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COMMISSION OF THE EUROPEAN COMMUNITIES

COM(83) 300 final

Brussels, 28th May 1983

RESEARCH ACTION PROGRAMME ON THE DEVELOPMENT OF NUCLEAR FISSION ENERGY (1984-1987)

(Communication from the Commission to the Council)



COM(83) 300 final

RESEARCH ACTION PROGRAMME ON THE DEVELOPMENT OF
NUCLEAR FISSION ENERGY (1984-87)

EXPLANATORY MEMORANDUM

In its Communication entitled "Proposals for a European Scientific and Technical Strategy: Framework Programme 1984-87"(1), the Commission set out the major goals to which this strategy should be geared. Among these goals, it is essential to improve the management of energy resources and to reduce energy dependence if the Community is to face up to the energy challenge. In order to attain these major goals, the Commission recommends that an approach centred on specific objectives be adopted with a view to :

"facilitating the implementation of the research specifically desired by the Member States;

"facilitaing the subsequent adoption of action programmes for implementation by identifying and putting into order the priority needs of the Community and thus the relative weighting to be given to the corresponding scientific and technical objectives; and

"testing in a specific manner the method of making political and techical choices as between national, international and Community activities".

As far as improving the management of energy resources and reducing energy dependance is concerned, the Commission proposed to concentrate its effort during the period 1984-87 on the following four scientific and technological objectives: the rational use of energy, the development of renewable energy sources, controlled thermonuclear fusion and the development of nuclear fission energy. The broad lines of the action programme on the development of nuclear fission energy that is the subject of this proposal are described in paper COM(82) 865 final, which includes in particular the following passage :

"The development of nuclear fission energy is one of the main ways of reducing, through the diversification of energy resources, the Community's dependance on oil. The continuation of a resolute nuclear programme is therefore an essential aspect of European energy policy. The Community strategy provides for the consolidation and intensification of research activities, in particular in the general fields of nuclear safety, health and environmental protection, and fissile materials safeguards. The European Parliament has adopted a resolution approving and confirming this strategy upon which the Council also took a favourable position. It should also be recalled that the nuclear

(1) COM(82) 865 final.

option embraces the development of the entire fuel cycle, including reprocessing and fast reactors. It is with this in mind that the present guidelines for Community R&D have been drawn up.

"Community R, D&D activities will therefore be mainly directed towards the safety aspects, i.e. the protection of workers and the general public against nuclear hazards. In this manner Community research can exert a positive influence on the nuclear controversy, by providing objective information that transcends the national dimension. By helping to harmonize national approaches to safety, Community action also assists in promoting industrial competitiveness by reducing the barriers to intra-European trade.

"At international level, there is an increasingly marked tendency to cooperate in the general field of nuclear safety, a trend which is considered extremely favourable for the development of this energy source and will be taken into account by Community action.

"The main areas taken into consideration are reactor safety, the management and storage of radioactive waste, radiation protection, fissile materials safeguards, the decommissioning of nuclear plants, and - the remainder of the fuel cycle that has already reached the industrial stage - certain safety aspects which all call for Community action".

The guidelines will be reflected in the contents of the action programme to be proposed. The sectoral research activities envisaged will generally come under the umbrella of the energy goals, although this rule will not be followed systematically. In the event, the objectives pursued by a number of activities overlap with the goal of improving living and working conditions as regards both protecting health and protecting the environment as implemented essentially by the research action programme health and safety. Other activities, while clearly working towards the objectives set for the development of nuclear fission energy, will simultaneously attain some of the targets of the goal of promoting industrial competitiveness, in particular those of eliminating barriers and of promoting and developing new technologies.

2. CONTENTS OF THE ACTION PROGRAMME ON THE "DEVELOPMENT OF NUCLEAR FISSION ENERGY"

This action programme is subdivided into a number of subprogrammes that the Commission proposes to distribute between direct action, which will be carried out in the Joint Research Centre laboratories, and shared-cost projects that will be conducted in laboratories in the Member States. The reasons

that prompted the Commission to propose such a breakdown will be explained case-by-case in the detailed proposals for the different subprogrammes; they result from a thorough examination of the situation and of the current capacities of Community research and national research in the Member States. The JRC's programme of direct-action research for the period 1984-87 will be presented and discussed in its entirety within the various Community bodies, but some aspects of that programme - which form an integral part of this action programme on the development of nuclear fission energy - must clearly be assessed from this angle, in particular as regards their overall budget and their interdependence with the other aspects of the action programme that are proposed as shared-cost projects.

The action programme on the development of nuclear fission energy comprises the following aspects:

1. Reactor safety activities

The aims pursued by some of these activities overlap with those covered by the goal of improving living and working conditions, namely improving safety, protecting health and protecting the environment. Part of these activities will also contribute towards the goal of promoting industrial competitiveness, in particular the objectives of removing and reducing barriers and of promoting and developing new technologies for conventional industries.

1.1. Direct action on reactor safety (1984-87)

This is the largest of the JRC's programmes. The research conducted is more often than not confirmatory in nature and is intended to back up the work of the licensing authorities with experiments and detailed theoretical analyses and to meet the needs of nuclear power station operators and nuclear component manufacturers. In addition to certain horizontal activities on topics of concern common to all reactor concepts, the projects relate essentially to light water reactors and liquid-metal fast breeder reactors.

1.2. Programme of shared-cost action on reactor safety (1984-87)

The field covered and the objectives are identical to those of direct action on reactor safety, while the projects proposed will either supplement or back up those to be conducted under direct action and will be closely integrated with the different national programmes being pursued at the centres where they will be carried out.

1.3. Implementation of the Council Resolution of 22 July 1975 on technological problems of nuclear safety

This activity began in 1976 with the entry in the research budget of a budget heading covering staff expenditure (for four Category A, two Category B and two Category C staff). The aim of this activity is to carry out comparative, analytical and re-

view studies, mainly concerning research coordination and the harmonization of methodologies, codes and safety standards for both the thermal light water reactor and sodium-cooled fast breeder reactor concepts.

In 1980, the Council agreed upon a Commission proposal to supplement this activity with a contractual component designed to provide financial support for comparative, analytical and review studies on codes and standards for fast reactors.

This activity will be continued during the period 1984-87 on the same level as in the past.

2. Direct action on plutonium fuels and actinides research (1984-87)

This programme comes under the umbrella of both fast reactor fuel development and more fundamental research on actinides. It is to be carried out mainly in the specialized laboratories at the European Institute for Transuranic Elements, Karlsruhe.

3. Activities relating to radioactive waste

Although specific to the objectives pursued for the development of nuclear fission energy, these activities make an extensive contribution to those adopted for the goal of improving living and working conditions, namely improving safety, protecting health and protecting the environment.

3.1. Direct action on the management of radioactive wastes (1984-87)

This programme focuses essentially on the problems that arise in the conditioning and interim or final disposal of radioactive waste, and both theoretical and experimental studies will be carried out in order to assess waste management procedures from a safety angle.

3.2. Programme of shared-cost action on the management and disposal of radioactive waste (1985-89)

A second five-year (1980-84) programme of shared-cost action is currently in progress. This programme is closely coordinated with the activities carried out by the JRC in the same field and has been thoroughly integrated with the national programmes since its inception in 1975. On completion of the current programme at the end of 1984, the Commission will propose, in accordance with the 1980-92 plan of action in the field of radioactive waste, that work be continued in this area. The broad lines of this new programme will comprise on the one hand the characterization of conditioned wastes with a view to its disposal and the improvement of the processes used, and on the other hand the study of the performance of the various geological storage options and their confinement methods and

the assessment of their safety. Although the expiry date of the current programme does not make it possible to begin the third radioactive waste programme at the same time as the 1984-87 action programme, it nevertheless forms part of the latter, and account should be taken of this fact as far as its links with the direct action proposed in section 3.1 above are concerned and as regards its financial repercussions on the action programme during the period concerned (1985-87).

4. Direct action on the safeguarding and management of fissile materials and support for the Safeguards Directorate (1984-87)

The continued desire to reinforce measures for the safeguarding and management of fissile materials underlines the need for a sustained research and development effort. In close coordination with the Euratom Safeguards Directorate, the national laboratories, those in charge of nuclear plants and the IAEA, the JRC proposes to increase its contribution to this effort. The proposed programme is aimed at developing various safeguards techniques for application in the main types of nuclear plant.

These techniques will help in the quantitative determination of nuclear material, in their identification, confinement and management. The related activities will also help in developing a system of management of the information originating from utilities and from inspection operations.

Finally the studies are concerned with the development of methodologies for the parametric analysis of the performance of the techniques of control in different types of plants or in the fuel cycle.

5. Programme of shared-cost action on the decommissioning of nuclear plants (1984-88)

This programme is the logical follow-up to that currently in progress on the decommissioning of nuclear power stations. Its scope is wider than the latter and its main aim is to make available effective solutions that are capable of ensuring the safety and protection of man and his environment against the potential risks associated with the decommissioning of nuclear plants. The financial repercussions of this programme to be taken into consideration in the action programme have been adjusted to make allowance for the fact that the present proposal covers a period of five years.

PARTICIPATION TO INTERNATIONAL PROJECTS OR TO RESEARCH PROGRAMMES
IMPLEMENTED IN MEMBER STATES

The complexity of research problems in the nuclear field, the increasing costs of the necessary installations and the very specific competences to be mustered for their solution, lead to the internationalization of nuclear research and to the development of scientific and technical relations between the Member States and Third Countries pursuing policies of nuclear energy for peaceful use.

The different sub-programmes proposed within this research action programme leave open to the Commission the possibility to participate to international research projects and to research programmes implemented in Member States when this participation is useful to the successful implementation of the proposed sub-programmes. According to needs this participation could take the form of financial contribution or exchange of information and results.

This type of collaboration has already been used in the past for the current programmes. Framework agreements already existing between the Commission and specialized organizations in Third Countries might be used.

RESOURCES

The proposed budgets for each of the seven headings of the action programme are set out in the following table. Part of

the resources allocated to several headings will cover to a certain extent - which will differ according to the case in point - expenditure on goals and objectives to which the Commission attaches priority but which do not relate to the specific aim of developing nuclear fission energy, nor even the energy goal.

The amounts set out in the following table are expressed in ECU at constant mid-1983 prices. The final programme proposals will comprise figures that will be updated in line with inflation forecasts and with due regard to the timetables for the commitment of appropriations.

The breakdown of resources between the different sectors and types of activity and the total budget, which amounts to 477.5 million ECU, are compatible with the guidelines set out in document COM(82) 865 final.

BUDGET ESTIMATES (1983 PRICES)

Action programme constituents	million ECU (1)	
1.1. Direct action on reactor safety	192.2	
1.2. Programme of shared-cost action on reactor safety (1984-87)	68.0	81.3(4)
1.3. Implementation of the Council Resolution of 22 July 1975 on technological problems of nuclear safety	3.3	
2. Direct action on plutonium fuels and actinides research (1984-87)	65.7	
3.1. Direct action on the safety of nuclear materials (1984-87)	48.9	
3.2. Programme of shared-cost action on the management and disposal of radioactive waste (1985-89)	43+pm(2)	75 or 100 ⁽⁵⁾
4. Direct action on the safeguarding and management of fissile materials and support for the Safeguards Directorate (1984-87)	45.4	
5. Programme of shared-cost action on the decommissioning of nuclear plants (1984-88)	<u>11(3)</u>	
T O T A L	477.5+pm	

(1) Mid-1983 prices.

(2) For the first three years of the third programme and the final year of the current (second) programme.

(3) For the first four years of the programme.

(4) Figures in actual ECU taking into account inflation (7 % per year) during the execution of the programme. This figure will appear in the formal proposal to be submitted to the Council. (Note 5 : see next page).

- (5) As point (4) above, but figures for 5 years. The high alternative (100 MECU) corresponds to the case in which a pilot installation would be decided. In this case the figure (1983 value) corresponding to the period covered by the action plan (43 MECU) should be increased (+ pm).

SYNCHRONISATION OF THE CONSTITUENT PARTS OF THE ACTION PROGRAMME

All the constituents of the action programme, with the exception of two, cover the period 1984-1987. The two exceptions are the following :

- Constituent 3.2. Shared-cost action on the management and disposal of radioactive waste, which is a part of the "Radioactive Waste Management" Sub-Programme.
The present programme will terminate at the end of 1984 and the next programme will start at the beginning of 1985.
- Constituent 5. Shared-cost action on the decommissioning of nuclear installations.
The present programme will terminate at the end of 1983 and the next programme will cover the period 1984-1988.

It is the intention of the Commission to unify the planning and the execution of the action programme by synchronizing the different subprogrammes.

The Commission reserves therefore the right to submit for revision all the constituents of the action programme at the end of 1986, at the same time as the reexamination of the JRC programme, which contains an important part of the action programme on the development of nuclear fission energy.

1. SUB-PROGRAMME "SAFETY OF FISSION REACTORS"

This programme covers both Light Water Reactor (LWR) Safety and Liquid Metal Fast Breeder Reactor (LMFBR) Safety.

In the description of objectives no distinction will be made between JRC and Cost shared activities. However, the activities will be identified separately for each type of action.

JRC activities bearing a star are discussed in the frame of the SUPER SARA replacement programme. In fact, the programme outlined hereunder takes into account the decisions to abandon the SUPER SARA Project and it is in line with the outcome of the orientation Council debate of 10.3.1983 on the future activities of the Joint Research Centre.

Programme objectives and activities will be discussed under two broad headings, i.e. accident prevention and accident analysis

control and mitigation, although some activities give contributions to both

General criteria for the selection of topics have been :

- to maximize effectiveness of Community effort by selecting a limited number of important areas where Commission can best stimulate coordination and collaboration amongst national programme ;
- searching for common interest of Member States, avoiding design-specific issues.

1.A. Light Water Reactor Safety

1.A.1. Objectives

Within the Member Countries of the European Community, by the end of 1981, a total of about 40 LWR nuclear power plants have been in operation, and 30 plants have been under construction. The corresponding electrical power generation capacity amounts to 40.000 MW for those already in operation, and an additional 37.000 MW for those at present under construction.

Although the existing plants show a satisfactory availability, and operation in above-average safety conditions, reactor safety research programmes must continue in order to ensure that the safety margins built-in today be further evaluated and quantified. The knowledge increase being acquired will at the same time make an important contribution to the development of reactor technology, particularly to the safety system desing.

In the area of accident prevention, the objective of the efforts is a continuous increase in design and fabrication quality of the various components and systems, with the aim of increasing the operation reliability. As a consequence, an important contribution is provided to the operational safety and economy.

The major effort of the Commission in this area is coming from the following actions :

- Risk and Reliability Assessment :

Methodologies are being developed with the aim to identify, model and analyse the accident sequences, and to investigate the reliability of components and systems. This action includes the collection of data and information from operating power plants in the framework of a data bank system (ERDS - European Reliability Data information System).

- Human Factors and Man-Machine Interaction :

Several meetings on this topic have been organized by the Commission during the past with the participation of experts from

US and Japan. For the Commission nuclear programme, this activity represents a new research area; within the Member countries, corresponding actions are limited and rather dispersed.

The objectives of the proposed actions focus on the improvement of the basic knowledge on operator behaviour taking into account the most important influencing factors (environment, special conditions, etc.).

The implementation of the ERDS will facilitate the collection, processing and use of data relating to the human reliability.

- Integrity of Components and Systems

The investigation of materials, the detection of flaws and the integrity of structures represent an important area of research in view of accident prevention.

The long term objectives are to establish a systematic approach which allows, by relying on different types of variables, to determine the residual life time of the structures.

More recently, some EEC member countries have brought to the attention of the Commission the desire to dispose of a medium size shaking table for seismic effect studies. This proposal will be analysed to better understand its technical merits and overall feasibility.

In the area of accident analysis, control and mitigation of accident consequences, the Commission intends to improve the knowledge of mechanisms governing the accident evolution. Merging the experimental and the analytical research is an essential goal to ensure that the results of expensive experiments are reflected in the improvement of models and codes used for the reactor safety analysis.

The availability of experimentally verified computer codes to potential code users (reactor vendors, licensing authorities and utilities) should enhance a progressive harmonisation of safety analysis within the European Community, and should at the same time provide the means necessary to satisfy a certain number of quality assurance criteria. The employment of both large in-pile and out-of-pile installations, and of skilled multidisciplinary teams require the widest possible international collaboration.

The objectives of the actions proposed deal mainly with areas which play an important role for the realistic evaluation of the course and consequences of accidents. The various subjects areas follows :

- Investigation of off-normal behaviour of reactor core and cooling system (core temperatures below 1200°C).

These studies cover small and large breaks and also transients in the primary and secondary cooling circuits which do not substantially damage the fuel elements. The principal aim of

these studies is the development of physical models and of computer codes for separate effects and for the complex interactions between various phenomena during the accident scenario of temporary loss of cooling of the core.

- Investigation of severe accident behaviour of reactor core and cooling system (core temperatures above 1200°C).

The aim of these investigations is the analysis of mechanisms and phenomena which are of primary importance during the course of an accident and might have the potential to cause loss of fuel integrity and, as a consequence, the release of fission products and hydrogen.

In the framework of this activity, the Commission proposes to make available to the Member Countries the competences acquired in executing the SUPER SARA programme in the past. A close cooperation with all laboratories of the Member States will be established in order to make best use of existing means and competences.

- The reactor outer containment phenomena during severe accident conditions.

Internal pressure and temperature loading of the outer containment are generated in hypothetical accident scenarios by gaseous products or vapour released from the reactor primary/secondary loops and by reaction products between molten core material and concrete. The evolution in time of this loading depends strongly on the postulated accident scenario and is in most of cases plant specific.

The objectives of the Community program are therefore to increase the understanding of phenomena which are common to all LWR reactor designs and have an important impact on risk evaluation, such as: the distribution, combustion and recombination possibilities of hydrogen in a complex environment as well as the fission product transport and chemistry.

External loading of the outer containment could be generated by air craft crash, gas cloud explosions, and seismic effects. The objectives of Community efforts are primarily concentrated on the understanding of the potential danger of gas cloud explosions and the analysis of possible techniques to prevent its effects.

- The dispersion of fission products in the atmosphere

This problem deserves particular attention in Europe where the individual states are relatively small and the population density high.

Therefore, the consequences of a large hypothetical release of fission products will under certain conditions have an impact on more than one country.

The identified Community task in this area is to promote a coherent approach of calculation model development and verification which should also consider the probabilistic aspect of a series of phenomena. It is in addition foreseen to join European laboratories in a common experimental exercise to investigate fission product transport phenomena over large distances.

1.A.2. Brief description of proposed activities

1.A.2.1. Reliability and Risk evaluation

- Direct action

The J.R.C. action is centered on two main activities, i.e.

- the creation of viable information system on reactor operation: the European reliability data system (ERDS). The aim of the present programme is to bring all the ERDS with its four data banks into full operation.
- the development of methodologies for probabilistic risk assessment and their application in identifying, modelling and analysing LWR accident sequences taking into account the timing of events, the operator intervention and uncertainties propagation.
These activities may be extended in developing techniques and models that make possible simulation (in real time or faster) of the various phases of accidents.

* Profitable use can be made here of fast running thermal hydraulic computation tools as were developed for SUPER SARA.

- Shared cost action

In order to support the programme mentioned under a) and to get more and more organisations involved in assessing advantages and disadvantages of the probabilistic risk assessment, a series of benchmark exercises will be organised on subjects to be agreed e.g. procedures to construct event trees, common cause/mode failure, probability of failure of structures, etc....

1.A.2.2. Human factors and man machine interactions

- Direct action : none proposed.
- Shared cost action :

The programme is divided into two main areas :

- the collection and analysis of relevant human behaviour data including informations available in non-nuclear activities ;

- the modelling of man behaviour, the comparison of different models and analysis of their suitability for probabilistic risk assessment (PRA) as well for their use for plant design and operation.

Close working relationships will be established with different organisations e.g. Halden, EPRI, NCR, the utilities, non-nuclear industries, etc....

1.A.2.3. Integrity of components and systems

- Direct action

The activities of J.R.C. concentrate on the following main topics :

- evaluation of the effectiveness of non destructive examination (NDE) techniques including the PISC II programme representing a comparison exercise of NDE techniques conducted on behalf of OECD/NEA and involving laboratories of 15 countries.

An extension to include austenitic welds inspection

- * techniques is under discussion as well as an exercise to be conducted on irradiated materials in the JRC ADECO facilities using real scale samples coming from power stations which are being dismantled.

- Primary circuit components life prediction using 1 to 5 scale models of PWR vessels. These tests are expected to check the validity of combined modelling and non destructive inspection techniques when determining the life expectancy of structures.

- * - Feasibility study and possibly design for a medium size shaking table.

- Shared cost action

The cost-shared program is expected :

- To help national laboratories in performing so called parametric studies in support of the PISC activities. These studies should better characterize the NDT equipments and help in assessing the validity of the NDE techniques in view of their use in nuclear power plants.
- In the field of fracture mechanics the sources and effects of residual stresses will be investigated and contributions for the numerical analysis of elasto-plastic fracture mechanics will be made.

1.A.2.4. Reactor core cooling system off normal behaviour investigations (fuel temperature < 1200°C)

- Direct action

The studies with the integral system LOBI facility built and exploited at present in cooperation with the BMFT are aiming at the investigation of the thermohydraulic behaviour of a PWR cooling system during large and small breaks and special transient conditions. Principal activities are :

- thermohydraulic analysis of the physical phenomena occurring in the core (including e.g. critical comparison of alternative emergency core cooling and decay heat removal (DHR) systems).
- Application of large system codes for test prediction and analysis calculations, and assessment of these codes in the framework of this activity.
- * LOBI experience in the area of code application and assessment shows that there is a need for an extension of the independent assessment of large computer codes including improvement of physical models on the basis of prediction calculations and thermohydraulic analysis of the results and the development of a plant code analysis as a tool to facilitate the assessment process.

- Shared cost action

The shared cost activities are a logic continuation of the existing programme and complementary to the J.R.C. activities.

The concern basic studies on small scale experiments and include detailed evaluations leading to the development of models for large system codes.

Examples of these studies are : basic heat transfer studies in the two phase flow regimes, coolant flow patterns in a variety of conditions simulating the coolant behaviour in different plans of the primary and secondary loop systems.

1.A.2.5. Reactor core and cooling systems under sever accident conditions (fuel temperature > 1200°C)

- Direct action

- * The chief aim of the SUPER SARA programme was to obtain an understanding of the key phenomea in a severe accident scenario involving core uncovering with subsequent fuel damage and fission product release and transport. The presently planned activities are directed towards the same goal but are essentially limited to : (i) analysis of available in-pile data, (ii) development of models respectively computation tools, (iii) specific experimental (out-of-pile) support. Thermal hydraulic analysis will focus on core uncovering and -reflood transient and involves modelling of : transient two phase flow, convective heat transfer in the uncovered (vapour)

region, effects of radiation and chemical reaction.

The phenomena to be modelled for the fuel are fuel rod and clad deformation, liquefaction and relocation as well as clad and fuel fragmentation phenomena. Tests in support of model and code development can be conducted on existing installations which are designed to cover an unusual wide pressure range.

In the field of fission product release a deep study and assessment of the world effort on modelling and code development is planned.

- Shared cost action

The aforementioned direct-action programme has to be closely associated with the planned cost shared activities (covering a variety of out-of-pile tests and model development tasks) in this field. It is further necessary to have access to results provided to establish collaborations with :

- the Swedish activity Marviken V
- the US/DOE sponsored activities LOFT and Clean-up TMI 2
- the US/NRC sponsored activities PBF, NRU, ACRR-Sandia and possibly at a later time with :
- the Canadian program NRX/NRU.

The Commission will also explore possibilities of participation in integral test programmes performed in Europe (PHEBUS).

In addition, the Commission proposes its participation in separate effect testing programmes and related analysis work in the areas of material reactions (chemical and physical processes), the formation and coolability of fuel debris, the likelihood and effects of steam explosions, the potential melt attack on pressure vessel and base-mat, etc.

It is expected that from these studies guidance is obtained to preserve or to recover the reactor core in a stable situation even in those cases where a large power-cooling mismatch has temporarily occurred.

The activities of fission product release/transport and the aerosol behaviour studies are related to the whole chain of events :

- the fission product release from fuel
- the physico/chemical effects during fission product transport from the primary circuit to the containment and the phenomena occurring in the containment.

1.A.2.6. The reactor outer containment phenomena during severe accidents conditions

- Direct action

- * The J.R.C. disposes of a large reservoir (100 m³) to contribute in the hydrogen combustion studies. Possibly the ESSOR outer containment could also be made available to analyse the distribution of hydrogen and other gases.

- Shared cost action

The activities foreseen in cooperation with national organisations are both analytical and experimental.

- Combustion processes will be studied to determine flammability and explosion limits for multiple component systems and particular attention will be devoted to the deflagration to detonation transition criteria.
- Techniques will be developed to mitigate the effects of hydrogen combustion using either controlled recombination with oxygen or other techniques.
- Always in the field of distribution and combustion processes, studies will be continued to determine outer containment external loading by gas cloud explosions and the response of reactor containment structures.

1.A.2.7. The dispersion of fission products in the atmosphere

- Direct action

None proposed.

- Shared cost action

The Commission participated, with a small effort in the past, to programmes which should help in assuring radioprotection to the population under accidental conditions.

This effort is planned to be increased and particular attention will be given to research in the areas of definition of the accidental release, the study of special effects like the dispersion of products over sea, the development of dispersion models and their verification in small and large distance tests to be conducted by collaborative field trials.

1.A.3. Resources

See table "Summary and articulation of action programme on the development of nuclear fission energy".

1.B. Fast Breeder Reactor Safety

1.B.1. Objectives

Most of the Member States of the Community have devoted substantial effort to the development of Liquid Metal Fast Breeder Reactors during the past 25 years. Very large financial efforts have been devoted to this development which to-day still accounts for approx. 20% to total R + D expenditure in the energy sector. The Community's technical achievements are unmatched in any other region of the world : several experimental reactors and prototypes have been successfully constructed and operated and one large demonstration station (Super Phenix, 1300 MWe) is nearing completion (1984).

The broad aim in the selection of topics for the Community (1984-1987) programme has been the consistency with the objectives of the Council Resolution of 18/2/1980 concerning fast breeder reactors (*).

The above mentioned Council Resolution underlines the importance of the fast breeder option for the future energy supply of the Community, stresses the importance of continuity in the effort of developing the system, reaffirms the paramount importance of safety as an objective of the development effort and calls upon the Community to lend support for the above objective.

Under the heading of accident prevention, it should first of all be mentioned that the effort on development of probabilistic risk analysis, human factors and man/machine interaction covered under the LWR section, are generally relevant to LMFBRs and are therefore not repeated here. The topics addressed more specifically in the LMFBR section are :

- Instrumentation, control and protection. Its broad objective is to improve the treatment of information originated in vital parts of the system, and particularly in the very compact core, in order to permit the monitoring of the state of the plant for operator information and eventually for automation of corrective action.
- Integrity of components and structures, and related studies on material properties. The long term objective is to arrive at a systematic approach permitting the correct assessment of the life time of structures taking into account the specific service loadings, materials and environment of LMFBRs.

It must be noted that the LMFBR structures are made of thin walled stainless steel working at high temperature and are therefore substantially different from those used in LWRs which are thick, made in great part of ferritic steels and work at lower temperature.

(*) O.J. N° C 51/5 of 29/2/1980.

Thus design and calculation codes as well as non destructive methods of inspection must take into account phenomena and material properties for which experience in Light Water Reactor components design, construction and operation is not necessarily sufficient or relevant.

Under the heading of accident analysis, control and mitigation, the objectives are to participate in solving specific thermo-hydraulic problems which are very important during the initiating phase of the accident. A significant effort will be devoted, like in the past, to the study of the most severe and unlikely accidents involving severe damage of the core. However, increased emphasis will be given to a more realistic description of the different phases of potentially severe accidents. This is expected to lead to a reduction of conservatism in the evaluation of mechanical energy release and it could in general show that the reactor behaves much more benignly than now postulated. The following topics are included under this heading :

- Reactor core and cooling systems in off-normal conditions
- Severe accident analysis
- Integrity of structures under dynamic loadings
- Outer containment in accident conditions.

1.B.2. Activities

1.B.2.1. Instrumentation, control and protection

- Direct Action : none proposed.

- Shared Cost Action :

Sensor Improvement

Improvement of instrumentation reliability and application to fault identification and location by :

- development of sensors for a LMFBR environment using novel or diverse measuring principles as well as novel transmission means,
- grouping of instruments into single easy-to-handle probes.

Computer base signal processing techniques & application

Application of computer based signal processing techniques (e.g. pattern recognition) and application to :

- thermal and acoustic noise analysis in sodium,
- improvement of discrimination between faults and artifacts in acoustic and eddy current inspection of reactor components,

- automation of failed fuel location using delayed neutron detectors,
- reactivity and subassembly state monitoring.

System Design

Development of system design concepts that reflect general trends towards distribution control, more elaborate control structures and increasing levels of monitoring and meet requirements for demonstrable reliability, safety, speed of operation and improved plant availability.

1.B.2.2. Integrity of Components and Structures

- Direct Action :

The JRC activities in this field are concentrated on :

- characterisation of reactor materials (under various strain-rates, temperature and irradiation conditions), in particular creep-fatigue tests,
- development of constitutive equations with the introduction of material damage models,
- fracture mechanics tests on different shaped specimens irradiated at different fluences for the evaluation of irradiation damage.

Shared Cost Action

- Validation of constitutive equations by experimental tests for shapes, materials (including weldments) using loading combinations which are representative of real operating conditions of fast reactors.
- Service life prediction exercises for selected austenitic steel components e.g. a pipe elbow and ferritic steel component, e.g. tubing section for boiler use.
- Structural defect propagation
Tests on large specimens and model structures (including weldments) subjected to typical reactor loading histories : biaxial loadings, combined membrane and biaxial loadings, combined primary (mechanical) and secondary (thermal, residual) stressing, cyclic loading.

1.B.2.3.Reactor core and cooling systems in off-normal conditions

- Direct Action

An existing well equipped sodium loop is available which will be used for the following activities :

- Measurement of the sodium boiling characteristics at steady state and transient mass flow conditions and thermal noise analysis with the 12-pin grid/wire spaced and full length test sections (this part of the programme will be concluded at the beginning of 1985).
- Simulation of decay heat removal from subassemblies : the specific phenomena to be investigated will be the heat transport by natural convection and its limit.

This study has validity for all fast reactor designs and is complementary to the proposals discussed hereafter.

- Shared Cost Action

- Sodium coolant thermo-hydraulic studies : Improvement to be modelling of natural convection and sodium boiling in transient and shut-down conditions. Attention will be paid to description of the heat path between the core and the intermediate heat exchanger and to the temperature field in the upper plenum.
- Transient fuel behaviour (in-pile experiment)
 - . Transient fuel behaviour

It is proposed to perform slow overpower transients in the HFR reactor at Petten in which similar experiments had already been carried out for loss of flow conditions. HFR is particularly suited for single pin transients with power doubling times of 1 to 10 sec. The reactor has the possibility to precondition fuel pins over a certain period at nominal power before the transient is initiated.

1.B.2.4. Severe Accident Analysis

- Direct Action

At present available computer codes deal with the initiating events up into the early transition phase (e.g. EAC/JRC) and with the later phases of the accident scenarios (e.g. SIMMER/NRC). In both the early and later phases of the scenarios complicated flow situations occur involving multicomponent / multiphase fluid dynamics. The present project aims at improving

the capabilities of both EAC and SIMMER to achieve greater realism in accident simulation and consequence evaluation.

The theoretical model development will be supported by an experimental validation programme with simulant and real reactor materials.

An important effort will be devoted to the experimental investigation and modelling of specific aspects of accident scenarios, such as plugging and freezing phenomena, fuel coolant interactions, coolability of debris bed under post accident conditions, formation and cooling of molten pools, thermomechanical load on core catcher structures.

To this aim the following activities are planned : Continuation of the in-pile PAHR programme coordinated and funded by the JRC to study the coolability of debris beds: the in-pile tests will be performed in the BR2 (Mol) and in Melusine (Grenoble) reactors.

- Out-of-pile tests in the multipurpose FARO facility where 100 Kg UO₂ can be melted and released in different test sections, to investigate plate erosion by UO₂ jets, plugging and freezing phenomena in channel and cluster geometry, thermomechanical load on structures, fragmentation and settlement, large mass fuel-coolant interaction.

- Cost shared action

- fuel post-failure phenomena (in-pile tests)

The simulation of two types of accidents is proposed : a loss of heat sink and subassembly accident.

The whole accident sequence will be investigated starting from the cooling perturbation, up to the melt down of fuel elements, and the behaviour of molten material. Particularly in case of a subassembly the behaviour of a molten pool and its cooling potential will be of main concern.

It is foreseen to perform these experiments in the BR2 (CEN-MOL) and SCARABEE (CEA-Cadarache) reactors.

The funding requested for the in-pole experiments covers the cost of feasibility studies which are necessary for the BR2 and part of the SCARABEE programme and the execution of some SCARABEE experiments during a two years period.

- Molten material motions and interactions

Separate effect type investigations will be concluded as a complement to direct action activities :

- . Experimental investigations of specific molten material problems, e.g., ejection from the core, interactions with structures.
- . Contribution to code development and validation for multi-phase, multicomponent phenomena treatment.

Activities will also be started concerning

- Fission product release from damaged fuel and distribution
 - . theoretical analysis and experimental verification of vaporisation rates for radiologically important species containing for example plutonium, higher actinides, caesium, ruthenium.
 - . radioactivity distribution in the primary circuit during and following a severe core accident.

1.B.2.5. Integrity of structure under dynamic loadings

- Direct Action

The investigation on dynamic material properties is strongly related to the study of material properties under operational conditions : the main objective is the definition of constitutive laws for materials in different damage situations and under dynamic loading.

Small specimens of virgin or damaged materials will be submitted to tensile tests at different strain rates and temperatures.

The special high load dynamic testing machine will be used for tests on large specimens (5000 mm² cross section) to investigate the influence of thickness, of real size defects etc. and to verify the validity of constitutive laws. Tests using concrete specimens are also envisaged.

In parallel to the study of material properties the extension and development of dynamic structure analysis codes will be continued.

- Cost shared action

- Development improvement and validation of codes for design and analysis of fast reactor structures (e.g. primary containment, reactor roof, piping systems) in presence of dynamic loadings.

1.B.2.6. Outer containment in accident conditions

- Direct Action: none proposed

- Shared Cost Action

This action addresses a number of problem areas which are related to the definition of a radioactivity source term for the consequence assessment of a severe accident during which sodium and possibly fission products are released into the outer containment.

- Interaction of sodium with air, water and concrete
- Fission product transport in the secondary containment
Modelling of aerosol behaviour
- Outer containment behaviour
Assessment of outer containment with regard to its retention capabilities.

1.B.3. Resources

See table "Summary and articulation of action programme on the development of nuclear fission energy".

1.C. Implementation of the Council Resolution of 22.7.1975 concerning the technological problems of nuclear safety

This action, which is entirely managed from headquarters, started in 1976 by the inscription in the budget of a line covering the expenses for staff (4A, 2B, 2C). The objective of this action is mainly to perform comparison, analysis and synthesis studies in the field of coordination of research and of harmonisation of safety methodologies, codes and standards both for Light Water Reactor and Fast Breeder Reactor systems.

In 1980 the Council agreed upon a Commission proposal to add a contractual part to this action, in view of financially supporting comparison, analysis and synthesis studies in the field of codes and standards for Fast Breeder Reactors.

The Commission reports periodically to the Council the progress of this action. The Commission attaches particular importance to this action and proposed that it should be continued during 1984-1987 at the same level of effort than in the past.

1.C.1. Activities

in the field of thermal reactors (LWR)

- Studies of technical and regulatory aspects
 - . Information exchange on applied safety reglementation, criteria, codes and standards with the scope to reach a certain degree of harmonisation by mutual information
 - . Identification of general and specific safety criteria,

codes and standards and approaches of specific LWR safety problems as they are applied or under development in the Member States.

- . Classification and identification of convergencies and divergencies, identification of their causes, proposals for improvement.
 - . Consultation on national reglementation projects, criteria, codes and standards in the Member States and on projects for codes and guides prepared in the national context.
 - . Coordination of safety analysis on specific projects, coordinated actions with other international organisations in particular with OECD/NEA and IAEA.
- Coordination of national research programmes
- . Handling of information on programmes in general which are provided by national experts and the JRC
 - . Handling of information on detailed programmes Annual publication of programme sheets - Index of research programmes
 - . Exchange of views and synthesis on generic problems
 - . Identification of themes for which cooperation and a concentration of resources is advantageous and of areas in which research should be initiated.

in the field of fast breeder reactors

- Comparison of safety measures in view of drafting preliminary common safety criteria and guidelines
- Information exchange and discussions on current research programmes performed in the Member States; concertation and coordination
- Production of state-of-the-art reports in selected areas and recommendation for new activities
- Execution of "benchmark"-type studies to compare different approaches applied to the treatment of specific problems.

Codes and Standards for Fast Reactors

- Comparative analysis of national standards for manufacture, inspection and quality control applicable to Fast Reactor components
- Comparative analysis of structural codes such as elastoplastic benchmark calculations, seismic benchmark calculations; design codes (such as ASME) needed for fast reactor components design

- Comparative analysis of material properties and specifications such as tensile and stress rupture properties, allowable stresses, creep fatigue data and data to assist material defect analysis. Materials are considered in function of their suitability for fast reactor use.
- Development of safety classification guide for fast reactor mechanical systems and components and comparison with comparable guides outside the Community.

1.C.2. Resources

The resources necessary for 1984-1987 amount to 2,2 MUCE for staff (A4, 2B, 2C) and 2 MUCE for contractual support to comparison, analysis and synthesis studies in the field of codes and standards for fast reactors.

Total 4,2 MUCE (3,3 MUCE 1983 value)

2. SUB-PROGRAMME "NUCLEAR FUELS AND ACTINIDE RESEARCH"

2.1. Objectives

This sub-programme is executed at the Transuranium Institute of JRC Karlsruhe. It is based on the internationally established experience of this Institute in the field of nuclear fuels and on its leading role in the field of actinide research.

The sub-programme has two main orientations, both directly relevant for the development of the nuclear fission industry :

- the improvement of nuclear fuels for fast breeder reactors;
- the safety of the fuel cycle for both light water and fast breeder reactors.

In addition, and as the focal point of a large cooperation with scientific laboratories of the Community, a part of this sub-programme is dedicated to the investigation of chemical and physical properties of actinide solids.

In this way, a basic knowledge relevant to all nuclear research is formed.

The research on nuclear fuels for FBR, covering in the past the largest part of the Institute's activity, is now oriented towards specification of an optimized carbide fuel.

The increasing effort concerned with the safety of the fuel cycle, covers a large part of the sub-programme, and provides support to other sub-programmes of the RAP "Nuclear Fission" (e.g., Reactor Safety and Waste Management). It covers a series of points such as :

- the determination of the thermodynamic properties at high and very high temperatures of selected nuclear materials, which are relevant for core accident analysis;
- the study of the oxide fuel under transient conditions to understand fission product migration within and release from the fuel;
- the study of the formation of actinides in pile (for both LWR and FBR) relevant for the handling of irradiated and recycled fuel;
- the study of powder and aerosol formation in the handling of plutonium fuels.

The part of the sub-programme concerned with actinide fundamental research includes work on crystal chemistry (preparation and characterization of samples) and study of the solid state physical properties, directed to establish a general theory of bonding in solid actinides as well as to form a basis for a possible application of actinide containing compounds as catalysts.

2.2. Proposed actions

2.2.1. Operation limits of nuclear materials

The project investigates essential aspects of nuclear materials :

- the evaluation of the impact of operating and extreme working conditions on the mechanical and chemical stability of advanced fuel for fast reactors
- the determination of the thermophysical properties of selected reactor materials at very high temperature, as needed for core accident analysis.

Advanced Fuel Optimization.

Based on extensive information gained during research programmes 1977-80 and 1980-83 the specification of optimized (as to burn-up, rod power and mechanical stability) advanced fuel will be elaborated, a carbide-rich and oxygen-controlled fuel for both helium and sodium bonding. This development will be followed and supported by the elaboration of a code describing fuel behaviour composed of sub-models tested by suitable experiments. The optimized fuels will be subjected to fast flux irradiations

in order to confirm the predicted performance.

Properties of Reactor Materials at Very High Temperatures

Fast neutron reactor materials, essentially fuels and coolants, will be subjected to high and very high temperatures and their thermodynamic characteristics will be determined. In this context rapid expansion upon heating by laser pulse impact will be one of the methods of investigation, another will be equilibrium vapour pressure measurements in a high temperature-high pressure autoclave. Measurements of specific heat at constant pressure above the melting point will fill a gap in the knowledge of thermophysical properties necessary for the prediction of material behaviour under accident conditions.

2.2.2. Actinide Cycle Safety

This project aims at answering questions arising from the impact of transuranium elements on the safety of the nuclear fuel cycle :

- measurements of actinide formation in-pile
- analysis of possible mechanisms of accidental release of dust and aerosols formed during fuel fabrication
- demonstration of the potential and limits of various reprocessing headend methods for advanced Pu-fuels and investigation of key reprocessing problems.

Formation of Actinides InPile (FACT).

The formation of actinides in high burn-up LWR and FBR fuel - due to their radiation hazards - is a decisive factor for the handling of irradiated and recycled fuel and for the fuel cycle in general. The formation of heavy metal isotopes and thus also minor actinides (No, Am, Cm) will be investigated with high precision under typical power reactor and prototype FBR conditions. Computer predictions will be checked. Radiation dose will be calculated. Capsule irradiations of mg amounts as well as of fuel pellets under well-defined conditions will be necessary. In the latter case isotopic analysis has to be complemented by chemical treatment which forms a natural link to the sub-project REPRO. Finally thermophysical characteristics, phase diagrams and fuel-clad interaction of fuel containing significant amounts of minor actinides like Np-237 and Am-241 will be determined.

Safe Handling of Nuclear Fuels (SHAPE).

The handling of nuclear fuels, essentially Pu-fuels, will be investigated with special regard to dust and aerosol formation. In this context also production procedures are reviewed with regard to elimination of dust formation by the use of gel-supported precipitated material and optimal homogenization of mixed oxides at low temperatures. Equally, aerosols formed under accidental conditions, as in glove box fires, will be investigated. Experimental competence required in this field

forms the sound basis of a focal point for the studies of harmful and poisonous aerosols in the context of various industries in the Community.

Fuel Reprocessing (REPRO)

Carbide head-end reprocessing studies will be completed with investigation of alternative processes. Key problems of nuclear fuel reprocessing such as Pu-containing residues, problems associated with Np-237 and separation of actinides from the reprocessing stream before they enter the waste stream will be treated.

2.2.3. Actinide Research

This project aims at investigating and understanding the chemical bond in solid actinides with emphasis on intermetallic and simple binary compounds of the least known elements in the first half of the series, especially Pa, Np, Am and Cm.

Actinide Chemistry

Specific compounds of major and minor actinides are produced by suitable crystal growth methods with very high purity and reproducible physical and chemical characteristics, a necessary condition not only for the sub-project "Actinide Physics" but also for the combined efforts on actinide research of the Member States of the Community. In addition, their basic physico-chemical properties like crystal structure, PVI-diagram and stability regions will be studied.

Actinide Physics

The physical characteristics of well-specified actinide compounds representative of certain bonding types are studied with special consideration of surface properties. This is done in the double context of studying the influence of 5f electrons on the chemical bond and to form a basis for possible catalytic application of actinide compounds.

2.2.4. Transient behaviour of oxide fuels and fission product release under severe fuel damage conditions

Preparation of a model to describe the behaviour of oxide fuels in a transient of power or temperature. Transient studied will range from the relatively mild deviations from normal operation which are inevitable as a result of fuel movements or mismatch of coolant flow and power to the extreme situations of a hypothetical accident in which severe fuel damage can be expected.

Modelling and transient experiments

Basic theoretical studies supported by experimental work on fission product migration within the fuel lattice will form the

basis for the model which will be developed and compared with results from experiments of more technological nature. These experiments will include in-reactor transient tests and simulation experiments using irradiated fuel in the hot cell.

Fission product release under accident conditions

The severe fuel damage regime will be covered primarily by examination of fuel tested in the course of reactor safety experiments. Short lives fission product release during irradiation experiments simulating severe fuel damage accidents will be studied.

Fuels used will include FBR mixed oxide, LWR UO_2 and possibly also LWR mixed oxide varieties.

2.3. RESOURCES

<u>Ref. to Activity</u>	<u>Activity</u>	<u>MUCE (1983 values)</u>
2.2.1.	Operation limits of nuclear materials	17.4
2.2.2.	Actinide cycle safety	28.
2.2.3.	Actinide research	13.8
2.2.4.	Transient behaviour of oxide fuels and fission product release under severe fuel damage conditions.	6.5
	TOTAL :	65.7

3. SUB-PROGRAMME "RADIOACTIVE WASTE MANAGEMENT"

3.1. Objectives

Radioactive Waste Management has been successfully practised in the Community since several decades only as far as low level wastes are concerned. Management of wastes containing long lived isotopes (and particularly plutonium contaminated wastes) and of high level wastes (that is wastes arising from reprocess-

ing operations) has not yet reached the stage of industrial maturity, although certain basic technologies are already available. Last but not least the definitive storage of these wastes is not yet practised.

The broad objective of RD & D activities of the Community is therefore to help creating a comprehensive waste management system, capable of assuring the safety of man and the protection of the environment.

The twelve year (1980-1992) Community action plan for radioactive wastes, approved by the Council in 1980 (*) ensures the necessary concertation within the Community as well as the orientation and the continuity of the activities.

The objectives of Community action will be :

- a) Concerning the phases treatment, conditioning and handling of wastes :
- to improve the existing methods of management taking advantage of the technological progress. In particular, to optimize the management methods of low and medium level wastes and to put at the disposal of the operators more economical, more performing and safer methods.
 - to develop and bring to maturity treatment and conditioning processes for high level wastes and long lived wastes, when these processes are not yet available.
 - to develop processes with similar purpose for those gaseous wastes which might not in the future be directly rejected to the atmosphere.
 - to work out methods of characterization, criteria of acceptance and quality control for wastes to be stored.
- b) Concerning the phase of final storage of high level wastes and long lived wastes
- the demonstration of feasibility of final storage in continental geological formations (salt, granite, clay, etc) by the study, the construction and exploitation of experimental vaults and the installation of underground prototypes.
 - the evaluation of feasibility of final storage involving burial under ocean sediments by laboratory and in situ experiments.
 - the evaluation of safety of the different options of final storage, by developing risk analysis methodologies, model-

(*) O.J. C 51/1 of 29.2.80.

ization of phenomena and acquisition of experimental results. This approach takes account of the impossibility to directly demonstrate safety for very long periods and is susceptible of continuous improvement in the light of experience which will be acquired in experimental installations.

c) Concerning management of radioactive wastes as a whole

- the optimization of radioactive waste management with respect to safety and cost.
- the integration waste management into a global strategy for the fuel cycle downstream the reactor.
- the study of the plurinational dimensions of the waste management and of their influence on management.

To attain these objectives, it will be necessary to continue without hesitation the effort of Community R & D both within the Joint Research Centre and through shared cost action which already covers, since many years, a significant part of the effort in Member States (particularly concerning the final storage).

Community cooperation and coordination must be reinforced according to the orientations of the Community action plan concerning radioactive wastes. Also international cooperation in the broadened sense must be reinforced as it is only through joint effort that the solution of the problem of final storage will carry conviction with the public.

3.2. Proposed actions

The future actions will be executed within the frame of plurian-shared cost programmes and of direct action by the JRC in strict cooperation. The JRC will contribute with the results of its own research, with its scientific support and with its expertise.

Other means of action could be envisaged in future in particular concerning the study and realization of pilot installations.

The proposed actions are summarized in what follows. It should be noted that they are defined in some more detail in the case of the JRC programme, which should start in 1984. Conversely, the 3rd shared cost action programme will start in 1985 (*), and it is too early to fix the details.

3.2.1. Direct action

Project 1. : Waste management and fuel cycle.

(*) The present programme covers the period 1980-84 (O.J. N° L 78/22 of 25.3.80).

This project aims at improving future installations for the fuel cycle with a view of optimizing the management of wastes.

- study of strategies minimizing the quantities of alpha emitters both from the point of view of feasibility (experimental activities) and of interest (cost/benefit studies).

In particular, the potential of the process OXAL-MAW will be studied on a larger scale ; in 1980-82, the application of this process to chemical separation of the actinides contained in the alpha contaminated wastes arising from reprocessing plant had already been studied. Hot cells from the ADECO laboratory of the ESSOR complex will be utilized. This action will be strictly coordinated with the shared cost action.

- characterization and control of conditioned waste from the physical and chemical point of view. Non-destructive methods of analysis will continue to be improved. Also new actions will be started particularly in the field of physical characterization. Certain experiments could be executed in the ADECO hot cells. This action completes and supports an on-going cost shared action (see subject 1 later on).

Project 2. : Safety of waste storage in continental geological formations.

No substantial reorientation of the high level waste storage safety analysis started in 1974 by the JRC is proposed. Rather, the efforts on risk evaluation for alpha bearing wastes will be intensified. These latter wastes are not included in project PAGIS (Performance Assessment of Geological Isolation System) executed in cooperation with the cost sharing action.

The gathering and validation of the necessary data will be achieved by laboratory long term experiments on the different barriers. A collaboration with CEN-SCK Mol on the study of plastic clay formations is existing since 1980 and will continue in view of the importance of connecting methodological studies to real experimental sites. A contribution of studies on hard rocks as well as salt formations will also be given, thus complementing national laboratory studies.

Coordination with shared cost action on project MIRAGE (Migration of radionuclides in the geosphere) will also be continued.

Project 3. : Feasibility and safety of final storage by burial under deep ocean sediments.

This long term research requires cooperation at World level in view of its multidisciplinary and international character. This cooperation has already started under the aegis of NEA, whose Working Group "Sub-Seabed Disposal" is a reference point in the subject.

The JRC will concentrate on well defined options (for instance : burial by free fall penetration) and on the development of specialized equipment (hyper pressure laboratory for the study of phenomena of migration and of barrier performance under high pressure).

In a following phase, the JRC will endeavour to stimulate the creation of European associations in the research concerning the problems raised by possible in-situ experiments.

Shared cost action will continue to contribute to the feasibility studies, in particular by engineering studies executed by the specialized industries in the Member States.

3.2.2. Shared cost action

The orientations given here are preliminary. They must be discussed with all concerned parties during 1983-84 :

- preliminary studies to be executed in a coordinated fashion amongst national laboratories in order to complete basic knowledge (e.g. characterization of different forms of wastes).
- activities aiming at demonstrating the validity of certain processes (e.g. waste treatment) or at validating certain options (e.g. storage in geological formations). These activities will be centered around pilot installation in Member States, if possible.
- studies concerning the economy, safety and regulatory aspects of waste management and, more generally, the strategies to be implemented for each stream of wastes.

These studies and activities will require a large exchange of information and ideas on the work of Member States and an intense concertation at Community level.

Subject 1. : Characterization and quality of conditioned wastes.

One activity, which has developed in the frame of the shared cost action since a number of years (programmes 1975-1979 and 1980-1984) links several laboratories in a close collaboration (concerted programmes, round robin tests, etc.) in the evaluation of the performances and of the long term behaviour of matrixes for coating different wastes in view of their storage. This activity will be continued particularly concerning the control of the quality of conditioned wastes.

The JRC will contribute with its Project N° 1.

Subject 2. : Demonstration of treatment and conditioning processes in view of an optimized management of wastes.

This activity will bring the financial support of the Community to the development of pilot scale of the processes already identified as the most promising for an optimized management of the different streams of wastes, and will ensure the exchange of information and experience amongst the concerned organizations.

All types of wastes will be considered, with particular attention being paid to alpha bearing wastes, to cladding wastes, and to certain wastes of medium and high level of radioactivity (e.g. residus of dissolution in reprocessing operations).

Subject 3. : Long term migration of radioactivity in continental geological storage.

The evaluation of the risk related to final waste storage in underground installation relies on knowledge about migration of radio-isotopes from the conditioned wastes through artificial barriers (container, filling materials, etc.) and natural barriers (the geological formation itself and its overburden) to the biosphere and man.

The proposed action will be based upon the continuation of Project MIRAGE (Migration of Radionuclides in the Geosphere), started in 1983 with the JRC. It aims at improving the knowledge of migration phenomena, their importance and their modelization.

Subject 4. : Conception of final storage of wastes in geological formation.

The accent on this project will depend upon the initiatives of Member States in achieving experimental or pilot installations for geological storage.

The work now in progress should, in any case, be brought to completion (salt mine at Asse, experimental clay vault at Mol, etc...).

Subject 5. : Safety evaluation of waste final storage.

An imported effort will be devoted to evaluate the safety of different concepts of final storage (both continental and under sea bed). This effort will be based mainly on Project PAGIS (Performance Assessment of Geological Isolation System). Its first phase, already started in 1982, aims at gathering existing information and at choosing methodologies and scenarios.

By 1986, an evaluation at Community level should become available. It would be the resultative process of evaluation

already started at national level since few years.

This action will be managed jointly with the JRC, and the radiation protection programme, with participation of Member States within the frame of point 2 of the Community Action Plan concerning radioactive wastes.

Subject 6. : Optimization of radioactive wastes management ;
strategy of management of different waste streams ;
global strategy for the fuel cycle downstream the
reactor.

These studies aim at the optimization of waste management from the point of view of safety and cost. Experimental support will be provided as necessary.

The questions to be examined are :

- Limitation in the volume and in the specific activity of the different categories of wastes produced.
- Quantitative appreciation of the different strategies with respect of each waste stream from source to final disposal.
- Global management strategy for the fuel cycle downstream the reactor ; different options ; time schedule.
- Plurational dimensions of management ; influence upon the optimization of management.

3.3. Resources

The present forecasts for the programme cost amount to 46 M ECU for the Direct Action (1984-87) and 75 to 100 M ECU for the shared cost action (1985-89). The above interval is a consequence of the necessity of preserving a large degree of flexibility for the possible financing of experimental installations, in particular for the final storage of radioactive wastes. Such installations should, in principle, be proposed for bilateral or multilateral cooperation within a Community frame by the interested Member States. This is not yet the case at the date of issue of this document. The Commission has expressed to the Council its interest to receive such proposals and its views about the necessary means.

The amounts corresponding to the period (1984-87) of the plan of action are included in the following indicative table which assumes a 7 % inflation in the future years.

Objectives

	Direct Action	Shared cost Action	% of budget
- Treatment, conditioning, handling of wastes	Project 1 (in part)	Subjects 1 and 2	approx. 50%
- Final storage of wastes underground	Project 2	Subjects 3, 4 and 5	approx. 35% p.m. (3)
under sea-bed	Project 3	Subject 5 (in part)	approx. 5%
- Optimization of waste management	Project 1 (in part)	Subject 6	approx. 10%
TOTAL BUDGET (1)	48.9 M ECU 40+3(2) + p.m. (3)		

(1) 1983 value.

(2) For the first 3 years of 3rd programme and the last year of 2nd (present) programme (48 + 3 M ECU in actual values).

(3) Pour mémoire. (It concerns the possible participation to the financing of experimental installations).

4. SAFEGUARDS AND FISSILE MATERIAL MANAGEMENT

(Direct Action Only)

4.1. Objectives

The establishment and the upholding of a credible safeguards system for the nuclear materials in circulation in Europe is among the fundamental elements, which condition the acceptability and the development of nuclear energy and is one of the means to respond to the concern of the proliferation risk of nuclear weapons.

Considering also the importance of the economic impact of a safeguards system, it is necessary to establish a European strategy in this field for the 1990's and this involves an important Community action and a concertation with the national effort.

The R and D programme proposed by the JRC is conceived to provide technical knowledge to the EURATOM Safeguards Directorate and to the European plant operators for the implementation of their obligations in the frame of the EURATOM and Non Proliferation Treaties or other Agreements.

Particular attention will be paid to find an equilibrium in the programme between the technical needs in respect to different safeguards obligation and the industrial reality. For the execution of the proposed programme, close collaboration will be maintained with the national research establishment (directly through ESARDA) and with the IAEA and US laboratories in the frame of existing cooperation agreements.

The JRC, which gradually developed since 1969 its R and D programme in the field of safeguards, has now the largest one in Europe. It will continue, through multiple contacts, with the national centres, the nuclear industry and the Inspectorates, to affirm its role as focus point for the R and D within the Community.

4.2. Proposed Action

In order to respond to the objectives mentioned above, the programme has been subdivided into three projects.

4.2.1. Methods and instrumentation for nuclear material assay and containment and surveillance

The objective of this project is :

- to develop and to make available the necessary means and methods to establish and to regularly verify the performance in field conditions of the instruments used for safeguards and fissile materials management, in particular for destructive assay (DA), non destructive assay (NDA) and containment and surveillance (C/S).
- to prepare the necessary conditions to enable the construction of reliable instruments suitable for routine use in field (industrial products).
- to develop new methods or to adapt existing ones, for the assay of fissile materials and containment and surveillance.

The two major activities are :

- a) Evaluation of performances of nuclear material assay and containment and surveillance methods and procedures ; establishment of validation and training laboratories.

This subproject aims at the establishment of performances values in field for material assay and C/S instruments.

The existing JRC laboratories or other specific facilities such as the spent fuel or fresh fissile material storage facilities, will be more adequately equipped for the calibration of instrument and methods ; in particular for non destructive assay and C/S. The laboratories will be made

available to inspectors or Member State experts and have to respond also to the increased request of training. Those laboratories will create the conditions, which are close to those encountered in the European nuclear industry.

b) Development of methods and instruments and Industrialisation of Instruments and Devices.

Some effort will be dedicated to the development of new methods, instruments or devices (such as seals) and data interpretational models needed for particular applications, where no satisfactory solutions have been obtained until now and to prepare the industrialisation process with the European industry for the reproduction of series of equipment originating from the development at the JRC or Member States laboratories and satisfactorily tested in field as prototypes by safeguards inspectors.

4.2.2. Safeguards data processing, transmission and evaluation

The objectives of this project are :

- to develop statistical and informatic tools for the evaluation of nuclear material accountancy data provided by the operator;
- to develop the necessary tools (hard and software) for the evaluation in field and at headquarters of measurement data taken by the inspector.

Two subprojects have been defined.

a) Nuclear material accountancy data management

This subproject aims at the creation of plant category specific rules and a data preparation language for the automatic insertion of the measurement errors for the declared batches in the existing statistical material accountancy codes, in order to evaluate different material balance characteristics.

Furthermore a critical review will be made on decision analysis procedures for material accountancy in connection with the ISADAM (International Safeguards Data Management System) code.

b) Automatic processing, transmission and evaluation of inspection data, produced by nuclear material assay and containment and surveillance instrumentation.

The activities in this subproject are the continuation of on going studies on the design and development of microprocessor interfaced instruments and related software for in field data evaluation and subsequent validation. Furthermore, it is foreseen to design detailed evaluation procedures of measure-

ment data and instrument performances.

Finally, a feasibility study and a demonstration will be performed on the on line transmission of inspectors measurements data into a local network or directly to headquarters.

4.2.3. Integration of safeguards activities

The objectives of this project are :

- to analyse the technical features of proposed safeguards practices ;
- to develop mathematical models for describing the safeguards relevant parameters of specific parts of a facility, of a complete facility or of parts of the fuel cycle ;
- to develop a methodology for the design of some specific safeguards activities taking into account the operational constraints from operators and inspectors side.

Four subprojects have been defined :

a) Study of safeguards practices

This subproject aims at evaluating the adequacy of the performances of measurement and C/S procedures for bulk handling facilities in particular for fuel fabrication plants. Furthermore, integrated experiments will be performed to assess the quality of several accountancy and verification activities at the input of reprocessing facilities.

b) Development of a conversational simulator for the analysis and assessment of safeguards practices

An upgraded version of an JRC existing plant simulator for material flow and measurement systems will be designed, it will include also C/S measures and at a later stage some statistical decision analysis features. This simulation tool will be designed also for inspector training purposes.

c) Application of EXPERT system techniques to safeguards studies

The applicability of and the benefits which may be gained from EXPERT system techniques to the planning of some specific inspection activities such as physical inventory taking will be studied.

d) Analysis of safeguards procedures through the fuel cycle

An analysis will be made of the shipper receiver difference (SRD) structure for a number of situations, and of the material balance of large parts of the fuel cycle, which pro-

ceeds from the combination of partial balances by material balance area and SRD's.

4.3. Resources

The following table summarizes the distribution of the resources among the three different projects. The values mentioned should be considered as indicative.

Projects	Total Cost for 4 years (in MECUS)
4.2.1. Methods and instrumentations...	30,8
4.2.2. Safeguards data processing.....	6,1
4.2.3. Integration of safeguards activities.....	8,5
TOTAL :	45,4 MECUS

5. SUB-PROGRAMME "DECOMMISSIONING OF NUCLEAR INSTALLATIONS"

(Shared cost action only)

5.1. Objective

Existing experience in the decommissioning of nuclear installations is limited (e.g., no large nuclear power plant has yet been dismantled). The aim of Community action in this field is the joint development of a system of management of nuclear installations finally shut down and of the radioactive wastes produced in their dismantling which, at its various stages, will ensure the safety and protection of man and the environment against the potential hazards involved in the decommissioning of these installations.

In this context, the proposed sub-programme pursues mainly the following objectives :

- To dispose of efficient surface decontamination techniques producing little secondary waste ; a particular objective with a view to substantially reducing the volume of radioactive waste is decontamination to such a degree that material treated can be released without restriction.
- To dispose of appropriate techniques for the dismantling of thick-walled steel components and reinforced concrete structures, and of the auxiliary techniques (e.g., remote

control), required to protect the workers against radiation.

- To dispose of techniques for conditioning the special radioactive waste materials arising from the dismantling of nuclear installations (i.e., steel, concrete, graphite), for final disposal.
- To dispose of more reliable predictions on the consequences of decommissioning as to radiation exposures, costs and waste repository requirements ; this involves optimization of overall decommissioning schemes, e.g., with regard to the timing of dismantling and to the mode of waste disposal.
- To dispose of certain cost-effective improvements for the design of future installations, which facilitate their decommissioning.
- To provide guiding principles for decommissioning.

5.2. Proposed actions

5.2.1. Section A of the sub-programme comprises seven research and development projects relating to the following topics :

1. Long-term integrity of building and systems ;
2. Decontamination for decommissioning purposes ;
3. Dismantling techniques ;
4. Treatment of specific waste materials : steel, concrete and graphite ;
5. Large containers for radioactive waste produced in the dismantling of nuclear installations ;
6. Estimation of the quantities of radioactive waste arising from decommissioning of nuclear installations in the Community ;
7. Influence of plant design features on decommissioning.

5.2.2. Section B is concerned with the identification of guiding principles, namely :

- certain guiding principles in the design and operation of nuclear installations with a view to simplifying their subsequent decommissioning;
- guiding principles in the decommissioning of nuclear installations which could form the initial elements of a Community policy in this field.

5.2.3. Section C is mainly concerned with the testing of new techniques within the framework of large-scale decommissioning operations undertaken in Member States. Besides, the exchange of information on such operation would be promoted, for example by delegating experts from other Member States.

This proposed sub-programme takes up the themes of the current programme (1979-1983) on the decommissioning of nuclear power plants, but includes section C as a new item. It would again be implemented by the way of shared-expense action, which proved to be especially suited for this fields of research.

5.3. Resource

The following table gives a break-down of the resources of the sub-programme and their planned utilization (in million ECU, over the five years 1984-1988):

Item	Community budget
Section A	5.5
Section B	0.2
Section C	4.0
Staff and Administration	2.4
TOTAL	12.1

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The Council is invited to note the orientations contained in this document in view of the discussions on the Commission proposals for the JRC programme (nuclear section), for a shared cost action in the field of "Safety of Fission Reactors" and for a shared cost action in the field of "Decommissioning of Nuclear Installations".

(All cost figures are preliminary and indicative)

Sub programme 1	Safety of Fission Reactors	Reference to Activities	Activity	Direct action MUCE 1983 values	Shared cost Action MUCE		Remarks		
					1983 values	actual values			
1.A LWR Safety		1.A.2.1.	Reliability and risk Evaluation	16.7		1.9			
		1.A.2.2.	Human factors and Man-machine Interaction	-		3.9			
		1.A.2.3.	Integrity of components and Systems	19.6		5.2			
		1.A.2.4.	Investigations of core and cooling system cif normal behaviour (< 1200°C)	43.1		3.9			
		1.A.2.5.	Reactor core and cooling system under severe accident conditions (> 1200°C)	13.4		12.0			
		1.A.2.6.	Reactor outer containment phenomena during severe accident conditions	-		14.9			
		1.A.2.7.	Dispersion of fission products in the atmosphere.	-		7.1			
		1.B. LMFBR Safety		1.B.2.1.	Instrumentation, Control and Protection	-		3.2	
				1.B.2.2.	Integrity of components and structures	10		7.2	
				1.B.2.3.	Reactor core and cooling systems in off-normal conditions	10		6.1	

Sub programme 1	Safety of Fission Reactors	Reference to Activities	Activity	Direct action	Shared cost Action		Remarks
				MUCE 1983 values	MUCE 1983 values	actual values	
		1.B.2.4.	Severe accident analysis	63.9		11.3	
		1.B.2.5.	Integrity of structures under dynamic loadings	15.5		1.4	
		1.B.2.6.	Outer containment in accident conditions	-		3.2	
				Sub-Total 192.2	Sub-Total 68	Sub-Total 81.3	
	1.C. Implementation of Council Resolution of 22.7.75 concerning the technological problems of Nuclear Safety	1.C.1.	LWR & LMFBR coordination of safety Research. Studies on methodologies, codes and standards	-	3.3	4.2	
			TOTAL	192.2	71.3	85.5	

Sub programme 2 Nuclear fuels and Actinide Research	Reference to Activities	Activity	Direct action MUCE 1983 values	Shared cost Action MUCE		Remarks
				1983 values	actual values	
	2.2.1.	Operator limits on nuclear materials	17.4	-		
	2.2.2.	Actinide research safety	28	-		
	2.2.3.	Actinide research	13.8	-		
	2.2.4.	Transient Behaviour	6.5	-		
			TOTAL 65.7	-		
Sub programme 3 Radioactive Waste Management						
	3.1.A.	Treatment, conditioning and handling	19.6		25.5	
	3.1.B.	Final storage (underground)	21.5		17.8 + pm	
		Final storage (under seabed)	5.0		2.5	
	3.1.C.	Optimization of management	2.8		5.2	
			TOTAL 48.9	43 + pm	51 + pm	

Sub programma 4	Safeguards and fissile material management	Reference to Activities	Activity	Direct action	Shared cost Action		Remarks
				MUCE 1983 values	1983 values	MUCE actual values	
		4.2.1.	Methods and Instrumentation	30.8	-		
		4.2.2.	Safeguards Data processing, transmission and evaluation	6.1	-		
		4.2.3.	Integration of safeguards activities	8.5	-		
		TOTAL			45.4	-	
Sub programme 5	Decommissioning of Nuclear Installations						
		5.2.1.	R&D Projects	-	6.2		
		5.2.2.	Guiding principles	-	0.2		
		5.2.3.	Testing of new techniques	-	4.6		
		TOTAL			-	11	

CONTRIBUTION OF THE RESEARCH ACTION PROGRAMME ON THE DEVELOPMENT OF NUCLEAR FISSION ENERGY (1984-1987) TO
THE OBJECTIVES OF THE SCIENTIFIC AND TECHNICAL FRAME-WORK PROGRAMME 1984-1987

	<u>Objective 4.</u> Improving the Management of energy resources. Scientific and technical <u>Objective 4.1.</u> Developing nuclear fission energy (In particular its safety aspects).		<u>Objective 6.</u> Improving living and working conditions		TOTAL
			Scientific and technical <u>Objective 6.1.</u> Improving safety and protecting health.	Scientific and technical <u>Objective 6.2.</u> Protecting the environment and preventing pollution.	
Sub-Programme 1. Safety of fission Reactors	74 %	195.5 MECU	13 %	34 MECU	263.5 MECU
Sub-programme 2. Nuclear fuels and Actinide Research	100 %	65.7 MECU			65.7 MECU
Sub-programme 3. Radioactive Wastes Management.	70 %	63.9 MECU	15 %	14 MECU	91.9 MECU
Sub-programme 4. Safeguards and fissile materials management	100 %	45.4 MECU			45.4 MECU
Sub-programme 5. Decommissioning of nuclear installations	100 %	11 MECU			11 MECU
TOTAL		381.5 MECU		48 MECU	477.5 MECU

NOTES :

1. All figures are approximate and expressed in 1983 values.
2. A nominal contribution to the objective "promoting industrial competitiveness" must be attributed to sub-programme 1 "Safety of fission reactors".

Opinion of the Euratom Scientific and Technical Committee on the Commission's proposals on the 1984-1987 programme of the Joint Research Centre (nuclear part), and on the 1984-1987 programme of shared-cost action on reactor safety

The Scientific and Technical Committee, at the meeting of 20 May 1983, examined the communications to be submitted to the Council by the Commission on the above mentioned programme.

The Committee had already discussed, at its previous meeting of 18 April 1983, the Commission proposals concerning the framework programme of research, development and demonstration of the scientific and technical activities of the Communities for the period 1984-1987 (doc. COM(82) 865 final). At the same meeting the Committee had discussed the guidelines of the proposed actions in the field of the development of nuclear fission energy as described in document XII/316/83 "Proposal for a 1984-87 action programme on the development of nuclear fission energy".

At the meeting of 20 May 1983 the Committee discussed the JRC programme and the shared-cost action on reactor safety in the light of the Commission's proposed action programme for 1984-87 on development of nuclear fission energy. The Committee welcomed this overall insight into Community R, D and D activities in the field of nuclear fission energy.

Specifically, the Committee addressed itself to the nuclear safety programme which is the subject of both direct action and shared-cost action and also to the actions which are the nuclear part of the proposed JRC programme only.

General considerations

1. The Committee stressed to the Commission the need to retain flexibility in the formulation and execution of the programme. However, the Committee took note of the fact that it would not be possible to finance a major new initiative such as the construction of a large scale machine from present resources and that such initiative would require fresh budgetary provision. The flexibility currently available would suffice to fund new projects of the order of 10-15 MUC only.
2. In order to enhance flexibility the Committee stresses the need to have clear lines of managerial responsibility.
3. The Committee recognizes that programmes of this scale are evolutionary in nature and the recommendation which follow seek to advise the Commission in the light of this consideration.
4. The Committee wished to be associated with and involved in this evolutionary process and it particularly asks to be supplied with such information as will give it a full historical picture.
5. The Committee notes with pleasure the increased provision for shared-cost actions in the present programme, recognizing the multiplier effect which operates on such actions.

II. Recommendations

Subject to the comments listed below, the Committee approves the general direction of the programme and the apportionment of resources.

II. 1. FUSION

The Committee noted that in the current cost-shared action programme in fusion a total of about 45 MUC will be devoted by the Commission to technology activities.

The Committee endorses the need for research into fusion safety but considers that now and for some considerable time to come the work should be focused on generic issues.

It considers that this work should include some consideration of the management of fusion waste.

II.2. REACTOR SAFETY

The Committee supported the expected close liaison between shared-cost and direct actions and drew attention to the importance of appropriate Community participation in extra-Community projects. The Committee suggested that within the evolution of the programme an effort should be made to transfer resources to the area of accident prevention (e.g. human factors, man/machine interface, maintenance of components and systems) from the area of accident mitigation. However, the problem of fission product deposition and decontamination should be analysed at Community level. The potential use of the large containment volumes available at JRC for H₂ distribution and combustion studies should be investigated. The importance of strengthening the LOBI project and the full exploitation of the experimental rig has been emphasized.

The Committee stressed the importance of LMFBR safety and agreed on the general outline of the corresponding programme.

II.3. RADIOACTIVE WASTE

The STC stresses the importance of all activities related to alpha-waste management and aiming both at diminishing the alpha content in waste and at fully characterizing it in view of its disposal.

II.4 CONTROL OF FISSILE MATERIAL

The Committee welcomed the proposed increase in this area and particularly endorsed the proposals to set up a calibration laboratory and to provide training facilities for safeguards inspectors and plant operators.

II.5. NUCLEAR FUELS AND ACTINIDE RESEARCH

The Committee notes and approves the intention of the Commission to use part of the potential of the Karlsruhe establishment for the benefit of the programmes II 2, II 3 and II 4.

The Committee recommends the Commission to reconsider the resources devoted to the study of advanced fuels and to the safe-handling of fuel elements.

III. FINAL REMARKS

The above are a few brief comments which were made during a course of an overshoot discussion and the Committee will wish to return to the individual programmes in much more detail before their implementation is finally initiated.

FINAL ADVICE

REACTOR SAFETY SECTION OF THE 1984-87 RESEARCH ACTION PROGRAMME29th ACMP-Reactor Safety, 16-17 May 1983

The 29th meeting of the ACMP-Reactor Safety took place on 16-17 May 1983. Its primary task was to discuss and give advice on the general objectives of the Reactor Safety Programme as they are proposed in the Commission documents (parts of ACS-335-e "Proposal for a 1984-87 Action Programme on the Development of Nuclear Fission Energy", ACS-336-e "The Future Activities of the JRC", relevant to Reactor Safety, ACS-332-e "Proposal for a Shared-Cost Research Programme on Reactor Safety 1984-87" and ACS-331-e "Proposal for the JRC 1984-87 Multiannual Programme").

The ACMP was informed at the beginning of the meeting that the proposals had been prepared following the strategy outlined in document COM(82)865-final. This strategy mainly foresees that all Commission sponsored research activities should satisfy the objectives outlined in the framework programme and should be executed by either direct (JRC) or shared-cost actions or a combination of these.

The Committee recognizes the value of the proposals of the Commission which is expected to increase the overall benefit and to favour the integration of Community research activities. The ACMP supports the expected close liaison between the proposed shared-cost actions and the direct actions for the various themes of the programme.

There was general agreement on the Commission choices of the themes to be pursued and six delegations gave support to the general balance between the direct actions (JRC) and shared-cost actions while emphasizing that a further examination of detail would be required. The Dutch delegation requires further information and more consultation before taking a position. The German delegation wanted to place more emphasis on achieving cooperation among member countries through concerted action in addition to shared-cost action and also wanted to maintain a reservation about the budget of the shared-cost action and balance between this action and the direct action programme. The French delegation gave a qualified approval in which, if a modification in the shared-cost budget is requested, this modification should be made on the basis of priorities related to the activities for which JRC competences may increase the value of Community collaboration.

The programme discussion was divided into four main headings, i.e. Accident Prevention and Accident Analysis for LWRs and LMFBRs respectively.

Concerning Accident Prevention in Light Water Reactors, the Committee agreed on the proposed work in the areas of Risk and Reliability Assessment as well as Integrity of Components and Systems. Some delegations were in favour of a more direct involvement of the JRC in the area of Human Factors. Others stressed the importance of strengthening the Commission effort in the development of PRA methodologies. The Committee took note that the Commission has started a study on the feasibility, value and possible programme for a medium size vibrating table for seismic research. It was emphasized that the JRC should collect data on similar installations and related research programmes, including those outside the Community, as a part of this study.

Concerning Accident Analysis in Light Water Reactors, the Commission presentations divided the field into the three regions, for convenience:

- core phenomena not exceeding 1200°C
- core phenomena exceeding 1200°C
- outer containment and fission product behaviour in severe accident conditions.

- 1) There is a general wish to maximize the benefits of LOBI for the Community and there is support for the proposed staff increase. The associated activity of code assessment is supported and a need to well coordinate this activity with other group activities concerned with codes (CSNI) was emphasized. The need to properly integrate into the international framework of activities, including in particular the activities in the member countries (e.g. BETHSY), was underlined. To this end, a combination of the different consultative groups (LOBI, Group A) tends to be supported.
- 2) The proposed JRC programme of severe accident analysis explicitly integrated with the proposed shared-cost actions was generally considered a desirable way to evolve towards a Community view of the LWR severe accident phenomenology. However, a possible conflict between personnel requirement for this action and the code assessment under 1) above was recognized. The Committee wishes to rebalance the staff between these two programme areas with the intention of reinforcing code assessment work on thermohydraulic aspects.
- 3) The shared-cost action on external gas cloud explosions should continue to the necessary completion of the on-going work. It is considered appropriate to begin the first shared-cost action in the two important areas, hydrogen phenomena and fission product behaviour in the containment.

In view of the launching of the shared-cost action on hydrogen phenomena and fission product behaviour in the containment, the JRC should acquire, at modest level initially, a competence in these two areas.

The theme of atmospheric dispersion of fission products is a particularly suitable area for Community collaboration.

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Concerning Accident Prevention for LMFBRs the Committee agrees generally on shared-cost activities in the field of instrumentation control and protection. There should be a contribution to these studies from the JRC. The Committee, while generally supporting the integrity of components and structures activities suggested that these should be concentrated on the development of generally applicable models.

The Committee approved the overall objectives of the work proposed under the heading Accident Analysis for LMFBRs.

It realized that the work on sodium boiling performed by JRC needs reorientation by the end of 1984 and that the Committee will have to give eventually recommendations on such reorientation.

The Committee took note that the in-pile experiments on fuel behaviour are in the planning phase and that only a few tests are included in the proposed budget.

In the area of Severe Accident Analysis the Committee places priority on the utilization of existing installations and agreed that before starting new activities, the existing programme should be properly concluded. Strong support was given for the work on integrity of structures under dynamic loading. Computational tools developed or under development should be maintained.