PUBLIC INFORMATION AND EDUCATION IN ENGLAND.

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Introduction

The education of the people of any country must take account of the history and the traditions which brought it to it's present standards and to it's status in the world community. In your country education is given a high priority and rightly so.
Education must, however, not only take account of what has and is happening in the country and the world but must look to the future so that the people of the country can progress to improved standards of living.
An important contributor to the standard of living is the energy available to power industry and to make houses more comfortable so people both adults and children should be given sufficient basic information to make them aware of the sources of energy available to their country and which particular sources are being developed to supply present and future needs.

Energy for lighting, heating and power is a key factor for a given standard of living as it influences home life, transport, industry, in fact the whole spectrum of life in a community. Your country has a wide range of requirements to cover your many different needs.

The source or sources of the energy for a country must be dependable and their use from production of the basic fuel to the disposal of the waste should be to standards which the people are aware of and accept. Therefore the people must be informed about the various options for energy supply and about the effect it will have on their environment.

Energy must therefore be a subject in the schools curriculum, and a topic which is discussed and explained in the media. The explanations of the energy position need only be in broad terms because the majority of the population of any country has little interest in delving into the details of fossil fuel, hydro based, renewable or nuclear energy sources. The broad explanation must be factual and presented in a way which is comprehendable to non-technical people as they make up the majority of any general population.

Many sources of energy have been used for thousands of years but the scale of the usage has been small. Modern living standards demand vast quantities of energy. A person can survive on less than a 100 watts of energy for heating in temperate climates but advanced

countries now have to provide some 4,000 to 7,000 watts of energy to families for cooking, heating, refrigeration, airconditioning etc.

The sources of such energy are many in general, but particular countries tend to turn first to their indigenous supplies. If these can be developed to supply areas of their country without adverse environmental consequences then it makes good sense to proceed with them. Most countries however, tend to require a diversity of sources so that future energy supply is more certain.

Sources of Energy.

Historically the most traditional sources of energy were hydro and wind power. Wind power is limited because it requires large areas to collect large quantities and it is not suitable for storage. Hydro power is an extremely valuable source as it is clean, storable and can be available in some areas in a range of quantities from small up to enormous amounts. It's impact on the environment needs careful assessment. Sea wave energy is like that from wind in that it is thinly distributed and not storable.

Fossil fuels play an important role world wide and are very flexible. They are particularly important to transport systems. However, now that they are used in enormous quantities their by-products and wastes produce a very real strain on the environmental conditions not only of their local area but world wide. The treatment plants needed to deal with their waste products make the economics of their use an important consideration.

Renewable energy like heat from the sun as well as that from wind, wave and hydro sources, already mentioned, are excellent for isolated and small requirements and are valuable as methods of conserving or reducing demands for energy but they cannot be developed on a sufficient scale to rule out the need for large quantities of energy from other sources.

For some 30 years nuclear power has been used as a major source of energy and the education of people and children should include an explanation of how nuclear power is produced from the mining of the uranium to the final disposal of the waste from the system. This paper attempts to put this source of energy in perspective.

An explanation of nuclear power.

The development of nuclear power has been a remarkable success story from the scientific and technological point of view. Yet after some 30 years of usage for electricity production almost world wide it is still not a favoured source of energy. Factually it is a clean

source of energy with little impact on the environment and it's safety record over the 30 years is good. The question to be answered is "Why is it not favoured" and the answer to that is "Lack of education on nuclear power in the schools and homes."

When nuclear power was being developed in the 1950's and '60's the attitude in the world was to glamorise scientific and technological achievement. Supersonic flight, space exploration and nuclear power all were seen to have enormous beneficial potential for the future of mankind.

The scientists and technologistes enjoyed their work, were excited about it and wanted to expand and develop their technologies. They spoke in glowing terms about the benefits of their discoveries. They did not look at the impact on the layman. They did not consider how the layman was taking on board all these changing ideas and novel concepts. In fact they were indifferent to the thoughts of those very people who would eventually need to make use of the development if the development were to succeed. This was not their fault because they were scientists and technologists and not communicators.

Communication is the oil that keeps modern society running smoothly in all fields of man's interests and education is a major ingredient in communication.

It must be remembered however, that all of the population do not think in the same terms. Scientists know their subject and actually think and speak in their scientific language. Other groups of people like for example, musicians know their subject and think and speak their language. The scientist and the musician will not understand or even accept each others endeavours unless they are educated to some extent in each others work. To achieve this the scientist must explain his interest to the musician in terms the musician can understand and visa versa. This is the essence of communication.

Nuclear power must therefore be explained to the public in factual but simple language and not made important or exclusive by the use of scientific jargon as most scientists try to do.

Nuclear power is essentially mining uranium, like mining coal, burning it in a reactor, like burning coal in a furnace and using the heat, and lastly disposing of the radioactive waste, like getting rid of the ash from coal.

Each stage of the coal or uranium process has safety hazards to man and environmental considerations which require assessment.

It is good that in the 1990's the safety and environmental considerations are receiving much more emphasis and detailed assessment than they did 30 years ago.

The acceptance of hydro and fossil based energy systems has developed over centuries and higher standards of safety have evolved over that time albeit all too slowly. Nevertheless people are generally familiar with what is involved in the systems but few understand the complexities.

Nuclear power is some 30 years old, a recent development in comparison with the hydro and fossil systems, but 30 years surely is long enough for to-day's generation of people to know something about it. Unfortunately that little that they do know is cloaked in fear due to the fact that 'nuclear' means 'bomb! Proper education will allow people to reassess the position and make their own judgement.

Radioactivity.

The element of hazard of the nuclear process is 'radioactivity'. Although the nuclear fuel cycle has been with us for some thirty years radioactivity has been part of the world since the planet was formed. In fact nuclear fusion in the sun is the earth's greatest and most beneficial energy source.

Radioactivity is natural and everywhere.

The hazard from radioactivity comes from man making concentrations of it or converting it to more hazardous forms. Man does this to many of the natural materials, be they fuels, chemicals etc. and then has to control and safeguard the systems. For radioactivity the safeguarding methods are understood and applied.

Radioactivity has a useful property - it can easily be detected. A geiger counter will detect even the low levels of the natural radioactive background which is present everywhere in the world.

So the first requirement in nuclear power is to develop an appreciation of radioactivity in the world. Scientists do this mathematically but for lay people illustrations and 'hands on experience' are necessary. Children should have it explained to them at an early age and told their bodies are subjected to it continuously. It is a natural process. In the United Kingdom a simple geiger counter suitable for use in home and school has been developed and

marketed so that children and parents can have 'hands on experience' checking materials which are found in the countryside which are naturally radioactive.

When it is appreciated that radioactivity is natural and everywhere the education system should explain the need to respect and control it. Like many things a little radioactivity like the natural background is part of our normal living conditions but concentrated radioactivity is harmful.

Concentrated radioactivity must be contained. The containment is necessary to stop inhalation or ingestion of air borne particles or for isotopes that produce harmful radioactive rays the containment must be a form of shielding which absorbes the rays.

So from the initial mining of the natural uranium to the final disposal of the radioactive waste man must be protected from the radioactivity of the process by containment and shielding. The methods of doing this are well proven and universally applied. Great stress is placed on maintaining high standards even under what is called maximum credible accident situations. That is where an independant group of specialists assess what might be the unlikely yet just possible accidents which might lead to a breach of the containment of any part of the processes in the nuclear plant. There must be a safety device to deal with this likelihood unless the likelihood of the event is almost incredible.

The nuclear process.

It would not be realistic in a single paper discussing education to attempt to deal in any detail with the technical side of the nuclear cycle. Not that the subject is too complicated for those who are deeply interested. Indeed it's science and technology is probably the most thoroughly explored subject of any modern development and it's practicability is well demonstrated. Further there are excellent scientific publications on all aspects of the nuclear cycle.

The important task, as emphasised above, is to bring the reality of the nuclear fuel cycle into clear perspective for non-scientists. To do this many countries have available books, pamphlets, slides, videos and exhibitions which present the elements of the nuclear cycle in the language of 'imagery' and relative to other more accepted processes.

The nuclear reactor is a vessel to heat water or gas to provide steam for the normal generation of electricity. The reactor needs very infrequent fuelling, in fact some of the uranium fuel will last for more than five years continuously generating heat. Hence unlike hydro or fossil systems, the volume of the fuel to supply the energy is tiny by comparison. This means that the waste arisings from the nuclear fuel cycle are in turn very small.

The waste arisings are mainly of low level activity. However a small part of them is highly radioactive and would be very dangerous if not carefully controlled. All operators of nuclear plant are required by international regulations to isolate the radioactive waste. The low level needs some 300 years isolation and the high level some 1,000's of years isolation. This can be achieved by placing the waste in special cannisters in deep geological caverns isolated from water.

Such rock formations exist in many areas where the rocks have been stable for hundreds of millions of years and waste isolated in such a place will safely decrease it's activity.

The educational resources.

In the United Kingdom albeit somewhat belatedly a useful range of documents and videos has been prepared offering information about nuclear matters. They can also be used to provide a complete educational service. In the Appendix a list is given of items for an information service with some comments about them.

In many other countries some equivalent information is available. International co-operation in maintaining the availability of such material is valuable but the standards of the material must always be on a sound factual base.

Conclusion.

Education about the basic concepts of new technological developments should be kept abreast of the progress of the technology. The education should not be an over simplified version of the scientific or technological material but should be presented in language suitable for people who are non scientific and think more in terms of the Arts where imagery and historical background form a platform for appreciation of new ideas.

The impact on society and the environment should be clearly and factually assessed and presented. It is important nuclear power is included and well presented in the school curriculum.

APPENDIX : - Commonts on United Kingdom Educational Material.

1. Nuclear Industry Education Programme

2. Mission

To contribute to public understanding and awareness of nuclear power as part of the energy mix of the UK.
To address issues in a responsible way for education, tailoring the messages to be used in conjunction with the national curricula requirements of the UK.

The education programme has been designed to contribute to public understanding of the energy issues which face the UK and the world now and in the future. The information is presented in a balanced and positive manner and is available to the general public and also to school students. The resources available to the students range widely and expand on topics which are mandatory in the National Curricula of the UK.

The resources available through the programme are designed so that they can be used by the whole of the industry to provide a complete education service.

3. Traditional areas

The programme has opened out the traditional areas covered by nuclear power education to incorporate energy as a whole. This gives a good basis to promote nuclear power as part of the energy mix which is necessary for the way we live today.

4. Curricula of the UK.

There are three sets of studies in the UK: the National Curriculum for England and Wales, the Northern Ireland Curriculum and the 5 - 14 Curriculum, Standard and Higher Levels for Scotland. All of these contain direct reference to the production of electricity through nuclear power and also include other topics.

5. Magazine for children

The flagship of the education programme is "Activate", the energy magazine for students aged 11 to 19. It has a bold design and has been formatted to provide classroom material that can be copied by the teacher and includes an activity for the students to do on their own.

6. "Activate" - 3rd world

This approach to energy allows us to explore areas such as the developing world and how it's energy needs are being met with solar, wind and water power as well as more conventional methods.

7. "Activate" - Electricity generation from different sources

We can compare how different sources of energy can all produce electricity in similar ways. This positions nuclear, wind, water as a normal part of the production processes.

8. "Activate". - Radiation and Medicine

We can also look at the spin offs from nuclear technology into medicine and other applications.

9. "Activate". - Teachers update section

It also includes details for teachers on new publications and events related to science and technology and has a full assessment of how each feature fits into the curriculum.

10. Comments on "Activate" from Teachers

Excellent
Informative
Colourful
Lively

The first issue of Activate has produced some very positive comments from teachers. We plan to conduct a survey after the second issue to evaluate the strengths and weaknesses of Activate so we can tailor

the approach to meet the needs of teachers even better in the future.

11. "No Easy Answers"

The programme includes a selection of videos which cover various topics. "No Easy Answers" discusses the issues behind energy production eg acid rain, CO2 emissions, lead in petrol. It gives reasons and effects and prompts classroom discussion of these difficult areas.

12. "Discovery and the Atom"

This video looks at the history and the people behind the discoveries.

13. "Big Science"

Of course various aspects of nuclear power are covered by video, like fusion at the JET project.

14. Radiation Causes and Effects

Explains the differences between ionising radiation and radioactivity and looks at natural background and man-made radiation: the dangers and the benefits.

15. Exploring Light and Electricity

We also address fundamental education at primary level, 5 - 11 years. This video looks at the basic concepts of light, shadows and things powered by electricity and is aimed at 5 - 7 year olds. A video being launched this year takes this a step further and looks at the history and more applications of electricity; logic circuits which give choices, dimmer switches and gives ideas to teachers for presenting the topics in the classroom. Both of these packs have been written in conjunction with a primary headteacher.

16. "Radcount"

Apart from the videos, there are other resources. "Radcount" is a portable radiation counting system which schools can use inside

and out for measuring radiation either naturally occurring or from sources. This is a good way to show students that radiation is part of the world and not confined to nuclear power stations. The pack includes 20 graded experiments from GCSE through to A level and beyond.

17. "Energy Book"

The "Energy Book" was written by an education examiner and was designed to fit in exactly with the GCSE - the general certificate of secondary education. There are also a selection of assignments that can be copied by the teacher for classroom or homework use.

18. Greenhouse Effect

There are a series of free booklets available which cover many of the main topics which are raised when discussing nuclear power. They range from The Greenhouse Effect through Radiation to Safety. These have proved very popular and were designed to answer the questions most often asked by the public. They are designed to be descriptive in pictures and words and can be easily understood by the public.

19. Reactors

Looks at the different types of reactor and explains how they work and differ from each other.

20. Radiation Around Us

This allows people to calculate their own annual dose of radiation depending on where they live, how often they fly, how many X-rays they have had etc. It shows the differences in man-made and natural radiation and how where we live affects the doses we receive.

21. Radiation and Medicine

Shows the benefits of radiation and how it is used in medicine.

22. Radioactive Waste

This gives a complete picture of the different levels of waste and how it is processed and stored.

23. Atoms at Work

This is a definition of what an atom is and relates directly to uranium and the fission process in a reactor.

24. Talks Service (lecture)

To complement the resources the education programme also includes a 'talks service'. Any school can ring and request a talk on a subject related to nuclear power given by a senior scientist. The talks usually last for about an hour and include some "hands on" experience for the students.

25. Educational Resources Catalogue

To enable schools to order any of the resources a full catalogue has been produced. Each entry has been thoroughly assessed as to it's curricular content and a summary on each item, for each curriculum, is included. The resources are held at a central distribution warehouse which enables them to be shipped out quickly and efficiently.

26. Advert - "Teach Your Class About Energy"

Advertising is done to publicise the programme nationally and raise public awareness that the nuclear industry takes education very seriously and supports the nation's teachers with useful materials.

27. Advert - "Their Energy Seems Limitless"

The publications are in the national press for general awareness and in trade publications to target teachers.

28. Nuclear Electric Competition leaflet

Other projects are undertaken to provide support to members of the

nuclear industry. At the moment the programme is managing a competition on behalf of the Nuclear Electric Company which is open to secondary students. There are two challenges, one to design part of a nuclear heritage and exhibition centre and another to design a new use for electricity in the 22nd century. This is a departure from the normal essay competitions and reflects the way technology and design is now taught in schools.