Written for P&S in January 1994

# MAJOR CONCERNS OVER THORP

There are three areas of concern being raised over the commissioning of the Thermal Oxide Reprocessing Plant (THORP). One relates to the costs involved. The second results from the increase in radiative discharge and other environmental problems which THORP will produce and the third results from the separation of plutonium, which THORP was designed to do.

## COSTS

Some press reports quote the cost of building THORP as £2.3 billion, others quote £2.8 billion.

It was originally decided to build THORP in 1977 when Britain, together with a number of other countries, were still developing fast breeder reactors, which would be able to use as fuel the uranium and plutonium THORP would separate from spent fuel from conventional reactors. At the time it was thought that THORP would make huge profits from reprocessing other countries waste. That now looks extremely doubtful. None of the fast breeders have worked successfully and the cost of refining uranium from ore is now much cheaper than in 1977. There is now a considerable glut of plutonium and uranium worldwide.

BNF have argued that the plant will make £500 million profit over a ten year period. However, very few people are prepared to believe BNF's figures which have consistently proven to be wildly optimistic in the past. The turn over which will produce this profit will be £10 billion, which means that the margin is tight, not to say tiny.

However, recently the government withdrew a commitment to underwrite any losses made by the customers. Scottish Nuclear then withdrew their contract and decided, instead, to 'dry store' their waste. Reprocessing "no longer appears to offer any immediate and significant advantage from a waste disposal point of view", they said. BNF have not revealed who their other customers will be or what quantities will be involved. It is difficult, therefore, for even the most starry eyed of its advocates to take these projected profits seriously.

One estimate of the cost of cleaning up the site once it has reached its safe working life at 40 billion. This remains speculative and it could prove an underestimation. For it to be less than that new technologies would have to have been developed and there is no sign of this happening. There is no theoretical possibility currently known to physics which would suggest such a technology could be forthcoming.

## ENVIRONMENTAL CONCERNS:-

At a meeting in June this year of the Paris Commission, the group of 13 nations who control pollution into the North Sea, a motion was agreed to calling for far tighter controls over discharges of nuclear material from THORP than Britian was proposing to opperate. They also called for more rigorous procedures in handling nuclear materials. Britain was the only government to vote against.

The THORP plant will discharge into both the sea and into the air. Sellafield village already has ten times the national average for childhood Leukaemia.

Some concerns are based on the fact that the process will produce sixteen times the quantity of nuclear waste than they receive as spent fuel for reprocessing. As yet no satisfactory method has been found for neutralising the radioactivity associated with this waste and so it will remain a problem for thousands of years to come.

The government's own advisory panel, the Committee on Medical Aspects of Radiation, has also voiced concerns in a recent report. They said that the rise in radioactive discharges resulting from THORP's activity "should be viewed with some concern" because it would inevitably involve a greater risk to the population."

The report also says that "No practice involving radiation should be adopted unless it produces benefit to the exposed individuals or to society to offset the radiation detriment it causes." The committee says that no estimate of the potential hazard has been made available and that no new process should be authorised without such information being taken into account.

Of the other governments who have voiced opposition to THORP on environmental grounds, Ireland, the United States and the Scandinavian countries have been the most outspoken.

## PROLIFERATION

It takes about 7kg of plutonium to make a nuclear bomb. THORP will be producing about 57 tons of it a year, much of it for export. There are two dangers in this. One is that the customers may sell material to a third party or that its security will be insufficient to prevent it from being stolen, either by terrorists or by governments who wish to make nuclear weapons. Bearing in mind that a hundred weight of the stuff would make up to 20 nuclear bombs it would not be too difficult to amass sufficient to produce an arsenal of weapons.

The second is that the customer countries themselves would use the plutonium to make nuclear weapons in the future. That possibility itself can be a destabilising element in international politics. The technological capability and the possession of a stockpile of plutonium taken together can be the basis for threatening other countries. The very existence of stockpiles of plutonium is itself a considerable incentive for governments to develop nuclear bombs.

It would take Japan, for instance, a matter of months to manufacture weapons once it has built a stock. This is one of the reasons North Korea is using as a justification for continuing its own nuclear weapons programme.

This is why considerable opposition to THORP is building within the United States government. Clinton has made statements that he is worried about what THORP will do. The Pentagons own Non-Proliferation office have been lobbying hard to have it stopped. 25 Congressmen and Congresswomen, including Joe Kennedy of Massechusetts; are promoting legislation in congress condemning THORP and calling on Clinton to initiate "High-level bilateral discussions" with the British Government with a view to halting the project.

# NUCLEAR POWER ????

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# NUCLEAR POWER ????

## ENERGY IN BRITAIN

Britain currently needs 50,000 megawatts of power. Nuclear power contributes 20% of this. The rest is produced by burning coal, gas and oil.

For many, the nuclear power industry is seen as being inherently evil. This is nonsense - it is a physical process with technical and engineering problems associated with it and should be treated as such. Cherishing the idea that it is evil discourages a full examination and understanding of its advantages and disadvantages. It discourages a balanced view of what we are dealing with. All the evidence indicates that the balance lies very heavily against the Nuclear industry. What follows is an attempt to assess the industry in the context of the economic and environmental advantages and dangers inherent in power generation.

## NUCLEAR GENERATORS AND THE NUCLEAR LEVY

There are 7 aging Magnox reactors and a further 12 modern reactors. The Magnox reactors are at the end of their safe/useful lifespan and the massive problems associated with decommissioning them will have soon to be addressed. The government haven't, therefore, been able to find a way of presenting this in a way the stock market find attractive and so are proposing to retain the Magnox reactors in public ownership, while privatising the rest.

Preparatory to privatisation the nuclear industry was divided into Nuclear Electric, Scottish Nuclear, British Nuclear Fuels and Nirex. Because producing electricity in Britain's nuclear power stations costs far more than electricity produced by coal or gas, the government have put a levy on all electricity prices in order to subsidize the nuclear part of the industry.

Between 1990 and 1998 the levy for the English and Welsh electricity supply will amount to roughly £9.1 billion. £2.5 billion of this is for the management of nuclear waste.

Scottish Nuclear have a guaranteed sale to electricity supply utilities in Scotland until the year 2005 at 3.6p/kWh, roughly 50% higher than that charged by the other suppliers in Scotland.

Scottish Nuclear also had £1.368 billion written off by the government.

There are also what amount to subsidies for a number of other aspects of the nuclear industry.

## THE PRICE OF ELECTRICITY

Nuclear power is expensive. As a fuel it out prices everything by about 50%. In other words it cost 50% more per unit of electricity than coal, about 30% more than by burning oil and about 70% more than burning gas.

The industry shrouds the de-commissioning costs in a relaxed blaze' mystery which makes believing them really very difficult.

The way that the de-commissioning costs have been calculated is that the redundant power stations will be partly dismantled and then left for 100 years or so, supposedly to allow the some aspects of the radioactivity to reduce to a manageable level. The final cost of de-commissioning has been estimated, a sum of money allocated and invested. This is on the assumption that in 100 years time the money will be worth considerably more - and it is this which will be used to cover the final costs. That initial sum is what has been added to the price of electricity.

The difficulty with this is that there can be no accurate estimate of the cost of final de-commissioning. Another is that there can be no guarantee that the value of that investment will continue to enhance itself. At the beginning of the 20th century the world was a dramatically different place, and this includes the distribution of wealth internationally. It is frankly incredible that any financial venture should be based on a set of estimates which depends on a view of what will happen in 100 years.

The consistent bending of the truth, if not downright dishonesty, by the people running the industry has to be a factor in judging the viability of the estimates of the costs. The proportion of the estimates of the finances of the nuclear industry put forward by its operators which have been accurate are small in proportion to the overall total.

At its inception, it was said that nuclear power would provide electricity so cheaply so cheaply that there would be no point in metering it. That it proved to be by far the most expensive of energy sources, is a testament to the accuracy of their estimating measures.

What is one of the most important factors here is that the levy is not just a pain in the wallet for the ordinary household consumer, it adds considerably to the cost of power to our manufacturing industry. It means that industrial competitiveness of our industry overall is reduced. If the government subsidises the industry it has to raise this money elsewhere, money which could be invested to enhance the competitiveness of industry in the international marketplace.

## POLLUTION AND ENERGY

Pollution is a very significant factor in energy production. In short, it is destroying us. Articles in the New-Scientist estimate that the effect of carbon dioxide emissions from burning fossil fuel will mean substantial famines in the central region of the planet every two years instead of every 20 years, as is currently the case. This, and other factors, mean that unless we change our practices the world will literally reach a point where it is no longer viable to exist upon in the way humanity currently does.

The Rio summit committed the major industrialised nations to reducing the level of carbon dioxide emitted from transport and power generation to the 1990 level and to reducing it further following this. The only two industrialised countries which are on target to achieve this are Britain and Russia. In the case of Russia it is because their economy has all but collapsed. In Britain's case it is because of a rapid move towards the use of gas and away from coal.

However, as our gas reserves diminish and the consumption of coal again increases, it is very probable that our pollution levels will rise again - as opposed to decrease in the way our government committed us to doing by signing the Rio treaty. Gas doesn't offer a long term solution to the need to reduce CO2 emissions.

Since Carbon Dioxide in the atmosphere takes about 100 to 150 years to diminish, it is clear solutions need to be found now, to avert a crisis ten years from now.

Energy is a key factor in the development of societies such as China and India who are rapidly industrialising. It is estimated that to maintain its current level of industrial expansion, China will require the opening of a major power station every two weeks. China's population currently produce a tiny amount of CO2 per head compared with Britain and the United States.

It is absolutely essential, therefore, that forms of energy production are developed which do not produce carbon dioxide - otherwise we could reach a point where human existence on this planet becomes non viable.

It is against this background that nuclear power is being promoted. The nuclear industry has taken what are very real problems and a very real threat to the world. The trouble is that, despite the assurances of the nuclear industries, nuclear power stations imply pollution too. One of the difficulties with this, however, is that the industry tends to disguise or suppress information about the scale of this pollution. The regular emissions which are a part of the general processes are monitored and are set by regulatory authorities. The other forms of emissions, leaks of radioactive material, are not monitored and, where possible, not admitted to by the industry. This type of thing happens on such a regular basis that it can only be regarded as inherent.

The pollution from the Nuclear industry is as pervasive and as destructive as carbon dioxide emissions from the burning of fossil fuels. It also, however, carries with dangers of catastrophe on a truly massive scale. It can not, therefore, be regarded as a viable alternative to the burning of fossil fuels.

## INFLEXIBILITY IN NUCLEAR POWER AND THE FRENCH SCAM

The power produced by nuclear reactors is inflexible (you can't increase their production or reduce it rapidly as is the case with other fuels) but the demand on the grid varies considerably, which means that other forms of power have to be used in conjunction with nuclear. Britain, for instance has a sharp peak at 6:00pm. If nuclear power were our primary source, as is the case in France, we would either have to waste a considerable amount of the power produced in the off-peak periods, or suffer shortages at peak periods.

Britain currently buys electricity from France which comes to us via a cable under the channel. Since France has a different time zone, their peak is an hour before Britain's. Thus by selling power to Britain, the waste in building up to the peak and reducing from it is spread over two peak demand periods (Britain's and France's) instead of the one, which is a considerable cost saving. In other words we should, in theory, be benefiting from low cost waste energy from French nuclear power stations. However, for some bizarre reasoning, Britain not only pays top whack prices for this electricity, we also pay the French stations the Nuclear Power subsidy.

## WASTE MANAGEMENT

This phrase has a reassuring ring to it - but forget it, there is no safe way of disposing of the vast amounts of radioactive material created by the industry. THORP was billed as a way of dealing with by "reprocessing" it but it produces more waste and increases the level of radioactivity. The only thing that can be done is the dry storage of the material for a very, very, very, long time. The claims made by the industry that they can do this without risk to the environment, or the public, are just plain dishonest.

## THE CATASTROPHIC COST OF FAILURE

Nuclear Power stations are unique amongst industries. No other industry carries with it the possibility of a catastrophe on such a scale. It is predictable, with certainty, that other incidents will occur involving nuclear power stations. If there is a statistical possibility that something will occur, then over a period of time, that possibility becomes a probability and eventually a certainty.

There have been a number of incidents which have demonstrated that this is a very real possibility. The two most significant other than are the Three Mile Island in the United States and the fire that occurred in the reactor in Winscale - now called Sellafield.

It is a very powerful argument indeed to say that the industry is not viable, because of the costs associated with failure.

In any industry there are costs associated with the safety of both employees and the general public. This is balanced against the profitability of the enterprise. If this occurs in the nuclear industry it automatically creates the possibility of failure, and therefore creates the probability of a catastrophe.

There could be no measure to the cost of the failure of the reactor in Chernobyl. A third of the children in Byelorussia have serious illnesses resulting from the Chernobyl pollution. The minister for health there estimates that the population as a whole in Byelorussia could be brought to extinction. The original estimates put the timescale for large scale serious health problems as a result, as being fifteen years, have been out by about ten years. In other words it took five years. This is what is being risked by developing nuclear power.

Below are two examples of the way in which cost cutting creates massive potential problems, taken from the October 14th issue of the New Scientist.

## i) Bulgaria

In February this year Bulgaria shut down its oldest reactor. There had been warnings about the state of some of the welds in fundamental parts of this reactor and a great deal of pressure had been applied by the European Union to have the welds tested. When welds are bombarded with neutrons over a period of time they become brittle and the greater the level of impurities in the weld, the more fragile it is likely to become. This reactor's design is regarded as being one of the most dangerous being operated in the world. The level of the catastrophe which could occur if the welds do fail, could be of the level of Chernobyl in terms of the radiation released, although, unlike Chernobyl, it would not involve an explosion and fire.

This reactor is one of four on the same sight and together they supply 40% of the country's electricity. Bulgaria's economy is in a state of virtual collapse and they have had difficulty paying for coal imports. In other words they are compromising safety because of the organisational and financial problems they face.

## ii) Britain, Japan, France and Germany

Britain proposes to fly 10 tonnes of Plutonium to Germany over the next ten years, in the form of Mixed Oxide fuel (MOX). The regulations being drawn up by the International Atomic Energy Agency (IAEA) specify three types of flask for carrying nuclear material. Plutonium has to be carried in flasks which can withstand high temperature and an impact of 324 Km/h.

In the last meeting of IAEA Britain, together with a number of other countries forced through the creation of a 'loophole' in the regulations to allow MOX to be flown in lower grade flasks which can only withstand an impact of 48 Km/h. There was opposition to this from the US government, the International Civil Aviation Organisation, International Federation of Airline Pilots' Associations and the International Air Transport Association, which represents 232 airlines. A spokesperson for the pilots' federation said they "were very concerned" at the decision to allow this.

Britain and Germany argued that MOX would not disperse if were in a crash in the way ordinary plutonium would, but a number of US experts have pointed out that there is no scientific evidence to support this. The minutes of the meeting where the decision was taken state "the difficulties of producing Type C packages and their high production costs were cited as supporting the need for the adoption of the very low dispersable material concept".

When asked by the New Scientist to comment the British transport department declined to do so. A senior German official told them "Our British colleagues told us they would like to keep a low profile on this."

In other words our government, relaxed and blaza' in its deceit, is prepared to have the law changed so that safety standards can be reduced, in order to save money - and "like to keep a low profile" while they do it.

# THE LINK WITH NUCLEAR WEAPONS

Sir Richard Marsh admitted that material had been passed from British civilian reactors to the Ministry of Defence for the production of weapons and also, to the United States for similar purposes. The US congress has released information showing that the US manufactured and exploded a nuclear bomb with material from British civilian nuclear reactors. There is a great deal of evidence to suggest that there is a close link between the development of nuclear power and the desire to acquire the technology and the material to produce nuclear weapons. South Africa, for instance, argued for years that their nuclear power plant was simply there to produce electricity yet, just prior to the fall of the whites only government, they admitted it was there to facilitate their nuclear weapons programme. Britain trained South African technicians, because they argued, the technicians were for a civilian electricity establishment - when it was as clear that the government was using the power programme as the base for its weapons programme.

(The bombs developed by South Africa were "Neutron" bombs designed to kill all living creatures and leave the buildings intact and the land not too polluted. It has been argued that the homelands policies of the Apartheid government was that it could destroy the political opposition by killing them all. They used what they claimed was a civilian nuclear power station to produce these weapons.)

Thus nuclear power stations are a necessary part of any programme for the development of a nuclear weapons industry, both in developing the skill base and in providing the handling facilities. It has two things going for it in this. One is that the country developing the nuclear weapons can pretend their power stations are civilian establishments. The other is that they can earn some income from the sale of electricity to offset the cost of providing their bomb making facilities.

British government policies have been to encourage this fiction, even to the point of helping vicious and repressive regimes develop nuclear weapons.

It is difficult to see that there any advantages to the generation of electricity by nuclear power over other forms of fuel that there has to be other reasons for the governments vociferous commitment to it. Since our government has sanctioned the use of some of the dirtiest forms of power generation, their claims that environmental concerns motivate them to use nuclear power are clearly disingenuous. The clear link with the development of nuclear weapons would appear to be one reason why the government feel so kindly towards it. Another is that nuclear power does not involve the NUM or the nasty beastly little working class people who are its members. Thatcher said as much on a couple of occasions.

Nuclear weapons have been made from nuclear power plant fuel. A Nuclear Power plant is necessary to effectively develop nuclear bombs. Nuclear power stations have no other advantages over conventional power stations.

# THE AGGRAVATED RISKS FROM PRIVATISATION OF THE INDUSTRY

The latest attempt to sell off the industry the Government have put a price tag of £2 billion pounds. The privatisation of the industry represents a significant threat to safety in the industry - according to at least one senior figure who was responsible for that safety. Richard Killick ceased to be Scottish Nuclear's director of safety and quality until the beginning of September 1995. He has said that he is concerned about the safety implications of the new management structure, its plans to introduce profit related remuneration and about low staff moral. The sell-off would "significantly reduce safety and in the longer term could have extremely severe implications." He went on to assert that he felt that "no one involved in safety, and that includes all the senior executives, should receive share options."

There is a balance between safety and profit. Cutting corners on safety can produce higher profits, especially in the short term. Linking the income of those with responsibility for safety means they will suffer financially if they are cautious and benefit if they take risks. This is inherent in the nuclear industry when it has to meet commercial criteria and it has to compete with other, much cheaper, forms of energy.

The possibility of mistakes being made and of equipment failures under these circumstances is significantly increased and in an industry where the cost of failure can be absolute, it is irresponsible to the point of treasonable to impose a management structure such as this upon it.

# PROFIT, COST AND THE EUROPEAN UNION

There is likely to be increasing pressure on the industry to "show a profit" in the not too distant future if the moves to "liberalise Europe's energy markets" are successful. The intention would be to allow electricity suppliers from throughout Europe to bid to supply anywhere in Europe. There was an attempt to set up this open market in 1989, which failed because of a reluctance by the French to allow competition against its publicly owned monopoly.

A deal is being negotiated between France and Germany to overcome some of the problems and a "breakthrough" is being predicted in the not too distant future. Because Britain has separated its nuclear industry from the rest of the power generation it means it will have to compete separately for generating orders. In real terms British nuclear power has no future in such a commercial environment. If it attempts to become commercially viable within such a savage environment by cutting its costs, safety will inevitably be compromised.

# LIES AND THE NUCLEAR INDUSTRY

When Wedgwood Benn was minister for energy he sacked Richard Marsh. Benn told him that he was part of the 'Nuclear Establishment'. Marsh said that no such thing existed and Benn replied to the effect that it did and Mr Marsh "shaved its face every morning". The massive investment and the massive technical problems associated with the nuclear industry have created an environment where the technical problems are talked down in order to justify the massive investment. That is the inherent danger with the 'nuclear establishment' and why it was wise of Benn to make sure it was kept firmly in check. This is why the nuclear industry has a long history of grossly overestimating the economic value of their projects and of grossly underestimating the costs.

When the fire occurred in the Winscale/Sellafield reactor a great deal of energy was put into public relations by the organisation running the reactor, to reassure the population. At the time Granada brought a cow from a farm next to Sellafield into the studio for the 6:00pm news, milked it in front of the camera and put a Geiger counter into the bucket of milk. The Geiger counter read dangerously high levels of radioactivity in the milk. The nuclear authorities tried very hard to have the producer, a man by the name of Kurt Lewenhack, sacked for doing this. The net effect was that the milk from the surrounding area had to be destroyed. The nuclear industry may have allowed the milk to carry on being distributed, as food produced in the areas polluted by Chernobyl is being distributed. Whether you believe the industry is capable of doing such a thing depends on what you think of those involved - they have been shown to be dishonest and untrustworthy elsewhere.

What this goes to show is that had that TV producer not gone to those lengths, it is possible that the public in this country would not have known the full extent of the disaster until people began showing signs of disease associated with that accident.

For a number of reasons inherent in the industry, the industry tells lies and has done systematically since its inception. There are reasons why it does this, largely to do with the cost involved and the need to maintain public confidence.

Another example of blatant dishonesty on the part of the nuclear industry is the affair of the staged train crash. The nuclear industry produced a video of a locomotive being driven into a flask of the type used to carry radioactive material by rail. The intention was to prove that the flasks wouldn't rupture, even were they hit by an oncoming train. The video was intended to be used to reassure the public that is was safe to transport radioactive material by rail through urban areas. However, engineers who closely examined the video believed it was clear that the locomotive had been tampered with. The bolts holding the engine in the locomotive had been loosened to cushion the blow when the locomotive hit the flask. The video was not circulated widely following this revelation.

So the industry lies about its costs, about the safety of its own practices and about the implications of accidents and emissions. Even without the pressure for privatisation there exists within the industry an inherent pressure to systematically distort the truth. Its not just the odd individual, its the nuclear industry as a whole and the political pressures it is under that create the dynamic to systematically lie to the public.

The current government are claiming that the decrease in $CO_2$ emissions we have achieved over the past couple of years will continue - but there is no real scope for it to do so. In fact their encouragement of traffic towards roads means the emissions will almost certainly begin to rise again, probably sharply, by the turn of the century. It isn't only nuclear power that our government consistently tell lies about, therefore, it is energy policy as a whole.

# GAS FIRED POWER STATIONS

Gas can be burned very efficiently. Modern stations burn the gas in a gas turbine and then use the exhaust to fire a boiler, the steam from which is put through another turbine. The result is that it is not only far cheaper than coal, it is also far cleaner. Gas emits about 50% of the amount of carbon dioxide per unit of electricity produced when compared with coal.

There is a limited supply of gas in the North Sea. The current scale of the enterprise has about 500 people working in the industry as a whole - that is disregarding the drilling operations it takes about 500 people to run the current level of gas extraction and the power stations burning gas. That is a tiny number compared to either coal or nuclear powered stations.

So its much cleaner and much cheaper but it isn't going to last. Current stocks will last about 10 years and it is likely that others will be found and that better extraction methods will allow more of the gas in existing reserves to be exploited, which gives it about 15 years. After that we may be able to have access to the large gas fields in Russia. But Russia is unstable and becoming more so. It is certain that the nature of the Russian government will have changed in 15 years time. That may mean we do not have access to the gas, that our government doesn't want to have commercial links with the new regime or that the gas isn't as cheap as we would have hoped.

# TRANSPORT AND ELECTRICITY

Transport accounts for a substantial proportion of the pollution generated by developed countries. To put it another way cars account for 50% of the CO2 emissions in countries such ours. There is a link, however, with the electricity generating industry in so far that a great deal traffic currently passing through our road system could very easily be passed on to rail, bus, tram or trolley bus.

There are three ways in which public, as opposed to private, transport has advantages in terms of energy consumption and pollution. One is that the fuel and primary power plant are not carried with the vehicle, and so energy is not consumed luging it about. The second is that the energy is generated in very large plants which can be made to work very much more efficiently. The third is that because public transport vehicles transport vast numbers of people the energy they use is shared by lots of people. The net result is that a train, for instance, uses about a fiftieth of the energy per passenger mile that a car.

# 'ALTERNATIVE' AND 'RENEWABLE' SOURCES OF ENERGY

An enormous amount of rubbish is talked about the possibility of 'Renewable' or 'Alternative' forms of energy. One - seaborne wind power - sticks out as being viable and the fact that little time or resources have been put into developing it is really quite startling. I shall briefly deal with it and a number of the others. Before doing so, it is worth noting that a programme to educate domestic consumers on ways of conserving energy could reduce the demand, and the pollution associated with it, considerably. Since it is now in the commercial interest for the companies not to discourage demand, this will have to be something the government takes responsibility for.

## Renewable

Some countries use other forms of renewable fossil fuel, principally wood. The largest scheme of this form is a power station in Ireland where they crop 'coppiced' woodland to fire the boilers. This is relatively small scale compared to the demand for electricity in a country such as our own. It also has the disadvantage, in common with other combustion fuels, it produces Carbon Dioxide.

## Hydro

There are a limited number of places where this is a possibility and there are some places where the project can result in considerable damage to the environment. They also have a tendency to silt up - the Aswan Dam, for instance works at 50% of its design capacity because of the problems created by silt.

A number of countries with massive environmental problems facing them would be able to build hydro electric schemes. Nepal, for instance, desperately needs to find an alternative fuel to wood and was planning a large hydro electricity scheme, but couldn't get the money from the World Bank to build it.

Britain has some hydro electricity in Scotland, but there is not much room for expanding this significantly.

## Solar

This has great advantages for inaccessible places. However, the devises for turning the suns rays into electricity are expensive and take considerable resources to be able to make. They don't work at night and they reduce in efficiency on dull days. They could not provide more than a marginal quantity of power, when compared to the overall needs of our country.

## Ducks

These were a particular form of wave power machines which hinged in the middle and would be tethered quite far out to sea. Although the green movement were much moved by them there are so many problems associated with them they would in practice not be viable.

They gained fame because the feasibility study commissioned by the electricity board was, for some mysterious reason, carried out by the Atomic Energy Research Establishment at Harwell. The Harwell scientists published information saying the Ducks were not financially viable but later revealed that they had made a mistake, putting the decimal point in the wrong place.

## Other forms of wave power

These fall into two categories, ones fixed to the bottom and those floating on the waves.

The latest design for a floating wave power projects come from Japan and are known as 'Wales' is the size of a small ship.

The other is fixed rigidly to the bottom of the sea. Waves are trapped in a compartment where air is forced up and down, passing through a turbine, as the wave rises and falls. An example of this is undergoing tests on the coast by Dounray nuclear power station and appears to be moderately successful.

A major advantage with wage power is that, because waves are a product of wind at sea, it is possible, by monitoring wind levels at sea, to predict when you will have a lot of wave activity. Energy planners would therefore, have a fair amount of forewarning about the power available from these units.

The difficulty with these is that there is a limited number of sites where they would be usable - too limited to make a serious impact on our energy needs.

## Wind energy on land

Wind power on land is unsightly, noisy and is not capable of producing enough to make a serious impact on Britain's energy needs.

Were all of the alternative' sources of energy outlined above developed to their recognised potential they could not produce more that 10% of Britain's energy needs, and there would be environmental and cost problems associated with them. The method outlined below, however, is a real runner.

## Wind energy at sea

A fair amount of design time has gone into developing wind generators and they have now reached a point where there is unlikely to be much in the way of improvement. Large ones, producing about a megawatt, are readily available. Britain currently uses about 50,000 megawatt of electricity. It would be possible to site commercially produced readily available generators on floating pillars anchored to the bottom of the sea.

Situating these in blocks roughly three miles deep and 30 miles apart at an eighth of a mile apart there would be roughly 5,500 in each block. The generators would be anchored to the sea bottom which, because of the relatively shallow nature of the north sea, would be possible.

In the very early 1980's the CEGB did some work on a feasibility study for such a project. Their conclusions were that in the area of the North Sea they were looking at there had been 5 days in the previous 20 years when there had not been enough wind to provide all of the electricity needs of this country.

There are very real possibilities to this one which should be pursued.

# BUILDING NEW REACTORS

The engineering industry were very keen to have new reactors ordered in Britain so that the design teams could be kept together and their experience in what they perceive to be a lucrative industry, maintained. It is immensely lucrative for reactor builders - these things cost billions. The cancellation of the two new stations at Hinkley point and Sizewell B in practice puts Britain out of the international reactor building game. In a lot of senses the debate is over and the nuclear industry has lost - for a tenth of the cost of a new nuclear station a gas powered station has twice the capacity and has non of the environmental problems associated with a nuclear station.

# CONCLUSIONS

Nuclear power has far too many dangers associated with it and the moves to make fit into a free market commercial environment are creating terrible risks. Closing them all down tomorrow is not a serious option, because of the shortfall in power generation capacity. It makes sense, therefore, to phase them out and plan the replacement of generating capacity, so that there is not the pressure to keep clapped out reactors on stream.

## The main issues are now:-

i) To make sure the nonsensical attempts to justify a resurrection of the industry are given short shrift.

ii) To make sure that the risks involved in de-commissioning are reduced to an absolute minimum and that sufficient resources are allocated to allow this - which means resisting the ideologically motivated attempts by the government to pretend the costs are less than they need to be.

iii) To make sure the nuclear industry does not have structures and management practices which could lead to risk taking or reductions in safety - such as having the income of those responsible for safety in the industry linked to the profit of the plant or the company they work for.

iv) That new generating capacity is created which does not involve pollution or the degradation of the environment. If this is developed, the export potential for this equipment would be immense.