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# COMMISSION OF THE EUROPEAN COMMUNITIES

COM(78) 166 final.

Brussels, 19 April 1978.

## PROPOSAL FOR A COUNCIL DECISION

adopting a programme of research for the European  
Atomic Energy Community on safety in thermal water  
reactors

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(submitted to the Council by the Commission)

COM(78) 166 final.

## 1. Introduction

According to the Resolution on Energy and the Environment adopted by the Council on 7 November 1974 "... the Communities and the Member States should investigate the special problems associated with the development of atomic energy, particularly the danger of radiation, the problems of reactor safety...." (1)

Again, in the Council Resolution of 22 July 75 on the technological problems of nuclear safety the Council agreed "... to strengthen Community efforts to coordinate applied research programmes in order to make the best possible use of the resources available in the Community and the Member States both technically and financially whilst avoiding as far as possible unnecessary duplication ; these efforts shall be aimed at improving systematic exchanges of information, promoting concerted action and cooperation between specialized bodies and institutes and stimulating where appropriate the development of Community programmes" (2)

To achieve these aims the Commission has accordingly initiated various activities as advised by its working group n° 2 which deals with thermal water reactor safety research.

Because of the large range and complexity of subjects and the various degrees of possible coordination the following working method was applied :

- to subdivide the huge field of research to be covered ;
- to focus efforts on improving exchanges of information both on modifications and developments of research programmes in member states and on progress and results obtained ;
- to endeavour at the same time to arrive at the best solution of the major technical problems and to identify priorities in the research programme.

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(1) Doc. R/2996/74 (ENV 137, ENER 48) of 14 Nov. 1974

(2) Official journal of the European Communities n° C185/1-14 August 1975

Generally speaking, the ultimate objectives of the Commission's measure are :

1. to establish an efficient and rapid information network in the Community and to facilitate exchanges of information with industrially-developed non-member countries : this allows the identification of areas where more knowledge is required
2. to promote - in selected fields and according to a pre-established order of priority - continuous consultation, coordination and cooperation between the specialized agencies and institutes of the Member States and, where appropriate those of the non-Member States.
3. to promote Community projects particularly to increase the knowledge in those specified areas where more knowledge is required.

Efforts to achieve items (1) and (2) have been underway for sometime. This present proposal concerns item (3).

## 2. Programme

The proposed Community research and development programme is intended to be complementary to existing and proposed programmes of thermal water reactor safety research in : (\*)

- Community Member States
- Nuclear advanced countries outside the Community (for ex. USA, Japan, Sweden)
- The Joint Research Centre of the Commission (direct action).

The work is intended to be carried out in organisations of the Community Member States with the financial participation of the Community (indirect action).

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(\*) This is essentially for Light Water Reactors (LWR) but it can be relevant to Heavy Water Pressure Tube Reactors.

The suggested programme is based on a comprehensive set of consultations at the technical level ; it has been examined by the Scientific and Technical Committee of Euratom who have given a favourable opinion.

- Three specific topics have been identified where maximum priority is necessary to improve and consolidate existing technical knowledge :

- (a) The loss of coolant accident (LOCA) and subsequent correct functioning and effect of the emergency core cooling system (ECCS).
- (b) The protection of nuclear installations against gas cloud explosions.
- (c) The escape of radioactive fission products and dispersion in the atmosphere following a reactor accident.

The intention of the Commission is that work on these topics can each be carried out, in parallel, and in a collaborative manner, at a number of organisations within the Community. In the case of experimental work the total cost to the Community can be considerably reduced by making use of high capital cost experimental facilities already existing within Community Member States.

The overall aim of this programme is to supply industry and governmental organisations with necessary basic information to consolidate the safe operation and assessment of thermal water reactors in use and under construction today- that is those types of nuclear plant providing the majority of current nuclear electricity generation.

The proposed duration of the programme is five years (mid 1978 - mid 1983).

The programme will be implemented under contracts. In the execution of this programme the Commission will be assisted by the Advisory Committee on Programme Management for reactor safety research (direct action) which will therefore exercise its consultative rôle on indirect actions as well as direct action.

#### 2.1. Work in the area of the loss of coolant accident (LOCA) and the functioning of the emergency core cooling system (ECCS).

Due to the nature of nuclear reactors an accident whereby primary coolant is lost has been identified as a major fault condition necessitating detailed study and carefully designed safety systems.

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Because of the phenomena of delayed heat caused by the decay of fission products it is impossible to completely and instantaneously terminate the production of heat. Thus if a rupture of the primary circuit occurs causing loss of primary coolant it is necessary, even with the reactor shut down, to maintain adequate cooling of the reactor core.

Reactor safety assessment is largely based on theoretical studies using computer codes, the validity of which are dependent on experimental studies covering the range from basic research through single effect tests to integral and large inpile tests. Numerous programmes currently exist in this area both inside and outside the Community, including the direct action programme at the JRC, and it is clearly not possible to describe all these in detail. Many are interconnected and some overlapping is necessary as a check between the various programmes. It is a fact that water reactors are being licensed to operate commercially while these research programmes are underway studying in more detail various important phenomena, such as occur during emergency core cooling. The mathematical models and associated computer codes developed for the design and licensing process (the so-called "licensing codes" compared to the "best estimate codes") have built in conservative margins in order to ensure safety. These theoretical and experimental programmes will allow a better understanding and a possible reduction of some of these margins in order to enable reactors to be safely operated more efficiently. Clearly a Community programme of research must take into account the extensive theoretical and experimental work being carried out, particularly in the USA and the JRC Ispra. A thorough examination of this work shows an attempt on the one hand to execute experiments under conditions more and more approaching real accident conditions and on the other to look into the thermohydraulic phenomena in a more detailed manner during the different stages of an accident caused by the loss of primary coolant. The 1977-1980 direct action programme of the JRC has already devoted a large effort to the initial blowdown process. However quite a number of phenomena are still to be analysed and specified particularly during the subsequent stages of a LOCA where re-wetting-reflooding of the core occur after the complete or partial uncovering of the fuel elements.

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The experiments proposed under the indirect action programme include the simulation of the production of nuclear decay heat by direct or indirect electrical heating of the pins and can be classified in three categories :

- study of the behaviour of a single pin with different variations of filling with particular observation of the clad behaviour and the mechanism of heat transfer at the quenching level ;
- study of the behaviour of a bundle of pins and the thermal and hydraulic phenomena not only at the quenching level but also in the upper part of the vessel with different outflow conditions ;
- study of the same hydraulic and thermal parameters for a bundle of deformed pins thus disturbing the hydraulic characteristics of cooling.

These proposed studies do not cover the field of in-pile experiments, nor the large integral tests.

A cooperative programme of investigations to be implemented by research contracts in the research centres of member countries of the Community.

COMMUNITY CONTRIBUTION : 4 805 000 ECU

## 2.2. The protection of nuclear installations against gas cloud explosions

In order to determine the necessary protection of nuclear power plants against external explosions a better understanding of the phenomena of unconfined gas cloud explosions is required, in particular the following items :

- Assessment of previous major incidents ;
- Study of flammable material release characteristics ;
- Study of explosive gas cloud formation and dispersion ;
- Study of flammability and explosivity ;
- Estimation of incident pressure waves generated by unconfined gas cloud explosions ;
- Interaction of incident pressure waves with target structures ;
- Study of structural response to imposed pressure loadings.

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The present programme will deal with the above items and will include both theoretical and experimental work. Several establishments within the Community already have a limited current programme of work in this field.

The JRC runs a research activity which has strong connections with the last two items of the above mentioned list. The object of this Community action is to encourage cooperation in this activity and to reinforce and extend an integral programme of work.

An experimental and theoretical cooperative programme to be implemented by means of research contracts in Community research establishments.

COMMUNITY CONTRIBUTION : 800 000 ECU

This figure includes possible small technical theoretical studies to be financed completely by the Commission.

2.3. The escape of radioactive fission products and dispersion in the atmosphere following a reactor accident.

Models describing the release of fission products from nuclear plant and their dispersion in the atmosphere have become increasingly important in connection with evaluating the risk and consequences to the environment, particularly in connection with postulated accidents. Such models are a major component of recent well publicised studies on reactor safety (for example the U.S. Rasmussen-Study WASH 1400) and are therefore very relevant to the current public debate on the comparison of nuclear and non-nuclear risks. Also the question of such dispersion is of particular concern to the Community because of the possibility of dispersion of radioactivity spreading across national boundaries following a reactor accident in one country.

Many such mathematical models have now been developed with however varying complexity and characteristics. The development of such complex models involving turbulent diffusion of plumes with its interdependence on meteorological and topographical conditions is itself a difficult task. Also the complications are augmented by the addition of radiation effects. Thus experimental verification and improvement of such models is necessary.

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It is therefore proposed that initially a detailed study and comparison of these models should be undertaken with a view to their suitability for European conditions. Such a study will indicate exactly where experimental verifications and improvements are required.

It seems for example that more information is required on vertical dispersion and for releases at coastal sites and dispersion over water.

The suggested programme consists of initial theoretical and subsequent experimental work taking in account the research already performed by the JRC under the Environment Direct Action Programme. Also to be considered is other relevant work underway including that within the Euratom Radiation Protection Programme.

An experimental and theoretical cooperative programme to be implemented by means of research contracts in Community research establishments.

COMMUNITY CONTRIBUTION: 1 400 000 EUA

This figure includes possible small technical theoretical studies to be financed completely by the Commission.

3. Financial and staff resources required

The funds and staff required for this programme are as follows :

Operating budget	7 005 000 EUA
Staff	3A + 1B + 1C
Staff costs	1 469 000 EUA
Administrative expenses	326 000 EUA
TOTAL FUNDS REQUIRED	8 800 000 EUA

PROPOSAL FOR A COUNCIL DECISION ADOPTING A PROGRAMME OF RESEARCH FOR THE  
EUROPEAN ATOMIC ENERGY COMMUNITY ON SAFETY IN THERMAL WATER REACTORS  
(INDIRECT NUCLEAR ACTION)

The Council of the European Communities,

Having regard to the Treaty establishing the European Atomic Energy Community,  
and in particular Article 7 thereof ;

Having regard to the proposal of the Commission presented after consultation  
with the Scientific and Technical Committee ;

Having regard to the Opinion of the European Parliament ;

Having regard to the Opinion of the Economic and Social Committee ;

Having regard to the Council resolution of 22 July 1975 (1) on the technolo-  
gical problems of nuclear safety;

Having regard to the Council resolution of 18 July 1977<sup>(2)</sup> on a direct  
action programme on reactor safety research ;

Whereas the promotion of programmes of nuclear safety research is one of the  
Community's essential ways of contributing to the safe production of nuclear  
power and to the protection of the population and the environment ;

Whereas it is opportune to complement the direct action programme by an  
indirect action programme of research ;

HAS ADOPTED THIS DECISION :

Article 1

A programme of research on the safety of thermal water reactors, as set out  
in the Annex, shall be adopted for a period of five years starting on  
1 July 1978. The Annex forms a part of this decision.

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(1) Official journal of the European Communities N° C 185 - 14 August 1975  
(2) Official journal of the European Communities N° L 200 - 8 August 1977

Article 2

For implementation of this programme, the amount of the expenditure commitments is estimated to be 8 800 000 EJA and the Commission staff shall be five persons.

Article 3

The programme defined in the Annex can be reviewed at the end of the second year, according to the appropriate procedures.

Article 4

The Advisory Committee on Management of the direct action programme on reactor safety research set up by the Council resolution of 18 July 1977<sup>(1)</sup> is also competent for advice on this indirect action programme.

Done at Brussels

For the Council

The President

<sup>(1)</sup> Official journal of the European Communities N° C192 - 11 August 1977

ANNEXINDIRECT NUCLEAR ACTIONSAFETY RESEARCH IN THERMAL WATER REACTOR

The purpose of the programme shall be the collaborative investigation of phenomena in order to further advance the safe operation of thermal water nuclear reactors.

The programme consists of three parts, each being a theoretical and experimental study on one of the following particular topics :

- (a) The loss of coolant accident (LOCA) and the functioning and performance of the emergency core cooling system (ECCS) ;
- (b) The protection of nuclear plant against gas cloud explosions ;
- (c) The release and distribution of radioactive fission products in the atmosphere following a reactor accident.

The programme will be mainly implemented under contract with possibly some small technical theoretical studies to be financed completely by the Commission.

FINANCIAL RECORD

1978 BUDGET.

A. PART I

1. Relevant budget heading code

Poste 3363

2. Title of budget heading

Research on thermal - water reactor safety

3. Legal basis

Article 7 of the Euratom Treaty

4. Description, objectives and justification of the project

4.0. Description of the project/persons concerned

4.0.0. Description

A EURATOM research programme on thermal water reactor safety

4.0.1. Persons concerned (outside the Commission)

4.0.1.0. Category

Nuclear research establishments

4.0.1.1. Number

Cannot be decided until after tenders have been returned and assessed.

4.0.1.2. Geographical location

Within the Community - Comment in 4.0.1.1. applies.

4.1. Objectives of the project

4.1.0. General Objectives

In the Council Resolution of 22 July 1975 on the technological problems of nuclear safety the Council considered it necessary "... to strengthen Community efforts to coordinate applied research programmes in order to make the best possible use of the resources available in the Community and the Member States both technically and financially whilst avoiding as far as possible unnecessary duplication ;

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these efforts shall be aimed at improving systematic exchanges of information, promoting concerted action and cooperation between specialized bodies and institutes and stimulating where appropriate the development of Community programmes"

It should also be noted that the anxiety felt by the general public as regards nuclear power is a major obstacle to the development of nuclear capacity within the Community.

The overall aim of this programme is to supply industry and governmental organizations with the necessary basic information to enable them to consolidate the safe operation and assessment of water-reactors in use and under construction today - i.e. the types of nuclear plant most commonly used for nuclear electricity generation at the present time.

Thus the aim of the programme is to effect the analysis of phenomena on a collaborative basis in order to further advance the safe operation of water-cooled reactors.

4.1.1. Specific objectives of the programme and its contribution towards the general objective

The Commission Working Group N° 2 which deals with water reactor safety research has identified three specific topics where maximum priority is necessary to improve and consolidate the present state of the art :

- (a) the loss-of-coolant accident (LOCA) and subsequent correct functioning and effect of the emergency core cooling system (ECCS)
- (b) the protection of nuclear installations against gas cloud explosions
- (c) the escape of radioactive fission products and dispersion in the atmosphere following a reactor accident

It is intended that work on each of these topics be carried out, in parallel, and on a collaborative basis, at a number of organizations within the Community.

4.2. Justification of the programme chosen to attain the objectives

The proposed programme is based on a number of technical level discussions between experts drawn from a wide range of institutes and organizations within the Community, thus ensuring the maximum possible coordination with the relevant nuclear organizations in the Member States.

This draft Community research and development programme is intended to be complementary to existing and planned programmes of LWR research in :

- Community Member States
- Non-Member States advanced nuclear technologies (e.g., USA, Japan, Sweden)
- the Joint Research Centre of the Commission (direct action)

5. Financial implications of the projects (in EUA)

5.0. Implications in respect of expenditure

- on Community budget 8 800 000
- by national administrations (1) -
- by other sectors at national level (1) -

TOTAL

5.0.0 Multiannual term

Commitments

	1978	1979	1980	1981	1982	1983
Staff	94 000	270 000	290 000	310 000	330 000	175 000
Manag.	26 000	56 000	62 000	68 000	74 000	40 000
Contracts	1 500 000	3 000 000	1 000 000	1 000 000	505 000	-
TOTAL	1 620 000	3 326 000	1 352 000	1 378 000	909 000	215 000

(1) to be defined later (see remark 4.0.1.1.)



Payments

	1978	1979	1980	1981	1982	1983
Staff	94 000	270 000	290 000	310 000	330 000	175 000
Manag.	26 000	56 000	62 000	68 000	74 000	40 000
Contracts	500 000	2 000 000	2 000 000	1 300 000	1 000 000	205 000
TOTAL	620 000	2 326 000	2 352 000	1 678 000	1 404 000	420 000

5.0.1. Evaluation method

a) Staff expenditure

The estimated staff required for this programme are :

2A, 1B, 1C for 6 months of 1978

3A, 1B, 1C for the remainder of the programme.

In addition to staff number estimates, the evaluation takes account of the data of the Council Decision of 21.12.1976, on the adaptation of salary of European Community staff and applicable correction coefficients adding to it - on a hypothetical basis - possible needs originating from the general evolution of prices in the Community.

The rates adopted are those used for the calculation of the three-year forecast 1978/1980.

b) Contracts expenditures

Due to the nature of the subject and to the qualifications of the contractants, a uniform evaluation method cannot be established.

In any case, the consultative Committee, provided for in the draft decision, will be consulted on the appropriation of the payments.

5.1. Incidence on the funds :

- Community income tax on staff
- Staff contribution for retirement fund

6. Funding action

6.0

6.1

6.2

6.3. Funds to be included in future(s) budget (s)