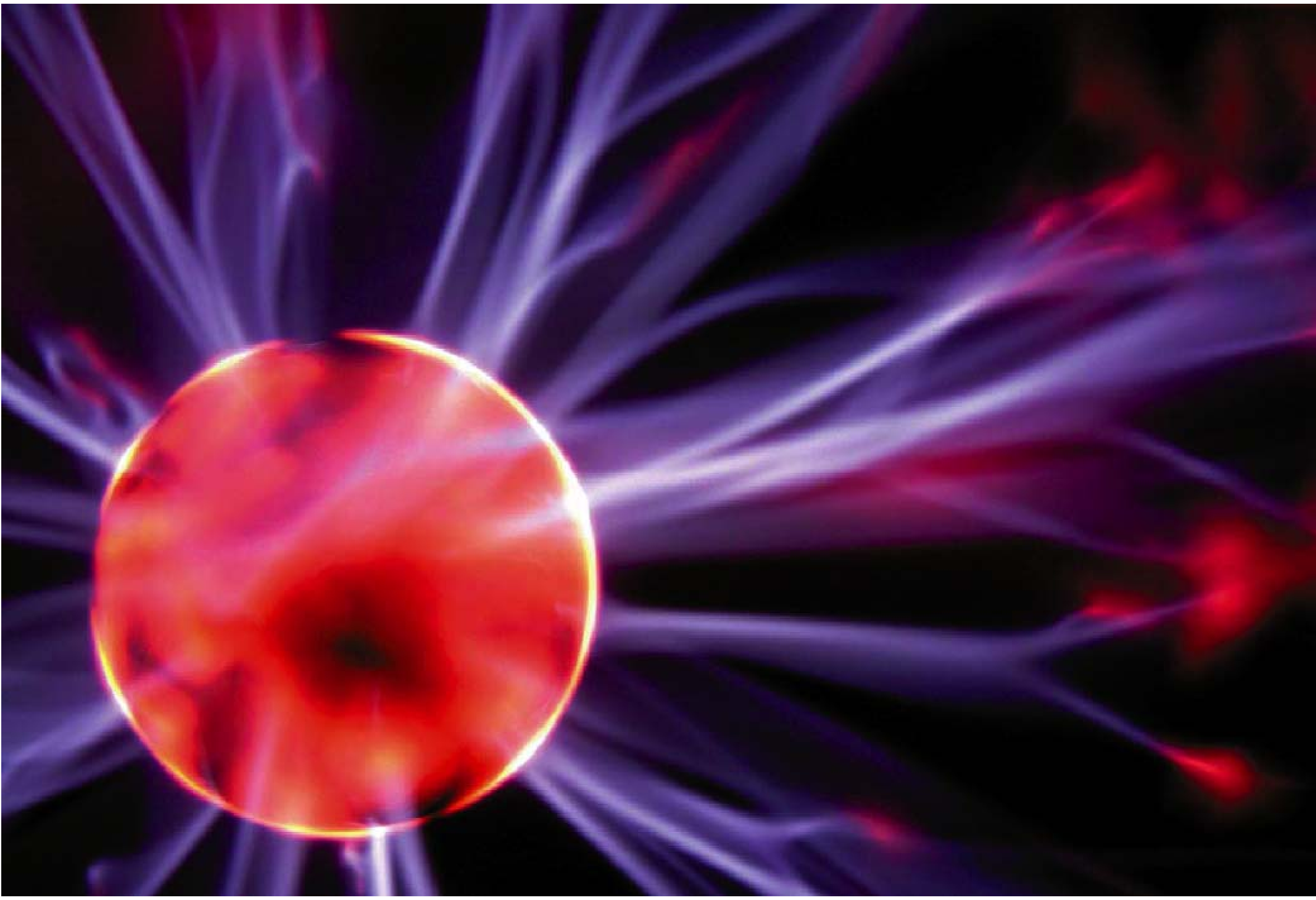

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Table of Contents

Tables and Figures

1. INTRODUCTION

The nuclear industry is currently at a crossroads, its future direction dependent on Government decisions on: the future sourcing of electricity supplies to meet the needs of UK residents and employers and; the future of the nuclear deterrent. Regardless of decisions on new-build facilities, the ongoing decommissioning work will still take place. The effects of the decision on new build will impact on all parts of the industry.

For the purposes of this report, Cogent sought advice and guidance from a broad spectrum of experts, covering different aspects of the industry – power generation, decommissioning, defence, and waste management, and combined these potential scenarios with the influence exerted by potential external activities.

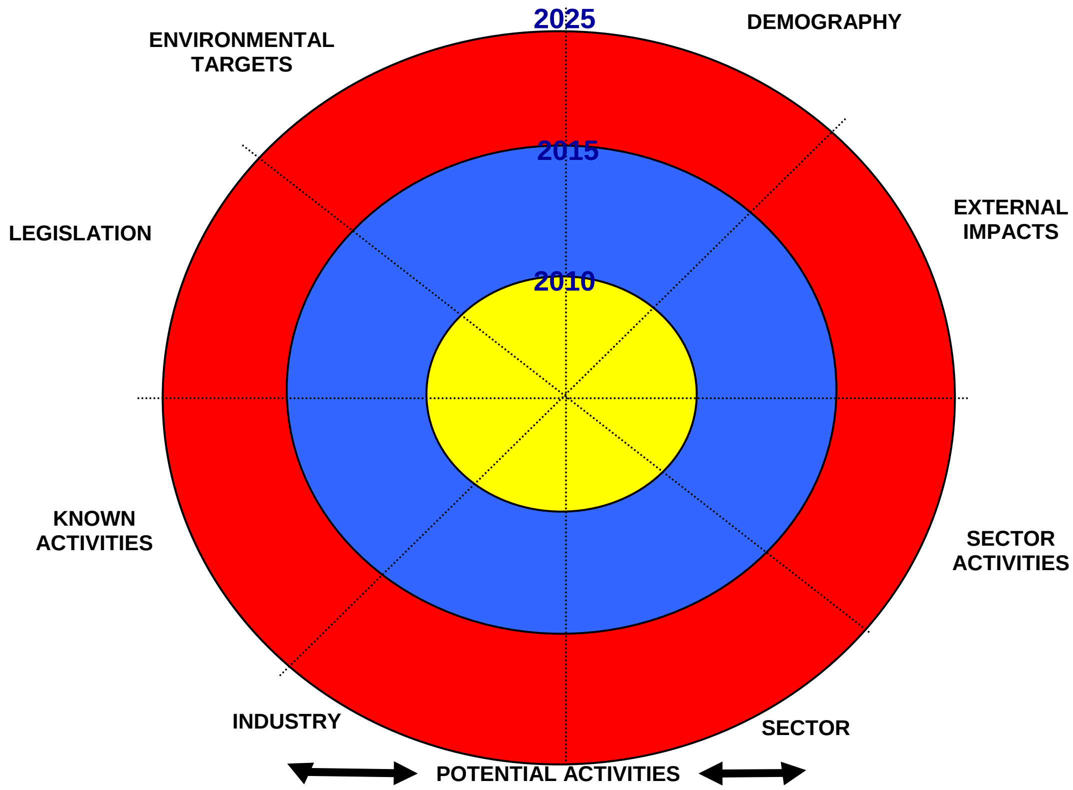


Figure 1—the Scenarios Radar

A “radar” describing potential future activity was constructed covering

- Known, planned future activity
- Likely or potential future activity
- Planned sectoral activity that may impact
- Likely or potential future activity that might impact
- Legislative timetables
- Planned external activity that may impact
- Environmental targets
- The projected shape of the future working population.

Unlike many other industries, employers dealing with nuclear facilities and technology tend to have a better informed view of future activity, allowing us to look at scenarios well into the future. The information will be presented in three time bands – a view at 2010, 2015, and 2025. Indeed, some activity planning is already in existence referring to the 22nd century.

1.1 RECRUITMENT & TRAINING

The nuclear industry recruits school leavers and people who have graduated from FE Colleges and Universities (HE). It also recruits from other industries and employers within the industry. In the past 5 years, most parts of the industry have seen declining numbers of SET (science, engineering and technology) personnel. Looking towards the longer term some employers have maintained graduate training schemes. Research indicates about 500 SET graduates were brought into the industry (in 2004/05), which employs some 20,000 SET professionals. At the same time, somewhat less than this volume of Apprentices are being employed by the industry.

The industry age profile tends to be more aged than the working population, although a flush of early retirements in the industry especially of professionals results in a temporary depression of average age.

To sustain its existing strength, closer to 1,000 each of Graduates and craft/technicians are needed. The industry could be managed downward by taking in reduced numbers (as currently) but to increase numbers will require a step change in recruitment.

1.1.1 APPRENTICESHIPS

Apprenticeships are becoming increasingly important as a means of recruiting and training the craftsmen and technicians of the future. The Apprenticeship route has the benefit of pay and work-oriented learning with a related job prospect, but is constrained by requirements to be less pure knowledge and more competence related. Decommissioning is a new task which can be taught as part of apprenticeships to develop a new younger workforce. But with (anticipated) extensions of life, the AGRs will also require a workforce for the longer term which can be sustained by apprenticeships. The nuclear industry is known to use some 24 FE Colleges in the UK for apprenticeships and technician/craft/process worker training. There are many apprenticeships, based on a variety of SET qualifications, mainly non nuclear in content. The industry is known to take in at least 330 apprentices in 2005. The nuclear decommissioning NVQ Level 2 (and planned Level 3) has been incorporated in apprenticeships in two centres so far, one of them the North Highland FE College at Thurso. Other nuclear related qualifications are in Radiation Protection.

1.1.2 GRADUATE DEVELOPMENT FOR THE NUCLEAR INDUSTRY

The Nuclear Employer Survey by Cogent estimates up to 500 graduates were recruited by the industry for Science Engineering and Technical roles in the previous 12 months. This is in addition to experienced professionals recruited by employers from within and outside the industry. This number can be expected to rise as the industry moves from the downsizing of the past 5 years towards gentle growth in some parts of the industry. Recruitment has been from a wide range of Universities – seven leading employers took SET graduates from 47 different Universities in 2005.

The employers want to recruit good engineering and science graduates. They do not look for nuclear graduates – they would be disappointed. There have been no first degree nuclear engineering courses for about 20 years past. The news is that University of Lancaster is starting a Nuclear Engineering BEng/ MEng this September.

There are about 15 Universities offering taught Masters courses and probably 8 which have serious nuclear research and offer Doctorates. There are 4 University Research Alliances that support industry's underpinning requirements for post-graduate related training and education in the following areas; radiochemistry (Manchester), Materials Performance (Manchester), Particle technology (Leeds) and Immobilisation (Sheffield) - in total there are approximately 120 researchers associated with these Alliances.

The NTEC Nuclear Technology Education Consortium group of 11 Universities offers a consolidated taught Masters programme picking best elements from each of the Universities in a modular teaching programme. This is funded by an EPSRC grant to start up, first cohort of over 30 students started September 2005.

Discussions are being progressed with EPSRC on a proposed new Nuclear Engineering Doctorate (EngD) Scheme. The proposal is led by the Dalton Nuclear Institute, University of Manchester in partnership with Imperial College London with the support of the Universities of Bristol, Leeds, Sheffield and Strathclyde.

The University of Manchester is currently planning additional centre in the following disciplines: Radiation Sciences, Decommissioning Engineering, Reactor Technology, Geological Disposal and a Nuclear Technology Computing & Simulation centre.

Increasingly important also are international post-graduate courses such as:

ENEN (European Nuclear Education Network) Masters
Joliot Summer School on Nuclear reactor technology
WNU World Nuclear University summer schools 2005, 2006.

The NDA and University of Manchester via the Dalton Nuclear Institute have signed a Memorandum of Agreement to invest in the establishment of a substantial research and education facility called the Dalton Cumbria Facility to be centred in West Cumbria. It will establish a world leading postgraduate research and education facility, undertaking research in key areas relating to the NDAs clean-up mission and will underpin critical skill areas. There is a great deal of interest in this proposal from Government, industry and academics.

The British Nuclear Energy Society hosts twice-yearly NAILS (Nuclear Academics and Industry Liaison Seminars) where industry and academia can develop collective action and exchange information.

1.2 EDUCATION AND INDUSTRY GENDER DIVERSITY

Workforce gender diversity can be explored by comparing the sector's SET workforce gender diversity with the gender diversity of those qualifying from subjects and courses that the sector recruits from.

The common factor for SET personnel is school science and engineering which is the first stage of the pipeline. The evidence is that career selection begins with A-Level / Highers choice at school or College, ONC, S/NVQ level 1/2 or equivalent at FE College. At the point of selection, options for SET careers are opened or shut, later re-opening of the option being difficult. Hence girls make their choice of subjects mainly at age 16 although those going on to science and engineering degrees may not make job applications until they are 22 or more.

To this extent, it is important for the industry to see school pupils properly informed on choices of course and of career and how they are related. In the FE/ HE phase, there is little education about the industries – more so in vocational FE courses than in HE.

1.2.1SCHOOL

At A-level/Higher, the dye is already seen to be cast. From 2005 data (Table 1) it is clear that overall, about 20% of A levels sat were in mainstream SET. Also although the number of females who sat the exam are equal to males in chemistry, but females are in a definite minority in maths physics & technology subjects.

Female choice of A-levels/Highers is seen to be highly biased away from science and maths – except for chemistry (and in Scotland Maths also). The trends for A-levels over the last 5 years show that while the female proportions of those sitting technology subjects has increased by 12%, those sitting maths at A-level has only increased by 1%, physics remains static at around 22% and the proportion of females studying chemistry has declined 2% over the last two years.

Going back to GCSE and Standard Grades, however, the balance is more even. The great majority of students sit GCSE Double Award Science (ten times as many as do chemistry or physics) and more than 50% of these were female in 2005. The problem therefore arises in A-level choice. In Standard Grade Physics the drop off of female students has already started in Scotland with only 27% making this choice.

School science and engineering has an important influence on future career path choices. As a result it is thought important for the industry to provide careers information to assist pupils to make well informed choices for post GCSE education though a more proactive approach is likely to be required to instigate any significant change.

Table 1: Percentage of females in science & maths 2005 – National Provisional A Level Results (all UK candidates); Pre-Appeal National Qualification Results (Scotland)

Subject	Total Sat A Level	% Females	Total Sat Higher	% Females
Chemistry	38,851	49.4	9,405	50.5
Maths	52,897	38.1	19,713	48.0
Further maths	5,933	28.6	N/A	N/A
Physics	28,119	22.0	8,951	28.5
Technology subjects *	17,914	39.1	848	5.8
All subjects	783,878	54.2	164,053	55.1

* This title covers a range of subjects at A-Level
Sources: Joint Council for Qualifications (2005), Scottish Qualification Authority (2005)

1.2.2FURTHER AND HIGHER EDUCATION

Table 2 below shows the percentage of female qualifiers from SET subjects related to the Cogent sector. The purpose of this comparison is to determine whether the workforce gender profile is in line with further and higher education courses or whether Sector employers are not attracting female graduates. Workforce supply from the education system is further explored in the Assessment of Current Training Provision report.

In general we can see from the table that the proportion of female graduates from the subjects of interest has increased over the last 10 years. The proportion of females varies from course to course with the Engineering subjects displaying the lowest proportions and the Polymers, Materials and Textiles courses dominated by females.

Only 18 percent of the total workforce and 12 percent of the Science, Engineering and Technical workforce in the nuclear industry is female.

The proportion of females in SET job roles within the Nuclear industry is the lowest across the whole Cogent sector – and is about half that for Chemical industry. While there are a minimal number of job roles in the industry where females (or pregnant females) cannot work, the workforce does appear to be unusually gender biased. The subject areas from which recruits for the nuclear industry are most likely to come from are Physics and Engineering - Physics and Chemical, Process and Energy Engineering show far higher proportions of female graduates 22-25% than the nuclear SET workforce does. The workforce profile is comparable to the profile for Mechanical, Electrical and Electronic Engineering where females made up 8-11% of graduates in 2005.

This example has been worked with the nuclear industry however this trend runs across the whole sector. While a certain element of the gender bias within the workforce can be explained by the gender profile of those coming through the education supply system, there remains an element whereby the Sector is not attracting suitably qualified females. Furthermore, the data in the table above raises the question as to whether this issue should be tackled in the earlier stages of the education system where females are opting out of subjects that could lead to further study in Science, Engineering and Technical courses.

Table 2: Percentage of female graduates 1995 – 2005 in science and engineering

Subject of study	Level of qualification	95/96	00/01	01/02	02/03	03/04	04/05
(F1) Chemistry	Postgraduate	34%	34%	39%	36%	38%	37%
	First degree	37%	43%	41%	45%	47%	48%
	HNC	38%	..	..	..	..	..
	Other undergraduate	..	..	..	40%	46%	57%
(F1) Chemistry Total *		36%	40%	41%	43%	44%	46%
(F3) Physics	Postgraduate	20%	20%	22%	24%	25%	25%
	First degree	20%	19%	21%	23%	23%	21%
(F3) Physics Total *		20%	20%	22%	23%	23%	22%
(H3) Mechanical engineering	Postgraduate	..	13%	..	..	13%	..
	First degree	9%	8%	8%	9%	9%	8%
(H3) Mechanical engineering Total *		8%	8%	7%	8%	9%	8%
(H6) Electronic & electrical engineering	Postgraduate	11%	14%	17%	17%	17%	19%
	First degree	8%	9%	10%	11%	11%	10%
(H6) Electronic & electrical engineering Total *		8%	9%	11%	11%	11%	11%
(H8) Chemical, process & energy engineering	Postgraduate	..	30%	..	27%	34%	30%
	First degree	23%	25%	26%	27%	24%	24%
(H8) Chemical, process & energy engineering Total *		22%	25%	25%	27%	27%	25%

Source: HESA Student Records (1995-2005)
.. Denotes that data is suppressed as population is less than 52 students. Where no data can be presented for a qualification level for the reason of low uptake / low female uptake it has been removed from the table
* Totals include all Higher Education courses: Post Graduate, First Degree, Foundation Degree, HND, HNC, Other Undergraduate (including N/SVQ levels 4/5, post-degree certificates at undergraduate level etc)

1.3 NUCLEAR INDUSTRY DESCRIPTION

The nuclear industry is divided for purposes of this report into four main activities:

nuclear heat generation – including power generation and the submarine nuclear propulsion plant

nuclear material processing – including the nuclear fuel cycle and the nuclear weapons production and handling

nuclear decommissioning and cleanup

nuclear waste management.

Each nuclear site is licensed by HSE Nuclear Installations Inspectorate under conditions for the organisation and operation of the sites. A construction site, such as a new nuclear power station, is not normally licensed until near the time when nuclear fuel is brought to the site.
There are few restrictions in the industry which prevent females from working in any role on any site. Some sites have considerably higher gender diversity than others. There are no barriers to ethnic diversity.

There are security restrictions which tend to prevent:

- foreign nationals from working on licensed nuclear sites

recently resident Europeans from working on licensed nuclear sites
and the Office of Civil Nuclear Security has a role in maintaining security.

Wherever nuclear materials – from fresh uranium through to spent fuel and waste products – are processed or handled, there is a requirement for certain skill sets to be applied. The nuclear regulator requires Suitably Qualified and Experienced People for all nuclear safety related roles. To some extent, the people working in the four activities above are transferable between them – there are a few core competences such as protection from radiation and contamination which apply across the industry.

There is a requirement at each site for induction training for anyone who will work on the site, to make them aware of the hazards. This training is in most cases not transferable between sites, a situation which creates irritation, and massive duplication of effort, around the industry. As the industry becomes more commercialised, there is a strong case for a consistent site induction regime which will be transferable whilst leaving control of site access with the licensee in each case – as is only proper.

1.3.1POWER GENERATION

Nuclear power is currently generated by 12 power stations in the UK, spread around the coastline. Each of these assets has been set an expected closure date, where it will enter into a decommissioning phase. Until that time, it is expected that, as a minimum it will remain an employer to the current workforce.

There are three possible futures for power generation:

Ceasing of generation in accordance with existing timelines

Extension of generation beyond currently planned closure dates

Expansion of generation in a number of newly built facilities.

The first of these, whilst at face value appearing to be the simplest in terms of fulfilling skills demands, presents its own set of challenges, in maintaining a stable, suitably skilled workforce on an asset seen to have a finite lifespan. Only four of these assets, as shown in Table 3 below, have a current lifespan of more than 10 years, but in the rather likely scenario of anticipated life extensions this rises to eight, and three of these continue to 20+ years. This is well beyond the remaining working life of a considerable proportion of the existing workforce. The industry and its partners must ensure that the required skills and knowledge remain a part of the training and education infrastructure.

Table 3: Operating nuclear power station lifetimes

	Start	Baseline (Current lifetime)	Most Case (Forecast extensions)
Dungeness A	1965	2006	2006
Sizewell A	1966	2006	2006
Oldbury-on-Severn	1968	2008	2008
Wylfa	1971	2010	2010
Hinkley Point B	1976	2011	2021
Hunterston B	1977	2011	2021
Hartlepool	1984	2014	2024
Heysham 1	1984	2014	2024
Dungeness B	1985	2018	2018
Heysham 2	1988	2023	2033
Torness	1989	2023	2033
Sizewell B	1995	2035	2045

Source: Nuclear Decommissioning Authority (2006)

In all probability, both of the second two futures will prevail – lifetime extensions and new build. This is the basis for the "Most Case" scenarios presented later in this report which would stretch the human resources and would certainly need a step change in power station recruitment and training within the next 10 years.

It is also likely that there will be shifts in technology, location and employer between new build stations and those which are just shutting down to decommission.

1.3.2 NEW BUILD

Should the decision be reached that new build capacity is viable and desirable, the industry would, to a certain extent, appear a more attractive future career path to entrants at all levels. The timeframe associated with new build is estimated to be in the region of 10 years between the decision being taken and the first asset being able to generate power to the grid. Approximately 5 years of this is consumed in the planning and approvals process, with the remainder taking in the building and commissioning of the asset.

In order to meet the predicted energy needs of the country, it is estimated that five twin build reactors, each unit with a capacity of 1200 MW may be needed in a new construction programme, starting in 2007 for Commercial Operation in 2017 and at a rate of one new build start per 18 months thereafter. The total build cost would rise to in the region of £2bn per annum by 2011, assuming one new asset construction commenced every 18 months. The current spend on civil engineering projects in the UK is approximately £50bn, therefore nuclear new build will be up to 4% of current spend. Skills associated with this scenario are by their nature non-Cogent-sector specific. Expertise in nuclear sciences would be required in the initial planning phase, but would not be maintained at the same levels throughout construction, where civil engineering skills would be the predominant requirement.

Many external factors that can and will affect the decisions on new build, such as:

The Business Case

- the expected return on investment through sale of electricity
- the policy and policies having a direct effect on the long-term viability of the assets and cost of the liabilities
- the licensing process, and the usage of available data and consents from similar projects outside the UK.

Most case and least case scenarios are considered which accelerate or decelerate the rate of new power station build and bringing into operation. The scenario of no new build has not been considered.

There has already been recognition that expertise in some aspects of engineering and manufacture would not be available in the UK, due to the demise of the heavy engineering industry, necessitating the purchase of specialist machinery such as turbines from abroad. However the UK construction industry has the technical capability for the programme.

1.3.3 DEFENCE

The Royal Navy (RN) currently operates 11 nuclear propelled submarines: 4x Vanguards, 2x Swiftsure and 7x Trafalgar class. There are currently 3 Astute class vessels under construction, with a fourth in the pipeline. These will, over time, replace Swiftsure and early Trafalgar vessels.

Supporting this fleet provides employment for approximately 4000 civilian people. The Royal Navy retains complete responsibility for the training of its own personnel who are not in the remit of this report. Maintenance is currently carried out in two locations – Devonport and Clyde, with each vessel undergoing refit every ten years, with up to two interim major maintenance schedules.

It is intended that the number of vessels will remain at current levels, albeit that vessel types may change, therefore there is an ongoing need to maintain current workforce levels, with 40% being nuclear specialists.

There are 2,500 Ministry of Defence roles focused on the nuclear deterrent, with 240 being specialists in operations and maintenance. Skills issues affecting the maintenance side reflect the downsizing currently taking place in the Royal Navy. It is anticipated that the future flow of skilled individuals from the RN to the private sector will decline. Design and maintenance activity, employs approximately 4,000 personnel, with substantial number of posts requiring specialist skills and knowledge at post-graduate level, such as mathematical modelling, physics, high performance computing.

1.3.4 NUCLEAR MATERIAL PROCESSING

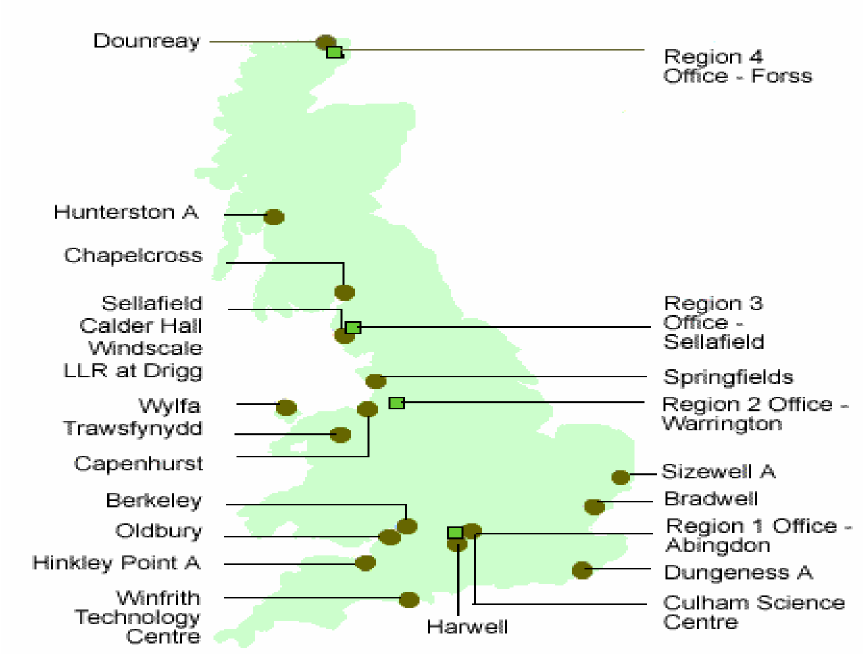
The nuclear fuel cycle, from uranium oxide to production of nuclear fuel, its use, subsequent storage and reprocessing is managed in this country by the nuclear industry. This part of the industry is also a significant international player. As long as there is nuclear power in operation in the UK, there is a case for an ongoing fuel cycle capability.

The nuclear materials within the deterrent weapon – currently Trident – are also produced and processed in this country. Changes in the weapons programme will have a significant effect on the demand for skilled people. This part of the industry employs about 13,000 SET people.

1.3.5 DECOMMISSIONING OF EXISTING ASSETS/LIABILITIES

As each asset reaches the end of its operational life, through defuelling to decommissioning, the actual number of people working on sites remains relatively stable, but will increasingly require a different skill set. Those previously involved in operating the asset in its generating phase could potentially be retrained to assume the roles of decommissioning operatives – the skills level is seen to be on a par although there is a trend towards craft skills to do the dismantling and demolition work. The group least likely to transfer are the less skilled – process and general workers.

Figure 2: The NDA sites – (by courtesy of the NDA)



The two potential scenarios involve either a continuation of the current schedule, or the revision of activity to take account of acceleration of decommissioning timeframes – foreseen by the NDA for decision in 2008. In the first scenario, it is, as already stated, conceivable that existing members of the workforce may seek or be directed towards retraining opportunities. Since the assets are widely geographically spread (see Figure 2 below), this would necessitate the provision of training accessible throughout the UK.

There is a potential impact on this approach from new build, which, were a decision made in 2007, could lead to an asset ready for operation as early as 2016 (if lowest estimate of build time is taken). This would overlap with the decommissioning of certain existing assets, and provide a competing source of employment for a tranche of skilled employees.

In any case, there must be concerns about attracting recruits into the decommissioning and cleanup enterprise. However, the visibility of new projects on the horizon may assist the industry as a whole to attract young people, including to the decommissioning programme.

1.3.6 WASTE MANAGEMENT

Recommendations on preferred methods of waste storage are expected in July 2006 Committee on Radioactive Waste Management (CoRWM), providing an expert view on which of the three possible scenarios would best meet the needs of the UK. The currently available options are:

- long term storage
- geological disposal
- non geological disposal

Each of these potential activities has ramifications for both nuclear and civil engineering skills. The associated skills needs (and timeframes) would vary according to the final selection. The NDA estimates there are 2000 M^3 of high level waste in storage and 350,000 M^3 of intermediate waste which will be produced from the decommissioning programme when completed. Of this a small part is currently stored securely in temporary locations awaiting final removal to long-term storage. This waste has been generated during the 50 years that nuclear power experimentation and generation has been carried out in the UK.

It is expected that future waste generation will be at a much lower annual level, due to enhancements in both technology and operating practices. The new build programme would include reactors which would produce only perhaps 10% of the waste arising from the AGRs. The design of the LWRs is such that they burn much less fuel, produce little waste and are more easily dismantled and demolished than the UK's gas cooled fleet. This translates to less skilled work and lower cost of decommissioning and waste.

The timeframes associated with building a geological disposal facility are long – potentially 20 to 25 years. As is the case with new build, there would be an input of nuclear related disciplines at the front end of the project (elements of design, safety features etc) followed by a requirement for civil engineering expertise, until handover to operational staff. CoRWM has already collated information on potential costs and manpower requirements – as an example, Nirex has indicated that the timescale and cost associated with the deep borehole disposal option is (indicative, but with a high level of uncertainty) in excess of £4.1bn, would consist of a planning phase of 12 years involving between 180 and 400 personnel, and 22 years to construct, with an estimated workforce of 275 per annum. Following this, the estimated operation workforce could be in the region of 275[1]. The actual operating skills needs related to this scenario fall outside the radar being considered, due to the long lead times.

[1] Summary note for CoRWM on distribution of cost, effort and employment profiles for deep borehole disposal option, A Technical Note 2005, Nirex

2. QUANTIFICATION OF NEED BASED ON SCENARIOS

Scenarios were built up with skill demand year on year to 2025, based on previous LMI in 2005, inputs at a Scenario planning workshop with the industry in January 2006 and other sources such as the NDA strategy. A total industry model was built up around the 4 segments described in section 1.3 of this report. A summary chart is given as Appendix 1 at the end of the document. The detail behind that chart is held in spreadsheet form by Cogent. The data provides indicative information of trend and change to form the basis for debate and action by the industry.

2.1 HEAT GENERATION

Nuclear Power

This section considers the power stations during design, construction, operation and defuelling period - decommissioning is dealt with in a separate section. The **Baseline** scenario is of a reduction in the number of operating power stations from 12 in 2005 down to a low of four in 2015, rising with new build to seven operating units in 2025. At that time there would be three units in construction and one in startup also.

On current employer assumptions of resourcing, the power stations and their engineering support organisation are expected to fall from 6,000 personnel in 2005, to approximately 5,000 in 2010, to 3,300 in 2015 rising from then on to about 4,000 in 2025 in the baseline case.

There is a shift in requirement during the new build phase from operations engineers to design and procurement. The number of station operating people falls from 4,700 now to in the region of 1,750 in 2015 but about 3,000 are needed again in 2025. However, the timing of the closure of the AGR stations (and the Magnox stations before them) will require engineering support which can to some extent be taken up by the new build programme which runs alongside.

Hence, the current balance of resources can be maintained with some planned reduction over the next 10 years. After that, demand for well qualified and competent personnel (in particular professionals) for new nuclear build grows at a rate of 150+ p.a. for 5 years before steadying out to 2025. In reality, this requires some continuity of planning from now onwards.

Variants:

*The **Least Case** has a sharp fall from 6,000 now to a projected 4,500 in 2010, and to 3,100 in 2015, rising gradually to 3,500 in 2025. Hence, it is a matter of managing the reduction over the next 10 years while maintaining scope for the modest new build requirement. The overall figures conceal the drop in operating people from 4,800 now, with an estimated loss of 3,000 jobs between 2010 and 2015 – then rising gradually to approximately 2,500 in 2025.*

*The **Most Case** projects a gradual fall to 5,000 in 2010 rising slowly thereafter to 5,300 in 2015 and reaching a peak in the region of 6,800 in 2025. This allows comfortable reduction for the first 5 years, but with the need for steady increases after that, a total of 1,500+ over 9 years. The recruitment requirement during the period 2015 – 2025 would be of the order of 500 per annum, more than double the current recruitment rate. The overall figures conceal the drop in **operations** people with a loss of demand by 1,300 to 2015, then rising by 1,500 to 2020-2025. Effectively an increase of approximately 450 p.a. is needed for this group alone over the period 2015 to 2020.*

The outcomes of these cases translate into a significant need for more design, procurement, construction management and operating staff many of whom are capable of the major tasks – i.e. SQEP - starting in 2015. There is also a large unknown element which would be additional, if the AGR lifetime extensions and the acceleration of new build projects take place. In any case, the overall numbers conceal shifts in technology and location which will require significant training and facilitation and which may also require enhanced recruitment and development arising from premature losses or retirements from the industry.

2.2 DEFENCE NNPP (Navy Nuclear Propulsion Programme)

It may be more difficult to identify and classify here the nuclear SET people in the MOD programmes because of security. However, these programmes are long term, although subject to political adjustment, which makes their planning all the more important.

The **Baseline** scenario is very steady for the dockyards and HQ functions, at around 1,200 nuclear staff p.a. for the foreseeable future. In the Defence Group companies of the Supply Chain, the demand is closely related to MOD's ordering pattern for submarine NNPP. The baseline scenario shows demand oscillating between >1,700 and <1,000 depending on whether 1 submarine or 2 is in construction at any one time. Demand/supply balance may be tracked and supported by MOD but it can also have a contingent effect on the remainder of the reactor engineering community.

Variants:
In most cases the dockyards and HQ functions are steady at least to 2020. It is the other supply chain companies in the Defence Group which are most affected by variants:

*The **Least Case** shows a dramatic fall to a support capability only for the fleet of perhaps 250 people by 2015 to provide service backup to the fleet*

*The **Most Case** is not much different from the baseline, in the range of 1,000-2,000 throughout the period.*

2.3 NUCLEAR MATERIAL PROCESSING

The fuel cycle work in the UK is concentrated mainly on three sites at Springfields Lancashire, Sellafield Cumbia and Capenhurst Cheshire. The weapons work is concentrated at the Aldermaston & Burghfield twin sites.

In the **Baseline Case**, Urenco's Uranium enrichment programme is the single biggest employer in the fuel cycle, growing steadily as world requirements rise. Sellafield reprocessing of Magnox fuel continues until shutdown at end 2013 – by which time all the UK's Magnox fuel should have been reprocessed after use. THORP continues to operate at Sellafield until 2011 and SMP to 2015. Springfields continues to produce the fuel for the AGR programme until the power stations are all shutdown. Springfields also continues to process some Uranium chemical intermediates for the international market until the end of 2017.

MoD's weapons programme continues in production at Adermaston & Burghfield through the period to 2025.

Total employment at fuel cycle sites is around 11,000 in 2005 and stays at this level to 2010, before declining gradually to a projected 7,500 in 2015 and to 6,000 by 2020-2025. The weapon programme employs about 3,600 people throughout the period with some short term increased activity around 2010 with the changeover to new technology.

Variants
*In the **Most Case**, the extension of the AGRs lifetime demands longer term fuel production. The new fuel for UK new build is not sourced in the UK although some more chemical intermediates are produced here. Urenco grows faster and further than in the Baseline Case. THORP operation is extended by 3 years to 2014 and SMP continues to produce throughout the period to 2025. This extends employment up to 9,000 people in 2015 falling to 8,500 in 2025.*

*In the **Least Case**, Magnox reprocessing and THORP both shutdown earlier than in the Baseline Case. Urenco produces at about the same rate. The net result is that SET demand falls to around 9,500 in 2010 and to 6,000 in 2015, stabilising at about 5,500 thereafter.*

2.4 NUCLEAR HEAT GENERATION & MATERIALS SUPPLY CHAIN

The companies which form the Supply Chain for the power stations and submarine NNPP, their fuel cycles and the weapon are essential to their success. The nuclear SET people in those companies are fewer in number than in the operations themselves and fulfil a range of demand such as:

- Maintenance and refurbishment outages
- Health Physics services
- Equipment and systems design, manufacture, test and build
- Provision of specialist equipment such as radiation cameras and monitors.

Of course, some of these requirements are seasonal and the first two above examples require a mobile work-force. Seasonality means e.g. that a demand for 150 man-years per year for maintenance of a power station may have to be met by 600 people working for 3 months and finding something else to do for 9 months. These groups of people will be in decreasing demand as the Magnox and AGR fleets are shutdown.

In the case of new build, the demand on the Supply Chain is for a relatively short burst of activity for each project. A general design support cohort will be needed for each station, presumably learning as it goes along, hence getting more efficient. Equipment and services requirements for new build will be very different than that for the support of the existing power stations. Innovation of engineering and production will be required to meet the demands of the competitive international supply chain market. An increasing workforce of nuclear system and equipment specialists will be needed, rather than the site service teams of the current programme. This may of course add to the potential market for UK suppliers abroad.

In the baseline case for nuclear power, there is a gradual decline from 2,000 currently to about 1,600 after 2010 overall. The rapid programme of shutdowns to 2020 is then estimated to balance out the new build programme in its impact, with a more or less continuous demand of between 2,000-2,200 nuclear SET personnel to 2015 and 2025.

The Defence NNPP programme reduces its supply chain demand from 2,000 now to 1,500 in 2010 and remaining more or less at this level until 2025. The fuel cycle and weapons supply chain is steady at about 2,000 people to 2015, then declines gradually to 1,500 at 2025.

The overall supply chain result is a fall from 6,000 in 2005 of about 1,000 by 2015, after that a gradual fall of about 400 p.a. to 2025.

Variants:
*In the **Least Case**, the fall in demand continues, declining to 4,200 in 2015 then staying just below 4000 until 2025.*

*Even the **Most Case** does not provide a bonanza of demand for the first 5 years falling by about 1,000 workers by 2010 then rising back 1,000 to 2015 and then more slowly to the region of 7,000*

2.5 DECOMMISSIONING AND CLEANUP

The biggest driver of change in the industry from 2005 is undoubtedly the NDA. Established by the Government through the 2004 Energy Act the NDA oversees the UK's civil public sector nuclear legacy, (the NDA is not responsible for private sector or MOD sites).

The NDA Strategy is to open up decommissioning and clean-up work across the 20 sites to the marketplace, so that competition will help drive efficiencies and innovation. However safety and high environmental standards will not be compromised as the NDA aims to create a world-class industry.

NDA is acting to gain clarity of the baseline scenario of all its sites, including the direct and indirect human resource demand. At the same time, it is itself demanding accelerated clean up programmes for all sites from its Tier 1 M&O contractors. These programmes are currently under discussion and are to be decided by 2008, by which time the majority of sites will be managed by new Tier 1 contractors with a longer term perspective.

This is creating significant change in the way that the Tier 1 managed Site License Companies plan and organise for the future:

- New job roles are identified
- More young people to be recruited – more apprentices and graduates
- Less willingness to release aspiring early retirees
- Changing mix of skills
    - ◊ project management skill increasingly a requirement shifting from operations management
    - ◊ more craft and technician less professional
- Demand for design & supply of interim waste stores on sites
- More demand for tier 2 and 3 contractors to top up the additional on-site resources demanded e.g. Radiation monitoring, planning and logistics
- Greater demand on the external world – demolition and construction etc.

In the **Baseline Case**, numbers of nuclear SET people on some NDA Magnox sites is increasing at present to meet the call for accelerated progress, whilst others are still removing fuel. Once the numbers settle in about 2007, they stay at about the same level for 5 years, before Oldbury and Wylfa go into decommissioning. After that, the AGR's follow into decommissioning and a peak site employment is expected to be about 3,200 in 2017, before numbers of nuclear specialists start to fall with a handover to a more conventional workforce.

The big increase in decommissioning workforce is at Sellafield when the reprocessing plants start into this phase. The decommissioning workforce there hits approximately 4,200 in 2015 rising to a projected 4,800 people after that until 2025. Dounreay increase slightly and maintain a constant level till 2015, before reducing slowly. Windscale grows in numbers to around 200 in 2010. Winfrith and Harwell decline gradually over the next 10 years to zero.

Overall, site numbers are projected to grow from 6,400 to 7,000 in 2010, nearly 9,000 in 2015 and then stay at that level.

> ***Variants***
> *The pace for the whole programme (combining SLC and Supply Chain resources) is set by NDA but largely on the basis of:*
> - *HM Treasury funding year on year*
> - *Income from existing revenue generating operations*
>   *Magnox electricity sales dependent on electricity pricing and plant availability*
>   *Production of fuel cycle intermediates for export (e.g. Hex)*
>   *Reprocessing and MOX fuel outputs dependent on plant availability*
>
> *(There is also the possibility that a policy decision be taken to terminate or, in the case of THORP, extend the life of the revenue generating operations).*

*The **Least Case** sees about 15% less people in decommissioning in the SLCs than for the Baseline Case. Fuel cycle decommissioning employs a projected 350 less in 2015 when Sellafield decommissioning activity is near to its peak. Total numbers in decommissioning grow to about 9,000 in 2015 and stay near that level to 2025.*

*The **Most Case** sees a significant rise in decommissioning total numbers from 6,300 now to a projected 7,000 in 2010 and 9,600 in 2015, falling back to in the region of 8,900 in 2025. AGR decommissioning requires less resource in 2025 because more of the units are still generating.*

2.6 WASTE MANAGEMENT

Waste management is an essential support service to the industry. At present the industry has rather few people working in this field. There is only one significant waste disposal site at Drigg and the decommissioning projects have not so far generated large quantities of old building materials. There are several waste treatment plants in the UK, of which the biggest concentration is at Sellafield. It is not thought that a new Waste Repository project would create significant skill demand by 2025.

The **Baseline** estimate is of about 2,800 people working in waste management, increasing to about 3,000 by 2015 and then falling gradually to 2,000 at 2025. This may be to deny a major activity as the old reactor structures come down – but to some extent the numbers in decommissioning and waste management may be interchangeable.

Variants
*In the **Most Case,** numbers rise more steeply to an estimated 5,000 by 2015, falling to 4,200 in 2025. This may be a more realistic scenario in view of NDA's strategy to accelerate Magnox and other sites decommissioning.*

2.7 THE DECOMMISSIONING & WASTE SUPPLY CHAIN

The Supply Chain has set its sights on gaining business from the NDA programme to replace the falling demand for power station support. That business has been slow to come but is expected to fall into place at about 6,000 by 2007. From then on, demand grows gently to approximately 6,600 in 2010. After that, demand rises by 400 p.a. in the supply chain to 2015, largely for Sellafield, then grows steadily to the region of 7,700 by 2025.

Variants
The pace for the whole programme (combining SLC and Supply Chain resources) is set by NDA but largely on the basis of:

- *HM Treasury funding year on year*
- *Income from existing revenue generating operations*
  - *Magnox electricity sales dependant on electricity pricing and plant availability*
  - *Production of fuel cycle intermediates for export (eg Hex)*
  - *Reprocessing and MOX fuel outputs dependant on plant availability*

(There is also the possibility that a policy decision be taken to terminate or, in the case of THORP, extend the life of the revenue generating operations).

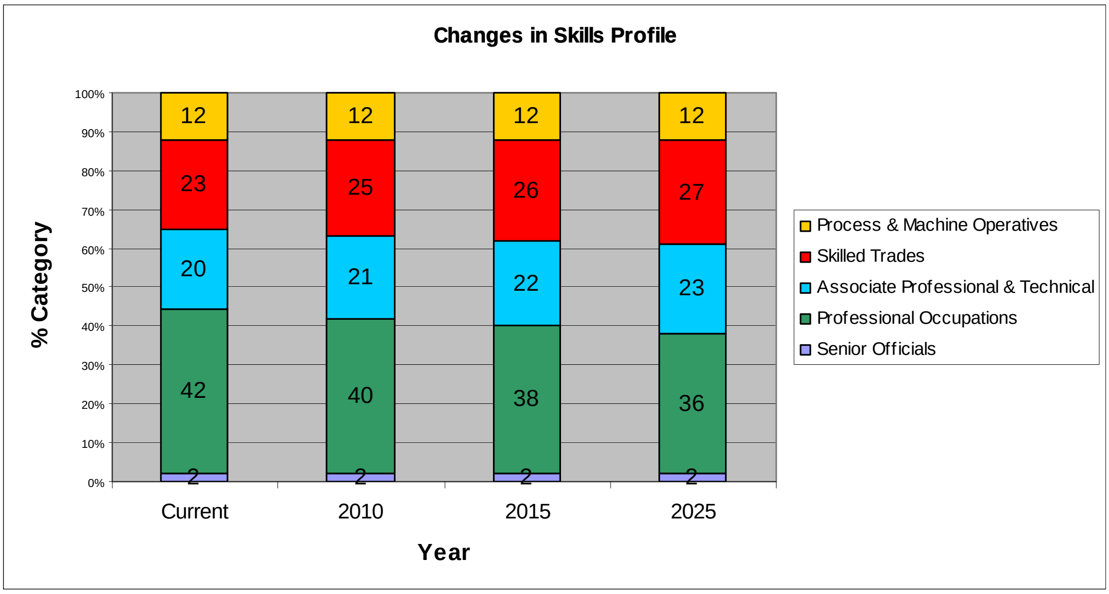
*The **Least Case** sees about 10% less people in decommissioning & waste supply chains than for the Baseline Case. Total numbers grow to about 8,500 in 2015 and fall to about 7,800 in 2025.*

*The **Most Case** sees a dramatic rise in decommissioning total numbers from 6,000 now to a projected 8,200 in 2010 and 11,400 in 2015, easing back to 11,000 in 2025. AGR decommissioning requires less resource 2025 because more of the units are still generating.*

2.8 CONSOLIDATED (WHOLE INDUSTRY) PICTURE

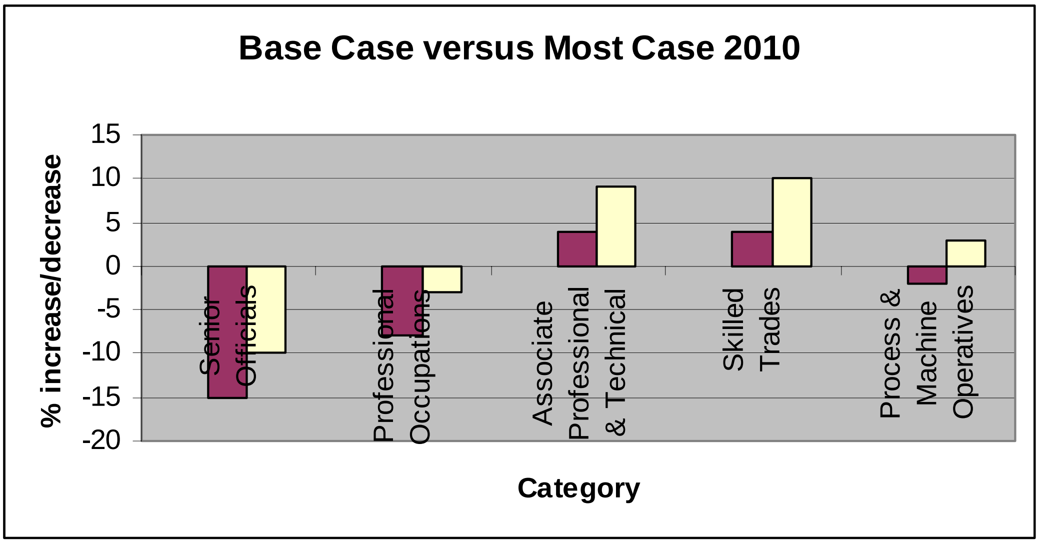
When looked at as a whole industry, the trend towards Associate Professional and Skilled Trades becomes more obvious, as shown in Figure 3 below. However, this masks the peaks and troughs of need. This analysis uses the **Base case** numbers from each of the scenarios.

Figure 3: Changing shape of skills needs



When a comparison is made between the **Base Case** and **Most Case** occupation demand, the percentage representation from each occupational category does not change, but the actual numbers increase significantly.

Figure 4: Base Case Vs Most Case – Skills Needs



Overall, the data shows a clear expansion in occupations below Senior and Professional level, with the greatest increase being in Skilled Trades.

The following tables show a summary of the potential stock and flow of workforce drawing from the Baseline Scenario and the Most and Least Cases. The replacement demand figures are derived from the application of occupational age profile findings from Cogent's Nuclear Employer Survey (2005) to the projected occupational demands and the assumption that those aged 55 and over will retire by 2015. Industry turnover has not been factored into the replacement demand figures at this time as further research will be required to ascertain what proportion of turnover is related to industry "churn" (i.e. movement between industry employers) and how much is related to industry attrition for example early retirement. As a result the projected replacement and net demands are anticipated to be conservative. In each scenario the retirement replacement demand remains constant as they are based on the same set of assumptions. The expansion / contraction demand for workforce reflect the potential impacts of the scenarios as described in this section of the report.

Table 4: Baseline Employment Demand 2005 – 2015 from Industry Scenarios

BASELINE SCENARIO	2005 Demand	Replacement Demand (for retirements & occupational mobility)	Expansion / Contraction Demand	Net Change in Demand 2005 - 2015
Nuclear Heat Generation	12,780	1,395	-4,050	-2,655
Decommissioning	12,120	1,355	5,535	6,890
Nuclear Material Processing	13,420	1,455	-3,750	-2,295
Waste Management	3,130	345	1,145	1,490
Nuclear Industry	41,450	4,550	-1,120	3,430

(The replacement demand figures take account of the anticipated change in occupational structure).

Table 5: Most-case Employment Demand 2005 – 2015 from Industry Scenarios

MOST CASE SCENARIO	2005 Demand	Replacement Demand (for retirements & occupational mobility)	Expansion / Contraction Demand	Net Change in Demand 2005 - 2015
Nuclear Heat Generation	12,780	1,395	-745	650
Decommissioning	12,120	1,355	8,140	9,500
Nuclear Material Processing	13,420	1,455	-2,390	-935
Waste Management	3,130	345	1,945	2,290
Nuclear Industry	41,450	4,550	6,950	11,500

Table 6: Least-case Employment Demand 2005 - 2015 from Industry Scenarios

LEAST CASE SCENARIO	**2005 Demand**	**Replacement Demand** (for retirements & occupational mobility)	**Expansion / Contraction Demand**	**Net Change in Demand 2005 - 2015**
Nuclear Heat Generation	12,780	1,395	-5,745	-4,350
Decommissioning	12,120	1,355	3,695	5,050
Nuclear Material Processing	13,420	1,455	-5,730	-4,275
Waste Management	3,130	345	645	990
Nuclear Industry	41,450	4,550	-7,135	-2,585

3. ANALYSING THE GAPS

3.1 DEFINING THE ISSUES

3.1.1 ENTERING THE INDUSTRY

At entry level to the industry, there is a dependence on generic provision, i.e. provision not designed specifically to meet the needs of the nuclear industry. A limited amount of new provision is starting to emerge, with HNC and HND for decommissioning already in place in Scotland, and a foundation degree being established in England. The industry itself is not large, and therefore would never be expected to require a large scale range of courses specifically to meet its needs. Rather, the view is that well designed general provision will meet the majority of needs.

One entry route worthy of further attention is apprenticeships. In the main, the framework based on OScEng standards overseen by SEMTA is used. Embedding of nuclear-related competences needs to be expanded to ensure that the number of trainees meets industry need. At the moment, only two centres offer this nuclear-specific model, one in England and one in Scotland, with no provision in Wales.

The numbers of apprenticeship places offered by employers varies greatly, dependent on company size and resource. In some regions, this can vary between less than five places, to greater than 50. Employers have an opportunity to increase efficiency and value by working together on delivery of apprenticeships. This would address employer concerns regarding variability of provision.

At graduate level, the industry as a whole does not appear to target specific universities. This reflects the view that good quality graduates are recruited from non-nuclear specific degree programmes. First degrees with nuclear content are starting to emerge, not necessarily to meet employer demand, but rather to take advantage of what is now seen as an employment opportunity. The Masters programme offered via the NTEC consortium illustrates an excellent model of co-operation among providers that is valued and supported by employers. Postgraduate education is vital to the knowledge base of the industry.

There are some specialist roles, unique to the nuclear industries (in some cases unique to a specific part of the industry) that require attention. The low numbers required make these relatively difficult for the education and training infrastructure to accommodate. However, availability of staff with these particular skills is vital. Some of he roles singled out were:

Project Management/Managers
Health Physics/ Radiation Protection at all levels
Computational Specialists: Stress, Thermal hydraulics analysts
Safety Case Engineering Specialists
C&I and System Engineering Specialists and technicians

National Occupational standards have been developed for some of these functions, but not all. Work is required to ensure that a clear definition of functions and performance criteria is available for the full range, allowing development of specific, measurable training (and qualifications where required).

3.1.1.1 Technical Specialists and R&D

Whilst the numbers of technical specialists in R&D and other roles may be small and has not been identified explicitly in this study, we must recognise their importance for the industry's success e.g. through innovation. Recently there has been a real expansion of research capability and academic resource in these areas which is helping to alleviate some shortages.

Certain Technical Specialists such as Safety Case writers and Health Physicists are known to be supply limited at present. Shortages create a spiral of demand leading to wage inflation. These can be tackled by modest amounts of training provided the employers take care to develop the people that they need and if they rely on a scarce supply chain resource, to support the development of the specialists by the supply chain employers.

It is also crucial to keep the pipeline for this limited group (eg mathematicians and radiochemists) flowing.

3.1.2 CONTINUED DEVELOPMENT

The Masters programme detailed above is only one of a number of programmes available to those in employment within the industry – there are several other opportunities both in the UK and in Europe, as detailed in Section 1 of this report. At non-graduate levels, there will be a shift in requirement from operations to decommissioning, leading to opportunities for development of level 2 roles into a differing skill set, albeit at a comparable level. The changes taking place in the industry structure and focus also provide an opportunity to investigate further the use of foundation degrees in England.

3.1.3 WORKING IN THE INUDSTRY

In addition to continued development of those already employed, several issues arose around measuring and assuring competence.

The NDA has called for the standardisation of job roles, allowing the development of a clear occupational and functional map. This would have the added value of driving towards harmonisation of training to a minimum standard and mutual recognition of competence (i.e. transferability of workforce).

Also arising from this, the use of a passport scheme would reduce the burden on employers at induction of contract workforce, or those transferring from another employer. This scheme would have to be managed and delivered in a fashion commensurate with the health, safety and security standards demanded by the industry.

3.1.4 GENERAL ISSUES

Gender diversity was recognised as an issue – the industry is missing out a large slice of the talent pool. It is recognised that attitudes to careers and in some instances, particular industries, is engrained from an early age. The study of sciences has gone through a period of being in severe decline, to making a slight upturn in recent years.

Industry wishes to work more closely with education at 14-19, and to this end has engaged in the development of vocational diplomas in England. However, further work on information, advice and guidance is required in order to ensure that a full and accurate picture of opportunities in science, engineering and technology in general, and the nuclear industry in particular, is needed.

3.2 POTENTIAL INTERVENTIONS

A full description of the issues, with potential interventions, has been prepared for consideration. This has been tested with industry groups and a small number of stakeholders prior to presentation to a wider audience. At the outset, eleven issues were presented to the Industry Advisory Council, leading to the development of a more concise listing.

It has been presented for consultation purposes only, showing the issue, the potential intervention, and the anticipated stakeholder involvement. Geographical relevance has been shown in the end column.

Issue	Intervention	Stakeholder involvement	Geographical relevance*
There is a lack of industry-accredited specific qualifications, with only a limited number emerging over the past 5 years.	Development of National Occupational Standards and qualifications frameworks to meet identified gaps, though the annual Standards Development Plan	QCA, SQA, ACCAC, Awarding body/ies Training providers	Whole UK, excluding NI
	Embed qualifications within the country-specific credit and qualifications framework	SQA/SCQF QCA/NQF ACCAC/CQFW	Whole UK, excluding NI
The "contractorisation" of the industry as it moves forward in decommissioning activities requires the management of standards for a mobile workforce	Development of a site induction passport system, accepted by all parts of the industry and managed in accordance with health, safety and security requirements	HSE	Whole UK, excluding NI
The number of apprentice technicians entering industry programmes will need to rise to meet industry forecast demand	Establishment of a national apprenticeship framework, complying with 4-nation models, delivered regionally through approved centres Approval of centres to meet industry standards and regional requirements	LSC, ScotExec, ELWa(WAG) And national approval groups	Scotland (inc HIE area) England (focus on Cumbria, and around BE & MoD locations) Wales (specifically north)
Training provision is not standardised, and there are no clearly mapped progression routes	The establishment of a National Skills Academy, delivering industry standard qualifications through a regional structure	DfES, DTI, WAG, LSC, SExec	Whole UK, excluding NI
There is a lack of defined skills for decommissioning roles	Define the roles and training requirements	None – employer action only	Industry only
	Define the standards and qualifications, should they not be met via current provision	QCA, SQA, ACCAC, Awarding Body/ies	
The industry has a poor image and level of understanding amongst young people	Ensure improvement energy content for school curriculum	SQA, QCA, ACCAC, DELNI, SExec, DfES	Whole UK

Issue	Intervention	Stakeholder involvement	Geographical relevance*
Young people don't understand careers in the industry – it is not attracting a broad spectrum of applications for careers in the industry	Development of up-to-date careers guidance and information for students and teachers	Careers Wales Association Careers Scotland Connexions etc	Whole UK ? NI
Aspects of HE and FE do not meet industry needs for specialist roles	Work with FE and HE to improve content	UUK, Subject Centres	Whole UK
Changes in industry demands new management and leadership skills	Map appropriate training and learning solutions for employers at all levels Investigate tailored provision of common elements of development needs	MSC, Training Providers LSC, ScotExec ELWa(WAG) SfBN Business Skills Board	Whole UK
**Supply chain manufacturers are not skilled up face potential new build demand	Work with other SSCs to ensure skills supply meets demand	Other SSCs	Whole UK
**Availability of suitably skilled and qualified engineering and construction resource has not been established, to meet the needs of potential new build	Production of a supply and demand forecast for the industry for the short, medium and longer term	Other SSCs, SSDA	Whole UK
There are no uniformly accepted role definitions across the industry	Develop standard job role definitions with employers	None – employer action only	Whole UK

*** These issues are not wholly within the remit and footprint of Cogent SSC Ltd, however they are of direct relevance to employers. The industry depends on these resources, however strategic management of these resources lies with other SSCs in the SfBN. Cogent's action is to require an account from those others as t the availability of the necessary resources.*

APPENDIX 1: MODEL OF NUCLEAR INDUSTRY SEGMENTS – SET EMPLOYMENT FROM 2005 – 2025

OVERALL SCENARIO PLAN SUMMARY

	2005	2010			2015			2025		
	BASE	LEAST	BASE	MOST	LEAST	BASE	MOST	LEAST	BASE	MOST
NUCLEAR HEAT GENERATION										
SLCs										
Nuclear power Operations	4760	3496	3812	3812	1748	1748	3496	2535	3028	5169
Nuclear power Support & Projects	1235	1065	1180	1180	1380	1540	1820	905	975	1440
Defence & Fusion	2650	2120	2120	2120	1590	2030	2470	1400	2170	2170
Regulators	139	130	132	132	108	119	138	102	118	144
Tier 2 & 3										
Supply chain	3997	3055	3090	3090	2209	3295	4265	2444	3381	4454
SUBTOTALs	12781	9866	10334	10334	7035	8732	12189	7386	9672	13378
DECOMMISSIONING										
SLCs										
Magnox decomm	2000	1250	1700	1700	1330	1900	1900	980	1000	1000
AGR Decomm	0	0	0	0	500	300	0	820	1090	500
Fuel cycle decomm	1840	2040	2040	2160	3850	4200	4850	4450	4750	5180
Research sites decomm	1977	2015	2085	2294	1702	1864	2050	1330	1330	1463
MOD Decomm	500	600	800	800	600	600	800	600	600	800
Regulators	130	135	135	135	160	160	160	170	170	170
Tier 2 &3										
Magnox & AGR Decomm	2200	1550	2100	2100	2330	2880	2480	2840	2840	2040
Fuel cycle decomm	1640	1960	1960	2560	3580	3360	5450	3170	3380	5780
Research sites decomm	1582	1612	1668	2294	1362	1491	2050	798	798	1463
Defence decomm	250	350	450	450	400	400	520	450	450	590
SUBTOTALs	12119	11513	12939	14493	15814	17154	20260	15608	16408	18986

APPENDIX 1: MODEL OF NUCLEAR INDUSTRY SEGMENTS – SET EMPLOYMENT FROM 2005 – 2025

NUCLEAR MATERIALS											
SLCs											
	MOD	3200	3325	3750	3750	3000	3360	3800	3000	3360	3560
	Sellafield	4000	3100	3900	4000	0	900	1500	0	0	700
	Other fuel cycle	4050	3000	3300	3400	3000	3300	3550	2300	2300	4200
Regulators		170	170	170	170	110	110	160	100	100	130
Tier 2 & 3											
	Supply chain	2000	1916	2148	2168	1580	1779	1898	1430	1529	1829
	SUBTOTALs	13420	11511	13268	13488	7690	9449	10908	6830	7289	10419
WASTE MANAGEMENT											
SLCs											
	Magnox & AGR	200	300	400	400	500	600	500	350	470	320
	MOD	100	200	200	200	200	200	200	100	100	100
	Sellafield	1950	2150	2350	2600	2250	2450	2950	1400	1550	2200
	Other fuel cycle	300	300	300	300	350	550	550	300	550	650
	Repository project	50	100	100	100	100	100	100	200	200	200
Regulators		10	10	10	10	15	15	15	15	15	15
Tier 2 & 3											
	Supply chain	520	420	520	720	360	360	760	50	50	740
	SUBTOTALs	3130	3480	3880	4330	3775	4275	5075	2415	2935	4225
WHOLE INDUSTRY		2005 BASE		2010 BASE			2015 BASE			2025 BASE	
	GRAND TOTALS	41450	36370	40420	42645	34314	39611	48432	32239	36304	47008
	Of which Tier 2 & 3	12189	10864	11936	13382	11821	13565	17423	11182	12428	16896