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5 October 1984

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AEA REVIEW: FINANCIAL IMPLICATIONS

Thank you for your letter of 2 October about the state of play following our two bilaterals on this department's programmes.

As regards the AEA Review, I have now considered the proposed savings in nuclear R&D which your officials were discussing with mine last week - £20m, £28.5m and £37m in the three PES years.

As you will know I have now held discussions with the Generating Boards, the Electricity Council, BNFL and the Authority about the Review. The Treasury representative at the meetings will confirm that, though there was a fair amount of qualified support for the main thrust of the Report in terms of extending customer/contractor relationships to the whole of the Authority's work, and setting up a Trading Fund, there was stiff opposition from most quarters to the proposals on thermal reactor and underlying research funding, although unanimity on the need for the work to be undertaken.

I was also impressed by Arnold Allen's forceful argument that, while an early Government statement on the principles of the Review is desirable, a very large amount of work lies ahead and that a successful outcome would be more likely if this were targeted on full implementation in April 1986, when the Trading Fund would come into effect, rather than piecemeal.

I see no reason to drop the recommendations on thermal reactor and underlying research. Walter Marshall left the door open to picking up the bill if suitable Parliamentary statements could be made about the Government's philosophy in this area, while Philip Jones' principal concern seemed to be that the ESI's EFL should be fully adjusted to reflect any additional costs and Don Miller for the SSEB appeared to accept the proposals. Doubtless the Authority could also be persuaded to fall into line if arrangements could be reached which were acceptable both to their principal customers and to my Department as the sponsoring Ministry. However Arnold Allen has

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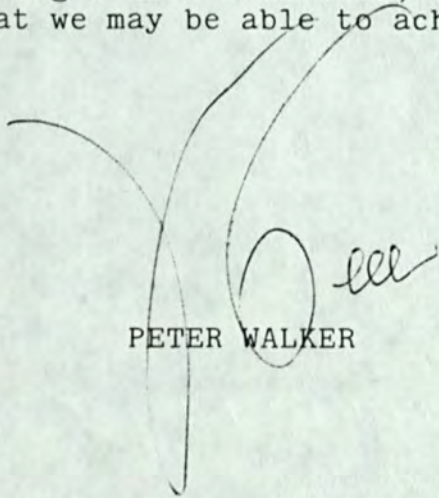
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a wider concern that, even if this could be achieved, the Authority would be unable to earn an additional surplus on other contract work, and that therefore the present level of underlying research could not be sustained.

All this suggests that a long period of delicate negotiation lies ahead, that excessive haste would be counter-productive, and that the eventual outcome is likely to be something less than the full transfer of funding suggested by the Review. Against this background while I should welcome a Treasury assurance that, if implementation of the Review led to a different outcome than that assumed, adjustments to the nuclear R & D vote would be made, I think it would be very dangerous to assume the figures suggested by your officials which are frankly incredible.

Indeed, even in public expenditure terms, I cannot see the need for greater haste, since the major transfers of funding that you are suggesting we assume can be made from the vote to the customers will be offset by increases in the customers' EFLs.

I therefore have it in mind for my paper to colleagues to suggest reductions in the nuclear R & D vote of £1m, £20m and £30m in the three PES years, as representing a more realistic, though still perhaps optimistic, assessment of what we may be able to achieve.

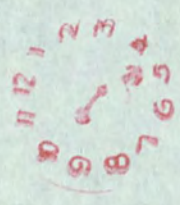
  
PETER WALKER

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Energy

Review of ATR March 84

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# **REVIEW OF THE UK ATOMIC ENERGY AUTHORITY**

Report by a  
Departmental Working Group

**August 1984**

**Department of Energy**

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REPORT OF THE WORKING GROUP TO REVIEW THE AEA

- I. Terms of Reference (paras 1-2);
- II. Summary of Conclusions and Recommendations (paras 3-20);
- III. Background information on the Authority (paras 21-23);
- IV. Analysis of programmes (paras 24-58);
- V. Customer/Contractor Relationships (paras 59-68);
- VI. Privatisation, in whole or in part (paras 69-81);
- VII. The Authority as a Trading Fund (paras 82-94);
- VIII. Technology transfer and the full exploitation of the Authority's assets (paras 95-99);
- IX. Role and composition of the Authority Board (paras 100-107).

I. Terms of reference and Introduction

The Secretary of State set up the Working Group in January this year under the chairmanship of Mr I T Manley, with representation from the relevant Divisions of the Department and, with the agreement of the Chief Secretary and Sir Peter Hirsch, from the Treasury and the Atomic Energy Authority. The Group's terms of reference were:

- "(i) to examine the main programmes of the AEA, with reference to the character, funding of and accountability for these programmes and their bearing on the role of the AEA;
- (ii) to consider, in the light of this review and of other factors, whether changes are required in the role and accountability of the AEA, and in its relationship with Government;

and to make recommendations to the Secretary of State for Energy.

In conducting its enquiry, the Group is asked:

- (a) to take full account of recent and current reviews of particular AEA programmes undertaken in Government or in the Authority;
- (b) to pay particular attention to the implications of developing customer-contractor relationships in the programmes of the Authority for the role of the Authority;
- (c) to take account of the Department's review of the present arrangements for allocating R & D resources across the whole field of the Department."

2. Two AEA representatives have been present throughout, and have provided much information and advice to the Working Group on AEA programmes and financial and other issues, and the AEA Board have commented on a summary of its preliminary conclusions. However, though the Group has taken the AEA comments into consideration in its further deliberations, its conclusions as set out here have not been put to the AEA Board, who therefore do not necessarily agree with them.

II. Summary of Conclusions and Recommendations

3. It is the Government's policy that the UK should have a significant nuclear power programme for the foreseeable future, and this had to be the Group's starting point. On this assumption a continuing research programme of some kind will be required. Our programmes analysis has confirmed that there is still a large amount of nuclear R & D to be done in the coming decades.
4. As to how this research should be done, the Authority has the advantage of already undertaking a wide range of work for a number of nuclear and non-nuclear customers, all of whom value the effective way it uses its highly qualified, multi-disciplined and motivated staff with their access to unique facilities. It is also clear that the unique nature of nuclear power and public perceptions of it will require a continuing Government interest in key programmes beyond the commercial interests of the nuclear industry.
5. The Group has concluded that an authoritative body of independent expertise not fundamentally different from the Authority in its present form will therefore continue to be required, and that it would be wrong, for instance, to "hand over" the Authority to the Generating Boards and BNFL.
6. We do however consider that there should be significant changes in the way in which the nuclear programmes are funded, and in the Authority's relationships with the rest of the nuclear industry, as summarised below:
  - i) Fast reactor. We have not attempted to re-examine the basic strategic decisions which have only recently been taken, but the Generating Boards will be the owners and operators of the eventual UK lead reactor and subsequent reactors and should therefore assume greater responsibility for funding R &



D as the programme approaches that stage (paras 26-27).

- ii) Thermal reactor. The Generating Boards are the beneficiaries and should therefore in principle pay for this research in its entirety. However the majority of the Group believe that it is right for the Authority to be able to undertake some work independently and that the best solution would be for this work to be wholly funded by the Generating Boards on a non-specific basis provided that arrangements can be agreed which ensure independence, NII access and continuity. The majority of the Group therefore recommend that further discussions should take place between the Department, the Authority, the Generating Boards and the NII with a view to securing this objective. The remainder of the Authority's thermal reactor research should be both financed and controlled by the Generating Boards (paras 28-35). The Treasury, on the other hand, consider that all funding in this area, as in others, should be on a specific project basis under a customer/contractor relationship;
- iii) General safety. The Generating Boards and BNFL are primary beneficiaries, but there are some areas where the Government also has an interest and a responsibility, as does the NII. The majority of the Group consider that further discussion should take place between the Department, the Authority and the Generating Boards to determine the extent of the work which the Department should continue to fund (para 36). The Treasury considers that specific projects in this area should be funded on a customer/contractor basis. This would automatically disentangle the present

funding.

The cost of the Authority team responsible for its own safety policy and for inspecting the safety of all Authority reactors and other facilities should be treated as an overhead and charged out to the other programmes, including those funded by the Department (para 37).

- iv) Radioactive waste and nuclear materials management. Departmental funding should continue for work which relates to the Authority's own waste from past vote funded programmes, although the nuclear industry should make a substantial contribution to the cost of WAGR decommissioning. It is also conceivable that, given the significance of radioactive waste issues for energy policy generally, the Secretary of State should from time to time fund some longer term research to be carried out independently of both the DoE and the nuclear industry (paras 39-42).

Some continued vote funding of other nuclear materials management R & D is justified in relation to the AEA's own operational requirements and perhaps also for other projects on an occasional and specific basis. However there are a range of beneficiaries other than the Department and the programme should be reviewed in detail to determine which elements are appropriate for continued Departmental funding and those which other beneficiaries should fund if they wish them to continue (para 43):

- v) Underlying research. A programme should be

maintained, to retain intellectual vigour, underpin the other programmes, and maintain the organisation's ability to secure future business. The Authority is the best judge of its detailed content. All the Authority's customers have benefited from the programme and should as proxies for future customers contribute to its cost. Using the present programme size as the starting point we consider that its cost should be recovered from all customers as part of the overall costs of the Authority's activities. The approach to cost recovery would however need to vary between customers (paras 44-46).

- vi) Fusion should be treated as a special case and is in any event the subject of a separate review (para 47).
- vii) Other minor nuclear programmes. Some of the work quite properly falls to the Department to fund; other aspects appear to benefit the nuclear industry and its regulatory agencies. Each element should be reviewed in detail, as for other nuclear materials management (paras 48-49).
- viii) Non-nuclear work (paras 50-51). We have sought the views of the DTI about the value of this research and the desirability of an external review. They have, however, expressed themselves well satisfied with the quality of work undertaken by the Authority for the Requirements Boards and have endorsed the Authority's present approach, as does the Group (para 52). We also consider that the Authority's recent proposals for private sector venture capital funding for the application of

selected research results should be encouraged (para 53). The wider question of constraints is dealt with below (paras 95-99).

7. The result of these recommendations, if fully implemented, would be to transfer substantial additional funding to the nuclear industry. There should also be significant reductions in the Department's planned PES allocations. The Department will however remain a very major customer for the Authority's services, to the tune of 40% or more of its total expenditure in 1987/88 (paras 54-58).
8. Customer/Contractor relationships (paras 59-68). The Group consider that there would be benefit in terms of a more disciplined approach by both parties, more meaningful monitoring and control and a desirable degree of commercial tension, in putting the Department's relationship with the Authority on to a customer/contractor footing, with each programme being the subject of a specific contract or contracts. Given the disparate nature of the programmes undertaken for the Department or to which it contributes, different contractual approaches will be required for different work areas with a varying degree of detail according to circumstances (paras 59-62). At one end of the spectrum, in the case of the fast reactor, the aim should be to secure the substance of a contract in terms of accountability through a jointly-agreed programme statement, the development of general and specific targets, cost details, and arrangements for improved financial and technical reporting and monitoring (para 63). At the other end of the spectrum, the small Safeguards programme should be put on a full contract basis at once (para 64).
9. In order to help it formulate and operate these various contracts the Department would need to engage perhaps 2-3 nuclear experts. The increased monitoring responsibilities might also require the strengthening of

AE Division in other ways (para 65).

10. Privatisation of the Authority (paras 69-81). A number of major considerations arise:

- the Authority's monopoly status in the core nuclear programmes, particularly the fast reactor, which means that there is no early prospect of competition and the operation of market forces;
- although the Authority's net assets have a book value of £154m, their sale value would probably be lower;
- the Authority has major continuing liabilities, for example in radioactive wastes and decommissioning;
- the Authority's statutory pension schemes, at present notionally funded. A cash transfer of £500m from the Exchequer might be required or, if the scheme continued, there would be a bringing forward of the date at which payments from the scheme exceeded contributions;
- the need for significant working capital;
- public concern over nuclear issues which might make it inappropriate to seek to launch this key element of the nuclear industry into the private sector at this time;
- security and AEA Constabulary implications.

11. The Group has concluded that, taken together, these factors imply that privatisation of the Authority as an entity, while possible in principle, is not in practice a

realistic option at present. Nevertheless, as the proportion of Departmentally funded work falls and the percentage of the Authority's work being undertaken on a commercial contract basis increases further, and as the fast reactor draws closer to fully commercial application, very different circumstances might emerge; prospects for privatisation as a longer term option should therefore be kept under review (paras 69-71).

12. The Group has also examined the feasibility of privatising individual establishments or the Harwell "business centres". The key issues are:

- the very highly integrated nature of the Authority's activities as a whole;
- the resultant weakening of both any privatised establishment and of the remainder of the Authority through the loss of staff and technical interchange and through the inefficient use and potential duplication of resources;
- the "business centres" appear to be viable only as an integral part of Harwell's overall work and organisation.

Taken together these make privatisation of single sites or business centres difficult to envisage and likely to lead to substantial diseconomies (paras 72-80).

13. Nevertheless our examination has not been exhaustive and, as with full privatisation, the situation may change over time. The need to keep the scope for partial privatisation under review should therefore be made a specific part of the remit of the Authority's management (para 81).

14. The Authority as a Trading Fund (paras 82-94). Possible eventual privatisation, and the extension of the

customer/contractor approach to the Authority's nuclear work for the Department, would be facilitated by putting the Authority on a Trading Fund basis. This would require all work to be accounted for on a fully commercial basis, impose additional discipline through the requirement to meet financial objectives, create financial flexibility between years, highlight major issues which need to be dealt with in commercial terms, and facilitate possible eventual privatisation. The absence of a competitive trading situation in certain areas, asset valuation, treatment of provisions and the setting of a realistic financial target, should not be insuperable problems (paras 82-87).

15. Within the Fund all contracts, including those for the Department, should be on a with profits basis as providing the maximum commercial incentive to increased efficiency (paras 88-90).
16. The move to a Trading Fund could be managed in such a way as to ensure the overall consequences are PSBR neutral, except for a small increase in own resources payments to Brussels. However overall public expenditure would technically increase and Ministers would need to consider how these issues should be handled (paras 91-93).
17. Putting the Authority on a Trading Fund basis would require an amendment to the 1954 Act, to enable the Fund to borrow as required (para 94).
18. Technology transfer and the full exploitation of the Authority's assets. The present financial and end year accounting constraints should be eased by setting up the Authority as a Trading Fund. We believe that the prohibition on non-nuclear manufacturing and the Authority's links with Civil Service pay and conditions are not major problems (paras 95-98).
19. We consider that a careful balance must continue to be struck between the extent of non-nuclear work and the core

nuclear programmes, and that this requirement should be drawn specifically to the attention of the Authority's management (para 99).

20. Role and composition of the Board. The Group conclude that, in the new circumstances which would result from implementation of its recommendations, the Authority Board should not include senior executives from its major customers, the Department, the ESI, BNFL or NNC. Appointment of Members with recent experience of these bodies should, however, not be precluded. The new circumstances would also increase the importance of the contribution and role of the independent part-time Members (paras 100-107).



III. Background information on the Authority

21. The Authority was created out of the then Ministry of Supply by the provisions of the Atomic Energy Authority Act 1954, at a time of rapid expansion in nuclear activities. Its original objectives encompassed all aspects of nuclear energy in the UK, both civil and military, and at its peak in 1961 it employed over 40,000 people. A significant reduction took place in the 1960s, followed by the hiving off in 1971 of fuel production/reprocessing to BNFL and of radiochemicals to what is now Amersham International (reducing the strength at that time by a third), and two years later by the transfer of weapons research and production at Aldermaston to the MoD (reducing strength by a third again). On the other hand, the 1965 Science and Technology Act enabled the Authority, at the request of Government, to carry out non-nuclear R & D, which now accounts for about 8% of overall expenditure.
22. The Authority remains a very large R & D organisation with a total staff of some 14,000, operating at nine geographically dispersed locations ranging from Dounreay on the north coast of Scotland to Winfrith in Dorset - see Figure 1. Total gross expenditure currently runs at around £380m in cash terms, with nearly £200m coming from the Department's nuclear vote and the balance from the Department's non-nuclear work with the Authority and from contracts with the Generating Boards, BNFL, DoE, DTI, MoD and a variety of other customers, including some in the private sector - see Figure 2.
23. The proportion of the Authority's nuclear programmes funded by the Department has fallen in recent years, and the reduction is expected to total nearly 30% in real terms by 1987/88 as compared with 1981/82. Because some costs have shifted from the Department to the nuclear industry\* the cut back in the Authority's total expenditure has been smaller - see Figure 3.
- Nevertheless, total staff numbers are on a declining trend

\* As used in this Report the term comprises the Generating Boards, BNFL and NNC.

- see figure 4. Although compulsory redundancies have so far been avoided, the Authority is incurring substantial expenditure on early retirements (about £4.5m in 1984/85).

IV. Analysis of the programmes

24. As required by our terms of reference we start with an examination of the Authority's current activities, bearing in mind that it is Government policy that the UK should have a significant nuclear power programme for the foreseeable future and that on this assumption, a continuing research programme of some kind will be required. The principal research areas are:

- i) the fast reactor;
- ii) thermal reactors;
- iii) general safety;
- iv) radioactive waste and nuclear materials management;
- v) underlying research;
- vi) fusion;
- vii) other minor nuclear programmes;
- viii) a range of non-nuclear contract work.

25. Table 1 sets out the expected expenditure in each area during the current financial year, broken down between funding from the Department of Energy's nuclear vote and from contract customers. Each of the main programmes has been examined, with particular focus on whether the current balance between the Department's vote and other customer funding, and therefore control of the programmes, is right. Section ix) draws some general conclusions.

i) Fast Reactor

26. The programme was thoroughly reviewed in 1982 following a proposal from the Authority and the nuclear industry that

a definite decision should be taken to move towards the construction of a demonstration or "lead" fast reactor in the UK. The Government concluded that, although the strategic justification for the research and development programme remained valid, the time when series ordering of fast reactors would be required was further ahead than previously thought, and that Government funding should therefore be scaled down as soon as possible by about one-third to around £70m pa at September 1981 price levels, with international collaboration if practicable. It was subsequently agreed that the best prospect lay in co-operation with other European countries, and an inter-Governmental Memorandum of Understanding was signed in January 1984, subsequently backed by a series of inter-organisational agreements. The intention is that there should be an integrated European programme of 3 lead reactors, with construction of the UK reactor starting not before 1993, but the details remain to be worked out. Meanwhile the Dounreay facilities will continue to operate and act as a test bed for components, fast reactor fuel and the fuel cycle. Although the CEGB, BNFL and NNC are all involved in the collaboration, the Authority is its pivot and significant Government funding will continue for a lengthy period.

27. The Group has taken account of these basic strategic decisions, which imply vote funding in cash terms of £88.4m in 1987/88. However, the Generating Boards will be the owners and operators of the eventual UK lead reactor and subsequent reactors, and we consider that the Boards should assume greater responsibility for funding as the programme approaches that stage.

ii) Thermal reactor

28. The Authority's gross expenditure on AGR and PWR research in 1984/85 is expected to be about £46m, with a net cost to the vote of around £17m. Ministerial initiatives in the last two years, and subsequent discussions between the Department, the Boards and the Authority, have led to new

working arrangements. A major shift in the burden of funding to the Boards has already taken place and by 1987/88 the net vote contribution is expected to be down to about £13m cash.

29. The Generating Boards and the NII have confirmed the importance of these programmes. The AGR work is essential to make the best use of the UK's existing stock of AGRs and of those under construction, for example by improving the life and performance of plant and fuel, and allowing restrictions adopted for initial operation to be removed progressively as knowledge builds up. The PWR work produces information independently from the CEGB which assists the NII's assessment of the CEGB's safety case for Sizewell B. If a number of subsequent PWRs are constructed a continuing safety and general back-up programme will be required.
30. The Authority has argued that continuing vote funding is in the public interest. It believes that some work on thermal reactor safety issues should be undertaken independently of the Generating Boards as commercial operators of nuclear installations, and that there should be some forward-looking work on issues with a longer term horizon than commercial customers need have regard to. However the Group considers that the Generating Boards are the direct beneficiaries of the research and therefore in principle should pay for it. The rate at, and arrangements by which, responsibility for funding what they do not already fund should pass to the Boards would clearly need to be discussed with them. They would naturally wish to put the work on a formal customer/contractor footing and control it to a greater extent than now.
31. The difficulty comes in the extent to which the commercial interests of the Boards may cause them to be unwilling to fund areas of research in the safety field or outside it which appear to the Authority to be of long-term importance. The present PWR work, for instance, which is

now accepted as being fundamental support for the CEGB's case at Sizewell B, was originally initiated by the Authority despite CEGB opposition. The Government's continuing strategic interest in the UK nuclear programme, and the sensitivity of the safety issues, are relevant here.

32. Also relevant is the role of the NII. The UK regulatory regime places the onus for establishing and proving a nuclear safety case to the satisfaction of the NII on its proponents (ie the operators of the proposed installation), who are expected to sponsor any necessary supporting R & D. There are no written regulations governing the licensing process, which depends upon a continuing dialogue between the NII and the owner. Under this system the NII spend only limited sums on R & D or technical support (some £2m pa currently), which are designed principally to assist their understanding of safety cases put forward by the owner. NII would prefer not to have to initiate and direct large safety R & D programmes.
33. Some would also see a danger that a large programme might lead the NII to suggest design changes themselves, and individual inspectors to become advocates of particular design solutions. The success of the present regulatory approach is seen as depending in part on the existence of the Authority as an expert body undertaking safety R & D independently of the nuclear industry. The NII currently enjoy good relations and direct access to Authority staff, and are able to influence the scope and direction of its safety work and draw on its expertise and independence of view. It is important that this position should not be jeopardised.
34. The Group believe that it would therefore be right for the Authority to be able to undertake some work independently of the Generating Boards. Currently some £17m of work is being undertaken by the Authority on the vote, reducing to £13m in 1987/88. Detailed analysis would be required to

determine what proportion should continue to be undertaken on an independent basis. The work could be financed in one of a number of ways - by the Generating Boards on a non-specific basis and with guaranteed access by the NII to the results, by some expansion of NII funding (although this could only cover the safety work) by the Department with NII advice where relevant, or by some combination of these.

35. The Group consider that the best solution would be for this work to be wholly funded by the Generating Boards on a non-specific basis, provided that arrangements can be agreed which ensure independence, NII access and continuity. We therefore recommend that further discussions should take place between the Department, the Authority, the Generating Boards and the NII with a view to securing this objective. The remainder of the Authority's thermal reactor research should be both financed and controlled by the Generating Boards.

iii) General Safety

36. Research into general reactor safety and acceptability is expected to cost £5.3m in the current financial year and £5.6m cash in 1987/88, funded entirely from the vote. About £4m of the current programme is designed to provide generic understanding of issues relating to the safety of nuclear plant, covering such matters as accident conditions in the reactor core, and consequences of accidental releases of radioactive materials. The Group considers that the Generating Boards and BNFL are primary beneficiaries of this work. However, here too there are some areas - such as studies relevant to the possible effects on the UK of a French PWR accident - where the Government clearly has an interest and a responsibility, as does the NII. It would be necessary to disentangle these threads in further discussions between the Department, the Authority and the Generating Boards before coming to a final view about the extent of the work which the Department should continue to fund.

37. The programme also covers the cost of the Authority team responsible for its own safety policy and for inspecting the safety of all Authority reactors and other facilities (about £1m per annum). The Group consider that these costs should be treated as an overhead and charged out to the other programmes, including those which are funded by the Department.
38. The Treasury does not agree with the recommendations in paras 35 and 36 above. These represent a retreat from one of the Report's major themes - namely that projects should be funded on a specific basis by their potential beneficiaries under a customer/contractor relationship. More particularly:
- (a) the recommendation in para 35 for non-specific funding is based on an assumption that specific funding by the potential beneficiaries would not produce the "right" level of activity in this area. The Treasury sees no basis for this assumption. There is nothing in the case-by-case approach involved in specific funding to suggest that worthwhile projects would not be funded. At the same time the approach does provide an important discipline on the parties concerned which is lacking with non-specific funding;
  - (b) the recommendation in para 36 is unclear. It is expressed in terms of the need to "disentangle" the threads of funding. The application of the customer/contractor principle to specific projects in this area would automatically disentangle the funding. It would leave projects to be funded by their potential beneficiaries while projects which attracted no backer would not be pursued;



(c) in both areas the Treasury considers that an appropriate safeguard would exist to protect the national interest. It would be open to the Department of Energy to be a customer for a specific project which it considered valuable but for which the AEA was unable to attract a customer from within the nuclear industry.

iv) Radioactive Waste and Nuclear Materials Management

39. Gross expenditure is expected to rise from £38m in 1984/85 to £48m in 1987/88 and net vote funding from £19.5m to £28.8m cash. It comprises, however, a number of distinct though inter-related component parts:

(a) the operational programmes, whose net cash cost is expected to rise to nearly £16m by 1987/88. This is expenditure, some of it on capital works, which is required for the safe handling, treatment, transport and storage of the Authority's own waste arisings from past vote funded programmes. As such it is both essential and, in the Group's view, a proper call on the Department's resources. The only area of doubt relates to the programme for decommissioning the Windscale AGR beyond normal safety requirements to a "green-field" site by 1993 as a demonstration project. The Authority is clearly liable for the decommissioning of its own reactors, but Generating Board contributions to the cost have been sought, as they will benefit from the knowledge and technical advances gained through the work. However, as a matter of policy, the Boards do not at present wish to participate, as decommissioning to a

"green-field" site for commercial reactors is not contemplated until some decades after station closure if at all.

Nevertheless the Boards (and BNFL) will clearly derive benefit from the programme if it increases the public acceptability of nuclear power and the Group therefore consider that they should make a substantial contribution to its cost.

(b) R & D judged necessary by the nuclear industry and the Authority to support the safe conduct of their own waste management operations, and to meet regulatory requirements in a cost-effective manner. This work is expected to cost £15.3m by 1987/88 (£5.4m net) of which:

- some £8m will be on repayment terms for nuclear customers;
- £3.1m will be for NIREX, the body set up by the AEA, BNFL, CEGB and SSEB for the disposal of low and intermediate level radioactive wastes from the partner organisations and, with appropriate charges, from other organisations. Of this £1.9m will be repayment work and £1.2m operational expenditure;
- £4.2m will be in support of the Authority's operational programmes. The Authority will continue, on commercial terms, to make available results from this research which have wider application to the rest of the nuclear industry.

(c) R & D funded and directed by the DoE in

support of their policy and regulatory responsibilities based on the Government's response in 1977 to the Sixth Report of the Royal Commission on Environmental Pollution (the Flowers Report) and the 1982 White Paper on Radioactive Waste Management. DoE funding is currently running at £3½m pa, including contracts with BNFL which have been sub-contracted to the Authority. DoE will clearly continue to have a major interest in R & D in this area.

- (d) other work which, in the Authority's view, is important to the long-term acceptability of nuclear power in the UK.  
This amounts at present to about £0.4m pa.

40. The analysis referred to in para 39(b) is complicated by differences of view between the DoE, the Authority and the Department about their respective roles following the Government's response to the Flowers Report. This gave DoE responsibility for nuclear waste management policy and for control of the waste management element in the total expenditure on nuclear R & D which the Authority is authorised to incur (Cmnd 6820 para 17). Whilst recognising that there is a grey area between operational work on the one hand and R & D on the other, DoE argue that they can only exercise such control if they have complete responsibility for research and development relating to the Authority's own wastes, for funding the Authority's contribution to NIREX R & D, and for commissioning longer term research.
41. By contrast the Department of Energy and the Group believe it is impracticable to draw a rigid line between operational work and R & D, and that since the Authority has responsibility for the safe operation of its own sites and the safe disposal of wastes final judgement on whether research to support these operations is necessary cannot

rest with DoE. The Secretary of State for Energy has ultimate responsibility for the Authority's discharge of its functions and must therefore be in a position to judge whether such R & D is required and to fund it if necessary. We also believe that mixing the DoE's regulatory role with sponsorship of R & D necessary to fulfil NIREX's obligations to meet regulations carries potential problems. Finally, the Group agree that, given the sensitivity of radioactive waste issues, it is conceivable that the Secretary of State for Energy might from time to time wish to fund some longer term research work to be carried out independently of both the DoE and the Generating Boards/BNFL. However, it considers that the work which the Authority currently believes should be in this category has not yet been sufficiently scrutinised for the Secretary of State to make a judgement on funding.

42. Discussions to resolve the Department's difference of view with the DoE continue, and the Group's conclusions in this area should therefore be regarded as subject to their outcome, which will be reported to Ministers separately.

e) Other nuclear materials management & R & D

43. This is the other main component part of the programme, comprising R & D related to the handling of radioactive materials, their transport and reprocessing. It is expected to cost £12m gross (£8m net) in 1987/88. Some continuing vote funding is clearly justified, to cover work in support of the Authority's own operational requirements. Also political and public perceptions in this area - for example on the safety of irradiated fuel transport flasks - mean that the option of Departmental funding of specific projects on an occasional basis should be retained. However there are a range of beneficiaries of the programme other than the Department, and the Group is not convinced that the present balance of funding between the vote and other customers is right, or that it is appropriate for the Authority to continue to fund R & D assistance to UK equipment manufacturers through its

active handling programme. We consider that the programme should be reviewed in detail to determine which elements are appropriate for continued Departmental funding and those which other beneficiaries should fund if they wish them to continue.

v) Underlying Research

44. The programme is planned to run at a fairly constant level in real terms, with net vote funding of about £23m (cash) in 1987/88. The Group consider that any research organisation must undertake some underlying research independently of its contracted work in order to retain intellectual vigour, to underpin the other programmes, and to maintain its ability to secure future business. Otherwise it is unlikely to survive in the longer term. The Authority is no exception to this requirement.
45. However, by the same logic, the Group consider that all the Authority's customers, both nuclear and non-nuclear, have benefited from underlying research and should, as proxies for future customers, to a greater or lesser extent contribute to its cost, whereas at the moment it is virtually entirely vote funded. This does not mean that the programme should be controlled by the customers. While the present consultations with interested parties should continue, only the Authority itself can have a fully informed view of the most appropriate content of the programme. Regarding its total size, the 1971 Rothschild Report considered that about 10% of R & D expenditure should be in "seed corn" or "blue skies" research, although this was no more than a rough rule of thumb which few research organisations have in fact achieved. In developing the approach recommended below it is suggested that the present programme should be taken as the starting point, although its future size will largely depend on the resources the Authority have available to deploy on it. There should also be no increase in its scale without prior consultation with the Department who, as the biggest customer for other Authority programmes, will continue to

make the largest single contribution to its cost.

46. The Group recommend therefore that the guiding principle should be that the costs of the underlying research programme - at present about 10% of other research expenditure - should be recovered as part of the overall costs of the Authority's activities, and incorporated in charges to all customers be they the Department's programmes, other Departments, the nuclear industry or non-nuclear customers. The approach to cost recovery would however need to vary between customers:

- i) for nuclear work Government Departments who, given the Authority's largely monopoly position, require a degree of transparency in their quotations, would have to accept that a cost element of about 10% as a contribution to underlying research was reasonable and in their long-term interests. There should be a smaller contribution from non-nuclear work;
- ii) the Department would use its good offices to overcome the likely reluctance of other parts of the public sector - principally the Generating Boards and BNFL - to adopting a similar approach;
- iii) for its private sector work, or where the approach above is not accepted, the Authority should aim to secure on average a similar contribution for underlying research; the amount recovered on individual contracts would vary with what the market would bear.

vi) Fusion

47. The plasma physics and fusion programme is costing £35.5

gross and £17.1m net this financial year. The present financial provision is for £35.8 gross and £18.8m net in 1987/88, but the Department's Strategic Review of the UK fusion programme recommends some scaling down. The Review is being handled separately and is therefore not further discussed in this Report. Whatever the eventual outcome it is clear that the UK's treaty obligations in relation to the JET project, and the remoteness of the programme from commercial application, make it something of a special case.

vii) Other Minor Nuclear Programmes

48. The Authority undertake a number of other small nuclear programmes on the nuclear vote, together totalling £3.2m net in 1984/85, which have not been separately considered by the Group. They include:

- a radiological protection and measurement programme (expected to cost £2.6m net in 1984/85) comprising safeguards work in support of the non-proliferation objectives of the International Atomic Energy Agency, R & D on nuclear instrumentation, and radiological protection research;
- a small assessment programme (£0.6m in 1984/85) concerned mainly with internal Authority economic and environmental policy planning;
- operation of the Winfrith reactor (cash surplus £0.15m in 1984/85).

Additionally there is a modest capital programme (£0.15m in 1984/85) for the maintenance/refurbishment of Harwell's two materials testing reactors. These might require major refurbishment or replacement towards the end of the decade, involving substantial expenditure of the order of £20-£30m in total.

49. Some of this work quite properly falls to the Department to fund - eg the Safeguards programme, which is discussed in Section V as a candidate for a full customer/contractor relationship between the Department and the Authority. However, the nuclear industry and its regulatory agencies would appear to be beneficiaries of the radiological protection research programme, and the capital provisions for the two materials testing reactors can only be justified as support for the other programmes, which should be charged accordingly. The Group therefore suggest that each element should be reviewed in detail to determine where the Department should remain the customer and where other beneficiaries should fund if they wish the work to continue.

viii) Non-nuclear Work

50. Although not specifically referred to in the Group's terms of reference non-nuclear work has become, as mentioned in para 21, a significant part of the Authority's total activities. Receipts in 1984/85 are forecast to be £28.6m, giving a cash surplus of about £5m which is used to reduce the net vote funding. The figures break down as follows:

£3.1m Oil and oil-related work for the Department.

£5.5m Harwell's management fee for the supervision by the Energy Technology Support Unit (ETSU) and by the Marine Technology Support Unit (MaTSU) of the Department's contracts with industry, principally for offshore work, renewable energy, and energy efficiency research.

£0.4m Other ETSU contracts.



£7.1m DTI industrial support through the Requirements Boards.

£3.5m Work for other Government Departments, particularly MoD.

£9m A large number of other contracts, mostly with the private sector.

Total £28.6m

51. The Authority's approach to non-nuclear repayment work was considered in detail by the Department in 1982. It is intended as a spin-off from the nuclear programmes, not as an independently-initiated activity. It enables the Authority to utilise the resources required for the nuclear programmes more effectively and economically, while at the same time making the Authority's expertise available to Government Departments and British industry. The costing arrangements are designed to ensure that the Authority does not subsidise the non-nuclear work from the nuclear vote.
52. In the context of the need for efficient technology transfer from the AEA to UK industry, the Group has sought the views of the DTI about the value of this research and the desirability of an external review. The DTI, as the Department principally concerned, have however expressed themselves well satisfied with the quality of work undertaken by the Authority for their Requirements Boards, and confirm that they regard the Authority as a public sector body which most effectively secures commercial exploitation of its work. They do not see the need for an external review. They endorse the Authority's policy of undertaking contract R & D work as the best means of achieving information and technology transfer to industry. So does the Group.
53. The Group has noted recent proposals by the Authority Board to try and obtain private sector venture capital

funding for the commercial exploitation of research results in selected cases. This seems likely to lead to a modest improvement in the Authority's record of technology transfer, and should therefore be encouraged. The wider question of constraints on the Authority's non-nuclear work and the most effective exploitation of its undoubted assets and commercial potential is dealt with later in the Report (paras 95-99).

ix) Conclusions from Programmes Analysis

54. A main theme of this analysis is that the nuclear industry, as the primary beneficiary of most of the Authority's work, should play a major part both in determining what R & D it requires and in paying for it under normal contractual arrangements. Scarce Government resources should be used strictly to support strategic and policy ends, not as a hidden subsidy for the nuclear industry. Similarly the willingness or otherwise of commercial customers to increase their funding can often be a decisive test of whether the work is likely to be worthwhile.
55. However a second major theme is that there remains an important range of nuclear R & D which Government should continue to support. First, projects which the Government wishes to see undertaken but which the industry considers do not satisfy its commercial requirements. This would include projects like the fast reactor where any benefits are very long term and uncertain. Second, projects which relate directly to Departmental responsibilities such as both DoE and Department of Energy concerns with waste management. Additionally there are areas such as thermal reactor and general safety where the Group believe (Treasury excepted) that the nuclear industry should fund, but on a non-specific basis.
56. These considerations, reinforced by the unique nature of nuclear power and the problems of public perceptions, seem to us to require an authoritative body of independent

expertise such as the Authority now represents.

57. Although major steps in transferring funding from the Department to the commercial customers have already been taken in recent years, application of these principles suggests that substantial additional funding might be so transferred. Full implementation of the Group's recommendations could result in savings in the Departmental vote of £26.5-£28.1m by 1987/88, and examination of the £16.1m of presently forecast Departmental expenditure recommended for further analysis should yield significant additional savings. There could also be additional savings beyond the end of the PES period as key programmes such as the fast reactor move further along the spectrum towards commercialisation and industry funding. On the other hand these figures make no provision for the Authority's share of BNFL's pre-1971 waste costs, which could amount to £2-3m per annum.
58. These changes would inevitably increase the influence of the nuclear industry over the content of the Authority's programmes. However they would not in themselves result in a reduction in the total volume of R & D (although this is a possible outcome), or undermine the requirement for a body like the Authority to do it. The Department will remain a very major customer for the Authority's services, to the tune of 40% or more of its total expenditure in 1987/88. Hence one key issue is what relationship between the Authority and the Department is most likely to make the Authority responsive to Government's requirements and give best value for money.

V. Customer/Contractor Relationships

59. The Authority is already a major contract R & D business. About 30% of its income comes from a range of informed customers whose relationship with the Authority is commercial and contractual. Our programmes analysis suggests that this proportion should be increased by a shift from Departmental funding to funding by the nuclear industry. The Department's relationship with the Authority, and the Authority's financial basis, should therefore be such as to facilitate this evolution.
60. With this in mind the Group has considered the extent to which it might be practicable and desirable to put the Department's work with the Authority on a formal contractual basis. The potential benefits are:
- a more disciplined approach by both parties, with work better defined and costed;
  - more meaningful milestones for monitoring and control purposes;
  - a desirable degree of commercial tension given that contracts and hence funding will run out and require re-negotiation on a regular basis.
61. The precise nature of such contracts would vary between different areas of work. All would set out such things as objectives, timescale, cost, resources and milestones. However the degree of detail would vary from area to area. For example specification of objectives would necessarily be less precise in the areas where a broadly based programme of research is required than at the other end of the spectrum for specific development of a component for a defined project. Continuing projects would usually move along this spectrum during their life, although by the end of the process the contracts might well be with the

nuclear industry rather than the Department. In the initial stages at least it would not be appropriate for most Department of Energy contracts to be legally framed, given the flexibility required and the unproductive effort which would be involved in their negotiation and drafting.

62. This approach would place a clear responsibility on the Department for the formulation of policy, for the overall formulation of a programme to implement that policy, for the choice of the AEA as contractors for the work and for monitoring its subsequent progress. The AEA would advise the Department, in particular on the detailed programme required to implement policy, and would remain responsible for its own performance as a contractor and for its general efficiency, effectiveness and economy. In essence, the programme formulation would be an iterative process between the Department and the Authority with other parties having an important input.

63. At one end of the spectrum the Group has given special attention to the nature of the relationship for the fast reactor programme, which currently and prospectively accounts for about half the nuclear R & D carried out on behalf of the Department and has major strategic and international significance. For some time to come, the Authority will have a major role in proposing the work to be done, negotiating with international collaborative partners, and making technical decisions. We believe that, while the Department would have ultimate policy and financial responsibility, it would need to prepare a jointly agreed programme statement on which the Authority would act, rather than a legally framed contract. This would give the substance of a contractual relationship in terms of accountability via the general and specific targets, cost details, and arrangements for financial and technical reporting and monitoring. An indication, based on present knowledge, of the type of statement which might result from an iterative discussion with the Authority is at Appendix 1. We would expect increasing precision, especially about cost and time targets, as the programme

nears commercialisation.

64. At the other end of the spectrum one example of work which might be put on a full contract basis at once is the small Safeguards programme in support of the non-proliferation objectives of the International Atomic Energy Agency in Vienna. Here the Department already has the necessary technical expertise and monitoring capacity in AE Division's Safeguards Office and the objectives relate specifically to the Department's own activities and direct responsibilities. An indication of the type of fully commercial contract which might be envisaged for this programme is at Appendix 2.
65. In order to help it operate this relationship and formulate the documents the Department would need to engage perhaps 2-3 nuclear experts. Their purpose would not be to second-guess the Authority technically, but rather to assist in the determination of meaningful programme targets and, by their ability to probe technical questions, to enhance the Department's informed customer capability. The increased monitoring responsibilities might also require the strengthening of the administrative resources and accounting expertise available to AE Division.
66. One additional source of advice on the Authority's activities would also be available to the Department. As announced earlier this year it has been decided that all the Department of Energy's vote funded R & D, both nuclear and non-nuclear, should be incorporated in a unified budget from 1985/86, and that the role of the Advisory Council on Research and Development for Fuel and Power (ACORD) should be expanded. Under these arrangements ACORD will in future review the Authority's programme annually, advising on its broad balance, the way it fits into the wider context of energy R & D as a whole, and its relationship to national energy policies.
67. Auditing of the Authority by the National Audit Office

(NAO) would also continue. Financial accountability under the new relationship would need to be settled with Treasury formally. New letters of appointment as Accounting Officer would be needed to make it clear what the Department's Permanent Under Secretary and the Authority Chairman would answer for to Parliament (eg the Public Accounts Committee). Broadly, the Department would answer on policy and overall programme specification, and the Authority on its technical advice and efficiency of programme execution. The balance would depend on the nature of the programme. For example, in the case of the fast reactor programme the Department would have to make it clear that the overall specification of the programme resulted from discussions with the Authority and the other interested parties, and that it could not take responsibility for technical detail. It would be important that the Department did not move further down the path towards more detailed technical control than the nature of the programme justified.

68. Subject to these important reservations the Group conclude that it would be both practicable and desirable for the Department's relationship with the Authority to move onto a customer/contractor footing, with each programme being the subject of a separate contract or contracts, but with a varying degree of detail and formality according to circumstances.

VI. Privatisation of the Authority in whole or in part

69. Government policy is to reduce the size of the public sector and to privatise wherever possible. The Group has therefore examined the possibility of privatising the Authority in whole or in part, particularly as its success in increasing the commercial component of its business and the recommended extension of customer/contractor relationships might anyway appear to point in this direction.

A. Full Privatisation

70. A number of major considerations arise:

- a) Monopoly Implications. The programmes analysis suggests that a small number of large Departmental programmes will continue to make up the core of the Authority's work for some years to come, with the fast reactor predominant. A key factor is the continuing monopoly status of the Authority in these activities. There is no realistic prospect of, for instance, the fast reactor work being opened up to competition in the immediate years ahead and, accordingly, privatisation could not, in these areas, lead to increased efficiency by exposure to market forces.
- b) Asset Values. The Authority's net assets have a book value of £154m, but their sale value would probably be lower. For example, potential purchasers might value stocks (eg of fissile materials) at disposal levels rather than replacement costs as in the AEA Accounts.
- c) Liabilities. The Authority has substantial liabilities for radioactive waste treatment facilities to deal with wastes currently accumulating in storage, the costs of management of spent oxide fuel from AEA reactors, and the



future costs of decommissioning its nuclear facilities. Rough estimates are that these liabilities could amount to some £200-300m over the next 15-20 years, with a discounted present value of £140-210m. Annual expenditure could be of the order of £15-20m. Appropriate arrangements to cover these liabilities would be required before any transfer of responsibilities to the private sector could be contemplated.

- d) Significant working capital (a rough estimate being £100-125m) would have to be injected by the purchaser or by Government, to cover the likely change in the timing of payments for Departmental work from monthly in advance to quarterly in arrears. (However, to the extent that a privatised Authority was being funded by Departmental contracts, this could be managed in a PSBR neutral manner).
- e) Pensions. At present the Authority's statutory schemes are notionally funded, with the excess of contribution receipts over pension payments going to the Exchequer. After privatisation (which could include the AEA pension office) a new funded company scheme would probably be set up. If responsibility for the existing schemes (which would probably be closed to new entrants) were transferred to the new organisation, a cash transfer from the Exchequer of £500m in respect of existing liabilities for AEA staff would be required - and a further £500m if (as would be likely in such circumstances) the new organisation took over all the liabilities of the schemes, including staff from BNFL, and some staff from Aldermaston, Amersham International, NRPB and SERC. Alternatively the scheme could remain as a Government responsibility, with immediate Exchequer costs limited to transfer costs for those employees who wished to join the new company

fund and, in the longer term, some bringing forward of the date at which the pension payments from the scheme exceeded contributions.

- f) Public Perceptions. Public concerns over nuclear issues suggest that now is not a good time to seek to privatise a key element of the nuclear industry, and that to do so might undermine wider policy objectives.

There might also be particular concerns in relation to the role of the AEA Constabulary, which has responsibility for both Authority and BNFL sites and is permitted to carry firearms to protect nuclear materials in store or in transit within the UK. Security aspects, for example in relation to a private sector body handling and generating classified material, would also require careful consideration.

71. The Group has concluded that, taken together, these factors mean that privatisation of the Authority as an entity, whilst possible in principle, is not a realistic option at this time. Nevertheless, as the proportion of Departmentally funded work falls and the percentage of the Authority's work being undertaken on a commercial contract basis increases further, and as the fast reactor draws closer to fully commercial application, very different circumstances might emerge. Prospects for privatisation as a longer term option should therefore be kept under review..

B. Partial Privatisation

72. The Group has also examined the feasibility of privatising individual establishments, or "business centres", particularly those engaged on non-nuclear work.

73. Individual Site Privatisation

The key issue is the nature of the Authority's work which requires it to organise its professional staff in terms of disciplines rather than on a programme or project basis, bringing together the various disciplines, expertise and facilities as required for individual projects. Each of the various component parts of a programme are handled at the establishment best equipped with the appropriate expertise and facilities. Would this highly-integrated approach and the interdependence of the Authority's establishments make partial privatisation of an individual location inefficient?

74. The Group has looked in most detail at Harwell as the most obvious candidate, given its high proportion of contract and non-nuclear work and favourable location. The nature of the Authority's work and the integrated approach are illustrated at Appendix 3 using an example from the fast reactor programme. The illustration highlights the key role of Harwell in the solution of the problem.

75. The illustration is also not untypical. Harwell covers 3 main areas of work. The nuclear power R & D embraces gas and water-cooled reactors, the fast reactor, safety and reliability, radioactive waste management and fusion. The underlying research programme underpins the totality of the nuclear programmes at Harwell and elsewhere. Harwell staff are thus very closely integrated with each of the main programmes efforts, and the site contains major facilities which are all employed on a variety of different vote funded and contract programmes. The non-nuclear work ensures the most cost-effective use of staff, expertise and facilities already required for the nuclear programme. It is interwoven with the nuclear work both at Harwell and elsewhere, with staff being employed for proportions of their time on various different programmes and using a range of laboratory and capital equipment.

76. To overcome, or at least limit, these problems, given the nature of the work and the integrated approach it demands,

would require a complex series of contracts between Harwell and the rest of the Authority in both the underlying research and applied areas. It is likely that Harwell would lose business, certainly with the rest of the Authority, putting at risk its present expertise and facilities and reducing its commercial attractiveness to potential customers. The opportunity for ready staff and technical interchange between establishments would be lost. In addition, measures would have to be taken to ensure retention of Harwell's key staff - its major asset.

77. Privatisation of Individual Business Centres. The Group has further considered whether privatisation of the Harwell "business centres", such as the Metals and Chemicals Technology Centre or the Non-Destructive Testing Centre, might be possible.
78. These Centres have been established to exploit particular areas of expertise or to serve a particular market by selling research services. However, whilst each Centre has a Manager, it does not have permanent resources. It must compete with other programmes for staff resources, equipment and services for each contract. Most contracts require an input from a range of scientific and engineering disciplines. The team will comprise some staff working full time and others part time whilst continuing to work on other programmes also. The staff mix and numbers working for the Centre will thus change as a contract progresses. The Centre will have first call on some capital equipment, experimental rigs and instruments, but will often also utilise those "owned" by other nuclear and non-nuclear projects. The Centres rely on Harwell's central engineering services for design, manufacture and engineering projects expertise. Appendix 4 gives an example of how a Harwell Business Centre draws on diverse inputs in undertaking work for its clients.
79. The Group has concluded that the very highly integrated nature of the Authority's activities as a whole, both between its nuclear and non-nuclear work and between

individual establishments, makes single site privatisation difficult to envisage and likely to lead to substantial diseconomies. The potential benefits of privatisation would be unlikely to outweigh the inevitable weakening of both the privatised establishment and the remainder of the Authority through the loss of staff and technical interchange and through the inefficient use and potential duplication of resources.

80. The Group has also concluded that the "business centres" as presently operated are viable and effective organisations only as an integral part of Harwell's overall work and organisation. They derive their expertise and strength only by drawing on the Authority's mainstream expertise. There must be doubt as to how long they would survive if hived off from the rest of the organisation.
81. However, in each case, and as with full privatisation, the situation may change over time. The Group has also not looked at the other sites in the same detail as Harwell, although it is clear that similar considerations apply. The assessment of the balance between the costs and benefits of privatisation turns largely on an assessment of the factors listed above which can only sensibly be done by AEA management. The need to keep under review the scope for partial privatisation should therefore be made a specific part of its remit.

VII. The Authority as a Trading Fund

82. Whilst not immediately practical, possible eventual privatisation would be facilitated by putting the Authority on a Trading Fund basis. This, and the Group's view that the customer/contractor approach should be extended to the Authority's nuclear work for the Department, has led us to consider other possible advantages of a Trading Fund. This would build on the existing situation in that the Authority already operate fully commercial accounts, and part of their work is already undertaken on a "trading basis".

83. The key features of Trading Funds are:

- a capital structure based on treating the value of assets at vesting day as a loan from Government. The Fund pays interest on the capital to the Exchequer;
- a profit and loss account and ability to carry surpluses/deficits forward from one year to the next;
- subject to an External Financing limit (EFL) and a limit on total indebtedness, the Fund can borrow as necessary from the National Loans Fund (NLF) to finance capital investment, existing debt or working capital;
- the responsible Minister sets financial objectives for the Fund with the agreement of the Treasury.

84. The principal advantages of making the Authority a Trading Fund are:

- (a) it should have a positive effect on attitudes. At present some 30% of the

Authority's work is undertaken on a trading basis, rising to about half if all the Group's recommendations are implemented. A Trading Fund would require that all work be accounted for on a fully commercial basis;

- (b) it would be the most appropriate financial vehicle for the extension of the customer/contractor regime to the Department's work;
- (c) it would impose an additional discipline through the requirement to meet financial objectives;
- (d) it would create financial flexibility between years. At present the Authority cannot carry over revenue surpluses/deficits, and has only limited powers of capital carryover;
- (e) it would highlight, via the requirement for a capital structure and opening balance sheet, major issues such as the provision for long-term liabilities, and ensure that such issues are faced in commercial terms;
- (f) it would facilitate possible eventual privatisation, as the Authority's major programmes move down the path to commercialisation.

85. The Group recognise that the benefits which might be expected to flow from a Trading Fund in the short term are circumscribed. Despite recommending an extension of the customer/contractor regime, the Group accept that some key programmes - particularly fast reactor and fusion research - would have to be handled on a contractual basis which would, at least initially be neither arm's length nor legally framed. Furthermore, in these areas the

Government would have effectively nowhere else to turn, so that there would not be a competitive trading situation. Nevertheless, to the extent that the programmes migrate over time towards full legal contracts, these constraints might be expected to diminish. Also, the Department's monitoring arrangements for these programmes would require "full disclosure" on the Authority's part and would be designed to encourage maximum efficiency.

86. There would additionally be many detailed issues to be settled before a Trading Fund could be established. For example, asset valuation, treatment of provisions, and the establishment of realistic financial objectives would all require careful study.
87. Nevertheless the Group conclude that the advantages of a Trading Fund are clearly greater than its limitations and that the Authority should therefore operate in future on this basis.
88. Once established as a Trading Fund the Authority would no longer receive Grant-in-Aid. Its income would come from contracts with commercial customers and from payments by the Department for its "contracts" placed with the Authority. A key point is whether Departmental "contracts" should contain a profit element. If they did not, it might encourage two distinct classes of Authority work, with priority attention being given to the profit-making areas at the expense of the Department's non-profit making programmes.
89. The Group therefore consider that a full Trading Fund in which all contracts, including those for the Department, would be on a with profits basis, so as to give a return on assets, is the right approach and would provide the maximum commercial incentive to increased efficiency.
90. The idea of the Authority making a profit out of the Department's nuclear vote might give some presentational difficulties. But since the Authority already make



profits on work done for other Government Departments, they should not be insurmountable.

91. The consequences of the change to a customer/contractor relationship between the Department and the Authority and the operation of the Authority as a Trading Fund would include the payment by the Department of a margin to the Authority and the payment of VAT on contracts. The Group consider that these transactions should be arranged to be PSBR neutral but it was noted that they would generate a small additional payment to European Community own resources. Preliminary calculations suggest that this would initially be of the order of £3m per annum net (after taking account of the rebate negotiated at Fontainebleau). The calculation of our contribution to own resources in any given year involves both the total VAT collected in that year, and the weighted average rate of VAT paid by final consumers in the UK two years previously. Customs and Excise are therefore being asked to investigate the likely effect on own resources of the additional VAT payments after the first two years.
92. PES savings would result from the other recommendations of the Group on future arrangements for non-departmental funding of work done by the Authority. The change to the customer/contractor relationship and the establishment of the Trading Fund would not increase the volume of the Department's nuclear programme but, through the payment of the margin and of VAT, would increase public expenditure. No consequential savings arise to offset this increase and it is normal practice for PES and Estimates to allow for the payment of VAT.
93. Ministers would therefore have to take a view when considering the Report as a whole on:
- (a) how any net increase in liability to the EC should be funded;
  - (b) adjustment of the PES and Estimates

provision to accommodate the technical increase in public expenditure flowing from the switch to a customer/contractor relationship and the establishment of a Trading Fund.

94. Putting the Authority on a Trading Fund basis would require an amendment to the 1954 Atomic Energy Authority Act, not to establish the Fund itself but to enable it to borrow as required. However, provided that the intention to take legislative powers is clearly announced in the Parliamentary statement on Ministerial decisions arising from the Review, it might be possible to establish a Fund on an interim basis in such a way as to avoid any early requirement to borrow.

VIII. Technology Transfer and Full Exploitation of the Authority's Assets

95. The Authority's multi-disciplinary skills and facilities have been built up over the years largely at public expense as part of the UK's long-term strategy for the development of nuclear power as an electricity supply source. In this the transfer of technology is a continuing and major task of the Authority which should, however, not be affected by the Group's proposals.
96. The Group has considered ways in which technology and information transfer to industry in the Authority's non-nuclear work, including the application of nuclear techniques to non-nuclear areas, might be further encouraged. The activities in question fall into three basic categories: the sale of technical services, research contracts for customers, and development of specific products for commercial exploitation. As noted above (para 51), DTI endorse the policy of contract R & D for industry as the best means of achieving information and technology transfer, and have welcomed the Authority's proposals for private sector venture capital for commercial exploitation of selected innovation products.
97. The Group has considered particularly possible constraints on the realisation of potential. There are financial constraints on the Authority's freedom systematically to exploit the contract research market, where substantial initial outlays are involved. These would be eased somewhat if the Authority was on a Trading Fund basis, although the NLF does not provide risk capital. A Trading Fund would also overcome the present restrictions imposed by year end accounting. The prohibition on non-nuclear manufacturing causes some limited problems, but the Authority Board feels that some progress can be made without removing the legislative constraint. Furthermore the Group consider that removal of the constraint might lead the Authority into competition with its present customers and that it would not be in line with the

overall drive to transfer R & D results to industry, who are best placed to ensure commercial exploitation and manufacture. The Authority's links with civil service pay and conditions entail some inflexibility compared with some private sector organisations, but are not seen as a major constraint in most areas.

98. The Group conclude that the foregoing are not major constraints on realisation of the Authority's potential or on information and technology transfer to the nuclear and non-nuclear industries.
99. Nevertheless the Group is conscious of the need for a continuing careful balance between non-nuclear work and the core nuclear programmes. Accepting that non-nuclear and applied nuclear work is undertaken only as a result of firm contracts, and that to this extent the market decides the level of work undertaken, the Group nevertheless consider that it should not be an automatic response for the Authority to seek to offset a decline in nuclear work by an increase in non-nuclear work, although this may sometimes be necessary to maintain a viable team. Nor should it be presumed that all non-nuclear activities initiated within the Authority should continue to be undertaken in-house; the Authority's role here should be as initiator and innovator, with the ideas and activities being spun off to the private sector for full exploitation and development. Current policies with regard to concentration on contract R & D, and the proposed developments in respect of use of private sector venture capital, are judged to be in accord with these concepts, but the continuing need for a careful balance should specifically be drawn to the attention of the Authority's management.

IX. Role and Composition of the Board

100. The Group consider that the recommended changes in the role of the Authority and its relationships with the Department also have considerable implications for the role and composition of the Authority Board.
101. The 1954 Act requires that there shall be a Chairman and 7-15 other members of 'The Authority', appointed by the Secretary of State. (The Chairman and Members together are normally referred to as 'the Authority Board'). It further stipulates that 3 must have had wider experience of, and shown capacity in dealing with problems associated with atomic energy, one in administration and finance, and one in the organisation of workers.
102. The present composition of the Board is as below:

Sir Peter Hirsch      Chairman (non-executive).  
Has overall  
responsibility for the  
Authority and is  
concerned primarily with  
the Authority's  
scientific and technical  
programmes.

Mr A M Allen      Deputy Chairman and Chief  
Executive with  
responsibility for the  
day-to-day affairs of the  
Authority.

Dr T N Marsham )  
Dr L E J Roberts)      Full-time members, with  
executive  
responsibilities for the  
major management units  
and for all research  
programmes excluding

fusion and general  
reactor safety research.

Part-time members:

Mr C Allday	Chairman and Chief Executive, BNFL
Mr F E Bonner	Deputy Chairman, CEGB
Sir John Boyd	Former General Secretary, AUEW. Appointed as the member with experience in the organisation of workers
Mr John Bullock	Managing Partner UK, Deloitte Haskins and Sells
Sir Alan Cottrell	Master, Jesus College, Cambridge
Dr N L Franklin	Former Managing Director, NNC
Mr I T Manley	Deputy Secretary, Department of Energy
Mr R E J Roberts	Managing Director, G.K.N. Group.

103. The Secretary of State has recently announced that Sir Peter Hirsch is stepping down from the chairmanship at the end of September, although remaining on the Board as a part-time Member, and that Mr Allen will succeed him as Chairman for a one-year period.
104. The Board sees as its role the formulation of nuclear R & D programmes for submission to the Department, advice on nuclear issues of concern to the Government, and the management of the Authority's activities including the approved programmes. The presence on the Board of senior executives from the CEGB, BNFL, NNC and the Department has reflected the view that, despite differences of emphasis, the close relationship between the Authority and these component parts of the nuclear industry should be reflected at the highest level, and that these Members

have important contributions to make by virtue of their experience and expertise on the wider issues of policy before the Board, including the overall strategy for nuclear R & D.

105. If the Group's recommendations are accepted the Authority would become primarily a contract R & D organisation, financed on a commercial basis through a Trading Fund with financial objectives, although a number of its principal "contracts" would still be programmes carried out for the Department. It would remain a key source of advice on the content of those programmes and one of a number of sources of advice on nuclear issues generally. However, the executive and commercial role of the Board would assume a greater significance than it does now. It is difficult to see how in this changed situation senior executives from the Authority's key customers could continue to sit on the Board without potentially serious conflicts of interest and the inhibition of free discussion.
106. The Department would, of course, remain in a special relationship with the Authority as being not merely a major customer but also its sponsor or quasi shareholder. Membership of the Board has undoubtedly facilitated Departmental communications with the Authority in the past, as it has for the nuclear industry Members. However, alternative arrangements could be made without great difficulty.
107. The Group conclude that, in the new circumstances which would result from implementation of the Report's recommendations, the Authority Board should not include a member of the Department or senior executives of the electricity supply industry, BNFL or NNC. This should, however, not preclude the appointment of members with recent experience of these bodies who would not have the same conflicts of interest. The new circumstances would also increase the importance of the contribution and role of the independent part-time Members. It would be essential that they continue to bring to bear their wider

external experience on the executive and commercial challenges facing the Authority, especially in their areas of particular expertise, and to provide assistance and support to the full-time Members of the Board.



# United Kingdom Atomic Energy Authority Establishments

FIGURE 1

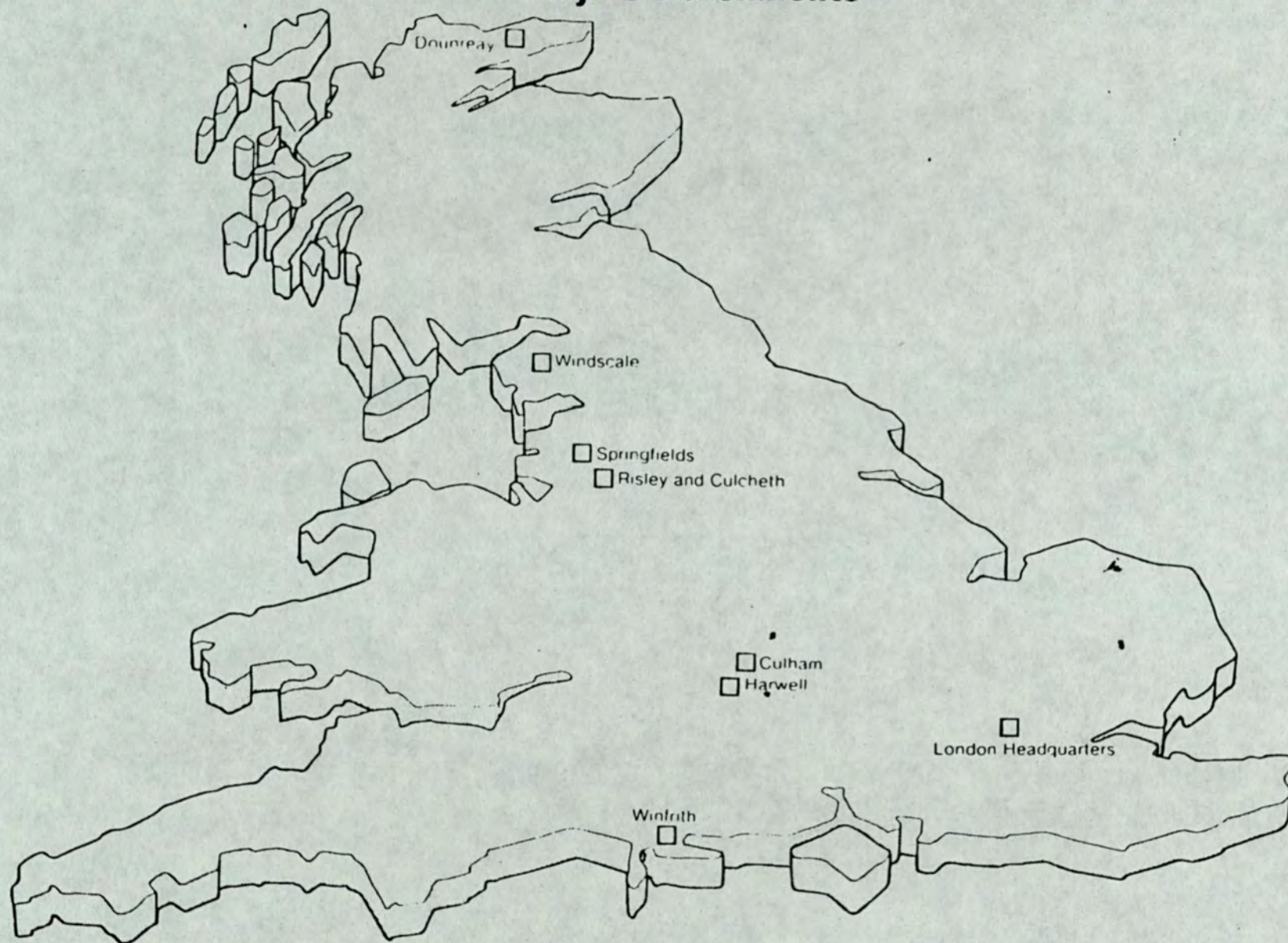


FIGURE 2

# Analysis of Funding by Customer

1984/85

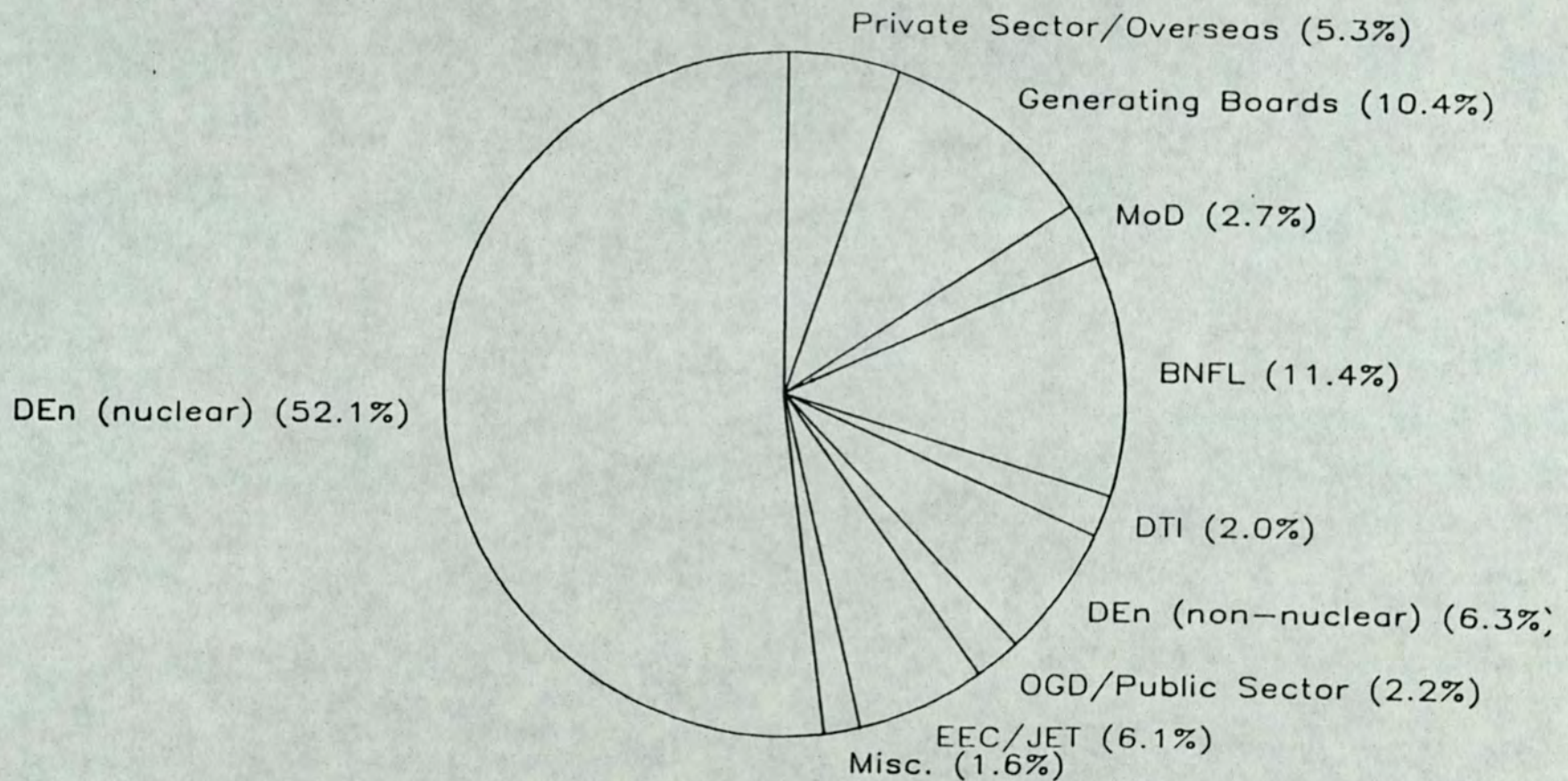
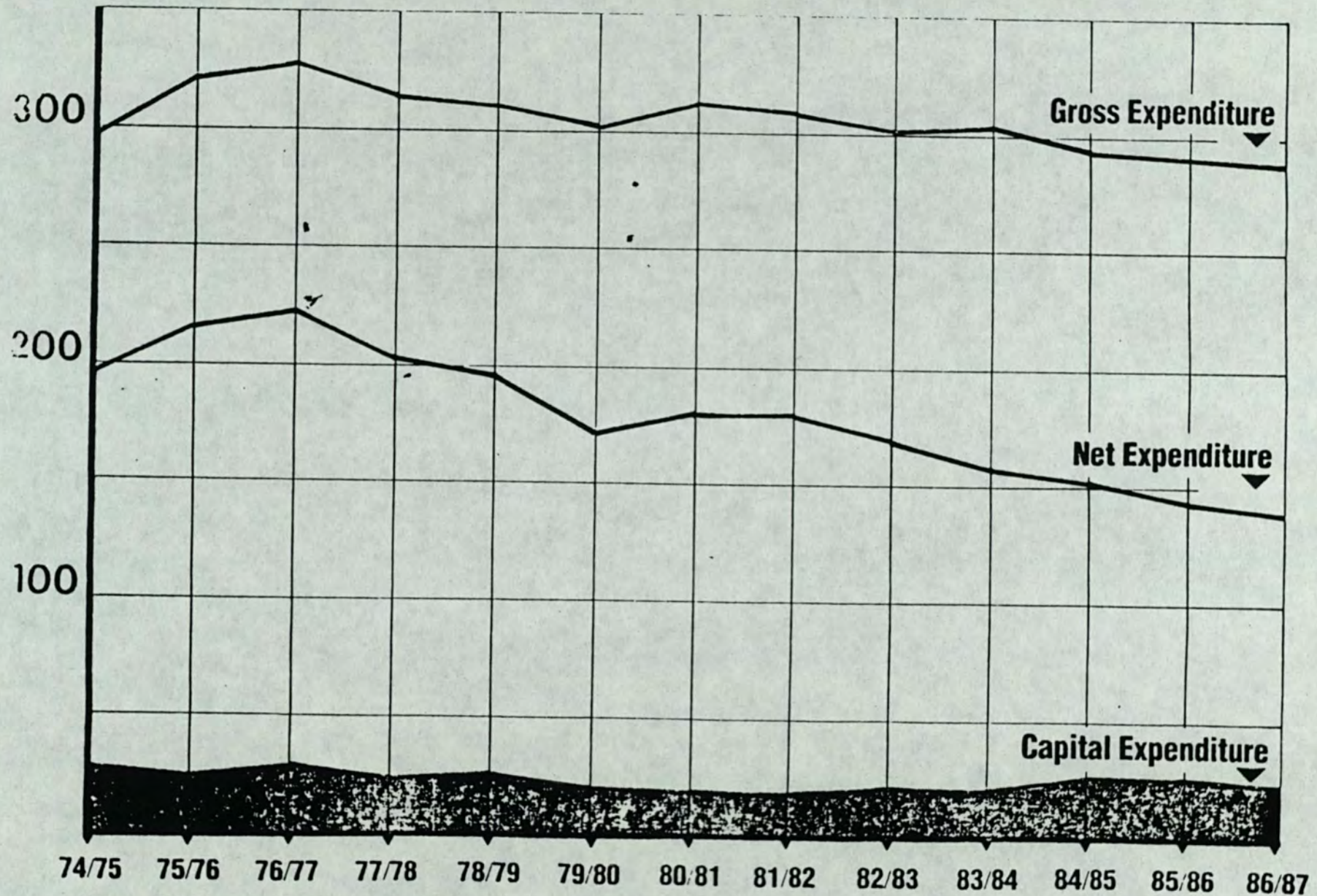


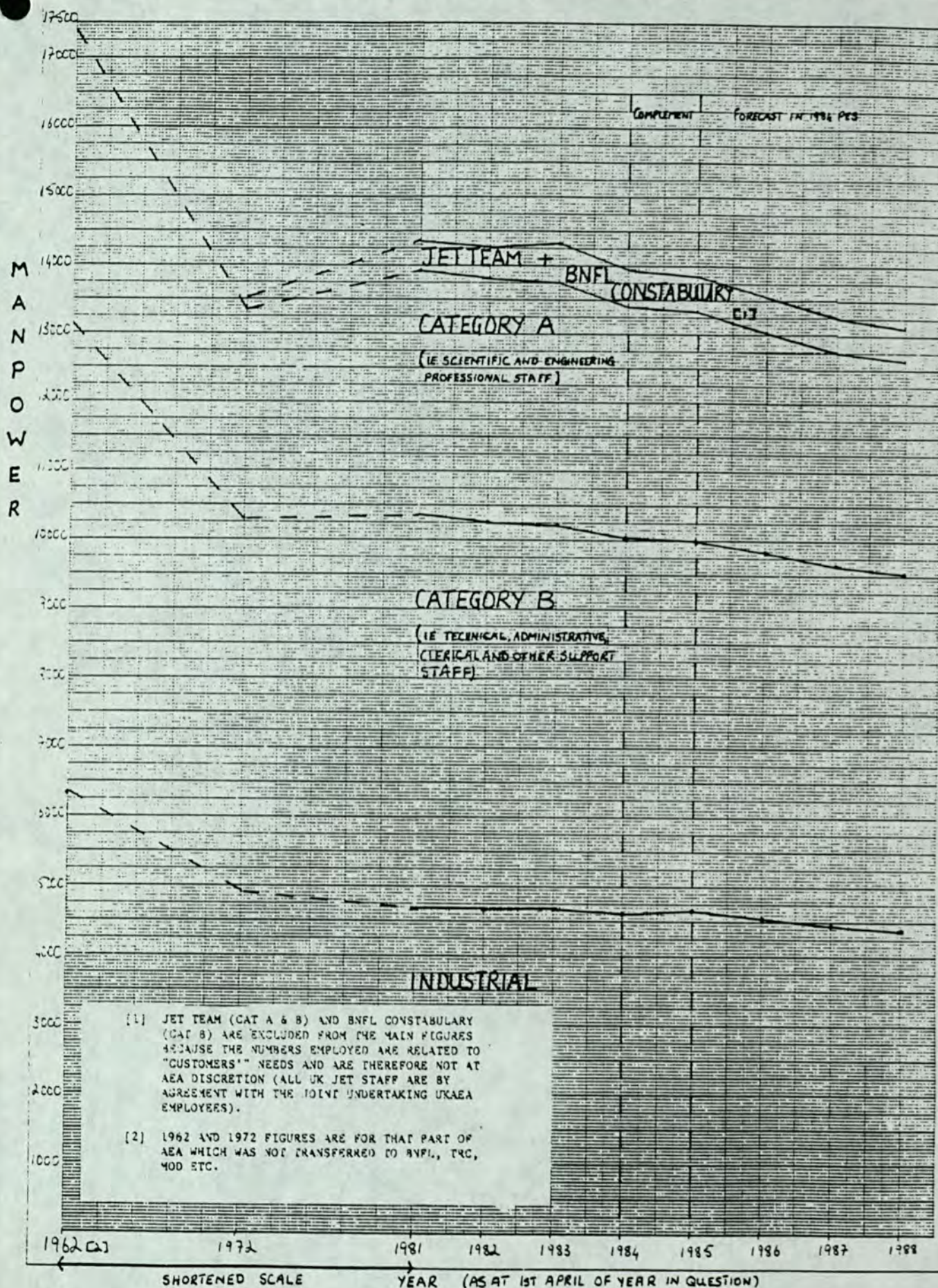
FIGURE 3

### Trends of Expenditure (£m 1980/81 Prices)



Note:- All Figures exclude expenditure on the IFT project

# AUTHORITY MANPOWER 1962-1988



Notes to Table 1

- (1) These comprise Operation of the Winfrith Reactor, Radiological Protection and Measurement, Assessment Work, Refurbishment of the Harwell MTRs.
- (2) The Authority's nuclear and non-nuclear repayment work generates a surplus in cash terms which is used to reduce the net call on the vote. Some of this surplus in cash terms is used to cover the charges to customers in respect of central services overheads and the Authority's Employer's superannuation contributions, items which in the cash PES presentation are included with early retirement payments under the heading of Other Provisions. For simplicity in this presentation the whole cash surplus is netted off against this heading.
- (3) Income from repayment work that can be associated with vote funded programmes has been included in the figures for external funding of those programmes. "Other repayment work" comprises nuclear R & D work on programmes with no direct Authority analogue (eg naval work for MoD), sales of technical and non-technical services, and royalty receipts.
- (4) Receipts arise mainly from the provision of administrative services on a repayment basis, in particular the provision of AEA Constabulary at BNFL sites, and in respect of amenities such as canteens, hostels and housing.

TABLE 1

1984/85 Authority Programme Provisions

	£m (cash)		
	<u>D/En Vote Funding</u>	<u>External Funding</u>	<u>Total Funding</u>
Fast Reactor R&D	93.5	8.4	101.9
Thermal Reactor R&D	17.4	28.9	46.3
General Safety	5.3	-	5.3
Radioactive Waste and Nuclear Materials Management	19.5	18.5	38.0
Underlying Research	21.8	-	21.8
Fusion	17.1	18.4	35.5
Other minor Vote programmes <sup>(1)</sup>	3.2	17.3	20.5
Non-Nuclear R&D	NIL <sup>(2)</sup>	28.6	28.6
D/En contracts on renewable energy sources and energy conservation managed by ETSU	NIL	14.9	14.9
Other repayment work <sup>(3)</sup>	NIL <sup>(2)</sup>	35.0	35.0
Other Provisions	18.8 <sup>(2)</sup>	10.4 <sup>(4)</sup>	29.2
TOTAL	<u>196.6</u>	<u>180.4</u>	<u>377.0</u>

FAST REACTOR PROGRAMME

- i) Overall objective
  1. The overall objectives of the programme, as set out in the Authority's Corporate Plan, are:
    - to retain for the UK the option of series ordering of fast reactors on a commercial scale at the time when it becomes likely to be an economically favourable strategy;
    - to carry out with our European partners joint R & D programmes leading to improvements in design and costs of fast reactor power stations and associated fuel process plants and which support the demonstration plants to be built under the provisions of the collaborative agreements with Europe;
    - to seek benefits for UK industry wherever possible.
- ii) Basis for and context of Programme
  2. The bases for the programme are:
    - a) the operation of the 240 MW prototype fast reactor at Dounreay, together with its associated reprocessing and research facilities, supported by work at other Authority sites, particularly Risley and Harwell;
    - b) the development work done at the Authority laboratories, in association with NNC design teams, and from now on in association with European partner organisations required to sustain one to three successively improved economic and safe full scale fast reactors.

3. The context of the programme is the inter-governmental Fast Reactor Memorandum of Understanding (MoU) signed on 10 January 1984, the three industry level MoUs on reactors, fuel fabrication and fuel reprocessing signed on 2 March 1984, and the discussions currently in progress in relation to specific agreements covering design, R & D and commercial aspects.
  4. In order to handle the requirements of the international collaborative programme a joint organisation - the Fast Reactor Joint Co-ordinating Committee - has been set up to control UK fast reactor activities. This body meets regularly under Authority chairmanship with representatives from the AEA, NNC, BNFL and the Generating Boards. There are also two independent assessors, and the Department is entitled to attend as an observer.
- iii) Specific Targets to be expanded in discussion with Authority and with assistance of Department's nuclear experts
5. (i) To achieve sustained operation of PFR at high power (240 MWe (gross) or higher) and a high availability (in excess of 50%) in time for the conceptual reactor design referred to in (ii) below, and to continue operation of the Dounreay fuel reprocessing plant:
    - (a) to provide (by 1989/90) improved confidence in the long-term operation of such plants;
    - (b) to provide data on performance, safety and reliability, essential for the design of large commercial-scale plant;
    - (c) to act as a test bed for new component development: and,
    - (d) to reduce to a minimum the amount of plutonium needed from other sources by enabling PFR to be operated on a closed fuel cycle.



- (ii) To develop and validate within the international joint programmes a conceptual design for a commercial-scale lead reactor and a design for a joint reprocessing plant (by 1989/90):
  - (a) by the establishment of agreed design objectives leading to reduced cost and improved reliability;
  - (b) by carrying out a major reactor design and proving programme on key components in collaboration with the UK nuclear industry.
- (iii) To provide research and development support with the UK making important contributions particularly in the international joint programmes on:
  - (a) engineering component development;
  - (b) high burn-up fuel development; and,
  - (c) fuel plant development.
- (iv) To establish by 1989/90 criteria for the licensing in the UK of fast reactor stations by:
  - (a) contributing to the preliminary safety assessment of the current NNC conceptual design of a commercial demonstration station; and,
  - (b) collaborating with the international fast reactor community in both the improvement of the inherent safety characteristics of reactor designs, engineered safeguards and high-integrity components and the development of appropriate common safety standards.

iv) Costs

a) Total cost of Programme to completion

5. The programme is predicated on the planning assumption that construction of a UK lead fast reactor, to be paid for and operated by the CEGB, will start in 1993. The research programme will thereafter begin to be wound down. Any research required to support the commercial ordering of fast reactors will be the subject of a subsequent programme, to be paid for in full by the Generating Boards. The total expenditure in 1982/83 prices through to completion in 2001/2002 on this basis is estimated at £1.3 billion. The annual profile is at Annex 1. It is, however, understood that any revision to the date at which a lead reactor is started in the UK would also require a revision to these figures.

b) Allocation of voted funds to specific targets

A breakdown of the planned annual allocation of voted funds to the specific targets through to 1991/92 is set out at Annex 2.

c) PES forecasts

Forecast expenditure in cash terms for PES during the present settling down phase of the programme is at Annex 3.

v) Progress and uncertainties

An annual statement of progress towards targets is to be provided to the Department with the PES returns and will be discussed with them. However:

(a) The programme will be subject to change in the light of decisions made in discussions of European collaboration. It is as yet uncertain where or when the next reactor will be built. The split of R & D between the partners will not be agreed until the end of 1984.

- (b) The structure of the programme will be subject to review in the light of technical developments for example, the performance of PFR and other Dounreay facilities.

AE 3

4 May 1984

## FAST REACTOR DEVELOPMENT COSTS (NET)

£m	1982/83	Constant Prices
1984/85		£85
1985/86		80
1986/87		75
1987/88		75
1988/89		75
1989/90		75
1990/91		75
1991/92		75
1992/93		80
1993/94		85
1994/95		85
1995/96		80
1996/97		80
1997/98		75
1998/99		65
1999/2000		55
2000/01		45
2001/02		35

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1300

The table assumes that construction of a UK CDFR would start in 1993, but the figures do not include its cost. They also do not include design and component proving work by NNC in certain years which it is assumed will be funded by CEGB.

Fast Reactor ProgrammePlanned Allocation of AEA Net Vote Funds to Specific Targets

	£m 1982/83 prices				
	<u>1985/86</u>	<u>1986/87</u>	<u>1987/88</u>	<u>1988/89</u>	<u>1989/90 - 1991/92</u>
i) <u>Operation of PFR and fuel reprocessing plants</u>					
£m Net	35	31	30	31	31
ii) <u>Design of lead reactor and joint reprocessing plant</u>					
£m Net	3	3	4	4	4
iii) <u>Research and Development support</u>					
£m Net	37	36	36	35	35
iv) <u>Safety</u>					
£m Net	5	5	5	5	5
v) <u>Total</u>					
£m Net	80	75	75	75	75

	£m (Cash)			
	<u>1984/85</u>	<u>1985/86</u>	<u>1986/87</u>	<u>1987/88</u>
Net Vote	93.3	90.2	85.8	88.4
PFR Receipts	6.4	9.9	11.8	17.7
Gross AEA	99.9	100.2	97.7	106.1
Assured CEGB funding of design and component proving work	5.0	8.0	9.4	9.6
<u>TOTAL</u>	104.9	108.2	107.1	115.7

Possible Contract For Safeguards R & D

1. This paper sets out how a safeguards R & D programme in support of the International Atomic Energy Agency (and in line with UK policy) might be contracted for from the Authority by the Department of Energy. The note lays down the structure of the contract and also refers to some of the elements that might be required in the contract proposal.

2. Because of the close contact between AE Division and the IAEA, agreement on broad objectives for the programme should be fairly easy; similarly, the Department with assistance from BNFL and AEA should be able to judge the relative merits of particular routes to those objectives as proposed by the Authority. Indeed, the programme currently being pursued is the result of discussions in which AE Division has been closely involved.

PREAMBLE AND OBJECTIVES

3. The preamble would state the background of the programme. This is that in June 1980, the UK offered a three-year programme of R & D assistance to the IAEA in the field of safeguards, and the programme was agreed and formally accepted by the IAEA in July 1981. At the request of the IAEA, the core of the programme is centred round aspects of the nuclear power programme in which the UK has particular expertise, viz the Fast Reactor and its fuel cycle, and uranium enrichment by ultra-centrifuges. The UK support programme is one of ten offered to the IAEA by member nations and international agencies.

4. The proposal and the contract would then go on to give the broad aims and objectives of the programme which remain as agreed when the programme was established:

- (a) To assist the IAEA in attainment of its safeguards goals in a cost-effective manner and to influence the formation of technical policy in that organisation.
- (b) To enable the UK to meet its obligations under the Non-Proliferation Treaty and associated Agreements in as

cost-effective a manner as possible, both for existing facilities and those at the design stage.

5. There would be scope for some explanation of the context and justification of the programme along the following lines. Member states of the United Nations have decided that the IAEA should not be funded to conduct its own development work in the safeguards field. As a result, member states with major nuclear power programmes have made voluntary offers of support programmes. Although some of these have been in place for a number of years, the task of providing the range of equipment and techniques required by the IAEA is far from complete.

6. The UK support programme is a tangible expression of the Government's willingness to play their part in providing the means whereby the IAEA might attain their non-proliferation objectives. The withdrawal of UK support before the task is substantially complete would be an implicit statement that the UK alone among the nuclear powers no longer supported the non-proliferation objectives of the IAEA in a practical way. Within the UK the absence of a credible UK stance on non-proliferation could seriously undermine the public acceptance of nuclear power.

#### PROPOSED PROGRAMME

7. Reference would then be made to the programme content for the years covered by the contract under discussion. There would be likely to be an annex containing detail of the content, but both the main contract and the proposal could describe the broad work areas. These are as follows:-

##### A. Service Programme

8. Under this heading certain services are supplied to the IAEA. The exact details are subject to their request but one example is the provision of an annual two week training course to IAEA inspectors.

##### B. Generic Programmes

9. These address those elements of instruments and systems that are common to many systems or are fundamental to major safeguards topics such as destructive and non destructive analysis. For example, work on neutron interrogation is undertaken to analyse and to improve the performance of a number of instruments used for non-destructive analysis.



C. Enrichment Plant Safeguards

10. Under this heading, the aim is to develop techniques for the safeguarding of centrifuge enrichment plants. For example a system is being developed to detect by monitoring pipework the production of enriched uranium of enrichment in excess of that declared to the safeguards authorities.

D. Field Trials

11. Field trials cover the testing of instruments and systems developed in the UK and elsewhere. An example is the field trial of computer file interrogation packages for audit and safeguards purposes, which aims to streamline the work of inspectors and internal auditors and to reduce paperwork errors.

E. Plant Studies

12. These are a group of studies relating to practical problems in plant safeguarding. An example is work on K-edge absorptiometry in process plants, which aims to develop a system for the on-line analysis of plutonium in solution.

F. Exploratory and Short Projects

13. The definitions of these small projects is self-explanatory.

14. The proposal would need to justify why work was needed on a particular topic. For example the requirement for work on non-destructive analysis as part of the generic programme could be explained as follows.

Non-destructive analysis, while lacking the precision obtainable by destructive analysis, has great advantages in timeliness, convenience, and avoidance of sampling problems. When the programme began, non-destructive analysis using passive techniques, in which assay is achieved by measuring the natural gamma-ray and neutron emissions, seemed fairly well established, so work concentrated on active neutron interrogation. In this, a neutron source stimulated neutron production by the sample under interrogation. The main application has been to the determination of fissile material in wastes. Work is still needed to improve methods of correction for the effects of the matrix in which the fissile material is embedded. Experience over the past years has now exposed limitations in passive systems. A review of these is proposed and it seems likely that these too will require further development.

RESOURCES AND COMMITMENTS

15. A major element in both contract and proposal would be a statement of overall resources and commitments. A detailed annex might be required in the contract. The proposal would be for a three year programme totalling £1830K, the breakdown and phasing being as follows:-

Project title	Cost £K*		
	84/85	85/86	86/87
Service Programme	64	64	64
Generic Programmes	215	190	190
Enrichment Plant Safeguards	30	20	-
Field Trials and Plant Studies	160	150	150
Exploratory and Short Projects	20	20	20
New Projects yet to be defined		55	75
Management	66	66	66
Contingency	45	45	45
TOTAL	610	610	610

\* The cost figures are estimated in 1984/85 money values at commercial rates

16. In support of the level of resources proposed in the UK it would be stated that these would be comparable with those from France, the Federal Republic of Germany, Canada, and Japan. A review conducted by the IAEA and national representatives in 1983 concluded that there was no significant overlap of activity between the programmes and little scope for the redistribution of tasks. The reduction in funding by Department of Energy of 20% in Autumn 1983 fortunately coincided with the completion of a number of tasks. A number of those remaining were about to enter a phase where a sharp rise in the rate of expenditure was required. By planned phasing of some of this it was possible to accommodate the programme within the reduced

budget without signalling to the IAEA that UK support was being reduced. It is unlikely, however, that further cuts in real funding could be sustained without political consequences. It is therefore proposed that the programme should continue at about the level agreed with the AEA for 1984/85.

17. Given the long term importance of international safeguards, it is likely that demand from the IAEA will continue. It is proposed to review the programme after 2 years with the probability of putting forward a case during the 3rd year for further work.

#### CUSTOMER INVOLVEMENT

##### (1) Customer monitoring

18. Since its inception, the programme has been managed within the normal AEA structure. Formal liaison with the IAEA is maintained by a "UK Support Programme Steering Committee" chaired by Dr. F. Brown, Department of Energy. UK policy matters and practical arrangements are at present agreed by an informal group, with representatives of the AEA, BNFL and DEn, which meets as required. Under a contract system, it would need to be stated in the contract that the day-to-day management of the project would rest with the AEA Project Manager and the formal liaison with IAEA would be through the Steering Committee chaired by DEn. It might be desirable to formalise the existing UK Group. The contract would also include a clause specifying the degree to which the contractor could change technical aims and resource allocations without reference back to the customer.

##### (ii) Periodic Technical Reporting Requirements

19. These would need to be specified in the proposal and the contract and would depend on the needs of the customer. The more detail required the greater the cost and staff requirements would be.

##### (iii) Intellectual Property Rights

20. The contract and proposal would cover appropriate provisions and it would be expected that ownership of the intellectual property would remain with the contractor (AEA). The Government as well as the AEA would have free use. Further/wider use including that by the IAEA would be subject to negotiation (although clearly IAEA must have access to the results).

FINANCE

(i) Financial Reports, Payments and Audit Rights

21. Relevant provisions would need to be included in the contract.

(ii) Nature of Charging

22. A cost plus system with limit of commitment would be appropriate. It is likely that charges would be on a fully commercial basis. The question of profit would be for discussion. VAT would also be added. A cost variation clause would also be required.

DURATION

23. The contract and proposal would need to cover the duration. The original programme agreed with IAEA was for three years and this would appear an appropriate period for any contract (c.f. also para. 17).

REVIEW AND NOTICE PROVISIONS

24. The contract and proposal would need to encompass (for both the Department's and the Authority protection) review and notice provisions (c.f. also para. 17).

WORKING GROUP TO REVIEW THE AEAILLUSTRATION OF THE INTEGRATED WORKING AND INTER-DEPENDENCE OF  
AUTHORITY ESTABLISHMENTS

To take an example from the fast reactor programme, the changes in dimensions of core components under fast neutron irradiation, involving mechanisms not previously encountered, created a major problem. The solution was achieved by using the wide diversity of expertise and facilities in the Authority, closely co-ordinated under its project system. Salient among the many contributions were:

- i) measurements by the Dounreay Fuel Technology Division of the deformation of fast reactor fuel pins (which are exposed to more extreme conditions than other fast reactor components) to guide the choice of the most deformation resistant alloys;
- ii) the development by the Harwell Chemistry and Metallurgy Divisions of an accelerator technique by which several years of fast neutron irradiation damage could be simulated in a few days, providing both a better understanding of the deformation mechanisms and a rapid sorting technique for selecting new alloys for further investigation;
- iii) the design by Risley Engineering Division and the National Nuclear Corporation fast reactor team of equipment by which the residual distortion of the core could be restrained and controlled;
- iv) the production by the Harwell Theoretical Physics Division of a theoretical model of the core deformation and a related computer programme (CRAMP) which predicts the dimensional changes of individual components

and the consequential forces between them; and which in collaboration with the Risley Engineering Division and the Dounreay PER Operations team was developed into a fuel management system for the Prototype Fast Reactor, and in collaboration with NNC into a design tool for the Civil Fast Reactor core;

- v) the development by the Acoustics Engineering Group at Risley of an ultrasonic under sodium viewing technique which, inter alia, allows any undue deformation of components beneath the surface of the molten sodium coolant to be monitored.

Inputs to the Harwell Business Centres

The Materials Engineering Centre is typical of Harwell Business Centres in the way it calls on varied resources from seven Harwell Scientific and Engineering Divisions. The attached histogram shows the proportion of time QSEs spend working on the project.

The Centre undertakes a wide ranging industrial programme with the emphasis on product and process development and the improved engineering use of materials. A typical current contract in which several Harwell Divisions are involved is a programme aimed at the development of advanced gas sensing devices. The programme is funded by a multi-client Working Party, whose objective is to develop new materials for semi-conductor devices for the detection of various gases. A parallel generic programme supported by the Department of Trade and Industry provides a fundamental understanding of the response mechanisms of semi-conductor sensors and information about the different ways in which these responses might best be exploited.

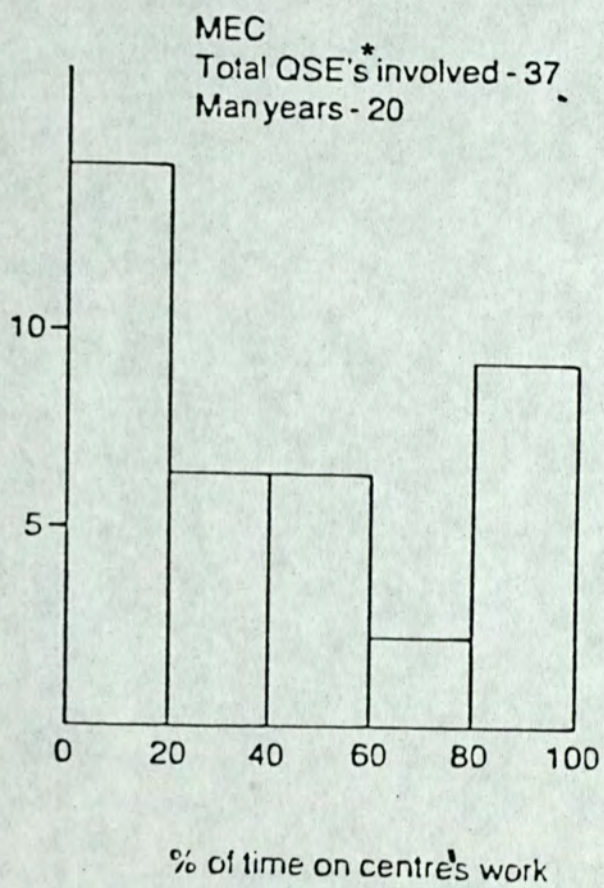
Contributions to the programme are provided by:

- Chemistry Division, together with the Materials Development Division, who have been involved in the identification, preparation and screening of over 300 different materials for responses to a range of flammable gases. Within the generic programme, Chemistry Division have also developed sophisticated sol-gel methods of oxide preparation used to prepare a series of compounds which give better quality gas response data. Sol-gel techniques were developed for application on nuclear programmes.
- Theoretical Physics Division which has undertaken a statistical analysis of the responses of the most promising materials, resulting in the categorisation of responses into four main types. This allows predictions to be made of the reaction involved in the detection of most of the test gases. Within the generic programme it has also developed a theoretical structure against which the results of the materials screening programme may be evaluated.

- Materials Physics and Metallurgy Division, which has fully characterised materials offering useful gas responses using X-ray diffraction techniques. These techniques are applied in a wide range of nuclear and non-nuclear programmes.

The same materials are also being screened for response to some toxic gases and responses have been recorded in some instances at gas concentrations as low as 20 ppm (parts per million). A number of new materials have now shown promise for the detection of toxic gases and others appear useful as low temperature moisture monitors.





\* Qualified Scientists and Engineers

