RESPONSES FROM BNFL TO SPECIFIC QUESTIONS AND PROPOSITIONS IN PIU NUCLEAR SCOPING NOTE

These responses are intended to be read in conjunction with BNFL's submission to the UK Energy Policy Review, conducted by the Government's Performance and Innovation Unit (PIU). In some cases the responses make reference to, and assume some knowledge of, the BNFL submission.

QUESTIONS

Question 1

Is there a real possibility of any Magnox stations being life extended significantly beyond 2010?

No. BNFL announced its closure programme for the Magnox reactors in May 2000, following a thorough review of the issues around Magnox station lifetimes. At that time, we undertook to continue with studies into potential extension of the lifetimes of the Oldbury and Wylfa stations (including consideration of the use of a new fuel type - Magrox fuel). Our detailed studies indicated that:

- Significant investment would be required at the stations in order to sustain the necessary safety and environmental operating regimes;
- There were major issues associated with the Magnox fuel cycle, and the age and status of existing facilities at Sellafield;
- There were significant commercial risks associated with keeping the reactors going, as unforeseen operational issues could potentially lead to further shutdowns (as evidenced by the recent shutdown at Wylfa).

Following detailed consideration of these factors alongside the potential benefits, we concluded that it was not commercially sustainable to extend the reactor lifetimes, and we announced that Oldbury and Wylfa would therefore both close before 2010. This was confirmed in our Annual Report published in August 2001. We do not therefore believe that extending the lifetimes of any of the Magnox stations makes sound commercial sense.

Question 2

If so, at what cost?

See above. Our extensive studies indicate that there is no commercial reason to pursue life extension of any of the Magnox stations.

Question 3

What are the main factors inhibiting Magnox life extension?

As summarised in our response to Question 1, there are a number of factors which, taken together, place major constraints on the potential to extend the lives of the Magnox stations:

Investment – In order to extend current safety cases beyond the scheduled closure dates, significant effort would be required. The cost of this work – and associated plant refurbishment – could easily exceed several tens of millions of pounds for a single station.

Technical – Acceptable plant safety margins are gradually eroded by ageing effects in the materials within the reactor. This is particularly true in the case of the Magnox units with steel pressure vessels. As the reactor ages, the situation can be dealt with by modifying the operating parameters to compensate. However there comes a point when this balance can no longer be met economically. The stations at Trawsfynydd and Hinkley Point A were closed when this position was reached. BNFL's detailed analysis indicates that this position will be reached for the remaining steel pressure vessel stations shortly beyond their current planned lifetimes. For the concrete pressure vessel stations (Oldbury and Wylfa), the situation is less clear-cut, but investment of many tens of millions of pounds could still be required in order to continue operation.

Regulatory – BNFL has made a commitment to cease reprocessing through the Sellafield Magnox reprocessing plant by about 2012 in order to meet national OSPAR commitments. The operation of Magnox reactors is inextricably linked to the associated fuel cycle, and thus lifetime extension would make it necessary to secure an alternative route for disposal of irradiated Magnox fuel. There is currently no identified alternative which has sufficient clarity in terms of costs and licensability to make its implementation worthwhile.

Question 4

What are the risks of all the Magnox stations closing well before 2010?

There are technical, operational and commercial risks attached to operation of the Magnox reactors, but we are planning to operate all stations in accordance with our declared lifetime plans. The single most significant item is the dependency of the Magnox stations on the performance of the Magnox reprocessing facilities and other downstream plants at Sellafield beyond what they have achieved in recent years. In the event of a serious shortfall in performance of these plants, there would be no alternative but to review the closure programme, and this would mean the early closure of some stations.

All stations are subject to a continuing economic viability review to ensure there is an expected positive return from continued operation, evaluated on a Net Present Value basis. This takes account of likely generation output and forward electricity prices balanced against the avoidable costs (operating, new investment and decommissioning related) over the planned operating period. Such reviews, which are undertaken at least annually, take cognisance of performance to date and continuing validity of assumptions.

In recent years, monitoring programmes have occasionally given unexpected results requiring substantial reactor outages and capital expenditure to correct. Any further findings would be examined and the benefits of undertaking remedial work against the alternative of early closure judged on a case by case basis.

Question 5

Is there a real possibility of AGR stations being life extended to 40 years or more?

This is a matter for British Energy.

Question 6

If so, at what cost?

This is a matter for British Energy.

Question 7

What are the main factors inhibiting AGR life extension?

This is a matter for British Energy.

Question 8

What are the risks of all the AGR stations closing by around 2010?

This is a matter for British Energy.

Question 9

Is it worth taking steps to ensure existing stations do not close early?

The necessary steps are being taken. As indicated above in our response to Question 2, we do not expect any station to close in advance of its declared planned lifetime though we continually review expected incomes as well as

operating, defuelling and investment needs to ensure this plan maximises value from the Magnox cycle.

If an issue arose which indicated that there was a risk of one or more stations closing in advance of their scheduled dates, then BNFL would consider risk mitigation options in conjunction with anticipated costs, benefits and uncertainties. However, we recognise that these are ageing assets, and so the amount of investment available to maintain their commercial viability is limited. If economic and safe operating regimes cannot be maintained, they will close early.

Question 10

How could this best be done, bearing in mind (a) that the Magnox stations remain in public ownership and (b) that any measures would need to be consistent with UK competition policy and EU State Aids policy?

The announced closure programme for the Magnox stations represents BNFL's best efforts to ensure that the stations do not close early. If alternative steps become apparent which make commercial sense, then we will take these.

The European Court recently ruled that a decision to supply renewable energy at above economic prices and to distribute the extra costs to suppliers and their customers was not State Aid. This is clearly relevant to support for other parts of the electricity supply industry, for example nuclear generation. The decision should allow Member States to introduce policies to support any form of electricity generation to meet national objectives

Question 11

To what level could nuclear generation costs fall for plant designs likely to be available over the next 10 years?

We have indicated in our submission that we believe overall generating costs from the AP1000 reactor if built in series in the UK could be in the range 2.2p to 3.0p per kW-hour. Delivery of this performance depends on the steps we are advocating in our submission. The exact figure depends on a number of factors, some of which are related to energy policy. Capital cost, without financing charges, is a well developed element of the overall cost for the AP series, however other elements of the overall cost - such as licensing and financing costs - are less certain, are highly dependent on policy decisions, and significantly affect the overall economics and hence investor confidence.

Question 12

What level of confidence can be placed on such cost estimates?

Overall nuclear generating costs are made up of a number of components. Costs associated with fuel fabrication, operations, maintenance, spent fuel management, waste management and decommissioning are all well established for modern LWR units and have high degrees of confidence associated with them. The accuracy of the estimated capital cost of a new plant depends on the extent of completion of the design - the AP600, having achieved Design Certification in the US, is well advanced, and this fact gives confidence in the overall capital cost. In addition, for the AP series of reactors, the capital cost of the plant has been validated by quotations from suppliers for major components.

However, there are two aspects of cost which are harder to specify exactly. Firstly, the costs for the planning and regulatory processes (particularly for the first of a kind unit in the UK), which is dependent on the extent of the planning approval processes, on the amount of work and modification required by the UK regulator to be satisfied with the design, and on the extent to which the regulator takes into account Design Certification in the US when assessing suitability for the UK. Secondly, the costs of financing, which depend to a large extent on the associated discount factor(s) assumed for the capital investment and, to a lesser extent, the time interval between the completion of major construction and plant work and the start of revenue income.

Both of these aspects are outside the scope of influence of the reactor vendor and operator. Both will be heavily impacted by the planning and regulatory approvals regime in force. This is why the BNFL submission stresses the importance of improvements in these processes in order to provide significant improvements in the economic attractiveness of new and replacement nuclear plant to investors.

To make the economic case for investment in new and replacement nuclear build, there has to be an acceptable level of risk in relation to timescales and returns, together with confidence in the regulatory regime over long time periods.

Question 13

Does past experience enable new stations to be built more cheaply?

Yes. Major suppliers of reactor technology worldwide have consolidated substantially over the last decade: there are now only three major vendor groups. The remaining vendors have a track record for delivery of projects worldwide; early experience of cost overruns in the UK is no longer relevant in today's nuclear industry.

In addition, the reactor vendors in developing their designs put emphasis on the cost saving measures, eg shorter construction times, modular designs, fewer components. BNFL's AP series is a very good example of such a design (see BNFL's submission).

Certainly, there are significant time and cost penalties associated with the construction, licensing, approval and commissioning of a "first of a kind" reactor of any type, as discussed in our submission and elsewhere in these responses (see for instance Question 12). Much of the reason for this is associated with final design and engineering work, which would only take place once a reactor were to be ordered. Also – as we have discussed – much relates to the planning and regulatory approvals processes for a first UK deployment of a specific design. For these reasons, previous experience with the same reactor system would be a major benefit when second or subsequent units were to be built. Such series build is vital to enable the economies of scale to be achieved, for instance in the supply chain for major components and in the transfer of experience.

It is over a decade since Sizewell 'B' was built, and already the skills and capabilities needed to see a new UK reactor build through to commissioning and operations have declined, including the regulatory skills to license a new design. Without urgent action to maintain and grow this skill base, the UK industry will be re-starting from scratch.

Question 14

Are the above estimates of lead times for nuclear realistic?

Yes. Firstly, it is important to be clear on the comparison quoted. The reference to a gas-fired station timescale of " as little as 3 years" is after seeking planning permission, where as the 15 years for Sizewell B covers everything from the Public Inquiry through to commissioning. BNFL estimates 36 months for an AP1000 from start of construction to hand-over to the operator. We would estimate that a further 12 months would then be needed for commissioning before reliable power generation to the grid is achieved. The key issue are those timescales related to "first of a kind" approval, which would not affect the delivery of a gas-fired station based on existing technology, but which would have a major bearing on the process for a new nuclear unit. As stated elsewhere, there are currently considerable uncertainties over the timescales for planning and regulatory approvals.

In addition, if current draft regulatory guidelines which give primacy to the progressive reduction of radioactive discharges are pursued, this would make any proposal for new nuclear generating capacity unsustainable. The regulatory processes must be "fit for purpose"; commensurate with the risks and scientifically based.

Turning to dates BNFL agree that PIU are correct to conclude that a new nuclear station would not operate until after 2010. This is largely due to the

current time period for planning and regulatory processes. The timescales for nuclear stations need to be streamlined to reduce the project completion time. By taking action *now* to preserve and facilitate the option of nuclear power into the future, the Government will confer corresponding benefits to all large infrastructure projects (e.g. Heathrow Terminal 5), where planning uncertainties result in major delays. In our response to Question 20, we indicate the timescales which we believe would be achievable under a streamlined "fit for purpose" regime.

Question 15

Could more be done to reduce lead times by harmonising UK licensing procedures with those of other countries?

Yes. See our response to Question 12. It is clear that much could be done to harmonise licensing and regulatory processes between the UK and other nations, and that this would benefit nuclear utilities wishing to build new nuclear plant in the UK. For instance the AP600 already has design certification issued by the US NRC, and taking this as a firm starting point for a UK planning and approvals process would allow significant improvements to be made to the lead time - and thus economic attractiveness - of this plant for UK deployment. The principles of licensing are currently different between the US and UK, but the benefits of moving to an international standard could be sufficiently large to be worth the inevitable detailed assessment, even though this would be likely to take some considerable time.

The same argument applies to the AP1000 design, which is very heavily based on the AP600.

Question 16

How can nuclear generators set aside adequate sums to meet eventual waste disposal costs?

Nirex, as a specialist organisation, was set up by the major waste producers in 1982 to research, develop and operate radioactive disposal facilities (principally for Intermediate Level Waste - ILW) on behalf of the nuclear power industry.

As part of their work, Nirex provide the nuclear industry with information on the likely future costs of constructing and operating a repository which will be capable of accepting the projected volumes of waste. Based on this information BNFL calculates its future ILW disposal costs, knowing what its share of the operational and decommissioning waste volumes will be. The information also forms the basis of the future disposal cost of High Level Waste (HLW), although it should be recognised that Nirex does not have a remit to consider HLW.

Based on these calculations, which are independently audited, BNFL sets aside a discounted amount of funding, ie a provision, in its annual accounts for these future costs. This provision is judged to be prudent and includes a measure of both contingency and risk.

Our main submission indicates that we are advocating changes to the UK's approach to waste management and storage. We are seeking a policy for radioactive waste management which recognises:

- that nuclear wastes are currently managed safely;
- that prolonged safe storage is a viable approach to the management of intermediate and high level wastes, whether fuel is reprocessed or not;
- the need to manage legacy waste on a commercial footing; and
- the need for clarity for future nuclear generators in respect of their obligations for spent fuel management costs.

Question 17

If the generator were to set aside sufficient funds to meet highly pessimistic estimates of waste disposal (and interim storage) costs, what fraction of total generating costs would this represent?

For modern LWRs with lifetimes of 40 to 60 years, it is possible to safely store fuel on site for the lifetime of the reactor. Discounting would mean that the amount to be set aside now would be only a small percentage of the overall costs.

For nuclear generation, the overall costs are dominated by capital and other "up-front" costs, not by fuel cycle and long-term waste management and disposal costs. Best estimates of waste storage and disposal costs are included in the levelised electricity cost. Even if pessimistic assumptions were to be made then these costs would only increase to be in the range of 7% to 10% of the total unit generating cost.

This pessimistic assessment would compare with practice in the US, where a fixed sum of 0.1 cents per kW-hour (less than 2% of the overall generating cost) is levied to cover all future waste management costs.

Question 18

If active consideration was to be given to compensating local communities for accepting nuclear waste facilities, would this significantly alter the acceptability of nuclear waste storage and disposal facilities?

Yes. We should particularly learn from the experiences of others in this respect.

The question of host communities and volunteerism is one which has been explored more extensively by the nuclear industry on the European mainland than in the UK. The issue is complex and based, to a degree, around the perception of risk by individuals and communities. Other EU countries have had positive experiences with this approach (e.g. Sweden and France) enabling them to secure acceptable sites for nuclear facilities with community consent.

Outside the nuclear industry, the practice is relatively widespread, for instance in Europe, North America and Japan, and is often used in relation to major projects such as fuel exploration or transport infrastructure. There may be constructive learning points from all of these experiences for the UK nuclear industry in the future.

However it is clear that compensation in the absence of appropriate education and information relating to nuclear waste is unlikely to significantly alter public acceptability - particularly of storage and disposal facilities.

It is also clear that the impact on individuals, as well as communities themselves, should form an important consideration.

Question 19

Views on the current and prospective safety risks, and on public attitudes to risk, are invited.

Our submission covers the safety record of the UK nuclear industry, and risks associated with new and replacement nuclear build in some detail.

In terms of public attitudes, it is clear that these are amenable to some change if presented clearly with risks put into context through sensible comparison with other forms of generation (see our response to Question 28). In this respect BNFL believes that Government has roles to play firstly in ensuring objective presentation of these issues, properly put into context, and in dispelling misplaced public anxieties, and secondly in ensuring that Government decision making is soundly based on objective assessment. This applies both to consideration of power generation and of waste management.

As a specific example, a MORI poll of MP's indicated that they underestimated public support for nuclear power by a factor of 14 and, likewise, significantly overestimated public opposition.

Question 20

Could pre-commissioning justification be more limited in scope?

Yes. This is most definitely the case. BNFL believes that there is a strong case for streamlining the planning and regulatory approvals processes to deliver a "fit for purpose" regime, which allows nuclear plant to be built and

operated much more quickly than today, without compromising either the safety of the plant or the proper role of democratic consultation.

An approach along the same lines as that developed in the US by the industry and the NRC is a sensible model – namely generic licensing of both reactor types and sites. Public Inquiries and regulatory assessments are then focused on purely local and site specific issues. Additionally it is essential that the UK Environment Agency authorisation and justification process should take place in parallel with licensing and planning approval to avoid the "double jeopardy" situation currently facing BNFL's Sellafield MOX Plant (SMP). Under today's processes, the Discharge Authorisation required to operate the plant can only be sought once the plant is built, thus exposing the investors behind the project to very significant commercial risk. This could be avoided with a generic approval in principle prior to construction.

Taken together such steps would lead to a process for an "nth of a kind" nuclear station that had a two year planning and regulatory approval stage, followed by a three year construction programme and one year commissioning.

Question 21

What, if any, is the economic case at present for reprocessing spent fuel from new reactors?

Firstly, it is important to recognise that many utilities around the world continue to choose the reprocessing option, recognising that the reprocessed uranium and plutonium are precious energy resources which, although not in short supply at the moment, should be retained for the future. For these reasons, there is a strong case in favour of reprocessing in the eyes of these utilities, many of whom are customers of BNFL.

At present the choice of which specific management option to adopt for spent fuel arisings from new reactors has very little impact on the overall economics of such reactors. The decisions, therefore, whether or not to reprocess spent fuel from new reactors, and when any kind of treatment should be undertaken, are likely to be dependent on national policy and other strategic considerations as well as on economics. In these circumstances, and since any kind of early treatment of the fuel is likely to be more expensive than deferring the treatment, new reactors will be designed to allow all the spent fuel projected to arise from the reactor in its operating life to be stored safely in associated facilities for many years. By this means future treatment options, including reprocessing, can be kept open allowing future techno-economic, socio-environmental, policy and strategic considerations to be taken into account before final decisions are taken. Relevant techno-economic factors include the price of uranium and the cost of reprocessing or other treatment in more advanced process plants.

Question 22

Are there good energy policy grounds for ensuring that the UK retains the local expertise and capability to build new nuclear plant?

Yes. There are many factors to take into account with respect to the expertise and capability to build new and replacement nuclear plant. However, we know of no examples worldwide of a nation ceding the complete capability outside its borders, and we believe it is unlikely that any nation would "outsource" a capability which could be so fundamental to national energy security.

In fact, in practice, the reverse is often the case, with emerging nations seeking to buy and license Western technology so that they may gradually become self-sufficient. Japan, Korea and South Africa are prime examples of this approach.

Unless existing local expertise and capability to build new plant is preserved and developed, the UK may lack the necessary skills base to build new plant. The availability of suitably skilled personnel from outside the UK (with knowledge of UK issues such as licensing, regulation and grid infrastructure, as well as site-specific issues) could not be assured. This would have potential adverse implications for the costs and timescales of a programme of new or replacement build in the UK.

There is no doubt that both the supply chain and potentially the owner-operators of new nuclear plant may well be part of major global businesses or consortia. However, technical expertise is still required locally to operate the plants and to provide a significant part of the operational support.

In addition, once such a plant were in operation, it would be unwise to expect to operate the plant for a period of several decades with no underpinning UK skillbase. Indeed, HM NII would be unlikely to allow such a *modus operandi*. It would contravene requirements under UK licensing for sufficient suitably qualified and experienced resources to be available to support continued safe and efficient operation.

However, the benefits arising from deployment of existing UK expertise may be enhanced by employing a suitable level of international resource to take advantage of specific knowledge and experience and to facilitate the transfer of expertise and know-how. For example, if a particular reactor design is the first of a kind built in the UK but similar models have been built in other countries it would be beneficial to employ the expertise of those who had worked on that design before.

Question 23

Would it be practicable for UK nuclear safety regulators to rely on using foreign personnel if the relevant skills were not available in the UK?

Yes. Many of the issues raised in our response to Question 22 are also relevant to this question.

Using foreign personnel to supplement UK nuclear safety regulator expertise may be a practical approach to a skills shortage, particularly with greater harmonisation between UK regulation and overseas regulation. However, foreign regulatory personnel or experts would experience a significant "learning curve" to gain detailed knowledge of UK-specific regulation.

It would not be prudent to rely predominantly on foreign personnel to carry out UK nuclear safety regulation as the long-term availability of such personnel could not be assured, and in any case would be determined by the requirements of their own countries. In any event, the UK safety regulators must be able to demonstrate that they have the credibility, experience and expertise to carry out their duties effectively. This would be true for any industry, but is particularly true of the nuclear sector, given its high public profile.

Question 24

Are there stronger grounds to ensure local nuclear capability than for other energy technologies?

Whilst the nuclear industry itself is global – with BNFL as one of the major global reactor vendors – these remains an ongoing need for local technical and operational skills in individual nations to underpin their national programmes, as outlined below.

As in any industry, there are certain skills and working practices which are unique to the nuclear industry. However the nature of nuclear power and the radioactive nature of the fuel materials mean that some of the skills and expertise required within the industry are particularly specialised and are very different from skills seen in other industrial sectors. For instance, whilst any form of power generation requires experts to understand the chemistry of the heat generation process and the behaviour of the materials used to build the power station, only a nuclear station will require specialist criticality and radiometrics expertise, as well as an understanding of the long term effects of radiation on the reactor materials.

The requirements of the nuclear safety case reflect these concerns, and so the specific regulatory framework of the nuclear industry also requires expertise in these fields to be available to support pre-operation and ongoing demonstrations of safety.

Finally, it is worth noting that the nuclear industry cannot simply "shut down" its operations and walk away. There remains an ongoing need for the safe management of all aspects of plant closure, including shutdown, dismantling, waste management, decommissioning and disposal, all of which require the availability of suitable resources.

Because of these specific skill requirements and the unavailability of resources in other sectors to meet these needs through transfer of staff, BNFL believes that the maintenance of a strong local capability in nuclear areas is more important than would be the case for other energy sector technologies. With much talk of a resurgence in nuclear power, and with a broad range of nuclear capabilities available within the UK, it would be most unwise for UK to allow the opportunity to capitalise on this skillbase to be missed.

Question 25

Is it likely that the UK would wish to proceed with new nuclear plant if other OECD countries were not doing so?

Yes. A decision on whether to proceed with building new nuclear plant would not be influenced solely by the choices exercised by other countries. However, any benefits of scale that might arise from a wider construction programme would be lost, unless there was series-ordering of reactors, with a common design, either in the UK itself or in other countries. The UK – in BNFL - has the advantage of having the full range of fuel cycle facilities, which would mean that any decision on new build would not be dependent on availability of those facilities in other countries for fuel requirements. The timing of any decision is also a factor to be taken into account. One country "going it alone" may do so because of the urgency of national circumstances. Others may not follow at that particular time and prefer to wait. Finland is a good example of this, in that the country needs more power, has decided that nuclear power is best suited and an application for a fifth nuclear unit has been submitted. The Finns have solicited bids from the existing portfolio of designs held by the world's reactor vendors, including BNFL, i.e. they will choose an international standard. There was no evidence of hesitation by the Finns on the grounds that no other European nations had immediate plans for new nuclear capacity.

BNFL believes that UK decisions should be based primarily on UK needs, whilst taking advantage where possible of international developments, such as moves in the USA to replace capacity with new nuclear units.

Question 26

If it were felt important to retain a local nuclear build capability, what would be the best way of doing so, short of ordering new stations?

Firstly, it is important to recognise that the UK's nuclear power plant construction capability is already close to being eroded to the point where it would effectively need to be re-built from scratch.

If there were no new plans for nuclear stations, it is unlikely that commercial companies would be willing to invest in ongoing research and development work (a key factor in ensuring high quality talent, skills and capabilities for the future), since there would be no clear incentive, nor a clear route to potential return on the investment. Under those circumstances, Government would need to become much more proactive in supporting international R&D programmes, and in ensuring participation of the key UK nuclear organisations.

There is already a large gap in this respect when the UK is compared to other leading nuclear nations. In the US, funding for the National Laboratories underpins much of the work of the nuclear industry, the utilities and the engineering companies. In Japan, the same is true of Government funding for JAERI and JNC. In France CEA receives substantial Government funding, which impacts beneficially on the work of EdF, Framatome and Cogema. Finally in Europe as a whole, the Joint Research Centres at Ispra and Karlsruhe carry out a wide range of relevant work, but with relatively little UK participation.

Question 27

How far would a declaration that fuel from any new reactor would not be reprocessed improve the public acceptability of nuclear power by avoiding further separation of plutonium and breaking the link with nuclear weapons?

Reprocessing is a legitimate spent fuel management option offered commercially to civil nuclear utilities who wish to recycle plutonium and uranium oxides for fabrication into fresh nuclear fuel. Many of BNFL's customers choose this option, recognising that the reprocessed uranium and plutonium are precious energy resources which, although not in short supply at the moment, should be retained for the future. If true sustainability is to be a goal, then reprocessing should continue to be viewed as an option for the future.

Civil reprocessing is not linked with nuclear weapons, and plutonium separated by means of reprocessing from used civil nuclear fuel is kept under strict international safeguards. Nuclear weapons are not made from safeguarded plutonium.

The reprocessing of used nuclear fuel from civil power stations has been undertaken safely and successfully in the UK for more than 40 years, and it remains the only current viable option for safely managing fuel removed from the Magnox power stations. In addition British Energy and a significant number of overseas nuclear utilities have chosen to reprocess their AGR and LWR fuel at BNFL's Thorp facility.

The choice of which spent fuel management option to adopt for fuel arising from new reactors is a decision for the utility, and has minimal impact on the overall economics of new reactors. The decision on how to manage spent fuel arisings from new reactors is likely to be a commercial judgement for the parties concerned. Given the likely timescales of new reactors, fuel arising from these reactors would be unlikely to be reprocessed in existing facilities. In the event of new reprocessing facilities being built, these will reflect the major technological advances which have taken place since current facilities were designed and constructed.

Turning now to public acceptability considerations, it is important to note at the outset that there is no hard evidence to substantiate the implication that nuclear power is not already acceptable to a large proportion of the public. Recent MORI figures suggest that around 75% of the UK population are either supportive or neutral regarding nuclear power. For those who are negative, there is also no evidence that reprocessing is the key determining factor in their stance.

BNFL recognise that there are vociferous interest groups who are often forceful in their opposition to nuclear power in general and / or reprocessing in particular. Whilst a declaration of the type proposed in the question might appease certain of these groups, there is nothing to suggest that a similar level of reaction (positive or negative) would be felt by the public in general.

Question 28

Are public attitudes to nuclear largely fixed or could they change with circumstances, such as changed perceptions of the problems associated with fossil fuel use?

Opinion polling carried out by MORI in recent years on behalf of BNFL suggests that public attitudes to nuclear are not fixed and do change with circumstances.

In the most recent survey (July 2001) once presented with information that, unlike fossil fuel generation, nuclear power does not produce greenhouse gases those surveyed were inclined to be more favourable towards nuclear energy. In addition, the main environmental and conservation concern expressed spontaneously by the general public was climate change.

Public attitudes towards nuclear power can be fickle, as has been seen in the US where recent problems with the supply of electricity in California have led to large increases in support for nuclear power. Indeed, MORI's recent work

for BNFL identified the main benefits of nuclear power as being: it leads to 'clean air'; provides a reliable supply of electricity; its cost factors; and also plays a positive role vis-à-vis climate change concerns. Further appreciation of these benefits, as well as developments that may put such 'needs' at risk, could further improve public support for nuclear power.

Question 29

Could greater public involvement in nuclear decision making significantly reduce public opposition to nuclear power and new nuclear facilities?

As already mentioned, a poll of UK MP's indicated that they felt underestimated public support for nuclear power by a factor of 14 and, likewise, significantly overestimated public opposition.

However, notwithstanding this clear perception gap, evidence *does* suggest that the general public would welcome more information about nuclear power and nuclear issues. It is widely recognised that gaining public acceptance is key to agreeing strategies and making constructive progress on issues related to nuclear power.

The most fundamental question to be addressed is finding an appropriate framework within which to engage the public on nuclear issues; ensuring appropriate representation and debate but whilst allowing nuclear operators to 'bank' decisions and understand that the debate is moving forward.

The UK nuclear industry has much experience in the areas of public consultation and the planning process. From the national perspective, the NIREX experience in the 1970s and 1980s has demonstrated that early involvement taking differing views and opinions about contentious environmental or public policy issues will avoid industry, Government, local authorities, regulators, other interested parties and ultimately the taxpayer having to participate in a 'decide, announce, defend' process which will not provide a positive direction for major infrastructure projects.

The existing decision-making system of seeking views through formal public consultation on Government proposals, planning inquiries or legalistic challenge does not achieve the detailed involvement and debate which should accompany such major policy decisions. The attendant time delays, resource and financial implications together with the implications for corporate and national reputation do require a fundamental review about other ways forward.

BNFL has been participating in a facilitated dialogue process ("Stakeholder Dialogue") for the past three years. The aim of this process has been to inform BNFL's environmental performance in the context of its overall business strategy. The process has enabled a wide range of views and concerns to be debated against the background of an understanding of assumptions which underpin business decisions taken at a

particular time. Joint fact-finding projects have also informed the discussions giving the added benefit of agreed credibility to data provision and its provenance. Where underlying assumptions are still of concern, the process enables contingency plans to be set in train should the basis of assumptions change. Options are therefore not prematurely closed down and also transparently explored. Experience also has demonstrated that areas of consensus can be identified together with the areas where concerns still remain.

The Government may wish to consider participation in a similar dialogue process to underpin the Parliamentary process about options for a UK Energy Policy, making implementation both more efficient and more cost effective.

Question 30

Since large nuclear stations in relatively remote sites can meet the electricity needs of large populations, is nuclear power compatible with effective involvement of local communities in decision taking?

Yes. Generally speaking, the communities around nuclear facilities are supportive of their presence, based on many years of experience of living and working within an industry seen as being important to their wellbeing, as well as to the nation.

BNFL is proud to work in partnership with our local communities - our objective is to make a positive difference. The relationship between large organisations, such as BNFL, and the communities in which they work must be based on mutual benefit and mutual respect.

Whilst large companies like BNFL bring employment, prosperity and vibrancy to communities, it is the people within those communities which provide the workforce and support so vital to BNFL as it goes about its operations.

There are issues for which it is important to secure effective community involvement. Equally, nuclear power also raises issues for which it is appropriate to engage other constituencies on a regional and national level. It is BNFL's intention to continue active engagement with stakeholders at local, regional and national levels.

Question 31

Is there a realistic prospect of new reactor designs emerging that could allay public concerns about safety, waste and proliferation?

As we explain in our submission, existing nuclear reactors exhibit very high levels of safety to both the workforce and the general public, they produce wastes which are manageable and are treated safely and effectively, and they do not pose a proliferation risk. However, nuclear technology is not static, and

the industry should never be complacent about safety, waste and proliferation issues: always striving to improve its performance. Continued participation in international programmes, targeting enhanced performance in these areas, is therefore vital.

Nonetheless, we recognise that concerns may exist. There is clearly potential for enhancing the effectiveness of communications between the nuclear industry and the general public. As explained above in the answer to Question 28, there is evidence that public opinion does change if the public are presented with clear and robust arguments which balance the advantages and disadvantages of different approaches. Government has a key role to play in ensuring that these messages are delivered clearly and objectively.

We believe that the key to an improved public perception of nuclear power is through a continued good safety record, supported by improved communication, rather than the quest for new reactor designs.

Question 32

Can we expect the private sector to come forward with new reactor designs?

It is important to recognise at the outset that the medium-term challenges outlined by the PIU in the scoping documents for the Energy Review can be met by nuclear reactor concepts which are already either commercially available or else at an advanced stage of development. Achievement of these Energy Policy objectives does not require the development of brand new reactor designs. This question therefore must be considered in the context of the longer-term.

The design of a new reactor system is a very significant undertaking, and it is likely that a truly new design (rather than an evolutionary development of a current plant) would always be carried out under some form of collaboration. This is indeed the case for the three different reactor concepts which BNFL is currently involved with.

The AP600 plant (forerunner of the larger AP1000 design) was developed by Westinghouse (then owned by CBS), but with input from a number of other organisations (including Bechtel, DTN, EPRI, US DoE, MHI and EdF). The PBMR team brings together BNFL, Eskom, Exelon and IDC. The IRIS project includes Westinghouse, Ansaldo, Bechtel, MHI, JAPC, as well as the Polytechnic of Milan, the University of Pisa, Massachusetts Institute of Technology, Tokyo Institute of Technology and others with the US DOE contributing funding.

Given the emphasis on collaboration, it would be expected that any new reactor concept would be developed by a combination of public and private organisations. Indeed, the involvement of private organisations, especially utilities and reactor owners, is vital to ensure good project focus and adequate commercial reality at an early stage.

Question 33

Is there a case for further UK public investment in new reactor designs?

UK Government has stated its energy policy objectives, which meet both long-term energy demand and long-term environmental objectives safely, securely and affordably. We have clearly demonstrated in our submission that nuclear power is a very valuable component of the future energy mix necessary to achieve these objectives, but also that current market forces alone will not deliver nuclear power as part of the solution, due to factors such as regulatory timescales and inequitable mechanisms for treatment of environmental impact. Indeed, market forces acting alone will not deliver a portfolio of electricity generation which allows the Government's objectives to be achieved, without a more appropriate policy framework.

Reactor designs have already been developed overseas which would be available for deployment in the UK over the next decade or so, for instance the Advanced Passive (AP) series. BNFL considers public investment in the UK licensing of such a reactor would be appropriate, leading to a "generic approval" analogous to the US Design Certification process. This would recognise the beneficial impact which such a reactor would have on the achievement of national energy policy objectives.

Long term reactor development takes place through international collaborations. The UK contribution to such developments could be fully or partly financed by public funds, up to the point where implementation in the form of a public private partnership would be possible. (This was the approach adopted in the US on the AP600 project). Early investment in international collaborative R&D projects offers a good potential return for the UK when the technology is exploited.

Question 34

What is the appropriate role for international collaboration in nuclear R&D?

The costs of developing new nuclear reactor designs to the stage of being licensed for commercial application are likely to be very large. In the case of the AP600 for example, some $400 million was invested by the US DoE, utilities and other companies in the supply chain, as well as by Westinghouse, to take the design to licensed status. The case for international collaboration is thus very strong, both for research and for taking promising projects further towards commercial realisation.

Although the Euratom Fifth Framework programme has a substantial budget, the vast majority is allocated to fusion research and much of the fission allocation is targeted to safety, environmental and waste management issues.

It does not seem logical that large funds should be directed towards fusion, which is so far from commercialisation, even though it promises much, whilst fission is being starved of the essential investment it needs to flourish and attain the step changes necessary in cost effectiveness and long term environmental performance. The nuclear industry is still relatively young, and appropriately supported R&D can be expected to yield step changes in the key technologies over time.

With the timescales to achieve commercialisation of new systems, and the costs and associated commercial risks involved, there is a danger that the gap which has formed as a result of policy decisions at both the national and European level will persist and widen.

There is a case for further UK public investment in new reactor designs to ensure that the UK stays abreast of emerging technologies and is able to capitalise on historical experience and expertise with respect to nuclear technology across the fuel cycle. As a minimum, funds should be available to allow the UK to have legitimate participation in the various initiatives such as those sponsored by the IAEA or for example the Generation IV initiative triggered by the US DoE.

There is a danger that large projects can develop a momentum of their own which can carry them away from commercial realities. Involvement at the outset with organisations likely to be involved in exploitation may be a way to counteract this.

Question 35

Is this classification correct – and how should any chosen option be given effect?

No. In BNFL's view, keeping the option for nuclear power open is not consistent with neutral support. With the exception of key actions already taken to increase the contribution of renewable energy within the UK's generating mix, current mechanisms will only deliver market responses targeted at the short term.

BNFL believes that there is a strong case for nuclear power to be supported. However if current market mechanisms are maintained over the next two decades and nuclear reactors are decommissioned as planned, no replacement capacity will be built. The UK will then be reliant on imported gas (up to 80% of supply) to meet the growing demand for electricity.

BNFL recommends that the Government take the following actions to provide a level playing field, which will help to keep open the option for nuclear power:

- Modification of current climate change mechanisms, such as the Climate Change Levy, recognising that nuclear generation should benefit from the fact that it makes virtually no contribution to greenhouse gas emissions.

- Streamlining of planning and regulatory approval processes to ensure that major nationally important infrastructure projects, such as new nuclear power stations, can be delivered effectively and efficiently.
- Reviewing how long-term electricity supply contracts - which are required for any baseload station, not just nuclear - can be put in place.
- Deciding on an overall policy for radioactive waste management which recognises:
  - that nuclear wastes are currently managed safely;
  - that prolonged safe storage is a viable approach to the management of intermediate and high level wastes, whether fuel is reprocessed or not;
  - the need to manage legacy waste on a commercial footing;
  - the need for clarity for future nuclear generators in respect of their obligations for spent fuel management costs.
- Encouraging the provision of nuclear education, training and R&D.

As a minimum there is an immediate need for this Government action (which may be classified by PIU as “weak support”) to recognise the true contribution nuclear power is making and can continue to make to the achievement of UK energy policy objectives.

PROPOSITIONS

Proposition 1

It is almost certain that nuclear plant will continue to operate in a number of countries, including some European ones, for at least the period to 2020.

BNFL agrees with this proposition.

As at 31 December 2000 there were 438 nuclear reactors in operation in the world, of which 359 were in OECD countries, and 33 under construction. Whilst some countries have announced policy decisions to phase out nuclear power, others will still continue with their nuclear programmes in order to extract maximum value. Many of the world's reactors are not yet 15 years old and, provided they can continue to meet regulatory and licensing requirements, should be able to provide power for many more years to come. The OECD's Nuclear Energy Agency points out in its Annual Report for 2000 that "availability factors of existing nuclear units in OECD countries have been steadily increasing and operating licences have been extended up to 60 years in such countries as the US." In France, for example, reactors that came on stream in the late 1980s or 1990s (eg Chooz B2 in 1997; Civaux 2 in 1999) can be expected to operate for several decades.

Proposition 2

Construction of new nuclear power stations will continue in at least some countries for many year to come (unless halted by a major accident).

BNFL agrees with this proposition.

Many countries such as Japan, Korea and China are actively pursuing programmes of nuclear reactor construction, and have been doing so for some time. In the West, France has brought several new reactors into commercial operation over the last decade and Finland has plans for a new nuclear station (see our response to Proposition 3). South Africa is leading the Pebble Bed Modular Reactor project, with a view to building and operating the first full-scale unit in that country followed by at least ten subsequent plants. Elsewhere in the world – for instance in the US – there is increased debate around a resurgence in nuclear power, accompanied by prospects of new nuclear units, for the same valid reasons outlined in BNFL's submission.

Proposition 3

There is a considerable likelihood of new nuclear stations being ordered somewhere in Europe in the next 10 years.

BNFL agrees with this proposition. Nuclear power stations continue to be constructed in Europe. Ten new reactors (all PWRs) have begun commercial operation since 1990 in France alone.

To give a specific example where nuclear construction is anticipated over the coming decade, it is worth looking to Finland. The Finnish utility TVO submitted an application to the Finnish authorities in November last year for a "decision in principle" on a new nuclear power unit to be built at an existing site (either Loviisa or Okiluoto). The application followed completion of a study that showed that a nuclear unit would be the least cost option for Finland for its required increase in generation capacity. In February this year Finland's nuclear safety authority, STUK, gave a preliminary assessment of the project and stated that the options in the application showed the unit "can be built to fulfil national safety requirements."

Proposition 4

Greenhouse gas emissions associated with nuclear generation are very small compared to generation from fossil fuels.

BNFL agree with this proposition. Greenhouse gas emissions associated directly with nuclear generation and indirectly through other aspects of the full energy chain are very small compared to emissions from fossil fuels.

The majority of greenhouse gas emissions from generation are from fossil fuels and are a direct and unavoidable consequence of the combustion process used in this form of generation. In contrast, the energy that drives a nuclear power plant derives from the heat produced during nuclear fission. No greenhouse gases are produced in this process.

There are some comparatively small secondary greenhouse gas emissions associated with the construction of plant and the energy used in the enrichment process. However, when evaluated in terms of emissions for the same quantity of electricity generated, these are two orders of magnitude less than the corresponding emissions from fossil fuels. Furthermore, when the electricity required is derived from nuclear power in the first place, these become negligible.

Proposition 5

Nuclear power produces negligible emissions of the gases casing acid rain (sulphur dioxide and nitrogen oxides) compared to generation from fossil fuels.

BNFL agrees with this proposition. There is no release of sulphur dioxide and nitrogen oxides from the operation of a nuclear power plant. In contrast fossil fuels, predominantly coal-fired generation, emit considerable quantities of these gases. A 1000 MW(e) coal plant, without abatement technology produces around 44,000 tonnes of sulphur oxides and 22,000 tonnes of nitrogen oxides annually.

The only significant sulphur dioxide and nitrogen oxides emissions associated with nuclear generation over the full energy chain are those associated with the energy used for the enrichment process, if that energy is derived from fossil fuels, and in plant construction. However, these emissions are very much lower than those associated with coal plant, and as outlined above, if derived from nuclear power are negligible.

Emissions from fossil fuel plant can be reduced by up to ten-fold using, for example, flue gas desulphurisation equipment or natural gas sweetening procedures. However, this results in the annual production of several hundred thousand tonnes of solid wastes from coal or gas plant. The abatement technology also raises the overall generation costs and can lead to an increase in greenhouse gas emissions.

Proposition 6

It is highly unlikely that a disposal route for HILW will be available for use in the UK within the next 20 years.

BNFL agrees with this proposition. A relatively optimistic view of the timescale to complete the various stages which would be needed before an ILW repository could be operational is about 40 years. The significant stages involved are judged to be:

Government Consultation
Geographic search for suitable sites
Detailed surface based site investigation programmes
Construction of a Rock Characterisation Facility
Public endorsement of the preferred site
Repository construction and commissioning

For a project such as a waste disposal repository, the social and political issue are more likely to determine how quickly progress is actually made and BNFL's judgement is that it is extremely unlikely that all the required steps can be completed within 40 years.

However, it is important to recognise that the availability of an ultimate disposal route for HILW on the 20 year timescale suggested in the proposition – in the UK or elsewhere - is not a determining factor in a decision to build new or replacement nuclear stations in the UK.

The key considerations in respect of HILW arising from the construction, operation and ultimate decommissioning of such stations are firstly whether or not the arising wastes pose any risk to the health and safety of the public and the workforce, and secondly, whether they pose any environmental risk.

The safe long term management of radioactive wastes of all classifications (low, intermediate and high level) has been demonstrated through BNFL's operations at Sellafield and elsewhere over several decades. The industry has developed a waste management route for ILW which involves immobilisation in cement, encapsulation of the immobilised waste and cement in stainless steel canisters and storage of these canisters in monitored storage facilities where they are confidently expected to reside safely for periods of several centuries. A similar approach is adopted for high level waste, which is vitrified prior to encapsulation in steel canisters and subsequent storage.

It is important to recognise, in the context of nuclear waste, that the legacy of the past is not a guide to the future. If a non-reprocessing strategy is adopted, pre-treatment and storage can be developed in line with emerging international best practice.

Finally, it is worth noting that decisions leading to the availability of a site for ultimate disposal of HILW are socio-political in nature rather than technological. Whilst technical work would be required to confirm the suitability of any specific site, the major obstacle at present is the lack of political will to select such a site and to allow the technical work to proceed.

Proposition 7

It is highly unlikely that the UK could dispose of HILW in some other country in the foreseeable future.

BNFL agrees with this proposition. UK Government policy precludes the export of UK nuclear waste for disposal.

Nevertheless, as noted above in our response to Proposition 6, the ultimate disposal of HILW arising from the operation of new or replacement reactors in the UK should not be a factor in decision as to whether or not to build and operate such stations. The important consideration is whether or not such wastes pose any risks to the public or to the industry workforce, and BNFL's proven experience of waste management demonstrates clearly that this is not the case.

Proposition 8

The technology already exists to store HILW safety, for many decades if necessary.

BNFL agrees with this proposition.

See our response to Proposition 6. Effective nuclear waste management is an operational reality, demonstrated at Sellafield with over £2 billion invested in state-of-the-art waste management and associated facilities over the last two decades. It provides a very good example of waste collection, treatment, containment, storage, supervision and monitoring.

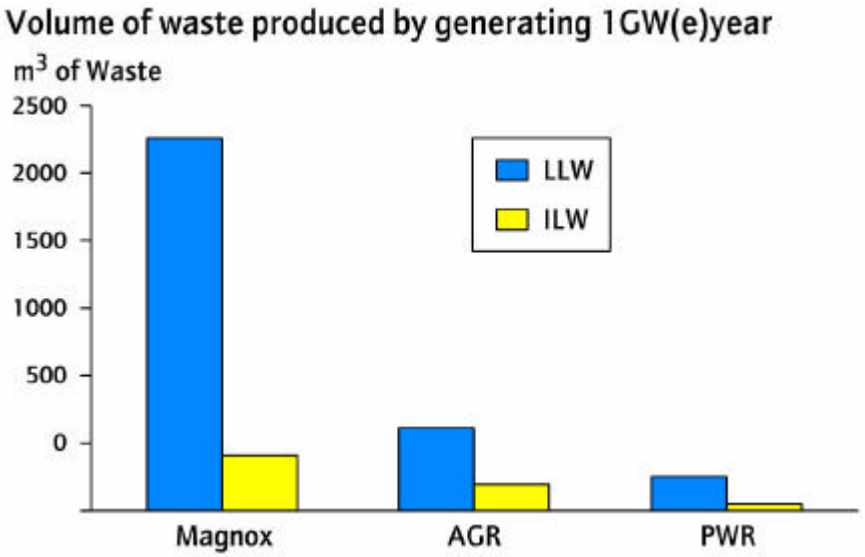
In addition, it is worth noting that all Intermediate Level Wastes which require cementation have suitable waste product forms identified which meet a Nirex specification of at least 100 years.

Proposition 9

Waste arising from new stations is likely to be significantly less than from existing stations.

BNFL agrees with this proposition.

This topic is discussed in our submission, and is demonstrated by the following graphical comparison:



Proposition 10

New waste will not be significantly different in kind to existing waste and will not require distinct approaches to storage or disposal.

BNFL agrees with this proposition.

This topic is discussed in our submission. In fact, it is likely that wastes arising from new or replacement nuclear build in the UK would be of the types which are more straightforward to treat than some historic wastes, which were not generated with ultimate treatment in mind.

Proposition 11

The marginal costs of dealing with extra waste are likely to be small compared to the costs of dealing with unavoidable waste.

BNFL agrees with this proposition.

As explained above, the types of waste generated from new nuclear build will be simpler to package and encapsulate than historic wastes because they will be well characterised and far more homogeneous.

In terms of disposal, the existing unavoidable wastes will require disposal in a repository, the costs of which will not change significantly if greater volumes are ultimately emplaced; the fixed costs for disposal are very high whereas the additional cost for extra volume is very low.

Proposition 12

The UK is likely to be able to secure sufficient supplies of uranium at relatively stable prices for the foreseeable future.

BNFL agrees with this proposition.

Global reserves of uranium are conservatively estimated to be sufficient for at least 50 years, use assuming current demand. Should it be desirable, reprocessing can extend this timeframe further, as can the utilisation of Mixed Oxide fuel in reactors.

In terms of price, the market price of uranium is not significantly less volatile than that of oil or gas. However, as explained in our submission, the impact which a change in fuel cost will have on overall generating cost is much less for nuclear than for fossil fuel sources, because of the relatively low fraction of the overall nuclear cost which is represented by the cost of the fuel.

Proposition 13

If new nuclear power stations were to be publicly acceptable in general terms, the availability of suitable sites in the UK seems unlikely to be significant constraint.

BNFL agrees with this proposition, at least in the medium term.

There are a number of nuclear licensed sites around the UK, which could be considered as potential locations for a nuclear reactor to replace current nuclear capacity. In particular, many of BNFL's Magnox reactor sites have features which would make them attractive for such a unit, such as grid infrastructure (albeit that some upgrading might be required); within local communities who understand and support the benefits which a nuclear power station brings – including a vibrant local economy often in remote and rural areas. As the AGR reactors owned by British Energy are gradually closed down and decommissioned, so further such suitable sites will become available.

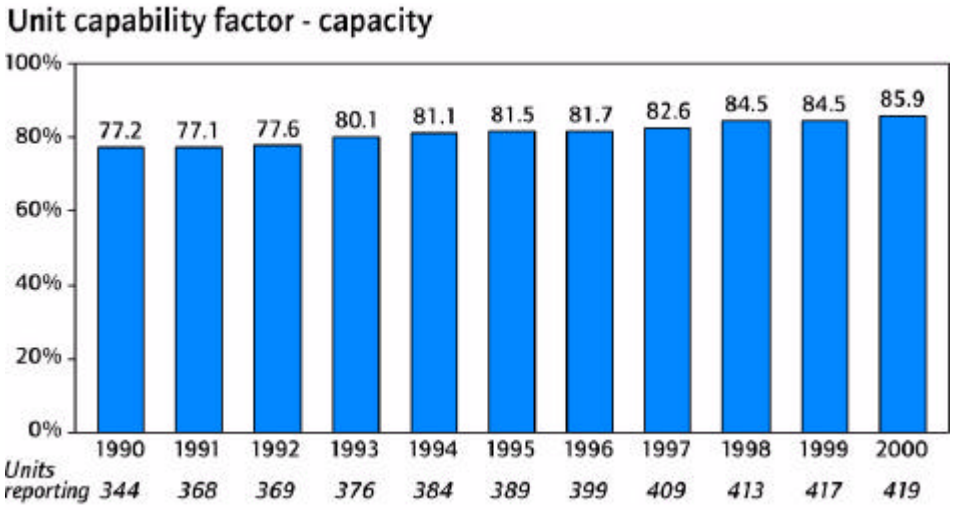
Whilst a suitable established nuclear licensed site would be the obvious location for a replacement nuclear station in the medium term, on a longer timescale there is no reason why other suitable sites should not seek and be granted nuclear site licences.

Proposition 14

Nuclear plant is more prone to the risk of widespread shutdowns on safety grounds than other types of generation.

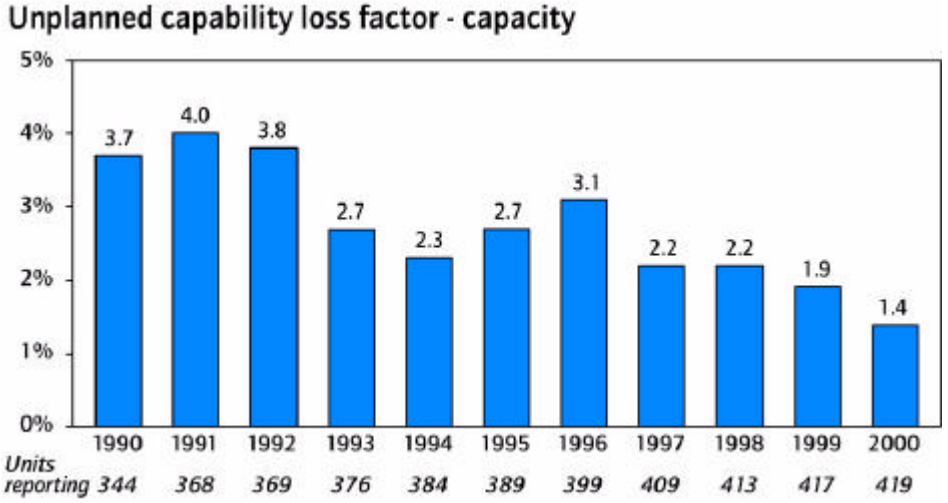
BNFL disputes this proposition.

Whilst it is true that nuclear power stations have to meet very stringent safety criteria, both in design and operation, the track record of the UK's reactors to date, and that of nations such as France with modern LWR units, is testimony to the reliable nature of nuclear generation. The continuous improvement in reactor performance worldwide over the last decade is illustrated by the following data from the World Association of Nuclear Operators (WANO):



The proposition is set in the context of a “standardised” series of replacement UK reactors. Our submission indicates that the design of choice for such a series would be the AP LWR series, which adopts many proven features which have operated successfully in LWRs around the world over several decades. They also embody simple passive safety features to meet licensing requirements on operational safety.

Finally, it is worth pointing out that consideration of this issue is not limited to nuclear. There is considerable commonality of plant and equipment in other generating sectors, for instance turbine equipment, which is equally liable to cause shutdown of more than one plant at a time. Indeed, this is further support for the argument, set out in our submission, that a balanced mix of



electricity generation is an essential component of a secure supply. Such a mix ensures that – should one component of the mix be lost or diminished – there is sufficient capacity from other sources to meet customer demand.