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UNITED KINGDOM ATOMIC ENERGY AUTHORITY

NUCLEAR AND NON-NUCLEAR RESEARCH AND DEVELOPMENT COMMITTEE

THE WEAPONS GROUP PROGRAMME ON PEACEFUL USES
OF NUCLEAR EXPLOSIVES (PNE)



AUTHORISATION, AIMS AND ORGANISATION

1. This programme was inaugurated by the Authority's Nuclear Research and Development Committee in November 1969 - ARD(N)(69)M7 refers - on the basis of considerations set out in the paper ARD(N)(69)30.

2. The aims of the programme are to understand the science and technology of peaceful nuclear explosions so as to be able to advise on and participate in IAEA activities in this field, to give advice to industry and to support studies aimed at assessing the technical and economic opportunities of PNE for the United Kingdom.

3. The programme is run on an inter-Departmental basis and co-ordination has continued to be a responsibility of [REDACTED] Chief of Applied Physics. Under his chairmanship the AWRE Working Party on the Peaceful Uses of Nuclear Explosives has met three times since the issue of ARD(NNN)(72)16/N, the previous report to the Committee a year ago.

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4. Actual and estimated effort and expenditure on the programme are as follows:

<u>Year</u>	<u>Effort, pmy</u>	<u>Expenditure, £K cash</u>
1969/70 actual	1	12
1970/71 actual	2	23
1971/72 actual	3	31
1972/73 forecast	3	35
1973/74 estimated	3	35

5. The 1972/73 authorised expenditure agreed by the Committee in February 1972 was £30K. The increase to £35K is in line with the authorised pay increases to the people working on the project in the 1972/73 financial year. The effort used has remained substantially the same.

6. The estimated 1973/74 figures assume that the programme will continue at the same general level but it should be noted that effort and expenditure could increase by an order of magnitude if it is decided to undertake a thorough feasibility of study on oil storage in nuclear chimneys beneath the seabed on the West European Continental Shelf (see paragraph 24).

PROGRESS DURING THE PERIOD FEBRUARY 1972-FEBRUARY 1973

IAEA Activities

7. Three AWRE staff attended the third IAEA Panel on Peaceful Nuclear Explosions, Vienna, 27-30 November 1972. Papers were presented on the production of radioactivity in peaceful nuclear explosions ([REDACTED]) and on the prediction of fallout levels resulting from peaceful nuclear cratering explosions [REDACTED]. Translations of the Russian and French Panel papers are being issued as AWRE Translation No. 65 and a report on the Panel has been issued as KP/1272/146.

8. The Panel heard presentations by the Egyptians and Venezuelans on possible PNE projects in their own countries and the principal

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recommendation of the Panel - suggested for action during 1973 - was that the Agency should develop detailed procedures for responding to requests from Member States for assistance in obtaining PNE services. The Panel suggested that a consultants' meeting with representation from potential supplier nations and Non-Nuclear Weapon States might be convened to advise the Director General on acceptable procedures.

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9. Towards the end of 1972 the Arms Control and Disarmament Unit of the Foreign and Commonwealth Office initiated discussions on PNE and Arms Control. AWRE played a full part on these discussions during which the Head of the Unit and a member of his staff visited Aldermaston. The resulting research study, issued as ACRDU(73)1 in January, incorporates a good deal of AWRE thinking, particularly on the difficult problem of PNE under a Comprehensive Test Ban (CTB) regime. The problem of control and inspection of PNE programmes in these circumstances is likely to need further analysis if and when a CTB becomes a real possibility.

Possibilities for cooperation with the French on PNE

10. During the Third IAEA Panel on PNE in November the French made an informal approach to the United Kingdom delegation on the possibilities for co-operation certainly between France and the UK but possibly involving other European countries as well.
11. During the past eighteen months the French appear to have carried out a detailed review of their programme and to have decided to concentrate on gas and oil storage applications, the subject of their two main presentations to the Third IAEA Panel on PNE. The sixth French Plan shows an expenditure on PNE of 60M francs (~ £5M) over the five years 1971-75 (mostly in the final three years). Moreover they are developing a nuclear explosive for PNE work. One of their Panel papers describes this as follows:

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The explosive appears to be a fission device particularly suitable for hydrocarbon storage and stimulation projects.

12. In discussing the use of PNE for North Sea oil storage - at the fields, close inshore or on land - the French expressed the view that any project would have to be an international one, possibly involving most of the littoral States. They expressed themselves as eager to co-operate in such a scheme, particularly with the UK, and are prepared to enter into formal or informal discussions at any level.

13. Because they have been able to draw on experimental results from their underground nuclear weapon tests in the Sahara and because they have studied one or two possible specific gas and oil storage projects in some detail, the French must be considered to be somewhat further advanced than the British in PNE technology but it is doubtful whether they have really come to grips with the political and public relations problems involved in any European PNE project.

14. These recent developments have been drawn to the attention of the UKAEA London Office and interested Government Departments.

Technical Studies

15. The small programme of technical studies continues to be aimed at improving the capability of AERE to give independent advice on PNE to independent bodies and to British organisations. It is largely orientated towards safety aspects and inspection problems. First drafts of a report on blast (principally from cratering effects) and on the production of waters produced in single nuclear explosions and on the effects of nuclear explosions have been

prepared.

16. As a result of IAEA interest a paper has been completed on the seismic monitoring of PNE explosion yields. It has been concluded that acceptable estimates of yields can be obtained by studying the surface (Rayleigh) waves received at existing seismic observatories, possibly augmented by a temporary station involving some £10K of instrumentation.

17. Several aspects of radioactivity are under study. Understanding of the production of radioactivity in underground nuclear explosions is now very good. Predictions of fallout from cratering explosions can be made but British methods could perhaps usefully be compared with those developed by the Russians and Americans. Further work on radioactivity will concentrate on those aspects important in the storage and stimulation of hydrocarbons, including methods of reducing the eventual hazards to consumers.

18. A report was issued on American and Russian PNE explosives in July and more recently the nature of the French PNE device has been discussed. The report on the 2 kton (conventional) explosion in the wreck of the "Kielce" off Folkestone in July 1967 has been published as AWRE Report No. 036/72.

Liaison with United Kingdom Organisations

19. Existing liaisons with organisations such as the Gas Council (now the British Gas Corporation) and British Petroleum have been maintained. Following the Third IAEA Panel arrangements were made [REDACTED], a leading American in the field, to address a representative gathering of governmental and industrial representatives held in the UKAEA London Office on 8 December.

20. In Spring 1972 the merchant bankers [REDACTED] sought the Authority's advice on the possibility of constructing

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compressed air storage cavities underground using nuclear explosives. Such cavities were under active consideration for an energy storage component of a possible tidal power scheme in the Bay of Fundy (Nova Scotia). A preliminary assessment of the feasibility and economics of a PNE approach to the problem was prepared at AWRE and submitted to the UKAEA London Office. It was concluded that there was a good chance that nuclear explosives could be safely and economically used in the scheme and that a more detailed feasibility study involving AWRE and the scheme's project engineers was a logical next step.

21. In December an approach was received from DTI Petroleum Division on behalf of the Scottish Office who are exploring crude oil and refined product storage requirements for planned and projected Scottish refineries. At a meeting with these two parties held on 17 January the possibilities for nuclear cavity oil storage were outlined by AWRE staff who submitted an assessment "Cheap oil storage beneath the bed of the North Sea in cavities/chimneys created by contained nuclear explosions" (KP/672/137). The reaction of DTI and the Scottish office is awaited.

22. During the summer of 1972 the same assessment, whose preparation was foreshadowed in last year's report (paragraph 23), was submitted to the International Management and Engineering Group of Britain Ltd as possible material for their report on opportunities in the expanding market for goods and services required to exploit oil and gas discoveries off the coast of Britain commissioned by DTI. The full report contained a reference to PNE for oil storage with a suggestion that it should be further investigated but in the publication version a short non-committal paragraph on the subject was eventually omitted to meet the wishes of DTI, apparently concerned that the press would seize on this

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possibly controversial issue to the detriment of recommendations calling for immediate action.

PROPOSED PROGRAMME FOR 1973-74

23. If the UKAEA is to carry out its essentially statutory role as the Government's adviser on PNE, a particular area of nuclear technology, then the programme should continue at no less than the present modest level with the completion of PNE reviews and problems stemming from IAEA activities taking a good proportion of the effort. But there is now some prospect that an expansion of the work may be justified.
24. As implied in last year's report the best immediate prospect for PNE in and around the United Kingdom appears to be oil storage beneath the seabed. A site on one of the uninhabited islands of the Shetlands could provide transit storage for oil brought by pipeline or tankers from the newly discovered Brent and Cormorant fields. Work is in progress to update last year's report on North Sea oil storage (KP/672/137) and produce a prospectus for a detailed feasibility study. Such a study, including laboratory-scale experimental work, seems likely to cost about £300K, providing no exploratory drilling is required to determine the geology at any particular site. A wide range of expertise would be needed to undertake such a study and it would be essential to involve a petroleum company. Not all the costs of such a study would fall within the area of AWRE expertise but a substantial increase in funds to AWRE would be required together with a tighter control of the staff involved in some kind of project management organisation. Sponsorship by government or industry appears to be required and the various possibilities should be explored during 1973-74. The recent meeting with DTI Petroleum Division and the Scottish Office is essentially part of this exercise.

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25. The possibility of co-operation with the French cannot be overlooked; this seems most likely in the very field discussed in the previous paragraph. Certainly it seems desirable to encourage better informal contacts with the French during the coming months. Any formal co-operation would almost certainly require an effort larger than the current minimum if it was to prove attractive to the French.

RECOMMENDATION

The Committee are asked to note the progress of the programme, to approve continuation at broadly the same level effort, £35,000 per annum, and to endorse exploration of the possibility of increased effort being devoted to the application of PNE to oil storage.

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