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E(79)54
18 October 1979

COPY NO. 57

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MINISTERIAL COMMITTEE ON ECONOMIC STRATEGY

NUCLEAR POWER POLICY AND THE NUCLEAR INDUSTRY

Note by Secretary of State for Energy

1. Nuclear power is vital to our energy policy. We need to take decisions about our nuclear power programme and the industry which is to build it, and make an early announcement.

THE MAIN TASKS

2. We need to :-

a. Take a firm Government stance in favour of nuclear power. We have made a good start since the Tokyo Summit, but we must continue to give a vigorous lead to public opinion, emphasising also the importance we attach to safety.

b. Announce a programme of further nuclear power station orders which will carry conviction and give industry confidence in the future of nuclear power.

c. Create in the National Nuclear Corporation (NNC) an effective body which can play a full part in constructing this programme.

NUCLEAR ORDERING (2 (b) above)

3. I believe we should endorse the CEGB's adoption of a basic nuclear programme as follows:-

a. They expect to require at least 1.5GW of new nuclear orders each year for 10 years from 1982/83. This would yield 15GW of new capacity by 2000 and would be a reasonable statement of intent on which industry could plan.

b. Additional orders over and above this 15GW would depend on the development of demand and the performance of industry.

c. Within this basic programme there would be an immediate and firm commitment to around 5GW of orders in the first three yea from 1982/83, subject only to safety and planning consents.

4. I also believe we should give industry greater assurance about ord for Pressurised Water Reactors (PWRs) than they have so far received, to ensure that the PWR option is fully developed, though it would be wrong to commit ourselves solely to one system at this stage.

NUCLEAR INDUSTRY ORGANISATION (2 (c) above)

5. Our immediate objectives should be to strengthen the Corporation's ability to provide the nuclear island, and to define the relationship between the CEGB and NNC in a way which encourages the NNC to move towar total management responsibility for the first Pressurised Water Reactor (PWR) and perhaps manufacturing.

6. I believe we should seek GEC's continuing involvement in NNC to he strengthen the industry, and insist on the CEGB's co-operation in meeti our objectives.

RECOMMENDATIONS

7. My proposals are explained in more detail in the attached memoran Before I can proceed further with the parties I must be sure that I have the support of my colleagues for the policy it contains including

a. the basic nuclear programme with a stronger commitment to PWRs of a Westinghouse design (paras 10 to 13);

b. steady evolution in the role of NNC towards responsibility for the first PWR and possibly manufacturing, and insistence that CEGB co-operate in this objective (paras 25-26);

c. a maintaining GEC's involvement in NNC without changing the share structure but terminating their supervisory management (paras 30-31);

d. reconstitution of NNC with a strong Board and managem .t (para 32

8. If the Committee agree, my aim would be to make plain to all concerne the Governments policies and to make a statement in the House in November which I would agree with my colleagues.

D.A.R.H.

DEPARTMENT OF ENERGY
18 October 1979

MINISTERIAL COMMITTEE ON ECONOMIC STRATEGY

NUCLEAR POWER POLICY AND THE NUCLEAR INDUSTRY

Memorandum by the Secretary of State for Energy

1. Nuclear power is vital to our energy policy. We need to take decisions about our nuclear power programme and the industry which is to build it, and make an early announcement.

PERSPECTIVE

2. The UK had a world lead in nuclear power in the 1950s and 1960s. This has since been lost, except on the nuclear fuel cycle. There have been too many reviews, delays and uncertainties. The new Advanced Gas-cooled Reactors (AGRs) are the first nuclear orders since 1970.

3. Because of this failure to press ahead we have no thermal reactor system readily available for series ordering and our nuclear industry would be unable immediately to take on a substantial programme of orders. And yet my Department's forecasts suggest that we may need to order some 30GW of new nuclear stations by 1993 to meet demand at the end of the century, or even more if they could be built in time: see Annex A.

4. The weakness of industry is disturbing. I have consulted the parties to see how it can be revitalised.

STRUCTURE

5. The nuclear industry is based on a single design and construction organisation, the National Nuclear Corporation (NNC) and its operating subsidiary the Nuclear Power Company (NPC). Manufacturing is carried out by the power plant industry and component manufacturers.

6. When NNC was established in 1973, the concept was of a partnership between Government and GEC. GEC held 50 per cent of the shares in NNC and were to provide financial and management strength through an agreement with NNC which placed NPC under their supervisory management. Government held 15 per cent of the shares through the UKAEA and took responsibility for national policy. The balance was held by a consortium of private interests, British Nuclear Associates (BNA), with limited powers and functions. Annex B gives more details.

7. This arrangement has not worked well, mainly because of the absence of nuclear orders and disagreement over thermal reactor strategy. GEC see overwhelming arguments for the Pressurised Water Reactor (PWR), the leading system internationally. After the SGHWR decision in 1974, they reduced their shareholding in NNC to 30 per cent, Government taking the balance. When two new AGRs were announced last year instead of the SGHWR, and the PWR was given second place, GEC said that they wished to end their supervisory management of NPC and possibly reduce their shareholding still further.

8. There have been many discussions since then but no action. The uncertainty has further weakened industry and our nuclear programme. We must act decisively to end this.

A BASIC NUCLEAR PROGRAMME

9. I believe the key to the problem is to give the nuclear industry and associated manufacturers greater confidence in the future of nuclear power. We cannot expect reorganisation, recruitment or investment to take place unless there is this confidence. I have therefore had discussions with the CEGB about the possibility of agreeing a nuclear programme which would hold out a realistic prospect of future orders without unacceptable financial risks. Officials have also carried out an assessment of options and risks on coal and nuclear investment as I agreed with the Chancellor in July. Their interim report is being circulated separately.

10. In the light of my discussions I propose that we should endorse in an early statement the CEGB's adoption of a basic nuclear programme on the following lines.

a. They expect to require at least 1.5GW of new nuclear orders each year for 10 years from 1982/83. This would yield 15GW of new capacity by 2000 and would be a reasonable statement of intent on which industry could plan.

b. Additional orders over and above this 15GW would depend on the development of demand and the performance of industry.

c. Within this basic programme there would be an immediate and firm commitment to around 5GW of orders in the first three years from 1982/83, subject only to safety and planning consents.

11. We must expect opposition to this programme from environmental and other groups. There is inevitably a risk of delays in the construction of stations because of longer than usual planning inquiries or other protest action, and we shall need to consider the handling of inquiries carefully. But we cannot have a nuclear programme unless we are prepared to face criticism and give a lead, explaining the energy situation and providing reassurance about safety. There may be pressure to set in hand the special procedure for public consultation which the last Government promised on major questions of nuclear development. But I do not consider the basic programme to be the kind of development for which the procedure was intended and I propose to resist demands of this kind.

REACTOR SYSTEM

12. The last Government endorsed the intention of the CEGB to order one PWR station subject to the necessary design work, consents and clearances, but there was uncertainty about the extent of their commitment. In announcing the basic programme I believe we must give industry greater assurance about future PWR orders than they have so far received, if the PWR option is to be fully developed. I propose to explore with those concerned whether this can best be done by committing ourselves now, subject to safety clearance, to two rather than one PWRs as part of the initial orders; or whether we should devise a formula which, subject again to safety, envisages a substantial proportion of the programme being PWRs. It would be premature to commit ourselves in principle to one reactor system at this stage when no safety clearances for the PWR have been obtained, but I intend to return to this question again when the inquiry into the first PWR has been completed.

13. The aim is to start construction of the first PWR at the end of 1982. If this timetable is to be met, licensing arrangements should go ahead without delay.

The NNC are in favour of Westinghouse with whom they already have a licensing agreement which would be activated by an order or Letter of Intent for a PWR: see Annex C. My understanding is that the CEGB agree with this but they have not yet formally told me so. I propose to tell the parties that I agree that Westinghouse should be the licensors and urge them to make progress.

14. It is unfortunate that Westinghouse are involved in major litigation against Rio Rinto Zinc. But I do not believe that PWR licensing would be an effective weapon against Westinghouse, given that they are claiming $6 billion from RTZ and only stand to gain $15-30 million in design and construction fees and royalties on the initial PWRs. To require NNC to start from scratch with another licensor would be a serious setback to the nuclear programme. Annex C explains the background.

FINANCIAL AND ECONOMIC ASPECTS

15. The total capital cost to the CEGB of the basic nuclear programme in paragraph 10 is estimated as being of the order of £10-£12 billion but we would not be formally committing ourselves to all of this at this stage. The initial firm commitment to 5GW would represent £3-£4 billion (March 1979 prices).

16. Some of this expenditure would fall within the PES period and has been provided for in the industry's PES return. It would not therefore entail any additional bid. The main body of expenditure would occur after the PES period and would mean a capital requirement for the CEGB of some £1000 million per year towards the end of the 1980s. If, however, colleagues accept the proposals on financial targets and pricing philosophy which I am putting to them, most of this expenditure should be financed from the industry's own resources.

17. The CEGB consider that the fossil fuel savings attributable to nuclear generation more than outweigh the heavy capital costs of a nuclear programme, viewed over the lifetime of the stations in it. Independent calculations by my Department support this view. The calculations rest on a number of assumptions, and in particular on the generally held view that fossil fuel prices will continue to rise substantially in real terms between now and the end of the century. Experience with the construction of nuclear power stations in this country has not been uniformly favourable. However, the calculations are generally robust against other sensitivities such as time and cost overruns in construction and variations in the growth of electricity demand. The broad conclusion is that investment in nuclear stations fully meets the Required Rate of Return of 5% on new investment.

18. If the growth of electricity demand were to fall to a historically low compound rate of less than 1 per cent per year, and the basic nuclear programme were to be continued steadily, there would be a period in the mid-1980s when the CEGB were ordering plant which they would not have needed on the traditional basis of meeting incremental demand plus replacement needs and a planning margin. The effect of this would be to increase public expenditure by the order of £650 million per annum in the late 1980s. But the argument about the economic benefit of nuclear power would still hold good in these circumstances, and the situation would be in balance again by the end of the century.

19. More generally, there is a strong argument for a basic programme as insurance against a shortage of energy supplies either for domestic or international reasons. The CEGB generating system, for instance, is heavily dependent on coal since 70 per cent of its capacity is coal-fired; and the long-term uncertainty in world oil supplies is clear. On any realistic assumption we shall find it difficult by the end of the century to meet our energy needs at tolerable prices without a major contribution from nuclear power. The value of greater security in energy supplies cannot be quantified in the same way as expenditure or capital costs, but is no less important because of that.

20. A detailed financial assessment, agreed with the Treasury and the electricity supply industry, is in Annex D. Some additional expenditure of at least £1m. a year for extra safety work by the UKAEA will be needed, but I will take this up bilaterally with the Chancellor of the Exchequer. Expenditure by BNFL will also be required but it will be part of their normal commercial operations and investment, and is not expected to raise new financing issues.

ROLE OF NNC/NPC

21. If the basic nuclear programme is agreed, I believe we shall have a real chance of tackling the industrial problems with success. One of the main issues is the precise role of NNC/NPC, a source of friction with the CEGB's establishment at Barnwood, which must be clarified. Barnwood is the headquarters of the CEGB's Generation, Development and Construction Division, a large architect-engineering group with a staff of over 2000 and wide responsibilities covering fossil-fired as well as nuclear stations.

22. Design and construction companies have in the past taken total management responsibility for the construction of stations. Some of the main parties have, however, advised that, given the weakness of NNC/NPC, the company should for the time being concentrate on supplying the nuclear island and re-establish their reputation in this area. This is the role which has been agreed for them in relation to the new AGRs.

23. The main disadvantage of this approach is that it leaves the responsibility for overall project management with the CEGB whose activities are already extensive. Moreover, if adopted for the first PWR it could establish a pattern of responsibilities which could only be changed with difficulty and at some cost to our programme later on. The chairmen of the Electricity Council and the CEGB have both been careful not to rule out steady evolution in the role of NNC/NPC which would take the Company back into the broader construction field as confidence and the scale of our programme grows.

24. There is also the question of the relationship between NNC and manufacturing industry. It is clearly essential to a successful nuclear construction programme to have efficient arrangements for the manufacture of components to back it up. I believe that the basic programme which I am proposing will stimulate industry to ensure that it can meet demand. It is nonetheless for consideration whether NNC should be directly involved in manufacturing, either by setting up its own facility or by taking one over or by taking a direct stake in a component or plant manufacturer. While this cannot be decided at this stage, I believe these possibilities should be actively explored by the new NNC.

25. I believe we should do all that we can to encourage a steady evolution in the role of NNC/NPC, and not expand the activities of the CEGB or the size of the public sector. I therefore propose to say that while we accept the limitation of NNC/NPC's role to the nuclear island for the new AGRs, we nonetheless hope that the Company will be in a position to take on total managerial responsibility for the construction of the first PWR possibly with the help of consulting architect-engineers and of CEGB staff on sub-contract. Similarly, I propose to make it clear that while the arguments against immediate acquisition of a manufacturing facility are convincing, we recognise that the Company might well want to develop in this direction later on.

26. This approach is not likely to be welcome to the CEGB who will be reluctant to bear the financial risks of our nuclear programme while responsibility for construction of stations rests with a Company in which they lack confidence. But it is a fact of life that however the nuclear industry is reorganised the CEGB will ultimately have to bear these risks; and the NNC will never be strong until they have a true arms-length relationship with the CEGB, free from interference by Barnwood. We must insist to CEGB management that the size of their Barnwood

establishment should become smaller rather than bigger in the years ahead, and that they must co-operate in building up the role of NNC in accordance with Government policy. It will of course be open to them to negotiate financial arrangements with NNC which give the Company incentives to perform efficiently.

INVOLVEMENT OF GEC

27. A second major issue is the future role of GEC in the nuclear industry.

28. Several parties have made clear their dislike of GEC's present dominant position, and various possible changes in the share structure of NNC have been canvassed including the creation of a consortium in which the main industrial parties would each hold an equal interest. On the other hand, the original logic which led to a partnership with GEC is still strong. They are the only company in the nuclear field with the financial and management strength to pull the business together, and their effective withdrawal from the company would create a vacuum which no other party could replace. Whatever changes are made will have to be with their agreement because of their legal position.

29. I believe it would be wrong to change the present arrangements unless we have something better to put in their place. The precise size of individual shareholdings is not of major significance. What matters is that the company should be under strong direction, free from conflicting interests; and the present arrangements can be used to secure this if Government and GEC act together.

30. I propose therefore to ask GEC to maintain their shareholding at its present level and to urge them, now that we have a basic nuclear programme, to use their very best efforts to give new vigour to the company and its management. I shall assure them that these efforts will have the full support of the Government, as the other major shareholders. If later we decide to sell some of the Government shares we shall be contractually bound to offer them first to GEC, but to do so at this stage would be provocative to other interests and is not necessary.

31. GEC's supervisory management agreement with NNC has not proved a satisfactory arrangement and, provided we can agree on a new strong Board, GEC would be content to end it. I think we should accept this. It has been a needless source of friction and all parties have advised me that it should be ended.

32. Once the supervisory agreement has ended, a number of other changes can be put in hand. The NNC and NPC can be merged into a normal Company with a single-tier structure. The Board of NNC can be reconstituted and strengthened. The question of a new chairman and managing director can be considered. And, if GEC are content, the shareholders of BNA can be allowed to hold their shares in NNC directly as they wish. These are all matters I shall pursue urgently with GEC.

DARH

October 1979

ANNEXES

ANNEX A - ENERGY PROJECTIONS

ANNEX B - NATIONAL NUCLEAR CORPORATION

ANNEX C - PWR LICENSING ARRANGEMENTS

ANNEX D - FINANCIAL AND ECONOMIC ASPECTS

ENERGY PROJECTIONS

1. North Sea oil and gas supplies are expected to begin to decline in the 1990s, following the period of net energy self-sufficiency in the 1980s. The Department of Energy's projections suggest that even with over 30 GW of new nuclear orders in the period 1982/82, representing about twice the proposed basic nuclear programme, the UK would still become a substantial net importer of energy once again by the year 2000.

Energy Balance

2. The projections assume an economic growth rate of between 2% and 3% p.a.. After allowing for substantial savings from energy conservation total demand for energy is projected to be 25% to 40% higher in the year 2000 than it is now, an increase equivalent to 85-150 million tonnes of coal (m.t.c.e.).

3. In the last decade of the century the UK should still be meeting a higher proportion of its fuel needs from indigenous sources than in 1977, taken as the base year in the table below. But the situation will be a rapidly changing one for, on present estimates of oil and gas reserves, supplies from the North Sea will be declining sharply. Renewable energy sources are not expected to make any significant contribution by the end of the century and this means that coal and nuclear power will have to be expanded to meet the decline in oil and gas production as well as the growth in demand.

4. The coal industry is currently investing in new and modern production capacity to replace older and less economic existing capacity. The Department's assessment is for an increase of 10% to 30% in coal production from 1977, representing 15-33m tonnes net increase of new capacity over exhaustions by the year 2000.

5. Nuclear capacity in the year 2000 is put at a maximum of 40 GW, (about 95 mtce) of which about 8 GW (or 20 mtce) represents capacity already ordered or under construction that will still be operating. This upper limit is low in comparison with those which are sometimes made for the year 2000, and a higher nuclear contribution would on some assumptions be desirable. But the limit represents approximately a fourfold increase on capacity already installed or under construction and, given the present weakness of the nuclear industry, the lack of a thermal reactor system readily available for series ordering and the long lead times involved in power station construction, will not be reached without very great efforts.

UK PRIMARY ENERGY BALANCE

m.t.c.e.

	1977	1990	2000
Demand	360	410-435	445-510
Indigenous Supply			
Coal	122	127-138	137-155
Gas	60	68-71	62-65
Oil	65	153	100
Nuclear and Hydro.	16	34-35	88-95
Total	263	280-395	390-410
Net Fuel Imports	97	15-50	35-120

NOTES 1. Hydro represents. 2% or less

2. Figures do not add vertically, primarily because of rounding.

6. The projections show a net import requirement of 35 to 120 m.t.c.e. in the year 2000, equivalent to some 20 to 70m tonnes of oil, at a time when oil supplies on international markets are expected to be becoming increasingly scarce and expensive. On the assumption that oil prices will rise about 2½ times in real terms by the end of the century it would cost £2.5–8.5 billion at 1977 prices to meet this requirement through oil imports.

Electricity

7. The full nuclear contribution of 40 GW assumed as a maximum by the Department (see para 5 above) might mean that about half of the UK's electricity was supplied from nuclear stations in the year 2000. This would imply some reduction in power station coal-burn from the levels reached in 1990. But during the 1990s as oil and gas become increasingly scarce and expensive, new markets are expected to be opening up for coal in industry. By the end of the century there could also be a developing market for coal for the manufacture of substitute natural gas.

UK POWER STATION FUELLING

m.t.c.e.

		Higher Case		Lower Case	
	1977	1990	2000	1990	2000
Coal	79½	94	78	89	66
Oil	18	19	13	16	10
Nuclear and Hydro	16½	35	95	34	88
Gas	2	0	0	0	0
TOTAL	116	147	186	140	163

Department of Energy
October 1979

ANNEX B

NATIONAL NUCLEAR CORPORATION

1. The present structure of the nuclear industry was negotiated in 1972-3.

THE FORMATION OF NNC

2. Previous reorganisations had cut the number of consortia in the nuclear industry from five to two. The consortia remaining in 1972 were:

a. The Nuclear Power Group (TNPG) based at Risley and owned by the UKAEA (20%), Reyrolle Parsons Ltd (20%), Clarke Chapman (20%), McAlpines (20%), Head Wrightson (10%), Strachan and Henshaw (5%) and Whessoe (5%); and

b. British Nuclear Design and Construction Ltd (BNDC) based at Whetstone and owned by the UKAEA (20%), DTI (26%), Babcock and Wilcox (25%), GEC (25%) and Taylor Woodrow (4%).

3. The then Government decided in 1972 to encourage the nuclear design and construction industry to consolidate into a single strong unit based on the National Nuclear Corporation (NNC) whose operating subsidiary, the Nuclear Power Company (NPC), was to take over the responsibilities of TNPG and BNDC and was to be under the general supervision of GEC.

4. The thinking behind this policy was as follows.

a. The industry had failed with the AGR programme and had to be strengthened. The UK neither needed nor had the resources for more than one company. Hence the need for a single organisation.

b. GEC were the only existing participants in the industry with the financial and managerial strength to provide effective leadership or to supervise NPC. They were therefore offered a partnership with Government in NNC, with a shareholding and associated rights which reflected this.

c. The Government were to continue to control reactor choice through the Generating Boards' programmes. In addition, they were to share control of the Company with GEC and have reserved rights in NNC's activities on matters affecting the national interest (international relations, open purchasing etc).

d. The other private shareholders in the consortia were offered a minority interest in the NNC with restricted rights on the basis that, as manufacturers of nuclear and conventional plant, they would benefit from a continuing link particularly overseas, but would have no role in the direction of its affairs. All but one joined the consortium, British Nuclear Associates (BNA), which held this interest: see para. 7 below.

5. Both NNC and NPC were formally incorporated in June 1973. NPC became fully operational in May 1975. The rights and duties of the parties were defined and safeguarded in nearly a dozen binding legal agreements to many of which Government is a party.

NNC SHARE STRUCTURE

6. The equity capital of NNC is £10 million. It was originally held as follows:

GEC 50 per cent: UKAEA 15 per cent: BNA 35 per cent.

Following the SGHWR decision in 1974, GEC asked to reduce their shareholding, while agreeing to continue with their supervisory role. The position is now:

GEC 30 per cent: UKAEA 35 per cent: BNA 35 per cent.

The UKAEA and GEC have each agreed to give the other first option on any shares they wish to sell.

7. The members of BNA, and the proportions of NNC capital represented by their shareholdings in BNA, are:

Babcock and Wilcox	12%
Clarke Chapman	10%
Taylor Woodrow	5%
Head Wrightson	3%
McAlpine	2.5%
Whessoe	2%
Strachan and Henshaw	0.5%

DIRECTORS

8. As long as the existing share structure of NNC is maintained:

a. the GEC appoint three out of the ten directors on the NNC Board;

b. the AEA appoint four directors to the Board (two on the recommendation of GEC as long as the Supervisory Agreement continues);

c. the AEA appoint the Chairman of the Board;

d. the remaining three directors are appointed by the shareholders in general meeting, subject to the agreement of both GEC and AEA.

9. The present members of the NNC Board are:

Chairman	Appointed by
Lord Aldington, also deputy chairman of GEC	UKAEA, both as director and chairman.
Deputy Chairman	
Lord McFadzean	UKAEA, nominated as deputy chairman by the NNC Board.
Other members	
Sir Richard Powell	UKAEA
Dr Walter Marshall, deputy chairman of the UKAEA.	UKAEA

Other members	Appointed by
Mr David Lewis, vice-chairman of GEC	GEC
Mr John Rogers, employee of GEC	GEC
Sir John King, chairman of Babcock and Wilcox and of BNA	GEC
Dr Ned Franklin, chairman and managing director of NPC	Shareholders in general meeting.
Two vacancies.	

SUPERVISORY AGREEMENT

10. All parties - the GEC, the AEA, the NNC, the BNA and the Secretary of State - agreed in 1973 that the business of NPC should be under the general supervision of GEC, on terms to be agreed from time to time between GEC and the NNC Board. NNC and GEC have implemented this by entering into a Supervisory Management Agreement. The Agreement is currently being renewed on a monthly basis.

11. GEC have the right to require the AEA to buy some or all of their shares within 6 months of termination of the Supervisory Agreement (provided they give the necessary notice before 11 July 1980). There are extensive detailed provisions regarding the price which the AEA would have to pay for shares if GEC decided to exercise this right.

RANGE OF ACTIVITIES

12. The authorised activities of NNC and NPC are the design, construction, management and co-ordination of construction of nuclear and other power stations and incidental activities (including manufacture) and the sale, but not manufacture, of nuclear fuel. These are set out in their Memoranda of Association.

13. In practice the main tasks of NNC/NPC since they were set up have been:

a. completion of the first AGR programme. Two of these five stations (Hinkley B and Hunterston) have been finished, three are still under construction (Dungeness B, Heysham and Hartlepool).

b. design and development of the commercial SGHWR announced in 1972. This work was cancelled in January 1978;

c. design and construction of the nuclear islands for the two new AGRs at Heysham and Torness;

d. design work on the fast reactor. This work, financed by the Department, has mainly been conducted on a short-term basis with tight manpower constraints, pending decisions on the CDFR. A two-year contract has now been agreed;

e. construction of an oil-fired 1900MW station for the SSEB at Inverkip. This station has been successfully completed;

f. completion of other outstanding commitments, including the design, procurement and erection of items of the balance of plant outside the nuclear steam supply system for Ko Ri II, a 595MW Westinghouse PWR in Korea.

Dept. of Energy
8 October 1979

ANNEX C

PWR LICENSING ARRANGEMENTS

1. The NNC, with the approval of Government, entered into a licensing agreement for PWR technology with Westinghouse in 1975. Following the decisions on thermal reactor strategy announced in 1978, they have once again reviewed the possible licensors and have concluded that their relationship with Westinghouse should be maintained. This annex gives the background.

THE 1975 AGREEMENT

2. When NNC and NPC were formed in 1973 they held discussions with major overseas suppliers of Light Water Reactors (LWR) to explore the possibilities for introducing the technology into the UK. They concluded that the Pressurised Water Reactor would be the best form of LWR for use in this country and that they could obtain satisfactory licensing arrangements from Westinghouse if Government selected this reactor system.

3. In the event the SGHWR was chosen in 1974, but at the same time the Government initiated a generic review of PWR safety by the Nuclear Installations Inspectorate (NII). In order to obtain the technical information needed for this exercise the NNC, with the agreement of Government, entered into a formal arrangement with Westinghouse in 1975 which gave the NII access to what they needed but also provided for the automatic activation of a full licensing agreement with Westinghouse in the event of NNC ever receiving an order or a letter of intent for the construction of a PWR in the UK. British Nuclear Fuels Ltd entered into a parallel agrangement with Westinghouse in respect of PWR fuel at the same time.

4. The standard Westinghouse design of PWR (an 1100 MW, four-loop unit) was also used as the basic model of PWR for the detailed Thermal Reactor Assessment which the NPC carried out in 1976/77.

FINANCE

5. The financial terms of the Westinghouse agreements are complex but in essence:

a. approximately £1.2m becomes payable for each of the first three Nuclear Steam Supply Systems (NSSS) ordered in the UK, payable soon after the orders are placed;

b. a further £1.5m is payable for each NSSS soon after the receipt of the first progress payments;

c. a further 55£ per KW (thermal) is payable in instalments thereafter.

An escalation clause tied to US indices of inflation backdated to December 1973 comes into operation for (b) and (c) three years after the Agreements come into effect.

6. The total sum payable to Westinghouse in design fees, construction fees and royalties under the NNC's agreements with them could be between £15-30 million for the first three PWR orders, the precise amount depending on timing and other factors. Payment for services provided by Westinghouse would be additional to this figure above a certain minimum level.

PWR DECISION 1978

7. In January 1978 the last Government announced that they had decided to develop the option of adopting the PWR system in the early 1980s. The electricity supply industry had indicated that, to establish the PWR as a valid option, it

wished to declare an intention that, provided design work was satisfactorily completed and all necessary Government and other consents and safety clearances had been obtained, it would order a PWR station. The Government endorsed this intention.

8. The statement made it clear that this intention to order a PWR did not call for an immediate order or a Letter of Intent. The Westinghouse licensing agreement has not therefore been activated as yet. But it is still in force and will be triggered automatically when a firm order or Letter of Intent is placed.

SECOND NNC REVIEW

9. Following the 1978 decision the NNC/NPC carried out a further review of possible licensing arrangements.

10. There are four companies which have developed their own commercial PWR units: Westinghouse, Combustion Engineering and Babcock & Wilcox in the United States and Kraftwerk Union in Germany. The French company, Framatome, uses Westinghouse technology under license.

11. Of these companies Westinghouse are pre-eminent in a number of important respe

a. they have supplied many more PWRs than any other PWR vendor, both at home and overseas, and have many more units under order: see the Table below;

b. they are the only company to have issued licenses for PWRs to major companies in other countries and their experience of introducing PWR technology is substantial (e.g. in Japan, Germany, France, Spain, Italy, Sweden, Switzerland);

c. their experience of manufacturing components for PWRs is also outstanding.

12. In addition, given the NNC's 1975 Agreements with Westinghouse there are a number of further arguments for licensing their technology in the UK.

a. Both the NPC and the NII now have a good basic knowledge of the Westinghouse PWR, including its safety and performance characteristics, and have had some experience of a close working relationship with Westinghouse.

b. Turning to another licensor would not only be a breach of commercial good faith but could involve the NNC in double payments because of royalties and fees which would automatically become due to Westinghouse regardless of whether their technology was used.

c. Setting up arrangements with another licensor would inevitably require lengthy negotiations which could seriously delay the first PWR in the UK.

d. NNC consider the financial terms of the Westinghouse agreement to be favourable to them.

13. The French have on a number occasions expressed interest in the possibility of supplying a PWR license to the UK. But NNC's assessment is that:

a. if we attempted to form a relationship with the French independently of Westinghouse we should be obliged to wait until the existing agreement between the French and Westinghouse came to a conclusion in 1982 (negotiations to bring forward this date have not, as far as we know, been concluded);

b. NPC could not expect to go forward with many of the preparations for the first PWR until the licence agreement had been concluded and the start-on-site would be delayed until 1984/85;

c. there is good reason to believe that in any agreement with the French there might be substantial restrictions on their passing information originally derived from Westinghouse; and

d. the French have no experience of licensing PWR technology to other countries.

14. The last three objections also apply in the case of Kraftwerk Union (KWU) And although KWU have now evolved their own design of PWR, their basic technology is still derived from Westinghouse with whom they had a licensing agreement over a long period.

15. In view of these arguments the NNC have made a recommendation to the CEGB that the development of the PWR in the UK should be based on Westinghouse technology. This need not, however, preclude an arrangement with European companies for the procurement of NSSS components.

PWR SALES AUTUMN 1979

VENDOR	UNITS ORDERED			UNITS OPERATING		
	Units	MW(e) (nett)	Units over 1000 MW	Units	MW(e) (nett)	Units over 1000 MW
Westinghouse						
U.S.	50	55938	44	26	19033	6
Overseas & licensees	86	80752	15	23	15298	2
Total	136	136690	59	49	34331	8
Combustion Engineering						
U.S.	22	26399	21	8	6394	0
Overseas	-	-	-	-	-	-
Total	22	26399	21	8	6394	0
Babcock & Wilcox						
U.S.	19	20229	11	10	8150	0
Overseas	2	2515	2	-	-	-
Total	21	22744	13	10	8150	0
Kraftwerk Union (PWR)						
Germany	12	15201	12	7	6362	3
Overseas	10	12150	8	2	1370	-
Total	22	27351	20	9	7732	3

ANNEX D

NUCLEAR POWER PROGRAMME: FINANCIAL AND ECONOMIC ASPECTS

CAPITAL COST

1 The Electricity Boards' latest estimates for the cost of stations in their capital programmes, excluding interest during construction, are based on the updating of work done by the National Nuclear Corporation (NNC) for the Thermal Reactor Assessment prepared for the last Government and are:

	Heysham II/ Torness AGR (1222 MW) £/kw sent out	First PWR (2190 MW) £/kw sent out
Station Costs	674	579
Initial Fuel Charge	74	66
	748	645

This yields figures of £915m for Heysham II, a similar amount for Torness, and £1413m for the first PWR. These figures may well rise in the light of tenders received.

2 For the purpose of assessing the economic benefit in the manner set out below, capital cost is calculated exclusive of interest during construction and of the initial fuel charge, and on the basis of series ordering of stations. The figures are:

	Net capacity MW sent out	£/kw
PWR (1 x 1100 MW (e) reactor, 2 turbine generators)	1095	546-633
AGR (2 x 660 MW (e) reactors, 2 turbine generators)	1222	694-779
Coal-fired (3 x 625 MW SO units)	1875	427

ECONOMIC BENEFIT

3 The economic benefit of a new station to the Generating Board is assessed by calculations which take account of its effect on all other stations in the system. The CEGB system is at present dominated by fossil-fired generating stations, with coal-fired capacity accounting for 70% or so. Nuclear stations have much lower fuel costs and displace fossil fired plant in the power station merit order. Using a test discount rate of 5% in real terms, the CEGB calculate that over the life of a new nuclear station, its total cost, both capital and running costs, will be outweighed by the fuel savings in other stations which it will make possible. Thus, although the initial capital cost of a

nuclear station is higher, kilowatt for kilowatt, than that of a fossil fired station, the cost savings to the system as a whole over the life of the nuclear station make it the better economic choice. The CEGB call the net sum of capital cost less resultant savings the Net Effective Cost of capacity. In paragraph 4 of Appendix 1 they show that this is negative for nuclear stations. The Department of Energy has carried out calculations which arrive at similar results. These conclusions remain valid even if it is assumed that there is no growth in electricity demand during the life of the new nuclear station, and that the CEGB's planning margin is reduced from the present 28% to 20%.

4 The calculation of the net benefit of a nuclear station rests on a number of assumptions and is subject to large uncertainties. The most important underlying assumption is the generally held view that fossil fuel prices will continue to rise substantially in real terms between now and the end of the century. Assumptions have also to be made about construction costs and periods, the performance of the nuclear stations when commissioned and the growth of electricity demand. The conclusion that the total lifetime benefits of a nuclear station, discounted at 5%, exceed the total lifetime costs, is robust against considerable uncertainties. This is demonstrated by the calculations made available to the Department by the CEGB, displayed at Appendix 1. Here, the (a) column in paragraph 6 shows the adverse change required in each individual basic assumption for it to cause lifetime costs to outweigh lifetime benefits. The (b) column however shows the further change required in each basic assumption for it to mean that the Net Effective Cost of introducing nuclear plant exceeds that of keeping older plant on the system. Extending the life of older plant can only be a temporary expedient, so Table 1 compares the costs and sensitivities of both types of nuclear station against a new coal-fired station. If the Net Effective Cost is assessed as negative, this indicates a strong economic case for the investment.

5 Experience with the AGR programme of the late sixties and early seventies has not been satisfactory. Construction delays and cost over-runs have in some cases exceeded those postulated in column (a) of paragraph 6 of Appendix 1. However, the Heysham II AGR is based on Hinkley Point and Hunterston, the two most successful stations in the programme, and should benefit from experience with them.

6 There is as yet no PWR experience in the UK on which to draw.

ELECTRICITY DEMAND AND THE PLANNING MARGIN

7 The electricity supply industry's present adopted load forecast for England and Wales shows increases in Simultaneous Maximum Demand (SMD) averaging 2.2% per year compound over the

planning period to 1985/6. This compares with 2.1% over the period 1975-6/1978-9. The industry also allows for a planning margin which aims at the maintenance of generating security standards in the light of forecasting error, plant breakdown and divergences from "normal" weather conditions. The load forecast plus the planning margin (now 28%), plus expected closures of old plant, are the principal factors in determining the need for power station orders. On the basis of the present load forecast, the CEGB would, from 1982 on, envisage placing orders during their planning period in excess of the 1.5 GW per year "basic nuclear programme". In a low growth case, if demand growth were to fall to just less than 1% per year, and the basic programme of 1.5 GW of nuclear orders per year were to be continued, this would mean that plant was being ordered in advance of need. The chart at Appendix B demonstrates this, and also shows that the situation would be in balance again by the end of the century.

8 The need for replacement capacity depends on many factors, including economic appraisal of refurbishment of existing plant. However, the existing 4 GW of Magnox stations will be retired between now and the end of the century. New nuclear capacity of that order will therefore be required simply to maintain the proportion of nuclear electricity in the system.

9 A "basic programme" would be a break with previous methods of determining power station orders, and if demand growth was low, would mean ordering in advance of need and thus advancing public expenditure. The amounts so advanced could be of the order of £650m in the late '80's. There may be circumstances in which the Government would not wish that to be done, even though it offers the long term economic benefits, in particular fuel saving, set out in paragraphs 3 and 4 above.

PUBLIC EXPENDITURE AND ELECTRICITY PRICES

10 Appendix 3 sets out the capital expenditure of the CEGB over the years 1984/85, and shows it to be within the PES provision discussed between the Chief Secretary to the Treasury and the Secretary of State for Energy on 25 September. The table ignores working capital, which is subject to short term fluctuations: it includes expenditure on the basic nuclear programme as well as other capital expenditure by the Board. As pointed out above, the adoption of a basic programme could mean that some of the expenditure was being incurred in advance of need; the extent to which that occurred would depend on the rate of load growth.

11 The internal sources for capital spending are depreciation and profits. The industry has recently put proposals to the Government for the adoption of a financial target calling for a gradually increasing rate of return on assets revalued on current cost (CCA) basis. The proposals, which span the next 5 years, should achieve, or come very close to achieving, full economic pricing on the basis of long run marginal cost (LRMC)

during that period. On the assumption that the Government accepts that the electricity supply industry should move towards prices based on LRMC, and that the competitive environment enables them to apply this philosophy during the 1980's, the basic nuclear programme of 1.5 GW per year should be capable of being financed largely from the CEGB's internal resources. Examination of the capital requirements of Area Boards and their internal resources suggests that the financing position for the industry as a whole would be broadly similar. However, if the electricity supply industry did not move towards full economic pricing, they would need to borrow extensively to finance the programme. This would increase public expenditure, perhaps by some hundreds of millions of pounds.

12 The implications for expenditure by the AEA and BNFL are discussed in Appendix 4.

PAPER BY THE CENTRAL ELECTRICITY GENERATING BOARD

Economic Appraisal of New Nuclear and Coal-fired Power Stations

1 The economics of new nuclear and coal-fired power stations have been evaluated by calculating the net effective cost (NEC), in £/kW per annum, of each new station type. The NEC gives the net cost (if positive) or benefit (if negative) of adding a new station to the system, taking into account all cost consequences, both to the new station and to the other stations on the system, throughout the construction, lifetime and decommissioning of the new station. Thus the station with the lowest NEC is economically the most attractive.

2 The NEC's set out below, for central estimates of input parameters and for a wide range of sensitivities, have been updated and are expressed at March 1979 price levels. They confirm that the choice of nuclear plant remains a robust one.

Background data and assumptions

3 The key parameters are (all prices and costs at March 1979 price levels):

(a) Test Discount Rate: 5%

(b) Fuel Prices:

		1986/7	1990/1	2000/1
Coal (NCB). Pithead price p/GJ		146	155	187
Heavy Fuel Oil. Ex-Ref taxed p/GJ		179	200	245
Nuclear	AGR £/MWh	3.7	4.0	4.7
	PWR £/MWh		3.8	4.7

(c) Capital Costs (for settled-down stations, excluding introduction costs):

	MWso	£/kW
PWR (1 x 1100 MW reactor, two turbogenerators)	1095	546/633
AGR (2 x 660 MW reactors, two turbogenerators)	1222	694/779
Coal-fired (3 x 625 MWso units)	1875	427

(d) The evaluation assumes that all the large 500 MW units and above coal-fired stations are kept fully operational on the system over a 40 year lifetime period.

The Economic Appraisal

4 Based on these input estimates, the NEC's of new plant are as follows (March 1979 prices):

	£/kW pa
PWR	-42/-35
AGR	-27/-20
Coal-fired	19

The economic advantage of nuclear plant is clearly shown. This will persist until the total nuclear plant on the system considerably exceeds that needed to meet base load. The fact that the NEC's of new nuclear plant are negative means that the savings from being able to burn less coal and oil on other stations exceed the whole lifetime capital and operating cost of the new nuclear station. In other words, it is economic to install new nuclear plant on energy cost saving alone. The NEC of successive new nuclear stations is estimated to remain negative up to about the year 2000.

5 A wide variety of sensitivities have been examined and these are summarised in the attached table. Among other things, they show that, even for widely differing assumptions on future fossil fuel prices, nuclear retains its economic advantage over coal-fired plant. The implications of possible cost over-run or performance shortfall are further developed in the next section.

Sensitivities to Shortfall in Performance

6 The above analysis indicates that it pays to build nuclear plant on grounds of energy cost savings alone. But in fact construction of new nuclear plant allows a further saving - the advancement of the retirement of old low thermal efficiency fossil-fired plant, which would save, typically, about £12/kW per annum. Thus the real test of the economics of new nuclear plant is that, under a wide variety of assumptions, its NEC remains below the cost of keeping old plant in service. The following table shows the increase in key cost and performance parameters needed to bring the NEC's of the AGR or PWR up to (a) zero and (b) the cost of keeping old plant in service, at £12/kW pa.

/over

	(a) Increases needed to raise NEC's to zero		(b) Increases needed to raise NEC's to £12/kW pa	
	AGR	PWR	AGR	PWR
Total Construction Cost increased by:	40%	80%	60%	110%
Nuclear island cost increased by:	80%	160%	120%	220%
Shortfall in rated output of:	30%	45%	40%	55%
Delay in Commissioning:	5 years	7 years	7 years	9 years

Summary

7 In conclusion these results show that new nuclear plant is the preferred economic choice and will pay for itself by energy cost saving and savings from early retirement of old plant, irrespective of the exact level of demand growth. This choice is robust against large uncertainties. Even so, it is vitally important to continue to take all steps to achieve timely commissioning to cost, and good lifetime performance, from new nuclear stations and this must be borne in mind when considering reactor choice.

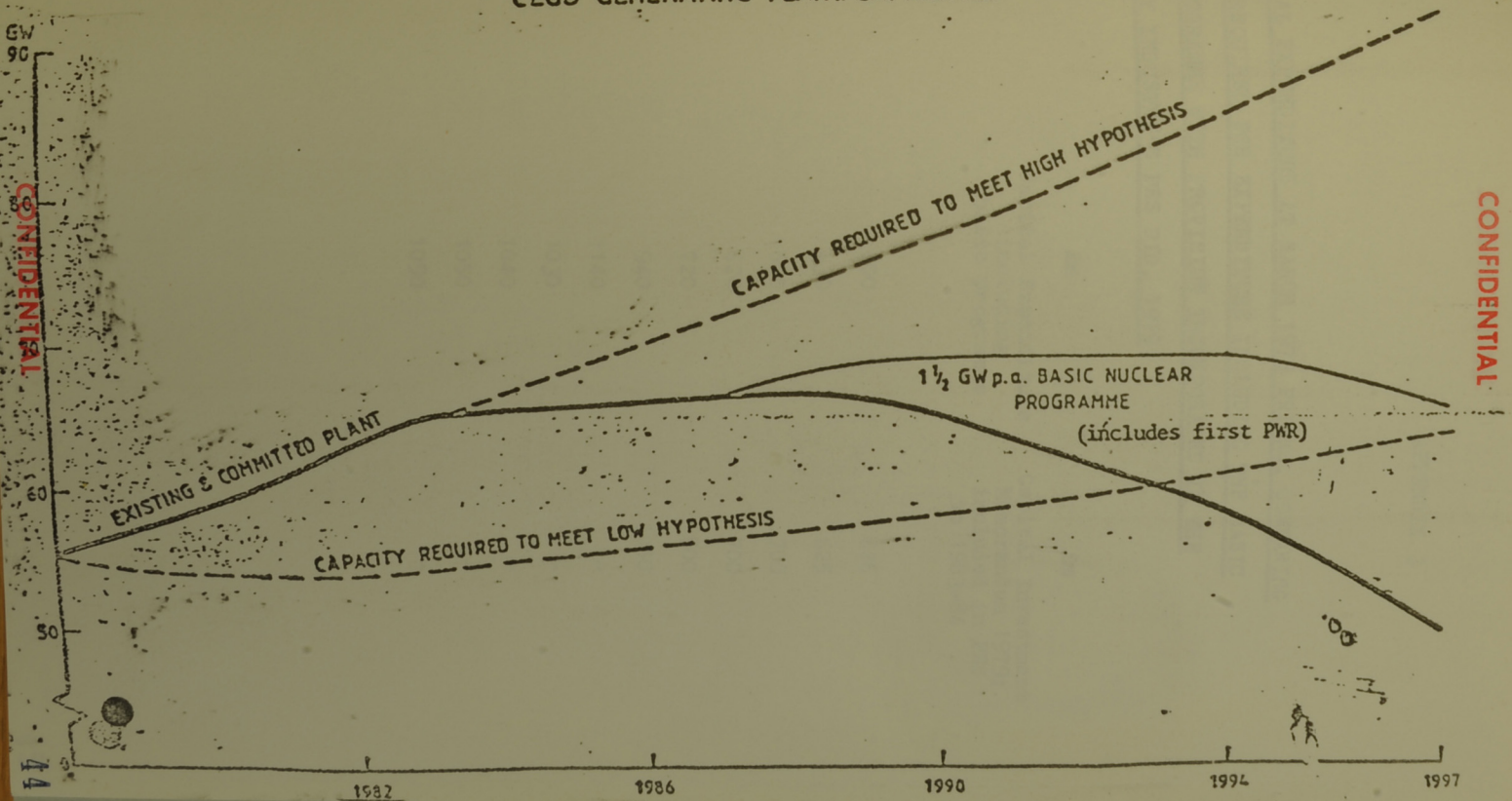
TABLE I

Economic Sensitivity of Typical Plants

(Assuming 5% t d r)

	PWR	AGR	Coal-Fired
NEC £/kW pa	-42/-35	-27/-20	19
Sensitivity of NEC to plant related factors £/kW pa			
a) Generation capital cost +10% OR Station rated output 10% decrease	+4½/+5½	+6/+6½	+3½
b) Commission 12 months late	+7	+7	+2
c) Lifetime average annual station availability - 4% points decrease	+6	+6	+1½
Sensitivity of NEC to background assumptions (affects all stations) £/kW pa			
e) Coal price - 20%	+15	+16	-3
f) Oil price - 20%	+9	+9	+9
g) Coal and oil price - 20%	+21	+21	+3
h) Total nuclear fuel cycle cost + 20% OR Alternatively, uranium price up 60%	+5	+5	0

CEGB GENERATING PLANT CAPACITIES



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APPENDIX 3

CEGB CAPITAL EXPENDITURE AT MARCH 1979 PRICES, COMPARING PROVISION REQUIRED FOR EXPENDITURE INCLUDING THE BASIC NUCLEAR PROGRAMME WITH PROVISION INCORPORATED IN THE ELECTRICITY INDUSTRY'S PES BID, 1979

	£m Capital Expenditure including basic programme	£m Capital Investment Memorandum 1979; included in PES to 1983-84
1979-80	600	626
1980-81	630	625
1981-82	600	700
1982-83	620	700
1983-84	720	800
1984-85	940	1050
1985-86	1140	-
1986-87	1030	-
1987-88	1040	-
1988-89	1050	-
1989-90	1090	-

VOTE FUNDED EXPENDITURE ON THE PWR

1. Against the background of the last Government's decision to develop the PWR option, the UKAEA advised that in parallel with the development of the PWR in the UK they should carry out a programme of research and development on PWR safety to support the preparation of a safety case by CEGB and NNC and its assessment by the Nuclear Installations Inspectorate. The UKAEA's proposals cannot however be finalised until they have talked to the main parties about what is needed in the light of the basic programme and agreed licensing arrangements. They estimate the cost of their present tentative proposals as follows (September 78 prices);

1980/81	1981/82	1982/83	1983/84	
4.3	4.2	4.4	4.5	£ million

2. Much of this expenditure could be accommodated within the UKAEA's existing financial provision but to absorb it all would affect the fast reactor or other programmes which are already under pressure. The UKAEA have therefore sought the following increases in their existing baseline.

+1.2	+1.5	+1.5	+1.5

3. British Nuclear Fuels Ltd will also need in due course to activate their license agreement with Westinghouse for the manufacture of PWR fuel and to begin investment in manufacturing facilities during the PES period. This expenditure is not, however, expected to raise new financing issues. The total cost of a manufacturing facility is estimated at £12 million, assuming a plant capacity of 200-300 tonnes per annum (a likely size), and will form part of their normal investment pattern. Activation of BNFL's licensing agreement with Westinghouse will cost £6 to 12 million, together with a continuing liability for royalties on some products.