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N Sanders Esq
Private Secretary to the
Prime Minister
10 Downing Street

7 May 1980

Dear Nick,

Thank you for your letter of 9 April about Walt Patterson's Guardian article of April 7th. I attach a Note and Annexes commenting on the article; it has taken a few days to carry out the work on which the assessment is based.

Yours ever,

Denis

Denis Walker
Private Secretary

Prime Minister

You won't want to read all of this. In brief, the Magnox programme has turned out to be a good investment even at the lower than designed output. But this would not have been the case if oil and coal prices hadn't escalated after 1973/74.

-7 [illegible] 1980

COMMENTS ON WALT PATTERSON'S GUARDIAN ARTICLE OF 7 APRIL

Walt Patterson's article in the Guardian of 7 April - "Britain Cooking the Nuclear Books", claims that the often quoted success of the Magnox programme is a myth; and that the programme has proved a costly and misguided policy saved only by the effects of inflation. He says that if technical problems currently affecting some of the Magnox stations were to force early closure, even inflation will not have saved the programme.

Background

2. The two main reasons advanced in favour of a Magnox programme in the 1950s and 1960s were expectations of competitive costs by comparison with coal and oil stations and the need to hedge against uncertain fossil fuel supplies. Electricity demand forecasts made at the time implied rapidly rising fuel requirements and, particularly after Suez, there was a desire to avoid the risks of undue dependence on oil imports and pressure on the balance of payments. (See Annex A for successive statements).

Accounting Costs

3. In the event Magnox costs (including interest during construction) in terms of money of the day remained above those of fossil fired stations until 1973/74 when escalating oil and coal prices raised fossil fired costs well above the Magnox level. Taking the whole period from commissioning the first Magnox station in 1962 up to 1978/79 it can be shown that the CEGB's 8 Magnox stations had saved £100 - £150m in money of the day terms compared with coal fired electricity produced from other new plant that might have been constructed instead, costed on the basis of actual experience with coal stations comparable in size and age to each of the Magnoxes. (Calculations made by the CEGB on this basis are described in greater detail in Annex B). This estimate of savings is conservative because some of this other plant would almost certainly have been fired by oil rather than coal and its generating costs after 1973 would have been higher still.

4. Leaving this point aside, and assuming that the Magnox stations continue to operate reasonably during the remainder of their 20 years design life, additional savings from 1978/1979 onwards, compared with the alternative coal fired stations, could be of the order of £300m (1978/79 prices discounted at 5%, the currently required rate of return). But if coal prices are assumed to continue rising gradually in real terms as both the Department of Energy and the CEGB expect, the additional savings could turn out even higher - a 1% p.a real increase in coal prices increases by £75m the total savings realised from having Magnox.

5. If the Magnox stations were to continue operating beyond 20 years (the CEGB have said that they believe this is not improbable, despite current problems at Dungeness and Bradwell) even larger savings would be achieved; for example a 25 year life as opposed to 20 years could double the savings to come. Patterson however suggests the possibility that all Magnox stations could be closed down early. If all were to cease providing electricity from next year onwards the cost of the Magnox programme would be equivalent to the coal fired alternative when the resources used are assessed at their contemporary costs.

Revalued Costs

6. Because of inflation, calculations based on historic cost accounting as above inevitably overstate the true profitability of capital intensive projects. Basing the comparison instead on costs revalued in present-day terms understates the benefits to capital intensive projects unless borrowing and other financial liabilities are also revalued. Furthermore, revaluing after the event ignores the benefits of the Magnox programme in spreading risks (political, economic and technical) and moderating the effect of rising fossil costs on electricity supplies to consumers, factors which must have been taken into account by the decision takers of the time.

7. Revaluing to present-day costs without a gearing adjustment would show a small advantage to coal. On a similar basis if coal prices are

assumed to increase by 2% per annum in real terms over the remaining years of Magnox life, costs would come out at about the same for both Magnox and coal; with a gearing adjustment there would be a positive benefit from Magnox.

8. Whilst there can be no conclusive answer because both of the two approaches discussed have their limitations, on both approaches the reactors appear to have been a good investment for the Board.

De-Rating

9. De-rating the Magnox stations does not affect the cost comparisons, which are based on the total capital costs incurred spread over actual outputs. (Current compared with design ratings are shown at Annex C). Patterson suggests that de-rating from design capability has led to a misleading view of Magnox performance - "cooking the books". It is true that statistics of performance comparing plant output with capability to generate are affected by de-rating which appears to improve performance. On the other hand it is common practice for performance to be calculated in this way and the European Commission Statistics, to which Patterson refers, are requested on this basis and supplied by Member Countries uniformly by relation to de-rated rather than to design capacity.

Plutonium Credit

10. In the same vein Patterson claims that the original forecast of Magnox costs was misleading as it included a substantial credit for plutonium sales. Whilst this is true for the early projections of Magnox costs (see Annex A) the practice was discarded and subsequent decisions on an extended Magnox programme were based on cost estimates that included a negligible credit only; the point is not therefore valid.

Conclusion

11. Patterson has been selective in the evidence he presents. Throughout he imples that costs are the only factor that should have

influenced policy and that it should have been clear by the 1960s that Magnox was more costly and technically poorer in performance than those concerned had hoped. He omits to say that by that time most of the orders for the programme had already been placed. Given the knowledge available at the time of decision Magnox offered potential benefits in terms of system flexibility and a hedge against inflation and other risks from which consumers have benfitted in the event. He has in fact ignored one of the mainsprings of the policy - the need to diversify fuel supply, to reduce dependence on imports and to protect the balance of payments, all important policy objectives at the time.

12. The Magnox programme has certainly not been "a fiasco". The developments of the 1970s could not have been foreseen in the 1950s; the Magnox programme can be shown to have produced savings assessed in terms of historic accounting costs or in terms of present-day costs. By criticising the basis of past nuclear programmes Patterson is of course casting doubt upon future programmes. What he does not say is that in an uncertain world, and the last 20 years have underlined the risks and uncertainties, diversity and the exploitation of nuclear power against limited fossil fuel resources is a policy option that should not have been and cannot be ignored.

ANNEX A

POLICY STATEMENTS:

ESTIMATES MADE OF NUCLEAR AND FOSSIL FUEL GENERATION COSTS

1. 1955 White Paper

The cost of electricity from the first commercial nuclear stations was estimated to be about 0.6d (old pence) a unit. [This assumed a significant "plutonium credit" for the sale of plutonium for civil purposes which CEGB estimated in evidence to the Select Committee on Nationalised Industries in 1962/3 as being 0.3d a unit while AEA estimated it in their evidence as 0.17d a unit]. The cost of generating from a modern coal fired station was also estimated at about 0.6d a unit. The White Paper proposed building 1.5 - 2GW of Magnox stations by 1965.

2. 1957 White Paper

Following Suez the Government announced that because of the fuel situation (the increased cost of imported fuel, mainly oil) and further technical progress, the Magnox programme should be increased to 5-6 GW to be completed by 1966. (By this time the plutonium credit had been significantly revised downwards to 0.05p per unit.)

3. 1960 White Paper

Announced that, since 1957 coal had become plentiful, oil supply prospects had improved and the need on fuel supply grounds for an immediate and sharp acceleration in the rate of ordering nuclear capacity had passed. A revised programme for 5 GW of capacity to be completed by the later date of 1968 was proposed. Although the cost of electricity from the first nuclear stations would probably be higher than estimated in 1955 later stations were expected to follow the downward trend foreseen in 1957; but conventional station costs were also falling. For stations designed in 1960 conventional power costs were estimated to be some 25% below nuclear costs but the Government were advised that nuclear generation for base load purposes was likely to become cheaper than conventional generation by about 1970. On the then estimates of demand the long term availability of fossil fuels was also uncertain.

4. 1962/63 Report of the Select Committee on Nationalised Industries

Examined (Paragraphs 371 et seq)the original White Paper cost assumptions in the light of evidence presented at this date by the CEGB. Points made included:

(i) plutonium credit for nuclear power reduced to 0.05d a unit by 1957.

(ii) rates of interest - had risen affecting nuclear more than coal stations.

(iii) conventional generation - improvements in efficiency had reduced costs.

The CEGB memorandum to the SCNI estimated that costs for all stations could be expected to fall but that nuclear costs would fall more rapidly than conventional.

	Nuclear	Conventional
	d/per unit	
Plant commissioned in 1962	1.00	.55
" " " 1965/6	.65*	.49

* Based on larger reactors.

At that time the Ministry of Power considered that nuclear and conventional stations might have similar costs by 1968, the AEA thought the later Magnox stations could be either competitive or nearly competitive by 1970 and CEGB a little later than 1970.

5. 1964 White Paper. (The 2nd Nuclear Power Programme)

Acknowledged that greater emphasis on the importance of returns on investment combined with the reduction in credits for plutonium would delay the date at which nuclear power would be competitive with conventional power.

6. 1972/3 Select Committee on Science and Technology

In its initial memorandum the Department of Trade and Industry said that the Magnox "although operating reliably and at lower running costs, are less economic than the best conventional stations when capital costs are included at constant money values,.....". At the request of the Committee the Department submitted a further memorandum (Appendix 4 of Minutes of Evidence) on comparative costs of generation. This gave two alternative methods of comparison between Magnox and fossil fired stations:

(i) Accounting cost comparison
The total cost of a unit of electricity sent out from Magnox stations (excluding Wylva) calculated in conformity with the Board's standard accounting conventions, ie using historic costs, the borrowing rate prevalent when the stations were built and actual use of the stations, was 0.43 p/kwh compared with 0.41 p/kwh for modern coal fired stations and 0.39 p/kwh for oil fired stations.

(ii) Adjusted cost comparison
This showed how the accounting costs would have appeared on a standardised basis done by revaluing all costs at 1972 money values, by using annuities for capital charges in place of straight line depreciation, and by assuming a common load factor of 75 per cent. (The memorandum stressed that because of the difficulties in revaluing outdated assets the figures should be treated with some reserve). The results were given with alternative interest rates for illustration. The ranges for the Magnox stations reflect the technological development during the programme with the lower costs reflecting the costs of the later stations. The published results were:

	8% interest	10% interest
Magnox	0.56-0.94	0.64-1.07
Coal	0.37-0.62	0.39-0.65
Oil	0.40-0.43	0.42-0.46

Patterson was no doubt quoting the second method, without the qualifications, in referring to Magnox electricity costing twice as much as fossil electricity according to the Department of Trade and Industry.

7. Comparative generation costs since 1971

In answer to Parliamentary Questions the following costs for the generation of electricity from Magnox stations compared with modern fossil stations have been published. These costs are on a historic basis with capital charges based on straight line depreciation up to 1977/78 (annuitised costs in 1978/79). Interest charges are at the average rate payable in the year of account applied to the written down capital expenditure (annuitised costs in 1978/9); actual fuel costs incurred (including nuclear reprocessing costs) and other operating costs including provision for decommissioning costs are also included. The coverage of stations in the calculations (mainly those commissioned in the previous 12 years) has changed from year to year and there have been other relatively minor changes in accounting conventions throughout the period.

p/kwh

	Magnox	Coal	Oil
71/2	0.43	0.43	0.39
72/3	0.48	0.49	0.40
73/4	0.52	0.53	0.55
74/5	0.48	0.74	0.88
75/6	0.67	0.97	1.09
76/7	0.69	1.07	1.27
77/8	0.76	1.23	1.42
78/9	1.02	1.29	1.31

(Note - only a nominal plutonium credit is included in these calculations).

ANNEX B

CEGB COMPARISON OF THE COST OF GENERATING FROM MAGNOX COAL FIRED STATIONS

The CEGB has calculated the actual capital costs incurred in building each Magnox station annuitised over 20 years at the rate of interest applying at the time of expenditure and the actual operating costs incurred, and has compared them with the total capital and operating costs that would have been incurred had the Board taken the electricity from coal fired stations of comparable size and age costed on the basis of actual experience with contemporary coal fired stations. It should be noted that the load factors for Magnox and coal fired stations may in the event have differed (coal fired stations would normally move down the merit order and away from base load while the Magnox stations have remained on base load output). However, the CEGB consider that this effect is offset by differences in the lives assumed for the stations upon which the calculations are based (30 years for coal and 20 years for Magnox, giving approximately the same total output for each). Had the Board been making a choice during the late 1950s and early 1960s when oil fired costs were lower they may have in fact chosen to build oil fired stations. If they had, the subsequent rise in oil prices would have resulted in an even larger calculated benefit attributable to the Magnox programme. Broadly speaking, the comparison with coal is less favourable to Magnox stations.

The calculations show that compared with coal fired stations the estimated benefit over the period from the start-up of each Magnox station up to 1978/79 is estimated to lie within the range £100 - £150m for the 8 Magnox stations that were built. The range allows for changes in accounting conventions over the period, for example the provisions that should be made for reprocessing and de-commissioning. It is true, as Patterson implies, that the effects of the significant increase in fossil fired prices from 1973 have brought about the advantage to Magnox. Up to that point there was probably no gain and perhaps some loss from the programme; but it would be more than offset by the subsequent gain once fossil fuel prices began to escalate. The programme

was introduced partly because of uncertainty about increases in fuel prices and about fuel availability. Assuming that the stations continue to operate at a reasonable if slightly declining level for the remainder of their 20 year amortisation life and that there is no real increase in fossil fuel or nuclear fuel costs, the additional benefit from the Magnox stations from 1978/79 onwards is estimated at some £300m (1979 money discounted at 5% per annum). However if coal prices were to rise in real terms from 1978/79 to the end of the 20 year lives by say 1% p.a. the additional total benefit would be about £75 million. Additional benefit could also be attributed if the stations were to operate for more than 20 years, eg at 25 years the benefit might double.

No credit has been assigned to plutonium arising from the Magnox programme in this assessment.

ANNEX C

CEGB MAGNOX POWER STATIONS

Station	Date Ordered	Date on Load	Design Output MWSO	Output as at 31 March 1979 MWSO
Berkeley	1957	1962	276	276
Bradwell	1957	1962	300	250
Hinkley Pt A	1957	1965	500	430
Trawsfynydd	1959	1965	500	390
Dungeness A	1960	1965	550	410
Sizewell A	1961	1966	580	420
Oldbury	1962	1967	600	416
Wylfa	1963	1971	1,180	840
TOTAL			4,486	3,432

7 MAY 1980

WALTER PATTERSON

Britain cooking the nuclear books

Guardian 7.4.80

THE difficulty of forecasting the future is amply documented. Britain's civil nuclear planners, however, seem to have equal difficulty forecasting the past. They are, to be sure, ruefully willing to concede that Britain's second nuclear programme, the Advanced Gas-cooled Reactors, were not all that could have been desired; the flagship of the AGR programme, Dungeness B, has after all been under construction since 1965 and is still unfinished.

But almost every official utterance on current civil nuclear policy makes ritual reference to the outstanding success of Britain's first nuclear programme, the Magnox reactors. Indeed, in my book Nuclear Power (Penguin, 1976). I took the industry's word for it in 1974 and called the Magnox reactors an "excellent investment." Before this myth is enshrined as holy writ, and used to sanctify another charge toward the nuclear precipice, it would be salutary to recall the true history of the Magnox programme.

The Magnox stations had as their precursor the Calder Hall station, opened by the Queen in 1956 with enormous fanfare as "the world's first nuclear power station." It was not at the time widely publicised that the primary purpose of Calder Hall was — and is — to produce weapons-plutonium, with electricity as a by-product. The civil Magnox programme had its beginnings in 1955, with the publication of a White Paper called a Programme of Nuclear Power. The White Paper was prepared by the Government and its advisors from the newly-fledged UK Atomic Energy Authority. The then Central Electricity Authority took no part in preparation of the White Paper and was given only one month to comment on its proposals before publication. The White Paper called for 2,000 megawatts of nuclear capacity to be built in the ensuing decade.

After the Suez debacle of October, 1956, it was decided to go for a greatly expanded nuclear power programme — 5,000 to 6,000 megawatts in operation by the end of 1956. However, by 1960 it was clear that the supply of low-priced coal and oil had drastically undermined the original estimates of the economic competitiveness of Magnox electricity. In June, 1960, the programme was cut back and its timetable extended.

In 1962-63 the Select Committee on Nationalised Industries, in a mammoth analysis of electricity supply, took evidence from many senior figures. Sir Christopher now Lord Hinton, chairman of the Central Electricity Generating Board and one of the architects of the British nuclear establishment, agreed with the committee that the cost of the Magnox programme to the CEGB had been pretty considerable. "If I could completely disregard history I would have a considerably smaller programme than I have today."

Official documents of the time are coy about what became of the plutonium produced in the civil Magnox stations, and about how much so-called "plutonium credit" was paid to the CEGB by the AEA. The plutonium credit postulated at the time of the first White Paper was a substantial fraction of the cost of a unit of Magnox electricity, an essential factor in making it look competitive with fossil-fuelled electricity. The credit was reckoned on the basis that the plutonium would be a valuable civil fuel; 25 years later plutonium stocks still require costly storage and are as far as ever from commercial utilisation.

The last Magnox station was Wylfa, on Anglesey. The Wylfa reactors were almost twice the size of the largest previous Magnox reactors. Wylfa was scheduled to come on stream in 1969. It did not even start up until 1971; and its boilers then developed so many leaks that it was shut down for most of the next five years for repairs. Its maximum output is now 840 megawatts, only some two-thirds of its original design output of 1,180 megawatts. The shortfall of power at Wylfa is equivalent to another nuclear station, larger than Berkeley, Bradwell or Hunterston A, paid for but never delivered.

Wylfa was not the only station to show this disparity between original design output and eventual "declared net capability," as the industry euphemism puts it. In September, 1968, corrosion was discovered inside the reactors at the Bradwell Magnox station — investigations revealed similar corrosion at all the other stations as well. To keep it from shortening the lifespan of the Magnox reactors, all but the smallest and earliest, at Berkeley, were "de-rated" — required to operate at a lower output. The fact of this de-rating is well known in the industry; what seems less well known is its magnitude. The four last and largest Magnox stations are all limited to a maximum output which is less than three-quarters of their original design output. Electricity users thus got three reactors for the price of four.

By 1970 problems with the Magnox stations had been overtaken by problems with the AGRs, including the bankruptcy of Atomic Power Constructions Limited at Dungeness B. However, to claim that compared to the AGRs the Magnox reactors were a success is like saying that, compared to Waterloo, Napoleon's retreat from Moscow was a success. When the electricity authorities submit nuclear performance figures to the European Commission, they compare the annual output of each Magnox station with its maximum de-rated capacity, not with its original design output. This means that a station like Oldbury may be credited with a performance some 20 percentage points better than it can reasonably claim. Such cooking of the nuclear books does not enhance the industry's credibility.

As recently as 1972 the Department of Trade and Industry, in evidence to the Select Committee on Science and Technology, stated that a unit of nuclear — that is, Magnox — electricity cost roughly twice as much as a unit of fossil-fuelled electricity. These figures expressly excluded Wylfa, whose occasional trickle of output up to that time must have been among the most costly in the land. Only the runaway inflation of the mid-1970s, including the dramatic increase in the cost of fossil fuel, gave British electricity users an opportunity to recover some of the money we had been paying over the odds for Magnox electricity for more than a decade.

It is ironic that, just as we have begun to recover some of our excessive outlays on the Magnox stations, they are showing signs of senility. The cracks at Dungeness A and other Magnox stations may indicate that they are nearing the end of their useful lifespan. If so, even the inflation of the mid-1970s will not have saved the Magnox programme from being yet another British nuclear fiasco. From 1955 onwards, whenever doubts were raised about the economic status of the nuclear programme, the nuclear planners always chanted their litany: "Even if it's not economic now, we must press on, because one day it will be." The echo is becoming painfully hollow.

Walter Patterson is international editor of the Bulletin of the Atomic Scientists, and energy consultant to Friends of the Earth.

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