NUCLEAR AND RADIOLOGICAL SKILLS STUDY

Report of the Nuclear Skills Group

PART 1

Executive Summary, Conclusions and Recommendations

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NUCLEAR AND RADIOLOGICAL SKILLS STUDY

The Chairman of the Nuclear Skills Group would like to thank all those who have contributed to the Nuclear Skills Study, including members of the Nuclear Skills Group, employers and employees in the nuclear and radiological sector who contributed to the nuclear skills audit and all those who took part in Foresight Workshops.

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Professor John Chesshire

CONTENTS

PART 1

PART 2
ANNEXES

NUCLEAR AND RADIOLOGICAL SKILLS STUDY

1 EXECUTIVE SUMMARY

The ability to apply nuclear and radiological technology has a key role in the health sector (approximately 30 million radiology examinations are carried out every year), plays a principal part in national defence, is essential for the continued operation of existing nuclear power stations (which currently make up approximately 23% of the UK's generating capacity), is essential to nuclear and radiological clean up, and is needed to support a wide spectrum of research, development and manufacturing activity. The recent PIU Energy Review also spoke of "good grounds for taking a positive stance to keeping the nuclear option open"; the availability of skilled people being key to such a policy.

Concern exists, however, that a shortage of people with the skills needed to apply nuclear and radiological technology is developing. Prompted by assessment of the international situation by the OECD/NEA, a survey of the national nuclear skill base has been conducted under the direction of the Nuclear Skills Group, chaired by Professor John Chesshire. The skills study has been a good example of effective joint working between a number of Government departments (the study being co-sponsored by DTI, HSE, MoD, DH, and DfES), industry, academia and professional institutions.

The survey has identified that the health sector currently has a shortage of people with radiological skills and although the nuclear sector does not have an immediate overall shortage, a number of 'hot spots' exist in disciplines such as safety case production and radiological protection. Postgraduate education and apprentice training are also in a fragile state, raising concerns about future workforce development.

Conservative estimates suggest that the sector will require around 50,000 recruits over the next 15 years, excluding potential demand from new build, equivalent to just under 60% of the current skilled population, and this demand must be satisfied from the wider engineering and physical science sector at a time when:

> *"The 'disconnect' between the strengthening demand for graduates (particularly in highly numerate subjects) on the one hand, and the declining numbers of mathematics, engineering and physical science graduates on the other, is starting to result in skills shortages."*[1]

This report outlines the measures that have been taken to quantify the problem, looking up to 15 years into the future, and sets out a number of recommendations to avert potential skill shortages developing in the future.

The key issues are:

Promotion of the Skill Sector: Engineering and physical sciences are unpopular fields of study and unpopular career choices for young people; and nuclear and radiological technologies are unpopular choices in this unpopular field. Action to encourage more young people into these sectors is urgently needed.

Underpinning of Essential Learning Pathways: The learning pathways required to develop the skills needed by the sector must be defined and a means devised of underpinning those pathways.

Underpinning Education Institutions: The education and training institutions, colleges and establishments needed to service the above learning pathways must be identified and a means of ensuring their viability established, otherwise the infrastructure to deliver essential training will be lost.

[1] SET for success: The supply of people with science, technology, engineering and mathematics skills. The report of Sir Gareth Roberts' Review. April 2002

BACKGROUND

1.1 The ability to apply nuclear and radiological technology has a key role in the health sector, plays a principal part in national defence and is fundamental to the operation of the United Kingdom's existing nuclear power stations. It is also essential for nuclear and radiological clean up and is needed to support a wide spectrum of research, development and manufacturing activity. The ability to manage the technology is also fundamental to keeping the option open for construction of new nuclear power stations, as considered in the recent PIU Energy Review. Concern exists, however, that a shortage of skilled people is developing that could undermine the ability of the nuclear and radiological sector (defined below) to operate, the potential shortage lying in all roles: practitioners, educators, trainers and regulators.

1.2 This concern has been expressed both nationally and internationally. International concern is articulated in the OECD report "Nuclear Education and Training: *a cause for concern?*" (2000), and evidenced by the recent IAEA Senior Level Meeting on the 'Management of Nuclear Knowledge" (June 2002). Nationally, the NII's report "Education and Research in British Universities" (2001, revised 2002) assessed the strength of one element of the UK sector and identified a situation of "ageing academics, ageing facilities and no undergraduate courses with significant nuclear content".

1.3 The OECD report contained the recommendation that "Governments should engage in strategic planning of education and manpower, integrated with human resource planning, to encourage young students into the industry". The Nuclear Skills Group (NSG) was therefore formed to assess the national situation and formulate a series of recommendations to overcome any potential shortfalls.

SKILLS STUDY

1.4 The NSG commissioned two reviews to provide evidence upon which to base their recommendations and to act as a foundation for future work:

- A skills audit to quantify the size and form of the sector today; and
- A foresight study to consider the factors that may affect the sector over the next 5, 10 and 15 years.

In addition, a wide range of individuals from within the nuclear, radiological and education fields, and from other Government departments, were consulted to ensure that the study was based on a broad consensus of opinion and that the recommendations made were consistent with more widely based initiatives.

NUCLEAR AND RADIOLOGICAL SECTOR

1.5 The sector encompasses organisations that apply nuclear and radiological technology as a primary purpose (power generation, health, defence, and nuclear clean up[2]) and also those that apply radiological technology as a secondary purpose (eg non-destructive examination, pharmaceuticals etc). The audit has identified a current (2002) population of approximately 135,000 skilled people, of which around 64% are primary users and 36% secondary users.

SKILLED POPULATION	POPULATION	%	POPULATION	%
PRIMARY USERS	86,000	64%		
HEALTH			30,000	22%
DEFENCE, POWER GENERATION, FUEL CYCLE & CLEAN UP			56,000	42%
SECONDARY USERS	49,000	36%	49,000	36%
TOTAL	**135,000**	**100%**	**135,000**	**100%**

[2] Encompassing the fields of decommissioning, waste management and environmental remediation.

1.6 Of the primary users, a distinction can be made between the health sub-sector, which comprises predominately medical diagnosticians and therapists supported by medical physicists and clinical scientists, and the power generation, defence and nuclear clean up sub-sector, which comprises engineers and physical scientists.

1.7 The Health sub-sector can be further subdivided into users of radiological techniques for diagnosis and therapy, typified by radiologists and radiographers, and the clinical scientists, engineers and technicians who design, maintain and specify how to operate radiological equipment. The health sub-sector has a population of approximately 25,000 radiologists and radiographers and around 5,000 clinical scientists, engineers and technicians.

1.8 The Defence, power generation, fuel cycle and clean up sub-sector can also be sub-divided into 'client' and 'support' organisations, the support organisations comprising contractors, educators, researchers and regulators, the population of these groups being 46,000 and 10,000 respectively.

FUTURE TRENDS

Foresight – Primary Users

1.9 Considering Primary Users of the technology, while trends in the health sub-sector could be judged fairly readily, the main uncertainty arose from how the defence, power generation, fuel cycle and clean up sub-sectors would evolve. A range of plausible scenarios were therefore considered, the following 'seasons' being postulated:

- **Autumn**: Operation of extant equipment to the end of design life, but not replaced, followed by nuclear and radiological clean up.
- **Winter**: Abandonment of nuclear or radiological technology, leaving nuclear clean up as the core of the industry.
- **Spring**: The 'autumn' scenario, but with equipment replacement.
- **Summer**: Significant expansion of nuclear or radiological technology.

1.10 The nature of the problem in each scenario is the same: to attract recruits from the wider national pool of engineers and physical scientists at a time when engineering and physical sciences are increasingly unpopular career choices. The sector therefore faces the challenge of recruiting from a potentially diminishing pool of suitable recruits. Nuclear clean up is common to all scenarios and the rate at which it can be pursued will be limited by the availability of skilled people. The recruitment and retention challenge is also likely to be differentially affected by the season, eg the winter scenario is likely to be compounded by skilled persons being attracted out of the industry to other UK and international sectors.

Indicative Scenario – Primary Users

1.11 Indicative numbers of the accumulated total of skilled primary users likely to be demanded by the sector over the next 5, 10 and 15 years are given in Table 1 for one illustrative scenario in which:

- Health grows by 10% every 5 years[3];
- Work on nuclear clean up doubles over the 15-year period, in addition to taking on station closures;
- The current power station closure programme is implemented, but new build is not pursued; and
- Defence and the Fuel Cycle remain status quo.

[3] Noting that the Health Sector already has a 10% shortage of radiologists and radiographers. Audit Commission review of national findings – Radiology – July 2002.

Table 1

TABLE 1

INDICATIVE SCENARIO – PRIMARY USERS

SECTOR SUPPLY - ACCUMULATED RETIREMENTS

Based upon the age profile of the current Primary User population, the accumulated number of skilled people likely to retire from the sector over the next 5, 10 and 15 years are:

RETIREMENTS – LOSS OF SUPPLY	Over 5 years 2002 – 2007	Over 10 years 2002 – 2012	Over 15 years 2002 – 2017
HEALTH	3,700	6,600	9,600
DEFENCE, POWER, FUEL, & CLEAN UP	6,400	14,500	22,600
TOTAL RETIREMENTS	**10,100**	**21,100**	**32,200**

SECTOR DEMAND – ACCUMULATED RETIREMENTS, SHORTAGE AND GROWTH

Although the scenario assumes that power generation will decline, health and nuclear clean up grow, giving rise to overall sector growth. The health sub-sector already has a skill shortage and to accommodate this, sector growth and retirements, the total accumulated demand could be as high as:

PRIMARY USER DEMAND	Now	Over 5 years 2002 – 2007	Over 10 years 2002 – 2012	Over 15 years 2002 – 2017
RETIREMENTS		10,100	21,100	32,200
SHORTAGE	3,000	3,000	3,000	3,000
GROWTH		4,900	8,900	14,800
TOTAL DEMANDS	**3,000**	**18,000**	**33,000**	**50,000**

The breakdown of the above, accumulated, demands are:

SUB-SECTOR DEMAND	Over 5 years 2002 – 2007	Over 10 years 2002 – 2012	Over 15 years 2002 – 2017
HEALTH			
Radiologists and Radiographers	8,000	13,000	18,000
Clinical Scientists	1,600	2,600	3,600
DEFENCE, POWER, FUEL, & CLEAN UP			
Professional and Associate Professional [i]	4,450	10,000	15,500
Skilled Trade, Process Plant and Machine Operator [ii]	2,250	4,900	7,850
Others [iii]	1,700	2,500	5,050
TOTAL DEMANDS	**18,000**	**33,000**	**50,000**

i. 'Professional and Associate Professional' refers to a person qualified to Level 4 and 5 in the National Qualifications Framework, typically having a minimum qualification of a Bachelors degree.

ii. 'Skilled Trade, Process Plant or Machine Operator' refers to a person with a vocational or occupational qualification at Level 3 or below in the National Qualifications Framework.

iii. Others include the remainder of the population, principally Administration and Secretariat.

Impact - Graduates

1.12 To put these figures into perspective, 15,500 graduates required by the power, fuel, defence and clean up sub-sectors over the next 15 years equates to approximately 1,000 graduates per year. Of these, 700 are replacements for retirements and 300 are a response to growth of nuclear clean up. By comparison, the sector's 2001 graduate recruitment target was approximately 560[4].

1.13 Considering the major engineering and physical science disciplines from which these graduates must be recruited (mechanical, electrical, electronic, civil and chemical engineering, physics and chemistry), in 1994 some 18,000 students were accepted to study these subjects at Higher Education Institutes. By 2001 this figure had fallen to 13,250, a fall of 26% in eight years. Noting also that these figures do not take account of students who fail to graduate or choose an alternative career on graduation, if these trends continue, of a rising demand and a falling supply, the nuclear and radiological sector may be seeking to recruit the equivalent of 10% of all UK engineering and physical science graduates in 10 years' time, even though the nuclear sector constitutes less than 1% of the national labour market engaged in engineering activity[5].

Impact – Apprenticeships

1.14 The indicative scenario also demonstrates that some 7,850 people with skilled trades skills will be required over the 15-year period, highlighting the need for apprenticeships. Such schemes are of paramount importance as they not only deliver people with the required skilled trades, but also provide an alternative entry route for people that may attain higher positions through career development. Despite their importance, a recent review of apprenticeship training led by Sir John Cassells[6] identified that:

"England does not currently have a strong apprenticeship system. It stood in danger of not having an apprenticeship system at all following the collapse of the previous system in the 1970s and 1980s. There is a real sense in which apprenticeship remains marginal within our education and training system… The reasons it is so are that it has been inconsistently delivered; poorly managed; and poorly known about and understood."

UNPOPULARITY OF ENGINEERING AND PHYSICAL SCIENCES

1.15 Engineering and physical sciences are unpopular fields of study, both academic and vocational. However it is from this pool of students that the nuclear sector must recruit. Unless this trend is reversed, the nuclear sector will face the challenge of recruiting from a diminishing pool of potential recruits. The general unpopularity of engineering and physical science has been recognised in the recent review conducted by Sir Gareth Roberts[7], which identified that:

"The 'disconnect' between the strengthening demand for graduates (particularly in highly numerate subjects) on the one hand, and the declining numbers of mathematics, engineering and physical science graduates on the other, is starting to result in skills shortages."

1.16 The IAEA have also recognised this issue, as identified at a recent IAEA conference on managing nuclear knowledge[8]:

"There is a general difficulty in attracting young people into the field of nuclear engineering and physical sciences: the courses seem too difficult; upon graduation the

[4] Estimate of the number of graduates that nuclear and radiological sector employers sought to recruit in 2001.

[5] Labour Market Statistics - September 2002: 7.85 million people engaged in Energy & Water, Construction, Manufacturing, and Transport & Communications.

[6] Modern Apprenticeships – the way to work. Report of the Modern Apprenticeship Advisory Committee. Chairman, Sir John Cassels. Sept 2001.

[7] SET for success: The supply of people with science, technology, engineering and mathematics skills. The report of Sir Gareth Roberts' Review. April 2002.

[8] Meeting of Senior Officials on Managing Nuclear Knowledge. 17-19 June 2002. International Atomic Energy Agency, Vienna International Centre, Austria.

jobs are uninteresting and the pay is too low, and there is a view that only the 'least attractive' people go into these fields. It was also pointed out "before we can educate new people in this field, we must first attract them to the field; and engineers themselves are lousy marketers!"

SECTOR ISSUES

1.17 People interviewed in the skills audit and foresight studies reiterated the above concerns and the research identified that while some skills shortages exist today, the greatest shortages being in the areas of medicine, science, technology and regulation, it was anticipated that these shortages would increase in coming years and would extend into the areas of operations and management. The foresight exercise identified several factors affecting this, but three recurrent themes were:

Poor Communication: The importance of communication was emphasised, both in encouraging people into the skill sector and encouraging the wider public to take a rational view of the application of nuclear and radiological technology. In particular it was emphasised that the media and public raise emotional concerns to which the nuclear and radiological sector invariably counter with logic, but rational argument often cannot counter emotional fears.

Poor Co-ordination: The potential for skills shortages is generally recognised and several initiatives exist to address the problem, but these tend to be uncoordinated, hence their collective effect is not as great as it should be.

Apparent Indecision: Indecision in an industry will discourage recruitment and having many policies under consideration will appear to potential recruits as indecision, eg 'keep the nuclear power option open' or 'implement safe-store and defer decommissioning'.

CURRENT 'HOT SPOTS'

1.18 A number of skill 'hot spots' have been identified in the sector now, including:

- **Health Sub-Sector**: Shortages currently exist in all health sub-sector occupations, with a national shortage of radiologists and radiographers of 10% being identified[9] and local shortages as high as 30% being reported in some disciplines. A number of Health Service workforce development plans exist, including 'The Cancer Plan' and the 'Strategy for the Professions in Healthcare Science'. These place emphasis on diagnosticians and therapists, but equal attention must be paid to the workforce development of clinical scientists, engineers and technicians.
- **Radiological Protection**: Health physics describes the skill sets needed to apply techniques and procedures to protect people from the effects of radiation and is an essential function for all primary and secondary users of radiological technology. Health physicists have been recognised as a shortage category for many years but evidence suggests that poor marketing of career opportunities is hampering recruitment. Career development paths also encourage people to leave their specialisation, principally into higher management, so compounding shortages. But good people with drive are unlikely to remain in a field where people from another discipline hold key management positions.
- **Radiochemistry**: Radiochemistry is essential for the production of radioactive samples used in countless medical procedures and is an important building block in nuclear and radiological clean up. BNFL's support for the Manchester radiochemistry department has corrected, in part, a decline in radiochemistry research but the question remains about what is required: a focal point upon which radiochemistry research is concentrated or a centre of excellence supporting satellite departments that achieves diversity across the research sector?
- **Regulation**: The age profile of NII inspectors exhibits a definite age skew, which, if unchecked, will result in a skill shortage within 5 to 10 years. This is due to NII's

[9] Audit Commission review of national findings – Radiology – July 2002: Identifying a mean vacancy rate for radiologists and radiographers of 10%.

need to recruit people with significant nuclear experience. Most recruits will be over 35, so automatically skewing the age profile, and NII are faced with a perpetual challenge of how to attract a small cadre of experienced people from within the sector.

- **Nuclear Education in HEIs**: A common view amongst employers is that they need generalist engineers and physical scientists who can be given specialist in-house training in nuclear technology. As a consequence, there is a low demand for specialist nuclear education in HEIs. This has two effects:
  - The ability to deliver postgraduate nuclear education is diminishing and will be lost if corrective action is not taken.
  - The ability to deliver nuclear modules in undergraduate education is diminishing; hence few undergraduate students are exposed to the challenges a career in the sector may offer.
- **Modern Apprenticeships**: Vocational education not only provides the skilled trades required by the sector, but also provides an alternative entry route for professionals and associate professionals through continuous professional development, many engineers in the sector today having entered through the apprenticeship route. However, vocational education has declined in recent decades, which is detrimental to the sector.
- **Safety Case Writing**: The nuclear sector has always had a strong safety culture and has evolved comprehensive safety practices including the application of written safety cases. The adoption of written safety cases is becoming more widespread in industry and, as a result, there is increased competition for good safety case authors. This is an example of skills developed in the nuclear sector being deployable in other sectors but without reciprocal transfer.
- **Criticality Assessment**: Criticality assessment is unique to the nuclear sector but, with the decline of nuclear research, fewer faculties exist to educate such people and there is less incentive for individuals to acquire those skills.
- **Nuclear Safety Research**: There is increased reliance on expertise and facilities abroad, especially on water reactor technology.
- **Control and Instrumentation**: Control and Instrumentation is key to all process engineering; hence the nuclear sector experiences stiff competition for such skilled people.
- **Numerate Graduates**: There is a migration of people with high quality mathematical modelling skills to the finance and insurance sectors, or to scientific consultancies, which have the ability to pay high salaries for those skills.
- **Project Management**: A decreasing number of people have both the skills to project manage a major development and an appropriate appreciation of nuclear issues.
- **Corporate Capabilities**: A number of corporate capabilities exist in only limited numbers, eg the design and manufacture of nucleonic detectors or the design and manufacture of large pressure vessels.

FUTURE PROGRAMME

1.19 The future programme must focus on three strategic issues:

Promotion of the Sector: Promotion of engineering and physical science in general, and of nuclear and radiological technology in particular, to encourage recruitment into the skill sector.

Underpinning of essential Learning Pathways: Definition and underpinning of the essential learning pathways needed to develop the skills required to apply nuclear and radiological technology.

Underpinning of Education Institutions: Measures to underpin the education and training establishments needed to support the above learning pathways.

1.20 Three closely linked functions, but with subtly different aims, are training, education and research. In addressing the required learning pathways and educational institutions a distinction must be made between these three functions and measures taken to ensure a correct balance is maintained. In this report the distinction is considered thus:

Training: The development of skills that enable people to perform predictable tasks.

Education: The advancement of an individual's fundamental understanding of a discipline, enabling that person to develop processes or consider situations beyond predictable limits.

Research: The expansion of fundamental understanding of a discipline to enable the person to explore new possibilities within a field to produce new diagnostic techniques, more efficient processes, or safer operations.

2 CONCLUSIONS

SKILL SHORTAGES – SHORT AND LONG TERM

2.1 The health sub-sector is experiencing a skill shortage now, while other sub-sectors exhibit a definite age skew meaning that, unless corrective action is taken, a growing skill shortage will develop over the next 5 to 10 years. With the exception of the health sector, Human Resource managers report that they have been able to satisfy recruitment demands to date, but the problem of finding suitable candidates is becoming increasingly difficult. It is conservatively estimated the overall sector will require approximately 50,000 new entrants over the next 15 years to satisfy anticipated demand. But worryingly, this demand must be satisfied from the engineering and physical sciences sector, which is diminishing in size due to its unpopularity as a field of academic study and career choice. A significant skill shortage is likely to develop over the next decade unless action is taken now.

ENGINEERING AND PHYSICAL SCIENCE

2.2 The nuclear and radiological sector is a sub-sector of engineering and physical science but, as Roberts identified: “the declining numbers of mathematics, engineering and physical science graduates is starting to result in skills shortages.” The challenge facing the nuclear and radiological sector is therefore two fold:

- To collaborate with other sectors to jointly increase the size of the engineering and physical science skilled population; and
- To recruit those people needed by the nuclear and radiological sector from the engineering and physical science skilled population.

FACTORS

2.3 Key factors that hinder recruitment and retention are:

- **Short-termism**: Employers tend to plan between 3 and 5 years ahead, whereas the lead-time for skill development is often between 5 and 10 years, or more.
- **Communication**: The sector has a difficult communication challenge inherent with the language used in the sector, emotional fears of the effects of the technology and a defensive stance brought about by hostile media.
- **Profile**: The profile of engineering and physical sciences in general, of nuclear and radiological technology in particular, and the state of the sector (winter, spring etc) has a significant impact on recruitment and retention.
- **Pay**: Relative pay is both a disincentive to joining the sector and a lure to leave, eg to the finance and insurance sectors. The relationship between remuneration and attraction is not a simple one however, and issues such as status, stimulation and career development influence people’s choice of career.
- **Indecision**: Potential recruits to the sector perceive an industry fraught with indecision, which is detrimental to recruitment, eg: ‘no new build but keep the option open’, ‘consider safe-store and defer decommissioning’, ‘long consultation periods are necessary before commencing decommissioning’.
- **Transferability**: Skills developed in the nuclear and radiological sector are readily transferable to other sectors but the reverse invariably requires significant additional training. Transferability compounds recruitment and retention as skilled people can be easily redeployed, either individually or by employers, in response to perceived poor remuneration or indecision in future programmes.

FRAGMENTATION

2.4 Fragmentation is exhibited in a number of forms:

- **Fragmented Management**: Competition to reduce the costs has led to a fragmented sector management structure, which now comprises a matrix of 'client' and 'supplier' organisations, within which it has become unclear who is responsible for skill development. This situation has developed in both the health and engineering/scientific sectors. In the engineering sub-sectors, Government organisations, primary clients and supply chain organisations typify the layers of split responsibility. Similar layers exist in the health sub-sector: the Department of Health, the National Health Service and individual Healthcare Trusts.
- **Multiple Qualifications**: A wide variety of qualifications exist, creating confusion about which are, or should be, valued and which are not. This confusion is a disincentive to candidates pursuing certain desirable learning pathways.
- **Training & Education**: A wide variety of training and education establishments exist; hence it is unclear which are vital to the sector, and which are not.
- **Government Organisations**: A wide variety of Government organisations exist to support training and education, eg SSDA, LSC, RDA, Connexions, HEFCE and Research Councils. Funding mechanisms are therefore complex and, in many cases, do not meet the Government's education objectives.
- **Industry initiatives**: A large number of industry initiatives exist targeting schools, but in many cases these do not support the curriculum or teachers' needs; hence they do not achieve their aim.

SECTOR COLLABORATION

2.5 Skill shortages are arising, not because of the failings of specific individuals or organisations in the sector, but because of the macro failure of the national process to recruit, educate and train scientists and engineers in the changing education and employment environment. There are no simple solutions to redress this situation. Corrective action requires attention to detail to improve the overall process and the involvement of many agents within the sector acting in consort. SR2002[10] states:

"as the Roberts report made clear, ensuring a supply of scientists and engineers for the future will also require business and the private sector to play a central role. While Government can help to create the right environment throughout the school, further and higher education systems, employers have a crucial role to play in improving the prospects and attractiveness of careers in science and research."

A successful workforce development strategy must therefore address:

- Action by employers to promote the attractiveness of careers in their sector; and
- Collaboration between employers and educators to provide the right learning pathways.

2.6 Responsibility for 'creating the right environment' for skill development lies primarily with the Department for Education and Skills, and to a lesser extent the Office of Science and Technology, but this responsibility is executed through a series of expert bodies that have delegated operational authority. These include the Learning and Skills Council, Regional Development Agencies, the Sector Skill Development Agency, Sector Skills Councils, the Higher Education Funding Councils and Research Councils. An effective workforce development strategy must therefore involve collaboration between employers (demand) and the above operational councils and authorities (suppliers) in order to implement Government policy to the benefit of the sector.

[10] Opportunity and Security for All: Investing in an enterprising, fairer Britain. August 2002.

2.7 Government policy on skills development is based on employers establishing their collective demand for skilled people, jointly promoting their sector to encourage recruitment and influencing suppliers of education and training to provide courses that will satisfy their demand. The current vehicle for delivery of this policy is through a Sector Skills Council (SSC).

SECTOR SKILLS COUNCIL CHARACTERISTICS

- Must be employer led
- Must aim to reduce skills gaps and shortages by:
  - Anticipating future demand for skilled people;
  - Applying leverage on the supply of skilled people;
  - Helping people make informed career choices;
- Must aim to improve learning supply by encouraging the development of:
  - Modern Apprenticeships;
  - Higher Education; and
  - National Occupational Standards.

2.8 Development of such councils is still at an early stage and the NSG envisage difficulties relating the SSC concept to the nuclear and radiological sector. The sector is too small to form a standalone council and the economic activity of the sector is diverse, the point of commonality being skills rather than activity. The view of the NSG is:

- Since the success of an SSC is dependent on employer support, formation of an SSC must be employer led: the council must be the organisation required by the sector, not an organisation prescribed by Government.
- It is not evident what the final shape and form of the sector tapestry will be.
- Considering its relatively small size, the unique demands of the nuclear and radiological sector must not be marginalized within a broad-based SSC.
- Collaboration between employers, educators and other involved organisations is essential but it is not clear that simple engagement with a single SSC represents the right way forward.

2.9 The expectation of the Sector Skills Development Agency (SSDA) is that an SSC, or SSCs, will eventually exist to cater for the nuclear and radiological sector, albeit that the application of nuclear and radiological technology may be a cross-sector skill in relation to the final tapestry of SSCs. eg Health is likely to have its own SSC, distinct and separate from Power Generation, although benefits may be found in cooperation in the delivery of training and education. The debate is around where the skills synergies best lie and into which SSCs the sector (and SSDA) consider they best fall. The advice of the SSDA is to make strategic plans accordingly.

2.10 It is likely to be some time before a fully functioning SSC(s) exists. A principal action must therefore be to pave the way for inclusion of the nuclear and radiological sector within the SSDA's national strategy. A means is therefore required of forging collaboration between employers and promoting synergy across the sector in order to implement Government policy in this area. In advance of an SSC(s), and where appropriate, interim action is also required to co-ordinate the activity of the various organisations currently: promoting the sector to encourage recruitment; providing training and education within the sector; and underpinning educational establishments needed by the sector. By this means some early gains can be achieved in addressing skill development. The NSG's recommendations therefore lie, initially, with a task group, whose role will be to:

- Forge collaboration between employers across the sector in order to encourage formation of appropriate Sector Skills Councils; and

- In advance of an SSC, and where appropriate, encourage collaboration amongst those currently engaged in skills development in order to achieve some early improvements.

As the tapestry of Sector Skills Councils develops, responsibility should be progressively transferred to the emerging council(s) and the interim arrangements dismantled.

STRATEGIC PLAN

2.11 The cross sector nuclear skills task group must formulate a strategic plan to stimulate initiatives to address the potential skill shortages identified by the foresight exercise. That strategic plan must concentrate on three issues:

- **Promotion of the Sector**: Collaborative promotion of engineering and physical science, to enlarge the pool of competent people who could potentially be recruited into the sector, and promotion of the nuclear and radiological sector to encourage recruitment into that sector.
- **Learning Pathways**: Collaborative initiatives to ensure that the learning pathways are available to train and educate the people needed by the sector. Learning and qualifications are inextricably linked, qualifications being an auditable measure of achieved learning. With the high number of learning pathways and qualifications available to students, it is imperative that mechanisms for establishing a 'common currency' for qualifications be established, such as the adoption of National Occupational Standards.
- **Viability of Education and Training**: Collaborative initiatives to ensure the viability of the further education colleges, higher education institutes and training establishments to enable those learning pathways to function.

TACTICAL AIMS

2.12 The priority tactical aims supporting that strategy must be:

- **Science, Engineering, Technology and Mathematics Network**: Action is required to promote engineering and physical science in schools, but the sector must collaborate with other initiatives in this action and must not start an independent campaign. SETNET is the recommended vehicle for achievement of this aim.
- **Vocational versus Academic Education**: Vocational education has declined in recent decades, to the detriment of the sector. Vocational education is required, not only to provide people with skilled trades, but also to provide an alternative source of professional and associate professional people through continuous professional development. Action must be taken to promote vocational education in order to achieve a balance between vocational and academic education within the sector.
- **Nuclear Education in HEIs** Action is required to establish the right level of provision of nuclear education in HEIs that complements the in-house training provided by employers, provides a viable infrastructure of education in universities and enables an introduction to be given to undergraduates of the opportunities the sector offers. To achieve this, collaborative action is required between employers, in-house training organisations, academia and the research councils.

3 RECOMMENDATIONS

SUMMARY OF RECOMMENDATIONS

STRATEGIC RECOMMENDATIONS

Recommendation 1: The Skills Development Strategy should focus on three issues:
- Promote the sector to encourage recruitment;
- Underpin essential learning pathways; and
- Underpin education establishments that support those pathways.

Recommendation 2: Encourage concerted industry support of education, training and research.

Recommendation 3: Establish a Nuclear Skills Task Group to:
- Forge collaboration between employers across the sector.
- Identify the right vehicle for carrying forward action in the long term.
- Take forward the NSG's recommendations and generate action.

Recommendation 4: Encourage collaboration with Regional Development Agencies and Enterprise Councils to ensure coherence of regional, national and sectoral programmes.

Recommendation 5: Raise the profile of radiological skills within the Health Sector and integrate NHS workforce development arrangements with those of the remainder of the sector.

TACTICAL RECOMMENDATIONS

Recommendation 6: Co-ordinate general promotion of the sector, employment and careers.

Recommendation 7: Remove artificial barriers to communication by use of language and openness.

Recommendation 8: Work with the Nuffield Foundation to include nuclear and radiological related material in the 2005 review of the national curriculum.

Recommendation 9: Promote sector support to continuing professional development for teachers.

Recommendation 10: Promote sector support for the promotion of science, engineering, technology and mathematics in schools.

Recommendation 11: Promote the use of Modern Apprenticeships in the sector.

Recommendation 12: Promote the use of National Occupational Standards.

Recommendation 13: Promote modular nuclear higher education courses to enable their use as:
- Taster units in undergraduate courses; and
- Building blocks to postgraduate qualifications.

Recommendation 14: Work with other sectors to lobby for increased per capita funding for undergraduate engineers and physical scientists.

Recommendation 15: Work with other sectors to lobby for collaborative development of higher education syllabi to balance employers' (vocational) requirements and academic criteria.

SKILLS DEVELOPMENT STRATEGY

3.1 The prime reason for shortages of skilled people in the nuclear and radiological sector is the inability to recruit, and subsequently retain, sufficient people into the sector, which is, in turn, dependent upon the number of people choosing engineering or the physical sciences as a career. Having recruited people into the sector, it is further necessary to educate and train those people in the unique disciplines required to manage nuclear and radiological technology in order to achieve the required skill mix within the workforce. This gives rise to the first recommendation, addressing the required strategy to increase the sector's skill base:

Recommendation 1

SKILLS DEVELOPMENT STRATEGY

The skills development strategy should focus on three principal issues:

- **Promotion of the Sector**: Collaborative promotion of engineering and physical science, to enlarge the pool of competent people who could potentially enter the sector, and promotion of the nuclear and radiological technology to encourage recruitment into that sub-sector.
- **Underpinning of Essential Learning Pathways**: Collaborative initiatives to ensure that the learning pathways needed to train and educate in the sector are available.
- **Underpinning of Education and Training Establishments**: Collaborative initiatives to ensure the viability of the further education colleges, higher education institutes and training establishments to enable those learning pathways to function.

3.2 A multiplicity of organisations are already involved in these activities, in Government, in industry, in academia and in professional institutions, but their efforts are fragmented and collectively they do not deliver the results they should. There are no simple solutions to redress this situation and the corrective action requires attention to detail to improve the overall process, with the involvement of many agents within the sector acting in consort.

Concerted Industry Support of Sector Skill Development

3.3 The Nuclear Skills Group noted that several employers in the sector carry out commendable work in support of skill development, but further effort is needed to ensure synergy across the sector and introduce diversity to defend against reliance upon single sources of support. This requires:

- Co-ordination of sector promotion;
- Harmonization of education, training and research initiatives that have common value across the sector;
- Proportionate support from all sector employers: large companies, SMEs and Government.
- Collaborative effort to develop the skilled people required by the sector, avoiding in-sector 'poaching' without contribution to commensurate sector growth.

Recommendation 2

ENCOURAGE CONCERTED EMPLOYER SUPPORT OF SECTOR SKILL DEVELOPMENT

Commitment is required from all sector employers to provide concerted support for promotion of the sector and the education, training and research needed to ensure that skill development in the sector will satisfy the future needs of all employers: large companies, SMEs and Government.

Action: Nuclear Skills Task Group / Sector Employers

Nuclear Skills Task Group

3.4 Government policy reflects the need for concerted action by employers, the accepted vehicle for delivery of which is a Sector Skills Council (SSC), licensed by the Sector Skills Development Agency (SSDA). However, the development of such councils is at an early stage and, as noted in Chapter 2, there is no obvious SSC for the nuclear and radiological sector. It is not clear at present what the best vehicle for collaborative action by the industry might be and equally it is not clear at this stage that there is total buy-in from employers to the action required to address skills issues. It is essential that these issues be addressed as soon as possible. In the meantime, a vehicle is required to pave the way for inclusion of the complete nuclear and radiological sector within the wider tapestry of developing sector skills councils and to drive forward action on the NSG's recommendations.

3.5 It is proposed that this be achieved by means of a task group, directed to promote collaboration and synergy across the sector, so seeking to implement Government policy in this area.

Recommendation 3

ESTABLISH A NUCLEAR SKILLS TASK GROUP

It is recommended that a task group be formed, the prime role of which must be to:

- Forge collaboration between employers across the sector.
- Pave the way for inclusion of the complete Nuclear and Radiological Sector within the developing tapestry of Sector Skills Councils.
- In the interim, take forward the NSG's recommendations and generate action.

Action: DTI / SSDA

3.6 It is recommended that the task group consist of:

- A steering group comprising senior representatives of sector employers and Government, charged with setting strategic objectives and monitoring progress; and
- An operational group, comprising secondees from public and private sector employers, to implement the actions arising from the recommendations made in this report and objectives set by the steering group.

3.7 The task group must work closely with:

- Sector employers;
- Deliverers of education and training; and
- Those that seek to promote and develop the sector.

3.8 This includes:

- The Sector Skills Development Agency (SSDA), who have responsibility for skills development, in particular implementation of the Sector Skills Council initiative;
- The Learning and Skills Council (LSC), at both central and regional level;
- Regional Development Agencies (RDA);
- Research Councils;
- Higher Education Funding Councils;
- The DTI Strategy and Competitiveness Unit, who are responsible for co-ordinating the DTI's response to the SSC initiative and are also responsible for implementing the DTI's response to the Roberts' recommendations;
- Providers of education and training in HEIs and FECs; and
- Professional Institutions.

3.9 As the tapestry of Sector Skills Councils develops, responsibility should be progressively transferred to the emerging council(s) and the interim arrangements dismantled.

Research

3.10 Skills development and research are closely related, exemplified by BNFL's investment in nuclear science and technology research alliances with Manchester, Leeds and Sheffield universities. Increasingly the funding of education and research is from diverse sources, which can result in conflicting demands on providers of learning pathways. The sector requires a coordinated strategy that balances the needs of employers, the requirements of academia and Government funding criteria, which should include collaboration between those organisations that fund research. This is an area in which the task group, and later the engaged Sector Skills Councils, must be involved.

Regional Development

3.11 The Regional Development Agencies (and regional Learning and Skills Councils) are key agents in skills development, as identified in SR2002:

"Consulting widely, in particular with employers, the Government will therefore undertake a fundamental review of the funding for adult learning… The review will also consider how current funding arrangements could be reformed to enable Regional Development Agencies (RDAs) to play a full and effective role in developing and implementing regional skills strategies… Increasing innovation was identified as priority by most regions… a new enhanced Higher Education Innovation Fund (will be created) to stimulate the commercialization of scientific research. The next round of this Fund will include a role for the RDAs in ensuring that universities' proposals for funding are aligned with the needs of business in the region."

3.12 Employers must engage with the relevant RDAs to ensure that regional skills related programmes reflect the requirements of the nuclear and radiological sector. It is recommended that, in the short term, the nuclear skills task group, and in the long term the relevant Sector Skills Councils, engage with the appropriate Regional Development Agencies to co-ordinate employer collaboration in skills development at the regional level. Four regions of particular interest are:

- **North West** (including Cumbria, Manchester and Risley);
- **Highlands and Islands** (including Caithness);
- **South West** (including Devonport, Bristol, Gloucester and the Severn Estuary); and
- **North East** (only limited nuclear and radiological skills are deployed in the region, but a number of employers are based in the region that are, or may become, key stakeholders in the sector).

Recommendation 4

COLLABORATION WITH REGIONAL DEVELOPMENT AGENCIES AND ENTERPRISE COUNCILS

The nuclear skills task group, and Sector Skills Councils in the longer term, should collaborate with the appropriate Regional Development Agencies, regional Learning and Skills Councils and Scottish Enterprise Councils on skills development.

Action: Nuclear Skills Task Group

Health Sector

3.13 As highlighted in the recent Audit Commission report, a shortage of people with radiological skills is resulting in the "inability to meet demand for 'round the clock' services" and "long waits for some types of examination, particularly CT and MRI scans." A higher profile must be given to radiological skills within the health sector; not only of the diagnosticians and therapists (radiographers and radiologists) but also the medical physicists and clinical scientists, engineers and technicians who provide essential support for the design and maintenance of health care equipment. The effectiveness of front line support is wholly dependent upon logistics support.

3.14 A number of health sector workforce plans already exist or are in development, including 'The Cancer Plan', 'Making the Change. A Strategy for the Professions in

Healthcare Science' and 'Human Resource in the NHS Plan'. These plans propose a programme of modernising workforce planning, including:

- Bottom-up planning by stakeholders represented in Workforce Development Confederations;
- Top-down planning by the National Workforce Development Board; and
- The concept of a 'Skills Escalator', in which careers are considered as a succession of stages with their own learning requirements. Staff are encouraged to constantly extend their skills and knowledge, enabling them to move up the escalator, while roles and workload are delegated down the escalator, generating skill mix benefits. A greater variety of step-on and step-off points are created, complementing traditional entry points, such as registered professional staff, with other entry routes, such as cadet schemes and role conversion, to attract people in other careers who are seeking new challenges.

3.15 While these plans are commendable, they must be turned into action and implementation of the nuclear and radiological skills initiative must be carefully planned to ensure synergy between extant and future health initiatives.

Recommendation 5

RAISE THE PROFILE OF RADIOLOGICAL SKILLS WITHIN THE HEALTH SECTOR

The profile of radiological skills within the health sector must be raised, not only of the diagnosticians and therapists, but also the medical physicists and clinical scientists, engineers and technicians that support them. The nuclear skills task group and emerging Sector Skills Councils must work closely with the health sector skills development organisations to ensure synergy in their actions. This must:

- Take into account the radiological sub-groups within the health sector;
- Encourage action to be taken by those best placed to do so; and
- Ensure that all elements of the sector are adequately represented.

Action: Nuclear Skills Task Group /

NHS National Workforce Development Board and Confederations

TACTICAL RECOMMENDATIONS

3.16 The following tactical recommendations are made to address the strategic issues.

Co-ordinate General Promotion of the Sector

3.17 Developing Recommendation 2, promoting the sector is a strategic objective of the skills initiative and helping employers and individuals make informed choices must be a principal aim of the task group and relevant Sector Skills Councils. Many organisations already promote the sector, including employers, professional institutions, careers advisers and trade associations, but their actions must be co-ordinated to have maximum effect.

3.18 Promotion of the sector must emphasise the factors that make the sector an "attractive" career option, including remuneration, career development, status, elimination of student debt and skills marketability. Collectively, it is these factors that will make individuals consider it worthwhile, or not, making the investment in time and effort to pursue an engineering or "hard" science option. Many of these factors are employer dependent and in promoting the sector both sector generic and employer specific attractions must be emphasised.

Recommendation 6

CO-ORDINATE GENERAL PROMOTION OF THE SECTOR

Many organisations already promote the sector, including employers, professional institutions, careers advisers and trade associations, but their actions must be co-ordinated to have maximum effect. Best practice must be identified and encouraged across the sector. This must address:

- The positive aspects of the sector and outputs that are in the public good, such as medical treatment or nuclear clean up.
- The attractions of working in the sector: the technical challenge, opportunities for career development and transferability of skills.
- The best vehicles for promotion: eg SET ambassadors, visitor centres, recruitment fairs, publications, websites etc.
- The nature of the message, emphasising the relevance of the work to managing the environment and the essential, exciting and stimulating nature of the work.

Action: Nuclear Skills Task Group / Sector Employers

3.19 The language used by the sector involves many technical and scientific terms, and much use is made of jargon and acronyms, all of which can alienate a lay audience. Because of its defence origins, much of the sector is also shrouded by security, not all of which is necessary. And, in an attempt to allay health and safety fears, the sector often 'dumbs down' the challenge of work within the sector. These factors create an artificial barrier with the lay public and make it difficult for potential recruits to find out about the sector or apply for entry. Success will inevitably be dependent upon the adoption of simple language and openness when promoting the sector.

Recommendation 7

REMOVE ARTIFICIAL BARRIERS - LANGUAGE AND OPENNESS

The task group must promote, encourage and motivate members of the sector to use simple language when promoting the sector and avoid the unnecessary use of jargon or acronyms. Unnecessary confidentiality must also be avoided as this inhibits communication of the challenges that exist in the sector and fosters an environment of mistrust.

Action: Nuclear Skills Task Group / Sector Employers / Trainers & Educators

SECTOR SUPPORT TO SCHOOLS

3.20 Young people are strongly influenced by their experience in schools; hence several recommendations are targeted at this period in the learning process. Much has been published recently about the teaching of science and technology, about the content of the curriculum and about the interest generated by the subjects. It is also evident that teaching staffs are under considerable pressure with changing curriculum demands and the availability of resources to deliver syllabi in a positive and effective manner. The following recommendations are made cognisant of these issues.

National Curriculum

3.21 A review of the national curriculum has been commissioned by the DfES, to be implemented in 2005; an opportunity therefore exists to influence its content. The University of York and the Nuffield Curriculum Centre are developing a science education course in support of this review, the aims of which are to:

- Communicate more clearly to students the key science explanations at the heart of scientific understanding;

- Draw young people meaningfully into engagement with science, teaching them about ideas and controversy, uncertainty and risk, as opposed to a largely uncontested body of knowledge;
- Use a range of teaching and learning activities and practical work, aimed at developing understanding of how we know about these explanations and the nature of scientific enquiry;
- Balance exact science (biology, chemistry, physics) with ideas drawn from sciences such as epidemiology and health sciences that depend upon assessment of risk and probability; and
- Use of model of core sciences, aimed at developing scientific literacy, studied by all, with additional science modules preparing students for further scientific study or pre-vocational study.

3.22 The Nuffield Foundation has contributed to the Nuclear Skills Study and has identified a number of ways in which the nuclear sector can contribute to the current review. This includes providing material on risk assessment and management, and contributing to the proposed core modules, which include: “Radiation and Life” and “Using Radioactive Materials”. This is a real opportunity for employers to contribute to the development of curriculum teaching materials in ways that would address the reality of nuclear and radiological technology as well as promoting skills objectives. It is therefore recommended that the sector contribute to the curriculum review through liaison with the Nuffield Foundation.

Recommendation 8

INCLUSION OF NUCLEAR AND RADIOLOGICAL MATERIAL IN THE NATIONAL CURRICULUM

The task group should collaborate with the Nuffield Foundation in order to influence the 2005 review of the national curriculum. Material should be included that will aid the general improvement of scientific literacy, in particular nuclear and radiological technology, which is in general poorly understood. That material should be introduced in such a way that stimulates an interest in the subject that: can be understood in the context of society, seeks new ways of learning and avoids ‘learning by rote’.

Action: Nuclear Skills Task Group / Nuffield Foundation

Support to Teachers and Pupils

3.23 Both teachers and pupils require strong sector support. A number of employers already work closely with schools and evidence exists of good practice in providing effective support. But there is also much evidence of the sector failing to appreciate the needs of teachers and pupils, failing to provide support or, where support is provided, it being of poor or inappropriate quality. Two recommendations are therefore made; both of which are examples of the need for employers to work with other sectors in pursuit of common objectives, taking full advantage of established national and regional schemes and initiatives.

3.24 Teachers have an important influence on young people, but they require support from employers to use that influence to the benefit of the sector. Established programmes for the Continuing Professional Development of teachers exist, but the effectiveness of that CPD is dependent on the provision of appropriate, good quality, materials and support from the sector. A number of organisations already deliver such support, but best practice must be established and implemented, and the actions of the diverse groups co-ordinated to have maximum effect.

3.25 The Council for Science and Technology has recommended that products and services should be supplied in teacher friendly ways and that government should work with key stakeholders to improve the operation of supply arrangements. A Centre of Excellence has been proposed which would act as a framework for achieving these outcomes. The Centre would be expected to develop the provision of CPD in science, working with partner organisations. DfES is currently undertaking a consultation on

the establishment of such a Centre. The task group should monitor progress of this initiative and encourage support of the Centre, once established, by employers within the nuclear and radiological sector.

Recommendation 9

SECTOR SUPPORT FOR CONTINUING PROFESSIONAL DEVELOPMENT FOR TEACHERS

The task group must act as an interface between those that provide continuing professional development for teachers and those elements of the sector that can provide good quality and appropriate material to support CPD.

To be effective, Continuing Professional Development for teachers requires good quality material on subjects such as careers advice, opportunities in industry, employers' requirements and experience in industry. A number of sector organisations are in a position to deliver this support, but their actions must be co-ordinated to have maximum effect.

This should include support for the Centre of Excellence for CPD in science, once established, as recommended by the Council for Science and Technology.

Action Nuclear Skills Task Group

3.26 Appropriate support also needs to be given to pupils to increase the propensity of people to enter careers in science and technology. Many such initiatives exist but collectively these initiatives are not achieving the success they should. Support must be given to extant schemes that have a proven track record of delivering the right support to schools. One such scheme, supported by DTI and DfES, is the Science, Engineering, Technology and Mathematics Network (SETNET). This should be used as a vehicle to form a collaborative arrangement with teachers and other sectors to promote science and engineering to young people.

Recommendation 10

PROMOTION OF SCIENCE ENGINEERING TECHNOLOGY AND MATHEMATICS IN SCHOOLS

The task group must promote appropriate sector support, to teachers and pupils, to increase the propensity of people to enter careers in science and technology through an extant scheme or schemes that have a proven track record of delivering the right support to schools. One such recommended scheme is the Science, Engineering, Technology and Mathematics Network (SETNET). This scheme encourages:

- Use of science ambassadors to promote science and engineering to young people.
- Provision of appropriate material to support delivery of the curriculum.
- Provision of support to help put the curriculum into context.

Action: Nuclear Skills Task Group

MODERN APPRENTICESHIPS AND FURTHER EDUCATION

3.27 In November 2001, the Government announced plans to make on-the-job training for young people in England match the best in the world, calling upon employers to help achieve a target of more than a quarter of young people entering Modern Apprenticeships by 2004. Modern Apprenticeships are joint agreements between students, employers, the LSC and accrediting organisations for young people to be employed to undertake education and training, which the employer prepares for them with the aim of progression within a chosen career.

3.28 The decline in apprenticeship training has not only affected the sector's ability to train skilled trades but has also curtailed an important supply route for professional staff, many of today's professional engineers having entered the sector as apprentices. Collaborative arrangements are needed to develop a range of Modern Apprenticeships that are recognised throughout the sector, the qualifications from which are transferable throughout the sector.

3.29 The Modern Apprenticeship Advisory Committee has set out an action plan for achieving the Government's ambition. The LSC, working closely with new Sector Skills Councils and the Connexions Service, are to spearhead the delivery of this new generation of Modern Apprenticeships. In the absence of a Sector Skills Council, the task group should pave the way for implementation of this initiative. This message is reiterated in SR 2002, which states:

"This investment will support reform in… key areas, (including) a drive to expand Modern Apprenticeships and work-relevant qualifications… From 2003, a step-change in the funding system for post-16 learning will be made, with three year budgets and 100 per cent end-year flexibility cascaded direct to local Learning and Skills Councils (LLSCs). The Government expects the benefits of these new arrangements to be passed on to colleges, allowing them to plan provision on the basis of local strategic priorities and employer needs, rather than just on the basis of short-term affordability."

3.30 This initiative must be promoted across the whole sector, including the medical sub-sector. By example, the competence standard for radiographers is currently a vocational degree but many tasks in that sub-sector could be carried out by persons qualified to an appropriately defined National Vocational Qualification. The Modern Apprenticeship scheme would be an ideal vehicle for implementing such an initiative. The NHS Consultation Document 'Human Resources in the NHS Plan' includes examples of progress made in new ways of working, which includes the use of Assistant Practitioners in Radiography, creating a new grade of assistant practitioner to undertake some tasks currently carried out by radiographers. There is much synergy between this initiative and the use of Modern Apprenticeships, which must be exploited in this and other areas.

Recommendation 11

MODERN APPRENTICESHIPS

The task group should promote the development of a range of Modern Apprenticeships that are recognised throughout the sector, including the health sub-sector, the qualifications from which are related to a common set of occupational standards to permit transferability.

Action: Nuclear Skills Task Group / Learning & Skills Council / SSDA

3.31 Investment in Modern Apprenticeships may not always meet short-term economic criteria but, in the NSG's view, is essential for the development of the nuclear skill base in the medium and long term. Action is primarily for employers. But the Task Group (and the sector skills initiative that succeeds it) should monitor progress with a view to identifying whether some form of Government support, eg training grants or tax credits, might be needed to sustain investment at the level required to ensure that skills needs are met.

National Occupational Standards

3.32 Increased use of contractors and increased mobility of the workforce places greater emphasis on the transferability of skills, which can only be achieved by the use of common occupational or competency standards. Organisations such as the Occupational Skills Council for Engineering and National Occupational Standards in Healthcare Science must be supported in developing such standards, and those

Recommendation 12

NATIONAL OCCUPATIONAL STANDARDS

The task group must promote and encourage the development and use of National Occupational Standards that are recognised across the sector and the work of organisations such as the Occupational Skills Council for Engineering and National Occupational Standards in Healthcare Science must continue to be supported.

Action: Nuclear Skills Task Group / Sector Employers / Trainers & Educators

engaged in delivery of further education, higher education and in-house training must be encouraged to adopt those standards when developing course syllabi.

HIGHER EDUCATION – SPECIALIST ISSUES

3.33 Employers currently prefer to recruit good generalist engineers and scientists and provide specialist nuclear training in-house. Postgraduate higher education is therefore in competition with in-house training, with employers preferring in-house training as it is targeted and more cost effective to deliver. As a consequence, there is a low demand for nuclear education in HEIs, which has two effects:

- The ability to deliver nuclear modules in undergraduate education is diminishing; hence few undergraduate students are exposed to the challenges a career in the sector may offer; and
- The ability to deliver postgraduate nuclear education is diminishing and will be lost if corrective action is not taken.

3.34 These effects are confirmed by the HSE's survey of higher education in the United Kingdom, which identified a situation of "ageing academics, ageing facilities and no undergraduate courses with significant nuclear content." There is a need to maintain an ability to provide nuclear education in HEIs as:

- Many undergraduates obtain their first experience of nuclear and radiological technology in undergraduate courses, which, if lost, removes an opportunity for promoting the sector with the aim of recruitment;
- In conjunction with research and undergraduate education, postgraduate education is one of the elements that make HEI faculties viable; and
- Professional engineering institutes now seek a Masters qualification as the competence standard for Chartered status but, without postgraduate education, people would be unable to achieve Chartered status in a nuclear discipline.

3.35 One solution lies in modularising nuclear and radiological HE courses, and seeking equivalent recognition for in-house training. Such modules would have a transferable currency and could be used either as 'taster' units in undergraduate courses, or collectively to build into a postgraduate certificate, diploma or Masters degree. Achievement of this aim must be employer led, but requires collaboration between employers, academia, and in-house trainers. Involvement of the research councils is also required, as the funding of elements of postgraduate education is part of their remit. The task group should act as facilitator to promote the initiative, which should:

- Seek synergy in delivering: right sized modules, at affordable costs, in study periods acceptable to employers;
- Ensure the relevance of courses to employers and students; and
- Make the best use of training techniques, including higher education, in-house and remote learning.

3.36 Such an initiative would support all three strategic aims: promote the sector, underpin learning pathways and underpin the viability of education institutes. The success of such an initiative must be measured by the ability of the course to be self-sustaining, ie students must want to take the courses, employers must value the qualification and adequate funding must be available to sustain the courses. If these criteria are not met the long-term viability of such courses is unlikely to be assured.

Recommendation 13

MODULAR SPECIALIST HIGHER EDUCATION - INCLUSION IN ENGINEERING AND PHYSICAL SCIENCE DEGREES

The modularization of specialist higher education, and recognition of its equivalence with certain in-house training courses through the application of Occupational Standards for Engineering, should be encouraged. Such modules could build into a postgraduate certificate, diploma or Masters degree. The inclusion of such units in undergraduate engineering and physical science degrees, as 'tasters' for the sector, should also be encouraged.

This demand for such modules rests with employers, hence the initiative should be employer led. But alliances will be required between employers, to enable a broad basis for the modules, and with Higher Education Institutions for delivery of some of the modules. One envisaged model could be modules developed by a specialist lead university, working with employers, and franchised to other HEI's. Although the requirement must be employer led, a third party facilitator will be required to stimulate such action, a role which should be undertaken by the task group in the first instance.

Action: Nuclear Skills Task Group / Sector Employers / Educators in HE

HIGHER EDUCATION - GENERIC ISSUES

3.37 Two generic issues that apply to Higher Education are:

- The need for increased per capita funding for engineering and physical science undergraduates to ensure the viability of university faculties; and
- The development of higher education syllabi that meet employer needs.

Funding – Higher Education Funding Councils

3.38 The sector is reliant on a supply of good quality graduate engineers and physical scientists from which to recruit but, with the decline in popularity of such courses, engineering and physical science faculties are under increased financial pressure and many are closing. Evidence suggests that closures are not only contributing to the shortage of engineers and physical scientists, but also to a shortage in educational staff to educate new engineers and physical scientists. This issue is wider than the nuclear and radiological sector and was considered in the Roberts Review, which identified that:

"For laboratory-based subjects these (HEFCE) premia appear to be insufficient to allow universities to maintain their laboratories properly and to met their staff and running costs… it is very likely that this under-investment was 'frozen-in' and has resulted in a continued under-resourcing of science and engineering departments."

3.39 The funding arrangements for undergraduate engineering and physical science education should be reviewed to ensure that reliance on market forces to ensure the viability of such courses does not result in unnecessary closures. This has been addressed, to some extent, in SR2002, which states that the Spending Review will take forward the key recommendations of the Roberts Review, including:

- Modernising science and technology laboratories in schools and universities;
- Increasing Research Council PhD stipends to an average of over £13,000 a year by 2005-06 and the salaries of Research Council-funded postdoctoral researchers by an average of around £4,000; and
- Targeted funds for improving universities' capacity to recruit and retain first-rate academics.

3.40 The spending review allocates additional funding to support university faculties, but a review of the subject teaching premia for science and engineering subjects is still required. As recommended by Roberts:

"In order to ensure that in future higher education institutions can and do invest properly in science and engineering teaching laboratories, the Review recommends

that HEFCE should formally review, and revise appropriately, the subject teaching premia for science and engineering subjects. The revisions should ensure that the funding of undergraduate study accurately reflects the costs – including paying the market rate for staff, as well as the capital costs – involved in teaching science and engineering subjects."

3.41 The task group must therefore collaborate with other Sector Skills Councils to establish whether a review of the HEFCE subject teaching premia for science and engineering subjects is still justified post implementation of SR2002 and, if so, jointly lobby to that effect.

Recommendation 14

INCREASE FUNDING PER ENGINEERING AND PHYSICAL SCIENCE UNDERGRADUATE

The task group should collaborate with other SSCs to review the subject teaching premia for science and engineering subjects. If evidence exists that under funding is resulting in the unnecessary closure of faculties, skills organisations should jointly lobby for increased funding.

Action: Nuclear Skills Task Group / DfES Higher Education Group / HE Funding Councils

Higher Education Curricula – Employers and Accrediting Organisations

3.42 Employers increasingly complain that graduates are poorly prepared for employment in the workplace. Employers, Higher Education Institutions, accrediting organisations, professional institutions and Government must therefore collaborate to develop courses that balance employer and academic requirements. This issue is wider than the nuclear and radiological sector and the task group must collaborate with other sectors to establish a means of developing higher education syllabi that more directly meet employers needs. This may require differentiation between HEIs that deliver vocationally biased courses and those delivering academic biased courses. This reiterates an issue considered by the Roberts Review, which states:

"the Review is concerned that a step change is needed in the skills communications between employers (particularly businesses) and HEIs. Greater business involvement in course development would give HEIs, businesses and students more confidence that students are acquiring the right skills, and would keep businesses in touch with the skills sets on offer from universities… HEIs and employers must be supported by those bodies that accredit science and engineering courses (eg the Engineering and Technology Board and professional bodies which are members of the Science Council). These bodies must work with HEIs to drive forward innovation in course design, and not allow the accrediting processes to inadvertently inhibit it."

Recommendation 15

COLLABORATIVE DEVELOPMENT OF HIGHER EDUCATION COURSES

The task group should collaborate with all relevant SSCs and other workforce development organisations in other sectors to establish a means of developing higher education syllabi that balance employer (vocational) and academic requirements.

Action: Nuclear Skills Task Group / SSCs / Workforce Development Organisations