nuclear issues

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Left on the Sidelines

In what can be seen as a farsighted international initiative and also as a determined effort to regain American leadership in the field of atomic energy development the US, on the initiative of President Bush, has brought together the leading nuclear nations in a Global Nuclear Energy Development Partnership (GNDP) for a coordinated effort to help meet the world's growing energy demand "in an environmentally sustainable manner". World energy demand is expected to more than double by 2050 while electricity demand could grow even more rapidly, by 75% over the next 20 years. To meet these demands nuclear energy is seen as the only proven technology that can provide abundant supplies of base-load electricity reliably, without air pollution or emissions of greenhouse gasses.

A first ministerial meeting was held on May 21st this year when China, France, Japan, Russia, and the US issued a joint statement in support of nuclear cooperation through the GNEP. The UK, no longer a leading nuclear nation and without any nuclear development activity to offer, was only present as an observer. (UK R & D for nuclear fission has been virtually nil since 1996. In comparison France spends about $500 million a year, while Japan has increased its expenditure to over $2000 million/year)

GNEP is both a research and technology development initiative and a major international policy partnership. Foremost amongst its aims is the need to avoid the profligate depletion of uranium resources in the present measures to deal with spent fuel, now classified as nuclear waste, by burying it in underground repositories (spent fuel typically contains about 96% of recoverable uranium and about 1% of transuranic elements, mostly plutonium). The aim is to develop new of methods of reprocessing which can recover uranium and other fissile elements while reducing the weapon proliferation risk by avoiding the separation of plutonium. Such proliferation-resistant technologies would recover more energy and reduce the quantity of waste, and amount to a large potential source of nuclear fuel. By 2010, the US expects to have accumulated more than 63 000 MT of commercial spent fuel. Reprocessing this material would separate the short-lived fission products (mainly cesium and strontium) which could, after storage to allow their radioactivity to decay, be disposed of as low level waste. Only structural materials and a small quantity of long lived fission products would need to be sent for storage and eventual low for ultimate disposal in a geologic repository. This will reduce many of the public concerns (but what about the waste?) over geologic disposal of spent nuclear fuel in terms of waste volume, heat load, radiotoxicity, and the number of repositories needed.

The recycled fuel can be used in any type of reactor, but the number of times the fuel can be recycled in current commercial LWRs is limited compared with fast reactors in which a larger portion of the transuranic elements are destroyed than created during each recycle. This, theoretically, enables an unlimited number of recycles until the transuranics are fully fissioned and destroyed. To reap the benefits of continuous recycling the GNEP technical programme is to concentrate on the development of fast reactor technologies, recognizing that fast reactor operating experience is much more limited than thermal reactor operating experience, and that fast burner reactor fuels, or transmutation fuels, are not fully developed.

It is at this point that the US recognizes the need for international collaboration, seeking to bring in the experience of France, Japan and Russia where the development of fast reactors has continued. (the UK abandoned its fast reactor development when funding for the Prototype Fast Reactor which ran from 1974 to1994 ended in 1994). As a consequence the initial focus seems to be focused on sodium cooled fast reactors. A first contract has already been negotiated with AREVA of France. A logical next step would be a collaboration with the other international groupings already working on advanced fuel cycles and reactors such as the Generation IV International Forum (GIF), formed in 2001 and which has grown to include 12 countries. GIF is also considering gas-cooled and lead-cooled fast reactor designs. There is also the International Project on Innovative Nuclear reactors and Fuel cycles in which 28 countries now take part (but not the UK which without any nuclear research or development has nothing to offer). INPRO was initiated at the IAEA conference in 2000 and launched in 2001. The two groupings have a number of members in common and also with the GNEP.

Assured fuel supply

GNEP goes further than the other two organizations, GIF and INPRO, in considering how the, now seemingly unstoppable, world-wide growth of nuclear generation can best be managed. It foresees a consortium of nations with advanced nuclear technologies which would provide fuel and reactors appropriately sized to meet the needs of other countries. “By participating in GNEP, growing economies can enjoy the benefits of clean, safe nuclear power while minimizing proliferation concerns and eliminating the need to invest in the complete fuel cycle (e.g., reprocessing and enrichment). In cooperation with the International Atomic Energy Agency, participating nations would develop international agreements to ensure reliable access to nuclear fuel.” States that refrain from enrichment and reprocessing would have reliable access at reasonable cost to fuel for civil nuclear power reactors.

Small reactors

GNEP then plans to develop reactors that are suitable for developing countries to meet their rising power demands associated with economic growth and urbanization, thus avoiding the use of fossil fuels that would otherwise be burned in power plants. Electricity demand in the developing countries has been forecast to grow by 150% by 2030. The standard commercial units of about 1 000 megawatts are not suitable for these countries which have much smaller electricity grids and less well-developed technical infrastructures. For this market GNEP proposes smaller reactors in standardized modular designs in the 50 to 350 megawatt range which will be safe, simple to operate, more proliferation-resistant and highly secure, with fuel designs that offer very long-life fuel loads (possibly lasting the entire life of the reactor, so that refueling is not needed). As well as generating electricity such reactors would have a potential use for district heating schemes, and water desalination. (In Sweden, another country which like the UK has withdrawn from nuclear power development, ASEA-Atom had in the mid-1980’s put forward their inherently safe “Secure” small reactors of up to 400 MW th which could be used for district or industrial heating systems.)

Atoms for Peace

In its wider aims the GNEP might be seen as a revival of the international vision of President Eisenhower’s Atoms for Peace declaration of 1953. As more countries consider nuclear power, it is important that they develop the required infrastructure capabilities, if necessary with the assistance of GNP partners, working with the IAEA, who are ready to share knowledge and experience to enable developing countries to make informed policy decisions on whether, when, and how to pursue nuclear power. The GNEP is intended to provide answers to growing and sustainable energy needs, concerns about climate change, management of nuclear waste, and proliferation challenges. It blends international cooperation in policy, technical support, and framework and infrastructure development.

In addition to the five original members, 11 further countries (Australia, Bulgaria, Ghana, Hungary, Jordan, Kazakhstan, Lithuania, Poland, Romania, Slovenia, and Ukraine) have now, at the second ministerial meeting held on September 16th, agreed to join the GNEP and sign the “Statement of Principles” which addresses the prospects of expanding the peaceful uses of nuclear energy, including enhanced safeguards, international fuel service frameworks, and advanced technologies..

The American revival

In addition to its far-sighted international aim a principal American interest in the GNEP is in reviving the country’s own nuclear technology. The GNEP can then be seen as a major component of the Nuclear Power 2010 programme launched by the US Department of Energy in 2002 with the aim to improve air quality and reduce the pressure on natural gas supply. This is a joint government/industry cost-shared effort to identify sites for new nuclear power plants; to develop and bring to market advanced nuclear plant technologies; to evaluate the business case for building new nuclear power plants; and to demonstrate untested regulatory processes. This will pave the way for an industry decision to build new advanced light water reactor nuclear plants early in the next decade.

At present over 50 percent of US electricity is generated from coal while most of the new power capacity is gas-fired. The climate of public opinion in the US which has been hostile to the development of nuclear power where it was once the world leader – no new nuclear stations have been ordered in the US for nearly 20 years – is now changing with, amongst other factors, the concern over the dependence of the US on imported oil and gas which as world oil production eventually declines will become evermore costly and uncertain. A large increase in electricity demand is also expected which will require the addition of 345 GWe of new capacity by 2030. Even to maintain the 20 percent of generation now met from the existing nuclear stations would require 3-4 new plants per year starting in 2015.

To meet this expected growth in nuclear capacity the DoE has now under the NP 2010 programme granted Early Site Permits (ESP) for three sites for new stations as a preliminary to the next step to issuing Construction and Operating Licences (COL) for Westinghouse’s AP-1000 and General Electric’s ESBWR advanced nuclear reactor designs. From the industry side NuStart Energy Development, LLC, is a limited liability company formed in 2004. The member companies are Constellation Energy Group, Duke Energy, EDF International North America, Entergy Nuclear, Exelon Corporation, Florida Power and Light, Progress Energy, SCANA Corporation, Southern Company and the Tenessee Valley Authority (TVA) along with the two reactor vendors of General Electric and Westinghouse Electric Company. (The US Government must now regret the sale of Westinghouse to BNFL as much as the UK Government ought to regret the later sale by BNFL of Westinghouse, to which they had added the Swedish Asea-Atom company, to the Japanese.)

In addition under the GNEP a number of initial contracts have already been placed in the US with industry and research organizations. Eleven sites are now being examined for the first of the new Consolidated Fuel Treatment Centres and conceptual design study contracts have been placed for advanced recycling reactors. A detailed costed programme for the GNEP has been drawn up and the progress of the work and level of expenditure will be periodically reviewed by Congress. This is a serious and determined effort for the US to regain the leadership it once had with the first development of the PWR and BWR

Good on you Gordon

Speaking for the first time as Prime Minister at the Labour Party Annual Conference, Gordon Brown called for the UK to be a leader on energy and the environment "from nuclear to renewables." This reinforces his positive position on nuclear energy. Of course the obligatory renewables are still there as a political imperative but sooner or later he must come to terms with the pathetically small contribution that they are likely to make.

The public also seem to be leaning towards the nuclear option with a public opinion poll conducted by Populus showing 63% who believe that nuclear energy may have a role to play in the UK's future overall energy mix. The poll indicated only 20% were opposed to nuclear. This is encouraging in a country which for several years prior to the recent change has been exposed to a generally antinuclear attitude from government departments.

Another voice in support came recently from James Lovelock the environmentalist promoter of the Gaia theory. Speaking to the World Nuclear Association's 32nd Annual Symposium in London he said that nuclear energy would be vital in a future where the Earth's feedback mechanisms are having to deal with the results of climate change. He said that climate change is more serious than we can possibly imagine, but he said that neither the Earth nor the human race is yet doomed.

Meanwhile a coalition of environmental groups have pulled out of the UK Government's consultation on plans to allow new nuclear power plants to be built. They complain that it is a "stich-up". Perhaps they should rather adopt the argument that we have that there is nothing new to consult on.

British Gas says its best?

They are up to there tricks again with a television advertisement showing a benign little blue flame and claiming that gas is best for electricity. It is not.

To start with for electricity production it is not a little blue flame but a great blast of flame feeding into a gas turbine. Burning natural gas in the UK discharge directly into the environment tens of millions of tonnes of carbon every single year in the form of the greenhouse gas, CO_2. This is now the largest source of greenhouse gas produced in the UK surpassing the amount emitted by transport – cars, buses, lorries and aeroplanes.

By contrast producing electricity by nuclear power emits no greenhouse gas and has produced a small fraction of the 10's of millions of tonnes over sixty years of civil and military production. This waste is safely isolated from the environment and after 300 years will have decayed to a smaller radiological burden than the uranium dug out of the ground in the first place.

Even if you ignore nuclear's near 20% of electricity – which we certainly don't – there is still about 5% produced in the UK from hydro power and about 2% produced by wind. Those are cleaner than gas.

Burning coal as we do at present produces about twice as much greenhouse gas for every unit of electricity generated. But we have long had the technology for converting it into mainly hydrogen which is much cleaner than the methane of natural gas and can be fed into a combined cycle gas turbine in exactly the same way as natural gas.

We complained about British Gas's previous advertisement to the Advertising Standards Bureau but they failed even to acknowledge receipt of our letter and have clearly done nothing about the completely false claim in the advertisement.

And where is it coming from? We will shortly be importing gas at the end of a long, long pipeline from Russia. Why aren't they using it themselves? Because they can get cleaner, safer and cheaper electricity by building more nuclear power plants. Their latest reactors are third generation designs which apart from extra safety offer to produce less than one tenth of the waste of our old first generation Magnox and Advanced Gas-cooled Reactors.

Good old Magnox

People are complaining about the cost of decommissioning nuclear plant as if the current costs would apply to a new third generation plant which is being proposed. Do they really think we would suggest building a 40 year old design today. Even a second generation design such as Sizewel B will only cost one tenth as much to decommission as the old Magnox plants according to a recent report from the International Atomic Energy Authority.

Why should there be such a large difference? To start with it is the large physical size of the plant relative to the power production. For example the Sizewel A station, which has just been retired, takes a building at least as large as Sizewel B to house two 325 MWe reactors compared with the one 1200 MWe plant at the B station. A 1600 MWe third generation reactor as is being proposed would occupy a smaller building than Sizewell B.

But there are other features of the 40 year old gas cooled plant which make it more expensive to pull apart. The thousands of fuel elements in the two reactor cores have to be downloaded – a one to two year job – and shipped off for reprocessing while the hundreds of fuel elements in a water cooled reactor can be down loaded into the fuel storage pond in about one week.

Each fuel assembly in the water cooled reactor will have been in the reactor core for two or three years – probably more in the third generation plant – and will have produced much more power than the fuel of the gas cooled reactor.

The third generation plants have also taken the requirements of eventual decommissioning into account. All the plant is fairly easy to remove – even the reactor pressure vessel. And a small charge for decommissioning and waste management is added into the normal operating costs.

All this is not to say the early Magnox reactors were not very successful, as is implied by the opponents banding around silly figures of billions of pounds. They were built for very little real money at a time when we were facing problems with oil after the Suez crisis. Up to 1966 the UK was producing more units of electricity from nuclear power than the rest of the world put together. The plants were competing with middle east oil which had to be shipped around the Cape of Good Hope and coal which on average at that time was killing one miner a week in accidents. The reactors became known as the work horses of the nationalised utility industry. They were producing large profits which went into the Treasury for spending on all of us.

At the time we had little choice but to build the large natural uranium fuelled gas cooled reactors. We had not yet developed the enrichment processes which would be needed for water cooled reactors. The designers of the plants were still using slide rules and log tables for calculations and only a few clever physicists had hand cranked calculating machines or could use precious hours of computing time on a machine which filled a large air conditioned room. That they produced plants, some of which are still performing safely 40 years on, is a remarkable achievement.

Yemen

There are reports that Yemen has signed a deal with a US-based energy company, Powered Corporation, to build five nuclear power plants generating 5000 MWe over the next 10 years. Yemen's Energy and Electricity Minister, Mustafa Bahran, said that Powered Corporation will oversee the financing of the project, and that the first reactor should be ready to produce 1,000 megawatts of electricity by the end of 2012. He also said that he had discussed the country's nuclear programme with Mohamed ElBaradei, director general of the International Atomic Energy Agency (IAEA), during IAEA's general conference of member states last week in Vienna. The overall costs for the project are expected to hit $15 billion, with construction of the first reactor expected to get under way in early 2009.

Yemen – which faces daily power shutdowns – wants to generate electricity and desalinate sea water to meet the needs of its urban population and boost the country's industrial development..

Power Corporation(sic), if that is the organisation concerned, is not a reactor vendor but a holding company formed in 1925 to manage the substantial investments in public utility companies involved in the electrical power industry in Canada. But even if this announcement is premature or even wishful thinking it may trigger other countries in the Middle East to turn to nuclear power as their oil production shows signs of falling while internal demands for electricity are growing. With the need to develop appropriate electricity grids it would seem that for some of these countries the smaller secure reactors being developed under the GNEP programme would be more suitable. The participation of Jordan in the GNEP may be a pointer.

A backward step

It is now becoming more widely accepted that the disposal of spent nuclear fuel, containing about 95% of uranium as well as plutonium and other fissionable actinides, by burying it in underground repositories is a needless waste of valuable energy resources. A principal aim of the Global Nuclear Energy Partnership (GNEP) is the recovery and re-use of these materials. But here again as in all previous nuclear decisions (the forced sale by British Energy of Bruce Power in Canada; BNFL's sale of its Westinghouse fuel and reactor division to Japan; and the emphasis now on nuclear decommissioning with the setting up of the NDA to take over what was left of BNFL rather than nuclear expansion) Government policy goes against the trend of the now unstoppable growth of nuclear power generation world-wide as more countries see this as a solution to the intertwined problems of carbon emissions and oil depletion.

Instead of actively seeking to contribute to the expansion of reprocessing spent fuel and develop improved technology to separate the small amount of highly active strontium and cesium which after temporary storage could be treated as low level waste the NDA seems more concerned with the date by which all current reprocessing contracts for THORP are expected to be completed so that they can fulfill the aim of decommissioning the plant rather than seek new business. The expected date of about 2010, has been delayed by the closure of THORP since April 2005 Decommissioning of the older Magnox reprocessing plant is still expected to begin in around 2016

As British Energy after its 'reconstruction' is now to an extent under Government control it is not surprising that in its response to the present nuclear Consultation it agrees with the Government view that the fuel from any new plants built in the UK will not be reprocessed nor fuelled by MOX fuel, although cautiously adding that the case for reprocessing may merit re-examination in future and the option of using mixed oxide fuels should not be ruled out entirely.

BE's view might also be influenced by the fact that under the imposed "nuclear sweep" it pays a substantial part of its earnings to fund the NDA to whom it can now hand over the spent fuel. Why complicate this with reprocessing?