ENVIRONMENTAL SCIENCE – A ROUTE INTO THE NUCLEAR INDUSTRY?

A DISCUSSION DOCUMENT

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EXECUTIVE SUMMARY

A recent Government report states that the nuclear industry will require around 1000 graduates a year for the next decade at least. Currently it recruits slightly over half that number. Given the parlous state of nuclear education at both the graduate and postgraduate levels and the continuing antipathy of students towards science, engineering and technology subjects, it is difficult to see how this requirement for suitably qualified technical graduates will be met.

If a crisis is to be averted an alternative recruitment stream to the traditional one from the physical sciences must be identified. Given the increasing significance that decommissioning will play in the industry and that by its very nature decommissioning is linked to the environment, then one possibility could be from those studying environmental or environmental related courses.

Such courses are very popular at both the undergraduate and postgraduate levels. For a number of reasons, not least their modular composition and the way they are funded, it is the latter that seem more appropriate to the nuclear industry. For the first time, from all the environmental masters courses available in the country, those containing both a nuclear and environmental content have been identified.

Whilst some contain a significant amount of nuclear teaching, it is evident that in many cases the nuclear content would have to be increased in order for the students to graduate with any detailed knowledge of the nuclear industry. Nevertheless there is a potential pool of some 400 students a year.

In addition, the current research links between the nuclear industry and those university departments having expertise in environmental science have also been identified, on the basis that such relationships may be fertile ground for jointly developing new courses.

Whilst the findings of this study support the thesis that environmental masters courses containing a significant nuclear content could represent a hitherto untapped recruitment stream into the nuclear industry, it is important that its appropriateness should be discussed with the industry. It is also important that the practicability of increasing the nuclear content of environmental courses be discussed with academics. Views and comments from any interested party are therefore most welcome.

1. INTRODUCTION

i) Background

This work is part of the contribution by the HSE-NII to the nuclear skills study conducted under the aegis of the DTI.

Previous HSE-NII studies[1] have shown that nuclear education in British universities is in an extremely fragile state. There is not one university undergraduate course with any significant nuclear content to it; many nuclear modules are optional and the majority constitute less than 5% of the degree. At the postgraduate level the situation is only slightly more encouraging: six courses with an entirely nuclear curriculum survive, producing some 70 graduates a year.

This position is exacerbated by the continuing antipathy of students towards science, engineering and technology subjects, with enrolment in these areas showing a fall of 26% in the 8 years prior to 2001[2]. As fewer and fewer high quality technical graduates become available, the competition for them is ever greater and there are signs already that the nuclear industry is losing out. The ability of companies to circumvent the shortage of graduates with a sizeable nuclear component to their degree by hiring good quality technical graduates and training them in house is thus being compromised.

According to the Nuclear and Radiological Skills Study[2], the power, fuel, defence and clean up sub-sectors of the nuclear industry will require approximately 1000 graduates a year for the next 15 years. Of these, approximately 700 would be replacements for retirements and 300 in response to the growth in nuclear clean up. These sub-sectors currently recruit around 560 graduates a year. However, although the report of this study was published after the Government White Paper on nuclear clean up[3] it was published before the Government White Paper on energy policy[4]. Since there are no proposals in the latter for building new nuclear power stations to replace those that close, it is likely that the emphasis will be even more on clean up.

As the decommissioning programme gains momentum over the next few years, so will the requirement for people to implement it. Yet, given the above-mentioned constraints that the industry faces regarding recruitment, there is concern as to where those people might come from. However, since decommissioning is inextricably linked to the environment then one source might be from those studying environmental or environmental related courses.

Such courses are currently very popular at both the undergraduate and masters levels. As far as the nuclear industry is concerned, involvement with masters courses would seem more appropriate for four reasons:

- The flexibility of most masters courses
- The variety of the first-degree background of the students
- The potential for research project placements
- The range of transferable skills taught on masters courses

Masters courses are usually taught on a modular basis and so the possibility exists of introducing radiochemistry or other nuclear specific modules into them. The funding of masters courses is also

[1] Nuclear Education and Research in British Universities, HSE-NII, October 2000; Nuclear Education in British Universities, HSE-NII, February 2002.
[2] Nuclear and Radiological Skills Study, DTI, December 2002.
[3] Managing the nuclear legacy – a strategy for action, July 2002.
[4] Our energy future – creating a low carbon economy, February 2003.

more flexible than the bloc funding found at the undergraduate level and more readily lends itself to the introduction of bursaries or grants.

The variety of the first-degree background of the students would also be an advantage. This might range from the social sciences to the physical sciences and such diversity, combined with a post-graduate qualification in environmental science, could equate to the diversity of skills required by the evolving nuclear industry.

Masters courses commonly involve a research project and this is often done as a placement in industry. If it were within the nuclear industry then the student would get invaluable first hand experience of the challenges and opportunities that this particular sector has to offer. From the point of view of industry, such placements can be viewed as extended interviews in the recruitment process as well as the means of obtaining technical information.

Finally, the level of transferable skills, such as public speaking, report writing, team working, researching information and so forth, that a student acquires on a masters course is far above that acquired during a first degree and more adequately prepares the student for the world of work.

ii) Objectives of the study

There is more likely to be some understanding of the changing needs of the nuclear industry by those departments that have an interest in it, or a connection to it, than those that do not. Consequently, such departments might be more agreeable than most to increasing the nuclear content of an existing course or even introducing a new one. With the aim of building on existing expertise and interests, the objectives of the study were thus twofold:

- To identify current links between the nuclear industry and university departments having expertise in environmental science.
- To identify those masters courses pertaining to environmental science that also include a topic of relevance to the nuclear industry.

It should be noted that this is the first time a survey of such courses has been attempted and although every care was taken to identify all environmental masters courses having a nuclear content it is possible that some have been overlooked.

iii) Methodology

The study was carried out between May and September 2003.

Details of the nuclear industry's current links with university departments having expertise in environmental science were obtained by directly approaching those in each company who were responsible for monitoring or administering contracts with universities. Of the 11 organisations approached, 1 did not respond, 1 was unwilling to disclose any information, 1 was unable to identify what links existed with universities, 1 had no links in the area of environmental science and 7 provided details: AWE, BNFL, SEPA, UKAEA, NIREX, MoD, WS Atkins. Most of the companies did not have a centralised system for recording university contracts and consequently the majority of the information was provided on an ad-hoc basis. It is, therefore, possible that it is incomplete but it is, nevertheless, the best that is available.

The previously cited HSE-NII studies revealed a number of masters courses with both a nuclear and environmental content. However, this was more by chance than design as these studies were concerned with identifying nuclear education that was of interest to the regulated industries: in other words, physical science rather than environmental science. The information searches for these studies were very focussed and detailed thanks to the input from an established forum of academics and industrialists who were able to advise on the probable location of physical science courses containing a nuclear component. Unfortunately, a similar forum to advise on the possible location of environmental courses having a nuclear content was not identified. Consequently, it was necessary to identify all environmental masters courses in order to arrive at the subset of interest. This task was achieved by Internet search.

Particularly useful was the graduate careers site, www.prospects.ac.uk, on which it was possible to search for postgraduate courses in any discipline. As well as using this route to identify environmental courses, the keyword search facility on the website was also used to ensure that no courses were overlooked. In addition, the search engines www.google.co.uk and www.altavista.co.uk were used. Also included were the websites of the universities cited in 'The Times'[5] list of top 20 universities noted for excellence in Environmental Science at the undergraduate level on the basis that such excellence could extend to the postgraduate level in the form of a course.

A total of 338 environmental masters courses, with topics as wide ranging as hydrogeology, land remediation, occupational health, energy, waste water engineering, geochemistry, analytical chemistry, and environmental management, were thus identified. By careful consideration of the course titles, this total was reduced to 138 courses that possibly contained some nuclear teaching.

The content of these courses was garnered primarily from university websites. However, these were found to vary considerably in the amount of information they carried. Where there was a singular lack of detail, prospectuses were obtained but very often these were no more informative. Consequently, there were a number of courses where it was not known for certain whether they contained any nuclear teaching or not. Where it seemed that they might, the academics were contacted by telephone. Only the 39 courses that were definitely identified as containing nuclear teaching are included in this report.

[5] The Times, T2, 9 May 2003

2. SUMMARY OF FINDINGS

i) Current links

Table 1, overleaf, gives a summary of the current links between the nuclear industry and university departments having expertise in environmental science. From the information received, these involve 23 departments in 17 universities. The nature of one link is unknown, 15 are through research and 7 are in connection with MSc courses.

In most cases the links are unique to individual companies. However, there is some commonality: the PGCert in Radioactive Waste Management and Decommissioning at Birmingham is supported by a Partnering Agreement with the university, the Regulator and 11 companies, including the 7 which gave information for this study, and Imperial College showed links with 4 of the 7 companies that provided information for this study.

Of the 7 MSc courses, it is known from the HSE-NII studies that 3 already have some nuclear content: PGCert in Radioactive Waste Management and Decommissioning at Birmingham, MSc in Environmental Diagnosis at Imperial and the MSc in Radiation and Environmental Protection at Surrey. From the university web sites it is not apparent that the other 4 courses have any nuclear content, although it is understood that the MSc in Urban Geoscience at Manchester is linked to RAWMAC (Radioactive Waste Management Advisory Committee).

ii) Masters courses having both a nuclear and environmental content

Table 2, overleaf, gives a summary of all the masters courses that have been identified as having both a nuclear and environmental content: there are 39 courses involving 32 departments in 27 universities. For completeness, the three courses mentioned above as having a nuclear content are included.

Although details of the taught components were not sought with any degree of detail, information on module length and content was available in some cases. There are examples of environmental science courses containing modules of up to one week in length, but generally the teaching is limited to only a few hours.

The environmental MSc courses listed in Table 2 are generally those relating to pollution management and control. The departments offering the courses are diverse, including environmental science, physics, chemistry, civil engineering, geography and earth sciences. The teaching often relates to waste management but includes ionising radiation and radiochemical techniques. Option titles include ‘Radiation exposure’, ‘Environmental radioactivity’, ‘Radioactive waste disposal’, ‘Geochemical applications of radioactivity’ and ‘Radioactive pollutants and their effects’. Perhaps what is most striking is the similarity of the topics within such a diverse range of courses.

3. CONCLUSIONS

In total there are 43 environmental masters courses, approximating to some 400 students a year, which could serve as a hitherto untapped recruitment stream into the nuclear industry: 39 that have been identified as containing some nuclear teaching and 4 with which the nuclear industry currently has links but which seemingly do not contain any nuclear teaching.

However, in many cases, the nuclear content would have to be increased so that it became a significant, if still a minor, component of the course in order for students to graduate with any detailed knowledge of the nuclear industry. And therein lies the challenge.

It is understood in the environmental sector that to gain employment graduates should obtain a qualification at the masters level. Hence the hundreds of masters courses related to the environment, earth sciences and energy. The reasons why very few of them contain teaching in radioactivity and related nuclear science depends on the course organisers and are probably due to a combination of factors, not least prioritisation of topics due to the limited contact time available in a one year MSc. A key factor is whether the department has access to expertise in the area, from within the department, within the institution or externally. Generally, such availability of expertise will result from contacts through research activities. The use of staff from other departments or externally has financial implications for the department and so does the use of laboratory facilities, technical support and instrumentation.

Precedents already exist for financial support from the nuclear industry (the Partnering Agreement between 11 companies, the Regulator and Birmingham University to support the MSc in reactor technology has worked exceptionally well) and for visiting lecturers and specialists from the nuclear industry to contribute to courses (amongst others Lancaster and Birmingham). The research project forms a significant part of a masters course, lasting as it does between 3 and 6 months. Placement in the nuclear industry would provide the opportunity for students to experience it first hand, with the potential for continuation of employment following graduation.

The industry, coordinated through the Nuclear Sector Skills Council, could thus help considerably to overcome the above-mentioned impediments to increasing the nuclear content of courses. However, the rate determining steps are whether the academics would be willing to reprioritise their course content in favour of nuclear and whether students would continue to apply to the courses if they did. Consultation with academics is therefore a priority.

In addition to MSc courses, the nuclear industry currently has research links with departments that have expertise in environmental science. Good teaching and good research often go together and it may be that the wider understanding of each other's cultures and needs that ensues from research collaborations could provide the opportunity for the industry and academe to jointly develop new courses.

Finally, it must be recognised that universities operate as businesses and can only afford to put on courses for which there is a clear demand. Before asking them to increase the nuclear content of their courses, the nuclear industry must be very specific in what its demand is going to be.

4. RECOMMENDATIONS

1. The views of the nuclear industry should be obtained on the appropriateness of the thesis articulated in this report, namely that environmental masters courses containing a significant nuclear content could represent a hitherto untapped recruitment stream

2. The views of academics should be obtained on the practicability of increasing the nuclear content of environmental courses.

3. The opinions of all interested parties should be canvassed and considered.

TABLES

Table 1. Summary of current links between the nuclear industry and university departments having expertise in environmental science.

UNIVERSITY	DEPARTMENT	NATURE OF LINK
Birmingham	School of Physics and Astronomy	PGCert Radioactive Waste Management and Decommissioning
	School of Civil Engineering and Geosciences	Research
	School of Geography, Earth and Environmental Sciences	Research
Bradford	Dept of Civil and Structural Engineering	Research
	School of Archaeological, Geographical and Environmental Sciences	Research
Cambridge	Dept of Earth Sciences	Research
Edinburgh	School of Geosciences	Research
East Anglia	School of Environmental Sciences	Research
Highlands and Islands	Environmental Research Institute, Thurso	Research
Imperial College	Dept of Environmental Science and Technology	Research
		MSc Environmental Diagnosis
Leeds	School of Earth Sciences	Research
	School of the Environment	Research
Liverpool	Dept of Earth Sciences	Research
Manchester	Dept of Earth Sciences	Research
		MSc Urban Geoscience
Newcastle upon Tyne	School of Civil Engineering and Geosciences	MSc Environmental Engineering
Nottingham	School of Chemical, Environmental and Mining Engineering	MSc Contaminated Land Management
Sheffield	Dept of Civil and Structural Engineering	Research
Southampton	School of Ocean and Earth Sciences	unknown
Stirling	Dept of Environmental Science	MSc Environmental Management
Surrey	School of Electronics and Physical Sciences	MSc Radiation and Environmental Protection
Wales, Bangor	Ocean Sciences	Research

Table 2. Summary of masters courses having both a nuclear and environmental content.

UNIVERSITY	DEPARTMENT	COURSE	NUCLEAR TOPIC
Aberdeen	Dept of Engineering	MSc Safety Engineering and Risk Management	Waste disposal
Birmingham	School of Physics and Astronomy	PGCert Radioactive Waste Management and Decommissioning	As course titles
		MSc Physics and Technology of Nuclear Reactors	
	School of Geography, Earth and Environmental Sciences	MSc Air Pollution Management and Control	Radioactive pollutants
Bolton	Dept of Biology and Environmental Studies	MSc Environmental Geotechnology	Environmental nuclear safety and civil protection
Bristol	School of Mathematics	MSc Industrial and Environmental Modelling	Nuclear waste storage
Brunel	Dept of Geography and Earth Sciences	MSc Environmental Hazards and Risks	Radioactivity as an environmental hazard
Central Lancashire	Dept of Environmental Management	MSc Waste Management	Nuclear waste management
City	School of Engineering and Mathematical Sciences	MSc Energy and Environmental Technology and Economics	Nuclear decommissioning
Derby	School of Environmental and Applied Sciences	MSc Environmental Management	Radiation
East Anglia	School of Environmental Sciences	MSc Environmental Sciences	Radiation exposure
Heriot-Watt	Dept of Science, Engineering and Technology	MSc Marine Resource Development and Protection	The nuclear industry
Hull	Dept of Engineering	MSc Advanced Materials, Processes and Manufacturing	Environmental engineering, risk and nuclear issues
Imperial College	Dept of Environmental Science and Technology	MSc Environmental Diagnosis	Radioactivity and the environment, radiochemical techniques
		MSc Environmental Technology	Radioactivity and the environment

UNIVERSITY	DEPARTMENT	COURSE	NUCLEAR TOPIC
Kingston	Dept of Chemistry and Pharmaceutical Sciences	MSc Analytical Chemistry	Radiochemical techniques
	School of Earth Sciences and Geography	MSc Environmental Geochemistry and Analysis	Radioactive waste
Lancaster	Dept of Engineering	MSc Decommissioning and Environmental Clean-up	Decommissioning of nuclear facilities
	Dept of Environmental Science	MSc Environmental Pollution and Protection	Environmental radioactivity
		MSc Environmental Technology	
		MSc Waste Management	
Leeds	School of Earth Sciences	MSc Geochemistry	Radioactive and radiogenic isotopes
		MSc Environmental Geochemistry	Radioactive waste disposal
	Dept of Fuel and Energy	MSc Environmental Pollution Control	Includes nuclear industry
Liverpool	Dept of Geography	MSc Environment and Climate Change	Introduction to radionuclide applications
	Dept of Physics	MSc Radiometrics PGCert in Radioactive Waste Monitoring and Decommissioning	As course title
Loughborough	Dept of Chemistry	MSc/PGDip/PGCert Analytical and Pharmaceutical Chemistry	Radiochemistry taught as part of the environmental module
		MSc/PGDip/PGCert Environmental Studies	
Manchester	School of Biological Sciences	MSc Pollution and Environmental Control	Radioisotopes, radioactive waste, radiation in the workplace
Newcastle upon Tyne	School of Civil Engineering and Geosciences	MSc Environmental Biogeochemistry	Risks and fate of radionuclides
Oxford Brookes	School of Biological and Molecular Sciences	MSc Environmental Assessment and Management	Nuclear waste and monitoring
Portsmouth	School of Environmental Design and Management	MSc Occupational and Environmental Health and Safety Management	Ionising radiation

UNIVERSITY	DEPARTMENT	COURSE	NUCLEAR TOPIC
Reading	Soil Science Dept	MSc Soils and Environmental Pollution	Radioactive contamination
Salford	School of Environmental and Life Sciences	MSc Sustainable Management of Waste	Radioactive waste streams
Southampton	School of Ocean and Earth Science	MGeol Geology	Environmental radioactivity and radiochemistry
Staffordshire	School of Sciences	MSc Water and Environmental Management	Nuclear waste management
		MSc Pollution Management	
Strathclyde	Faculty of Science	MSc Environmental Science	Radionuclides in the environment
Surrey	School of Electronics and Physical Sciences	MSc Radiation and Environmental Protection	As course title