COMMISSION OF THE EUROPEAN COMMUNITIES

COM (78) 405 final

Brussels, 12 September 1978

PROPOSAL FOR A COUNCIL DECISION ADOPTING A RESEARCH PROGRAMME FOR THE EUROPEAN ENERGY COMMUNITY ON CODES AND STANDARDS FOR FAST BREEDER REACTORS (STRUCTURAL INTEGRITY OF COMPONENTS).

(Submitted by the Commission to the Council)

COM (78) 405 final

INTRODUCTION

In April 1970 the Council created the Fast Reactor Coordinating Committee (FRCC) with the mandate "to work out and implement plans for coordination and cooperation on the broadest possible scale between the various programmes by means of the most suitable procedures and to make any helpful suggestion in this connection".(*)

Part of the work of the Committee is executed by Working Groups. One of these is the Working Group "Codes and Standards"(WGCS), which was set up in 1974 and whose terms of reference included:

- to draw up a list of the construction codes, standards and regulations in force in the Member States with regard to component design criteria and the choice of structural materials, their use and their control for operating conditions in sodium cooled fast reactors;
- to define the points of similarity and analyse the problems relating to points of dissimilarity;
- to define the fields in which additional theoretical or experimental data are required.

At the end of 1977 the Working Group "Codes and Standards" , concluded a first important phase of its work by making a full report of its activities to the Fast Reactor Coordinating Committee. The WGCS organized its investigations into four main headings, namely:

- manufacturing standards and quality control
- structural analysis and design calculations
- materials
- classification of components.

In its report to the FRCC, the WGCS produced a qualitative comparison of codes and standards for fast reactors and identified points of similarity and dissimilarity between Member States. It also outlined a programme for future work aimed at a detailed evaluation and quantification of the points of similarity and dissimilarity. Such evaluation could form the basis for a subsequent progressive elimination of the dissimilarities.

(*) AP/166/70 (ATO 50)

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The FRCC considered the report of the WGCS at its meeting of 7/12/77 and expressed an opinion whose full text is appended as Annex 1. In its opinion the FRCC:

- broadly approved the programme of future work proposed by the WGCS
- adjusted the mandate of the WGCS in order to allow it to proceed with the above programme;
- requested tha national organizations to contribute as efficiently as possible to the activities of the WGCS;
- invited the Commission to take suitable initiatives to obtain the necessary support for the future activities of the WGCS.

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The proposed Community actions are consistent with the programme of work outlined by the WGCS. These actions are also to be seen in the framework of the Communication to the Council entitled "The fast breeder option in the Community contect - Justifications, Achievements, Problems and Action Perspectives"(*).

On the other hand the Council Resolution of 22/7/75(**) on the technological problems of nuclear safety is also relevant. In fact, the Council received a first communication on the activity of the Commission in the field of Codes and Standards for Fast Reactors with the first progress report(***), transmitted in compliance with point 8 of the above Resolution.

(*) COM(77)361 final. Chapter 4, item (iv)

(**) ECJO Nº C.185 of 14/8/75

(***) COM(77)168 final, par. 2.2.

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2. OBJECTIVES, SCOPE AND JUSTIFICATION OF COMMUNITY ACTION

The objective of the Community Programme is to enable industry to proceed towards establishing a firm technical basis upon which a progressive elimination of dissimilarities on Codes and Standards for components which are specific to Liquid Metal Fast Breeder Reactors (LMFBRs) can take place. Special LMFBRs components are those non-replaceable components which are or can be in contact with the liquid metal, its vapour or blanket gazes.

The assurance of structural integrity of components plays an important part in achieving overall safety and economy in the construction of the plant and in its exploitation. Only when such structural integrity can be assured for adequately long periods of time, the plant can be considered commercially viable.

Whilst it is important that Codes and Standards are not frozen in advance of technological developments and of the commercial demonstration, it is nevertheless necessary to initiate now the process of quantitative technical evaluation and comparison.

Only matters of technical consideration are involved. The implications of any national legal requirements that may be applied to special LMFBR components will only become clear when the technical bases have been compared.

Within the span of time which is concerned by this proposal (1979-1983) the envisaged programme would consist mainly in work involving qualified expert manpower, although some supporting experimental evidence would have to be generated towards the latter half of this period.

The Commission believes that this programme should be contracted mainly to industry (reactor design and construction companies, component and materials manufacturers, and electric utilities).

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3. Past achievements and content of the proposed programme of work

As already mentioned, the past work of the WGCS has been organized according to four main headings, i.e.:

- manufacturing standards and quality control
- structural analysis and design calculations
- materials
- classification of components.

The long range goals against which the necessity of future work has been assessed are the following:

(i) It should eventually be possible for the regulatory authority of a Member State to accept as being structurally sound a component licensed by the regulatory authority of another Member State, without substantial modification or additional restriction other than as dictated by the site; and

(ii) It should eventually be possible for an electric utility to accept as sufficiently reliable a component accepted by the electric utility of another Member State without substantial modification or additional restriction other than as dictated by the site.

In what follows brief description of the results achieved up to now and of the proposed items of programme are given according to each area. The programme covers the period 1/1/79 to 31/12/83.

3.1. Manufacturing Standards and Quality Control

3.1.1. Achievements

A document, the "Code Qualité" prepared for the construction of Super-Phénix has been used as the framework for investigations. Using this document, more than thirty separate manufacturing operations have been selected. The interrelation of activities, such as tests on purchased material, preparation of the work, execution of the work, tests on completion of the work has been identified for each operation. The practice adopted by each member State on each activity has been determined.

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It has then been established where practices are identical in detail, where they are similar and have the same intent and where they differ significantly. It has been found that in a majority of cases, the national practices examined are either identical or show similarity. However, a substantial number of points of significant difference exist.

3.1.2. Future programme

The priority task is an evaluation and quantification of the points of difference which have been disclosed. Evaluation necessitates discovering the basis for the differences as applied to special LMFBR components and the importance of the differences for various components and various conditions of use. The second task is to extend the list of manufacturing operations which should be considered.

The work will include:

1. A listing of practices which could be accepted as equivalent, together with statements about the ranges of conditions and applications within the equivalence could be accepted.
2. A short list of differences in practice which will require resolution.
3. Work tending to resolve the most significant differences.

3.2. Structural Analysis and Design Calculations

3.2.1. Achievements

It has been found that Member States do not have identified national Codes which have been developed specifically for LMFBR components. It has also been found that there is agreement among experts that the field of components operating at elevated temperatures presents that of the greatest difficulty. This field has therefore been accorded priority in the reported investigations. In this field the only published set of design rules is contained in A.S.M.E. Code Case 1592(*), which is used to a limited extent in Europe. However, because many of the rules are questionable, and some of the procedures are difficult to apply, the code case is nowhere completely adopted, and is supplemented or replaced by other design methods and design criteria.

(*) The American Society for Mechanical Engineers (ASME) has developed a design code for boilers and pressure vessels, which permits the design and calculation of pressure vessels and circuits up to 450°C. The ASME code case 1592 proposes rules and methods to extend this code in the temperature region above 450°C, which is a region of interest for several components for sodium cooled fast breeder reactors.

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The problem facing the designer-owners and licensing authorities is that of demonstrating the integrity of components over their whole working life, despite the time dependent degradation of material properties such as those due to the high temperature.

3.2.2. Future programme

1. Detailed information exchanges on problems, design methods and design criteria. Topics for detailed evaluation will be selected on a continuing basis and status reports issued. In addition to the high temperature class I(*) components which have been the main topic of discussion so far, future considerations will include design rules for the low temperature Class I(*) components, as well as Class 2(*) and Class 3 components(*).
2. Computational investigations, partly to check the adequacy of the various programmes which are used, and partly to provide information in a number of problem areas.
3. Analysis of previous experience of structural performance of components in demonstration plant and large sodium test loops, to establish the adequacy with which proposed design procedures predicted integrity.
4. Pooling of materials data from programmes of work carried out for specific reactor projects. There is, in addition, need for jointly available reference tests to establish long term behaviour, especially of welds.

3.3. Materials

3.3.1. Achievements

Selection of material specifications for construction of special LMFBR components lies in a field particularly strongly influenced by national, non-LMFBR experience.

(*) Class I components : components which contain large amounts of high level radio-active materials.

Class II components : components preventing the consequences of failure of class I components or containing less important quantities of radio-active materials.

Class III components : components, preventing the consequences of failure of class II components or containing low level radio-active materials.

N.B. This is a preliminary classification of components by the Codes and Standards Working Group - see also § 3.4.

The task undertaken in this field was to investigate how materials are selected and approved in Community Member States for specific applications and what range of nominal materials is in present or projected use for Community LMFBRs. Nine different materials were identified. One of these materials, Stainless Steel Type 316, was then selected for a study in greater depth. It was found that nine different versions of Stainless Steel type 316 are in use and that these versions may have very different mechanical properties.

It is considered that broad specifications do not form a satisfactory basis from which to achieve the long range goals stated at par. 3(i) and (ii).

3.3.2. Future programmes

The next phase of the work should be the identification of the information comprising both mechanical properties and chemical composition which should be made available so that in future it would be possible to establish equivalence of materials compatibly with the long range goals stated at par. 3(i) and (ii), according to various limitations of use. This required information will take into account the intended service conditions, such as high temperature or low temperature.

This work will include:

1. Listing of materials which could be acepted as equivalent for specific LMFBR components, together with statements about the ranges of conditions and applications within which the equivalence could be accepted.
2. Quantitative interpretation of differences in properties of the various materials.
3. Quantitative comparison of material properties derived from various testing techniques.
4. Reference tests on selected materials and conditions.

3.4. Classification of components

This area of work is mentioned in this proposal only for the sake of completeness. No programme of work involving Community funding is proposed.

Classification is the method for making the measures taken to ensure that failure will be unlikely, consistent with the consequences of such failure.

The reactors Phénix and PFR have been built without a formal classification system. Such a system is required in the licensing of SNR 300. Safety classification of structural components will be required in future for LMFBRs to be built in Germany and France. Italy has not as yet plans for its own classification system, as far as commercial reactors are concerned, but the PEC reactor has been designed in the framework of a classification system. There are no indications so far that a classification system will formally be required in the U.K. Detailed comparison of national classification prac ices was therefore not possible. Accordingly, the most advanced available document was taken as a basis for discussion. This document has been produced specifically for the construction of Super-Phénix at Creys-Malville. It has been adapted in order both to simplify it and to make it generally applicable to a wider range of LMFBR designs.

It is considered that the Classification document which will be progressively reviewed by the WGCS could eventually be used as a basis for a Community classification system for safety and availability of LMFBRs structural components..

4. Financial ressources required for the proposed programme

The programme of work being considered is that defined at paragraph 3.1.2., 3.2.2. and 3.3.2. It will be executed by contracts.

The cost of the programme is estimated at 5 M.E.U.A. Such programme covers studies and investigations over the 5 years (3 M.E.U.A.) and supporting experiments over the last 3 years of the 5 years period (2 M.E.U.A.).

To this it must be added the cost of personnel and administration.

The total cost of the programme is therefore estimated at 5.825 M.E.U.A. broken down as follows:

Contracts	5 M.E.U.A.
Personnel	1 grade A, 1 grade B, 1 grade C.
Personnel expenses	752,000 E.U.A..
Administrative cost	73,000 E.U.A..

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5. Programme Advisory Committee

It is proposed that the Fast Reactor Coordinating Committee acts as Programme Advisory Committee for this programme, with the assistance of its Codes and Standards Working Group.

ANNEXE I

FAST REACTOR COORDINATING COMMITTEE 31/1/78

OPINION of the FAST REACTOR COORDINATING COMMITTEE concerning the WORKING GROUP "CODES AND STANDARDS"

1. The Committee has examined the report of its Working Group "Codes and Standards" (doc. XII/607/77). This report presents a proposal for its future activities based on the work of the last two years.
2. The Committee is of the opinion that the Working Group "Codes and Standards" has very well fulfilled its mandate, given to it in 1974 - by producing a qualitative comparison of codes and standards for fast reactors and by identifying the points of similarity and dissimilarity that exist between the Member States.
3. The Committee considers that the achievement of these future activities - which aim at bringing the Member States closer together regarding the methodology in the field of codes and standards - is a very important element in facilitating the existing cooperation in the Community in the construction of fast reactors, taking into account the industrial and regulatory realities.

The Fast Reactor Coordinating Committee thinks it therefore necessary to enlarge the mandate of the Working Group "Codes and Standards" by adding the following clause:

" The Working Group"Codes and Standards" shall try to reach a consensus of views on the evaluation of the points of dissimilarity in the methodology by promoting work which will facilitate such consensus, also taking into account the contribution the Joint Research Center could make in this field. For this purpose it shall propose to the FRCC the necessary measures and shall keep it informed about the results achieved in view of a progressive elimination of these dissimilarities".

- The Coordination Committee requests the national organizations to contribute as efficiently as possible to the execution of these activities.
- The Coordinating Committee invites the Commission to take suitable initiatives to obtain the necessary support for the future activities of the group.

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PROPOSAL

FOR A COUNCIL DECISION ADOPTING A RESEARCH PROGRAMME FOR THE EUROPEAN ENERGY COMMUNITY ON CODES AND STANDARDS FOR FAST BREEDER REACTORS (STRUCTURAL INTEGRITY OF COMPONENTS)

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 from the Commission following 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.

Whereas the Council adopted on 22 July 1975 (1) a Resolution on the technological problems of nuclear safety;

Whereas the implementation of a research programme on the structural integrity of components for fast breeder reactors is of major importance in the development of a safe and reliable reactor concept;

Whereas the technical bases for a gradual opening up of the market in components for this concept should now be laid down,

HAS DECIDED AS FOLLOWS :

Article 1

A research programme on Codes and Standards for fast breeder reactors as set out in the Annex hereto is hereby adopted for a period of five years with effect from 1 January 1979.

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(1) O.J. Nº C.185 of 14.8.1975

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Article 2

The expenditure commitments required for the implementation of the programme are estimated at 5 825 000 EUA and the members of staff to be assigned to this project by the Commission is set at three.

Article 2

The programme set out in the Annex may be revised at the end of the second year, in accordance with the appropriate procedures.

Done at Brussels

For the Council
The President

ANNEX 2

INDIRECT NUCLEAR ACTION PROJECT

RESEARCH ON CODES AND STANDARDS (STRUCTURAL INTEGRITY OF COMPONENTS) FOR BREEDER REACTORS

The aim of the programme is to make gradual progress towards the establishment of a comprehensive technological base which could be used for the gradual elimination of dissimilarities in codes and standards for fast breeder reactor components in the Community. These codes and standards relate to the structural integrity of components.

The programme comprises the following points:

1. Manufacturing standards and quality codes

Evaluation and quantification of dissimilarities.

2. Structural analysis and design codes

Comparative analysis of design methods and criteria. Computational investigations. Analysis of experience with the structural behaviour of components.

3. Materials

Evaluation and quantification of dissimilarities. Reference tests.

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FINANCIAL RECORD

1. RELEVANT BUDGET HEADING

Chapter 33 - Article 3366

2. TITLE OF THE PROJECT

Codes and Standards for the design, construction and inspection of components for sodium-cooled fast reactors.

3. LEGAL BASIS

Article 7 of the EAEC Treaty.

4. OBJECTIVE OF THE PROJECT

General objective: Creation of the conditions necessary for the growth of nuclear industries and promotion of research (Articles 1 and 4 of the EAEC Treaty).

Specific objective: Evaluation of the discrepancies between codes and standards specific to fast breeder reactors, with a view to the gradual elimination of these discrepancies and, therefore, harmonization.

This objective is in accordance with the Council Resolution of 22 July 1975 on the technical problems of nuclear safety.

The structural integrity of fast reactor components is an essential factor in the safety of these reactors.

The intended aim, namely that of preparing the ground for possible harmonization, is essentially a Community one. The achievement of this aim will help, on the other hand, to provide an equivalent and satisfactory degree of protection for the public in the various countries and, on the other, to open up the market in components.

5. FINANCIAL IMPLICATIONS OF THE PROJECT

5.0. Total cost for the intended duration of the project: 5 825 000 EUA

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5.0.0.0. Chargeable to the Community budget: 5 825 000 EUA[1]

5.0.0.1. Chargeable to national administrations.

5.0.0.2. Chargeable to other sectors at national level.

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(1) The total sum for expenditure on codes and standards specific to fast reactors in the Member States of the Community during the period under consideration is far greater than the amount chargeable to the Commission for the purpose of this project. Since the specific objective in the context of this limited project is essentially of a Community nature (see explanation in section 4), it is advisable for this project to be financed in principle entirely by the Community.

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5.0.1. MULTIANNUAL TIMETABLE FOR THE APPROPRIATIONS

Appropriations for commitment in EUA

	1979	1980	1981	1982	1983	TOTAL
Staff	134 000	142 000	150 000	158 500	167 500	752 000
Adm.exp.	12 000	13 000	14 500	16 000	17 500	73 000
Contracts	1 000 000	1 500 000	2 000 000	500 000	-	5 000 000
TOTALS	1 146 000	1 655 000	2 164 500	674 500	185 000	5 825 000

Appropriations for payment in EUA

	1979	1980	1981	1982	1983	TOTAL
Staff	134 000	142 000	150 000	158 500	167 500	752 000
Adm.exp.	12 000	13 000	14 500	16 000	17 500	73 000
Contracts	300 000	600 000	900 000	1 600 000	1 600 000	5 000 000
TOTALS	446 000	755 000	1 064 500	1 774 500	1 785 000	5 825 000

5.0.2. METHOD OF CALCULATION

(a) Staff expenditure

The requirements were assessed on the basis of the following staff complement:

1 Category A official

1 Catégory B official

1 Catégory C official.

In addition to this staff complement, the calculations take account of the parameters determined for the drawing up of the preliminary draft of the budget for the financial year 1979. No increase in purchasing power has been provided for. Only a change in the correction factor has been taken into consideration so as to allow for the development of the overall price level in the Community.

(b) Administrative expenditure

This covers the cost of travel, missions and the organization of meetings.

c) Expenditure under contracts

Since the nature of the subject and the qualifications of the contractors are variable, a standard method of calculation cannot be established.

At all events, the Advisory Committee on Programme Management would be consulted regarding the allotment of appropriations.

5.1. Implications in respect of revenue

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6. FINANCING

6.3. Appropriations to be entered under future budgets